Compilation of Known or Suspected Quaternary Faults Within 100 km of Yucca Mountain, Nevada and California

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CONVERSION FACTORS AND ACRONYMS

Multiply	By	To obtain
centimeter (cm)	0.394	inch
kilometer (km)	0. 621	mile
meter (m)	3.28	foot
millimeter (mm)	0.0394	inch

The following terms and abbreviations also are used in this compilation.

ka	thousands of years old
mm/yr	millimeters per year
myr	millions of year ago
Ma	millions of years old

CONTENTS

ILLUSTRATIONS

TABLES

Compilation of Known and Suspected Quaternary Faults within 100 km of Yucca Mountain

By L.A. Piety

Abstract

Geologic data have been compiled for known and suspected Quaternary faults in southern Nevada and southeastern California within about 100 km of the potential repository site at Yucca Mountain. This compilation is based on published and readily available literature, including theses and dissertations. The data set includes regional studies that attempt to identify and evaluate lineaments, scarps, and other possible tectonic landforms of possible Quaternary age, detailed studies that focus on a single fault, and geologic studies that were completed for purposes other than evaluation of Quaternary fault activity. Studies included in this compilation are those that were available as of December 1993. Faults that have known or suspected Quaternary activity are presented on a topographic base map at a scale of 1:250,000. Data for each fault that are pertinent to the assessment of future faulting and earthquake events are assembled on description sheets and summarized on tables.

Faults that have known evidence for or are suspected of Holocene (≤10 ka) or late Pleistocene (>10 ka and <130 ka) surface rupture are highlighted on the map because these faults may be the most likely to produce ground motions that could impact the potential repository. This compilation identifies ten faults within 50 km of the site but outside the site area and an additional fourteen faults between 50 km and 100 km of the site for which evidence for Holocene or late Pleistocene surface rupture has been reported in the literature. The longest and most continuous of these faults is the northwest–striking, 250–km–long Furnace Creek fault (including its possible extension into Fish Lake Valley), which is located about 50 km west of the site. In addition to identifying known or suspected Quaternary faults within about 100 km of the site, this compilation demonstrates the lack of information for most of these faults. Future work will undoubtedly change the portrayal of Quaternary faults presented in this report and on the accompanying map by eliminating some faults shown here, by adding other faults for which Quaternary rupture has not yet been recognized, and by revising and refining the age designations and other data for many of the faults.

INTRODUCTION

This report and accompanying map present the results of a compilation of published literature and readily available data on known and suspected Quaternary faults within about 100 km of Yucca Mountain. The report and map were prepared as part of Activity 8.3.1.17.4.3.2, "Evaluate Quaternary Faults Within 100 km of Yucca Mountain", which is an activity within Study 8.3.1.17.4.3, "Quaternary Faulting within 100 km of Yucca Mountain, including the Walker Lane" (Department of Energy, 1988). The objective of Study 8.3.1.17.4.3 is to collect and synthesize "information pertaining to the abundance, distribution, geographic orientation, displacement rate, and recurrence interval of movement" for faults within about 100 km of Yucca Mountain (Department of Energy, 1988). An important purpose of the work summarized in this report and on the accompanying map is to provide a basis and direction for future investigations under Activity 8.3.1.17.4.3.2. Specifically, this report shows in detail what data are presently available for known and suspected Quaternary faults in the study area.

Data from Study 8.3.1.17.4.3 will be used to "assist in predicting the likely locations, timing, and magnitudes of future faulting and earthquake events that could have an impact on the design or performance of the waste facility" (Department of Energy, 1988). Data presented in this report may be used in preliminary analyses of future faulting and earthquake events. The actual identification of earthquake sources will be performed under Study 8.3.1.17.3.1, "Relevant Earthquake Sources" (Department of Energy, 1988). Data will also support Activity 8.3.1.17.4.12, "Tectonic Models and Synthesis".

A preliminary draft of this report without the map was submitted as an interim report to the U.S. Geological Survey in March 1993 (Piety and others, 1993). This report supersedes the interim report.

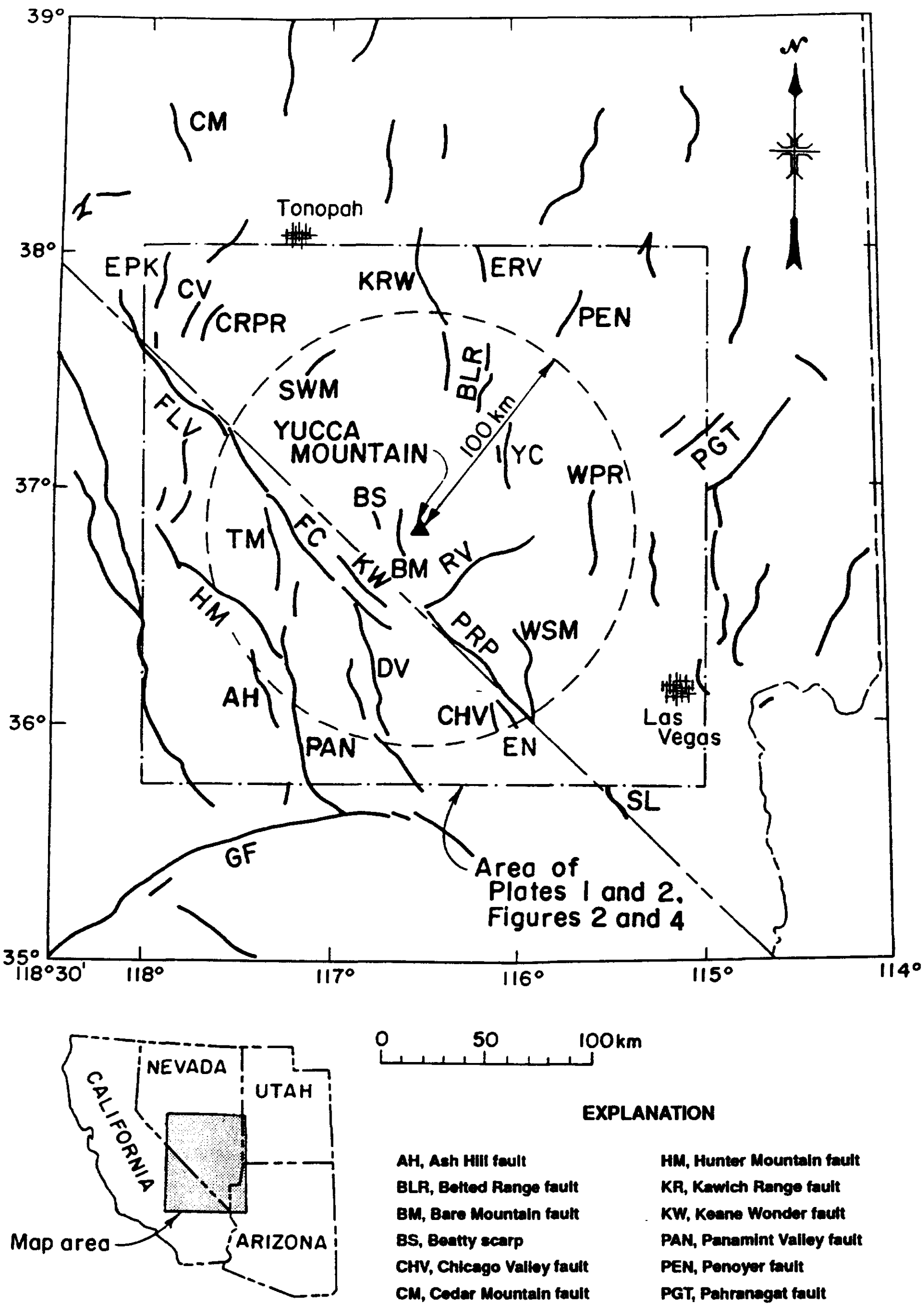
This work was supported by the U.S. Department of Energy under a Memorandum of Understanding (MOU) between the U.S. Geological Survey and the U.S. Bureau of Reclamation dated January 13, 1986.

Regional Geologic and Tectonic Setting

Yucca Mountain is located in the central portion of the southern Basin and Range (fig. 1). Rocks of nearly all geologic ages are present within the region, but volcanic rocks of Miocene age are especially common and voluminous. Geologic structures in this region are characterized in part by the elongate mountain blocks and alluvial basins typical of other parts of the Basin and Range. The mountain ranges and intervening basins are the result of late Cenozoic extensional faulting. Wernicke and others (1988) believed that, at the latitude of Yucca Mountain, both normal and strike–slip faults have accommodated nearly 250 km of extension between the Colorado Plateau and the Sierra Nevada during the last 20 m.y. It is clear from available data that dip–slip, oblique–slip, and strike–slip Quaternary faults are all present in the region surrounding Yucca Mountain.

Figure 1. Major known or suspected Quaternary faults in southern Nevada and southeastern California in the region surrounding Yucca Mountain.

For this assessment of Quaternary faulting within about 100 km of Yucca Mountain, Data on specific known or suspected Quaternary faults within the study area are presented. However, discussion of possible relationships between these faults and proposed regional geologic structures has been omitted. A synthesis of various tectonic models for the site and region will be conducted as part of Study 8.3.1.17.4.12, "Tectonic Models and Synthesis" (Department of Energy, 1988).



EXPLANATION

AH, Ash Hill fault
BLR, Belted Range fault
BM, Bare Mountain fault
BS, Beatty scarp
CHV, Chicago Valley fault
CM, Cedar Mountain fault
CRPR, Clayton Ridge–Paymaster Ridge fault
CV, Clayton Valley fault
DV, Death Valley fault
EN, East Nopah fault
EPK, Emigrant Peak faults
ERV, East Reveille fault
FC, Furnace Creek fault
FLV, Fish Lake Valley fault
GF, Garlock fault
HM, Hunter Mountain fault
KR, Kawich Range fault
KW, Keane Wonder fault
PAN, Panamint Valley fault
PEN, Penoyer fault
PGT, Pahranagat fault
PRP, Pahrump fault
RV, Rock Valley fault
SDV, South Death Valley fault
SL, State Line fault
SWM, Stonewall Mountain fault
TM, Tin Mountain fault
WPR, West Pintwater Range fault
WSM, West Spring Mountains fault
YC, Yucca fault

Figure 1. Major known or suspected Holocene and late Pleistocene (≤130 ka) faults in southern Nevada and southeastern California in the region surrounding Yucca Mountain. Faults have been compiled from Stewart and Carlson, 1978; Nakata and others, 1982; Zhang and others, 1990; Dohrenwend and others, 1991, 1992; Hoffard, 1991; Reheis, 1991a, 1992; Reheis and McKee, [1991]; Reheis and Noller, 1991.

Definitions

All tectonic features described in this report are called faults even if they have been labeled fault zones, fault systems, or lineaments by previous workers. This was done for consistency. Some tectonic features have enough data that differences in terminology could be distinguished on the basis of the following definitions; some of these features may be more correctly called fault sets or fault systems. However, most of the tectonic features described in this report have limited data available from only a single locality or, at most, a few localities so that the criteria used to distinguish between the terms have not been determined. The following definitions have been used in preparing this report.

Quaternary fault: Fault with displacement since approximately 1.6 Ma. In general, evidence for such activity is displacement of deposits or surfaces of latest Tertiary or Quaternary age or geomorphic features or characteristics indicative of Quaternary activity.

Known Quaternary fault: Fault with documented evidence of displacement during the Quaternary (since approximately 1.6 Ma) presented on published geologic maps or in other literature. Documented evidence may include descriptions of displaced Quaternary deposits or landforms, fault scarps on Quaternary surfaces, faults or shears that displace Quaternary deposits as displayed in natural or man–made exposures, or faults with historical surface rupture.

Suspected Quaternary fault: A fault or lineament that, based on presently available data (usually published geologic maps or other literature), is suspected of having or representing Quaternary tectonic displacement. Quaternary activity is suspected because the fault may have an apparent association (e.g., proximity, orientation, tectonic or structural setting) with a known Quaternary fault, or it may be in deposits of uncertain but possibly Quaternary age. In this report, the category of suspected Quaternary faults also includes lineaments that have characteristics similar to those of lineaments associated with known Quaternary faults and that are on surfaces of known Quaternary age or of uncertain but possibly Quaternary age.

Fault: "A fracture or a zone of fractures along which there has been displacement of the sides relative to one another parallel to the fracture" (Bates and Jackson, 1987, p. 235).

Fault zone: "A fault that is expressed as a zone of numerous small fractures or of breccia or fault gouge. A fault zone may be as wide as hundreds of meters" (Bates and Jackson, 1987, p. 237).

Fault set: "A group of faults that are parallel or nearly so, and that are related to a particular deformational episode" (Bates and Jackson, 1987, p. 236).

Fault system: "Two or more interconnecting fault sets", which are "a group of faults that are parallel or nearly so, and that are related to a particular deformational episode" (Bates and Jackson, 1987, p. 236-237).

Lineament: "A mappable, simple or composite linear feature of a surface, whose parts are aligned in a rectilinear or slightly curvilinear relationship and which differs distinctly from the patterns of adjacent features and presumably reflects a subsurface phenomenon" (O'Leary and others, 1976, p. 1467).

Scarp or fault scarp: A relatively linear break in slope formed directly by movement along a fault and separating surfaces at different topographic levels (Bates and Jackson, 1987, p. 236, 590).

Holocene: The time period that includes about the last 10,000 years.

Late Pleistocene: The time period between about 10,000 years ago and about 130,000 years ago.

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COMPILATION OF KNOWN AND SUSPECTED QUATERNARY FAULTS WITHIN 100 KM OF YUCCA MOUNTAIN

Methods

The primary purposes of this report and accompanying map were to systematically identify all potential Quaternary faults that are within about 100 km of the potential nuclear waste repository at Yucca Mountain and to assemble available data about their Quaternary activity into a consistent and usable format. Principal references used in this compilation are regional studies that have examined small–scale (1:124,000 to 1:58,000) aerial photographs for geomorphic features that might indicate Quaternary surface rupture (Schell, 1981; Dohrenwend and others, 1991, 1992; Reheis, 1991a, 1992; Reheis and Noller, 1991; fig. 2). Faults that underwent Quaternary surface rupture are assumed to exhibit one or more geomorphic features that are preserved on surfaces of known or suspected Quaternary (primarily) or latest Tertiary age and that are visible on aerial photographs or on the ground. These features include scarps; disrupted drainages; alignments of vegetation, drainages, topographic saddles, hills, tonal or color differences, springs, spring deposits, and depressions; and range fronts that are linear, steep, and faceted. These references include reconnaissance–level field examination of some of these geomorphic features.

Figure 2. Extent of previous studies that evaluated Quaternary displacement along faults in the area covered by plates 1 and 2.

Three additional primary references for this compilation are products of regional studies in which data on faults with possible Quaternary displacement in California have been collected and evaluated (Hart and others, 1989; Jennings, 1985, 1992) (fig. 2). These three studies were principally undertaken as part of a fault evaluation program designed to carry out the objectives of the Alquist–Priola Special Studies Zones Act. Because the part of California that is near Yucca Mountain is sparsely populated, faults in this area were given less attention in these studies than were similar faults in other parts of the state.

All of these regional studies, which cover the study area except for the portion south of latitude 36°N. and a small area northeast of Yucca Mountain north of latitude 37°N. (fig. 2), have probably identified most of the features that could be attributable to Quaternary surface rupture. They have also inferred type of displacement on associated faults on the basis of the geomorphic features visible on the aerial photographs. From characteristics of surfaces affected by or overlying the faults, these studies also provide an estimate of the age of youngest surface rupture (e.g., Dohrenwend and others, 1991, 1992). However, only rough estimates of the ages of the surfaces can be inferred from aerial photographs, and these studies yield no information about the lengths of ruptures, the amount of displacement caused by individual ruptures, the amount of total displacement, slip rate, and recurrence, because these parameters cannot be estimated from aerial photographs. Consequently, more detailed studies of individual faults were used as supplemental sources of information if such studies are available. These more detailed studies include field mapping, measurement of topographic scarp profiles, interpretation of trench exposures, and radiometric dating of displaced and undisplaced deposits and surfaces. These studies can directly address the amounts of displacement, the number of displacements, slip rates, and recurrence, as well as provide better age estimates. However, these studies are primarily limited to one or, at most, a few localities along a fault that may be several tens of kilometers long and may consist of several strands. Thus, the representativeness of this information for an entire fault is not known. With exception of some faults within about 5 km of the potential waste repository (site faults), no fault within 100 km has yet been studied in enough detail at enough localities to estimate values for all of the above parameters or to understand their variation along the entire fault.

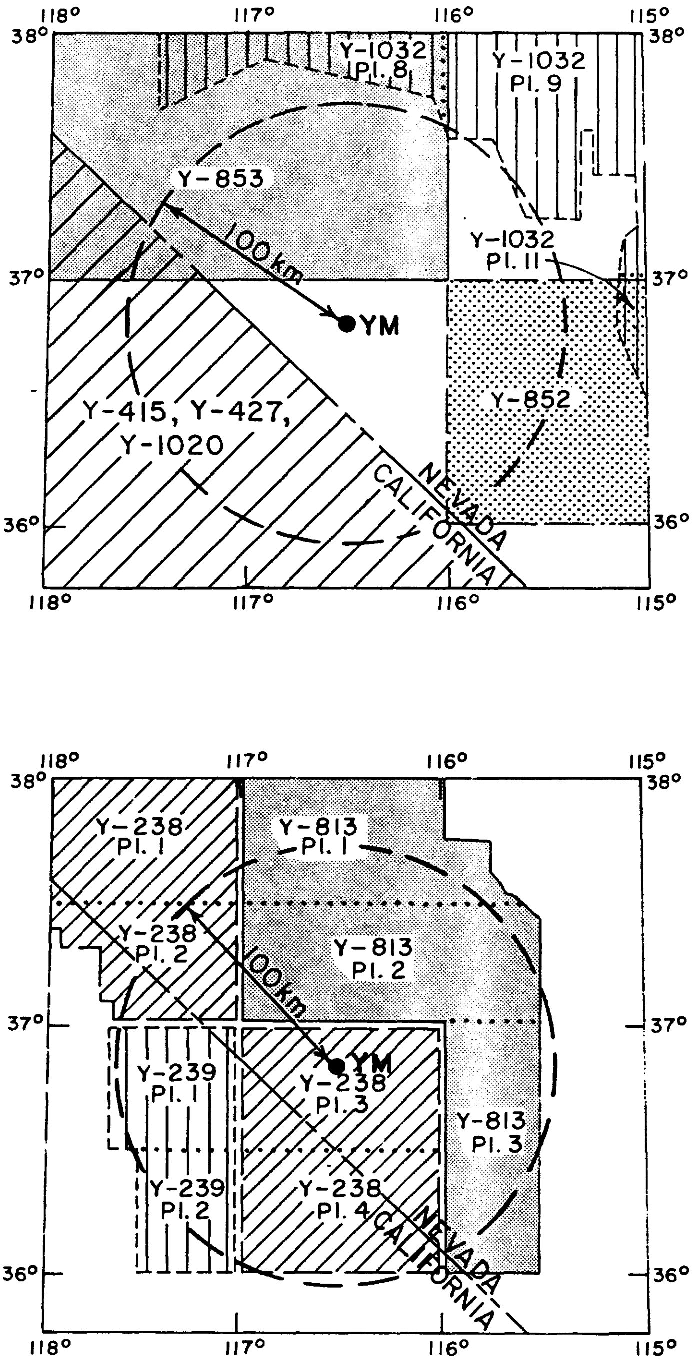

Figure 2. Extent of previous studies that evaluated Quaternary activity along faults in the area covered by plates 1 and 2. Numbers indicate the references, which are listed by number in appendix 4. For the upper drawing, references are Y-415 (Jennings, 1985), Y-427 (Hart and others, 1989), Y-852 (Dohrenwend and others, 1991), Y-853 (Dohrenwend and others, 1992), Y-1020 (Jennings, 1992), and Y-1032 (Schell, 1981). For the lower drawing, references are Y-238 (Reheis and Noller, 1991), Y-239 (Reheis, 1991a), and Y-813 (Reheis, 1992). Numbers preceded by "Pl." show the plate numbers within these references. YM indicates the location of the potential nuclear waste repository at Yucca Mountain.

Additional faults that were not shown by either the regional studies that specifically evaluated possible Quaternary tectonic features or the more detailed studies of Quaternary displacement on individual faults were taken from geologic maps completed with the primary objective of portraying the distribution and structure of pre–Quaternary rocks (e.g., Albers and Stewart, 1972; Cornwall, 1972; Frizzell and Shulters, 1990). Possible Quaternary surface rupture was inferred for faults that are shown on these maps as displacing Quaternary (or Quaternary/Tertiary) deposits or as faulted contacts between Quaternary deposits and older units. Because associated geomorphic features that would indicate Quaternary surface rupture are not usually noted by the authors of these maps, the presence of such features is not known unless they are shown by one of the studies specifically evaluating possible Quaternary tectonic features. In general, the only information about Quaternary surface rupture obtainable from the geologic maps are crude estimates of both Quaternary rupture length and age of the youngest ruptured units.

All mapped faults that are portrayed by previous workers as disrupting deposits or surfaces of known or suspected Quaternary age are included in this compilation even if the reported geologic interpretations or age estimates are inconsistent. This was done because (1) the objectives, evaluation methods, and scales differed among the numerous references used to compile this report, (2) preparation of this report included no independent evaluation of the mapped faults, scarps, lineaments, or range fronts either on aerial photographs or in the field, and (3) this compilation is supposed to provide a basis for additional study of known and suspected Quaternary faults. Geomorphic features (e.g., scarps, lineaments, linear range fronts, etc.) that are interpreted as possibly indicating Quaternary surface rupture by at least one worker are also included in this compilation and are called faults even though no associated fault has yet been documented. Additional study may eliminate some of these geomorphic features as being tectonic in origin.

Known and suspected Quaternary faults identified from the literature were compiled onto a base map at a scale of 1:250,000 (pls. 1 and 2). This scale was chosen because the faults could be readily shown relative to the potential waste site and topographic features, and the entire area could be included on a map of manageable size. Faults were transferred from maps in the cited references by visual inspection. Accuracy of the locations of the faults is dependent upon the scale of the original maps. Previously mapped faults are labeled using fault names employed by previous authors as indicated in appendix 2. If no name was reported in the literature, faults were assigned names taken from nearby physiographic features. Geomorphic features that have not yet been related to a known and previously named fault have been included with or combined into faults, if possible, on the basis of similarities in (1) relationship to physiographic features (e.g., along a range front, within a valley), (2) strike or trend, and (3) type of displacement and were assigned names taken from nearby physiographic features. It is unknown if these geomorphic features are structurally related. Occasionally, several relatively short faults in one area are discussed together even though they have variable strikes, relationships to physiographic features, or types of displacement (e.g., Central Spring Mountains faults, Saline Valley faults). This was done for ease of discussion and is not meant to imply a geologic relationship among the faults.

During the initial stages of this compilation, an attempt was made to collect and examine all published and unpublished data. However, this compilation is primarily limited to published literature and other readily available data that were available as of December 1993. The compilation concentrates on major faults in the region, especially those within 50 km of the potential waste repository. Although faults at distances greater than 100 km are also included in this compilation, less effort was made to identify all the potential Quaternary faults (and the associated references) at this distance than for faults within 100 km of the site. References were organized into a data base and assigned an accession number beginning with "Y-". This was done to provide a unique identifier for each reference and to indicate that the reference is part of the data base for Yucca Mountain. References were initially examined in a cursory manner. Those directly addressing geomorphic features that might be related to Quaternary fault displacement, those showing the distribution of Quaternary deposits and surfaces, and those presenting age estimates for Quaternary deposits and surfaces were examined in the most detail. Relatively little time was spent reviewing articles discussing regional tectonic models and pre–Quaternary geology.

Although Activity 8.3.1.17.4.3.2 indicates that faults within 100 km of Yucca Mountain will be evaluated for possible Quaternary displacement, the study plan suggests concentration on faults within approximately 45 km of the site (the distance stated there as the distance to the Furnace Creek fault), "because faults in this area are considered to have the greatest potential for producing ground motions that may affect repository design and performance" (Department of Energy, 1988). Consequently, this compilation, while including known and suspected Quaternary faults within about 100 km of the site, has focused on faults within about 50 km of Yucca Mountain, the measured distance to the Furnace Creek fault from the site using an arbitrary location near the center of the potential repository site as the site location (pl. 2). Radius circles at distances of 50 km and 100 km from the potential nuclear waste repository site at Yucca Mountain are denoted on plates 1 and 2. Faults within about 5 km of the potential repository site are shown on figure 3 and are included on the description sheets and in the summary tables, although Quaternary activity on these faults is being examined under separate studies (8.3.1.17.4.2, "Location and Recency of Faulting Near Prospective Surface Facilities", and 8.3.1.17.4.6, "Quaternary Faulting Within the Site Area"). These faults are included in this compilation so that their characteristics could be compared to those of faults farther from the site. Faults that are greater than 100 km from Yucca Mountain are also included in our assessment because (1) the Quaternary displacement histories of these faults may be used to infer Quaternary displacement histories along faults closer to the site, (2) some of these faults may merge with or be part of faults within 100 km of the site, or (3) these faults may impact the interpretation of the regional tectonic setting for the site. Furthermore, a few faults at distances greater than 100 km from the site are specifically mentioned in the study plan, for example the Pahranagat fault (Department of Energy, 1988).

Figure 3. Known and suspected Quaternary faults near the potential repository at Yucca Mountain.

Of the faults shown on plates 1 and 2, those faults with known or suspected Historical, Holocene ($\leq$10 ka), or late Pleistocene (10 ka to 130 ka) displacements at any locality along their length are emphasized on the plates by thicker lines because these faults are the most likely to produce ground motions that may adversely affect the potential repository site. Faults shown by the thinner lines on the plates have known or suspected Quaternary displacement that is either thought to be older than late Pleistocene (>130 ka) or whose age cannot be more specifically defined at this time. Thus, late Pleistocene and Holocene displacements cannot be ruled out on many faults shown by the thinner lines. In designating the faults primarily by age, relative significance of faults determined on the basis of rupture length or amount of displacement is not obvious. For example, faults that have experienced one Holocene or late Pleistocene surface rupture are combined with faults that have experienced several surface ruptures during this same time interval. For example, the Death Valley, Furnace Creek, and Panamint Valley faults, which have evidence for multiple Holocene surface ruptures, are portrayed in the same way as the Carpetbag fault, which is reported to have evidence for late Pleistocene fault rupture that is limited to fracturing.

Faults that are portrayed only in Tertiary deposits or on Tertiary surfaces are generally not included in this compilation even though they have been noted by previous workers to be potentially young faults (Dohrenwend and others, 1991, 1992; Reheis, 1991a, 1992; Reheis and Noller, 1991). Faults expressed solely in Tertiary deposits or on Tertiary surfaces were excluded in order to focus the compilation on those faults that have reported evidence for known or suspected Quaternary displacement. Faults in Tertiary deposits or on Tertiary surfaces are shown on the plates only if they align with (and thus may be related to) faults or fault-related geomorphic features of known or suspected Quaternary age. Thus, all faults in pre-Quaternary deposits or on pre-Quaternary surfaces are treated in a similar manner. Eventually many of these faults may need to be examined to determine if they could have experienced Quaternary displacement, but additional study should probably be focused initially on those faults with known or suspected Quaternary surface rupture.

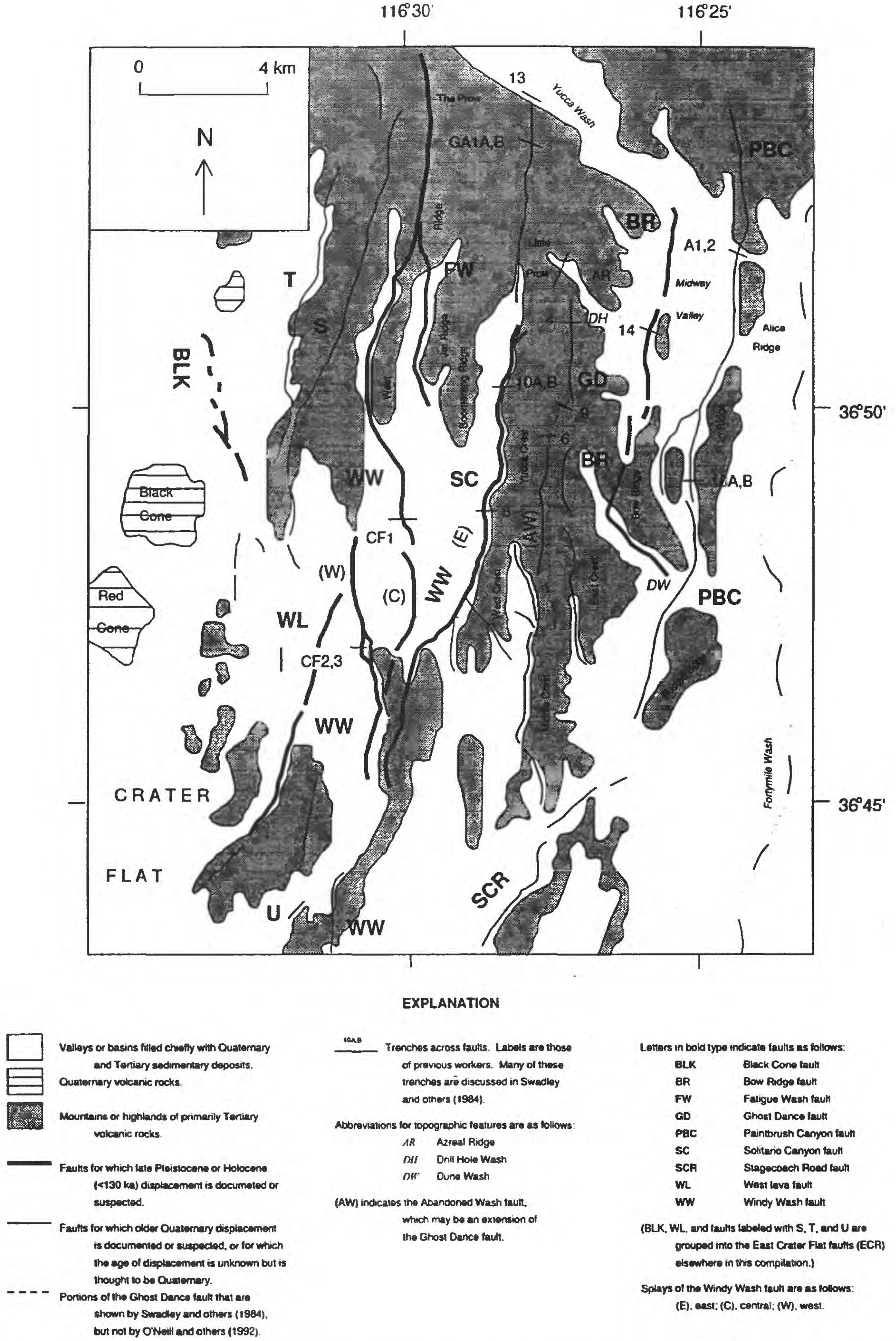

Figure 3. Known and suspected Quaternary faults near the site of the potential nuclear waste repository at Yucca Mountain. The potential waste repository is located on Yucca Crest south of Drill Hole Wash (*DH*). Figure has been adapted from O'Neill and others (1992, pl. 1), Faulds and others (1991), Scott and Bonk (1984, pl. 1), and Swadley and others (1984, pl. 1).

In addition to compiling the faults on plates 1 and 2, description sheets were assembled for each fault shown on the plates, for some faults near the potential nuclear waste repository (fig. 3), and for two faults outside of the area covered by the plates (the Cedar Mountain fault and the State Line fault that are shown on fig. 1). The description sheets summarize available information about fault location, fault strike and length, estimated ages of displaced and undisplaced Quaternary deposits, scarp characteristics, total displacement, Quaternary displacement, single–event displacement, slip rate, and recurrence of Quaternary surface rupture (appen. 2). These criteria were chosen because they will likely be important in evaluating whether or not a fault should be considered an earthquake source. A more detailed discussion of the information included on the description sheets is given in appendix 2.

The data on the description sheets presented in appendix 2 are summarized in tables in appendix 1. These summary tables were put together so that the characteristics of the individual faults within a given radius from the potential waste repository could be readily compared and contrasted. The methods used to assemble the tables are described in appendix 1.

Limitations of the Data Presented in this Compilation

The faults depicted on plates 1 and 2 and the data reported on the description sheets (appen. 2) and summarized in the tables (appen. 1) are influenced by a number of factors. First, the distribution of the faults and their age assessments are strongly biased by the information that is available in published literature. Some of the faults and the information about them have been inferred from studies in which the primary objective was something other than evaluating young fault displacements. The detail of mapping for faults varies considerably throughout the region. For example, studies evaluating possible Quaternary fault displacements south of latitude 36°N. are limited to investigations done at scales of 1:250,000 or smaller (fig. 2). In contrast, some faults have been mapped at a scale of 1:24,000 or larger.

Second, the scale of the maps in the original references influences the accuracy of the location of faults shown on plates 1 and 2. Faults that were shown on 1:250,000–scale maps could be directly transferred onto the base map. Faults shown by Reheis (1991a, 1992) and Reheis and Noller (1991) are portrayed on 1:100,000–scale maps with metric contour intervals requiring that the location of the faults on plates 1 and 2 be approximated. In addition, faults shown on maps with scales significantly smaller than 1:250,000, especially where topographic features are lacking and those shown on maps with scales significantly larger than 1:250,000 are also difficult to portray accurately. The purpose of plates 1 and 2 is to show the regional pattern of known and suspected Quaternary faults. Cited references should be consulted for the accurate location of an individual fault.

Third, the delineation of faults with Historical, Holocene, and late Pleistocene displacement should be considered with caution. Whereas some of these faults have documented evidence for one or more surface ruptures over much of their length during these time intervals (e.g., Death Valley fault, Furnace Creek fault, Panamint Valley fault), such displacement may be recorded at only a single locality along faults several tens of kilometers in length (e.g., Rock Valley fault, Bare Mountain fault). Extrapolation of data from a single site to the entire fault may not be a valid method of assessing the characteristics of the entire fault. In addition, faults shown on plates 1 and 2 as not having Historical, Holocene, and late Pleistocene displacement are not necessarily older Quaternary faults. These faults may have experienced younger ruptures that have not yet been identified or documented.

Fourth, assembling short, individual fault traces (or tectonic–related geomorphic features) into one fault and implying a single seismotectonic source, when no such grouping has been previously described in the literature, is very subjective and the resulting fault shown and labeled on plates 1 and 2 may not bear any relationship to geologic reality. Relationship to physiographic features, strike, type of displacement, and the criteria used to group the faults, can all vary along a single known fault. The faults that result from these groupings not only influence the visual image presented on the plates, but also affect various fault characteristics, most notably fault length, reported on the description sheets and in the summary tables.

Fifth, the data shown on the description sheets and in the summary tables are influenced by all the factors that limit assessment of Quaternary displacement along faults and by the differences in interpretation that result from each worker's skills and biases. These include, but are not limited to, problems in accurately dating the ages of Quaternary deposits, problems with determining the exact relationship between Quaternary deposits and faults (e.g., is the deposit really displaced?), problems of finding Quaternary deposits of several appropriate ages in proximity to the fault, and factors (e.g., climate, location, degree of cementation, erosion, deposition) that influence the preservation of scarps and other geomorphic features indicative of Quaternary displacement.

Sixth, the compilation of the description sheets and, especially, the summary tables required putting the various types of age data found in individual references into a single time scale. The reported ages of the deposits and surfaces in relationship to the faults do not always allow this to be done easily. Terms such as late Pleistocene or late Quaternary are used in different ways by individual workers, sometimes without specifying the age range that is meant. Additionally, both relative and numerical age estimates often have large uncertainties. As a result, reported ages for displaced deposits sometimes overlap with or appear to be older than the ages for the undisplaced deposits. Also, ages noted by some authors cross the age categories used by other authors and in this compilation.

Seventh, a compilation such as this can never be complete, in part because work is ongoing. This report and accompanying map are a first attempt to compile the information available as of December 1993 into a usable format for future studies. As in any study, existing work may been unintentionally overlooked. Thus, original references should examined before beginning any detailed study of a particular fault.

PATTERN OF KNOWN AND SUSPECTED QUATERNARY FAULTS WITHIN ABOUT 100 KM OF YUCCA MOUNTAIN AND ACCOMPANYING DATA

Ten faults within 50 km of the potential waste repository have Holocene or late Pleistocene (≤130 ka) displacements. Of these ten faults, the longest and most continuous is the northwest–striking Furnace Creek fault about 50 km southwest and west of the potential repository site (pls. 1 and 2). This fault is reported to have evidence for recurrent surface displacement along most of its 250 km length (including its possible extension into Fish Lake Valley). This fault may be even longer if it connects with the north–striking Death Valley fault, which also exhibits evidence for recurrent Holocene displacements, immediately to its south. If these faults represent a single fault system, then the length of the entire system would be at least 325 km, by far the longest geologic structure in the region with reported recurrent Holocene displacements.

The other nine faults within 50 km of the potential repository site for which Holocene or late Pleistocene surface ruptures have been reported include the following (listed in order of increasing distance from the site): the north–striking Bare Mountain fault located 14 km west of the site, the north–northeast–striking faults along the east side of Oasis Valley located 24 km northwest of the site, the northeast–striking Rock Valley fault located 24 km south of the site, the north– to northwest–trending Beatty scarp located 26 km west of the site, the north–striking Ash Meadows fault located 34 km south of the site, the northeast–striking Eleana Range fault located 37 km northeast of the site, the northwest–striking Amargosa River fault located 40 km south of the site, the north–striking Yucca fault located 40 km northeast of the site, and the north–striking Carpetbag fault located 43 km northeast of the site (pls. 1 and 2). Of these faults, only the Rock Valley fault, the Ash Meadows fault, the Yucca fault, and the Carpetbag fault have suggested lengths of greater than 30 km. Displacements along these faults have been reported to be normal, lateral, or oblique.

Fifteen more faults that are reported to have Holocene or late Pleistocene displacements are located between >50 km and about 100 km from the potential waste repository. The longest of these faults is the north– to north–northwest–striking Panamint Valley fault, which is at least 80 km long, and the northwest–striking Hunter Mountain fault, which is also about 80 km long. These two faults may represent a continuous fault system similar to the Death Valley and Furnace Creek faults to the east. The closest approach of these faults to the site is about 95 km. Other relatively long faults on which Holocene or late Pleistocene displacements have been noted are the generally north–striking, 85–km–long Kawich Range fault located 57 km north of the site, the northwest–striking, 70–km–long Pahrump fault located 70 km south–southeast of the site, the north–striking, 60–km–long West Pintwater Range fault located 76 km east of the site, the north– to north–northeast–striking, 55–km–long Belted Range fault located 55 km northeast of the site, and the north–striking, 50–km–long Cactus Flat fault located 84 km north of the site (pls. 1 and 2). Except for the Hunter Mountain fault and the Pahrump fault, most of these faults generally strike north.

Thirty–three faults that are reported to have Holocene or late Pleistocene displacements are located at distances greater than 100 km of the potential waste repository but within the area covered by plates 1 and 2. These faults, some of which have received more extensive work than faults within 100 km of the site, are included because some may be related to closer faults and some of these are specifically noted in the study plan (Department of Energy, 1988).

Available data on the Quaternary activity on the known and suspected Quaternary faults within the study area are assembled on description sheets in appendix 2 and in summary tables in appendix 1. Data for selected characteristics that are needed to assess each fault's potential seismic hazard are listed in tables 1 through 3. These tables highlight the lack of data about known and suspected Quaternary faults within about 100 km of Yucca Mountain. Even for faults within 50 km of the site, data are generally based on only limited or reconnaissance studies. For only a few faults have the parameters been estimated that will be needed to assess the potential of these faults for future earthquake activity (e.g., potential rupture length, type of displacement, amount of displacement per event, slip rate, and recurrence of surface–rupturing events). Even for these few faults, examination of available maps and reports indicates that these values are often rough guesses, are based on limited field data, or are estimated for only a short section or at only a single locality along the fault. A primary obstacle in calculating slip rate and recurrence is the lack of reliable age estimates for deposits or surfaces displaced by or burying the faults. Although the dating of deposits and surfaces is a continual problem in Quaternary studies, for many faults within 100 km of Yucca Mountain, no attempt has yet been made to map the distribution of Quaternary deposits in relation to the faults and to evaluate the potential for obtaining numerical ages on these deposits. The possibility for correlating Quaternary deposits and surfaces with those that have been studied in detail in Midway Valley (e.g., Gibson and others, 1991; Wesling and others, 1992) has also not been evaluated. In addition, types of displacement and amounts of displacement have not yet been determined. The component of strike–slip displacement, in particular, needs to be addressed because some initial workers assumed that displacements along faults in the area were principally dip slip, an assumption that subsequent workers have suggested may not be correct for some faults. In addition, conclusions of some studies are contradictory and open to alternative interpretations.

Additional examination of faults in the region may eliminate some of the known and suspected Quaternary faults shown on plates 1 and 2, may add other faults that do have Quaternary displacements but are as yet unrecognized, or may change the age designations and other information shown on the plates and noted on the description sheets and in the summary tables. Hopefully, future studies will provide additional detailed information to expand our knowledge of these faults, so that those within about 100 km of the potential waste repository can be evaluated on the basis of more uniform and reliable data.

Table 1. Data for known and suspected Quaternary faults within 50 km of Yucca Mountain

[Detailed data are on tables in appendix 1 and on description sheets in appendix 2. Displacement rates are usually apparent slip rates and are for late Quaternary ($\leq$130 ka) or shorter (younger) time periods unless otherwise indicated; F, indicates that fracturing has been recognized but no significant fault displacement; leaders (--), no information was noted during the literature review]

Fault or faults [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Amargosa River fault (AR)	P2	40	--	--	--	
Area Three fault (AT)	P1	44	--	--	--	
Ash Meadows fault (AM)	P2	34	--	--	--	
[Northern section]	P2	--	--	--	--	
[Central section]	P2	--	--	0.04	--	Donovan, 1991
[Southern section]	P2	--	--	--	--	
Bare Mountain fault (BM)	P1, P2	14	--	--	--	
[Section #1]	F5	--	--	--	--	
[Section #2]	F5	--	--	--	--	
[Section #3]	F5	--	--	--	--	
[Section #4]	F5	--	20 to 25	0.19	--	Reheis, 1988a
[Section #5]	F5	--	--	--	--	
Beatty scarp (BS)[1]	P1, P2	26	--	--	--	
Bow Ridge fault (BR)	F3	1	--	0.001	--	Menges and others, 1993
Bullfrog Hills faults (BUL)	P1	38	--	--	--	
Cane Spring fault (CS)	P1, P2	26	--	--	--	

Table 1. Data for known and suspected Quaternary faults within 50 km of Yucca Mountain--Continued

Fault or faults [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Carpetbag fault (CB)	P1	43	[2]25	F	--	Shroba and others, 1988a, 1988b
Checkpoint Pass fault (CP)	P2	44	--	--	--	
Crossgrain Valley faults (CGV)	P2	48	--	--	--	
[North Ridge front fault]	P2	--	--	--	--	
[Northeast valley faults]	P2	--	--	--	--	
[Southwest valley fault]	P2	--	--	--	--	
East Crater Flat faults (ECR)	F3					
Fault S	F3	4	--	--	--	
Fault T	F3	5	--	--	--	
Black Cone fault (BLK)	F3	7	--	0.03 to 0.06	--	Ramelli and others, 1991
West lava fault (WL)	F3	7	--	--	--	
Fault U	F3	16	--	--	--	
Eleana Range fault (ER)	P1	37	--	--	--	
Fatigue Wash fault (FW)	F3	2	--	--	--	
Furnace Creek fault (FC)	P1, P2	50	[3]1.7 to 2.5	--	[4]2.3	Reynolds, 1969; Bryant, 1988; Brogan and others, 1991
Ghost Dance fault (GD)	F3	0	--	--	--	

Table 1. Data for known and suspected Quaternary faults within 50 km of Yucca Mountain--Continued

Fault or faults [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Keane Wonder fault (KW)	P2	43	--	--	--	
Mercury Ridge faults (MER)	P2	--	--	--	--	
[Northwest fault]	P2	48	--	--	--	
[Southeast fault]	P2	51	--	--	--	
Mine Mountain fault (MM)	P1	19	--	--	--	
Oasis Valley faults (OSV)	P1	--	--	--	--	
[Eastern faults]	P1	24	--	[5]0.001 to 0.005	--	
[Western faults]	P1	30	--	--	--	Hoover and others, [1981]; Reheis and Noller, 1989
Pahute Mesa faults (PM)	P1	48	--	--	--	
Paintbrush Canyon fault (PBC)	F3	3	[6]117 to140; 10^3 to 10^4	[7]$\leq$0.01	[8]0.0083	Swan and others, 1993; Whitney and Muhs, 1991
Plutonium Valley-North Halfpint Range fault (PVNH)	P1	46	--	--	--	
Ranger Mountains faults (RM)	P2	49	--	--	--	
[North faults]	P2	--	--	--	--	
[South faults]	P2	--	--	--	--	
Rock Valley fault (RV)	P2	[9]24;27; 32; 65	--	[10]0.003 to 0.01	--	Yount and others, 1987

Table 1. Data for known and suspected Quaternary faults within 50 km of Yucca Mountain--Continued

Fault or faults [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Rocket Wash-Beatty Wash fault (RWBW)	P1	19	--	--	--	
Solitario Canyon fault (SC)	F3	0.5	--	0.03 to 0.06	--	Faulds and others, 1991; Ramelli and others, 1991
Stagecoach Road fault (SCR)	F3	10	--	--	--	
Tolicha Peak fault (TOL)	P1	42	--	--	--	
Wahmonie fault (WAH)	P2	22	--	--	--	
Windy Wash fault (WW)	F3	3	[11]75	[12]0.0015	--	Scott, 1990; Whitney and others, 1986
			--	[13]0.001 to 0.03	--	Ramelli and others, 1991
Yucca fault (YC)	P1	40	--	--	--	
Yucca Lake fault (YCL)	P1	36	--	--	--	

[1]Although a tectonic origin for the Beatty scarp is not clear, a non-tectonic origin for the scarp has not been verified. Therefore, the feature is included in this compilation, which is based on published literature and other readily available data for known and suspected Quaternary faults.

[2]This recurrence interval is for episodes of fracturing during the last 130,000 years.

[3]This recurrence interval assumes four to six ruptures on FC since 10 ka.

[4]This rate is for FC in northern Death Valley since about 20 ka.

[5]This rate is based on displacement of deposits with an estimated age of 730 ka to 3 Ma.

[6]The first entry is the average recurrence interval for surface-faulting events since 117 ka to 140 ka. The second entry is the estimated intervals between three and five middle and late Pleistocene surface-faulting events on a western splay of PBC.

Table 1. Data for known and suspected Quaternary faults within 50 km of Yucca Mountain--Continued

[8]This is an oblique slip rate for PBC at Busted Butte since about 700 ka.

[9]The variation in the length of RV reflects different interpretations of the ends of the fault. The longest value assumes that RV extends from Frenchman Flat southwestward across the Amargosa Desert.

[10]This rate is for the central part of the fault at the trench sites of Yount and others (1987).

[11]This is the average recurrence interval that was estimated on the basis of four faulting events since 300 ka.

[12]This rate is based on an interpretation that 40 cm of vertical displacement has occurred since 270 ka.

[13]This is an average apparent vertical slip rate for the southern Windy Wash fault during the late Pleistocene and Holocene.

Table 2. Data for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain--(

[Detailed data are on tables in appendix 1 and on description sheets in appendix 2. Slip rates are usually apparent slip rates and are for late Quaternary (≤130 ka) or shorter (younger) time periods unless otherwise indicated; leaders (--), no information was noted during the literature review]

Fault or fault [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Belted Range fault (BLR)	P1	55	--	--	--	
Bonnie Claire fault (BC)	P1	74	--	--	--	
Boundary fault (BD)	P1	51	--	--	--	
Buried Hills faults (BH)	P1, P2	53	--	--	--	
Cactus Flat fault (CF)	P1	84	--	--	--	
Cactus Flat-Mellan fault (CFML)	P1	80	--	--	--	
Cactus Range-Wellington Hills fault (CRWH)	P1	87	--	--	--	
Cactus Springs fault (CAC)	P2	59	--	--	--	
Central Pintwater Range faults (CPR)	P1	79	--	--	--	
Central Spring Mountains faults (CSM)	P2	76	--	--	--	
[Northwest fault]	P2	--	--	--	--	
[Northeast fault]	P2	--	--	--	--	
[Southeast fault]	P2	--	--	--	--	
Chalk Mountain fault (CLK)	P1	87	--	--	--	
Chert Ridge faults (CHR)	P1	65	--	--	--	
[Eastern faults]	P1	--	--	--	--	
[Western faults]	P1	--	--	--	--	

Table 2. Data for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain--Continued

Fault or fault [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Chicago Valley fault (CHV)	P2	90	--	--	--	
Cockeyed Ridge-Papoose Lake fault (CRPL)	P1	53	--	--	--	
Death Valley fault (DV)	P2	55	0.65	[1]0.08 to 11.5; 0.15 to 2.5	--	Brogan and others, 1991
East Belted Range fault (EBR)	P1	80	--	--	--	
East Nopah fault (EN)	P2	85	--	[2]0.006 to 0.06	--	McKittrick, 1988; Hoffard, 1991
East Pintwater Range fault (EPR)	P1, P2	81	--	--	--	
Emigrant fault (EM)	P2	73	--	--	--	
Emigrant Valley North fault (EVN)	P1	60	--	--	--	
Emigrant Valley South fault (EVS)	P1	66	--	--	--	
Fallout Hills faults (FH)	P1	70	--	--	--	
Gold Flat fault (GOL)	P1	62	--	--	--	
Gold Mountain fault (GOM)	P1	90	--	--	--	
Grapevine fault (GV)	P1, P2	58	--	--	--	
Grapevine Mountains fault (GM)	P1	--	--	--	--	
[Southern trace]	P1	67	--	--	--	
[Northern trace]	P1	70	--	--	--	
Groom Range Central fault (GRC)	P1	82	--	--	--	

Table 2. Data for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain--Continued

Fault or fault [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Groom Range East fault (GRE)	P1	85	--	--	--	
Hidden Valley-Sand Flat faults (HVSF)	P2	87	--	--	--	
[Fault along the eastern sides of Hidden Valley/Ulida Flat]	P2	--	--	--	--	
[Fault along the southern sides of Ulida Flat/Sand Flat]	P2	--	--	--	--	
[Fault along the southeastern side of Sand Flat]	P2	--	--	--	--	
[Fault along the northeastern side of Sand Flat]	P2	--	--	--	--	
[Fault along the western side of Ulida Flat]	P2	--	--	--	--	
Hunter Mountain fault (HM)	P2	95	--	--	--	
Indian Springs Valley fault (ISV)	P1, P2	67	--	--	--	
Jumbled Hills fault (JUM)	P1	77	--	--	--	
Kawich Range fault (KR)	P1	57	--	--	--	
Kawich Valley fault (KV)	P1	61	--	--	--	
La Madre fault (LMD)	P2	82	--	--	--	
North Desert Range fault (NDR)	P1	80	--	--	--	
Oak Spring Butte faults (OAK)	P1	57	--	--	--	
Pahrump fault (PRP)	P2	70	--	--	--	

Table 2. Data for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain--Continued

Fault or fault [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Panamint Valley fault (PAN)	P2	95	--	--	--	
[Fault south of Ballarat]	P2	--	[3]0.7 to 2.5; 0.86 to 2.36	--	[4]1.74 ± 0.65; 2.36 ± 0.79; 1 to 2; 2.5	Smith and others, 1979; Ellis and others, 1989; Zhang and others, 1990
[Fault north of Ballarat]	P2	--	--	--	--	
Penoyer fault (PEN)	P1	97	--	--	--	
Racetrack Valley faults (RTV)	P2		--	--	--	
[Eastern fault]	P2	97	--	--	--	
[Western fault]	P2	102	--	--	--	
Sarcobatus Flat fault (SF)	P1	52	--	--	--	
Slate Ridge faults (SLR)	P1	87	--	--	--	
[Northern fault]	P1	--	--	--	--	
[Southern fault]	P1	--	--	--	--	
South Ridge faults (SOU)	P2	--	--	--	--	
[Northern fault]	P2	55	--	--	--	
[Southern fault]	P2	50	--	--	--	
Spotted Range faults (SPR)	P1, P2	59	--	--	--	
[Range-front fault]	P1, P2	--	--	--	--	
[Fault along unnamed ridge]	P1, P2	--	--	--	--	

Table 2. Data for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain--Continued

Fault or fault [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
[Faults within the range]	P1, P2	--	--	--	--	
Stonewall Mountain fault (SWM)	P1	92	--	--	--	
Stumble fault (STM)	P1	74	--	--	--	
Three Lakes Valley fault (TLV)	P1	84	--	--	--	
Tikaboo fault (TK)	P1	92	--	--	--	
Tin Mountain fault (TM)	P1, P2	90	--	--	--	
Towne Pass fault (TP)	P2	76	--	--	--	
West Pintwater Range fault (WPR)	P1, P2	76	--	--	--	
West Spring Mountains fault (WSM)	P2	53	--	[5]0.02 to 0.2; 0.06	--	Hoffard, 1991

[1]The first range of vertical slip rates is for DV south of Furnace Creek Wash and is based on the maximum vertical displacement of deposits with an estimated age between 0.2 ka to 2 ka. The second range of vertical slip rates is based on the maximum vertical displacement of deposits with an estimated age of 2 ka to 10 ka.

[2]This rate was estimated from a 3-m-high fault scarp on surfaces with an estimated age of 50 ka to 500 ka.

[3]The first entry is the average recurrence interval for a 20-km-long section of PAN between Ballarat and Goler Wash Canyon assuming that all events produced 1.4 to 2.6 m of right-lateral displacement so that a displacement of 20 m represents eight to fourteen events since 10 ka to 20 ka. The second entry is the average recurrence interval for the Holocene and latest Pleistocene assuming single-event displacements of about 3 m and a right-lateral slip rate of 2.36 ± 0.79 mm/yr.

[4]The first slip rate is a minimum rate for PAN near Manly Peak during the Holocene and latest Pleistocene. The second slip rate is a minimum rate for the fault near the southern extent of fault scarps at Goler Wash Canyon (5.3 km south of Manly Peak) during the Holocene and latest Pleistocene. The third rate is based on displaced deposits that have an estimated age of 10 ka to 20 ka at the mouth of Goler Wash Canyon. The fourth slip rate is for the southern portion of the fault since 15 ka.

[5]The first slip rate was estimated for WSM near the mouth of Wheeler Wash using displacement of a surface with an estimated age of 50 ka to 500 ka. The second rate was estimated for the fault in the same area using displacement on a surface with an estimated age of 200 ka.

Table 3. Data for known and suspected Quaternary faults greater than 100 km from Yucca Mountain

[Detailed data are on tables in appendix 1 and on description sheets in appendix 2. Slip rates are usually apparent slip rates and are for late Quaternary (≤130 ka) or shorter (younger) time periods unless otherwise indicated; leaders (--), no information noted during the literature review]

Fault or fault [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Airport Lake fault (AIR)	P2	138	--	[1]0.03 to 0.07	--	Roquemore, 1981
Ash Hill fault (AH)	P2	105	--	--	--	
Badger Wash faults (BDG)	P1	111	--	--	--	
Cedar Mountain fault (CM)	F1	200	([2])	--	[3]0.05; 0.1	Bell and others, 1988
Central Reveille fault (CR)	P1	108	--	--	--	
Clayton-Montezuma Valley fault (CLMV)	P1	126	--	--	--	
Clayton Ridge-Paymaster Ridge fault (CRPR)	P1	126	--	--	--	
Clayton Valley fault (CV)	P1	132	--	--	--	
Deep Springs fault (DS)	P1	148	--	[4]0.24; 0.3	--	Bryant, 1989; Reheis and McKee, [1991]
East Magruder Mountain fault (EMM)	P1	113	--	--	--	
East Reveille fault (ERV)	P1	112	--	--	--	
East Stone Cabin fault (ESC)	P1	115	--	--	--	
Emigrant Peak faults (EPK)	P1	166	--	[5]0.16; 0.5 to 1	--	Reheis, 1988b, 1991b
Emigrant Valley East fault (EURE)	P1	110	--	--	--	
Emigrant Valley West fault (EURW)	P1	140	--	--	--	
Fish Lake Valley fault (FLV)	P1	135	[6]1.1±0.6	[7]0.1 to 0.3; [8]0.8 to 1.6	[7]0.4 to 0.6; [9]0.6 to 0.8	Sawyer, 1990, 1991

Table 3. Data for known and suspected Quaternary faults greater than 100 km from Yucca Mountain--Continued

Fault or fault [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Freiburg fault (FR)	P1	133	--	--	--	
Frenchman Mountain fault (FM)	P2	146	([10])	--	--	Anderson and O'Connell, 1993
Garden Valley fault (GRD)	P1	126	--	--	--	
General Thomas Hills fault (GTH)	P1	137	--	--	--	
Golden Gate faults (GG)	P1	144	--	--	--	
Hiko fault (HKO)	P1	131	--	--	--	
Hiko-South Pahroc faults (HSP)	P1	130	--	--	--	
Hot Creek-Reveille fault (HCR)	P1	103	--	--	--	
Lee Flat fault (LEE)	P2	113	--	--	--	
Lida Valley faults (LV)	P1	115	--	--	--	
Little Lake fault (LL)	P2	163	[11]0.02	--	[12]0.6 to 1.8; 1.1 to 4.9; 3	Duffield and Bacon, 1981; Roquemore, 1981, 1988; Wills, 1988
Lone Mountain fault (LMT)	P1	165	--	--	--	
McAfee Canyon fault (MAC)	P1	155	--	--	--	
Monitor Hills East fault (MHE)	P1	125	--	--	--	
Monitor Hills West fault (MHW)	P1	124	--	--	--	
Monotony Valley fault (MV)	P1	103	--	--	--	
Montezuma Range fault (MR)	P1	121	--	--	--	
Mud Lake-Goldfield Hills fault (MLGH)	P1	113	--	--	--	

11C-2

Table 3. Data for known and suspected Quaternary faults greater than 100 km from Yucca Mountain--Continued

Fault or fault [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Owens Valley fault (OWV)	P2	126	3.3 to 5; 5 to 10.5	--	[13]0.4 to 1.3; 0.7 to 2.2; 2±1; 3; 3 to 7	Lubetkin and Clark, 1988; Hart and others, 1989; Beanland and Clark, 1993
Pahranagat faults (PGT)	P1	106	--	--	--	
[Arrowhead Mine fault (ARM)]	P1	--	--	--	--	
[Buckhorn fault (BUC)]	P1	--	--	--	--	
[Maynard Lake fault (MAY)]	P1	--	--	--	--	
Pahroc fault (PAH)	P1	144	--	--	--	
Pahrock Valley faults (PV)	P1	155	--	--	--	
Palmetto Mountains-Jackson Wash fault (PMJW)	P1	112	--	--	--	
Palmetto Wash faults (PW)	P1	131	--	--	--	
Quinn Canyon fault (QC)	P1	127	--	--	--	
Saline Valley faults (SAL)	P2	108	--	--	--	
[Fault along the front of the Inyo Mountains (WF)]	P2	--	--	--	--	
[Fault along the eastern side of Saline Valley (ES)]	P2	--	--	--	--	
[Fault in central Saline Valley (CEN)]	P2	--	--	--	--	
Seaman Pass fault (SPS)	P1	153	--	--	--	
Sheep Basin fault (SB)	P1, P2	112	--	--	--	

11C-3

Table 3. Data for known and suspected Quaternary faults greater than 100 km from Yucca Mountain--Continued

Fault or fault [Segment or individual fault]	Plate (P) or figure (F)	Closest approach (km)	Recurrence interval (10^3 yr)	Vertical slip rate (mm/yr)	Lateral slip rate (mm/yr)	References
Sheep-East Desert Ranges fault (SEDR)	P2	104	--	--	--	
Sheep Range fault (SHR)	P1, P2	122	--	--	--	
Sierra Nevada fault (SNV)	P2	154	--	0.1 to 0.8	--	Beanland and Clark, 1993
Silver Peak Range faults (SIL)	P1	142	--	--	--	
Six-Mile Flat fault (SMF)	P1	138	--	--	--	
Southeast Coal Valley fault (SCV)	P1	132	--	--	--	
Southern Death Valley fault (SDV)	P2	105	--	--	[14]0.3; 32 to 63	Butler, 1984; Brady, 1986
State Line fault (SL)	F1	130	--	--	--	
Stonewall Flat fault (SWF)	P1	101	--	--	--	
Sylvania Mountains fault (SYL)	P1	111	--	--	--	
Tem Piute fault (TEM)	P1	101	--	--	--	
Tule Canyon fault (TLC)	P1	104	--	--	--	
Weepah Hills fault (WH)	P1	145	--	--	--	
West Railroad fault (WR)	P1	112	--	--	--	
Wilson Canyon fault (WIL)	P2	140	--	--	--	

Table 3. Data for known and suspected Quaternary faults greater than 100 km from Yucca Mountain--Continued

[1] This is the rate for the Southern segment of Roquemore (1981) estimated using displaced alluvium with an estimated age of 50 ka to 126 ka.

[2] On the basis of the subdued scarps older than the 1932 rupture, a recurrence interval of possibly tens of thousands of years for surface-rupturing events was inferred.

[3] The first rate is since 135 ka. The second rate is since 20 ka.

[4] These are minimum slip rates estimated using different amounts of displacement of deposits containing Bishop ash (740 ka).

[5] Both slip rates are for the westernmost fault of EPK. The first rate is a minimum rate calculated using deposits containing Bishop ash (740 ka). The second rate is a maximum late Holocene rate estimated using displacement of deposits with an estimated age of 2 ka.

[6] This is the average recurrence interval between three ruptures that have occurred since 2.5 ka. The interval could be as long as 3,000 yr or as short as 500 yr.

[7] These rates were estimated for deposits with an estimated age of 5 ka to 8 ka for a single trace of FLV in northern Fish Lake Valley.

[8] This slip rate was estimated for deposits with an age of 150 ka across the entire FLV in northern Fish Lake Valley.

[9] This rate was estimated for deposits with an estimated age of 150 ka for a single trace of FLV in northern Fish Lake Valley.

[10] The recurrence interval for surface-rupturing events since 500 ka was estimated to be tens to possibly thousands of years.

[11] This recurrence interval is based on the occurrence of earthquakes of magnitude ≥ 5 every 20 years for the past 60 years.

[12] The first rate was based on displacement of an Owens River channel that is cut into a basalt dated at 400 ka and that is filled by a basalt dated at 140 ka. The second rate was estimated for deposits with an estimated age of 51 ka to 229 ka. The third rate is a Holocene rate that was estimated for deposits with an estimated age of ≤ 10 ka.

[13] These rates are for various time intervals. The first rate is since latest Pleistocene. The second rate is an average Holocene rate at Lone Pine. The third rate is an average Holocene net slip rate. The fourth rate is for the late Quaternary. The fifth rate is an average Historical right-lateral slip rate that was measured geodetically.

[14] The first rate is an average right-lateral slip rate for one set of traces of SDV that displaces a volcanic cone (Cinder Hill) that has been dated at 700 ka. The second rate is a maximum apparent lateral slip rate that was estimated for SDV in the Noble Hills on the basis of displacement of alluvial-fan deposits with an estimated age of 8 ka to 15.5 ka.

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APPENDIX 1. DATA TABLES FOR KNOWN AND SUSPECTED QUATERNARY FAULTS WITHIN ABOUT 100 KM OF YUCCA MOUNTAIN

INTRODUCTION

This appendix contains tables that summarize properties of known and suspected Quaternary faults located within the area covered by plates 1 and 2. It includes known and suspected Quaternary faults within 100 km of the potential waste repository at Yucca Mountain. Data shown on these tables have been extracted from the description sheets presented in appendix 2. The tabulated properties provide information about possible earthquake sources relevant to the potential waste repository. The properties shown in the tables in this appendix are listed below. The tables in which the properties appear are shown in parentheses.

- Strike of the fault (Tables 8, 13, 18)
- Type of displacement identified along the fault (Tables 8, 13, 18)
- Estimated length of the fault (Tables 4, 9, 14)
- Percent of the fault's total length that has experienced late Quaternary surface rupture (Tables 4, 9, 14)
- Closest approach of the fault to the potential waste repository at Yucca Mountain (Tables 4, 9, 4)
- Estimated age(s) of the youngest displaced deposit(s) (Tables 5, 10, 15)
- Estimated age(s) of the oldest undisplaced deposit(s) (Tables 5, 10, 15)
- Amount of displacement that occurred in the youngest surface–rupturing event (Tables 5, 10, 15)
- Amount of displacement that has occurred during the late Quaternary (Tables 5, 10, 15)
- Slip rates or apparent slip rates estimated for time intervals during the Quaternary (Tables 6, 11, 16)
- Estimated number of surface–rupturing events for time intervals during the Quaternary (Tables 7, 12, 17)
- Recurrence interval between surface–rupturing events during the late Quaternary or the Quaternary (Tables 8, 13, 18)

Two additional pieces of information are shown for the faults:

- Plate or figure number where the fault is shown (Tables 4, 9, 14)
- Reference(s) from which the data were taken (Tables 4, 5, 8, 9, 10, 13, 14, 15, 18). The numbers beginning with "Y-" have been arbitrarily assigned to the references. The references are listed by these numbers in appendix 4.

The faults shown in the tables in this appendix are grouped by distance from the potential waste repository at Yucca Mountain as follows: faults within 50 km of Yucca Mountain (tables 4 through 8, pages 18 through 35), faults between >50 and 100 km from Yucca Mountain (tables 9 through 13, pages 36 through 55), and faults at distances greater than 100 km from the site but within the area covered by plates 1 and 2 (tables 14 through 18, pages 56 through 75).

Previous workers have subdivided several faults into segments (although these are not necessarily rupture segments). These segments or sections are listed separately in the tables under the fault name. Some individual traces of a fault have received enough study that they are also listed separately under the fault name. In addition, some separate, short faults are listed together under one name on plates 1 and 2 and on the description sheets in appendix 2. These short faults are shown under the name for the group of faults, but properties are listed for each short fault.

Large uncertainties exist in the ages of the displaced and undisplaced deposits. These uncertainties partly reflect the problems in determining the ages of Quaternary deposits. In some cases, ages have been estimated at different localities along a fault, but studies are not detailed or extensive enough to determine if the differences in ages actually reflect differences in rupture histories. These uncertainties sometimes result in age estimates for the youngest displaced deposits that overlap with or are younger than the age estimates for the oldest undisplaced deposits.

DISCUSSION

The tables in this appendix demonstrate that, with but a few exceptions, little data about the properties listed above are available for known and suspected Quaternary faults within about 100 km of the potential waste repository at Yucca Mountain. The exceptions are the faults within about 5 km of the site (site faults) and a few other faults that have received relatively detailed study (e.g., the Carpetbag fault in Yucca Flat). Additional studies may eliminate some faults listed in the tables in this appendix by demonstrating that no Quaternary surface rupture has occurred. Additional studies may also change the way in which some faults are portrayed on plates 1 and 2. Previously mapped fault traces that have known or suspected Quaternary activity and geomorphic features (e.g., scarps, lineaments, and linear range fronts) that may indicate Quaternary surface rupture have been grouped together where these traces and geomorphic features have similar strikes or trends and similar relationships to topographic features (e.g., at or near the base of a mountain range), and a similar senses of displacement, if they are indicated. However, once an understanding of fault displacements and their ages becomes clearer, grouped fault traces as shown on plates 1 and 2 may change. This could be significant for some properties shown in the tables in this appendix. An example is fault length, a property used to assess potential hazard but one that is primarily dependent upon how individual fault traces have been grouped together.

Compilation of existing data is in constant revision because of the continuing study of the faults near and around Yucca Mountain. Because of this, a primary goal of this compilation is to provide an exhaustive bibliography of what was available as of December 1993. Additional studies will, hopefully, provide the data necessary to complete the tables in this appendix.

Table 4. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults within 50 km of Yucca Mountain

[Detailed data are on data sheets in appendix 2. References are listed by number in appendix 4. Queried entries indicate uncertainty in information. Entries separated by a comma (,) indicate data for individual faults or at different localities along a fault or faults; entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (– –), no information was noted during the literature review; YM, the proposed repository site at Yucca Mountain]

Fault or faults [Segment, individual fault]	Plate (P) or Figure (F) number	Estimated total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
Amargosa River fault (AR)	P2	15	– –	– –	– –	40	695
Area Three fault (AT)	P1	[1]5 to 7.5	– –	– –	– –	44	181, 224, 526
Ash Meadows fault (AM)	P2	60	– –	– –	– –	34	69, 695
[Northern section]	P2	7	– –	[2]≥0.05	– –	– –	695
[Central section]	P2	5	·	[3] (0.002 to 0.003)	– –	– –	695
[Southern section]	P2	48	– –	– –	– –	– –	69, 695
Bare Mountain fault (BM)	P1, P2	15.5	– –	≥2.6	– –	14	3, 101
[Section #1]	F5	3.5	– –	– –	– –	– –	
[Section #2]	F5	3.3	– –	– –	– –	– –	
[Section #3]	F5	2.5	– –	– –	– –	– –	
[Section #4]	F5	3.8	– –	– –	– –	– –	
[Section #5]	F5	2.5	– –	– –	– –	– –	
Beatty scarp (BS)[4]	P1, P2	8; 10; 25?	– –	– –	– –	26	6, 232, 1041
Bow Ridge fault (BR)	F3	≥6; 9 to10	– –	[5]≥0.2	– –	1	26, 46, 55, 217, 224, 298, 772, 1042
Bullfrog Hills faults (BUL)	P1	[6]4, 7	–	– –	– –	38	232
Cane Spring fault (CS)	P1, P2	14; 27	– –	– –	– –	26	104, 210, 232
Carpetbag fault (CB)	P1	16.5; 30	– –	[7]≥0.6; 1.2?	[8]≥0.6	43	181, 182, 224, 526
Checkpoint Pass fault (CP)	P2	8	– –	– –	– –	44	813, 852
Crossgrain Valley faults (CGV)[9]	P2	– –	– –	– –	– –	48	

Table 4. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults [Segment, individual fault]	Plate (P) or Figure (F) number	Estimated total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
[North Ridge front fault]	P2	7; 8.5	--	--	--	--	813, 852
[Northeast valley faults]	P2	1.5; 2.5	--	--	--	--	813, 852
[Southwest valley fault]	P2	3	--	--	--	--	813
East Crater Flat faults (ECR)	F3	--	--	--	--	--	
Fault S	F3	12	--	--	--	4	26
Fault T	F3	7	--	--	--	5	26
Black Cone fault (BLK)	F3	3.5 to 6.5	--	--	--	7	1196, 1201
West lava fault (WL)	F3	8	--	--	--	7	1196, 1201, 1230
Fault U	F3	0.2; 0.5	--	--	--	16	26
Eleana Range fault (ER)	P1	6; 9; 13	--	--	--	37	526, 813, 853
Fatigue Wash fault (FW)	F3	4.5; 7.5	--	--	--	2	26, 1042
Furnace Creek fault (FC)	P1, P2	[10]105; 115; 160; 165; 175; >250; 400	[11]75 to 80	--	[12]10; ≥19; 24 to 48; 50; 68±4; 80; 80 to 128	50	216, 236, 262, 389, 468, 479, 596, 600, 651, 683, 1027
Ghost Dance fault (GD)	F3	9; 19 to 20	--	≥0.025	--	0	26, 55, 396, 1042
Keane Wonder fault (KW)	P2	25		--	[13]5	43	238, 1357
Mercury Ridge faults (MER)	P2	--	--	--	--	--	
[Northwest fault]	P2	9; 10	--	--	--	48	813, 852
[Southeast fault]	P2	3	--	--	--	51	852
Mine Mountain fault (MM)	P1	16; 22; 27	--	--	≥1	19	104, 182, 205, 232
Oasis Valley faults (OSV)	P1	--	--	--		-	
[Eastern faults]	P1	[14]16 to 20(?)	--	[15]≥0.004	-	24	10, 238, 813, 1223
[Western faults]	P1	[14]7 to 11(?)	-	--		30	238, 813
Pahute Mesa faults (PM)	P1	[16]9	--	--		48	813
Paintbrush Canyon fault (PBC)	F3	18; 25; 30	--	[15]0.3; ≥0.5	-	3	26, 46, 55, 217, 224, 575, 1042
Plutonium Valley–North Halfpint Range fault (PVNH)	P1	15; 26	--	--	-	46	232, 813

Table 4. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults [Segment, individual fault]	Plate (P) or Figure (F) number	Estimated total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
Ranger Mountains faults (RM)[16]	P2	--	--	--	--	--	
[North faults]		3; 5	--	--	--	--	813, 852
[South faults]		3; 4	--	--	--	--	813, 852
Rock Valley fault (RV)	P2	[19]19; 32; 65	--	--	([20])	[21]24; 27	20, 62, 68, 224, 238, 695
Rocket Wash Beatty Wash fault (RWBW)	P1	[22]5; 17	--	--	--	19	238, 813, 853
Solitario Canyon fault (SC)	F3	≥12; 13	--	[23]≥0.4; 1	--	0.5	26, 396, 1201
Stagecoach Road fault (SCR)	F3	[24]≥9; 12; 13; 31	--	[25]≥10	[26]≥1	10	31, 46, 55, 189, 396
Tolicha Peak fault (TOL)	P1	22	--	--	--	42	813
Wahmonie fault (WAH)	P2	14; 15	--	--	--	22	104, 232
Windy Wash fault (WW)	F3	[27]14; 25	--	≥0.4	--	3	396, 701
Yucca fault (YC)	P1	[28]22; 25; 24 to 32; 34 to 40	--	[29]≥0.2; 0.31 to 0.61; >0.61	([30])	40	181, 526, 693, 813, 853
Yucca Lake fault (YCL)	P1	17	--	--	--	36	232

[1]The northern portion is about 2 km long. The southern section has two branches, a western one 3 or 4 km long and an eastern one 3.5 to 5.5 km long (Y-181; Y-224; Y-526).

[2]This displacement is for a 3.2-Ma tuff along the western branch of the northern section (Y-695).

[3]This is the minimum vertical displacement of a deposit with an estimated age of about 40 ka as interpreted from trenches (Y-695).

[4]Although a tectonic origin is not clear, a non-tectonic origin for the Beatty scarp has not been verified. Therefore, the feature is included in this compilation, which is based on published literature and other readily available data for known and suspected Quaternary faults.

[5]The is the apparent vertical separation reported by Y-217 and Y-298 for the Topopah Spring Member of the Paintbrush Tuff (13.1±0.8 Ma; K-Ar).

[6]BUL includes four faults. The eastern and western faults are each about 7 km long. The other two faults are each about 4 km long (Y-232).

[7]Y-181 (p. 27) reported an average vertical displacement in Tertiary volcanic tuff of 600 m. Y-182 (p. 21, 23-24) noted that alluvium adjacent to the southern end of CB is 600 to 1,200 m thick and interpreted this depression to be a structural feature formed in part by vertical displacement on CB.

[8]Y-181 (p. 27) noted that the amount of right-lateral displacement on CB since deposition of Tertiary volcanic tuff could be ≥600 m and that Paleozoic rocks could be displaced laterally "several thousand feet."

[9]CGV includes several faults: one along the front of North Ridge (North Ridge front fault), faults about 0.5 km north of North Ridge in Crossgrain Valley and faults at the northeastern end of the ridge (Northeast valley faults), and a fault at the southwestern end of North Ridge (Southwest valley fault).

[10]Variation in length estimates results from differences in the interpretation of the ends of FC, especially it southeastern extension along the Furnace Creek basin into the Amargosa Valley, and the relationships between FC and the Fish Lake Valley fault (FLV) to the northwest and the Death Valley fault (DV) to the south. (See data sheets in appendix 2.)

[11]Percent of length with late Quaternary displacement was estimated using a late Quaternary rupture length of 130 km (between the northern end of Death Valley and Navel Spring adjacent to Furnace Creek Wash) and a total length of 165 to 175 km (between the northern end of Death Valley and the Amargosa Valley).

[12]Y-683 (p. 128) thought that development of Furnace Creek basin requires no more than 10 km of right-lateral displacement on FC. Y-468 (p. 157) implied that right-lateral displacement on FC has been at least 19 km. Y-389 (p. 56) suggested that FC has experienced 24 to 48 km of right-lateral displacement. Y-596 estimated 50 km of right-lateral displacement on FC at the northern end of Death Valley. On the basis of correlations of Mesozoic thrust faults, Y-1027 suggested that 68±4 km of apparent right-lateral displacement has occurred on FC between the Cottonwood and Funeral mountains. Y-600 (p. 133, 135) estimated about 80 km of right-lateral displacement on FC on the basis of isopachs on Upper Precambrian and Lower Cambrian rocks. Y-262 (p. 1411) interpreted isopachs and facies of Devonian and Silurian rocks and the distribution of Mississippian rocks as indicating 80 to 128 km of right-lateral displacement on FC in northern Death Valley.

[13]Y-1357 reported about 5 km of right-lateral displacement on the southeastern end of KW. This amount was estimated from displaced, northeast-trending axes of folds in Proterozoic rocks.

Table 4. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

[14]A graben shown by Y-813 in the northern part of Oasis Valley does not clearly align with the faults along either side of the valley. The larger, queried value is the length of the faults if this graben, which is about 3.5 km long, is included with the other faults.

[15]Y-10 (p. 58) reported that one fault along the eastern side of Oasis Valley displaces Quaternary and Tertiary alluvial-fan deposits about 4 m.

[16]Individual faults have lengths between 0.5 and 4 km (Y-813)

[17]Stratigraphic dip separation on PBC in the Topopah Spring Member of the Paintbrush Tuff (13.1±0.8 Ma) is 515±5 m at the northern end of Fran Ridge (Y-55; Y-217). Total displacement across the Fran Ridge fault, which Y-217 (p. 52) included as a splay of PBC, is about 300 m

[18]RM includes two faults north of the Ranger Mountains (North faults) and four faults in the southern Ranger Mountains (South faults).

[19]RV as mapped by Y-224 extends from the Specter Range to Frenchman Flat for a length of about 32 km. The length of RV as portrayed by Y-20 is only 19 km because they do not show fault traces in Frenchman Flat to be part of RV. Y-68, Y-238, and Y-695 extend RV about 33 km southwest of the Specter Range into the Amargosa Desert for a total length for RV of about 65 km.

[20]Total lateral displacement on RV is estimated to be "a few kilometers" (Y-62).

[21]Distance is 27 km if RV is considered to extend from the Specter Range to Frenchman Flat. Distance is 24 km if the southwestern end of RV extends into the Amargosa Desert as suggested by Y-68, Y-238, and Y-695.

[22]The length of 5 km is from Y-853, who show only some of the fault traces that are shown by Y-238 and Y-813. Y-238 and Y-813 estimated RWBW to be 17 km long.

[23]Y-396 (p. 273) reported a dip-slip displacement of 0.4 km along the central portion of SC since 13.5 Ma. Y-396 (p. 259) noted a cumulative displacement of about 1 km at the southern end of the fault.

[24]The length of SCR is 12 km as estimated from Y-55 and about 9 km as estimated from Y-189, but SCR extends to the edge of their map areas. If concealed sections between Yucca Mountain and Jackass Flats, across Jackass Flats, and northeast of the flats are considered part of SCR, then the total length of SCR as portrayed by Y-46 is 31 km.

[25]On the basis of tectonic tilt of volcanic units (Paintbrush Tuff at 13 Ma to 13.5 Ma and Timber Mountain Tuff at 11.5 Ma), Y-396 (table 2, p. 275) suggested 6.7 km of vertical displacement on SCR between 13 Ma and 11.5 Ma, 3.3 km of vertical displacement since 11.5 Ma, and 4.5 m of vertical displacement since some time after 1.7 Ma. This is a total vertical displacement of at least 10 km.

[26]Y-31 (p. 332) identified as much as 1 km of left-lateral displacement of ridges composed of a 13-Ma tuff.

[27]Y-701 reported a length of 14 km for WW. The length of WW is about 25 km as estimated from the map by Y-396 (p. 256).

[28]The total length of YC is about 22 km as estimated from Y-813 (pl. 2) and Y-853, about 25 km as estimated from Y-526, at least 24 km and possibly 32 km as noted by Y-181 (p. 26), and about 34 km to 40 km as inferred by Y-693 (p. 209). The longest values include the Butte fault (BT) as part of YC.

[29]Y-181 (p. 27) reported a vertical displacement of ≥200 m in Tertiary volcanic tuff. Y-693 (p. 201) reported that alluvial and lacustrine deposits are 305 to 610 m thick on the downthrown side of YC; alluvium in the south-central part of the basin and east of YC (downthrown side) is >610 m thick (Y-688, p. 50). These thicknesses may represent the amount of vertical displacement on YC.

[30]Y-181 (p. 29) reported that Paleozoic rocks may be displaced laterally "several thousand feet" on YC. Y-181 (p. 27) also noted that the lateral component of displacement in Tertiary volcanic tuff may be equal to or greater than the amount of vertical displacement (≥200 m)

Table 5. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults within 50 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. Ages are estimated primarily from photogeologic, geomorphic, and pedologic criteria. (See individual references and description sheets in appendix 2 for limitations.) References are listed by number in appendix 4. Overlap of ages reported in columns 2 and 3 reflects uncertainties in age estimates and in stratigraphic interpretations (appen. 2). Abbreviations for ages (used where age is not specified in years): Hist., Historical; Hol., Holocene; E.Hol., Early Holocene; Lt.Pleist., Latest Pleistocene; L.Pleist., Late Pleistocene; L/M Pleist., Late and Middle Pleistocene; M.Pliest., Middle Pleistocene; E.Pleist, Early Pleistocene; L.Plio., Latest Pliocene; L.Quat., Late Quaternary; Quat., Quaternary; Tert., Tertiary. Late Quaternary displacement is since 130 ka. Queried entries indicate uncertainty of information. Entries separated by a semicolon (;) indicate different interpretations by different authors; entries separated by a comma (,) indicate data for individual faults or at different localities along a fault or faults; leaders (--), no information was noted during the literature review]

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y-)
			Vertical	Lateral	Vertical	Lateral	
Amargosa River fault (AR)	≤10	--	--	--	--	--	695
Area Three fault (AT)	[1]Hist.; ≤10	--	--	--	--	--	181, 224, 526
Ash Meadows fault (AM)							
[Northern section]	[2]≤10	--	--	--	[2]≤50	--	695
[Central section]	>10; 40	--	1.6, >3	--	--	--	695
[Southern section]	E.Hol./Lt.Pleist.	≤10	--	--	--	--	69
Bare Mountain fault (BM)	Hol.	--	--	--	--	--	3, 1041
[Section #1]	L/M Pleist.?	--	--	--	--	--	3
[Section #2]	<350	--	--	--	--	--	3
[Section #3]	L/M Pleist.?	≤8.3±0.075	--	--	--	--	3, 64
[Section #4] locality 3	<(5 to 15)	--	--	--	--	--	3
locality 4	<9	--	1.75	--	--	--	3
locality 5	E.Hol.	--	--	--	--	--	
[Section #5]	L/M Pleist.?	--	--	--	--	--	3
Beatty scarp (BS)[3]	[4]<(10 to12)	[5]>(1 to 3?)	--	--	[6]≥2 to 30	--	6
Bow Ridge fault (BR)	[7]38±10 to 270±90; 270 and 1,200	[8]40; 38±10; 90±50	Fracturing; [9]0.05 to 0.2	[9]0.11 to 0.28	[10]0.45	[10]0.76 to 1.32	26, 87, 217, 1091
Bullfrog Hills faults (BUL)	Quat.	Quat.	--	--	--	--	43, 232
Cane Spring fault (CS)	Quat.?	Quat.	--	--	--	--	104, 210, 226, 232
Carpetbag fault (CB)	[11]Hist.; 30	[12]35±15; 125 to 130 (350?); 170	[13]Fracturing	[14]0.15	--	--	181, 224, 327, 1106

Table 5. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y-)
			Vertical	Lateral	Vertical	Lateral	
Checkpoint Pass fault (CP)	[15]Quat.	Quat./Tert.	--	--	--	--	62, 813, 852
Crossgrain Valley faults (CGV)	Quat.	--	--	--	--	--	813, 852
[North Ridge front fault]	Quat.	Quat./Tert.	--	--	--	--	62, 813, 852
[Northeast valley faults]	Quat.	Quat./Tert.	--	--	--	--	62, 813, 852
[Southwest valley fault]	Quat.	Quat./Tert.	--	--	--	--	62, 813, 852
East Crater Flat faults (ECR)							
Fault S	E.Pleist.-L.Plio. (1,100 to 2,000); ([16])	M.Pleist.	--	--	--	--	26, 1230
Fault T	E.Pleist.-L.Plio. (1,100 to 2,000)	--	--	--	--	--	26
Black Cone fault (BLK)	6.6 to 11.1; (270 to 800)?	--	--	--	--	--	26, 1201, 1230
West lava fault (WL)	17.3 to 30.3	--	<1	--	--	--	1201
Fault U	E.Pleist.-L.Plio. (1,100 to 2,000)	7 to 9	--	--	--	--	26
Eleana Range fault (ER)	10 to 130; 160 to180	--	--	--	--	--	526, 853
Fatigue Wash fault (FW)	≤10	270 to 800	--	--	--	--	26, 1201
Furnace Creek fault (FC)	[17]0.2 to 2	[17]<0.2; 0.2 to 2; Pleist.	[18]0.6 to 1.5	[19]<0.6 to 1.5	--	[20]≥21; ≥46	216, 236
Ghost Dance fault (GD)	Quat.	7 to 9; 270 to 800	--	--	--	--	26, 1201, 1227, 1230
Keane Wonder fault (KW)	Quat.	--	--	--	--	--	238, 468, 746, 1020, 1357
Mercury Ridge faults (MER)							
[Northwest fault]	Quat.?	Quat./Tert.	--	--	--	--	62, 813, 852

Table 5. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y-)
			Vertical	Lateral	Vertical	Lateral	
[Southeast fault]	Quat.?	Quat./Tert.	--	--	--	--	62, 852
Mine Mountain fault (MM)	Quat.	Quat.	--	--	--	--	104, 205, 232, 238
Oasis Valley faults (OSV)							
[Eastern faults]	[21]>(27 to 35) to <730; 145 to 430; Quat.	--	--	--	≥4	--	10, 73, 264, 1223
[Western faults]	Quat.	--	--	--	--	--	813
Pahute Mesa faults (PM)	Quat.	--	--	--	--	--	813
Paintbrush Canyon fault (PBC)	[22]L.Quat.; 270 to 700; 270 to 800; 700 to 750; L.Pleist.	[23]160 to 250; 270 to 700; Quat.	[24]0.15	--	[25]≤4.1; ([26]); [27]≤(1.7 to 2.7)	--	26, 217, 575, 1098
Plutonium Valley–North Halfpint Range fault (PVNH)	Quat.	Quat.	--	--	--	--	232, 813
Ranger Mountains faults (RM)[28]							
[North faults]	Quat.	--	--	--	--	--	852
[South faults]	Quat.	--	--	--	--	--	852
Rock Valley fault (RV) [Central section]	[29]<(31 to 38); ≤10	([30])	0.1 to 0.32	--	[31]≤(2.5 to 3)	--	20, 70
[Northeast section]	[32]10 to130	--	--	--	--	--	852
[Possible southwest extension]	≤10	--	--	--	--	--	68, 90, 695
Rocket Wash–Beatty Wash fault (RWBW)	Quat.	--	--	--	--	--	238, 813
Solitario Canyon fault (SC)	6.6 to 11.1; ≤15	270 to 800	([33])	--	≤1	--	26, 396, 700, 1196, 1201, 1230
Stagecoach Road fault (SCR)	1100 to 2000; Quat.	700 to 750	--	--	--	[34]≤(10 to 30)	26, 31
Tolicha Peak fault (TOL)	Quat.	--	--	--	--	--	813
Wahmonie fault (WAH)	270 to 740; >740; Quat.	160 to 740	[35]<1 to 3?	--	--		226, 238
Windy Wash fault (WW)	3 to 6.5	--	<0.1	--	[36]≤(1.5 to 2)	--	12, 701

Table 5. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y-)
			Vertical	Lateral	Vertical	Lateral	
Yucca fault (YC)	[37]Hist.; 1 to 10; 10 to 130; ≥35	≤10	--	--	[38]1.5 to 6; >12; 15	--	181, 224, 526, 688, 693, 853, 1106
Yucca Lake fault (YCL)	Quat.	--	--	--	--	--	181, 232

[1]Surficial expression of parts of the Area Three fault may be the result of underground nuclear explosions (Y-181; Y-224).

[2]Data are for the western branch of the northern section.

[3]Although a tectonic origin is not clear, a non-tectonic origin for the Beatty scarp has not been verified. Therefore, the feature is included in this compilation, which is based on published literature and other readily available data for known and suspected Quaternary faults.

[4]Age is uncertain. Radiocarbon dates suggest that faulted deposits are about 10 ka (10±0.3 ka and 9.8±0.3 ka), but uranium-trend analyses suggest that the age of these same deposits is about 500 ka (480±50 ka). Maximum scarp-slope angles suggest that displacement is younger than 12 ka, but older than a few thousand years (Y-6).

[5]Age is based on interpretation of maximum scarp-slope angles (Y-6; see note 4 above).

[6]These are the measurements of scarp heights (Y-6). Number of events is not known; ages for the scarps are not specified.

[7]These first two ages were estimated using uranium-trend methods (Y-26). Y-217 concluded that the dates are inconsistent. The last two numbers are from Y-87, who concluded that the most-recent event exposed in Trench 14 is represented by undated basaltic ash that they correlated with 1.2-Ma and 0.27-ka ashes from Crater Flat.

[8]Y-217 concluded that deposits with an estimated age of 40 ka overlie the fault. Y-87 interpreted an eolian unit that yielded dates (uranium-trend analyses) of 38±10 ka and 90±50 ka as undisplaced.

[9]Y-1091 inferred a per-event vertical displacement between 5 and 20 cm (average of about 10 cm) and an average net (left-oblique) displacement per event between 11 and 28 cm.

[10]Y-1091 inferred a cumulative vertical displacement of 45 cm since middle Quaternary and a cumulative net (left-oblique) displacement of 76 to 132 cm since middle Quaternary.

[11]The youngest fracturing occurred about 30 ka (Y-327). Y-181, Y-224, Y-327, and Y-1106 all reported that portions of CB were reactivated by an underground nuclear explosion in 1970.

[12]On the basis of a date (uranium-trend analyses) of 35±15 ka for an unfractured deposit, Y-327 (p. 231) and Y-1106 (p. 25, 30) concluded that no surface fracturing (or larger displacement) had occurred on at least part of CB since that time. Another unfractured deposit was estimated to have an age of about 170 ka by Y-1106 (p. 30) on the basis of development of both rock varnish and an argillic soil horizon. On the basis of an absence of prehistoric scarps and undisplaced stratigraphic units exposed in three trenches, Y-327 (p. 231) and Y-1106 (p. 14, 31) concluded that no significant vertical displacement had occurred at least since 10 ka, probably since 125 ka to 130 ka, and possibly since 350 ka.

[13]Youngest displacements have been interpreted by Y-327 to be fracturing only.

[14]An historical subsurface explosion resulting from nuclear testing produced 15 cm of right-lateral displacement across a 1.2-m-high scarp and left-stepping, *en echelon* cracks (Y-181).

[15]The Quaternary age is based on the faults juxtaposing Quaternary alluvium against bedrock along a range front or ridge that has morphologic features similar to those along major range-front faults (Y-852).

[16]A map by Y-1230 (fig. 5) portrays as "recently active" a fault that is probably correlative with Fault S.

[17]The youngest units displaced at several localities have estimated ages of late Holocene (0.2 ka to 2 ka; Y-216, table 3). The oldest undisplaced units noted by Y-216 (table 3, p. 20) along most of FC are latest Holocene (<200 yr). However, they recognized no displacement of late Holocene units (0.2 ka to 2 ka) northwest of Grapevine Canyon. Similarly, Y-66 portrayed FC northwest of Grapevine Canyon as displacing deposits no younger than Pleistocene. Y-421 (p. 8, pl. 1) shows an undisplaced surface with an estimated age of older Pleistocene across FC above Navel Spring about 15 km southeast of the Furnace Creek Inn in the Furnace Creek basin.

[18]Y-236 (p. 238) noted 0.6 to 1.5 m of east-side-down, vertical displacement in a gravel deposit with an estimated Holocene age in northern Death Valley.

[19]This is the range of right-lateral displacements noted by Y-216 (table 3) on late Holocene surfaces.

[20]The maximum right-lateral displacement noted by Y-216 (table 3) on a Pleistocene surface is 21 m near Grapevine Canyon. Y-236 (p. 238) reported right-lateral displacement of 46 m for an alluvial fan with well-developed desert varnish and pavement and an estimated Pleistocene age in the area northwest of Red Wall Canyon.

[21]These are the different age estimates that were given by Y-73 and Y-264 for the faulted deposits.

[22]Y-575 (p. A119) estimated that the youngest rupture at Busted Butte probably occurred during late Quaternary. On the basis of correlation of stratigraphic units, Y-26 (table 4, p.21) inferred an age of 270 ka to 700 ka for the youngest displacement on PBC. Y-26 (table 1, p. 5) noted that the youngest rupture that is recorded in two trenches near Yucca Wash near the northern end of PBC displaced units with an estimated age of 700 to 750 ka in one trench and an estimated age of 270 ka to 800 ka in the other trench. Y-26 (table 1, p. 5) concluded that the youngest rupture recorded in two trenches west of Fran Ridge displaces deposits with an estimated age of 700 ka to 750 ka. On the basis of faulted and unfaulted colluvial deposits exposed in a trench, Y-1098 (p. 153) inferred a late Pleistocene age for the most-recent displacement along a western splay of PBC.

[23]Y-26 (table 1, p. 5) noted that the youngest rupture that is recorded by two trenches near Yucca Wash near the northern end of PBC does not displace deposits with an estimated age of 160 ka to 250 ka. Y-26 (table 1, p. 5) concluded that the youngest rupture recorded in two trenches west of Fran Ridge does not displace deposits with an estimated age of 270 ka to 700 ka. PBC is shown by Y-224 as concealed over much of its length.

[24]Y-1098 (p. 153) estimated a vertical displacement of about 15 cm during the youngest rupture along a western splay of PBC. They estimated a vertical displacement per event of 40 to 85 cm for all but this youngest event

[25]Y-575 (p. A119) reported an apparent maximum vertical displacement of 4.1 m at Busted Butte for the deepest of several buried soils (maximum age of 700 ka) developed in sand ramps. Assuming oblique displacement of 45° Y-575 (p. A119) calculated a total oblique displacement of 5.8 m since the beginning of middle Pleistocene.

[26]Y-26 (p. 13) noted that displacement in middle and late Pleistocene deposits exposed in trenches near Yucca Wash have apparently been minor (less than a few centimeters).

[27]Y-1098 (p. 153) estimated a cumulative dip-slip displacement of about 170 to 270 cm in middle Pleistocene deposits along a western splay of PBC.

[28]RM includes two faults north of the Ranger Mountains (North faults) and four faults in the southern Ranger Mountains (South faults).

[29]Data are for the central part of RV at the trench sites of Y-20.

[30]Y-70 noted that younger Holocene units (their Q1b deposits) are deposited against fault scarps on older Pleistocene (160 ka to 740 ka) surfaces.

[31]Vertical displacement on the central part of RV is 2.5 to 3 m in deposits thought to be older than 740 ka (Y-20).

[32]Data are for scarps along Frenchman Flat at the northeastern end of the fault (Y-852).

Table 5. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

[33]Scarps on surfaces thought to be Holocene or latest Pleistocene are a few tens of centimeters high (Y-700; Y-1201, p 1-65; Y-1230, p. [4])

[34]Y-31 (p 332) noted that drainages on Quaternary bedrock pediments and on Quaternary surfaces are displaced 10 to 30 cm across SCR. All or part of this amount may have occurred during the late Quaternary

[35]These are the heights of scarps on surfaces of unspecified age

[36]This is the maximum cumulative displacement since about 300 ka (Y-701)

[37]Underground nuclear testing may have caused displacement at the southern end of YC (Y-224) or along a northeast-striking splay fault, or both (Y-181, fig 7; Y-224). Y-181 (p 26) concluded, on the basis of a comparison of the scarp associated with YC to 100-yr-old scarps in Owens Valley, that the YC scarp probably formed between 1 ka and 10 ka. Y-853 portrayed YC as fault scarps on depositional or erosional surfaces of late Pleistocene age (10 ka to 130 ka). Y-1106 (p. 2) reported a minimum age of 35 ka for one of the younger events on YC.

[38]The height of the scarp associated with YC is reported by Y-693 (p 209) to be 1.5 to 6 m, but no age is given. The height of a scarp on an alluvial surface of unspecified age at the fault's northern end is noted by Y-693 (p 209) to be more than 12 m and by Y-688 (p 50) to be about 15 m

Table 6. Slip rates (mm/yr) for known and suspected Quaternary faults within 50 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. References are listed on tables 4, 5, and 8 and in appendix 2. Rates in italics are for apparent lateral slip; rates in vertical type are for apparent vertical slip. F indicates fracturing has been recognized, but no significant displacement. Numbers in parentheses indicate the time interval for which the rate has been estimated. The pre–Quaternary rates are based on displacement of units that are older than 1.6 Ma, but the time interval over which the rates are estimated may continue into the Quaternary. Queried entries indicate uncertainty in information. Entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (– –), no information was noted during the literature review]

Fault or faults	Holocene			Pleistocene		Late		Pre-Quaternary	
	Late	Middle	Early	Late	Middle	Quaternary	Quaternary		Interval
[Segment or Individual fault]	0-4 ka	4-8 ka	8-10 ka	10-130 ka	130-790 ka	<130 ka	<1.6 Ma	Rate	(10^6 yr)
Amargosa River fault (AR)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Area Three fault (AT)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Ash Meadows fault (AM)									
[Northern section]	– –	– –	– –	– –	– –	– –	– –	[1]0.016	<3.2
[Central section]	------------ 0.04 ------------ (<40 ka)				– –	– –	– –	– –	– –
[Southern section]	– –	– –	– –	– –	– –	– –	– –	– –	– –
Bare Mountain fault (BM)									
[Section #1]	– –	– –	– –	– –	– –	– –	– –	– –	– –
[Section #2]	– –	– –	– –	– –	– –	– –	– –	– –	– –
[Section #3]	– –	– –	– –	– –	– –	– –	– –	– –	– –
[Section #4]	------------ 0.19 ------------ (<9 ka)				– –	– –	– –	– –	– –
[Section #5]	– –	– –	– –	– –	– –	– –	– –	– –	– –
Beatty scarp (BS)[2]	– –	– –	– –	– –	– –	– –	– –	– –	– –
Bow Ridge fault (BR)	------------------ F ------------------ (<(38 to 270) ka)					[3]0.001	– –	0.016 to 0.018; 0.009 to 0.011	<(12.3 to 13.9); <(11.4 to 13.6)
Bullfrog Hills faults (BUL)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Cane Spring fault (CS)	– –	– –	– –	– –	– –	– –	– –	([4])	11 to 14
Carpetbag fault (CB)				(>10; >39; >130; >850?) ------ [5]F --- ------- (<(230 to 240) ka)		– –	– –	– –	– –
Checkpoint Pass fault (CP)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Crossgrain Valley faults (CGV)									
[North Ridge front fault]	– –	– –	– –	– –	– –	– –	– –	– –	– –
[Northeast valley faults]	– –	– –	– –	– –	– –	– –	– –	– –	– –
[Southwest valley fault]	– –	– –	– –	– –	– –	– –	– –	– –	– –

Table 6. Slip rates (mm/yr) for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults	Holocene			Pleistocene		Late		Pre-Quaternary	
	Late	Middle	Early	Late	Middle	Quaternary	Quaternary		Interval
[Segment or individual fault]	0-4 ka	4-8 ka	8-10 ka	10-130 ka	130-790 ka	<130 ka	<1.6 Ma	Rate	(10^6 yr)
East Crater Flat faults (ECR)									
Fault S	--	--	--	--	--	--	--	--	--
Fault T	--	--	--	--	--	--	--	--	--
Black Cone fault (BLK)	----------	[6]0.03 to 0.06	----------	(<(17.3 to 30.3) ka)	--	--	--	--	--
West lava fault (WL)	--	--	--	--	--	--	--	--	--
Fault U	--	--	--	--	--	--	--	--	--
Eleana Range fault (ER)	--	--	--	--	--	--	--	--	--
Fatigue Wash fault (FW)	--	--	--	--	--	--	--	--	--
Furnace Creek fault (FC)	----------	2.3	----------	(<20 ka)	--	--	--	*4.1 to 4.4*	<(7.3 to 7.9)
Ghost Dance fault (GD)	--	--	--	--	--	--	--	--	--
Keane Wonder fault (KW)	--	--	--	--	--	--	--	--	--
Mercury Ridge faults (MER)									
[Northwest fault]	--	--	--	--	--	--	--	--	--
[Southeast fault]	--	--	--	--	--	--	--	--	--
Mine Mountain fault (MM)	--	--	--	--	--	--	--	0.07 to 0.09	<(11.5 to 13.5)
Oasis Valley faults (OSV)									
[Eastern faults]	--	--	--	--	--	--	[7]0.001 to 0.005	--	--
[Western faults]	--	--	--	--	--	--	--	--	--
Pahute Mesa faults (PM)	--	--	--	--	--	--	--	--	--
Paintbrush Canyon fault (PBC)	---------- ----------	---------- ----------	[8]0.0083 [9]≤0.01	---------- ----------	(<700 ka) ----------	--	--	0.035; 0.006	9 to 13; 0.7 to 9
Plutonium Valley–North Halfpint Range fault (PVNH)	--	--	--	--	--	--	--	--	--
Ranger Mountains faults (RM)[10]									
[North faults]	--	--	--	--	--	--	--	--	--
[South faults]	--	--	--	--	--	--	--	--	--
Rock Valley fault (RV)	----------	[11]0.003 to 0.01	----------	(<(31 to 38) ka)	--	--	--	--	--
Rocket Wash–Beatty Wash fault (RWBW)	--	--	--	--	--	--	--	--	--

Table 6. Slip rates (mm/yr) for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Holocene: Late 0-4 ka	Holocene: Middle 4-8 ka	Holocene: Early 8-10 ka	Pleistocene: Late 10-130 ka	Pleistocene: Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma	Pre-Quaternary: Rate	Pre-Quaternary: Interval (10^6 yr)
Solitario Canyon fault (SC)	0.03 to 0.06 (<(17.3 to 30.3) ka) [spans Late Holocene through Late Pleistocene]				--	--	--	0.19; 0.01	<(11.5 to 13); <11.5
Stagecoach Road fault (SCR)	--	--	--	--	--	--	>0.003	0.08; [12]0.45; [13]0.029	<13; 11.5 to 13; <11.5
	--	--	--	--	--	--	--	0.45	11.5-13
Tolicha Peak fault (TOL)	--	--	--	--	--	--	--	--	--
Wahmonie fault (WAH)	--	--	--	--	--	--	--	--	--
Windy Wash fault (WW)	[14]0.001 to 0.03 (<270 ka); [15]0.0015 (<270 ka) [spans Late Holocene through Middle Pleistocene]					--	--	[16]0.07; [17]0.026	11.5 to 13; <11.5
Yucca fault (YC)	--	--	--	--	--	--	--	--	--
Yucca Lake fault (YCL)	--	--	--	--	--	--	--	--	--

[1]Data are for the western branch of the northern section of the fault (Y-695; Y-996).

[2]Although a tectonic origin is not clear, a non-tectonic origin for the Beatty scarp has not been verified. Therefore, the feature is included in this compilation, which is based on published literature and other readily available data for known and suspected Quaternary faults.

[3]Y-1091 (p. 120) estimated that slip rates on BR during middle and late Quaternary have been very low (about 0.001 mm/yr).

[4]Y-181 and Y-210 noted that left-lateral displacement along CS becomes progressively less in tuffs that range between 14 Ma and 11 Ma, but no amounts are specified.

[5]See notes 11 and 12 on Table 5.

[6]This is a maximum vertical slip rate during the last 17,000 yr to 30,000 yr. The rate was estimated using the <1 m of displacement on a surface with an estimated age of 17.3 ka to 30.3 ka as reported by Y-1201 (p. 1-64).

[7]This slip rate was estimated using the 4 m of displacement noted by Y-10 (p. 58) in deposits with an estimated age of 730 ka to 3 Ma (Y-73, p. 2, 26) for one fault along the eastern side of Oasis Valley since early Quaternary or latest Tertiary.

[8]On the basis of an estimated 5.8 m of oblique displacement since about 700 ka, Y-575 (p. A119) estimated an oblique slip rate for PBC at Busted Butte of 0.0083 mm/yr since the beginning of middle Pleistocene

[9]An apparent vertical slip rate of about 0.01 mm/yr or less during middle and late Quaternary was estimated by Y-1098 (p. 153) for a western splay of PBC.

[10]RM includes two faults north of the Ranger Mountains (the North faults) and four faults in the southern Ranger Mountains (the South faults).

[11]Data are for the central part of RV at the trench sites of Y-20.

[12]This rate assumes that 6.7 km of vertical displacement occurred during the 1.5-million-year interval between 11.5 Ma and 13 Ma (Y-396, table 2, p. 275).

[13]This rate assumes that 3.3 km of vertical displacement occurred since 11.5 Ma and that Cenozoic displacement rates occurred in a step-wise manner in which rates sharply decreased about 11.5 Ma (Y-396, p. 273).

[14]This is the average vertical slip rate estimated by Y-1201 (p. 1-67) for their southern WW (western splay of Y-1042) for the late Pleistocene and Holocene, using the interpretations of Y-12 (40 cm of vertical displacement in 270-ka deposits and 10 cm of vertical displacement in 3-to-6-ka deposits).

[15]This rate was calculated by Y-396 (table 2, p. 275) based on the 40 cm of vertical displacement since 270 ka that was interpreted by Y-12.

[16]This rate assumes that about 0.14 km of vertical displacement occurred during the 1.5-million-yr interval between 13 Ma and 11.5 Ma (Y-396, table 2, p. 275).

[17]This rate assumes that about 0.26 km of vertical displacement has occurred on WW since 11.5 Ma and that Cenozoic displacement rates have varied in a step-wise manner in which rates sharply decreased about 11.5 Ma (Y-396, table 2, p. 273, 275).

Table 7. Estimated number of events/time interval for known and suspected Quaternary faults within 50 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. Numbers with age units in parentheses indicate the estimated age of the faulting event(s). References listed on tables 4, 5, and 8 and in appendix 2. Queried entries indicate uncertainty in information. F, fracturing (no significant displacement). Entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (--), no information was noted during the literature review. Number of events are shown in the last two columns only if more specific information is unavailable]

Fault or faults	Holocene			Pleistocene		Late	
	Late	Middle	Early	Late	Middle	Quaternary	Quaternary
[Segment or individual fault]	0-4 ka	4-8 ka	8-10 ka	10-130 ka	130-790 ka	<130 ka	<1.6 Ma
Amargosa River fault (AR)	----------	1	----------(≤10 ka)	--	--	--	--
Area Three fault (AT)	----------	1	----------(≤10 ka)	--	--	--	--
Ash Meadows fault (AM)							
[Northern section]	----------	[1]≥1	----------(≤10 ka)	--	--	--	--
[Central section]	----------	≥1	----------	----------(≤40 ka)	--	--	--
[Southern section]	----------	----------	1	----------([2])	--	--	--
Bare Mountain fault (BM)							
[Section #1]	--	--	--	----------≥1?	----------([3])	--	--
[Section #2]	----------	≥1	----------	----------(<350 ka)	(>350 ka) ----≥1 ----------	--	--
[Section #3]	--	--	--	----------≥1?	----------([3])	--	--
[Section #4] locality 3	----------	1	----------	----------(<(5 to 15) ka)	--	--	--
locality 4	----------	1	----------(<9 ka)	----------1 ----------	(<(145 to 160) ka)	--	--
locality 5	----------	[4]2	----------	----------(<(40 to 50) ka)	--	--	--
[Section #5]	--	--	--	----------≥1?	----------([3])	--	--
Beatty scarp (BS)[5]	(>(1 to 3?) ka)----------	1?	----------(<(10 to 12) ka)		--	--	--
Bow Ridge fault (BR)	----------	----------	5 to 6	----------	----------	--	--
Bullfrog Hills faults (BUL)	--	--	--	--	--	--	≥1
Cane Spring fault (CS)	--	--	--	--	--	--	1?
Carpetbag fault (CB)	--	--	--	(>10, >30, >130, >350?)---[6]F4	---(<(230 to 240) ka)	[6]4	≥(5 to 6)
Checkpoint Pass fault (CP)	--	--	--	--	--	--	≥1?
Crossgrain Valley faults (CGV)							
[North Ridge front fault]	--	--	--	--	--	--	≥1?
[Northeast valley faults]	--	--	--	--	--	--	≥1?
[Southwest valley fault]	--	--	--	--	--	--	≥1?

Table 7. Estimated number of events/time interval for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults	Holocene			Pleistocene		Late	
	Late	Middle	Early	Late	Middle	Quaternary	Quaternary
[Segment or individual fault]	0-4 ka	4-8 ka	8-10 ka	10-130 ka	130-790 ka	<130 ka	<1.6 Ma
East Crater Flat faults (ECR)							
Fault S	--	--	--	--	--	--	≥1?
Fault T	--	--	--	--	--	--	≥1?
Black Cone fault (BLK)	----------	≥1 ---------- (<(6.6 to 11.1) ka;<(270 to 800) ka)			--	--	--
West lava fault (WL)	--	--	--	----- ≥1 ------ (<(17.3 to 30.3) ka)	--	--	--
Fault U	--	--	--	--	--	--	≥1?
Eleana Range fault (ER)	----------	≥1 ---------- (<(10 to 130) ka)			--	--	--
Fatigue Wash fault (FW)	--	--	--	--	--	--	--
Furnace Creek fault (FC)	(>0.2 ka) ----------	4 to 6 ---------- (≤10 ka)		--	--	--	--
Ghost Dance fault (GD)	--	--	--	--	--	--	≥1?
Keane Wonder fault (KW)	--	--	--	--	--	--	≥1
Mercury Ridge faults (MER)							
[Northwest fault]	--	--	--	--	--	--	≥1?
[Southeast fault]	--	--	--	--	--	--	≥1?
Mine Mountain fault (MM)	--	--	--	--	--	--	≥1
Oasis Valley faults (OSV)							
[Eastern faults]	--	--	--	---------- ≥1 ---------- (<(27 to 35) ka to 730 ka)		--	--
[Western faults]	--	--	--	--	--	--	≥1
Pahute Mesa faults (PM)	--	--	--	--	--	--	≥1
Paintbrush Canyon fault (PBC)	----------	----------	[7]5 ----------	----------	---------- (<700 ka)	--	--
				---------- [8]3 to 5 ----------			
Plutonium Valley–North Halfpint Range fault (PVNH)	--	--	--	--	--	--	≥1
Ranger Mountains faults (RM)[9]							
[North faults]	--	--	--	--	--	--	≥1
[South faults]	--	--	--	--	--	--	≥1
Rock Valley fault (RV)							
[Central section]	----------	1 ---------- (<(31 to 38) ka)		------- 1? --- (<180 ka)		--	--

Table 7. Estimated number of events/time interval for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults	Holocene			Pleistocene		Late	
	Late	Middle	Early	Late	Middle	Quaternary	Quaternary
[Segment or individual fault]	0-4 ka	4-8 ka	8-10 ka	10-130 ka	130-790 ka	<130 ka	<1.6 Ma
[Northeast section]	------------	≥1	------------	------------(<(10 to 30) ka)	--	--	--
[Possible southwest extension]	------------ ≥1	------------	----(≤10 ka)	--	--	--	--
Rocket Wash–Beatty Wash fault (RWBW)	--	--	--	--	--	--	≥1
Solitario Canyon fault (SC)	------------	≥1 ------------	(<(6.6 to 11.1) ka; ≤15 ka)		--	--	--
Stagecoach Road fault (SCR)	--	--	--	--	(>(700 to 750) ka)---- ------ ≥1 --------	--	--
Tolicha Peak fault (TOL)	--	--	--	--	--	--	≥1
Wahmonie fault (WAH)	------------	≥1	------------	------------	(<(270-740) ka)	--	--
Windy Wash fault (WW)	-------- [10]1	--------(<(3 to 6.5) ka)	--	(>40 ka)---------- [10]6	----------(>300 ka)	--	[10]≥7
Yucca fault (YC)	(>1 ka)------------ (>1 ka)------------	1 ------------ 1 ------------	------------(<10 ka) ------------(<(10 to 130) ka)	 (≥35 ka)----------	 ≥1 ------------	--	--
Yucca Lake fault (YCL)	--	--	--	--	--	--	≥1

[1]Data are for the western branch of the northern section (Y-695).

[2]The age of the youngest faulted deposits are noted as early Holocene and (or) latest Pleistocene (no age specified; Y-69).

[3]Y-3 inferred a possible event during middle and late Pleistocene.

[4]Two events since 40 ka to 50 ka, one of which probably occurred during early Holocene (Y-3)

[5]Although a tectonic origin is not clear, a non–tectonic origin for the Beatty scarp has not been verified. Therefore, the feature is included in this compilation, which is based on published literature and other readily available data for known and suspected Quaternary faults.

[6]Fracturing is noted to have occurred at about 30 ka, 45 ka, 65 ka, 100 ka, and 230 ka, so that five fracturing events occurred in all during the late and middle Pleistocene. Four of these fracturing events occurred during the late Pleistocene. See notes 11 and 12 on Table 5.

[7]On the basis of buried soils in faulted sand ramps at Busted Butte, Y-575 (p. A119) interpreted five events since about 700 ka.

[8]Y-1098 (p. 55) estimated that three to five separate surface-faulting events had occurred during middle and late Pleistocene on a western splay of PBC.

[9]RM includes two faults north of the Ranger Mountains (the North faults) and four faults in the southern Ranger Mountains (the South faults).

[10]Y-12 (p. 787) interpreted trench exposures as indicating at least seven Quaternary faulting events on the southern portion of WW. Three of these events occurred before 300 ka; event 4 occurred around or just before 300 ka; event 5 occurred between 270 ka and 190 ka; event 6 occurred between 190 ka and 40 ka; and event 7 occurred after 3 ka to 6.5 ka.

Table 8. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults within 50 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. References are listed in appendix 4. Abbreviations of trends: E, east; N, north; NE, northeast; NW, northwest; ENE, east–northeast; NNE, north–northeast; NNW, north–northwest. Abbreviations for displacement type: F, fracturing; LL, left lateral; LO, left oblique; N, normal; RL, right lateral; RO, right oblique. Queried entries indicate uncertainty in information. Number of events and time period are shown only when used to estimate recurrence interval; entries separated by a comma (,) indicate data for individual fault traces or for different localities along the fault or faults; entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (– –), no information was noted during the literature review]

Fault or faults [Segment or individual fault]	Number of events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
Amargosa River fault (AR)	--	--	--	N.48°W.	RL	238, 695
Area Three fault (AT)	--	--	--	[1]N, NE, NE to NW	--	181, 224, 526
Ash Meadows fault (AM)	--	--	--	N	N	69, 695
[Northern section]	--	--		[2]N.18°W., N.28°E.	N	68, 695
[Central section]	--	--	--	N.10°W.	N	695
[Southern section]	--	--	--	N	N?	69, 695
Bare Mountain fault (BM)	--	--	--	N	N, RL?	1, 1041
[Section #1]	--	--	--	N to NNE	--	3
[Section #2]	--	--	--	NNW, NE	--	3
[Section #3]	--	--	--	NNW	--	3
[Section #4] locality 3	--	--	--	NNE	--	3
locality 4	2; 1	<(145-160)	≥(73 to 80)	--	--	3
locality 5	2; 1	<(40-50)	20 to 25	--	--	3
[Section #5]	--	--	--	NNW to NNE	--	3
Beatty scarp (BS)[3]	--	--	--	N.40°W. to N.10°E.	N?	6, 40, 43, 379
Bow Ridge fault (BR)	--	--	--	N	N, LO	26, 55, 87, 1042, 1091
Bullfrog Hills faults (BUL)	--	--	--	N-NW to NW	N?	232
Cane Spring fault (CS)	--	--	--	NE	LO?, LL	104, 210, 226, 232
Carpetbag fault (CB)	[4]4	[4]125 to 130	[4]25	N to NNW	F, RL	60, 182, 224, 327, 1106
Checkpoint Pass fault (CP)	--	--	--	[5]NNE to NE, E	[6]N, LL	813, 852
Crossgrain Valley faults (CGV)						
[North Ridge front fault]	--	--	--	NE to ENE	LO; LL	62, 813
[Northeast valley faults]	--	--	--	NE	LL, N	813
[Southwest valley fault]	--	--	--	NE	LL, N	813

Table 8. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Number of events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
East Crater Flat faults (ECR)						
Fault S	--	--	--	NNE	N	26
Fault T	--	--	--	NNE	N	26
Black Cone fault (BLK)	--	--	--	NNW, NW	N	26, 224, 1201, 1230
West lava fault (WL)	--	--	--	NNE	N	1196, 1201, 1230
Fault U	--	--	--	NE	N	26
Eleana Range fault (ER)	--	--	--	NE to NNE	N	181, 182, 526, 813, 853
Fatigue Wash fault (FW)	--	--	--	NNE to NNW	N, LL, L?O	26, 55, 506, 1042
Furnace Creek fault (FC)	4 to 6	≤10	1.7 to 2.5	NW	RL; RO	66, 216, 475, 479, 600, 683, 880
Ghost Dance fault (GD)	--	--	--	N, NNW, NNE	N	26, 55, 189, 1042, 1239
Keane Wonder fault (KW)	--	--	--	NW	[7]N, RL	238, 336, 390, 1357
Mercury Ridge faults (MER)						
[Northwest fault]	--	--	--	NE	LO; RO	62, 813
[Southeast fault]	--	--	--	NE	LO	62
Mine Mountain fault (MM)	--	--	--	NNE to NE	LO?	104, 205, 232
Oasis Valley faults (OSV)						
[Eastern faults]	--	--	--	NNE	N?	238, 813, 1223
[Western faults]	--	--	--	NNE	N?	813
Pahute Mesa faults (PM)	--	--	--	Variable	N, RO?	10, 813, 922
Paintbrush Canyon fault (PBC)	5 to 6	<700	[8]117 to 140; [9]10^3 to 10^4	NNE	N, LL, LO	26, 55, 217, 224, 396, 575, 1042, 1098
Plutonium Valley–North Halfpint Range fault (PVNH)	--	--	--	NNW	N	232, 813
Ranger Mountains faults (RM)						
[Northern faults]	--	--	--	NE, ENE	N?	813, 852
[Southern faults]	--	--	--	NE; NNE to NE	N?	813, 852
Rock Valley fault (RV)	--	--	--	NE	LL; LO	20, 238
Rocket Wash–Beatty Wash fault (RWBW)	--	--	--	[10]N; NNE	N	238, 813

Table 8. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults within 50 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Number of events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
Solitario Canyon fault (SC)	--	--	--	NNE	N, LO, LL	26, 55, 700, 1042
Stagecoach Road fault (SCR)	--	--	--	NE to NNE	N, LL, LO	46, 55, 189, 575, 1042
Tolicha Peak fault (TOL)	--	--	--	NNW	[11]N; RO	813
Wahmonie fault (WAH)	--	--	--	[12]NE, N to NE	N	104, 226, 232, 238
Windy Wash fault (WW)	[13]4	[13]<300	[13]75	[14]N, NNW, N to NNW, NE	N, LL	12, 55, 224, 701, 1042
Yucca fault (YC)	--	--	--	N	[15]N; RL; RO	50, 60, 181, 182, 224, 526, 693, 813
Yucca Lake fault (YCL)	--	--	--	NNW	N	232

[1]The northern section strikes generally north. The southern section has two branches, a western one that strikes generally northeast and an eastern one that strikes between northeast and northwest (Y-181, Y-224; Y-526).

[2]The northern section consists of two branches, a western one striking N. 18° W. and an eastern one striking N. 28° E. (Y-68; Y-695).

[3]Although a tectonic origin is not clear, a non-tectonic origin for the Beatty scarp has not been verified. Therefore, the feature is included in this compilation, which is based on published literature and other readily available data for known and suspected Quaternary faults.

[4]Data are for fracturing, not for significant surface displacement (Y-327). Recurrence interval is for the last 125,000 to 130,000 years. See notes 11 and 12 on Table 5.

[5]The eastern half of CP has a curving, but general east, strike (Y-813). The northern trace of the western half strikes northeast; the southern trace of the western half strikes north-northeast.

[6]Displacement on the eastern half of CP is shown by Y-813 as left-lateral. Displacement on the two branches of the western half is shown as dip slip (normal).

[7]Y-238 showed displacement on KW as down to the southwest. Y-1357 concluded that displacement on KW has been right-lateral strike slip, which was accompanied by northeast tilting of the Funeral Mountains. Y-336 (p. 149) also mentioned right-lateral displacement on KW.

[8]Using the conclusion of Y-575 (p. A119) for five events since about 700 ka and adding one event for the present interval, the average recurrence interval for surface-faulting events on PBC at Busted Butte since the beginning of middle Pleistocene ranges between 117,000 to 140,000 yr.

[9]On the basis of weakly developed soils that are preserved on sediments deposited between surface faulting events, Y-1098 (p. 153) concluded that recurrence intervals of 10^3 to 10^4 yr separate three to five middle and late Pleistocene surface-faulting events on a western splay of PBC.

[10]RWBW strikes generally north (Y-813; Y-853). Traces at the southern end of RWBW strike north-northeast (Y-238).

[11]Displacement on one trace at the southern end of TOL is portrayed by Y-813 as down to the southwest. One trace of TOL that crosses Tolicha Peak is shown by Y-813 to have right-oblique displacement.

[12]WAH strikes generally northeast, but its trace curves so that the strike of WAH ranges between north and northeast (Y-232).

[13]On the basis of four faulting events since 300 ka, Y-12 (p. 787) and Y-701 estimated an average recurrence interval between surface-rupturing events of 75,000 yr.

[14]Displacement on WW is shown by Y-12 and Y-701 as dip slip (normal) with a left-lateral component of an undetermined amount. A left-lateral component of displacement was also interpreted by Y-1042 (p. 17, 20) from observed geomorphic features and slickensides that plunge 43° to 47°.

[15]Displacement on YC is shown by Y-50, Y-60, Y-224, and Y-526 to be dip slip (normal). Y-181 (p. 27-28) concluded that the left-stepping, *en echelon* pattern of scarps suggests right-lateral displacement. Y-182 suggested that YC belongs to a set of north-striking faults with right-oblique displacement.

Table 9. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. References are listed by number in appendix 4. Queried entries indicate uncertainty in information. Entries separated by a comma (,) indicate data for individual fault traces or for different localities along the fault or faults; entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (--), no information was noted during the literature review; YM, the proposed repository site at Yucca Mountain]

Fault or faults [Segment or individual fault]	Plate (P) or Figure (F) number	Total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
Belted Range fault (BLR)	P1	38; 51; 53; 54	--	>0.61	--	55	5, 232, 813, 853
Bonnie Claire fault (BC)	P1	27	--	--	--	74	238
Boundary fault (BD)	P1	3 to 6.5	--	--	--	51	224, 526, 813, 853
Buried Hills faults (BH)	P1, P2	[1]10, 26	--	--	--	53	813
Cactus Flat fault (CF)	P1	50	--	--	--	84	813
Cactus Flat–Mellan fault (CFML)	P1	35	--	--	--	80	813
Cactus Range–Wellington Hills fault (CRWH)	P1	25; 29	--	--	--	87	232, 813
Cactus Springs fault (CAC)	P2	12	--	--	--	59	813, 852
Central Pintwater Range faults (CPR)	P1	[2]4.5; 16	--	--	--	79	813
Central Spring Mountains faults (CSM)[3]	P2	--	--	--	--	76	
[Northwest fault]	P2	16	--	--	--	--	813
[Northeast fault]	P2	6 to 9	--	--	--	--	813, 852
[Southeast fault]	P2	5 to 12	--	--	--	--	813, 852
Chalk Mountain fault (CLK)	P1	[4]8; 20?	--	--	--	87	813
Chert Ridge faults (CHR)[5]	P1	--	--	--	--	65	
[Eastern faults]	P1	14	--	--	--	--	813
[Western faults]	P1	12	--	--	--	--	813
Chicago Valley fault (CHV)	P2	20	--	--	--	90	69, 238
Cockeyed Ridge–Papoose Lake fault (CRPL)	P1	21				53	813
Death Valley fault (DV)	P2	[6]51; 64 to 104; 68; 72; 79	--	[7]1.2 to 3; 2.3; 5; 10 to 20	--	55	216, 389, 429, 594, 976, 1048
East Belted Range fault (EBR)	P1	26	--	--	--	80	813, 853
East Nopah fault (EN)	P2	>(17 to 19)	--	[8]≥0.008	--	85	69, 238, 696

Table 9. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Plate (P) or Figure (F) number	Total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
East Pintwater Range fault (EPR)	P1, P2	58	--	--	--	81	813, 852
Emigrant fault (EM)	P2	13	--	--	--	73	239
Emigrant Valley North fault (EVN)	P1	28	--	--	--	60	813
Emigrant Valley South fault (EVS)	P1	20	--	--	--	66	813
Fallout Hills faults (FH)	P1	4 to 8	--	--	--	70	813
Gold Flat fault (GOL)	P1	16	--	--	--	62	813
Gold Mountain fault (GOM)	P1	17; 18	--	--	--	90	238, 853
Grapevine fault (GV)	P1, P2	20; 30	--	4.3	0.002	58	236, 239, 755, 917
Grapevine Mountains fault (GM)	P1		--	--	--		
[Southern trace]	P1	9; 23	--	--	--	67	238, 239, 853
[Northern trace]	P1	13; 21	--	--	--	70	238, 853
Groom Range Central fault (GRC)	P1	31	--	--	--	82	813
Groom Range East fault (GRE)	P1	20	--	--	--	85	813
Hidden Valley–Sand Flat faults (HVSF)	P2	--	--	--	--	87	
[Fault along the eastern sides of Hidden Valley/Ulida Flat]	P2	12	--	--	--	--	239
[Fault along the southern sides of Ulida Flat/Sand Flat]	P2	9	--	--	--	--	239
[Fault along the southeastern side of Sand Flat]	P2	[9]10	--	--	--	--	239
[Fault along the northeastern side of Sand Flat]	P2	7.5	--	--	--	--	239
[Fault along the western side of Ulida Flat]	P2	3	--	--	--		239
Hunter Mountain fault (HM)	P2	78; 85	--	[10]≥(1 to 1.5); ≤2; ≥6	[11]0.7 to 2; 1; ≥6; 8 to 10	95	239, 356, 697, 864, 1148, 1274
Indian Springs Valley fault (ISV)	P1, P2	23; 28	--	--	--	67	813, 852
Jumbled Hills fault (JUM)	P1	27	--	--	--	77	813
Kawich Range fault (KR)	P1	80; 84	--	0.9; ≥1.2	--	57	5, 232, 813

Table 9. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Plate (P) or Figure (F) number	Total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
Kawich Valley fault (KV)	P1	43	--	--	--	61	813
La Madre fault (LMD)	P2	33	--	--	--	82	813
North Desert Range fault (NDR)	P1	[12]3.5, 24	--	--	--	80	813
Oak Spring Butte faults (OAK)	P1	[13]19; 21; 40	--	[14]≥0.46	--	57	693, 813, 853
Pahrump fault (PRP)	P2	50; 65 to 70; 130	--	[15]≥0.3	[16]>(16 to 19)	70	161, 238, 696, 813, 845, 888, 1105
Panamint Valley fault (PAN)	P2	80; 100	[17]25 to 38	[18]1.8; 9.2	--	95	397, 399, 427, 697, 698, 868
[Fault south of Ballarat]	P2	30	100	--	8 to 10	--	427, 864
[Fault north of Ballarat]	P2	50	--	--	[19]≥(3.1 to 4.6)	--	614, 632, 698
Penoyer fault (PEN)	P1	25; 35, 56	--	--	--	97	25, 404, 1032
Racetrack Valley faults (RTV)	P2						
[Eastern fault]	P2	22	--	--	--	97	239
[Western fault]	P2	22	--	--	--	102	239
Sarcobatus Flat fault (SF)	P1	27; 51	--	--	--	52	238, 813, 853
Slate Ridge faults (SLR)	P1					87	
[Northern fault]	P1	12; 13	--	--	--	--	238, 853
[Southern fault]	P1	5; 12	--	--	--	--	238, 853
South Ridge faults (SOU)	P2	--	--	--	--	--	
[Northern fault]	P2	[20]1 to 3, 2.5, 5	--	--	--	55	852
[Southern fault]	P2	[21]7, 19	--	--	--	50	813
Spotted Range faults (SPR)	P1, P2	--	--	--	--	59	
[Range-front fault]	P1, P2	20 to 30	--	--			813, 852
[Fault along unnamed ridge]	P1, P2	9 to 12	--	--			813, 852
[Faults within the range]	P1, P2	4; 7	--	--			813, 852
Stonewall Mountain fault (SWM)	P1	10; 13; 22	--	--	--	92	232, 238, 813, 853
Stumble fault (STM)	P1	31 to 33	--	--	--	74	25, 813

Table 9. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Plate (P) or Figure (F) number	Total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
Three Lakes Valley fault (TLV)	P1	[22]≥9; 27	--	--	--	84	813
Tikaboo fault (TK)	P1	10; 33	--	--	--	92	25, 813, 1032
Tin Mountain fault (TM)	P1, P2	29	--	--	--	90	238, 239
Towne Pass fault (TP)	P2	38	--	[23]≥0.2; ≥2.4	--	76	239, 390, 427, 458, 763
West Pintwater Range fault (WPR)	P1, P2	≥60	--	--	--	76	813, 852
West Spring Mountains fault (WSM)	P2	[24]30; 36; 60	--	≥3.5	--	53	161, 238, 696, 813, 852

[1]The BH includes three faults. Two of the faults are adjacent to the Buried Hills: one about 10 km long along their eastern side and one about 26 km long along the western side of the hills. The third fault, about 10 km long, is along northern Nye Canyon, which is about 1 km west of the Buried Hills.

[2]CPR is composed of two main faults, one along the eastern side and one along the western side of an unnamed valley within the northern Pintwater Range. The eastern fault of CPR is about 16 km long. The western fault is about 4.5 km long.

[3]CSM includes three faults: (1) one on the northwestern side of Wheeler Wash (Northwest fault), (2) one on the northeastern side of the Wheeler Wash drainage (Northeast fault), and (3) one on the southeastern side of the Wheeler Wash drainage (Southeast fault).

[4]Length of CLK could be as much as 20 km if north-striking faults on the western side of northern Emigrant Valley are included in CLK. (The north-striking faults are shown in this compilation as possibly part of the Emigrant Valley North fault (EVN?, pl. 1).)

[5]CHR is composed of numerous faults along the eastern and western sides of Chert Ridge.

[6]Estimates of the length of the Death Valley fault range between 51 and 104 km. The difference in length estimates results from differences in the interpretation of the end points of the fault with the Southern Death Valley fault (SDV) to the south and the Furnace Creek fault (FC) to the north. (See the data sheet for the Death Valley fault in appendix 2.)

[7]Estimates of total vertical displacement are based on a variety of topographic, structural, gravity, and geobarometric data. (See data sheet for the Death Valley fault in appendix 2.)

[8]This is the amount of apparent vertical displacement estimated from fault scarps on early Pleistocene and (or) Tertiary surfaces thought by Y-69 to be older than 300 ka to 500 ka (Y-696, p. 40).

[9]The fault along the southeastern side of Sand Flat may extend an additional 13 km north of Sand Flat toward White Top Mountain.

[10]Y-864 (p. 10,424) estimated down-to-the-southwest vertical displacement of 0 to 2 km on HM in the area of Panamint Butte in northern Panamint Valley. This estimate was made using outcrops of a near-vertical contact between early Jurassic Hunter Mountain batholith and an unconformity at the base of Miocene/Pliocene volcanic rocks. Y-1148 (p. 25) reported a vertical displacement of "perhaps tens of meters" on HM in southeastern Saline Valley at Grapevine Pass and a vertical displacement of at least 6,000 m on HM in southwestern Saline Valley at Daisy Canyon. These amounts were estimated using the elevation difference between the Inyo Mountains and the depth of fill in Saline Valley that was inferred from gravity data by Y-917. Y-864 (p. 10,423) interpreted a steep escarpment at the northern end of Panamint Valley as corresponding to HM. The escarpment has 1 to 1.5 km of topographic relief that is assumed to reflect the minimum vertical displacement on HM.

[11]Y-864 (p. 10,424) estimated right-lateral displacement of 8 to 10 km on HM in the area of Panamint Butte in northern Panamint Valley. This estimate was made using outcrops of a near-vertical contact between early Jurassic Hunter Mountain batholith and an unconformity at the base of Miocene/Pliocene volcanic rocks as piercing points. On the basis of displaced stream channels, Y-1148 (p. 25, 34) estimated a total lateral displacement between 700 and 2,000 m on HM in Saline Valley. He speculated that right-lateral displacement at the northwestern end of HM in Saline Valley at San Lucas Canyon may be nearly 1,000 m. Y-1274 (p. 38) noted that the displacement of a prominent magnetic anomaly centered over Hunter Mountain indicates right-lateral displacement of at least 6 km along HM.

[12]The first entry is for fault traces along the front of the northern Desert Range; the second entry is for fault traces 0.5 to 1 km west of the range front.

[13]The 40 km length is the combined length of the Butte fault (BT, a portion of one fault in OAK) and the Yucca fault (YC) to the south. Y-693 (p. 209) suggested that BT and YC join.

[14]Y-693 (p. 210) reported a vertical displacement of nearly 458 m in Tertiary volcanic rocks (Belted Range Tuff) along the Butte fault (a portion of one fault in OAK).

[15]A minimum vertical displacement of about 300 m along PRP was estimated by Y-845 (p. 18, 21) on the basis of this amount of erosion of basin-fill sediments from the upthrown block of the fault.

[16]Right-lateral displacement of greater than about 16 to 19 km was estimated by Y-888 (p. 694) from relationships among Precambrian and Paleozoic rocks.

[17]The length of the scarps formed in the most-recent pre-historic earthquake (≤10 ka) south of Ballarat is 25 to 30 km (Y-697, p. 4859). Using a total length for PAN of 80 to 100 km, the rupture length in this most-recent event is 25 to 38% of the estimated total length of PAN.

[18]Total pre-Quaternary dip slip across faults bounding the eastern side of Panamint Valley, which includes the modern trace of PAN, is 9,150 m (Y-399, p. 426; Y-698, p. 112). Total vertical displacement on PAN is reported by Y-427 (p. 6) to be about 1.8 km.

[19]About 11 km south-southeast of Highway 19, near the mouth of Wildrose Canyon, a landslide is displaced right laterally 3,050 to 4,575 m from its source at Wildrose Canyon (Y-614, Y-632).

[20]The northern fault includes a western trace that is 1 to 3 km long and that is less than 1 km north of the front of South Ridge, a central trace that is 5 km long and that is along the front of the ridge, and an eastern trace that is 2.5 km long and that is at the very eastern end of South Ridge (Y-852).

[21]The trace of the southern fault as shown by Y-813 is nearly continuous for 19 km. A branch fault south of the southern fault is 7 km long (Y-813). Y-852 showed each of the two traces south of the ridge as 2 to 3 km long.

[22]The length of TLV is 9 km as estimated from Y-813, but the fault intersects the eastern edge of her map area at long 115°30'W. The linearity of the range front east of this point suggests that TLV may continue southeastward, so that the total length of TLV could be about 27 km.

[23]Y-390 (p. A114) reported displacement on TP of at least 153 m. Y-458 (p. 57-58) noted at least 2,380 m of displacement on TP and concluded that this displacement has accounted for most of the elevation of the Panamint Range southeast of Towne Pass.

[24]WSM is noted by Y-696 (p. 83) as about 30 km long, which includes a nearly continuous, 12-km-long section along the range front. WSM is about 36 km long as estimated from Y-238 and Y-813. If north-trending traces in Pahrump Valley between Hidden Hills and Manse, Nevada, are considered part of WSM, then WSM would have a total length of about 60 km.

Table 10. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. Ages are estimated primarily from photogeologic, geomorphic, and pedologic criteria. (See individual references and description sheets in appendix 2 for limitations.) References are listed by number in appendix 4. Overlap of ages reported in columns 2 and 3 reflects uncertainties in age estimates and in stratigraphic interpretations (appendix 2). Abbreviations for ages (used where age is not specified in years): Hol., Holocene; L.Hol., Late Holocene; E.Hol., Early Holocene; Lt.Pleist., Latest Pleistocene; L.Pleist., Late Pleistocene; Pleist., Pleistocene; Plio., Pliocene; L.Quat., Late Quaternary; Quat., Quaternary; Tert., Tertiary. Late Quaternary displacement is since 130 ka. Quaternary displacement is since 1.6 Ma. Queried entries indicate uncertainty in information. Entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (--), no information was noted during the literature review]

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y-)
			Vertical	Lateral	Vertical	Lateral	
Belted Range fault (BLR)	10 to 130	Quat.	--	--	--	--	5, 232, 853
Bonnie Claire fault (BC)	Quat.	--	--	--	--	--	232, 238, 853
Boundary fault (BD)	[1]8 to 10; >8; 130 to 1,500	≤10	--	--	--	--	90, 526
Buried Hills faults (BH)	Quat.	--	--	--	--	--	404, 813, 852
Cactus Flat fault (CF)	L.Pleist.	--	--	--	--	--	813
Cactus Flat–Mellan fault (CFML)	Quat.	--	--	--	--	--	813
Cactus Range–Wellington Hills fault (CRWH)	Quat.	Quat.	--	--	--	--	232, 813
Cactus Springs fault (CAC)	Quat.	--	--	--	--	--	813, 852
Central Pintwater Range faults (CPR)	Quat.	--	--	--	--	--	404, 813, 852
Central Spring Mountains faults (CSM)							
[Northwest fault]	Quat.	--	--	--	--	--	813
[Northeast fault]	Quat.	--	--	--	--	--	813, 852
[Southeast fault]	Quat.; 10 to 1,500	--	--	--	--	--	813, 852
Chalk Mountain fault (CLK)	Quat.	--	--	--	--	--	813
Chert Ridge faults (CHR)							
[Eastern faults]	Quat.	--	--	--	--	--	404, 813, 852
[Western faults]	Quat.	--	--	--	--	--	813
Chicago Valley fault (CHV)	>10 and <(300 to 500)	([2])	--	--	--	--	69
Cockeyed Ridge–Papoose Lake fault (CRPL)	Quat.	--	--	--	--	--	232, 813

Table 10. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y-)
			Vertical	Lateral	Vertical	Lateral	
Death Valley fault (DV)	[3]0.2; 0.2 to 2; ≤10	[3]<0.2	[4]0.15 to 3	[5]1.8 to 3.6	[6]6.6 to 15; 61; 63	--	216, 252, 390, 429, 474, 1020
East Belted Range fault (EBR)	Quat.	--	--	--	--	--	813, 853
East Nopah fault (EN)	[7]>10 and <(300 to 500); E.Hol. to Lt.Pleist.	E.Hol. to L.Hol.	[8]3?	--	[8]≤8	--	69, 696
East Pintwater Range fault (EPR)	130 to 1,500	--	--	--	--	--	852
Emigrant fault (EM)	Quat.	--	--	--	--	--	222, 239
Emigrant Valley North fault (EVN)	[9]L.Quat.	--	--	--	--	--	813
Emigrant Valley South fault (EVS)	Quat.	--	--	--	--	--	813
Fallout Hills faults (FH)	Quat.	--	--	--	--	--	813
Gold Flat fault (GOL)	Quat.	--	--	--	--	--	813
Gold Mountain fault (GOM)	10 to 130	--	--	--	--	--	853
Grapevine fault (GV)	[10]Quat.	[10]Plio.?	--	--		--	236, 239, 755
Grapevine Mountains fault (GM)							
[Southern trace]	Quat.	--	--	--	--	--	238, 239, 853
[Northern trace]	(10 to 130)?; Quat.	--	--	--	--	--	238, 239, 853
Groom Range Central fault (GRC)	Quat.	--	--	--	--	--	25, 813
Groom Range East fault (GRE)	Tert.?	Quat.	--	--	--	--	25, 813
Hidden Valley–Sand Flat faults (HVSF)							
[Fault along the eastern sides of Hidden Valley/Ulida Flat]	Quat.	--	--	--	--	--	239
[Fault along the southern sides of Ulida Flat/Sand Flat]	Quat.	--	--	--	--	--	239
[Fault along the southeastern side of Sand Flat]	Quat.	--	--	--	--	--	239
[Fault along the northeastern side of Sand Flat]	Quat.	--	--	--	--	--	239

Table 10. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y-)
			Vertical	Lateral	Vertical	Lateral	
[Fault along the western side of Ulida Flat]	Quat.	--	--	--	--	--	239
Hunter Mountain fault (HM)	≤10	--	--	--	--	[11]183; 305 to 610	698, 1020
Indian Springs Valley fault (ISV)	Quat.	--	--	--	--	--	813, 852
Jumbled Hills fault (JUM)	Quat.	--	--	--	--	--	813
Kawich Range fault (KR)	10 to 1,500; Quat.	Quat.	--	--	--	--	5, 232, 813, 853
Kawich Valley fault (KV)	Quat.	--	--	--	--	--	813, 853
La Madre fault (LMD)	Quat.	--	--	--	--	--	813, 852
North Desert Range fault (NDR)	Quat.	--	--	--	--	--	813
Oak Spring Butte faults (OAK)	'10 to 130	Quat.	--	--	--	--	50, 212, 693, 813, 853
Pahrump fault (PRP)	[12]Hol. or L.Pleist.(?)	≤10	--	--	[13]≥(5 to 15)	--	696
Panamint Valley fault (PAN)							239, 697
[Fault south of Ballarat]	([14])	--	[15]0.4 to 1.2; 0.6 to 1.8	[16]3.2±0.5; 2.0±0.6	--	[17]≥11±2; ≥20	697, 868
[Fault north of Ballarat]	--	--	--	--	--	[18]183	698
Penoyer fault (PEN)	15 to 200; Quat.	15 to 200; Quat.	--	--	--	--	404, 813, 1032
Racetrack Valley faults (RTV)							
[Eastern fault]	Quat.	--	--	--	--	--	239
[Western fault]	Quat.	--	--	--	--	--	239
Sarcobatus Flat fault (SF)	Quat.	--	--	--	--	--	238, 813, 853
Slate Ridge faults (SLR)							
[Northern fault]	Quat.	Hol.	--	--	--	--	238, 407, 853
[Southern fault]	Tert.	Hol.	--	--	--	--	238, 407
South Ridge faults (SOU)							
[Northern fault]	Quat.	--	--	--	--	--	813, [illegible]

Table 10. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m) Vertical	Displacement in youngest event (m) Lateral	Late Quaternary displacement (m) Vertical	Late Quaternary displacement (m) Lateral	References (Y-)
[Southern fault]	Quat.?	Quat./Tert.	--	--	--	--	62, 813
Spotted Range faults (SPR)							
[Range-front fault]	Quat.	--	--	--	--	--	813, 852
[Faults along unnamed ridge]	Quat.	--	--	--	--	--	813
[Faults within the range]	Quat.?	--	--	--	--	--	813, 852
Stonewall Mountain fault (SWM)	10 to 130; 10 to 1,500; Quat.	--	--	--	--	--	232, 238, 813, 853
Stumble fault (STM)	Quat.	Hol. to Plio.; Quat./Tert.	--	--	--	--	25, 404, 813
Three Lakes Valley fault (TLV)	Quat.	--	--	--	--	--	813
Tikaboo fault (TK)	≤200	≤15	--	--	--	--	1032
Tin Mountain fault (TM)	Quat.	--	--	--	--	--	216, 238, 239
Towne Pass fault (TP)	[19]Hol.; Lt.Pleist. to Hol.; Quat.	Pleist./Plio.	--	--	--	--	222, 239, 427, 458, 763, 1020, 1032
West Pintwater Range fault (WPR)	10 to 1,500; Quat.	--	--	--	--	--	813, 852
West Spring Mountains fault (WSM)	[20]L.Pleist. to Hol.; 10 to 130; <130?; ≥120; Quat.	--	--	--	[21]≥12; >20	--	238, 696, 813, 845, 852

[1]The youngest event inferred by Y-90 from scarp morphology occurred between 8 ka and 10 ka and is the youngest reported age for displacement on BD. A caliche that yielded a date (uranium-thorium) of >8 ka is displaced by BD (Y-90) Y-526 estimated an age between about 160 ka and 800 ka for displaced deposits. Y-853 noted scarps on surfaces with estimated ages between 130 ka and 1.5 Ma.

[2]No faults are shown by Y-69 on surfaces of either early Holocene and (or) latest Pleistocene age or in deposits of Holocene age.

[3] Ages of the youngest units displaced by DV and overlying DV are based on a variety of data noted at different localities. (See data sheet for the Death Valley fault in appendix 2.) Y-216 suggested that the youngest section of DV is near Golden Canyon. A level line established by Y-252 in 1970 across DV about 2 km south of Furnace Creek Wash (near Golden Canyon) suggests that vertical displacement continues.

[4]Maximum vertical separations estimated across scarps on late Holocene (0.2 ka to 2 ka) surfaces range between 0.15 m on the main trace of DV along the Badwater turtleback to 3 m near Salt Springs (north of Furnace Creek Wash) (Y-216).

[5]Right-lateral displacement is for a gully on a northwest-striking section of DV south of Copper Canyon as reported by Y-429 (p. 7).

[6]Maximum vertical separations across scarps on Pleistocene surfaces range between 6.6 m near Ashford Mill and 15 m near Copper Canyon (Y-216, table 4). Y-390 (p. A71-A72) proposed eastward tilting of 61 m and northward tilting of 92 m on the basis of deformed strandlines and lake gravels between Mesquite Flat and Shore Line Butte. They thought that the lake features were formed during the Wisconsin (correlated to the Tahoe glaciation in the Sierra Nevada). Y-474 (p. 2073, 2091) estimated a total post-Wisconsin (since about 10 ka to 11 ka) displacement of 63 m on DV using the present elevations of tufa and strandlines on the east and west sides of Death Valley.

[7]Surfaces of this age (10 ka to 300-500 ka) are displaced by abundant fault traces. Surfaces of early Holocene and (or) latest Pleistocene age may also be displaced at one locality (Y-69; Y-696).

[8]A scarp on a surface for which no age was estimated is 3 m high (Y-696). Scarps on early Pleistocene and (or) late Tertiary surfaces are 8 m high (Y-696, p. 40).

[9]Y-813 (p. 6) noted that fault traces included in EVN include "many scarps formed on late Quaternary fan deposits and possibly on pluvial lake deposits of Groom Lake." No further age was specified by Y-813.

[10]North of Red Wall Canyon, rocks of possible Pliocene age are noted by Y-236 (p. 234) to overlie GV. Y-755 (p. 21) inferred recurrent Quaternary displacement on different sections of GV between Red Wall Canyon and Titanothere Canyon, because Quaternary alluvium that was subdivided into at least four different age groups by Y-390 and Y-236 is faulted against the range front at some localities and deposited against fault scarps at other localities.

[11]Along a northwest-striking fault that could be part of HM (shown on HM? on plate 2 of this compilation) and that is north of Highway 19, Y-698 (p. 113) noted 183 m of right-lateral displacement that was estimated on the basis of the juxtaposition of a late Quaternary alluvial-fan deposit that is composed of clasts of Precambrian and Paleozoic rocks against a 61-m-high hill of Tertiary volcanic rocks. About 3 km southeast of Highway 19, right-lateral displacement of older alluvial-fan deposits totals 305 to 610 m (Y-698, p. 114).

[12]Y-696 (table 1, p. 28) suggested that the youngest geomorphic surfaces displaced by PRP are middle to late Holocene at the northern end of the fault and late Pleistocene(?) at the southern end. In Stewart Valley, the youngest displaced deposits are reported to be probably late Pleistocene to early Holocene (Y-696, p. 81-82).

Table 10. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

[13]South of lat 36°05'N. (but north of lat 36°00'N.), the main escarpment of PRP is up to 15 m high (Y-696, p. 53). North of lat 36°05'N., the maximum scarp height is 5 m (Y-696, p. 78). The surfaces on which these scarps are located have not been dated.

[14]The youngest event is estimated to have occurred during the last few hundred years (Y-697).

[15]Y-697 (p. 4859) recognized dip-slip displacement from the most-recent event of 0.4 to 1.2 m along the trace of PAN along the range front at Goler Wash. Y-868 (p. 413) suggested that scarps between 0.6 and 1.8 m high represent single-event displacement on fault traces that are subsidiary to the main trace of PAN.

[16]Y-697 (p. 4862-4863) reported an average right-lateral displacement during the most-recent event south of Ballarat of 3.2±0.5 m as indicated by scarps at six localities. Y-868 (p. 412-413) concluded that right-lateral displacements of 2.0±0.6 m characterize the last surface-rupturing event on PAN between Ballarat and Goler Wash.

[17]Y-697 (p. 4861-4762) noted right-lateral displacements of 11±2 m for three to four surface-rupturing events on PAN near Manly Peak Canyon. Y-868 (p. 411, 413, 415) noted a maximum right-lateral displacement along PAN near Manly Peak Canyon of 20 m in mudflow levees that were buried by strandlines that date between 10 ka and 20 ka.

[18]Y-698 (p. 113) noted 183 m of right-lateral displacement along the northwest-striking section that could be part of either PAN or HM (shown as HM? on plate 2 of this compilation). This estimate of displacement is based on the juxtaposition of a late Quaternary alluvial-fan deposit that is composed of Precambrian and Paleozoic rocks against a 61-m-high hill of Tertiary volcanic rocks.

[19]Y-1020 showed one short section of TP as Holocene, but the rest as having Quaternary displacement. Y-763 (p. 13) reported that locally TP juxtaposes Paleozoic bedrock against Holocene alluvium. Y-222 showed the northern part of TP as juxtaposing Holocene alluvium against Pliocene and (or) Pleistocene rocks. Y-427 (table 1, p. 22) noted beheaded drainages, which he thought suggested latest Pleistocene to Holocene displacement. Most of TP is portrayed by Y-239 as prominent lineaments or scarps on surfaces of Quaternary deposits.

[20]The youngest scarps that were noted by Y-852 along the Spring Mountains range front and 2 to 3 km west of the front near the northern end of WSM are on depositional or erosional surfaces of late Pleistocene age (10 ka to 130 ka). Some fault traces in Pahrump Valley between Hidden Hills and Manse, Nevada, cut paludal sediments of probable late Pleistocene to Holocene age (<130 ka?; Y-696, p. 91). The youngest geomorphic surfaces with scarps along the western front of the Spring Mountains may be about or older than 120 ka when compared to surfaces at Kyle Canyon on the eastern side of the Spring Mountains (Y-696, p. 86). Y-238 and Y-813 portrayed much of WSM as prominent (mainly) to weakly expressed lineaments and scarps on surfaces of Quaternary deposits.

[21]A graben on a surface of unspecified age just north of Wheeler Wash has a minimum displacement of 12 m (Y-696, p. 87-88). Scarps on surfaces of alluvium with an estimated age of 120 ka? or >730 ka? are noted by Y-696 as >20 high.

Table 11. Slip rates (mm/yr) for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. Rates in italics are for apparent lateral slip; rates in vertical type are for apparent vertical slip. Numbers in parentheses indicate the time interval for which the rate has been estimated. The pre-Quaternary rates are based on displacement of units that are older than 1.6 Ma, but the time interval over which the rates are estimated may continue into the Quaternary. Entries separated by a comma (,) indicate data for different time intervals for a portion of the fault; entries separated by a semicolon (;) indicate different interpretations by different authors. Queried entries indicate uncertainty in information. Leaders (—), no information was noted during the literature review]

Fault or faults [Segment or individual fault]	Holocene: Late 0-4 ka	Holocene: Middle 4-8 ka	Holocene: Early 8-10 ka	Pleistocene: Late 10-130 ka	Pleistocene: Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma	Pre-Quaternary: Rate	Pre-Quaternary: Interval (10^6 yr)
Belted Range fault (BLR)	—	—	—	—	—	—	—	—	—
Bonnie Claire fault (BC)	—	—	—	—	—	—	—	—	—
Boundary fault (BD)	—	—	—	—	—	—	—	—	—
Buried Hills faults (BH)	—	—	—	—	—	—	—	—	—
Cactus Flat fault (CF)	—	—	—	—	—	—	—	—	—
Cactus Flat–Mellan fault (CFML)	—	—	—	—	—	—	—	—	—
Cactus Range–Wellington Hills fault (CRWH)	—	—	—	—	—	—	—	—	—
Cactus Springs fault (CAC)	—	—	—	—	—	—	—	—	—
Central Pintwater Range faults (CPR)	—	—	—	—	—	—	—	—	—
Central Spring Mountains faults (CSM)									
[Northwest fault]	—	—	—	—	—	—	—	—	—
[Northeast fault]	—	—	—	—	—	—	—	—	—
[Southeast fault]	—	—	—	—	—	—	—	—	—
Chalk Mountain fault (CLK)	—	—	—	—	—	—	—	—	—
Chert Ridge faults (CHR)									
[Eastern faults]	—	—	—	—	—	—	—	—	—
[Western faults]	—	—	—	—	—	—	—	—	—
Chicago Valley fault (CHV)	—	—	—	—	—	—	—	—	—
Cockeyed Ridge–Papoose Lake fault (CRPL)	—	—	—	—	—	—	—	—	—
Death Valley fault (DV)	(<0.2 ka)---- [1]0.08 to 11.5---- -----(<2 ka)	(>2 ka)------[1]0.15 to 2.5-------	(≤10 ka)	---- [1]7 ----	—	—	—	0.03, 0.08	([2])
East Belted Range fault (EBR)	—	—	—	—	—	—	—	—	—
East Nopah fault (EN)	----------------------------------	[3]0.006 to 0.06	----------------------------------	----------------------------------	(<(50 to 500) ka)	—	—	—	—

Table 11. Slip rates (mm/yr) for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Holocene Late 0-4 ka	Holocene Middle 4-8 ka	Holocene Early 8-10 ka	Pleistocene Late 10-130 ka	Pleistocene Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma	Pre-Quaternary Rate	Pre-Quaternary Interval (10^6 yr)
East Pintwater Range fault (EPR)	--	--	--	--	--	--	--	--	--
Emigrant fault (EM)	--	--	--	--	--	--	--	--	--
Emigrant Valley North fault (EVN)	--	--	--	--	--	--	--	--	--
Emigrant Valley South fault (EVS)	--	--	--	--	--	--	--	--	--
Fallout Hills faults (FH)	--	--	--	--	--	--	--	--	--
Gold Flat fault (GOL)	--	--	--	--	--	--	--	--	--
Gold Mountain fault (GOM)	--	--	--	--	--	--	--	--	--
Grapevine fault (GV)	--	--	--	--	--	--	--	--	--
Grapevine Mountains fault (GM)									
[Southern trace]	--	--	--	--	--	--	--	--	--
[Northern trace]	--	--	--	--	--	--	--	--	--
Groom Range Central fault (GRC)	--	--	--	--	--	--	--	--	--
Groom Range East fault (GRE)	--	--	--	--	--	--	--	--	--
Hidden Valley–Sand Flat faults (HVSF)									
[Fault on the eastern sides of Hidden Valley/Ulida Flat]	--	--	--	--	--	--	--	--	--
[Fault on the southern sides of Ulida Flat/ Sand Flat]	--	--	--	--	--	--	--	--	--
[Fault on the southeastern side of Sand Flat]	--	--	--	--	--	--	--	--	--
[Fault on the northeastern side of Sand Flat]	--	--	--	--	--	--	--	--	--
[Fault on the western side of Ulida Flat]	--	--	--	--	--	--	--	--	--
Hunter Mountain fault (HM)	--	--	--	--	--	--	--	[4]*2 to 3.2*; [5]*2 to 2.7*; [5]<*(1.3 to 1.8)*	≤3 ≤4; <6
Indian Springs Valley fault (ISV)	--	--	--	--	--	--	--	--	--
Jumbled Hills fault (JUM)	--	--	--	--	--	--	--	--	--
Kawich Range fault (KR)	--	--	--	--	--	--	--	--	--
Kawich Valley fault (KV)	--	--	--	--	--	--	--	--	--

Table 11. Slip rates (mm/yr) for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Holocene Late 0-4 ka	Holocene Middle 4-8 ka	Holocene Early 8-10 ka	Pleistocene Late 10-130 ka	Pleistocene Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma	Pre-Quaternary Rate	Pre-Quaternary Interval (10^6 yr)
La Madre fault (LMD)	--	--	--	--	--	--	--	--	--
North Desert Range fault (NDR)	--	--	--	--	--	--	--	--	--
Oak Spring Butte faults (OAK)	--	--	--	--	--	--	--	--	--
Pahrump fault (PRP)	--	--	--	--	--	--	([6])	--	--
Panamint Valley fault (PAN)									
[Fault south of Ballarat]	[7] $\geq 2.36 \pm 0.79$ (<17±4 ka) [8] $\geq 1.74 \pm 0.65$ (<17±4 ka) [9] 2.5 (<15 ka) [10] 1 to 2 (<(10 to 20)				--	--	--	--	--
[Fault north of Ballarat]	--	--	--	--	--	--	--	--	--
Penoyer fault (PEN)	--	--	--	--	--	--	--	--	--
Racetrack Valley faults (RTV)									
[Eastern fault]	--	--	--	--	--	--	--	--	--
[Western fault]	--	--	--	--	--	--	--	--	--
Sarcobatus Flat fault (SF)	--	--	--	--	--	--	--	--	--
Slate Ridge faults (SLR)									
[Northern fault]	--	--	--	--	--	--	--	--	--
[Southern fault]	--	--	--	--	--	--	--	--	--
South Ridge faults (SOU)									
[Northern fault]	--	--	--	--	--	--	--	--	--
[Southern fault]	--	--	--	--	--	--	--	--	--
Spotted Range faults (SPR)									
[Range-front fault]	--	--	--	--	--	--	--	--	--
[Fault along unnamed ridge]	--	--	--	--	--	--	--	--	--
[Faults within the range]	--	--	--	--	--	--	--	--	--
Stonewall Mountain fault (SWM)	--	--	--	--	--	--	--	--	--
Stumble fault (STM)	--	--	--	--	--	--	--	--	--
Three Lakes Valley fault (TLV)	--	--	--	--	--	--	--	--	--
Tikaboo fault (TK)	--	--	--	--	--	--	--	--	--

Table 11. Slip rates (mm/yr) for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Holocene Late 0-4 ka	Holocene Middle 4-8 ka	Holocene Early 8-10 ka	Pleistocene Late 10-130 ka	Pleistocene Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma	Pre-Quaternary Rate	Pre-Quaternary Interval (10^6 yr)
Tin Mountain fault (TM)	--	--	--	--	--	--	--	--	--
Towne Pass fault (TP)	--	--	--	--	--	--	--	--	--
West Pintwater Range fault (WPR)	--	--	--	--	--	--	--	--	--
West Spring Mountains fault (WSM)	[11]0.06 (<200 ka)					--	--	--	--
	[12]0.02 to 0.2 (<(50 to 500) ka)					--	--	--	--

[1]Using the range of maximum vertical separations of 0.15 to 2.3 m in deposits estimated to be 0.2 ka to 2 ka as reported by Y-216 (table 4) for DV south of Furnace Creek Wash, the apparent vertical slip rate ranges between 0.08 to 11.5 mm/yr for this portion of DV during late Holocene. Using the range of maximum vertical separations of 1.5 to 5 m that is reported by Y-216 (table 4) for older Holocene (2 ka to 10 ka) surfaces, an apparent vertical slip rate of 0.15 to 2.5 mm/yr is estimated for DV during the Holocene. Y-474 (p. 2096) estimated a vertical slip rate of 7 mm/yr for DV since late Pleistocene using his estimate of the present tilting rate of Death Valley (0.016°·1,000 yr) and the assumption that the axis of tilting is 25 km west of DV.

[2]Y-389 (p. 66) suggested "crude" estimates of the minimum average vertical slip rates on DV: 0.03 mm/yr (100 ft/yr) since middle Miocene and 0.08 mm/yr (250 ft/yr) since middle Pliocene.

[3]This is an apparent vertical slip rate estimated by Y-696 (p. 48) at one locality along EN using a 3-m-high scarp on a middle to late Pleistocene surface with an estimated age of 50 ka to 500 ka (Y-69).

[4]By assuming that a maximum age of 3 Ma for the formation of Saline Valley reflects the age of inception of HM at the northern end of Panamint Valley and that the net slip on HM is reflected by 8 to 10 km of lateral slip and 0 to 2 km of vertical slip, Y-864 (p. 10,424) calculated a minimum average slip rate of 2 to 3.2 mm/yr for HM.

[5]Y-697 (p. 4,858) calculated an apparent (lateral?) slip rate of 2 to 2.7 mm/yr for HM using a displacement of 9.3±1.4 km for a 4-Ma basalt that they reported from Y-864. Using this same amount of displacement but assuming that displacement began about 6.1 Ma as suggested by Y-909 (p. 657), Y-697 (p. 4,858) calculated a minimum apparent (lateral?) slip rate of 1.30 to 1.75 mm/yr for HM.

[6]Slip rate for an unspecified time interval is estimated to be low (Y-696), but the actual rate is not specified.

[7]This is a minimum Holocene and latest Pleistocene right-lateral slip rate estimated on the basis of 37±4 m of right-lateral displacement of ridges with a maximum age of 17±4 ka (may be younger than 12 ka or 13 ka) near the southern extent of fault scarps at Goler Wash Canyon (Y-697).

[8]This is a minimum Holocene and latest Pleistocene right-lateral slip rate estimated on the basis of 24±4 m and 27±4 m of right-lateral displacement of ridges with a maximum age of 17±4 ka (may be younger than 12 ka or 13 ka) near Manly Peak 5.3 km north of Goler Wash Canyon (Y-697).

[9]This right-lateral slip rate was estimated using the 20 m of displacement of mudflow levees observed by Y-868 (p. 413) at the mouth of Goler Wash Canyon and an estimated age of 10 ka to 20 ka for the levees (Y-868, p. 411).

[10]Y-900 (p. 465) suggested that the lateral slip rate on the southern portion of PAN since 15 ka has been about 2.5 mm/yr.

[11]This is an average apparent vertical slip rate on WSM that was estimated by Y-696 (p. 87) assuming an age of 200 ka for a surface containing a graben near the mouth of Wheeler Wash and a minimum displacement of 12 m across the graben.

[12]Y-696 (p. 87) estimated an apparent vertical slip rate of 0.02 to 0.2 mm/yr for WSM near the mouth of Wheeler Wash, using a range of 50 ka to 500 ka for the age of the displaced surface.

Table 12. Estimated number of events/time interval for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. Numbers with age units in parentheses indicate the estimated age of the faulting event(s). Queried entries indicate uncertainty in information. Leaders (– –), no information was noted during the literature review. Number of events is shown in the last two columns only if more specific information is not available]

Fault or fault [Segment or individual fault]	Holocene Late 0-4 ka	Holocene Middle 4-8 ka	Holocene Early 8-10 ka	Pleistocene Late 10-130 ka	Pleistocene Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma
Belted Range fault (BLR)		≥1 (<10 to 130) ka)			– –	– –	– –
Bonnie Claire fault (BC)	– –	– –	– –	– –	– –	– –	≥1
Boundary fault (BD)	– –	– –	1 (8 to 10 ka)	– –	– –	– –	– –
Buried Hills faults (BH)	– –	– –	– –	– –	– –	– –	≥1
Cactus Flat fault (CF)		≥1				– –	– –
Cactus Flat–Mellan fault (CFML)	– –	– –	– –	– –	– –	– –	≥1
Cactus Range–Wellington Hills fault (CRWH)	– –	– –	– –	– –	– –	– –	≥1
Cactus Springs fault (CAC)	– –	– –	– –	– –	– –	– –	≥1
Central Pintwater Range faults (CPR)	– –	– –	– –	– –	– –	– –	≥1
Central Spring Mountains faults (CSM)							
[Northwest fault]	– –	– –	– –	– –	– –	– –	≥1
[Northeast fault]	– –	– –	– –	– –	– –	– –	≥1
[Southeast fault]	– –	– –	– –	– –	– –	– –	≥1
Chalk Mountain fault (CLK)	– –	– –	– –	– –	– –	– –	≥1
Chert Ridge faults (CHR)							
[Eastern faults]	– –	– –	– –	– –	– –	– –	≥1
[Western faults]	– –	– –	– –	– –	– –	– –	≥1
Chicago Valley fault (CHV)	– –	– –	– –	(≥10 ka) ≥1 (≤300 to 500) ka)		– –	– –
Cockeyed Ridge–Papoose Lake fault (CRPL)	– –	– –	– –	– –	– –	– –	≥1
Death Valley fault (DV)	(>0.2 ka) ≥3 (<2 ka)			– –	– –	– –	– –
East Belted Range fault (EBR)	– –	– –	– –	– –	– –	– –	≥1
East Nopah fault (EN)	– –	– –	(10 ka)	≥1	(<300 to 500) ka)	– –	– –
East Pintwater Range fault (EPR)			≥1? (<130 to 1,500) ka)			– –	≥1
Emigrant fault (EM)	– –	– –	– –	– –	– –	– –	≥1

Table 12. Estimated number of events/time interval for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or fault [Segment or individual fault]	Holocene Late 0-4 ka	Holocene Middle 4-8 ka	Holocene Early 8-10 ka	Pleistocene Late 10-130 ka	Pleistocene Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma
Emigrant Valley North fault (EVN)	--	--	--	--	--	≥1	--
Emigrant Valley South fault (EVS)	--	--	--	--	--	--	≥1
Fallout Hills faults (FH)	--	--	--	--	--	--	≥1
Gold Flat fault (GOL)	--	--	--	--	--	--	≥1
Gold Mountain fault (GOM)	≥1 (<(10 to 130) ka)				--	--	--
Grapevine fault (GV)	--	--	--	--	--	--	>1
Grapevine Mountains fault (GM)							
[Southern trace]	--	--	--	--	--	--	≥1
[Northern trace]	≥1? (<(106 to 130) ka?) or (<(1[illegible] [illegible] 150) ka)					--	--
Groom Range Central fault (GRC)	--	--	--	--	--	--	≥1
Groom Range East fault (GRE)	--	--	--	--	--	--	≥1?
Hidden Valley–Sand Flat faults (HVSF)							
[Fault along the eastern sides of Hidden Valley/Ulida Flat]	--	--	--	--	--	--	≥1
[Fault along the southern sides of Ulida Flat/Sand Flat]	--	--	--	--	--	--	≥1
[Fault along the southeastern side of Sand Flat]	--	--	--	--	--	--	≥1
[Fault along the northeastern side of Sand Flat]	--	--	--	--	--	--	≥1
[Fault along the western side of Ulida Flat]	--	--	--	--	--	--	≥1
Hunter Mountain fault (HM)	≥1 (≤10 ka)			--	--	--	--
Indian Springs Valley fault (ISV)	--	--	--	--	--	--	≥1
Jumbled Hills fault (JUM)	--	--	--	--	--	--	≥1
Kawich Range fault (KR)	≥1 (<(10 to 1,500) ka)					--	--
Kawich Valley fault (KV)	--	--	--	--	--	--	≥1
La Madre fault (LMD)	--	--	--	--	--	--	≥1
North Desert Range fault (NDR)	--	--	--	--	--	--	≥1
Oak Spring Butte faults (OAK)	≥1 (<(10 to 130) ka)				--	--	--

Table 12. Estimated number of events/time interval for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or fault [Segment or individual fault]	Holocene Late 0-4 ka	Holocene Middle 4-8 ka	Holocene Early 8-10 ka	Pleistocene Late 10-130 ka	Pleistocene Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma
Pahrump fault (PRP)	?------	≥1	------	------?	--	--	--
Panamint Valley fault (PAN)							
[Fault south of Ballarat]	------	[1]6 to 14	------(<17±4 ka)		--	--	--
[Fault north of Ballarat]	--	--	--	--	--	--	≥1
Penoyer fault (PEN)	------	≥1	------	------(<15 to 200) ka)		--	--
Racetrack Valley faults (RTV)							
[Eastern fault]	--	--	--	--	--	--	≥1
[Western fault]	--	--	--	--	--	--	≥1
Sarcobatus Flat fault (SF)	--	--	--	--	--	--	≥1
Slate Ridge faults (SLR)							
[Northern fault]	--	--	--	--	--	--	≥1
[Southern fault]	--	--	--	--	--	--	1?
South Ridge faults (SOU)							
[Northern fault]	--	--	--	--	--	--	≥1
[Southern fault]	--	--	--	--	--	--	1?
Spotted Rage faults (SPR)							
[Range-front fault]	--	--	--	--	--	--	--
[Fault along unnamed ridge]	--	--	--	--	--	--	≥1
[Faults within the range]	--	--	--	--	--	--	1?
Stonewall Mountain fault (SWM)	------	≥1	------(<10 to 130) ka)		--	--	--
Stumble fault (STM)	--	--	--	--	--	--	≥1
Three Lakes Valley fault (TLV)	--	--	--	--	--	--	1?
Tikaboo fault (TK)	(≤15 ka)------	≥1	------	------(≤200 ka)		--	--
Tin Mountain fault (TM)	--	--	--	--	--	--	≥1
Towne Pass fault (TP)	------	≥1	------(≤10 ka)	--	--	--	--
West Pintwater Range fault (WPR)	------	≥1	------	------	------(<10 to 1,500) ka)	--	--
West Spring Mountains fault (WSM)	------	≥1	------(<10 to 130) ka)		--	--	--

[1]Y-697 (p. 4866) inferred that strandlines from the last high stand of Lake Panamint (estimated to have occurred about 17 ka ± 4 ka) are displaced by possibly six to fourteen events, assuming single-event displacements of about 3 m.

Table 13. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. References are listed in appendix 4. Abbreviations of trends: E, east; N, north; NE, northeast; NW, northwest; ENE, east–northeast; NNE, north–northeast; NNW, north–northwest; WNW, west-northwest. Abbreviations for displacement type: L, unspecified lateral; LL, left lateral; LO, left oblique; N, normal; R, reverse; RO, right oblique; RL, right lateral. Number of events and time period are shown only when used to estimate recurrence interval. Queried entries indicate uncertainty in information. Entries separated by a comma (,) indicate data from individual fault traces or for different localities along the fault or faults; entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (– –), no information was noted during the literature review]

Fault or faults [Segment or individual fault]	Number of events events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
Belted Range fault (BLR)	– –	– –	– –	[1]N; NNE	N?	5, 232, 813, 853
Bonnie Claire fault (BC)	– –	– –	– –	NE	N?	232, 238, 853
Boundary fault (BD)	– –	– –	– –	NE	N	50, 224, 526, 813, 853
Buried Hills faults (BH)	– –	– –	– –	N	N	813
Cactus Flat fault (CF)	– –	– –	– –	N	([2])	813
Cactus Flat–Mellan fault (CFML)	– –	– –	– –	N	– –	813
Cactus Range–Wellington Hills fault (CRWH)	– –	– –	– –	NW	N	813
Cactus Springs fault (CAC)	– –	– –	– –	ENE, E, WNW	N	813
Central Pintwater Range faults (CPR)	– –	– –	– –	N to NNW	N	404, 813, 852
Central Spring Mountains faults (CSM)						
[Northwest fault]	– –	– –	– –	NNE	N	813
[Northeast fault]	– –	– –	– –	NNW	N	813, 852
[Southeast fault]	– –	– –	– –	N, E	N	813, 852
Chalk Mountain fault (CLK)	– –	– –	– –	NE to NNE	– –	813
Chert Ridge faults (CHR)						
[Eastern faults]	– –	– –	– –	[3]N	[4]N	813
[Western faults]	– –	– –	– –	[3]N	[4]N, RL	813
Chicago Valley fault (CHV)	– –	– –	– –	N to NNW	N	69, 238
Cockeyed Ridge–Papoose Lake fault (CRPL)	– –	– –	– –	NNW	N	232, 813
Death Valley fault (DV)	3	<2	0.65	N.4°W. to N.28°W.	[5]N, RL; RO	216, 389, 429, 473, 474
East Belted Range fault (EBR)	– –	– –	– –	NNW	– –	813, 853
East Nopah fault (EN)	– –	– –	– –	[6]N.33°W.	RL	696
East Pintwater Range fault (EPR)	– –	– –	– –	N	N	404, 813, 852

Table 13. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Number of events events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
Emigrant fault (EM)	--	--	--	N	N	239
Emigrant Valley North fault (EVN)	--	--	--	NNE to NE	N, L	813
Emigrant Valley South fault (EVS)	--	--	--	NNE	N, L	813
Fallout Hills faults (FH)	--	--	--	NNW	N	813
Gold Flat fault (GOL)	--	--	--	NE	--	813
Gold Mountain fault (GOM)	--	--	--	ENE	--	238, 853
Grapevine fault (GV)	--	--	--	NW	N, L?	236
Grapevine Mountains fault (GM)						
[Southern trace]	--	--	--	NNE to NE	N	238, 239, 853
[Northern trace]	--	--	--	NE	N	238, 239, 853
Groom Range Central fault (GRC)	--	--	--	[7]N to NNE, NNW	N	813
Groom Range East fault (GRE)	--	--	--	NNE	N	813
Hidden Valley–Sand Flat faults (HVSF)						
[Fault along the eastern sides of Hidden Valley/Ulida Flat]	--	--	--	N to NE	N	239
[Fault along the southern sides of Ulida Flat/Sand Flat]	--	--	--	NW	N	239
[Fault along the southeastern side of Sand Flat]	--	--	--	N to NE	N	239
[Fault along the northeastern side of Sand Flat]	--	--	--	NW	N	239
[Fault along the western side of Ulida Flat]	--	--	--	N to NE	N	239
Hunter Mountain fault (HM)	--	--	--	[8]NNW, WNW	RO?	239, 356, 427, 494, 698, 864, 1148
Indian Springs Valley fault (ISV)	--	--	--	NNW	N	813, 852
Jumbled Hills fault (JUM)	--	--	--	N	N	25, 813
Kawich Range fault (KR)	--	--	--	NE, NNW, NW, NNE	N	5, 813, 853
Kawich Valley fault (KV)	--	--	--	NE, NNE, N	--	813, 853
La Madre fault (LMD)	--	--	--	NW	N	813

Table 13. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Number of events events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
North Desert Range fault (NDR)	--	--	--	N	N	813
Oak Spring Butte faults (OAK)	--	--	--	N	N	50, 212, 813, 853
Pahrump fault (PRP)	--	--	--	N.45°W.	RO	161, 238, 696, 806
Panamint Valley fault (PAN)						
[Fault south of Ballarat]	[9]6 to 14; [10]8 to 14	[9]<17±4; [10]<(10 to 20)	[9]0.86 to 2.36; [10]0.7 to 2.5	NNW	[11]N, RL, RO	697, 868
[Fault north of Ballarat]	--	--	--	N	N	239
Penoyer fault (PEN)	--	--	--	[12]NNE to NE, N to NNW	N	25, 404, 813, 1032
Racetrack Valley faults (RTV)						
[Eastern fault]	--	--	--	NNE	N	239
[Western fault]	--	--	--	NNE to NNW	N	239
Sarcobatus Flat fault (SF)	--	--	--	NNW	N	238, 813, 853
Slate Ridge faults (SLR)						
[Northern fault]	--	--	--	E to ENE	N	238, 853
[Southern fault]	--	--		E to ENE	N	238, 853
South Ridge faults (SOU)						
[Northern fault]	--	--	--	E	N	813, 852
[Southern fault]	--	--	--	[13]E, ENE, NE	N, LL	62, 813
Spotted Range faults (SPR)						
[Range-front fault]	--	--	--	N, NNE	--	813
[Fault along unnamed ridge]	--	--	--	NE	--	813
[Faults within the range]	--	--	--	N, NNE	N	813
Stonewall Mountain fault (SWM)	--	--	--	NE, ENE	[14]N; LO, R	10, 238, 813, 853
Stumble fault (STM)	--	--	--	[15]NNE, N to NNW	N	25, 404, 813
Three Lakes Valley fault (TLV)	--	--	--	NW	N?	404, 813
Tikaboo fault (TK)	--	--	--	NNW	N	25, 813, 1032
Tin Mountain fault (TM)	--	--	--	N to NNE	N	238, 239

Table 13. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults between >50 and 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Number of events events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
Towne Pass fault (TP)	--	--	--	NNE	N; ([16])	239, 390, 458
West Pintwater Range fault (WPR)	--	--	--	[17]N, NNW, NNE	N	852
West Spring Mountains fault (WSM)	--	--	--	N.12°W.	[18]N, RL	161, 696, 813, 852

[1]The southern half of BLR strikes north-northeast; the northern half strikes north. Short sections of BLR strike between north-northwest and north-northeast (Y-5; Y-232; Y-813; Y-853).

[2]Y-813 shows four north-northeast-trending folds subparallel to the northern end of CF. Y-813 (p. 6) suggested that these folds indicate that compression has been associated with CF during the Quaternary.

[3]Faults included in CHR generally strike north, but individual faults curve so that their strikes range between north-northwest and northeast (Y-813).

[4]Faults in CHR are shown to have vertical displacement except for short faults at the southern end of the western side of Chert Ridge. These faults are portrayed by Y-813 as having right-lateral displacement

[5]Displacement on DV is reported to have been predominantly dip slip (normal; Y-216; Y-389; Y-429), but Y-216 and Y-474 both noted evidence for right-lateral displacement near Badwater and Copper Canyon. Y-473 (p. 436) noted a component of right-lateral displacement on northeast-striking fault traces along the Black Mountains. Y-429 (p. 6) thought displacement on DV had been right-oblique.

[6]The southern 9 km of EN strike N. 16° W. to N. 30° W. (Y-696, p. 41). Fault traces that splay to the southeast away from the main trace of EN strike between N. 18° W. and N 8° E. (Y-696, p. 41).

[7]Traces of GRC strike generally north to north-northeast (Y-813). The left-stepping pattern of traces results in a general north-northwest strike for the entire fault.

[8]HM in northern Panamint Valley and adjacent to Hunter Mountain strikes north-northwest. Y-864 (p. 10,422) noted a strike of N. 6° W. near Panamint Butte in northern Panamint Valley. Y-494 (p. 175) and Y-698 (p. 113) both noted a strike of N. 55° W. for a near-vertical fault trace at Grapevine Pass southwest of Hunter Mountain. HM strikes west-northwest between Hunter Mountain and Daisy Canyon along the southern edge of Saline Valley Y-1148 (p. 20) reported a strike of N. 60° W. for HM in Saline Valley.

[9]This is the average recurrence interval for the southern section of PAN estimated by Y-697 (p. 4868) for the Holocene and latest Pleistocene assuming single-event lateral displacements of about 3 m (3.2 ± 0.5) and a right-lateral slip rate of 2.36 ± 0.79 mm/yr.

[10]This is the average recurrence interval for surface-rupturing events on a 20-km-long section of PAN between Ballarat and Goler Wash. The interval was estimated by Y-868 (p. 415) assuming that all events produced right-lateral displacement of 1.4 to 2.6 m and that the total displacement of 20 m represents eight to fourteen events since 10 ka to 20 ka.

[11]Along the southern section of PAN, fault traces at the range front have dip-slip (normal), down-to-the-west displacement (Y-697, p. 4858). Right-lateral displacement has been dominant along fault traces several hundred meters west of the range front. Y-697 (p. 4869) noted that right-oblique slip is "partitioned between strike-slip and dip-slip faults."

[12]The first entry is for the southern half of PEN; the second entry is for the northern half of PEN (Y-1032).

[13]The main trace of the southern fault varies in strike from east-northeast at the western end of South Ridge, to northeast in the central part of the ridge, to east at the eastern end of the ridge (Y-813). A branch fault south of the main trace strikes primarily northeast.

[14]SWM generally exhibits evidence for dip-slip (normal) displacement (Y-813), but the fault may have had left-oblique displacement at its southwest end (Y-10). Y-10 (p. 58) suggested that high-angle reverse displacement may have occurred on part of SWM.

[15]The first entry is for the southern half of STM (south of about Cattle Spring); the second entry is for the curving, northern half of STM. The northern half is composed of four fault traces (Y-813).

[16]Y-458 (p. 57) reported that he observed no evidence for lateral displacement on TP.

[17]WPR strikes generally north, but its trace curves, so that the southern end of WPR strikes north-northeast and the northern portion strikes north-northwest (Y-852). WPR is portrayed by Y-852 as composed of curving, overlapping, and branching traces with strikes ranging between north-northwest and northeast.

[18]Y-696 (p. 86-87) noted that dip-slip (normal) and down-to-the-west displacement on WSM is indicated by bedrock relationships in the Spring and Montgomery mountains and by scarps (Y-696; Y-813; Y-852). Y-696 (p. 84-85) suggested that sharp bends in the fault's trace preclude a significant lateral component of displacement. Y-813 (p. 9) noted that displacement on WSM is predominantly dip slip with little or no strike slip. Fault traces in Pahrump Valley between Hidden Hills and Manse, Nevada, exhibit dip slip, but a left-stepping fault pattern suggests some right-lateral displacement (Y-696).

Table 14. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults greater than 100 km from Yucca Mountain

[Detailed data are on description sheets in appendix 2. References are listed by number in appendix 4. Queried entries indicate uncertainty in information. Entries separated by a comma (,) indicate data for individual fault traces or for different localities along the fault or faults; entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (--), no information was noted during the literature review; YM, the proposed repository site at Yucca Mountain]

Fault or faults [Segment or individual fault]	Plate (P) or Figure (F) number	Estimated total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
Airport Lake fault (AIR)	P2	≥30; >35; >50; ≥60	--	≥0.5; ≥0.6	--	138	640, 1035, 1052, 1110, 1145
Ash Hill fault (AH)	P2	>45	--	0.1	--	105	239, 399
Badger Wash faults (BDG)	P1	[1]4, 8, 13	--	--	--	111	25
Cedar Mountain fault (CM)	F1	≥45; 60	100	--	[2]≥0.1	200	17, 170, 794, 969
Central Reveille fault (CR)	P1	29	--	--	--	108	1032
Clayton–Montezuma Valley fault (CLMV)	P1	13; 14	--	--	--	126	238, 853
Clayton Ridge–Paymaster Ridge fault (CRPR)	P1	≥51; ≥53	--	--	--	126	238, 853
Clayton Valley fault (CV)	P1	26; 27	--	--	--	132	238, 853
Deep Springs fault (DS)	P1	27	--	[3]1.5; ≥1.6	--	148	651, 872, 1033
East Magruder Mountain fault (EMM)	P1	7	--	--	--	113	238
East Reveille fault (ERV)	P1	19; 22; 36	--	--	--	112	5, 232, 813, 853, 1032
East Stone Cabin fault (ESC)	P1	35	--	--	--	115	1032
Emigrant Peak faults (EPK)	P1	[4]26	--	[5]>0.9	--	166	635, 665, 853
Eureka Valley East fault (EURE)	P1	34; 50?	--	--	--	110	853, 1031
Eureka Valley West fault (EURW)	P1	22	--	--	--	140	853
Fish Lake Valley fault (FLV)	P1	≥80	≥25	≥(0.54 to 0.75); ≥0.68	<(15 to 25)	135	647, 651
Freiburg fault (FR)	P1	18; 19	--	--	--	133	404, 1032
Frenchman Mountain fault (FM)	P2	18; 20	--	--	--	146	852, 1073
Garden Valley fault (GRD)	P1	12 to 15(?)	--	--	--	126	25
General Thomas Hills fault (GTH)	P1	11; 26	--	--	--	137	238, 853
Golden Gate faults (GG)	P1	23; 24	--	--	--	144	25, 404
Hiko fault (HKO)	P1	15; 45; 47	--	--	--	131	25, 404, 1032
Hiko–South Pahroc faults (HSP)	P1	27	--	--	--	130	25, 404

Table 14. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults greater than 100 km from Yucca Mountain —Continued

Fault or faults [Segment or individual fault]	Plate (P) or Figure (F) number	Estimated total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
Hot Creek–Reveille fault (HCR)	P1	83	--	[6]≥0.46	--	103	232, 1032
Lee Flat fault (LEE)	P2	[7]0.5, 5, 7	--	--	--	113	356, 1148
Lida Valley faults (LV)	P1	[8]3.5, 10	--	--	--	115	238
Little Lake fault (LL)	P2	≥24; >30; 40	[9]25	--	[10]>0.25; ≥0.4	163	374, 542, 1035, 1052, 1110
Lone Mountain fault (LMT)	P1	9; 15; 70	--	--	--	165	238, 407, 853
McAfee Canyon fault (MAC)	P1	14; 17	--	--	--	155	238, 853
Monitor Hills East fault (MHE)	P1	8	--	--	--	125	813
Monitor Hills West fault (MHW)	P1	12 to 15	--	--	--	124	813
Monotony Valley fault (MV)	P1	[11]1; 5.5	--	--	--	103	813
Montezuma Range fault (MR)	P1	≥18; 29; 33	--	--	--	121	238, 853, 1032
Mud Lake–Goldfield Hills fault (MLGH)	P1	≥33	--	--	--	113	238
Owens Valley fault (OWV)	P2	100	[12]100	[13]1.8 to 3.1; 2.4; 5.8	[14]20	126	427, 694, 1046, 1055, 1115, 1116
Pahranagat fault (PGT)	P1	40 to 45	--	--	[15]9 to 16	106	25, 395, 404
[Arrowhead Mine fault (ARM)]	P1	14; 15; 66	--	≥0.5	2; 8	--	25, 395, 404
[Buckhorn fault (BUC)]	P1	20 to 25; 27; 40; 42	--	--	5	--	25, 395, 404, 1032
[Maynard Lake fault (MAY)]	P1	40; 44; ≥45; 91	--	--	≤(5 to 6)	--	25, 395, 404, 1032
Pahroc fault (PAH)	P1	42; 59; 74	--	--	--	144	25, 404, 1032
Pahrock Valley faults (PV)	P1	[16]9, 11	--	--	--	155	25, 404
Palmetto Mountains–Jackson Wash fault (PMJW)	P1	12	--	--	--	112	238
Palmetto Wash faults (PW)	P1	[17]8; 10; 14 to 16?	--	--	--	131	238, 853
Quinn Canyon fault (QC)	P1	16; 18; 19	--	--	--	127	25, 404, 1032
Saline Valley faults (SAL)	P2		--	--	--	108	
[Fault along the front of the Inyo Mountains (WF)]	P2	13.5; 22	--	[18]6	--	--	222, 1148

Table 14. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Plate (P) or Figure (F) number	Estimated total fault length (km)	Percent of total length with late Quaternary displacement	Total vertical displacement (km)	Total lateral displacement (km)	Closest approach to YM (km)	References (Y-)
[Fault along the eastern side of Saline Valley (ES)]	P2	5, 6	--	--	--	--	356
[Fault in central Saline Valley (CEN)]	P2	20	--	--	--	--	222
Seaman Pass fault (SPS)	P1	[19]22; ≥34	--	--	--	153	404
Sheep Basin fault (SB)	P1, P2	[20]≥35; ≥42; 47	--	[21]≥0.37; >0.46	--	112	852, 918, 1148
Sheep–East Desert Ranges fault (SEDR)	P2	45	--	--	--	104	852
Sheep Range fault (SHR)	P1, P2	30; ≥50	[22]≥40	--	--	122	852, 1032
Sierra Nevada fault (SNV)	P2	25	--	--	--	154	1054
Silver Peak Range faults (SIL)	P1	24	--	--	--	142	238
Six–Mile Flat fault (SMF)	P1	24	--	--	--	138	1032
Southeast Coal Valley fault (SCV)	P1	[23]8; ≥19	--	--	--	132	1032
Southern Death Valley fault (SDV)	P2	[24]51; 63; 85; 200; 300	--	--	[25]≤8; <(10 to 12); ≥19; 24 to 48; 50	105	389, 413, 468, 479, 592, 593, 602, 612, 955
State Line fault (SL)	F1	32	--	[26]>3.5	--	130	743, 893, 1105
Stonewall Flat fault (SWF)	P1	5; 22	--	--	--	101	238, 853
Sylvania Mountains fault (SYL)	P1	14	--	--	--	111	238
Tem Piute fault (TEM)	P1	8; 22	--	--	--	101	25, 404, 1032
Tule Canyon fault (TLC)	P1	[27]10; 14; 26	--	--	--	104	238, 853
Weepah Hills fault (WH)	P1	15	--	--	--	145	238
West Railroad fault (WR)	P1	42	--	--	--	112	1032
Wilson Canyon fault (WIL)	P2	[28]29; 42	--	--	--	140	415, 1020, 1122

[1]BDG includes four faults. The east-central fault is the longest (13 km). The eastern and western faults are each 8 km long. The west-central fault is 4 km long.

[2]Along the northern section of CM, a minimum of 100 m of right-lateral displacement was inferred by Y-170 (p. 53) from displacement of the contact between Miocene units and the rake of exposed striations.

[3]Y-872 (p. 55) estimated a total apparent vertical displacement across DS of 1525 m based on identification of basement rock beneath Deep Springs Valley from a geophysical survey and the present height of the front of the Inyo Mountains above the valley. Y-651 (p. 40) suggested a minimum estimate of total apparent vertical displacement on DS of 1625 m on the basis of the topographic height of bedrock and its location beneath Deep Springs Valley as interpreted from gravity data.

[4]This is the length of the longest fault included in the Emigrant Peak faults. It is the westernmost of four faults. The west-central fault (north of Middle Wash) is 9.5 to 11.5 km long. The east-central fault is only 2 km long The easternmost fault of EPK is greater than 12 km long.

[5]Y-665 (p. 30) suggested that late-early to middle Pliocene sediments in the present Silver Peak Range between Fish Lake Valley and Clayton Valley have been uplifted at least 900 m since 5.9 Ma (K-Ar date on trachyandesite flows in the sediments).

[6]The is the stratigraphic throw (stratigraphic unit is not specified) across a normal fault on the eastern side of the Kawich Range (Y-232, p. 32). It is not clear if this fault is part of HCR as defined in this compilation.

[7]LEE includes fault traces within and bordering northern Lee Flat. The longest trace, which is on the eastern side of Lee Flat, is 7 km long (Y-1148). The longest trace on the western side of Lee Flat is 5 km long as estimated from Y-1148 and 6.5 km long as estimated from Y-356. Lengths of other traces are variable with 0.5 km as the shortest (Y-1148).

Table 14. Estimated length, total displacement, and distance from the site for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

[8]The first entry is for the fault along the northwestern side of Lida Valley; the second entry is for the fault along the southeastern side of Lida Valley (Y-238).

[9]Ground cracks attributed to a 1982 magnitude 5.2 earthquake occur in two areas over a combined length of about 10 km (Y-1035, p. 199).

[10]Southeast of the Owens River, a basalt flow dated at about 400 ka is displaced right laterally about 250 m (Y-542), ≥250 m (Y-1110, p. 10, 12), or 400 m (Y-1052, p. [5]).

[11]The first entry is for the fault trace on the northern side of the highland (northern trace); the second entry is for the fault trace on the western side of the highland (western trace) (Y-813).

[12]Surface rupture length in 1872 (M7.8, March 26) occurred on 90 to 110 km of OWV between Owens Lake and north of Big Pine, essentially the entire mapped length of OWV (Y-1046, p. 2; Y-1055).

[13]On the basis of gravity data interpreted by them, Y-1116 (p. 50) reported that the Cenozoic rocks that are faulted against pre-Tertiary rocks in the Inyo Mountains south of Independence, California, are about 1,830 to 3,050 m thick. Y-1046 (p. 2, *citing* Y-1116) noted a maximum vertical displacement on OWV of about 2,400 m near Lone Pine. Y-1116 (p. 54) inferred a total vertical displacement of about 5,800 m, which is "the difference in altitude between the summit of Mount Whitney and the buried pre-Tertiary floor of Owens Valley east of Line Pine."

[14]Y-1046 (p. 2) noted a maximum right-lateral displacement on OWV of about 20 km based on the correlation of two Cretaceous plutons by Y-1115 (p. D88) and work by Y-694.

[15]This is given as the displacement of unspecified type (Y-25; Y-395; Y-404). This may be primarily lateral displacement because of the orientation of the fault.

[16]The first entry is for the eastern fault; the second entry is for the western fault (Y-25; Y-404).

[17]PW may be as long as 14 to 16 km if traces with similar strike to that of PW but south of PW in Fish Lake Valley are included in PW (shown as PW? on plate 1 of this compilation).

[18]This is the total vertical displacement on WF estimated by Y-1148 (p. 50) on the basis of the elevation difference between the height of the Inyo Mountains and the depth of fill within Saline Valley as determined from gravity data.

[19]The portion of SPS with surficial expression is 22 km long. The fault is portrayed by Y-404 as concealed for another 12 km along Scaman Wash, so that the total length of SPS could be 34 km. However, SPS extends to the northern edge of their map area, so that this would be a minimum length.

[20]The length of SB is at least 35 km, as mapped by Y-852. The straight range front continues another 12 km to the north, so that the length of SB could be as much as 47 km.

[21]Using the elevation difference between the floor of Sheep Basin and a pass at the northern end of the Sheep Range, Y-918 (p. 4) estimated a minimum of 366 m of subsidence of the basin. Y-1148 (p. 4-5) inferred that pediments that were once connected to the Sheep Range have been faulted below the present floor of the basin on the footwall of SB and are preserved about 458 m above the basin floor in the Desert Range on the hanging wall.

[22]Percent was calculated using 20 km for the length of continuous scarps and 50 km for the total length of the fault.

[23]If SCV extends to the south to the Pahranagat Valley, then its length may be ≥19 km (Y-1032).

[24]The length of SDV is at least 51 km between Cinder Hill in southern Death Valley and the northeastern side of the Avawatz Mountains in the Silurian Valley as estimated from Y-413. The length may be 63 km if a concealed trace shown by Y-413 along the northeastern side of the Avawatz Mountains is included. If SDV extends 20 km south of the Avawatz Mountains to the southern Halloran Hills as suggested by Y-602 (p. 180-181) and Y-955 (p. 1, 10-11), then the total length of SDV is about 85 km. The length of SDV may be about 200 km, if SDV extends southeast from the Avawatz Mountains through a series of aligned valleys as speculated by Y-479 (p. 934). Y-612 (p. 530-531) proposed that SDV extends about 250 km southeast of the Avawatz Mountains along northwest-striking faults to the Big Maria, Little Maria, and Riverside mountains, which are just north of Blythe, California, along the Colorado River, for a total length of about 300 km for SDV.

[25]Y-479 (p. 947) inferred that the total right-lateral displacement on the northern part of SDV could be no more than 8 km based on trends of formational contacts (e.g., Precambrian Kingston Peak Formation and Noonday Dolomite). Y-593 (p. 1413) estimated that the displacement on the Garlock fault by SDV has been limited to about 8 km. Y-592 (p. 29, 31) concluded that "considerable geologic evidence" suggests that the maximum lateral displacement on SDV has been about 8 km. Y-602 (p. 130, 191) estimated that the total lateral displacement across the Noble Hills is less than 10 to 12 km. Y-468 (p. 157) interpreted the distribution of Precambrian Pahrump Series as indicating a minimum of about 19 km of right-lateral displacement on SDV. Y-389 (p. 56) concluded that the distribution of these same rocks suggested right-lateral displacement of 24 to 48 km. Y-612 (p. 530-531) recontoured isopach data of Y-479 and concluded that SDV had experienced 50 km of right-lateral displacement.

[26]This is the apparent vertical separation of pre-Tertiary rocks across the steep escarpment along the northeastern side of Mesquite Valley and interpreted by Y-1105 to be an extension of SL. The estimate is based on a maximum depth of 2 to 3 km to pre-Tertiary rocks beneath Mesquite Valley as interpreted from geophysical data and the elevations of the surrounding mountains (Y-1105, p. 8689).

[27]The length of TLC north of the mouth of Oriental Wash at the eastern edge of Death Valley is 10 km as estimated from Y-853 and about 14 km as estimated from Y-238. If north- and north-northwest-striking fault traces in Death Valley south of Oriental Wash are included in TLC, then the length of TLC is about 26 km.

[28]WIL is about 42 km long as estimated from Y-1020. Of this length, the eastern 21 km north and east of Searles Lake is shown by Y-1020 as concealed and has been inferred from geophysical evidence (Y-415, p. 191). Y-1122 (p. 49) noted that WIL is about 29 km long.

Table 15. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults greater than 100 km from Yucca Mountain

[Detailed data are on description sheets in appendix 2. Ages are estimated primarily from photogeologic, geomorphic, and pedologic criteria. (See individual references and description sheets in appendix 2 for limitations.) References are listed by number in appendix 4. Overlap of ages reported in columns 2 and 3 reflects uncertainties in age estimates and in stratigraphic interpretations (appen. 2). Abbreviations for ages (used where age is not specified in years): Hist., Historical; Hol., Holocene; L.Hol., Late Holocene; M.Hol., Middle Holocene; E.Hol., Early Holocene; Lt.Pleist., Latest Pleistocene; L/M Pleist., Late and Middle Pleistocene; M.Pleist., Middle Pleistocene; Pleist., Pleistocene; Quat., Quaternary; Tert., Tertiary. Late Quaternary displacement is since 130 ka. Queried entries indicate uncertainty in information. Entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (--), no information was noted during the literature review]

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y–)
			Vertical	Lateral	Vertical	Lateral	
Airport Lake fault (AIR)	≤10	--	--	--	[1]3, 4	--	1052, 1110
Ash Hill fault (AH)	≤10	Active stream channels	--	--	--	--	222, 427, 458, 1020
Badger Wash faults (BDG)	[2]Quat.	--	--	--	--	--	25
Cedar Mountain fault (CM)	[3]Hist.	--	[4]0.15 to 0.3; ≤0.5; 0.6	[4]1 to 2	[5]3	[5]≥21	13, 17, 170, 794, 795, 1069
Central Reveille fault (CR)	15 to 200	≤15	--	--	--	--	1032
Clayton–Montezuma Valley fault (CLMV)	10 to 1,500; Quat.	--	--	--	--	--	238, 853
Clayton Ridge–Paymaster Ridge fault (CRPR)	700 to 1,800; Quat.	15 to 200	--	--	--	--	238, 1032
Clayton Valley fault (CV)	10 to 1,500; Quat.	≤10	--	--	--	--	238, 407, 853
Deep Springs fault (DS)	≤6 ka	--	[6]2.3 to >20	--	[7]≥180; ≥201	--	651, 861, 1020, 1033
East Magruder Mountain fault (EMM)	Quat.?	--	--	--	--	--	238
East Reveille fault (ERV)	700 to 1800; Quat.	≤15	--	--	--	--	813, 1032
East Stone Cabin fault (ESC)	15 to 200; 10 to 130	≤15	--	--	--	--	853, 1032
Emigrant Peak faults (EPK)	[8]1 to 1.4	--	[9]≥1	--	[10]≥25.7	--	635
Eureka Valley East fault (EURE)	10 to 130	--	--	--	--	--	853
Eureka Valley West fault (EURW)	10 to 1,500	Hol./Lt.Pleist.	--	--	--	--	762, 853
Fish Lake Valley fault (FLV)	≤0.2; 0.6 to 1 or 1.5	--	≤1	≤3	40	92; 122	216, 647, 665
Freiburg fault (FR)	Quat.	15 to 200	--	--	--	--	404, 1032
Frenchman Mountain fault (FM)	10 to 130; [11]30 to >500(?)	[11]1 to 7	2	--	--	--	852, 1073
Garden Valley fault (GRD)	Quat.	--	--	--	--	--	25, 1032

Table 15. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y–)
			Vertical	Lateral	Vertical	Lateral	
General Thomas Hills fault (GTH)	Quat.	--	--	--	--	--	238, 853
Golden Gate faults (GG)	Quat.	Quat./Tert.	--	--	--	--	404, 1032
Hiko fault (HKO)	15 to 200; Quat.	≤15	--	--	[12]≥9	--	25, 1032
Hiko–South Pahroc faults (HSP)	Quat.	--	--	--	--	--	25, 404, 1032
Hot Creek–Reveille fault (HCR)	15 to 200; 10 to 130	≤15	--	--	[12]≤134	--	853, 1032
Lee Flat fault (LEE)	Quat.	--	--	--	--	--	356, 1148
Lida Valley faults (LV)	Quat.	--	--	--	--	--	238
Little Lake fault (LL)	Hist.	--	([13])	--	--	[14]≥30	427, 1035, 1110
Lone Mountain fault (LMT)	Hol; 10 to 130; 15 to 200	15 to 200	1	--	[15]≤5	--	407, 853, 1032, 1069, 1070
McAfee Canyon fault (MAC)	10 to 1,500; Quat.	--	--	--	--	--	238, 853
Monitor Hills East fault (MHE)	Quat.	--	--	--	--	--	813
Monitor Hills West fault (MHW)	Quat.	--	--	--	--	--	813
Monotony Valley fault (MV)	Quat.?	--	--	--	--	--	813
Montezuma Range fault (MR)	15 to 200; 10 to 1,500; Quat.	≤15	--	--	--	--	238, 853, 1032
Mud Lake–Goldfield Hills fault (MLGH)	Quat.	--	--	--	--	--	238
Owens Valley fault (OWV)	Hist.	--	[16]1±0.5; 2 to 3	[17]6±2; 7 to 11	--	--	1025, 1055
Pahranagat fault (PGT)							
[Arrowhead Mine fault (ARM)]	Quat.	--	--	--	--	--	25, 332, 395
[Buckhorn fault (BUC)]	17,000 to 34, 000	15 to 200	--	--	--	--	1032
[Maynard Lake fault (MAY)]	[18]15 to 200	[18]15 to 200	--	--	--	--	1032
Pahroc fault (PAH)	700 to 1,800	15 to 200	--	--	--	--	1032
Pahrock Valley faults (PV)	Quat.?	--	--	--	--	--	25, 404
Palmetto Mountains–Jackson Wash fault (PMJW)	L/M Pleist.; Quat.	--	--	--	--	--	10, 238

Table 15. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y–)
			Vertical	Lateral	Vertical	Lateral	
Palmetto Wash faults (PW)	10 to 1,500; <1,500; [19]E.Hol. to M.Pleist.	[20]L.Hol. and M.Hol.	--	--	--	--	238, 853, 1031
Quinn Canyon fault (QC)	700 to 1,800; Quat.; Pleist.(?)	--	--	--	--	--	25, 404, 1032
Saline Valley faults (SAL)							
[Fault along the front of the Inyo Mountains (WF)]	Hol.	--	--	--	--	--	1148
[Fault along the eastern side of Saline Valley (ES)]	Hol. or Pleist.; [21]0.17 to 27	--	--	--	≥12	--	356, 1148
[Fault in central Saline Valley (CEN)]	Hol.	--	--	--	--	--	222
Seaman Pass fault (SPS)	[22]15 to 1,800; Quat.	--	--	--	--	--	404, 1032
Sheep Basin fault (SB)	10 to 30; 15 to 1,800; ([23])	--	--	--	--	--	852, 918, 1032
Sheep–East Desert Ranges fault (SEDR)	10 to 1,500; <1,500	--	--	--	--	--	852
Sheep Range fault (SHR)	15 to 200; ≤30	≤15	--	--	--	--	852, 1032
Sierra Nevada fault (SNV)	Hol.; Lt.Pleist.; <700	Lt.Pleist.	--	--	--	--	425, 1020, 1054
Silver Peak Range faults (SIL)							
[Northeastern fault]	Quat.	--	--	--	--	--	238
[Southwestern fault]	Quat.	--	--	--	--	--	238
Six–Mile Flat fault (SMF)	15 to 200	≤15	--	--	--	--	1032
Southeast Coal Valley fault (SCV)	15 to 200	≤15	--	--	--	--	1032
Southern Death Valley fault (SDV)	[24]8 to 15.5; Hol.				[25]100	[26]200; <500	429, 602, 603, 955, 1020
State Line fault (SL)	[27]M.Pleist.(?); Quat.; ([28])	Quat.; ([29])	--	--	--	--	742, 893, 1020, 1105
Stonewall Flat fault (SWF)	≤30; 10 to 1,500; Quat.	--	--	--	--	--	238, 853
Sylvania Mountains fault (SYL)	Quat.	--	--	--	--	--	238
Tem Piute fault (TEM)	Quat.	15 to 200	--	--	--	--	1032

Table 15. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Age of youngest unit/surface displaced (10^3 yr)	Age of oldest unit/surface undisplaced (10^3 yr)	Displacement in youngest event (m)		Late Quaternary displacement (m)		References (Y–)
			Vertical	Lateral	Vertical	Lateral	
Tule Canyon fault (TLC)	10 to 1,500; Quat.	--	--	--	--	--	238, 853
Weepah Hills fault (WH)	Quat.	--	--	--	--	--	238
West Railroad fault (WR)	[30]10 to 130; 15 to 200; Quat.	≤15	--	--	[31]≥10	--	813, 853, 1032
Wilson Canyon fault (WIL)	[32]Hol.; Pleist.; Quat.	--	--	--	--	--	413, 415, 1020, 1110

[1]This is the apparent vertical displacement for the southern segment of Y-1110 (pls. 2 and 3). Displacement is for alluvium containing clasts of obsidian that is correlated with rhyolitic domes dated at 90 ka±25 ka and 88 ka±38 ka (K-Ar; Y-1110, p. 31, 74).

[2]A portion of the east-central fault and portions of the two western faults included in BDG are shown by Y-25 as faulted contacts between pre-Tertiary or Tertiary rocks and Holocene and Pleistocene alluvium.

[3]CM ruptured in an earthquake (M7.2) on December 20, 1932.

[4]In Monte Cristo and Stewart valleys, right-lateral displacements in 1932 were up to 1 to 2 m; vertical displacements were ≤0.5 m (Y-13; Y-170; Y-794; Y-1069). Y-17 reported as much as 0.6 m of vertical displacement at one locality. Y-795 noted 15 to 30 cm of vertical displacement and about 1 to 2 m of right-lateral displacement from the 1932 earthquake as interpreted from a trench in Monte Cristo Valley. Y-13 inferred that the ratio of vertical to horizontal displacement in 1932 was at least 1:3. Rupture in 1932 was primarily along a southern section of the fault between northwestern Monte Cristo Valley and the southern edge of Kibby Flat (Y-170).

[5]This is the displacement inferred by Y-795 since 730 ka from trench exposures in Monte Cristo Valley. The lateral displacement is based on a ratio of vertical to horizontal displacement of 1 to 7.

[6]This is the range of heights of scarps on surfaces of unspecified age (Y-1033, p. 244-245). Slope angles of these scarps range between 21° and 39° (Y-1033).

[7]Using the elevation differences of Bishop ash (740 ka), Y-1033 (p. 247) estimated a minimum vertical displacement of 180 m and Y-651 (p. 40) estimated a minimum apparent vertical displacement of 201 m.

[8]Late Holocene scarps are along the westernmost fault of EPK (Y-635).

[9]This is the minimum vertical surface displacement across a scarp on late Holocene alluvium (Y-635). Scarp is on the westernmost fault of EPK.

[10]This is the minimum vertical surface displacement across scarps on early Holocene and late Pleistocene alluvium. Scarps are along the westernmost fault of EPK (Y-635).

[11]Y-1073 (p. 49, 101) stated that their best guess for the age of the youngest rupture on FM is late Quaternary (<130 ka), but that this event could be as young as early Holocene. Scarps are preserved on surfaces with estimated ages of 30 ka to >500 ka(?). The only deposits that overlie the fault could be as young as late to middle Holocene (1 ka to 7 ka; Y-1073, appen. 2).

[12]This is the maximum scarp height reported. No age was specified (Y-1032).

[13]Ground cracks up to 4 mm in width were reported from a 1982 (M 5.2) earthquake (Y-1035).

[14]Y-1110 (p. 10, 27) reported that young (not dated but probably Holocene) alluvium and landslide debris are displaced right laterally 30 m at the northern end of LL where the fault merges with the Sierra Nevada fault.

[15]Y-1069 (p. 388) and Y-1070 (p. 406) both reported that middle and late Pleistocene surfaces are displaced up to 5 m.

[16]The first entry is the average vertical component of displacement in the 1872 earthquake. Y-1025 (p. 763, 766) reported an additional dip-slip component of 1 to 2 m on the Lone Pine fault, a secondary trace of OWV. Average net oblique displacement was 6.1±2.1 m with a maximum net oblique displacement of 11 m (Y-1055).

[17]The first entry is the average right-lateral component of displacement in the 1872 earthquake. Maximum displacement was about 10 m at Lone Pine (Y-1055). Including the horizontal component of slip on the Lone Pine fault (a secondary trace of OWV) in 1872, Y-1025 (p. 766) concluded that the maximum horizontal component of slip in 1872 was 7 to 11 m.

[18]Data in columns 2 and 3 are from different localities along the fault.

[19]The map by Y-1031 shows that faults that are possibly part of PW (the traces that are in Fish Lake Valley and that are shown as PW? on plate 1 of this compilation) displace alluvial-fan deposits of early Holocene to late-middle Pleistocene age.

[20]The map by Y-1031 shows that faults that are possibly part of PW (the traces that are in Fish Lake Valley and that are shown as PW? on plate 1 of this compilation) are concealed by late and middle Holocene alluvium.

[21]This is the age range for the youngest event on ES estimated by Y-1148 (p. 63-64) on the basis of a comparison of the characteristics of the scarps along ES with those of scarps studied by Y-1118, the lack of varnish on scarp faces, the presence of scarps on all but the most-recent surfaces, and the disruption of drainages by the scarps.

[22]This is the probable age of the youngest event as estimated by Y-1032 (pl. 9).

[23]Y-918 (p. 5-7) concluded that scarps "preserved between canyons appear remarkably fresh" given the unconsolidated character of the alluvial-fan deposits. He (Y-918, p. 7) suggested that displacement probably occurred not "more than a few hundred years ago."

[24]Y-602 (p. 127) reported that an eastern branch of SDV in the northern Avawatz Mountains cuts early Holocene to late Pleistocene (8 ka to 15.5 ka) alluvial-fan deposits, so that displacement could be as young as 8 ka, although Y-602 (p. 130) speculated that most of the displacement in this area occurred between 1 Ma and 2 Ma. Along the eastern side of the Avawatz Mountains, bedrock is faulted over late Pleistocene or early Holocene (8 ka to 15.5 ka) alluvial-fan deposits (Y-955, p. 6). Y-1020 portrayed displacement on some traces of SDV as Holocene (≤10 ka). Y-429 (p. 10, fig 3f) reported that the expression of SDV along the northeastern side of the Noble Hills suggests some Holocene displacement.

[25]Y-603 (p. 26) reported a maximum vertical displacement of about 100 m for their eastern subzone of SDV in southern Death Valley since 700 ka to 900 ka.

[26]Y-603 (p. 30, 99) estimated about 200 m of right-lateral displacement of Cinder Hill in southern Death Valley since 700 ka to 900 ka. Y-955 (p. 9-10) estimated that late Pleistocene-early Holocene (8 ka to 15.5 ka) alluvial-fan deposits in the northern Avawatz Mountains have a cumulative lateral displacement of <500 m on western traces of SDV.

[27]Y-742 (p. 18) concluded that normal faults bounding Ivanpah Valley are younger than basalt flows that overlie an upland surface. He inferred that the upland was eroded and that the basalt flows were extruded during middle Pleistocene (Y-742, p. 18).

Table 15. Estimated ages of displaced and undisplaced deposits and amounts of youngest displacement for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

[28]Y-893 (p. 103) suggested that displacement along SL possibly coincided with downwarping of Mesquite Valley, which he thought had occurred recently.

[29]Y-1105 (p. 8689) concluded that the lack of obvious topographic expression of a range-bounding fault in Mesquite Valley (an inferred extension of SL) "suggests that most of the slip probably occurred before Holocene or even late Quaternary time."

[30]The youngest fault scarps along WR that are shown by Y-853 are on depositional or erosional surfaces of late Pleistocene age (10 ka to 130 ka). Y-1032 (tables 3 and A2) noted that the youngest unit displaced along WR is alluvial-fan deposits with an estimated age of 15 ka to probably about 200 ka. WR is shown by Y-813 as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits.

[31]Y-1032 (table A2, p. A19) noted a maximum scarp height of 10 m on surfaces of unspecified age.

[32]Y-413 showed the western end of WIL in the Coso Basin as displacing Holocene alluvium. WIL is noted by Y-415 (p. 191) to cut Pleistocene volcanic rocks. Y-1020 portrayed the entire length of WIL as having Quaternary displacement. The eastern portion of WIL is not exposed at the ground surface but is reported by Y-415 (p. 191) to affect Quaternary sediments at depth as inferred from geophysical data. Y-1110 (p. 79) concluded that WIL has not been active during the Quaternary.

Table 16. Slip rates (mm/yr) for known and suspected Quaternary faults greater than 100 km of Yucca Mountain

[Detailed data are on description sheets in appendix 2. Rates in italics are for apparent lateral slip; rates in vertical type are for apparent vertical slip. Numbers in parentheses indicate the time interval for which the rate has been estimated. Abbreviation Lt.Pleist. is Latest Pleistocene. The pre–Quaternary rates are based on displacement of units that are older than 1.6 Ma, but displacement may have continued into the Quaternary. References are listed on Tables 14, 15, and 18 and on data sheets in appendix 2. Queried entries indicate uncertainty in information. Entries separated by a semicolon (;) indicate different interpretations by different authors; leaders (– –), no information was noted during the literature review]

Fault or faults	Holocene			Pleistocene		Late		Pre-Quaternary	
	Late	Middle	Early	Late	Middle	Quaternary	Quaternary		Interval
[Segment or individual fault]	0-4 ka	4-8 ka	8-10 ka	10-130 ka	130-790 ka	<130 ka	<1.6 Ma	Rate	(10^6 yr)
Airport Lake fault (AIR)	----------- [1]0.03 to 0.07	-----------	----------- (<50 to 126) ka)		– –	– –	[2]*0.1 to 0.3*	– –	– –
Ash Hill fault (AH)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Badger Wash faults (BDG)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Cedar Mountain fault (CM)	----------- *0.1*	-----------	-----------	[3]*0.05*	[4]*>0.03*	– –	– –	– –	– –
Central Reveille fault (CR)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Clayton–Montezuma Valley fault (CLMV)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Clayton Ridge–Paymaster Ridge fault (CRPR)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Clayton Valley fault (CV)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Deep Springs fault (DS)	– –	– –	– –	– –	– –	– –	[5]≥0.24; ≥0.3	[6]≥(0.06 to 0.07); ≥(0.13 to 0.16)	<(10 to 12)
East Magruder Mountain fault (EMM)	– –	– –	– –	– –	– –	– –	– –	– –	– –
East Reveille fault (ERV)	– –	– –	– –	– –	– –	– –	– –	– –	– –
East Stone Cabin fault (ESC)	– –	– –	– –	– –	– –	– –	– –	– –	–
Emigrant Peak faults (EPK)	[7]<(0.5 to 1)	– –	– –	– –	– –	– –	[8]≥0.16; [9]≥0.2	0.15	<5.9
Emigrant Valley East fault (EURE)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Emigrant Valley West fault (EURW)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Fish Lake Valley fault (FLV)	----------- [10]*0.4 to 0.6*	-----------	----------- (<5 to 8 ka)	– –	– –	– –	[11]0.3 to 0.7	– –	– –
	----------- [10]0.1 to 0.3	-----------	----------- (<5 to 8 ka)	– –	– –	– –	– –	[12]0.05 to 0.2	0.74 to 10.8
	----------- [13]*0.6 to 0.8*	-----------	-----------	-----------	----------- (<150 ka)	– –	– –	[14]0.3	<1
	----------- [15]0.8 to 1.6	-----------	-----------	-----------	----------- (<150 ka)	– –	– –	[16]0.15 to 0.25	<3
	– –	– –	– –	– –	– –	– –	– –	[17]0.06 to 0.07	<(10 to 12)
	– –	– –	– –	– –	– –	– –	– –	[18]*4 to 6*	<(8.2 to 11.9)
	– –	– –	– –	– –	– –	– –	– –	[19]*0.3*	<3.5, <160
Freiburg fault (FR)	– –	– –	– –	– –	– –	– –	– –	– –	– –

Table 16. Slip rates (mm/yr) for known and suspected Quaternary faults greater than 100 km of Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Holocene Late 0-4 ka	Holocene Middle 4-8 ka	Holocene Early 8-10 ka	Pleistocene Late 10-130 ka	Pleistocene Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma	Pre-Quaternary Rate	Pre-Quaternary Interval (10^6 yr)
Frenchman Mountain fault (FM)	--	--	--	--	--	--	--	--	--
Garden Valley fault (GRD)	--	--	--	--	--	--	--	--	--
General Thomas Hills fault (GTH)	--	--	--	--	--	--	--	--	--
Golden Gate faults (GG)	--	--	--	--	--	--	--	--	--
Hiko fault (HKO)	--	--	--	--	--	--	--	--	--
Hiko–South Pahroc faults (HSP)	--	--	--	--	--	--	--	--	--
Hot Creek–Reveille fault (HCR)	--	--	--	--	--	--	--	--	--
Lee Flat fault (LEE)	--	--	--	--	--	--	--	--	--
Lida Valley faults (LV)	--	--	--	--	--	--	--	--	--
Little Lake fault (LL)	-------	*3* -------	------- (≤10 ka)			[20]*0.6 to 1.8;* *≥1; ≤1*	--	--	--
	-------	-------	*1.1 to 4.9* -------	-------	------- (<151 to 229) ka)				
Lone Mountain fault (LMT)	--	--	--	--	--	--	--	--	--
McAfee Canyon fault (MAC)	--	--	--	--	--	--	--	--	--
Monitor Hills East fault (MHE)	--	--	--	--	--	--	--	--	--
Monitor Hills West fault (MHW)	--	--	--	--	--	--	--	--	--
Monotony Valley fault (MV)	--	--	--	--	--	--	--	--	--
Montezuma Range fault (MR)	--	--	--	--	--	--	--	--	--
Mud Lake–Goldfield Hills fault (MLGH)	--	--	--	--	--	--	--	--	--
Owens Valley fault (OWV)	-------	[21]*3 to 7* -------				[22]*3*	--	--	--
	-------	[23]*2±1* -------	------- (≤10 ka)			--	--	--	--
	-------	[24]*0.7 to 2.2* -------	------- (≤10 ka)			--	--	--	--
	-------	[25]0.4 to 1.3 -------	-------	------- (<Lt.Pleist.)		--	--	--	--
	-------	-------	[26]*1.5±1* -------	-------	------- (<300 ka)	--	--	--	--
Pahranagat fault (PGT)									
[Arrowhead Mine fault (ARM)]	--	--	--	--	--	--	--	--	--
[Buckhorn fault (BUC)]	--	--	--	--	--	--	--	--	--
[Maynard Lake fault (MAY)]	--	--	--	--	--	--	--	--	--
Pahroc fault (PAH)	--	--	--	--	--	--	--	--	--
Pahrock Valley faults (PV)	--	--	--	--	--	--	--	--	--
Palmetto Mountains–Jackson Wash fault (PMJW)	--	--	--	--	--	--	--	--	--

Table 16. Slip rates (mm/yr) for known and suspected Quaternary faults greater than 100 km of Yucca Mountain — Continued

Fault or faults	Holocene			Pleistocene		Late		Pre-Quaternary	
	Late	Middle	Early	Late	Middle	Quaternary	Quaternary		Interval
[Segment or individual fault]	0-4 ka	4-8 ka	8-10 ka	10-130 ka	130-790 ka	<130 ka	<1.6 Ma	Rate	(10^6 yr)
Palmetto Wash faults (PW)	--	--	--	--	--	--	--	--	--
Quinn Canyon fault (QC)	--	--	--	--	--	--	--	--	--
Saline Valley faults (SAL)									
[Fault along the front of the Inyo Mountains (WF)]	--	--	--	--	--	--	--	--	--
[Fault along the eastern side of Saline Valley (ES)]	--	--	--	--	--	--	--	--	--
[Fault in central Saline Valley (CEN)]	--	--	--	--	--	--	--	--	--
Seaman Pass fault (SPS)	--	--	--	--	--	--	--	--	--
Sheep Basin fault (SB)	--	--	--	--	--	--	--	--	--
Sheep–East Desert Ranges fault (SEDR)	--	--	--	--	--	--	--	--	--
Sheep Range fault (SHR)	--	--	--	--	--	--	--	--	--
Sierra Nevada fault (SNV)		[27]0.1 to 0.8 (≤10 ka)		--	--	--	--	--	--
Silver Peak Range faults (SIL)									
[Northwestern fault]	--	--	--	--	--	--	--	--	--
[Southeastern fault]	--	--	--	--	--	--	--	--	--
Six–Mile Flat fault (SMF)	--	--	--	--	--	--	--	--	--
Southeast Coal Valley fault (SCV)	--	--	--	--	--	--	--	--	--
Southern Death Valley fault (SDV)		[28]*≤(32 to 63)* (<18 to 15 ka)				--	--	[30]*2 to 3*	1 to 10
			[29]*0.3* (<700 ka)						
State Line fault (SL)	--	--	--	--	--	--	--	--	--
Stonewall Flat fault (SWF)	--	--	--	--	--	--	--	--	--
Sylvania Mountains faults (SYL)	--	--	--	--	--	--	--	--	--
Tem Piute fault (TEM)	--	--	--	--	--	--	--	--	--
Tule Canyon fault (TLC)	--	--	--	--	--	--	--	--	--
Weepah Hills fault (WH)	--	--	--	--	--	--	--	--	--
West Railroad fault (WR)	--	--	--	--	--	--	--	--	--
Wilson Canyon fault (WIL)	--	--	--	--	--	--	--	--	--

[1]This is the apparent vertical slip rate for the Southern segment of Y-1110 (pls. 2 and 3) estimated using the displacement of alluvium with a maximum age of 50 ka to 126 ka (Y-1110, p. 31)

[2]This rate is for the Southern segment of Y-1110 (pls. 2 and 3) and is based on the apparent right-lateral displacement of 125 m of a basalt flow assumed by Y-1110 (p. 74, pl. 2) to be >400 ka and <1 Ma

Table 16. Slip rates (mm/yr) for known and suspected Quaternary faults greater than 100 km of Yucca Mountain — Continued

[3]This is the rate since 135 ka and was estimated assuming 7 m of right-lateral displacement (Y-795, p. 1-35).

[4]This is the rate since 730 ka and was estimated assuming >21 m of right-lateral displacement (Y-795, p. 1-35).

[5]These are minimum apparent vertical slip rates since 740 ka. The rates were estimated by Y-651 (p. 37, 40) and Y-1033 (p. 254) on the basis of the inferred displacements of Bishop ash. These displacements were inferred from ≥180 m, which is the uplift of fluvial gravels interbedded with pumice fragments tentatively correlated with the Bishop ash, and 201 m, which is the elevation difference across the fault between uplifted fluvial gravel that contains Bishop ash and the floor of Deep Springs Valley.

[6]These are minimum apparent vertical slip rates estimated by Y-651 (p. 37, 40) for the period since 10 Ma to 12 Ma using the elevation of a basalt of this age and its inferred elevation beneath Deep Springs Valley (yields a rate of 0.06 to 0.07 mm/yr) and using the elevation of bedrock and its inferred elevation beneath Deep Springs Valley and assuming that all displacement has occurred since 10 Ma to 12 Ma (yields a rate of 0.13 to 0.16 mm/yr).

[7]This is a maximum apparent vertical slip rate for the westernmost fault of EPK during the late Holocene. The rate was estimated by Y-330 (p. 223) using 1 to 2 m of displacement in deposits that date at about 2 ka.

[8]This is the minimum vertical slip rate since about 740 ka (Bishop ash) along the westernmost fault of EPK (Y-635).

[9]This is the minimum vertical slip rate since about 1 Ma for the westernmost fault of EPK (Y-651). It is also the apparent vertical slip rate since about 2 Ma for the three western faults of EPK (Y-651).

[10]This rate is based on data from only a single trace of FLV at Indian Creek in northern Fish Lake Valley (Y-647; Y-665).

[11]This is the range in vertical slip rates estimated at several places along FLV for deposits containing Bishop ash (0.74 Ma; Y-651).

[12]This is a post-Miocene apparent vertical slip rate (Y-651, p. 26, 42).

[13]This rate is based on data from only a single trace of FLV at Leidy Creek and Indian Creek in northern Fish Lake Valley (Y-647; Y-665).

[14]This is a minimum vertical slip rate estimated for FLV at Perry Aiken Creek in central Fish Lake Valley (Y-651, p. 39).

[15]This rate was estimated across the entire FLV at Indian Creek in northern Fish Lake Valley (Y-647). The apparent vertical slip rate at this same locality across a single trace of FLV is about 0.3 mm/yr (Y-647; Y-665).

[16]This is the range of vertical slip rates estimated for FLV near Davis Mountain in southern Fish Lake Valley (Y-651, p. 40).

[17]This vertical slip rate is based on displacement of a 10-Ma-to12-Ma basalt near Chocolate Mountain in southern Fish Lake Valley (Y-651, p. 38).

[18]In the Horse Thief Hills–Willow Wash area just south of Fish Lake Valley, volcanic rocks that underlie and that are interbedded with fault-derived sediments yield ages of 8.2 Ma and 11.9 Ma (Y-651, p. 36). If the 50 m of right-lateral displacement that was noted by Y-475 (p. 509-510, 512) is assumed, then the post-Miocene right-lateral slip rate is 4 to 6 mm/yr for FLV in southern Fish Lake Valley (Y-651, p. 36).

[19]Right-lateral slip rates of 0.26 mm/yr since about 3.5 Ma and 0.3 mm/yr since about 160 Ma were estimated by Y-475 (p. 510, 512) for FLV in the Cucomungo Canyon area between Fish Lake Valley and Death Valley. Y-651 (p. 27) speculated that the rate in the older rocks is a minimum value because displacement on FLV probably did not begin until middle Miocene (Y-26, *cited by* Y-651, p. 23; Y-706, p. 2).

[20]Y-1052 (p. [2-3]) suggested a lateral slip rate of 0.6 to 1.8 mm/yr for LL on the basis of a reinterpretation of 250 m of apparent lateral displacement of a channel wall of the Owens River (Y-1110, p. 10). The age of displacement is bracketed by a basalt dated at about 400 ka into which the channel is cut and an intra-canyon basalt flow dated at about 140 ka. Y-374 (p. 225) suggested that the lateral slip rate on LL may be "as high as 1 mm/yr or greater based on most-recent evaluation of fault morphology." Y-1052 (p. [5], [8]) calculated a maximum lateral slip rate of 1 mm/yr of LL on the basis of 400 m of displacement of a basalt with an age of 400 ka.

[21]Y-1025 (p. 766, *citing* Y-1362 and Y-1363) reported an average historical right-lateral slip rate of about 3 to 7 mm/yr, which was measured geodetically across Owens Valley

[22]Y-427 (p. 6) reported a late Quaternary slip rate of about 3 mm/yr.

[23]At several sites, data of Y-1055 yielded an average Holocene net slip rate of 2±1 mm/yr.

[24]Y-1025 (p. 766) calculated an average Holocene horizontal slip rate at Lone Pine of 0.7 to 2.2 mm/yr using the total slip component (7 to 11 m) during the 1872 earthquake and an average recurrence interval for earthquakes similar to the one in 1872.

[25]Using an estimate of the average total slip per event (4.3 to 6.3 m) and a range of recurrence intervals (5,000 to 10,500 yr), Y-1025 (p. 765-766) calculated an average late Quaternary (oblique) slip rate of 0.4 to 1.3 mm/yr for the Lone Pine fault (one of several traces of OWV).

[26]Y-1055 reported an average net slip rate of 1.5±1 mm/yr at one site on OWV since about 300 ka.

[27]Y-1055 (p. 7) concluded that faults along the Sierra Nevada front have experienced a vertical slip rate of 0.1 to 0.8 mm/yr during the Holocene. These faults may be a part of SNV of this compilation

[28]Using observations by Y-955 (p. 9-10, table 1) that early Holocene to late Pleistocene (8 ka to 15.5 ka) alluvial-fan deposits are displaced laterally <500 m, a maximum apparent lateral slip rate of 32 to 63 mm/yr can be estimated for SDV in the Noble Hills.

[29]Y-603 (p. 30) inferred an average apparent right-lateral slip rate on his eastern subzone of SDV of about 0.3 mm/yr, which is based on his estimate of a maximum lateral displacement of 200 m at Cinder Hill, which has been dated at about 700 ka.

[30]Y-603 (p. 29) concluded that the average apparent right-lateral slip rate on his western subzone of SDV adjacent to the Owlshead Mountains is about 2 to 3 mm/yr, which is based on 20 to 35 km of displacement that he thought occurred between about 10 Ma and 1 Ma.

Table 17. Estimated number of events/time interval for known and suspected Quaternary faults greater than 100 km from Yucca Mountain

[Detailed data are on description sheets in appendix 2. Numbers with age units in parentheses indicate the estimated age of the faulting event(s). References are listed on Tables 14, 15, and 18 and in appendix 2. Leaders (––), no information was noted during the literature review. Number of events is shown in the last two columns only if more specific information is not available]

	Holocene			Pleistocene		Late	
Fault or faults	Late	Middle	Early	Late	Middle	Quaternary	Quaternary
[Segment or individual fault]	0-4 ka	4-8 ka	8-10 ka	10-130 ka	130-790 ka	<130 ka	<1.6 Ma
Airport Lake fault (AIR)	-------	≥1	------- (≤10 ka)	––	––	––	––
Ash Hill fault (AH)	-------	≥1	------- (≤10 ka)	––	––	––	––
Badger Wash faults (BDG)	––	––	––	––	–– ––	––	≥1?
Cedar Mountain fault (CM)	1	-------	[1]5 to 6?	-------	------- (?)	––	––
Central Reveille fault (CR)				(≤15 ka) ---- ≥1	---- (<200 ka)	––	––
Clayton–Montezuma Valley fault (CLMV)	––	––	––	––	––	––	≥1
Clayton Ridge–Paymaster Ridge fault (CRPR)	––	––	––	––	(>200 ka) -- [2]≥1 -- (<1.8 Ma)	––	––
Clayton Valley fault (CV)	––	––	––	(>10 ka) -------	≥1 ------- (<1.5 Ma)	––	––
Deep Springs fault (DS)	(>1.5 ka) -------	≥1 ------- (<6 ka)	––	––	––	––	––
East Magruder Mountain fault (EMM)	––	––	––	––	––	––	≥1?
East Reveille fault (ERV)	––	––	––	(0 to 15 ka) ---- [2]≥1	------- (<700 to 1,800) ka)	––	––
East Stone Cabin fault (ESC)	––	––	––	(0 to 15 ka) ---- [2]≥1	---- (<130 ka or <200 ka)	––	––
Emigrant Peak faults (EPK)	---- [3]≥1 ---- (≤(1 to 1.4) ka)	––	––	––	––	––	––
Emigrant Valley East fault (EURE)	-------	≥1	-------	------- (<(10 to 130) ka)	––	––	––
Emigrant Valley West fault (EURW)	––	––	––	(>(10 to 15) ka) -------	≥1 ------- (<1.5 Ma)	––	––
Fish Lake Valley fault (FLV)	--[4]3-- (≤2.5 ka)	––	––	––	––	––	––
Freiburg fault (FR)	––	––	––	––	––	––	≥1
Frenchman Mountain fault (FM)	(>(1 to 7) ka) -------	-------	≥1	-------	------- (<(30 to 500) ka)	––	––
Garden Valley fault (GRD)	––	––	––	––	––	––	≥1
General Thomas Hills fault (GTH)	––	––	––	––	––	––	≥1
Golden Gate faults (GG)	––	––	––	––	––	––	≥1
Hiko fault (HKO)	––	(>≤15 ka)? -------	[2]≥1	-------	------- (<(15 to 200) ka)	––	––
Hiko–South Pahroc faults (HSP)	––	––	––	––	––	––	≥1
Hot Creek–Reveille fault (HCR)	––	(>(≤15 ka))? -------	[2]≥1	-------	------- (<(15 to 200) ka)	––	––

Table 17. Estimated number of events/time interval for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

Fault or faults	Holocene			Pleistocene		Late	
	Late	Middle	Early	Late	Middle	Quaternary	Quaternary
[Segment or individual fault]	0-4 ka	4-8 ka	8-10 ka	10-130 ka	130-790 ka	<130 ka	<1.6 Ma
Lee Flat fault (LEE)	--	--	--	--	--	--	≥1
Lida Valley faults (LV)	--	--	--	--	--	--	≥1
Little Lake fault (LL)	-- ≥4 -- (<2.5 ka)	--	--	--	--	--	--
Lone Mountain fault (LMT)	----------	≥1	---------- (≤10 ka)	--	--	--	--
McAfee Canyon fault (MAC)	----------	----------	≥1	----------	---------- (<(10 to 1,500) ka)	--	--
Monitor Hills East fault (MHE)	--	--	--	--	--	--	≥1
Monitor Hills West fault (MHW)	--	--	--	--	--	--	≥1
Monotony Valley fault (MV)	--	--	--	--	--	--	≥1?
Montezuma Range fault (MR)	--	(>(≤15 ka))?----------	----------	[2]≥1	---------- (<(15 to 200) ka)	--	--
Mud Lake–Goldfield Hills fault (MLGH)	--	--	--	--	--	--	≥1
Owens Valley fault (OWV)	≥1	----------	≥1	---------- (<(10 to 21) ka)		--	--
Pahranagat fault (PGT)							
[Arrowhead Mine fault (ARM)]	--	--	--	--	--	--	≥1
[Buckhorn fault (BUC)]	--	--	--	--	--	--	≥1?
Maynard Lake fault (MAY)]	----------	----------	≥1	----------	---------- (<(15 to 200) ka)	--	--
Pahroc fault (PAH)	--	--	--	(15 to 200 ka)----------	[2]≥1 ---------- (<(700 to 1,800) ka)	--	--
Pahrock Valley faults (PV)	--	--	--	--	--	--	≥1?
Palmetto Mountains–Jackson Wash fault (PMJW)	----------	----------	>1	----------		--	--
Palmetto Wash faults (PW)	--	--	--	--	--	--	≥1
Quinn Canyon fault (QC)	--	--	--	(>15 ka)----------	[2]≥1 ---------- (<1.8 Ma)	--	--
Saline Valley faults (SAL)	--	--	--	--	--	--	--
[Fault along the front of the Inyo Mountains (WF)]	----------	≥1	---------- (≤10 ka)	--	--	--	--
[Fault along the eastern side of Saline Valley (ES)]	----------	≤3	----------	---------- (≤27 ka)	--	--	--
[Fault in central Saline Valley (CEN)]	----------	≥1	---------- (≤10 ka)	--	--	--	--
Seaman Pass fault (SPS)	--	--	--	(>15 ka)----------	[2]≥1 ---------- (<1.8 Ma)	--	--
Sheep Basin fault (SB)	----------	≥1	----------	---------- (<(10 to 30) ka)	--	--	--

Table 17. Estimated number of events/time interval for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Holocene Late 0-4 ka	Holocene Middle 4-8 ka	Holocene Early 8-10 ka	Pleistocene Late 10-130 ka	Pleistocene Middle 130-790 ka	Late Quaternary <130 ka	Quaternary <1.6 Ma
Sheep–East Desert Ranges fault (SEDR)	---------- ≥1 ---------- (<(10 to 1,500) ka)					--	--
Sheep Range fault (SHR)	(≤15 ka) ---------- ≥1 ---------- (<(15 to 200) ka; ≤30 ka)					--	--
Sierra Nevada fault (SNV)	--	--	--	--	--	≥1	--
Silver Peak Range faults (SIL)							
[Northwestern fault]	--	--	--	--	--	--	≥1
[Southeastern fault]	--	--	--	--	--	--	≥1
Six–Mile Flat fault (SMF)	(≤15 ka) ---------- [2]≥1 ---------- (<(15 to 200) ka)					--	--
Southeast Coal Valley fault (SCV)	(≤15 ka) ---------- [3]≥1 ---------- (<(15 to 200) ka)					--	--
Southern Death Valley fault (SDV)	---------- ≥1 ---------- (<(8 to 15) ka)				--	--	--
State Line fault (SL)	---------- ≥1? ----------				--	--	--
Stonewall Flat fault (SWF)	---------- ≥1 ---------- (≤30 ka)				--	--	--
Sylvania Mountains fault (SYL)	--	--	--	--	--	--	≥1
Tem Piute fault (TEM)	--	--	--	((15 to 200) ka) ---- ≥1 ---- (<1.6 Ma)		--	--
Tule Canyon fault (TLC)	---------- ≥1 ---------- (<(10 to 1,500) ka)					--	--
Weepah Hills fault (WH)	--	--	--	--	--	--	≥1
West Railroad fault (WR)	(≤15 ka) ---------- [1]≥1 ---------- ((15 to 200) ka)					--	--
Wilson Canyon fault (WIL)	--	--	--	--	--	--	≥1

[1]On the basis of stratigraphic and geomorphic relationships, Y-170 (p. 73-75) inferred at least three, and probably five or six, pre-1932 surface ruptures that occurred during the latest Pleistocene and Holocene on CM between northwestern Monte Cristo Valley and the southern edge of Kibby Flat.

[2]This is the best guess of the age of the youngest event as noted by Y-1032.

[3]This is for the westernmost fault included in EPK. The other three faults appear to be older and are portrayed by Y-635 as mostly concealed by early Holocene and late middle Pleistocene alluvium. The number of older events is not known.

[4]On the basis of interpretation of four trenches in Fish Lake Valley (two between Indian and Leidy creeks in northern Fish Lake Valley and two south of Cottonwood Creek in southern Fish Lake Valley), Y-665 (table 10, p 231-232) concluded that three ruptures had occurred since about 2.5 ka.

Table 18. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults greater than 100 km from Yucca Mountain

[Detailed data are on description sheets in appendix 2. References are listed in appendix 4. Abbreviations of trends: E, east; N, north; NE, northeast; NW, northwest; ENE, east–northeast; NNE, north–northeast; NNW, north–northwest; WNW, west-northwest. Abbreviations for displacement type: LL, left lateral; LO, left oblique; N, normal; RL, right lateral; RO, right oblique. Number of events and time period are shown only when used to estimate recurrence interval. Entries separated by a semicolon (;) indicate different interpretations by different authors; entries separated by a comma (,) indicate data for individual fault traces or for different localities along the fault or faults; leaders (– –), no information was noted during the literature review]

Fault or faults [Segment or individual fault]	Number of events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
Airport Lake fault (AIR)	– –	– –	– –	N	[1]N, RL	1035, 1052, 1110
Ash Hill fault (AH)	– –	– –	– –	NNW	RL, N?	239, 698, 1020
Badger Wash faults (BDG)	– –	– –	– –	NNW	N?	25, 404
Cedar Mountain fault (CM)	– –	– –	([2])	N.30°W., N	RL, N, RO	13, 17, 170, 794, 795, 969, 1075
Central Reveille fault (CR)	– –	– –	– –	[3]NNW, N to NNE	N	813, 853, 1032
Clayton–Montezuma Valley fault (CLMV)	– –	– –	– –	NE	– –	238, 853
Clayton Ridge–Paymaster Ridge fault (CRPR)	– –	– –	– –	NNE	N; LO	10, 238, 852
Clayton Valley fault (CV)	– –	– –	– –	NE	– –	238, 853
Deep Springs fault (DS)	– –	– –	– –	N.25°E.	[4]N	484, 853, 872, 1033
East Magruder Mountain fault (EMM)	– –	– –	– –	NE	– –	238
East Reveille fault (ERV)	– –	– –	– –	NNW	N	5, 232, 813, 853, 1032
East Stone Cabin fault (ESC)	– –	– –	– –	NE	N	813, 853, 1032
Emigrant Peak faults (EPK)	– –	– –	– –	NNE	[5]N, LL	10, 635, 651
Emigrant Valley East fault (EURE)	– –	– –	– –	NNW	N	853, 1031
Emigrant Valley West fault (EURW)	– –	– –	– –	NNE	– –	853
Fish Lake Valley fault (FLV)	3	≤2.5	[6]1.1±0.6	[7]N.35°W. to N.40°W.	RO	216, 665
Freiburg fault (FR)	– –	– –	– –	N	N	404
Frenchman Mountain fault (FM)	5 to 9	≤500	([8])	NW to NE	– –	852, 1073
Garden Valley fault (GRD)	– –	– –	– –	N	N	25
General Thomas Hills fault (GTH)	– –	– –	– –	[9]NNW; NE	– –	238, 853
Golden Gate faults (GG)	– –	– –	– –	NNE	N	25, 404, 1032
Hiko fault (HKO)	– –	– –	– –	NNW	N	25, 404, 1032
Hiko–South Pahroc faults (HSP)	– –	– –	– –	NNW	– –	25, 404
Hot Creek–Reveille fault (HCR)	– –	– –	– –	NNW	N	5, 232, 813, 853, 1032

Table 18. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

Fault or faults [Segment or individual fault]	Number of events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
Lee Flat fault (LEE)	--	--	--	NW	N	222, 356, 1148
Lida Valley faults (LV)	--	--	--	NE	--	238
Little Lake fault (LL)	[10]3	[10]<0.06	[10]0.02	NW	RL	374, 1020, 1035, 1052
Lone Mountain fault (LMT)	--	--	--	NE	[11]N, RL	238, 407, 853, 1069
McAfee Canyon fault (MAC)	--	--	--	N, NNW	--	238, 853
Monitor Hills East fault (MHE)	--	--	--	N	--	813
Monitor Hills West fault (MHW)	--	--	--	N to NNW	--	813
Monotony Valley fault (MV)	--	--	--	[12]NE, N to NNW	N	813
Montezuma Range fault (MR)	--	--	--	NE	N	10, 238, 853
Mud Lake–Goldfield Hills fault (MLGH)	--	--	--	NNW	--	238
Owens Valley fault (OWV)	3	≤10	3.3 to 5	N to NW	[13]RL, N	427, 694, 1046, 1055
	3	<(10 to 21)	5 to 10.5			
Pahranagat fault (PGT)	--	--	--	N.50°E.	LO	25, 395, 404
[Arrowhead Mine fault (ARM)]	--	--	--	N.50°E.	LO, RL	395, 404
[Buckhorn fault (BUC)]	--	--	--	N.50°E.	LO	395
[Maynard Lake fault (MAY)]	--	--	--	N.50°E.	LO; RL?	395, 404, 1032
Pahroc fault (PAH)	--	--	--	NNE to NNW	N	25, 404, 1032
Pahrock Valley faults (PV)	--	--	--	NNE	N?	25, 404
Palmetto Mountains–Jackson Wash fault (PMJW)	--	--	--	NE, N to NNE	N	238
Palmetto Wash faults (PW)	--	--	--	NNW, NW, N	N	238, 853
Quinn Canyon fault (QC)	--	--	--	NE	N	25, 404
Saline Valley faults (SAL)						
[Fault along the front of the Inyo Mountains (WF)]	--	--	--	N.40°W.	N	1148
[Fault along the eastern side of Saline Valley (ES)]	--	--	--	N	N, RL	356, 864, 1148
[Fault in central Saline Valley (CEN)]	--	--	--	NW to W	N, RL?	1148
Seaman Pass fault (SPS)	--	--	--	[14]N, NNW, NW	--	404, 1032
Sheep Basin fault (SB)	--	--	--	[15]N, NE, NNW	N	671, 852

Table 18. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults greater than 100 km from Yucca Mountain—Continued

Fault or faults [Segment or individual fault]	Number of events	Time period (10^3 yr)	Recurrence interval (10^3 yr)	Strike	Type displacement	References (Y-)
Sheep–East Desert Ranges fault (SEDR)	--	--	--	[16]NNE	--	852
Sheep Range fault (SHR)	--	--	--	N	--	852
Sierra Nevada fault (SNV)	--	--	--	NNW	N, RL	425, 1054
Silver Peak Range faults (SIL)						
[Northwestern fault]	--	--	--	NNE	--	238
[Southeastern fault]	--	--	--	NW	--	238
Six–Mile Flat fault (SMF)	--	--	--	NE	N	1032
Southeast Coal Valley fault (SCV)	--	--	--	N, NNW	N	25, 1032
Southern Death Valley fault (SDV)	--	--	--	NW; N.30°W. to N.40°W.; ([17])	RL; ([18])	216, 248, 429, 468, 472, 473, 603
State Line fault (SL)	--	--	--	NW, N.55°W.	N; RL	743, 893, 1105
Stonewall Flat fault (SWF)	--	--	--	NE	N	238, 853
Sylvania Mountains fault (SYL)	--	--	--	[19]E	N	238
Tem Piute fault (TEM)	--	--	--	ENE	[20]LL; N	25, 404
Tule Canyon fault (TLC)	--	--	--	NNE, NNW	N	238, 853
Weepah Hills fault (WH)	--	--	--	WNW	N	238
West Railroad fault (WR)	--	--	--	[21]N; NNW, NNE	--	813, 853, 1032
Wilson Canyon fault (WIL)	--	--	--	[22]NW, NNW	LL	413, 1020, 1110

[1]Right-lateral displacement is only on the Southern and Northern segments of Y-1110 (p. 17, 19-20).

[2]On the basis of the subdued character of scarps older than the 1932 rupture, Y-795 (p. 1-34) inferred a recurrence interval of possibly tens of thousands of years for surface-rupturing events.

[3]The southern part of CR strikes north-northwest; the northern part strikes north to north-northeast (Y-853; Y-1032).

[4]Y-1033 (p. 247) noted that displacement on DS appears to be entirely dip slip (normal) and that no evidence for left-lateral strike slip, which might be expected along a northeast-striking fault, has been observed.

[5]Faults in EPK are generally down to the west with dip slip (normal) displacement (Y-10; Y-635; Y-651). Y-635 noted left-lateral displacement along one section of the westernmost fault, the portion just south of South Wash that extends into the Silver Peak Range. This section strikes north-northwest.

[6]On the basis of interpretation of four trenches in Fish Lake Valley, Y-665 (table 10, p. 231-232) concluded that the recurrence interval between three ruptures since about 2.5 ka has been about 1,100±600 yr, although the recurrence interval could be as long as 3,000 yr or as short as 500 yr.

[7]This is the average strike. Strikes range between N. 22° W. and N. 55° W. (Y-216, p. 5-13).

[8]Recurrence interval is estimated to be tens to possibly hundreds of thousands of years assuming that displacement/event has been 1 to 2 m for a 9-m-high scarp on a surface with an estimated age of 500 ka (Y-1073, p. 101).

[9]The first entry is the strike of GTH on the south along Paymaster Ridge; the second entry is the strike of GTH on the north along the General Thomas Hills (Y-238; Y-853).

[10]Y-374 (p. 225) reported that earthquakes of magnitude ≥5.0 have recurred every 20 yr for the past 60 yr on LL. Earthquakes of this size occurred in 1938, 1961, and 1981 (Y-1052, p. [4]).

[11]Predominant vertical displacement on LMT was inferred by Y-1069 (p. 388) on the basis of the sinuous character and large heights of the associated scarps. In addition, Y-1069 (p. 388) reported right-lateral displacement of stream channels at two localities.

[12]The first entry is for the fault on the northern side of the highland (northern trace); the second entry is for the fault on the western side of the highland (western trace; Y-813).

[13]Displacement on OWV has been primarily right lateral, with a minor component of dip-slip (normal) displacement (Y-427; Y-1046). However, the dip-slip component may be significant locally (Y-427, p. 6).

[14]SPS has a curving trace (Y-404). Its northern part strikes north. Its central section strikes north-northwest. Its southern part strikes northwest.

[15]SB adjacent to the Sheep Range front has a curving trace (Y-671; Y-852). The northern portion strikes north-northwest. The central portion strikes north. The southern portion strikes northeast.

[16]SEDR has a general north-northeast, curving strike (Y-852). The southern end of SEDR strikes northwest. The remainder of SEDR strikes between north-northeast and north-northwest.

[17]The western subzone of SDV of Y-472 (p. 404) and Y-603 (p. 25) between the Confidence Hills and the southern Owlshead Mountains strikes between N. 15° E. and N. 30° W., their eastern subzone in this same area strikes between N. 40° W and N. 50° W.

Table 18. Recurrence interval, strike, and type displacement for known and suspected Quaternary faults greater than 100 km from Yucca Mountain — Continued

[18]Y-429 (p. 4) suggested that SDV has a minor component of vertical displacement. Y-472 (p. 407) recognized both lateral and vertical displacement on his eastern subzone of SDV between the Confidence Hills and the southern Owlshead Mountains. Displacement on his western subzone in this area has been predominantly right-lateral strike slip.

[19]SYL strikes generally east, but the trace curves slightly so that portions of the fault strike either northeast or northwest (Y-238).

[20]Displacement on TEM is shown by Y-25 as left-lateral strike slip and by Y-404 (pl. 3) as down-to-the-north dip slip.

[21]WR has a curving, but generally north strike. WR north of Fang Ridge strikes north-northwest; WR south of the ridge strikes north-northeast (Y-813; Y-853).

[22]WIL strikes generally northwest (Y-413; Y-1020). The southeastern end of WIL strikes north-northwest (Y-1020).

APPENDIX 2: DESCRIPTION SHEETS COMPILED FOR KNOWN AND SUSPECTED QUATERNARY FAULTS WITHIN ABOUT 100 KM OF YUCCA MOUNTAIN

This appendix summarizes available data about known and suspected Quaternary faults identified within about 100 km of the potential repository at Yucca Mountain. The data, which have been summarized from published and readily available literature, are organized on description sheets in a format that emphasizes the Quaternary characteristics of the faults. Data for each fault are assembled into the sections described below. An entry of "No information" indicates that no information for that section was found in the cited references. Measurements that were reported in the references in metric units are noted in these units in the appendix. Measurements that were reported in English units in the references are noted in both metric and English units in the appendix.

FAULT NAME

Names for the faults are taken from the cited references, if possible. The reference from which the name has been taken is indicated under the "References" section, although other authors may also use the name. If alternative names have been used in the literature, then these names are also indicated. If no name was noted in the references, a name was given to the fault, usually on the basis of a nearby geographic feature. The abbreviations noted after the fault name were assigned for ease in labeling of the faults on the plates and figures.

PLATE OR FIGURE

This is the number of the plate or figure in this compilation on which the fault is shown.

REFERENCES

References that show or discuss the fault are listed. The references have been assigned a number beginning with "Y–", so that each reference has a unique identifier. Full citations of the references are listed numerically in Appendix 4 and alphabetically in Appendix 5. References listed under "Not shown by . . ." are those references (primarily maps) that cover the area in which the fault is located but that do not show the fault. Some references that are noted show only a portion of the fault, either because the authors did not recognize the entire fault as portrayed in another reference or because their map or study area does not include the area of the entire fault. References that portray a fault in a significantly different manner from the way it is shown on plates 1 and 2 of this compilation are also noted in this section.

LOCATION

The location of each fault in relation to the potential repository site at Yucca Mountain was measured on topographic maps at a scale of 1:250,000. The first two numbers (separated by a /) give the location of the closest point of the fault to the site (indicated by the black circle labeled "YM" on plate 2 of this compilation) in terms of distance and compass direction using an azimuthal scale and north as 0°. The second group of numbers gives the same point in terms of approximate latitude and longitude.

A brief description of the location of the fault follows. Major physiographic features noted here and in the following sections are shown on fig. 4 or on plates 1 and 2.

Figure 4. Physiographic features in the area covered by plates 1 and 2.

USGS 7-1/2′ QUADRANGLE:

The U.S. Geological Survey topographic quadrangles that cover the area of the fault are listed alphabetically.

FAULT ORIENTATION

This is the general direction of the fault's strike (1) as recognized on plates 1 and 2 of this compilation, or (2) as noted in the references. A measured strike, dip direction, or dip amounts may also be listed if these figures were noted in the references. The width of the fault is sometimes given.

FAULT LENGTH

This is the length of the fault as reported in the listed references or as estimated from the maps in these references. Because the scales of the maps are variable, the accuracy of these measurements is also variable. The measurements should be considered approximations only. As noted elsewhere in this compilation, the lengths reported here are sometimes dependent upon how fault traces have been grouped together into an individual fault in this compilation. The lengths do not necessarily reflect rupture length. If a fault has been subdivided into segments or sections (e.g., the Ash Meadows fault, the Bare Mountain fault), then the length of each segment or section is noted. In some cases, several distinct faults have been grouped under one name for ease of discussion. In these cases, the lengths of the individual faults are given. If major sections of a fault are portrayed as concealed, the lengths of these sections, as well as that of the entire fault, are noted. If available, the lengths of associated scarps or the lengths of sections of the fault that have scarps are reported.

STYLE OF FAULTING

The type or types of displacement along the fault are given in this section. The type of displacement noted in this section may have been (1) reported directly in the references, (2) inferred from the portrayal of the fault on maps, or (3) interpreted from reported fault–scarp characteristics, stratigraphic relationships, or other geologic evidence, as indicated in this section. Occasionally, the types of displacement reported in the references appear to conflict. These differences are noted and may be the result of studies that were completed at different localities along the fault or of changes in displacement over time along the fault.

SCARP CHARACTERISTICS

Characteristics of associated fault scarps, such as height, surface displacement, and maximum scarp–slope angle, are noted if they are reported in the references.

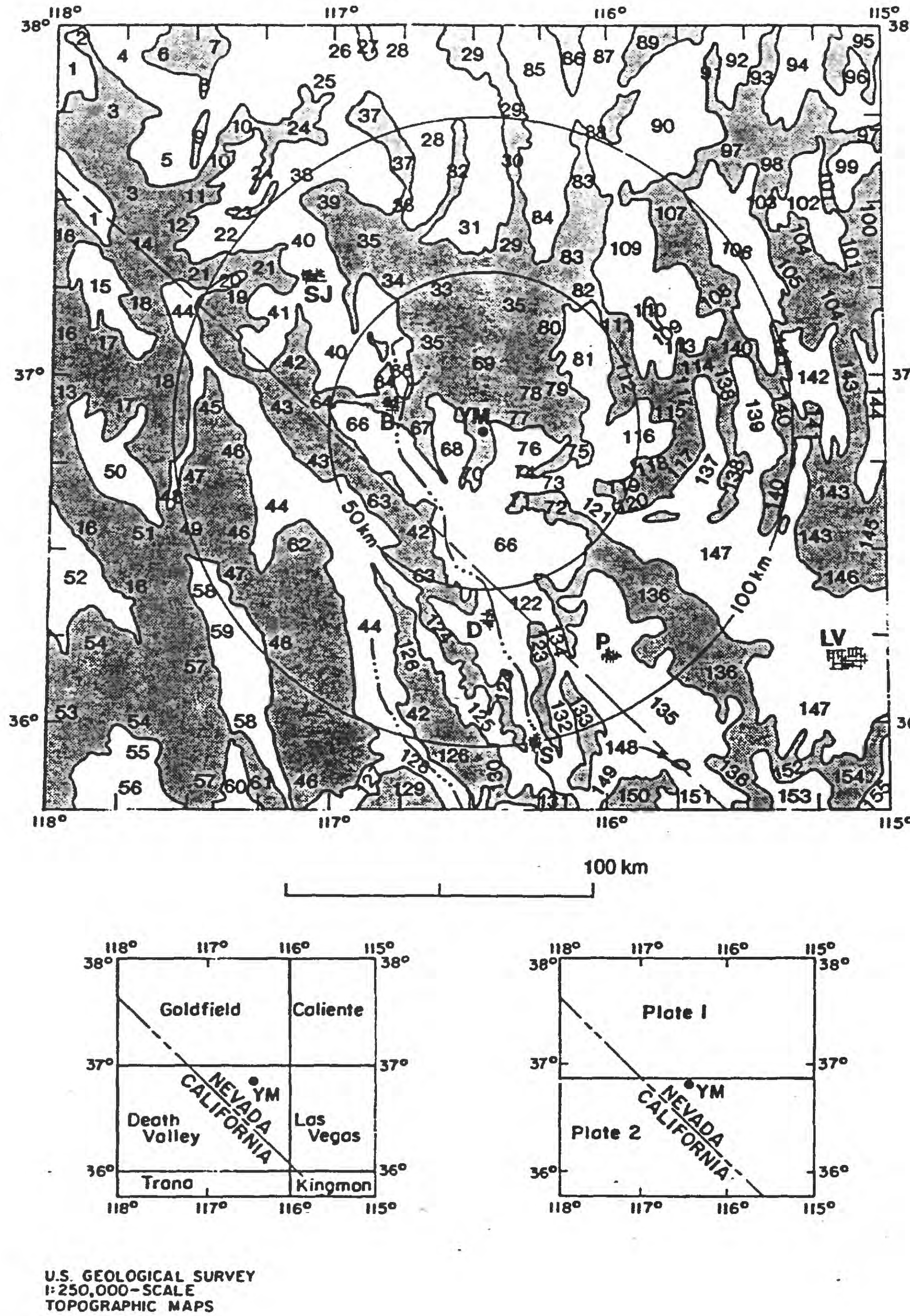

Figure 4. Physiographic features in the area covered by plates 1 and 2. Features have been taken from U.S. Geological Survey 1:250,000–scale topographic maps as shown by the inset map. Two features that have the same number indicate that the two features are too close to separate at the scale of this map.

The numbered physiographic features are listed both alphabetical and numerically on the following pages. The numbers and letters in parentheses in these two lists give the general location of the feature. The number refers to the radius circle in which the feature is located (e.g., 50 means the feature is within 50 km, 100 means the feature is between 50 and 100 km, and >100 means the feature is outside of the 100–km circle). If a feature spans more than one circle, the closest location is noted. The letters give the quadrant of the area where the feature can be found. The area was subdivided into quadrants using "YM" as a center point. Two sets of letters separated by a dash mean that the feature spans more than one quadrant.

Letters show the locations of towns as follows: B, Beatty; D, Death Valley Junction; LV, Las Vegas; P, Pahrump; S, Shoshone; SJ, Scottys Junction. YM indicates the approximate location of the potential nuclear waste repository at Yucca Mountain. The dot–dash line shows the channel of the Amargosa River. This river flows south from near Beatty to the southern edge of the map area and then flows north into Death Valley.

Physiographic features shown on Figure 4 listed alphabetically:

Amargosa Desert – 66 (50 SW-SE)
Amargosa Range – 42 (50 SW-NW)
Argus Range – 57 (>100 SW)
Ash Hill – 59 (>100 SW)
Ash Meadows – 122 (100 SE)

Bare Mountain – 67 (50 NW-SW)
Belted Range – 83 (100 NE)
Big Smoky Valley – 4 (>100 NW)
Bird Spring Range – 152 (>100 SE)
Black Butte – 148 (>100 SE)
Black Mountain – 33 (50 NW)
Black Mountains – 126 (100 SW-SE)
Bonnie Claire Lake – 41 (100 NW)
Bullfrog Hills – 64 (50 NW)
Buried Hills – 115 (100 NE)

Cactus Flat – 28 (100 NW)
Cactus Range – 37 (100 NW)
Calico Hills – 77 (50 NE)
California Valley – 149 (>100 SE)
Cathedral Ridge – 30 (100 NE)
Chert Ridge – 113 (100 NE)
Chicago Valley – 132 (100 SE)
Clayton Ridge – 9 (>100 NW)
Clayton Valley – 5 (>100 NW)
Coal Valley – 94 (>100 NE)
Cockeyed Ridge – 111 (100 NE)
Confidence Hills – 128 (>100 SW)
Coso Basin – 55 (>100 SW)
Coso Range – 54 (>100 SW)
Cottonwood Mountains – 47 (100 SW)
Coyote Spring Valley – 144 (>100 NE-SE)
Crater Flat – 68 (50 NW-SW)
Cuprite Hills – 23 (>100 NW)

Death Valley – 44 (50 SW-NW)
Deep Springs Valley – 13 (>100 NW)
Desert Range – 140 (100 NE-SE)
Desert Valley – 142 (>100NE-SE)

East Desert Range – 141 (100 NE-SE)
East Pahranagat Range – 104 (>100 NE)
Eldorado Valley – 155 (>100 SE)
Eleana Range – 80 (50 NE)
Emigrant Peak – 2 (>100 NW)
Emigrant Valley – 109 (100 NE)
Eureka Valley – 15 (>100 NW)

Fallout Hills – 114 (100 NE)
Fish Lake Valley – 1 (>100 NW)
Freiburg Range – 91 (>100 NE)
Frenchman Flat – 116 (50 NE-SE)
Funeral Mountains – 63 (50 SW)

Garden Valley – 92 (>100 NE)
Gass Peak – 146 (>100 SE)
General Thomas Hills – 7 (>100 NW)
Gold Flat – 31 (100 NW-NE)
Gold Mountain – 19 (100NW)
Gold Mountain – 32 (100 NW)
Golden Gate Range – 93 (>100 NE)
Goldfield Hills – 24 (>100 NW)
Grapevine Mountains – 43 (100 NW-SW)
Greenwater Range – 124 (100 SW-SE)
Greenwater Valley – 125 (100 SW-SE)
Groom Range – 107 (100 NE)

Halfpint Range – 112 (50 NE)
Hiko Range – 101 (>100 NE)
Hunter Mountain – 49 (100 SW)

Ibex Hills – 130 (>100 SE)
Indian Spring Valley – 137 (100 NE-SE)
Indian Wells Valley – 56 (>100 SW)
Inyo Mountains – 16 (>100 NW-SW)
Ivanpah Valley – 153 (>100 SE)

Jackass Flats – 76 (50 SE-NE)
Jumbled Hills – 108 (100 NE)

Kawich Range – 29 (100 NE-NW)
Kawich Valley – 84 (100 NE)
Kingston Range – 150 (>100 SE)

Las Vegas Range – 145 (>100 SE)
Las Vegas Valley – 147 (100 SE)
Last Chance Range – 18 (100 NW)
Lida Valley – 22 (100 NW)
Little Skull Mountain – 74 (50 SE)
Long Valley – 127 (>100 SW)

Magruder Mountain – 12 (>100 NW)
McCullough Range – 154 (>100 SE)
Mercury Ridge – 119 (50 SE)
Mercury Valley – 121 (50 SE)
Mesquite Valley – 151 (>100 SE)
Mine Mountain – 79 (50 NE)
Monitor Hills – 27 (>100 NW)
Monotony Valley – 88 (100 NE)
Montezuma Range – 10 (>100 NW)
Mount Helen – 36 (100 NW)
Mount Irish – 98 (>100 NE)
Mount Jackson Ridge – 23 (>100 NW)
Mud Lake – 25 (>100 NW)

Nelson Range – 51 (>100 SW)
Nopah Range – 133 (100 SE)
North Pahranagat Range – 103 (>100 NE)
North Ridge – 120 (50 SE)

Oak Spring Butte – 82 (100 NE)
Oasis Valley – 65 (50 NW)
Oriental Wash – 20 (100 NW)
Owens Valley – 52 (>100 SW)
Owlshead Mountains – 129 (>100 SW)

Pahranagat Range – 105 (>100 NE)
Pahranagat Valley – 102 (>100 NE)
Pahroc Valley – 99 (>100 NE)
Pahrock Valley – 96 (>100 NE)
Pahrump Valley – 135 (100 SE)
Pahute Mesa – 35 (50 NW-NE)
Palmetto Mountains – 11 (>100 NW)
Panamint Range – 46 (100 SW-NW)
Panamint Valley – 58 (100 SW)
Papoose Range – 110 (100 NE)
Paymaster Ridge – 8 (>100 NW)
Pintwater Range – 138 (100 NE-SE)

Quinn Canyon Range – 89 (>100 NE)

Racetrack Valley – 48 (100 SW)
Railroad Valley – 87 (>100 NE)
Ralston Valley – 26 (>100 NW)
Ranger Mountains – 118 (50 SE)
Resting Spring Range – 123 (100 SE)
Reveille Range – 86 (>100 NE)
Reveille Valley – 85 (>100 NE)
Rock Valley – 73 (50 SE)

Saline Range – 17 (>100 NW)
Saline Valley – 50 (>100 SW-NW)
Sand Spring Valley – 90 (100 NE)
Sarcobatus Flat – 40 (50 NW)
Seaman Range – 95 (>100 NE)
Searles Valley – 60 (>100 SW)
Sheep Range – 143 (>100 NE-SE)
Shoreline Butte – 128 (>100 SW)
Shoshone Mountain – 78 (50 NE)
Sierra Nevada – 53 (>100 SW)
Silver Peak Range – 3 (>100 NW)
Sixmile Flat – 99 (>100 NE)
Skeleton Hills – 71 (50 SE)
Skull Mountain – 75 (50 SE)
Slate Range – 61 (>100 SW)
Slate Ridge – 21 (100 NW)
South Pahroc Range – 100 (>100 NE)
South Ridge – 120 (50 SE)
Specter Range – 72 (50 SE)
Sperry Hills – 131 (>100 SE)
Spotted Range – 117 (100 NE-SE)
Spring Mountains – 136 (100 SE)

Stewart Valley – 134 (100 SE)
Stonewall Flat – 38 (100 NW)
Stonewall Mountain – 39 (100 NW)
Striped Hills – 71 (50 SE)
Sylvania Mountains – 14 (>100 NW)

Three Lakes Valley – 139 (100 NE-SE)
Tikaboo Valley – 106 (100 NE)
Timber Mountain – 69 (50 NW-NE)
Timpahute Range – 97 (>100 NE)
Tin Mountain – 45 (100 NW)
Tolicha Peak – 34 (100 NW)
Tucki Mountain – 62 (100 SW)

Weepah Hills – 6 (>100 NW)
Worthington Mountains – 91 (>100 NE)

Yucca Flat – 81 (50 NE)
Yucca Mountain – 70 (50 SW-SE)

Physiographic features shown on Figure 4 listed numerically:

1 – Fish Lake Valley (>100 NW)
2 – Emigrant Peak (>100 NW)
3 – Silver Peak Range (>100 NW)
4 – Big Smoky Valley (>100 NW)
5 – Clayton Valley (>100 NW)
6 – Weepah Hills (>100 NW)
7 – General Thomas Hills (>100 NW)
8 – Paymaster Ridge (>100 NW)
9 – Clayton Ridge (>100 NW)
10 – Montezuma Range (>100 NW)

11 – Palmetto Mountains (>100 NW)
12 – Magruder Mountain (>100 NW)
13 – Deep Springs Valley (>100 NW)
14 – Sylvania Mountains (>100 NW)
15 – Eureka Valley (>100 NW)
16 – Inyo Mountains (>100 NW-SW)
17 – Saline Range (>100 NW)
18 – Last Chance Range (100 NW)
19 – Gold Mountain (100NW)
20 – Oriental Wash (100 NW)

21 – Slate Ridge (100 NW)
22 – Lida Valley (100 NW)
23 – Cuprite Hills (>100 NW)
23 – Mount Jackson Ridge (>100 NW)
24 – Goldfield Hills (>100 NW)
25 – Mud Lake (>100 NW)
26 – Ralston Valley (>100 NW)
27 – Monitor Hills (>100 NW)
28 – Cactus Flat (100 NW)
29 – Kawich Range (100 NE-NW)
30 – Cathedral Ridge (100 NE)

31 – Gold Flat (100 NW-NE)
32 – Gold Mountain (100 NW)
33 – Black Mountain (50 NW)
34 – Tolicha Peak (100 NW)
35 – Pahute Mesa (50 NW-NE)
36 – Mount Helen (100 NW)
37 – Cactus Range (100 NW)
38 – Stonewall Flat (100 NW)
39 – Stonewall Mountain (100 NW)
40 – Sarcobatus Flat (50 NW)

41 – Bonnie Claire Lake (100 NW)
42 – Amargosa Range (50 SW-NW)
43 – Grapevine Mountains (100 NW-SW)
44 – Death Valley (50 SW-NW)
45 – Tin Mountain (100 NW)
46 – Panamint Range (100 SW-NW)
47 – Cottonwood Mountains (100 SW)
48 – Racetrack Valley (100 SW)
49 – Hunter Mountain (100 SW)
50 – Saline Valley (>100 SW-NW)

51 – Nelson Range (>100 SW)
52 – Owens Valley (>100 SW)
53 – Sierra Nevada (>100 SW)
54 – Coso Range (>100 SW)
55 – Coso Basin (>100 SW)
56 – Indian Wells Valley (>100 SW)
57 – Argus Range (>100 SW)
58 – Panamint Valley (100 SW)
59 – Ash Hill (>100 SW)
60 – Searles Valley (>100 SW)

61 – Slate Range (>100 SW)
62 – Tucki Mountain (100 SW)
63 – Funeral Mountains (50 SW)
64 – Bullfrog Hills (50 NW)
65 – Oasis Valley (50 NW)
66 – Amargosa Desert (50 SW-SE)
67 – Bare Mountain (50 NW-SW)
68 – Crater Flat (50 NW-SW)
69 – Timber Mountain (50 NW-NE)
70 – Yucca Mountain (50 SW-SE)

71 – Skeleton Hills (50 SE)
71 – Striped Hills (50 SE)
72 – Specter Range (50 SE)
73 – Rock Valley (50 SE)
74 – Little Skull Mountain (50 SE)
75 – Skull Mountain (50 SE)
76 – Jackass Flats (50 SE-NE)
77 – Calico Hills (50 NE)
78 – Shoshone Mountain (50 NE)
79 – Mine Mountain (50 NE)
80 – Eleana Range (50 NE)

81 – Yucca Flat (50 NE)
82 – Oak Spring Butte (100 NE)
83 – Belted Range (100 NE)
84 – Kawich Valley (100 NE)
85 – Reveille Valley (>100 NE)
86 – Reveille Range (>100 NE)
87 – Railroad Valley (>100 NE)
88 – Monotony Valley (100 NE)
89 – Quinn Canyon Range (>100 NE)
90 – Sand Spring Valley (100 NE)

91 – Freiburg Range (>100 NE)
91 – Worthington Mountains (>100 NE)
92 – Garden Valley (>100 NE)
93 – Golden Gate Range (>100 NE)
94 – Coal Valley (>100 NE)
95 – Seaman Range (>100 NE)
96 – Pahrock Valley (>100 NE)
97 – Timpahute Range (>100 NE)
98 – Mount Irish (>100 NE)
99 – Pahroc Valley (>100 NE)
99 – Sixmile Flat (>100 NE)
100 – South Pahroc Range (>100 NE)

101 – Hiko Range (>100 NE)
102 – Pahranagat Valley (>100 NE)
103 – North Pahranagat Range (>100 NE)
104 – East Pahranagat Range (>100 NE)
105 – Pahranagat Range (>100 NE)
106 – Tikaboo Valley (100 NE)
107 – Groom Range (100 NE)
108 – Jumbled Hills (100 NE)
109 – Emigrant Valley (100 NE)
110 – Papoose Range (100 NE)

111 – Cockeyed Ridge (100 NE)
112 – Halfpint Range (50 NE)
113 – Chert Ridge (100 NE)
114 – Fallout Hills (100 NE)
115 – Buried Hills (100 NE)
116 – Frenchman Flat (50 NE-SE)
117 – Spotted Range (100 NE-SE)
118 – Ranger Mountains (50 SE)
119 – Mercury Ridge (50 SE)
120 – North Ridge (50 SE)
120 – South Ridge (50 SE)

121 – Mercury Valley (50 SE)
122 – Ash Meadows (100 SE)
123 – Resting Spring Range (100 SE)
124 – Greenwater Range (100 SW-SE)
125 – Greenwater Valley (100 SW-SE)
126 – Black Mountains (100 SW-SE)
127 – Long Valley (>100 SW)
128 – Confidence Hills (>100 SW)
128 – Shoreline Butte (>100 SW)
129 – Owlshead Mountains (>100 SW)
130 – Ibex Hills (>100 SE)

131 – Sperry Hills (>100 SE)
132 – Chicago Valley (100 SE)
133 – Nopah Range (100 SE)
134 – Stewart Valley (100 SE)
135 – Pahrump Valley (100 SE)
136 – Spring Mountains (100 SE)
137 – Indian Spring Valley (100 NE-SE)
138 – Pintwater Range (100 NE-SE)
139 – Three Lakes Valley (100 NE-SE)
140 – Desert Range (100 NE-SE)

141 – East Desert Range (100 NE-SE)
142 – Desert Valley (>100NE-SE)
143 – Sheep Range (>100 NE-SE)
144 – Coyote Spring Valley (>100 NE-SE)
145 – Las Vegas Range (>100 SE)
146 – Gass Peak (>100 SE)
147 – Las Vegas Valley (100 SE)
148 – Black Butte (>100 SE)
149 – California Valley (>100 SE)
150 – Kingston Range (>100 SE)

151 – Mesquite Valley (>100 SE)
152 – Bird Spring Range (>100 SE)
153 – Ivanpah Valley (>100 SE)
154 – McCullough Range (>100 SE)
155 – Eldorado Valley (>100 SE)

DISPLACEMENT

This section includes estimates or measurements of the total fault displacement, the displacement recorded by Quaternary deposits (the Quaternary or late Quaternary displacement), and the displacement that occurred during the youngest rupture, if this information is available. The amount of displacement, the unit or deposit displaced and its estimated age, and the location at which the displacement was estimated or measured are noted. Displacements of several different deposits and at several different localities may be reported for some faults.

AGE OF DISPLACEMENT

In this section, the age of the youngest surface rupture on the fault is emphasized if it has been reported. The age of older surface ruptures are also noted, if available. The estimated ages of displaced deposits or surfaces and of undisplaced deposits or surfaces are given if possible. The techniques (e.g., radiometric, soil development, surface characteristics) used to estimate the ages for the deposits or surfaces are also noted. In some references, the ages of the displacements are reported using an age term, such as late Quaternary. If stated, the author's definition of the time interval is given. Age terms are used occasionally with no further definition of the time interval intended. If ages are reported for several localities along the fault, all of the ages are listed with a brief description of each locality. Individual references should be consulted for the exact locations and detailed information.

SLIP RATE

Rates given in this section were either reported directly in the references or were estimated using reported information about the amount and age of displacement on the fault. The time interval for which the rate is reported or estimated is noted. Because the exact displacement direction is unknown for most of the faults in this compilation and because most of the reported amounts of displacement have not been measured within the fault plane, the slip rates listed in this section are usually apparent slip rates.

RECURRENCE INTERVAL

Recurrence intervals in this section were either reported directly in the references or were estimated using reported information about the number of surface ruptures interpreted to have occurred during a given time interval. The time interval for which the recurrence is reported or estimated is noted.

RANGE–FRONT CHARACTERISTICS

If a range front is associated with the fault, the front's characteristics (e.g., straightness, steepness, general age of deposits preserved along the front) are noted. Most of the reported characteristics are from Dohrenwend and others (1991, 1992).

ANALYSIS

This is a brief description of the methods used to study the fault as reported in the references.

RELATIONSHIP TO OTHER FAULTS

The relationships noted in this sections are either (1) from the references in which authors directly or indirectly relate the fault to other faults in the region or (2) from spatial relationships observed on plates 1 and 2 of this compilation (e.g., is the fault parallel or perpendicular to adjacent faults). The relationships among some faults have received much speculation and alternative interpretations are noted, if available. In general, however, the structural relationships among faults in this region are largely unknown.

Airport Lake fault (AIR)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-413: Jennings and others, 1962 (Trona sheet); Y-415: Jennings, 1985 (Death Valley and Trona sheets); Y-425: Stinson, 1977; Y-427: Hart and others, 1989; Y-640: Duffield and Roquemore, 1988; Y-1020: Jennings, 1992; Y-1035: Roquemore and Zellmer, 1983; Y-1052: Wills, 1988 (evaluated only the southern half of AIR, the portion on the Ridgecrest North, Volcano Peak, and White Hills quadrangles, p. [3]); Y-1053: Wills, 1989 (discussed only the Hot Springs segment of AIR); Y-1110: Roquemore, 1981 (subdivided AIR into four segments); Y-1111: Roquemore and Zellmer, 1987; Y-1112: Walter and Weaver, 1980; Y-1113: Duffield and Bacon, 1981; Y-1122: von Huene, 1960; Y-1126: Roquemore, 1980; Y-1145: Roquemore and Zellmer, 1983.

Location: 138 km/234° (distance and direction of closest point from YM) at lat 36°06′N. and long 117°40′W. (location of closest point). AIR is located along the western side of the Coso Basin (a graben), in the southern Coso Range, and in Indian Wells Valley. Y-1110 (pls. 2 and 3) subdivided AIR into four segments, from south to north: Southern segment, Northern segment, Coso Hot Springs segment, and Haiwee Springs segment. (The segments are not shown on plate 2.)

USGS 7-1/2′ quadrangle: Airport Lake, Cactus Peak, Pearsonville, Petroglyph Canyon, Ridgecrest North, Volcano Peak, White Hills.

Fault orientation: AIR strikes approximately north (Y-1035, p. 198; Y-1110, pls. 2 and 3; Y-1145, p. 6) to northeast (Y-1110, pls. 2 and 3). The Southern and Northern segments of Y-1110 (pls. 2 and 3) strike north; the Coso Hot Springs segment of Y-1110 strikes northeast; the Haiwee Springs segment of Y-1110 strikes north–northeast (Y-1110, pls. 2 and 3). Y-1110 (p. 76) reported that AIR strikes between N. 10° E. and N. 20° E. and dips between 50°E. and vertical.

Fault length: The length of AIR was noted to be ≥30 km by Y-1110 (p. 21, 74), >35 km by Y-1145 (p. 6), >50 km by Y-1052 (p. [3, 8]), and ≥60 km (from the Coso Range into Indian Wells Valley) by Y-1035 (p. 198). AIR forms a narrow zone along the western side of the Coso Basin, but to the south in Indian Wells Valley, the zone widens to ≥8 km (Y-1035, p. 198; Y-1052, p. [6]). The width of AIR is reported to be 10 km by Y-427 (table 1, p. 17).

Style of faulting: AIR is a broad zone of left–stepping, *en echelon* approximately north–striking traces that show normal displacement (Y-1035, p. 198; Y-1052, p. [3]; Y-1110, p. 17, 76). A right–lateral component of displacement has been inferred by Y-1110 (p. 17, 19-20) for the his Southern and Northern segments on the basis of (1) the left–stepping, *en echelon* pattern of traces (Y-1052, p. [8]; Y-1110, p. 17), (2) the displacement of stream channels observed by Y-1110 (p. 19-20, pl. 2), (3) the presence of shutter ridges (Y-1110, p. 19-20), and (4) the first motions determined from historic earthquakes reported by Y-1112 (p. 2442, 2448-2449).

No right–lateral component of displacement has been recognized along the Coso Hot Springs segment to the north (Y-1053, p. [2]), but the segment has evidence for vertical displacement (Y-1110, p. 20). Fumaroles and hot springs are aligned with this segment (Y-1110, p. 20-22, pl. 3).

Y-1145 (p. 7, 8) interpreted geodetic and level–line surveys as showing continuing extensional deformation across the section of AIR adjacent to Indian Wells Valley.

Airport Lake fault (AIR) — Continued

Scarp characteristics: Scarps on alluvial surfaces along the Coso Hot Springs segment have slopes of 20° to 30° (Y-1053, p. [2]). On the basis of five topographic profiles measured across beveled scarps on the Coso Hot Springs segment, Y-1110 (p. 50-51, table 1) noted a maximum scarp height of 7.1 m and lower scarp heights of 6.2, 4.3, 4.1, and 3.4 m. Two or three bevels identified by Y-1110 (table 1, p. 50) on all scarps except the one that is 3.4 m high suggest that these scarps formed during multiple events.

Two scarp profiles measured across the southern segment of AIR suggest scarp heights of 16.9 and 4.8 m and "free-face" angles of 49° and 69°, respectively (Y-1110, table 1, p. 50).

Displacement: Y-1145 (p. 6) reported a total vertical displacement of at least 600 m near Coso Basin on the Southern segment of Y-1110 across a zone about 5 km wide. On the basis of trench exposures on this segment, Y-1110 (p. 31, 74) noted an apparent vertical (east-side-down) displacement of 3.4 m in alluvium containing clasts of obsidian correlated with rhyolite domes in the Coso Range. These domes have dates of 90 ka ± 25 ka and 88 ka ± 38 ka (K-Ar; Y-1110, p. 31, 74, *citing* C.R. Bacon, written commun., 1979). About 6 km north of this trench site but still on his Southern segment, Y-1110 (p. 74, pl. 2) recognized right-lateral displacement of 125 m in a basalt flow that he assumed to be >400 ka and <1 Ma.

Y-640 (p. 173) reported that Mesozoic rocks have been displaced, down to the east, at least 500 m near Coso Hot Springs and Airport Lake.

Age of displacement: Y-1052 (p. [6]) noted that AIR displaces Holocene and late Pleistocene alluvium along the western side of the Coso Basin and in Indian Wells Valley. The fault also displaces a late Pleistocene basalt in the southern Coso Range.

The youngest deposits shown by Y-1113 to be displaced by AIR are Holocene and Pleistocene alluvial deposits (their Qya unit). AIR is also portrayed by Y-1113 to displace Pleistocene alluvium (their Qoa deposits), Pleistocene basalt flows (their Qbw, Qbc (1.07 Ma ± 0.14 Ma; K-Ar), and Qba deposits), Pleistocene and Pliocene sedimentary rocks in the White Hills (their QTs unit), and Pleistocene and Pliocene basalt flow and pyroclastic deposits (their QTbr and QTbrp units). This map also shows that traces of the Southern segment of Y-1110 appear to be concealed by Pleistocene basalt west of the White Hills (their Qbh unit; 188 ka ± 35 ka; K-Ar). However, Y-1052 (p. [3]) reported that basalt of this age is displaced by AIR (*citing* Y-1113).

On his Southern segment, Y-1110 (p. 28) estimated that alluvial fans containing scarps are not older than 10 ka (Holocene). He (Y-1110, p. 17-19) inferred Holocene surface rupture on the basis of a lack of varnish on surface stones that he concluded had been flipped by seismic shaking. Scarps are noted by Y-1052 (p. [3]) to have a "fresh" morphology. The age of the youngest rupture on this segment was estimated initially by Y-1110 (p. 51) to be about 40 yr on the basis of scarp morphology. However, Y-1110 (p. 51) concluded that this age must be incorrect given the lack of recorded historic earthquakes large enough to produce this scarp. In a trench across this segment of AIR, Y-1110 (p. 31) noted displacement of alluvium containing clasts of obsidian that correlated with rhyolite domes dated at 90 ka ± 25 ka and 88 ka ± 38 ka (*citing* C.R. Bacon, written commun., 1979). Y-1110 (p. 74, pl. 2) also reported displacement of a basalt flow that has not been radiometrically dated but that Y-1110 concluded was emplaced some time between 400 ka and 1 Ma on the basis of stratigraphic relationships.

On the basis of geodetic and level-line surveys, Y-1145 (p. 7-8) concluded that deformation within the Coso Range and Indian Wells Valley is continuing "at rates significantly higher than those observed in much of the tectonically active western United States."

Slip rate: Using 3.4 m of vertical displacement in alluvium containing obsidian correlated to rhyolite dated at 90 ka ± 25 ka and 88 ka ± 38 ka (range of 50 ka to 126 ka) as noted by Y-1110 (p. 31), an apparent vertical slip rate between 0.03 and 0.07 mm/yr is estimated for his Southern segment of AIR. This would be a minimum rate because the displaced alluvium must be younger than the included obsidian clasts.

On the basis of 125 m of right-lateral displacement of a basalt flow emplaced between 400 ka and 1 Ma, Y-1110 (p. 81) noted an apparent lateral slip rate of 0.1 to 0.3 mm/yr on his Southern segment of AIR.

Recurrence interval: No information.

Airport Lake fault (AIR) — Continued

Range-front characteristics: Along a portion of the southern Coso Range adjacent to his Southern segment, Y-1110 (p. 19-20, fig. 13) noted a very sharp front with faceted spurs.

Analysis: Aerial photographs (Y-1052, p. [5], scales 1:12,000 and 1:24,000; Y-1053, p. [2], scale 1:30,000; Y-1110, p. 8, scales 1:6,000 to 1:60,000 (some low–altitude, low–sun–angle photographs); Y-1122, p. 8, scales 1:12,000 and 1:47,500). Field examination (Y-1052, p. [5]; Y-1110, p. 8). Detailed geologic mapping (Y-1122, p. 8). Topographic scarps profiles using plane table and alidade and the methods of Wallace (1977, Y-1118) (Y-1110, p. 8-9, 44-51). Trenches (Y-1110, p. 28-39, Trench A on his Southern segment). Gravimetric survey and data interpretation (Y-1122, p. 8, 54-57, appen. A). Geodetic and level–line triangulation network (Y-1145, p. 7).

Relationship to other faults: Y-427 (table 1, p. 17) and Y-1052 (p. [3]) suggested that AIR either merges with or intersects the northwest–striking Little Lake fault (LL) in Indian Wells Valley. Northwest–striking fault traces in Indian Wells Valley have been considered part of LL by Y-1035, Y-1110, and Y-1111 (all *cited in* Y-1052, p. [2]), although these traces are continuous with AIR and have similarities to both faults (Y-1052, p. [2]). In contrast, Y-1035 (p. 198) suggested that AIR is truncated by LL because their preliminary mapping revealed no evidence for AIR southwest of LL in Indian Wells Valley. Y-1035 (p. 200) also speculated that the fault pattern and distribution of epicenters of earthquakes along the traces of LL and AIR suggest that displacement along both faults has been interrelated. For example, Y-1035 (p. 200) cited the change in the dip of flexures along LL as they truncate the eastern and western sides of AIR as indicating a direct relationship between the two faults.

Y-1145 (p. 6) suggested that AIR and LL are a result of the same regional stress field and that the two faults "are components of the regional right–slip shear and the east–west extension that characterize the tectonics of the western Basin and Range physiographic province."

Amargosa River fault (AR)

Plate or figure: Plate 2.

References: Y-238: Reheis and Noller, 1991 (pl. 4); Y-695: Donovan, 1991 (name from this reference); Y-809: Donovan, 1990 (her north–northwest–striking Ash Meadows fault?); Y-892: Claassen, 1985 (his northwest–striking, inferred Stewart Valley fault?, fig. 1, p. F2). Not shown by Denny and Drewes, 1965 (Y-386, pl. 1).

Location: 40 km/183° (distance and direction of closest point from YM) at lat 36°29′N. and long 116°28′W. (location of closest point). AR is located in the Ash Meadows portion of the Amargosa Desert parallel to and about 4 km northeast of the Amargosa River (Y-695, p. 47).

USGS 7-1/2′ quadrangle: Franklin Well.

Fault orientation: AR strikes northwest. AR is shown by Y-695 (pl. 1, p. 47, 49, fig. 3-4) as discontinuous, *en echelon* lineaments and scarps that form a zone that trends N. 48° W. AR is portrayed as a nearly continuous, relatively prominent northwest–trending lineament by Y-238 (pl. 4).

Fault length: The length of AR is about 15 km as measured from sec. 17, T. 17 S., R. 49 E. to sec. 16, T. 18 S., R. 50 E. (Y-695, p. 47). AR is about 7 km wide (Y-695, p. 47-48).

Style of faulting: Y-695 (p. 50) inferred right–lateral displacement on AR, because of the possibility that AR is an extension of the Pahrump fault (PRP), on which displacement is thought to be right lateral. Y-695 (p. 50) interpreted east–trending folds in Tertiary (Miocene?) sediments to have formed by compression caused by a left step between PRP and AR. Such compression would occur if displacement on both faults has been right–lateral.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The youngest surfaces on which scarps or lineaments have been mapped are interpreted to be Holocene (≤10 ka) by Y-695 (p. 50).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with AR.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-695, p. 3, 37, 39, scales 1:12,000 (low–sun–angle) and 1:60:000). Field examination (Y-695, p. 37). Topographic scarp profiles (Y-695, p. 50, appen. A, profile P3).

Relationship to other faults: Y-695 (p. 50, 74) inferred AR to be an extension of the PRP because, as she noted, the two faults have parallel strikes and nearly join across a left step between Stewart Valley and southern Ash Meadows. Y-238 (pl. 4) portrayed the two faults as nearly continuous. The mapping by Y-695 (pl. 1) suggests that a 20–km–long break in surficial expression exists between PRP in Stewart Valley and AR in Ash Meadows.

Y-695 (p. 48) suggested that the southeastern end of AR may extend to the north–striking Ash Meadows fault (AM), at a point where a discontinuity exists in the surficial expression of AM. In contrast, Y-238 (pl. 4) portrayed northwest–trending lineaments associated with AR as continuing east of the northern end of the Resting Spring Range across the trace of AM as mapped by Y-695 (pl. 1).

Y-695 (p. 48) suggested that the northwestern end of AR may truncate the northern end of a zone of north–trending, west–facing fault scarps on surfaces of Quaternary/Tertiary polestrian carbonate rocks. (These scarps are shown as fault traces on plate 2 of this compilation, but they are not labeled with a fault name.) However, she noted that one north–trending graben within this zone extends north of AR.

Area Three fault (AT)

Plate or figure: Plate 1.

References: Y-181: Carr, 1974 (his Area 3 fault); Y-224: Frizzell and Shulters, 1990; Y-526: Swadley and Hoover, 1990; Y-693: Barosh, 1968 (his Area 3 fault, fig. 1, p. 201); Y-961: Fernald and others, 1968 (name from this reference). Not shown by Colton and McKay, 1966 (Y-60), by Dohrenwend and others, 1992 (Y-853), nor by Reheis, 1992 (Y-813).

Location: 44 km/60° (distance and direction of closest point from YM) at lat 37°02′N. and long 116°01′W. (location of closest point). AT is located in east–central Yucca Flat.

USGS 7-1/2′ quadrangle: Yucca Flat.

Fault orientation: The northern half of AT strikes generally north as a single, slightly sinuous strand (Y-526) or as two subparallel strands (Y-181; Y-224). The southern half is composed of two branches. The western branch is slightly sinuous but generally strikes northeast (Y-224; Y-526). The eastern one is curving and strikes between northeast and northwest (Y-224). The western branch dips west; the eastern branch dips east (Y-181).

Fault length: The northern section is about 2 km long as estimated from Y-181, Y-224, and Y-526. The western branch of the southern section has a length of about 3 km as estimated from Y-526 or 4 km as estimated from Y-181 and Y-224. The eastern branch of the southern section has a length of about 3.5 km as estimated from Y-526, about 4 km as estimated from Y-181, or about 5.5 km as estimated from Y-224.

Style of faulting: No information.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The youngest displacement on AT may be Holocene (≤10 ka). The map by Y-526 implies that displacement along AT occurred after deposition of both their Qap deposits (about 160 ka to 800 ka) and their Qah deposits (≤10 ka), because the fault is shown within these deposits, not concealed by them.

The map by Y-961 portrays AT as an indefinite or approximately located fault in gravelly alluvium (their Qtg deposits) of Pleistocene and Holocene age. This map also shows the southern end of the western branch of AT as terminating at the contact between their Qtg deposits and sandy alluvium along modern washes (their Qfs deposits; Holocene). This relationship suggests that displacement on this branch may be older than Holocene. The southern 2.5 km of the western branch is shown by Y-181 (fig. 7) as having Quaternary displacement.

AT also displaces surficial deposits as a result of underground nuclear testing (J.C. Cole, written commun., 1987, *cited in* Y-224), so that at least part of its surficial expression may be historical. The northern section of AT and the northern 1.5 km of the western branch of the southern section are shown by Y-181 (fig. 7) to have experienced displacement induced by nuclear explosions. The eastern branch of the southern section has been portrayed by Y-181 (fig. 7) as a natural or explosive–produced fracture.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with AT. The fault is located at least 2 km from the closest range front.

Analysis: Aerial photographs (Y-526, scale 1:24,000). Limited field examination (Y-526).

Relationship to other faults: AT may be related to the generally north–striking Yucca fault (YC), the north–striking Carpetbag fault (CB), and other short unnamed faults within Yucca Flat (Y-181, fig. 8, p. 23, 25, 31-33).

Ash Hill fault (AH)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-239: Reheis, 1991 (pl. 2); Y-399: Hopper, 1947 (pl. 1); Y-427: Hart and others, 1989; Y-458: Hall, 1971 (pl. 1; shows only the northern part of AH north of lat 36°15'N.; name from this reference); Y-698: Smith, 1975; Y-906: MIT 1985 Field Geophysics Course and Biehler, 1987; Y-1020: Jennings, 1992 (his fault #246).

Location: 105 km/236° (distance and direction of closest point from YM) at lat 36°20'N. and long 117°25'W. (location of closest point). AH is located along the western side of Panamint Valley between Ash Hill and the Argus Range.

USGS 7-1/2' quadrangle: Maturango Peak, Maturango Peak NE, Maturango Peak SE, Panamint Springs, Revenue Canyon.

Fault orientation: AH strikes generally north–northwest (Y-239, pl. 2).

Fault length: AH has a length of 32 to 38 km between south of Panamint Springs on the north, and west of Ballarat on the south as estimated from mapping by Y-239 (pl. 2). This is a minimum length because the map area of Y-239 does not extend south of lat 36°N. As shown by Y-239 (pl. 2), AH is composed of two sections, each about 15 km long, with a 3–km–long gap between them. Y-239 (p. 3) noted that AH may be continuous for >45 km.

Style of faulting: AH is shown as down to the west by Y-239 (pl. 2) and by Y-698 (p. 112). Y-239 (pl. 2, p. 3) noted that one north–northwest–striking trace, which is near the mouth of Snow Canyon, displays evidence for right–lateral displacement. The northern end of AH is shown by Y-1020 as having right–lateral displacement. Y-698 (p. 115) reported fractures in alluvial–fan deposits along the southern section of AH. These features "which feather into the main [fault] scarp, strike about 30° clockwise from the scarp's strike." He interpreted this relationship as suggesting that a component of right–lateral displacement was present during the youngest rupture on AH.

Scarp characteristics: Scarps associated with AH along the eastern side of the Argus Range generally face up–fan or up–slope (to the west) and are relatively prominent (Y-239, pl. 2). The west–facing scarp near the Minnietta Mine Road is reported by Y-698 (p. 114) to be 46 to 61 m high (150 to 200 ft).

Displacement: Y-399 (p. 426) reported a maximum vertical displacement of about 122 m (400 ft) at the northern end of AH (what he called "the north–trending fault on the east edge of the Argus Range"). Y-458 (p. 59) noted that 61 m (200 ft) of west–side–down displacement has occurred on AH since late Pliocene.

Age of displacement: The youngest displacement on AH probably occurred during the Holocene (≤10 ka). Y-222 portrayed AH as juxtaposing Holocene alluvium on the west against both Pleistocene nonmarine rocks and Pliocene volcanic rocks on the east. Y-222 also showed AH within Pleistocene nonmarine rocks. Y-698 (p. 115) reported that the southern section of AH displaces all alluvial deposits except those in active stream channels. This suggests that the youngest rupture probably occurred during the latest Holocene. Likewise, Y-458 (p. 59) concluded that "[t]he fault has had very recent movement, as the fanglomerate in the present drainage north of Ash Hill is displaced." His map (Y-458, pl. 1) shows a 0.5–km–long section north of Ash Hill as displacing Quaternary alluvium (his Qal deposits). Y-427 indicated that AH north of Ballarat has experienced Holocene displacement.

Y-1020 showed displacement on different parts of AH as occurring either during the Holocene, during the late Quaternary (which he defined as since 700 ka), or during the Quaternary (which he defined as since 1.6 Ma). AH is portrayed by Y-239 (pl. 2) as a previously mapped fault that is expressed as relatively prominent lineaments and scarps on surfaces of Quaternary deposits preserved between Ash Hill and the Argus Range. Y-399 (p. 426) noted that AH displaces "old alluvium" but is buried by younger alluvium at its northern end. The map by Y-458 (pl. 1) shows the northern part of AH as a faulted contact between Pliocene volcanic rocks (his Tr, Tb2, and Tp units) on the east and Quaternary alluvium (his Qal deposits) on the west.

Ash Hill fault (AH) — Continued

Recurrent displacements on the southern section of AH along the Nadeau Trail Road are indicated by a stream that breaches a fault scarp (Y-698, p. 114). This stream has been "beheaded several times by uplift along the scarp" (Y-698, p. 114).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000; Y-427, p. 8). Limited field examination (Y-239, p. 2; Y-427, p. 8). Compilation of published and unpublished literature (Y-427, p. 8).

Relationship to other faults: AH approximately parallels the Panamint Valley fault (PAN) along the eastern side of the Panamint Valley. Two large clusters of north–trending lineaments and scarps extend across the northwest–trending Panamint Valley between PAN and AH (Y-239, p. 3, pl. 2), but the structural relationship between AH and PAN has not been reported.

The relationship of AH to either the northwest–striking Hunter Mountain fault (HM) along the eastern side of Panamint Valley north of Panamint Springs or to the north–northeast–striking Towne Pass fault (TP) in the Cottonwood Mountains east of Panamint Valley is not known.

Ash Meadows fault (AM)

Plate or figure: Plate 2.

References: Y-68: Swadley, 1983; Y-69: McKittrick, 1988; Y-238: Reheis and Noller, 1991 (pl. 4); Y-386: Denny and Drewes, 1965 (pl. 1, part of AM may correlate with their north–striking, ~1–km–long fault about 1.5 km southwest of Devils Hole); Y-389: Drewes, 1963 (fig. 2, p. 5; shows the Shoshone fault zone in Amargosa Valley south of Eagle Mountain); Y-695: Donovan, 1991 (name from this reference); Y-809: Donovan, 1990 (her north–striking Rooker Road fault?); Y-892: Claassen, 1985 (AM may correlate with a portion of his north–northwest–striking, inferred Gravity fault, fig. 1, p. F2); Y-996: Hay and others, 1986; Y-1020: Jennings, 1992 (shows two north–northwest–striking faults along the Amargosa River south of Eagle Mountain and one north–northwest–striking fault west of Eagle Mountain).

Location: 34 km/169° (distance and direction of closest point from YM) at lat 36°33′N. and long 116°22′W. (location of closest point). AM is located in the Ash Meadows portion of the Amargosa Desert and along the western side of the Resting Spring Range.

USGS 7-1/2′ quadrangle: Bole Spring, Devils Hole, Eagle Mountain, East of Deadman Pass, Skeleton Hills, Stewart Valley, Twelve Mile Spring.

Fault orientation: AM strikes generally north. AM is composed of *en echelon* lineaments and scarps that are discontinuous in geomorphic expression and variable in strike (Y-238, pl. 4; Y-695, pl. 1). Y-695 (p. 51) subdivided AM into three sections (northern, central, southern) on the basis of these discontinuities. The northern section consists of two branches, a western one striking N. 18° W. and an eastern one striking N. 28° E. (Y-68; Y-695, p. 51-52). The central section strikes north to N. 10° W. and is juxtaposed on an alignment of springs that trends N. 24° W. (Y-695, p. 51, 55). The southern section of AM, located along the Resting Spring Range, strikes north (Y-69; Y-695, p. 71).

Fault length: The total length of AM is about 60 km from just south of the Rock Valley fault (RV) to the southern end of the Resting Spring Range as estimated from Y-69 and Y-695 (pl. 1). The northern section of Y-695 is 7 km long and 3 km wide (Y-695, p. 53). The central section is 5 km long and 3 km wide (Y-695, p. 57). The southern section of AM is about 48 km long as estimated from Y-69 and Y-695. This section includes fault traces along the western side of the Resting Spring Range.

Style of faulting: Normal dip slip has been dominant along AM as indicated by (1) a graben along the southern section (Y-695, p. 71), (2) slickensides that are exposed in a trench (TR3) along the central section and that have a 90° rake (Y-695, p. 59), and (3) west–facing scarps that contain material on their hanging wall that is younger than material on their footwall (Y-695, p. 51). Faults exposed in Trenches TR3 and TR4 along the central section dip 55° to 58° to the west (Y-695, p. 59-60).

Scarp characteristics: Y-695 (p. 51) noted west–facing fault scarps associated with the western branch of the northern section. Scarps along the central section of AM are 0.35 to 1.2 m high with maximum slope angles of 10.5° and 12.5° (Y-695, p. 58, appen. A, p. 142-143). Vertical scarp heights along the southern section (along the Resting Spring Range) are generally ≤1 m (Y-69).

Displacement: Y-996 (p. 1,490) inferred at least 50 m of down–to–the–west displacement along a north–striking fault 0.5 km west of Fairbanks Butte by assuming that tuffs dated at about 3.2 Ma at several localities in the Amargosa Desert are correlative. Y-695 (p. 53) interpreted this displacement to be along the western branch of her northern section of AM.

Vertical separation is >2 m, and probably >3 m, along the central section of AM at Trench TR3 (Y-695, p. 59-60). Y-695 (p. 64) estimated a vertical displacement of 155 cm across AM at Trench TR4 along her central section of the fault. This estimate was made using the base of an exposed soil profile as a piercing point.

Age of displacement: Scarps along the western branch of the northern section are mostly on surfaces of Holocene alluvium (her Q1a deposits; ≤10 ka; Y-695, p. 51). The map by Y-68 portrays northeast–striking traces along the eastern branch of the northern section of Y-695 in Pleistocene deposits (his Q2bc deposits) and Pleistocene and Pliocene? deposits (his QTa deposits).

Soils developed on displaced deposits along the central section and exposed in Trench TR4 are interpreted by Y-695 (p. 64) to suggest an age of >10 ka and possibly about 40 ka for these deposits. Y-695 (p. 69) suggested that this age estimate is supported by the possible correlation of the deposits in Trench TR4 to deposits exposed along the Rock Valley fault (RV). The deposits along RV have been dated by uranium–trend methods at 38 ka by Yount and others (1987, Y-20). The youngest displaced deposits exposed in Trench TR3, another trench along the central section, are interpreted by Y-695 (p. 59) to be most likely late Pleistocene. This interpretation is based on degree of soil development and induration. A 1–km–long fault trace in the central section of Y-695 is portrayed by Y-386 (pl. 1) as displacing Quaternary playa and alluvial–fan deposits (their Qp and Qgs units). However, they inferred the presence of the fault from the distribution of the playa and alluvial–fan deposits, which abut each other, and suggested that "differential erosion along some sort of structural break" is the best explanation for the pattern that they noted (Y-386, p. L42).

The youngest surfaces that exhibit scarps along the southern section of AM (along the Resting Spring Range) are portrayed by Y-69 as early Holocene and/or latest Pleistocene (her Qf3 deposits). The map by Y-69 also shows scarps preserved on surfaces of older deposits: late and/or middle Pleistocene (her Qf2 deposits, older than 10 ka and younger than 300 ka to 500 ka), middle and/or early Pleistocene (her Qf1 deposit, older than 300 ka to 500 ka), early Pleistocene and/or late Tertiary (her QTf deposits), and Miocene and older (her Ts deposits). In addition, Y-69 noted that Holocene deposits (her Qf4 deposits, ≤10 ka) are not cut by fault traces. On the basis of these relationships, the embayed character of the range front, and the presence of pediments formed on bedrock preserved basinward of the range front, Y-69 speculated that late Quaternary fault activity has been minimal along the Resting Spring Range.

The three faults south and west of Eagle Mountain are noted to be Quaternary by Y-1020, because he noted evidence for displacement since 1.6 Ma.

Slip rate: The average apparent vertical slip rate since late Pliocene along the western branch of the northern section of AM is 0.016 mm/yr as reported by Y-695 (p. 53). This rate is based on 50 m of displacement of a 3.2–Ma tuff (Y-695, p. 53; Y-996, p. 1,490).

The apparent vertical slip rate since about 40 ka along the central section of AM is about 0.04 mm/yr. This rate assumes an estimated age of about 40 ka for a deposit displaced about 155 cm in Trench TR4 as reported by Y-695 (p. 64-69).

Recurrence interval: No information.

Range-front characteristics: No range front is associated with the northern and central sections of AM. The southern section bounds the western side of Resting Spring Range, which is noted by Y-69 to be embayed by alluvial–floored channels and to include pediments formed on bedrock basinward (west) of the range front.

Analysis: Aerial photographs (Y-69, scale 1:30,000; Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-695, p. 3, 37, 39, scales 1:12,000 (low–sun–angle) and 1:60,000; Y-809 (low–sun–angle)). Field examination (Y-69; Y-695, p. 37). Scarp profiles (Y-695, appen. A, profiles P1-P2, P9-P12, p. 132-133, 140-143). Trenches (Y-695, p. 37, Trenches TR3 and TR4). Soil descriptions (Y-695). Transects measured on alluvial fans (Y-69).

Relationship to other faults: Y-695 (p. 54) speculated that the eastern branch of the northern section of AM could, instead, be a southwest–striking branch of the generally northeast–striking Rock Valley fault (RV).

Ash Meadows fault (AM) — Continued

Y-695 (p. 58) noted that an apparent discontinuity at the southern end of the central section of AM occurs across a 3–km right step that coincides with the southeastern projection of the northwest–striking Amargosa River fault (AR).

Y-892 (p. F3) noted that the hydrologic characteristics of Ash Meadows change in the vicinity of the central section of AM as portrayed by Y-695 (Gravity fault of Y-892). This change is in part indicated by large springs along and east of the fault (Y-892, p. F3).

Y-695 (p. 75-76, fig. 7-1, p. 117) proposed that the central and northern sections of AM are extensions of either the southern section along the Resting Spring Range or a north–northwest–striking branch of the Pahrump fault (PRP).

Y-389 (p. 55) inferred strike slip on his Shoshone fault zone in the Amargosa Valley and suggested that it is one of several "master" faults in the Death Valley region, along with the Furnace Creek fault (FC), the Southern Death Valley fault (SDV; his Confidence Hills fault zone), and the Death Valley fault (DV).

Badger Wash faults (BDG)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3).

Location: 111 km/68° (distance and direction of closest point from YM) at lat 37°12′N. and long 115°18′W. (location of closest point). BDG includes four faults within Badger Valley and in small unnamed valleys between the Pahranagat Range and the East Pahranagat Range.

USGS 7-1/2′ quadrangle: Alamo, Badger Spring, Desert Hills NE, Lower Pahranagat Lake NW.

Fault orientation: The four faults in BDG strike primarily north–northwest (Y-25; Y-404).

Fault length: The longest fault of the four included in BDG (the east–central fault) is about 13 km long. The eastern and western faults are each 8 km long. The shortest fault (the west–central fault) is 4 km long. These lengths were estimated from the map by Y-25.

Style of faulting: Three of the four faults included in BDG are shown by Y-25 to be down to the west; the longest fault is shown by Y-25 as down to the east.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Portions of the two eastern faults included in BDG are shown by Y-25 as faulted contacts between pre–Tertiary or Tertiary rocks and Holocene to Pliocene alluvium and colluvium (their QTa deposits). One short section of the longest fault is shown by Y-25 as a faulted contact between their QTa deposits and Holocene and Pleistocene alluvium (their Qa deposits). Portions of the two western faults in BDG are shown by Y-25 as faulted contacts between pre–Tertiary or Tertiary rocks and their Qa deposits. Y-404 portrayed all four faults of BDG as post–Laramide structures. They showed the longest fault as a faulted contact between Tertiary volcanic rocks and either unconsolidated Quaternary and Tertiary gravel and alluvium (pl. 3) or Pliocene lake beds (pl. 2).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Compilation of previous work (Y-25). Aerial photographs (Y-404, p. 2, scale 1:60,000). Field mapping (Y-404, p. 2).

Relationship to other faults: The southern ends of the eastern two faults may terminate at the northeast–striking Arrowhead Mine fault (ARM) of the Pahranagat fault (PGT). Faults in BDG parallel the Hiko fault (HKO) and the Hiko–South Pahroc faults, all of which are east of ARM.

Bare Mountain fault (BM)

Plate or figure: Plates 1 and 2, Figure 5.

Figure 5. Bare Mountain fault along the eastern side of Bare Mountain.

References: Y-1: Carr and Monsen, 1988; Y-3: Reheis, 1988 (her Bare Mountain range–front fault or range–front fault, p. 103; subdivided BM into five segments, p. 110, fig. 8.1, p. 104); Y-26: Swadley and others, 1984 (their Bare Mountain fault zone, pl. 1, p. 18); Y-40: Cornwall and Kleinhampl, 1961; Y-64: Swadley and Parrish, 1988; Y-101: Ackermann and others, 1988; Y-232: Cornwall, 1972; Y-234: Monsen, 1983; Y-238: Reheis and Noller, 1991 (pl. 3); Y-572: Zhang and Schweickert, 1991; Y-662: Hamilton, 1987; Y-1041: Monsen and others, 1992.

Location: 14 km/260° (distance and direction of closest point from YM) at lat 36°48′N. and long 116°37′W. (location of closest point). BM is located along the eastern side of Bare Mountain and the western side of Crater Flat.

USGS 7-1/2′ quadrangle: Beatty Mountain, Carrara Canyon, Crater Flat, East of Beatty Mountain.

Fault orientation: BM strikes generally north. Most fault traces dip eastward 60° to 80°; some traces dip gently southeastward (Y-1, p. 55). For example, northeast of Chuckwalla Canyon BM dips southeast 35° to 45° (Y-3, p. 105). Y-64 showed a dip of 65° near the central part of BM east of the Panama Mine. Y-1041 portrayed eastward dips between 30° and 55°.

Fault length: The length of BM is about 15.5 km as estimated from fig. 8.1 (p. 104) of Y-3 (from Joshua Hollow? on the north to Steves Pass on the south). Five segments that were identified by Y-3 (p. 110, fig. 8.1, p. 104) have been numbered from north to south (fig. 5; locality names from Beatty 1:100,000 topographic quadrangle): #1=3.5 km (Joshua Hollow? to Tarantula Canyon), #2=3.25 km (to Diamond Queen mine), #3=2.5 km (to SE1/4, sec. 13, T. 13 S., R. 47 1/2 E.), #4=3.75 km (to Wildcat Peak), #5=2.5 km (to Steves Pass). Lengths have been estimated from Y-3 (fig. 8.1, p. 104). Y-1 (p. 55) suggested a segment boundary at Chuckwalla Canyon along segment #2 above. The map by Y-64 portrays BM as very discontinuous, especially south of Chuckwalla Canyon.

Style of faulting: BM is shown primarily as having down–to–the–east or down–to–the–southeast dip–slip (normal) displacement (Y-1041). Y-1 (p. 55) reported a "strong component" of right–lateral displacement along steep eastward–dipping fault traces that compose a system of faults along the eastern front of Bare Mountain about 3 km north of Steves Pass. Nearly pure dip–slip was suggested by Y-1 (p. 55) for gentle southeast–dipping fault traces in this same area.

Scarp characteristics: No information.

Displacement: Y-3 (p. 107) reported a minimum vertical displacement of 1.75 m on segment #4. The displaced deposit has an age of about 9 ka as estimated by Y-3 (p. 107) on the basis of its soil development and possible correlation to Q1c deposits at Fortymile Wash.

Paleozoic rocks have been downdropped about 2.6 km into Crater Flat according to Y-101 (p. 33).

Age of displacement: Ages of displacement as estimated by Y-3 (p. 106-110, fig. 8.1, p. 104) for her five segments are as follows (fig. 5). Segment #1: Middle and late Pleistocene(?), no data. Segment #2: At least one event >350 ka and at least one younger event, based on a scarp just south of Tarantula Canyon. Segment #3: Middle to late Pleistocene(?), based on a scarp that has been destroyed by mining activities. Segment #4: Holocene or late Pleistocene, based on (1) evidence at locality 3 for one event younger than 5 ka to 15 ka, (2) evidence at locality 5 for two events younger than 40 ka to 50 ka, one of which probably occurred during early Holocene, and (3) evidence at locality 4 for one event after about 145 ka–160 ka and another event since 9 ka. Segment #5: Middle to late Pleistocene(?), no data.

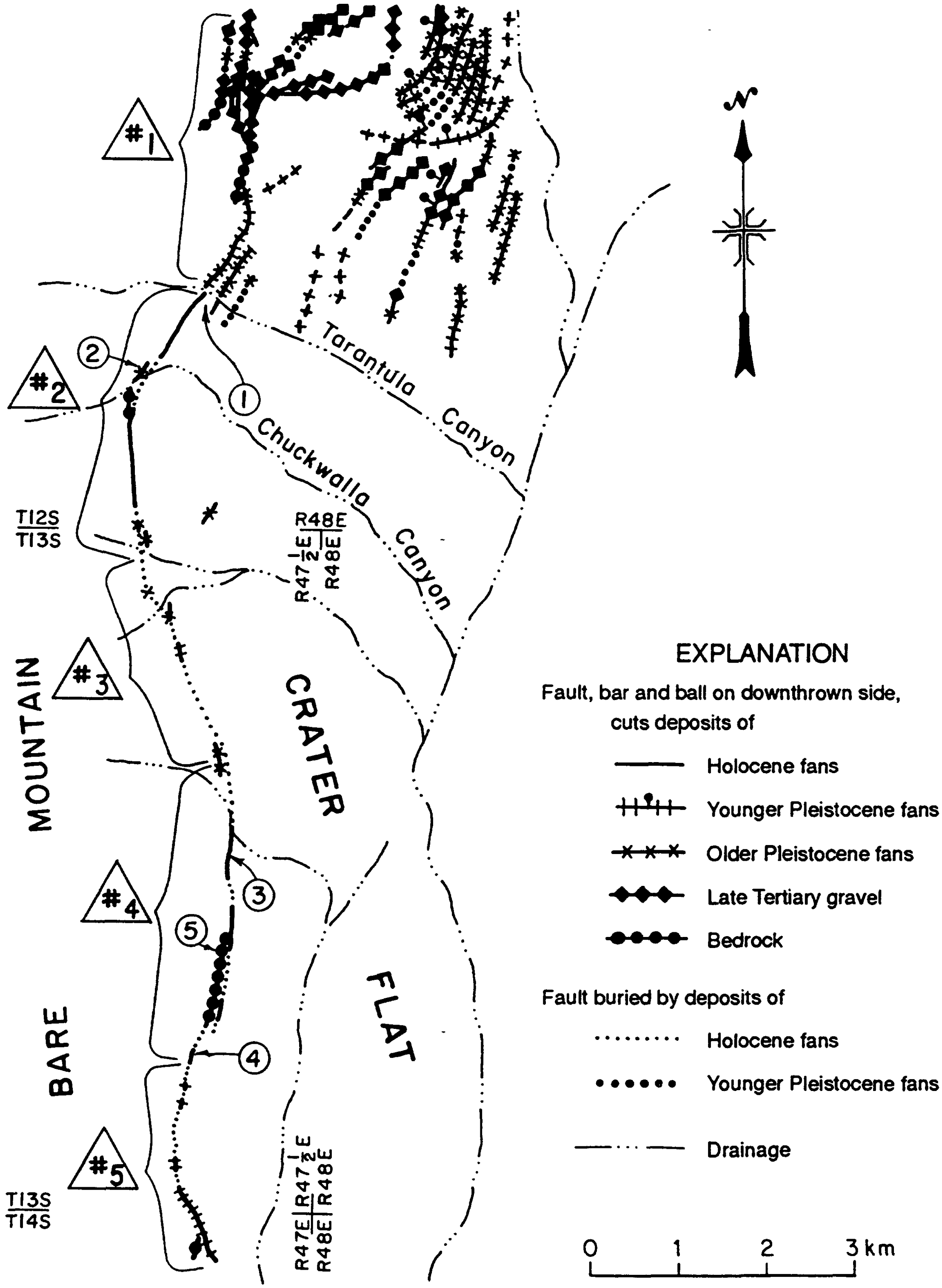

Figure 5. Bare Mountain fault along the eastern side of Bare Mountain. Numbers in triangles indicate fault segments defined by Reheis (1988). Numbers in circles refer to sites noted in Reheis (1988) and discussed in the description sheet. Figure is adapted from Reheis (1988, fig. 8.1, p. 104).

Bare Mountain fault (BM) — Continued

The map by Y-64 shows BM as displacing early Pleistocene and Pliocene(?) alluvial and colluvial deposits (their QTa deposits), which they estimated to be much greater than 740 ka and probably greater than 1.2 Ma. This map also portrays BM as a faulted contact between either Miocene gravel (their Tgs deposits), QTa deposits, or Pleistocene alluvium (their Q2c deposits; <740 ka and >270 ka ± 30 ka, uranium–trend analyses) on the east side of the fault and Paleozoic and Proterozoic rocks on the west side. In addition, this map shows Holocene alluvium (their Q1c and Q1ab deposits; ≤8,300 ± 75 yr, ^{14}C date) overlying the central part of BM, east of the Panama Mine.

The map by Y-1041 shows that the youngest displaced deposits are younger alluvial fan deposits (their Qyf deposits), which they concluded are Holocene. They stated that these deposits are equivalent in part to the Q1a, Q1ac, and Q1c deposits of Y-64.

Slip rate: An apparent vertical slip rate during the Holocene of 0.19 mm/yr is estimated for segment #4 of BM, using 1.75 m minimum displacement in a deposit with an age of about 9 ka as noted by Y-3 (her locality #4, p. 107).

Recurrence interval: The average recurrence interval for ruptures at locality #4 on segment #4 is estimated to be 73,000 to 80,000 yr on the basis of the conclusions of Y-3 (p. 107) that two ruptures have occurred in a buried gravel with a soil inferred by Y-3 to have formed in 145,000 to 160,000 yr. This recurrence may be an over estimate because, as Y-3 (p. 107) noted, the soil must have been mostly developed before the first faulting event, so that this event may have occurred close to the age of the overlying unit, which was estimated to be 9 ka by Y-3 (p. 107).

The average recurrence interval for ruptures at locality #5 on segment #4 is estimated to be 20,000 to 25,000 yr on the basis of the conclusions of Y-3 (p. 110) that two ruptures occurred since deposition of an alluvial deposit with an age of 40 ka to 50 ka (correlation of the soil developed in the alluvial deposit at locality #5 with that in deposits in Fortymile Wash).

Range-front characteristics: Y-3 (p. 105) concluded that geomorphic characteristics along the eastern front of Bare Mountain south of Tarantula Canyon (segments #2 through #5) suggest recurrent Quaternary fault displacement. These characteristics are (1) a steep front with faceted spurs and (2) drainages that are deeply incised in the mountains but that are aggrading adjacent to the range front on steeply sloping Holocene alluvial fans that bury older alluvial fans. However, Y-3 (p. 105) noted that Holocene deposits north of Tarantula Canyon (segment #1) are primarily limited to arroyos cut into older deposits and concluded from this observation that fault displacement is older on this segment of BM than it is on the other segments to the south.

Analysis: Geomorphic mapping, interpretation of aerial photographs (scale 1:12,000), field reconnaissance, examination of arroyos and prospect pits, soil studies (Y-3, p. 103).

Relationship to other faults: The relationship between BM and the Fluorspar Canyon fault (and other low–angle normal faults cutting Bare Mountain) has been commented upon by several previous workers. Mapping by Y-1 (p. 54) along Tates Wash and the relationship between a low–angle fault and a 14–Ma dike at their Stop 6 suggested to them that the Fluorspar Canyon fault is separate from and older than (activity ceased by late Miocene) BM, which is located along the range–front. Y-1041 speculated that the north–northeast–striking Tates Wash fault joins the northern end of BM. Y-662 suggested that the Fluorspar Canyon fault and BM are part of the same system of detachment faults on top of the mid–crustal rocks.

Beatty scarp (BS)

Plate or figure: Plates 1 and 2.

References: Y-6: Swadley and others, 1988; Y-18: Swadley and others, 1986; Y-40: Cornwall and Kleinhampl, 1961; Y-43: Cornwall and Kleinhampl, 1964 (show only that part of BS west of long 116°45′W.); Y-113: Harding, 1988; Y-182: Carr, 1984 (fig. 26, p. 58); Y-232: Cornwall, 1972; Y-379: Cornwall and Kleinhampl, 1961; Y-629: Rodriguez and Yount, 1988; Y-1041: Monsen and others, 1992 (show BS as a heavy dashed line; an inferred fault?).

Location: 26 km/272° (distance and direction of closest point from YM) at lat 36°51′N. and long 116°45′W. (location of closest point). BS is located along the western side of Bare Mountain south of Beatty, Nevada, adjacent to the Amargosa River and in the northern Amargosa Desert.

USGS 7-1/2′ quadrangle: Beatty, Beatty Mountain, Carrara Canyon, Gold Center.

Fault orientation: BS trends N. 40° W. to N. 10° E. as estimated from Y-6 (fig. 9.1, p. 114).

Fault length: The length of BS (from Beatty, Nevada, to the northern Amargosa Desert) is about 8 km as estimated from Y-1041 or about 10 km as noted by Y-6 (p. 113) and as estimated from Y-232 (pl. 1). BS is shown by Y-232 as concealed another 15 km to the south, so that the total length of BS could be as much as 25 km.

Style of faulting: The origin of the Beatty scarp is in question. BS has been mapped as a Quaternary fault or as a faulted contact between Quaternary deposits and Paleozoic rocks by Y-40, Y-43, and Y-379. The morphology of the scarp is consistent with dip–slip (normal) displacement along a west–dipping fault.

In contrast, Y-6 (p. 119) concluded that BS "formed as an erosional scarp produced by lateral migration of the Amargosa River." They based this conclusion on "the trend and location of margins of the bottom lands occupied by the river in late Quaternary time, the occurrence of fluvial deposits at or near the base of the scarp, the lack of conclusive evidence of faulting revealed by surficial mapping and trenching, and the lack of offset of subsurface horizons as shown by seismic–refraction and seismic–reflection profiles." In addition, Y-113 (p. 123) concluded that BS is not fault related because seismic–reflection data, which he interpreted, indicate that the only possible projection of the surface scarp to depth would have down–to–the–east relative displacement, which is the reverse of the displacement direction suggested by the scarp at the ground surface.

Scarp characteristics: BS is a discontinuous scarp that has been partially eroded by crosscutting streams and partially buried by alluvium along about half its length (Y-6, p. 113). Scarp heights range between 2 and 30 m, with maximum values occurring near the middle of the scarp (Y-6, p. 116). Maximum scarp–slope angles range between 35°, where the scarp is highest, and about 20°, where the scarp is about 4 m high (Y-6, p. 116).

Displacement: No information.

Age of displacement: Y-182 (p. 65) suggested that BS may represent Quaternary reactivation of an older fault. The map by Y-43 (pl. 1) shows the northwestern 1 km of BS as an approximately located fault that juxtaposes Tertiary welded tuff (their Tw unit) and Quaternary alluvium (their Qal deposits).

BS is interpreted by Y-6 (p. 119) to be early Holocene. This estimate is based on a ^{14}C date of 10 ka ± 0.3 ka, which was determined by M. Rubin (written commun., 1985, *cited by* Y-6, p. 118), on carbonized wood fragments that were discovered in gravelly alluvium (their Qf deposits) exposed at the base of the scarp in Trench BF–1 (sample #W-5673, Y-6, fig. 9.3, p. 117). This age is supported by an additional ^{14}C date of 9.8 ka ± 0.3 ka that was determined on carbonized wood from the same stratigraphic unit (Qf deposits) exposed about 1 km southwest of Trench BF–1 in a vertical bank adjacent to the Amargosa River (sample #W-5676, Y-6, p. 118). In addition, a comparison of maximum scarp–slope angles for BS with those for dated fault scarps in north–central Nevada suggested to Y-6 (p. 116) that BS is younger than 12 ka but is "more than a few thousand years in age."

Beatty scarp (BS) — Continued

In contrast, uranium–trend analyses yielded an age estimate of 480 ka ± 50 ka for the Qf deposits (the same stratigraphic unit that contained the carbonized wood that was dated at about 10 ka; Y-6, p. 118). In addition, similar analyses suggested an age of about 70 ka for gravelly alluvium (their Q2c deposits). This age conflicts with the older age estimate "in that it infers that the fan composed of unit Q2c truncated by the scarp is younger than post–scarp deposits of unit Qf" (Y-6, p. 118). These inconsistencies in age estimates could not be resolved by Y-6 (p. 118).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Measurement of twenty–five topographic profiles across the scarp (Y-6, p. 116), but no plotted profiles are shown by them. Maximum scarp angles are summarized by Y-6 (p. 116) in a histogram and correlated to histograms of scarp–slope angles compiled for young fault scarps in north–central Nevada by Wallace (1977, Y-1118). Surficial mapping and a crude map that combines six Quaternary deposits into three units (Y-6, fig. 9.1, p. 114, table 9.1, p. 115-116). There are no independent age determinations for the deposits, which have been correlated to Quaternary stratigraphic units near the Nevada Test Site. Trenches (BF–1 and BF–2, Y-6, p. 116-117; Y-18). Sketch logs of these trenches are included in Y-6 (figs. 9.3 and 9.4, p. 117) and are summarized in Y-18. Radiometric age determinations (Y-6, p. 118). High–resolution seismic–reflection survey using MINI–SOSIE technique (Y-6, p. 119; Y-113, p. 121-123). Seismic–refraction profiles (Y-6, p. 118, fig. 9.5; Y-629, p. 139-140).

Relationship to other faults: No information.

Belted Range fault (BLR)

Plate or figure: Plate 1.

References: Y-5: Ekren and others, 1971; Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pls. 1 and 2); Y-853: Dohrenwend and others, 1992.

Location: 55 km/22° (distance and direction of closest point from YM) at lat 37°18′N. and long 116°13′W. (location of closest point). BLR is located along the western side of the Belted Range and along the eastern side of Kawich Valley.

USGS 7-1/2′ quadrangle: Belted Peak, Lambs Pond, Monotony Valley, Oak Spring Butte, Quartet Dome, Rhyolite Knob, Sundown Reservoir, Wheelbarrow Peak.

Fault orientation: The strike of the southern half of BLR averages north–northeast. The strike of the northern half averages north. BLR curves so that short sections strike in directions between north–northwest and north–northeast (Y-5; Y-232; Y-813; Y-853).

Fault length: The length of BLR is 38 km as estimated from Y-853. This length includes a 7–km–long gap in surficial expression. The length of BLR is 51 km as estimated from Y-813, 53 km as estimated from Y-5, and 54 km as estimated from Y-232. BLR north of Antelope Reservoir is shown as three subparallel strands by Y-5.

Style of faulting: No information.

Scarp characteristics: BLR is shown primarily as west–facing scarps (Y-5; Y-232; Y-813).

Displacement: Displacement on BLR near Cliff Spring has been interpreted from gravity data to be >610 m (2,000 ft), valley side down, by Y-5 (p. 70) and by Y-232 (p. 32), *both citing* D.L. Healy (oral commun., 1964).

Age of displacement: BLR at two localities is portrayed by Y-853 as scarps on depositional or erosional surfaces of late Pleistocene age (their Q_2 surfaces with estimated ages between 10 ka and 130 ka). They portrayed BLR at two other localities as scarps on surfaces of early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). BLR at another locality is shown on surfaces of early to middle Pleistocene age (their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma).

BLR is shown by Y-813 as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping. She also portrayed BLR as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits.

BLR is shown by Y-5 as concealed by Pliocene through Holocene alluvium and colluvium (their QTa deposits). However, Y-5 (p. 70) reported that BLR is expressed on aerial photographs as a "feeble" lineament and as "small offsets of older alluvium." Y-232 (pl. 1) showed most of BLR as concealed by Quaternary alluvium (his Qal deposits). Both Y-5 and Y-232 portrayed an 8–km–long section at the southern end of BLR as a fault in Tertiary rocks (Y-5; Y-232, pl. 1).

Earliest displacement on BLR, and on other north–striking faults in the adjacent area, is interpreted by Y-5 (p. 70-71) as occurring after extrusion of the Timber Mountain Tuff (early Pliocene; about 11 Ma to 13 Ma).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: BLR is portrayed by Y-853 as a major range–bounding fault that borders a tectonically active range front, which is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to the range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high-gradient, narrow, steep–sided canyons orthogonal to range front." Portions of BLR are shown by Y-813 as topographic lineaments bounding a linear range front.

Belted Range fault (BLR) — Continued

Analysis: Aerial photographs (Y-5; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000). Field mapping (Y-5).

Relationship to other faults: BLR is approximately parallel to other north–northeast– and north–northwest–striking faults along major range fronts in the area (Y-813; Y-853). These faults include the Hot Creek–Reveille fault (HCR) along the eastern side of the Kawich Range northwest of BLR, the Kawich Range fault (KR) along the western side of the Kawich Range east of BLR, and the West Railroad fault (WR) along the eastern side of the Reveille Range and the East Reveille fault (ERV) along the western side of the Reveille Range, both immediately north of BLR. BLR also parallels north–northeast– and north–northwest–striking faults within basins in the area, such as the Cactus Flat fault (CF) and the Cactus Flat–Mellan fault (CFML) both in Cactus Flat that is northwest of BLR, the Emigrant Valley North fault (EVN) in Emigrant Valley east of BLR, and the Kawich Valley faults (KV) along the western side of Kawich Valley immediately west of BLR (Y-813; Y-853). The relationship between BLR and KV, which bound opposite sides of Kawich Valley, is not known. The relationship between BLR and ERV, which is immediately north of BLR and has a strike similar to that of BLR, is also not known.

Bonnie Claire fault (BC)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989: Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 2); Y-407: Albers and Stewart, 1972; Y-853: Dohrenwend and others, 1992.

Location: 74 km/304° (distance and direction of closest point from YM) at lat 37°13′N. and long 117°08′W. (location of closest point). BC bounds ridges west of Bonnie Claire Lake (west of Sarcobatus Flat).

USGS 7-1/2′ quadrangle: Bonnie Claire, Bonnie Claire Lake, Gold Mountain, Scottys Castle, Scottys Junction, Scottys Junction SW.

Fault orientation: BC generally strikes northeast (Y-232; Y-238; Y-853). Some individual traces in BC curve, so that their strikes range between north–northwest and east–northeast (Y-232; Y-238; Y-853).

Fault length: The total length of BC is about 27 km as estimated from Y-238. The lengths of individual fault traces range between 1 km and 8 km as estimated from Y-238.

Style of faulting: Displacements on fault traces near and southwest of Bonnie Claire Lake are generally down to the northwest (Y-238). Displacements on fault traces north of Bonnie Claire Lake are generally down to the southeast (Y-238).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The longest down–to–the–southeast fault trace at the northeastern end of BC (just southwest of Scottys Junction) is shown by Y-232 as displacing Quaternary alluvium (his Qal deposits). The map by Y-853 shows fault traces of BC at Bonnie Claire Lake primarily as scarps and (or) prominent topographic lineaments on surfaces of Tertiary volcanic and sedimentary rocks. This map may portray one curving trace immediately west of Bonnie Claire Lake as juxtaposing Quaternary alluvium against bedrock (difficult to differentiate line width on map). Y-238 portrayed portions of BC as weakly expressed or prominent lineaments or scarps on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with BC, although some fault traces do bound outcrops of Timber Mountain Tuff (Tp unit of Y-232; Ttm unit of Y-407; about 11 Ma). The escarpments along some of these outcrops are linear. Y-238 showed additional fault traces primarily as topographic lineaments that bound linear bedrock ridges.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: BC is one of several northeast–striking faults that mostly bound the northwestern sides of ranges, such as the Grapevine Mountains (Grapevine Mountains fault (GM)), Gold Mountain (Gold Mountain fault (GOM)), Magruder Mountains (Lida Valley faults (LV)), possibly Slate Ridge (Slate Ridge faults (SLR)), and the southeastern sides of Magruder Mountain (East Magruder Mountain fault (EMM)), and part of the Palmetto Mountains (Lida Valley faults (LV); Y-238, p. 4). Y-10 (p. 59) and Y-238 (p. 4) suggested that these northeast–striking faults could be conjugate shears of the northwest–striking Furnace Creek fault (FC) to the west, but the expected left–lateral displacement on BC and on the other northeast–striking faults has not been documented by field observations. Thus, Y-10 (p. 59) and Y-238 (p. 4) suspected that the northeast–striking faults are an expression of dip–slip displacement perpendicular to a northwest least–principal–stress direction.

Bonnie Claire fault (BC) — Continued

Scarps and (or) lineaments on surfaces of Tertiary deposits are shown as part of BC on plate 1 of this compilation only where they align with fault traces portrayed at least in part as having possible Quaternary displacement. Other scarps and (or) prominent topographic lineaments that are shown by Y-238 and Y-853 (primarily) to be on surfaces of Tertiary deposits between BC and the Gold Mountain fault (GOM) are not on plate 1. Some of these scarps and lineaments correlate with some of the numerous faults in Tertiary volcanic rocks shown by Y-232 and Y-407. These scarps and lineaments extend north to the eastern end of Slate Ridge where their trends are more northerly than the strikes of fault traces included in BC. If the faults between BC and GOM are included in BC, then BC could be as wide as 15 km. In addition, the boundary between BC and GOM would not be as clear as it appears on plate 1 and would be indicated only by a slight change in fault strike.

Y-407 (p. 51) described the geologic structure between Grapevine Canyon and Gold Mountain (the area of BC) as ash flows (Timber Mountain Tuff) that strike east–northeast and dip southeast. According to Y-407 (p. 51), the tuffs are cut by three prominent east–striking faults downdropped on the north and by minor northeast–striking faults (BC?) that branch from the east–striking faults and that are downdropped on the northwest.

Boundary fault (BD)

Plate or figure: Plate 1.

References: Y-50: Barnes and others, 1963 (name from this reference); Y-90: Szabo and others, [1981]; Y-181: Carr, 1974; Y-224: Frizzell and Shulters, 1990; Y-526: Swadley and Hoover, 1990; Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992.

Location: 51 km/38° (distance and direction of closest point from YM) at lat 37°13′N. and long 116°05′W. (location of closest point). BD is located at the northern end of Yucca Flat.

USGS 7-1/2′ quadrangle: Oak Spring.

Fault orientation: BD strikes northeast and is slightly sinuous. A northern extension of BD strikes north (Y-50; Y-224; Y-853).

Fault length: Mapped lengths of BD range between about 3 km and about 6.5 km. BD is shown on two maps as between Oak Spring Wash and Butte Wash only for a length of 3 km (Y-813) or about 3.5 km (Y-224). Y-526 indicated a total length of about 5 km for BD between Smoky Hills and Butte Wash. Y-50 extended the length of BD to about 6.5 km by mapping concealed portions to the south (~2 km) and north (~0.5 km). The map by Y-853 shows BD as two sections: a northeast–striking one that is 3 km long (the northeastern end of the fault mapped by Y-224 and Y-813) and a north–striking one (the northern extension) that is also 3 km long.

Style of faulting: BC is shown by Y-526 and Y-813 as down to the southeast with dip–slip (normal) displacement.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Y-526 implied that the youngest displacement on BD is Quaternary and could be late Pleistocene, because the fault is observable on aerial photographs on surfaces of Quaternary alluvial deposits of two different ages, one with an estimated age between about 160 ka and at most 800 ka (their Qap deposits) and one with an estimated age of >740 ka (their QTa deposits). They also showed part of BD as a faulted contact between Cretaceous intrusive rocks and their Qap or QTa deposits.

Y-90 (p. 17, 19, 28) reported dates (uranium–thorium analyses; samples 50 and 51, tables 1 and 3) of >8 ka and ≥24 ka for laminar caliche exposed in a trench across BD. The younger caliche has been displaced by BD; the older caliche is from the fault zone (Y-90, p. 28). Consequently, fault displacement occurred after deposition of most of the laminar caliche. They (Y-90, p. 28) noted that the morphology of the scarp associated with BD "suggests younger significant offset than on the Rock Valley fault." A comparison of the characteristics of this scarp to those of scarps in north–central Nevada studied by Wallace (1977, Y-1118, p. 1,275) suggested to them (Y-90, p. 28) that the scarp along BD formed about 10 ka. On the basis of the uranium–thorium analyses and the scarp characteristics, they concluded that the fault "may have moved a little as recently as 8,000 years ago" (table 3, p. 19).

A 3–km–long section of the northeast–striking portion of BD is portrayed by Y-853 as a scarp on depositional or erosional surfaces of early to middle Pleistocene age (their Q_I surfaces with estimated ages between 130 ka and 1.5 Ma).

Y-526 portrayed BD as concealed beneath Holocene (≤10 ka) alluvium (their Qah deposits) at the mouth of Oak Spring Wash.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Boundary fault (BD) — Continued

Analysis: Aerial photographs (Y-526, scale 1:24,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000). Limited field examination (Y-526). Analyses of samples from a trench across the fault (Y-90, p. 28).

Relationship to other faults: The northern end of BD is portrayed by Y-224 as merging with the north-striking Yucca fault (YC). Y-50 and Y-853 indicated that this end of BD merges with the north-striking Butte fault (BT, part of the Oak Spring Butte faults of this compilation) along the eastern side of Oak Spring Butte. The southern end of BD is shown by Y-224 as merging with the north-northeast-striking Carpetbag fault (CB). The exact relationships among these faults are not known.

Bow Ridge fault (BR)

Plate or figure: Figure 3.

References: Y-26: Swadley and others, 1984 (their Fault C, p. 13); Y-46: Maldonado, 1985; Y-55: Scott and Bonk, 1984 (name from their pl. 1); Y-73: Hoover and others, [1981]; Y-74: Hoover, 1989; Y-87: Taylor and Huckins, 1986; Y-189: Lipman and McKay, 1965; Y-217: Gibson and others, 1991; Y-224: Frizzell and Shulters, 1990; Y-238: Reheis and Noller, 1991 (pl. 3); Y-298: Gibson and others, 1990; Y-396: Scott, 1990; Y-576: O'Neill and others, 1991; Y-577: Wesling and others, 1991; Y-586: Zartman and Kwak, 1991; Y-772: Neal, 1986; Y-773: Carr, 1991; Y-1042: O'Neill and others, 1992; Y-1091: Menges and others, 1993; Y-1239: Wesling and others, 1992.

Location: 1 km/90° (distance and direction of closest point from YM) at lat 36°50′N. and long 116°26′W. (location of closest point). BR bounds the western side of the main part of Midway Valley along the western sides of Bow Ridge and Exile Hill.

USGS 7-1/2′ quadrangle: Busted Butte, Pinnacles Ridge.

Fault orientation: BR strikes generally north (Y-26, pl. 1, p. 13; Y-87, p. 418). Where it is exposed in Tertiary rocks on the western side of Bow Ridge, BR dips 75° W. (Y-55, pl. 1). BR is nearly vertical where it is exposed in Trench 14 (Y-87, p. 418) and dips 76° W. where it is exposed in Trench 14D (Y-1091, p. 120). Y-396 (p. 259) reported an average dip for BR of 69°, which was calculated on the basis of three measurements.

Fault length: Y-26 (p. 13) reported that BR extends at least 6 km north from Trench 15, which is located adjacent to Bow Ridge, but that BR does not appear to cross Yucca Wash. Y-1042 (p. 10) noted that BR may terminate on the north in Midway Valley and extend to the south to intersect the Paintbrush Canyon fault (PBC). Y-217 (p. 47) estimated a length of 9 to 10 km for BR from maps by Y-46, Y-55, and Y-224.

Style of faulting: Y-55 (pl. 1) showed BR as a dip–slip (normal) with down–to–the–west displacement. Y-1091 (p. 120) interpreted striations that plunge 65° to 20° on carbonate fault laminae as indicating left–oblique displacement. Y-1042 (p. 12) also inferred a component of left–lateral displacement on BR from a rhombic–shaped structural depression that is bounded on the east by BR.

Scarp characteristics: No information.

Displacement: As noted in Y-217 (table 4-1, p. 46), who cited data from Y-298, BR has an apparent vertical separation of 220 m in the Topopah Spring Member of the Paintbrush Tuff (13.1 ± 0.8 Ma; K-Ar). It has an apparent vertical separation of 120 m in the Tiva Canyon Member of the Paintbrush Tuff (12.5 ± 1.1 Ma; K-Ar). As also noted in Y-217 (table 4-2, p. 48), using data from Y-55, Y-772, and Y-773, the stratigraphic dip separation of the Topopah Spring Member along BR ranges between 115 ± 5 m and 145 ± 5 m at the northern end of BR adjacent to Exile Hill (Y-217, fig. 4-9, p. 62, fig. A-1, p. A-2, figs. 4-11 and 4-12, p. 66, 67) to 220 ± 5 m in the central part of BR just north of Bow Ridge (Y-217, figs. 4-9 and 4-10, p. 62, 63). Y-217 (p. 46) reported that displacement in their Q2s deposits (38 ka to 270 ka; uranium–trend analyses) has been limited to fracturing.

On the basis of exposures in a trench, Y-1091 (p. 120) inferred (1) a cumulative vertical displacement of 45 cm since middle Quaternary, (2) a cumulative net (left–oblique) displacement of 76 to 132 cm during the same time period, (3) a vertical displacement per event between 5 and 20 cm and averaging about 10 cm, and (4) an average net (left–oblique) displacement per event between 11 and 28 cm.

Age of displacement: On the basis of exposures in Trench 14 and uranium–trend analyses, Y-26 (table 4, p. 21) interpreted the youngest event on BR to have occurred between 270 ± 90 ka and 38 ± 10 ka, because their Q2s deposits with an estimated age of 270 ka to 700 ka are fractured by BR but their Q2a deposits with an estimated age of about 40 ka overlie BR. However, Y-217 (p. 50) noted that the dates on which this interpretation was made are inconsistent. Y-87 (p. 418) concluded that the most–recent event exposed in Trench 14 is represented by an undated basaltic ash that is preserved in the fault zone and in fractures; they correlated this ash with 1.2 Ma and 0.27 Ma ashes from Crater Flat. Y-87 (p. 418) reported that sandy colluvium faulted down against the Tiva Canyon Member of the Paintbrush Tuff has a minimum age of 490 ± 90 ka (uranium–trend analyses); an opaline band within the sandy colluvium yielded a date of >500 ka (uranium–series analyses).

Y-87 (p. 418) interpreted an eolian unit that yielded dates of 90 ± 50 ka and 38 ± 10 ka (uranium–trend analyses) as "not demonstrably fractured or offset by faulting." Y-87 (p. 418) further concluded that the K–horizon developed in the sandy colluvium and that yielded dates of 490 ± 90 ka and >500 ka is fractured but not displaced. Y-1091 (p. 120) concluded that the two youngest events on BR (out of a total of five or six recognized) occurred during the late Pleistocene.

The map by Y-55 (pl. 1) shows BR as concealed beneath alluvium over much of its length. Y-1042 (p. 7, 10) noted that BR is difficult to recognize on aerial photographs at a scale of 1:12,000, but identified north–trending tonal contrasts and aligned drainages along the western side of Exile Hill, along with segmented, left–stepping drainage alignments, all which probably correspond to BR. They also identified a small scarp along a projection of BR between Bow Ridge and Boundary Ridge (Y-1042, p. 7). Lineaments that may be associated with BR were also recognized by Y-1239 (p. 45-46) along the contact between bedrock and alluvium north of Bow Ridge and along Exile Hill and within alluvium north of Exile Hill. Y-577 (p. A119) identified lineaments of possible tectonic origin on surfaces of colluvial and alluvial deposits along BR in Midway Valley.

Slip rate: Based on 220 m of displacement since 12.3 Ma to 13.9 Ma as suggested by Y-217 (table 4-1, p. 46), the apparent vertical slip rate on BR since that time has been 0.016–0.018 mm/yr. Based on 120 m of displacement since 11.4 Ma to 13.6 Ma as suggested by Y-217 (table 4-1, p. 46), the apparent vertical slip rate on BR since that time has been 0.009–0.011 mm/yr. Y-1091 (p. 120) estimated that slip rates on BR during middle and late Quaternary have been very low (about 0.001 mm/yr).

Recurrence interval: Y-1091 (p. 120) concluded that displacements in fault colluvium and buried soils exposed in Trench 14D, along with degraded fault scarps, suggest five to six surface–rupturing events during the middle and late Quaternary with long recurrence intervals (10^4 to 10^5 yr) between events.

Range-front characteristics: No tectonic geomorphic interpretation of the west sides of Bow Ridge and Exile Hill has been done.

Analysis: Compilation of published and unpublished information (Y-26, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000) and vertical aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-1239, p. 3, scales 1:6,000, 1:12,000, and 1:60,000). Mapping of surficial deposits and field investigations in Midway Valley (Y-1239, p. 3). Trenches, chiefly Trench 14 excavated along the northwestern side of Exile Hill (Y-26, table 1, p. 5; Y-87, p. 418) and Trench 14D (Y-1091, p. 120). Y-26 (pl. 1, p. 13) noted that another trench across BR exists, Trench 15 on the western side of Bow Ridge, but they did not discuss it or show the results on their table 1 (p. 5). Y-217 (p. 50) mentioned that five additional trenches were planned in the area of Trench 14 but that these were not yet completed. Where BR is obscured by alluvium, the fault has been located on the basis of anomalies observed in geophysical survey data (Y-55, pl. 1).

Bow Ridge fault (BR) — Continued

Relationship to other faults: Y-1042 (p. 7) suggested that northwest–trending linear features (e.g., linear drainages, tonal contrasts, vegetation alignments) that extend from Bow Ridge to Fran Ridge onto alluvial surfaces near Fortymile Wash may structurally connect BR to the Paintbrush Canyon fault (PBC), which bounds the eastern side of Midway Valley. These linear features coincide with short faults mapped by Y-55 (pl. 1). Y-26 (pl. 1) and Y-55 (pl. 1) also suggested that the southern end of BR may merge with PBC. Y-217 (p. 47, 49) interpreted the northern end of BR as obliquely intersecting their proposed northwest–striking Yucca Wash fault.

Bullfrog Hills faults (BUL)

Plate or figure: Plate 1.

References: Y-43: Cornwall and Kleinhampl, 1964; Y-232: Cornwall, 1972. Not shown by Reheis and Noller, 1991 (Y-238, pl. 3), unless a northwest–trending scarp in southern Sarcobatus Flat is part of BUL.

Location: 38 km/280° (distance and direction of closest point from YM) at lat 36°52′N. and long 116°55′W. (location of closest point). BUL includes four faults in the Bullfrog Hills between Sawtooth Mountain and the Grapevine Mountains on the east and west, and between Sarcobatus Flat and Crater Flat on the north and south.

USGS 7-1/2′ quadrangle: Beatty, Bullfrog Mountain.

Fault orientation: Faults in BUL generally strike north–northwest to northwest (Y-232).

Fault length: The eastern and western faults in BUL are about 7 km long; the other two faults are about 4 km long. (Lengths are estimated from Y-232.)

Style of faulting: The two longer faults in BUL (the only ones for which type displacement is shown) are both down to the southwest (Y-232, pl. 1).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Parts of each of the four faults are shown by Y-232 (pl. 1) within Quaternary alluvium (his Qal deposits) or as faulted contacts between Tertiary volcanic and sedimentary rocks (chiefly Miocene rhyolite (his Tr unit) and Pliocene Timber Mountain Tuff (his Tp unit)) and his Qal deposits. The two longer faults and the western fault of the two shorter ones are all shown by Y-43 (pl. 1) as concealed by Quaternary alluvium (their Qal deposits). Short portions (≤about 0.5 km) of the eastern fault of the two shorter ones are shown by Y-43 (pl. 1) as a faulted contact between Tertiary welded tuff (their Tw unit) and their Qal deposits (primarily), or between pre–Tertiary rocks and their Qal deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range fronts are associated with the four faults in BUL.

Analysis: Aerial photographs (Y-232).

Relationship to other faults: All four faults of BUL are within the Bullfrog Hills caldera (Y-232, pl. 1 and fig. 2, p. 29). Other faults in the Bullfrog Hills cut Tertiary rocks (Y-232, pl. 1), but these faults are not portrayed as having possible Quaternary displacement, so they are not shown on plate 1 of this compilation. Y-232 (p. 33-34) suggested that displacement on all of these faults, those considered part of BUL plus the other faults not shown on plate 1, may have been caused by subsidence of the caldera.

The map of Y-238 (pl. 3) shows a curving, northwest–trending, down–to–the–northeast, weakly expressed scarp on the surface of a Quaternary deposit just north of the Bullfrog Hills in Sarcobatus Flat. This scarp has a trend similar to the strikes of the four faults in BUL (north–northwest) and is located near the edge of the caldera. Although this scarp could be part of the Sarcobatus Flat fault (SF), its trend is more northwesterly than the strike of SF, and it is separated from faults in SF by nearly 15 km. This scarp is only 4 km north of faults in BUL. Whether or not this scarp is related to the faults in BUL is unknown.

The relationship of BUL to either the Beatty scarp (BS) or to the Bare Mountain fault (BM), both southeast of the Bullfrog Hills, is not known.

Buried Hills faults (BH)

Plate or figure: Plates 1 and 2.

References: Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3); Y-813: Reheis, 1992 (pls. 2 and 3); Y-852: Dohrenwend and others, 1991 (show only that part of BH south of lat 37°N., the northern edge of their map area). Not shown by Ekren and others, 1977 (Y-25).

Location: 53 km/85° (distance and direction of closest point from YM) at lat 36°52′N. and long 115°51′W. (location of closest point). BH includes two main faults adjacent to the Buried Hills: one along their eastern side and the other along their western side. It also includes a fault along northern Nye Canyon, which is located about 3 km west of the Buried Hills.

USGS 7-1/2′ quadrangle: Aysees Peak, Frenchman Lake, Frenchman Lake SE, Papoose Lake, Plutonium Valley.

Fault orientation: BH strikes generally north, but the individual faults curve so that sections strike between north–northwest and north–northeast (Y-813).

Fault length: The fault along the eastern side of the Buried Hills and the fault along Nye Canyon are both 10 km long as estimated from Y-813. The total length of the fault along the western side of the Buried Hills is about 26 km as estimated from Y-813. This length includes three overlapping traces that result in nearly continuous surface expression for about 17 km and several discontinuous, short (0.5 to 1.5 km long) traces for another about 9 km to south of Aysees Peak (Y-813). BH is 4 km wide as estimated from Y-813.

Style of faulting: The fault along the eastern side of the Buried Hills is down to the east (Y-813). The fault along the western side of the Buried Hills and the fault along Nye Canyon are shown by Y-813 as down to the west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Faults in BH are shown by Y-813 primarily as either lineaments along a linear range front or as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary and Tertiary deposits. She also portrayed portions of some as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping. Faults in BH are also shown by Y-404 as juxtaposing Pleistocene(?) older alluvium (their Qol deposits) against bedrock. Faults of BH south of lat 37°N. are portrayed by Y-852 as juxtaposing Quaternary alluvium against bedrock.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Portions of range fronts along some faults within BH are shown by Y-813 to be linear. Portions of range fronts south of lat 37°N. are shown by Y-852 as having a morphology similar to that along major range–front faults.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000). Field mapping (Y-404, p. 2).

Buried Hills faults (BH) — Continued

Relationship to other faults: Fault traces at the northern end of BH along the eastern side of the Buried Hills strike north–northeast and are approximately parallel to and aligned with fault traces to the north within southern Emigrant Valley (Emigrant Valley South fault, EVS). BH as a whole is approximately parallel to faults to the east, such as the Chert Ridge faults (CHR) along both sides of Chert Ridge, the Indian Springs Valley fault (ISV) along the eastern side of the Spotted Range, the Spotted Range fault (SPR) along the western side of the Spotted Range, the Fallout Hills faults (FH) within the Fallout Hills, and the three faults along and within the Pintwater Range (the East Pintwater Range fault (EPR), the Central Pintwater Range fault (CPR), and the West Pintwater Range fault (WPR)). Faults at the southern end of BH along the western side of the Buried Hills strike obliquely to the northeast–striking Rock Valley fault (RV).

Cactus Flat fault (CF)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (her Cactus Flat lineament, pl. 1); Y-1108: Locke and others, 1940. Not shown by Cornwall, 1972 (Y-232), except for a concealed fault that is shown along the eastern side of the Cactus Range at the southern end of CF. Not shown by Dohrenwend and others, 1992 (Y-853).

Location: 84 km/343° (distance and direction of closet point from YM) at lat 37°35'N. and long 116°44'W. (location of closest point). Most of CF is located along the western side of Cactus Flat and separates Cactus Flat from the basin of Mud Lake to the west (Y-813, p. 6). The southern end of CF is located along the southeastern side of the Cactus Range.

USGS 7-1/2' quadrangle: Breen Creek, Cactus Spring, East of Cactus Peak, Mellan, Reeds Ranch, Roller Coaster Knob, Stinking Spring NW, Stinking Spring SW, Trappman Hills.

Fault orientation: CF strikes generally north (Y-813). However, its northern end strikes north–northeast, and its southern end strikes north–northwest.

Fault length: The length of CF is 50 km as estimated from Y-813 between the northern end of her map area at lat 38°N. and south of Antelope Hill (north of Mount Helen). This length includes a gap in surficial expression along the eastern side of the Cactus Range. This gap is nearly 5 km long as estimated from Y-813.

Style of faulting: Y-813 shows four north–northeast–trending folds subparallel to the northern end of CF just south of lat 38°N. She (p. 6) suggested that these folds indicate that Quaternary compression has been associated with CF.

Scarp characteristics: CF is shown by Y-813 as having both east– and west–facing scarps at its northern end, as primarily west–facing scarps in Cactus Flat, and as primarily east–facing scarps (one is west–facing) at its southern end along the Cactus Range.

Displacement: No information.

Age of displacement: Much of the northern portion of CF in Cactus Flat is shown by Y-813 (pl. 1) as prominent topographic lineaments that she (Y-813, p. 4) interpreted as suggesting Quaternary displacement. Some of this portion of CF also is portrayed by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary (chiefly) and Tertiary deposits. Other parts of CF are shown by Y-813 as faults that are in Tertiary deposits and that were identified by previous mapping. The southern portion of CF along the Cactus Range is shown by Y-813 as weakly expressed to prominent lineaments and scarps on surfaces of Tertiary deposits.

Late Pleistocene displacement along CF is inferred by Y-813 (p. 6) on the basis of (1) the diversion of drainages by west–facing scarps along CF (e.g., drainage from the Kawich Range to the east is ponded in an unnamed playa north of Antelope Lake), (2) the small drainages that flow along and are diverted by left–stepping scarps of CF on surfaces of Quaternary deposits, and (3) the lack of pluvial–lake shorelines and local topography, which both together suggest that Cactus Flat basin was once contiguous with Mud Lake basin (before late Pleistocene?) and that the two basins were separated by displacement along CF.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: Clusters of lineaments and (or) scarps with trends similar to the strike of CF are preserved 5 to 10 km east of CF in Cactus Flat. These lineaments and (or) scarps are combined into the Cactus Flat–Mellan fault (CFML) of this compilation. The relationship between CFML and CF is not known.

Cactus Flat fault (CF) — Continued

Y-232 (p. 32) stated that the Cactus Range is a horst. The east–bounding fault correlates with faults at the southern end of CF along the Cactus Range. Y-232 (p. 32) suggested that deformation resulting in the Cactus Range occurred primarily during the Miocene and was related to volcanic activity, but Y-1108 (Y-232, p. 32, *citing* Y-1108) speculated that the southeast elongation of the range may be related to the northwest–trending Walker Lane.

A discontinuity in the bedrock units that flank Mount Helen south of the Cactus Range, just south of and aligned with the southernmost fault traces of CF (pl. 1), has been suggested to be due to strike–slip faulting related to the Walker Lane (Ekren and others, written commun., 1966, *cited in* Y-232, p. 33). The relationship between this possible fault and CF is not known.

Cactus Flat–Mellan fault (CFML)

Plate or figure: Plate 1.

References: Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pls. 1 and 2). Only a few faults of CFML, as mapped by Y-813, are shown by Y-232. Not shown by Dohrenwend and others, 1992 (Y-853).

Location: 80 km/355° (distance and direction of closest point from YM) at lat 37°34′N. and long 116°38′W. (location of closest point). CFML includes several clusters of lineaments and scarps within Cactus Flat between about Gold Mountain and north of Mellan, Nevada, and east of the prominent Cactus Flat fault (CF).

USGS 7-1/2′ quadrangle: Breen Creek, Mellan, Roller Coaster Knob, Stinking Spring SW, Trappman Hills, Triangle Mountain.

Fault orientation: The strike of the entire CFML is approximately north (Y-813). Individual lineaments and scarps or clusters of lineaments and scarps trend between northeast and northwest (Y-813).

Fault length: The length of CFML, which extends from north of Gold Hill to north of Mellan, is about 35 km as estimated from Y-813. The width of CFML is about 10 km as estimated from Y-813.

Style of faulting: No information.

Scarp characteristics: Scarps within CFML are shown by Y-813 as both east– and west–facing.

Displacement: No information.

Age of displacement: CFML is portrayed by Y-813 as weakly expressed to prominent lineaments or scarps on surfaces of Quaternary deposits (primarily) or as topographic lineaments bounding a linear range front or in bedrock. Two fault traces between Gold Mountain and Mellan are shown by Y-232 as faulted contacts between Tertiary volcanic rocks and Quaternary alluvium (his Qal deposits). One of these two fault traces is also shown by Y-813.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with CFML, although some of the faults do bound linear ridges or outcrops of Tertiary volcanic rocks (Y-813).

Analysis: Aerial photographs (Y-232; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: CFML includes several groups of lineaments and scarps in Cactus Flat. Although lineaments and scarps in CFML have slight differences in trend and in relationships to geologic and topographic features, these lineaments and scarps are combined into one fault because of their location in Cactus Flat and their general north alignment. CFML does not include scarps and lineaments recognized as part of the prominent, nearly continuous Cactus Flat fault (CF) that was identified by Y-813 (pl. 1, p. 6). The structural relationship between CFML and CF is not known. CFML is shown separately from CF, although the strikes of the two faults are similar, because (1) CFML lies east of the relatively well–defined CF, (2) CFML is more discontinuous than CF, and (3) lineaments and scarps in CFML are more widely scattered than those in CF.

The structural relationships between CFML and other faults surrounding Cactus Flat are not known. These include faults bounding the eastern side of Stone Cabin Valley, the East Stone Cabin fault (ESC), which is directly north of CFML, and faults bounding the western side of the Kawich Range, the Kawich Range fault (KR), which is northwest of CFML. North of Silverbow, Nevada, ESC generally strikes more northeastward than CFML, although one trace of ESC strikes northward, which is similar to the strike of CFML. South of Silverbow, KR strikes northwest, which is markedly different from the general north strike of CFML.

Cactus Flat–Mellan fault (CFML) — Continued

The relationship between CFML and the Gold Flat fault (GOL), which is immediately south of CFML, also is not known. GOL generally strikes northeast, in contrast to the nearly north strike of CFML. However, a few fault traces in GOL do strike northward.

Fault traces at the southern end of CFML, near Gold Mountain, are subparallel to faults, lineaments, and scarps shown by Y-232 and Y-813 to affect Tertiary volcanic rocks. Only those features noted with possible Quaternary displacement are portrayed on plate 1 of this compilation.

Cactus Range–Wellington Hills fault (CRWH)

Plate or figure: Plate 1.

References: Y-5: Ekren and others, 1971; Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pl. 1). Not shown by Dohrenwend and others, 1992 (Y-853).

Location: 87 km/337° (distance and direction of closest point from YM) at lat 37°34′N. and long 116°49′W. (location of closest point). The northern portion of CRWH includes fault traces along the western side of the Cactus Range. The southern portion of CRWH includes fault traces along the western side of the Wellington Hills.

USGS 7-1/2′ quadrangle: Cactus Peak, Cactus Spring, Civet Cat Cave, White Patch Draw.

Fault orientation: CRWH strikes generally northwest, but CRWH curves so that the northern and southern ends strike north (Y-813).

Fault length: The length of CRWH is about 29 km as estimated from Y-813. This length includes about 15 km of fault traces at the northern end of CRWH along the Cactus Range, a 7–km–long gap in surficial expression, and about 7 km of fault traces at the southern end of CRWH along the Wellington Hills. The length of CRWH is about 25 km as estimated from Y-232, of which 17 km on the fault's southern end apparently has no surficial expression (shown as concealed by Y-232).

Style of faulting: Most of CRWH is shown by Y-813 as having down–to–the–west or down–to–the–southwest displacement.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: CRWH is portrayed by Y-813 primarily as weakly to moderately expressed lineaments and scarps on surfaces of Tertiary deposits, as faults that are in Tertiary deposits and that were identified by previous mapping, and as prominent topographic lineaments where upper Cenozoic deposits are juxtaposed against bedrock. At one locality near Sleeping Column Canyon, CRWH is shown by Y-813 as a moderately expressed scarp or lineament on surfaces of Quaternary deposits. In contrast, Y-232 portrayed the northern 8 km of CRWH as a fault in Tertiary rocks and the southern 17 km as concealed by Quaternary alluvium (his Qal deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000). Information shown by Y-232 was taken in part from Y-5.

Relationship to other faults: Y-232 (p. 32) noted that the Cactus Range is a northwest–trending horst that is bounded by "an elliptical ring of mapped and inferred faults. The complex structural evolution of the range is believed to have resulted mainly from volcano–tectonic deformation in the Miocene, but the northwest–southeast elongation of the range may be related to a major regional northwest–trending lineament, such as the Walker Lane * * *, whose extension may pass near or along the Cactus Range" (Y-232, p. 32).

The relationship of CRWH to the Cactus Flat fault (CF) along the southeastern side of the Cactus Range, to the northeast–striking Stonewall Mountain fault (SWM) along the northern side of Stonewall Mountain west of CRWH, or to the north–striking Pahute Mesa faults (PM) directly south of CRWH on Pahute Mesa is not known.

Cactus Springs fault (CAC)

Plate or figure: Plate 2.

References: Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991.

Location: 59 km/119° (distance and direction of closest point from YM) at lat 36°35'N. and long 115°52'W. (location of closest point). CAC is located along the northern side of an unnamed ridge northwest of Cactus Springs, Nevada.

USGS 7-1/2′ quadrangle: Indian Springs, Indian Springs NW, Mercury NE, Mercury SE.

Fault orientation: CAC has a curving strike that ranges between east–northeast, east, and west–northwest.

Fault length: CAC is mapped continuously along the base of the unnamed ridge for about 12 km as estimated from Y-813 and Y-852. A 2–km–long fault trace that is slightly north of the unnamed ridge is also shown by Y-852.

Style of faulting: CAC is portrayed by Y-813 (pl. 3) as down to the north.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Part of CAC is shown by Y-813 (pl. 3) as weakly to moderately expressed lineaments or scarps on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Most of CAC is portrayed by Y-852 as a fault juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of the northern side of the unnamed ridge along which CAC has been mapped is noted by Y-852 as similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." However, CAC is significantly less extensive and any fault scarps are substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852). Part of CAC is shown by Y-813 (pl. 3) as a topographic lineament bounding a linear range front.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Relationship to other faults: The general east strike of CAC is similar to the strikes of the South Ridge faults (SOU) north of CAC. These two faults have been interpreted by Y-813 (p. 8) to be part of the Spotted Range–Mine Mountain section of the Walker Lane belt.

The strike of the generally north–striking West Pintwater Range fault (WPR) becomes more northeasterly as WPR approaches CAC from the east. The relationship between these two faults is unknown.

Cane Spring fault (CS)

Plate or figure: Plates 1 and 2.

References: Y-62: Barnes and others, 1982; Y-104: Ekren and Sargent, 1965; Y-181: Carr, 1974; Y-182: Carr, 1984; Y-192: Marvin and others, 1970; Y-205: Orkild, 1968 (shows the northeastern end of CS only); Y-210: Poole and others, 1965 (name from this reference); Y-226: Swadley and Huckins, 1990 (They show fault traces along the southern side of Skull Mountain. These traces possibly align with the southwestern end of CS, but they do not exactly correlate with CS as mapped by Y-104.); Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 3; they show one fault, which is within Tertiary deposits and may align with CS as shown by Y-232.); Y-301: Fleck, 1970; Y-314: Ekren, 1968; Y-1107: Carr, 1974.

Location: 26 km/112° (distance and direction of closest point from YM) at lat 36°45′N. and long 116°11′W. (location of closest point). This includes the southwestern section of Y-232. From northeast to southwest along the fault, CS is located along the southern side of Yucca Flat, along Cane Spring Wash, and along the southern side of Skull Mountain.

USGS 7-1/2′ quadrangle: Cane Spring, Skull Mountain, Specter Range NW, Yucca Lake.

Fault orientation: CS strikes generally northeast, but its trace is slightly curving (Y-232). The map by Y-232 shows a southwestern section of CS that is separated by about 1 km from a main, continuous trace of CS to the northeast. Maps by both Y-104 and Y-210 show CS, including the southwestern section of Y-232, as having continuous surficial expression. CS also includes a northeast–striking branch fault southwest of Cane Spring and south of the main, continuous trace (Y-210; Y-232).

Fault length: The length of CS is about 14 km as estimated from Y-104 and Y-210 and up to 27 km as estimated from Y-232. The longer value includes a 4–km–long section at the southwestern end of CS that is separated from the longer, continuous trace by about 1 km. Fault traces mapped by Y-226 along the southern side of Skull Mountain are 0.6 to 2.6 km long.

Style of faulting: Displacement on CS may be oblique. The southwestern end of CS (includes the separate southwestern section of Y-232) is shown by Y-104 and Y-210 as down to the southeast; its central part near Cane Spring is shown by Y-210 as down to the northeast; its northeastern end northeast of Cane Spring is portrayed by Y-210 as left–lateral. The map by Y-232 shows CS as having left–lateral strike slip along its entire length. The southern branch of CS southwest of Cane Spring is shown as down to the northwest by Y-210 and Y-232 and down to the southeast by Y-210. Faults along the southern side of Skull Mountain are portrayed by Y-226 as both down to the northwest and down to the southeast.

Scarp characteristics: No information.

Displacement: Y-181 (p. 6) and Y-210 noted that left–lateral displacement along CS becomes progressively less in tuffs with ages ranging between 14 Ma and 11 Ma, but no amounts are specified.

Age of displacement: Some sections of CS are portrayed as faulted contacts between Tertiary rocks and younger Tertiary or Quaternary deposits. This includes (1) one 0.5–to–1.0–km–long section at the fault's southwestern end, which is shown by Y-232 as a faulted contact between Wahmonie and Salyer formations (his Tws unit) and Quaternary alluvium (his Qal deposits), (2) fault traces along Skull Mountain, which are portrayed by Y-226 as faulted contacts between Pliocene to Oligocene rocks (their Tr unit) and early Pleistocene and Pliocene(?) alluvium (their QTa deposits), and (3) other fault traces that are shown by Y-104 as displacing Tertiary volcanics of Wahmonie Flat (their Twm unit), Pliocene Piapi Canyon Formation (their Tpr and Tpat units), or Pliocene basalt of Skull Mountain (their Tbs unit) against Pliocene older alluvium (their Tao deposits) and Quaternary alluvium (their Qa deposits).

Cane Spring fault (CS) — Continued

Other sections of CS are portrayed as faults in Tertiary or Quaternary deposits, or as lineaments or scarps on Tertiary or Quaternary surfaces. Y-210 showed parts of CS as fault scarps or fault–line scarps on surfaces of Miocene and Pliocene(?) Wahmonie Formation, Pliocene alluvium and colluvium, and Pliocene Timber Mountain Tuff against which Quaternary alluvium and colluvium (their Qac deposits) have been either displaced or deposited. Y-210 also showed several fault lines or lineaments approximately parallel to CS on surfaces of Quaternary alluvium and colluvium (their Qa and Qac deposits) along Cane Spring Wash. The traces of CS mapped by Y-238 (pl. 3) are shown as faults that are in Tertiary or Quaternary deposits and that were identified by previous mapping. CS is portrayed by Y-232 to displace Pliocene and Miocene volcanic and sedimentary units, including the Wahmonie and Salyer formations (his Tws units), Timber Mountain Tuff, Paintbrush Tuff, and (or) tuff of Crater Flat (his Tp unit), and basalt flows and plugs (his Tb unit).

CS is generally shown as concealed by Quaternary alluvium by Y-104 (their Qa deposits), Y-210 (their Qac deposits), and Y-232 (his Qal deposits). The northeastern extension of CS as shown by Y-232 would be crosscut by faults or lineaments mapped by Y-210 on surfaces of Quaternary alluvium and colluvium (their Qa and Qac deposits) east of the junction of Neilson Wash with Cane Spring Wash.

The Spotted Range–Mine Mountain structural zone (SRMM), a zone of northeast–striking faults of which CS may be a part, is considered by Y-182 (p. 44, 61) to be seismically active because of the numerous earthquakes in the area. However, Y-62 (*citing* Y-301) suggested that most of the displacement on SRMM may have occurred between 5 Ma and 7 Ma, during the late Miocene and early Pliocene. In addition, Y-182 (p. 64) concluded that much of SRMM had developed and considerable erosion had occurred before middle Oligocene. This conclusion was based on the age of the oldest Tertiary rocks in SRMM, which are correlated with the Horse Spring Formation that was dated (K–Ar) at slightly greater than 29 Ma (Y-192, tables 1 and 2, sample locality #19, p. 2663, 2665).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with CS.

Analysis: Aerial photographs (Y-226; Y-232; Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: CS is one of four main faults that have been grouped into the 30–to–60–km–wide Spotted Range–Mine Mountain structural zone (SRMM), which is characterized by northeast–striking, left–lateral faults that have experienced relatively small amounts of displacement (Y-181, p. 9; Y-182, p. 56). The other three faults in SRMM are the Mine Mountain fault (MM), the Rock Valley fault (RV), and the Wahmonie fault (WAH). These faults have been interpreted by Y-62 (*citing* Y-1107) to be "first–order structures that form a conjugate system with the northwest–striking, right–lateral faults of the Las Vegas Valley shear zone." Y-314 (p. 16-17) suggested that displacement along faults in SRMM resulted from what he called rotary slippage that occurred during right–lateral displacements along the Las Vegas Valley shear zone (LVS). However, Y-182 (p. 63) noted that neither the LVS nor the northwest–striking La Madre shear zone crosses SRMM and that significant curving or bending of faults in SRMM, which would be required if such rotation had occurred, is lacking. In contrast, faults of SRMM are probably related to northwest–striking faults and flexure zones with right–lateral displacement or bending north of LVS (e.g., the Frenchman flexure of Y-181 (fig. 11, p. 34) or the Yucca–Frenchman shear zone of Y-182 (fig. 8, p. 17)), because faults in SRMM and LVS mutually displace one another as indicated by field relationships (W.J. Carr, unpublished data, 1976, *cited by* Y-181, p. 9) and because both SRMM and LVS are locally active as indicated by associated seismicity (Y-181, p. 9).

Alternatively, Y-182 (p. 62) thought that displacements on faults in SRMM are conjugate to displacements on faults in the northwest–trending Walker Lane.

Cane Spring fault (CS) — Continued

Both the similarity in types of displacement and the alignment of surficial expression suggested to Y-182 (p. 62) that SRMM may be connected to the Pahranagat fault (PGT) to the northeast (the Pahranagat shear zone of Y-182). However, 70 km separates SRMM and PGT and no northeast–trending structures have been recognized in the Paleozoic rocks that are exposed in numerous places within this gap, which includes the north– and north–northwest–trending Spotted, Pintwater, and Desert ranges (Tschanz and Pampeyan, 1970 (Y-404); Ekren and others, 1977 (Y-25); Y-182, p. 62).

Carpetbag fault (CB)

Plate or figure: Plate 1.

References: Y-50: Barnes and others, 1963; Y-60: Colton and McKay, 1966; Y-181: Carr, 1974 (Carpetbag fault zone on his fig. 7); Y-182: Carr, 1984 (name from his fig. 12, p. 24; also shows CB as the Carpetbag fault zone on fig. 11, p. 23); Y-196: McKeown and others, 1976; Y-224: Frizzell and Shulters, 1990; Y-327: Shroba and others, 1988 (their Carpetbag fault system); Y-526: Swadley and Hoover, 1990; Y-693: Barosh, 1968; Y-813: Reheis, 1992 (pl. 2); Y-1106: Shroba and others, 1988 (their Carpetbag fault system). Not shown by Dohrenwend and others, 1992 (Y-853).

Location: 43 km/46° (distance and direction of closest point from YM) at lat 37°07′N. and long 116°06′W. (location of closest point). CB is located in the western half of central Yucca Flat.

USGS 7-1/2′ quadrangle: Oak Spring, Yucca Flat.

Fault orientation: CB generally strikes north to north–northwest (Y-182, fig. 12, p. 24; Y-1106, fig. 1, p. 3). In the subsurface, CB is inferred to be slightly sinuous (Y-182; Y-224) and branching (Y-224). At the surface, CB is shown by Y-526 to be composed of several subparallel strands. Y-1106 (fig. 1, p. 3) recognized several north–northeast–striking or northeast–striking splays of CB. CB generally dips steeply to the east (Y-60; Y-182, p. 21; Y-224). Antithetic faults dip to the west (Y-182, fig. 11, p. 23). Y-181 (p. 26, fig. 8, p. 25) noted that CB in southwestern Yucca Flat may dip as little as about 40°.

Fault length: The length of CB is about 30 km as estimated from Y-224 and 16.5 km as estimated from Y-526. CB is portrayed by Y-224 as concealed beneath Quaternary alluvium along most of its length, and its extent has been inferred from drilling or gravity data.

Style of faulting: Y-60 and Y-224 both showed CB as generally down to the east. Y-181 (p. 27) noted evidence for right–lateral displacement that resulted from an underground nuclear explosion. Y-327 (p. 231) and Y-1106 (p. 30) concluded that the youngest ruptures that formed before those produced by underground nuclear testing were limited to fracturing.

Scarp characteristics: Prominent, generally east–facing scarps, some forming a graben, were produced during and following an underground explosion in Yucca Flat in 1970 (Y-181, fig. 7; Y-1106, p. 2-5, 30; the Carpetbag event). Y-327 (p. 231) and Y-1106 (p. 2) noted that, unlike the Yucca fault (YC) to the east, CB lacks prehistoric (before nuclear testing) scarps. However, Y-224 indicated that a 1–km–long portion of CB does displace surficial deposits prehistorically, but no scarp characteristics are given by them.

Displacement: The average vertical displacement in Tertiary volcanic tuff along CB is 600 m (Y-181, p. 27). Alluvium in Yucca Flat is thickest just east of the southern end of CB. The alluvium at this locality is 600 to 1,200 m (2,000 to 4,000 ft) thick in an area <3 km wide (Y-182, p. 21, figs. 11 and 12, p. 23-24). Y-182 (p. 21) interpreted this depression as a structural feature formed in part by vertical displacement on CB. Y-1106 (p. 15) measured apparent vertical offsets across explosion–produced scarps of 1.7, 2, and 2.3 m at their three trench sites.

Y-181 (p. 27) noted that the amount of right–lateral displacement on CB since deposition of Tertiary volcanic tuff could be ≥600 m. Y-181 reported that Paleozoic rocks could be displaced laterally "several thousand feet." Y-181 (p. 32) thought that CB may account for as much as 1,500 m of horizontal extension. Y-181 (p. 27) noted that the Carpetbag event (a nuclear explosion) produced at one locality (near UE2b, Y-181, fig. 7) 15 cm of right–lateral displacement across a 1.2–m–high scarp, along with left–stepping, *en echelon* cracks.

Age of displacement: A portion of CB that is about 2 km long (Y-181, fig. 7; Y-327, p. 231; Y-1106, p. 30) to 4.5 km long (as estimated from Y-224) is shown as having been reactivated by an underground nuclear explosion in 1970.

Carpetbag fault (CB) — Continued

Y-1106 (p. 2) noted that displacement on CB (and on the Yucca fault to the east) has probably occurred during late Quaternary. A 1–km–long section of CB, which is at the southern end of the fault and east of the traces reactivated by underground testing, is shown by Y-224 to displace surficial deposits prehistorically. A 1.5–km–long portion of CB has been identified by Y-182 (fig. 12, p. 24) as having Quaternary (but prehistoric) displacement. Using aerial photographs, Y-1106 (p. 14, 30) also recognized north–trending lineaments that may be associated with CB.

Y-327 (p. 231) and Y-1106 (p. 30) interpreted at least six major episodes of fracturing (and perhaps minor faulting) on CB since 250 ka. On the basis of uranium–series analyses on secondary carbonate in eight fracture–fill features interpreted by Y-1106 (p. 12) to have been produced by surface or near–surface displacement, episodes of fracturing and minor faulting on CB occurred about 30 ka, 45 ka, 65 ka, 100 ka, 125 ka to 130 ka, and 230 ka to 240 ka (Y-327, p. 231; Y-1106, p. 30). Y-1106 (p. 5) noted that a date (uranium–series analyses) of 37 ka was determined by Knauss (1981, Y-1242, *cited in* Y-1106, p. 5) on one fracture–fill deposit near CB (site CBF3, Y-1106, fig. 2).

On the basis of a lack of prehistoric scarps and undisplaced stratigraphic units exposed in three trenches, Y-327 (p. 231) and Y-1106 (p. 14, 31) concluded that no significant vertical displacement has occurred on CB at least since 10 ka, probably since 125 ka to 130 ka, and possibly since 350 ka. On the basis of a date (uranium–trend analyses) of 35 ± 15 ka for an unfractured deposit and a lack of fracture fillings in deposits younger than about 30 ka, Y-327 (p. 231) and Y-1106 (p. 25, 30) concluded that no surface fracturing (or larger surface displacements) had occurred on at least part of CB since about 30 ka. (Another unfractured surficial deposit was estimated to have an age of about 170 ka by Y-1106 (p. 30) on the basis of development of both rock varnish and an argillic soil horizon.) Y-1106 (p. 25, 30-31) also concluded that little or no fracturing or faulting occurred on CB between about 240 ka and 350 ka, because dates determined by uranium–series analyses on the carbonate–rich fracture fillings do not fall within this time interval.

Slip rate: The slip rate along CB between about 30 ka and 125 ka to 130 ka or earlier has been nearly zero, because displacements, as interpreted by Y-327 (p. 231) and by Y-1106 (p. 30), have been limited to fracturing and minor faulting. No evidence for fracturing or faulting has been recognized since about 30 ka.

Recurrence interval: Y-327 (p. 231) and Y-1106 (p. 31) inferred an average recurrence interval of about 25,000 yr for fracturing events during the last 125,000 to 130,000 yr.

Range-front characteristics: No range front is associated with CB.

Analysis: Analysis of conventional aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-1106, p. 14, scale about 1:5,000). Description of surficial deposits and soils (Y-1106, p. 5). Interpretation of deposits exposed in trenches at three localities (Y-327, p. 231; Y-1106, p. 4-5, Trenches T1, T2, and T3). Interpretation of exposures along explosion–produced scarps (Y-1106, p. 4-5, Sites S1–S4). Radiometric dating (uranium–trend and uranium–series methods) of surficial deposits and carbonate–rich fracture fillings (Y-1106, p. 5, 15-30). Measurement of characteristics of explosion–produced scarps (Y-1106, p. 15). Geophysical and gravity data for Yucca Flat (Y-181). Additional information from M.N. Garcia, U.S. Geological Survey, written commun., 1988 (*cited in* Y-526).

Relationship to other faults: CB is probably related to other faults in Yucca Flat: the Yucca fault (YC), the Area Three fault (AT), the Eleana Range fault (ER), the Yucca Lake fault (YL), and several short, unnamed faults. Y-182 suggested that displacement on all of these fault probably resulted in the formation of Yucca Flat as a structural basin. Y-1106 (p. 15) proposed that seismic shaking associated with YC, located about 3.5 km east of CB, may have triggered one or more episodes of minor displacement on CB and resulted in the carbonate–rich fracture fillings.

Carpetbag fault (CB) — Continued

Y-182 (p. 21) interpreted CB to be a typical Basin and Range fault. He suggested that the southern end of CB is intersected by the northwest–trending Yucca–Frenchman shear and flexure zone, which is located northwest of the Las Vegas Valley shear zone and is interpreted by Y-182 (p. 21) to be a part of the Walker Lane. Y-182 (p. 21) proposed that the interaction between CB and the Yucca–Frenchman shear zone has enhanced north–northwest extension and subsidence of Yucca Flat.

Cedar Mountain fault (CM)

Plate or figure: Figure 1.

References: Y-13: dePolo and others, 1987; Y-14: Gianella and Callaghan, 1934; Y-15: Bell, 1988; Y-16: Doser, 1987; Y-17: Gianella and Callaghan, 1934; Y-170: Molinari, 1984 (his Stewart–Monte Cristo fault zone); Y-794: dePolo and others, 1988; Y-795: Bell and others, 1988 (p. 1-25 to 1-36); Y-797: Bell and others, 1987; Y-969: Shawe, 1965; Y-1069: Yount and others, 1993; Y-1070: Yount and others, 1993; Y-1074: Doser, 1988; Y-1075: Molinari, 1983.

Location: 200 km/328° (distance and direction of closest point from YM) at lat 38°20′N. and long 117°50′W. (location of closest point). CM consists of fault traces that ruptured in an earthquake on December 20, 1932. It includes traces previously referred to as the Gabbs Valley, Cedar Mountain, and Monte Cristo faults.

USGS 7-1/2′ quadrangle: Bettles Well, Dicalite Summit, Eddyville, Gabbs Mountain, Granny Goose Well, Kirby Flat, Luning, Mount Ferguson, Stewart Spring, Sunrise Flat.

Fault orientation: CM consists of a discontinuous zone of fault traces that generally strike N. 30° W. (Y-170, p. 45-46; Y-1075). Main fault traces that ruptured in 1932 in Monte Cristo Valley strike approximately north; other fault traces have varying orientations (Y-794, p. 5; Y-969, p. 1,364).

Fault length: CM is ≥45 km long along the western edge and south–central portion of Stewart Valley and in Monte Cristo Valley south of Kibby Flat playa (Y-170, p. 45, his Stewart–Monte Cristo fault zone; Y-1075). The length of the traces that ruptured in 1932 is about 60 km (38 miles) from about 6 km (3.6 miles) east of Warrens Well in Gabbs Valley southeast to about 13 km (8 miles) east of Pilot Peak (Y-17, p. 8; Y-794, p. 3; Y-969, p. 1,364). The width of the rupture zone in 1932 was about 6 to 16 km (4 to 10 miles; Y-17, p. 8; Y-794, p. 3; Y-969, p. 1,364).

Style of faulting: Displacements along CM in 1932 and in pre–1932 ruptures have been primarily right lateral, with a minor component of dip–slip (normal) displacement or normal right–oblique displacement (Y-170, p. 46; Y-794, p. 5, 6, 8; Y-1075). Right–lateral displacement in 1932 is suggested by a left–stepping, *en echelon* pattern of ruptures (Y-13; Y-17, p. 8), by lateral displacement of small–scale geomorphic features (Y-13), and by near–horizontal slickensides (Y-13).

During the 1932 earthquake, the main, north–striking fault traces in Monte Cristo Valley experienced right–lateral and normal right–oblique displacements (Y-794, p. 5). Northeast–striking fault traces, which are more numerous to the north (e.g., in Gabbs Valley), had dominantly normal displacement (Y-794, p. 5). Northwest–striking fault traces that form steps or bends in traces of the main fault appear to have evidence for compressional deformation (Y-794, p. 5).

Scarp characteristics: Y-13 noted that west–facing scarps that formed in 1932 are 30 to 50 cm high and that these scarps are superimposed on older, subdued scarps. Y-1069 (p. 386) reported scarp heights of a few centimeters to 60 cm from the 1932 earthquake. In contrast, Y-170 (p. 115) suggested that scarps from the 1932 earthquake were 1.4 m high.

Displacement: The largest and most continuous ruptures in 1932 occurred in Monte Cristo Valley (Y-794, p. 4). In this valley and in Stewart Valley, right–lateral displacements were up to 1 to 2 m in 1932; vertical displacements in this earthquake were ≤0.5 m (Y-13; Y-170, p. 115; Y-794, p. 5; Y-1069, p. 386). Y-17 (p. 15) reported as much as 0.6 m (2 ft) of vertical displacement at one locality from the 1932 earthquake. Y-795 (p. 1-35) noted 15 to 30 cm of vertical displacement and about 1 to 2 m of right–lateral displacement from the 1932 event at their Trench 3 in Monte Cristo Valley. Y-13 inferred that the ratio of vertical to horizontal displacement in 1932 was at least 1:3.

Cedar Mountain fault (CM) — Continued

On the basis of their interpretation of stratigraphy exposed in trenches, Y-795 (p. 1-34) inferred a minimum vertical separation since 730 ka of 3 m at one locality on CM in Monte Cristo Valley. They suggested that the total amount of right–lateral displacement may be >21 m, because the ratio of vertical to horizontal displacement was 1:7 (Y-795, p. 1-35). Furthermore, possible correlation of deposits across the fault at this same locality suggests that about 1 m of vertical separation has occurred since about 135 ka (Y-795, p. 1-34).

Along the northern section of CM, along the eastern side of the Gabbs Valley Range, a minimum of 100 m of right–lateral displacement is inferred by Y-170 (p. 53) from displacement of the contact between Miocene units and from the rake of exposed striations. The number and size of folds and the amounts of vertical displacement across faults along this northern section and along a central section suggested to Y-170 (p. 100) that the amount of deformation increases to the north along CM.

CM includes folds in the Esmeralda Formation (middle to late Miocene; 11 Ma to 16 Ma; Y-170, p. 31) east of the main fault trace (Y-170, p. 46). One northeast– to north–striking fault trace in south–central Stewart Valley may have experienced 0.7 m of left–lateral displacement and a minor amount of vertical displacement in middle and late Miocene rocks (Y-170, p. 57, his north section).

Age of displacement: The youngest displacement along CM is historical. Surface ruptures were associated with an earthquake (M 7.2) on December 20, 1932. The approximate epicentral location of this earthquake was in Gabbs Valley (Y-17, p. 2, 4).

On the basis of differences in style and amount of deformation, Y-170 (p. 47-48) subdivided CM (his Stewart–Monte Cristo fault zone) into three sections. These sections also show a difference in age of displacement. Along a 13–km–long northern section along the eastern side of the Gabbs Valley Range, the fault displaces and deforms Quaternary alluvium as well as middle to late Miocene volcanic rocks and lacustrine sediments, and it is expressed as prominent topographic lineaments (Y-170, p. 47-57; Y-1075). Displacement of middle(?) to late Pleistocene surfaces indicates that late Pleistocene displacement has occurred along this section (Y-170, p. 54, 100). However, late Holocene alluvium is not displaced and no surface ruptures associated with the 1932 earthquake have been identified along this section (Y-170, p. 54, 100). Along an 8–km–long central section between south–central Stewart Valley and northwestern Monte Cristo Valley, displacement is expressed as folds, faults, and tilting of Miocene sediments (Esmeralda Formation; Y-170, p. 58-59), but no Quaternary displacement has been recognized (Y-1075). Along a 24–km–long southern section between northwestern Monte Cristo Valley and the southern edge of Kibby Flat, CM is expressed as either north– to northwest–trending, west–facing, prominent scarps on surfaces of middle(?) to late Quaternary alluvial and lacustrine deposits (the northern 12 km) or as a northwest–trending vegetation lineament across Kibby Flat (the southern 12 km; Y-170, p. 61; Y-1075). The southern section is the primary location of the surface ruptures produced in 1932 (Y-170, p. 61-72).

Y-1075 (p. 384) noted that displacement along CM began after the middle to late Miocene and continues, as indicated by the 1932 earthquake.

Slip rate: The following preliminary, minimum lateral slip rates for CM in Monte Cristo Valley were estimated by Y-795 (p. 1-35): >0.03 mm/yr since 730 ka assuming >21 m of right–lateral displacement, 0.05 mm/yr since 135 ka assuming 7 m of right–lateral displacement, and 0.1 mm/yr since 10 ka assuming 1 m of right–lateral displacement.

Recurrence interval: Because Holocene deposits lack pre–1932 scarps and because pre–1932 scarps are subdued and generally lack "fresh" evidence for strike–slip displacement, Y-795 (p. 1-34) inferred that the recurrence interval for surface ruptures along CM is relatively long, "possibly tens of thousands of years." On the basis of stratigraphic and geomorphic relationships, Y-170 (p. 73-75) inferred that at least three, and probably five or six, pre–1932 surface ruptures occurred during the latest Pleistocene and Holocene along his southern section of CM, between northwestern Monte Cristo Valley and the southern edge of Kibby Flat.

Range-front characteristics: CM is located primarily in the middle of valleys and is not associated with range fronts (Y-1069, p. 386).

Cedar Mountain fault (CM) — Continued

Analysis: Aerial photographs (Y-170, p. 6, scales 1:80,000 and 1:16,000 for conventional and 1:18,000 for low–sun–angle; Y-795, p. 1-34). Field examination (Y-17; Y-170, p. 7; Y-794, p. 5). Topographic scarp profiles (Y-170, p. 77, 80). Soil development (Y-170, p. 39-44; Y-794, p. 4). Trenches (Y-13; Y-795, p. 1-34). Tephrochronology (Y-794, p. 4).

Relationship to other faults: CM is subparallel to and east of the Bettles Well fault and faults along the eastern side of the Pilot Mountains (Y-170, p. 46). CM is also subparallel to but west of the fault along the western side of the northern Cedar Mountains (Y-170, p. 46). Y-170 (p. 116) and Y-1075 suggested that right–lateral displacement along CM indicates that CM was part of a left–stepping, *en echelon* fault system that included five main right–lateral faults in the Gillis and Gabbs Valley ranges, which are west of CM.

Central Pintwater Range faults (CPR)

Plate or figure: Plate 1.

References: Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3, show only the western fault); Y-813: Reheis, 1992 (pls. 2 and 3); Y-852: Dohrenwend and others, 1991 (show both faults, but only south of lat 37°N., which is the northern boundary of their map area). Not shown by Ekren and others, 1977 (Y-25).

Location: 79 km/77° (distance and direction of closest point from YM) at lat 36°59′N. and long 115°34′W. (location of closest point). CPR is composed of two main faults: one each along the eastern and western sides of an unnamed valley within the northern Pintwater Range.

USGS 7-1/2′ quadrangle: Quartz Peak, Southeastern Mine.

Fault orientation: The faults of CPR generally strike north to north–northwest, but they curve so that sections of the faults strike between northwest and north–northeast (Y-404; Y-813; Y-852).

Fault length: The length of the eastern fault of CPR is about 16 km as estimated from Y-813. The length of the western fault of CPR is about 4.5 km as estimated from Y-813.

Style of faulting: Sections of the eastern fault are shown by Y-813 as down to the west. These sections consist of curving, branching, and subparallel traces along the range front, within the range, and within the unnamed valley that is bounded by CPR (Y-813; Y-852).

Sections of the western fault are shown by Y-404 and Y-813 as down to the east. The western fault is generally expressed as a single surface trace along the range front; however, short subparallel traces at the northern end of the western fault extend into the unnamed valley (Y-813).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Sections of the eastern fault along the range front and within the range are shown by Y-813 as faults that are in Tertiary rocks and that were identified from previous mapping (primarily), as weakly to moderately expressed lineaments and scarps on surfaces of Tertiary deposits, and as lineaments along linear range fronts. The sections of this fault that are within the unnamed valley are shown by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary (mainly) and Tertiary deposits and as faults that are in Quaternary deposits and that were identified from previous mapping.

Sections of the western fault and the southern part of the eastern fault (south of lat 37°N.) are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock. Sections of the western fault are also portrayed by Y-404 as post–Laramide structures; some are shown by them as faulted contacts between pre–Tertiary rocks and Pliocene(?) and Pleistocene(?) older gravels (their QTg deposits). Some fault traces are portrayed by Y-813 as faults that are in Quaternary (primarily) and Tertiary deposits and that were identified from previous mapping. The northern end of the western fault is portrayed by Y-813 as weakly expressed lineaments and scarps on surfaces of Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Y-852 portrayed sections of the western fault and the southern portion of the eastern fault (south of lat 37°N.) as having morphological characteristics similar to those of fronts along major range–front faults (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep-sided canyons orthogonal to range front), except that "associated fault systems are significantly less extensive and fault scarps are substantially lower, shorter, and less continuous." Portions of the range front adjacent to sections of the western fault are shown to be linear by Y-813.

Analysis: Aerial photographs (Y-404, p. 2, scales 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000). Field mapping (Y-404, p. 2)

Relationship to other faults: CPR is approximately parallel to faults along the eastern and western sides of the Pintwater Range: the East Pintwater Range fault (EPR) and the West Pintwater Range fault (WPR). The structural relationships among these faults are not known.

The northern end of CPR appears to terminate south of the northeast–striking North Desert Range fault (NDR), which is directly north of CPR along the northern end of the Pintwater Range.

Central Reveille fault (CR)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 1; shows only that part of CR south of lat 38°N., which is the northern boundary of her map area); Y-853: Dohrenwend and others, 1992 (show only that part of CR south of lat 38°N., which is the northern boundary of their map area); Y-1032: Schell, 1981 (pls. 7 and 8; name from his table A2, fault #109). Not shown by Cornwall, 1972 (Y-232, pl. 1).

Location: 108 km/12° (distance and direction of closest point from YM) at lat 37°48′N. and long 116°11′W. (location of closest point). CR is located in central Reveille Valley between the Reveille and Kawich ranges.

USGS 7-1/2′ quadrangle: Georges Well, Kawich Peak NE, Reveille, Reveille Peak, Reveille Peak NW, Warm Springs SE.

Fault orientation: The southern part of CR strikes north–northwest (Y-853; Y-1032); the northern part strikes north to north–northeast (Y-853; Y-1032).

Fault length: The length of CR is 29 km as noted by Y-1032 (table A2, p. A20).

Style of faulting: Fault traces are generally shown by Y-813, Y-853, and Y-1032 as down to the west or southwest.

Scarp characteristics: Scarps are shown by Y-813, Y-853, and Y-1032 as primarily west facing. Some scarps are noted to be indistinct by Y-1032 (table 3, p. 23).

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along CR is noted by Y-1032 (table A2, p. A20) as late to early Pleistocene (defined as >15 ka and <1.8 Ma by Y-1032, p. 29-30). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i, table A2, p. A20) with an estimated age of 15 ka to probably about 200 ka (Y-1032, table 3, p. 23). Displacement is indicated by indistinct scarps on these alluvial fans (Y-1032, table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y, table A2, p. A20) with an estimated age of ≤15 ka (Y-1032, table 3, p. 23). The oldest unit displaced is his latest Tertiary volcanic rocks (Tv_4, table A2, p. A20) with an estimated age of 1.8 Ma to 6 Ma (Y-1032, table A1, p. A1).

The map by Y-853 shows one scarp on a Quaternary depositional or erosional surface at the southern end of Reveille Valley, but Y-853 did not estimate a more precise age for this displacement. Their map also shows several scarps and (or) prominent topographic lineaments on the surfaces of Tertiary volcanic or sedimentary rocks just south of lat 38°N.

The map by Y-813 includes two scarps in central Reveille Valley south of lat 38°N. One is portrayed as a lineament or scarp on surfaces of Tertiary deposits; the other is portrayed as a topographic lineament within bedrock.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with CR.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: The relationship of CR either to the East Reveille fault (ERV), which bounds the eastern side of Reveille Valley at its junction with the Reveille Range, or to the Hot Creek–Reveille fault (HCR), which bounds the western side of Reveille Valley at its junction with the Kawich Range, is not known. Y-1032 (pl. 7) suggested that CR may merge with ERV north of lat 38°N. (north of the area shown in pl. 1 of this compilation).

Central Spring Mountains faults (CSM)

Plate or figure: Plate 2.

References: Y-696: Hoffard, 1991 (pl. 1, shows only the fault on the southeastern side of the Wheeler Wash drainage); Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991.

Location: 76 km/130° (distance and direction of closest point from YM) at lat 36°23′N. and long 115°48′W. (location of closest point). Faults in CSM are located within the Spring Mountains south of Wheeler Pass in the area of Wheeler Wash. CSM includes three faults: (1) one on the northwestern side of Wheeler Wash, (2) one on the northeastern side of the Wheeler Wash drainage, and (3) one on the southeastern side of the Wheeler Wash drainage.

USGS 7-1/2′ quadrangle: Horse Spring, Wheeler Well, Willow Peak.

Fault orientation: Fault orientations are variable (Y-813; Y-852). The northwest fault generally strikes north–northeast (Y-813). The northeast fault generally strikes north–northwest (Y-813; Y-852). The southeast fault generally strikes north, except at its northern end where the fault turns eastward and parallels Clark Canyon, a tributary to Wheeler Wash (Y-813; Y-852).

Fault length: The length of the northwest fault is 16 km (Y-813). The length of the northeast fault is 6 km (Y-852) to 9 km (Y-813). The length of the southeast fault is 5 km (Y-852) to 12 km (Y-813).

Style of faulting: Traces of the northwest fault are shown by Y-813 as generally down to the northwest. Traces of the northeast and southeast faults are portrayed by Y-813 and Y-852 as generally down to the west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The northwest fault is shown by Y-813 primarily as a topographic lineament along a linear range front or in bedrock. The northeastern end of this fault is portrayed by her as weakly expressed lineaments or scarps on surfaces of Quaternary deposits.

The northeast fault is shown by Y-813 as weakly expressed lineaments or scarps on surfaces of Quaternary deposits and as topographic lineaments along a linear front or in bedrock. Y-852 showed this fault as juxtaposing Quaternary alluvium against bedrock.

The southeast fault is portrayed by Y-813 as weakly expressed lineaments or scarps on surfaces of Quaternary deposits and as topographic lineaments along a linear front or in bedrock. Y-852 showed this fault as scarps on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). Y-696 (pl. 1) showed part of the southeast fault as a prominent fault or lineament.

Y-813 (p. 8) noted that the Spring Mountains "contain a few possible Quaternary faults and lineaments, generally north–trending, but they appear to be relatively inactive."

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The range front along the northeast fault and part of the range front along the southeast fault are noted by Y-852 to be similar to that along major range–front faults (e.g., characterized by "a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front"), except that the faults of CSM are "significantly less extensive and fault scarps are substantially lower, shorter, and less continuous."

Analysis: Aerial photographs (Y-696, p. 8-9, scale 1:80,000; Y-813, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Central Spring Mountains faults (CSM) — Continued

Relationship to other faults: The relationships among the three faults combined here in CSM are not known. The northwest fault aligns with a northeast–striking portion of the West Spring Mountains fault (WSM) east of Pahrump, but the relationship of faults in CSM to WSM is not known. Y-813 (pl. 3) labeled the southwestern portion of the northwest fault of CSM as the Wheeler Pass thrust.

Chalk Mountain fault (CLK)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 1). Not shown by Cornwall, 1972 (Y-232).

Location: 87 km/31° (distance and direction of closest point from YM) at lat 37°32′N. and long 115°57′W. (location of closest point). CLK extends along the western side of Chalk Mountain and into southern Sand Spring Valley. It is north of the drainage divide separating Emigrant Valley from Monotony and Sand Spring valleys.

USGS 7-1/2′ quadrangle: White Blotch Springs.

Fault orientation: The southern end of CLK strikes generally north–northeast; the northern end strikes northeast (Y-813).

Fault length: The length of CLK as defined here is 8 km as estimated from Y-813. CLK could also include north–striking fault traces along the western side of northern Emigrant Valley. (These are shown as possibly part of the Emigrant Valley North fault (EVN?) on plate 1 of this compilation.) If these faults are included in CLK, then the length of the fault could be as much as about 20 km (estimated from Y-813).

Style of faulting: No information.

Scarp characteristics: CLK is shown by Y-813 as west– or northwest–facing scarps.

Displacement: No information.

Age of displacement: CLK is shown by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits, as lineaments along linear range fronts or in bedrock, and (rarely) as weakly to moderately expressed lineaments and scarps on surfaces of Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 and 1:80,000).

Relationship to other faults: North–striking fault traces along the western side of northern Emigrant Valley (shown as possibly part of the Emigrant Valley North fault, labeled EVN? on plate 1 of this compilation) could be part of CLK instead or they could connect EVN and CLK. Although CLK is relatively short, the northern part has a more easterly strike than the southern part, a pattern similar to that of the Stumble fault (STM) located east of CLK along the western side of the Groom Range. This change in strike could be the result of influence by one or both faults along the southern edge of Sand Spring Valley: the northeast–striking Penoyer fault (PEN) and the east–striking Timpahute lineament (expressed as the east–northeast–striking Tem Piute fault; TEM). The structural relationships among these faults are not known.

Checkpoint Pass fault (CP)

Plate or figure: Plate 2.

References: Y-62: Barnes and others, 1982; Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991 (show only the north–northeast–striking portion of the western half of CP as portrayed by Y-813).

Location: 44 km/113° (distance and direction of closest point from YM) at lat 36°40'N. and long 116°00'W. (location of closest point). CP is located along the northern side of unnamed bedrock hills between a narrow gap at Checkpoint Pass and northeast of Mercury, Nevada.

USGS 7-1/2' quadrangle: Mercury.

Fault orientation: CP is curved, with one orientation for the eastern half and another for the western half of the fault. The eastern half of CP, shown as a single fault trace, has a curving but a general east strike (Y-813). The western half of CP actually consists of two traces as shown by Y-813 (pl. 3). Of these two traces, the northern trace strikes northeast and the southern trace strikes north–northeast.

Fault length: The eastern half of CP is about 3.5 km long (Y-813). The northern trace of the western half of CP is about 3 km long (Y-813). The southern trace of the western half is 3 to 4 km long (Y-813; Y-852).

Style of faulting: Displacement on CP is shown by Y-813 as left–lateral for the eastern half of CP. Displacement on the northern trace of the western half is portrayed by her as down to the southeast. Displacement on the southern trace of the western half is shown by Y-813 as down to the northwest.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Y-852 portrayed the north–northeast–striking portion of the western half of **CP** (the southern trace) as a fault that juxtaposes Quaternary alluvium against bedrock (*see* Range–front characteristics).

The eastern half of CP and part of the northern trace of the western half are shown by Y-813 (pl. 3) as faults that are preserved in Tertiary deposits and that were recognized by previous mapping. The southern trace of the western half in the vicinity of Checkpoint Pass is shown by Y-62 as concealed by alluvial deposits of Quaternary and Tertiary age.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The southern trace of the western half of CP is portrayed by Y-852 as a fault juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of the northwestern side of the unnamed ridge adjacent to this part of CP would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." Although this morphology is similar to that of major range–front faults, the "associated fault systems are significantly less extensive and fault scarps are substantially lower, shorter, and less continuous" (Y-852). Part of the northern trace and the southern trace of the western half of CP are shown by Y-813 (pl. 3) as topographic lineaments bounding a linear range front or in bedrock.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Checkpoint Pass fault (CP) — Continued

Relationship to other faults: The eastern half of CP has a strike similar to that of the Rock Valley fault (RV), which is located about 6 km north of CP. The strike of this part of CP is more easterly than the strikes of the northeast–striking Mercury Ridge faults (MER) and the Crossgrain Valley faults (CGV), both of which are 3 to 6 km east and southeast of CP.

The southern trace of the western half of CP is oblique to both MER and CGV. The strike of this portion of CP is similar to the trend of a west–facing fault scarp shown by Y-852 at the southwestern end of South Ridge. This scarp is included in the South Ridge faults (SOU) of this compilation.

Chert Ridge faults (CHR)

Plate or figure: Plate 1.

References: Y-404: Tschanz and Pampeyan, 1970 (show only a few faults along Chert Ridge); Y-813: Reheis, 1992 (pls. 2 and 3); Y-852: Dohrenwend and others, 1991 (show only the southern end of one fault that is south of lat 37°N., which is the northern boundary of their map area). Not shown by Ekren and others, 1977 (Y-25).

Location: 65 km/74° (distance and direction of closest point from YM) at lat 37°00′N. and long 115°44′W. (location of closest point). CHR is composed of numerous faults along the eastern and western sides of Chert Ridge.

USGS 7-1/2′ quadrangle: Fallout Hills, Fallout Hills NW.

Fault orientation: Faults in CHR generally strike north, but individual faults curve so that their strikes range between north–northwest and northeast (Y-813).

Fault length: The length of the curving and branching faults located primarily along the range front along the eastern side of Chert Ridge is about 14 km as estimated from Y-813. The length of the curving, branching, and subparallel faults along the western side of Chert Ridge is about 12 km as estimated from Y-813. The faults along the western side of Chert Ridge form a zone up to 2.5 km wide as estimated from Y-813.

Style of faulting: The faults along the eastern side of Chert Ridge are shown as down to the east (Y-813). One branch east of the range front, along with the southern part of the fault along the range front, is shown as down to the west (Y-813). Short (0.5 to 1.2 km long) faults at the southern end of the western side of Chert Ridge are shown to have right–lateral strike–slip displacement (Y-813).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Faults on the eastern side of Chert Ridge are portrayed by Y-813 as faults that are in Tertiary deposits and that were identified from previous mapping (primarily), as weakly to moderately expressed lineaments and scarps on surfaces of Tertiary deposits, as weakly expressed lineaments and scarps on surfaces of Quaternary deposits, and as lineaments along a linear range front. Some faults on this side of the ridge are shown by Y-404 as juxtaposing pre–Tertiary rocks and Pleistocene(?) older alluvium (their Qol deposits). The very southern 2 km (south of lat 37°N.) of CHR are portrayed by Y-852 as faults that also juxtapose Quaternary alluvium against bedrock.

Faults on the western side of Chert Ridge are portrayed by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits (primarily), as lineaments along a linear range front, and as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Some faults along both the eastern and western sides of Chert Ridge are shown by Y-813 as lineaments that bound a linear front. According to Y-852, the eastern side of Chert Ridge adjacent to the very southern 2 km of CHR has morphologic characteristics similar to those of fronts along a major range–front fault (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front), except that "associated fault systems are significantly less extensive and fault scarps are substantially lower, shorter, and less continuous."

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000). Field mapping (Y-404, p. 2).

Chert Ridge faults (CHR) — Continued

Relationship to other faults: Faults in CHR on the eastern side of Chert Ridge approximately align with a fault located along the western side of the Spotted Range south of the Fallout Hills. This fault is not included in CHR but is instead combined with the Spotted Range faults (SPR), because faults in CHR are generally down to the east, whereas faults in SPR are generally down to the west.

Y-813 showed northeast–striking, down–to–the–southeast faults at the northern end of Chert Ridge as faults that are in Quaternary deposits and that were identified from previous mapping. The structural relationship between these faults and faults included in CHR is not known. It is also unknown how either of these faults relate to north–northeast–striking faults to the northwest in Emigrant Valley (the Emigrant Valley South fault (EVS) of this compilation).

Chicago Valley fault (CHV)

Plate or figure: Plate 2.

References: Y-69: McKittrick, 1988; Y-161: Burchfiel and others, 1983; Y-238: Reheis and Noller, 1991 (pl. 4); Y-657: Dohrenwend and others, 1984; Y-778: Huddleston, 1986; Y-783: Butler, 1986.

Location: 90 km/163° (distance and direction of closest point from YM) at lat 36°05′N. and long 116°09′W. (location of closest point). CHV is located along the eastern side of Chicago Valley at its junction with the western side of the Nopah Range.

USGS 7-1/2′ quadrangle: Nopah Peak, North of Tecopa Pass, Resting Spring, Twelve Mile Spring.

Fault orientation: CHV strikes generally north to north–northwest. Individual fault traces strike between northwest and northeast (Y-69; Y-238).

Fault length: Discontinuous, subparallel, and *en echelon* fault traces included in CHV are mapped by Y-69 along the eastern side of Chicago Valley over a total length of about 20 km. The lengths of individual traces range between 0.2 and 0.8 km as estimated from Y-69.

One 0.6–km–long zone of subparallel fault traces is shown by Y-69 on the western side of Chicago Valley. Two fault traces are portrayed by Y-238 (pl. 4) near the center of Chicago Valley. The one that is located about 2.5 km west of the Nopah Range at Twelvemile Spring is 2.5 km long. The other, which is located about 5 km west of the range, is about 4 km long.

Style of faulting: Displacement on CHV is shown by Y-238 to be dip slip (normal) and down to the west. Y-161 (p. 1373) suggested that rocks in the Nopah Range have been tilted eastward by CHV and noted that the range front consists of several arcuate segments, each of which is concave westward. They accepted a model of a curved or listric fault that merges with a low–angle detachment fault at depth to explain the arcuate shape of the range front.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Fault traces in CHV are shown by Y-69 on surfaces of late and (or) middle Pleistocene age (her Qf2 deposits with an estimated age between 10 ka and 300 ka to 500 ka) and on surfaces of middle and (or) early Pleistocene age (her Qf1 deposits with a minimum age of 300 ka to 500 ka). Faults are not shown by Y-69 on surfaces of either early Holocene and (or) latest Pleistocene age (her Qf3 deposits) or Holocene age (her Qf4 deposits). Fault traces along the western side of Chicago Valley are shown by Y-69 on late and (or) middle Pleistocene surfaces (her Qf2 deposits) and at the contact between a pediment on bedrock and middle and (or) early Pleistocene surfaces (her Qf1 deposits). Fault traces are absent from Holocene surfaces (her Qf4 deposits) along the western side of Chicago Valley (Y-69).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Part of CHV is portrayed by Y-238 (pl. 4) as a topographic lineament along a linear range front.

Analysis: Aerial photographs (Y-69; Y-238, p. 2, scales 1:24,000 to 1:80,000). Field examination (Y-69). Transects measured on alluvial fans (Y-69).

Relationship to other faults: The relationship of CHV to either the north–northwest–striking East Nopah fault (EN), which bounds the eastern side of the Nopah Range, or to the Ash Meadows fault (AM), which bounds the western side of the Resting Spring Range to the west of CHV, is not known.

Clayton–Montezuma Valley fault (CLMV)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 1); Y-407: Albers and Stewart, 1972; Y-853: Dohrenwend and others, 1992.

Location: 126 km/314° (distance and direction of closest point from YM) at lat 37°38′N. and long 117°27′W. (location of closest point). CLMV is located in an unnamed valley between Clayton Ridge and the Montezuma Range.

USGS 7-1/2′ quadrangle: Lida Wash, Montezuma Peak SW, Split Mountain.

Fault orientation: CLMV strikes generally northeast, but the fault curves so that individual sections strike between north–northwest and northeast (Y-238; Y-853).

Fault length: The length of CLMV is 13 km as estimated from Y-853 and 14 km as estimated from Y-238. The width of CLMV is 1 to 4 km as estimated from Y-238.

Extension of CLMV to the north or south of the unnamed valley between Clayton Ridge and the Montezuma Range is unclear. As portrayed in this compilation, CLMV does not continue across the drainage divide at the northeastern end of the unnamed valley. However, CLMV may extend to the north or east and may include north– and east–trending lineaments south of and along Alkali Lake. The north–trending lineaments in this area are included instead with the General Thomas Hills fault (GTH; pl. 1 of this compilation). The east–trending lineaments in this area are not combined with either CLMV or GTH. CLMV may also extend to the south and include some fault traces between the Clayton Ridge–Paymaster Ridge fault (CRPR) and the Montezuma Range fault (MR). These traces have not been combined with any of the labeled faults in this compilation.

Style of faulting: No information.

Scarp characteristics: Scarps along CLMV are shown by Y-238 and Y-853 as northwest facing primarily. Some are portrayed as southeast facing.

Displacement: No information.

Age of displacement: CLMV is shown by Y-853 as scarps on depositional and erosional surfaces with ages of early to middle and (or) late Pleistocene (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma) and early to middle Pleistocene (their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma). The northeastern end of CLMV is portrayed by Y-238 as weakly to moderately expressed lineaments and scarps chiefly on surfaces of Quaternary deposits; similar features on the southwestern end are shown by Y-238 as chiefly on surfaces of Tertiary deposits. Short sections of CLMV are shown by Y-238 as faults that are in Quaternary deposits and that were identified from previous mapping.

The map by Y-407 (pl. 1) shows faults with various, but primarily northeast, strikes in the valley between Clayton Ridge and Montezuma Ridge. These faults are portrayed in Tertiary volcanic rocks (their Taf unit). Some of these faults may correlate with the lineaments and scarps identified by Y-238 (pl. 1, p. 3).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with CLMV.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000). Field observations for some faults in CLMV (Y-238, p. 3).

Clayton–Montezuma Valley fault (CLMV) — Continued

Relationship to other faults: CLMV is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat, such as the Emigrant Peak faults (EPK) along the western side of the Silver Peak Range northwest of CLMV, the Montezuma Range fault (MR) along the western side of the Montezuma Range immediately east of CLMV, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges immediately west of CLMV, and south of CLMV, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains. CLMV is also approximately parallel to northeast–striking faults within basins, such as the Clayton Valley fault (CV) in Clayton Valley west of CLMV, the Stonewall Flat faults (SWF) within Stonewall Flat east of CLMV, and the Palmetto Mountains–Jackson Wash faults (PMJW) within an unnamed valley northeast of the Palmetto Mountains and southeast of CLMV (Y-238; Y-853). The structural relationships among all these faults are not known.

Y-238 (p. 4) speculated that the northeast–striking faults in the area around CLMV could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred these faults could be rooted in a detachment fault at depth.

Clayton Ridge–Paymaster Ridge fault (CRPR)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989 (their Clayton Ridge and Paymaster Ridge faults); Y-238: Reheis and Noller, 1991 (pl. 1); Y-407: Albers and Stewart, 1972 (pl. 1; show only one fault about 16 km long along the western side of Clayton Ridge); Y-853: Dohrenwend and others, 1992; Y-1032: Schell, 1981 (pl. 8; shows only the northern 15 km of CRPR, which is his Paymaster Canyon fault (or fault #12); the western boundary of his map area is east of long 117°30′W.)

Location: 126 km/310° (distance and direction of closest point from YM) at lat 37°34′N. and long 117°31′W. (location of closest point). The southern end of CRPR is located along the western side of Clayton Ridge at its junction with Clayton Valley. The northern end of CRPR is located along the western side of Paymaster Ridge adjacent to Paymaster Canyon. These faults are combined because Paymaster Ridge and Clayton Ridge are nearly continuous topographically. In addition, the two ridges are continuous in their stratigraphic and structural characteristics as noted by Y-407 (p. 50).

USGS 7-1/2′ quadrangle: Alcatraz Island, Lida Wash, Montezuma Peak SE, Paymaster Canyon, Paymaster Ridge, Split Mountain.

Fault orientation: CRPR strikes generally north–northeast, but the fault curves so that short sections strike between northwest and northeast (Y-238; Y-853).

Fault length: The length of CRPR is 51 km as estimated from Y-853 and 53 km as estimated from Y-238. These lengths may be minimum values, because CRPR extends to the edges of both of these map areas at lat 38°N.

Style of faulting: Y-10 (p. 57-58) reported that some traces of CRPR have dip–slip (normal) displacement and steep (70° to 90°) northwest dips. On the basis of exposures at one locality on the northeastern end of Clayton Ridge, Y-10 (p. 58) concluded that observed crenulations and slickensides within bedrock shear zones suggest left–lateral oblique displacement.

Scarp characteristics: CRPR is shown by Y-238 (pl. 1) as primarily west–facing scarps.

Displacement: No information.

Age of displacement: CRPR is portrayed by Y-238 as moderately expressed to prominent lineaments and scarps on surfaces of chiefly Quaternary deposits; a few lineaments and scarps are shown on surfaces of Tertiary deposits. Some traces of CRPR are shown by Y-238 as faults that are in Quaternary deposits and that were identified from previous mapping.

For the portion of CRPR that he shows, Y-1032 (table A2, p. A3) noted that the age of the youngest displacement is probably middle to early Pleistocene (defined as >200 ka and <1.8 Ma by Y-1032, p. 30). The youngest (and also the oldest) unit displaced along this portion of CRPR is his old–age alluvial–fan deposits (Y-1032, table A2, p. A3) with an estimated age of 700 ka to 1.8 Ma (Y-1032, table 3, p. 23). The oldest unit not displaced along this section is his intermediate–age alluvial–fan deposits (Y-1032, table A2, p. A3) with an estimated age of 15 ka to probably about 200 ka (Y-1032, table 3, p. 23).

Y-853 portrayed CRPR as one of the major range–front faults in the area; they interpreted these faults as displaying evidence for Quaternary activity. Late Quaternary displacement on CRPR is interpreted by Y-10 (p. 58) from stratigraphic relationships along both Clayton and Paymaster ridges. Upper Pleistocene and Holocene alluvial–fan deposits are reported to abut the fronts of these ridges and appear to bury older alluvial–fan deposits (Y-10, p. 58). Recurrent Quaternary displacements are inferred by Y-10 (p. 58) from layers of sheared alluvium or colluvium that overlie sheared bedrock. On the basis of variations in particle size of, extent of shearing in, and degree of cementation of the alluvial or colluvial layers, Y-10 (p. 58) concluded that the layers become younger and less disturbed by faulting away from the bedrock. These relationships suggested to them that several episodes of displacement have occurred rather than a single episode.

Clayton Ridge–Paymaster Ridge fault (CRPR) — Continued

Y-407 (p. 49) inferred that "Clayton Ridge is separated from Clayton Valley by a high–angle fault, which is mapped in places, having movement that both pre–dates and post–dates the Tertiary volcanic and sedimentary rocks in the central part of the ridge."

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: CRPR is portrayed by Y-853 as a major range–bounding fault that borders a tectonically active range front that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front."

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field observations at two localities (Y-238, p. 3). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: CRPR is approximately parallel to other northeast–striking, major range–bounding faults in the area, such as the Emigrant Peak faults (EPK) along the western side of the Silver Peak Range northwest of CRPR, the Montezuma Range fault (MR) along the western side of the Montezuma Range east of CRPR, the Clayton–Montezuma Valley fault (CLMV) in an unnamed valley between Clayton and Montezuma ridges immediately east of CRPR, and south of CRPR, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains. The eastern end of the northwest–striking Weepah Hills fault (WH), which is along the southern side of the Weepah Hills, nearly intersects CRPR at the northern end of Clayton Valley. The structural relationships among all these faults are unknown.

Y-238 (p. 4) speculated that the northeast–striking faults in the area around CRPR could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of FC and west of Pahute Mesa, Y-10 (p. 60) inferred that these faults could be rooted in a detachment fault at depth.

Clayton Valley fault (CV)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 1); Y-407: Albers and Stewart, 1972 (pl. 1); Y-853: Dohrenwend and others, 1992.

Location: 132 km/310° (distance and direction of closest point from YM) at lat 37°36′N. and long 117°35′W. (location of closest point). CV is located primarily along the eastern side of Clayton Valley. It also includes fault traces in central and western Clayton Valley.

USGS 7-1/2′ quadrangle: Alcatraz Island, Goat Island, Lida Wash, Lida Wash NW, Lida Wash SW, Oasis Divide.

Fault orientation: CV strikes generally northeast, but the fault curves so that short sections strike between northwest and east–northeast (Y-238; Y-853). Fault traces in central and western Clayton Valley strike northeast or north–northeast (Y-238).

Fault length: The length of the part of CV along the eastern side of Clayton Valley is 26 km as estimated from Y-853 and 27 km as estimated from Y-238. Fault traces in both central and western Clayton Valley are about 3.5 km long (estimated from Y-238 and Y-853).

Style of faulting: No information.

Scarp characteristics: Most scarps along the part of CV along the eastern side of Clayton Valley are shown by Y-238 and Y-853 as northwest–facing. Scarps in central and western Clayton Valley are portrayed by Y-238 as both down to the northwest and down to the southeast.

Displacement: No information.

Age of displacement: Y-10 (p. 58) noted that fault scarps in Clayton Valley appear to cross surfaces of several ages. The part of CV along the eastern side of Clayton Valley is portrayed by Y-853 as scarps on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma) and, at one locality, early to middle Pleistocene age (their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma). Most of CV is shown by Y-238 (pl. 2) as fault traces that are in Quaternary deposits and that were identified by previous mapping and, in places, as prominent scarps (primarily) on surfaces of Quaternary deposits. They also portrayed the northeastern end of CV as a lineament around Angel Island.

Y-407 portrayed fault traces in central and western Clayton Valley as a fault in Pliocene/Miocene sedimentary rocks (e.g., shale, siltstone, sandstone, tuff) and as faulted contacts between Cambrian/Ordovician rocks and Holocene alluvium, colluvium, and playa deposits (their Qal deposits). The map by Y-407 shows this part of CV as concealed by Holocene alluvium, colluvium, and playa deposits (their Qal deposits). Fault traces in this part of CV are shown by Y-238 as weakly expressed on surfaces of Quaternary deposits or as prominent on surfaces of Tertiary deposits (the ones on surfaces of Tertiary deposits are not shown on pl. 1 of this compilation).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with CV.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000). Compilation by Y-407 of unpublished mapping by Moiola (1962) and by Albers, Stewart, and McKee (1960-62).

Clayton Valley fault (CV) — Continued

Relationship to other faults: CV is one of several northeast–striking faults within basins in the area, such as the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range east of CV. All of these have evidence for Pleistocene displacement (Y-238; Y-853). CV differs from these other faults in that the scarps in Clayton Valley "are relatively long and appear to offset surfaces of several ages" (Y-10, p. 58). CV is also approximately parallel to northeast–striking, major range–bounding faults west of Cactus Flat, such as the Emigrant Peak faults (EPK) along the western side of the Silver Peak Range northwest of CV, the Montezuma Range fault (MR) along the western side of the Montezuma Range east of CV, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges immediately east of CV, and southeast of CV, the Palmetto Mountains–Jackson Wash faults (PMJW) in the valley northeast of Palmetto Mountains, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain, and the Lida Valley faults (LV) along the eastern side of the Palmetto Mountains and the western side of Magruder Mountain (Y-238; Y-853).

Y-238 (p. 3) speculated that the northeast–striking faults in the area around CV could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred that these faults could be rooted in a detachment fault at depth.

Cockeyed Ridge–Papoose Lake fault (CRPL)

Plate or figure: Plate 1.

References: Y-232: Cornwall, 1972 (pl. 1); Y-813: Reheis, 1992 (pl. 2).

Location: 53 km/63° (distance and direction of closest point from YM) at lat 37°03′N. and long 115°55′W. (location of closest point). CRPL is located along the northeastern side of Cockeyed Ridge and along the eastern sides of unnamed ridges west of Papoose Lake.

USGS 7-1/2′ quadrangle: Jangle Ridge, Paiute Ridge, Papoose Lake.

Fault orientation: CRPL strikes generally north–northwest (Y-232; Y-813).

Fault length: The total length of CRPL is about 21 km as estimated from Y-813, which includes a 5–km–long gap in the surficial expression of the fault south of Cockeyed Ridge.

Style of faulting: The southern half of CRPL north of the gap in surficial expression is shown by Y-813 as down to the east. The northern half of this part of CRPL is portrayed by Y-813 as down to the west. The direction of displacement for the part of CRPL south of the gap is shown by Y-813 as down to the east.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Most of CRPL is shown by Y-813 as faults that are in Quaternary deposits and that were identified from previous mapping (primarily) and as weakly expressed lineaments or scarps on surfaces of Quaternary deposits. Y-232 portrayed a short portion of one north–northwest–striking fault trace at the southern end of CRPL as a faulted contact between Quaternary alluvium (his Qal deposits) and Pliocene and Miocene tuff (his Tp unit). Y-813 portrayed a short section (about 1.5 km long) of CRPL along the eastern side of Cockeyed Ridge as a fault that is in Tertiary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: The structural relationship of CRPL to other faults in the area is not known. The northern end of CRPL abuts at an oblique angle the southern end of the northeast–striking Emigrant Valley North fault (EVN; Y-813). CRPL is approximately parallel to fault traces along the western side of the Halfpint Range. These are shown as the Plutonium Valley–North Halfpint Range fault (PVNH) in this compilation (pl. 1).

Along the western side of the Papoose Range east of Papoose Lake, two west–facing scarps that are shown by Y-813 to trend slightly more eastward than CRPL are not included in CRPL (pl. 1).

Crossgrain Valley faults (CGV)

Plate or figure: Plate 2.

References: Y-62: Barnes and others, 1982; Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991.

Location: 48 km/114° (distance and direction of closest point from YM) at lat 36°40′N. and long 115°58′W. (location of closest point). CGV includes several faults within Crossgrain Valley and along the southern side of the valley at its junction with North Ridge.

USGS 7-1/2′ quadrangle: Mercury, Mercury NE.

Fault orientation: CGV has a curving but generally northeast strike.

Fault length: The fault along the front of North Ridge is 7 km or 8.5 km long as estimated from Y-852 and Y-813, respectively. Faults about 0.5 km north of North Ridge in Crossgrain Valley are 1.5 km long (Y-852). Faults at the northeastern end of the ridge are about 2 km long as estimated from both Y-813 and Y-852. A fault trace at the southwestern end of North Ridge is 3 km long (Y-813).

Style of faulting: Displacement on the fault along the front of North Ridge is shown by Y-62 as down to the northwest and left–lateral. Y-813 portrayed displacement on 2.5 km at the southwestern end and 4.5 km at the northeastern end of this fault as left–lateral. Y-813 also showed a fault in Crossgrain Valley at the southwestern end of, but north of, North Ridge as left–lateral and down to the northwest. One short section of a fault in Crossgrain Valley at the northeastern end of North Ridge is portrayed by Y-813 (pl. 3) as having left–lateral displacement. One short section of this same fault is shown as having down–to–the–north displacement (Y-813).

Scarp characteristics: Y-813 (pl. 3) portrayed a 2–km–long section near the center of the fault along the front of North Ridge as a northwest–facing scarp. Two sections of the fault in Crossgrain Valley at the northeastern end of North Ridge are portrayed by Y-813 (pl. 3) as north–facing scarps.

Displacement: No information.

Age of displacement: CGV has surficial expression on surfaces of both Quaternary and Tertiary deposits according to Y-813 and Y-852. A 2–km–long section of the fault along the front of North Ridge, a 0.5–km–long section along the fault in Crossgrain Valley along the southwestern end of North Ridge, and most of the fault in Crossgrain Valley along the northeastern end of North Ridge are shown by Y-813 (pl. 3) as moderately to strongly expressed lineaments or scarps on surfaces of Quaternary deposits. Y-62 showed the fault along the front of North Ridge as displacing pre–Tertiary rocks and as concealed by Quaternary and Tertiary alluvium. Faults north of North Ridge in Crossgrain Valley displace Oligocene tuff and limestone and pre–Tertiary rocks but are concealed by Quaternary and Tertiary alluvium according to Y-62.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Faults both along the front of North Ridge and within Crossgrain Valley are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock, but not as major range–front faults. The morphology of the front of North Ridge is similar to that along a major range–front fault and is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). Although this morphology is similar to that along a major range–front fault, the "associated fault systems are significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous" (Y-852).

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Crossgrain Valley faults (CGV) — Continued

Relationship to other faults: CGV may be the southwestern extension of the Spotted Range faults (SPR), which are located about 5 km east of CGV. However, the Ranger Mountains and the valley of Sandy Wash separate CGV from these faults. The strike of CGV is similar that of the Rock Valley fault (RV), located along the southern side of Frenchman Flat about 10 km north of CGV. The strike of CGV also is similar to those of the faults along Mercury Ridge (MER) about 1.5 km to the north. The structural relationships among these faults are not known.

Death Valley fault (DV)

Plate or figure: Plate 2.

References: Y-29: Hamilton, 1988; Y-216: Brogan and others, 1991 (subdivided DV between Salt Springs and Ashford Mill into eleven segments on the basis of changes in the strike or character of the fault, p. 3); Y-222: Streitz and Stinson, 1974; Y-246: Troxel, 1986; Y-249: Troxel and others, 1986; Y-251: Troxel, 1986; Y-252: Sylvester and Bie, 1986 (their Artist's Drive fault; p. 41); Y-389: Drewes, 1963 (his Black Mountains fault system, which he subdivided into three north–northwest–striking faults (southern, central, northern) that are linked by two northeast–striking faults (southern and northern); fig. 2, p. 5, 61-66); Y-390: Hunt and Mabey, 1966; Y-391: Denny, 1965; Y-399: Hopper, 1947; Y-402: Drewes, 1959 (his Black Mountains fault system); Y-413: Jennings and others, 1962; Y-415: Jennings, 1985 (his Death Valley sheet); Y-421: McAllister, 1970 (shows the part of DV north of Gower Gulch); Y-427: Hart and others, 1989; Y-429: Wills, 1989 (his Death Valley fault zone between Furnace Creek and Shore Line Butte); Y-467: Curry, 1954 (his Frontal fault; description of turtleback surfaces); Y-468: Noble and Wright, 1954; Y-471: Burchfiel and Stewart, 1966; Y-472: Butler and others, 1988; Y-473: Hill and Troxel, 1966; Y-474: Hooke, 1972 (his Black Mountain fault; subdivided alluvial–fan deposits into seven stratigraphic units; used characteristics of alluvial fans and pluvial features on the eastern and western sides of Death Valley to infer a tilting history for a structural block that includes both the Panamint Range and Death Valley); Y-594: Fleck, 1970 (his Death Valley fault zone is shown as approximately located in the central part of Death Valley; DV is referred to as the frontal fault of the Black Mountains); Y-597: Wright and others, 1974; Y-746: Wright and Troxel, 1954 (maps 7 and 8); Y-779: Cole, 1984 (measured topographic profiles of alluvial surfaces and active washes along Willow Creek and three small drainages between Willow Creek and Sheep Canyon); Y-805: Keener and others, 1990; Y-880: Curry, 1938; Y-976: Wills, 1989; Y-1020: Jennings, 1992 (his Death Valley fault zone, fault #248); Y-1039: Keener and others, 1993; Y-1040: Miller, 1991 (his active segment of the Badwater Turtleback fault; relationship between DV and his older turtleback segments); Y-1043: Pavlis and others, 1993 (attempted to explain the geometry of DV and older faults along the Mormon Point turtleback); Y-1048: Holm and Wernicke, 1990; Y-1150: Hunt, 1960 (survey of archaeology sites in and adjacent to Death Valley; used by Y-390 to assess the age of faulting in Death Valley); Y-1153: Noble, 1926; Y-1248: Holm and others, 1993; Y-1307: Curry, 1938 (named the "turtleback" surfaces along the western front of the Black Mountains).

Location: 55 km/220° (distance and direction of closest point from YM) at lat 36°28′N. and long 116°50′W. (location of closest point). DV is located along the base of the western side of the Black Mountains and the eastern side of Death Valley between about Furnace Creek Wash on the north and Shoreline Butte on the south.

USGS 7-1/2′ quadrangle: Badwater, Dantes View, Devils Golf Course, Furnace Creek, Gold Valley, Mormon Point, Shore Line Butte.

Fault orientation: Most sections of DV strike between N. 4° W. and N. 28° W. (Y-216, p. 13-18). Exceptions are the Willow Creek section of Y-216 (p. 17), which strikes N. 53° E., and the Mustard Canyon section, which strikes N 55° W (Y-216, p. 14). Y-429 (p. 1) distinguished DV from the northwest–striking Furnace Creek fault (FC) to the north and the Southern Death Valley fault (SDV) to the south by its more northerly strike.

Y-389 (p. 63) reported that dips of 40° W. to 55° W. are common on individual fault planes of DV, but that dips of up to 75° SW. were observed southwest of Badwater and near Mormon Point. Y-1153 (p. 425) noted that fault planes, where they are exposed in bedrock, are nearly vertical. On the basis of near–vertical fault scarps on alluvial surfaces and a steep fault–line scarp, Y-1040 (p. 374) inferred that DV near Badwater dips at least 60° W.

Fault length: Estimates of the length of DV range between 51 and 104 km, as described below. Differences in the length estimates result from differences in interpreting the end points of DV with the Southern Death Valley fault (SDV) to the south and the Furnace Creek fault (FC) to the north.

Y-389 (p. 61) reported a length of 64 to 104 km (40 to 65 miles) for DV (his Black Mountains fault system).

Death Valley fault (DV) — Continued

The map of Y-216 (pls. 3 and 4) shows DV to have nearly continuous expression from west–facing scarps between Furnace Creek Wash and Mormon Point for a minimum length of about 51 km as estimated from Y-216 (pls. 3 and 4). This includes a 6–km–long section of DV north of Natural Bridge, where the map by Y-216 (pl. 3) shows little surficial expression of DV.

Y-216 (fig. 2, p. 4) extended DV south of Mormon Point to the southern limit of their map area near Shore Line Butte. They recognized little geomorphic expression for lateral displacement on this section, but noted vertical scarps similar in size to those north of Mormon Point (Y-216, pl. 4). If DV extends to near Shore Line Butte, a section about 17 km long, then the length of DV would be about 68 km as estimated from Y-216 (pl. 4). However, Y-429 (p. 8, fig. 3e, locality 1) and Y-473 both reported evidence for right–lateral displacement on this portion of DV. This type of displacement is similar to that on the northwest–striking SDV south of Shore Line Butte. This section could instead be the northern part of SDV or a transitional section between DV and SDV.

Y-216 (fig. 2, p. 4) extended DV north of Furnace Creek Wash to Salt Springs, although the fault in this area is expressed as scattered scarps, some trending north (similar to the strike of DV to the south) and some trending northwest (similar to the strike of FC to the north; Y-216, pls. 2 and 3). The portion of the fault between Furnace Creek Wash and Salt Springs is about 11 km long as estimated from Y-216 (pls. 2 and 3) and would increase the length of DV to 79 km. The map by Y-216 (pl. 2) shows no surficial expression of either DV or FC between Salt Springs and a northwest–trending vegetation lineament, which appears to be surficial expression of FC. This lineament is located about 4 km north of Salt Springs. If DV extends to this lineament, then the entire length of DV could be about 83 km.

Y-429 (p. 6, fig. 3a, locality 1) noted that the northernmost well–defined surface trace of DV is just south of the Harmony Borax Works about 4 km north–northwest of Furnace Creek. This interpretation would make DV about 72 km long between this scarp and near Shore Line Butte.

Lengths of individual scarps associated with DV range between 2.3 and 13.1 km (Y-216, table 4, p. 21).

Style of faulting: Displacement on DV has been predominantly dip–slip (normal) according to Y-216 (p. 13), Y-389 (p. 61), and Y-429 (p. 2). DV dips generally west (Y-389, p. 61; Y-429, p. 2). Y-216 (p. 18, table 4, p. 21) noted some evidence for right–lateral displacement, but only on his Badwater turtleback and Copper Canyon sections.

Y-429 (p. 6) called DV a "right–oblique fault with the west side down." He (Y-429, p. 6, fig. 3a) noted two northwest–trending, *en echelon* anticlines, one at Mustard Canyon and the other south of the Harmony Borax Works. (This sections is north of Furnace Creek Wash and could be part of FC instead of DV.) He (Y-429, p. 6) interpreted the anticlines to be the result of right–lateral displacement. On the basis of oblique–slip striations on some fault surfaces, Y-473 (p. 436) inferred a component of right–lateral slip on northeast–striking faults along the Black Mountains (e.g., north of Mormon Point). Y-429 (p. 6) reasoned that numerous small gullies that cross DV at about 30° clockwise to the fault scarp south of Breakfast Canyon indicate right–lateral displacement (e.g., tension fractures or reidel shears along a right–lateral fault). Y-429 noted right–lateral deflection of small drainages along DV east of Desolation Canyon (p. 6, fig. 3a, locality 4) and along a northwest–striking section of DV south of Copper Canyon (p. 7, figs. 2b and 3d, locality 9). Because deposition has been concentrated on the southwestern sides of alluvial fans between Badwater and Copper canyons, Y-474 (p. 2096) inferred that the youngest displacements on DV have been right–lateral strike slip.

Y-389 (fig. 2, p. 5, 56, 61) inferred a fault near the axis of Death Valley (his Death Valley fault zone) and suggested that the north–northwest–striking faults along the front of the Black Mountains (part of his Black Mountains fault system) splay away from his inferred fault within the valley and are connected to each other by shorter, northeast–striking faults along the mountain front (also part of his Black Mountains fault system).

Y-1153 (p. 427) described DV as irregular in detail, with a zig–zag pattern that results from a succession of faults that displace each other and create indented "cusps" along the front of the Black Mountains. Similarly, Y-29 (p. 76) suggested that DV is not likely a single steep range–front fault, but is probably "a series of step faults or the downdip continuation of the turtleback faults or a combination of steep and gentle faults."

Y-429 (p. 7, fig. 3c) interpreted a graben, which is up to 3 m deep, at the toe of the alluvial fan … Badwater to be the result of lateral spreading and liquefaction of sand beds within alluvium.

Scarp characteristics: Maximum vertical separations estimated across scarps on late Holocen… 2 ka; QIB; table 2, p. 8) surfaces (these are the youngest surfaces with scarps) range between 0.15 m o… fault trace of DV along the Badwater turtleback section of Y-216 (table 4, p. 21, pl. 3) and 3.0 m along … Springs section of Y-216 (north of Furnace Creek Wash; table 4, p. 21, pl. 2). The maximum slope angl… scarp along the Salt Springs section is 31° (Y-216, table 4, p. 21). The maximum slope angle reported by (table 4, p. 21) for scarps on late Holocene surfaces is 57° for a scarp with a maximum vertical separation … This is on the Golden Canyon section of Y-216 (just south of Furnace Creek Wash) and may represent tw… rupturing events according to Y-216 (table 4, p. 21, pl. 3).

Maximum vertical separations across scarps on earlier Holocene (2 ka to 10 ka; QIC; table 2, p. 8) … along the main trace of DV range between 1.5 m along the Black Mountains section of Y-216 and 5.0 m a… Artists Drive section of Y-216 (table 4, p. 21, pl. 3). The maximum slope angles for these scarps are about … 48°, respectively (Y-216, table 4, p. 21).

The highest Holocene scarps observed by Y-429 (p. 7, fig. 3c, locality 6) are at Badwater, where he rep… that scarps are 10 m high and have free faces 3 to 4 m high.

Maximum vertical separations across scarps on Pleistocene (>10 ka; Q2) surfaces (Y-216, table 2, p. 8) al… the main trace of DV range between 6.6 m along the North Ashford Mill section of Y-216 and 15 m along the Cop… Canyon turtleback section of Y-216 (table 4, p. 21, pl. 4). Maximum slope angles for these two scarps are 40° … 90°, respectively (Y-216, table 4, p. 21).

Y-1153 (p. 427) noted that five alluvial fans along DV have scarps and that some of these scarps are 6 m (20 … high.

Displacement (vertical): Estimates of vertical displacement on DV range between 2 mm and 20 km. The estimates are based on a variety of stratigraphic and structural markers of different ages, as noted in the followi… paragraphs in which displacements are discussed in order of decreasing unit age.

Y-976 (p. 197) estimated a total vertical displacement of about 5 km (about 3 miles) in central Death Va… by adding the height of the Black Mountains (about 1,525 m; about 5,000 ft) and the thickness of the valley fill … was estimated by Y-390 (about 3,000 m; about 10,000 ft).

On the basis of geobarometric, metamorphic, and structural data, Y-1048 (p. 523) estimated 10 to 20 km … uplift of the Black Mountains south of Badwater.

Y-594 (p. 2811) suggested that as much as 2,288 m (7,500 ft) of structural relief has resulted since depositi… of the Furnace Creek Formation began about 6.3 Ma (p. 2810) and that this formation has been vertically displaced at least 305 m (1,000 ft) along DV. He (p. 2811) also noted that the Artist Drive Formation has been vertically displaced as much as 1,525 m (5,000 ft).

Y-389 (p. 63) estimated vertical displacement on DV using topographic evidence because footwall rocks are not exposed in the hanging wall. From observations that prominent triangular facets along the front of the Black Mountains are about 610 m (2,000 ft) high and that higher ridges about 3 km (2 miles) east of the front are about 1,525 m (5,000 ft) above Death Valley, Y-389 (p. 63) concluded that the minimum vertical displacement on DV is probably "in the order of [1,220 m] 4,000 ft." He (Y-389, p. 63, 65) estimated that the maximum total vertical displacement is about 3 km (2 miles). This estimate is based on (1) gravity studies (*citing* Mabey, 1959, Y-1364, and Mabey, written commun., no date given) that suggest that Cenozoic fill in the central part of Death Valley is 1,525 to 2,135 m (5,000 to 7,000 ft) thick, (2) the assumption that this fill is probably thicker along the eastern edge of Death Valley since the valley has been tilted eastward, (3) the 3,660 m (12,000 ft) thickness of deposits in Copper Canyon basin (a small structural basin), and (4) using half of the suspected thickness of 3,050 to 4,575 m (10,000 to 15,000 ft) for the thickness of fill in Death Valley adjacent to the Black Mountains (Y-389, p. 63-65).

Y-391 (p. 32) reported that the Black Mountains have been uplifted along DV "several thousand feet relative to the valley floor" and speculated that >30 m (>100 ft) of this amount occurred during "the last few thousand years."

Death Valley fault (DV) — Continued

Using the fault scarps and range–front facets preserved along the Black Mountains, Y-389 (p. 65) suggested that the minimum displacement represented by the range front occurred during at least six events that resulted in cumulative vertical separations of 763 m (2,500 ft) in crystalline rocks, 397 m (1,300 ft) in fanglomerates of the Pliocene(?) Copper Canyon formation, 46 m (150 ft) in older Pleistocene gravel deposits near Mormon Point, 14 m (45 ft) in younger Pleistocene or Holocene gravel deposits, and about 1.5 m (about 5 ft) in all but the youngest gravel deposits.

Total vertical relief is 200 m across a dissected west–facing fault scarp at the Black Mountains range front along their North Ashford Mill section of DV (about 8 km south of Mormon Point; Y-216, p. 17). Vertical relief across fault scarps on surfaces of interlayered basalt, breccia, and fanglomerate thought by Noble (1941, Y-401) to be Pliocene(?) is 80 m along DV east of Cinder Hill on the northern part of their South Ashford Mill section (about 13 km south of Mormon Point and just north of Shore Line Butte; Y-216, p. 18).

Y-390 (p. A71-A72) suggested that shorelines and lake gravels (shingled) that are associated with a late Pleistocene stand of Lake Manly that they thought occurred during the Wisconsin (tentative correlation of the lake stand to the Tahoe glaciation in the Sierra Nevada) have been deformed between Mesquite Flat and Shore Line Butte. They (Y-390, p. A72) proposed eastward tilting of 61 m (200 ft) and northward tilting of 92 m (300 ft) on the basis of differences in the present elevations of the shorelines and lake deposits that they thought correlated to a single lake stand.

Using the present elevations of tufa and strandlines on the eastern side of Death Valley (on the uplifted footwall of DV) and on the western side of the valley, Y-474 (p. 2073, 2091) estimated a total post–Wisconsin (since about 10 ka to 11 ka; p. 2086) displacement of about 63 m on DV.

The maximum vertical separation that is reported by Y-216 (table 4, p. 21) is 15 m across a scarp on a Pleistocene surface (>10 ka; Q2; table 2, p. 8). This is along their Copper Canyon turtleback section (Y-216).

The maximum vertical separation that is reported by Y-216 (table 4, p. 21) across the main trace of DV on surfaces thought to be Holocene (<10 ka; Q1B and Q1C; table 2, p. 8) is 5.0 m along their Artists Drive section (Y-216, table 4, p. 21).

Y-390 (p. A100) reported that the eastern shoreline of a lake that they inferred existed in Death Valley about 2 ka (*see* Age of Displacement) is about 6 m (20 ft) lower than the western shoreline of this same lake. They (Y-390, p. A100) inferred that this tilting occurred abruptly, because concentric salt rings associated with the salt pan related to the lake are crowded against the eastern side of the Badwater Basin and because they thought that the tilting was related to the formation of a 3–m–high (10–ft–high) Holocene fault scarp along the base of the Black Mountains. The tilting of the shoreline is reflected in the differences in the geomorphology of alluvial fans on the eastern and western sides of Death Valley (Y-390, p. 106). Those on the eastern side are small; those on the western side are long and high (Y-390, p. 106). The tilting is also reflected by the smooth, aggrading nature of the drainages on the eastern side of Death Valley in the vicinity of Badwater and by the deeply entrenched (dissected) channels of the Amargosa River and its tributaries on the western side of the valley in this area. Y-391 (p. 37, pls. 4 and 5) also interpreted the differences in the size and morphology of alluvial fans on the western side (relatively large, gentle, incised fans that include large remnants of older varnished surfaces) and eastern side (relatively small, steep, undissected fans that include only small, scattered remnants of older varnished surfaces) as reflecting Quaternary deformation and eastward tilting of the floor of Death Valley as suggested by Y-390.

A level line established in 1970 across DV about 2 km south of Furnace Creek Wash (the Golden Canyon section of Y-216, pl. 3) and periodically resurveyed recorded about 2 mm of vertical displacement across the fault between 1978 and 1984 (Y-252, p. 41).

Displacement (right–lateral): Right–lateral displacements are reported by Y-216 (table 4, p. 21) at only two localities. Maximum right–lateral separations are 3.6 m along the Copper Canyon turtleback section of Y-216 and 0.2 m along the Badwater turtleback section of Y-216. Both of these displacements are on older Holocene (2 ka to 10 ka; Q1C; table 2, p. 8) surfaces and both are measured across branch faults rather than the main trace of DV.

Death Valley fault (DV) — Continued

Y-429 (p. 7, fig. 2b and 3d, locality 9) reported 1.8 to 3.6 m of right–lateral displacement for a gully on a northwest–striking section of DV south of Copper Canyon.

Age of displacement: The youngest displacement on most of DV is latest Holocene. A level line established by Y-252 (p. 41) in 1970 across DV about 2 km south of Furnace Creek Wash (the Golden Canyon section of Y-216, pl. 3) suggests that displacement continues.

Y-216 (p. 19) speculated that the youngest surface rupture on DV occurred on their Golden Canyon section (immediately south of Furnace Creek Wash) and may be nearly historical. They based this age estimate on the lack of varnish on the youngest disrupted surface, the preservation of scarps that have free faces that "persist only a few hundred to a few thousand years," and on the gradational contact between faulted and unfaulted alluvium (Y-216, p. 15). Y-976 (p. 198) noted that the "fresh scarps are especially well developed near the mouth of Golden Canyon." Y-389 (p. 61) observed that DV between about 2.5 km north of Badwater and about 8 km south of Mormon Point is either exposed, covered by only a thin veneer of gravel, or associated with "young fault scarps."

Y-390 (p. A100-A101, figs. 72 and 73) suggested that the youngest surface rupture on DV about 2 km south of Furnace Creek Wash (between Breakfast Canyon and Golden Canyon on the Golden Canyon section of Y-216) must be prehistoric because Indian mesquite storage pits have been constructed in "colluvium that overlaps the scarp" (Y-390, p. A100; Y-1150, p. 178-179, site 85-56, circle D). The circular pits were probably built during or after Death Valley III occupation (Y-1150, p. 1-2, 177, since 2 ka). Y-1150 (p. 178) concluded that the surface rupture that formed the fault scarp was "sufficiently older than the circles for the [scarp] to have weathered enough to produce the colluvial slope."

Y-1153 (p. 425) noted that "parts of [the] huge scarps [along DV] are fresher than any other scarps of similar magnitude in the West," but no specific location is given.

The youngest surfaces reported by Y-216 (table 4, p. 21) to lack scarps along DV are younger than 0.2 ka (table 2, p. 8, their Q1A surfaces).

The only disrupted surface that Y-216 reported as having any age control is the surface with the 3–m–high scarp along their Salt Springs section, which is the northernmost of their sections along DV (Y-216, p. 13, 19). This scarp crosscuts a lake shoreline (Lake Manly) that dates from about 2 ka, for which Y-216 (p. 13) cited Y-390 and Y-1150. Y-390 (p. A70-A82) reported that this shoreline, at elevation 240 ft below sea level, is interpreted from "the upper limit of highly saliferous ground" (p. A79). The 2–ka age estimate for this lake is based on artifacts contained in sand dunes that overlie the lake floor on the western side of Badwater Basin (west of Badwater about 35 km south of Salt Springs; Y-390, p. A82, A87). The artifacts are from Death Valley III and IV occupations as interpreted by Y-1150 (p. 2, 111-112, 163-166) and noted by Y-390 (p. A82, A87).

Y-216 (p. 19) concluded that three or more late Holocene surface ruptures have occurred on DV as indicated by displacements of late Holocene alluvium (his Q1B unit with an estimated age of 0.2 ka to 2 ka).

Y-216 (p. 18) recognized Holocene surface rupture on all of DV except for their Mustard Canyon section, which is located near the northern end of the fault as interpreted by Y-216 (between the Park Service facilities at Cow Creek and about 2 km north of Furnace Creek Ranch), and their Artists Drive section, which is between Natural Bridge and Mushroom Rock.

Y-1020 portrayed nearly all of DV (between Furnace Creek Wash or Salt Springs and south of Jubilee Pass) as having Holocene (≤10 ka) displacement. Y-429 (p. 1) noted that the evidence for Holocene displacement on DV is "abundant." Fault traces on the western side of Death Valley and some on the eastern side of Death Valley are shown as Holocene (≤10 ka) by Y-1020, based on the presence of sag ponds and fault scarps that show little erosion.

Y-429 (p. 7) noted that the alluvial fan with a scarp 10 m high at Badwater has only weak varnish and little or no carbonate in the associated soil suggesting a Holocene age for the disrupted surface.

Death Valley fault (DV) — Continued

Y-474 (p. 2073, 2077, 2086) interpreted segments (breaks in slope) of alluvial fans on the western and eastern sides of Death Valley as indicating six episodes of tilting in Death Valley, three of which occurred after the last major high stand of Lake Manly (his Blackwelder stand) that was interpreted by him to have ended between about 10 ka and 11 ka. Y-474 (p. 2073) suggested that "distinct tectonic events" occurred at about 0.2 ka, 1 ka, 6 ka, 17 ka, 30 ka, and 42 ka. These ages were derived from estimating volumes of sediment deposited after each tilting event.

Fault traces on the western side and in the central part of the valley are shown by Y-1020 as late Quaternary with displacement since 700 ka. This age estimate was based on features that are similar to but less distinct than those suggesting Holocene displacement (Y-1020).

Some fault traces are shown by Y-1020 as Quaternary, undifferentiated, with displacement since 1.6 Ma.

Y-389 (p. 65-66) concluded that displacement on DV has recurred at least six times since Miocene(?) to early Pliocene. He speculated that (1) the oldest displacement, which includes three stages, occurred in the Miocene(?) to early Pliocene, because this displacement postdates older volcanics and predates the Copper Canyon formation; (2) the second and third displacements occurred in early(?) or middle Pleistocene and in middle(?) Pleistocene, respectively, because these displacements postdate Funeral Formation and predate gravels of Lake Manly; (3) the fourth displacement occurred in late(?) Pleistocene, because it postdates gravels of Lake Manly and predates poorly indurated gravels; (4) the fifth displacement occurred in late Pleistocene or Holocene, because it postdates poorly indurated gravels and predates Holocene gravels, and (5) the sixth displacement occurred in the Holocene and disrupts all but the youngest gravels (Y-389, p. 66).

Y-594 (p. 2,811) concluded that most of the vertical displacement on DV probably occurred since about 6 Ma (before deposition of the Furnace Creek Formation), although Death Valley may have begun to form before this time.

The maximum age for the onset of faulting is assumed by Y-216 to be middle Miocene on the basis of K–Ar ages for displaced volcanics believed to be coeval with faulting.

Slip rate: An apparent vertical slip rate of 1.5 mm/yr is estimated for the Salt Springs section of Y-216 (part of DV?), using the 3 m vertical displacement of a 2,000–yr–old shoreline as reported by Y-216 (table 4, p. 21). Using the range of maximum vertical separations of 0.15 to 2.3 m in deposits estimated to be 0.2 ka to 2 ka (their Q_{IB} deposits, table 2, p. 8) as reported by Y-216 (table 4, p. 21) for DV south of Furnace Creek Wash, the apparent vertical slip rate ranges between 0.08 to 11.5 mm/yr for this portion of DV during the late Holocene. Using the range of maximum vertical surface separations of 1.5 to 5 m that is reported by Y-216 (table 4, p. 21) for older Holocene (2 ka to 10 ka) surfaces, an apparent vertical slip rate of 0.15 to 2.5 mm/yr is estimated for DV during the Holocene.

Y-389 (p. 66) suggested that the vertical slip rate on DV has increased since middle Miocene(?). This suggestion is based on estimates of minimum displacement in rocks or deposits, which yield the following "crude" estimates of the minimum average vertical slip rates (Y-389, p. 66): 0.03 mm/yr (100 ft/1 myr) since middle Miocene, 0.08 mm/yr (250 ft/1 myr) since middle Pliocene, 0.12 mm/yr (400 ft/1 myr) since middle Pleistocene, and 0.23 mm/yr (750 ft/1 myr) since latest Pleistocene. Although Y-389 (p. 66) indicated little confidence in the actual values, he concluded that the general increase in the rates is significant.

Using differences in elevation of tufa and strandlines thought to correlate with stands of Lake Manly, Y-474 (p. 2093-2096) estimated late Pleistocene tilting rates on DV. From his estimate of the present tilting rate (0.016°/ 1,000 yr) and the assumption that the axis of tilting is 25 km west of DV, Y-474 (p. 2096) estimated a vertical slip rate of 7 mm/yr for DV since late Pleistocene.

Recurrence interval: Assuming that three or more surface ruptures have occurred on DV during the late Holocene (<2 ka) as reported by Y-216 (p. 19), the maximum recurrence interval for surface–rupturing events is about 650 yr. Y-216 concluded this number of events from three distinct scarps that are preserved on late Pleistocene surfaces. They inferred that these scarps represent three separate events on their Artists Drive section.

Death Valley fault (DV) — Continued

Range-front characteristics: Y-1153 (p. 425) described the front of the Black Mountains adjacent to DV as "exceedingly rugged" and noted that it "rises abruptly from the valley floor." He (Y-1153, p. 425-426) described the front, from its base above the alluvial scarps upward, as composed of (1) a small vertical cliff, which marks the recent fault just above the valley floor, (2) a relatively steep escarpment (just above the cliff) that slopes 35° and that is dissected by parallel drainages that are "deep, straight, and acutely V–shaped," and (3) a gentler escarpment that slopes 25° and that has a relatively subdued and rounded topographic form. Y-1153 (p. 426) attributed this configuration to recurrent "earth–movement" with the more recent movements recorded by the vertical cliff and scarps on the alluvial fans immediately west of the range front.

Y-389 (p. 63-64, fig. 11) noted that the western front of the Black Mountains adjacent to DV and above fault scarps on alluvial fans is linear, abrupt, and faceted. He (Y-389, p. 63-64) recognized two groups of facets: a lower group that is steeper and less dissected than an upper group. Facets in the lower group have an average slope of 40° to 45° toward the valley, are trapezoidal, are preserved along the lowermost 61 m (200 ft) of the range front, and are associated with gravel remnants preserved above the facets (Y-389, p. 63). Facets in the upper group slope 35° to 40°, are triangular, and are positioned between the lower group of facets and elevations of 427 to 671 m (1,400 to 2,200 ft). Y-389 (p. 63) interpreted these facets, possibly along with straight ridge segments that slope 20° to 30° for 305 to 610 m (1,000 to 2,000 ft) above the upper facets, to be the result of recurrent displacements on DV, tilting of the footwall, and subsequent erosion.

Three portions of the western front of the Black Mountains (at Mormon Point, Copper Canyon, and Badwater) are marked by "smooth, broadly convex, slightly eroded surfaces" that rise "thousands of feet toward or to the crest of the range" (Y-1307, p. 1875). These structural and topographic features, which were named "turtleback" surfaces by Y-1307 (p. 1875) because their form resembles a land tortoise, were interpreted by Y-1307 (p. 1875) to represent late Tertiary, warped thrust faults (called turtleback faults by Y-467, p. 54) "from which the hanging wall has been largely stripped." These exhumed surfaces slope between 15° and 60°, but are rarely >32° (Y-1307, p. 1875). The facets described above are on the sides of the Copper Canyon and Badwater turtlebacks (Y-467, p. 58-59).

Y-1040 (p. 372) interpreted the facets on the Badwater turtleback as "three distinct west–dipping faults that decrease in age and increase in dip westward." He (Y-1040, p. 372) called these faults from older (highest on the range front) to youngest (lowest on the range front) as the low–angle segment, the frontal segment, and the active segment (DV). The upper, low–angle segment is planar, dips 17° W., and is locally disrupted by younger faults (Y-1040, p. 374). The intermediate, frontal segment, which cuts the low–angle segment, dips between 35° and 54° W. or WSW. and juxtaposes remnants of Tertiary volcanic rocks and Quaternary(?) alluvial–fan deposits above the fault against mylonitic, mostly Precambrian rocks below the fault (Y-1040, p. 374).

Analysis: Aerial photographs (Y-216, p. 3, scale ~1:12,000 (low–sun–angle); Y-389, p. 3 (vertical black and white and low–angle oblique color); Y-390, p. A7-A8; Y-429, p. 10, scale 1:12,000 (low–sun–angle), 1:20,000, and 1:24,000). Geomorphic interpretation made using low–sun–angle aerial photography (Y-427, p. 8). Mapping at a scale of 1:24,000 (Y-429, p. 5). Aerial reconnaissance (Y-390, p. A8). Field reconnaissance (Y-216, p. 3; Y-429, p. 5-6). Subdivision of DV into eleven sections based on the orientation of the fault, the apparent age of faulting, the width of the fault zone, the pattern of faulting, and the position of the fault relative to the range front (Y-216, p. 3-4, fig. 2, pls. 2-4). Subdivision of Quaternary geomorphic surfaces into relative–age groups based primarily on surface characteristics and topographic position (Y-216, p. 5, 8, table 2, 4 groups; Y-474, p. 2073, 7 groups). Field examination (Y-216, p. 3-5; Y-427, p. 8;). Compilation of published and unpublished literature (Y-427, p. 8). Geologic field mapping (Y-389, p. 3 (work done between 1956 and 1958 and included plane table and alidade and 1:48,000–scale topographic base); Y-390, p. A7-A8 (using ground traverses); Y-474, p. 2073 (work done between 1967 and 1970)). Interpretation of geomorphic features (Y-216, p. 3-5). Surveying of level lines 300 to 500 m long and arranged perpendicular to the fault (Y-252, p. 41). Topographic profiles on alluvial fans (Y-474, p. 2081).

Death Valley fault (DV) — Continued

Relationship to other faults: The relationship between DV and the turtlebacks or turtleback faults has received much speculation. Y-467 (p. 58) noted that DV (his Frontal fault) joins the turtleback faults at Badwater and south of Copper Canyon but does not cut either turtleback. From these relationships he (Y-467, p. 58) suggested that DV "may coincide with the turtleback fault at depth, and that there may have been recurrent normal movement on the west flanks of both turtlebacks." Y-1040 (p. 374) concluded that DV (his active segment of the Badwater Turtleback fault) intersects the lower–angle faults above DV on the Badwater turtleback (his frontal segment of the Badwater Turtleback fault) because DV (1) dips more steeply than the frontal segment, (2) is younger than the frontal segment, and (3) is similar in position to that of an active fault (DV) interpreted by Y-805 (p. 34) on the Mormon Point Turtleback fault. Y-805 (p. 34) observed that Quaternary fault scarps at Mormon Point are coincident with an abrupt increase in gradient that they interpreted from gravity and magnetic data. From this observation, they (Y-805, p. 34) concluded that the faults associated with the Quaternary scarps "probably project at depth to a steeply dipping fault that cuts" a shallow–dipping portion of their Mormon Point fault system. The shallow–dipping portion separates crystalline rocks from deformed Quaternary(?) gravels (Y-805, p. 34). Y-1039 (p. 330) interpreted geophysical data as indicating that a northeast–striking, low–angle fault along the northern side of Mormon Point (their segment 5) is displaced by approximately parallel, younger, moderate–to–high–angle faults (their segment 2; part of DV). Y-251 (fig. 1, p. 38) sketched an exposure that is located about 1.6 km (about 1 mile) south of Mormon Point and that shows that west–dipping, relatively steep, west–side–down normal faults flatten and merge with the west–dipping, relatively low–angle turtleback fault. Although the relatively steep normal faults have orientations similar to that of DV, the relationship between the trace of DV that is associated with young fault scarps (west of the normal faults observed at this locality) and the turtleback fault is not exposed at this locality. Y-402 (p. 1506-1508) proposed that relatively recent displacement on DV (his Black Mountains fault system) allowed blocks of fanglomerate to slide toward Death Valley along the turtleback faults during the late Pliocene or early Pleistocene.

Y-1043 (p. 267, 270) concluded that the irregular geometry of the Quaternary ruptures along DV in the vicinity of Mormon Point is derived from the complex geometry of older faults at this locality and the rotation of these older faults (now preserved in the footwall of the active fault trace) during repeated ruptures.

Fault scarps are preserved on Quaternary surfaces on the western side of Death Valley opposite DV. Y-216 (p. 13) concluded that the main fault is along the eastern side of the valley.

DV is part of a fault system that is >300 km long (Y-216, p. 1). Other faults in the system are the Fish Lake Valley fault (FLV), the Furnace Creek fault (FC), and the Southern Death Valley fault (SDV). Y-390 (fig. 71, p. A100) suggested that DV is cut off on the north by FC and on the south by SDV (their Confidence Hills fault zone). Y-471 (p. 439-440) concluded that right–lateral displacement on northwest–striking FC and SDV (their Death Valley fault zone) has caused extension that has caused a "pulling apart" of the two sides of central Death Valley along a north trend. Y-473 (p. 435-436) suggested that geologic structures in the Death Valley region are products of northwest–southeast extension and northeast–southwest horizontal shortening on a system of strike–slip faults and that extensional features along DV are compatible with this interpretation.

On the basis of the marked differences between the large structural block of the Black Mountains and adjacent structural blocks (e.g., a near absence of Paleozoic rocks in the Black Mountains), Y-389 (p. 56) proposed that large, north–striking faults inferred in Death Valley (his Death Valley fault zone along the axis of the valley between near Furnace Creek and the Owlshead Mountains) and in the Amargosa Valley (his Shoshone fault zone) connect two large, northwest–striking faults, FC and SDV (his Confidence Hills fault zone). In addition, Y-389 (p. 56) suggested that if these faults are related physically and temporally, then they are probably also related genetically.

Y-1153 (p. 425) noted similarities in the strike, geomorphic expression, and recency of displacement between DV and the Panamint Valley fault (PAN) along the western side of the Panamint Range about 40 km (25 miles) west of DV and suggested that the faults have a "common origin."

Deep Springs fault (DS)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 2; show only that portion of DS north of about lat 37°21′N. and east of long 118°W., which are the boundaries of their map area); Y-427: Hart and others, 1989; Y-484: McKee and Nelson, 1967 (show only that portion of DS east of long 118°W., which is the boundary of their map area); Y-651: Reheis and McKee, [1991]; Y-762: Bryant, 1988 (preliminary report revised in Y-1033); Y-853: Dohrenwend and others, 1992 (show only that portion of DS east of long 118°W., which is the boundary of their map area); Y-861: Lustig, 1965 (does not show DS on his generalized geologic map (pl. 8), but does discuss scarps and other evidence for faulting in his text); Y-862: Miller, 1928; Y-869: Nelson, 1966 (shows only that portion of DS south of lat 37°15′N. and west of long 118°W., which are the boundaries of his map area); Y-870: Nelson, 1966 (shows only that portion of DS north of lat 37°15′N. and west of long 118°W., which are the boundaries of his map area); Y-872: Wilson, 1975; Y-1020: Jennings, 1992: Y-1033: Bryant, 1989; Y-1072: Reheis, 1993. Name from Y-862 (p. 516), *cited by* Y-762 (p. 2), Y-872 (p. 10), and Y-1033 (p. 246).

Location: 148 km/294° (distance and direction of closest point from YM) at lat 37°23′N. and long 117°57′W. (location of closest point). DS is located along the eastern side of Deep Springs Valley at its junction with the Inyo Mountains. It includes scarps shown by Y-853 along the northeastern side of Deep Springs Valley.

USGS 7-1/2′ quadrangle: Chocolate Mountain, Cowhorn Valley, Deep Springs Lake, Soldier Pass.

Fault orientation: DS generally strikes northeast, but it curves to strike north and north–northwest at the northern end of Deep Springs Valley (Y-484; Y-853). Y-872 (p. 55) reported a strike of N. 25° E. and a dip of 40° ± 2° W. at one locality along DS.

Fault length: The length of DS is about 27 km as estimated from Y-1033 (fig. 1, p. 243). This is slightly longer than Deep Springs Valley, which is 24 km long (Y-762, p. 2; Y-872, p. 2).

Style of faulting: Y-1033 (p. 247) noted that displacement on DS appears to be entirely dip–slip (normal) and that no evidence for left–lateral strike slip, which might be expected along a northeast–striking fault, has been observed. At the northern end of Deep Springs Valley north of Chocolate (Piper?) Mountain, DS may include north– or north–northwest–striking faults east of Deep Springs Valley within the Inyo Mountains (Y-238; Y-484; Y-1033, p. 248). Y-1033 (p. 248) reported that a northwest–striking, well–defined fault trace north of Deep Springs playa is characterized by northeast–facing scarps on alluvial surfaces, right–laterally deflected drainages, and vegetation lineaments. Just south of Deep Springs College, DS is a complex and discontinuous zone of scarps and linear troughs in granitic rocks (Y-1033, p. 247). This zone may delineate a right step in DS (Y-1033, p. 247).

Scarp characteristics: Scarps on DS are primarily west–facing (Y-484; Y-762, p. 3; Y-870). Heights of fault scarps that are located between Deep Spring playa and an unnamed drainage from the southern side of Chocolate (Piper?) Mountain range between 2.3 m and >20 m with scarp–slope angles between 21° and 39° (Y-1033, localities 1 through 9, fig. 2, table 1, p. 244-245). Scarps on surfaces of alluvial deposits north of the right step just south of Deep Springs College are generally less steep than scarps south of the step (Y-1033, p. 247). Y-1033 suggested that scarp heights in a graben east of Deep Springs playa may have been enhanced by lateral spreading caused by liquefaction, because displacement appears to have been mostly extensional rather than vertical (Y-1033, localities 1 and 2, fig. 2, table 1, photo 5, p. 244, 248). This conclusion is based on the projection of alluvial fans across the 3.5–m–wide graben (Y-762, p. 7).

Displacement: Displacement along DS has been estimated on the basis of a variety of stratigraphic markers as shown in the following paragraphs in which displacement is discussed in order of decreasing age of the stratigraphic marker.

Deep Springs fault (DS) — Continued

Y-872 (p. 55, fig. 22, p. 58) estimated that the total apparent vertical displacement across DS is about 1,525 m (5,000 ft). This is based both on the interpretation of a geophysical survey across Deep Springs Valley, which suggests that basement rocks are 793 m (2,600 ft) below the floor of the valley (assumes that DS dips about 45°), and on the height (732 m; 2,400 ft) of the front of the Inyo Mountains above the playa in Deep Springs Valley.

A minimum estimate of total apparent vertical displacement along DS is reported by Y-651 (p. 40) as about 1,625 m. This estimate is based on (1) the highest elevation (about 2,387 m; 7,830 ft) of bedrock in the footwall near Soldier Pass, (2) the depth (about 792 m; 2,600 ft) to bedrock beneath Deep Springs Valley adjacent to the fault at Soldier Pass as inferred from gravity data by Y-872 (p. 55), and (3) the elevation (about 1,554 m; 5,100 ft) of the valley floor at this locality.

Y-872 (p. 10) noted 153 m (500 ft) of vertical displacement across DS in Tertiary units just east of Deep Springs College. Y-872 (p. 9) also reported that Pliocene basalt had been displaced 458 m (1,500 ft).

A minimum apparent vertical displacement of 714 m since 10 Ma to 12 Ma has been estimated on the basis of the difference between the highest elevation (2,348 m; 7,703 ft) of a basalt dated at 10 Ma to 12 Ma (Y-651, p. 30, *citing* Dalrymple, 1963, Y-1243) at the top of Chocolate (Piper?) Mountain and the lowest elevation (about 1,634 m; 5,360 ft) of the surface of the hanging wall. This assumes that the basalt is probably buried beneath the alluvium in Deep Springs Valley.

Y-872 (p. 10) reported 61 m (200 ft) of vertical displacement on a northeast–striking branch fault mapped through Soldier Pass. This amount of displacement was calculated on the basis of the elevation differences between ridges on opposite sides of the fault within the Inyo Mountains. Likewise, Y-861 (p. 141) estimated about 61 m (200 ft) of uplift near Soldier Pass on the basis of a west–tilted and uplifted conglomerate at the northern end of Deep Springs Valley just southwest of Piper (Chocolate?) Mountain. Y-861 (p. 141) noted that the rocks in the conglomerate could have been derived only from the Wyman–Crooked Creek drainages on the western side of Deep Springs Valley, so that uplift and tilting probably caused disruption of the drainage pattern.

The elevation (1,805 m; 5,930 ft) of gravels in a canyon south of Chocolate (Piper?) Mountain, their position above the floor of Deep Springs Valley, and the Bishop ash (740 ka; Y-651, p. 30, *citing* M.C. Reheis, personal commun., 1989) that is interbedded with the gravels indicate a minimum of 180 m (590 ft) of late Quaternary vertical displacement along DS (Y-1033, p. 247).

The minimum apparent displacement since 740 ka has been estimated by Y-651 (p. 40) to be 201 m (660 ft). This is based on the elevation difference between a wind gap containing Bishop ash (740 ka) south of Chocolate (Piper?) Mountain, which is on the footwall, and the floor of Deep Springs Valley, which is on the hanging wall.

Age of displacement: The youngest displacement on DS is estimated to be Holocene by Y-1020 and Y-1033 (p. 247) on the basis of offset drainages and well–defined scarps on surfaces of Holocene deposits. Y-1033 (p. 250) reported that the morphology of scarps determined from measured topographic profiles suggests an age of middle to late Holocene (1.5 ka to 6 ka) or post–early Holocene for the youngest surface rupture. Post–early Holocene displacement is also indicated by scarps on both alluvial fans that are probably early Holocene and on younger alluvium deposited in channels incised into these alluvial fans (Y-1033, p. 254). Y-861 (p. 140-141) thought that "Recent" displacement along DS is indicated by scarps trending across alluvial surfaces, by springs and bogs, and by two carbonate–cemented conglomerates (Pleistocene?) that suggest post–lake uplift and tilting. One of these conglomerates is sparsely preserved in Soldier Canyon and dips west; the other crops out above the floor of Deep Springs Valley (Y-861, p. 140-141).

Fault scarps on Quaternary alluvial fans are also shown by Y-484 (their Qf deposits) and by Y-870 (his Qf deposits); fault scarps on early to middle and (or) late Pleistocene surfaces are shown by Y-853 (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). Springs coincide with or parallel some scarps, especially those adjacent to Deep Springs Lake (Y-870).

Y-238 portrayed some fault traces as being in Tertiary deposits and as having been identified by previous mapping. South of lat 37°15′N. (south of Deep Springs playa), DS is concealed by Quaternary alluvial–fan deposits according to Y-869. The exception is one short (0.5 km to 0.8 km long) section that may have experienced Quaternary (Y-869) or perhaps Holocene displacement (Y-762, p. 9).

Deep Springs fault (DS) — Continued

On the basis of topographic position and lithologic composition of fluvial gravel deposits interbedded with tephra correlated with the Bishop ash (740 ka) and preserved in present–day wind gaps in the Inyo Mountains, Y-651(p. 30, 42) and Y-861 (p. 141) concluded that streams draining the White Mountains on the western side of Deep Springs Valley once flowed across Deep Springs Valley and probably into Eureka Valley across Gilbert Summit (Cottonwood Creek), south of Chocolate (Piper?) Mountains (Wyman Creek), and across Soldier Pass (unnamed creek). This drainage pattern was disrupted by uplift on DS since 740 ka. The uplift has resulted in ponding in Deep Springs Valley or capture of drainages into Fish Lake Valley (Y-651, p. 30, 42; Y-861, p. 141).

Slip rate: Several minimum apparent vertical slip rates have been estimated for DS on the basis of a variety of stratigraphic markers and assumptions as noted in the following paragraphs in which the rates are discussed in order of decreasing unit age.

Y-651 (table 2, p. 37, 40) estimated a minimum apparent vertical slip rate of 0.06 to 0.07 mm/yr since 10 Ma to 12 Ma on the basis of the elevation of a basalt of this age on Chocolate (Piper?) Mountain and its inferred elevation beneath Deep Springs Valley.

Y-651 (p. 37, 40) estimated a minimum apparent vertical slip rate of 0.13 to 0.16 mm/yr for DS at Soldier Pass using a minimum vertical displacement determined from the elevation of bedrock in the Inyo Mountains and its inferred elevation beneath Deep Springs Valley and assuming that all displacement has occurred since 10 Ma to 12 Ma.

A minimum late Quaternary (since 740 ka) apparent vertical slip rate of 0.24 mm/yr was estimated for DS south of Chocolate (Piper?) Mountain by Y-1033 (p. 254). This estimate is based on at least 180 m of uplift of fluvial gravels interbedded with pumice fragments tentatively correlated with Bishop ash (740 ka) by M. Reheis (personal commun., 1989, *cited by* Y-1033, p. 254). Y-1033 (p. 254) recognized that this is a minimum late Quaternary rate because the Bishop ash fragments were eroded and deposited with the gravel some time after eruption of the ash at 740 ka.

Y-651 (table 2, p. 37, 40) calculated a minimum apparent vertical slip rate of 0.3 mm/yr since 740 ka for DS south of Chocolate (Piper?) Mountain. This estimate is based on the elevation difference (201 m; 660 ft) across the fault between uplifted fluvial gravel that contains Bishop ash and the floor of Deep Springs Valley.

Y-651 (p. 40) noted that the apparent vertical slip rate since 740 ka has probably been nearly twice the post–Miocene apparent vertical slip rate and suggested that this apparent difference could result for one or more of the following reasons. (1) The calculated post–Miocene rate is too low because of significant erosion of rocks from the footwall. (2) Displacement along DS actually began after 6 Ma rather than beginning immediately after the basalt erupted at 10 Ma to 12 Ma and concurrently with right–lateral displacement along the Fish Lake Valley fault (FLV), which began between 8.2 Ma and 11.9 Ma. (3) The post–740–ka rate is indeed faster than the post–Miocene rate (Y-651, p. 36, 42).

Recurrence interval: No information.

Range-front characteristics: The western front of the Inyo Mountains (east of long 118°W.) is portrayed by Y-853 as a tectonically active, major range front that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." The map by Y-238 shows part of DS as lineaments bounding a linear range front. Y-1033 (p. 246) noted that this range front is linear and very steep. Y-862 (p. 516, *cited by* Y-872, p. 9 and Y-1033, p. 246) noted "great triangular facets" along the front. These facets and wineglass valleys are interpreted by Y-1033 (photo 3, p. 247, 254) as evidence for recurrent displacement along DS.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-762, scale about 1:26,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1033, scale about 1:26,000). Field observations (Y-861; Y-872, p. 4, 18). Limited field mapping (Y-1033). Measurement of topographic scarp profiles (Y-1033). Estimates of ages of deposits and surfaces using soil development, rock varnish, pavement, gravel weathering, and surface preservation compared to similar characteristics of dated deposits or surfaces on the western side of Silver Lake (Y-1033, p. 250-254). Seismic refraction survey (Y-872, p. 4, 18-26). Gravity survey (Y-872, p. 4, 26-27). Magnetic survey (Y-872, p. 4, p. 26-27).

Relationship to other faults: The Fish Lake Valley fault (FLV) is about 5 km northeast of DS. Y-1033 (p. 248) suggested that FLV may influence displacement along DS (e.g., the relatively wide zone at the northern end of DS with displacement apparently distributed across it). Y-651 (p. 40) suggested that Deep Springs Valley "may represent a rhombochasm in the southern White Mountains between the right–oblique [FLV] and the right–lateral Owens Valley fault zone to the west." Y-861 (p. 140) also proposed that Deep Springs Valley may be connected to Fish Lake Valley, either directly or through Eureka Valley. The north–striking portion of DS along the range front south of Soldier Pass turns and becomes a northeast–striking fault through Soldier Pass. This northeast–striking fault coincides with elevation differences within the Inyo Mountains (Y-484; Y-861, p. 141, *citing* Nelson, oral commun., 1961).

The maps by Y-238 and Y-484 show a northwest–striking, left–lateral fault that extends from the northern end of Deep Springs Valley to FLV. This fault is indicated to be in Tertiary deposits and identified from previous mapping (Y-238) or in Jurassic rocks (Y-484). North–striking traces of DS appear to terminate at this left–lateral fault (Y-238). Two additional northeast–striking traces are shown by Y-238 and Y-484. These two traces are located south of the northeast–striking fault described above and north of Chocolate (Piper?) Mountain. Y-238 indicated that these two faults have down–to–the–north vertical displacement. The structural relationships among these faults and DS are not known.

Faults in DS are approximately parallel to fault traces to the east in northwestern Eureka Valley, the Eureka Valley West fault (EURW) (Y-484; Y-853).

Y-762 (p. 6) concluded that faults along the western side of Deep Springs Valley have probably been inactive since middle to late Pleistocene (in contrast to DS, which has evidence for Holocene displacement). Y-872 (p. 10) noted that faults on the western side of Deep Springs Valley are "almost entirely concealed by alluvium." The much larger size of alluvial fans along the western side of Deep Springs Valley when compared to those on the eastern side of the valley indicates eastward tilting along DS and supports the conclusion that the most–recent rate of activity has been higher along DS than along faults on the western side of Deep Springs Valley (Y-762, p. 6; Y-872, p. 10). Y-862 (p. 516, *cited by* Y-872, p. 10) estimated that the main fault on the western side of Deep Springs Valley has a maximum displacement of 427 m (1,400 ft).

East Belted Range fault (EBR)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pls. 1 and 2); Y-853: Dohrenwend and others, 1992. Not shown by Cornwall, 1972 (Y-232) nor by Ekren and others, 1971 (Y-5).

Location: 80 km/29° (distance and direction of closest point from YM) at lat 37°28'N. and long 116°00'W. (location of closest point). EBR is located along the eastern side of the Belted Range at its junction with both Monotony Valley and the northern part of Emigrant Valley.

USGS 7-1/2' quadrangle: Belted Peak, Groom Mine NW, Monotony Valley, White Blotch Springs.

Fault orientation: EBR strikes generally north–northwest (Y-813; Y-853). The very southern end of EBR strikes north–northeast (Y-813).

Fault length: The length of EBR is 26 km as estimated from Y-813 and Y-853, but the fault does not have continuous surficial expression over this entire length.

Style of faulting: No information.

Scarp characteristics: EBR is shown as east– or southeast–facing scarps (Y-813).

Displacement: No information.

Age of displacement: The northern part of EBR is shown by Y-853 as fault–related lineaments on Quaternary depositional or erosional surfaces and as faults juxtaposing Quaternary alluvium against bedrock. The southern part of EBR is shown by Y-813 as weakly expressed lineaments or scarps on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: The structural relationships between EBR and other faults in the area are not known. These faults include the north– to north–northeast–striking Belted Range fault (BLR) on the western side of the Belted Range immediately west of EBR, the north–northeast– to northeast–striking Chalk Mountain fault (CLK) along the western side of Chalk Mountain immediately east of EBR, the northeast–striking Emigrant Valley North fault (EVN) in northern Emigrant Valley southeast of EBR, and the north–striking Oak Spring Butte faults (OAK) north of Yucca Flat and on the eastern side of the Belted Range immediately south of EBR.

East Crater Flat faults (ECR)

Plate or figure: Figure 3.

References: Y-19: Swadley and Hoover, 1983; Y-26: Swadley and others, 1984 (their Faults S, T, U, and V); Y-29: Hamilton, 1988; Y-141: Crowe and Carr, [1980]; Y-144: Carr and others, 1986; Y-182: Carr, 1984; Y-224: Frizzell and Shulters, 1990 (show the Black Cone faults, Faults S and T, and one north–northwest–striking fault between the Black Cone and west lava faults, but not the west lava fault); Y-238: Reheis and Noller, 1991 (pl. 3); Y-396: Scott, 1990; Y-616: Carr, [1982]; Y-1042: O'Neill and others, 1992 (pl. 1. They show possible tectonic lineaments west of the Windy Wash fault (parts of Faults S? and T? of Y-26). Their map does not include the area of the other faults included in ECR.); Y-1196: Faulds and others, 1991 (They show the Black Cone and the west lava faults of Y-1201 and Y-1230, plus several other approximately north–striking faults between the two. They also portray several other faults west of the Windy Wash fault. These faults may correlate with Faults S and T of Y-26.); Y-1201: Ramelli and others, 1991 (They show their Black Cone fault, as well as the west lava fault of Y-1230 (p. 1-64, fig. 2, p. 1-74). They also show faults west of the Windy Wash fault. These faults may correlate with Faults S, T, and U of Y-26.); Y-1230: Bell and others, 1990 (They show their west lava fault (fig. 2, p. [8]), an unnamed fault located 1 km northeast of Black Cone (fig. 3, p. [9]) that they correlate with Fault V of Y-26 and that appears to correlate with the Black Cone fault of Y-1201, and faults west of the Windy Wash fault. The faults west of the Windy Wash fault probably correlate with Faults S, T, and U of Y-26.) An extension of the west lava fault of Y-1230 (fig. 2, p. [8]) south of lat 36°45'N. is not shown by Swadley and Carr (1987, Y-65) along an outcrop of Pliocene basalt (the Basalt of Crater Flat of Y-65).

Location: ECR includes three faults along the eastern side of Crater Flat and west of the Windy Wash fault: Faults S, T, and U of Y-26. ECR also includes two faults in eastern Crater Flat: the west lava fault (WL) and the Black Cone fault (BLK) of Y-1201 and Y-1230. (A portion of Fault V of Y-26 appears to correlate with BLK.) Locations are shown below in order of increasing distance from the site.

For Fault S: 4 km/279° (distance and direction of closest point from YM) at lat 36°51'N. and long 116°31'W. (location of closest point).

For Fault T: 5 km/270° (distance and direction of closest point from YM) at lat 36°50'N. and long 116°32'W. (location of closest point).

For BLK: 7 km/255° (distance and direction of closest point from YM) at lat 36°49'N. and long 116°33'W. (location of closest point).

For WL: 7 km/218° (distance and direction of closest point from YM) at lat 36°46'N. and long 116°31'W. (location of closest point).

For Fault U: 16 km/209° (distance and direction of closest point from YM) at lat 36°43'N. and long 116°32'W. (location of closest point).

USGS 7-1/2' quadrangle: Big Dune, Crater Flat, East of Beatty Mtn.

Fault orientation: Most of Fault S strikes north–northeast; its southern end strikes north–northwest (Y-26, pl. 1, p. 17). Fault T generally strikes north–northeast (Y-26, pl. 1, p. 17). BLK consists of a zone of north–northwest– or northwest–striking traces (Y-26, pl. 1, p. 17; Y-1201, p. 1-65; Y-1230, p. [7]). WL strikes north–northeast and is vertical where exposed at one locality (Y-1196; Y-1201, p. 1-64). Fault U strikes northeast (Y-26, pl. 1, p. 17).

Fault length: Y-26 (pl. 1, p. 17) noted that the length of Fault S is about 12 km. Y-26 (p. 17) stated that Fault T is 7 km long. BLK forms a zone 3.5 to 6.5 km long as estimated from Y-1196 and Y-1201 (fig. 2, p. 1-74). (The longer value is measured if a north–striking trace east and southeast of Black Cone is included in BLK.) The portion of BLK that is shown by Y-26 (pl. 1, their Fault V) is about 1 km long. WL is about 8 km long as estimated from Y-1201 (fig. 2, p. 1-74) and Y-1230 (fig. 2, p. [8]). The portion of Fault U that has definite surficial expression is noted by Y-26 (p. 17) to be 0.2 km long; the fault apparently continues to the southwest as a lineament on aerial photographs another 0. 3 km (Y-26, p. 17) for a total length of about 0.5 km.

East Crater Flat faults (ECR) — Continued

Style of faulting: Displacement on Fault S (Y-26, pl. 1, p. 17) is down to the east at the southern end of the fault and down to the west at the northern end. Displacement on Fault T (Y-26, pl. 1, p. 17) is down to the west. BLK consists of scarps that are chiefly east–facing, but some are west–facing (Y-26, pl. 1, p. 17; Y-224; Y-1201, p. 1-65; Y-1230, p. [10]). WL has west–side–down displacement (Y-1201, p. 1-64). Displacement on Fault U (Y-26, pl. 1, p. 17) is down to the west.

Scarp characteristics: Y-26 (p. 17) measured a topographic profile across a scarp along Fault T and concluded that the maximum scarp–slope angle is 11°, the scarp height is 1 m, and the surface offset is 0.7 m. (This scarp is on surfaces of early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9).)

Y-1201 (p. 1-65) and Y-1230 (p. [4]) interpreted lineaments associated with BLK as small scarps a few centimeters high. However, they noted that these lineaments are visible on aerial photographs only under certain low–sun–angle conditions and that they are difficult to locate on the ground.

By viewing low–sun–angle aerial photographs, Y-1201 (p. 1-64) recognized a "subdued" scarp associated with WL. This scarp, which is located on a late Pleistocene surface (their Late Black Cone surface) north of the outcrop of Pliocene basalt that is bounded in part by WL, is <1 m high.

Displacement: The only report of displacement on these faults is that of Y-1201 (p. 1-64), who noted that the late Pleistocene displacement on WL is <1 m. (This is the displacement on their Late Black Cone surface.)

Age of displacement: Y-26 (pl. 1, p. 17) noted that the southern 1.1 km of Fault S displaces early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9). They also suggested that middle Pleistocene deposits (their Q2c unit with an estimated age of 270 ka to 800 ka; fig. 3, p. 9) appear to be deposited along the scarps on the QTa surfaces. A map by Y-1230 (fig. 5, p. [14]) shows two northeast–striking faults west of the Windy Wash fault. One of these two, both of which are portrayed as "recently active," is probably correlative with Fault S of Y-26.

Y-26 (p. 17) indicated that Fault T displaces early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9) and that it also displaces these deposits against Tertiary volcanic rocks. A map by Y-1230 (fig. 5, p. [14]) shows two northeast–striking faults west of the Windy Wash fault. One of these two, both of which are portrayed as "recently active," might be correlative with Fault T of Y-26.

Y-1042 (pl. 1) noted several primarily north–trending lineaments, chiefly topographic or geomorphic features but also some drainage alignments, west of the Windy Wash fault. Some of these lineaments may correspond to the northern portions of Faults S and T as mapped by Y-26 (pl. 1). Y-1042 (p. 4) concluded that these lineaments are associated with "minor northwest–trending dike–filled fractures" and that they "define a diffuse zone of minor faulting that lies west of the main strand of the Windy Wash fault."

Y-26 (p. 17) concluded that their Fault V (part of BLK of Y-1201) displaces early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9). They reported that this part of BLK is also visible on aerial photographs as a vegetation lineament where the fault crosses surfaces of middle Pleistocene deposits (their Q2c unit with an estimated age of 270 ka to 800 ka; fig. 3, p. 9). They could not determine if the fault actually displaces the middle Pleistocene deposits or if the lineament is the result of vegetation following fractures in the underlying QTa deposits. Y-1201 (p. 1-65) reported that BLK is expressed as "sharp lineations" on Pleistocene or early Holocene surfaces (their Little Cones surface that Y-1196 (p. 1-56) reported to be bracketed by rock varnish dates of 6.6 ka and 11.1 ka). Y-1230 (p. [4, 10]) noted that BLK is expressed on low–sun–angle and other high–contrast, black–and–white aerial photographs as indistinct tonal lineaments. Both Y-1201 (p. 1-65) and Y-1230 (p. [4, 10]) interpreted the lineaments to be small scarps a few centimeters high. However, Y-1201 (p. 1-65) noted that these lineaments are visible only under certain low–sun–angle conditions, and Y-1230 (p. [10]) reported that the features were difficult to find on the ground, partly because the scarps are preserved on fluvial gravel bars but have been modified by flow in the adjacent swales. Y-1201 (p. 1-65) stated that "[f]ield inspection neither definitely confirms nor disproves a Holocene surface–rupture origin for these features, but recent surface faulting appears to be the most plausible origin." Y-1201 (p. 1-65) and Y-1230 (p. [10]) concluded that the size, morphology, and possible age of these scarps indicate that the youngest rupture on BLK is similar in size and age to those interpreted by Whitney and others (1986, Y-12) for the Windy Wash fault (about 10 cm of displacement in deposits with an estimated age of 3 ka to 6 ka).

WL bounds the western side of the largest outcrop of Pliocene basalt in eastern Crater Flat (Y-1201, p. 1-64). Y-1201 (p. 1-64) noted one exposure where the fault is a "vertical contact between the Pliocene basalt and cemented Quaternary alluvium." Y-1201 (p. 1-64) identified a scarp associated with WL on a late Pleistocene surface (their Late Black Cone surface with its age bracketed by rock varnish dates of 17.3 ka and 30.3 ka as reported by Y-1196, p. 1-56).

Fault U was reported by Y-26 (p. 17) to displace early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9) against Tertiary volcanic rocks. They also noted that Fault U to the southwest is partly covered by early Holocene alluvium (their Q1c unit with an estimated age of 7 ka to 9 ka; fig. 3, p. 9).

Y-238 (pl. 3) showed parts of Faults S and T, the portion of BLK portrayed as Fault V by Y-26, and Fault U as faults that are in Quaternary deposits and that were identified from previous mapping.

Slip rate: Using the <1 m of displacement on a surface with an estimated age of 17.3 ka to 30.3 ka as reported by Y-1201 (p. 1-64), the maximum apparent vertical slip rate on WL is 0.03 to 0.06 mm/yr during the last 17,000 yr or 30,000 yr.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished information (Y-26, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000; Y-1201, p. 1-62) and vertical aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000). Measurement of topographic profiles across fault scarps (Y-26, p. 6).

Relationship to other faults: Y-1042 (p. 4) suggested that the north–trending lineaments west of the Windy Wash fault represent minor geologic structures (Faults S? and T? of Y-26), if they indeed reflect normal fault displacements at all, and that these faults may merge with the Windy Wash fault south of West Ridge (Y-1042, pl. 1).

Because vegetation lineaments, but no fault scarps, are recognized by Y-1201 (p. 1-66) on a middle Pleistocene surface (their Yucca surface that Y-1196 (p. 1-56) reported to be bracketed by rock varnish dates of 360 ka and 370 ka) between the scarps of BLK and the Bare Mountain piedmont, Y-1201 (p. 1-66) concluded that "the recent activity of the Black Cone fault [BLK] reactivated a small portion of a more extensive northwest–trending structure."

East Crater Flat faults (ECR) — Continued

The northern end of WL as mapped by Y-1201 (fig. 2, p. 1-74) and by Y-1230 (fig. 2, p. [8]) nearly intersects the western splay of the Windy Wash fault as portrayed by Y-1042 (pl. 1).

Y-182 (fig. 29, p. 67, 70) suggested that faults on the eastern side of Crater Flat may be related to calderas buried beneath Crater Flat, his Crater Flat caldera to the south and his Prospector Pass caldera to the north, so that the *en echelon* faults on the eastern side of Crater Flat are reactivated ring fracture faults that were oriented favorably to younger stresses (Y-144, p. 27). He (Y-182, p. 72) based this conclusion in part on the correlation of suspected Quaternary faults and his proposed location of the caldera margins (or ring fractures), which he determined by fault patterns, basalt distribution, gravity studies, and aeromagnetic maps, and by an apparent relationship between the timing of Quaternary fault displacements and basaltic volcanism in Crater Flat (Y-26). Y-396 (p. 276-277) summarized arguments both for and against the presence of calderas beneath Crater Flat.

Y-616 (p. 7) reasoned that the occurrence of outcrops of Tertiary volcanic tuff in Crater Flat west of the eastern margin of the basin as defined by alluvium suggests that the eastern margin of Crater Flat is not controlled by "large–scale youthful faulting." Y-616 (p. 7) further concluded that the abrupt termination of 3.75–Ma basalts and tuffs slightly east of the center of Crater Flat indicates "that an important fault or fault zone may lie nearly along the north–south axis of the basin." This inferred fault is shown on his fig. 2 (p. 4) and by Y-141 (fig. 1, p. 4) as a down–to–the–west fault concealed beneath Quaternary and late Tertiary alluvium (his QTa deposits). He (Y-616, p. 7) also noted that gravity studies by Snyder and Carr (U.S. Geological Survey, written commun., 1981, *cited by* Y-616, p. 7) suggest that volcanic and alluvial deposits extend to a depth of at least 2,500 m (8,200 ft) beneath central Crater Flat. The East Crater Flat faults described here all appear to be east of the concealed fault proposed by Y-616 (fig. 2, p. 4) and Y-141 (fig. 1, p. 4), from which the map of Y-616 was taken. The difference in location implies that the East Crater Flat faults are probably not the surficial expression of their concealed fault. However, the structural relationships between the East Crater Flat faults and the proposed fault concealed beneath Crater Flat are not known. For example, Y-616 (fig. 2, p. 4) and Y-141 (fig. 1, p. 4) both showed a concealed fault between Black Cone and a small outcrop of Miocene tuff, lava, and sedimentary rocks (their Tt deposits) northeast of Black Cone. BLK as portrayed by Y-1196 appears to be located east of this outcrop of Tertiary rocks. This implies that BLK is probably not the surficial expression of the concealed fault of Y-141 and Y-616.

Y-1201 (p. 1-66) concluded that surface faults in the Yucca Mountain area are characterized by a dense system of interconnected faults and that the system extends from Yucca Wash to the southern end of Crater Flat, an area about 30 km by 15 km.

Y-29 (p. 55) suggested that a low–angle (about 30°) detachment fault surface extends beneath Crater Flat. However, the relationship between the higher–angle faults and this surface is not known.

East Magruder Mountain fault (EMM)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 2). Not shown by Albers and Stewart, 1972 (Y-407) nor by Dohrenwend and others, 1992 (Y-853).

Location: 113 km/305° (distance and direction of closest point from YM) at lat 37°26'N. and long 117°29'W. (location of closest point). EMM is located along the southeastern side of Magruder Mountain.

USGS 7-1/2' quadrangle: Lida, Magruder Mountain, Tule Canyon.

Fault orientation: EMM strikes northeast (Y-238).

Fault length: The length of EMM is 7 km as estimated from Y-238.

Style of faulting: No information.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: EMM is portrayed by Y-238 as a lineament along a linear range front.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: EMM is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat, such as the Montezuma Range fault (MR) along the western side of the Montezuma Range north of EMM, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges northwest of EMM, the Gold Mountain fault (GOM) along the western side of Gold Mountain southeast of EMM, and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains immediately northwest of EMM. EMM differs from these faults in that it apparently has down–to–the–southeast displacement instead of the fairly consistent down–to–the–northwest displacement exhibited by most of the other northeast–striking faults in the region (Y-10, p. 60). EMM is also approximately parallel to northeast–striking faults within basins, such as the Stonewall Flat faults (SWF) within Stonewall Flat northeast of EMM, the Palmetto Mountains–Jackson Wash faults (PMJW) in the valley northeast of Palmetto Mountains immediately northeast of EMM, and the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range north of EMM (Y-238; Y-853). The structural relationships among all these faults are not known.

Y-238 (p. 3) speculated that the northeast–striking faults in the area around EMM could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) suggested that these faults are rooted in a detachment fault at depth.

East Nopah fault (EN)

Plate or figure: Plate 2.

References: Y-69: McKittrick, 1988; Y-161: Burchfiel and others, 1983; Y-222: Streitz and Stinson, 1974; Y-238: Reheis and Noller, 1991; Y-696: Hoffard, 1991 (pls. 1 and 2; name from this reference, pl. 1, p. 3; part of her Pahrump fault system, p. 3); Y-706: Wright, 1989; Y-806: Hoffard, 1990 (her Nopah Range fault zone); Y-1020: Jennings, 1992. Not shown by Malmberg, 1967 (Y-845).

Location: 85 km/159° (distance and direction of closest point from YM) at lat 36°08′N. and long 116°07′W. (location of closest point). EN is located about 0.5 km east of the Nopah Range along the southwestern edge of Pahrump Valley.

USGS 7-1/2′ quadrangle: Nopah Peak, Sixmile Spring, Stewart Valley.

Fault orientation: Y-696 (table 1, p. 28, 41) noted that the overall strike of EN is N. 33° W. The strike of the southern 9 km, which is composed of five *en echelon* segments, is N. 16° W. to N. 30° W. (Y-696, p. 41). Fault traces that splay to the southeast away from the main trace of EN strike between N. 18° W. and N. 8° E. (Y-696, p. 41).

Y-696 (p. 33) suggested that EN is probably nearly vertical because surface traces remain straight and linear across changes in topography.

Fault length: The minimum length of EN is between 17 km (Y-238; Y-696, table 1, p. 28) and 19 km (estimated from Y-69). The southern end of EN extends to lat 36°N. as portrayed by Y-696 (pl. 1). This is the southern edge of her map area, so that EN may continue south of this. In addition, EN may extend northward and include strong vegetation lineaments along the western side of Stewart Valley (Y-696, p. 30). However, no evidence has been found for fault displacement through Chicago Pass (between Pahrump and Stewart valleys), and Y-696 (p. 30) suggested that it is likely that EN terminates at the northern end of a series of north–striking, left–stepping, east–side–down normal fault traces near the northern end of the Nopah Range. Individual fault traces within EN are between 1.8 and 3 km long (Y-696, p. 41).

Style of faulting: Y-696 (p. 33, 38, 48) inferred right–lateral displacement on EN by the fault's straight and narrow trace, scarps that face both east and west, juxtaposition of alluvial–fan deposits of different ages, possible right–lateral displacement of alluvial–fan remnants, lack of topographic expression, possible right–lateral displacement of drainages, and a left–stepping, *en echelon* fault pattern. Preservation of horsts, grabens, and low hills interpreted to be alluvial–fan remnants that have been deformed by compression also suggests right–lateral displacement (Y-696, p. 33). However, Y-696 (p. 37-38) admitted that possibly displaced drainage channels do not show consistent right–lateral displacement as interpreted from aerial photographs.

Y-696 (p. 48) concluded that there is no evidence that suggests a component of vertical displacement during the most–recent activity on EN. The ratio between lateral and vertical displacement is not known for older events (Y-696, p. 48).

Scarp characteristics: Y-696 (p. 32, 47) noted that scarps are readily visible on aerial photographs, but appear subdued from the ground. Scarps are both east– and west–facing and apparently juxtapose laterally displaced alluvial–fan remnants (Y-696, p. 38). A scarp at one locality is 3 m high; scarps on early Pleistocene and (or) late Tertiary surfaces (QT surfaces of Y-69) are 8 m high (Y-696, p. 40). The highest scarps are preserved where older alluvial–fan remnants are juxtaposed against younger fan remnants (Y-696, p. 40). Alluvium has ponded against west–facing (uphill–facing) scarps (Y-696, p. 33). EN is also expressed as *en echelon* and subparallel lineaments (Y-238; Y-696), dark lines that are commonly fractures or cracks on strongly carbonate–cemented surfaces (Y-696, p. 33).

East Nopah fault (EN) — Continued

Displacement: Scarps on early Pleistocene and (or) late Tertiary surfaces (QT surfaces of Y-69 thought to be older than 300 ka to 500 ka) indicate 8 m of apparent vertical displacement (Y-696, p. 40). Vertical displacement across many of the scarps is difficult to estimate from scarp height because surfaces of different ages are preserved on opposite sides of the scarps (Y-696, p. 47). The amount of lateral displacement has not been estimated.

Age of displacement: The youngest faulting event on EN is estimated by Y-696 (p. 47) to have occurred probably in the middle to late Pleistocene. The youngest surfaces displaced by abundant faults are late and (or) middle Pleistocene age (Qf2 surfaces of Y-69 thought to be older than 10 ka and younger than 300 ka to 500 ka) (Y-696, p. 46-47). Older surfaces (Qf1 and QTf surfaces of Y-69 thought to be older than 300 ka to 500 ka) are also displaced (Y-69; Y-696). Early Holocene and (or) latest Pleistocene surfaces (Qf3 surfaces of Y-69) may be displaced at one locality (Y-69). Early to late Holocene surfaces (Qf4 surfaces of Y-69) are not displaced (Y-69; Y-696, p. 47).

Y-696 (p. 47) noted that scarp morphology is difficult to use to estimate age of displacement because scarps are on surfaces cemented by pedogenic carbonate, which influences scarp morphology and erosion rates. In addition, scarps may juxtapose surfaces of different ages as a result of a lateral component of displacement (Y-696, p. 47). Strong, *en echelon* vegetation lineaments on youngest Holocene sediments along the northwestern edge of the Pahrump playa may indicate middle to late Holocene displacement (Y-696, p. 47). However, these lineaments trend north to northeast and the relationship between any fault directly associated with these lineaments and EN is not known.

Y-1020 showed EN as having Quaternary (since 1.6 Ma as defined by Y-1020) displacement, based on an assessment by Jennings (1985, Y-415).

Slip rate: An apparent vertical slip rate of 0.006 to 0.06 mm/yr was estimated by Y-696 (p. 48) at one locality along a north–striking trace of EN, using a 3–m–high scarp on a middle to late Pleistocene surface (Qf2 surface of Y-69 with an estimated age of 50 ka to 500 ka).

Recurrence interval: No information.

Range-front characteristics: EN is located about 0.5 km east of the Nopah Range front (Y-696). Tectonic features along this range front have not been evaluated.

Analysis: Conventional and low–sun–angle aerial photographs (Y-69; Y-161; Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-696, p. 8-9, scales 1:12,000 (low–sun–angle) and 1:80,000). Field examination of several fault traces in EN (Y-161; Y-696, p. 9). Analysis of seismic reflection lines (Y-696).

Relationship to other faults: EN is the westernmost fault in the Pahrump fault system of Y-696 (p. 3). This system also includes the Pahrump fault (PRP; her Pahrump Valley fault zone) and the West Spring Mountains fault (WSM; her West Spring Mountains fault zone). EN has been included with the Pahrump fault by other investigators (e.g., Y-238).

Weakly expressed lineaments and a linear contact between alluvial–fan deposits and playa deposits in Pahrump Valley are subparallel to and 1 to 2.5 km east of EN. These features may indicate that additional fault traces exist east of EN as it is shown on plate 1 of this compilation.

East Pintwater Range fault (EPR)

Plate or figure: Plates 1 and 2.

References: Y-404: Tschanz and Pampeyan, 1970 (pl. 3; the northern 22 km of EPR is shown as their Pintwater fault); Y-671: Guth, 1990; Y-813: Reheis, 1992 (pls. 2 and 3); Y-852: Dohrenwend and others, 1991. Not shown by Ekren and others, 1977 (Y-25).

Location: 81 km/86° (distance and direction of closest point from YM) at lat 36°53′N. and long 115°32′W. (location of closest point). EPR is located along the eastern side of the Pintwater Range at its junction with Three Lakes Valley (unlabeled on pls. 1 and 2 of this compilation).

USGS 7-1/2′ quadrangle: Black Hills NW, Dog Bone Lake South, Heavens Well, Quartz Peak, Southeastern Mine, Tim Spring.

Fault orientation: EPR strikes generally north (Y-813; Y-852). The fault is portrayed by Y-813 and Y-852 as discontinuous, curving traces with strikes ranging between northwest and northeast.

Fault length: EPR is discontinuous over a length of about 58 km as estimated from Y-852 south of lat 37°N. and from Y-813 north of this latitude.

Style of faulting: Displacement on EPR north of lat 37°N. is shown as down to the east by Y-404 (pl. 3) and by Y-813 (pl. 2). Displacement on EPR south of lat 37°N. is portrayed by Y-813 (pl. 3) as also down to the east.

Scarp characteristics: No information.

Displacement: No information

Age of displacement: Scarps are noted at only one locality by Y-852 and are shown on depositional or erosional surfaces that are possibly early to middle Pleistocene (their Q_1? surfaces with estimated ages between 130 ka and 1.5 Ma). The map by Y-813 shows EPR primarily as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping. This map also portrays short (generally ≤1 km) sections as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits and as weakly expressed to prominent lineaments or scarps on surfaces of Tertiary deposits. Y-404 portrayed the northern 22 km as a faulted contact between pre–Tertiary rocks and Pleistocene(?) older alluvium (their Qol deposits).

Faults and lineaments that branch from EPR are portrayed by Y-813 as having expression on surfaces of Tertiary deposits only. These branch faults are omitted from plates 1 and 2 of this compilation.

Slip rate: No information

Recurrence interval: No information

Range-front characteristics: Most of EPR has been portrayed by Y-852 as a fault juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of the eastern side of the Pintwater Range is similar to that along a major range–front fault in that it is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, EPR is significantly less extensive and fault scarps are substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852). Portions of EPR are also shown by Y-813 as a topographic lineament bounding a linear range front.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000). Field mapping (Y-404, p. 2).

East Pintwater Range fault (EPR) — Continued

Relationship to other faults: EPR is one of several north–striking faults bounding range fronts directly east of Yucca Mountain and north and northwest of Las Vegas. Other north–striking faults in this area are the West Pintwater Range fault (WPR), the Sheep Range fault (SHR), the Sheep Basin fault (SB), and the Sheep–East Desert Ranges fault (SEDR). Y-671 (p. 242) suggested that these faults are related to an inferred major detachment system (his Sheep Range detachment), but that the style of displacement along these faults changes somewhere between SEDR and his inferred Dog Bone Lake fault (not shown on pls. 1 and 2 of this compilation) along the western side of the Desert Range. Faults west of this change have caused less rotation of rocks than have the faults to the east, have been localized by Mesozoic structures, and have developed along the western edges of ranges so that the faults define structural blocks that include the next range to the west (Y-671, p. 242). However, EPR differs from these faults because it bounds the eastern side of the Pintwater Range (Y-813, p. 5).

EPR has a strike similar to those of faults within the Pintwater Range. These faults are shown by Y-813 as faults that are in Tertiary deposits and that were identified from previous mapping. They are not shown on plates 1 and 2.

The southern end of the Pintwater Range (along with the southern end of the Spotted Range to the west) bends to the southwest as it approaches east–striking faults to the west, such as the Cactus Springs fault (CAC) and the South Ridge faults (SOU). These east–striking faults have been interpreted to be part of the Las Vegas shear zone by Y-813 (p. 5). EPR, as a range–bounding fault, correspondingly bends. Y-813 (p. 5) suggested that EPR appears to merge with the northeast–striking, left–lateral faults of the Spotted Range–Mine Mountain section of the Walker Lane.

Several northeast–trending, down–to–the–west, <2–km–long fault scarps are shown by Y-852 within Three Lakes Valley about 5 km east of the Pintwater Range (pl. 2). These scarps are shown by Y-852 to be on depositional or erosional surfaces that are early to middle Pleistocene (their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma) and latest Pleistocene and (or) Holocene (their $Q_{2\text{-}3}$ surfaces with estimated ages of less than 30 ka). The structural relationship of these scarps to EPR is not known.

The northward extension of EPR is unclear. Fault traces along the western side of the northern Desert Range (the North Desert Range fault; NDR) are directly north of and approximately coincident with EPR (pl. 1). However, displacement on NDR is down to the west rather than down to the east as it is for EPR. In addition, the southern part of NDR strikes northeast and appears to cut across any northward extension of the north–striking EPR. Furthermore, the northwest–striking Three Lakes Valley fault (TLV) nearly intersects both NDR and EPR in this area (pl. 1). The structural relationships among these faults are not known.

A map by Y-671 (fig. 3, p. 240) shows an inferred north–northeast–striking, down–to–the–west fault that is concealed along the eastern side of Three Lakes Valley where the valley merges with the Desert Range. He called this the Dog Bone Lake fault and inferred that such a fault must exist because more than 5 km of vertical displacement is needed in order to juxtapose Precambrian and Ordovician rocks (Y-671, p. 242). This fault has been inferred to "have reactivated the ramp in the basal decollement for Sevier thrusts* * *" (Y-671, p. 242).

East Reveille fault (ERV)

Plate or figure: Plate 1.

References: Y-5: Ekren and others, 1971; Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pl. 1); Y-853: Dohrenwend and others, 1992; Y-1020: Jennings, 1992; Y-1032: Schell, 1981 (pls. 7 and 8; name from his table A2, fault #110; he extended ERV north of lat 38°N.).

Location: 112 km/14° (distance and direction of closest point from YM) at lat 37°49'N. and long 116°08'W. (location of closest point). ERV is located along the western side of the Reveille Range at its junction with the Reveille Valley.

USGS 7-1/2' quadrangle: Reveille Peak, Reveille Peak NW, Reveille Peak SE.

Fault orientation: ERV strikes generally north–northwest (Y-5; Y-232; Y-813; Y-853).

Fault length: The total length of ERV is noted to be 22 km by Y-1032 (table A2, p. A20). The length of ERV is also 22 km as estimated from Y-232 and Y-813. The length of ERV is 19 km as estimated from Y-853, who does not extend ERV south of Reveille Peak as does Y-813. The length of ERV is 36 km as estimated from Y-5, which includes an extension of the fault southeast into Monotony Valley to the eastern boundary of their map area at long 116°W. ERV intersects the edges of the map areas of Y-232, Y-813, and Y-853 at lat 38°N. and the edge of the map area of Y-5 at lat 37°52'30"N.

Style of faulting: ERV is shown by Y-813 and Y-1032 primarily as a down–to–the–west fault.

Scarp characteristics: Scarps associated with ERV that were identified by Y-813 are primarily west–facing.

Displacement: No information.

Age of displacement: The age of the youngest displacement along ERV is noted by Y-1032 (table A2, p. A20) as probably late Pleistocene (defined as 15 ka to 700 ka by Y-1032, p. 29). This age estimate is based on a short segment at the southern end of the Reveille Range where the fault displaces his old–age alluvial–fan deposits (A5o; table A2, p. A20) with an estimated age of 700 ka to 1.8 Ma (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A20) with an estimated age of <15 ka (table 3, p. 23).

ERV is portrayed by Y-813 as faults that are in Quaternary, primarily, and Tertiary deposits and that were identified from previous mapping and as weakly expressed to prominent lineaments and scarps on surfaces of Tertiary deposits. She also showed portions of ERV at scattered localities as weakly expressed lineaments or scarps on surfaces of Quaternary deposits. ERV is also indicated by Y-853 to be one of the major range–front faults in the area, all of which, they noted, display evidence for Quaternary activity. In contrast, the map by Y-5 shows ERV as concealed by Pliocene through Holocene alluvium and colluvium (their QTa deposits), and Y-232 indicated that ERV is concealed by Quaternary basalt (his Qb unit). The map by Y-232 shows that ERV juxtaposes Miocene Tuff of White Blotch Spring (his Twb unit) against Quaternary alluvium (his Qal deposits), Miocene dacite and rhyodacite (his Td unit), or Oligocene/Miocene tuff (his Tw unit).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: ERV is portrayed by Y-853 as a major range–bounding fault that borders a tectonically active range front that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." Parts of ERV are shown by Y-813 as lineaments along a linear range front.

East Reveille fault (ERV) — Continued

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1020, p. 15-16, scales ~1:25,000 and ~1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-5). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: ERV is approximately parallel to other north–northeast– and north–northwest–striking, major range–bounding faults in the area. These faults include the Hot Creek–Reveille fault (HCR) along the eastern side of the Kawich Range west of ERV, the Kawich Range fault (KR) along the western side of the Kawich Range west of ERV, the Belted Range fault (BLR) along the western side of the Belted Range immediately south of ERV, and the West Railroad fault (WR) along the eastern side of the Reveille Range (Y-5; Y-232; Y-813; Y-853). ERV is also approximately parallel to faults within basins in the area. These faults include the Central Reveille fault (CR) within Reveille Valley immediately west of ERV, the East Stone Cabin fault (ESC) in the Stone Cabin Valley west of ERV, and the Cactus Flat fault (CF) within Cactus Flat. The structural relationship among these faults is not known.

ERV has been extended by Y-5 southeast of the Reveille Range front into the central part of the Monotony Valley as a concealed fault. The map by Y-813 shows lineaments and scarps in Monotony Valley, but the relationship between ERV and possible faults in Monotony Valley is not known.

Y-1020 (pl. 8) showed lineaments approximately parallel to ERV preserved west of the range front within Reveille Valley. Their structural relationship to ERV is not known.

East Stone Cabin fault (ESC)

Plate or figure: Plate 1.

References: Y-232: Cornwall, 1972 (pl. 1; He shows a northeast–striking fault in Tertiary rocks south of lat 38°N. This fault is east of the scarps of ESC as shown by Y-853 and Y-1032.); Y-813: Reheis, 1992 (pl. 1; shows only that portion of ESC south of lat 38°N.); Y-853: Dohrenwnd and others, 1992 (show only that portion of ESC south of lat 38°N.); Y-1032: Schell, 1981(pls. 7 and 8; name from his table A2, fault #135).

Location: 115 km/348° (distance and direction of closest point from YM) at lat 37°50'N. and long 116°42'W. (location of closest point). ESC is located along the eastern side of Stone Cabin Valley.

USGS 7-1/2' quadrangle: Stinking Spring, Stinking Spring NW, Stone Cabin Ranch NE, Stone Cabin Ranch SE, Stone Cabin Ranch SW, Warm Springs Summit.

Fault orientation: ESC generally strikes northeast (Y-1032), but a trace near its southern end strikes north (Y-853; Y-1032).

Fault length: The length of ESC is noted to be 35 km by Y-1032 (table A2, p. A25). Branching and subparallel scarps and lineaments shown by Y-813 would make ESC nearly 7 km wide.

Style of faulting: Displacement on fault traces is shown by Y-813, Y-853, and Y-1032 as down to the west or northwest.

Scarp characteristics: Scarps are shown by Y-813, Y-853, and Y-1032 as west– or northwest–facing. ESC is described by Y-1032 (table A2, p. A25) as a highly discontinuous zone of scarps.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along ESC is noted by Y-1032 (table A2, p. A25) as late Pleistocene (defined as >15 ka to <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i, table A2, p. A25) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y, table A2, p. A25) with an estimated age of ≤15 ka (table 3, p. 23). The oldest unit displaced is his middle Tertiary volcanic rocks (Tv_2, table A2, p. A25) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

Y-853 portrayed ESC as fault scarps on depositional or erosional surfaces with ages of late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) and early to middle and (or) late Pleistocene (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). These scarps are aligned with fault–related lineaments on Quaternary depositional or erosional surfaces. The map of Y-813 shows ESC as weakly (primarily) to moderately expressed lineaments or scarps on surfaces of Quaternary (primarily) and Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

East Stone Cabin fault (ESC) — Continued

Relationship to other faults: The structural relationship of ESC to faults within Cactus Flat south and west of ESC (e.g., the Cactus Flat–Mellan fault (CFML) and the Cactus Flat fault (CF)) or to faults along the western side of the Kawich Range east of ESC (the Kawich Range fault (KR)) is not known. ESC generally strikes more northeastward than the north–striking CFML (although one trace of ESC strikes northward as shown by Y-853). Because of this apparent difference in strike, the two faults have been separated in this compilation. However, CFML may actually be a southern extension of ESC. ESC as portrayed by Y-813 (pl. 1) does not seem to intersect CF to the west, because the southern end of ESC parallels CF. KR generally strikes northwestward, but its northern end strikes north–northeast and approximately parallels ESC. It is possible that the two faults intersect north of lat 38°N., the northern boundary of plate 1 of this compilation. However, Y-1032, the only reference to extend mapping north of this latitude, does not show KR.

Eleana Range fault (ER)

Plate or figure: Plate 1.

References: Y-90: Szabo and others, [1981]; Y-176: Gibbons and others, 1963; Y-181: Carr, 1974; Y-182: Carr, 1984; Y-224: Frizzell and Shulters, 1990; Y-526: Swadley and Hoover, 1990; Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992; Y-961: Fernald and others, 1968.

Location: 37 km/38° (distance and direction of closest point from YM) at lat 37°05′N. and long 116°11′W. (location of closest point). ER is located along the eastern side of the Eleana Range at its junction with the western edge of Yucca Flat.

USGS 7-1/2′ quadrangle: Rainier Mesa, Tippipah Spring.

Fault orientation: ER strikes northeast to north–northeast. Y-526, Y-813, and Y-853 showed part of ER as several subparallel strands.

Fault length: ER is mapped discontinuously for lengths of 6 km (Y-526), 9 km (Y-813), and 13 km (Y-853). The longer measurement of Y-853 includes a northern extension of ER along a north–northwest–trending drainage (not shown on pl. 1 of this compilation).

Style of faulting: Displacement on ER has been dip slip (normal) and down to the east (Y-181, fig. 7; Y-182, fig. 12, p. 24; Y-224).

Scarp characteristics: At least two short (0.2 to 0.5 km long) scarps on alluvial surfaces are shown by Y-526. One scarp is located just north of Red Canyon and the other is located north of an unnamed drainage north of Red Canyon. Y-853 indicated one sharp, well–defined scarp (0.75 km long) on an alluvial surface.

Displacement: No information.

Age of displacement: The youngest surfaces on which scarps have been mapped by Y-853 are late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka). Y-526 mapped scarps at three other localities on alluvial surfaces: east of Pinyon Butte, east of Captain Jack Spring, and southeast of Captain Jack Spring. Some of these scarps are on surfaces of late and middle Pleistocene deposits (their Qap deposits with ages between about 160 ka and 800 ka). Most of the scarps are on early Pleistocene and Pliocene? surfaces (their QTa deposits thought to be older than 740 ka). Much of the fault is shown by Y-853 as juxtaposing Quaternary alluvium against Permian to late Proterozoic rocks along the Eleana Range front. They portrayed a 4–km–long section of ER as fault–related lineaments on Quaternary surfaces. The map by Y-961 shows east–facing fault scarps on surfaces of Quaternary alluvium and colluvium of two different ages (their older Qtr deposits and their younger Qfr and Qfrg deposits).

Y-90 (table 3, p. 20, 28) obtained dates (uranium–thorium method) of 128 ka ± 20 ka and >5 ka on carbonate in deposits along the eastern side of the Eleana Range. They concluded that the older date predates the present topography (before displacement on ER?) but that it is a minimum value. They further concluded that the younger date post–dates the present topography (after displacement on ER?).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The eastern side of the Eleana Range is indicated by Y-853 as having characteristics similar to those along major range–front faults, except that ER is significantly less extensive and fault scarps are lower, shorter, and less continuous. Y-813 indicated that part of ER is expressed as a lineament bounding a linear range front. Rocks at the range front generally dip to the east–southeast, into Yucca Flat (Y-176).

Analysis: Aerial photographs (Y-526; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000). Limited field examination (Y-526). Uranium–thorium analyses on carbonate samples (their H1 and H2 samples) taken from a trench along the Eleana Range (Y-90).

Eleana Range fault (ER) — Continued

Relationship to other faults: ER is probably related to other faults in Yucca Flat: the Yucca fault (YC), the Carpetbag fault (CB), the Area Three fault (AT), and several short unnamed faults. Y-182 suggested that displacement on all of these faults may have been responsible for the development of Yucca Flat into a structural basin.

Emigrant fault (EM)

Plate or figure: Plate 2.

References: Y-29: Hamilton, 1988; Y-222: Streitz and Stinson, 1974; Y-239: Reheis, 1991 (pls. 1 and 2); Y-390: Hunt and Mabey, 1966; Y-916: Wernicke and others, 1986.

Location: 73 km/245° (distance and direction of closest point from YM) at lat 36°34'N. and long 117°10'W. (location of closest point). EM is located along the western side of Tucki Mountain and east of Emigrant Canyon.

USGS 7-1/2' quadrangle: Emigrant Canyon, Stovepipe Wells.

Fault orientation: EM strikes generally north (Y-239).

Fault length: The length of EM between Emigrant Canyon and north of Tucki Mountain is 13 km as estimated from Y-239. EM may continue south of Emigrant Canyon, if fault traces mapped by Y-239 in Tertiary deposits are included in EM (not shown on pl. 2 of this compilation).

Style of faulting: Displacement on EM is shown by Y-239 as down to the west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: EM is portrayed by Y-239 as prominent lineaments or scarps on surfaces of Quaternary deposits where a fault in Quaternary deposits was identified from previous mapping. The map of Y-222 shows EM as juxtaposing Pliocene and Pleistocene nonmarine rocks on the west against Precambrian rocks on the east.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: Y-239 (p. 2-3, *citing* Y-29 and Y-916) suggested that EM, along with the north–northeast–striking Towne Pass fault (TP), may be a northern continuation of the Panamint Valley fault (PAN) along the western side of Tucki Mountain. EM as shown by Y-239 appears to intersect TP along the northern side of Tucki Mountain.

Y-390 (p. A116) suggested that a structural valley and trough may have been present in this area along Emigrant Wash during the early Quaternary. These features may have connected Mesquite Flat to the north in Death Valley with Panamint Valley to the south (Y-390, p. A116).

Emigrant Peak faults (EPK)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-182: Carr, 1984; Y-238: Reheis and Noller, 1991 (pl. 1); Y-330: Reheis, 1988 (name from this reference; her Emigrant Peak fault zone); Y-635: Reheis, 1991 (her Emigrant Peak fault is the western fault of EPK); Y-651: Reheis and McKee, [1991]; Y-665: Sawyer, 1990; Y-737: Robinson and others, 1968; Y-853: Dohrenwend and others, 1992 (show only the western trace of EPK); Y-1028: Robinson and others, 1976 (show the western and eastern faults and parts of the two central faults of EPK). Not shown by Albers and Stewart, 1972 (Y-407).

Location: 166 km/310° (distance and direction of closest point from YM) at lat 37°48'N. and long 117°53'W. (location of closest point). EPK includes four approximately parallel faults along the eastern side of Fish Lake Valley north of lat 37°45'N. and along the western side of the Silver Peak Range and associated foothills.

USGS 7-1/2' quadrangle: Rhyolite Ridge, Rhyolite Ridge NE, Rhyolite Ridge NW, Rhyolite Ridge SW.

Fault orientation: Faults in EPK strike generally north–northeast, but they are curving so that strikes of sections of individual faults range between east–northeast and north (Y-635).

Fault length: The length of the main trace of the western fault in EPK is about 26 km as estimated from Y-635 and Y-853. Between First Wash and Second Wash, a north–striking branch fault extends about 3 km to the south (as estimated from Y-635).

The west–central fault of EPK (north of Middle Wash) is 9.5 to 11.5 km long as estimated from Y-635. This fault may join the main trace of the western fault north of Emigrant Pass Wash.

The east–central fault of EPK is only 2 km long as estimated from Y-635.

The east fault of EPK is composed of a single trace north of about First Wash and two branches to the south of this wash (Y-635). The length of the single trace is 7.5 km as estimated from Y-635. The western branch at the fault's southern end is about 1.5 km long. The eastern branch is about 4.5 km long as estimated from Y-635. (The lengths for the east fault are minimum values because the fault extends to both the north and south edges of her map area.)

Style of faulting: Faults in EPK are generally down to the west (Y-10, p. 58; Y-635) with dip–slip (normal) displacement (Y-635; Y-651, p. 26). The western branch at the southern end of the east fault is shown by Y-635 as down to the east. One section of the western fault, the portion just south of South Wash that extends into the Silver Peak Range, strikes north–northwest and has left–lateral displacement (Y-635). This fault is interpreted by Y-10 (p. 58) to be a tear fault.

Scarp characteristics: The western fault of EPK is shown primarily as west–facing scarps (Y-635; Y-853). A few short traces or short portions of traces are shown as east–facing scarps (Y-635). Minimum vertical offset across scarps along the western fault ranges between 25.7 m and 1 m (Y-635). The higher amount was estimated at a locality about 1.3 km southwest of Middle Wash across a scarp on early Holocene and late Pleistocene alluvium (Qfl deposits of Y-635; date (^{14}C) of 6.55 ka from within these deposits; Y-635). The lower amount was estimated at Second Wash across a scarp on late Holocene alluvium (Qfcm deposits of Y-635). This fault displaces five separate alluvial–fan deposits, and scarps are progressively higher in progressively older deposits (Y-330, p. 223). No fault scarps are shown by Y-635 to be associated with the other three faults of EPK.

Displacement: On the basis of the differences between the elevation of beach sands that contain Bishop ash (740 ka) on the footwall and the present elevation of the pluvial–lake shoreline related to these sands on the hanging wall, Y-651 (p. 41, table 2, p. 37) estimated a minimum vertical displacement of 122 m for the western fault of EPK. Displacement of at least 150 m on the western fault has been estimated by Y-330 (p. 223) for deposits that include tephra tentatively identified as the Tuff of Taylor Canyon (2.2 Ma).

On the basis of projections of Glass Mountain tephra (about 1 Ma) that is exposed on the hanging wall but eroded from the footwall, Y-651 (p. 41) estimated a minimum vertical displacement of 213 m for the west–central fault of EPK.

On the basis of a projection of the base of Quaternary and Tertiary gravel (their QTg deposits, fig. 1, p. 25) on the footwall into the fault, Y-651 (p. 41) estimated a minimum vertical displacement of 74 m for the east–central fault. The projection was necessary because the base of the QTg deposits is not exposed on the hanging wall.

Y-651 (p. 41) reported that the vertical displacement across the eastern fault of EPK is not known because the fault juxtaposes QTg deposits against older Tertiary rocks.

Y-651 (p. 41) calculated a minimum cumulative displacement of 409 m since about 2 Ma across the three western faults of EPK.

Y-665 (p. 30) suggested that late–early to middle Pliocene sediments in the present Silver Peak Range between Fish Lake Valley and Clayton Valley have been uplifted at least 900 m since 5.9 Ma (K–Ar date on trachyandesite flows in the sediments). However, Y-665 (p. 30) cited Y-737 as proposing that the present topography in the Silver Peak Range was established by late Pliocene.

Age of displacement: Faults in EPK displace sediments ranging between Holocene and late Pliocene (Y-10, p. 58).

The western fault of EPK is identified by Y-330 (p. 223) as the one fault of EPK that is presently active. The youngest deposits that exhibit scarps along the western fault are shown by Y-635 to be late Holocene (her Qfcm deposits with dates (^{14}C, tephra) that range between about 1 ka and about 1.4 ka (Y-635, table 1)). These scarps are preserved at the mouths of drainages between Third Wash and an unnamed drainage north of South Wash (Y-635). The youngest depositional or erosional surfaces exhibiting scarps along this same fault are indicated by Y-853 to be early to middle and (or) late Pleistocene (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). Y-1028 portrayed the western fault of EPK as scarps along which Pleistocene and Pliocene gravel (their QTg deposits) or older Pleistocene(?) alluvium is now juxtaposed against Holocene(?) alluvial–fan deposits (their Qa deposits).

The three other faults of EPK appear to be older than the western fault and may now be inactive (Y-330, p. 223; Y-635). The three eastern faults are shown by Y-635 to displace early middle Pleistocene to late Pliocene alluvium (her QTg deposits, which contain tephra with ages between 0.7 Ma and 2.2 Ma; Y-635, table 1). These faults are generally portrayed by Y-635 as concealed by early Holocene and late middle Pleistocene alluvium (her Qfy deposits). The eastern fault juxtaposes QTg deposits (0.7 Ma to 2.2 Ma, Y-635; Y-1028) or Pliocene sedimentary rocks (Y-1028) against older Tertiary rocks (Y-635, table 1; Y-651, p. 41; Y-1028).

Slip rate: On the basis of the elevation difference (122 m) of pluvial–lake deposits associated with Bishop ash (740 ka), Y-651 (p. 41, table 2, p. 37) estimated a minimum apparent vertical slip rate of 0.16 mm/yr for the western fault of EPK. Y-651 (p. 41, table 2, p. 37) also estimated a minimum apparent vertical slip rate of about 0.2 mm/yr since about 1 Ma for this fault using the possible displacement (213 m) of a tephra of this age.

However, a minimum apparent vertical slip rate of 0.05 mm/yr for the western fault for the time interval since 2.2 Ma was estimated by Y-330 (p. 223) using 150 m of displacement in alluvial–fan deposits that include tephra tentatively correlated with the Tuff of Taylor Canyon. In addition, a maximum apparent vertical slip rate of 0.5 to 1 mm/yr for the late Holocene was estimated by Y-330 (p. 223) using 1 to 2 m of displacement in deposits estimated to have been deposited about 2 ka. Y-330 (p. 223) concluded that these two rates, plus some unstated ones estimated using alluvial–fan deposits of intermediate age, suggest that the slip rate on the western fault has progressively increased since 2.2 Ma.

For the three western faults in EPK, Y-651 (p. 41) estimated a minimum Quaternary apparent slip rate of 0.2 mm/yr using a minimum cumulative displacement of 409 m since about 2 Ma. On the basis of the minimum amount of 900 m of vertical uplift that was noted by Y-665 (p. 30) for the Silver Peak Range since 5.9 Ma, a long–term apparent vertical slip rate of 0.15 mm/yr can be estimated. This is similar to the minimum Quaternary apparent slip rate estimated by Y-651.

Emigrant Peak faults (EPK) — Continued

Recurrence interval: No information.

Range-front characteristics: The map of Y-853 shows EPK as being a major range–front fault along a range front characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to the range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to the range front."

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-635). Topographic scarp profiles and tephra correlations (Y-635, table 2). Deposit ages estimated using rock varnish, soil development, and surface morphology (Y-635, table 1).

Relationship to other faults: The approximately north–striking faults of EPK are on the opposite side of Fish Lake Valley from the Fish Lake Valley fault (FLV). Y-651 (p. 41; *citing* both Y-10 [p. 59] and Y-665) interpreted EPK as serving "as part of a pull–apart basin that transfers slip on the [FLV] to slip on faults of the Walker Lane to the northeast."

Earthquakes of up to magnitude 5.0 that were recorded between 1931 and 1974 have been located near EPK (Y-10, p. 59; *citing* W.J. Carr, written commun., 1987).

The Silver Peak caldera is located in the Silver Peak Range southeast of EPK (Y-10, p. 59, fig. 1, p. 61; *citing* Y-182). The relationship between this caldera and the faults of EPK is not reported.

Emigrant Valley North fault (EVN)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 2). Not shown by Cornwall, 1972 (Y-232), Ekren and others, 1977 (Y-25), nor by Tschanz and Pampeyan, 1970 (Y-404).

Location: 60 km/43° (distance and direction of closest point from YM) at lat 37°14'N. and long 115°59'W. (location of closest point). EVN is located in Emigrant Valley north of the Halfpint Range, east of the Belted Range, and west of Groom Lake, the Groom Range, and the Papoose Range.

USGS 7-1/2′ quadrangle: Cattle Spring, Groom Mine, Groom Mine NW, Groom Mine SW, Jangle Ridge.

Fault orientation: EVN strikes generally north–northeast to northeast (Y-813).

Fault length: The length of EVN is about 28 km as estimated from Y-813. The width of EVN is up to 12 km as estimated from Y-813. Individual fault traces range in length between about 0.5 to 7 km (Y-813).

Style of faulting: Short, subparallel traces are shown by Y-813 as both down to the northwest and down to the southeast. Down–to–the–northwest displacement seems to predominate (Y-813). A few fault traces are shown by Y-813 to have lateral displacement.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: EVN is portrayed by Y-813 as faults that are in Quaternary deposits and that were identified from previous mapping, as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits, and, rarely, as faults that are in Tertiary deposits and that were identified from previous mapping. Y-813 (p. 6) noted that EVN "includes many scarps formed on late Quaternary fan deposits and possibly on pluvial lake deposits of Groom Lake."

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with EVN.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: Structural relationships between EVN and surrounding faults are not known. Surrounding faults include the Cockeyed Ridge–Papoose Lake fault (CRPL) south of EVN, the Emigrant Valley South fault (EVS) that includes north–northeast–striking fault traces, lineaments, and scarps in Emigrant Valley south of the Papoose Range, and the Stumble fault (STM) along the western side of the Groom Range that bounds the eastern side of north Emigrant Valley. A north–northwest–striking fault trace that extends south from EVN is shown by Y-813 to nearly intersect CRPL. According to Y-813 (p. 6), EVN may transfer displacement on the north–striking Yucca fault (YC), which is southwest of EVN in central Yucca Flat, to STM, which is east of EVN. Both YC and STM are reported to have experienced Quaternary displacement (*see* description sheets for these faults).

Emigrant Valley South fault (EVS)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 2). Not shown by Ekren and others, 1977 (Y-25) nor by Tschanz and Pampeyan, 1970 (Y-404).

Location: 66 km/63° (distance and direction of closest point from YM) at lat 37°07′N. and long 115°47′W. (location of closest point). EVS is located in Emigrant Valley south and east of the Papoose Range and Groom Lake, west of the Jumbled Hills, and north of the Buried Hills.

USGS 7-1/2′ quadrangle: Fallout Hills, Fallout Hills NW, Groom Range SW, Papoose Lake, Papoose Range.

Fault orientation: EVS strikes north–northeast (Y-813).

Fault length: The length of EVS is about 20 km as estimated from Y-813. The width of EVS could be as much as 9 km, if a north–northeast–trending, east–facing scarp along the eastern side of the Papoose Range is included in EVS. Otherwise, the width of EVS is about 4 km as estimated from Y-813. EVS is arbitrarily confined to north–northeast–striking fault traces and north–northeast–trending lineaments and scarps east of and between about Papoose Lake and Groom Lake within Emigrant Valley.

Style of faulting: Short, subparallel fault traces are shown by Y-813 as both down to the west and down to the east. One fault trace is indicated as having strike–slip displacement (Y-813).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: EVS is portrayed by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits, as faults that are in Quaternary deposits and that were identified from previous mapping, and, rarely, as moderately expressed lineaments and scarps on surfaces of Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with EVS.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: Structural relationships between EVS and surrounding faults are not known. Surrounding faults include the Chert Ridge faults (CHR) southeast of EVS, the Jumbled Hills fault (JUM) east of EVS, the Buried Hills fault (BH) directly south of EVS, and scattered, short faults along the eastern and western sides of the Papoose Range.

Eureka Valley East fault (EURE)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 2; show only that portion of EURE north of about lat 37°18'N. and east of about long 117°53'W.); Y-484: McKee and Nelson, 1967 (show only one 1–km–long trace of EURE at the mouth of Horse Thief Canyon, north of lat 37°15'N. and west of long 117°45'W.); Y-853: Dohrenwend and others, 1992; Y-861: Lustig, 1965; Y-1031: Reheis, 1992 (shows only that portion of EURE north of about lat 37°18'N. and east of about long 117°53'W.); Y-1072: Reheis, 1993.

Location: 110 km/286° (distance and direction of closest point from YM) at lat 37°07'N. and long 117°37'W. (location of closest point). EURE is located along the northeastern side of Eureka Valley at its junction with the Last Chance Range south of Willow Creek and with the Horse Thief Hills north of Willow Creek.

USGS 7-1/2' quadrangle: Chocolate Mountain, East of Joshua Flats, Hanging Rock Canyon, Horse Thief Canyon, Last Chance Mountain, Last Chance Range SE, Last Chance Range SW, Sand Spring, Soldier Pass, Sylvania Canyon.

Fault orientation: EURE strikes generally north–northwest, but the trace curves and individual sections strike between northwest and northeast (Y-853; Y-1031).

Fault length: The length of EURE is 34 km as estimated from Y-853, but EURE is not shown by them northwest of Willow Creek. Y-1031 indicated fault traces northwest of Willow Creek that are about 6.5 km long, which could make EURE as long as about 50 km. This length would include an apparent gap in surficial expression in the vicinity of Willow Creek.

Style of faulting: Displacement on fault traces north of Willow Creek are shown by Y-1031 as down to the west and down to the southwest.

Scarp characteristics: Scarps are primarily west– or southwest–facing; a few scarps are east–facing (Y-853; Y-1031).

Displacement: No information.

Age of displacement: Fault scarps along EURE south of Willow Wash are shown by Y-853 to be on depositional or erosional surfaces with ages of possibly late Pleistocene (their Q_2? surfaces with estimated ages between 10 ka and 130 ka) and early and middle and (or) late Pleistocene (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma).

Fault scarps north of Willow Wash are shown by Y-1031 to be between Cambrian or late Proterozoic rocks on the upthrown side of EURE and one of the following on the downthrown side of the fault: early Pliocene and late Miocene rhyolite and basalt (her Trb unit), middle Pleistocene older alluvium that contains Bishop ash (740 ka; her Qfo deposits), early Holocene to late middle Pleistocene younger alluvium (her Qfy deposits), or late and middle Holocene alluvium (her Qfc deposits). However, Y-1031 noted that the deposits on the downthrown side of the scarps are commonly not faulted. Thus, the age of youngest rupture is unclear. A 1–km–long fault trace north of Willow Creek is shown by Y-484 to be between Cambrian rocks and Miocene/Pliocene sediments (their Ts deposits) that dip 60° to 70° to the southwest away from the fault trace.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Most of the Last Chace Range along EURE is shown by Y-853 as a tectonically active major range front that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front."

Eureka Valley East fault (EURE) — Continued

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1031). Compilation of unit correlations and age determinations for Quaternary and Tertiary deposits (Y-1031).

Relationship to other faults: EURE nearly connects with the Furnace Creek fault (FC) or the Fish Lake Valley fault (FLV) at Cucomungo Canyon, where Willow Creek enters Eureka Valley. Eureka Valley is connected to Fish Lake Valley at Horse Thief Canyon, where the divide between the two valleys is within Fish Lake Valley, so that Horse Thief Canyon drains into Eureka Valley (Y-861, p. 140).

Several east–northeast–striking faults are mapped by Y-1031 in the Horse Thief Hills east of EURE. The southern one of these faults is shown by Y-1031 as displacing early Holocene to late middle Pleistocene alluvium (her Qfy deposits) and possibly late and middle Holocene alluvium (her Qfc deposits). Two of these east–striking faults (one just south of Red Wash) are portrayed by Y-1031 as having left–lateral oblique displacement and as dipping 75° N. The relationship of these faults to EURE or to FLV along the eastern side of the Horse Thief Hills is not known.

The northern end of EURE nearly connects with the north–northeast–striking Eureka Valley West fault (EURW). However, the structural relationship between these two faults is not known.

Eureka Valley West fault (EURW)

Plate or figure: Plate 1.

References: Y-484: McKee and Nelson, 1967; Y-762: Bryant, 1988; Y-853: Dohrenwend and others, 1992.

Location: 140 km/290° (distance and direction of closest point from YM) at lat 37°17′N. and long 117°54′W. (location of closest point). EURW is located along the northwestern side of Eureka Valley about 2 km from the Inyo Mountains. It may extend to the southwest into the Inyo Mountains and along Cowhorn Valley.

USGS 7-1/2′ quadrangle: Joshua Flats, Soldier Pass.

Fault orientation: EURW strikes generally north–northeast; some portions of EURW strike north or northeast (Y-853).

Fault length: The total length of EURW could be as much as 22 km (as estimated from Y-853 east of long 118°W.), if faults in the Inyo Mountains and along Cowhorn Valley are included in EURW. A scarp in northwestern Eureka Valley is 2.5 km long as estimated from Y-484 or as noted by Y-762 (p. 10) or 4 km long as estimated from Y-853. The longer value includes a 2.5–km–long fault–related lineament northeast of the scarp.

EURW could be as wide as 3.5 km, if the faults in the Inyo Mountains are included in EURW.

Style of faulting: No information.

Scarp characteristics: The scarp in northwestern Eureka Valley is shown as northwest–facing at its southwestern end by both Y-484 and Y-853 and as southeast–facing at its northeastern end by Y-484.

Displacement: No information.

Age of displacement: The southwestern end of the scarp in northwestern Eureka Valley is noted by Y-853 to be on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). This end of the scarp is noted by Y-762 (p. 8) to displace older Pleistocene alluvium and lacustrine deposits and is described by him as moderately expressed on aerial photographs. The northeastern end of this scarp is shown by Y-853 as a fault–related lineament on surfaces of Quaternary deposits. This end of the scarp is noted by Y-762 (p. 8) to be poorly defined on aerial photographs. Y-762 (p. 9) thought this end to be concealed by latest Pleistocene to Holocene alluvium.

This same scarp is portrayed by Y-484 to be on Quaternary alluvial fans (their Qf deposits) and between these fans and Quaternary lake beds (their Ql deposits). The lake beds are noted by Y-484 to dip 20° to the southeast, away from the scarp.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: Y-762 (p. 3-4) noted that the northeast–trending scarp that is mapped by Y-484 in Eureka Valley and included in EURW is not associated with the Deep Springs fault (DS), which is northwest of EURW, although the scarp has a similar orientation to that of DS.

EURW is approximately perpendicular to the north–northwest–striking Eureka Valley East fault (EURE) along the eastern side of Eureka Valley.

Fault traces of EURW in the Inyo Mountains have strikes similar to those of faults that are shown by Y-853 in the Inyo Mountains southeast of EURW. These faults are not included in EURW and are not shown on plate 1 of this compilation.

Fallout Hills faults (FH)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 2). Not shown by Ekren and others, 1977 (Y-25) nor by Tschanz and Pampeyan, 1970 (Y-404).

Location: 70 km/72° (distance and direction of closest point from YM) at lat 37°02′N. and long 115°41′W. (location of closest point). FH includes four main faults within the Fallout Hills.

USGS 7-1/2′ quadrangle: Fallout Hills.

Fault orientation: FH generally strikes north–northwest, but individual faults curve, so that the strikes of some faults and sections of some faults range between northwest and north–northeast (Y-813). The two western faults and the eastern fault strike northwest to north–northeast. The fourth (east–central) fault strikes north to north–northwest.

Fault length: The lengths of faults within FH vary between 4 and 8 km as estimated from Y-813. FH is up to 5 km wide as estimated from Y-813.

Style of faulting: The map by Y-813 shows the displacement on the northern half of the western fault and on most of the east–central fault as down to the west.

Scarp characteristics: The southern half of the western fault, the west–central fault, and a branch fault that appears to connect the east–central and eastern faults are all shown by Y-813 as west–facing scarps. The eastern fault is shown by Y-813 as northeast–facing scarps.

Displacement: No information.

Age of displacement: Parts of the west–central, east–central, and eastern faults are shown by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits. The southern half of the western fault and parts of the other three faults are shown as weakly to moderately expressed lineaments and scarps on surfaces of Tertiary deposits. Most of the east–central fault is portrayed by Y-813 as a fault that is in Quaternary deposits and that was identified from previous mapping. The northern half of the western fault is portrayed as a fault that is in Tertiary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Short (0.5 to 1.5 km long) portions (e.g., parts of the eastern two faults) of FH are shown by Y-813 as lineaments along a linear range front.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: North–striking fault traces of the Indian Springs Valley fault (ISV) extend northward into the Fallout Hills, and faults of FH may be an extension of ISV. Faults in FH are approximately parallel to faults east of FH along the eastern and western sides of and within the Pintwater Range. These faults include the East Pintwater Range fault (EPR), the Central Pintwater Range fault (CPR), and the West Pintwater Range fault (WPR). Faults in FH are also approximately parallel to faults west of FH along Chert Ridge, which are continued as the Chert Ridge faults (CHR). The structural relationships among these faults have not been reported.

Fatigue Wash fault (FW)

Plate or figure: Figure 3.

References: Y-26: Swadley and others, 1984 (Their Fault K, which they continue north to the southeastern edge of The Prow. This is in contrast to the portrayal of Y-1042 (pl. 1), who show FW cutting the crest of West Ridge.); Y-46: Maldonado, 1985; Y-55: Scott and Bonk, 1984 (name from their pl. 1; portray FW similar to Y-26); Y-74: Hoover, 1989 (includes dates for stratigraphic units described by Y-26); Y-189: Lipman and McKay, 1965; Y-224: Frizzell and Shulters, 1990; Y-238: Reheis and Noller, 1991 (pl. 3); Y-396: Scott, 1990; Y-506: Shroba and others, 1990 (considered FW together with the Windy Wash fault in what they called the Windy Wash–Fatigue Wash system); Y-1042: O'Neill and others, 1992 (show FW cutting the crest of West Ridge and connecting with the Windy Wash fault on the north); Y-1182: Simonds and Whitney, 1993; Y-1201: Ramelli and others, 1991; Y-1230: Bell and others, 1990 (They defined FW, at least for the youngest events, as including Fault M of Y-26. Their FW appears to correspond to the central splay of the Windy Wash fault of Y-1042 (pl. 1).).

Location: 2 km/283° (distance and direction of closest point from YM) at lat 36°51′N. and long 116°30′W. (location of closest point) as portrayed by Y-1042 (pl. 1, p. 4). FW bounds the western side of southern Jet Ridge and crosses the crest of West Ridge.

USGS 7-1/2′ quadrangle: Busted Butte, Crater Flat, Pinnacles Ridge.

Fault orientation: FW has a curving strike that varies between north–northeast in its central part and north–northwest at its northern and southern ends (Y-1042, pl. 1). Y-396 (p. 259) reported an average dip for FW of 74°, which was calculated from seven measurements. The map by Y-55 (pl. 1) shows west dips between 71° and 82° on the southern portion of FW.

Fault length: FW is 4.5 km long as estimated from Y-1042 (pl. 1). This includes a scarp about 1 km long. Y-26 (pl. 1, p. 15) reported a length of 7.5 km for their Fault K. Y-506 (p. 83) reported a length of 33 km for their combined Fatigue Wash–Windy Wash system.

Style of faulting: Displacement on FW is shown by Y-26 (pl. 1), Y-55 (pl. 1), and Y-1042 (pl. 1) as down to the west. By its apparent association with the Windy Wash fault, which has received more study, Y-506 (p. 83) suggested that displacement on FW has been chiefly dip slip but could be oblique slip with an undetermined component of left?–lateral slip. Left–lateral slip is suggested at one locality by slickensides that plunge 70° in an orientation south of the fault's dip as noted by Y-55 (pl. 1).

Scarp characteristics: Y-1201 (p. 1-64) and Y-1230 (p. [4]) reported a previously unrecognized scarp along the base of Jet Ridge. This scarp trends away from Jet Ridge and connects with a scarp along Fault M of Y-26 (pl. 1) (or the central splay of the Windy Wash fault of Y-1042, pl. 1). The map of Y-1042 (pl. 1) portrays a section along the western side of the north–trending portion of Jet Ridge as a scarp and identifies other portions of FW to the north and south of this scarp as linear topographic or geomorphic features.

Displacement: Y-1230 (p. [4]) noted that the northern portion of FW displaces Miocene tuffs significantly less that do the adjacent Solitario Canyon and Windy Wash faults (fig. 3). Y-1230 (p. [4]) concluded that displacement along FW increases to the south, so that FW along the southern part of Jet Ridge has a throw of a few hundred meters, similar to the displacements on other faults in the Yucca Mountain area. Y-1201 (p. 1-64) stated that the southern part of the scarp described above has a "throw comparable to other principal faults in the area."

Age of displacement: Y-1201 (p. 1-67) noted a small displaced and modified surface with morphology that they interpreted as indicating a Holocene age. Y-26 (p. 15) suggested that early Pleistocene or latest Pliocene alluvium (their QTa deposits with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9) is faulted against Tertiary volcanic rocks along FW (their Fault K) and that middle and late Pleistocene alluvium (their Q2c deposits with an estimated age of 270 ka to 800 ka; fig. 3, p. 9) overlies the fault. Y-1230 (p. [4]) thought that the scarp along the base of Jet Ridge was the result of reactivation of part of a northeast–striking fault that extends into Tertiary volcanic rocks on the upthrown (east) side of FW.

Fatigue Wash fault (FW) — Continued

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished information (Y-26, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000; Y-1230, p. [4]) and conventional aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000). Surficial mapping and field investigations (Y-26, p. 3; Y-506, p. 83; Y-1042, p. 2; Y-1201, p. 1-65).

Relationship to other faults: Y-1042 (pl. 1, p. 4) suggested that FW strikes north–northwest across the crest of West Ridge and merges with the northern portion of the Windy Wash fault (WW). Y-1182 (p. A-141) proposed that the three faults on the western side of Yucca Mountain (FW, the Solitario Canyon fault (SC), and WW) are interconnected along strike and possibly at depth. Y-506 (p. 83) noted that the anastomosing surface pattern of faults in the Yucca Mountain area suggests that these faults are interconnected. Y-396 (p. 279) concluded that steep normal faults at Yucca Mountain, like FW, sole into a low–angle normal fault or faults at depths of 1 to 4 km. Y-506 (p. 83) concluded that the faults in the Yucca Mountain area are middle and late Miocene (and possibly Pliocene) faults that have been reactivated. They also concluded that the displacement on the faults may have been contemporaneous with volcanism in the area.

Fish Lake Valley fault (FLV)

This discussion includes the Fish Lake Valley fault zone of Y-651, the Fish Lake Valley fault zone of Y-665, the northern part of the Northern Death Valley–Furnace Creek fault zone of Y-470, and the northern part of the Death Valley–Furnace Creek fault zone of Y-475. Plate 1 of this compilation shows only that part of FLV east of long 118°W.

Plate or figure: Plate 1.

References: Y-29: Hamilton, 1988; Y-66: Moring, 1986; Y-216: Brogan and others, 1991 (pl. 1; subdivided what they called the Furnace Creek fault zone into twelve segments, four of which are in Fish Lake Valley and part of FLV of this compilation); Y-222: Streitz and Stinson, 1974; Y-236: Reynolds, 1969; Y-328: Sawyer and Slemmons, 1988; Y-355: Ross, 1967; Y-427: Hart and others, 1989; Y-456: Bryson, 1937; Y-468: Noble and Wright, 1954; Y-470: Bryant, 1988; Y-474: Hooke, 1972; Y-475: McKee, 1968; Y-478: Stewart, 1983; Y-479: Wright and Troxel, 1967; Y-482: Krauskopf, 1971; Y-483: McKee, 1985; Y-484: McKee and Nelson, 1967; Y-485: Robinson and Crowder, 1973; Y-486: Stewart and others, 1974; Y-600: Stewart, 1967; Y-647: Sawyer, 1991 (subdivided FLV between long 117°45′W. and long 118°15′W. into four subzones: Northern, Dyer, Eastern, and Western); Y-651: Reheis and McKee, [1991]; Y-652: Reheis and others, [1991]; Y-665: Sawyer, 1990; Y-706: Wright, 1989; Y-746: Wright and Troxel, 1954; Y-853: Dohrenwend and others, 1992; Y-1020: Jennings, 1992 (his fault #211).

Location: 135 km/298° (distance and direction from YM) at 37°22′ and 117°48′ (location of closest point). FLV is located along the eastern front of the White Mountains and within Fish Lake Valley.

USGS 7-1/2′ quadrangle: Chocolate Mountain, Indian Garden Creek, Oasis Divide, Sylvania Canyon.

Fault orientation: FLV generally strikes northwest with an average strike between N. 35° W. and N. 40° W. (Y-665, p. 130). Strikes range between N. 22° W. and N. 55° W. (Y-216, p. 5-13). The very northern about 8 km of FLV north of Indian Creek strikes north–northeast (Y-216, pl. 1A, fig. 1, p. 5). FLV between Wildhorse Creek and the Sylvania Mountains in Fish Lake Valley is composed of a western trace along the front of the White Mountains and an eastern one that traverses alluvial fans within the valley.

Fault length: Y-647 (p. 115) noted that the length of FLV is at least 80 km. The northwestern end of FLV may terminate in folds that extend beyond the fault's trace (Y-600, p. 133-139).

Potential rupture length along FLV is estimated to be at least about 80 km, because no possible rupture endpoints were discovered between the northwestern end of the fault and a bend at Cucomungo Canyon (Y-665, p. 213-228, 237). The youngest event (mid–to–late Holocene) interpreted from trenches at Marble Creek and south of Indian Creek in Fish Lake Valley apparently ruptured at least 20 km of FLV (Y-647, p. 135-136).

Style of faulting: FLV exhibits evidence for oblique right–lateral displacement. The right–lateral separation of geomorphic features of late Pleistocene age or younger (<10 ka) is less than dip separation in most places (Y-216, p. 7, 8, 22, 28). Minor dip–slip displacement may be due to changes in the strike of the fault (Y-216, p. 19).

Scarp height: Table 3 in Y-216 (p. 20-21) lists scarp data collected along their four segments of FLV. Maximum vertical separation is 64 m on a late Pleistocene surface (their Q2 surface; estimated age >10 ka) at Perry Aiken Creek along their Dyer segment (Y-216, table 3, p. 20). This large scarp is probably the result of several ruptures, although no direct evidence of multiple ruptures was found by Y-216 (p. 8).

Displacement (right–lateral): Estimates of right–lateral displacement range between 3 m and 25 km. These estimates are based on a variety of stratigraphic and structural markers, as noted in the following paragraphs in which the displacements are discussed in order of decreasing unit age. Displacements south of Fish Lake Valley are described under the Furnace Creek fault (FC).

In northern Fish Lake Valley, total right–lateral displacement was estimated by Y-651 (p. 36) to be <15 to 25 km. This estimate is based on the northwest–southeast width of the northern part of the valley and on the apparent northwest–southeast separation of a thrust–fault contact that is in Paleozoic rocks and that is preserved on the eastern and northwestern sides of Fish Lake Valley.

Y-475 (p. 509-510, 512) estimated about 48 km (30 miles) of right–lateral displacement in southern Fish Lake Valley since about 160 Ma (Middle Jurassic) by correlating similar–looking granitic rocks in the Sylvania Mountains and the White–Inyo Mountains.

Y-475 (p. 510, 512) estimated about 0.9 km (3,000 ft) of right–lateral displacement on FLV since about 3.5 Ma using relationships between Pliocene deposits and drainages at Horse Thief Canyon, Willow Wash, and Cucomungo Canyon in southern Fish Lake Valley and reconstruction of the Pliocene drainage system.

At Leidy Creek near the northern end of FLV, debris–flow levees on an alluvial fan (described as ballenas or eroded fan remnants by Y-665, p. 126) with an estimated age of about 150 ka show that right–lateral displacement on FLV has been about 92 m (Y-647, p. 126-128, table 2, p. 132; Y-665, p. 166-170, 371-372). (Vertical displacement is negligible at this locality.)

At Indian Creek, north of Leidy Creek in Fish Lake Valley, a channel across an alluvial fan with an estimated age of about 150 ka is displaced by the main trace of FLV about 122 m in a right–lateral direction (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 169-172, 374-375). (Vertical displacement is about 40 m at this locality.)

Right–lateral displacement of about 3 m was noted in a channel on an alluvial fan with an estimated age of 5 ka to 8 ka at Indian Creek near the northern end of FLV (Y-647, p. 131, table 2, p. 132; Y-665, p. 170, 172-173, 375-376).

Displacement (vertical): Estimates of vertical displacement on FLV range between 1 and 750 m in upper Cenozoic deposits as noted in the following paragraphs in which displacements are discussed in order of decreasing deposit age.

Using the elevation difference between a 10–to–12–Ma basalt on Chocolate Mountain and a similar one at the base of a stratigraphic section at Willow Wash, a vertical displacement of about 680 m since 10–12 Ma was estimated by Y-651 (p. 38) for FLV in southern Fish Lake Valley.

In northern Fish Lake Valley, vertical displacement between 540 and 750 m was estimated across the northern FLV by projecting the elevation of a 3–Ma andesite on Davis Mountain to the fault and using the elevation difference between this projection and the present valley (Y-651, p. 40).

At Perry Aiken in central Fish Lake Valley, a minimum vertical displacement of 305 m since about 1 Ma was estimated by using the gradient of the modern surface to project the elevation of alluvium now preserved in the footwall to the present location of the fault (Y-651, p. 39).

At McAfee Creek in central Fish Lake Valley, a minimum vertical displacement of 244 m since about 740 ka was estimated by Y-651 (p. 39) using the difference between the elevation of the base of alluvium that is younger than the Bishop ash (740 ka) and that is preserved in the footwall and the estimated elevation of the pluvial lake in Fish Lake Valley prior to faulting. As much as 488 m of vertical displacement may have occurred since 740 ka, if the estimated elevation of lake sediments beneath Fish Lake Valley is used to calculate the elevation difference (Y-651, p. 39).

In southern Fish Lake Valley, a maximum vertical displacement of 540 m since about 740 ka was estimated by Y-651 (p. 38) using the elevation of gravels that include Bishop ash (740 ka) at Gilbert Summit and the inferred elevation of the Bishop ash beneath Fish Lake Valley.

At Indian Creek, at the northern end of FLV in Fish Lake Valley, a channel across an alluvial fan with an estimated age of about 150 ka is displaced by the main fault trace about 40 m vertically (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 169-172, 374-375). (Right–lateral displacement is about 122 m at this locality.)

At the same locality at Indian Creek just described, vertical displacement across the entire FLV has been estimated to be about 160 m by assuming a once–constant gradient for a displaced alluvial fan with an estimated age of about 150 ka (Y-647, p. 131, table 2, p. 132).

Fish Lake Valley fault (FLV) — Continued

A channel on an alluvial fan with an estimated age of about 5 ka to 8 ka has vertical displacement of about 1 m at the same Indian Creek near the northern end of FLV (Y-647, p. 131, table 2, p. 132; Y-665, p. 170, 172-173, 375-376).

Age of displacement: The youngest displacement on FLV is probably latest Holocene. Y-216 (p. 9-10) noted a 13.7–km–long zone of vegetation lineaments and small scarps along their Horse Thief and Oasis segments. These tectonic features are on the surfaces of young alluvial deposits and may be nearly historical (their surface Q_{1A}; 0 to 200 yr). Using exposures in trenches along FLV (at Marble Creek and south of Indian Creek), Y-647 (p. 135-136) interpreted two significant middle to late Holocene events, the youngest of which occurred between 1.5 ka or 1.0 ka and 0.6 ka.

Elsewhere along FLV, evidence for late Pleistocene to Holocene surface ruptures is common. This evidence includes linear fault scarps, shutter ridges, pressure? ridges, side–hill benches, ridge–crest saddles, linear troughs, vegetation lineaments in playas, deflected drainages, offset drainages, beheaded drainages, faceted spurs, and well–defined tonal lineaments (Y-470, p. 10; Y-665; Y-1020). The map by Y-853 shows FLV as scarps on surficial deposits or erosional surfaces with estimated ages of primarily late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) and early to middle and (or) late Pleistocene (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma).

Sedimentary rocks in the basin along Willow Wash near the southern end of Fish Lake Valley suggest a minimum age of latest Miocene or earliest Pliocene for the beginning of displacement along FLV in southern Fish Lake Valley (Y-651, p. 36). In addition, relationships among stream gravels preserved on divides between Deep Springs, Fish Lake, and Eureka valleys show that streams flowed from the southern White Mountains into Eureka Valley, which implies that southern Fish Lake Valley and Deep Springs Valley did not exist in their present configuration until after 0.7 Ma (Y-651, p. 36).

Slip rate (right–lateral): Estimated long–term, right–lateral slip rates are about an order of magnitude greater than estimated long–term, vertical slip rates on FLV (Y-651, table 2, p. 37; p. 42). At one locality in Fish Lake Valley at the northern end of FLV (Indian Creek), the ratio of right–lateral to vertical displacement is 2:1 to 5:1 in deposits with an estimated age of about 150 ka (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 169-172, 374-375).

Right–lateral slip rates range between 0.3 mm/yr and 6 mm/yr depending upon the age and location of the stratigraphic markers used to estimate the rates, as noted in the following paragraphs listed in the order of decreasing age of the units used to estimate the slip rate.

In northern Fish Lake Valley, a minimum right–lateral slip rate of 1 to 2 mm/yr and a maximum right–lateral slip rate of 2 to 3 mm/yr were estimated by Y-651 (p. 36) using displacement of a thrust–fault contact in Paleozoic rocks and the width of the valley.

Right–lateral slip rates of 0.26 mm/yr since about 3.5 Ma (Pliocene) and 0.3 mm/yr since about 160 Ma (Middle Jurassic) were estimated by Y-475 (p. 510, 512) for FLV in the Cucomungo Canyon area between Fish Lake and Death valleys. Y-651 (p. 27) speculated that this rate, which was estimated for FLV since Middle Jurassic, is a minimum value because displacement on FLV probably did not begin until middle Miocene (Y-29, *cited by* Y-651, p. 23; Y-706, p. 2).

Assuming that the 48 m of displacement recognized by Y-475 (p. 509-510, 512) occurred after 8.2 Ma to 11.9 Ma, Y-651 (p. 36) estimated a right–lateral slip rate of 4 to 6 mm/yr for FLV in southern Fish Lake Valley since that time.

In the Horse Thief Hills–Willow Wash area just south of Fish Lake Valley (near the Cucomungo Canyon area of Y-475), volcanic rocks that underlie and that are interbedded with fault–derived sediments yield ages of 8.2 Ma and 11.9 Ma (Y-651, p. 36). If the 50 km of right–lateral displacement that was noted by Y-475 (p. 509-510, 512) is assumed, then the post–Miocene right–lateral slip rate is 4 to 6 mm/yr for FLV in southern Fish Lake Valley (Y-651, p. 36).

Fish Lake Valley fault (FLV) — Continued

In northern Fish Lake Valley at Leidy Creek and Indian Creek, the right–lateral slip rate since about 150 ka is 0.6 and 0.8 mm/yr along one trace of FLV (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 166-172, 371-375).

In northern Fish Lake Valley at Indian Creek, the right–lateral slip rate since 5 ka to 8 ka is 0.4 to 0.6 mm/yr along one trace in FLV (Y-647, p. 131, table 2, p. 132; Y-665, p. 170, 172-173, 375-376).

Slip rate (vertical): Vertical slip rates for FLV range between 0.05 mm/yr and 1.6 mm/yr in Fish Lake Valley.

The post–Miocene vertical slip rate (10.8 Ma to 0.74 Ma), although poorly constrained, appears to range between 0.05 and 0.2 mm/yr along FLV (Y-651, p. 26, 42).

In southern Fish Lake Valley near Chocolate Mountain, displacement of a basalt yields a vertical slip rate of 0.06 to 0.07 mm/yr since 10 Ma to 12 Ma (Y-651, p. 38).

In northern Fish Lake Valley near Davis Mountain, the vertical slip rate since about 3 Ma has apparently been between 0.15 to 0.2 mm/yr and 0.2 to 0.25 mm/yr (Y-651, p. 40).

At Perry Aiken Creek in central Fish Lake Valley, a minimum vertical slip rate of 0.3 mm/yr was estimated by Y-651 (p. 39) since about 1 Ma.

The vertical slip rates since 0.74 Ma (deposition of Bishop ash) range between 0.3 and 0.7 mm/yr on several parts of FLV (e.g., 0.7 mm/yr at McAfee Creek in the central part of the valley and at Gilbert Summit in the southern part of the valley; Y-651, p. 26, 38, 39, 42). These rates are much higher than the post–Miocene rates (Y-651).

In northern Fish Lake Valley at Indian Creek, the vertical slip rate across one trace of FLV is about 0.3 mm/yr (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 169-172, 374-375).

At the same locality at Indian Creek in Fish Lake Valley, the vertical slip rate estimated across the entire FLV is 0.8 to 1.6 mm/yr since about 150 ka (Y-647, p. 131, table 2, p. 132).

The vertical slip rate since 5 ka to 8 ka for one trace of FLV at Indian Creek in Fish Lake Valley has been estimated to be 0.1 to 0.3 mm/yr (Y-647, p. 131, table 2, p. 132; Y-665, p. 170, 172-173, 375-376).

Recurrence interval: On the basis of interpretations in four trenches in Fish Lake Valley (two between Indian and Leidy creeks in northern Fish Lake Valley and two south of Cottonwood Creek in southern Fish Lake Valley), Y-665 (pls. I, IIB, IIC, IIE; table 10, p. 188; p. 231-232) concluded that three ruptures had occurred since about 2.5 ka and that the recurrence between events has been about 1,100 ± 600 yr, although the recurrence could be as long as 3,000 yr or as short as 500 yr.

Range-front characteristics: The map by Y-853 shows FLV along the southwestern side of Fish Lake Valley through the Cucomungo Canyon–Last Chance Canyon area as being a major range–front fault with a range front characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to the range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to the range front."

Analysis: Aerial photographs, including low–sun–angle, at scales of 1:12,000 (Y-216, p. 3; Y-470, p. 8; Y-665), 1:20,000 (Y-470, p. 8), 1:24,000 to 1:30,000 (Y-470, p. 8), 1:48,000 (Y-665, p. 8-11), 1:60,000 (Y-665, p. 8-11), and 1:115,000 to 1:124,000 (Y-853). Scarp profiles (Y-216, p. 5; Y-665, p. 8-11). Field examination (Y-216, p. 5; Y-470, p. 8; Y-665, p. 8-11). Estimates of ages of faulted and unfaulted surfaces using relative-age parameters (e.g., desert varnish, pavement development, surface preservation and morphology, position above active channels, and soil descriptions; Y-216, p. 5; Y-665, p. 8-11; Y-853). ^{14}C ages on alluvial surfaces in Fish Lake Valley (Y-328; Y-647) were used to establish a chronology of surface morphology. Surveys of geomorphic features using a Wild theodolite and trench interpretations to estimate displacements (Y-665, p. 8-11). Pseudo–segmentation was done based on fault orientation, apparent age of faulting, the width of the fault zone, the pattern of faulting, and the position of the fault relative to the range front (Y-216).

Fish Lake Valley fault (FLV) — Continued

Relationship to other faults: FLV may be the northern extension of the northwest–striking Furnace Creek fault (FC). However, the exact relationship between the two faults has not been determined.

Freiburg fault (FR)

Plate or figure: Plate 1.

References: Y-404: Tschanz and Pampeyan, 1970 (name from their pl. 3); Y-1032: Schell, 1981 (pl. 9; his fault #47). Not shown by Ekren and others, 1977 (Y-25).

Location: 133 km/35° (distance and direction of closest point from YM) at lat 37°49′N. and long 115°35′W. (location of closest point). FR is located along the eastern side of the Worthington Mountains (sometimes called the Freiberg Range; e.g., Y-404, p. 96) at their junction with Garden Valley.

USGS 7-1/2′ quadrangle: Meeker Peak, Worthington Peak.

Fault orientation: FR has a slightly curving strike that is generally north (Y-404).

Fault length: The length of FR is 19 km as estimated from Y-404 (pl. 3). The length of FR is noted to be 18 km by Y-1032 (table A2, p. A10).

Style of faulting: Displacement on FR is shown by Y-404 as down to the east.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along FR is noted by Y-1032 (table A2, p. A10) as indeterminate, but suspected of being Quaternary. Scarps are prominent, but their age could not be determined by Y-1032 (pl. 9) because young stratigraphic units are not present along the fault. The youngest unit definitely displaced by FR is Paleozoic rocks (Y-1032, table A2, p. A10). The oldest unit not displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A10) with an estimated age of 15 ka to probably 200 ka (table 3, p. 23). Y-404 portrayed FR as a post–Laramide structure that is inferred or concealed by Pleistocene(?) older alluvium (their Qol deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The eastern front of the Worthington Mountains appears relatively linear on topographic maps at scales of 1:250,000 and 1:500,000; this linearity could suggest influence by fault displacement. An evaluation of the characteristics of this range front has not been done.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: FR is approximately parallel to other north–striking faults along range fronts in the area. These fault include the northern part of the Penoyer fault (PEN), which bounds the western side of the Worthington Mountains immediately west of FR, the Garden Valley fault (GRD) along the western side of unnamed hills at the southeastern edge of Garden Valley southeast of FR, the Golden Gate fault (GG) along the eastern side of the Golden Gate Range east of FR, the West Railroad fault (WR) along the eastern side of the Reveille Range west of FR, and the East Reveille fault (ERV) along the western side of the Reveille Range. The northern end of PEN curves around the northern end of the Worthington Mountains and appears to nearly intersect FR. FR is approximately perpendicular to the east–northeast–striking Tem Piute fault (TEM) south of FR. The structural relationships among these faults are not known.

Frenchman Mountain fault (FM)

Plate or figure: Plate 2.

References: Y-852: Dohrenwend and others, 1991; Y-1073: Anderson and O'Connell, 1993 (name from this reference).

Location: 146 km/120° (distance and direction of closest point from YM) at lat 36°13′N. and long 115°01′W. (location of closest point). FM is located east of Las Vegas, Nevada, along the western sides of Frenchman Mountain on the south and Sunrise Mountain on the north at their junction with Las Vegas Valley.

USGS 7-1/2′ quadrangle: Las Vegas NE.

Fault orientation: FM has a curving strike. The southern portion strikes northwest; the northern portion strikes northeast (Y-852; Y-1073, fig. 2-1).

Fault length: The length of FM is about 20 km as estimated from Y-852. The surficial expression of FM is noted by Y-1073 (p. 42) to be about 18 km from Nellis Air Force Base on the north to just north of Las Vegas Wash on the south.

Style of faulting: No information.

Scarp characteristics: Scarps are shown by Y-852 as northwest–facing or southwest–facing. Scarps on a Ql surface of Y-1073 have surface offsets of 6.6 and 8.9 m with maximum scarp–slope angles of 20.5° and 21.5°, respectively, at two localities where scarp profiles were measured by Y-1073 (p. 42, appen. D). A scarp on a younger, Q2 surface of Y-1073 is about 2 m high and has been interpreted by Y-1073 (p. 49) to possibly record surface rupture during the most–recent event along FM.

Displacement: No information.

Age of displacement: The youngest scarps along FM are shown by Y-852 to be on possibly late Pleistocene depositional or erosional surfaces (their Q2? surfaces with an estimated age between 10 ka and 130 ka). Scarps are also shown by Y-852 on depositional or erosional surfaces with ages of early to middle and (or) late Pleistocene (their Q1-2 surfaces with estimated ages between 10 ka and 1.5 Ma) and possibly early to middle Pleistocene (their Q1? surfaces with estimated ages between 130 ka and 1.5 Ma).

Y-1073 (p. 49, 101) stated that their best guess for the age of the youngest rupture along FM is late Quaternary (<130 ka), but this event could be as young as early Holocene. Scarps are preserved on surfaces of their Q1 and Q2 deposits with estimated ages of 30 ka to >500 ka(?). The only deposits that they noted to overlie FM are their Q3 deposits, which could be as young as late to middle Holocene (1 ka to 7 ka, Y-1073, appen. C).

Slip rate: No information.

Recurrence interval: By inferring that a 9–m–high scarp on ≤500 ka deposits formed during multiple events each causing 1 to 2 m of surface displacement, Y-1073 (p. 101) concluded that "the recurrence of surface faulting events could be tens to possibly hundreds of thousands of years."

Range-front characteristics: Most of FM is portrayed by Y-852 as a fault juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of the western sides of Frenchman and Sunrise mountains would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, FM would be significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852).

Frenchman Mountain fault (FM) — Continued

Analysis: Aerial photographs (Y-852, scale 1:58,000; Y-1073, p. 1, scale 1:58,000). Field reconnaissance (Y-1073, p. 1). Low–sun–angle aerial overflight (Y-1073, p. 1). Scarp profiles (Y-1073, p. 42, appen. D). Soil descriptions (Y-1073, appen. C).

Relationship to other faults: No information.

Furnace Creek fault (FC)

FC includes the southern part of the northern Furnace Creek fault zone of Y-651 and the southern part of the Northern Death Valley–Furnace Creek fault zone of Y-470.

Plate or figure: Plates 1 and 2.

References: Y-29: Hamilton, 1988; Y-66: Moring, 1986 (His Furnace Creek fault segment of the Death Valley-Furnace Creek fault zone. He shows FC between Grapevine Canyon and Last Chance Canyon at the northern end of Death Valley.); Y-216: Brogan and others, 1991 (pls. 1 and 2; Their Furnace Creek fault zone includes the Fish Lake fault (FLV) of this compilation to Chiatovich Creek in Fish Lake Valley. They subdivided FC into twelve segments, seven of which are in Death Valley.); Y-222: Streitz and Stinson, 1974; Y-236: Reynolds, 1969 (his Death Valley–Furnace Creek fault zone (fig. 41, p. 235)); Y-262: Stewart and others, 1968; Y-355: Ross, 1967; Y-389: Drewes, 1963; Y-390: Hunt and Mabey, 1966 (show FC between long 116°45′W. and 117°15′W.); Y-397: Pistrang and Kunkel, 1964; Y-421: McAllister, 1970; Y-427: Hart and others, 1989; Y-456: Bryson, 1937; Y-468: Noble and Wright, 1954; Y-470: Bryant, 1988; Y-474: Hooke, 1972; Y-475: McKee, 1968; Y-478: Stewart, 1983; Y-479: Wright and Troxel, 1967 (part of their Death Valley-Furnace Creek fault zone); Y-482: Krauskopf, 1971; Y-483: McKee, 1985; Y-484: McKee and Nelson, 1967; Y-485: Robinson and Crowder, 1973; Y-486: Stewart and others, 1974; Y-596: Wright and Troxel, 1970; Y-600: Stewart, 1967 (his Death Valley–Furnace Creek fault zone); Y-603: Butler, 1984; Y-651: Reheis and McKee, [1991]; Y-652: Reheis and others, [1991]; Y-683: Cemen and others, 1985; Y-706: Wright, 1989; Y-746: Wright and Troxel, 1954; Y-853: Dohrenwend and others, 1992; Y-880: Curry, 1938; Y-1020: Jennings, 1992 (his Northern Death Valley–Furnace Creek fault zone in Death Valley and his Furnace Creek fault along Furnace Creek Wash (includes the southern part of the Fish Lake Valley fault (FLV) of this compilation, that part of FLV in California); his fault #211); Y-1026: Oakes, 1987; Y-1027: Snow and Wernicke, 1988.

Location: 50 km/230° (distance and direction from YM) at lat 36°33′N. and long 116°52′W. (location of closest point). FC is located in northern Death Valley north of Furnace Creek Wash. Y-479 (p. 947) extended FC southeastward across the Amargosa Desert where they suggested that it may connect with a northwest–striking fault that extends into the Resting Spring Range or that it may splay to the south into normal faults in the Amargosa Valley (part of the Ash Meadows fault (AM) of this compilation) and terminate against the northwest–striking Sheephead fault (not shown on pls. 1 and 2 of this compilation). Y-468 (pl. 7) and Y-683 (p. 128) extended FC to the southeast into the Amargosa Valley, where FC strikes north–northwest southeast of Death Valley Junction and may merge with dip-slip (normal) faults in the valley. Y-478 (p. 155, fig. 3) portrayed FC as ending abruptly west of the Resting Spring Range.

USGS 7-1/2′ quadrangle: Beatty Junction, Chloride City, Dry Bone Canyon, East of Tin Mountain, Echo Canyon, Fall Canyon, Furnace Creek, Grapevine Peak, Grotto Canyon, Hanging Rock Canyon, Last Chance Mountain, Last Chance Range SE, Mesquite Flat, Nevares Peak, Ryan, Sand Spring, Scottys Castle, Stovepipe Wells NE, Thimble Peak, Tin Mountain, Tule Canyon, Ubehebe Crater, West of Furnace Creek, West of Gold Mountain.

Fault orientation: FC strikes generally northwest. FC northwest of Grapevine Canyon strikes north-northwest (Y-66).

Fault length: The minimum length of FC is 105 km from Last Chance Canyon at the northern end of Death Valley to Salt Springs as estimated from Y-216 (pl. 1, p. 11-13). If FC continues to the mouth of Furnace Creek Wash and merges with the Death Valley fault (DV) in Death Valley, then the length of FC is 115 km (estimated from plates 1 and 2 of this compilation). Y-236 (p. 36-37) reported a length of about 160 km (about 100 miles) for FC between near Furnace Creek Wash to Fish Lake Valley. If FC extends to near Death Valley Junction in the Amargosa Valley as suggested by Y-468 (pl. 7) and Y-683 (p. 128), then the length of FC is 165 km. If FC continues southeast of the Amargosa Valley to terminate in the Resting Spring Range as proposed by Y-479 (p. 934-935, fig. 1), then FC is 175 km long. Y-651 (p. 26) stated that the length of FC is >250 km (includes the possible extension of FC north into Fish Lake Valley; the Fish Lake Valley fault (FLV) of this compilation). Y-600 (p. 131) noted that the length of FC is at least 400 km (250 miles). Y-880 (p. 1875) noted that individual fault traces are continuous for 32 km (20 miles) or more.

Style of faulting: Right–lateral displacement predominates for Holocene and late Pleistocene ruptures in most places (Y-216, p. 19). Minor dip–slip displacement observed at some localities may be due to changes in strike of the fault (Y-216, p. 19). In general, dip–slip (normal) displacement is limited to northeast-striking faults that splay from the main trace of FC (Y-216, p. 5).

Right-lateral displacement has been recognized on FC by Y-475 (p. 509), Y-479 (p. 937), Y-600 (p. 131), and Y-683 (p. 134-135). Right–lateral displacement in Death Valley north of Furnace Creek is indicated by displaced alluvial fans and drainages, shutter ridges, drag folds, horizontal slickensides, trenches, pressure ridges, and sag ponds (Y-880, p. 1875). Y-66 inferred right-lateral displacement on FC from the presence of both east– and west–facing fault scarps.

Y-683 (p. 139) noted that clast composition of the Pliocene Furnace Creek Formation as observed by Y-421 suggests that vertical displacement has occurred on FC along Furnace Creek Wash southeast of the Furnace Creek Inn.

Scarp height: Both east– and west–facing scarps are preserved in northern Death Valley (Y-66). Y-216 (table 3) noted scarps heights of 23 m on a Pleistocene surface near Red Wall Canyon, 0.3 to 2 m on middle and early Holocene (2 ka to 10 ka) surfaces, and 0.3 to 1.8 m on late Holocene (0.2 ka to 2 ka) surfaces. The maximum scarp–slope angle for the 23–m–high scarp is 33° (Y-216, table 3). The maximum scarp–slope angles for a 1.5–m–high scarp on a middle and early Holocene surface is 10° (Y-216, table 3). The maximum scarp–slope angle for a 1.8–m–high scarp on a late Holocene surface is 27° (Y-216, table 3).

Displacement (right–lateral): Estimates of right–lateral displacements on FC range between 128 km and 0.6 m, based on a variety of stratigraphic and structural markers, as shown in the following paragraphs in which displacement is discussed in order of decreasing unit age.

Y-389 (p. 56) suggested that FC had experienced 24 to 48 km (15 to 30 miles) of right–lateral displacement. Y-468 (p. 157) implied that right-lateral displacement on FC has been at least 19 km (12 miles). Y-683 (p. 128) stated that the development of Furnace Creek basin "requires no more than 10 km of right-lateral slip in the area of Furnace Creek Wash."

Y-596 estimated that the maximum right–lateral displacement on FC about 150 km northwest of Bat Mountains north of the northern end of Death Valley has been 50 km on the basis of greater extension on the southwestern side of the fault than on the northeastern side. They also concluded that displacement progressively increases northwestward on FC.

Y-600 (p. 133, 135) estimated about 80 km (50 miles) of right–lateral displacement on FC based on interpretation of isopach lines that indicate abrupt changes in facies and thicknesses of Upper Precambrian and Lower Cambrian rocks. He interpreted these changes to be the result of fault displacement.

On the basis of the alignment of linear features (e.g., stratigraphic contacts, a mineralization zone, distribution of distinctive facies) in Precambrian and Cambrian rocks, Y-479 (p. 945-947) suggested that right–lateral displacement along FC south of the Furnace Creek Ranch in Death Valley (along the Funeral Mountains) has been limited to "no more than a few miles" (p. 947), possibly <2 miles (about 3 km).

Three major northeast–striking Mesozoic thrust faults were correlated on the basis of geometric properties (e.g., size, vergence, order, spacing) independent of stratigraphy (Y-1027). Y-1027 used these correlations to suggest that 68 ± 4 km of apparent right–lateral displacement had occurred along FC between the Cottonwood and Funeral mountains.

Y-262 (p. 1411) interpreted 80 to 128 km (50 to 80 miles) of right–lateral displacement on FC in northern Death Valley using isopach lines and facies of Devonian and Silurian rocks and the distribution of Mississippian rocks.

Y-1026 estimated 32 km of right–lateral displacement by interpreting a granitic stock in the northern Grapevine Mountains as once continuous with a similar stock in the Last Chance Range that has been dated at 7.3 Ma to 7.9 Ma (Y-483, *cited by* Y-1026).

Y-390 (p. A103, A115) noted that the Funeral Formation (Pliocene and Pleistocene(?)) in the Salt Creek Hills in northern Death Valley has several hundred feet of structural relief.

Y-470 (p. 10) noted a minimum amount of late Cenozoic right–lateral displacement of about 5.3 km in the Cucomungo Canyon–Last Chance Canyon area between FC and FLV based on the apparent displacement of Cucomungo Canyon.

Y-236 (p. 238) reported right–lateral displacement of 46 m (150 ft) of an alluvial fan with well–developed desert varnish and pavement and an estimated Pleistocene age (Q_4; Y-236, p. 155-157) in the area northwest of Red Wall Canyon. Displacement is indicated by the fan margins and by drainages offset in the direction opposite to the regional slope (Y-236, p. 238). Y-470 (p. 8) assumed that this fan was deposited about 20 ka, based on the possible early Holocene age of younger fan deposits that partially bury the displaced fan and occur as terraces upstream of the displaced fan margin. Holocene gravel deposits (Q_1 and Q_2; Y-236, table 9, p. 156) overlie the fault (Y-236, p. 159-161).

Y-880 (p. 1875) measured right–lateral displacements of at least 9 m (30 ft), but he thought that larger displacements, although not measured by him, had probably occurred.

The maximum right–lateral displacement noted by Y-216 (table 3) on a Pleistocene surface (their Q2 unit) is 21 m on their Grapevine Canyon section. The maximum right–lateral displacement noted by them on middle and early Holocene surfaces (their Q1C unit) is 8.5 m on their Grapevine Canyon section, although most displacements are between 1.5 and 2.7 m. Right-lateral displacements observed by Y-216 (table 3) on late Holocene surfaces (their Q1B unit) are <0.6 and 1.8 m. The highest value occurs on their Beatty Junction section.

Displacement (vertical): Y-236 (p. 238) noted 0.6 to 1.5 m (2 to 5 ft) of east–side–down vertical displacement in a gravel deposit with an estimated Holocene age in northern Death Valley (NW1/4, sec. 34, T. 13 S., R. 44 E.).

Age of displacement: The youngest displacement on FC is latest Holocene (Y-216, table 3, p. 20). Y-216 (table 3) noted scarps on late Holocene surfaces (0.2 ka to 2 ka; their Q1B surfaces) at several localities. The map by Y-853 shows FC as scarps on surficial deposits or erosional surfaces with estimated ages of primarily late Pleistocene (Q2; 10 ka to 130 ka) and early to middle and(or) late Pleistocene (Q1-2; 10 ka to 1.5 Ma).

The map by Y-1020 shows most of FC in Death Valley as Holocene (≤10 ka). The part of FC along Furnace Creek Wash is portrayed by Y-1020 either as undifferentiated Quaternary (defined by him as <1.6 Ma) or as concealed (e.g., the portion of FC east of Ryan, California).

Y-880 (p. 1875) noted that parts of FC are "marked by a churned–up furrow in the recent alluvium."

Furnace Creek fault (FC) — Continued

The oldest undisplaced surfaces noted by Y-216 (table 3, p. 20) along most of FC are latest Holocene (<200 yr; their Q1A unit). However, they recognized no displacement of late Holocene surfaces (0.2 ka to 2 ka; their Q1B unit) northwest of Grapevine Canyon. Similarly, Y-66 portrayed FC between Grapevine Canyon and the north end of Death Valley as displacing deposits no younger than Pleistocene (age not further specified). Y-421 (p. 8, pl. 1) shows a surface above Navel Springs about 15 km southeast of the Furnace Creek Inn that extends across FC and is not displaced. The surface is capped by gravel with an estimated age of older Pleistocene (his Qoa unit).

Slip rate: A right–lateral slip rate of 2.3 mm/yr is estimated by Y-470 (p. 8-9) for FC in northern Death Valley, using the 46 m of right–lateral displacement noted by Y-236 (p. 238) and estimating that the displaced alluvial fan was deposited about 20 ka.

For FC between the northern Grapevine Mountains and the Last Chance Range, an area 5 to 10 km south of the Cucomungo Canyon area studied by Y-475, Y-1026 estimated a right–lateral slip rate of 4.1 to 4.4 mm/yr since 7.3 Ma to 7.9 Ma, a rate about 16 times that of the rates (0.26 and 0.3 mm/yr) estimated by Y-475 for Pliocene and Middle Jurassic rocks the Cucomungo Canyon area.

Recurrence interval: Y-216 (p. 19) concluded that four to six separate events have occurred on FC during the Holocene (≤10 ka). This number of events suggests that the recurrence interval between events is 1,700 yr to 2,500 yr.

Range-front characteristics: Most of FC is located in the central part of Death Valley and is not directly associated with a major range front.

Analysis: Aerial photographs, including low–sun–angle, at scales of 1:12,000 (Y-216, p 3; Y-470, p. 8; Y-665), 1:20,000 (Y-470, p. 8), 1:24,000 to 1:30,000 (Y-470, p. 8), and 1:115,000 to 1:124,000 (Y-853). Aerial photographs (no scale given; Y-236, p. 13). Scarp profiles (Y-216, p. 5). Field examination (Y-216, p. 5; Y-236, p. 13, work completed between 1961 and 1963; Y-470, p. 8). Estimates of ages of faulted and unfaulted surfaces, using relative-age parameters (e.g., desert varnish, pavement development, surface preservation and morphology, position above active channels, soil descriptions, and correlation to Lake Manly shorelines) (Y-216, p. 5; Y-853). It is not apparent from reading the text whether or not scarp diffusion models were utilized for actual age derivation (Y-216). Pseudo–segmentation was done based on fault orientation, apparent age of faulting, the width of the fault zone, the pattern of faulting, and the position of the fault relative to the range front (Y-216). Geologic mapping at a scale of about 3 inches per mile (enlarged from the Grapevine Peak 15–minute quadrangle; Y-236, p. 13).

Relationship to other faults: FC is probably related to the Fish Lake Valley fault (FLV), the Death Valley fault (DV), the Southern Death Valley fault (SDV), the Keane Wonder fault (KW), and the Grapevine fault (GV). The exact relationships among these faults are not known, however.

Right–lateral displacement on SDV is estimated to be <8 km using Precambrian units (Wright and Troxel, 1970 (Y-596); Davis, 1977 (Y-592)), which is much less than the approximately 80 km of right–lateral displacement estimated on FC using units of similar age (Y-600, p. 133). Y-478 (p. 154, 156-157) hypothesized that this large difference can be explained by about 80 km of northwestward movement of the Panamint Range from an original position adjacent to the Resting Spring and Nopah ranges along one or more low–angle detachment faults some time after the Mesozoic.

Y-600 (p. 133) proposed that FC may terminate on the south in a "gigantic" fold, but noted that there is no structural evidence for such a fold.

Furnace Creek fault (FC) — Continued

Y-600 (fig. 1, p. 133, 135) portrayed FC as intersecting SDV (his Death Valley fault zone) at the northern end of the Black Mountains, so that FC northwest of this point is his Death Valley–Furnace Creek fault zone and southeast of this point FC is his Furnace Creek fault zone. Y-236 (p. 236-237) suggested that FC merges with DV near Furnace Creek Wash.

Y-421 (p. 8) suggested that FC may curve southward adjacent to Furnace Creek Wash about 10 km southeast of Furnace Creek Wash and merge into a northeast–striking fault that crosses Furnace Creek Wash (the Cross-valley fault of Y-683 (p. 136), the Mont Blanco of Y-389, the valley crossing fault of Y-421 (p. 8); fault shown but not labeled on plate 2 of this compilation). Y-421 (p. 8) speculated that this northeast–striking fault may connect FC to the northwest–striking Grand View fault along the southwest side of the Furnace Creek basin.

Garden Valley fault (GRD)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-1032: Schell, 1981 (pl. 9; shows a short fault at approximately the same position of GRD as shown by Y-25). Not shown by Tschanz and Pampeyan, 1970 (Y-404).

Location: 126 km/40° (distance and direction of closest point from YM) at lat 37°42′N. and long 115°31′W. (location of closest point). GRD is located along the western side of an unnamed ridge at the southern end of Garden Valley.

USGS 7-1/2′ quadrangle: Meeker Peak, Monte Mountain.

Fault orientation: GRD is curving, but generally strikes north (Y-25).

Fault length: The length of GRD is about 12 km as estimated from Y-25. Y-25 continued GRD another about 3 km to the north as a concealed fault beneath Garden Valley (not shown on pl. 1 of this compilation).

Style of faulting: Displacement on GRD is shown by Y-25 as down to the west. Pliocene and Miocene debris (their Tda deposits, <24 Ma) along the western side of GRD "is interpreted [by Y-25] as having been formed during a period or periods of intense strike–slip faulting," which implies that older displacements on GRD may have been different from younger displacements.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along GRD is noted by Y-1032 (pl. 9) as indeterminate, but suspected of being Quaternary. Scarps are described as prominent, but their age could not be determined by Y-1032 (pl. 9), because young stratigraphic units are not present along the fault.

About 3.5 km of GRD are shown by Y-25 as a faulted contact between Oligocene welded tuff (their Tt2 unit) and Holocene to Pliocene alluvium and colluvium (their QTa deposits). The northernmost 3 km of GRD are portrayed by Y-25 as concealed by their QTa deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: The northern end of GRD intersects an east–striking, 1.5–km–long, down–to–the–north fault shown by Y-25. This east–striking fault is portrayed by Y-25 as a faulted contact between Tertiary volcanic rocks and Holocene to Pliocene alluvium and colluvium (their QTa deposits). The relationship between this fault and GRD is not known.

The southern end of GRD intersects a east–northeast–striking trace of the Tem Piute fault (TEM). Displacement on TEM is primarily left–lateral. The relationship between TEM and GRD is not known.

GRD is approximately parallel to other north–striking faults along range fronts in the area. These fault include the northern part of the Penoyer fault (PEN), which bounds the western side of the Worthington Mountains west of GRD, the Freiburg fault (FR) along the eastern side of the Worthington Mountains northwest of GRD, and the Golden Gate fault (GG) along the eastern side of the Golden Gate Range northeast of GRD. The structural relationships among these faults are not known.

General Thomas Hills fault (GTH)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 1; show only that part of GTH along the General Thomas Hills); Y-853: Dohrenwend and others, 1992. Not shown by Albers and Stewart, 1972 (Y-407).

Location: 137 km/320° (distance and direction of closest point from YM) at lat 37°47′N. and long 117°25′W. (location of closest point). GTH is located along the eastern sides of the General Thomas Hills and Paymaster Ridge at their junction with the valley surrounding Alkali Lake.

USGS 7-1/2′ quadrangle: Klondike, Paymaster Canyon, Paymaster Ridge.

Fault orientation: GTH has a curving strike that is north–northwest on the south along Paymaster Ridge and northeast on the north along the General Thomas Hills (Y-238; Y-853).

Fault length: The length of GTH is 11 km as estimated from Y-238 and 26 km as estimated from Y-853. This difference in length results because the map by Y-238 shows only that part of GTH along the General Thomas Hills.

Style of faulting: No information.

Scarp characteristics: Scarps along GTH are shown by Y-238 as primarily southeast–facing. A few scarps are portrayed by Y-238 and Y-853 as northwest–facing.

Displacement: No information.

Age of displacement: GTH is shown by Y-853 as scarps on Quaternary depositional or erosion surfaces. Most of GTH is portrayed by Y-238 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits. Two sections of GTH are shown by Y-238 as faults that are in Quaternary deposits and that were identified from previous mapping. However, Y-10 (p. 60) noted that "[f]aults along the General Thomas Hills appear inactive."

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: GTH along the eastern side of Paymaster Ridge is portrayed by Y-853 as faults juxtaposing Quaternary alluvium against bedrock and adjacent to a range front that is characterized by "fault scarps and lineaments on surficial deposits along or immediately adjacent to the range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." GTH is associated with a range front that is less extensive and fault scarps that are lower, shorter, and less continuous than those along a major range–front fault (Y-853).

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: GTH is approximately parallel to other north– and northeast–striking major range–bounding faults west of Cactus Flat. These faults include the Emigrant Peak faults (EPK) along the western side of the Silver Peak Range west of GTH, the Montezuma Range fault (MR) along the western side of the Montezuma Range south of GTH, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges immediately west of GTH, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain south of GTH, and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains south of GTH (Y-10, p. 57; Y-238; Y-853).

General Thomas Hills fault (GTH) — Continued

GTH is also approximately parallel to northeast–striking faults within basins in the area. These faults include the Lone Mountain fault (LMT) in Big Smoky Valley west of GTH, the Stonewall Flat fault (SWF) within Stonewall Flat southeast of GTH, the Palmetto Mountains–Jackson Wash fault (PMJW) in the valley northeast of the Palmetto Mountains south of GTH, the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and the Montezuma Range immediately south of GTH, and the Clayton Valley fault (CV) in Clayton Valley southwest of GTH (Y-10, p. 57; Y-238; Y-853). GTH along the General Thomas Hills is similar to other faults within basins in the area in that the fault traces composing GTH are short and apparently displace surfaces of only one age (Y-10, p. 58). Unlike other intrabasin faults, fault traces within GTH primarily exhibit down–to–the–southeast displacement (similar to traces in LV along the southeastern side of the Palmetto Mountains) instead of down–to–the–northwest displacement. The structural relationships among all these faults are not known.

Y-238 (p. 3) speculated that northeast–striking faults in the area around GTH could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred that the faults could be rooted in a detachment fault at depth.

Ghost Dance fault (GD)

Plate or figure: Figure 3.

References: Y-26: Swadley and others, 1984 (their Fault F, which includes both the Ghost Dance fault and the Abandoned Wash fault of Y-55 and Y-1042); Y-46: Maldonado, 1985; Y-55: Scott and Bonk, 1984 (name from their pl. 1; they portrayed GD and the Abandoned Wash fault as nearly continuous structures; they included only the northern half of the Abandoned Wash fault as shown by Y-1042); Y-182: Carr, 1984; Y-189: Lipman and McKay, 1965; Y-224: Frizzell and Shulters, 1990; Y-238: Reheis and Noller, 1991 (pl. 3; They showed only an unnamed fault along the western side of Middle Crest. This unnamed fault was interpreted by Y-1042 as one of several traces of GD south of Dune Wash.); Y-396: Scott, 1990; Y-1042: O'Neill and others, 1992 (show GD as a single trace north of Dune Wash and as several traces south of Dune Wash); Y-1201: Ramelli and others, 1991 (their Ghostdance fault); Y-1227: Ramelli and others, 1989; Y-1230: Bell and others, 1990; Y-1239: Wesling and others, 1992 (continued GD north of Drill Hole Wash to Azreal Ridge).

Location: 0 km (distance of closest point from YM) at lat 36°50'N. and long 116°27'W. (location of closest point). GD is located along the eastern side of Yucca Crest between at least Drill Hole Wash (Y-1042, p. 6) or Azreal Ridge (Y-1239, p. 45) on the north and an unnamed ridge south of Whale Back Ridge (Y-1042, pl. 1; Y-1239, p. 45) on the south. Y-1042 (p. 6-7) suggested that GD splits into several traces on the south: an unnamed fault trace along the western side of Middle Crest, the Abandoned Wash fault (AW) between Yucca Crest and Middle Crest, an unnamed fault trace along the western side of East Crest, and two parallel fault traces along the eastern side of East Crest.

USGS 7-1/2' quadrangle: Busted Butte.

Fault orientation: The single trace of GD north of Dune Wash strikes north (Y-26, pl. 1; Y-55, pl. 1; Y-1042, pl. 1). For the splays south of Dune Wash, the unnamed fault on the western side of Middle Crest generally strikes north–northwest (Y-1042, pl. 1). AW has a curving strike that is north–northwest on the south and north–northeast on the north (Y-26, pl. 1; Y-1042, pl. 1). The unnamed fault traces along the eastern and western sides of East Crest strike north–northwest (Y-1042, pl. 1).

Y-55 (pl. 1) noted dips on GD of 84° W. and 89° W. Y-396 (p. 259) reported a dip of 77° W. for GD, where the fault is exposed at the ground surface. He (Y-396, p. 50) interpreted a dip of 50° W. for this same fault trace on the basis of a shear zone exposed in a drill hole that was located about 0.4 km west of the surface expression of GD. South of Whale Back Ridge just north of where GD strikes north–northeast as portrayed by Y-55 (pl. 1), they noted a dip of 86° E. for GD. Y-55 (pl. 1) indicated that AW dips 75° W. to 76° W.

Fault length: The following lengths for the various traces of GD have been estimated from Y-1042 (pl. 1). The trace of GD north of Dune Wash is 2.5 km long. The unnamed fault trace along the western side of Middle Crest is 6.5 km long. AW is 3.5 km long. The unnamed fault trace along the western side of East Crest is 3.5 km long. The two unnamed fault traces along the eastern side of East Crest are 2 and 3.5 km long.

Fault F of Y-26, which includes GD and AW of Y-1042, is 9 km long as estimated from Y-26 (pl. 1). The lengths of GD and AW are estimated as 3 km each, using Y-55 (pl. 1).

Style of faulting: Displacement on GD is shown as normal and down to the west by Y-26 (pl. 1), Y-55 (pl. 1), and Y-189. Y-1239 (p. 45) noted that disrupted marker horizons indicate that displacement on GD has been down to the west.

Scarp height: No information.

Displacement: Y-396 (p. 259) reported >25 m of displacement on a fault trace that he noted to be a southern extension of GD.

Ghost Dance fault (GD) — Continued

Age of displacement: Y-1201 (p. 1-63) stated that GD "transects the repository site and may have Quaternary movement." Y-1227 (p. [6]) noted a lack of evidence for Quaternary displacement on GD, but concluded that GD is structurally connected to other faults in the Yucca Mountain area that have evidence for Quaternary rupture, so that "the possibility of future displacement [on GD] cannot be dismissed." Y-1230 (p. [3]), summarizing prior work, reiterated the lack of evidence for Quaternary displacement on GD, but implied that this may be because of a lack of middle to early Quaternary deposits in association with the fault.

Y-26 (p. 14) discussed one trench (Trench 4) across GD and two others (Trenches 6 and 9) across AW as mapped by Y-55 and Y-1042 (Fault F of Y-26). These trenches were dug across projections of fault traces that had been mapped in Tertiary volcanic rocks (Y-26, table 1, p. 5, 25, 26, 28). Y-26 (p. 14) recognized no tectonic features in any of these trenches. In Trench 4 (across GD) and Trench 6 (across AW), Y-26 interpreted Holocene alluvium (their Q1c deposits with an estimated age of 7 ka to 9 ka; fig. 3, p. 9) as overlying projections of the two fault traces. Thus, they (Y-26, table 1, p. 5) concluded that no displacements had occurred on either GD or AW since at least 7 ka.

Trench 9 was dug across a north–northeast–striking continuation of AW as shown by Y-26 (pl. 1) and by Y-55 (pl. 1), but not as shown by Y-1042 (pl. 1). By interpreting deposits exposed in this trench, Y-26 (table 1, p. 5) noted that middle Pleistocene alluvium (their Q2c deposits with an estimated age of 270 ka to 800 ka; fig. 3, p. 9) overlies the fault's projection. Thus, Y-26 (table 1, p. 5) concluded that no fault displacement had occurred on this part of AW since at least 270 ka.

Y-1042 (p. 6) noted that, although GD is readily visible on the ground, it is less obvious on aerial photographs (they used 1:12,000–scale photographs). They did report some linear topographic features that cut across the east–trending ridges of Tertiary volcanic rocks east of Yucca Crest (Y-1042, p. 6). In contrast, Y-1239 (p. 45) reported "well–expressed," north–trending lineaments that correspond to GD as mapped by Y-55 (pl 1; north of about Whale Back Ridge) and interpreted these lineaments (which include tonal contrasts, linear drainages, bedrock scarps, topographic saddles, and displaced units) as the surface expression of GD (they used 1:60,000–scale photographs). Y-1042 (p. 6) noted surficial expression of the multiple traces of GD south of Dune Wash. They reported that the southern end of the unnamed fault trace along the western side of Middle Crest is marked by small scarps and that the northern end of this trace is marked by topographic lineaments and tonal contrasts. They also recognized that AW is delineated by pronounced topographic lineaments, that the unnamed fault trace along the western side of East Crest is delineated on the south by small, west–facing scarps and on the north by fractures in Tertiary volcanic rocks, and that the two parallel fault traces along the eastern side of East Crest are delineated by topographic lineaments, tonal contrasts, minor fractures, and displaced Tertiary volcanic rocks (Y-1042, p. 6). It is not clear that any of these lineaments cross Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished information (Y-26, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000) and conventional aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-1239, p. 3, scales 1:6,000, 1:12,000, and 1:60,000). Mapping of surficial deposits and field investigations in Midway Valley (Y-1239, p. 3). Trenches (4, 6, and 9, which are summarized in Y-26, table 1, p. 5, 25–26, 28).

Relationship to other faults: Y-1042 (p. 10) concluded that GD is a minor structure compared to the other north–striking faults in the Yucca Mountain area. Y-396 (p. 259) interpreted the flattening of dip of GD with depth as indicating that GD has a listric geometry.

Gold Flat fault (GOL)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pls. 1 and 2). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 62 km/345° (distance and direction of closest point from YM) at lat 37°23′N. and long 116°38′W. (location of closest point). GOL is located along the northwestern side of Gold Flat.

USGS 7-1/2′ quadrangle: Gold Flat West, Mount Helen, Triangle Mountain.

Fault orientation: GOL strikes primarily northeast (Y-813). A few fault traces of GOL strike north–northwest (Y-813).

Fault length: GOL is about 16 km long as estimated from Y-813. The lengths of individual fault traces range between 0.5 and 4 km as estimated from Y-813.

Style of faulting: No information.

Scarp characteristics: Scarps along GOL are shown by Y-813 as primarily west–facing or northwest–facing.

Displacement: No information.

Age of displacement: Most fault traces of GOL are portrayed by Y-813 as weakly and moderately expressed lineaments or scarps on surfaces of Quaternary deposits. A couple of traces are shown by Y-813 as moderately expressed lineaments or scarps on surfaces of Tertiary deposits.

Y-813 (p. 9) suggested that faults in Gold Flat have been relatively quiescent during the Quaternary and Tertiary, similar to faults in Sarcobatus Flat southwest of GOL, to faults along the Cactus Range northwest of GOL, and to faults at greater distances in Las Vegas Valley and along the Spring Mountains.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with GOL.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: The traces of GOL that strike north–northwest could be a southern extension of north–northwest–striking faults along the Lizard Hills, Gold Mountain, Triangle Mountain, Gabbard Hills, and Trappman Hills as shown by Y-813 (part of the Cactus Flat–Mellan fault (CFML) on pl. 1 of this compilation).

Gold Mountain fault (GOM)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 2); Y-407: Albers and Stewart, 1972; Y-853: Dohrenwend and others, 1992.

Location: 90 km/303° (distance and direction of closest point from YM) at lat 37°18′N. and long 117°17′W. (location of closest point). GOM is located along the northern side of Gold Mountain at its junction with the valley of Oriental Wash.

USGS 7-1/2′ quadrangle: Gold Mountain, Gold Point, Gold Point SW, West of Gold Mountain.

Fault orientation: GOM strikes generally east–northeast, but GOM curves so that portions strike northeast (Y-238; Y-853).

Fault length: The length of GOM is 17 km as estimated from Y-853 and 18 km as estimated from Y-238.

Style of faulting: No information.

Scarp characteristics: Scarps along GOM are shown by both Y-238 and Y-853 as north–facing.

Displacement: No information.

Age of displacement: GOM is portrayed by Y-853 as scarps on depositional and erosional surfaces with ages of late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) and early to middle and (or) late Pleistocene (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). GOM is shown by Y-238 as weakly expressed to prominent lineaments and scarps chiefly on surfaces of Quaternary deposits and as prominent lineaments and scarps on surfaces of Tertiary deposits. Short sections of the western end of GOM are portrayed by Y-407 as faults in Tertiary volcanic tuff with an age of about 11 Ma.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: GOM is shown by Y-853 as juxtaposing Quaternary alluvium against bedrock, and the northern side of Gold Mountain, which is adjacent to GOM, is a range front that is characterized by "fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to the range front." These characteristics are similar to those along major range–bounding faults except that GOM is less extensive and fault scarps are substantially lower, shorter, and less continuous that those along a major range–front fault (Y-853).

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 and 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: A 1.5–km–long fault trace at the western end of GOM and immediately south of GOM is portrayed by Y-238 as striking nearly north, approximately parallel to lineaments and scarps that are on Quaternary surfaces along the eastern side of Death Valley south of GOM (pl. 1). This fault trace is also nearly parallel to a north–northeast–striking fault mapped by Y-238 in Quaternary deposits at the western end of Slate Ridge (the Tule Canyon fault (TLC) of this compilation). TLC extends northward from the lineaments and scarps along the eastern side of Death Valley. The structural relationships among these faults are unknown.

GOM has a slightly more northerly strike than east–striking faults along Slate Ridge (the Slate Ridge faults; SLR). It is not known if GOM and SLR intersect or merge.

Gold Mountain fault (GOM) — Continued

GOM (except for the western 1.5 km as mapped by Y-238) has a slightly more easterly strike than north–northeast– and northeast–striking faults along range fronts that predominate west of Cactus Flat. These north–northeast–striking and northeast–striking faults include the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain northwest of GOM, the Montezuma Range fault (MR) along the western side of the Montezuma Range north of GOM, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges northwest of GOM, and the Grapevine Mountains fault (GM) along the western side of the Grapevine Mountains southeast of GOM.

GOM also has a slightly more easterly strike than north–northeast– and northeast–striking faults within basins in the area around GOM. These faults include the Stonewall Flat fault (SWF) within Stonewall Flat northeast of GOM, the Palmetto Mountains–Jackson Wash fault (PMJW) in the valley northeast of Palmetto Mountains north of GOM, the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and the Montezuma Range northwest of GOM, and the Clayton Valley fault (CV) in Clayton Valley also northwest of GOM (Y-238; Y-853). The structural relationships among these faults are unknown.

Golden Gate faults (GG)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show only the fault within Coal Valley); Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3; name from their pl. 3 for the fault along the range front); Y-1032: Schell, 1981 (pl. 9; shows only the faults within the Golden Gate Range).

Location: 144 km/40° (distance and direction of closest point from YM) at lat 37°50'N. and long 115°24'W. (location of closest point). GG includes faults at three locations: (1) a fault along the eastern side of the Golden Gate Range at its junction with Coal Valley, (2) several faults within the Golden Gate Range, and (3) a fault in Coal Valley 1.5 to 4 km east of the Golden Gate Range.

USGS 7-1/2' quadrangle: Coal Valley Reservoir, Murphy Gap, Murphy Gap NW, Murphy Gap SE.

Fault orientation: The fault along the Golden Gate Range front curves, but has a general north–northeast strike (Y-404). The faults within the Golden Gate Range include two that strike north–northeast and parallel the range front and three that strike northeast (Y-404; Y-1032). The fault in Coal Valley strikes northeast, slightly more eastward than does the fault along the range front (Y-25; Y-404).

Fault length: The length of the fault along the Golden Gate range front is 23 km as estimated from Y-25 and about 24 km as estimated from Y-404 (pl. 3). However, this fault extends to the northern edge of both of their map areas at lat 38°N., so that these lengths are minimum values.

The faults in the Golden Gate Range are 3 to 5 km long as estimated from Y-404 (pl. 3).

The part of the fault in Coal Valley that is south of lat 38°N. (shown on pl. 1 of this compilation) is 6 to 8 km long as estimated from Y-404 (pls. 2 and 3). The maps of Y-404 (pls. 2 and 3) show an additional fault trace in Coal Valley north of lat 38°N. (not shown on pl. 1). This trace is about 6.5 km long. The total length of the fault in Coal Valley could be about 23 km if both of these traces are combined (includes a gap in surficial expression between the traces).

Style of faulting: Displacement on the fault along the Golden Gate Range front is shown by Y-25 and Y-404 as down to the east; displacement on the fault in Coal Valley is shown as down to the southeast. Displacements on the faults within the Golden Gate Range are shown by Y-404 and Y-1032 as both down to the southeast and down to the northwest.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Y-404 (pl. 3) portrayed the fault along the Golden Gate Range front as a post–Laramide structure. They (pl. 3) indicated that this fault is either inferred in or concealed by Quaternary and Tertiary gravel, alluvium, and undeformed lake beds (their QT deposits). The geologic map by Y-404 (pl. 2) does not include this fault, which implies that the fault along the range is concealed by older Pleistocene alluvium (their Qol deposits).

The probable age of youngest displacement on the faults within the Golden Gate Range is noted by Y-1032 (pl. 9) as indeterminate, but suspected of being Quaternary. Y-1032 (pl. 9) reported prominent scarps, but he could not determine their age because he found that young stratigraphic units are not present along the faults. These faults are shown by Y-404 (pl. 3) as post–Laramide structures.

The fault in Coal Valley is shown by Y-404 as a probable or inferred fault in Pleistocene(?) younger lake beds (their Ql deposits). This fault is noted by Y-404 (p. 85) to be one of the youngest normal faults in Lincoln County, because it cuts Pliocene and early Quaternary valley fill. Y-404 (pl. 3) portrayed this fault as a post–Laramide structure.

Slip rate: No information.

Recurrence interval: No information.

Golden Gate faults (GG) — Continued

Range-front characteristics: The eastern side of the Golden Gate Range is noted to be steep by Y-404 (p. 95), and it appears to be relatively linear on the 1:250,000–scale topographic map. No range front is associated with the fault in Coal Valley or with those within the Golden Gate Range.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: The structural relationships among the faults of GG are not known. These faults have been arbitrarily grouped into GG.

Drainages in Garden Valley west of the Golden Gate Range flow through the range at four places and empty into the Coal Valley playa east of the range (Y-404, p. 95). It is not known if this drainage pattern developed as a result of displacement on any of the faults included in GG.

Grapevine fault (GV)

Plate or figure: Plates 1 and 2.

References: Y-236: Reynolds, 1969 (his Grapevine fault zone); Y-239: Reheis, 1991 (pl. 1); Y-390: Hunt and Mabey, 1966; Y-755: Reynolds, 1976; Y-917: Mabey, 1963. Not shown by Hart and others (1989; Y-427).

Location: 58 km/260° (distance and direction of closest point from YM) at lat 36°46′N. and long 117°05′W. (location of closest point). GV is located along the southwestern side of the Grapevine Mountains and along the northeastern side of Death Valley between about Titanothere Canyon on the south and north of Red Wall Canyon on the north.

USGS 7-1/2′ quadrangle: Fall Canyon, Thimble Peak.

Fault orientation: GV has a curving, generally northwest strike. Y-236 (p. 224) noted that individual fault traces strike N. 30° W. to N. 35° W., which is parallel to the front of the Grapevine Mountains and nearly parallel to the Furnace Creek fault (FC), located about 3 km southwest of GV in the central part of northern Death Valley.

Fault length: The total length of GV between Titanothere Canyon and north of Red Wall Canyon is 20 km as estimated from Y-239 (pl. 1). Y-755 (p. 21) reported that alluvium adjacent to the Grapevine Mountains is not faulted south of Titanothere Canyon to at least Boundary Canyon, but that the alluvium in this area is locally warped. The length of this section is about 10 km, so that the total length of GV could be close to 30 km.

Style of faulting: Although Y-236 (p. 227) concluded that displacement on GV occurred primarily on a single fault trace, he noted that GV does include many closely spaced, northwest–striking fault traces and that total displacement is likely cumulative across these. Displacement on these traces is dominantly dip slip (normal) and down to the southwest. Evidence for horizontal displacement on GV is rare. Horizontal slickensides were observed by Y-236 (p. 227) on fault surfaces at two localities.

The main trace of GV is dominantly west–dipping; traces thought to be antithetic to the main trace are east–dipping (Y-236, p. 224, 226).

Scarp characteristics: Y-755 (p. 24) reported that fault scarps slope 44° to 75° toward Death Valley (to the southwest) and that antithetic fault scarps slope into the Grapevine Mountains (to the northeast).

Displacement: Y-236 (p. 228) reported that the total vertical separation on GV could be at least 4,270 m (14,000 ft). This estimate assumes that the oldest Cenozoic rocks on the hanging wall in Death Valley are correlative with the Titus Canyon Formation, which is now at elevations >1,220 m (>4,000 ft) in the Grapevine Mountains on the footwall. He (Y-236, p. 234) suggested that displacement is greatest at the southern end of GV, where the vertical separation is reported to be up to 427 m (1,400 ft) by Y-236 (p. 227), and decreases northwestward toward Red Wall Canyon. Y-755 (p. 24) suggested that warping has accounted for a substantial portion of the structural relief along the front of the Grapevine Mountains. Likewise, Y-236 (p. 228) concluded that folding along the range front and at the edge of Death Valley accounts for some of the displacement across GV. According to Y-755, (p. 24) and Y-917, the vertical separation on a pre–Tertiary surface between Death Valley and the Grapevine Mountains may be at least 4.3 km (down to the west), an estimate that is based on the distribution of Tertiary rocks in the southern part of the Grapevine Mountains along with gravity data. Y-755 (p. 24) concluded that the apparent vertical separation on GV diminishes north of Fall Canyon, where right–lateral displacement becomes more important on faults within the Grapevine Mountains. Y-236 (p. 226) noted that displacements on small faults vary between a few meters to about 76 m (a few feet to 250 ft).

Y-236 (p. 227, 232) noted that evidence of horizontal displacement is rare and has apparently been insignificant. He (Y-236, p. 227) reported a demonstrable horizontal separation on GV of at most about 2 m (8 ft). This value is based on slickensides observed on fault surfaces at two localities.

Grapevine fault (GV) — Continued

Age of displacement: Y-239 (pl. 1) interpreted part of GV as moderate to prominent lineaments or scarps on surfaces of Quaternary deposits. Y-755 (p. 21) inferred recurrent Quaternary displacement on different sections of GV between Titanothere and Red Wall canyons, because Quaternary alluvium that was subdivided into at least four different age groups by Y-390 and Y-236 is faulted against the range front at some localities and deposited against fault scarps at other localities.

Y-236 (p. 231) concluded that displacement on GV, especially on the fault's southern end, occurred primarily during the late Pliocene and early Pleistocene, but has recurred throughout the Quaternary. He based this conclusion on (1) the steepness of the front of the Grapevine Mountains; (2) the small size of the alluvial fans on the eastern side of Death Valley compared to the size of those on the western side; (3) the possible Pliocene gravels that overlap Cambrian rocks along the range front, which suggests pre–Pliocene(?) displacement on GV, but that are tilted by post–Pliocene displacement on GV; (4) the Pleistocene and Holocene alluvial deposits that are faulted against older rocks along GV south of Titus Canyon; and (5) the location of Pleistocene and Holocene playa sediments against the front of the Grapevine Mountains (Y-236, p. 230-231). Y-755 (p. 21) also noted the eastward migration of playa sediments toward the Grapevine Mountains, which he concluded was the result of the eastward tilt of Death Valley by displacement on GV.

North of Red Wall Canyon, rocks of possible Pliocene age are noted by Y-236 (p. 234) to overlie GV. Y-755 (p. 21) reported that alluvium adjacent to the Grapevine Mountains south of Titanothere Canyon is not displaced by GV although this alluvium is warped.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Part of GV is shown by Y-239 (pl. 1) as a topographic lineament bounding the front of the Grapevine Mountains.

Analysis: Compilation of geologic mapping (Y-755, p. 19). Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000). Field examination (Y-236). Field mapping (Y-755, p. 19). Analyses of gravity data (Y-917).

Relationship to other faults: GV is located about 3 km northeast of the northwest–striking, chiefly right–lateral strike–slip Furnace Creek fault (FC) in the central part of northern Death Valley. Y-755 (p. 21) reported that Death Valley between Titus and Titanothere canyons (adjacent to the southern part of GV) appears to have been tilted downward to the east toward the Grapevine Mountains. Several north– to north–northwest–striking fault traces have been mapped by Y-239 (pl. 1) on surfaces of Quaternary deposits in Death Valley between GV and FC. GV may continue to the northwest along the same strike into the Grapevine Mountains or the fault may step westward and join FC (Y-239, pl. 1). The exact structural relationship between GV and FC has not been determined.

Y-236 (p. 224) concluded that GV "is superimposed across [an] older fold system and appears to truncate [a] set of north–south–[striking] Cenozoic faults characteristic of the" northeastern Grapevine Mountains. He (Y-236, p. 231) also suggested that GV is a "structural hinge" between Death Valley to the west and the Grapevine Mountains to the east. He (p. 232) noted that displacement along GV may "represent surficial failure under gravity in response to arching which accompanied uplift of the mountain block relative to the Death Valley block," which is described below.

Grapevine fault (GV) — Continued

Y-236 (p. 233-234) proposed that GV bounds the eastern side of a triangular block (Death Valley) that is bounded on the south by an east–northeast–striking fault mapped by Y-390 (the Towne Pass fault (TP) of this compilation) and on the west by a fault along the western side of the Cottonwood Mountains (unnamed in this compilation). The triangular block is lowest both structurally and topographically at its southern end, where Death Valley is the widest, and slopes upward to the north, where Death Valley is the narrowest (Y-236, p. 234). Y-236 (p. 234) further proposed that strike–slip displacement on FC, in combination with northeast–southwest–directed regional compression, has resulted in normal displacement along GV and on the other two faults bounding the Death Valley block. Furthermore, the normal displacement on these three faults has resulted in the triangular–shaped valley as a pull–apart basin (Y-236, p. 235-236).

GV is located about 15 km northwest of the Keane Wonder fault (KW) that has a strike and sense of displacement similar to those of GV. Several northwest–trending, down–to–the–northeast (uphill–facing) lineaments and scarps are preserved between GV and KW near Mud Canyon as reported by Y-239 and by Reheis and Noller (1991, Y-238, pl. 3). The exact structural relationship between GV and KW has not yet been determined.

Grapevine Mountains fault (GM)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 2); Y-239: Reheis, 1991 (pl. 1); Y-407: Albers and Stewart, 1972; Y-853: Dohrenwend and others, 1992.

Location: 67 km/294° (distance and direction of closest point from YM for the southern trace) at lat 37°06′N. and long 117°07′W. (location of closest point); 70 km/295° (distance and direction of closest point from YM for the northern trace) at lat 37°07′N. and long 117°09′W. (location of closest point). GM includes two main traces along the northwestern end of the Grapevine Mountains at their junction with Grapevine Canyon.

USGS 7-1/2′ quadrangle: Bonnie Claire Lake, Bonnie Claire SW, Grapevine Peak, Scottys Castle.

Fault orientation: The southern trace of GM strikes north–northeast on its southern end and northeast on its northern end (Y-238; Y-239). The northern trace of GM strikes northeast (Y-238).

Fault length: The length of the southern trace of GM is approximately 9 km as estimated from Y-853 and 23 km as estimated from Y-238 and Y-239. The length of the northern trace of GM is approximately 13 km as estimated from Y-853 and 21 km as estimated from Y-238.

Style of faulting: Displacement on both traces of GM is shown by Y-238, Y-239, and Y-853 as dip slip (normal?) and down to the west. Displacement on a 1.5–km–long section at the eastern end of the northern trace is shown by Y-238 as down to the east.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Portions of both the southern and northern traces of GM are shown by Y-853 as faults that juxtapose Quaternary alluvium against bedrock. Quaternary displacement is also implied by Y-238 and Y-239, because they show most of both traces as topographic lineaments (subtle to prominent) on surfaces of Quaternary deposits. Short sections of both traces are indicated by Y-238 and Y-239 to be lineaments or scarps on surfaces of Tertiary deposits.

Portions of the northern trace of GM are portrayed by Y-853 as scarps on depositional or erosional surfaces with ages of early to middle Pleistocene (their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma) and possibly late Pleistocene (their Q_2? surfaces with estimated ages between 10 ka and 130 ka).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The Grapevine Mountains along portions of both the southern and northern traces are shown by Y-853 to have characteristics (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, subparallel systems of high–gradient, narrow, steep–sided canyon perpendicular to range front) similar to those along major range–front faults, except that the portions of GM are less extensive, and scarps are lower, shorter, and less continuous.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-239, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Grapevine Mountains fault (GM) — Continued

Relationship to other faults: GM is one of several northeast–striking faults that bound the northwestern and southeastern sides of ranges in the area. These faults include the Bonnie Claire fault (BC) along the hills west of Bonnie Claire Flat immediately northwest of GM, the East Magruder Mountain fault (EMM) along the southeastern side of Magruder Mountain northwest of GM, and the Lida Valley faults (LV) along the northwestern side of Magruder Mountain and along the southeastern side of part of the Palmetto Mountains also northwest of GM (Y-238, p. 4). Y-10 (p. 59) and Y-238 (p. 4) both speculated that the northeast–striking faults in this area could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternately, Y-10 (p. 59) and Y-238 (p. 4) suggested that these northeast–striking faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding faults east of FC and west of Pahute Mesa, Y-10 (p. 60) inferred that these faults could be rooted in a detachment fault at depth.

Groom Range Central fault (GRC)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show only the northern two traces); Y-813: Reheis, 1992 (pls. 1 and 2). Not shown by Tschanz and Pampeyan, 1970 (Y-404).

Location: 82 km/47° (distance and direction of closest point from YM) at lat 37°20′N. and long 115°46′W. (location of closest point). GRC includes three main, left–stepping traces within the Groom Range.

USGS 7-1/2′ quadrangle: Cattle Spring, Groom Mine, Groom Range, Groom Range SW, White Blotch Springs SE.

Fault orientation: Traces in GRC strike generally north to north–northeast, but the traces curve so that some sections strike north–northwest (Y-813). The left–stepping pattern results in a general north–northwest strike for the entire fault.

Fault length: The total length for GRC is 31 km as estimated from Y-813. The lengths of the northern and central traces are 9 km each; the length of the southern trace is 13 km as estimated from Y-813.

Style of faulting: Displacement on the northern and central traces is shown by Y-25 and Y-813 as down to the west.

Scarp characteristics: Parts of the northern and central traces are expressed as west–facing scarps (Y-25; Y-813). The southern trace is expressed as east–facing scarps (Y-813).

Displacement: Y-25 suggested that a fault (the central trace of GRC) that cuts the western side of the Bald Mountain caldera has had large displacement of an unspecified amount.

Age of displacement: GRC is portrayed by Y-813 as weakly expressed lineaments and scarps on surfaces of Quaternary deposits (the central trace and short sections of the northern trace), as faults that are in Tertiary deposits and that were identified from previous mapping (chiefly the central trace and also the southern end of the northern trace), and as weakly expressed to prominent lineaments and scarps on surfaces of Tertiary deposits (the entire southern trace and one short section of the northern trace). The map by Y-25 shows parts of the northern and central traces as faulted contacts between Holocene and Pliocene alluvium and colluvium (their QTa deposits) and either Miocene ash–flow tuff or pre–Tertiary sedimentary rocks.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Most of the northern trace of GRC is portrayed by Y-813 as a lineament along a linear range front.

Analysis: Aerial photographs (Y-25; Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: GRC is approximately parallel to faults that bound the western and eastern sides of the Groom Range (the Stumble fault (STM) and the Groom Range East fault (GRE), respectively). GRC is also parallel to faults that bound the western side of the Jumbled Hills southeast of the Groom Range (the Jumbled Hills fault (JUM) of this compilation).

GRC may intersect the northeast–striking Tem Piute fault (TEM) along the northern side of the Timpahute Range or the east–northeast–striking portion of the Penoyer fault (PEN) along the southeastern side of Sand Spring Valley.

GRC does not coincide with a fault that was mapped by Y-404 (pls. 2 and 3) and that they called the Main fault. GRC as mapped by Y-813 does coincide in part with faults shown by Y-25. The parts that are coincident are the northern and central traces of GRC and the northern end of the southern trace of GRC.

Groom Range Central fault (GRC) — Continued

Mapping by Y-25 suggests that the central trace and the northern end of the southern trace of GRC bound, in part, the Bald Mountain caldera. The relationship between the volcanic center and displacement on these traces of GRC is not known. However, Y-25 inferred, on the basis of stratigraphic relationships among volcanic units, that dip–slip displacement occurred along these traces after the volcanic center was active.

Groom Range East fault (GRE)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show only part of GRE as portrayed by Y-813); Y-813: Reheis, 1992 (pl. 2); Y-1109: Ekren and others, 1974. Not shown by Tschanz and Pampeyan, 1970 (Y-404).

Location: 85 km/49° (distance and direction of closest point from YM) at lat 37°20′N. and long 115°44′W. (location of closest point). GRE is located along the eastern side of the Groom Range and Bald Mountain.

USGS 7-1/2′ quadrangle: Groom Range, Groom Range SW.

Fault orientation: GRE curves, but strikes generally north–northeast (Y-813). The northern end of the fault strikes north–northwest (Y-813).

Fault length: GRE has a length of about 20 km as estimated from Y-813.

Style of faulting: Portions of GRE are shown by Y-813 as down–to–the–east fault traces.

Scarp characteristics: Portions of GRE are shown by Y-813 as east–facing scarps.

Displacement: No information.

Age of displacement: GRE is shown by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Tertiary deposits, or as faults that are in Tertiary deposits and that were identified from previous mapping. The map of Y-25 shows GRE as displacing Miocene volcanic units (their Ta3 and Tt3 units), and as concealed by Holocene to Pliocene alluvium and colluvium (their QTa deposits). The northern end of GRE is portrayed by Y-813 as concealed by a Quaternary landslide deposit.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Portions of GRE are shown by Y-813 as lineaments along a linear range front.

Analysis: Aerial photographs (Y-25; Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: GRE is approximately parallel to faults along the western side of and within the Groom Range (the Stumble fault (STM) and the Groom Range Central fault (GRC), respectively). GRE is also nearly parallel to the fault along the western side of the Jumbled Hills southeast of the Groom Range (the Jumbled Hills fault (JUM) of this compilation). Although no Quaternary displacement has been reported along GRE, the fault is included in this compilation because of its similar trend and close geographic association with these other faults for which Quaternary displacement has been noted.

Y-25 (*citing* Y-1109) attributed the absence of tuff from the Bald Mountain caldera in the area east of the Groom Range in part to a left–lateral strike–slip fault that was present before Basin–and–Range displacement. Y-25 noted that this fault probably projects into Tikaboo Valley. The proposed fault apparently does not coincide with GRE as mapped by Y-813. A north–northwest–striking fault shown by Y-25 along the eastern side of Bald Mountain correlates only in part with GRE as mapped by Y-813. One short section of a fault south of Bald Mountain as portrayed by Y-25 also coincides with GRE as mapped by Y-813.

Hidden Valley–Sand Flat faults (HVSF)

Plate or figure: Plate 2.

References: Y-239: Reheis, 1991 (pl. 1). Not shown by Streitz and Stinson, 1974 (Y-222).

Location: 87 km/256° (distance and direction of closest point from YM) at lat 36°39′N. and long 117°24′W. (location of closest point). HVSF includes five main faults that bound Hidden Valley, Ulida Flat, and Sand Flat in the Panamint Range north of Hunter Mountain: (1) a fault along the eastern sides of Hidden Valley and Ulida Flat, (2) a fault along the southern sides of Ulida Flat and Sand Flat, (3) a fault along the southeastern side of Sand Flat, (4) a fault along the northeastern side of Sand Flat, and (5) a fault along the western side of Ulida Flat.

USGS 7-1/2′ quadrangle: Harris Well, Jackass Canyon, Sand Flat, Ubehebe Peak.

Fault orientation: Variable (Y-239, pl. 1). The fault along the eastern sides of Hidden Valley and Ulida Flat, the fault along the southeastern side of Sand Flat, and the fault along the western side of Ulida Flat all strike approximately north to north–northeast. The fault along the southern sides of Ulida and Sand flats and the fault along the northeastern side of Sand Flat both strike approximately northwest.

Fault length: Variable. The following lengths were estimated from Y-239 (pl. 1). (1) The fault along the eastern sides of Hidden Valley and Ulida Flat is about 12 km long. This fault is composed of two traces: a northern one along the eastern side of Hidden Valley is 6.5 km long and a southern one along the eastern side of Ulida Flat is 3.5 km long. The two traces may be connected by a northeast–striking trace about 1.5 km long. (2) The fault along the southern sides of Ulida and Sand flats is 9 km long. (3) The fault along the southeastern side of Sand Flat has a length of about 10 km. This fault is composed of two traces that are separated by a right step. The northern trace is about 5.5 km long; the southern trace is about 4 km long. (4) The fault along the northeastern side of Sand Flat is 7.5 km long. (5) The fault along the western side of Ulida Valley is 3 km long.

Two additional faults extend north of Sand Flat toward White Top Mountain. The eastern fault is 13 km long; the western one is 7.5 km long. It is not clear how these faults relate to faults in HVSF. For example, the eastern fault could be a northern extension of the fault along the southeastern side of Sand Flat. These two faults may be separated by a left step along the fault along the northeastern side of Sand Flat.

Style of faulting: Displacement on portions of the fault along the eastern sides of Hidden Valley and Ulida Flat and on portions of the fault along the southeastern side of Sand Flat are shown by Y-239 as down to the west. Displacement on the fault along the southern sides of Ulida Flat and Sand Flat is portrayed by Y-239 as down to the northeast. Displacement on most of the fault along the northeastern side of Sand Flat is shown by Y-239 as down to the southwest. Displacement on the fault on the western wide of Ulida Flat is portrayed by Y-239 as down to the east.

Scarp characteristics: Portions of the fault on the eastern sides of Hidden Valley and Ulida Flat and portions of the fault along the southeastern side of Sand Flat are portrayed by Y-239 as west–facing scarps. The fault along the northeastern side of Sand Flat is shown by Y-239 as southwest–facing scarps.

Displacement: No information.

Hidden Valley–Sand Flat faults (HVSF) — Continued

Age of displacement: At least a portion of each of the faults grouped into HVSF has expression on surfaces of Quaternary deposits or along a linear range front that could have formed by Quaternary fault rupture (Y-239). (1) The fault along the eastern sides of Hidden Valley and Ulida Flat is shown primarily as moderately expressed scarps or lineaments on surfaces of Quaternary deposits. Short sections of this fault are shown as moderately expressed scarps or lineaments on surfaces of Tertiary deposits or as faults that are in Tertiary deposits and that were identified from previous mapping. (2) The fault along the southern sides of Ulida and Sand flats has a 0.5–km–long section portrayed as a moderately expressed scarp or lineament on surfaces of Quaternary deposits; the remainder of this fault is portrayed as a topographic lineament along a linear front. (3) The faults along both the southeastern and northeastern sides of Sand Flat are portrayed as moderately expressed to prominent scarps or lineaments on surfaces of Quaternary deposits. (4) The fault along the western side of Ulida Flat is portrayed as a topographic lineament along a linear front.

Of the faults north of Sand Flat and south of White Top Mountain, the western fault and the southern 5 km of the eastern fault are shown by Y-239 as faults that are in Tertiary deposits and that were identified from previous mapping. The northern 8 km of the eastern fault is shown by Y-239 as a fault that is in Quaternary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Range fronts adjacent to two faults in HVSF, both the fault along the southern sides of Ulida Flat and Sand Flat and the fault along the western side of Ulida Flat, are portrayed by Y-239 (pl. 1) as linear.

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000). Limited field examination (Y-239, p. 2).

Relationship to other faults: The structural relationships among the five faults grouped into HVSF are not known. The north– or north–northeast–striking faults along the eastern sides of Hidden Valley and Ulida Flat, along the eastern side of Sand Flat, and along the western side of Ulida Flat approximately parallel the Racetrack Valley faults (RTV) west of HVSF and the Tin Mountain fault (TM) northwest of HVSF (pl. 2 of this compilation). The northwest–striking faults along the southern sides of Ulida Flat and Sand Flat and along the northeastern side of Sand Flat are approximately perpendicular to RTV and TM, but are approximately parallel to the Hunter Mountain fault (HM) to the south in Panamint Valley. The north–northeast–striking fault along the western side of Ulida Flat may connect with the north–northeast–striking faults along the eastern side of Racetrack Valley along a north–northwest–striking, down–to–the–northeast fault that is about 4 km long (Y-239, pl. 1).

Of the two faults north of Sand Flat and south of White Top Mountain, the eastern fault appears to terminate against the fault along the northeastern side of Sand Flat, whereas the western fault appears to merge with the fault along the northeastern side of Sand Flat.

Hiko fault (HKO)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970 (name from their pl. 3); Y-1032: Schell, 1981 (pl. 9, his fault #90, table A2; shows only that portion of HKO north of lat 37°30′N.).

Location: 131 km/53° (distance and direction of closest point from YM) at lat 37°33′N. and long 115°15′W. (location of closest point). HKO is located along the western side of the Hiko Range and along the eastern side of the Pahranagat Valley. The northern end of HKO parallels the White River.

USGS 7-1/2′ quadrangle: Fossil Peak, Hiko, Mail Summit, Mount Irish SE.

Fault orientation: HKO has a curving, but generally north–northwest strike (Y-25; Y-404; Y-1032). The northern end of HKO, which is about 3 km wide (Y-1032, pl. 9), strikes generally northeast.

Fault length: The length of HKO is 45 km as estimated from Y-404 (pl. 3) and 47 km as estimated from Y-25. Both of these lengths include an approximately 20–km–long section between Crystal Springs, Nevada, and north of Alamo, Nevada, that has no surficial expression. The length of HKO is noted to be 15 km by Y-1032 (table A2, p. A17), but his map includes only the northern part of the Hiko Range and HKO (north of lat 37°30′N.).

Style of faulting: Displacement on HKO is portrayed by both Y-25 and Y-1032 as both down to the east and down to the west.

Scarp characteristics: Y-1032 (table A2, p. A17) reported a maximum scarp height of 9 m and a maximum scarp–slope angle of 15°.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement that was noted by Y-1032 (table A2, p. A17) is late Pleistocene (defined as >15 ka to <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A17) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A17) with an estimated age of ≤15 ka (table 3, p. 23). The oldest unit displaced is his late Tertiary volcanic rocks (Tv_3; Y-1032, table A2, p. A17) with an estimated age of 6 Ma to 17 Ma (table A1, p. A1).

North of Crystal Springs, parts of HKO (primarily the northeast–striking northern end) are shown by Y-25 to displace Holocene and Pliocene alluvium and colluvium (their QTa deposits). South of about Alamo, the southern end of HKO is portrayed by Y-25 as a faulted contact between Miocene ash–flow and air–fall tuff (their Tt4 unit) and unconsolidated Quaternary and Tertiary gravel and alluvium (their QTa deposits). Portions of this part of HKO are shown by Y-25 to be inferred or concealed by their QTa deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: HKO approximately parallels other north–northwest–striking faults in the area. These faults include the Hiko–South Pahroc faults (HSP) east of HKO, the Pahroc fault (PAH) also east of HKO, the Sheep Range fault (SHR) south of HKO, the Sheep Basin fault (SB) also south of HKO, and the Badger Wash faults (BDG) west of HKO.

Hiko fault (HKO) — Continued

HKO is approximately perpendicular to other faults in the area, such as the northeast–striking Pahranagat fault (PGT) on the south and to the east–striking Tempahute lineament (expressed as the Tem Piute fault (TEM)) on the north.

HKO is also approximately parallel to the southern part of the Southeast Coal Valley fault (SCV) and the southern part of the Seaman Pass fault (SPS), both north of HKO. However, the northern end of HKO strikes northeast, which is oblique to these faults and approximately parallel to the Six–Mile Flat fault (SMF) east of HKO.

Hiko–South Pahroc faults (HSP)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3); Y-1032: Schell, 1981 (pl. 9; shows only those fault traces north of about lat 37°25′N., which is the southern edge of his map area).

Location: 130 km/68° (distance and direction of closest point from YM) at lat 37°17′N. and long 115°06′W. (location of closest point). HSP includes two main faults that bound the eastern and western sides of an unnamed valley located between the Hiko and South Pahroc ranges and between the Pahranagat fault on the south and Pahroc Valley (or Sixmile Flat) on the north.

USGS 7-1/2′ quadrangle: Alamo NE, Alamo SE, Hiko SE.

Fault orientation: HSP strikes north–northwest (Y-25; Y-404).

Fault length: The length of HSP is 27 km as estimated from Y-25 and Y-404.

Style of faulting: Displacement on the fault along the eastern side of the unnamed valley is shown by Y-25 as primarily down to the west. Displacement on the fault along the western side is shown by Y-25 as primarily down to the east.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The age of the youngest displacement along faults of HSP north of about lat 37°25′N. (the extent of his map area) is shown by Y-1032 (pl. 9) as indeterminate, but suspected of being Quaternary. Scarps along HSP are noted by Y-1032 (pl. 9) as prominent, but their age could not be determined by him because young stratigraphic units are not preserved along the faults.

Portions of faults within HSP are shown by Y-25 as faulted contacts between Miocene volcanic tuff (their Tt3 and Tt4 units) and Holocene to Pliocene alluvium and colluvium (their QTa deposits). Y-404 (pl. 3) portrayed faults of HSP as post–Laramide structures. Parts of these faults are shown by them to be faulted contacts between Tertiary volcanic rocks and Pleistocene(?) older alluvium (their Qol deposits; Y-404, pl. 2).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: Faults in HSP are approximately parallel to other north–northwest–striking faults in the area. These faults include the Hiko fault (HKO) west of HSP, the Badger Wash faults (BDG) also west of HSP, the Pahroc fault (PAH) east of HSP, the Sheep Range fault (SHR) south of HSP, and the Sheep Basin fault (SB) southwest of HSP.

HSP is approximately perpendicular to northeast–striking faults in the area, such as the Six–Mile Flat fault (SMF) west of HSP and the Pahranagat fault (PGT) immediately south of HSP. HSP may intersect PGT.

Hot Creek–Reveille fault (HCR)

Plate or figure: Plate 1.

References: Y-5: Ekren and others, 1971 (show only that part of HCR south of lat 37°52′30″N., which is the northern edge of their map area); Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pl. 1); Y-853: Dohrenwend and others, 1992 (Y-232, Y-813, and Y-853 show only that part of HCR south of lat 38°N., which is the northern edges of their map areas.); Y-1032: Schell, 1981 (pls. 7 and 8; name from his table A2, fault #50; shows HCR between lat 38°30′N. and about lat 37°45′N., which is the southern edge of his map area).

Location: 103 km/6° (distance and direction of closest point from YM) at lat 37°45′N. and long 116°18′W. (location of closest point). South of lat 38°N. and north of Cedar Pass, HCR is located along the eastern side of the Kawich Range at its junction with Reveille Valley. North of lat 38°N. and south of Hot Creek Canyon at about lat 38°30′N., HCR is located along the eastern side of the Hot Creek Range at its junction with the Hot Creek Valley (this part of HCR is north of the area shown on pl. 1 of this compilation).

USGS 7-1/2′ quadrangle: Georges Well, Kawich Peak, Kawich Peak NE, Kawich Peak SW.

Fault orientation: HCR strikes generally north–northwest (Y-5; Y-232; Y-813; Y-853; Y-1032).

Fault length: The total length of HCR is reported by Y-1032 (table A2, p. A10) as 83 km. The length of HCR south of lat 38°N. (the area shown on pl. 1 of this compilation and by each of these references) is 29 km as estimated from Y-853, 30 km as estimated from Y-813, and 32 km as estimated from Y-232.

Style of faulting: Displacement on HCR is shown primarily as down to the northeast (Y-5; Y-232; Y-813).

Scarp characteristics: HCR is portrayed by Y-813, Y-853, and Y-1032 as primarily northeast–facing scarps. A maximum scarp height of <134 m (<440 ft) is reported by Y-1032 (table A2, p. A10) with a maximum scarp–slope angle of 27°.

Displacement: Stratigraphic throw across a normal fault on the eastern side of the Kawich Range (part of HCR?) is reported by Y-232 (p. 32) to be 458 m (1,500 ft). The stratigraphic unit involved is not noted by Y-232.

Age of displacement: The probable age of the youngest displacement along HCR is noted by Y-1032 (table A2, p. A10) to be late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A10) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). Y-1032 (p. 33) reported that HCR is primarily preserved at the contact between bedrock and alluvium, but he suggested a late Pleistocene age for the fault's youngest displacement on the basis of minor displacement of his A5i deposits where the fault crosses the mouths of drainages (Y-1032, p. 33). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A10) with an estimated age of ≤15 ka (table 3, p. 23). The oldest unit displaced is his middle Tertiary volcanic rocks (Tv_2; Y-1032, table A2, p. A10) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

On the basis of a geomorphic analysis, Y-1032 (p. 35, table A2, p. A10) concluded that the high (<134 m) scarp at Empire Canyon represents multiple surface ruptures on HCR and speculated that at least four episodes of displacement have occurred at this locality during and since the late Tertiary.

HCR is portrayed by Y-853 as scarps on depositional or erosional surfaces with ages of possibly late Pleistocene (their Q_2? surfaces with estimated ages between 10 ka and 130 ka) and possibly early to middle and (or) late Pleistocene (their Q_{1-2}? surfaces with estimated ages between 10 ka and 1.5 Ma). The map by Y-853 also shows HCR as fault–related lineaments on Quaternary depositional or erosional surfaces.

Hot Creek–Reveille fault (HCR) — Continued

HCR is portrayed by Y-813 as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping, as weakly expressed lineaments and scarps on surfaces of Quaternary deposits, and as weakly to moderately expressed lineaments or scarps on surfaces of Tertiary deposits. However, HCR is shown by Y-5 as concealed beneath Pliocene through Holocene alluvium and colluvium (their QTa deposits) and as fault traces juxtaposing Miocene Tuff of White Blotch Spring (their Tws unit) against Miocene lava and tuff (their Td and Tzt units). HCR is portrayed by Y-232 as concealed beneath Quaternary alluvium (his Qal deposits) at some localities and as juxtaposing Miocene Tuff of White Bloch Spring against Quaternary alluvium (his Qal deposits), primarily, and against Miocene dacite and rhyodacite (his Td unit) and against Pliocene ash–fall and ash–flow tuff (his Tt unit).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: HCR is portrayed by Y-853 as a major range–bounding fault that borders a tectonically active range front that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front."

Analysis: Aerial photographs (Y-5; Y-813, p. 4, scales 1:62,500 to 1:80,000 and 1:58,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field mapping (Y-5). Field reconnaissance (Y-1032, p. 17-18). Topographic scarp profiles (Y-1032, p. 18-20). Gravity analyses (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: HCR is approximately parallel to other north–, north–northeast–, and north–northwest–striking faults bounding range fronts and within basins in the area. These faults include the Belted Range fault (BLR) along the western side of the Belted Range southeast of HCR, the East Reveille fault (ERV) along the western side of the Reveille Range east of HCR, the West Railroad fault (WR) along the eastern side of the Reveille Range also east of HCR, the Central Reveille fault (CR) in Reveille Valley immediately east of HCR, the Kawich Range fault (KR) along the western side of the Kawich Range immediately west of HCR, and the Cactus Flat fault (CF) and the Cactus Flat–Mellan fault (CFML) both within Cactus Flat west of HCR (Y-813; Y-853; Y-1032). The structural relationships among these faults have not been reported.

Y-5 (p. 72) noted that the Kawich Range is a horst. In addition to the range–bounding faults, HCR on the east and KR on the west, numerous normal faults are present in the range (Y-5, p. 72). These faults have displacements of a few meters to 153 m (a few feet to 500 ft) and create a sequence of randomly dipping, tilted fault blocks (Y-5, p. 72).

Hunter Mountain fault (HM)

Plate or figure: Plate 2.

References: Y-29: Hamilton, 1988; Y-222: Streitz and Stinson, 1974; Y-239: Reheis, 1991 (pls. 1 and 2; shows only that part of HM east of about long 117°35'W.; her extension of HM south to about Towne Pass in northern Panamint Valley is shown as HM? on pl. 2 of this compilation); Y-356: McAllister, 1956 (shows only those portions of HM along Hunter Mountain, adjacent to Grapevine Canyon, and in Saline Valley east of long 117°45'W.); Y-399: Hopper, 1947; Y-427: Hart and others, 1989; Y-494: Smith, 1976; Y-518: Smith and Pratt, 1957; Y-697: Zhang and others, 1990; Y-698: Smith, 1975; Y-864: Burchfiel and others, 1987; Y-900: Ellis and others, 1989; Y-906: MIT 1985 Field Geophysics Course and Biehler, 1987 (discusses only that part of HM in northern Panamint Valley and adjacent to Hunter Mountain); Y-909: Schweig, 1989; Y-916: Wernicke and others, 1986; Y-1020: Jennings, 1992 (his fault #244, p. 16, name from this reference); Y-1148: Zellmer, 1980 (shows only that portion of HM along the southern edge of Saline Valley; his Grapevine Canyon fault zone; fig. 3.1, p. 20, 22); Y-1274: Blakely and others, 1994.

Location: 95 km/238° (distance and direction of closest point from YM) at lat 36°24'N. and long 117°20'W. (location of closest point). HM is located along the southwestern side of Hunter Mountain and adjacent to Grapevine Canyon between Panamint and Saline valleys, and along the northeastern side of the Nelson Range at its junction with the southern edge of Saline Valley. HM may extend southeastward along the southwestern side of the Cottonwood Mountains and the Panamint Range to nearly Towne Pass in northern Panamint Valley (Y-239).

USGS 7-1/2' quadrangle: Emigrant Pass, Jackass Canyon, Lee Wash, Nova Canyon, Panamint Butte, The Dunes.

Fault orientation: HM in northern Panamint Valley and adjacent to Hunter Mountain strikes north–northwest. Y-864 (p. 10,422) noted a strike of N. 6° W. for HM near Panamint Butte in northern Panamint Valley. Y-494 (p. 175) and Y-698 (p. 113) both noted a strike of N. 55° W. for a near–vertical fault trace at Grapevine Pass southwest of Hunter Mountain between Panamint and Saline valleys.

HM strikes west–northwest between Hunter Mountain and Daisy Canyon along the southern edge of Saline Valley. Y-1148 (p. 20) reported a strike of N. 60° W. for HM in Saline Valley.

Fault length: The total length of HM may be about 85 km from about Towne Pass to the western edge of Saline Valley. This length includes about 78 km as estimated from Y-239 (pls. 1 and 2) and from Y-356, which is only for that portion of HM east of long 117°45'W. Y-1148 (fig. 3.1) extended HM to the western edge of Saline Valley for an additional about 7 km.

Style of faulting: On the basis of geomorphic evidence, Y-427 (p. 6) suggested that right–lateral displacement has predominated on HM. Y-239 (pls. 1 and 2) indicated both right–lateral and dip–slip (normal) displacement for HM. Vertical displacement is portrayed by Y-239 (pls. 1 and 2) as both down to the northeast and down to the southwest at different localities along the fault.

The southern portion of HM in northern Panamint Valley is shown by Y-239 (pl. 2) as having right–lateral and down–to–the–southwest displacement. HM adjacent to Hunter Mountain and between Panamint and Saline valleys is portrayed by Y-239 (pl. 2) as having right–lateral and down–to–the–northeast displacement. Y-356 portrayed the portion of HM between Hunter Mountain and San Lucas Canyon in Saline Valley as principally down to the northeast, but he showed some traces as down to the southwest.

Y-1148 (p. 25) noted that HM in Saline Valley has variable types of displacement: predominantly right lateral at Grapevine Pass at the southeastern end of Saline Valley and predominantly vertical (normal) at Daisy Canyon at the southwestern corner of Saline Valley (the northwestern end of HM). Y-1148 (p. 29) interpreted the pattern of scarps on alluvial fans at the mouth of Grapevine Canyon at the southeastern end of Saline Valley as suggesting right–lateral displacement.

Hunter Mountain fault (HM) — Continued

Y-698 (p. 112-113) suggested that HM along Hunter Mountain has experienced thrust displacement on a fault that dips 17° to 35°NE. beneath the mountain. To the northwest at Grapevine Pass, Y-698 (p. 113) observed horizontal slickensides that he interpreted as indicating right–lateral displacement on this portion of the fault.

Y-356 concluded that HM may be a scissors fault with a pivot near the head of Grapevine Canyon. He suggested this in order to explain the down–to–the–northeast displacement in Saline Valley and the down–to–the–southwest displacement in Panamint Valley.

Scarp characteristics: Y-1148 (p. 25) noted that scarps on both alluvial and bedrock surfaces in Saline Valley commonly have heights of ≥20 m. He (Y-1148, p. 30, 32) measured scarp heights of 15 and 23 m at two localities along HM in southeastern Saline Valley and noted that the scarps at these localities have been oversteepened by erosion. On the basis of bevels interpreted from a scarp profile measured at one locality near the southeastern end of Saline Valley (his profile site P3), Y-1148 (p. 35) concluded that at least three, and perhaps five or more, surface ruptures have occurred on HM.

Displacement: Y-356 reported a maximum throw on HM of "at least several thousand feet" where HM is opposite the highest part of the Nelson Range in Saline Valley. However, Y-356 noted that the throw on HM at the head of Grapevine Canyon is close to zero.

Y-864 (p. 10,424) estimated right–lateral displacement of 8 to 10 km and down–to–the–southwest vertical displacement of 0 to 2 km on HM in the area of Panamint Butte in northern Panamint Valley. This estimate was made using outcrops of a N. 7° W.–striking, near–vertical contact as piercing points. This contact is between early Jurassic Hunter Mountain batholith and an unconformity at the base of Miocene/Pliocene volcanic rocks (Y-864, p. 10,422-10,423). The contact is preserved across HM on both sides of northern Panamint Valley at two localities: southeast of Hunter Mountain on the eastern side of the valley and on the northeastern edge of the Darwin Plateau on the western side of the valley (Y-864, fig. 2, p. 10,424). Y-697 (p. 4,858, *citing* Y-864) reported that a 4–Ma, well–defined piercing point is displaced 9.3 ± 1.4 km by HM. (I could not find this amount of displacement reported in Y-864.)

On the basis of displaced stream channels, Y-1148 (p. 25, 34) estimated total lateral displacement of between 700 m and 2,000 m on HM in Saline Valley. He (Y-1148, p. 43) speculated that right–lateral displacement at the northwestern end of HM in Saline Valley at San Lucas Canyon may be nearly 1,000 m. In Saline Valley between San Lucas and Daisy canyons, Y-1148 (p. 42) observed a total cumulative lateral displacement on HM of 22 m in lacustrine deposits. Stream channels in this area are displaced laterally by smaller amounts (Y-1148, p. 42). Displacements (lateral?) in individual events in Saline Valley range between 2 and 7 m (Y-1148, p. 42).

Y-1274 (p. 38) noted that the displacement of a prominent magnetic anomaly centered over Hunter Mountain indicates right–lateral displacement of at least 6 km along HM, which supports the suggestions made by others on the basis of geologic mapping.

Y-1148 (p. 25) reported a vertical displacement of "perhaps tens of meters" on HM in southeastern Saline Valley at Grapevine Pass and a vertical displacement of at least 6,000 m on HM in southwestern Saline Valley at Daisy Canyon. He (Y-1148, p. 25) estimated these amounts of displacement from the elevation difference between the Inyo Mountains and the depth of fill in Saline Valley that was inferred from gravity data of Mabey (1963, Y-917). Y-1148 (p. 35) reported a vertical displacement of about 50 m that was estimated from topographic profiles measured across fault scarps in southeastern Saline Valley. Utilizing profiles measured across scarps associated with a splay of HM in southeastern Saline Valley, Y-1148 (p. 36-39) noted vertical displacements of 4.5 m in one event, 16 m in four to six events, and 30 m in at least four events. Y-864 (p. 10,423) interpreted a steep escarpment at the northern end of Panamint Valley as corresponding to HM. This escarpment, which trends N. 6° W., has 1 to 1.5 km of topographic relief that is assumed to reflect the minimum vertical displacement on HM.

Hunter Mountain fault (HM) — Continued

Along the northwest–striking section that may be part of either PAN (Y-399; Y-698) or the Hunter Mountain fault (shown as HM? on pl. 2 of this compilation), Y-399 (p. 399) reported observing evidence for right–lateral displacement on nineteen stream channels south of Highway 19. This evidence includes the development of shutter ridges. Y-399 (p. 399) estimated right–lateral displacements of 24 to 61 m (80 to 200 ft) and apparent vertical displacements (southwest side up) of about 12 m (40 ft). In this same area but north of the highway, Y-698 (p. 113) noted 183 m (600 ft) of right–lateral displacement estimated on the basis of the juxtaposition of a late Quaternary alluvial–fan deposit composed of clasts of Precambrian and Paleozoic rocks against a 61–m (200–ft) hill of Tertiary volcanic rocks.

About 3 km (2 miles) southeast of Highway 19, right–lateral displacement of older alluvial–fan deposits totals 305 to 610 m (1,000 to 2,000 ft; Y-698, p. 114).

About 11 km (7 miles) south–southeast of Highway 19, near the mouth of Wildrose Canyon, a "sheet of monolithologic (landslide) breccia" is displaced right laterally 3,050 to 4,575 m (10,000 to 15,000 ft) from a source at Wildrose Canyon (Y-698, p. 114).

Y-1148 (p. 50) speculated that as much as 2.5 km of extension may have occurred on HM in Saline Valley. Y-906 (p. 10,437) estimated extension of about 6 to 10 km on a low–angle fault beneath northern Panamint Valley assuming that the 5–to–9–km–wide area over which lower Pliocene basalts are absent beneath the valley has been the result of displacement that has separated the Darwin Plateau and the Panamint Range in a direction parallel to HM.

Age of displacement: The map by Y-1020 shows part of HM as having Holocene (≤10 ka) displacement and part as having Quaternary (defined by him as <1.6 Ma) displacement. Y-427 (p. 6) called HM "a major late Quaternary fault." Most of HM in Panamint Valley is shown by Y-239 (pl. 2) as prominent lineaments or scarps on surfaces of Quaternary deposits. HM adjacent to Hunter Mountain is shown by Y-239 (pls. 1 and 2) as a fault that is in Quaternary deposits and that was identified from previous mapping. Part of HM in Saline Valley is portrayed by both Y-222 and Y-356 as displacing Holocene and (or) Pleistocene alluvium. The northwestern and southeastern ends of HM are noted by Y-239 (p. 4) to be two of the most active faults in this area.

Late Cenozoic basalts (4.0 Ma to 4.3 Ma, K–Ar dates reported by Larson, 1979, Y-1241) capping Panamint Butte east of northern Panamint Valley were correlated by Y-864 (p. 10,422-10,423) to basalts in the Argus Range and on the Darwin Plateau both on the western side of northern Panamint Valley. On the basis of this correlation, Y-864 (p. 10,422-10423) inferred that northern Panamint Valley must have formed after eruption of these lower Pliocene basalts. In support, Y-697 (p. 4,858) noted that if Panamint Valley were older than this, then the basalts should have filled the valley. Interpretation of gravity data by Y-906 (p. 10,437) suggests that the basalts are absent beneath most of northern Panamint Valley. Similarly, on the basis of correlation of a displaced tuff near Hunter Mountain, Y-1148 (p. 28) suggested that displacement on HM in Saline Valley began after 3 Ma. On the other hand, Y-909 (p. 657-658) concluded that formation of northern Panamint Valley (along with other topographic features in the area) had occurred by 7 Ma to 8 Ma, because (1) alluvial–fan deposits thought to be from the Panamint Range (east of Panamint Valley) were deposited before 7.7 Ma to 6.1 Ma, (2) exposures in Rainbow Canyon (northern Argus Range, west side of Panamint Valley) suggest that some faults are terminated by volcanic units that were deposited between 5.8 Ma and 6.1 Ma, and (3) the oldest basalt in the Rainbow Canyon area was extruded about 7.7 ± 0.5 Ma (extrusion probably related to regional? extension).

Y-698 (p. 112-113) interpreted Quaternary displacement on a west–northwest–striking fault (HM?), because crystalline rocks have been thrust over talus along the southern side of Hunter Mountain. Y-698 (p. 113) inferred that this fault trace is presently inactive because "streams have dissected it to a depth of [61 m] 200 ft" and younger displacement has probably occurred on a parallel fault trace that is about 2.5 km (1.5 miles) southwest of the inactive trace.

Y-1148 (p. 36-39) estimated a minimum age of 280 ka and 380 ka for surface rupture on a splay of HM in southeastern Saline Valley. This estimate was based on a comparison of characteristics of the fault scarps in Saline Valley to the characteristics of fault scarps presented by Wallace (1977, Y-1118).

Slip rate: By assuming that a maximum age of 3 Ma for the formation of Saline Valley reflects the age of inception of HM at the northern end of Panamint Valley and that net slip on HM is reflected by 8 to 10 km of lateral slip and 0 to 2 km of vertical slip, Y-864 (p. 10,424) calculated a minimum average slip rate of 2 to 3.2 mm/yr for HM. Y-864 (p. 10,423-10,424) further assumed that the displacement on this part of HM is equal to the amount of extension in both northern Panamint Valley and in Saline Valley, so that the slip rate of 2 to 3.2 mm/yr corresponds to minimum rates of extension in this area.

Y-900 (p. 465) suggested that the average Pliocene slip rate for HM is about 2 to 3 mm/yr in a direction of N. 60° W.

Y-697 (p. 4,858) calculated an apparent (lateral?) slip rate of 2 to 2.7 mm/yr for HM using a displacement of 9.3 ± 1.4 km for a 4–Ma basalt that they reported from Y-864. Using this same amount of displacement but assuming that displacement began about 6.1 Ma as suggested by Y-909 (p. 657), Y-697 (p. 4,858) calculated a minimum apparent (lateral?) slip rate of 1.30 to 1.75 mm/yr for HM.

Recurrence interval: No information.

Range-front characteristics: A portion of HM is shown by Y-239 (pl. 2) as a topographic lineament bounding the linear front of the Cottonwood Mountains. No other information is available.

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000; Y-697; Y-1148, p. 1, 9, scales 1:20,000, 1:37,400, and 1:60,000). Detailed geologic mapping (Y-864, p. 10,422; Y-909, p. 652). Examination of volcanic and alluvial stratigraphy (Y-909, p. 652). Topographic profiles of fault scarps in Saline Valley (Y-1148, p. 2, 55). Gravity data, seismic refraction lines, resistivity profiles, and magnetotelluric measurements in northern Panamint Valley (Y-906, p. 10,428-10,434). Measurement and analysis of joints at Hunter Mountain (Y-1148, p. 95-108).

Relationship to other faults: Y-697 (p. 4,858) suggested that HM may extend southward along the Panamint Valley fault (PAN), which strikes north–northwest and has down–to–the–west, dip–slip (normal) displacement. Alternately, Y-239 (p. 2-3, *citing* Y-29 and Y-916) noted that splays of PAN may continue northward along the Towne Pass fault (TP) and Emigrant fault (EM), both of which strike north–northeast along the western side of Tucki Mountain. Thus, she (Y-239, p. 3, *citing* Y-29) concluded that PAN is "probably a continuation and (or) a reactivation of the Tucki Mountain detachment fault." Alternatively, Y-239 (p. 2-3) noted that HM may intersect PAN near Wildrose Canyon and that this intersection "is marked by a large complex of faults and lineaments on the floor of Panamint Valley" (Y-239, p. 1). Y-239 (p. 3) suggested that this complex may be the surface expression of stresses resulting from the intersection of HM and PAN, and that "[s]ome of the northwest–[striking] faults and lineaments in this cluster are arranged in a left–stepping, *en echelon* pattern, suggesting a component of right–lateral movement in this area."

Y-698 (p. 113) concluded that it is unlikely that HM and PAN are continuous, so that right–lateral displacement on PAN results in horizontal shortening between northern Panamint Valley and Hunter Mountain.

Y-239 (p. 3) speculated that HM may be "connected to" the northwest–striking, right–lateral Furnace Creek fault (FC) by north–northeast–striking, possible Quaternary faults, such as the Racetrack Valley faults (RTV) and the Tin Mountain fault (TM; pl. 2 of this compilation).

Y-222 mapped two west–northwest–trending lineaments on surfaces of granitic rocks on the northern side of Hunter Mountain. These lineaments parallel HM, and Y-239 (p. 3, *citing* Reheis and Noller, 1991, Y-238) concluded that these lineaments "may be shear zones like those in granitic rocks of the Sylvania Mountains to the north that are adjacent to the [Death Valley fault]."

Y-864 (p. 10,422) noted that HM links Panamint Valley and Saline Valley. They interpreted these two valleys as paired pull–apart basins that formed as the result of late Pliocene to Holocene extension on HM, which acted as a transfer fault (Y-864, p. 10,423).

Hunter Mountain fault (HM) — Continued

Y-900 (p. 465) noted that HM is linked with PAN through a bend of 70° and proposed that the lack of a deep basin in this area may be because uplift at the northwestern end of PAN is approximately equal to subsidence at the southeastern end of HM.

Y-864 and Y-906 both proposed that the formation of northern Panamint Valley is the result of extension on a low–angle, west–dipping detachment or normal fault or faults. By restoring the pre–valley configuration of basalts (4 Ma to 4.3 Ma) now preserved on the Darwin Plateau on the western side of Panamint Valley and on Panamint Butte on the eastern side of the valley, Y-864 (p. 10,424) inferred that such a low–angle fault exists, dips 0 to 15° west, and is expressed at the ground surface along the eastern side of northern Panamint Valley. On the basis of their interpretation of geophysical data, Y-864 (p. 10,424) and Y-906 (p. 10,440) concluded that Paleozoic rocks are at shallow depths (primarily 100 to 200 m, Y-906 (p. 10,440)) beneath northern Panamint Valley and that the lower Pliocene basalts are not preserved beneath most of the valley. These conclusions are supported by Y-518, who noted only 111 m (365 ft) of Cenozoic fill above Paleozoic rocks in a drill hole (their Panamint Drill Hole #2, fig. 1, p. 2, 54-57, pl. 1) in the central part of northern Panamint Valley. These two interpretations are cited by both Y-864 (p. 10,424) and Y-906 (p. 10,437) to support their models of a low–angle fault beneath northern Panamint Valley. Y-906 (p. 10,437) noted that the absence of basalt remnants in northern Panamint Valley makes extension on steep faults unlikely. Y-864 (p. 10,424) concluded that the absence of basalts suggests that these hanging–wall rocks have been completely removed from the footwall beneath the valley, which supports their interpretation of displacement along a low–angle fault. Because the total extension (6 to 10 km) across northern Panamint Valley inferred by Y-906 (p. 10,437) is comparable to the amount of lateral displacement (8 to 10 km) suggested by Y-864 for HM, Y-906 (p. 10,438) concluded that the low–angle fault is probably not older than either HM or northern Panamint Valley (both features are supposedly younger than 3 Ma to 6 Ma) and that reactivation of an older fault that experienced large displacement before formation of northern Panamint Valley is unlikely. Y-864 (p. 10,425) concluded that displacement on the low–angle fault "is directly responsible for the present Basin and Range topography that characterizes the Panamint Butte–Darwin Plateau area" and that this fault is still active.

Indian Springs Valley fault (ISV)

Plate or figure: Plates 1 and 2.

References: Y-813: Reheis, 1992 (pls. 2 and 3); Y-852: Dohrenwend and others, 1991. Not shown by Ekren and others, 1977 (Y-25) nor by Tschanz and Pampeyan, 1970 (Y-404).

Location: 67 km/82° (distance and direction of closest point from YM) at lat 36°55′N. and long 115°42′W. (location of closest point). ISV is located along the western side of Indian Springs Valley at its junction with the Spotted Range.

USGS 7-1/2′ quadrangle: Fallout Hills, Quartz Peak NW, Quartz Peak SW.

Fault orientation: ISV generally strikes north–northwest (Y-813; Y-852). Individual traces of the fault strike between northwest and northeast (Y-813; Y-852).

Fault length: The length of ISV is about 23 km as estimated from Y-852 or about 28 km as estimated from Y-813. These lengths include a 5–km–long section at the northern end of ISV that extends into the Fallout Hills (labeled ISV? on pl. 1 of this compilation).

Style of faulting: Displacement on parts of ISV, primarily at the northern end of the Indian Springs Valley, is portrayed by Y-813 as chiefly down to the east. ISV consists of subparallel, *en echelon* traces with a general left–stepping pattern (Y-813; Y-852).

Scarp characteristics: Scarps along parts of ISV are portrayed by Y-813 as primarily east–facing.

Displacement: No information.

Age of displacement: Parts of ISV are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock and as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary (primarily) and Tertiary deposits. Branches and subparallel fault traces shown by Y-813 only within Tertiary rocks of the Spotted Range have been omitted from plate 1 of this compilation.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Portions of ISV are shown by Y-813 to be expressed as lineaments along a linear range front. Portions of ISV are shown by Y-852 to have morphological characteristics similar to those of fronts along a major range–front fault (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front), except that "associated fault systems are significantly less extensive and fault scarps are substantially lower, shorter, and less continuous."

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Relationship to other faults: ISV is parallel to and aligned with the north–northwest–striking faults in the Fallout Hills (Fallout Hills faults; FH) north of ISV. However, displacement on faults in FH is generally down to the west, whereas displacement on ISV is generally down to the east. Consequently, ISV and FH are shown separately on plate 1 of this compilation.

ISV is approximately parallel to faults west of ISV, including the Spotted Range faults (SPR) along the western side of the Spotted Range, the Chert Ridge faults (CHR) that bound Chert Ridge, and the Buried Hills fault (BH) that bounds part of the Buried Hills. ISV is also parallel to faults east of ISV, including the East Pintwater Range fault (EPR), the Central Pintwater Range fault (CPR), and the West Pintwater Range fault (WPR), all three associated with the Pintwater Range.

Jumbled Hills fault (JUM)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-813: Reheis, 1992 (pl. 2). Not shown by Tschanz and Pampeyan, 1970 (Y-404).

Location: 77 km/65° (distance and direction of closest point from YM) at lat 37°08′N. and long 115°39′W. (location of closest point). JUM is located along the western side of the Jumbled Hills at their junction with the southern Emigrant Valley.

USGS 7-1/2′ quadrangle: Fallout Hills, Fallout Hills NW, Quartz Peak NW.

Fault orientation: JUM strikes generally north, but the fault curves, so that short sections strike between northwest and north–northeast (Y-25; Y-813).

Fault length: The length of JUM is 27 km as estimated from Y-813.

Style of faulting: Displacement on part of JUM is shown by Y-813 as primarily down to the west. Some portions of JUM are composed of multiple, subparallel or branching strands (Y-813).

Scarp characteristics: Several short (<2 km long) traces are shown by Y-813 as west–facing scarps.

Displacement: No information.

Age of displacement: JUM is portrayed by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary (mainly) and Tertiary deposits and as fault traces that are in Tertiary (mainly) and Quaternary deposits and that were identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Y-813 (pl. 2) portrayed two sections near the northern end of JUM as lineaments along a linear range front.

Analysis: Aerial photographs (Y-25; Y-813, p. 4, scales 1:62,500 to 1:80,000). Field mapping (Y-25).

Relationship to other faults: JUM is approximately parallel to north–striking faults in the area. These faults include the Fallout Hills faults (FH) in the Fallout Hills south of JUM, the Groom Range East fault (GRE), the Groom Range Central fault (GRC), and the Stumble fault (STM). These last three faults are located in and along the Groom Range northwest of JUM.

The northern end of JUM nearly intersects with the northeast–striking Emigrant Valley South fault (EVS) west of JUM.

The map by Y-25 shows a fault concealed beneath Holocene through Pliocene alluvium and colluvium (his QTa deposits) between the southern end of JUM and the northern end of the West Pintwater Range fault (WPR). The actual relationships among these faults are not known.

Kawich Range fault (KR)

Plate or figure: Plate 1.

References: Y-5: Ekren and others, 1971; Y-10: Reheis and Noller, 1989; Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pls. 1 and 2); Y-853: Dohrenwend and others, 1992 (show only the southern portion of KR along Cathedral Ridge and the southern Kawich Range).

Location: 57 km/0° (distance and direction of closest point from YM) at lat 37°20′N. and long 116°27′W. (location of closest point). KR is located along the western side of the Kawich Range, including Cathedral Ridge, at the range's junction with Cactus Flat on the north and Gold Flat on the south.

USGS 7-1/2′ quadrangle: Apache Tear Canyon, Breen Creek, Cedar Pass, George's Well, Gold Flat East, Kawich Peak, Kawich Peak SW, Quartzite Mountain, Silent Butte, Stinking Spring, West of Quartzite Mountain, Wild Horse Ranch.

Fault orientation: The strike of KR is variable (Y-5; Y-813; Y-853). The southern portion of KR between Silent Butte and Quartzite Mountain strikes generally northeast. The section between Quartzite Mountain and Cedar Pass, including the part along Cathedral Ridge, strikes north–northwest. The section between Cedar Pass and Kawich Peak strikes northwest. The northern section of KR between Kawich Peak and the northern edge of the map area at lat 38°N. strikes north–northeast. One fault trace directly west of Silent Butte at the southern end of KR along the range front strikes northeast (Y-813). Fault traces near and east of Silent Butte within the Kawich Range strike north (Y-813; Y-853).

Fault length: The total length of KR is about 80 km as mapped by Y-232, but KR extends to the northern edge of his map area at lat 38°N. A similar total length of the fault, 84 km, is estimated from Y-813 (pls. 1 and 2) between the northern edge of her map area at lat 38°N. and Silent Butte.

The southern section of KR, which is between Quartzite Mountain and Cedar Pass and consists of overlapping, parallel fault traces, is about 20 km long as estimated from Y-813 (pls. 1 and 2). The north–northwest–striking section along the Kawich Range front between Quartzite Mountain and Cedar Pass is composed of nearly continuous fault traces. This section is about 25 km long as estimated from Y-813 (pl. 1). A 13–km–long portion of this section between Cedar Pass and the central part of Cathedral Ridge is shown by Y-813 (pl. 1) to lack surficial expression except for a 1–km–long fault trace just south of Cedar Pass. The northwest–striking section, which is along the range front between Cedar Pass and Kawich Peak, is about 30 km long. The north–northeast–striking portion, which is north of Kawich Peak, is about 6 km long and consists of overlapping, subparallel fault traces (Y-813).

Style of faulting: Displacement on parts of KR is shown by Y-5 and Y-813 as down to the west or southwest. About half (about 45 km) of KR consists of one fault trace or, in places, two approximately parallel fault traces (Y-5; Y-232; Y-813). The northern end of KR (north of about Kawich Peak) is a relatively wide (about 5 km or more) zone of subparallel and branching fault traces. These traces may extend into Cactus Flat as portrayed by Y-813.

Scarp characteristics: Portions of KR are shown by Y-813 as west– or southwest–facing scarps.

Displacement: Stratigraphic throw on the portion of KR along the northern Kawich Range is reported by Y-232 (p. 32) to be 915 m (3,000 ft). Stratigraphic throw of at least 1,220 m (4,000 ft) was measured by Y-5 (p. 71) in Precambrian Stirling Quartzite across a north–striking fault trace west of Quartzite Mountain along the southern Kawich Range.

Age of displacement: Along the southern portion of KR at one locality west of Quartzite Mountain, the fault is shown by Y-853 to be expressed as scarps on depositional or erosional surfaces of early to middle Pleistocene and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). Y-813 portrayed KR as weak or moderate lineaments or scarps on surfaces of Quaternary deposits, as weak or moderate lineaments or scarps on surfaces of Tertiary deposits, and as a fault that is in Tertiary deposits and that was identified from previous mapping.

Kawich Range fault (KR) — Continued

In contrast, KR is portrayed by Y-5 as concealed by Pliocene through Holocene alluvium and colluvium (their QTa deposits) along most of the fault's length. Similarly, most of KR is shown by Y-232 (pl. 1) as concealed by Pleistocene and Holocene alluvium (his Qal deposits). The only surficial expression of KR that is portrayed by Y-232 (pl. 1) is along two sections in Tertiary volcanic rocks, one south of Quartzite Mountain at the southern end of KR and the other north of Silverbow, Nevada, at the northern end of KR. Some sections of KR between Kawich Peak and Cedar Pass are shown by Y-232 to have surficial expression in Tertiary rocks.

Y-813 (p. 10) suggested that the northwest–striking section of KR along the northern Kawich Range shows little or no evidence for Quaternary displacement.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Y-853 noted that KR between just north of Trailer Pass along Cathedral Ridge and Grass Spring Canyon along the southern Kawich Range has characteristics (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, subparallel systems of high–gradient, narrow, steep–sided canyon perpendicular to range front) similar to those along other major range–front faults. Y-813 portrayed part of KR as a lineament bounding a linear range front.

Analysis: Aerial photographs (Y-5; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: The southern half of KR (south of Cedar Pass) parallels other north–striking faults in the region: the Kawich Valley fault (KV) along the western side of Kawich Valley and the eastern side of the Kawich Range, the Belted Range fault (BLR) that bounds the western side of the Belted Range east of KR, the East Belted Range fault (EBR) along the eastern side of the Belted Range east of KR, and the Cactus Flat–Mellan fault (CFML) in the central part of Cactus Flat west of KR. The northern half of KR (north of Cedar Pass) parallels other north–northwest–striking faults in the area. These faults include the Hot Creek–Reveille fault (HCR) along the eastern side of the northern Kawich Range immediately east of KR, the East Reveille fault (ERV) along the western side of the Reveille Range east of KR, the Central Reveille fault (CR) in central Reveille Valley east of KR, and part of the East Stone Cabin fault (ESC) west of KR.

Lineaments and scarps with a general north–northeast orientation west of the Kawich Range front and in Cactus Flat are grouped into the East Stone Cabin fault (ESC) of this compilation. The relationship of these lineaments and scarps, which are up to 10 km west of the Kawich Range front, and KR, which is immediately adjacent to the front, is not known.

Y-813 (p. 10) noted that the lack of evidence for Quaternary displacement on the northwest–striking portion of KR along the northern Kawich Range is similar to other northwest–striking faults in the area (Carr, 1984, Y-182, p. 20; Y-813, p. 10) and is consistent with least principal stress in a northwest–southeast direction as proposed by Carr (1974, Y-181, p. 10-11, fig. 3). Y-813 (p. 10) suggested that the northwest–striking faults in this area were active during early and middle Miocene.

The relationship between the central portion of KR and the Cathedral Ridge caldera is not known. This caldera is centered around Cathedral Ridge and extends between Gold Reed Pass on the south and north of Cedar Pass on the north (Y-5, pl. 1, p. 72; Y-232, pl. 1). A northwest–striking fault trace of KR just north of Cedar Pass may coincide with the caldera rim (Y-232, pl. 1). Y-5 (p. 72) and Y-232 (p. 32) both reported that the caldera may be filled with at least 2,135 m (7,000 ft) of Fraction Tuff (Miocene) as a result of simultaneous subsidence of the caldera and extrusion of the tuff. The western margin of the caldera is interpreted by Y-5 (p. 72) to be faulted downward along fault traces that are included in KR of this compilation. This margin is now buried by basin–fill deposits in Gold Flat.

Kawich Range fault (KR) — Continued

Y-5 (p. 71-72) subdivided the Kawich Range–Quartzite Mountain block into three *en echelon* structural segments between Saucer Mesa (south of Quartzite Mountain) and the northern edge of their map area at lat 37°52′30″N. The southern segment extends between Saucer Mesa and Cathedral Ridge over about 19 km (12 miles) and includes Quartzite Mountain; this segment is predominately composed of pre–Tertiary (primarily Precambrian) sedimentary rocks. The central segment extends from Gold Reed Pass to Cedar Pass and is *en echelon* to the southern segment. The central segment includes the Cathedral caldera and is almost entirely composed of Tertiary igneous rocks. The northern segment extends between about White Ridge (just south of Cedar Pass) and the northern edge of the map area. It is predominantly composed of Tertiary igneous rocks that are older than those of the central segment, and it is interpreted by Y-5 to be a horst block. The effect of these structural segments on possible Quaternary displacements along KR has not been addressed. Y-813 (p. 10) suggested that evidence for Quaternary displacement on the northern part of KR, which approximately corresponds to the northern segment of Y-5, is sparse or absent, which may imply that displacement on this segment is older than it is on the segments to the south.

Kawich Valley fault (KV)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pls. 1 and 2); Y-853: Dohrenwend and others, 1992 (show only the southern cluster of fault traces). Not shown by Cornwall, 1972 (Y-232) nor by Ekren and others, 1971 (Y-5).

Location: 61 km/14° (distance and direction of closest point from YM) at lat 37°24'N. and long 116°17'W. (location of closest point). KV includes three clusters of fault traces: (1) a northern one near the middle of northern Kawich Valley, (2) a central one along the western side of central Kawich Valley near Gold Reed, Nevada, and (3) a southern one along the western side of southern Kawich Valley (labeled KV? on pl. 1 of this compilation).

USGS 7-1/2' quadrangle: Apache Tear Canyon, Cedar Pass, Dead Horse Flat, Quartet Dome, Quartzite Mountain, Rhyolite Knob.

Fault orientation: The northern portion of KV strikes northeast; the central portion of KV strikes generally north–northeast; the southern portion of KV strikes approximately north (Y-813; Y-853).

Fault length: If all three clusters of fault traces are included, then the total length of KV is about 43 km as estimated from Y-813.

The length of the northern portion of KV in northern Kawich Valley is about 9 km as estimated from Y-813. This portion of KV includes a cluster of traces that is about 2.5 km wide, but could be as wide as 8 km if a scarp or lineament that intersects Cedar Well along White Ridge west of the main cluster is included in this portion of KV.

The length of the central portion of KV is about 8 km.

The length of the southern portion of KV is about 15 km. Fault traces in the southern portion of KV are 0.5 to 1.5 km long as estimated from Y-813.

Style of faulting: No information.

Scarp characteristics: Most of KV is shown by Y-813 as primarily southeast– or east–facing scarps.

Displacement: No information.

Age of displacement: The northern portion of KV is portrayed by Y-813 as weakly expressed lineaments and scarps on surfaces of Quaternary deposits. The central portion is shown by Y-813 as weakly expressed lineaments and scarps on surfaces of Tertiary deposits. The southern portion of KV is portrayed by Y-813 as weakly expressed lineaments and scarps on surfaces of Quaternary deposits and by Y-853 as fault–related lineaments on Quaternary depositional or erosional surfaces.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with KV.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: The relationship between KV and the north–striking Belted Range fault (BLR) along the western front of the Belted Range is not known. The northern end of KV strikes northeastward toward the northern end of BLR.

The southern portion of KV aligns with and has a strike similar to those of faults on Pahute Mesa, immediately south of Kawich Valley. These faults are shown by Y-813 and Y-853 to be in Tertiary deposits or to be expressed as scarps or lineaments on surfaces of Tertiary deposits. Y-813 identified some of these faults from previous geologic mapping. The faults on Pahute Mesa are not shown on plate 1 of this compilation, because evidence for Quaternary displacement has yet to be recognized on them. The relationship between KV and these faults is not known.

Keane Wonder fault (KW)

Plate or figure: Plate 2.

References: Y-216: Brogan and others, 1991 (not shown on their maps, but is mentioned on p. 5 of their report); Y-222: Streitz and Stinson, 1974; Y-238: Reheis and Noller, 1991 (pl. 3); Y-336: Cemen and Wright, 1988; Y-390: Hunt and Mabey, 1966 (pl. 1); Y-468: Noble and Wright, 1954 (name from this reference); Y-525: Wright and others, 1989 (their geologic cross section shows KW); Y-746: Wright and Troxel, 1954; Y-1020: Jennings, 1992 (his fault #244A); Y-1357: Wright and Troxel, 1993. Not shown by Hart and others (1989, Y-427).

Location: 43 km/230° (distance and direction of closest point from YM) at lat 36°37'N. and long 116°48'W. (location of closest point). KW is located in Death Valley along the western side of the Funeral Mountains (or Amargosa Range) between about Boundary Canyon on the north and Winters Peak on the south.

USGS 7-1/2' quadrangle: Beatty Junction, Chloride City, Nevares Peak.

Fault orientation: KW is curving, but strikes generally northwest (Y-238). KW is shown by Y-238 as several subparallel, curving strands along part of its length.

Fault length: The total length of KW is 25 km as estimated from Y-238 (pl. 3) between just south of Death Valley Buttes (south of Boundary Canyon) and Winters Peak.

Style of faulting: Displacement along KW is shown by Y-238 as down to the southwest. Y-390 (p. A118) suggested that KW dips 25° to 40° into Death Valley, which is similar to the dips of the Precambrian rocks in the Funeral Mountains.

Y-1357 concluded that displacement on KW has been right–lateral strike slip, which was accompanied by northeast tilting of the Funeral Mountains. Their map shows the southeastern end of KW as a low–angle normal fault with lateral displacement. Y-336 (p. 149) also mentioned right–lateral displacement on KW.

Scarp characteristics: No information.

Displacement: Y-1357 reported about 5 km of right–lateral displacement on the southeastern end of KW. They estimated this amount from displaced, northeast–trending axes of folds in Proterozoic rocks.

Age of displacement: Y-216 (p. 5) completed an aerial reconnaissance of KW and concluded that it lacks "geomorphic expression of youthful faulting." However, a few short sections of KW have been portrayed as affecting Quaternary deposits or surfaces.

A fault trace that is southwest of the front of the Funeral Mountains at the northwestern end of KW is shown by Y-238 as a prominent lineament or scarp on surfaces of Quaternary deposits. This trace is 4.5 km long. Y-1357 portrayed two sections at the southeastern end of KW, each about 0.3 km long, as faulted contacts between Late Proterozoic rocks on the northeast and Pleistocene alluvial–fan deposits (their Qg_1 and Qg_2 units). Although the map by Y-468 (pl. 7) portrays most of KW as juxtaposing Precambrian or Cambrian rocks on the northeast against Tertiary volcanic rocks of at least two different ages (their To and Ty units), it also shows KW juxtaposing the older rocks against Quaternary alluvium (their Qa unit) at two localities: at Cow Creek at the southeastern end of the fault and near Boundary Canyon at the northeastern end. Y-238 (pl. 3) indicated north–striking fault traces at the southeastern end of KW as either Quaternary faults identified from previous mapping or as weakly or moderately expressed scarps or lineaments on surfaces of Quaternary deposits. Y-1357 also recognized these traces, showing them as displacing Pleistocene alluvial–fan deposits (their Qg_2 unit) or Pliocene(?) and Miocene Furnace Creek Formation (their Tfc unit). Y-1020 showed KW as a probable Quaternary fault, which he defined as one having evidence for displacement since 1.6 Ma. He based this assessment on interpretations by Y-238. Y-746 (p. 30) noted that KW along the base of the Funeral Mountains separates pre–Tertiary rocks on the east from Tertiary and Quaternary rocks on the west.

Keane Wonder fault (KW) — Continued

In contrast, Y-238 portrayed most of KW as concealed, as lineaments or scarps on surfaces of Tertiary deposits, or as faults that are in Tertiary deposits and that were identified by previous mapping. Y-1357 portrayed and described the northwestern end of KW as separating Proterozoic rocks from Tertiary sedimentary rocks on the southwest. They suggested that most of the rest of KW is a complex zone of faulting and folding in pre–Tertiary rocks. Y-390 (p. A118) suggested that KW has displaced Titus Canyon(?) Formation (Oligocene?) downward against Precambrian rocks. Y-238 (p. 4) proposed that KW was a range–bounding fault during the late Tertiary or early Quaternary.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: About half of KW is shown by Y-238 as a topographic lineament bounding the front of the Funeral Mountains.

Analysis: Aerial photographs (Y-216, p. 3, scale ~1:12,000 (low–sun–angle); Y-238, p. 2, scales 1:24,000 to 1:80,000). Aerial reconnaissance (Y-216, p. 5).

Relationship to other faults: KW is located about 3 km northeast of the northwest–striking, chiefly right–lateral strike–slip Furnace Creek fault (FC) in Death Valley. KW is about 15 km southeast of the Grapevine fault (GV), which has a strike and, possibly, sense of displacement similar to those of KW. Several northwest–trending lineaments and several northwest–trending, down–to–the–northeast (uphill–facing) scarps are preserved between KW and GV near Mud Canyon (Y-238, pl. 3). The structural relationships among these three faults has not been specifically addressed.

Y-390 (p. A118) proposed that Precambrian rocks in the Funeral Mountains form a dissected turtleback surface that dips 25° to 40° into Death Valley. This surface is continuous with thrust faults at Boundary Canyon and at Echo Mountain. Y-390 (p. A118) speculated that the relationship between KW and this turtleback is similar to the relationships between other turtleback surfaces and the Emigrant fault (EM) along the western side of Tucki Mountain or the Death Valley fault (DV) at Mormon Point. From this, Y-390 (p. A118) concluded that the histories of these turtlebacks may also be similar.

On the basis of a variety of observations, Y-1357 concluded that KW is spatially separated from the Boundary Canyon fault, which is located near the northwestern end of KW in Boundary Canyon. Y-336 (p. 149) suggested KW may be at least in part controlled by Mesozoic thrust fault surfaces.

La Madre fault (LMD)

Plate or figure: Plate 2.

References: Y-813: Reheis, 1992 (pl. 3); Y-824: Sowers, 1985; Y-852: Dohrenwend and others, 1991 (show only the west–northwest–striking northern end of LMD as portrayed by Y-813); Y-894: Sowers, 1986. (Y-824 and Y-894 include a geomorphic map of the large alluvial fan that issues from Kyle Canyon at the central part of LMD and descriptions of geomorphic surfaces, soil development, and ages. Neither reference directly addresses displacements on LMD.)

Location: 82 km/129° (distance and direction of closest point from YM) at lat 36°23′N. and long 115°45′W. (location of closest point). LMD is located along the eastern side of the Spring Mountains between Bonanza Peak on the north and La Madre Mountain on the south.

USGS 7-1/2′ quadrangle: Angel Peak, Charleston Peak, Cold Creek, La Madre Spring.

Fault orientation: LMD strikes generally northwest but its trace curves (Y-813, pl. 3). The northern end of LMD strikes west–northwest; the central portion strikes north–northwest (Y-813, pl. 3). The very southern end of LMD strikes nearly north (Y-813).

Fault length: The total length of LMD is about 33 km as estimated from Y-813 (pl. 3). The west–northwest–striking northern portion of LMD (between Lee Canyon and Bonanza Peak) is 10 km long as estimated from Y-813 and Y-852. The north–northwest–striking central portion of LMD (between Lee Canyon and La Madre Mountain) is about 23 km long as estimated from Y-813.

Style of faulting: Displacement on a short section of the west–northwest–striking northern portion of LMD is shown by Y-813 as down to the north.

Scarp characteristics: Parts of the northern and central portions of LMD are portrayed by Y-813 as north–facing or northeast–facing scarps.

Displacement: No information.

Age of displacement: Two sections of LMD, one 5 km long and the other 3 km long, are portrayed by Y-813 as moderately expressed lineaments or scarps on surfaces of Quaternary deposits. LMD at the mouths of Kyle Canyon, Lee Canyon, and North Fork Deer Creek is shown by Y-813 as concealed. The map by Y-852 indicates that the northern 4 km of LMD is expressed as a fault–related lineament on Quaternary depositional or erosional surfaces. Y-813 (p. 10) suggested that LMD shows little or no evidence for Quaternary displacement.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Parts of the north–northwest–striking central portion of LMD are portrayed by Y-813 (pl. 3) as topographic lineaments bounding a linear range front.

About 6 km of the west–northwest–striking northern portion is shown by Y-852 as juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of this part of the Spring Mountains front would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, this part of LMD would be significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852).

La Madre fault (LMD) — Continued

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-824, p. 8; Y-852, scale 1:58,000). Soils studies (Y-824, p. 8 (field descriptions, petrographic microscope, x–ray diffraction); Y-894). Quaternary stratigraphy (Y-824, p. 8; Y-894). Field studies (Y-824, p. 8). Paleomagnetics and uranium–thorium analyses on calcrete (Y-824, p. 8, 18-22).

Relationship to other faults: Y-813 (p. 10) noted that the general lack of evidence for Quaternary displacement on LMD is similar to that of other northwest–striking faults in the area (e.g., the Las Vegas shear zone) and is consistent with a least principal stress direction of northwest–southeast as proposed by Carr (1974, Y-181, p. 10-11, fig. 3).

Lee Flat fault (LEE)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-356: McAllister, 1956 (shows only that part of LEE in Lee Flat north of lat 36°30′N.); Y-1148: Zellmer, 1980 (shows only that part of LEE in Lee Flat north of lat 36°30′N., pls. 3.1 and 3.5, his Lee Flat fault zone).

Location: 113 km/253° (distance and direction of closest point from YM) at lat 36°32′N. and long 117°38′W. (location of closest point). LEE includes fault traces within and bordering northern Lee Flat, which is located between the Nelson Range and the Inyo Mountains.

USGS 7-1/2′ quadrangle: Nelson Range, Santa Rosa Flat.

Fault orientation: LEE generally strikes northwest (Y-222; Y-356; Y-1148, pl. 3.5, p. 74).

Fault length: The longest trace of LEE, which is on the eastern side of Lee Flat, is about 7 km long as estimated from Y-1148 (pl. 3.5). The longest trace of LEE on the western side of Lee Flat is about 5 km long as estimated from Y-1148 (pl. 3.5) and about 6.5 km long as estimated from Y-356, but the trace extends to the southern edge of his map area at lat 36°30′N. Other traces have variable lengths; the shortest is about 0.5 km long as estimated from Y-1148 (pl. 3.5).

Style of faulting: Traces of LEE are shown by Y-1148 (pl. 3.5) as primarily down to the southwest; some are portrayed by him as down to the northeast.

Scarp characteristics: One topographic profile measured by Y-1148 (p. 74) across a fault scarp on the surface of a basalt on the eastern side of Lee Flat suggests a slope angle of 5°, a maximum scarp–slope angle of 82°, and a vertical surface displacement of 28 m (profile P23, fig. B.1, p. 152).

Displacement: Y-1148 (p. 74) estimated a vertical displacement of 28 m across the longest trace of LEE on the eastern side of Lee Flat. He based this estimate on one topographic profile measured across a fault scarp on the surface of a basalt.

Age of displacement: Y-356 portrayed LEE as fault traces on surfaces of Quaternary alluvium (his Qal deposits) and as faulted contacts between Paleozoic rocks and Quaternary alluvium. He showed LEE as low scarps on alluvial surfaces. Y-1148 (p. 76) noted that LEE cuts unconsolidated alluvial deposits and basalt flows, but no specific ages are given.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Analysis of aerial photographs (Y-1148, p. 1, 9, scales 1:20,000, 1:37,400, and 1:60,000). Aerial reconnaissance (Y-1148, p. 1). Field reconnaissance (Y-1148, p. 2). Field mapping (Y-356). Topographic profile across one fault scarp (Y-1148, p. 1, 74, 78–86, table 4.1, fig. B.1, p. 152). Detailed (1:50,000) map of fault scarps (Y-1148, pls. 3.1 and 3.5). Study of scarp material (Y-1148, p. 1-2).

Relationship to other faults: Y-1148 (p. 74-77) suggested that LEE, which approximately bounds both sides of northern Lee Flat, aligns with (1) his Western Frontal fault (WF, discussed with the Saline Valley faults (SAL) of this compilation) along the eastern front of the Inyo Mountains in Saline Valley, (2) a graben that crosses at Daisy Canyon into the Inyo Mountains between Lee Flat and Saline Valley, and (3) faults in both Centennial Flat and the Coso Range south of Lee Flat. He (Y-1148, p. 74-74) concluded that all these faults could be the surficial expression of a major tear fault that resulted from the formation of Saline Valley.

LEE is approximately parallel to the northwest–striking Hunter Mountain fault (HM) east of LEE and to the northwest–striking portion of the Owens Valley fault (OWV) west of LEE.

Lida Valley faults (LV)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 2). Not shown by Albers and Stewart, 1972 (Y-407) nor by Dohrenwend and others, 1992 (Y-853).

Location: 115 km/305° (distance and direction of closest point from YM) at lat 37°27'N. and long 117°30'W. (location of closest point). LV includes two main faults: one along the northwestern side of Lida Valley at its junction with the Palmetto Mountains and the other on the southeastern side of Lida Valley at its junction with Magruder Mountain.

USGS 7-1/2' quadrangle: Lida, Magruder Mountain.

Fault orientation: Both faults of LV strike northeast (Y-238).

Fault length: The length of the northwest fault of LV is 3.5 km as estimated from Y-238. The length of the southeast fault of LV is about 10 km as estimated from Y-238.

Style of faulting: No information.

Scarp characteristics: Most of the northwest fault of LV is shown by Y-238 as southeast–facing scarps. Parts of the southeast fault are shown by Y-238 as northwest–facing scarps.

Displacement: No information.

Age of displacement: Both faults of LV are portrayed by Y-238 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Parts of both faults are shown by Y-238 as lineaments bounding a linear range front.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: LV is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat. These faults include the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain immediately southeast of LV, the Montezuma Range fault (MR) along the western side of the Montezuma Range north of LV, the southern half of the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western side of Clayton Ridge north of LV, and the Gold Mountain fault (GOM) along the western side of Gold Mountain southeast of LV. LV is also approximately parallel to northeast–striking faults within basins. These faults include the Palmetto Mountains–Jackson Wash fault (PMJW) east of Lida Valley and immediately northeast of LV, the Stonewall Flat faults (SWF) within Stonewall Flat northeast of LV, the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and the Montezuma Range north of LV, and the Clayton Valley fault (CV) within Clayton Valley northwest of LV (Y-238; Y-853). All of these northeast–striking faults belong to a wide zone located 10 to 15 km east of the northwest–striking Furnace Creek fault (FC; Y-238, p. 4).

Y-238 (p. 4) speculated that the northeast–striking faults in the area around LV could be conjugate shears to FC. However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 4) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred that these faults could be rooted in a detachment fault at depth.

Lida Valley faults (LV) — Continued

The relationship between LV and the northeast–striking fault traces of the Palmetto Mountains–Jackson Wash fault (PMJW) is unknown. LV aligns with some of these fault traces, but a ridge extends east from the Palmetto Mountains between Lida Valley and the valley of Jackson Wash. This ridge has no reported evidence for possible Quaternary fault surface rupture.

Little Lake fault (LL)

Plate or figure: Plate 2.

References: Y-374: Roquemore, 1988; Y-413: Jennings and others, 1962; Y-415: Jennings, 1985 (Trona sheet); Y-425: Stinson, 1977; Y-427: Hart and others, 1989; Y-542: Roquemore and Zellmer, 1986; Y-640: Duffield and Roquemore, 1988; Y-1020: Jennings, 1992; Y-1035: Roquemore and Zellmer, 1983; Y-1052: Wills, 1988; Y-1056: Roquemore and Simila, 1993; Y-1110: Roquemore, 1981; Y-1111: Roquemore and Zellmer, 1987; Y-1112: Walter and Weaver, 1980; Y-1113: Duffield and Bacon, 1981; Y-1114: Duffield and Smith, 1978; Y-1145: Roquemore and Zellmer, 1983.

Location: 163 km/227° (distance and direction of closest point from YM) at lat 35°50′N. and long 117°45′W. (location of closest point). LL extends southeast from the Sierra Nevada front at the southern end of the Coso Range across Indian Wells Valley where its expression dies out near Ridgecrest, California, or continues to the Garlock fault with little surface expression (Y-1110, p. 10).

USGS 7-1/2′ quadrangle: Little Lake, Ninemile Canyon, Pearsonville, Volcano Peak, White Hills.

Fault orientation: LL strikes northwest (Y-1020; Y-1035, p. 198; Y-1052, p. [2]).

Fault length: The length of LL is reported by Y-1110 (p. 27) as ≥24 km, by Y-374 (p. 225) as >30 km, and by Y-1035 (p. 198) and Y-1052 (p. [2]) as about 40 km from west of the town of Little Lake, California, to south of Ridgecrest (includes northwest–striking fault traces in Indian Lake Valley where LL appears to merge with the Airport Lake fault (AIR)). Ground cracks attributed to the 1982 magnitude 5.2 earthquake occur in two areas over a combined length of about 10 km and along four consecutive *en echelon* segments of LL (Y-1035, p. 199).

Style of faulting: Displacement along LL is right–lateral strike slip (Y-1035, p. 198; Y-1052, p. [2]). The northern part of the fault has a narrow, linear pattern; the southeastern part in Indian Wells Valley is composed of widely spaced, discontinuous fault traces that form a series of *en echelon*, monoclinal flexures (Y-1035, p. 198). The flexures are down to the east where LL crosses the western side of the Airport Lake graben, but change to down to the west where LL crosses the eastern side of the graben (Y-1035, p. 198). At its southern end, LL becomes very diffuse and fault traces splay (Y-1110, p. 28).

Y-1110 (p. 12-16) noted a 2–km–long section of LL where geomorphic expression suggests that a thrust fault is associated with right–lateral displacement.

Scarp characteristics: Historical rupture is limited to ground cracks up to 4 mm wide in thick alluvial deposits along LL in Indian Wells Valley (Y-1035, p. 199). The cracks are generally at the crest of flexures or along the face of the flexures (Y-1035, p. 199). Trenches revealed "open cracks to a depth of about 0.5 m and wider, filled cracks extending to at least 5 m, but there was no indication of direct fault rupture within the alluvial and lacustrine deposits exposed in the trench" (Y-1035, p. 199). Y-1110 (p. 10, 27) noted that the surficial expression of LL includes aligned springs, shutter ridges, hillside troughs, linear troughs, sag ponds, and pressure ridges.

Displacement: Y-1110 (p. 10, 27) reported that young (not dated but probably Holocene) alluvium and landslide debris are displaced right–laterally 30 m at the northern end of LL where the fault merges with the Sierra Nevada fault. Southeast of the Owens River, a basalt flow dated (K-Ar) at 399 ka ± 45 ka (~400 ka; Y-1113, their Qb1 unit of the Basalt Southeast of Little Lake) is reported to be displaced right–laterally about 250 m by Y-542, ≥250 m by Y-1110 (p. 10, 12), and 400 m by Y-1052 (p. [5]). A channel of the Pleistocene Owens River is cut into this flow and is filled with another flow dated (K-Ar) at 140 ka ± 89 ka (Y-1113, their Basalt East of Little Lake).

Y-1110 (p. 2) noted that Pliocene and Pleistocene sediments have been warped into an anticline >25 m high.

Little Lake fault (LL) — Continued

Age of displacement: The youngest displacement on LL is historical. Ground cracks in Indian Wells Valley are attributed to the 1982 magnitude 5.2 earthquake (Y-427, p. 6; Y-1035, p. 198). Prior to this, the youngest displacement noted by Y-1110 (p. 42) in a trench appears to extend to the ground surface. A unit exposed in this trench 1 to 3 m below the surface contains open fracture fillings, liquefaction features, and probably "mud volcanoes" that are thought to have a tectonic origin. The radiocarbon date on carbonized twigs and charcoal from this unit is 2,545 ± 160 yr (Y-1110, p. 42). Thus, Y-1110 (p. 42) concluded that a major earthquake occurred on LL since about 2.5 ka.

A displaced basalt flow in a channel of the Owens River has an estimated age of about 22 ka based on assuming a constant downcutting rate along the river between 10 ka and 130 ka (Y-1114, table, p. 406).

Slip rate: Y-1052 (p. [2-3]) suggested a "loosely constrained" lateral slip rate between 0.6 and 1.8 mm/yr for LL on the basis of a reinterpretation of the 250 m of apparent lateral displacement of a channel wall of the Owens River (Y-1110, p. 10). The age of the displacement is bracketed by the basalt (the upper flow of basalt southeast of Little Lake, Qb1 of Y-1113, basalt of Lower Little Lake Ranch of Y-1114, p. 405) dated at 399 ka ± 45 ka into which the channel is cut and an intra–canyon flow dated at 140 ka ± 89 ka (basalt east of Little Lake, Qbe of Y-1113). Y-374 (p. 225) suggested that the lateral slip rate on LL may be "as high as 1 mm/yr or greater based on most recent evaluation of fault morphology." Y-1052 (p. [5], [8]) calculated a maximum lateral slip rate of 1 mm/yr for LL on the basis of 400 m of displacement in a basalt flow with an age of 400 ka.

The 30 m of displacement of suspected Holocene alluvium and landslide debris reported by Y-1110 (p. 10, 27) yields a minimum Holocene slip rate of 3 mm/yr. Using ≤250 m of displacement of the basalt with an estimated age of 51 ka to 229 ka (Y-1113; Y-1052), an apparent maximum (lateral?) slip rate is estimated to be between 1.1 and 4.9 mm/yr.

Recurrence interval: Y-374 (p. 225) reported that earthquakes of magnitude ≥5.0 have recurred every 20 yr for the past 60 yr along LL. Earthquakes of this size occurred in 1938, 1961, and 1981 (Y-1052, p. [4]).

Range-front characteristics: No range front is associated with LL.

Analysis: Aerial photographs (Y-1052, p. [5], scales 1:24,000 and 1:12,000; Y-1110, p. 8, scales 1:6,000 to 1:60,000). Field evaluation (Y-1052, p. [5]; Y-1110, p. 8). Evaluation of fault morphology (Y-374). Topographic profiles across ground cracks formed in 1981 (Y-1035, p. 199). Trench (Y-1110, p. 39-42).

Relationship to other faults: LL may be related to the Airport Lake fault (AIR) to the southeast and to the Sierra Nevada fault (SNV) or the Owens Valley fault (OWV) to the northwest.

Y-427 (table 1, p. 17) and Y-1052 (p. [2]) suggested that LL merges with the northwest–striking AIR in Indian Wells Valley. Northwest–striking fault traces in Indian Wells Valley have been considered part of LL by Y-1035, Y-1110, and Y-1111 (*all cited in* Y-1052, p. [2]), although these traces are continuous with AIR and have similarities to both faults (Y-1052, p. [2]). In contrast, Y-1035 (p. 198) suggested that AIR is truncated by LL because there is no evidence for AIR southwest of LL in Indian Wells Valley. Y-1035 (p. 200) also speculated that the fault pattern and distribution of epicenters of earthquakes along the traces of LL and AIR suggest that displacement along both faults has been interrelated. For example, Y-1035 (p. 200) cited a change in the dip of flexures along LL as they truncate the eastern and western sides of AIR as indicating a direct relationship between the two faults.

Y-1145 (p. 6) suggested that AIR and LL are a result of the same regional stress field and that the two faults "are components of the regional right–slip shear and the east–west extension that characterize the tectonics of the western Basin and Range physiographic province."

Little Lake fault (LL) — Continued

LL may merge with the SNV on the northwest (Y-1110, p. 10). However, although Y-374 (p. 224) noted that LL comes close to SNV near Little Lake, both Y-374 (p. 224) and Y-1052 reported no evidence that the two faults actually merge. Y-374 (p. 224) suggested that LL may continue northward separate from SNV and merge with the southern part of the Owens Valley fault (OWV). Y-427 (p. 6) speculated that LL is a right–lateral southern extension of OWV.

LL aligns with the Blackwater fault to the south and with the southern OWV to the north and may provide "a pathway for the Mojave shear zone into Indian Wells and Owens Valleys" (Y-1056). Y-1056 suggested that the Indian Wells/Coso area may be "the most likely site for the next large earthquake within the Mojave shear zone."

Lone Mountain fault (LMT)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 1); Y-407: Albers and Stewart, 1972; Y-853: Dohrenwend and others, 1992; Y-1032: Schell, 1981 (pl. 7, his fault #8, Millers Pond fault; he shows only that part of LMT north of about lat 38°05′N., which is north of the area shown on pl. 1 of this compilation); Y-1069: Yount and others, 1993 (name from this reference); Y-1070: Yount and others, 1993.

Location: 165 km/319° (distance and direction of closest point from YM) at lat 37°57′N. and long 117°40′W. (location of closest point). LMT is located along the southeastern side of Big Smoky Valley and along the northwestern side of Lone Mountain, which is north of lat 38°N. (north of the area shown on pl. 1 of this compilation).

USGS 7-1/2′ quadrangle: North of Silver Peak, Weepah.

Fault orientation: LMT strikes northeast (Y-238; Y-853).

Fault length: The length of LMT is 9 km as estimated from Y-238, 15 km as estimated from Y-853, and 70 km as estimated from Y-407. LMT extends to the edge of the map areas (at lat 38°N.) of both Y-238 and Y-853. The map by Y-407 covers the entire Big Smoky Valley.

Style of faulting: Predominate vertical displacement on LMT was inferred by Y-1069 (p. 388) on the basis of the sinuous character and large heights of the associated scarps. Y-407 (p. 53) noted that displacements on the fault traces are down to the north. In addition, right–lateral displacements of stream channels at two localities were reported by Y-1069 (p. 388).

Scarp characteristics: LMT is shown by Y-238, Y-407, and Y-853 as primarily northwest–facing scarps. One scarp south of lat 38°N. is portrayed by Y-238 and Y-853 as southeast–facing. Y-1032 (table A2, p. A3) reported a maximum scarp height of 5 m along LMT north of about lat 38°05′N. and a maximum scarp–slope angle of 21.5°.

Displacement: Y-1069 (p. 388) noted that Holocene surfaces are displaced about 1 m. Y-1069 (p. 388) and Y-1070 (p. 406) both reported that middle and late Pleistocene surfaces are displaced up to 5 m.

Y-407 (p. 53) stated that the "dip separation displacement" across the fault scarps associated with LMT ranges between a few meters and about 12 m (a few feet to about 40 ft).

Age of displacement: Scarps on surfaces of Holocene to probably early Pleistocene deposits are described by Y-1069 (p. 388) as spectacular. LMT is shown by Y-407 as faults in Holocene colluvium, alluvium, and playa deposits (their Qal deposits) and as faults that juxtapose Qal deposits on the northwest against older Pleistocene or Holocene alluvium (their Qoa deposits). Y-407 (p. 53) reported that the scarps on Holocene alluvium can be traced about 24 km (15 miles) and have an arcuate trend. LMT is portrayed by Y-1069 (p. 407) as displacing Holocene and late Pleistocene alluvial–fan deposits.

LMT is portrayed by Y-853 as scarps on depositional or erosional surfaces of late Pleistocene age (their Q_2 surfaces with estimated ages between 10 ka and 130 ka), early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma), and early to middle Pleistocene age (their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma). LMT is portrayed by Y-238 as weakly to moderately expressed lineaments and scarps chiefly on surfaces of Quaternary deposits and as faults that are in Tertiary deposits and that were identified from previous mapping.

For portions of LMT north of about lat 38°05′N. (north of the area covered by pl. 1), Y-1032 (table A2, p. A3) estimated that the probable age of the youngest rupture is Holocene "based on strong geomorphic expression of [the] scarp." The youngest unit displaced in this area (and also the oldest unit not displaced) is his intermediate–age alluvial–fan deposits (Y-1032, table A2, p. A3) with an estimated age of 15 ka to probably about 200 ka (Y-1032, table 3, p. 23).

Lone Mountain fault (LMT) — Continued

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Only part of LMT, that along the northwestern side of Lone Mountain, appears to bound a range front. The characteristics of this front have not been reported.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Compilation by Y-407 of unpublished geologic mapping by Moiola (1962) and by Albers, Stewart, and McKee (1960-1962). Field examination (Y-1032, p. 17-18). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: LMT is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat. These faults include part of the Emigrant Peak fault (EPK) along the western side of the Silver Peak Range west of LMT, the northern part of the General Thomas Hills fault (GTH) along the eastern side of the General Thomas Hills east of LMT, the Montezuma Range fault (MR) along the western side of the Montezuma Range southeast of LMT, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges east of LMT, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain south of LMT, and the Lida Valley faults (LV) between the Palmetto Mountains and Magruder Mountain south of LMT. LMT is also approximately parallel to northeast–striking faults within basins. These faults include the Stonewall Flat faults (SWF) within Stonewall Flat southeast of LMT, the Palmetto Mountains–Jackson Wash faults (PMJW) in the valley northeast of Palmetto Mountains and southeast of LMT, the Clayton Valley fault (CV) within Clayton Valley south of LMT, and the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range southeast of LMT (Y-238; Y-853). In contrast, LMT is nearly perpendicular to the Weepah Hills fault (WH) along the southern side of the Weepah Hills immediately south of LMT.

Y-238 (p. 4) speculated that the northeast–striking faults in the area around LMT could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Reheis and Noller (1989, Y-10, p. 60) inferred that these faults could be rooted in a detachment fault at depth.

Y-1069 (p. 388-389) speculated that LMT may transfer right–lateral displacement associated with the northwest–striking Fish Lake Valley fault (FLV), located in Fish Lake Valley about 50 km west of LMT, to the northwest–striking Cedar Mountain fault (CM), located about 40 km northwest of LMT.

McAfee Canyon fault (MAC)

Plate or figure: Plate 1.

References: Y-216: Brogan and others, 1991 (pl. 1A; show only that portion of MAC in Fish Lake Valley and east of their Oasis section of the Furnace Creek fault); Y-238: Reheis and Noller, 1991 (pl. 1); Y-853: Dohrenwend and others, 1992.

Location: 155 km/300° (distance and direction of closest point from YM) at lat 37°33′N. and long 117°56′W. (location of closest point). The northern part of MAC is located along a portion of the western front of the northern Silver Peak Range (south of Piper Peak) at its junction with Fish Lake Valley. The southern portion of MAC is located within Fish Lake Valley.

USGS 7-1/2′ quadrangle: Indian Garden Creek, Piper Peak.

Fault orientation: MAC strikes generally north; a central portion strikes north–northwest (Y-238; Y-853).

Fault length: The length of MAC is about 14 km as estimated from Y-853 and about 17 km as estimated from Y-238.

Style of faulting: Displacement is down to the west on the part of MAC that is shown by Y-238 as a previously mapped fault.

Scarp characteristics: Scarps, which are along part of MAC, are shown by Y-238 and Y-853 as west–facing.

Displacement: No information.

Age of displacement: Part of the southern portion of MAC (in Fish Lake Valley) is shown by Y-853 as scarps on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). This same portion of the fault is portrayed by Y-238 as weakly or moderately expressed lineaments or scarps on surfaces of Quaternary deposits and as a fault that is in Quaternary deposits and that was identified from previous mapping. Y-216 (pl. 1A, p. 8) indicated that this portion of MAC is a prominent set of vegetation lineaments on surfaces for which no age estimate was given.

The northern portion of MAC (along the Silver Peak Range front) is portrayed by Y-853 as juxtaposing Quaternary alluvium against bedrock. Y-238 showed this same portion of the fault as a topographic lineament along a linear range front, as a strongly expressed lineament or scarp on surfaces of Tertiary deposits, and as a fault that is in Tertiary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The southern part of the western front of the Silver Peak Range along MAC is shown to be linear by Y-238. The morphology of this range front is noted by Y-853 to be similar to that along major range–front faults (e.g., characterized by "a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front"), except that MAC is "significantly less extensive and fault scarps are substantially lower, shorter, and less continuous."

Analysis: Aerial photographs (Y-216, scale 1:12,000; Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: The southern end of MAC nearly intersects the northwest–striking, primarily right–lateral strike–slip Fish Lake Valley fault (FLV) in Fish Lake Valley. Y-238 (p. 2-3) speculated that MAC, along with other north–striking and north–northeast–striking, primarily dip–slip faults east of the main trace of FLV, may be related to displacement on FLV. In addition, they (Y-238, p. 3) noted that both the northwest–striking faults and the north– to north–northeast–striking faults "are consistent with an east–west direction of least principal stress." They (Y-238, p. 3) suggested that the north– and north–northeast–striking faults "in northern Fish Lake Valley may function as pull–apart faults in a giant right step between the northern end of the right–lateral [FLV] and the northern part of the right–lateral Walker Lane, which ends about 40 km to the north."

Mercury Ridge faults (MER)

Plate or figure: Plate 2.

References: Y-62: Barnes and others, 1982; Y-671: Guth, 1990; Y-813: Reheis, 1992 (pl. 3; shows only the northwest fault); Y-852: Dohrenwend and others, 1991.

Location: 48 km/110° (distance and direction of the closest point of the northwest fault of MER from YM) at lat 36°41′N. and long 115°56′W. (location of closest point of the northwest fault); 51 km/109° (distance and direction of the closest point of the southeast fault of MER from YM) at lat 36°41′N. and long 115°55′W. (location of closest point of the southeast fault). MER includes two main faults: one along the northwestern side of Mercury Ridge and the other along the southeastern side of Mercury Ridge.

USGS 7-1/2′ quadrangle: Mercury, Mercury NE.

Fault orientation: The two faults of MER strike generally northeast (Y-813; Y-852).

Fault length: The northwest fault is 9 km long (Y-813) to 10 km long (Y-852). Two short traces, each 1 to 1.5 km long, compose the southwestern end of this fault (Y-852; these traces are not shown separately on pl. 2 of this compilation). The southeast fault is 3 km long (Y-852).

Style of faulting: The northwest fault is shown by Y-62 and Y-813 as having oblique displacement with the dip–slip portion being down to the northwest. The strike–slip portion is portrayed by Y-813 as left lateral and by Y-62 as right lateral.

The southeast fault is shown by Y-62 as having oblique displacement with the dip–slip portion as down to the southeast and the strike–slip portion as left lateral. Y-62 noted that the evidence for dip–slip displacement is primarily topographic in that the existing topographic relief across the fault cannot be explained entirely by differential erosion of different rock types on opposite sides of the fault.

Scarp characteristics: No information.

Displacement: Y-62 reported about 1 km of left–lateral displacement in Mississippian rocks along the southeast fault of MER. Right–lateral displacement across the northwest fault of MER is noted by Y-62 as up to 0.5 km.

Age of displacement: Both faults of MER are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock. Y-62 portrayed both faults as juxtaposing Oligocene rocks against pre–Tertiary rocks and as concealed by Quaternary and Tertiary alluvium. The map of Y-813 (pl. 3) shows about 1 km of the northwest fault as a fault that is in Tertiary deposits and that was identified by previous mapping.

Slip rate: No information.

Recurrence rate: No information.

Range-front characteristics: Both faults of MER are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock, but not as major range–front faults. The morphology of the northwestern and southeastern sides of Mercury Ridge would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." Although the morphology of the sides of Mercury Ridge is similar to that along major range–front faults, the "associated fault systems are significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous" (Y-852). All but about 1 km of the northwest fault is shown by Y-813 (pl. 3) as a topographic lineament bounding a linear range front.

Analysis: Aerial photographs (Y-671; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Mercury Ridge faults (MER) — Continued

Relationship to other faults: MER may be the southwestern extension of the Spotted Range faults (SPR). However, the Ranger Mountains and the Sandy Wash Valley separate MER from SPR to the east. The strike of MER is similar that of the Rock Valley fault (RV), which is located about 8 km north of MER. The strike of MER is also similar to that of the faults in Crossgrain Valley (CGV) and the South Ridge faults (SOU), both of which are located south of MER.

The Ranger Mountains faults (RM), located immediately north of MER, strike at an oblique angle to MER.

Mine Mountain fault (MM)

Plate or figure: Plate 1.

References: Y-62: Barnes and others, 1982; Y-104: Ekren and Sargent, 1965 (show only the southwestern part of MM south of lat 36°52′30″N. and east of long 116°15′W.); Y-181: Carr, 1974; Y-182: Carr, 1984 (name from his fig. 7); Y-192: Marvin and others, 1970; Y-205: Orkild, 1968 (shows only that part of MM between Mine Mountain and Shoshone Mountain); Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 3; show only one lineament or scarp along Shoshone Mountain that may align with MM as portrayed by Y-205 and Y-232); Y-301: Fleck, 1970; Y-314: Ekren, 1968; Y-1107: Carr, 1974.

Location: 19 km/87° (distance and direction of closest point from YM) at lat 36°50′N. and long 116°14′W. (location of closest point). MM is located along the southern side of Mine Mountain and in Mid Valley. It extends into the northern edge of Jackass Flats.

USGS 7-1/2′ quadrangle: Mine Mountain, Skull Mountain, Yucca Lake.

Fault orientation: MM strikes generally northeast, but the fault curves, so that its strike ranges between north–northeast and northeast (Y-232).

Fault length: The length of MM is about 16 km as estimated from Y-104 and Y-205 between Mine Mountain and south of Shoshone Mountain, 22 km as estimated from Y-232, and about 27 km as estimated from Y-182 (fig. 7). The lineament or scarp that is shown by Y-238 along Shoshone Mountain is about 3 km long.

Style of faulting: Displacement on MM may be oblique, because the displacement is shown by Y-104, Y-205, and Y-232 as down–to–the–southeast dip slip and left–lateral strike slip.

Scarp characteristics: No information.

Displacement: Y-182 (p. 61) and Y-205 both suggested that left–lateral displacement of the Paintbrush and Timber Mountain tuffs (about 11.5 Ma to 13.5 Ma) has been about 1 km along MM south of Mine Mountain. However, Y-182 (p. 61) noted that lateral displacement is difficult to measure because of the lack of correlative units across MM.

Age of displacement: The 3–km–long section along Shoshone Mountain and west of Barren Spot is shown by Y-238 (pl. 3) as a weakly to moderately expressed lineament or scarp on surfaces of Quaternary deposits and as a topographic lineament along a range front or in bedrock. Parts of this same section of MM are portrayed by Y-205 as displacing older Quaternary alluvium (his Qoa deposits) against Miocene Wahmonie Formation (his Tw unit). The youngest unit shown by Y-232 (pl. 1) as displaced by MM is a combination of Pliocene Timber Mountain Tuff, Miocene Paintbrush Tuff, and tuff of Crater Flat (his Tp unit). This unit is faulted against Devonian rocks southeast of Mine Mountain (Y-232).

The map by Y-205 shows most of MM in and adjacent to Mid Valley as concealed by older Quaternary alluvium (his Qoa deposits) and younger Quaternary alluvium and colluvium (his Qal and Qac deposits). Similarly, maps by both Y-104 and Y-232 portray MM as concealed by Quaternary alluvium (their Qa and Qal deposits).

The Spotted Range–Mine Mountain structural zone (SRMM), a zone of northeast–striking faults of which MM may be a part, is considered by Y-182 (p. 44, 61) to be seismically active because of the numerous earthquakes in the area. However, Y-62 (*citing* Y-301) suggested that most of the displacement on SRMM may have occurred between 5 Ma and 7 Ma during the late Miocene and early Pliocene. In addition, Y-182 (p. 64) concluded that much of SRMM had developed and considerable erosion had occurred before middle Oligocene. This conclusion is based on the age of the oldest Tertiary rocks in SRMM (correlated with the Horse Spring Formation dated at slightly greater than 29 Ma (K–Ar) by Y-192, tables 1 and 2, sample locality #19, p. 2663, 2665).

Slip rate: Based on 1 km of left–lateral displacement that was noted by Y-182 (p. 61) and Y-205 in volcanic tuffs that erupted between 11.5 Ma and 13.5 Ma, the average apparent lateral slip rate on MM since late Tertiary is 0.07 to 0.09 mm/yr.

Mine Mountain fault (MM) — Continued

Recurrence interval: No information.

Range-front characteristics: No range front is associated with MM.

Analysis: Aerial photographs (Y-232; Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: MM is one of four main faults that have been grouped into the 30–to–60–km–wide Spotted Range–Mine Mountain structural zone (SRMM), which is characterized by northeast–striking, left–lateral faults that have experienced relatively small amounts of displacement (Y-181, p. 9; Y-182, p. 56). The other three faults in SRMM are the Cane Spring fault (CS), the Rock Valley fault (RV), and the Wahmonie fault (WAH). These faults have been interpreted to be "first–order structures that form a conjugate system with the northwest–striking, right–lateral faults of the Las Vegas Valley shear zone" (Y-62, *citing* Y-1107). Y-314 (p. 16-17) suggested that displacement along faults in SRMM resulted from what he called rotary slippage during right–lateral displacements along the Las Vegas Valley shear zone (LVS). However, Y-182 (p. 63) noted that neither the LVS nor the northwest–striking La Madre shear zone crosses SRMM and that significant curving or bending of faults in SRMM, which would be required if such rotation had occurred, is lacking. Y-181 concluded that the northwest–striking faults and flexure zones with right–lateral displacement or bending north of LVS (e.g., the Frenchman flexure; Y-181, fig. 11, p. 34) and the faults of SRMM are probably related because faults in the two zones mutually displace one another as indicated by field relationships (W.J. Carr, unpublished data, 1976, *cited by* Y-181, p. 9) and because both zones are locally active as indicated by associated seismicity (Y-181, p. 9).

Displacements on faults in SRMM are thought by Y-182 (p. 62) to have been conjugate to displacements on faults in the northwest–trending Walker Lane.

Both the similarity in types of displacement and the alignment of surficial expression suggested to Y-182 (p. 62) that SRMM may be connected to the Pahranagat fault (PGT) to the northeast (the Pahranagat shear zone of Y-182). However, 70 km separates SRMM and PGT and no northeast–trending structures have been recognized in the Paleozoic rocks that are exposed in numerous places within this gap, which includes the north– and north–northwest–trending Spotted, Pintwater, and Desert ranges (Tschanz and Pampeyan, 1970 (Y-404); Ekren and others, 1977 (Y-25); Y-182, p. 62).

The northeastern end of MM may terminate at or near the north–northwest–striking Yucca Lake fault (YCL).

Monitor Hills East fault (MHE)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 1). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 125 km/343° (distance and direction of closest point from YM) at lat 37°56′N. and long 116°51′W. (location of closest point). MHE is located along the eastern side of the Monitor Hills and in the adjacent area of Cactus Flat.

USGS 7-1/2′ quadrangle: Monitor Peak, Reeds Ranch.

Fault orientation: MHE generally strikes north. Individual fault traces on the western side of MHE strike north or north–northwest; individual fault traces on the east strike north–northeast (Y-813).

Fault length: The length of MHE is about 8 km as estimated from Y-813.

Style of faulting: No information.

Scarp characteristics: Scarps along MHE are shown by Y-813 as primarily east–facing. One scarp at the southern end of MHE is portrayed by Y-813 as west–facing.

Displacement: No information.

Age of displacement: Most of MHE is portrayed by Y-813 as weakly expressed lineaments and scarps on surfaces of Quaternary deposits. The northern end of MHE is shown by Y-813 as weakly expressed lineaments and scarps on surfaces of Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: MHE is approximately parallel to other north–striking faults in the area. These faults include the Monitor Hills West fault (MHW) that bounds the western side of the Monitor Hills immediately west of MHE, the Cactus Flat fault (CF) in Cactus Flat east of MHE, the East Stone Cabin fault (ESC) along the eastern side of Cactus Flat, and the Mud Lake–Goldfield Hills fault (MLGH) that "may be a continuation of the north–[striking] faults characteristic of the Basin and Range to the north and east of the Walker Lane" (Reheis and Noller, 1991, Y-238, p. 3).

Monitor Hills West fault (MHW)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 1). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 124 km/341° (distance and direction of closest point from YM) at lat 37°55′N. and long 116°53′W. (location of closest point). MHW is located along the western side of the Monitor Hills at their junction with the Ralston Valley.

USGS 7-1/2′ quadrangle: Monitor Peak, Reeds Ranch.

Fault orientation: MHW strikes north to north–northwest. Individual fault traces strike between north–northwest and northeast (Y-813).

Fault length: The length of MHW is about 12 km as estimated from Y-813 to the northern edge of her map area at lat 38°N. It is not known if MHW continues north of this latitude. If a northeast–trending alignment of lineaments and scarps shown by Y-813 in Ralston Valley south of the Monitor Hills is part of MHW, then the length of MHW is about 15 km as estimated from Y-813.

Style of faulting: No information.

Scarp characteristics: Scarps associated with MHW are shown by Y-813 as primarily west–facing.

Displacement: No information.

Age of displacement: MHW is portrayed by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: MHW is approximately parallel to other north–striking faults in the area. These faults include the Monitor Hills East fault (MHE) that bounds the eastern side of the Monitor Hills immediately east of MHW, the Cactus Flat fault (CF) in Cactus Flat east of MHW, the East Stone Cabin fault (ESC) along the eastern side of Cactus Flat, and the Mud Lake–Goldfield Hills fault (MLGH) that "may be a continuation of the north–[striking] faults characteristic of the Basin and Range to the north and east of the Walker Lane" (Reheis and Noller, 1991, p. 3, Y-238).

MHW aligns with the north–striking northern portion of the Cactus Range–Wellington Hills fault (CRWH), which is directly south of MHW along the western side of the Cactus Range. A gap in surficial expression of at least 10 km separates the two faults.

Monotony Valley fault (MV)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 1). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 103 km/22° (distance and direction of closest point from YM) at lat 37°42′N. and long 116°00′W. (location of closest point). MV includes one fault trace along the northern side and one fault trace along the western side of an unnamed highland at the northeastern end of Monotony Valley.

USGS 7-1/2′ quadrangle: Monotony Valley.

Fault orientation: The northern fault trace strikes northeast; the western fault trace strikes north to north–northwest (Y-813).

Fault length: The length of the northern trace is 1 km, and the length of the western trace is 5.5 km (both estimated from Y-813).

Style of faulting: Displacement on the northern trace is shown by Y-813 as down to the northwest. Displacement on the western trace is portrayed by Y-813 as down to the west.

Scarp characteristics: A 0.5–km–long section of the western trace is portrayed by Y-813 as a west–facing scarp.

Displacement: No information.

Age of displacement: The western trace is shown by Y-813 primarily as a fault that is in Tertiary deposits and that was identified from previous mapping. One short (<0.5 km long) portion of this trace is portrayed by Y-813 as a weakly expressed lineament or scarp on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The northern trace is shown by Y-813 as a topographic lineament along a linear front or in bedrock.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: The relationship of the two fault traces of MV to each other and to other faults in the area has not been reported. The western trace of MV is approximately parallel to faults along the eastern and western sides of the Belted Range: the Belted Range fault (BLR) on the west and the East Belted Range fault (EBR) on the east.

Several north–northeast–trending, weakly expressed lineaments and scarps shown by Y-813 on surfaces of Tertiary deposits (not shown on pl. 1 of this compilation) cross Monotony Valley west of and at an oblique angle to MV. The relationship of these features to MV is not known.

Montezuma Range fault (MR)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 1); Y-853: Dohrenwend and others, 1992; Y-1032: Schell, 1981 (pl. 8; name from his table A2, fault #11; shows only the northern part of MR, which extends to the southern edge of his map area at about lat 37°40′N.). Not noted by Albers and Stewart, 1972 (Y-407).

Location: 121 km/310° (distance and direction of closest point from YM) at lat 37°33′N. and long 117°27′W. (location of closest point). MR is located along the northwestern side of the Montezuma Range at its junction with an unnamed valley.

USGS 7-1/2′ quadrangle: Alkali, Lida Wash, Montezuma Peak, Montezuma Peak SW, Paymaster Ridge, Split Mountain.

Fault orientation: MR strikes generally northeast, but the fault curves so that individual sections strike between northwest and northeast (Y-238; Y-853).

Fault length: The length of MR is 29 km as estimated from Y-238 and 33 km as estimated from Y-853. Unlike Y-238, Y-853 extended MR northeast of Montezuma Range. Y-1032 (table A2, p. A3) reported a length of at least 18 km for MR; however, he shows only the northern portion of the fault.

Style of faulting: On the basis of observations from aerial photographs and field reconnaissance, Y-10 (p. 57-58) inferred that MR has dip–slip (normal) displacement and a steep (70° to 90°) northwest dip.

Scarp characteristics: Scarps associated with MR are shown by Y-238, Y-853, and Y-1032 as primarily northwest–facing.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along MR is noted by Y-1032 (table A2, p. A3) to be late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A3) with an estimated age of 15 ka to probably about 200 ka (Y-1032, table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A3) with an estimated age of ≤15 ka (Y-1032, table 3, p. 23). The oldest unit displaced is his old–age alluvial–fan deposits (A5o; Y-1032, table A2, p. A3) with an estimated age of 700 ka to 1.8 Ma (Y-1032, table 3, p. 23).

At one locality near the fault's southern end, MR is shown by Y-853 as a scarp on a depositional or erosional surface with an early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surface with estimated ages between 10 ka and 1.5 Ma). Portions of MR are portrayed by Y-238 as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits. Most of MR is shown by Y-853 to be one of the major range–front faults in the area, all of which they noted display evidence for Quaternary activity.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: MR is portrayed by Y-853 as a major range–bounding fault that borders a tectonically active range front that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front."

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Magnetometer surveys (Y-1032, p. 16-17). Gravity analysis (Y-1032, p. 16).

Montezuma Range fault (MR) — Continued

Relationship to other faults: MR is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat. These faults include the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges west of MR, the General Thomas Hills fault (GTH) along the eastern side of the General Thomas Hills north of MR, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain south of MR, and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains south of MR. MR is also approximately parallel to northeast–striking faults within basins. These faults include the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range immediately west of MR, the Clayton Valley fault (CV) in Clayton Valley west of MR, the Lone Mountain fault (LMT) along the southeastern side of Big Smoky Valley northwest of MR, the Stonewall Flat faults (SWF) within Stonewall Flat east of MR, and the Palmetto Mountains–Jackson Wash faults (PMJW) in the valley northeast of the Palmetto Mountains east of MR (Y-238; Y-853).

Y-238 (p. 4) speculated that the northeast–striking faults in the area around MR could be conjugate shears to the northwest–striking Furnace Creek fault (FC) to the southwest. However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred the faults could be rooted in a detachment fault at depth.

Mud Lake–Goldfield Hills fault (MLGH)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 1). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 113 km/330° (distance and direction of closest point from YM) at lat 37°46′N. and long 117°05′W. (location of closest point). MLGH is located along the western side of Mud Lake and extends into the northeastern portion of the Goldfield Hills.

USGS 7-1/2′ quadrangle: East of Goldfield, Goldfield, McMahon Ridge, Mud Lake NW, Mud Lake South.

Fault orientation: Fault traces in MLGH are left stepping, so that the strike of the MLGH is north–northwest (Y-238). Most fault traces within MLGH strike north to north–northwest (Y-238). A few fault traces strike north–northeast (Y-238).

Fault length: The length of MLGH is 33 km as estimated from Y-238. This is a minimum value because MR extends to the edge of their map area at lat 38°N.

Style of faulting: One 2–km–long section of MLGH is shown by Y-238 as a graben.

Scarp characteristics: Scarps associated with MLGH are shown by Y-238 as primarily east–facing. Some scarps are shown by Y-238 as west–facing.

Displacement: No information.

Age of displacement: Most of MLGH is portrayed by Y-238 as moderately expressed to prominent lineaments and scarps on surfaces of Tertiary deposits. The map by Y-238 shows two sections in the central part of MLGH west of Mud Lake, each about 2 km long, as faults that are in Quaternary deposits and that were identified from previous mapping. In addition, one section at the southern end of MLGH (about 3.5 km long) and two sections northwest of Mud Lake (1 km and 4 km long) are mapped by Y-238 as weakly expressed scarps on surfaces of Quaternary deposits. The two scarps northwest of Mud Lake were noted by Y-238 (p. 3) to be "degraded and only offset relatively old Pleistocene deposits." They interpreted these characteristics to indicate "that this area is now quiescent" (Y-238, p. 3).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with MLGH.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: MLGH is approximately parallel to other north–striking to north–northwest–striking faults in the area. These faults include the Monitor Hills East (MHE) and the Monitor Hills West (MHW) faults that bound the eastern and western sides of the Monitor Hills east of MLGH, the Cactus Flat fault (CF) that is in central Cactus Flat east of MLGH, and the northern part of the Clayton Ridge–Paymaster Ridge fault (CRPR) that bounds the western side of Paymaster Ridge west of MLGH. Y-238 (p. 3) noted that the north– to north–northeast–striking MLGH "may be a continuation of the north–[striking] faults characteristic of the Basin and Range to the north and east of the Walker Lane."

MLGH is immediately north of and aligns with the north–northeast–striking Stonewall Flat fault (SWF). The relationship between these two faults has not been reported.

North Desert Range fault (NDR)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970; Y-813: Reheis, 1992 (pl. 2).

Location: 80 km/67° (distance and direction of closest point from YM) at lat 37°07′N. and long 115°35′W. (location of closest point). NDR is located along the western and northern sides of the northern Desert Range. The southern end of NDR is adjacent to Emigrant Valley. The northern end of NDR is adjacent to the Jumbled Hills on the west or to Tikaboo Valley on the east. Some traces included in NDR are located 0.5 to 1 km west of the Desert Range.

USGS 7-1/2′ quadrangle: Fallout Hills NE, Groom Range SE, Southeastern Mine.

Fault orientation: NDR generally strikes north, but the fault curves (Y-813). Parts of its northern and southern ends strike northeast or north–northwest (Y-813). NDR includes branching, anastomosing, and subparallel traces (Y-813).

Fault length: The length of NDR along the front of the Desert Range is 24 km as estimated from Y-813. The length of fault traces that are located 0.5 to 1 km west of the range front is 3.5 km (also estimated from Y-813).

Style of faulting: Parts of NDR along the front of the Desert Range (chiefly the northern and southern ends of NDR) are shown by Y-813 as down–to–the–west (primarily) faults.

Scarp characteristics: Parts of NDR along the front of the Desert Range (chiefly the central part of NDR) are shown by Y-813 as primarily west–facing scarps. Parts of the fault traces located 0.5 to 1 km west of the range front are portrayed by Y-813 as both east–facing and west–facing scarps.

Displacement: No information.

Age of displacement: NDR is shown by Y-813 as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits and as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Parts of NDR are shown by Y-813 as lineaments along a linear range front.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000). Field mapping (Y-404, p. 2).

Relationship to other faults: Most of NDR is approximately parallel to other north–striking faults in the area. These faults include the Jumbled Hills fault (JUM) along the western side of the Jumbled Hills immediately west of NDR; the East Pintwater Range fault (EPR) and the Central Pintwater Range fault (CPR) immediately south of NDR; the West Pintwater Range fault (WPR) along the western side of the Pintwater Range immediately southwest of NDR; the Tikaboo fault (TK) in Tikaboo Valley east of the northern Desert Range and NDR; the Stumble fault (STM), the Groom Range East fault (GRE), and the Groom Range Central fault (GRC) along the eastern and western sides of and within the Groom Range northwest of NDR; the Fallout Hills faults (FH), the Chert Ridge faults (CHR), and the Buried Hills fault (BH), all southwest of NDR.

North Desert Range fault (NDR) — Continued

Neither EPR nor CPR extend north of the southern end of NDR (pl. 1) as shown by Y-813. This end of NDR strikes northeast; it is portrayed by Y-813 (pl. 2) as a previously identified fault in Tertiary deposits. The north–striking central portion of NDR aligns with the north–striking northern end of EPR. However, displacement is in opposite directions (down to the west for NDR and down to the east for EPR), and is of apparently different ages (primarily in Quaternary deposits or on Quaternary surfaces for the central part of NDR and as a fault previously identified in Tertiary deposits for EPR). In contrast, WPR extends north of the western projection of NDR (Y-813). The northern end of WPR is portrayed by Y-813 as fault traces in both Quaternary and Tertiary deposits. The northwest–striking Three Lakes Valley fault (TLV) does not appear to extend northwest of the southern end of NDR (pl. 1). The map by Y-813 portrays the 0.5–km–long, northwestern end of TLV as concealed and connecting with the southern end of NDR. The actual structural relationships among these faults are not known.

One section near the northern end of NDR strikes northeast across the northern end of the Desert Range (pl. 1) and is shown by Y-813 (pl. 2) as a down–to–the–northwest fault trace in Tertiary deposits. This section "connects" the down–to–the–west, north–striking portion of NDR along the western front of the northern Desert Range to a fault trace that strikes north and north–northwest with down–to–the–east displacement at the very northern end of what may be NDR along the western edge of Tikaboo Valley. The fault trace in Tikaboo Valley is parallel to and has a similar sense of displacement as the north–northwest–striking traces combined into the Tikaboo fault (TK of this compilation) east of the northern Desert Range. The structural relationship between NDR and TK is not known.

Two fault traces 2.5 to 3.5 km west of the northern Desert Range front and adjacent to the Jumbled Hills are each 2 km long as estimated from Y-813. The actual relationship of these traces to NDR is not known, although these traces are included in NDR in this compilation for discussion purposes.

Oak Spring Butte faults (OAK)

Plate or figure: Plate 1.

References: Y-50: Barnes and others, 1963 (show only a portion of one fault in OAK, the Butte fault (BT) south of Oak Spring Butte (south of lat 37°15'N.)); Y-181: Carr, 1974; Y-212: Rogers and Noble, 1969 (OAK includes their Butte fault); Y-232: Cornwall, 1972 (pl. 1; fig. 2, p. 29; showed the Yucca fault and the Butte fault as a singe fault trace); Y-693: Barosh, 1968 (p. 209-210; suggested that the Butte fault joins the north–striking Yucca fault, which is immediately south of BT in Yucca Flat); Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992.

Fault traces shown on plate 1 of this compilation have been taken from Y-853 (primarily) and Y-212. Maps by Y-212, Y-813, and Y-853 all show more faults in this area than are indicated on plate 1. Only those faults that are portrayed by at least one reference as having possible Quaternary displacement are included in this compilation. Y-853 indicated faults in Tertiary rocks northeast of Wheelbarrow Peak, but these faults are not shown by Y-813 and so are not included in OAK. Individual fault traces shown by Y-813, Y-181 (fig. 7), Y-212, and Y-232 (pl. 1) do not coincide.

Location: 57 km/39° (distance and direction of closest point from YM) at lat 37°14'N. and long 116°03'W. (location of closest point). OAK is located along the eastern side of the Belted Range, west of northern Emigrant Valley, and north of Yucca Flat.

USGS 7-1/2' quadrangle: Groom Mine NW, Groom Mine SW, Jangle Ridge, Oak Spring, Oak Spring Butte, Wheelbarrow Peak.

Fault orientation: OAK strikes generally north, but individual faults strike between north–northeast and north–northwest (Y-50; Y-212; Y-813; Y-853).

Fault length: The total length of faults considered part of OAK in this compilation is about 19 km as estimated from Y-853 and about 21 km as estimated from Y-813. The lengths of individual faults range between 2 and 11 km as estimated from Y-853 or between 0.5 and 13 km as estimated from Y-813. Y-693 (p. 209), who suggested that BT joins the Yucca fault (YC) to the south, noted that the combined length of these faults is 40 km (25 miles).

Style of faulting: Displacement on faults in OAK is portrayed by Y-212 and Y-813 as both down to the east and down to the west. Displacement on BT has been down to the east (Y-50; Y-212).

Scarp characteristics: The one scarp shown by Y-853, which is along the northern part of the Butte fault, is east–facing. Scarps shown by Y-813 along portions of faults in OAK are both east–facing and west–facing.

Displacement: Y-693 (p. 210) reported vertical displacement of nearly 458 m (1,500 ft) in Tertiary volcanic rocks (his Grouse Canyon Member of the Belted Range Tuff) along BT.

Age of displacement: The youngest fault in OAK appears to be BT, which is portrayed by Y-853 as a scarp on depositional or erosional surfaces of possible late Pleistocene age (their Q2? surfaces with estimated ages between 10 ka and 130 ka). Y-813 portrayed BT as a topographic lineament bounding a linear range front (primarily), as weakly expressed lineaments or scarps on surfaces of Quaternary deposits, and as faults that are in Tertiary deposits and that were identified from previous mapping. However, BT is shown by Y-50 and Y-212 as concealed by Quaternary alluvium and colluvium (their Qac deposits). The map by Y-50 portrays the southern part of BT as juxtaposing Tertiary volcanic units (their Tb, Tigl, Tits, and Tiz units) against each other and against older rocks (e.g., Ordovician Eureka Quartzite (Oe)). The map by Y-232 shows BT in a similar manner. Y-693 (p. 209) noted that BT displaces bedrock, but "passes beneath the alluvium" to the north.

Oak Spring Butte faults (OAK) — Continued

Most faults in OAK, other than BT, are portrayed by Y-813 as faults that are in Tertiary deposits and that were identified from previous mapping. Short sections of faults in OAK are portrayed by Y-813 as weakly to moderately expressed lineaments or scarps on surfaces of Tertiary deposits. These same faults are shown by Y-853 as scarps and (or) prominent topographic lineaments on surfaces of Tertiary volcanic or sedimentary rocks or as faults juxtaposing Quaternary alluvium against bedrock. Portions of faults in OAK are shown by Y-212 as faulted contacts either between different Tertiary volcanic tuff units (chiefly Miocene Belted Range Tuff; their Tba, Tbg, Tbts) or between these Tertiary tuffs and Quaternary alluvium and colluvium (their Qac deposits).

Faults in OAK occur between two faults, the north–striking Yucca fault (YC) in Yucca Flat on the south and the north–northeast–striking Emigrant Valley north fault (EVN) in northern Emigrant Valley on the north. Because of these relationships and because both YC and EVN have probably experienced Quaternary displacement, Y-813 (p. 7) reasoned that faults in OAK, although preserved primarily in Tertiary rocks, have probably experienced Quaternary displacement.

Y-232 (p. 32, *citing* Ekren and others, written commun., 1966) suggested that two ages of faults occur within the Belted Range. The older faults strike northeast and northwest and displace Tertiary rocks older than the late Miocene Belted Range Tuff. The younger faults strike north and occur within the Belted Range and immediately adjacent to it. These faults displace Pliocene to Holocene deposits. Because of their orientation and their displacement of the tuff, faults of OAK may belong to the younger set of faults defined by Y-232.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Part of the eastern front of Oak Spring Butte adjacent to BT is suggested by Y-813 to be linear. Other faults in OAK do not bound range fronts.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: Faults in OAK have the same strike as the Yucca fault (YC) in Yucca Flat immediately south of OAK (pl. 1). BT nearly aligns with and has the same direction of displacement as YC, so that BT could be a northern extension of YC as suggested by Y-232 (pl. 1, fig. 2) and Y-693 (p. 209). Y-232 (pl. 1, fig. 2) showed YC and BT as a single, continuous fault. Y-693 (p. 209) suggested that BT joins YC at the northern end of Yucca Flat. In contrast, Y-813 (p. 7) noted that the northern end of YC in Yucca Flat consists of several splays in Quaternary alluvial–fan deposits around Oak Spring Butte.

Y-813 (p. 7) suggested that the north–striking faults in Tertiary volcanic rocks north and east of YC (faults of OAK of this compilation) connect YC to the north–northeast–striking to northeast–striking Emigrant Valley North fault (EVN). YC and EVN are prominent faults, both of which have apparently experienced Quaternary displacement. The strikes of faults in OAK are similar to that of YC and more northerly than that of EVN.

The northeast–striking Boundary fault (BD) at the northern end of Yucca Flat may connect with BT as shown by Y-50, Y-181 (fig. 7), and Y-853. The structural relationships among OAK, BT, YC, and BD are not known.

Y-181 (fig. 2) portrayed the northwest–trending edge of the Gold Meadow caldera as crosscutting faults of OAK. The relationship of OAK to the caldera is not known.

BT, and what is perhaps its northern extension, is mapped by Y-853 at the boundary between Quaternary deposits and older rocks and as a scarp or prominent lineament on surfaces that are possibly late Pleistocene (about 160 ka to 800 ka).

Oasis Valley faults (OSV)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 3); Y-813: Reheis, 1992 (pl. 2); Y-1223: Bell and others, 1989 (fig. 2, p. 1-9). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 24 km/290° (distance and direction of closest point from YM) at lat 36°55′N. and long 116°42′W. (location of closest point) for faults along the eastern side of Oasis Valley (Eastern faults); 30 km/304° (distance and direction of closest point from YM) at lat 37°00′N. and long 116°44′W. (location of closest point) for faults along the western side of Oasis Valley (Western faults). Faults of OSV bound part of Oasis Valley between Beatty, Nevada, on the south and Thirsty Canyon on the north.

USGS 7-1/2′ quadrangle: Beatty Mountain, Thirsty Canyon SE.

Fault orientation: Faults in OSV strike north–northeast.

Fault length: Faults along the eastern side of Oasis Valley are about 16 km long as estimated from Y-238, Y-813, and Y-1223 (fig. 2). This length includes northern traces that are 5 to 7 km long, a gap in surficial expression that is about 4 km long, and southern traces that are about 7 km long.

Faults along the western side of the valley are about 7 km long. This length includes two fault traces each 2.5 to 3 km long as estimated from Y-238 and Y-813. These traces are separated by a 3–km–long gap.

A graben shown in the northern part of the Oasis Valley by Y-813 does not clearly align with the faults along either side of the valley, but would add about 3.5 km to the total length of OSV.

Style of faulting: Displacement on faults along the eastern side of Oasis Valley is primarily down to the west as shown by Y-238, Y-813, and Y-1223 (fig. 2). Displacement on faults along the western side of the valley is portrayed by Y-813 as both down to the east and down to the west.

Scarp characteristics: Scarps associated with fault traces on the eastern side of Oasis Valley are shown by Y-238 and Y-813 as west–facing. Fault scarps on the eastern side of Oasis Valley are portrayed by Y-1223 (fig. 2) as primarily west–facing; a few at the southern end of Oasis Valley are shown by them as east–facing. Scarps associated with the graben at the northern end of Oasis Valley are portrayed as both east–facing and west–facing (Y-813).

Displacement: Y-10 (p. 58) reported that one fault along the eastern side of Oasis Valley displaces Quaternary and Tertiary alluvial–fan deposits (QTa deposits of Hoover and others, [1981], Y-73, fig. 2, p. 9) about 4 m down to the east.

Age of displacement: Y-10 (p. 58) reported that faults along the eastern side of Oasis Valley may displace Pleistocene alluvium (Q2b or Q2c deposits of Y-73). Y-73 (p. 24-26) estimated these deposits to be older than 27 ka to 35 ka and younger than 730 ka. Taylor (1986, Y-264, p. 14, appen. G, p. 192) obtained dates (uranium–trend) that range between 145 ka to 430 ka.

Y-10 (p. 58) also noted that Quaternary and Tertiary alluvial–fan deposits (QTa deposits of Y-73) are displaced by one fault along the eastern side of Oasis Valley. These deposits are estimated to be older than 730 ka and younger than about 3 Ma by Y-73 (p. 2, 26). On the basis of volcanic ashes found near Yucca Mountain and in the Amargosa Desert, Y-264 (table 1, p. 15, appen. G, p. 192) estimated an age of 1.1 Ma to 2 Ma for these deposits.

Fault scarps mapped by Y-1223 (fig. 2, p. 1-9) along the eastern side of Oasis Valley are interpreted by them to be probably Quaternary.

Of the two fault traces bounding the western side of Oasis Valley, the southern one is on surfaces of Quaternary deposits and the northern one is on surfaces of Tertiary deposits (Y-813).

Faults bounding the narrow graben at the northern end of the Oasis Valley displace Pleistocene alluvium (Q2b or Q2c deposits of Y-73; older than 27 ka to 35 ka, younger than 730 ka (Y-73, p. 24, 26)) and may be inset into a larger graben that displaces older deposits (Y-10, p. 58).

Oasis Valley faults (OSV) — Continued

Slip rate: Using the 4 m of displacement that was noted by Y-10 (p. 58) in QTa deposits of Y-73 and an estimated age for these deposits of 730 ka to 3 Ma (Y-73, p. 2, 26), an apparent slip rate of 0.001-0.005 mm/yr is estimated for one fault along the eastern side of Oasis Valley since early Quaternary or latest Tertiary.

Recurrence interval: No information.

Range-front characteristics: No range front is directly related to faults on either side of Oasis Valley.

Analysis: Aerial photographs (Y-10; Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-1223, p. 1-8, low–sun–angle (morning) photos, scale 1:12,000).

Relationship to other faults: Y-1223 (p. 1-8) suggested that the fault scarps in Oasis Valley do not seem to be part of a throughgoing geologic structure. Y-232 (p. 34, *citing* F.M. Byers, Jr. and others, written and oral commun., 1968) postulated that a caldera related to the eruption of the Ammonia Tanks Member of the Timber Mountain Tuff (Pliocene) is located beneath alluvium in Oasis Valley. If such a caldera exists, its influence on the origin of or displacement along the faults included in OSV is not known.

Owens Valley fault (OWV)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-415: Jennings, 1985 (Death Valley sheet); Y-426: Stinson, 1977; Y-427: Hart and others, 1989; Y-694: Beanland and Clark, in prep.; Y-869: Nelson, 1966; Y-1020: Jennings, 1992; Y-1025: Lubetkin and Clark, 1988; Y-1046: Bryant, 1988; Y-1055: Beanland and Clark, 1993; Y-1115: Ross, 1962; Y-1116: Pakiser and others, 1964; Y-1117: Carver, 1970; Y-1362: Savage and Lisowski, 1980; Y-1363: Savage and others, 1975.

Location: 126 km/244° (distance and direction of closest point from YM) at lat 36°19'N. and long 117°42'W. (location of closest point), if the northwest–striking fault traces in Lower Centennial Flat are included as part of OWV (shown as OWV? on pl. 2 of this compilation); 132 km/250° (distance and direction of closest point from YM) at lat 36°25'N. and long 117°49'W. (location of closest point), if the north–striking fault traces near Owens Lake are used as the closest point of OWV to Yucca Mountain. OWV is located between the Sierra Nevada on the west and the White–Inyo Mountains on the east. Only the Owens Valley segment of Y-1046 (p. 8) is within the area covered by plate 2 of this compilation. This is the southern segment of eleven into which OWV has been subdivided as summarized in Y-1046 (p. 9-12). Y-427 (pl. 1) shows OWV along the western side of Owens Lake only. He did not include any of the fault traces along the eastern side of the lake or within Lower Centennial Valley.

USGS 7-1/2' quadrangle: Centennial Canyon, Cerro Gordo Peak, Coso Peak, Dolomite, Haiwee Reservoirs, Keeler, Owens Lake, Talc City Hills, Upper Centennial Flat, Vermillion Canyon.

Fault orientation: OWV has a north to northwest strike (Y-1046, p. 2). The overall strike of OWV is 340°; its dip is 80° ± 15° ENE. (Y-1055).

Fault length: The length of OWV is about 100 km between Owens Lake on the south and north of Big Pine, California, on the north (Y-427, p. 6; Y-1046, p. 2; Y-1055). Surface rupture length in 1872 (M7.8, March 26) occurred on 90 to 110 km of OWV between Owens Lake and north of Big Pine, essentially the entire mapped length of OWV (Y-1046, p. 2; Y-1055).

Style of faulting: Displacement on OWV has been primarily right lateral, with a minor component of down–to–the–east, dip–slip (normal) displacement (Y-427, p. 6; Y-1046, p. 2, *citing* Y-694). However, the dip–slip component may be significant locally (Y-427, p. 6). In the Owens Valley area, the ratio of horizontal to vertical displacement during the Holocene is estimated to be 6:1 (Y-1046, p. 13, *citing* Y-694).

Scarp characteristics: Y-1025 (p. 765) reported maximum slope angles of 30° to 38° for the youngest pre–1872 scarps and maximum slope angles of about 70° to 90° for the 1872 portions of the scarps.

Displacement: On the basis of his conclusion that two Cretaceous plutons (his Santa Rita Flat pluton in the Inyo Mountains and his Tinemaha Granodiorite in the Sierra Nevada) are correlative, Y-1115 (p. D88) inferred that lateral displacement on OWV "is limited to a few miles at most since emplacement of the Sierra Nevada batholith."

Y-1046 (p. 2) noted a maximum right–lateral displacement on OWV of about 20 km. He based the estimate on the correlation of Y-1115 and work by Y-694.

Y-1116 (p. 54) inferred a total vertical displacement of about 5,800 m (19,000 ft), which is "the difference in altitude between the summit of Mount Whitney and the buried pre–Tertiary floor of Owens Valley east of Lone Pine."

On the basis of gravity data interpreted by them, Y-1116 (p. 50) reported that the Cenozoic rocks that are faulted against pre–Tertiary rocks in the Inyo Mountains south of Independence, California, are about 1,830 to 3,050 m (8,000 ± 2,000 ft) thick. Y-1046 (p. 2, *citing* Y-1116) noted a maximum vertical displacement on OWV of about 2,400 m near Lone Pine.

Owens Valley fault (OWV) — Continued

In the 1872 earthquake, the right–lateral component of displacement on the main trace of OWV averaged 6 ± 2 m with a maximum displacement at Lone Pine of about 10 m (Y-1055). The vertical component of displacement, which was normal and variable in sense, averaged 1 ± 0.5 m (Y-1055). The average net oblique displacement in 1872 was 6.1 ± 2.1 m with a maximum net oblique displacement of 11 m (Y-1055).

Y-1025 (p. 766) reported that the horizontal component of slip in the 1872 earthquake on the Lone Pine fault, a secondary fault trace of OWV up to 1.4 km west of and approximately parallel to the main trace of OWV at Lone Pine, is 4 to 6 m. Adding this amount of displacement to that experienced along the main trace of OWV at Lone Pine (2.7 to 4.9 m), Y-1025 (p. 766) indicated that the maximum horizontal component of slip in 1872 was 7 to 11 m. In addition, Y-1025 (table 2, p. 763, 766) reported a dip–slip component of 1 to 2 m on the Lone Pine fault in 1872.

Age of displacement: The youngest rupture on OWV is historical. Most of OWV experienced surface rupture during an earthquake on March 26, 1872 (M7.8) with an epicentral location near Lone Pine (Y-1046, p. 2; Y-1055). Elsewhere along OWV, evidence of Holocene surface rupture predominates (Y-1046, p. 8).

Y-1025 (p. 764) reported that pre–1872 fault scarps are preserved on alluvial fans that they estimated were latest Pleistocene on the basis of the degree of weathering of granitic boulders, soil–oxidation color, and fan surface morphology. They suggested a range of 10 ka to 21 ka for these surfaces, but thought it likely that the age is close to 10 ka.

Some features attributed to the 1872 earthquake in the area near Owens Lake may be the result of slumping or liquefaction (Y-1046, p. 7, 13-14, *citing* Y-1117).

Slip rate: Y-427 (p. 6) reported a late Quaternary slip rate of about 3 mm/yr. Y-1046 (p. 2 *citing* Y-694) noted an average net slip rate on OWV of approximately this same amount, but emphasized that the strike–slip component is not well defined. Y-1055 reported an average net slip rate of 1.5 ± 1 mm/yr at one site on OWV since about 300 ka. They also examined several other sites, where data yielded an average Holocene (≤10 ka) net slip rate that is estimated to be 2 ± 1 mm/yr (Y-1055).

Y-1025 (p. 766) calculated an average Holocene horizontal–slip rate at Lone Pine of 0.7 to 2.2 mm/yr using the total horizontal slip component (7 to 11 m) during the 1872 earthquake and an average recurrence interval for earthquakes similar to the one in 1872.

Using an estimate of the average total slip/event (4.3 to 6.3 m) and a range of recurrence intervals (5,000 to 10,500 yr), Y-1025 (p. 766) calculated an average late Quaternary (oblique) slip rate of 0.4 to 1.3 mm/yr for the Lone Pine fault, one of several traces of OWV. Because they thought an age at the younger end of their estimated range was better for the disrupted pre–1872 alluvial fans, they favored the higher slip–rate estimate.

Y-1025 (p. 766, *citing* Y-1362 and Y-1363) reported an average historical right–lateral slip rate of about 3 to 7 mm/yr, which was measured geodetically across Owens Valley.

Recurrence interval: Y-1055 suggested that OWV has experienced three major earthquakes during the Holocene, although these events are not precisely dated. These data suggest a minimum average recurrence interval is 5,000 yr along the Lone Pine fault and an average recurrence interval of 3,300 to 5,000 yr elsewhere along OWV (Y-1055). Y-1055 (p. 756, 766) concluded that the average late Quaternary recurrence interval for an earthquake similar to the one that occurred in 1872 is 5,000 to 10,500 yr, on the basis of three events since 10 ka to 21 ka (p. 764).

Y-1025 (p. 765) speculated that the recurrence interval along the Lone Pine fault since 10 ka to 21 ka has been 5,000 to 10,500 yr. They based this on an interpretation of topographic scarp profiles, which they thought indicated three earthquakes since this time.

Range-front characteristics: No information.

Owens Valley fault (OWV) — Continued

Analysis: Compilation of existing information (Y-415; Y-427, p. 2). Aerial photographs (Y-427, p. 2; Y-1046, p. 8, scales 1:54,000; 1:24,000; 1:12,000; and 1:10,000). Field reconnaissance (Y-427, p. 2). Field examination (Y-1046, p. 8; Y-1115, p. D86; Y-1116, p. 23). Topographic profiles across fault scarps (Y-1025, p. 757). Seismic surveys (Y-1116, p. 42-43). Aeromagnetic surveys (Y-1116, p. 39). Rock mineralogy and chemistry (Y-1115, p. D86-D87). Geophysical surveys (Y-1116, p. 23). Gravity measurements (Y-1116, p. 23-24). Interpretation of gravity data (Y-1116, p. 25-26).

Relationship to other faults: Y-1055 suggested that OWV "accommodates some of the relative motion (dextral shear) between the North American and Pacific plates." They further concluded that "in Owens Valley, displacement is partitioned between [OWV] and the nearby, subparallel, and purely normal range–front faults of the Sierra Nevada" (Sierra Nevada fault (SNV) of this compilation; Y-1055). These range–front faults are noted by Y-1055 to be very discontinuous and have lower Holocene displacement rates (0.1 to 0.8 mm/yr) than that estimated for OWV.

Y-427 (p. 6) noted that SNV, which is along the eastern front of the Sierra Nevada, is closely associated with OWV and may be partly coincidental with it.

Y-427 (p. 6) speculated that the Little Lake fault (LL) may be a southern extension of OWV.

Pahranagat fault (PGT)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-181: Carr, 1874; Y-332: Jayko, 1988; Y-395: Jayko, 1990 (name from this reference); Y-404: Tschanz and Pampeyan, 1970 (their Pahranagat shear system; also their Arrowhead Mine fault, Buckhorn fault, and Maynard Lake fault); Y-614: Wernicke and others, 1988; Y-632: Wernicke and others, 1988; Y-969: Shawe, 1965; Y-1032: Schell, 1981 (pl. 9; table A2, his fault #32, the Maynard Lake fault zone, and his fault #34, the Buckhorn fault zone); Y-1107: Carr, 1974; Y-1119: Liggett and Ehrenspeck, 1974; Y-1120: Wernicke and others, 1984; Y-1121: Hamblin, 1965.

Location: 106 km/75° (distance and direction of closest point from YM) at lat 37°06′N. and long 115°18′W. (location of closest point). PGT is located in the southern end of the Pahranagat Valley between the East Pahranagat Range on the north and the Sheep Range on the south. It extends eastward into the southern Delamar Valley.

USGS 7-1/2′ quadrangle: Alamo, Alamo SE, Badger Spring, Delamar 3 NE, Delamar 3 NW, Delamar 3 SE, Delamar 3 SW, Delamar Lake, Desert Hills NE, Desert Hills SE, Gregerson Basin, Lower Pahranagat Lake, Lower Pahranagat Lake NW, Lower Pahranagat Lake SE, Lower Pahranagat Lake SW.

Fault orientation: The strike of PGT is approximately N. 50° E. (Y-395, p. 225). PGT is composed of three major traces with this strike, which have been called (north to south): the Arrowhead Mine fault (ARM), the Buckhorn fault (BUC), and the Maynard Lake fault (MAY) (Y-395, p. 225-226; Y-404, p. 83). A splay at the northeastern end of BUC, named the Nine Mile fault, strikes N. 20-30° E. (Y-395, p. 227).

Fault length: The length of PGT is 40 to 45 km; its width is about 13 km (Y-395, p. 225).

The length of ARM is about 14 km as estimated from Y-25 and 15 km as noted by Y-395 (p. 227-228). However, Y-404 suggested that the total length of ARM may be as much as about 66 km. This includes a 6.5–km–long section of ARM that they show as having post–Laramide displacement (estimated from pls. 2 and 3 of Y-404). In addition, they inferred a 39–km–long westward continuation of ARM to the Papoose Range (estimated from pl. 3 of Y-404).

The length of BUC is 20 to 25 km (Y-395, p. 227-228), 27 km (Y-1032, table A2, p. A7), 40 km (estimated from Y-25), or about 42 km (estimated from Y-404, pl. 3).

MAY is the longest fault trace in PGT (Y-1032, table A2, p. A7). The length of MAY is about 40 km (Y-395, p. 227-228), 44 km (estimated from Y-25), or ≥45 km (Y-1032, table A2, p. A7). The portion of MAY experiencing Laramide displacement is 45 km long as estimated from Y-404 (pls. 2 and 3). A northeastward continuation of MAY beneath Tertiary volcanic rocks is inferred by Y-404. This continuation would add 46 km (estimated from pl. 3 of Y-404) to MAY, so that the total length of MAY could be as much as 91 km.

Style of faulting: Fault traces constituting PGT generally dip steeply northwest and have had oblique displacement that includes a major component of dip slip as well as left–lateral strike slip (Y-25; Y-395, p. 227; Y-404). On the basis of dips of Tertiary beds, Y-395 (p. 227) suggested that PGT is listric to the north. Y-404 (p. 84) proposed that Laramide displacement along ARM and perhaps MAY may have been right lateral. Y-1032 (table A2, p. A7) suggested that abundant low–angle slickensides along MAY indicate "complex–oblique slip movement, possibly strike–slip."

Scarp characteristics: No information.

Displacement: Displacement on PGT is noted to be "on the order of 9 to 16 km" by Y-395 (p. 227, *citing* Y-1119) and "as great as 10 miles [16 km]" as measured on a spheroidally weathered ignimbrite (Y-404, p. 84). Y-25 also noted 16 km of displacement on PGT.

On the basis of displacement of Tertiary rocks, Y-395 (p. 227) inferred a maximum vertical displacement along ARM of at least 0.5 km in the Pahranagat Valley area. Lateral displacement along ARM is "on the order of 2 km, if the west–dipping normal faults that bound Paleozoic and Tertiary strata north and south of [ARM] are correlative" (Y-395, p. 227). On the basis of a spheroidally weathered ignimbrite, Y-404 (p. 100) inferred an apparent post–Miocene displacement on ARM of about 8 km (about 5 miles).

Pahranagat fault (PGT) — Continued

A minimum of 1 to 2 km of left-lateral displacement along BUC is suggested by displaced fault traces in the Pahranagat Range (Y-395, p. 228). Apparent post–Miocene left-lateral displacement along BUC is about 5 km (3 miles), if the tilting of the Tertiary strata occurred before lateral displacement (Y-395, p. 228).

Displacement across MAY of "not more than 5 to 6 km" between the Pahranagat Range and the northern Sheep Range has been inferred by Y-395 (p. 228) on the basis of the distribution of a Tertiary(?) conglomerate. Left–lateral displacement appears to have been the dominant component of lateral displacement across MAY, but some right–lateral displacement has also been inferred from the geometry of folds near the fault.

Age of displacement: Y-25 portrayed MAY, BUC, and ARM all as faulted contacts between Tertiary volcanic or sedimentary rocks and either Holocene to Pliocene alluvium and colluvium (their QTa deposit) or Holocene to Miocene older gravels (their QTg deposits). These relationships suggest Quaternary displacement along all three faults. Y-332 (p. 171) noted that "prominent scarps in raised, dissected alluvial–fan deposits in the southern part of Tikaboo Valley, and significant deflection of drainages in younger alluvial deposits within the valley, suggest possible Quaternary tectonic activity" on PGT. In addition to these scarps, Y-332 (p. 171) noted scarps along the northern side of the Sheep Range and numerous small–magnitude earthquakes in the vicinity of PGT. He concluded that these all suggest continuing activity on PGT. Y-395 (p. 227, 234, *citing* unpub. data of Jayko, Sarna–Wojcicki, and Myers) noted that significant displacement along PGT apparently did not occur until after 7.7 Ma (latest Miocene or early Pliocene), which is the youngest age for interbedded tuffs and alluvium that conformably overlie displaced middle Oligocene to upper Miocene volcanic rocks.

Fault scarps are also preserved on alluvial deposits north of ARM (Y-395, p. 227), but their relationship to ARM is unclear.

The probable age of youngest displacement along BUC is noted by Y-1032 (table A2, p. A7) as indeterminate, but suspected of being Pliocene. Determination of the age of displacement is difficult, because young stratigraphic units are not present along the fault trace (Y-1032, table A2, p. A7). The youngest unit definitely displaced is his middle Tertiary volcanic rocks (Tv_2, table A2, p. A7) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1). The oldest unit not displaced is his intermediate–age alluvial–fan deposits (Y-1032, table A2, p. A7) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). According to Y-1032 (table A2, p. A7), BUC has strong magnetic expression but no evidence for Quaternary surface displacement.

Quaternary activity on at least one trace of PGT, MAY, is interpreted from prominent fault scarps on dissected alluvial deposits at the northern end of the Sheep Range and by contemporary seismicity in the Pahranagat area (Y-332; Y-395, p. 227). The probable age of the youngest displacement along MAY is noted by Y-1032 (table A2, p. A7) to be Pleistocene. He bases this estimate on a minor scarp of probable late Pleistocene age in Pahranagat Valley. This scarp is on his intermediate–age alluvial–fan deposits (A5i, table A2, p. A7) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). Y-1032 noted no evidence for Quaternary displacement elsewhere along MAY, where his intermediate–age alluvial–fan deposits (his A5i deposits, table A2, p. A7) have not been displaced. The oldest unit that he recognized as displaced is middle Tertiary volcanic rocks (Tv_2, table A2, p. A7) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with PGT.

Analysis: Aerial photographs (Y-395; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field mapping (Y-395; Y-404, p. 2). Field reconnaissance (Y-1032, p. 17-18). Gravity analyses (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Pahranagat fault (PGT) — Continued

Relationship to other faults: Y-395 (p. 225) suggested that PGT "generally forms the boundary between an actively extending area to the north and a previously extended area to the south." Y-25 noted that fault traces included in PGT align with northeast–striking, left–lateral traces of the Rock Valley fault (RV) and the Cane Spring fault (CS) to the east (pls. 1 and 2). However, the fault traces are not continuous between these two major systems of northeast–striking faults and are separated by several mountain ranges (e.g., the Desert Range, the Pintwater Range). Y-395 (p. 227) could not find any evidence suggesting that ARM, BUC, or MAY continue westward through Paleozoic rocks of the Desert Range or the northern Pintwater Range. Although he (Y-395, p. 227) noted that several east–striking faults do exist in the East Desert Range, he concluded that none of these has experienced a large enough lateral displacement to be a southwestern extension of PGT. Y-25 noted that the faults in both systems have similar characteristics and that they may be aligned "along a broad zone of structural weakness that predates the Tertiary volcanic activity" (Y-25). Y-25 (*citing* Y-181, Y-969, and Y-1107) suggested that these left–lateral faults are probably "part of a conjugate system that includes the northwest–trending, right–lateral Las Vegas Valley shear zone, the Walker Lane, and other right–lateral faults."

ARM and, perhaps, MAY are inferred by Y-25 and Y-404 (p. 83-84) to have been part of major right–lateral shear zone during the Laramide. This inference is based on facies and thickness changes in Paleozoic rocks and on possible displacement of Laramide fold and thrust belts that occur north and south of PGT. For example, Y-404 (p. 83-84) estimated 48 km (30 miles) of right–lateral displacement across ARM between the Pahranagat/Spotted Range thrust and a buried fault south of the Papoose Range. On the basis of a tentative correlation of the Delamar Range fold and thrust belt and the Highland Range thrust, Y-404 (p. 83-84) suggested a similar amount of right–lateral displacement across MAY.

Strike slip on PGT has probably been accompanied by folding of Tertiary rocks. These folds, dominantly trending N. 35° E. and plunging northeast, probably began "as monoclinal flexures that formed over deep–seated, blind normal faults and are a type of fault–bend fold or drag fold" (Y-395, p. 229, *citing* Y-1121). The folds were probably "tightened by drag folding associated with the lateral component of displacement within [PGT]" (Y-395, p. 229).

PGT has been interpreted by Y-395 (p. 233) to be within the Escalante zone, a broad zone of geographic, geologic, and geophysical features that trends southwest from the Wasatch fault zone into the Pahranagat area and that probably terminate at the Walker Lane. PGT has also been interpreted by Y-395 (p. 234, *citing* Y-1119 and Y-1120) to be a tear or transfer fault "that accommodates extension (connects detachment faults) between Delamar–Dry Lake valleys and the Desert Valley as suggested by previous workers." Y-395 (p. 234) also suggested that PGT is part of what has been called the Death Valley normal–fault system (*citing* Y-614 and Y-632).

A close spatial association seems to occur between left–lateral faults (including PGT) and Tertiary basaltic volcanism (which probably occurred between 17 Ma and 6 Ma) or volcanic centers, although the exact relationships are not known (Y-25). The Kane Springs Wash and Caliente volcanic centers occur at the intersections between northeast–striking, left–lateral faults and northwest–striking, possibly right–lateral faults (Y-25). The northeast–striking faults (including those of PGT) appear to terminate (in a northeast direction) at the volcanic centers (Y-25).

The map by Y-25 portrays the Kane Springs Wash fault, southeast of the Kane Springs Wash volcanic center in the southern Delamar Mountains, and the Burnt Springs Range faults, northwest of the Caliente volcanic center northeast of the Kane Springs Wash volcanic center, as having strikes similar to that of PGT and as experiencing left–lateral, oblique displacement (both faults are east of the area shown by pls. 1 and 2 of this compilation). Y-25 concluded that scarps on alluvial surfaces in the valley of Kane Springs Wash indicate that the Kane Springs Wash fault has experienced Holocene displacement. It is not known if these faults are part of or genetically related to PGT. The Burnt Springs Range fault is slightly north of the northeast projection of PGT, but it lies along the projection of the Timpahute lineament (Y-25).

Pahroc fault (PAH)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3; name from their pl. 3); Y-1032: Schell, 1981 (table A2, fault #33).

Location: 144 km/62° (distance and direction of closest point from YM) at lat 37°27′N. and long 115°00′W. (location of closest point). The southern portion of PAH is located along the eastern side of the South Pahroc Range. It extends northward across the North Pahroc Range and along the eastern side of the Seaman Range at its junction with the valley of the White River.

USGS 7-1/2′ quadrangle: Alamo NE, Hiko NE, Hiko SE, Pahroc Spring, Weepah Spring, White River Narrows.

Fault orientation: PAH has a curving strike that varies between north–northeast and north–northwest (Y-25; Y-404; Y-1032).

Fault length: The length of PAH is 59 km as estimated from Y-25. Y-404 (p. 94) reported that the total length of PAH is 74 km (46 miles). The length of PAH is noted to be 42 km by Y-1032 (table A2, p. A7), but he does not include an approximately 15–km–long section of PAH that is shown by Y-25.

Style of faulting: Displacement on PAH is portrayed by Y-25 and Y-404 as down to the east.

Scarp characteristics: No information.

Displacement: Y-404 (p. 94) reported that the stratigraphic separation in volcanic rocks across PAH and the White River fault, which is parallel to and east of PAH and which bounds the western side of the North Pahroc Range, "is less than a few hundred feet where it can be measured."

Age of displacement: The probable age of the youngest displacement along PAH is noted by Y-1032 (table A2, p. A7) to be middle to early Pleistocene (defined as >200 ka and <1.8 Ma by Y-1032, p. 30). The youngest unit displaced is his old–age alluvial–fan deposits (A5o; Y-1032, table A2, p. A7) with an estimated age of 700 ka to 1.8 Ma (table 3, p. 23). This displacement is along the northern portion of PAH.

The rest of PAH is shown as a faulted contact between bedrock and alluvium or as a fault within bedrock (Y-1032, table A2, p. A7). The oldest unit not displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A7) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit displaced is Paleozoic rocks (Y-1032, table A2, p. A7).

Portions of PAH are shown by Y-25 as faulted contacts between Miocene volcanic rocks and either Miocene to Holocene older gravels (their QTg deposits) or Holocene to Pliocene alluvium and colluvium (their QTa deposits). Other portions of PAH are shown by Y-25 as concealed by their QTg and QTa deposits. Y-404 portrayed PAH as a post–Laramide structure and showed sections as faulted contacts between Tertiary volcanic rocks and either Pleistocene(?) older alluvium (their Qol deposits) or Pliocene(?) and Pleistocene(?) older gravels (their QTg deposits). Portions are also shown by Y-404 as concealed by their Qol and QTg deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Pahroc fault (PAH) — Continued

Relationship to other faults: The southern end of PAH nearly intersects the eastern end of the northeast–striking Pahranagat fault (PGT) to the south. PAH is approximately parallel to the Hiko–South Pahroc faults (HSP) to the west along the western side of the South Pahroc Range. Y-1032 (table A2, p. A17) noted that the northeast–striking Six–Mile Flat fault (SMF) is located between PAH on the east and the north–northeast–striking Hiko fault (HKO) on the west. However, the relationships among these faults are not known.

Maps by Y-25, Y-404, and Y-1032 all show east–striking faults in the South Pahroc Range. These faults seem to terminate at PAH, but the exact relationship among these faults is not known.

The main part of the Seaman Range volcanic center is located west of the northern end of PAH (Y-25). The relationship between PAH and this volcanic center is not known.

Pahrock Valley faults (PV)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970. Not shown by Schell, 1981 (Y-1032, pl 9).

Location: 155 km/48° (distance and direction of closest point from YM) at lat 37°45′N. and long 115°08′W. (location of closest point). PV includes two faults: an eastern fault along the eastern side of the Seaman Range and a western fault along a ridge within Pahrock Valley.

USGS 7-1/2′ quadrangle: Seaman Wash, White River Narrows.

Fault orientation: Both faults in PV strike north–northeast (Y-25; Y-404).

Fault length: The length of the western fault in PV is about 11 km as estimated from Y-25 and Y-404. The length of the eastern fault is 9 km as estimated from Y-25 and Y-404.

Style of faulting: No sense of displacement is indicated by either Y-25 or Y-404 for either fault in PV. However, stratigraphic relationships as mapped by Y-25 and Y-404 suggest that displacement on the western fault has been down to the east and that displacement on the eastern fault has been down to the west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Parts of both faults in PV are shown by Y-25 as faulted contacts between Miocene lavas or pre–Tertiary sedimentary rocks and Holocene to Miocene older gravels (their QTg deposits). Part of the western fault is portrayed by Y-404 as a faulted contact between pre–Tertiary rocks and Pliocene(?) and Pleistocene(?) older gravels (their QTg deposits). Part of the eastern fault is shown by Y-404 as a faulted contact between Pliocene basalt and their QTg deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000). Compilation of existing structural and stratigraphic information (Y-25). Field reconnaissance (Y-404, p. 2).

Relationship to other faults: PV approximately aligns with the north–northwest–striking northern portion of the Pahroc fault (PAH). The southern ends of the faults in PV are directly east of and nearly intersect with the southeastern end of the north–northwest–striking Seaman Pass fault (SPS) in Coal Valley. The relationships among these faults are not known.

PV is located southeast of the main part of the Seaman Range volcanic center (Y-25), but the relationship of PV to the center is not known.

Pahrump fault (PRP)

Plate or figure: Plate 2.

References: Y-9: Fox and Carr, 1989; Y-137: Carr, 1988; Y-161: Burchfiel and others, 1983 (their Stewart Valley fault may correspond to the northern part of PRP); Y-182: Carr, 1984 (his Stewart Valley fault (fig. 7, p. 16) may correspond to PRP); Y-232: Cornwall, 1972 (shows only the northern part of PRP in Stewart Valley within Nye County, Nevada; the part of PRP north of about lat 36°10′N.); Y-238: Reheis and Noller, 1991 (pls. 3 and 4); Y-262: Stewart and others, 1968 (their Stewart Valley fault may correspond to the northern part of PRP); Y-614: Wernicke and others, 1988; Y-672: Carr, 1990; Y-695: Donovan, 1991; Y-696: Hoffard, 1991 (her Pahrump Valley fault zone; part of her Pahrump fault system, p. 5); Y-706: Wright, 1989 (his Pahrump fault zone); Y-806: Hoffard, 1990 (her Stateline–Pahrump Valley fault zone); Y-813: Reheis, 1992 (pl. 3; her Pahrump fault zone, p. 3, 8); Y-845: Malmberg, 1967; Y-852: Dohrenwend and others, 1991; Y-887: Schweickert, 1989 (his Stewart Valley–Stateline fault); Y-888: Stewart, 1988 (his Pahrump fault zone); Y-889: Liggett and Childs, 1973 (their Pahrump fault zone); Y-892: Claassen, 1985; Y-1105: MIT Field Geophysics Course, 1985 (geophysical investigation of Mesquite Valley, which is south of PRP; pl. 2 of this compilation).

Location: 70 km/160° (distance and direction of closest point from YM) at lat 36°16′N. and long 116°10′W. (location of closest point) for the northern extent of PRP in Stewart Valley as mapped by Y-696; 42 km/175° (distance and direction of closest point from YM) at lat 36°28′N. and long 116°24′W. (location of closest point) for the northern extent of PRP in Ash Meadows as shown by Y-238. PRP is located in central Pahrump Valley and along the eastern side of Stewart Valley. It may extend to the north through Ash Meadows and the Amargosa Desert (Y-238). PRP approximately parallels the California–Nevada border.

USGS 7-1/2′ quadrangle: Blackwater Mine, Calvada Springs, Green Monster Mine, Hidden Hills Ranch, High Peak, Horse Thief Springs, Mound Spring, Nopah Peak, Pahrump, Pahrump NE, Sixmile Spring, Stewart Valley, Stump Spring, West of Shenandoah Peak.

Fault orientation: The overall strike of PRP is N. 45° W. (Y-696, table 1, p. 28). Between lat 36°05′N. and lat 36°00′N., two main traces strike N. 45° W., but minor traces strike between N. 45° W. and N. 30° E. (Y-696, p. 74). To the north in Stewart Valley, fault traces strike N. 25° W. to N. 30° W., which Y-696 (p. 77) attributed possibly to structural control of the Montgomery Mountains. A northwest–striking fault in Stewart Valley, which they called the Stewart Valley fault, is shown by Y-161 (fig. 2) to have a more westerly strike than that of PRP in Stewart Valley as mapped by Y-238 and Y-696 (pls. 1 and 5).

Fault length: Y-888 (p. 694) suggested that PRP has a length of 130 km. Individual lineaments and scarps along the southern part of PRP are >15 km long; other traces are >6 km long (Y-696, p. 74).

The length of PRP between Black Butte at the southern end of Pahrump Valley and the northern end of Stewart Valley is 50 km (Y-696, table 1, p. 28, 49). Y-696 (p. 49) suggested that the southern end of PRP dies out north of Mesquite Valley near Black Butte, because Y-1105 (p. 8689) reported that they found no topographic expression that would indicate a fault that has experienced Holocene or late Quaternary displacement. A northwest–trending topographic break that is preserved on an alluvial surface and that may be associated with PRP extends 45 km southeast from the southern Montgomery Mountains (Y-161, p. 1,371, *citing* Y-889). The map by Y-845 (pl. 1) shows PRP concealed within Pahrump Valley and 24 km long.

If PRP extends north of Stewart Valley, then the length of PRP is 65 to 70 km as estimated from Y-238 and Y-813 between the Hidden Hills in Pahrump Valley (lat 36°N.) and an east–northeast–trending lineament in the Amargosa Desert along which PRP may terminate (Y-238, p. 6).

Style of faulting: Right–oblique displacement along PRP was interpreted by Y-696 from (1) west–facing scarps combined with seismic refraction profiles that indicate down–to–the–west displacement of disrupted basin–fill sediments (Y-696, p. 78), and (2) a westward shift in the locus of deposition of alluvium in Pahrump Valley across PRP and a left–stepping pattern of fault traces, both of which indicate a right–lateral component of displacement (Y-696, p. 94; Y-806). Other workers have also suspected a right–lateral component because of (1) the left–stepping, *en echelon* fault traces and possible right–lateral offset of a stream (Y-889, *cited in* Y-696 and Y-161, p. 1371) and (2) the weak topographic expression of faults within the valley (Y-238, p. 6).

A right–lateral component of displacement on the Stewart Valley fault has been inferred by Y-161 (p. 1371, 1374) from the oblique angle between this fault and folds within the Resting Spring Range and Montgomery Mountains and by the stratigraphic relationships in the Montgomery Mountains on opposite sides of the fault. However, the direction of displacement on individual fault traces is not known (Y-238, p. 6).

Y-696 (p. 49) subdivided PRP into two sections: one south of lat 36°05′N. (but north of lat 36°00′N.) and one north of this latitude.

Scarp characteristics: South of lat 36°05′N. (but north of lat 36°00′N.), the main escarpment is up to 15 m high and is consistently west side down (Y-696, p. 53). Lineaments to the west of this main escarpment show no vertical displacement (Y-696). North of lat 36°05′N., maximum scarp height is 5 m, consistently west side down (Y-696, p. 78). No evidence for lateral displacement was observed by Y-696, and no clear surface displacement is exhibited along many of the fault traces (Y-696).

Displacement: A minimum vertical displacement of about 300 m (about 1,000 ft) along PRP was estimated by Y-845 (p. 18, 21) on the basis of this amount of erosion of basin–fill sediments from the upthrown block of the fault. Right–lateral displacement of greater than about 16 to 19 km has been estimated by Y-888 (p. 694) from relationships among Precambrian and Paleozoic rocks.

Age of displacement: The age of the most–recent displacement along PRP is Quaternary. However, the exact ages of displacements are not known because deposits associated with PRP have not been dated. Y-696 (table 1, p. 28) suggested that the youngest geomorphic surfaces displaced are middle to late Holocene at the northern end of PRP and late Pleistocene(?) at the fault's southern end. The timing of the initial displacement is unknown, but Y-706 suggested that the scarps and lineaments that are presently observable are the result of renewed displacement on an older (middle Miocene?) fault. He based this conclusion on elongate northwest–trending gravity anomalies beneath Pahrump Valley that coincide with PRP and that suggest that displacement occurred contemporaneously with development of sedimentary basins. Y-614 proposed that Pahrump basin initially formed between 10 Ma and 15 Ma with the beginning of displacement on the Death Valley fault (DV of this compilation).

South of lat 36°05′N. (but north of lat 36°00′N.), the youngest deposits clearly displaced are QT deposits of Y-696 (p. 78-79; these are the QTol deposits of Y-845), which are probably Pliocene or Pleistocene (Y-696, p. 29). The highly sinuous and dissected character of an escarpment that is >8 m high suggests that no major displacement has occurred "in quite some time," but the age of this displacement is not known (Y-696, p. 79). The map by Y-852 does not show this escarpment. Younger sediments inset into the QT deposits are also displaced, but their age is also unknown (Y-696). Sand dunes that are probably Holocene (≤10 ka) bury the escarpment and do not appear to be displaced (Y-696, p. 80). Y-696 (p. 80) concluded that terrace deposits dated at 800 ± 50 yr (^{14}C date, J. Quade, personal commun., 1989, *cited in* Y-696, p. 80) are not displaced.

North of lat 36°05′N., numerous scarps are present on surfaces of playa sediments (Qya deposits of Y-845; these are the "op" deposits of Y-696), which are younger than the QT deposits of Y-696, but their age is not known (Y-696, p. 81). Y-845 suggested that these playa deposits may be late Quaternary. The scarps are inferred by Y-696 (p. 60, 81) to be probably late Pleistocene. This inference is based on the geomorphically youthful appearance of the scarps despite being on surfaces of unconsolidated clay and silt that would be easily eroded. These scarps are linear and have a distinctive appearance on aerial photographs (Y-696).

Pahrump fault (PRP) — Continued

Y-696 (p. 81-82) suggested that the youngest deposits in Stewart Valley that are displaced by PRP are probably late Pleistocene to early Holocene because (1) the deposits are in the same area as modern playa deposits, (2) the deposits are only shallowly dissected by modern drainages, (3) the deposits are only a few meters higher than the modern playa deposits, and (4) the soils on the deposits are weakly developed. Scarps on the surfaces of these deposits have a geomorphically youthful appearance, are linear, and are distinct on aerial photographs (Y-696, p. 82). Y-161 inferred that their Stewart Valley fault is older than a possible continuation of the fault to the south in Pahrump Valley. Y-161 suggested that the Stewart Valley fault dates from a period of deformation during the early Cenozoic or perhaps the late Mesozoic that was contemporaneous with folding in the northern Resting Spring Range and Montgomery Mountains. At the northern end of the Resting Spring Range, the Stewart Valley fault is overlain by Cenozoic deposits and is cut by younger faults (Y-161).

Slip rate: The slip rate on PRP is estimated by Y-696 (p. 82) to be low (an exact rate is not specified) because of (1) the distributed nature of fault traces in northern Pahrump Valley and in Stewart Valley and (2) the absence of fault traces on some of the younger inset alluvial fans in southern Pahrump Valley.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with the fault traces in Pahrump Valley. PRP borders the western side of the Montgomery Mountains in Stewart Valley, but range–front characteristics have not been evaluated.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-696, p. 8-9, scales 1:12,000 (low–sun–angle) and 1:80,000; Y-813, p. 4, scales 1:62,000 to 1:80,000). Field examination (Y-161; Y-696, p. 9; Y-845, p. 4). Analysis of seismic reflection lines (Y-696, p. 97-111; Y-806). Analysis of gravity data (Y-672; Y-706; Y-1105, p. 8685). Topographic scarp profiles (Y-696, p. 60, figs. 27 and 28, p. 64-65, figs. 31 and 32, p. 70-71).

Relationship to other faults: PRP is part of the Pahrump fault system as defined by Y-696 (p. 3), along with the East Nopah fault (EN) and the West Spring Mountains fault (WSM; pl. 2).

All or parts of PRP have been called the Pahrump Valley–Stateline fault zone (Y-806), the Pahrump fault zone (Y-238; Y-706; Y-889), and the Stewart Valley fault (Y-161; Y-892). PRP may extend as far north as the southernmost east–northeast–striking fault trace that may be part of the Rock Valley fault zone (RV) in the Amargosa Desert north of Ash Meadows. If extended this far northward, then PRP would include the Ash Meadows and Amargosa River faults of Y-695 and the Stewart Valley fault of Y-892 in the Amargosa Valley (Y-9; Y-238). PRP may extend to the south and include the State Line fault (SL; Y-9, p. 43).

PRP has been interpreted by Y-813 (p. 8) to be the western boundary of the Spring Mountains section of the Walker Lane that extends to the east to the Las Vegas shear zone. PRP has also been interpreted to be the northeastern boundary of a structural "rift" zone, such as the Amargosa Desert rift zone of Y-706 (p. 2-3; fig. 4, p. 8), an unnamed dextral strike slip fault described by Y-887 (Y-696, p. 21, called this the Stateline–Crater Flat shear zone from R. Schweickert, personal commun., *cited in* Y-696, p. 21), and the Kawich–Greenwater volcano–tectonic rift of Y-137 and Y-672. This structural "rift" zone supposedly extends to and includes the Death Valley fault (DV; Y-706) and may extend northward under both Ash Meadows and Crater Flat to Yucca Mountain (Y-137; Y-672; Y-706, p. 2-3; Y-887).

PRP has also been interpreted to be a right–lateral strike–slip fault that has been offset from the Furnace Creek fault (FC) by left–lateral displacement along the Rock Valley fault (RV; Y-9; Y-238, p. 6). This was proposed because FC and PRP have parallel strikes, because both faults terminate against fault traces that may be a southwestern extension of RV, and because late Cenozoic sediments in Ash Meadows could have been severely folded and faulted as a result of compression at a left step in the combined right–lateral fault system (Y-9; Y-238, p. 6). Y-887 (p. A90) proposed a minimum right separation of about 26 m using a distinctive fold–thrust system of the CP thrust as piercing points. Because surface expression of this fault is lacking, Y-887 (p. A90) inferred that most displacement occurred before ash–flow tuffs in the region were deposited between 10 Ma and 14 Ma.

Pahrump fault (PRP) — Continued

Seismic reflection lines interpreted by Y-696 (p. 108-111) show a large horst block beneath PRP that extends to at least the southern end of Pahrump Valley (the boundary of her study area). She interpreted this as a zone of high–angle faulting, where PRP has behaved as a broad oblique shear disrupting basin stratigraphy and possibly downdropping originally continuous basin reflectors in a fault–bounded graben or half–graben. In addition, this broad shear may be aligned along a hinge surface of a broad anticlinal fold.

Y-161 (p. 1371) suggested that folds at the northern end of the Resting Spring Range may "represent renewed strain along the Stewart Valley fault zone but unaccompanied by surficial faulting." They also suggested that valleys in the area may "owe their origin as much to folding as to faulting" (Y-161, p. 1371).

Pahute Mesa faults (PM)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992; Y-922: Hamilton and others, 1972.

Location: 48 km/354° (distance and direction of closest point from YM) at lat 37°17′N. and long 116°32′W. (location of closest point). PM includes scattered faults on Pahute Mesa. The only ones shown on plate 1 of this compilation are faults that either have been mapped on surfaces of Quaternary deposits or align with those mapped on surfaces of Quaternary deposits. The above references show more faults in this area. These fault are primarily in Tertiary deposits.

USGS 7-1/2′ quadrangle: Black Mountain, Pack Rat Canyon, Tolicha Peak, Tolicha Peak NE, Tolicha Peak NW, Trail Ridge.

Fault orientation: Variable.

Fault length: The lengths of individual faults of PM range between 0.5 and 4 km as estimated from Y-813 (pl. 2). The longest series of aligned, *en echelon*, and overlapping fault traces is about 9 km long as estimated from Y-813 (pl. 2).

Style of faulting: Faults of PM are primarily shown by Y-813 to have primarily vertical displacements (direction is variable). Y-813 (p. 7) suggested that the displaced features along some faults that occur on Tertiary volcanic rocks and the apparent lack of major vertical scarps suggest right–lateral displacement. Y-10 (p. 59, *citing* Y-922) noted that earthquakes triggered by underground nuclear explosions on Pahute Mesa have produced both dip–slip and right–lateral components of displacement on north– to north–northeast–striking faults. However, right–lateral displacement on faults on Pahute Mesa has not been confirmed by field mapping (Y-10, p. 59).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Faults of PM are shown by Y-813 (pl. 2) as weak to prominent lineaments or scarps on surfaces of Quaternary deposits (e.g., the east–striking ones east of Black Mountain). Some of these lineaments or scarps extend onto surfaces of Tertiary deposits (Y-813, pl. 2).

Many faults on Pahute Mesa (most are not shown on pl. 1 of this compilation) are portrayed by Y-813 and Y-853 as weak to prominent lineaments or scarps on surfaces of Tertiary deposits or as faults that are in Tertiary deposits, volcanic rocks, or sedimentary rocks and that have been identified from previous mapping. Y-232 also showed faults in Tertiary deposits on Pahute Mesa.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with PM.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: Y-10 (p. 59) speculated that north–striking faults on Pahute Mesa are a continuation of north–striking faults of the Basin and Range province (e.g., the Kawich Range fault (KR) and the Belted Range fault (BLR) of this compilation, both of which are located north of Pahute Mesa) and may be, in part, strike–slip conjugate shears.

Paintbrush Canyon fault (PBC)

Plate or figure: Figure 3.

References: Y-8: Fox and Carr, 1988; Y-26: Swadley and others, 1984 (show only that portion of PBC north of the southern end of Fran Ridge); Y-31: Scott and Whitney, 1987 (their Busted Butte–Paintbrush Canyon normal fault zone); Y-46: Maldonado, 1985; Y-55: Scott and Bonk, 1984 (name from their pl. 1; show only that portion of PBC north of the southern end of Fran Ridge; includes their Fran Ridge fault along the southern end of Fran Ridge); Y-189: Lipman and McKay, 1965; Y-217: Gibson and others, 1991 (show only that portion of PBC north of the southern end of Fran Ridge); Y-224: Frizzell and Shulters, 1990 (extend PBC north of Yucca Wash); Y-238: Reheis and Noller, 1991 (pl. 3); Y-298: Gibson and others, 1990; Y-396: Scott, 1990; Y-575: Whitney and Muhs, 1991 (their Paintbrush Canyon–Stagecoach Road fault system, which they subdivided into 5 segments; assume that their segment along Busted Butte is part of PBC); Y-577: Wesling and others, 1991; Y-1042: O'Neill and others, 1992 (found no evidence for PBC north of Yucca Wash); Y-1098: Swan and others, 1993 (discuss only a western splay of PBC in Midway Valley); Y-1239: Wesling and others, 1992.

Location: 3 km/117° (distance and direction of closest point from YM) at lat 36°49′N. and long 116°25′W. (location of closest point). PBC is located along the eastern side of Midway Valley and along the western sides of Alice Point and Fran Ridge.

USGS 7-1/2′ quadrangle: Busted Butte, Pinnacles Ridge.

Fault orientation: PBC has a curving, but generally north–northeast strike (Y-26, pl. 1; Y-55, p. 1; Y-217, p. 50; Y-224; Y-1042, pl. 1). The map by Y-55 (pl. 1) shows westward dips of 55° on PBC north of Alice Point and westward dips of 61° to 86° adjacent to Fran Ridge (their Fran Ridge fault). Along the western side of Fran Ridge, PBC is expressed as a brecciated zone that is about 4 m wide and that dips 60° to 70° W. (Y-1042, p. 13). A western splay of PBC in Midway Valley strikes N. 30° E. to N. 45° E. and dips about 78° W. (Y-1098, p. 153). Y-396 (p. 259) reported an average dip of 69° for PBC on the basis of fourteen measurements.

Fault length: PBC is noted by Y-26 (p. 13) to be about 18 km long. Y-217 (p. 50) suggested that PBC is about 25 km long as estimated from Y-46 and Y-224. Y-217 (p. 50, 52) noted that PBC extends about 11 km north of Yucca Wash as mapped by Y-224. Segments of the Paintbrush Canyon–Stagecoach Road fault system of Y-575 (p. A119) have lengths of 3 to 4 km. PBC could be as long as 30 km if it connects to the Stagecoach Road fault (SCR) to the south (Y-575, p. A119).

Style of faulting: Displacement of Miocene volcanic rocks along PBC is shown as dip slip (normal) and down to the west and northwest (Y-26, pl. 1, p. 13; Y-55, pl. 1; Y-224). Left–lateral displacement on PBC adjacent to Fran Ridge has been inferred by Y-575 (p. A119) and by Y-1042 (p. 13) from slickenlines that are preserved on Tertiary fault breccia and that plunge 39° to 47° to the southwest. Y-575 (p. A119) and Y-1042 (p. 20) interpreted deflected and displaced stream channels that cross Fran Ridge as suggesting Quaternary left–oblique displacement on PBC.

Scarp characteristics: No information.

Displacement: Y-26 (p. 13) noted that fractures exposed in Trenches A1 and A2 near Yucca Wash are difficult to assess because bedding features are scarce, but that displacements in middle and late Pleistocene deposits have apparently been minor (less than a few centimeters). Likewise, fractures in deposits of similar age exposed in Trench 16B west of Fran Ridge (called the Fran Ridge fault by Y-217, p. 53) are interpreted by Y-26 (p. 13) "as indicating minor offset on the fault in the underlying bedrock that produced fractures with no visible offset in the unconsolidated sand of unit Q2e" (estimated age of 700 ka to 750 ka; Y-26, fig. 3, p. 9). Total displacement across the Fran Ridge fault, which Y-217 (p. 52) included as a splay of PBC, is about 300 m.

Paintbrush Canyon fault (PBC) — Continued

At Busted Butte, Y-575 (p. A119) reported an apparent maximum vertical displacement of 4.1 m for the deepest of several buried soils (maximum age of 700 ka) developed in sand ramps. Assuming oblique displacement of 45°, Y-575 (p. A119) calculated a total oblique displacement of 5.8 m since the beginning of middle Pleistocene. Y-1042 (p. 8) noted that there is no expression of the fault at this locality on aerial photographs, but they recognized small fractures directly south of the fault exposed at Busted Butte.

As noted in Y-217 (table 4-1, p. 46), who were using data from Y-298, PBC has apparent vertical separations of 200 m in the Tiva Canyon Member of Paintbrush Tuff (12.9 Ma ± 1.1 Ma; K–Ar), 90 m in Waterpipe Butte rhyolite (9.6 Ma; stratigraphic relationships to dated units), 70 m in Dome Mountain basalt (9.3 Ma to 9.6 Ma; stratigraphic relationships to dated units), 45 m in Thirsty Canyon tuff (7.5 Ma ± 0.6 Ma; K–Ar), and 4.1 m in alluvium (Q2e deposits; 500 ka from uranium–trend or <700 ka from stratigraphic relationships with deposits containing Bishop ash).

As noted in Y-217 (table 4-2, p. 48), stratigraphic dip separation on PBC in the Topopah Spring Member of the Paintbrush Tuff (13.1 ± 0.8 Ma; K–Ar) is 220 ± 5 m as estimated from cross section A–A′ of Y-55 (Y-217, fig. 4-10, p. 63), which is drawn across the central part of Fran Ridge, and is 515 ± 5 m as estimated from cross section B–B′ of Y-55 (Y-217, fig. 4-11, p. 66), which is drawn across the northern end of Fran Ridge.

Along a western splay of PBC, Y-1098 (p. 153) estimated a cumulative dip–slip displacement of about 170 to 270 cm in middle Pleistocene deposits. They (Y-1098, p. 153) also estimated a vertical displacement of about 15 cm during the youngest rupture along this splay. They estimated a vertical displacement per event of 40 to 85 cm for all but the youngest event.

Age of displacement: Y-575 (p. A119) concluded that sand ramps west of Busted Butte have been displaced at least four times since about 700 ka. Y-575 (p. A119) estimated that the youngest rupture at Busted Butte probably occurred during late Quaternary. On the basis of correlation of stratigraphic units, Y-26 (table 4, p. 21) inferred an age of 270 ka to 700 ka for the youngest displacement on PBC. In contrast, PBC is shown as concealed over much of its length by Y-224. Y-1042 (p. 9) noted that a large slump block along the northwestern side of Fran Ridge appears to overlie the trace of PBC. Although surficial mapping by Y-26 (p. 13) revealed no evidence for Quaternary ruptures along PBC, exposures in trenches do suggest Quaternary displacement.

Of four trenches located on PBC, Y-26 (table 1, p. 5) noted that the youngest rupture recorded in the two trenches west of Fran Ridge (the Fran Ridge fault of Y-217, p. 53) occurred between 700 ka and 270 ka as interpreted from Trench 16B (displacement of Q2e deposits with an estimated age of 700 ka to 750 ka, but no displacement of Q2s deposits with an estimated age of 270 ka to 700 ka; Y-26, fig. 3, p. 9). On the basis of exposures in Trench 17, Y-26 (table 1, p. 5) interpreted the youngest rupture as older than 700 ka (no displacement of Q2e deposits). Y-26 (table 1, p. 5) noted that the youngest rupture that is recorded in the two trenches near Yucca Wash near the northern end of PBC occurred either between 700 ka and 160 ka as interpreted from Trench A1 (displacement of Q2e deposits and Q2e soil, but no displacement of Q2b deposits with an estimated age of 160 ka to 250 ka; Y-26, fig. 3, p. 9) or between 270 ka and 800 ka as interpreted from Trench A2 (displacement of Q2c deposits with an estimated age of 270 ka to 800 ka, but no displacement of Q2c soil or Q2b deposits).

Y-577 (p. A119) identified lineaments of possible tectonic origin on colluvial and alluvial surfaces along PBC in Midway Valley. Y-1042 (p. 8) noted north–trending fault scarps along the western sides of Alice Point, Fran Ridge, and Busted Butte. Photolineaments that are preserved on surfaces of colluvial and alluvial units and that are of possible tectonic origin are located along PBC (Y-577). Y-1239 (p. 45) suggested that PBC is "moderately well expressed as alignments of north–trending lineaments" and that these lineaments "are associated primarily with the bedrock/alluvium contact along the margins of bedrock highs or within colluvial aprons that have local bedrock exposures."

On the basis of faulted and unfaulted colluvial units exposed in a trench, Y-1098 (p. 153) inferred a late Pleistocene age for the most–recent displacement along a western splay of PBC.

Slip rate: On the basis of an estimated 5.8 m of oblique displacement since about 700 ka, Y-575 (p. A119) estimated an oblique slip rate for PBC at Busted Butte of 0.0083 mm/yr since the beginning of middle Pleistocene.

Paintbrush Canyon fault (PBC) — Continued

Using amounts of vertical displacement in dated Tertiary volcanic units, Y-217 (fig. 4-13, p. 72) estimated an apparent vertical slip rate of 0.035 mm/yr for PBC between about 13 Ma and 9 Ma and a rate of 0.006 mm/yr between about 9 Ma and 700 ka.

An apparent vertical slip rate of about 0.01 mm/yr or less during middle and late Quaternary was estimated by Y-1098 (p. 153) for a western splay of PBC.

Recurrence interval: On the basis of buried soils in faulted sand ramps at Busted Butte, Y-575 (p. A119) interpreted five events since about 700 ka. Using this conclusion of five events and adding one more event for the present interval, the average recurrence interval for events on PBC at Busted Butte since the beginning of middle Pleistocene ranges between 117,000 and 140,000 yr.

On the basis of weakly developed soils that are preserved on sediments deposited between surface–faulting events, Y-1098 (p. 153) concluded that recurrence intervals of 10^3 to 10^4 yr separate three to five middle and late Pleistocene events on a western splay of PBC.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished information (Y-26, p. 1; Y-217, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000) or conventional aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-1239, p. 3, scales 1:6,000, 1:12,000, and 1:60,000). Trenches (Y-26, p. 3, table 1, p. 5, figs. A12-A16, p. 35-39, Trenches 16, 16B, 17, A1, and A2; Y-1098, p. 153). Surficial mapping and field investigations (Y-26, p. 3; Y-1042, p. 2; Y-1239, p. 3). Analysis of stream patterns (Y-575, p. A119). Study of 20–m–deep exposures in arroyos along Busted Butte and Fran Ridge (Y-575, p. A119). Where obscured by alluvium, PBC has been located using geophysical anomalies detected on aeromagnetic and electromagnetic surveys (Y-55; Y-217, p. 45, 52).

Relationship to other faults: PBC is one of the major north–striking faults in the Yucca Mountain area (Y-1042, p. 8). Both Y-575 (p. A119) and Y-1042 (p. 8) suggested that PBC curves southeastward and merges with the Stagecoach Road fault (SCR). Alternately, Y-1042 (p. 10) suggested that PBC may continue southward and connect to a north–striking reverse fault cutting Busted Butte. Y-31 (p. 332) suggested that the combined fault zone of PBC and SCR forms an arcuate breakaway zone related a detachment fault underlying the Yucca Mountain area. Y-217 (p. 52) noted that the Fran Ridge fault is one of several splays of PBC in southern Midway Valley. They further suggested that the Fran Ridge fault and PBC may rejoin to the south in the Dune Wash area, as shown by Y-224.

Palmetto Mountains–Jackson Wash fault (PMJW)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pls. 1 and 2). Not shown by Albers and Stewart, 1972 (Y-407) nor by Dohrenwend and others, 1992 (Y-853).

Location: 112 km/309° (distance and direction of closest point from YM) at lat 37°30′N. and long 117°24′W. (location of closest point). PMJW is located in the valley of Jackson Wash northwest of Mount Jackson along the eastern sides of the Palmetto Mountains and the Montezuma Range.

USGS 7-1/2′ quadrangle: Lida, Montezuma Peak SE, Montezuma Peak SW.

Fault orientation: The northern end of PMJW strikes northeast (Y-238). The southern end of PMJW strikes north to north–northeast (Y-238).

Fault length: The length of PMJW is about 12 km as estimated from Y-238 (pls. 1 and 2).

Style of faulting: PMJW is composed of short, subparallel, and overlapping fault traces on which displacement has been both down to the east and down to the west (Y-238). PMJW is up to 1 km wide (Y-238).

Scarp characteristics: Scarps are both east– or southeast–facing and west– or northwest–facing (Y-238).

Displacement: No information.

Age of displacement: PMJW is portrayed by Y-238 as weakly expressed to prominent lineaments and scarps chiefly on surfaces of Quaternary deposits and as faults that are in Quaternary deposits and that were identified by previous mapping. Y-10 (p. 58) reported multiple displacements in alluvial–fan deposits with an estimated age of middle to late Pleistocene.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is directly associated with PMJW. PMJW is approximately parallel to the fronts of the Palmetto Mountains and the Montezuma Range, but is 1 km or more east of these fronts.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24:000 to 1:80,000). Field observations for the part of PMJW northeast of the Palmetto Mountains (Y-238, p. 3).

Relationship to other faults: PMJW is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat, such as the Montezuma Range fault (MR) along the western side of the Montezuma Range west of PMJW, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of the Clayton and Paymaster ridges west of PMJW, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain southwest of PMJW, and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains west of PMJW. PMJW is also approximately parallel to northeast–striking faults within basins, such as the Stonewall Flat faults (SWF) within Stonewall Flat east of PMJW, the Clayton Valley fault (CV) within Clayton Valley west of PMJW, and the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range northwest of PMJW (Y-238).

Y-238 (p. 4) speculated that these northeast–striking faults could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred that these fault could be rooted in a detachment fault at depth.

Palmetto Mountains–Jackson Wash fault (PMJW) — Continued

Unlike regional, intrabasin faults that are short and on surfaces of only one age, Y-10 (p. 58) suggested that the faults east of Montezuma Range (part of PMJW) define the Palmetto graben. "These faults appear to offset one fan and two graben–fill deposits which are middle to late Pleistocene in age; offsets are successively smaller with decreasing age of the deposit" (Y-10, p. 58).

Extension of PMJW to the southwest as the Lida Valley faults (LV) or as the East Magruder Mountain fault (EMM) or both is possible, but the relationships among these faults are not known.

Palmetto Wash faults (PW)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pls. 1 and 2); Y-853: Dohrenwend and others, 1992; Y-1031: Reheis, 1992 (shows only the western traces of PW, those in and adjacent to Fish Lake Valley). Not shown by Brogan and others, 1991 (Y-216).

Location: 131 km/302° (distance and direction of closest point from YM) at lat 37°28′N. and long 117°41′W. (location of closest point). PW is located along the southwestern front of the southern Silver Peak Range and in the valley containing Palmetto Wash. Northwest–striking fault traces within Fish Lake Valley to the southwest (shown as PW? on pl. 1 of this compilation) may be part of PW.

USGS 7-1/2′ quadrangle: Lida Wash SW, Oasis Divide, Sylvania Canyon, Sylvania Mountains.

Fault orientation: Faults included in PW generally strike north–northwest or northwest (Y-238; Y-853). Fault traces that are in Fish Lake Valley and that may be part of PW (labeled PW? on pl. 1) strike north.

Fault length: The total length of faults included in PW, but not those in Fish Lake Valley (PW? on pl. 1), is about 8 km as estimated from Y-238 or about 10 km as estimated from Y-853. The section labeled PW? would extend PW 6 km to the south (Y-238), for a total length of 14 to 16 km.

The width of PW is about 13 km (Y-238) or 7 km (Y-853, who does not show all the traces that are shown by Y-238).

Style of faulting: Displacement on fault traces in and adjacent to Fish Lake Valley is shown by Y-1031 as both down to the east and down to the west. Displacement on fault traces north of Palmetto Wash is portrayed by Y-238 as primarily down to the east, but displacement on a couple of traces is shown as down to the west.

Scarp characteristics: Scarps are both east–facing and west–facing (Y-238; Y-853; Y-1031)

Displacement: No information.

Age of displacement: Faults in PW are portrayed by Y-238 as weakly to moderately expressed scarps and lineaments on surfaces of Quaternary deposits and as faults that are in Quaternary deposits and that were identified from previous mapping. Faults in PW that are immediately north of Palmetto Wash are shown by Y-853 as scarps on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). The eastern faults of PW are expressed as fault–related lineaments on depositional or erosional surfaces of Quaternary age (defined as <1.5 Ma; Y-853. The map by Y-1031 shows that faults that are possibly part of PW (the fault traces in Fish Lake Valley) displace alluvial–fan deposits of early Holocene to late middle Pleistocene age (her Qfl, Qfi, and Qfy deposits), but are concealed by late and middle Holocene alluvium (her Qfc deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The morphology of the western front of the Silver Peak Range along PW is noted by Y-853 to be similar to that along a major range–front fault (e.g., characterized by "a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front"), except that PW is "significantly less extensive and fault scarps are substantially lower, shorter, and less continuous." Y-238 showed two faults of PW as topographic lineaments bounding the eastern and western sides of a linear ridge at the western edge of the Silver Peak Range.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Palmetto Wash faults (PW) — Continued

Relationship to other faults: The section shown as PW? nearly intersects the Fish Lake Valley fault (FLV) in Fish Lake Valley (Y-238; Y-1031). Y-238 (p. 4) speculated that displacement along north–striking faults in Fish Lake Valley may be related to right–lateral displacement along the Furnace Creek fault (FC).

Two fault traces immediately west of the Palmetto Mountains at the eastern side of PW strike nearly due north and align with a north–striking fault trace that is located about 7 km to the north between the Palmetto Mountains and the northeast–striking Clayton Valley fault (CV). The structural relationships among these faults are not known.

Panamint Valley fault (PAN)

Plate or figure: Plate 2.

References: Y-29: Hamilton, 1988; Y-222: Streitz and Stinson, 1974; Y-239: Reheis, 1991 (pl. 2); Y-356: McAllister, 1956; Y-399: Hopper, 1947; Y-427: Hart and others, 1989: Y-458: Hall, 1971; Y-489: Murphy, 1932; Y-494: Smith, 1976; Y-591: Albee and others, 1981; Y-614: Wernicke and others, 1988; Y-632: Wernicke and others, 1988; Y-697: Zhang and others, 1990 (discuss only the southern portion of PAN between Ballarat and Wingate Pass); Y-698: Smith, 1975; Y-864: Burchfiel and others, 1987; Y-866: Maxon, 1950; Y-868: Smith, 1979; Y-900: Ellis and others, 1989; Y-901: Hodges and others, 1989; Y-909: Schweig, 1989; Y-910: Sternlof, 1988; Y-912: Walker and Coleman, 1987; Y-915: Wernicke and others, 1989; Y-916: Wernicke and others, 1986; Y-1020: Jennings, 1992 (his fault #247, p. 16); Y-1153: Noble, 1926 (name from this reference, p. 425).

Location: 95 km/227° (distance and direction of closest point from YM) at lat 36°16′N. and long 117°13′W. (location of closest point). PAN is located along the western side of the Panamint Range and the eastern edge of Panamint Valley.

USGS 7-1/2′ quadrangle: Ballarat, Copper Queen Canyon, Emigrant Pass, Jail Canyon, Manly Fall, Manly Peak, Nova Canyon, Panamint Butte, Sourdough Spring, The Dunes, Wingate Pass.

Fault orientation: PAN strikes north and northwest. Along the section between Ballarat and Goler Wash, PAN strikes between N. 10° W. and N. 30° W. (Y-697, p. 4859).

Fault length: The total length of PAN is about 80 km as estimated from fig. 2 of Y-697 (p. 4859). Y-868 (p. 411) noted that PAN extends 100 km northwest of the Garlock fault along the western front of the Panamint Range. The minimum length of scarps interpreted to have formed during the most–recent prehistoric earthquake south of Ballarat is 25 km; the maximum rupture length along this portion of PAN is about 30 km (Y-697, p. 4859).

Style of faulting: Displacement type varies among different sections of PAN. Along the central section (between Ballarat and Wildrose Canyon) dip–slip (normal), down–to–the–west displacement has been dominant (Y-239). Fault traces dip between 60° W. and 90° W. (Y-489, p. 354).

Along the southern section (south of Ballarat), fault traces at the range front also have dip–slip (normal), down–to–the–west displacement (Y-697, p. 4858). However, right–lateral displacement has been dominant along fault traces several hundred meters west of the range front on this portion of PAN. Y-697 (p. 4869) noted that oblique–slip on the southern portion of PAN is "partitioned between strike–slip and dip–slip faults, and * * * dip–slip faults are commonly restricted to the range front while strike–slip faults are off the range front." Y-868 (p. 412) also recognized that along a 20-km-long section of PAN between Ballarat and Goler Wash right-lateral displacement is confined to the westernmost fault trace with dip-slip displacement observed on other traces that have west-facing scarps. This is a style of late Cenozoic and modern deformation that they concluded characterizes the Death Valley region.

Scarp characteristics: Between Ballarat and Goler Wash along the southern section of PAN, one set of scarps is present along the range front and another set crosses alluvial fans west of the range front (the range–front fault and the fan–slope fault of Y-697, p. 4859). At Goler Wash Canyon, the height of a southwest–facing scarp that is located 1.5 km west of the range front along the fan–slope trace varies between 0.1 to 0.4 m (Y-697, p. 4860). At Manly Peak Canyon along the southern section, Y-697 (p. 4861) noted that an east–facing scarp is preserved, but concluded that displacement has been dominantly right lateral. Y-868 (p. 413) observed that scarps between Ballarat and Goler Wash are between 0.6 and 1.8 m high and have maximum scarp-slope angles primarily between 27° and 31°. However, some scarps have short, vertical sections. He (Y-868, p. 414) suggested that these scarps probably represent single-event displacement that was subsidiary to displacement on the main trace of PAN. He further concluded that scarps 2 to 6 m high probably formed during multiple ruptures (Y-868, p. 414). Y-866 (p. 104) noted that scarps at Wildrose Canyon at up to 61 m (200 ft) high.

Panamint Valley fault (PAN) — Continued

Displacement: Average right–lateral displacement during the most–recent event on the southern section (south of Ballarat) is 3.2 ± 0.5 m as indicated by scarps at six localities along the fan–slope trace (Y-697, p. 4862-4863). At Goler Wash, displacement is about 4 m (Y-697, p. 4862-4863). Ridges are displaced in a right–lateral sense 24 ± 4 m, 27 ± 4 m, and 37 ± 4 m during this and older events as indicated at two localities (near Manly Peak Canyon and just north of Goler Wash Canyon). Scarps from older events show right–lateral displacements of 6 to 7 m for possibly two events (between Goler Wash and Manly Peak Canyons) and 11 ± 2 m for three to four events (near Manly Peak Canyon; Y-697, p. 4861-4862). Total right–lateral displacement is reported to be 8 to 10 km (Y-427, p. 6, *citing* Y-864).

Y-868 (p. 412-413) noted that most measurements of right-lateral displacement along a 20-km-long section of PAN between Ballarat and Goler Wash are in the range of 2.0 ± 0.6 m, which he suggested characterizes the last surface-rupturing event along this section of the fault. A minimum right-lateral displacement of 0.9 to 1.4 m is reported by Y-868 (p. 413) for PAN at Goler Wash. The maximum right-lateral displacement that was observed by Y-868 (p. 413) is 20 m for mudflow levees at the mouth of Manly Peak Canyon.

Dip–slip displacement from the most–recent event on the southern section of PAN is 0.4 to 1.2 m along the range–front fault as shown at one locality (Goler Wash Canyon; Y-697, p. 4859).

Along the northwest–striking section that may be part of either PAN (Y-399; Y-698) or the Hunter Mountain fault (shown as HM? on pl. 2 of this compilation), Y-399 (p. 399) reported observing evidence for right–lateral displacement on nineteen stream channels south of Highway 19. This evidence includes the development of shutter ridges. Y-399 (p. 399) estimated right–lateral displacements of 24 to 61 m (80 to 200 ft) and apparent vertical displacements (southwest side up) of about 12 m (40 ft). In this same area but north of the highway, Y-698 (p. 113) noted 183 m (600 ft) of right–lateral displacement estimated on the basis of the juxtaposition of a late Quaternary alluvial–fan deposit composed of clasts of Precambrian and Paleozoic rocks against a 61–m (200–ft) hill of Tertiary volcanic rocks.

About 3 km (2 miles) southeast of Highway 19, right–lateral displacement of older alluvial–fan deposits totals 305 to 610 m (1,000 to 2,000 ft; Y-698, p. 114).

About 11 km (7 miles) south–southeast of Highway 19, near the mouth of Wildrose Canyon, a "sheet of monolithologic (landslide) breccia" is displaced right laterally 3,050 to 4,575 m (10,000 to 15,000 ft) from a source at Wildrose Canyon (Y-698, p. 114).

The total pre–Quaternary dip–slip across the zone of faults bounding the eastern side of Panamint Valley, which includes the modern trace of PAN, is 9,150 m (30,000 ft) that has occurred in a step–wise, down–to–the–west pattern (Y-399, p. 426; Y-698, p. 112). Total vertical displacement on PAN is reported to be about 1.8 km by Y-427 (p. 6). Displacement of Mesozoic and lower Paleozoic rocks suggests maximum extension of 300 m (300%) in an east–west direction (Y-614; Y-632).

Age of displacement: Most of PAN is shown as having Holocene (≤10 ka) displacement; some parts are portrayed as having late Quaternary (<700 ka) displacement or Quaternary (<1.6 Ma) displacement. The most–recent event on the southern section (south of Ballarat) is noted by Y-697 (p. 4859) and by Y-868 (p. 413-414) to be "young" and is estimated to have occurred during the last few hundred years based on the fresh appearance of the scarps (sharp, uneroded, sparsely vegetated, and little or no desert varnish). Y-1153 (p. 428) inferred that fault scarps along PAN, some of which are 6.1 m (20 ft) high, "must be very recent features indeed, for even in that dry region they could not stand up long in the unconsolidated materials that make the fans."

Y-697 (p. 4866) inferred that shorelines from the last high stand of Lake Panamint (estimated to have occurred about 17 ka ± 4 ka) are displaced by more than the most–recent event on the southern section of PAN, possibly by 6 to 14 events, assuming single–event displacements of about 3 m. The most active fault traces along the central section are south of Hall Canyon, where the modern playa is located along the range front (Y-239, p. 4).

The Panamint Range and the Darwin Plateau may have been covered by a continuous sequence of basalts (age of their upper part is about 4 Ma) before extension began (Y-697, p. 4858, *citing* Y-910).

Slip rate: Y-697 calculated lateral slip rates for the southern section of PAN (south of Ballarat) on the basis of data obtained at two localities. Based on 37 ± 4 m of right–lateral displacement of ridges with a maximum age of 17 ± 4 ka (may be younger than 12 ka or 13 ka) near the southern extent of scarps at Goler Wash Canyon, Y-697 (p. 4865-4866) estimated a minimum Holocene and latest Pleistocene right–lateral slip rate of 2.36 ± 0.79 mm/yr (range of 1.57 to 3.15 mm/yr). Based on 24 ± 4 m and 27 ± 4 m of right–lateral displacement of ridges with a maximum age of 17 ± 4 ka (may be younger than 12 ka or13 ka) near Manly Peak Canyon 5.3 km north of Goler Wash Canyon, Y-697 (p. 4865) calculated a minimum Holocene and latest Pleistocene right–lateral slip rate of 1.74 ± 0.65 mm/yr (range of 1.09 to 2.38 mm/yr). Y-697 (p. 4871) noted that these rates are similar to the rate (2 to 2.7 mm/yr) since about 4 Ma as determined from a basalt along the northwest–striking Hunter Mountain fault (HM) in northern Panamint Valley.

Y-900 (p. 465) suggested that the lateral slip rate on the southern portion of PAN since 15 ka has been about 2.5 mm/yr in a direction of N 20° W.

Recurrence interval: Assuming single–event right–lateral displacements of about 3 m (3.2 ± 0.5 m) and a right–lateral slip rate of 2.36 ± 0.79 mm/yr, the average recurrence interval for the southern section of PAN was estimated by Y-697 (p. 4868) to be 860 yr to 2,360 yr during the Holocene and latest Pleistocene.

Y-868 (p. 415) suggested that the mean recurrence interval between surface-rupturing events on the 20-km-long section of PAN between Ballarat and Goler Wash is "on the order of 700 to 2,500 years." This estimate assumes that all events produced right-lateral displacement of 1.4 to 2.6 m, so that the total displacement of 20 m represents eight to fourteen events since the deposits with these displacements were buried by strandlines of pluvial Lake Panamint between 10 ka and 20 ka. Y-868 (p. 415) further concluded that desert varnish developed on multiple-event fault scarps between Ballarat and Goler Wash suggests that dip-slip displacement recurred "only every 1,000 years or more."

Range-front characteristics: No evaluation of tectonic geomorphology of the Panamint Range front has been done. The range front near Ballarat is described by Y-489 (p. 353) as "unusually steep and rugged" with triangular facets. Large landslides are preserved along the front and east of the range–front trace (Y-239; Y-591). Because these landslides are associated with Quaternary faults, Y-239 (p. 3) speculated that they may be related to rapid uplift of the Panamint Range. A central valley topographic high is marked by the Wildrose graben at Wildrose Canyon (Y-697, p. 4858).

Analysis: Interpretation of conventional and low–sun–angle aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000; Y-697, p. 4859). Field examination (Y-399, p. 395; Y-697, p. 4860). Detailed mapping of displaced topographic features at several localities along the southern section of PAN using plane table and alidade (Y-697, p. 4860).

Relationship to other faults: PAN may extend northward along the Hunter Mountain fault (HM), which strikes N. 60° W., in northern Panamint Valley and Saline Valley (pl. 2 of this compilation). Alternately, PAN may intersect HM at Wildrose Canyon, and splays of PAN may continue northward along the north–northeast–striking Towne Pass fault (TP) and Emigrant fault (EM) along the western side of Tucki Mountain (Y-239, p. 2-3, *citing* Y-29). Y-239 (p. 3) suggested that PAN "consists mainly of normal faults that are probably a continuation and (or) a reactivation of the Tucki Mountain detachment fault [of Y-29]."

Y-900 (p. 465) noted that HM is linked with PAN through a bend of 70° and proposed that the lack of a deep basin in this area may be because uplift at the northwestern end of PAN is approximately equal to subsidence at the southeastern end of HM.

Faults that are parallel to PAN are present within the Panamint Range. These faults displace Pliocene and Quaternary megabreccias as mapped by Y-591, but Y-239 (p. 2) concluded that these faults have apparently been inactive during the late Quaternary. Y-698 (p. 112) noted that the modern trace of PAN is the westernmost of a "family of faults" that bound the eastern side of Panamint Valley.

Panamint Valley fault (PAN) — Continued

Y-239 (p. 3) noted that north– and northeast–striking fault traces at two localities extend across Panamint Valley between PAN and the north–northwest–striking Ash Hill fault (AH) along the western side of the valley. The exact structural relationship between PAN and AH is not known.

Penoyer fault (PEN)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970 (name from their pl. 3); Y-813: Reheis, 1992 (pl. 1); Y-1032: Schell, 1981 (pl. 9). The map by Y-813 shows only the southwestern end of PEN. Y-404 and Y-1032 both show the northern portion of PEN along the Worthington (or Freiburg) Mountains. This portion is not shown by either Y-25 or Y-813. Y-1032 included in PEN an east–striking fault trace in southern Sand Spring Valley. This trace is not shown by Y-25, Y-404, or Y-813.

Location: 97 km/30° (distance and direction of closest point from YM) at lat 37°36′N. and long 115°53′W. (location of closest point). PEN is located along the eastern and southeastern sides of Sand Spring Valley at its junction with the Worthington Mountains on the north and near its junction with the Timpahute Range on the south.

USGS 7-1/2′ quadrangle: Honest John Well, McGutchen Spring, Quinn Canyon Springs, Tempiute Mountain North, Tempiute Mountain South, White Blotch Springs, White Blotch Springs NE, White Blotch Springs NW, White Blotch Springs SE, Worthington Peak SW.

Fault orientation: The southern half of PEN has a curving, north–northeast to northeast strike. The northern half of PEN, along the Worthington Mountains, has a north to north–northwest strike (Y-1032).

Fault length: The length of PEN is noted by Y-1032 (table A2, p. A18) as 56 km. This length includes the east–striking section in Sand Spring Valley that is shown only by Y-1032. PEN is about 35 km long as estimated from Y-404 (pl. 3). This length includes the north–striking section along the western side of the Worthington Mountains, but not the east–striking section in Sand Spring Valley. PEN is about 25 km long as estimated from Y-25.

Style of faulting: Displacement on PEN is shown by Y-25, Y-404, Y-813, and Y-1032 as down to the west or northwest.

Scarp characteristics: Y-1032 (table A2, p. A18) noted a maximum scarp height of 9 m and a maximum scarp–slope angle of 22°.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along PEN is noted by Y-1032 (table A2, p. A18) as late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i, table A2, p. A18) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is also his intermediate–age alluvial–fan deposits (A5i, table A2, p. A18). The oldest unit displaced is his middle Tertiary volcanic rocks (Tv_2, table A2, p. A18) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

The southern half of PEN is portrayed by Y-25 as a faulted contact either between Miocene ash–flow tuff (their Tt3 unit) and Holocene to Miocene alluvium and colluvium (their QTa deposits) or between Holocene to Miocene older gravels (their QTg deposits) and their QTa deposits. This section of PEN is shown by Y-404 as a faulted contact primarily between Pleistocene(?) and Pliocene(?) gravels (their QTg deposits) and older Pleistocene(?) alluvium (their Qol deposits). The southwestern end of the northeast–striking portion of PEN is indicated by Y-813 as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping and as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits.

The northern half of PEN, the part along the Worthington Mountains, is shown by Y-404 (pl. 1) as a Laramide structure that is inferred or concealed by Quaternary and Tertiary gravel, alluvium, and undeformed lake beds (their QT deposits).

Slip rate: No information

Recurrence interval: No information.

Penoyer fault (PEN) — Continued

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: Faults in and along the Groom Range south of PEN (e.g., the Stumble fault (STM), the Groom Range Central fault (GRC), and the Groom Range East fault (GRE)) terminate near the southwestern end of PEN (Y-25). The structural relationships among these faults are not known.

The southwestern end of PEN nearly intersects with the southwestern end of the Tem Piute fault (TEM) south of PEN. Y-25 portrayed the western end of the Tem Piute fault (TEM) as having a more westerly strike than that portrayed by Y-1032, so that PEN and TEM appear as if they may coincide east of Sand Spring Valley as shown by Y-25. This end of PEN also strikes toward the Chalk Mountain fault (CLK) west of PEN. The exact structural relationships among these faults are not known.

The northern end of PEN as mapped by Y-1032 (pl. 9) curves eastward around the northern side of the Worthington Mountains and nearly intersects with the north–striking Freiburg fault (FR) along the eastern side of the mountains. The northeast–striking northern portion of PEN is approximately parallel to the Quinn Canyon fault (QC) northwest of Sand Spring Valley and to the Golden Gate faults (GG) along the eastern side of the Golden Gate Range east of PEN. The structural relationships among these faults are not known.

Plutonium Valley–North Halfpint Range fault (PVNH)

Plate or figure: Plate 1.

References: Y-181: Carr, 1974 (shows several north–northwest–striking faults buried beneath Plutonium Valley in addition to faults along the eastern side of Paiute Ridge, along the western side of Slanted Butte, and along the eastern side of Banded Mountain); Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pls. 2 and 3, shows only the southern part of PVNH along and south of Paiute Ridge). Not shown by Swadley and Hoover, 1990 (Y-526).

Location: 46 km/74° (distance and direction of closest point from YM) at lat 36°58′N. and long 115°57′W. (location of closest point). PVNH is located along the western side of the northern Halfpint Range at its junction with Plutonium Valley and Yucca Flat. Traces of PVNH bound the eastern and western sides of Paiute Ridge, the western side of Slanted Butte, and the eastern side of Banded Mountain.

USGS 7-1/2′ quadrangle: Jangle Ridge, Oak Spring, Paiute Ridge, Plutonium Valley, Yucca Flat.

Fault orientation: PVNH generally strikes north–northwest (Y-232; Y-813). Fault traces curve slightly so that short sections of PVNH strike north–northeast (Y-813).

Fault length: The length of PVNH is about 15 km as estimated from Y-813 (pls. 2 and 3) and 26 km as estimated from Y-232. The longer estimate includes the northern portion of PVNH north of Paiute Ridge.

Style of faulting: Displacement on the northern traces of PVNH is portrayed by Y-232 as down to the east. Displacement on portions of fault traces along and south of Paiute Ridge is shown by Y-813 as both down to the east and down to the west.

Scarp characteristics: Sections of fault traces along and south of Paiute Ridge are portrayed Y-813 as scarps, all of which are west–facing.

Displacement: No information.

Age of displacement: Short sections along the portion of PVNH adjacent to and south of Paiute Ridge are shown by Y-813 (pls. 2 and 3) as weakly expressed lineaments and scarps on surfaces of Quaternary (chiefly) and Tertiary deposits. Other sections of this portion of PVNH, especially east of Camera Station Butte and along Paiute Ridge, are portrayed by Y-813 (pl. 2) as faults that are in Tertiary deposits and that were identified from previous mapping. The map by Y-232 (pl. 1) shows this portion of PVNH as a fault within Miocene and Pliocene Timber Mountain and/or Paintbrush tuffs (his Tp unit) and as concealed by Quaternary alluvium (his Qal deposits).

Sections of the portion of PVNH along Paiute Ridge and Banded Mountain are shown by Y-232 (pl. 1) as a faulted contact between pre–Tertiary rocks and Quaternary alluvium (his Qal deposits). Other sections of this portion of PVNH are shown by Y-232 (pl. 1) as a fault within Miocene and Pliocene Timber Mountain and/or Paintbrush tuffs (his Tp unit).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Portions of PVNH adjacent to and south of Paiute Ridge are portrayed by Y-813 as lineaments along a linear range front.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: PVNH strikes at an oblique angle to the north–striking, right–lateral strike–slip Yucca fault (YC) in central Yucca Flat west of PVNH. PVNH is approximately parallel to the Cockeyed Ridge–Papoose Lake fault (CRPL) along the eastern side of the northern Halfpint Range. The strike of PVNH is slightly more westerly than the strikes of faults along and within ranges to the east (e.g., the Belted Range fault (BH), the Chert Ridge fault (CHR), and the Spotted Range faults (SPR)). A northeastern projection of the Cane Spring fault (CS) would intersect the southern end of PVNH. The structural relationships among these faults are not known.

Quinn Canyon fault (QC)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970; Y-1032: Schell, 1981 (pls. 6 and 9; name from his table A2, fault #102).

Location: 127 km/22° (distance and direction of closest point from YM) at lat 37°55′N. and long 115°53′W. (location of closest point). QC is located within the Quinn Canyon Range. Part of QC bounds the western side of a valley along Quinn Canyon.

USGS 7-1/2′ quadrangle: Quinn Canyon Springs, Quinn Canyon Springs NW.

Fault orientation: QC is curving, but strikes generally northeast (Y-25; Y-404).

Fault length: The length of QC is noted to be 19 km by Y-1032 (table A2, p. A19). The length of QC is 16 km as estimated from Y-404 and 18 km as estimated from Y-25. Y-25 mapped fault traces further to the southwest than does Y-404. Both Y-25 and Y-404 showed a continuous fault trace to the northern edges of their map areas at just north of lat 38°N. QC intersects the western edge of the map area of Y-25 along the Lincoln County line west of long 115°45′W.

Style of faulting: Displacement on QC is shown by Y-25 as down to the east. According to Y-1032 (table A2, p. A19), displacement along QC occurs entirely within a mountain block.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along QC is noted by Y-1032 (table A2, p. A19) to be Pleistocene (defined as >15 ka and <1.8 Ma by Y-1032, p. 29-30). The youngest unit displaced is his old–age alluvial–fan deposits (A5o; Y-1032, table A2, p. A19) with an estimated age of 700 ka to 1.8 Ma (table 3, p. 23). Y-1032 (table A2, p. A19) gives no information on the age of the oldest unit not displaced along QC. The oldest unit that he noted to be displaced is Paleozoic rocks (Y-1032, table A2, p. A19).

Y-25 portrayed part of QC (about 7 km) as a faulted contact between Oligocene welded tuff (their Tt4 unit) and Quaternary alluvium (their Qa deposits). Y-404 showed part of QC as a faulted contact between Tertiary volcanic rocks (their Tvy unit) and older Pleistocene(?) alluvium (their Qol deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17). Compilation of geologic mapping (Y-25).

Relationship to other faults: QC is approximately parallel to faults along the eastern side of the Reveille Range (the West Railroad fault; WR) west of QC and to faults along the western sides of the Worthington Mountains and Timpahute Range (the Penoyer fault; PEN) and along the eastern side of the Golden Gate Range (the Golden Gate fault; GG), both faults east of QC.

Y-25 recognized the Quinn Canyon Range as a volcanic center that has been the source of several ash–flow tuffs. The relationship between volcanism and displacement on QC is not known.

Racetrack Valley faults (RTV)

Plate or figure: Plate 2.

References: Y-239: Reheis, 1991 (pl. 1); Y-356: McAllister, 1956; Y-1148: Zellmer, 1980 (pl. 3.1, maps only those fault scarps at the very southern end of Racetrack Valley).

Location: 97 km/264° (distance and direction of closest point from YM for the fault along the eastern side of Racetrack Valley) at lat 36°45'N. and long 117°30'W. (location of closest point) for the fault along the eastern side of Racetrack Valley; 102 km/265° (distance and direction of closest point from YM for the fault along the western side of Racetrack Valley) at lat 36°45'N. and long 117°33'W. (location of closest point) for the fault along the western side of Racetrack Valley. RTV includes two faults: one along the eastern side of Racetrack Valley and the other along the western side of Racetrack Valley. Parts of both faults bound the fronts of unnamed mountain ranges.

USGS 7-1/2' quadrangle: Jackass Canyon, Ubehebe Peak, Teakettle Junction.

Fault orientation: The faults of RTV generally strike north–northeast. Some individual traces strike between north–northeast and north–northwest (Y-239).

Fault length: The eastern fault has a total length of about 22 km between Lost Burro Gap at the northern end of Hidden Valley and Grapevine Canyon west of Hunter Mountain (pl. 2). This fault, as shown by Y-239, is composed of two sections that are separated by a right step about 0.5 km long at a northwest–striking fault that extends into Racetrack Valley from the unnamed mountain range to the east. The southern section of the eastern fault, south of this step, is 14 km long; the northern section is 7 km long as estimated from Y-239. Y-239 portrayed the eastern fault as extending about 11 km south of the main topographic expression of Racetrack Valley (pl. 2).

The fault along the western side of Racetrack Valley is shown by Y-239 as discontinuous with *en echelon* traces that extend for about 22 km between near Teakettle Junction and Saline Valley (estimated from Y-239). Similar to the eastern fault, the western fault is shown by Y-239 as extending about 8 km south of the topographic expression of Racetrack Valley (pl. 2). The southern 4 km of this fault bounds the southeastern end of Saline Valley.

Style of faulting: Displacement along the southern section of the eastern fault is shown by Y-239 as down to the west. Displacement along most of the western fault is down to the east (Y-239). Displacement on the southern 6.5 km of the western fault, which bounds the southeastern end of Saline Valley, is shown by Y-239 as down to west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Parts of both the eastern and western faults are thought to be Quaternary by Y-239 (defined by her to be <1.8 Ma). Sections of the western fault and the northern section of the eastern fault are shown by Y-239 (pl. 1) as moderately expressed to prominent lineaments or scarps on surfaces of Quaternary deposits. The southern 6 km of the eastern fault south of Racetrack Valley is portrayed by Y-239 as a fault that is in Quaternary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence rate: No information.

Range-front characteristics: Portions of both the eastern and western faults are portrayed by Y-239 as topographic lineaments bounding a linear range front.

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000; Y-1148, p. 1, 9-10, scales 1:37,400 and 1:60,000). Aerial reconnaissance (Y-1148, p. 1). Field reconnaissance (Y-1148, p. 2). Detailed (1:50,000) map of fault scarps (Y-1148, pl. 3.1, includes only the very southern end of RTV).

Racetrack Valley faults (RTV) — Continued

Relationship to other faults: The two faults of RTV are approximately parallel to the faults bounding the eastern sides of Hidden Valley, Ulida Flat, and Sand Flat (part of the Hidden Valley–Sand Flat faults (HVSF) of this compilation) east of RTV. The eastern fault in RTV aligns with the Tin Mountain fault (TM) north of Racetrack Valley. Both the eastern and western faults have strikes similar to that of TM. RTV and TM could be related; they are separated by an *en echelon* right step. RTV and TM together extend between the northwest–striking Hunter Mountain fault (HM) on the south and the northwest–striking Furnace Creek fault (FC) on the north. The southern ends of both the eastern and western faults of RTV nearly intersect HM in the vicinity of Grapevine Canyon.

Ranger Mountains faults (RM)

Plate or figure: Plate 2.

References: Y-671: Guth, 1990; Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991.

Location: 49 km/105° (distance and direction of closest point from YM) at lat 36°44′N. and long 115°55′W. (location of closest point). RM includes faults on both the northern and southern sides of and within the Ranger Mountains.

USGS 7-1/2′ quadrangle: Frenchman Lake, Frenchman Lake SE, Mercury, Mercury NE.

Fault orientation: The two faults north of the Ranger Mountains strike northeast and east–northeast (Y-852). The four faults in the southern Ranger Mountains strike generally northeast (Y-852) or north–northeast to northeast (Y-813).

Fault length: The two faults north of the Ranger Mountains are 3 and 5 km long (estimated from Y-813 and Y-852). The four faults in the southern Ranger Mountains are 3 and 4 km long (estimated from Y-813 and Y-852).

Style of faulting: One fault north of the Ranger Mountains and one fault in the southern Ranger Mountains are indicated by Y-813 to be down to the northwest and down to the west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The two faults north of the Ranger Mountains and three of the faults in the southern Ranger Mountains are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock. Part of one of the faults north of the mountains is shown by Y-852 as a fault–related lineament on surfaces of Quaternary depositional or erosional surfaces. Part of one of the faults north of the mountains is portrayed by Y-813 as a weakly expressed lineament or scarp on surfaces of Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The two faults north of the Ranger Mountains and three of the faults in the southern Ranger Mountains are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock, but not as major range–front faults. The morphology of the adjacent fronts or ridges of the Ranger Mountains would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). Although this morphology is similar to that of major range–front faults, the "associated fault systems are significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous" (Y-852). Portions of one of the faults north of the mountains and one fault in the southern Ranger Mountains are shown by Y-813 as topographic lineaments along linear range fronts.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Relationship to other faults: The relationships of some of the faults grouped in RM to the northeast–striking Rock Valley fault (RV) north of RM, to the northeast– and east–striking Mercury Ridge faults (MER) south of RM, or to the north– and north–northeast–striking Spotted Range faults (SPR) east of RM are not known.

Rock Valley fault (RV)

Plate or figure: Plate 2.

References: Y-20: Yount and others, 1987; Y-62: Barnes and others, 1982; Y-68: Swadley, 1983; Y-70: Swadley and Huckins, 1989; Y-90: Szabo and others, [1981]; Y-177: Hinrichs, 1968; Y-181: Carr, 1974; Y-182: Carr, 1984; Y-218: Sargent and Stewart, 1971; Y-224: Frizzell and Shulters, 1990; Y-226: Swadley and Huckins, 1990; Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 3); Y-314: Ekren, 1968; Y-526: Swadley and Hoover, 1990; Y-695: Donovan, 1991; Y-809: Donovan, 1990; Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991.

Location: 27 km/130° (distance and direction of closest point from YM) at lat 36°41'N. and long 116°12'W. (location of closest point), if the southwestern end of RV is at the Specter Range; 24 km/158° (distance and direction of closest point from YM) at lat 36°39'N. and long 116°20'W. (location of closest point), if southwestern end of RV extends into the Amargosa Desert (the portion shown as RV? on pl. 1 of this compilation). RV is located in Rock Valley between the Specter Range (or the Amargosa Desert) and Frenchman Flat.

USGS 7-1/2' quadrangle: Camp Desert Rock, Frenchman Lake, Frenchman Lake SE, Mercury, Mercury NE, Skull Mountain, South of Lathrop Wells, Specter Range NW, Striped Hills.

Fault orientation: RV strikes northeast. It dips 70° SE. near the central portion of the fault (Y-70).

Fault length: RV is portrayed with various lengths. RV "proper" extends from the Specter Range to Frenchman Flat along a length of about 32 km (Y-224). However, the length of RV as portrayed by Y-20 is only 19 km, because they did not show fault traces along Frenchman Flat to be part of the RV. Alternatively, Y-68, Y-238, and Y-695 (p. 39-40) extend RV about 33 km southwest of the Specter Range into the Amargosa Desert to section 33, T. 16 S., R. 49 E., for a total length for RV of about 65 km between the Amargosa Desert and Frenchman Flat.

Style of faulting: Displacement on RV is noted by Y-238 (p. 5) to be left–lateral strike slip and by Y-20 to be left–lateral oblique slip.

Scarp characteristics: Scarps, vegetation lineaments, and offset drainages are preserved along RV (Y-20; Y-181; Y-218; Y-238; Y-813). Scarps are primarily along traces in the central part of the fault (Y-20; Y-70; Y-177), where scarp heights range between <1 m and 2.5 m (Y-70) with maximum slope angles of 8° (Y-90). Scarps at two trenches in the central part of RV are about 0.5 m high (Y-20). Scarps along the possible southwestern extension of RV into the Amargosa Desert face both northwest and southeast and have maximum slope angles of 5° to 14° (Y-695, p. 41, appen. A).

Displacement: Total lateral displacement on RV is estimated by Y-62 to be a few kilometers. No large amount of vertical displacement is suspected on RV since 10 Ma because no deep structural basins, except for Frenchman Flat, are associated with RV (Y-182, p. 61). Vertical displacement at trench sites located in the central part of RV is 2.5 to 3 m down to the north (Y-20) in their Unit E (QTa deposits of Hoover and others ([1981], Y-73) thought to be older than 740 ka. Vertical displacement in Unit C of Y-20 (31 ka to 38 ka) is 10 to 32 cm down to the north (Y-20). No information on amount of lateral displacement was determined from these trenches.

Age of displacement: At trench sites near the center of RV, Y-20 interpreted the youngest displacement along RV to have occurred after 31 ka to 38 ka (based on uranium–trend analyses on their Unit C, which is displaced vertically 10 to 32 cm), but a minimum age for this displacement could not be estimated by Y-20. An additional faulting event may have occurred between 180 ka (after their Unit D was deposited) and 31 ka to 38 ka (before their Unit C was deposited), but the observed stratigraphic discontinuities can also be explained by a large component of lateral displacement (Y-20).

Rock Valley fault (RV) — Continued

Fault scarps in the central part of RV are reported by Y-70 to be on surfaces of Quaternary deposits ranging in age between Pleistocene–Pliocene? (their QTa deposits; estimated by them to be >740 ka) and older Holocene (their Q1a deposits; estimated by them to be ≤10 ka). Y-70 noted that younger Holocene units (their Q1b deposits) are deposited against fault scarps on surfaces of their Q2bc deposits (estimated by them to be about 160 ka to 740 ka).

Scarps along Frenchman Flat at the northeastern end of RV are shown by Y-852 on depositional or erosional surfaces of possible late Pleistocene age (their Q2? surfaces with estimated ages between 10 ka and 130 ka) and on surfaces of early to middle and (or) late Pleistocene age (their Q1-2 surfaces with estimated ages between 10 ka and 1.5 Ma). An earthquake (magnitude 3 to 4) on February 19, 1973, located 1.6 km northeast of Frenchman Lake playa (Y-181, p. 36, *citing* F.G. Fischer, oral commun., 1973) near the northeastern end of RV, may have produced two cracks in the playa deposits (Y-181).

The youngest deposits that are shown to be displaced (Q1s and Q1c deposits of Y-68) along the possible southwestern extension of RV in Amargosa Desert are Holocene (≤10 ka; Y-68; Y-90; Y-695).

Slip rate: On the basis of 10 to 32 cm of vertical displacement of deposits estimated to be 31 ka to 38 ka as interpreted from the trenches by Y-20, an apparent vertical slip rate of 0.003–0.01 mm/yr since 31 ka to 38 ka can be estimated for the central part of RV.

The amount of lateral displacement has not been determined.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with RV.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-695, p. 3, 37, 39, scale 1:12,000 (low–sun–angle) and 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000). Scarp profiles along the southwestern extension of RV (Y-695, p. 41, appen. A, profiles P4 through P8). Trenches along the central part of RV (Y-20) and along the southwestern part of RV (Y-695, p. 37, Trenches TR1 and TR2).

Relationship to other faults: RV was reported by Y-182 (p. 56-64) and Y-695 (p. 11, 39) to be part of the northeast–striking, 55–km–long, dominantly left–lateral Spotted Range–Mine Mountain structural zone that cuts across the northwest–trending Walker Lane. The Spotted Range–Mine Mountain zone as defined by Y-695 (p. 39) also includes the Mine Mountain fault (MM), the Cane Spring fault (CS), and the Wahmonie fault (WAH).

Rocket Wash–Beatty Wash fault (RWBW)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 3); Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992. Not shown by Cornwall, 1972 (Y-232).

Location: 19 km/318° (distance and direction of closest point from YM) at lat 36°58′N. and long 116°35′W. (location of closest point). RWBW is located between Rocket Wash on the north and Beatty Wash on the south and west of Timber Mountain.

USGS 7-1/2′ quadrangle: Beatty Mountain, East of Beatty Mountain, Thirsty Canyon SE, Thirsty Canyon SW.

Fault orientation: RWBW strikes generally north (Y-813; Y-853). Traces at the southern end strike north–northeast (Y-238).

Fault length: The length of RWBW is about 17 km as estimated from Y-238 and Y-813 or about 5 km as estimated from Y-853, who show only some of the fault traces shown by Y-238 and Y-813.

Style of faulting: Displacement on some traces of RWBW is portrayed by Y-813 as primarily down to the west.

Scarp characteristics: Scarps are shown by Y-238 and Y-813 as generally west–facing.

Displacement: No information.

Age of displacement: Parts of traces of RWBW are shown by Y-238 and Y-813 as moderately expressed lineaments or scarps on surfaces of Quaternary deposits. Other parts are portrayed by Y-238, Y-813, and Y-853 as weakly expressed to prominent lineaments and (or) scarps on surfaces of Tertiary deposits. Other parts are shown by Y-238 and Y-813 as faults that are in Tertiary deposits and that were identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-813, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: RWBW is approximately parallel to other north–striking faults mapped on and around Pahute Mesa, including the north–striking Oasis Valley faults (OSV), which are located about 8 km west of RWBW (Y-232; Y-238; Y-813; Y-853). Unlike RWBW and OSV, which are expressed at least in part on Quaternary surfaces, many of the other north–striking faults on and around Pahute Mesa are expressed only in Tertiary deposits. These faults are not included on plate 1 of this compilation. One of these faults, which is about 20 km long, is located about 2 km east of RWBW. It extends north to Pahute Mesa and is indicated by Y-813 (pl. 2) as having left–lateral displacement. The structural relationship between this fault and RWBW is not known.

RWBW approximately aligns with the Bare Mountain fault (BM) located directly south of RWBW. The structural relationship between these two faults is not known.

Saline Valley faults (SAL)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-355: Ross, 1967 (presents generalized geology of the entire Saline Valley); Y-356: McAllister, 1956 (shows north–striking faults on the eastern side of Saline Valley and south of lat 36°45'N.; the East Side fault zone of Y-1148); Y-415: Jennings, 1985 (Death Valley sheet); Y-417: Burchfiel, 1969; Y-864: Burchfiel and others, 1987; Y-906: MIT Field Geophysics Course and Biehler, 1987; Y-1148: Zellmer, 1980 (shows fault scarps in Saline Valley south of lat 36°45'N., pl. 3.1; SAL includes his Western Frontal fault zone (WF) along the Inyo Mountain front, his East Side fault zone (ES) on the eastern side of Saline Valley adjacent to the Panamint Range, and his Central Valley fault zone (CEN) within central Saline Valley); Y-1240: Lombardi, 1963; Y-1241: Larson, 1979; Y-1247: Ross, 1968.

Location: 108 km/261° (distance and direction of closest point from YM) at lat 36°41'N. and long 117°37'W. (location of closest point). SAL includes faults within and bordering Saline Valley (except for the Hunter Mountain fault along the southern side of the valley). It includes the faults delineated by Y-1148: WF along the eastern front of the Inyo Mountains north of Daisy Canyon, ES along the eastern side of Saline Valley adjacent to the Panamint Range, and CEN in the playa within Saline Valley.

USGS 7-1/2' quadrangle: Craig Canyon, Lower Warm Springs, New York Butte, Pat Keyes Canyon, West of Ubehebe Peak.

Fault orientation: Variable. Y-1148 (p. 20) noted that WF strikes N. 40° W., that ES strikes north, and that CEN strikes northwest to west. Y-1148 (p. 53) reported that WF, where it is exposed in granitic rock near Beveridge Canyon, is nearly vertical.

Fault length: Variable. The length of the WF is 21 km as estimated from Y-222. Y-1148 (p. 60) reported a length of 13.5 km for WF. Individual fault traces in ES are 0.5 to 2 km long as estimated from Y-356. These traces are concentrated into two groups, one about 5 km long and the other about 6 km long. Fault traces in CEN have lengths between about 1 km and 17 km as estimated from Y-222. The total length of CEN is about 20 km.

Style of faulting: Y-1148 (p. 50) noted that WF, which is along the front of the Inyo Mountains, has experienced primarily dip–slip (normal) displacement. He recognized no evidence for lateral displacement along WF.

Y-1148 (p. 62) reported that displacement along ES, which includes a system of grabens, has been chiefly vertical. Y-864 (p. 10,423) noted that normal slip has predominated along ES, but that some fault traces also have evidence for right–lateral displacement. Y-356 portrayed fault traces in ES as primarily down to the west.

Y-1148 (p. 62) reported that CEN is a zone of fault traces with principally dip–slip (normal) displacement and inconclusive evidence for lateral displacement.

Scarp characteristics: Y-1148 (p. 61) suggested that at least three surface ruptures are recorded by fault scarps at several localities along WF.

Y-1148 (p. 63) reported scarps on surfaces of alluvial, lacustrine, and eolian deposits along ES. He (Y-1148, p. 63) also noted that the heights of these scarps range between 2 and 12 m and that the shapes of topographic profiles measured across two scarps suggest that the scarps were formed by up to three events on ES.

Displacement: On the basis of the elevation difference between the height of the Inyo Mountains and the depth of fill within Saline Valley as determined from gravity data, Y-1148 (p. 50) estimated a total vertical displacement on WF of at least 6,000 m. At least 32 to 35 m of vertical displacement on WF is recorded by scarps on alluvial fans (Y-1148, p. 51, 60, 65). The maximum vertical surface displacement across a scarp associated with WF at Beveridge Canyon is 15 m (Y-1148, p. 54). Alluvial fans near Keynot Canyon have maximum vertical displacements of about 8 m as measured across scarps associated with WF, and some older fans in this area may have been uplifted as much as about 32 m (Y-1148, p. 55). A natural levee in Keynot Canyon is displaced about 1.5 m by WF (Y-1148, p. 57-58).

Saline Valley faults (SAL) — Continued

Age of displacement: Y-1148 (p. 55) noted that scarps along WF are on all but the youngest alluvial fans. He (Y-1148, p. 70-71) reported that the floor of Saline Valley is being tilted to the west along WF (and the Hunter Mountain fault, HM) toward the Inyo Mountains. He based this conclusion on evidence from Y-1240 that playa deposits in southern Saline Valley have been uplifted and tilted to the west. The present drainage pattern within the valley also supports this conclusion (Y-1148, p. 70-71). WF is shown by Y-222 as a faulted contact between pre–Quaternary rocks and Holocene alluvium (their Qal deposits).

Y-356 portrayed faults of ES as displacing Pleistocene or Holocene alluvial fans (his Qal deposits). Y-1148 (p. 63-64) concluded that the age of the youngest event on ES ranges between 170 yr and 27 ka on the basis of a comparison of the steepness of these scarps with those reported by Wallace (1977, Y-1118). He (Y-1148, p. 65) also used the lack of varnish on scarp faces, the presence of scarps on all but the most–recent surfaces and active channels, the presence of fewer and smaller creosotes on scarp faces than on stable surfaces, and the disruption of drainages to support the conclusion that displacement on ES is likely relatively young.

Fault traces of CEN are portrayed by Y-222 as displacing Holocene alluvium (their Qal deposits), Holocene dune sand (their Qs deposits), Holocene/Pleistocene? sand deposits (their Qst deposits), and Quaternary lake deposits (their Ql deposits). Y-415 (p. 136, 138, note #17, *citing* Y-1240) and Y-1148 (p. 12, *citing* Y-1240) both reported that fault traces within Saline Valley displace Quaternary deposits. Y-1148 (p. 70) inferred that displacement along CEN has been relatively recent because fault traces are preserved on the surfaces of fine–grained, and frequently wet, playa deposits. He assumed that these traces could not be preserved for very long on the playa surfaces. He (Y-1148, p. 70-72) also suggested that displacement on CEN may be continuing because Y-1240 observed tilt of the playa floor and because a northwest–trending lineament that Y-1148 interprets to have a tectonic origin is sharper on photographs (approximate scale of 1:117,000) taken during aerial reconnaissance in 1979 than it is on aerial photographs (scale of 1:37,400) taken in 1947. He interpreted the better expression in 1979 when compared to that in 1947 as being due to increased displacement during the intervening 32 yr.

Y-864 (p. 10,423, *citing* Y-355, Y-415, Y-1241, and Y-1247) concluded that Saline Valley did not begin to form until after extrusion of the oldest basalts (3.8 Ma to 2.8 Ma) that are preserved in the Saline Range (Y-417, Y-1241), which is located north of Saline Valley.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Analysis of aerial photographs (Y-1148, p. 1, 9, scales 1:20,000, 1:37,400, and 1:60,000). Aerial reconnaissance (Y-1148, p. 1). Field reconnaissance (Y-1148, p. 2). Detailed geologic mapping (Y-864, p. 10,422). Topographic scarp profiles of fault scarps (Y-1148, p. 1, 78–86, table 4.1). Detailed (1:50,000) map of fault scarps (Y-1148, pls. 3.1, 3.1a, 3.2, 3.3, and 3.4). Study of scarp material (Y-1148, p. 1-2).

Relationship to other faults: Y-1148 (p. 109-113) interpreted Saline Valley as a rhombochasm between two northwest–striking, right–lateral faults (the Hunter Mountain fault (HM) on the south and an unnamed fault to the north) and between two north–northwest–striking principally dip–slip (normal) faults (WF on the west and ES on the east). WF intersects the western end of HM at an angle of greater than 90° at the southwest corner of Saline Valley.

In contrast to models suggested by Y-864 and by Y-906 that northern Panamint Valley is relatively shallow and was likely formed by extension on a low–angle, west–dipping detachment or normal fault, Y-864 (p. 10,425-10,426) concluded that a low–angle fault cannot be responsible for extension in Saline Valley. They noted several types of evidence that suggest that extension in Saline Valley probably occurred along closely spaced planar faults. This evidence includes (1) the numerous, northeast–striking, west–dipping normal faults that project into Saline Valley from the surrounding ranges (Y-355; Y-417), (2) the continuous exposure of Pliocene volcanic rocks across ranges adjacent to Saline Valley, and (3) the great depth of Saline Valley as interpreted from gravity data.

Sarcobatus Flat fault (SF)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pls. 1 and 2); Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992; Y-1071: Weiss and others, 1993. Not shown by Cornwall, 1972 (Y-232).

Location: 52 km/305° (distance and direction of closest point from YM) at lat 37°07′N. and long 116°55′W. (location of closest point). SF is located along the northeastern side of Sarcobatus Flat and along the western edge of Pahute Mesa.

USGS 7-1/2′ quadrangle: Scottys Junction, Scottys Junction NE, Springdale NW, Springdale SW, Stonewall Spring, Tolicha Peak SW.

Fault orientation: SF strikes generally north–northwest, but the fault curves, so that short sections strike north and northeast (Y-238; Y-813).

Fault length: The total length of SF is 27 km as estimated from Y-853. This includes a 15–km–long section with surficial expression at the fault's northern end, an 8.5–km–long gap in surficial expression, and a 4–km–long section with surficial expression at the fault's southern end.

The total length of SF is 51 km as estimated from Y-238 and Y-813. This includes a 5.5–km–long gap in surficial expression, where Y-813 interprets lineaments on either side of the gap to be related (the dotted portion of SF on pl. 1 of this compilation).

Style of faulting: Displacement on fault traces for which such information is given is shown by Y-238 and Y-813 as generally down to the west. The fault traces in part overlap and branch.

A 3–to–4–km–long left step occurs in the fault's trace at Stonewall Mountain near the northern end of SF (Y-238; Y-813; Y-853). The map by Y-238 (pl. 2) shows a northeast–striking, down–to–the–southeast trace at this step.

Scarp characteristics: Portions of some fault traces are portrayed by Y-238 and Y-813 as fault scarps. These scarps are west–facing, primarily. A few are east–facing.

Displacement: No information.

Age of displacement: Short sections of SF are shown by Y-238 and Y-813 as moderate to prominent lineaments or scarps on surfaces of Quaternary deposits. Y-853 showed most of the fault traces in SF as juxtaposing Quaternary alluvium against bedrock. In contrast, north–northwest– and northwest–trending lineaments that bound the western edge of Pahute Mesa are noted by Y-813 (p. 7) to be subdued, which Y-813 (p. 7) interpreted as suggesting that SF has experienced little of no Quaternary displacement.

Portions of SF are portrayed by Y-238 and Y-813 as prominent lineaments on surfaces of Tertiary deposits and as fault traces that are in Tertiary deposits and that have been identified from previous mapping. Y-238 (pl. 2) showed a northeast–striking, down–to–the–southeast fault trace expressed as a moderate and prominent lineament on surfaces of Tertiary rocks at the left step in SF near Stonewall Mountain.

Displacement rate: No information.

Return period: No information.

Range-front characteristics: Portions of SF, which bounds the western edge of Pahute Mesa, are shown by Y-853 to have characteristics similar to those of major range–front faults (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to the range front), except that the front is less extensive than those along major range–front faults. Scarps are noted by Y-853 to be lower, shorter, and less continuous than those along a major range-front fault. Y-238 and Y-813 portrayed much of SF as a topographic lineament bounding a linear range front.

Sarcobatus Flat fault (SF) — Continued

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: SF is parallel to other fault traces that bound the southwestern side of Pahute Mesa along and south of Tolicha Peak, the Tolicha Peak fault (TOL). SF is nearly parallel to the northwest–striking Furnace Creek fault (FC) located about 50 km west of SF in northern Death Valley.

SF is perpendicular to the Stonewall Mountain fault (SWM) along the northern side of Stonewall Mountain at the northern end of SF (Y-238; Y-853; pl. 1 of this compilation). Y-238 (pl. 1) showed that the southwestern end of the east–northeast–striking SWM curves to a nearly north strike and aligns with SF. The exact structural relationship between these two faults is not known. Both SF and SWM correlate with a boundary that was noted by Y-1071 (fig. 2, p. 355) to separate an area to the west that has undergone marked deformation since middle Miocene (includes Death Valley) and one to the east that has undergone little deformation since middle Miocene (includes the southwestern Nevada volcanic field). Y-1071 (p. 362) noted that the "prominent west–facing scarps south of Stonewall Mountain, forming the west edge of Pahute Mesa [SF], mark the eastern limit of [a] period of faulting [that occurred after deposition of the 7.6–Ma Spearhead Member of the Stonewall Flat Tuff] and define the eastern margin of the Sarcobatus Flat structural basin." At its northern end, SF bounds the western side of the Stonewall Mountain volcanic center (Y-1071, fig. 2).

Seaman Pass fault (SPS)

Plate or figure: Plate 1.

References: Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3; name from their pl. 3); Y-1032: Schell, 1981 (pl. 9; shows short faults coincident with and near SPS as mapped by Y-404). Not shown by Ekren and others, 1977 (Y-25).

Location: 153 km/47° (distance and direction of closest point from YM) at lat 37°47′N. and long 115°09′W. (location of closest point). SPS is located within Coal Valley and in the Seaman Range along Seaman Wash.

USGS 7-1/2′ quadrangle: Coal Valley Reservoir, Murphy Gap SE, Oreana Spring, Seaman Wash.

Fault orientation: SPS has a curving trace: its northern part strikes north; its central part strikes north–northwest; its southern part strikes northwest (Y-404). The map by Y-1032 shows two north–northeast–trending lineaments thought to be fault–related just east of the northern part of SPS as mapped by Y-404. Y-1032 also showed one northwest–striking fault and one north–northwest–striking fault at the southern end of SPS as mapped by Y-404.

Fault length: The portion of SPS with surficial expression is 22 km long, but the fault is portrayed by Y-404 as concealed for another 12 km along Seaman Wash. Thus, the total length of SPS may be as much as 34 km as estimated from Y-404. However, SPS extends to the northern edge of their map area at lat 38°N., so that this would be a minimum estimate of total fault length.

Style of faulting: No type or direction of displacement for SPS is shown by Y-404.

Scarp characteristics: Y-1032 indicated both east– and west–facing scarps near the southern end of SPS.

Displacement: No information.

Age of displacement: The youngest displacement along SPS is probably on a 1.5–km–long portion in the central part of the fault. The probable age of this displacement is noted by Y-1032 (pl. 9) to be Pleistocene (defined as about 15 ka to 1.8 Ma by Y-1032, pl. 9).

Faults near the southern end of SPS are shown by Y-1032 (pl. 9) as indeterminate in age, but he suspected them of having Quaternary displacement because of the prominent scarps preserved along this portion of the fault. However, the age of these scarps cannot be determined because young stratigraphic units are not present along the fault trace (Y-1032, pl. 9).

Y-404 portrayed SPS as a post–Laramide structure (1) in Pleistocene(?) older lake beds (their Qol deposits), (2) as a faulted contact between Pleistocene(?) younger lake beds (their Ql deposits) and their Qol deposits, or (3) as concealed by their Qol deposits and by Pliocene older lake beds (their Tl deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with SPS.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: The southern end of SPS nearly intersects the north–northeast–striking Pahrock Valley faults (PV). The northern end of SPS is approximately parallel to and aligns with the Southeast Coal Valley fault (SCV) at the southern end of Coal Valley. This end of SPS is also approximately parallel to part of the Golden Gate fault (GG) along the western side of Coal Valley. The structural relationships among these faults are not known.

Sheep Basin fault (SB)

Plate or figure: Plates 1 and 2.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970; Y-671: Guth, 1990 (name from his fig. 3, p. 240); Y-852: Dohrenwend and others, 1991; Y-918: Longwell, 1930 (may have been the first to recognize fault scarps along the western side of the Sheep Range); Y-1032: Schell, 1981 (pl. 11; shows a few fault traces along the range front north of lat 36°45'N.).

Location: 112 km/93° (distance and direction of closest point from YM) at lat 36°46'N. and long 115°12'W. (location of closest point). SB is located along the western side of the northern Sheep Range at its junction with Sheep Basin (name from Y-918, p. 2). An additional fault trace is located along the western side of Mule Deer Ridge.

USGS 7-1/2' quadrangle: Hayford Peak, Mormon Well, Mule Deer Ridge, Mule Deer Ridge NE, Mule Deer Ridge NW, Mule Deer Ridge SE.

Fault orientation: The part of SB that is immediately adjacent to the Sheep Range front is curving. The northern portion strikes north–northwest; the central portion strikes north; the southern portion strikes northeast (Y-671, fig. 3, p. 240, p. 243; Y-852).

Fault traces up to 5 km west of the range front within Sheep Basin and along the western side of Mule Deer Ridge strike north (Y-852).

Fault traces between those along Mule Deer Ridge and those along the Sheep Range front strike northeast (Y-852). Two parallel fault surfaces are exposed in an eroded drainage. The western (younger) one dips 50° W. (Y-918, p. 11), and the eastern (older) one dips 68° W. (Y-918, p. 12).

Fault length: The part of SB that is along the Sheep Range front is about 35 km long as estimated from Y-852, but the fault extends north of their map area at lat 37°N. Y-918 (fig. 2, p. 3) extended SB along the base of the Sheep Range about 7 km north of lat 37°N., so that the total length of SB is at least 42 km. The range front continues about 12 km north of this latitude, so that the total length could be as much as 47 km.

The north–striking fault traces 5 km west of the range front along Mule Deer Ridge are in a zone 18 km long.

The northeast–striking fault traces west of the range front are in a zone 3.5 km long (Y-852).

Style of faulting: Displacement along SB is shown by Y-671 (fig. 3, p. 240, section AA', p. 246) as generally down to the west. Displacement along fault traces that are along the range front and the north–striking fault traces 5 km west of the Sheep Range front along Mule Deer Ridge is shown as down to the west by Y-852.

Scarp characteristics: Scarps associated with the northeast–striking fault traces west of the range front are shown by Y-852 as down to the northwest. Y-918 (p. 5) noted a maximum scarp height of 34 m (110 ft) on a west–facing scarp on an alluvial fan near the middle of the part of SB that is along the range front. The height of this scarp decreases to the north and south of this point. A lower east–facing scarp forms a graben along another portion of SB (Y-918, p. 8).

Displacement: Using the elevation difference between the floor of Sheep Basin and a pass at the northern end of the Sheep Range, Y-918 (p. 4) estimated a minimum of 366 m (1,200 ft) of subsidence of the basin. He also inferred that westward–sloping surfaces preserved in what is now part of the Desert Range west of Sheep Basin are about 458 m (1,500 ft) above the basin floor and are pediments that once connected to the western side of the Sheep Range 16 to 18 km (10 to 11 miles) to the east but have been faulted below the present floor of the basin (Y-918, p. 4-5).

Age of displacement: The youngest scarps on the part of SB that is adjacent to the Sheep Range front are shown by Y-852 to be on depositional or erosional surfaces that are possibly late Pleistocene age (their Q_2? surfaces with estimated ages between 10 ka and 130 ka). Other scarps along the range front are portrayed by Y-852 on depositional or erosional surfaces that are early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). Y-1032 portrayed a short section of these scarps as Pleistocene (defined by him to be between about 15 ka and 1.8 Ma). Y-918 (p. 5-7) concluded that, although the highest scarp is eroded by small gullies, the scarps "preserved between canyons appear remarkably fresh" given the unconsolidated character of the alluvial–fan deposits. He (Y-918, p. 7) suggested that displacement probably occurred not "more than a few hundred years ago." Y-918 (p. 13) concluded that the morphology of the scarp interpreted to have formed during the youngest rupture "suggests that faulting is still in progress."

The youngest north– and northeast–trending scarps within Sheep Basin are portrayed by Y-852 on depositional or erosional surfaces that are latest Pleistocene and (or) Holocene age (their $Q_{2\text{-}3}$ surfaces with estimated ages of less than 30 ka). Other scarps along this portion of SB are shown by Y-852 to be on depositional or erosional surfaces that are late Pleistocene age (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) or early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma).

The youngest scarps along Mule Deer Ridge are shown by Y-852 to be on depositional or erosional surfaces that are possibly late Pleistocene age (their Q_2? surfaces with estimated ages between 10 ka and 130 ka). They also portrayed scarps on depositional or erosional surfaces that are early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: About half of SB is portrayed by Y-852 as being along a tectonically active front of a major mountain range that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." Y-918 (p. 4) described the western front of the northern Sheep Range as "precipitous" and suggested that it "would be recognized as an eroded scarp even without direct evidence of recent movement at its base."

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-671, p. 237; Y-852, scale 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field examination (Y-671, p. 237; Y-918, p. 1, 5; Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Topographic profiles on alluvial fans across fault scarps (Y-918, p. 7-8, fig. 6). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: SB is one of several primarily north–striking faults that bound range fronts east of Yucca Mountain and north and northwest of Las Vegas. SB merges with both the north–striking Wildhorse Pass fault within the Sheep Range west of SB and the Mormon Pass fault within the Sheep Range southeast of SB (Y-671, p. 243, fig. 3, p. 240). Y-671 (p. 243) suggested that the Mormon Pass fault forms the eastern boundary of an inferred major detachment system (his Sheep Range detachment). Other north–striking faults in this area are the Sheep Range fault (SHR) along the eastern side of the northern Sheep Range directly east of SB, the Sheep–East Desert Ranges fault (SEDR) along the western sides of the Desert Range and the southern Sheep Range directly west of SB, and the East Pintwater Range fault (EPR) and the West Pintwater Range fault (WPR) along the eastern and western sides of the Pintwater Range west of SB. The structural relationships among these fault are not known.

Y-671 (p. 243) reported that SB forms the northwestern boundary of the main structural block of the Sheep Range.

Sheep-East Desert Ranges fault (SEDR)

Plate or figure: Plate 2.

References: Y-671: Guth, 1990; Y-852: Dohrenwend and others, 1991.

Location: 104 km/95° (distance and direction of closest point from YM) at lat 36°45′N. and long 115°18′W. (location of closest point). SEDR is located along the western sides of the southern Sheep Range and the East Desert Range. It also includes a fault trace along the eastern side of the Black Hills west of the range front.

USGS 7-1/2′ quadrangle: Black Hills, Corn Creek Springs, Dead Horse Ridge, White Sage Flat.

Fault orientation: SEDR has a general north–northeast, curving strike. The southern end of SEDR strikes northwest (Y-852). North of this, the strike of SEDR ranges between north–northeast and north–northwest.

Fault length: SEDR is about 45 km long as estimated from Y-852. The fault trace along the Black Hills is about 10 km long as estimated from Y-852.

Style of faulting: No information.

Scarp characteristics: Scarps associated with SEDR are shown by Y-852 as primarily west–facing.

Displacement: No information.

Age of displacement: Scarps at four localities, both immediately at the range front and 1 to 2 km west of the front, are shown by Y-852 to be on depositional or erosional surfaces that are early to middle and (or) late Pleistocene age (their Q1-2 surfaces with estimated ages between 10 ka and 1.5 Ma). Part of SEDR along the range front is shown by Y-852 as fault–related lineaments on depositional or erosional surfaces of Quaternary age, which they define as <1.5 Ma.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Y-852 indicated that most of SEDR bounds a tectonically active front of a major mountain range that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." The fault trace along the Black Hills, which juxtaposes Quaternary alluvium against bedrock, is not shown by Y-852 as a major range–front fault. The morphology of the eastern side of the Black Hills would be similar to that along a major range–front fault, but would be significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852).

Analysis: Aerial photographs (Y-671; Y-852, scale 1:58,000).

Relationship to other faults: SEDR is one of several generally north–striking faults bounding range fronts east of Yucca Mountain and north and northwest of Las Vegas. Other north–striking faults in this area are the Sheep Basin fault (SB) along the western side of the northern Sheep Range directly east of SEDR, the Sheep Range fault (SHR) along the eastern side of the northern Sheep Range east of SEDR, and the East Pintwater Range fault (EPR) and the West Pintwater Range fault (WPR) along the eastern and western sides of the Pintwater Range west of SEDR. The structural relationships among these faults are not known.

Sheep Range fault (SHR)

Plate or figure: Plates 1 and 2.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970; Y-671: Guth, 1990; Y-852: Dohrenwend and others, 1991; Y-1032: Schell, 1981 (pls. 9 and 11; name from his table A2, fault #27);

Location: 122 km/95° (distance and direction of closest point from YM) at lat 36°45′N. and long 115°06′W. (location of closest point). SHR is located along the eastern side of the Sheep Range at its junction with Coyote Spring Valley.

USGS 7-1/2′ quadrangle: Hayford Peak SE, Mormon Well, Mule Deer Ridge NE, Mule Deer Ridge SE.

Fault orientation: SHR strikes generally north (Y-852).

Fault length: SHR is discontinuous over a length of about 50 km as estimated from Y-852, but SHR extends north beyond the boundary of their map area at lat 37°N. Scarps are continuous over a length of 20 km as estimated from Y-852. The length of SHR is noted to be 30 km by Y-1032, but he did not extend SHR south of about lat 36°50′N. (pl. 11, table A2, p. A6).

Style of faulting: No information.

Scarp characteristics: Scarps at the range front are shown as east–facing by Y-852.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along SHR is noted by Y-1032 (table A2, p. A6) to be late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit that Y-1032 recognized as displaced is his intermediate–age alluvial–fan deposits (table A2, p. A6) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (table A2, p. A6) with an estimated age of ≤15 ka (table 3, p. 23). The oldest unit that Y-1032 noted as displaced is Paleozoic rocks (table A2, p. A6).

The youngest scarps along SHR recognized by Y-852 are on depositional or erosional surfaces that are latest Pleistocene and (or) Holocene (their Q_{2-3} surfaces with estimated ages of 30 ka or younger). Y-852 also showed scarps on depositional or erosional surfaces that are late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) and early to middle and (or) late Pleistocene (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Part of SHR has been portrayed by Y-852 as a fault juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of the eastern side of the Sheep Range would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, SHR would be significantly less extensive and faults scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852).

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-671; Y-852, scale 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Sheep Range fault (SHR) — Continued

Relationship to other faults: SHR is one of several generally north–striking faults bounding range fronts east of Yucca Mountain and north and northwest of Las Vegas. Other north–striking faults in this area are the Sheep Basin fault (SB) along the western side of the northern Sheep Range directly west of SHR, the Sheep–East Desert Ranges fault (SEDR) along the western sides of the Desert Range and the southern Sheep Range west of SHR, and the East Pintwater Range fault (EPR) and the West Pintwater Range fault (WPR) along the eastern and western sides of the Pintwater Range west of SHR. The northern end of SHR nearly intersects the east–northeast–striking Maynard Lake fault (MAY), the southern trace of the Pahranagat fault (PGT). The structural relationships among these faults are not known.

Sierra Nevada fault (SNV)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-413: Jennings and others, 1962; Y-425: Stinson, 1977; Y-427: Hart and others, 1989 (name from their southern segment); Y-1020: Jennings, 1992; Y-1052: Wills, 1988; Y-1054: Wills, 1989 (his Haiwee segment of the Sierra Nevada fault); Y-1055: Beanland and Clark, 1993; Y-1110: Roquemore, 1981.

Location: 154 km/245° (distance and direction of closest point from YM) at lat 36°14'N. and long 117°59'W. (location of closest point). SNV includes only the southern end of this fault, where it bounds the eastern front of the Sierra Nevada. SNV includes fault traces on alluvial fans <1.5 km east of the Sierra Nevada front in the Haiwee–Rose Valley area.

USGS 7-1/2′ quadrangle: Coso Junction, Haiwee Reservoirs, Little Lake, Ninemile Canyon, Pearsonville, Volcano Peak.

Fault orientation: SNV strikes generally north–northwest (Y-1054, fig. 1).

Fault length: The length of SNV is about 25 km as estimated from Y-1054 (fig. 1).

Style of faulting: Fault traces of SNV are shown by Y-425 (his cross sections) as dip slip (normal), down to the east, and steeply dipping. A right–lateral component of displacement is interpreted by Y-1054 (p. [2]) on the basis of a left–stepping, *en echelon* pattern of scarps at one locality and by a deflected drainage at another locality.

Scarp characteristics: Scarps are generally portrayed by Y-1054 (p. [2]) as east–facing, but a few are west–facing. Scarps are reported by Y-1054 (p. [2]) "to be low and erosionally degraded except near springs where spring sapping may have steepened the scarps. Lateral stream erosion also has steepened some scarps."

Displacement: No information.

Age of displacement: Y-425 portrayed fault traces of SNV as displacing Holocene deposits, his Qf and Qal deposits (alluvium, eolian sand, alluvial–fan deposits), along the eastern side of the portion of the Sierra Nevada that borders the western side of Rose Valley and the western side of Haiwee Reservoir.

In contrast, Y-1054 (p. [2-3]) subdivided the Qf deposits of Y-425 into older and younger Pleistocene alluvium with minor Holocene alluvium in stream channels. Low, degraded scarps are preserved in the older Pleistocene alluvium at at least two localities. Y-1054 inferred that this alluvium is equivalent to Tahoe–stage glacial deposits or older (estimated age of 60 ka to 100 ka) on the basis of the pitting and weathering of granitic boulders and on soil development (7.5YR colors and well–developed B horizons). The younger alluvium contains no scarp at one locality. At another locality the younger alluvium contains a scarp that is visible on aerial photographs but that could not be located on the ground by Y-1054. The younger alluvium is thought to be equivalent to Tioga–stage glacial deposits of latest Pleistocene age on the basis of the color of the unweathered deposits and on the pitting, spalling, and weathering of granitic boulders. Y-1054 (p. [4]) suggested that these latest Pleistocene deposits are not displaced.

Y-1020 indicated that displacement along SNV is late Quaternary, which he defines as <700 ka.

Slip rate: Y-1055 (p. 7) concluded that faults along the Sierra Nevada front (part of SNV of this compilation?) have experienced a vertical slip rate of 0.1 to 0.8 mm/yr during the Holocene.

Recurrence interval: No information.

Range-front characteristics: The southern front of the Sierra Nevada along SNV is noted by Y-1054 (p. [2]) to be straight and high.

Analysis: Aerial photographs (Y-1054, p. [2], scales 1:30,000 and 1:12,000). Field reconnaissance (Y-1054, p. [2]).

Relationship to other faults: The northwest–striking Little Lake fault (LL) may merge with this portion of SNV near Little Lake (Y-1052, *citing* Y-1110). However, Roquemore, 1988 (Y-374) suggested that although the two faults are close together at one point, he found no evidence that would indicate that the two faults actually merge.

Y-427 (p. 6) noted that SNV is closely associated with the Owens Valley fault (OWV), which is located north of SNV between the Sierra Nevada and the White–Inyo Mountains. They suggested that SNV may be partly coincidental with OWV.

Silver Peak Range faults (SIL)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 1). Not shown by Dohrenwend and others, 1992 (Y-853).

Location: 142 km/305° (distance and direction of closest point from YM) at lat 37°35′N. and long 117°44′W. (location of closest point). SIL includes two faults in the Silver Peak Range: a northwestern fault west of and extending south of Red Mountain and a southeastern fault between Big Spring and Oasis Divide.

USGS 7-1/2′ quadrangle: Lida Wash SW, Mohawk Mine, Oasis Divide, Piper Peak, Rhyolite Ridge.

Fault orientation: The northwestern fault of SIL strikes north–northeast with individual fault traces striking north to northeast (Y-238). The southeastern fault generally strikes northwest with individual traces striking west–northwest or northeast (Y-238).

Fault length: The total length of both faults included in SIL is about 24 km as estimated from Y-238. The northwestern fault is about 16 km long; the southeastern fault is 8 to 9 km long (estimated from Y-238). Individual traces of the southeastern fault are 1 to 2 km long. A 5–km–long gap in surface expression separates the traces of the southeastern fault.

Style of faulting: No information.

Scarp characteristics: Short scarps associated with the northwestern fault are generally west–facing (Y-238). Scarps associated with the southeastern fault are north–facing, northeast–facing, or northwest–facing (Y-238).

Displacement: No information.

Age of displacement: Short sections of the northwestern fault of SIL are shown by Y-238 as weakly expressed lineaments or scarps on surfaces of Quaternary deposits. Most of the northern 8 km of this fault is portrayed by Y-238 as a topographic lineament along a linear front or in bedrock. Y-238 (p. 2) interpreted this lineament as suggesting Quaternary fault displacement. The southern 8 km of the northwestern fault is portrayed by Y-238 as a fault that is in Tertiary deposits and that was identified from previous mapping.

Traces of the southeastern fault of SIL are shown by Y-238 as weakly to moderately expressed lineaments or scarps on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: The northwestern fault of SIL is approximately parallel to the McAfee Canyon fault (MAC) on the western side of the Silver Peak Range west of SIL, to the Clayton Valley fault (CV) east of SIL in Clayton Valley, and to the northeast–striking portion of the western fault of the Emigrant Peak faults (EPK) northwest of SIL in Fish Lake Valley. The southeastern fault of SIL is approximately parallel to the Palmetto Wash fault (PW) south of the Silver Peak Range south of SIL.

The southeastern fault nearly intersects the northeast–striking southern portion of CV.

Six–Mile Flat fault (SMF)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show some of the faults in the highland between Sixmile Flat and Pahrock Valley); Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3); Y-1032: Schell, 1981 (pl. 9, name from his table A2, fault #91).

Location: 138 km/51° (distance and direction of closest point from YM) at lat 37°36'N. and long 115°12'W. (location of closest point). SMF is located in the northern part of Sixmile Flat (or Pahroc Valley) and in the unnamed highland that is directly north of Sixmile Flat. This highland trends eastward between the Hiko Range on the west and the North Pahroc Range on the east.

USGS 7-1/2' quadrangle: Fossil Peak, Hiko, Hiko NE, Hiko SE.

Fault orientation: SMF generally strikes northeast (Y-1032). SMF includes two major fault traces so that SMF is about 5 km wide (Y-1032, table A2, p. A17).

Fault length: The length of SMF is noted to be 24 km by Y-1032 (table A2, p. A17).

Style of faulting: Displacement along fault traces in SMF for which type displacement has been noted is shown by Y-1032 (pl 9) as down to the southeast.

Scarp characteristics: Y-1032 (table A2, p. A17) reported a maximum scarp height of 2 m.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along SMF is noted by Y-1032 (table A2, p. A17) to be late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i, table A2, p. A17) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y, table A2, p. A17) with an estimated age of 15 ka or younger (table 3, p. 23). The oldest unit displaced is middle Tertiary volcanic rocks (Tv_2, table A2, p. A17) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

Neither Y-25 nor Y-404 showed fault traces that displace Quaternary deposits in this area.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: SMF lies between two approximately north–striking faults: the Hiko fault (HKO) to the west and the Pahroc fault (PAH) to the east (Y-1032, table A2, p. A17). The structural relationships among these faults are not known.

Slate Ridge faults (SLR)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 2); Y-407: Albers and Stewart, 1972; Y-853: Dohrenwend and others, 1992.

Location: 87 km/308° (distance and direction of closest point from YM) at lat 37°20'N. and long 117°14'W. (location of closest point). SLR includes two faults at the eastern end of Slate Ridge (east of Gold Point). The northern fault is located along the northern side of Slate Ridge. The southern fault is located between Slate Ridge and Gold Mountain.

USGS 7-1/2' quadrangle: Gold Point, Gold Point SW, Scottys Junction SW.

Fault orientation: The faults in SLR strike east to east–northeast (Y-238; Y-853).

Fault length: The length of the northern fault is 13 km as estimated from Y-853; the length of the southern fault is 5 km as estimated from Y-853. The lengths of the northern and southern faults are about 12 km each as estimated from Y-238. The map by Y-407 shows the northern fault as connected by a concealed fault to faults to the west in the area south of Magruder Mountain.

Style of faulting: Major portions of both the northern and southern faults are shown by Y-238 as having down–to–the–north displacement.

Scarp characteristics: Short section of both the northern and southern faults are shown by Y-238 as scarps, all of which are north–facing.

Displacement: No information.

Age of displacement: Major portions of both faults in SLR are portrayed by Y-238 as faults that are in Tertiary deposits and that were identified from previous mapping. Both the northern and southern faults are portrayed by Y-853 as faults forming scarps and (or) prominent topographic lineaments on surfaces of Tertiary volcanic or sedimentary rocks. The faults of SLR are shown by Y-407 as concealed by Holocene alluvium, colluvium, and playa deposits (their Qal deposits).

A 0.6–km–long section at the western end of the northern fault is shown by Y-238 as a weakly expressed lineament or scarp on surfaces of Quaternary deposits. Part of the northern fault (from the central part to the eastern end) is shown by Y-853 as a fault–related lineament on Quaternary depositional or erosional surfaces.

The western end of the southern fault is shown by Y-238 as a lineament or scarp on surfaces of Tertiary deposits. SLR is shown by Y-407 as faults between Tertiary rocks and older rocks, within pre–Tertiary rocks, and within Tertiary rocks.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: Faults in SLR have a slightly more easterly strike than that of the Gold Mountain fault (GOM) along the northern side of Gold Mountain. SLR and GOM could intersect near the eastern end of Slate Ridge. The two faults in SLR are approximately perpendicular to the north–northeast– and northeast–striking major range–bounding faults west of Cactus Flat, such as the Montezuma Range fault (MR) along the western side of the Montezuma Range northwest of SLR, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain west–northwest of SLR, the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains west–northwest of SLR, and part of the Grapevine Mountains fault (GM) along the western side of the Grapevine Mountains south of SLR.

Slate Ridge faults (SLR) — Continued

The two faults in SLR are at an oblique angle to northeast–striking faults within basins, such as the Stonewall Flat faults (SWF) within Stonewall Flat north of SLR, the Palmetto Mountains–Jackson Wash faults (PMJW) in the valley northeast of Palmetto Mountains northwest of SLR, and the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range northwest of SLR (Y-238; Y-853).

The two faults in SLR are perpendicular to the north–northwest–striking Sarcobatus Flat fault (SF) along the western edge of Pahute Mesa about 15 km east of SLR.

The structural relationships among all of these faults are not known.

Solitario Canyon fault (SC)

Plate or figure: Figure 3.

References: Y-26: Swadley and others, 1984 (SC includes their Solitario Canyon fault and their Fault H); Y-46: Maldonado, 1985; Y-55: Scott and Bonk, 1984 (name from their pl. 1); Y-58: Christiansen and Lipman, 1965 (show only the northern portion of SC north of lat 36°52′30″N.); Y-74: Hoover, 1989 (includes dates for stratigraphic units described in Y-26); Y-189: Lipman and McKay, 1965; Y-224: Frizzell and Shulters, 1990 Y-238: Reheis and Noller, 1991 (pl. 3); Y-396: Scott, 1990; Y-576: O'Neill and others, 1991; Y-700: Whitney, 1992; Y-1042: O'Neill and others, 1992; Y-1182: Simonds and Whitney, 1993; Y-1201: Ramelli and others, 1991; Y-1230: Bell and others, 1990.

Location: 0.5 km/297° (distance and direction of closest point from YM) at lat 36°51′N. and long 116°28′W. (location of closest point). SC bounds the western sides of the Yucca Crest and West Crest of Yucca Mountain along the western border of the potential repository site. It splits into three or four splays immediately south of West Crest as interpreted by Y-26 (p. 14), Y-396 (p. 259), and Y-1042 (pl. 1, p. 6).

USGS 7-1/2′ quadrangle: Busted Butte, Pinnacles Ridge.

Fault orientation: SC strikes generally north–northeast (Y-26, pl. 1; Y-55, pl. 1). Y-396 (p. 259) reported an average dip of 65°, which was computed from 31 measurements.

Fault length: Y-26 (p. 14) noted a minimum length of 12 km for SC. Y-1201 (p. 1-64) reported a length of 13 km for a prominent compound scarp on Quaternary surfaces along SC. A portion at the northern end of the West Crest, a part of SC that is shown by Y-55 (pl. 1) as displacing alluvium, is about 0.6 km long (estimated from Y-55, pl. 1). Y-26 (pl. 1, p. 14) noted that Quaternary/Tertiary debris–flow deposits are faulted against bedrock at several locations along SC over a total length of 4.5 km. Y-1182 (p. A-141) reported that Quaternary rupture has occurred along as much as 10 km of SC.

Style of faulting: SC is shown by Y-26 (pl. 1, p. 14) and Y-55 (pl. 1) as having down–to–the–west, dip–slip (normal) displacement. It is portrayed as having left–lateral oblique (down–to–the–west) displacement by Y-1042 (pl. 1). Y-700 and Y-1042 (pl. 1, p. 6) interpreted several types of evidence as indicating a significant left–lateral component of slip on SC. This evidence is (1) displaced streams, (2) a pattern of *en echelon* fault splays, (3) oblique slickenlines, and (4) a rhomboid–shaped zone that links two left–stepping traces of SC along Yucca Crest and that is similar in shape to that of a pull–apart graben.

Y-26 (p. 15, their Fault H) and Y-1042 (pl. 1, p. 6) noted that the northern end of SC north of Little Prow, dips east and has down–to–the–east displacement. This is in contrast to the apparent displacement along SC south of Little Prow. Y-1042 (p. 6) noted only minor displacement along SC directly west of Little Prow. They interpreted these changes in fault dip and type of displacement as indicating complex scissors displacement along SC (Y-1042, p. 6, 10).

Scarp characteristics: Y-1201 (p. 1-64) noted a prominent compound scarp that is 1 to 3 m high on Quaternary surfaces. Y-1201 (p. 1-65) and Y-1230 (p. [4]) interpreted lineations visible on low–sun–angle aerial photographs as fault scarps a few tens of centimeters high. Y-1230 (p. [7]) recognized subdued fault scarps along SC south to nearly the Stagecoach Road fault (SCR), which is farther south than SC is shown by Y-26 (pl. 1).

Displacement: Y-26 (p. 14, pl. 1) could not determine the amount of displacement of early Pleistocene or latest Pliocene deposits that were exposed in either their Trench 8 in the central part of SC or their Trench 10B located 3.3 km to the north of Trench 8. Y-1201 (p. 1-65) reported up to 1 m of vertical displacement on a late Pleistocene surface (their late Black Cone surface) at Trench 8 of Y-26 (pl. 1) and at other localities 2 km south of the trench. They also reported bedrock scarps about 3 m high (Y-1201, p. 1-65).

Y-396 (p. 259) noted a cumulative displacement of zero along the northern end of SC and a cumulative displacement of about 1 km along the fault's southern end. Y-396 (p. 273) reported that dip–slip displacement along the central portion of SC since 13.5 Ma has been 0.4 km, a maximum for faults in the Yucca Mountain area.

Solitario Canyon fault (SC) — Continued

Age of displacement: Evidence that might indicate Quaternary rupture has been reported by various workers. This evidence includes (1) topographic lineaments and drainage alignments of possible tectonic origin preserved along the fault (Y-1042, p. 6), (2) prominent scarps on Quaternary surfaces (Y-1201, p. 1-64), and (3) faulted contacts between Quaternary and (or) Tertiary alluvium or colluvium and older rocks (Y-26, pl. 1, p. 14-15; Y-55, pl. 1).

On the basis of an inferred age for a basaltic ash preserved in a fracture zone and on the presence of fracturing but no visible displacement of a K horizon developed in early Pleistocene or latest Pliocene alluvium, Y-26 (p. 14, pl. 1) interpreted tectonic features exposed in their Trench 8 in the central part of SC as recording an event that occurred about 1.2 Ma (Y-26, table 1, p. 5). Tectonic features exposed in their Trench 10B, located 3.3 km north of Trench 8, are inferred by Y-26 (table 1, p. 5) to be younger than 2 Ma.

Y-700 reported that displacement along SC has occurred during the last 500,000 yr. Sharp lineations noted by Y-1201 (p. 1-65) and Y-1230 (p. [4]) and interpreted by them to be small (a few tens of centimeters high) fault scarps are on surfaces thought to be Holocene or latest Pleistocene age (8,425 ± 70 yr, AMS radiocarbon date on rock varnish, for which they cite Dorn (1988, Y-308)). These are their Little Cones surfaces with bar and swale topography, weak desert pavement, cambic B horizon, and stage I carbonate development (Y-1201; Y-1230). Faulds and others (1991, Y-1196, p. 1-56) reported rock varnish ages of 6.6 ka to 11.1 ka for Little Cones surfaces in Crater Flat. Thus, Y-1201 (p. 1-65) concluded that the amount and age of the youngest rupture on SC are similar to those on the better–studied Windy Wash fault to the west (about 10 cm of displacement since 3 ka to 6 ka). Likewise, Y-700 suggested that if the scarp near the southern end of SC proves to have a tectonic origin, then displacement along this portion of SC probably occurred in the last 15,000 yr.

Y-1201 (p. 1-64) reported that the southern end of a prominent Quaternary scarp "is obliterated by late Holocene alluviation." On the basis of exposures in their Trench 10B in the central part of SC, Y-26 (p. 15) interpreted no displacement of either a K horizon developed in early Pleistocene and latest Pliocene alluvium or in overlying middle Pleistocene coarse fluvial deposits (their Q2c deposits) with an estimated age between 270 ka and 800 ka (Y-26, fig. 3, p. 9). Similarly, Y-26 (p. 15, table 1, p. 5) inferred no displacement since 270 ka on SC north of Little Prow (their Fault H) because middle Pleistocene fluvial deposits (their Q2c deposits with estimated ages of 270 ka to 800 ka) overlie SC.

Y-1201 (p. 1-65) reported that a late Pleistocene surface (their late Black Cone surface) was displaced vertically ≤1 m. Y-1196 (p. 1-56) noted rock varnish dates of 17.3 ka to 30.3 ka for this surface in Crater Flat.

Slip rate: Based on the maximum displacement of 1 m that was reported by Y-1201 (p. 1-65) for their late Black Cone surface with an age of 17.3 ka to 30.3 ka as noted by Y-1196 (p. 1-56), the maximum apparent vertical slip rate on SC is between 0.03 and 0.06 mm/yr since latest Pleistocene.

Y-396 (p. 273, table 2, p. 275) reported an apparent vertical slip rate of 0.19 mm/yr on SC between 13 Ma and 11.5 Ma. This rate assumes that 70% (about 0.3 km) of the total dip slip on SC occurred during this 1.5–million–yr interval.

Y-396 (p. 273-274, table 2, p. 275) reported an apparent vertical slip rate of 0.010 mm/yr on SC since 11.5 Ma. This rate was estimated by subtracting the dip slip that occurred between 13 Ma and 11.5 Ma from the total dip slip (this means that about 0.1 km of dip slip occurred since 11.5 Ma) and assumes a stepwise decreasing rate of Cenozoic deformation in which rates sharply decreased about 11.5 Ma.

Recurrence interval: No information.

Range-front characteristics: No information.

Solitario Canyon fault (SC) — Continued

Analysis: Compilation of published and unpublished information (Y-26, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-576, p. A119; Y-1042, p. 2, scale 1:12,000; Y-1230, p. [4]) or conventional aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000). Surficial mapping and field investigations (Y-26; Y-700; Y-1042, p. 2; Y-1201, p. 1-65). Interpretations of trench exposures (Y-26, trenches 8, 10A, and 10B across the central part of SC west of Yucca Crest, pl. 1, table 1, p. 5, 14-15; trenches 13, GA1A, and GA1B across the northern part of SC north of Little Prow; preliminary analysis). Y-700 noted that one trench was excavated across SC in the early 1980's, but that it has been difficult to interpret because SC at this locality is between bedrock and slope colluvium. Portions of SC that are obscured by alluvium have been located on the basis of aeromagnetic anomalies (Y-55, pl. 1, p. 8)

Relationship to other faults: At its southern end, SC splits into several traces. Y-1042 (pl. 1, p. 6) noted that the western trace of SC in this area appears to be tectonically linked to the Windy Wash fault (WW). Y-1182 (p. A-141) proposed that the three faults on the western side of Yucca Mountain (Fatigue Wash fault, SC, and WW) are interconnected along strike and possibly at depth. Y-1182 (p. A-141) speculated that Quaternary rupture along the Stagecoach Road fault (SCR) may be a continuation of either the Paintbrush Canyon fault (PBC) or an eastern splay of SC.

SC has been interpreted to be structurally linked to the Bow Ridge fault (BR) east of Yucca Mountain in the largest pull–apart zone in the area (Y-576, p. A119). Y-396 (p. 279) concluded that steep normal faults at Yucca Mountain, like SC, sole into a low–angle normal fault or faults at depths of 1 to 4 km.

Y-55 (pl. 1) mapped a series of small faults across a low ridge between Yucca Crest and West Crest of Yucca Mountain. Y-1042 (p. 10) suggested that these faults may connect SC with an unnamed fault along the western side of Middle Crest, although Y-1042 (pl. 1, p. 10) recognized no evidence for these faults on aerial photographs.

Y-1042 (p. 6) concluded that SC terminates south of the northwest–trending Yucca Wash. In contrast, Y-58 interpreted SC as crossing Yucca Wash and connecting with a major east–dipping fault to the north.

South Ridge faults (SOU)

Plate or figure: Plate 2.

References: Y-62: Barnes and others, 1982; Y-671: Guth, 1990; Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991.

Location: 55 km/109° (distance and direction of closest point from YM) at lat 36°40′N. and long 115°52′W. (location of closest point) for the fault along the northern side of South Ridge; 50 km/120° (distance and direction of closest point from YM) at lat 36°36′N. and long 115°58′W. (location of closest point) for the fault along the southern side of South Ridge. SOU includes two main faults: one along the northern side of South Ridge east of East Sandy Wash and the other along the southern side of South Ridge.

USGS 7-1/2′ quadrangle: Mercury, Mercury NE.

Fault orientation: The northern fault strikes east (Y-813; Y-852). The main trace of the southern fault, which is along the front of the South Ridge, varies in strike from east–northeast at the western end of the ridge, to northeast in the central part of the ridge, and to east at the eastern end of the ridge (Y-813). A fault that branches south from the main trace of the southern fault strikes primarily northeast. The western end of this branch fault strikes north–northeast.

Fault length: The northern fault includes a western trace that is 1 to 3 km long <1 km north of the front of South Ridge, a central trace that is 5 km long along the front of the ridge, and an eastern trace that is 2.5 km long at the very eastern end of South Ridge (Y-852).

The trace of the southern fault as shown by Y-813 is nearly continuous for 19 km. Y-852 portrayed the southern fault as two sections, each about 2 to 3 km long. The branch fault south of the southern fault is 7 km long (Y-813).

Style of faulting: The main trace of the southern fault is portrayed by Y-62 and Y-813 with variable types of displacement: down to the south on the eastern and western ends and left lateral along the central portion. Displacement on the branch fault south of the southern fault is down to the southeast.

Scarp characteristics: One section of the western trace of the northern fault is shown by Y-813 as a scarp, which is north–facing.

Displacement: No information.

Age of displacement: The northern fault juxtaposes Quaternary alluvium against bedrock (Y-852). Y-813 portrayed one section of the western trace of this fault as a prominent scarp on Tertiary surfaces.

Y-62 showed portions of the main trace of the southern fault as concealed by Quaternary and Tertiary alluvium. Y-813 portrayed much of the southern fault as a fault that is in Tertiary deposits and that was recognized from previous mapping.

A short section of the branch fault south of the southern fault is shown by Y-813 as a weakly expressed lineament or scarp on surfaces of Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

South Ridge faults (SOU) — Continued

Range-front characteristics: The northern and southern faults have been shown by Y-852 as juxtaposing Quaternary alluvium against bedrock, but not as major range–front faults. The morphology of the fronts of South Ridge would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, the faults of SOU would be significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852).

About 5.3 km of the main trace of the southern fault and most of the branch fault are shown by Y-813 as topographic lineaments along linear range fronts.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Relationship to other faults: A north–northeast–trending, down–to–the–west, 1–km–long scarp at the western end of South Ridge is shown by Y-852 to be on depositional or erosional surfaces that are possibly early to middle Pleistocene age (their Q1? surfaces with estimated ages between 130 ka and 1.5 Ma). However, the trend of this scarp is more northerly than the strike of the faults along South Ridge, so its relationship to SOU is not clear.

Faults in SOU may be the southwestern extension of the Spotted Range faults (SPR), which are about 3 km northeast of SOU. However, SOU strikes east, whereas SPR strikes north or northeast. In addition, SOU extends eastward of the possible intersection with SPR.

Faults in SOU have a more easterly strike than those of the faults in the Rock Valley fault (RV) 12 to 15 km north of SOU along the southern side of Frenchman Flat. The strike of SOU is similar to that of the Cactus Springs fault (CAC), which is about 5 km south of SOU. The structural relationships among these fault are not known.

Y-671 (p. 241) speculated that a normal fault along the northern side of South Ridge (the northern fault of SOU?) may reactivate the ramp of the Spotted Range thrust.

Southeast Coal Valley fault (SCV)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show two faults that coincide with SCV as mapped by Y-1032; both of their faults are shown as displacing Quaternary deposits); Y-404: Tschanz and Pampeyan, 1970 (pl. 2; show faults in the same area of SCV as mapped by Y-1032, but only one of these faults, the one along the eastern side of Irish Mountain, is shown as displacing Quaternary deposits); Y-1032: Schell, 1981 (pl. 9; name from his table A2, fault #22).

Location: 132 km/48° (distance and direction of closest point from YM) at lat 37°37′N. and long 115°20′W. (location of closest point). SCV is located along the western side of an unnamed ridge at its junction with southeastern Coal Valley. A possible southern extension of SCV toward the Pahranagat Valley along the eastern side of Irish Mountain and through the North Pahranagat Range may include three approximately parallel north–northwest–striking fault traces (labeled SCV? on plate 1 of this compilation).

USGS 7-1/2′ quadrangle: Mail Summit, Mount Irish SE, Murphy Gap SE.

Fault orientation: The northern part of SCV strikes approximately north; faults in the southern part of SCV strike north–northwest (Y-1032).

Fault length: The length of SCV is noted to be 8 km by Y-1032 (table A2, p. A5). If SCV extends to the south to the Pahranagat Valley, then its length may be ≥19 km (Y-1032, table A2, p. A5).

Style of faulting: Displacement on fault traces along the unnamed ridge is shown as down to the west; displacement on fault traces at the southern end of SCV through the North Pahranagat Range is portrayed as both down to the east and down to the west (Y-25; Y-1032).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along SCV is noted by Y-1032 (table A2, p. A20) as late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i, table A2, p. A5) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is his Bonneville–Lahontan–shoreline features (A4o, table A2, p. A5) with an estimated age of ≤15 ka (table 3, p. 23). The oldest unit displaced is his middle Tertiary volcanic rocks (Tv_2, table A2, p. A5) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

Y-404 showed one fault trace along the eastern side of Irish Mountain as a faulted contact between Devonian rocks and older Quaternary alluvium (their Qol deposits with an estimated Pleistocene? age). Y-25 portrayed this same trace as a faulted contact between pre–Tertiary sedimentary rocks and Holocene to Pliocene alluvium and colluvium (their QTa deposits). They (Y-25) also showed a portion of a fault trace along the eastern side of the section labeled SCV? as a faulted contact between pre–Tertiary sedimentary rocks and Quaternary alluvium (their Qa deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17). Compilation of structural and stratigraphic information (Y-25).

Southeast Coal Valley fault (SCV) — Continued

Relationship to other faults: SCV may extend southward from the unnamed ridge, through the North Pahranagat Range (labeled SCV? on pl. 1 of this compilation), and connect with late Pleistocene fault scarps in the Pahranagat Valley (Y-1032, table A2, p. A5).

Southern Death Valley fault (SDV)

Plate or figure: Plate 2.

References: Y-216: Brogan and others, 1991 (pl. 4; their South Ashford Mill section and possibly their Gregory Peak and North Ashford Mill sections may be part of SDV); Y-246: Troxel, 1986; Y-247: Butler, 1986; Y-248: Troxel and Butler, [1986]; Y-338: Butler, 1988; Y-339: Brady, 1988 (tentatively correlated SDV with faults along the Avawatz Mountains, in the Soda Mountains, and in the northern Bristol Mountains); Y-389: Drewes, 1963 (his Confidence Hills fault zone; fig. 2, p. 5); Y-390: Hunt and Mabey, 1966 (their Confidence Hills fault zone; fig. 71, p. A100); Y-401: Noble, 1941 (pls. 3 and 4); Y-413: Jennings and others, 1962 (Trona sheet; their Death Valley fault zone); Y-424: Wright and Troxel, 1984 (show SDV between north of Cinder Hill and the Confidence Hills, between lat 35°52′30″N. and lat 36°00′N.); Y-427: Hart and others, 1989 (included SDV in their Death Valley fault zone); Y-429: Wills, 1989 (included SDV in his Death Valley fault zone, the portion south of Shore Line Butte); Y-468: Noble and Wright, 1954; Y-471: Burchfiel and Stewart, 1966 (their Death Valley fault zone); Y-472: Butler and others, 1988 (subdivided the portion of SDV between the Confidence Hills and the southern Owlshead Mountains into a western subzone along the eastern side of the Owlshead Mountains and an eastern subzone within southern Death Valley); Y-473: Hill and Troxel, 1966; Y-478: Stewart, 1983 (his Death Valley fault zone); Y-479: Wright and Troxel, 1967; Y-550: Butler and others, 1986; Y-592: Davis, 1977 (his Death Valley fault zone, which he noted is south of lat 36°00′N.); Y-593: Davis and Burchfiel, 1973; Y-599: Butler, 1984; Y-600: Stewart, 1967 (his Death Valley fault zone); Y-602: Brady, 1986 (his southern Death Valley fault zone); Y-603: Butler, 1984 (subdivided the portion of SDV between the Confidence Hills and the southern Owlshead Mountains into a western subzone along the eastern side of the Owlshead Mountains and an eastern subzone within southern Death Valley); Y-612: Hamilton and Myers, 1966; Y-746: Wright and Troxel, 1954 (map 8, p. 34); Y-764: Brady, 1991; Y-955: Brady, 1986 (discussed the portions of SDV in the Noble Hills and in the Avawatz Mountains); Y-990: Beratan and Murray, 1992 (stratigraphy of the Confidence Hills); Y-991: Gomez and others, 1992 (geology of the Confidence Hills); Y-992: Pluhar and others, 1992 (paleomagnetics of sediments that compose the Confidence Hills); Y-1020: Jennings, 1992 (part of his Death Valley fault zone, fault #248).

Location: 105 km/193° (distance and direction of closest point from YM) at lat 35°56′N. and long 116°43′W. (location of closest point). SDV is located between at least Cinder Hill and the Avawatz Mountains in southern Death Valley.

USGS 7-1/2′ quadrangle: Anvil Spring Canyon East, Avawatz Pass, Confidence Hills East, Confidence Hills West, East of Owl Lake, Old Ibex Pass, Shore Line Butte.

Fault orientation: SDV strikes approximately northwest (Y-216, p. 13; Y-472, p. 402). Y-429 (p. 4, 8) suggested that the strike of SDV is generally N. 30° W., but it is N. 40° W. along the southeastern side of the Confidence Hills. The western subzone of Y-472 (p. 404) and Y-603 (p. 25), where it is exposed in six deeply incised drainages, strikes between N. 15° E. and N. 30° W.; dips vary between 35° to 65° to the east or northeast. Their eastern subzone strikes between N. 40° W. and N. 50° W.; the dip is inferred to be vertical or near–vertical on the basis of the fault's straight trace (Y-472, p. 404; Y-603, p. 25).

Fault length: Estimates of the length of SDV range between about 50 km and greater than 300 km as described below. SDV is about 3 to 6.5 km (2 to 4 miles) wide in southern Death Valley between the Owlshead and Avawatz mountains (Y-468, p. 157). It is nearly 2.5 km wide in the northern Avawatz Mountains (Y-602, p. 123).

The length of SDV is at least 51 km between Cinder Hill in southern Death Valley to the northeastern side of the Avawatz Mountains in the Silurian Valley as estimated from Y-413. It may extend 12 km farther if a concealed fault trace shown by Y-413 along the northeastern side of the Avawatz Mountains is included in SDV.

Y-602 (p. 180-181) and Y-955 (p. 1, 10-11) suggested that SDV extends at least 20 km south of the Avawatz Mountains beneath Holocene sediments in Silver Lake Valley to the southern Halloran Hills. If true, then the total length of SDV would be about 85 km.

Y-479 (p. 934) speculated that SDV may extend >160 km (100 miles) southeast from the Avawatz Mountains through a series of aligned valleys. This interpretation would make SDV about 200 km long.

Southern Death Valley fault (SDV) — Continued

Y-612 (p. 530-531) proposed that SDV extends about 250 km southeast of the Avawatz Mountains along northwest–striking faults to the Big Maria, Little Maria, and Riverside mountains, which are just north of Blythe, California, along the Colorado River. If true, SDV would be about 300 km long. However, Y-592 (p. 27, 31) concluded that subsequent work has revealed that the northwest–striking faults southeast of the Avawatz Mountain are overlain by latest Miocene and Pliocene sediments (Bouse Formation) and are, thus, too old to be correlative with SDV, which has had recurrent Quaternary displacement. For example, Y-592 noted that Grose (1959, Y-1360) portrayed SDV as joining the Soda–Avawatz fault zone in the Soda Mountains west of Baker, California. However, Y-592 (p. 29) concluded that SDV is not related to this fault zone because of differences in age, inferred displacement history, and geologic relationships. He (Y-592, p. 29) further concluded that SDV cannot correlate to northwest–striking faults in the Bristol Mountains farther to the southeast, because late Tertiary or early Quaternary fanglomerates unconformably overlie these faults, which are expressed as sheared granite and Tertiary sedimentary and volcanic rocks. These northwest–striking faults, instead, may be a southeastern extension of the Soda–Arrastre Spring fault zone (Y-592, p. 29). On the basis of these observations and similar ones on faults to the southeast to the Colorado River, Y-592 (p. 31) concluded that SDV does not extend southeast of the southern Death Valley area and that SDV "dies out beneath Quaternary deposits north of Silver Lake."

SDV may extend north of Cinder Hill along the front of the Black Mountains south of Mormon Point. Y-216 (p. 17-18, pl. 4) recognized little geomorphic evidence for lateral displacement between Mormon Point and Cinder Hill (their Gregory Peak and North Ashford Mill sections). However, Y-473 (p. 436) reported striations that plunge about 30° NW. on fault surfaces along this section of the Black Mountains and interpreted these striations as indicating right–lateral displacement. In addition, Y-429 (p. 8, fig. 3e, locality 11) noted that a drainage about 9 km south of Mormon Point has been right–laterally deflected about 170 m. If SDV does extend to near Mormon Point, then the length of the fault would be increased by about 12 km.

Style of faulting: Displacement on SDV has been predominantly right–lateral (Y-473, p. 436). Y-468 (p. 157) interpreted displaced streams as indicating right–lateral displacement. Y-216 (p. 17-18, pl. 4) suggested that the *en echelon*, left–stepping pattern of some fault scarps near the Amargosa River north of Ashford Mill between Cinder Hill and Shore Line Butte (their South Ashford Mill section) indicates a component of right–lateral displacement. Y-248 (p. 25) reported that the two strands of SDV that bound the Confidence Hills appear to be left–stepping, right–lateral faults and concluded that the folds in the Confidence Hills are a result of transpression between these two strands. However, Y-992 (p. 14) found, on the basis of paleomagnetic data, that the lake sediments that compose the Confidence Hills have not undergone net tectonic rotation. Y-429 (p. 4) suggested that SDV has a minor vertical component of displacement.

Displacement on the western subzone of SDV of Y-472 (p. 402) between the Confidence Hills and the southern Owlshead Mountains has been predominantly right–lateral strike–slip. Displacement on the eastern subzone of Y-472 (p. 407) has been both lateral and vertical.

Scarp characteristics: Y-429 (p. 9, fig. 3f, locality 15) reported that a scarp at the southern end of the Confidence Hills is 1.8 m high and has a maximum slope angle of 28°.

Displacement: Estimates of right–lateral displacement on SDV range between 1.2 m and about 50 km. These estimates are based on a variety of stratigraphic and structural markers of different ages, as discussed in the following paragraphs in order of decreasing age of the displaced unit.

Y-468 (p. 157) interpreted the distribution of Precambrian Pahrump Series as indicating a minimum of about 19 km (12 miles) of right–lateral displacement on SDV.

Y-389 (p. 56) thought that the distribution of the Precambrian Pahrump Series on opposite sides of Death Valley suggested right–lateral displacement of 24 to 48 km (15 to 30 miles) on SDV.

Y-602 (p. 130, 191) estimated that the total lateral displacement across the Noble Hills is less than 10 to 12 km.

Y-479 (p. 947) inferred that the total right–lateral displacement on the northern part of SDV could be no more than 8 km (5 miles). This was based on trends of formational contacts (e.g., the intersection of the lower contact of the Precambrian Kingston Peak Formation with an unconformity at the base of the overlying Noonday Dolomite) and isopach data. However, Y-592 (p. 29) pointed out that of the eight stratigraphic sections used by Y-479, only one is west of SDV, so that in general "the trend and therefore the offset of isopachs west of the fault zone is indeterminate."

Y-612 (p. 530-531) recontoured the isopach data used by Y-479 and concluded that SDV had experienced 50 km of right–lateral displacement and that single faults have displacements of 2 to 15 km each (*cited in* Y-472 (p. 404) and *in* Y-592 (p. 27, 29)).

On the basis of bedrock exposures in the area between SDV and the east–striking Garlock fault, Y-593 (p. 1413) found no evidence for large lateral displacement at the eastern end of the Garlock fault where it crosses SDV; they estimated that the displacement of the Garlock fault by SDV has been limited to about 8 km.

Y-592 (p. 29, 31) concluded that "considerable geologic evidence" suggests that the maximum lateral displacement on SDV has been about 8 km.

On the basis of observations on faults southeast of the Avawatz Mountains to the Colorado River, Y-592 (p. 31) concluded that SDV "diminishes in lateral displacement southeast of the northeastern corner of the Avawatz Mountains."

Y-955 (p. 2) concluded, on the basis of structural and sedimentological evidence, that the minimum right–lateral displacement across SDV during the Pliocene and Pleistocene is 20 km. He also concluded that the amount of deformation increases from northwest to southeast along the Noble Hills and that the greatest displacement in this area is on the eastern traces of SDV (Y-955, p. 2).

Y-602 (p. 130, 191) estimated that one trace of SDV on the eastern side of the Noble Hills has had at least 8 km of right–lateral displacement during the Quaternary.

Y-472 (p. 406) concluded that about 35 km of right–lateral displacement has occurred at the southern end of the Owlshead Mountains along their western subzone. This was estimated by matching remnants of alluvial–fan deposits (their QTf unit; fig. 4, p. 404-405) with their source to the northwest. Gravel clasts in the alluvial–fan deposits are composed of two rock types (pebble conglomerate of the late Precambrian Kingston Peak Formation and Paleozoic carbonate rocks) for which the closest source is Warm Spring Canyon. (They ruled out sedimentary processes alone as explaining the configuration of the remnants that they observed.) They could not determine the age of the alluvial–fan deposits (Y-472, p. 406). An earlier estimate by Y-603 (p. 26, 92-93), made on the basis of these same alluvial–fan deposits, was 20 to 35 km of lateral displacement for the western subzone of SDV. He (Y-603, p. 28) suggested that this displacement had occurred between about 10.7 Ma and slightly less than 1 Ma. An amount of right–lateral displacement that was estimated geometrically by Y-603 (p. 93-94, fig. 25) using a pull–apart model of Y-471 agreed with the value estimated using the alluvial–fan deposits.

Y-955 (p. 4, 10) reported that clasts in a granite–bearing conglomerate on the eastern side of the Noble Hills were derived from the Owlshead Mountains 8 km to the northwest. The conglomerate was moved to its present position by right–lateral displacement on SDV, so that 8 km is the minimum amount of right–lateral displacement on an eastern trace of SDV at Denning Spring Wash in the Noble Hills since the clasts were deposited (Quaternary?).

Y-603 (p. 27) reported lateral displacement of about 4 to 13 km along a trace in the western subzone of SDV. This amount of displacement is based on the correlation of alluvial–fan deposits that contain volcanic debris.

Y-401 (p. 989) noted right–lateral displacement of "several hundred feet" on a fault trace that parallels the Confidence Hills anticline along the crest of the Confidence Hills. This amount of displacement was interpreted from northeastward–draining stream channels that are sharply deflected in a right–lateral direction where they cross the fault (Y-401, p. 989). Y-401 (p. 989) noted vertical as well as right–lateral displacement on this trace.

Southern Death Valley fault (SDV) — Continued

Y-472 (p. 407) noted that right–lateral displacement across two fault traces at the northern end of their eastern subzone has been "on the order of a few hundred meters." This estimate is from a small cinder cone (called Cinder Hill by Y-424), whose conical structure has been displaced by these traces (Y-424, p. 9). Y-603 (p. 30, 99) estimated about 200 m of right–lateral displacement of Cinder Hill. Y-603 (p. 26) reported a maximum lateral displacement of "on the order of several hundred meters" for their eastern subzone and a maximum vertical displacement of about 100 m for this subzone. These displacements have occurred since 700 ka to 900 ka.

Y-401 (p. 988-989) concluded that northwest–striking fault traces in southern Death Valley between Shore Line Butte (his Shoreline Hill) and Ashford Mill displace (laterally?) Quaternary alluvium commonly not more than 15 m (50 ft), which is much less than the amounts of displacement he noted in the underlying Funeral Formation.

Y-955 (p. 9-10) estimated that late Pleistocene–early Holocene (8 ka to 15.5 ka; table 1, p. 5) alluvial–fan deposits (his Qf2 unit) near Pipeline Wash in the Noble Hills in the northern Avawatz Mountains have a cumulative lateral displacement of <0.5 km on western traces of SDV. This estimate is based on the inference that "dioritic" clasts included in the deposits were probably derived from the eastern Avawatz Mountains.

Y-429 (p. 9, fig. 3f, locality 14) reported that a drainage along the southwestern side of the Confidence Hills adjacent to Contact Canyon in the Owlshead Mountains (the western subzone of Y-472 and Y-603) has been displaced right–laterally 360 m. Y-429 also noted that a smaller drainage at this same locality is displaced right–laterally 30 m.

Y-429 (p. 9, fig. 3g, locality 16) noted that a drainage along a trace of SDV with southern Death Valley (the eastern subzone of Y-472 and Y-603) has been displaced right–laterally 1.2 m in each of two surface ruptures. Directly east of this locality on another trace of SDV, Y-429 (p. 9, fig. 3g, locality 17) reported 27 m of right–lateral deflection of an entrenched drainage and 3 m of right–lateral displacement of a smaller drainage.

Age of displacement: The youngest displacement on at least part of SDV may be Holocene. Y-1020 portrayed displacement on some traces as Holocene (<10 ka) as indicated by sag ponds, uneroded scarps, displaced stream channels, and shutter ridges, some of which are on surfaces thought to be Holocene. Y-427 (table 1, p. 18) described SDV as "moderately to well defined by side–hill troughs, benches, and right–laterally deflected drainages." Displacement on other traces are shown by Y-1020 as late Quaternary (<700 ka) or Quaternary (<1.6 Ma).

Y-602 (p. 127) reported that the eastern branch of SDV between Pipeline Wash and Cave Spring Wash in the northern Avawatz Mountain cuts Quaternary alluvial–fan deposits (his Qf2 unit with an estimated age of early Holocene to late Pleistocene, 8 ka to 15.5 ka; table 1, p. 101) and is expressed as a series of right–stepping shutter ridges. Although Y-602 recognized that this displacement could be as young as 8 ka, he (Y-602, p. 130) speculated that most of the displacement in this area occurred between 1 Ma and 2 Ma.

Y-401 (p. 960) reported that alluvial–fan deposits east of Sheep Creek Spring at the base of the northeastern side of the Avawatz Mountains are displaced by "recent faults."

Y-429 (p. 9) interpreted a maximum angle of 28° on a 1.8–m–high scarp preserved on an alluvial surface as suggesting Holocene displacement on SDV at the southern end of the Confidence Hills.

Y-429 (p. 10, fig. 3f, locality 20) reported that SDV along the northeastern side of the Noble Hills is expressed as scarps and tonal lineaments on young alluvial surfaces, indicating some Holocene displacement on this part of the fault.

Along the eastern side of the southern Avawatz Mountains, bedrock is faulted over late Pleistocene or early Holocene (8 ka to 15.5 ka) alluvial–fan deposits (his Qf1 and Qf2 units; Y-955, p. 6).

Y-429 (p. 8, fig. 3e, locality 13) reported fault scarps and a side–hill trough in the basalt on Shore Line Butte that are "considerably sharper and "fresher" than adjacent Pleistocene shorelines and may truncate those shorelines." These geomorphic features align with scarps on late Pleistocene alluvial surfaces south of Shore Line Butte (Y-429, p. 8).

Southern Death Valley fault (SDV) — Continued

Quaternary displacement on the northern end of the eastern subzone of Y-472 and Y-603 is recorded by uplifted and tilted basalt flows on Shore Line Butte and by right–lateral displacement of Cinder Hill about 2 km north of Shore Line Butte (Y-401, p. 989; Y-472, p. 407; Y-473, p. 436). The basalt flows on Shore Line Butte have been radiometrically (K–Ar) dated at 1.5 Ma (Y-424, p. 5, *citing* R. Drake, personal commun., 1979). The andesite that forms Cinder Hill yielded a date (K–Ar) of 0.69 Ma (Y-424, p. 5, *citing* R. Drake, personal commun., 1979).

Y-955 (p. 5) noted that the Pleistocene (>15.5 ka) alluvial fans (his Qf1 unit) on the eastern and northern sides of the Avawatz Mountains have been deformed and uplifted, as well as deeply dissected. The fans have also prograded northward, partially burying the Saddleback and Ibex Hills and deflecting the course of the Amargosa River. He (Y-955, p. 6) attributed these characteristics to uplift of the Avawatz Mountains that occurred during and shortly after deposition of the alluvial fans.

Y-472 (p. 406) speculated that all displacement on their western subzone occurred between about middle Miocene and 1 Ma. The older estimate is based on two dates (K–Ar) on volcanic rocks (10.66 ± 0.28 Ma and 12.66 ± 1.04 Ma; *they cite* R.E. Drake, written commun., 1982) and an assumption that the onset of faulting and volcanism are coeval (Y-472, p. 406). The younger estimate is based on relationships that suggest that faulting ceased before old alluvial–fan gravels (their Qf2 unit) were deposited and a tephra just below the gravels that has been radiometrically (K–Ar) dated at 0.62 ± 0.52 Ma (*they cite* R.E. Drake, written commun., 1983) and that is magnetically reversed (0.73 Ma to 0.90 Ma or 0.97 Ma to 1.14 Ma) (Y-472, p. 407). Y-602 (p. 130) concluded that displacement on SDV was probably initiated at the same time that Death Valley began to form.

Folding and faulting of the lake beds that compose the Confidence Hills also indicate Quaternary displacement on SDV, because these lake beds are thought to be 2 Ma (Y-246), 1.5 Ma (Y-424), or younger (Y-248, p. 25). Detailed work utilizing paleomagnetics and tephrochronology led Y-991 (p. 3) to conclude that these lake sediments were deposited between at least 2.2 Ma and <1.5 Ma.

Y-424 portrayed SDV across Shore Line Butte and in the northern Confidence Hills (the eastern subzone(?) of Y-472) as displacing Quaternary gravel, their Qg1 deposits, which are deeply dissected and slightly deformed, and their Qg2 deposits, which are moderately dissected and undeformed. The Qg1 gravels were probably deposited between <1.5 Ma and >0.69 Ma, because Qg1 gravels abut a basalt tentatively correlated with the basalt on Shore Line Butte (1.5 Ma) and because tephra from the eruption forming Cinder Hill (0.69 Ma) overlies the eroded surface of the Qg1 gravels. Y-424 also showed SDV in this area as also displacing older deposits, Pliocene and Pleistocene Funeral Formation (their QTfc and QTfs units) and the volcanic rocks at Shore Line Butte and Cinder Hill. The map by Y-424 shows traces of SDV in this area as concealed by younger Quaternary gravels (their Qg3 unit), which are undeformed and relatively undissected. North–northwest–striking fault traces north of the Amargosa River are portrayed by Y-424 as displacing the Qg3 gravels.

Y-955 (p. 2) reported that SDV along the Noble Hills consists of six main branches along which Cenozoic sediments have been tectonically juxtaposed against crystalline basement rocks. Displacement on these branches has formed the Noble Hills, with the youngest displacement on the eastern branches (Y-955, p. 8).

Because Y-602 (p. 130) thought that the age of Death Valley is constrained by the age of the Furnace Creek Formation, which is suggested by Y-390 (p. A59) to have a maximum age of 5 Ma, he speculated that initial displacement on SDV occurred about 5 Ma.

Slip rate: Y-603 (p. 29) concluded that the average apparent right–lateral slip rate on the western subzone of SDV adjacent to the Owlshead Mountains is about 2 to 3 mm/yr based on 20 to 35 km of displacement that he thought occurred between about 10 Ma and 1 Ma.

Y-603 (p. 30) inferred an average apparent right–lateral slip rate on the eastern subzone of SDV of about 0.3 mm/yr based on his estimate of a maximum lateral displacement of 200 m at Cinder Hill, which has been dated at about 700 ka.

Using the observations by Y-955 (p. 9-10, table 1) that early Holocene to late Pleistocene (8 ka to 15.5 ka) alluvial–fan deposits are displaced laterally <0.5 km, a maximum apparent lateral slip rate of 32 to 63 mm/yr can be estimated for SDV in the Noble Hills.

Southern Death Valley fault (SDV) — Continued

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished literature (Y-427, p. 8). Summary of published and unpublished data (Y-427, p. 8; Y-429, p. 1-5). Interpretation of aerial photographs (Y-427, p. 8; Y-429, p. 5, scales 1:12,000 for low–sun–angle photographs, 1:20,000, and 1:24,000 for vertical aerial photographs; Y-599, p. 108, scale 1:18,000; Y-602, p. 3, scale ~1:14,500; Y-991, p. 5). Geologic mapping at a scale of 1:24,000 (Y-429, p. 5; Y-472, p. 402; Y-602, p. 3; Y-991, p. 5). Reconnaissance geologic mapping or field checking (Y-429, p. 5-6; Y-592, p. 27, 29). Geologic mapping (Y-602, p. 3-4). Detailed cross sections and longitudinal profiles of the Amargosa River and associated terraces using a Leitz B-4 level and tape (Y-599, p. 108). Paleomagnetic sampling and measurements (Y-992, p. 12-14). Detailed surveying (Y-603, p. 5). Gravity profiles (Y-602, p. 4). Seismic refraction data (Y-602, p. 4).

Relationship to other faults: Y-600 (fig. 1, p. 132, 135) portrayed SDV (his Death Valley fault zone) as joining his Furnace Creek fault zone at the northern end of the Black Mountains and becoming what he called the Death Valley–Furnace Creek fault zone (the Furnace Creek fault (FC) of this compilation).

Y-471 (p. 440) proposed that right–lateral displacement on both SDV (their Death Valley fault zone) and the northwest–striking Furnace Creek fault (FC; their Death Valley–Furnace Creek fault zone) to the north has resulted in tension that caused the two sides of Death Valley to pull apart along a north trend forming the deep trough of the present Death Valley.

Y-468 (p. 159) suggested that SDV intersects the left–lateral, east–striking Garlock fault just west of Sheep Creek in the northeastern corner of the Avawatz Mountains. Because the area of their intersection is covered by alluvium and their angle of intersection is acute, "it is impossible to be certain whether one fault zone is cutting the other or whether they are contemporaneous" (Y-468, p. 159). In contrast, Y-593 (p. 1,413-1,415) proposed that the Garlock fault must cross SDV and continue to the east, either terminating beneath Quaternary alluvium in Kingston Wash or merging with what they called the Nopah Range frontal fault. Y-602 (p. 188) concluded that SDV most likely steps eastward at the Garlock fault (specifically the Mule Spring fault zone) and is buried beneath alluvium. These relationships are discussed in detail in Y-602 (primarily p. 185-188).

Y-472 (p. 410) postulated that the differences in type and age of displacement that are noted on their two subzones of SDV between Cinder Hill and the southern end of the Owlshead Mountains may be related to interactions between SDV and the Garlock fault to the south. Y-472 (p. 410) suggested that, as the Avawatz Mountains are thrust eastward along a branch of the Garlock fault, SDV is deflected eastward such that the most recent activity on SDV would shift from the western subzone to the eastern subzone.

Spotted Range faults (SPR)

Plate or figure: Plates 1 and 2.

References: Y-671: Guth, 1990; Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991.

Location: 59 km/104° (distance and direction of closest point from YM) at lat 36°42′N. and long 115°48′W. (location of closest point). SPR is located primarily along the western side of Spotted Range. SPR also includes a fault along the western side of an unnamed ridge about 3 km west of the western front of the Spotted Range and two relatively short faults within the range.

USGS 7-1/2′ quadrangle: Indian Springs NW, Mercury NE, Quartz Peak NW, Quartz Peak SW.

Fault orientation: The fault along the range front strikes generally north at the northern end of the Spotted Range and strikes generally north–northeast at the southern end of the range. The fault along the unnamed ridge west of the Spotted Range strikes slightly more easterly than does the range–front fault (Y-813). Faults within the Spotted Range curve but generally strike north–northeast or north (Y-813).

Fault length: The range–front fault is 20 km (Y-852) to 30 km (Y-813) long. The fault along the unnamed ridge is 9 km (Y-852) to 12 km (Y-813) long. The two faults within the range are 4 km and 7 km long.

Style of faulting: Displacement on portions of the faults within the range is portrayed by Y-813 as down to the west.

Scarp characteristics: Major portions of all faults of SPR are shown by Y-813 as scarps. These are primarily west–facing.

Displacement: No information.

Age of displacement: The range–front fault is portrayed by Y-852 as juxtaposing Quaternary alluvium against bedrock. Portions of this fault are shown by Y-813 as scarps on both Quaternary and Tertiary surfaces.

The fault along the unnamed ridge is portrayed by Y-813 as scarps on Quaternary surfaces (primarily) and on Tertiary surfaces.

The faults within the Spotted Range are shown by Y-813 both as faults that are in Tertiary deposits and that were identified from previous mapping and as lineaments along a linear front or in bedrock. These faults are indicated by Y-852 to be faults that juxtapose Quaternary alluvium against bedrock.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The range–front fault has been shown by Y-852 as juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of the western front of the Spotted Range would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, SPR would be significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852). Portions of this fault, as well as the faults in the range, have been shown by Y-813 as topographic lineaments along a linear range front.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Relationship to other faults: The relationship of SPR to the northeast–striking Rock Valley fault (RV) west of SPR; to the north– and north–northwest–striking West Pintwater Range fault (WPR) and the East Pintwater Range fault (EPR) east of SPR; and to the northeast– and east–striking Mercury Ridge faults (MER), Crossgrain Valley faults (CGV), South Ridge faults (SOU), or Cactus Springs fault (CAC), all south of SPR, is not clear.

Spotted Range faults (SPR) — Continued

The southern end of the Spotted Range (along with the southern end of the Pintwater Range to the east) bends to the southwest as it approaches the east-striking faults (e.g., CAC, CGV, MER, SOU). These east–striking faults have been interpreted by Y-813 (p. 5) to be part of the Las Vegas shear zone, which was inferred by Stewart (1988, Y-888) to separate two sections of the Walker Lane: the Spotted Range–Mine Mountain section on the north from the Spring Mountains section on the south. SPR, as a range–bounding fault, correspondingly bends and appears to merge with either the east–striking faults or perhaps with the northeast–striking, left–lateral faults (e.g., RV), which have been interpreted by Y-813 (p. 5) to be part of the Spotted Range–Mine Mountain section.

Stagecoach Road fault (SCR)

Plate or figure: Figure 3.

References: Y-9: Fox and Carr, 1989; Y-26: Swadley and others, 1984 (possibly their Fault I); Y-31: Scott and Whitney, 1987; Y-46: Maldonado, 1985 (shows SCR as a concealed fault from west of Yucca Mountain to possibly extending northeast across Jackass Flats and correlating with a fault in Tertiary volcanic rocks in the Calico Hills); Y-55: Scott and Bonk, 1984; Y-189: Lipman and McKay, 1965 (show SCR as concealed except for a trace in Tertiary volcanic rocks along the eastern side of Busted Butte; extend SCR northeast to Fortymile Wash; neither section is shown on fig. 3 of this compilation); Y-194: McKay and Sargent, 1970; Y-224: Frizzell and Shulters, 1990; Y-238: Reheis and Noller, 1991 (pl. 3); Y-396: Scott, 1990; Y-575: Whitney and Muhs, 1991 (their Paintbrush Canyon–Stagecoach Road fault system, which they subdivided into five segments); Y-1042: O'Neill and others, 1992 (name from their pl. 1); Y-1182: Simonds and Whitney, 1993.

Location: 10 km/180° (distance and direction of closest point from YM) at lat 36°44′N. and long 116°27′W. (location of closest point). SCR is located along the northwestern side of unnamed hills south of the Middle Crest of Yucca Mountain and southwest of Busted Butte.

USGS 7-1/2′ quadrangle: Lathrop Wells, Busted Butte.

Fault orientation: SCR strikes generally northeast (Y-189; Y-224; Y-396; Y-1042) or north–northeast (Y-1042, p. 13). It is the only major northeast–striking fault in the immediate vicinity of Yucca Mountain (Y-1042, p. 8). SCR where it is exposed north of Old Stage Coach Road dips west (Y-1042, p. 13).

Fault length: The length of SCR is 12 km as estimated from Y-55. It is about 9 km long as estimated from Y-189, but SCR extends to the southern edge of their map area at lat 36°45′N. The portion of SCR that is shown by Y-46 as a concealed trace from west of Yucca Mountain to the western edge of Jackass Flats is about 13 km long. Y-46 continued SCR northeastward another 7 km across Jackass Flats as a concealed trace and an additional 11 km northeast of that as both a fault in volcanic rocks in the Calico Hills and as a concealed trace in the basin north of the hills. Thus, the total length of SCR as portrayed by Y-46 is 31 km.

Y-1182 (p. A-141) reported that the length of Quaternary rupture along SCR is 4.3 km. The length of SCR as shown by Y-1042 (pl. 1) and determined from the fault's expression on aerial photographs is about 4.5 km, but SCR extends to the southern edge of their map area. Fault I of Y-26, which may correspond with SCR, is nearly 3 km long as estimated from their plate 1.

Style of faulting: Y-46, Y-55, and Y-189 all portrayed displacement on SCR as down to the southeast. Y-46 also noted that SCR has left–lateral displacement. Y-575 (p. A119) and Y-1042 (p. 17) both noted slickenlines with rakes as great as 47°. These slickenlines are exposed on Tertiary fault breccia and are interpreted by them to indicate left–lateral–oblique slip on SCR. Y-575 (p. A119) and Y-1042 (p. 20) both recognized deflected and displaced stream channels that suggest left–lateral–oblique displacement.

Scarp characteristics: No information.

Displacement: Y-31 (p. 332) noted that drainages on Quaternary bedrock pediments and on Quaternary surfaces are displaced 10 m to 30 m across SCR. They also identified as much as 1 km of left–lateral displacement of ridges formed on a 13–Ma tuff (Y-31, p. 332).

On the basis of tectonic tilt of volcanic units (Paintbrush Tuff of 13.5 Ma to 13 Ma and Timber Mountain Tuff of 11.5 Ma), Y-396 (table 2, p. 275) indicated 6.7 km of vertical displacement on SCR between 13 Ma and 11.5 Ma, 3.3 km of vertical displacement since 11.5 Ma, and 4.6 m of vertical displacement since some time after 1.7 Ma.

Age of displacement: Several features suggest Quaternary displacement on SCR. Y-1042 (p. 8, 10) noted that SCR is not well defined on aerial photographs, but identified topographic lineaments and linear tonal changes along Old Stage Coach Road. These lineaments are continuous with well–developed scarps further south. Y-31 (p. 332) recognized displaced drainages on surfaces of Quaternary bedrock pediments and Quaternary deposits. Y-26 (table 4, p. 21) inferred that the youngest rupture on their Fault I (part of SCR?) occurred between 700 ka and 2 Ma because early Pleistocene and latest Pliocene alluvium with an estimated age of 1.1 Ma to 2 Ma (their QTa deposits, fig. 3, p. 9) is displaced, but middle Pleistocene eolian sand with an estimated age of 700 ka to 750 ka (their Q2e deposits, fig. 3, p. 9) is not displaced.

Slip rate: Y-396 (table 2, p. 275) estimated an apparent vertical slip rate of >0.003 mm/yr for SCR during all or part of the Quaternary (some time after 1.7 Ma).

Using the maximum 1 km of left–lateral displacement of ridges of 13–Ma volcanic tuff, which was noted by Y-31 (p. 332), the apparent lateral slip rate on SCR since 13 Ma is 0.08 mm/yr.

Y-396 (table 2, p. 275) calculated an apparent vertical slip rate on SCR of 0.45 mm/yr between 13 Ma and 11.5 Ma. This rate assumes that 6.7 km of vertical displacement occurred during this 1.5–million–yr interval. Y-396 (table 2, p. 275) also reported an apparent vertical slip rate of 0.029 mm/yr since 11.5 Ma. This rate assumes that 3.3 km of vertical displacement occurred since 11.5 Ma and that Cenozoic displacement rates occurred in a step–wise manner in which rates sharply decreased about 11.5 Ma (Y-396, p. 273).

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished information (Y-26, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000) and conventional aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000). Surficial mapping and field investigations (Y-26, p. 3; Y-1042, p. 2). Analysis of stream patterns (Y-575, p. A119).

Relationship to other faults: The northeast strike of SCR contrasts with the predominant north strike of faults in the Yucca Mountain area. SCR may merge on the north with the north–striking Paintbrush Canyon fault (PBC) north of Busted Butte (Y-31, p. 332, their Busted Butte–Paintbrush Canyon normal fault zone; Y-575, p. A119; Y-1042, p. 8; Y-1182, p. A-141). Y-1042 (p. 8) noted tonal contrasts on alluvial surfaces directly north of Old Stage Coach Road. These lineaments trend northeastward between SCR and the west side of Busted Butte, so that Y-1042 (p. 8) suggested that the lineaments may reflect buried fault traces that link SCR and PBC. Y-9 (fig. 3, p. 41) and Y-575 (p. A119) also inferred a connection between SCR and PBC (the Paintbrush Canyon–Stagecoach Road fault system of Y-575). Y-396 (p. 265) reported that his detailed mapping suggests that SCR probably projects to the east–northeast along the west side of Busted Butte and connects with PBC. The above interpretations contrast with interpretations of previous workers (Y-46, Y-189, and Y-194) in which SCR was extended to the northeast along southern side of Busted Butte.

Y-1042 (p. 10) suggested that PBC may continue southward and connect to a reverse fault cutting Busted Butte. Y-1182 (p. A141) speculated that SCR could be a continuation of an eastern splay of the Solitario Canyon fault (SC).

Y-31 (p. 332) suggested that the combined fault zone of PBC and SCR may form an arcuate breakaway zone related to a detachment fault underlying the Yucca Mountain area. They noted that the steep, west–dipping, north–striking normal faults in the upper plate of this detachment die out along SCR on the south and against northwest–striking, right–lateral strike–slip faults near Yucca Wash on the north (Y-31, p. 332).

Y-1042 (p. 17) reported that slickenlines along SCR plunge more steeply than those along PBC, which they interpreted to indicate a larger component of dip slip along SCR than along PBC. Y-396 (p. 269) concluded that extension progressively increases to the south in the Yucca Mountain area, which is apparently supported by the field observations of Y-1042 (p. 17).

State Line fault (SL)

Plate or figure: Figure 1.

References: Y-415: Jennings, 1985 (his fault #7, p. 144-145, Kingman sheet, information from Y-893); Y-742: Hewett, 1954; Y-743: Hewett, 1954 (pl. 1, shows an unnamed fault along the border between Nevada and California; Y-893: Hewett, 1956 (name from his pl. 2); Y-1020: Jennings, 1992; Y-1105: MIT Field Geophysics Course, 1985.

Location: 130 km/155° (distance and direction of the closest point from YM) at lat 35°40′N. and long 115°30′W. (location of closest point). SL is approximately parallel with the border between Nevada and California, and extends from the southern end of Mesquite Valley, across State Line Pass, and along the northeastern side of Ivanpah Valley.

USGS 7-1/2′ quadrangle: Desert, Nipton, Ivanpah Lake, Mesquite Lake, Roach, Stateline Pass.

Fault orientation: SL has a northwest, but slightly curving, strike (Y-893, pl. 1). Y-893 (p. 55-56) noted that SL in State Line Pass strikes N. 55° W. and dips 70° SW.

Fault length: The length of SL between State Line Pass and near Nipton, California, is 32 km as estimated from Y-743 (pl. 1) and Y-893 (pl. 1).

Style of faulting: Displacement along SL is shown as down–to–the–southwest dip slip (Y-743, pl. 1; Y-893, pl. 1, p. 106). This style of displacement is thought to be the reverse of that of older displacements along SL (Y-893, p. 105). Y-893 (p. 55-56, fig. 15) noted that "local features suggest that [SL] was originally a steep thrust fault along which later movement in the reverse direction has exceeded the original displacement." Y-1105 (p. 8685, 8689) inferred a large component of strike–slip displacement along SL on the basis of (1) the linearity of the fault, (2) its expression on aerial photographs, and (3) the apparent continuity between an inferred escarpment on the northeastern side of Mesquite Valley and the northwest–striking, right–lateral Pahrump fault (PRP).

Scarp characteristics: No information.

Displacement: Y-893 (p. 105) noted that the youngest displacements downdropped the southwestern side of SL nearly 610 m (2,000 ft). Apparent vertical separation of pre–Tertiary rocks across the steep escarpment along the northeastern side of Mesquite Valley and interpreted by Y-1105 to be an extension of SL is >3,500 m (Y-1105, p. 8689). This estimate is based on a maximum depth of 2 to 3 km to pre–Tertiary rocks beneath Mesquite Valley as interpreted from geophysical data and the elevations of the surrounding mountains (Y-1105, p. 8689).

Age of displacement: Y-742 (p. 18) concluded that normal faults bounding Ivanpah Valley (1) are younger than an upland surface in the eastern Mojave region (which he calls the "Ivanpah upland"), and (2) are probably younger than basalt flows overlying this upland. He inferred that the upland was eroded and that the basalts were extruded during the middle Pleistocene (Y-742, p. 18), so that displacement on SL would be younger than this. Y-893 (pl. 2) showed SL, along with other faults in and near Ivanpah Valley, as a "late Tertiary and Recent [Holocene] normal fault." Y-893 (p. 106) suggested that displacement along SL possibly coincided with downwarping of Mesquite Valley, which he thought occurred recently. A 2.5–km–long section at the northern end of SL is shown by Y-893 (pl. 1) as a faulted contact between pre–Tertiary (Mississippian and Pennsylvanian) rocks and Quaternary alluvium (his Qal deposits). Y-1020 noted that SL shows some evidence of displacement during the Quaternary (since 1.6 Ma as defined by him).

In contrast, the map of Y-893 (pl. 1) shows most of SL as concealed by Quaternary alluvium (his Qal deposits). Y-1105 (p. 8689) concluded that the "absence of obvious topographic expression of this [range–bounding] fault in Mesquite Valley [an inferred extension of SL] suggests that most of the slip probably occurred before Holocene or even late Quaternary time."

Slip rate: No information.

Recurrence interval: No information.

State Line fault (SL) — Continued

Range-front characteristics: No range front is associated with most of SL. Y-743 (pl. 1) portrayed the southern 24 km of SL as a "fault inferred from aligned range fronts that are discordant with structural features in hard rocks within the ranges."

Analysis: Field examination (Y-743, p. 15; Y-893). Interpretation of aerial photographs (Y-743, p. 15). Analyses of gravity data (Y-1105, p. 8685). Electrical resistivity profiles (Y-1105, p. 8685, 8688). Magnetotelluric measurements (Y-1105, p. 8689).

Relationship to other faults: Ivanpah Valley, along which part of SL is located, is bounded by the northwest–striking, down–to–the–northeast Ivanpah fault on the southwest and by the north–striking McCullough fault on the east (Y-893, p. 105). SL approximately parallels the Ivanpah fault within Ivanpah Valley and is located about 11 km to the northeast of this fault (Y-893, pl. 1). Y-743 (p. 18) suggested that the floor of Ivanpah Valley approximately coincides with a block that has been downdropped about 6,100 m (about 20,000 ft). The dip–slip displacement along the Ivanpah fault is estimated to be 2,440 m (8,000 ft) or greater at its southern end, and the dip–slip displacement along the McCullough fault is estimated to be 6,100 m (20,000 ft) (Y-893, p. 18, 105). Y-893 (p. 8) noted that a physiographic or structural change occurs in Ivanpah Valley. This change, which is approximately coincident with the Ivanpah fault, is expressed as a transition from nearly north–trending linear ranges and valleys typical of the Basin and Range province to the northeast to isolated, generally variously trending mountains and ridges of diverse form to the southwest. The coincidence of this change with the Ivanpah fault implies that the fault is a major geologic structure in the region. The structural relationship between the Ivanpah fault and SL is not known.

The northwest–trending Mesquite Valley located just northwest of Ivanpah Valley is not bounded by faults as is the Ivanpah Valley. However, Y-893 (p. 103, 106) noted that Mesquite Valley coincides with a downwarp, which is indicated by the trace of the Mesquite thrust fault and the attitude of the Resting Spring Formation (late Pliocene and Pleistocene). Y-1105 (p. 8685) suggested that "no clearly active, range–bounding normal faults" exist in Mesquite Valley and that "the surrounding topography is more subdued than in regions farther west or north." SL aligns with the axes of both the Mesquite and Pahrump valleys (Y-1105, p. 8685). SL is presumed by Y-1105 (p. 8685, 8689) to have formed a steep, buried escarpment on the northeastern side of Mesquite Valley. The buried escarpment, which probably slopes at least 45° and could be vertical, is inferred by Y-1105 (p. 8685) from a steep gradient in gravity data at this location.

Stonewall Flat fault (SWF)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 1); Y-853: Dohrenwend and others, 1992. Not shown by Albers and Stewart, 1972 (Y-407) nor by Cornwall, 1972 (Y-232).

Location: 101 km/322° (distance and direction of closest point from YM) at lat 37°34′N. and long 117°08′W. (location of closest point). SWF is located primarily along the northwestern side of Stonewall Flat southeast of its junction with the Goldfield Hills. The southern portion of SWF is located along the northwestern side of the Cuprite Hills.

USGS 7-1/2′ quadrangle: East of Goldfield, Goldfield, Montezuma Peak SE, Ralston, Stonewall Spring.

Fault orientation: SWF strikes generally northeast (Y-238; Y-853).

Fault length: The total length of SWF is about 22 km as estimated from Y-238. This length includes a section of SWF in Stonewall Flat that is about 13 km long and a section along the northwestern side of the Cuprite Hills that is 9 km long. The length of SWF is 5 km as estimated from Y-853 with individual traces that are 1 to 2 km long.

Style of faulting: Displacement on several fault traces at the eastern side of SWF is shown by Y-238 to be both down to the northwest and down to the southeast.

Scarp characteristics: Scarps associated with SWF are shown as primarily southeast–facing by Y-853 and as both northwest– and southeast–facing by Y-238.

Displacement: No information.

Age of displacement: The youngest portions of SWF are portrayed by Y-853 as scarps on depositional or erosional surfaces of latest Pleistocene and (or) Holocene age (their $Q_{2\text{-}3}$ surfaces with estimated ages of 30 ka or younger). Other portions of SWF are shown by Y-853 to be on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). SWF is shown by Y-238 as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits and as fault traces that are in Quaternary deposits and that were recognized from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with most of SWF. The southern 9 km of SWF bounds the northwestern side of the Cuprite Hills. The characteristics of this front are not known. Y-238 (pl. 1) shows part of SWF as a topographic lineament bounding a linear range front or within bedrock.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000). Limited field reconnaissance (Y-238, p. 3).

Relationship to other faults: SWF is approximately parallel to other north–northeast– or northeast–striking major range–bounding faults west of Cactus Flat, such as the Montezuma Range fault (MR) along the western side of the Montezuma Range northwest of SWF, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges northwest of SWF, the Bonnie Claire fault (BC) bounding a highland west of Bonnie Claire Lake south of SWF, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain southwest of SWF, and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains southwest of SWF. SWF is also approximately parallel to northeast–striking faults within basins, such as the Clayton–Montezuma Valley fault (CLMV) within an unnamed valley between Clayton Ridge and the Montezuma Range northwest of SWF, the Palmetto Mountains–Jackson Wash faults (PMJW) within an unnamed valley northeast of the Palmetto Mountains west of SWF, and the Clayton Valley fault (CV) within Clayton Valley northwest of SWF (Y-238; Y-853). The structural relationships among all these faults are not known.

Stonewall Flat fault (SWF) — Continued

SWF has a slightly more northerly strike than does the Stonewall Mountain fault (SWM) along the northern side of Stonewall Mountain east of SWF. SWF has a more easterly strike than the Mud Lake–Goldfield Hills fault (MLGH) along the northern end of the Goldfield Hills and across Mud Lake directly north of SWF. The structural relationships among these faults are not known.

Stonewall Mountain fault (SWM)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 1); Y-813: Reheis, 1992 (pl. 1); Y-853: Dohrenwend and others, 1992; Y-1071: Weiss and others, 1993.

Location: 92 km/330° (distance and direction of closest point from YM) at lat 37°33′N. and long 116°58′W. (location of closest point). SWM is located along the northwestern end of Stonewall Mountain. It extends east of Stonewall Mountain to east of Civet Cat Canyon.

USGS 7-1/2′ quadrangle: Civet Cat Cave, Pack Rat Canyon, Ralston, Stonewall Spring.

Fault orientation: SWM strikes northeast and east–northeast (Y-238; Y-813; Y-853). At the southwestern end of SWM, exposed fault traces dip 65° NW. (Y-232) and 70° NW. to 90° (Y-10, p. 58).

Fault length: The length of SWM is shown as 10 km (Y-232), 13 km (Y-853), and 22 km (Y-238; Y-813). Y-238 and Y-813 portrayed SWM as three overlapping traces. The northern one is 11 km long; the central one is 4 km long; and the southern one is 18 km long. The southern trace has a north branch about 4 km long. Short traces, each 1 to 1.5 km long, are also mapped by Y-813, especially at the northeastern end of SWM.

Style of faulting: Displacement on most of SWM is down to the northwest; a few short sections (1 to 1.5 km long) are shown as down to the southeast (Y-238; Y-813; Y-853). Y-813 (p. 8) reported slickenlines that indicate dip–slip displacement, but Y-10 (p. 58) noted crenulations and slickenlines within bedrock shear zones that suggest left–lateral oblique displacement at the southwestern end of SWM. Y-10 (p. 58) suggested that high–angle (70°) reverse movement may have also occurred along part of SWM, because Tertiary rhyolite tuff has apparently been thrust over alluvium at one locality.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: A short portion of SWM is portrayed by Y-853 as abrupt and well–defined scarps on Quaternary depositional or erosional surfaces of late Pleistocene age (their Q_2 surfaces with estimated ages between 10 ka and 130 ka). Another section is shown by Y-853 to have scarps on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). The rest of SWM is shown by both Y-232 and Y-853 as a fault juxtaposing Quaternary alluvium against bedrock. Portions of SWM is portrayed by Y-238 and Y-813 as weak to prominent lineaments or scarps on surfaces of Quaternary deposits. Y-813 (p. 7) noted that faults and scarps are abrupt and that some scarps occur on surfaces of late Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Stonewall Mountain along SWM is noted by Y-853 to have characteristics (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, subparallel systems of high–gradient, narrow, steep–sided canyon perpendicular to range front) similar to those along major range–front faults except that SWM is less extensive. Short sections of SWM are shown by Y-813 to be expressed as topographic lineaments bounding a linear range front.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Stonewall Mountain fault (SWM) — Continued

Relationship to other faults: SWM is one of several northeast–striking fault west of Cactus Flat and east of Fish Lake Valley (Y-238; Y-813). Most of these faults bound the northwestern sides of ranges, such as the Grapevine Mountains fault (GM) along the western side of the Grapevine Mountains south of SWM, the Bonnie Claire fault (BC) that bounds the hills west of Bonnie Claire Flat south of SWM, the Gold Mountain fault (GOM) along the western side of Gold Mountain southwest of SWM, and the southeastern fault in Lida Valley (LV) along the northwestern side of Magruder Mountain west of SWM (Y-238, p. 4). Some of the northeast–striking faults bound the southeastern sides of ranges, such as the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain and the northwestern fault in Lida Valley (LV) along the southeastern side of the Palmetto Mountains, both west of SWM (Y-238, p. 4). Faults with this orientation are also present within valleys, such as the Clayton Valley fault (CV) northwest of SWM, the Stonewall Flat fault (SWF) directly west of SWM, and the Palmetto Mountains–Jackson Wash faults (PMJW) west of SWM (Y-10, p. 58; Y-238, p. 3).

Y-238 (p. 4) speculated that the northeast–striking faults in the area surrounding SWM could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred that these fault could be rooted in a detachment fault at depth.

SWM is perpendicular to the Sarcobatus Flat fault (SF), which is along the western side of Stonewall Mountain and Pahute Mesa south of western end of SWM (Y-238; Y-853). Y-238 (pl. 1) shows the southwestern end of the east–northeast–striking SWM as curving to a nearly north strike and aligning with SF. Both SF and SWM correlate with a boundary that was noted by Y-1071 (fig. 2, p. 355) to separate a western area that has undergone marked deformation since middle Miocene (includes Death Valley) and an eastern area that has undergone little deformation since middle Miocene (includes the southwestern Nevada volcanic field). Y-1071 (p. 362) noted that the "prominent west–facing scarps south of Stonewall Mountain, forming the west edge of Pahute Mesa [SF], mark the eastern limit of [a] period of faulting [that occurred after deposition of the 7.6–Ma Spearhead Member of the Stonewall Flat Tuff] and define the eastern margin of the Sarcobatus Flat structural basin." The western half of SWM bounds the northern side of the Stonewall Mountain volcanic center (Y-1071, fig. 2).

Stumble fault (STM)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (name from their pl. 3; show a single, concealed fault trace that approximately corresponds with STM as portrayed by Y-813); Y-404: Tschanz and Pampeyan, 1970; Y-813: Reheis, 1992 (pls. 1 and 2).

Location: 74 km/47° (distance and direction of closest point from YM) at lat 37°18′N. and long 115°50′W. (location of closest point). STM is located along the western side of the Groom Range at its junction with northern Emigrant Valley.

USGS 7-1/2′ quadrangle: Cattle Spring, Groom Mine, White Blotch Springs, White Blotch Springs SE.

Fault orientation: The southern half of STM (south of about Cattle Spring) is a single trace that strikes north–northeast (Y-813). The northern half of STM is curving, is composed of four strands, and strikes generally north to north–northwest (Y-813).

Fault length: The length of STM is about 31 km as estimated from Y-813 and about 33 km as estimated from Y-25. The length of STM is only about 21 km as estimated from Y-404 (pl. 3), but their map shows only the southern part of the fault.

The width of the northern half of STM, where it is composed of four strands, is nearly 8 km as estimated from Y-813.

Style of faulting: Displacement on STM has been down to the west (Y-25; Y-404; Y-813).

Scarp characteristics: Scarps associated with STM are west–facing (Y-813).

Displacement: No information.

Age of displacement: STM is portrayed by Y-813 primarily as faults that are in Quaternary deposits and that were identified by previous mapping. Parts of the fault are also shown by Y-813 to be weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits. In contrast, STM is shown by Y-25 as concealed by Holocene to Pliocene alluvium and colluvium (their QTa deposits) and by Y-404 as inferred in or concealed by Quaternary and Tertiary gravel and alluvium (their QT deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Parts of STM are shown by Y-813 as topographic lineaments bounding a linear range front.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000). Field mapping (Y-404, p. 2). Compilation of structural and stratigraphic information (Y-25).

Relationship to other faults: STM is approximately parallel to faults along the eastern side and within the Groom Range (the Groom Range East fault (GRE) and the Groom Range Central fault (GRC), respectively). STM is also parallel to the fault that bounds the western side of the Jumbled Hills southeast of the Groom Range (the Jumbled Hills fault (JUM)).

STM is nearly perpendicular to the northeast–striking southern end of the Penoyer fault (PEN) directly north of STM. STM is oblique to the east–northeast–striking Tem Piute fault (TEM) northeast of STM and the northeast–striking fault traces in northern Emigrant Valley (the Emigrant Valley North fault (EVN)) west of STM. The strikes of fault traces at the northern end of STM change from north–northwest adjacent to Cattle Spring to north–northeast or northeast at the northern end of the Groom Range. This change in strike could be the result of influence by the southern part of PEN and perhaps TEM, both of which are along the southeastern edge of Sand Spring Valley immediately north of the Groom Range.

Stumble fault (STM) — Continued

Y-813 (p. 6) suggested that fault traces in northern Emigrant Valley (EVN of this compilation) transfer displacement from the north–striking Yucca fault (YC) in Yucca Flat northeastward across Emigrant Valley to faults along the Groom Range (STM of this compilation).

Sylvania Mountains fault (SYL)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 2). Not shown by Dohrenwend and others, 1992 (Y-853).

Location: 111 km/300° (distance and direction of closest point from YM) at lat 37°22′N. and long 117°30′W. (location of closest point). SYL is located within the Sylvania Mountains between Cucomungo Spring at the head of Cucomungo Canyon on the west and the mouth of Tule Canyon on the east.

USGS 7-1/2′ quadrangle: Last Chance Mountain, Magruder Mountain, Sylvania Mountains, Tule Canyon.

Fault orientation: SYL strikes generally east, but the trace curves slightly so that portions of SYL strike either northeast or northwest (Y-238).

Fault length: The length of SYL is about 14 km as estimated from Y-238.

Style of faulting: No information.

Scarp characteristics: A portion of SYL is shown by Y-238 as north–facing scarps.

Displacement: No information.

Age of displacement: SYL is shown by Y-238 as weakly to moderately expressed scarps or lineaments on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Parts of SYL are portrayed by Y-238 as lineaments along a linear highland.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: SYL is in an area of the Sylvania Mountains where Y-238 (pl. 2) shows possible tectonic lineaments in granitic rocks. SYL has a more easterly strike than the trends of these lineaments. In addition, SYL is the only lineament in the area that is shown by Y-238 to exhibit scarps or lineaments on surfaces of Quaternary deposits (and thus is the only one shown on pl. 1 of this compilation). These lineaments are interpreted by Y-238 (p. 4), on the basis of field observations, to represent compressional shear zones. It is not known if SYL has a similar origin.

The eastern end of SYL nearly intersects both the southern end of the northeast–striking East Magruder Mountain fault (EMM) north of SYL and the northern end of the north–striking Tule Canyon fault (TLC) south of SYL. SYL is oblique to the northwest–striking Furnace Creek fault (FC) in the Last Chance Range southwest of SYL. SYL is approximately parallel to and approximately aligns with the east–striking Slate Range faults (SLR), which are located about 15 km east of SYL across Lida Valley. The structural relationships among these faults are not known.

Tem Piute fault (TEM)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show a concealed fault trace to the north of the one shown on plate 1 of this compilation, which is taken from Y-1032; trace of Y-25 has a more westerly strike than the one of Y-1032 and it nearly intersects the Penoyer fault (PEN)); Y-404: Tschanz and Pampeyan, 1970 (name from their pl. 3); Y-1032: Schell, 1981 (pl. 9; table A2, fault #94, his Tempiute fault).

Location: 101 km/35° (distance and direction of closest point from YM) at lat 37°34'N. and long 115°45'W. (location of closest point). TEM is located along the northern side of the western Timpahute Range.

USGS 7-1/2′ quadrangle: Monte Mountain, Mount Irish, White Blotch Springs NE.

Fault orientation: TEM strikes generally east–northeast (Y-25; Y-404).

Fault length: The length of TEM is 8 km as estimated from Y-404 and 22 km as estimated from Y-25 and as noted by Y-1032 (table A2, p. A18).

Style of faulting: Displacement on TEM is shown as left–lateral, strike slip by Y-25 and as down–to–the–north dip slip by Y-404 (pl. 3).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along TEM as noted by Y-1032 (table A2, p. A18) is indeterminate, but suspected of being Quaternary. Scarps are prominent, but the age of youngest displacement along TEM could not be determined by him because of the lack of young stratigraphic units along the fault (Y-1032, table A2, p. A18). The youngest unit that he noted as being displaced is Paleozoic rocks (Y-1032, table A2, p. A18). The oldest unit not displaced is his intermediate–age alluvial–fan deposits (Y-1032, table A2, p. A18) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23).

Y-25 portrayed one short (about 1.5–km–long) section of TEM as juxtaposing pre–Tertiary sedimentary rocks against Holocene to Miocene older gravels (their QTg deposits), but showed a 16–km–long section along the western end of TEM as concealed by these gravels. Y-404 portrayed TEM as a post–Laramide structure and showed a 2.5–km–long section as a faulted contact between Devonian or Pennsylvanian rocks and Pliocene(?) and Pleistocene(?) older gravels (their QTg deposits). They also showed a 6–km–long section as concealed by QTg deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17). Compilation of structural and stratigraphic information (Y-25).

Relationship to other faults: TEM may be the surface expression of the east–trending Timpahute lineament. The eastern end of TEM may include two east–northeast–striking fault traces, a northern one with left–lateral displacement (Y-25; Y-404) and a southern one with right–lateral displacement (Y-25). The relationship between these two fault traces and TEM is not known.

The western end of TEM nearly intersects the curving, northeast–striking Penoyer fault (PEN) located along the eastern and southeastern sides of Sand Spring Valley immediately north of TEM and the north– to north–northeast–striking Groom Range Central fault (GRC) located within the Groom Range south of TEM. The structural relationships among these faults are not known.

Three Lakes Valley fault (TLV)

Plate or figure: Plate 1.

References: Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3, show only the northwestern 4 km of TLV); Y-813: Reheis, 1992 (pl. 2, shows only the northwestern portion of TLV west of the eastern edge of her map area at long 115°30′W.). Not shown by Dohrenwend and others, 1991 (Y-852), but TLV as mapped by Y-813 is north of their map area, which does not extend north of lat 37°N. However, a straight portion of the Desert Range front suggests that TLV could continue south of this latitude and into the area mapped by Y-852. TLV is not shown by Ekren and others, 1977 (Y-25).

Location: 84 km/68° (distance and direction of closest point from YM) at lat 37°07′N. and long 115°34′W. (location of closest point). TLV is located along the eastern side of northern Three Lakes Valley and along part of the western side of the Desert Range.

USGS 7-1/2′ quadrangle: Desert Hills SW, Fallout Hills NE, Southeastern Mine.

Fault orientation: TLV strikes northwest (Y-404; Y-813).

Fault length: The length of TLV is 9 km as estimated from Y-813, but the fault intersects the eastern edge of her map area at long 115°30′W. The continued linearity of the range front east of this point suggests that TLV may extend southeastward of its location as shown on plate 1 of this compilation. The length of this additional linear section is about 18 km, so that the total length of TLV could about 27 km.

TLV consists of two traces, each about 4 km long and separated by 1–km–long zone that lacks surficial expression (Y-813).

Style of faulting: Displacement along TLV is shown by Y-813 as down to the southwest.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The northwestern 4 km of TLV is shown by Y-813 as a fault that is in Tertiary deposits and that was identified by previous mapping. Y-404 portrayed this portion of TLV as a post–Laramide structure that displaces pre–Tertiary rocks. The southeastern 4 km of TLV is shown by Y-813 as a lineament along a linear range front or within bedrock. This lineament is interpreted by Y-813 (p. 4) to suggest Quaternary fault displacement.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: A portion of the western side of the Desert Range adjacent to Three Lakes Valley and TLV is portrayed by Y-813 as linear.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000). Field mapping (Y-404, p. 2).

Relationship to other faults: The northwestern end of TLV nearly intersects the north– to northeast–striking North Desert Range fault (NDR). Y-813 (pl. 2) suggests that a 0.5–km–long, concealed section of TLV continues northwestward to NDR. The southeastern end of TLV nearly intersects a north–striking fault in pre–Tertiary or Tertiary rocks within the Desert Range. This fault is tentatively included with the Tikaboo fault (shown as TK? on pl. 1 of this compilation). The structural relationships among these faults are not known.

Tikaboo fault (TK)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show only one short trace at the southern end of TK); Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3; show only one 5–km–long trace near the southern end of TK); Y-813: Reheis, 1992 (pl. 2); Y-1032: Schell, 1981 (pl. 9; name from his table A2, fault #136; does not show all the fault traces that are shown by Y-813 along the western side of Tikaboo Valley).

Location: 92 km/62° (distance and direction of closest point from YM) at lat 37°13′N. and long 115°32′W. (location of closest point). TK is located in central and western Tikaboo Valley.

USGS 7-1/2′ quadrangle: Crescent Reservoir, Cutler Reservoir, Desert Hills NW, Fallout Hills NE, Groom Range, Groom Range NE, Groom Range SE.

Fault orientation: TK strikes north–northwest (Y-813; Y-1032). Individual fault traces strike between north–northeast and northwest (Y-813; Y-1032).

Fault length: The length of TK is 33 km as estimated from Y-25 and Y-813. The length of TK is noted to be 10 km by Y-1032 (table A2, p. A25). TK is composed of several subparallel or branching strands. TK is up to 10 km wide (Y-813; Y-1032).

Style of faulting: Displacement along several traces of TK are shown by Y-25 and Y-813 as primarily down to the east.

Scarp characteristics: Scarps associated with TK are shown by Y-813 primarily as east–facing. A few scarps are portrayed by her as west–facing.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along TK is noted by Y-1032 (table A2, p. A25) as Holocene and late Pleistocene (defined as <700 ka by Y-1032, p. 29). This is probably along a fault trace in the central part of Tikaboo Valley. The youngest units displaced are his young–age and intermediate–age alluvial–fan deposits, undifferentiated (A5y/A5i; Y-1032, table A2, p. A25) with an estimated age of probably about 200 ka or younger (table 3, p. 23). However, Y-1032 (table A2, p. A25) noted that the age of the displaced units is uncertain. The oldest unit not displaced by TK is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A25) with an estimated age of 15 ka or younger (table 3, p. 23). The oldest unit displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A25) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23).

Traces in TK are shown by Y-813 as weakly expressed scarps and lineaments on surfaces of Quaternary deposits, as lineaments bounding linear range fronts or within bedrock, as weakly to moderately expressed lineaments or scarps on surfaces of Tertiary deposits, and as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping. Y-25 portrayed a 3.5–km–long fault trace at the southern end of TK (east of long 115°30′W.) as cutting Holocene to Pliocene alluvium and colluvium (their QTa deposits). The 5–km–long section of TK shown by Y-404 is portrayed either as displacing older Quaternary alluvium (their Qol deposits) or as displacing this alluvium against younger Tertiary volcanic rocks (their Tvy unit). Y-404 (p. 85) noted that because faults in Tikaboo Valley (includes TK?) cut Pliocene and early Quaternary valley fill, they are some of the youngest normal faults in Lincoln County.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Tikaboo fault (TK) — Continued

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17). Compilation of structural and stratigraphic information (Y-25).

Relationship to other faults: The map by Y-25 shows a north–northwest–striking fault trace immediately south of Tikaboo Valley in the Desert Range. This trace crosses the divide between Tikaboo Valley and Three Lakes Valley and is shown by Y-25 as concealed by Holocene to Pliocene alluvium and colluvium (their QTa deposits). Y-813 also shows a fault trace at this location. She portrayed this trace as a fault that was recognized from previous mapping and as a lineament suspected of signaling Quaternary fault displacement. Displacement on this trace is shown as both down to the east and down to the west. It is not known whether or not this trace (labeled TK? on pl 1 of this compilation) is part of TK. The southern end of this trace nearly intersects the northwest–striking Three Lakes Valley fault (TLV) in northern Three Lakes Valley.

TK is approximately parallel to other north– to northwest–striking faults in the region, such as the North Desert Range fault (NDR) along the western side of the northern Desert Range immediately west of TK; the Jumbled Hills fault (JUM) along the western side of the Jumbled Hills west of TK; the Groom Range East fault (GRE), the Groom Range Central fault (GRC), and the Stumble fault (STM) along the sides of and within the Groom Range west of the northern part of TK; and the East Pintwater Range fault (EPR), the Central Pintwater Range fault (CPR), and the West Pintwater Range fault (WPR) along the sides of and within the Pintwater Range southwest of TK.

Short (<2 km long) lineaments and scarps have been mapped by Y-813 and Y-1032 to the east of TK in the central part of the Tikaboo Valley. The relationship between these lineaments and scarps and TK is not known.

Tin Mountain fault (TM)

Plate or figure: Plates 1 and 2.

References: Y-216: Brogan and others, 1991 (pl. 1C); Y-238: Reheis and Noller, 1991 (pl. 2); Y-239: Reheis, 1991 (pl. 1; name from this reference); Y-697: Zhang and others, 1990.

Location: 90 km/275° (distance and direction of closest point from YM) at lat 36°55′N. and long 117°27′W. (location of closest point). TM is located along the western side of the Cottonwood Mountains between Ubehebe Crater on the north and Lost Burro Gap on the south.

USGS 7-1/2′ quadrangle: Dry Mountain, Last Chance Range SE, Teakettle Junction, Tin Mountain, Ubehebe Crater, White Top Mountain.

Fault orientation: TM strikes north to north–northeast. TM is shown by Y-238 and Y-239 as several subparallel traces generally at the base of the range front, but also as short traces extending into the unnamed valley west of the front.

Fault length: The length of TM is about 29 km as estimated from Y-238 and Y-239.

Style of faulting: Displacement along TM is shown by Y-239 (pl. 1) as down to the west. Displacements have apparently been dip–slip only (Y-239, p. 3).

Scarp characteristics: Scarps associated with TM are portrayed by Y-238 and Y-239 as primarily west–facing.

Displacement: No information.

Age of displacement: Most of TM is portrayed by Y-239 as relatively prominent scarps or lineaments on surfaces of Quaternary deposits. Scarps or lineaments at the northern end of TM are shown as weakly to moderately expressed on surfaces of Quaternary deposits (Y-238). The central part of TM is portrayed by Y-239 as a fault that is in Quaternary deposits and that was identified from previous mapping.

TM cuts one landslide along the front of the Cottonwood Mountains southwest of Tim Mountain and is concealed by another large landslide along the range front near Quartz Spring (Y-239, pl. 1, p. 3).

Fault scarps that are mapped by Y-216 (pl. 1C) southwest of Ubehebe Crater and that may be associated with TM are noted by Y-216 to be mantled by unfaulted ash deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Short portions of TM are shown by Y-239 as topographic lineaments bounding a linear range front.

Analysis: Aerial photographs (Y-216, p. 3, scale ~1:12,000 (low–sun–angle photographs); Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-239, p. 2, scales 1:24,000 and 1:80,000).

Relationship to other faults: TM extends northward from and has a strike similar to that of the fault along the eastern side of Racetrack Valley (part of the Racetrack Valley faults (RTV) of this compilation). TM could be related to, possibly an extension of, this fault. TM is separated from the eastern fault of RTV by an *en echelon* right step at Lost Burro Gap just north of Racetrack Valley. TM and the eastern fault of RTV together extend from the northwest–striking Hunter Mountain fault (HM) on the south to the northwest–striking Furnace Creek fault (FC) on the north. The northern end of TM nearly intersects FC in northern Death Valley.

Tolicha Peak fault (TOL)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 2). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 42 km/320° (distance and direction of closest point from YM) at lat 37°08′N. and long 116°45′W. (location of closest point). TOL is located along the southwestern side of Pahute Mesa and Tolicha Peak.

USGS 7-1/2′ quadrangle: Springdale, Springdale NE, Tolicha Peak.

Fault orientation: TOL strikes generally north–northwest.

Fault length: The total length of TOL is about 22 km as estimated from Y-813. This length includes overlapping traces that are about 8 km long at the northern end of TOL along Tolicha Peak. These traces are separated from traces to the southeast by a 7–km–long gap in surficial expression. The southeastern end of TOL consists of three traces that have a total length of 7 km.

Style of faulting: Displacement on one trace at the southern end of TOL is portrayed by Y-813 as down to the southwest. One trace of TOL that crosses Tolicha Peak is shown by Y-813 to have right–lateral, oblique displacement.

Scarp characteristics: Scarps associated with TOL are shown by Y-813 as primarily west–facing. One scarp at the southern end of TOL is shown by her to be east–facing.

Displacement: No information.

Age of displacement: TOL is shown by Y-813 as moderately expressed to prominent lineaments or scarps on surfaces of Quaternary deposits, especially along the southwestern side of Tolicha Peak. Traces at the southeastern end of TOL are portrayed by Y-813 as weakly to moderately expressed lineaments or scarps on surfaces of Quaternary deposits. Y-813 (p. 7) concluded that the subdued character of north–northwest– and northwest–striking fault traces that bound the western edge of Pahute Mesa (includes TOL?) suggests that little to no Quaternary displacement has occurred on these faults.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Characteristics of the western edge of Pahute Mesa adjacent to TOL are not reported.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: TOL is parallel to and overlaps the southern end of the Sarcobatus Flat fault (SF) that bounds the northwestern edge of Pahute Mesa. TOL has a slightly more westerly strike than the north–striking faults on Pahute Mesa (the Pahute Mesa faults (PM) of this compilation) north of TOL and in Oasis Valley (the Oasis Valley faults; OSV) south of TOL. The structural relationships among these faults are not known.

Towne Pass fault (TP)

Plate or figure: Plate 2.

References: Y-29: Hamilton, 1988; Y-222: Streitz and Stinson, 1974; Y-239: Reheis, 1991 (pls. 1 and 2); Y-390: Hunt and Mabey, 1966 (pl. 1); Y-427: Hart and others, 1989; Y-458: Hall, 1971 (shows only the southern 13 km of TP, that part west of long 117°15′W.; name from this reference, pl. 1, p. 57); Y-763: Bryant, 1989; Y-906: MIT 1985 Field Geophysics Course and Biehler, 1987; Y-916: Wernicke and others, 1986; Y-1020: Jennings, 1992 (his fault #245).

Location: 76 km/244° (distance and direction of closest point from YM) at lat 36°33′N. and long 117°12′W. (location of closest point). TP is located along the western sides of Tucki Mountain and Pinto Peak in the Panamint Range between Death Valley on the north and Panamint Valley on the south.

USGS 7-1/2′ quadrangle: Emigrant Canyon, Emigrant Pass, Nova Canyon, Panamint Butte, Stovepipe Wells.

Fault orientation: TP strikes north–northeast (Y-239). Y-222 indicated two traces of TP that are separated by an *en echelon* left step near Towne Pass. Y-458 (p. 57) noted dips of 45° W. to 80° W. on TP near Towne Pass.

Fault length: The length of TP is 38 km as estimated from Y-239 (pls. 1 and 2) from north of about Wildrose Canyon in Panamint Valley to north of Tucki Mountain along Emigrant Wash in Death Valley.

Style of faulting: Displacement along TP is shown by Y-239 and noted by Y-390 (p. A114) and Y-458 (p. 57) as down to the west. Y-458 (p. 57) reported that he observed no evidence for lateral displacement on TP.

Scarp characteristics: Scarps associated with TP are portrayed by Y-239 as west–facing.

Displacement: Y-390 (p. A114) reported displacement on TP of at least 153 m (500 ft). Y-458 (p. 57-58) noted at least 2,380 m (7,800 ft) of displacement on TP and concluded that displacement on TP has accounted for most of the elevation of the Panamint Range southeast of Towne Pass. This amount of displacement is also reported by Y-427 (table 1, p. 22) and by Y-763 (p. 13).

Age of displacement: Most of TP is portrayed by Y-239 as prominent lineaments or scarps on surfaces of Quaternary deposits where a fault in Quaternary deposits was identified from previous mapping. The map by Y-458 (pl. 1) shows a 4–km–long section of TP near Towne Pass as a faulted contact between Ordovician or Mississippian rocks on the east and one of the following on the west: Quaternary alluvium (his Qal deposits), Quaternary alluvial–fan deposits (his Qf1 deposits), or Quaternary and Tertiary alluvial–fan deposits (his QTf2 deposits). Y-427 (table 1, p. 22) noted beheaded drainages, which he thought suggested latest Pleistocene to Holocene displacement on TP. Y-1020 showed one short section of TP as Holocene, but the rest as having Quaternary displacement (since 1.6 Ma as defined by him). Y-763 (p. 13) reported that TP juxtaposes Paleozoic bedrock against Pliocene–Pleistocene fanglomerates and, locally, Holocene alluvium.

Y-222 showed the northern part of TP as juxtaposing Holocene alluvium on the west against Pliocene and (or) Pleistocene nonmarine rocks on the east. The northern end of TP east of Emigrant Wash along Tucki Mountain is shown by Y-390 (pl. 1) as being concealed by upper Pleistocene alluvial–fan gravel (their Qg_3 deposits).

Y-222 indicated that the southern end of TP north of Wildrose Canyon is concealed by Pliocene and (or) Pleistocene nonmarine rocks and juxtaposes Pliocene nonmarine rock against Pliocene and (or) Pleistocene nonmarine rocks. The very southern part of TP that is shown by Y-458 (pl. 1; just west of long 117°15′W.) is portrayed by him as displacing Pliocene alluvial–fan deposits (his Tf3 unit) against Quaternary and Tertiary alluvial–fan deposits (his QTf2 deposits). In contrast, Y-427 portrayed the southern end of TP as having Holocene displacement.

The map by Y-458 (pl. 1) shows additional north–northwest–striking faults near Nova Canyon west of the Panamint Range front (part of TP?). These faults displace Pliocene alluvial–fan deposits (his Tf3 deposits) and Quaternary and Tertiary alluvial–fan deposits (his QTf3 deposits).

Y-458 (p. 58) suggested that most of the displacement on TP is older than an overlying, unfaulted late Pliocene basalt.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: A 7–km–long, north–striking section south of Towne Pass has been portrayed by Y-239 (pl. 2) as a topographic lineament bounding a linear range front.

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000). Compilation of existing data (Y-763). Field examination (Y-458).

Relationship to other faults: Y-29 and Y-239 (p. 2; *citing* Y-916) suggested that TP along the western side of Tucki Mountain may be a northern continuation of the Panamint Valley fault (PAN). Y-458 (p. 58) stated that TP extends about 48 km (30 miles) south of Towne Pass, through Wildrose graben, and along the eastern side of Panamint Valley to the Slate Range, an extension that would include PAN.

The north–striking Emigrant fault (EM) as shown by Y-239 appears to intersect TP along the northern side of Tucki Mountain.

TP in the vicinity of Nova Canyon parallels the Nova fault of Y-458 (pl. 1). This fault is about 13 km (8 miles) long, dips 45° W. to 85° W., has dip–slip (normal) displacement, has an estimated 610 m (2,000 ft) of west–side–down displacement, displaces Pliocene through Quaternary alluvial–fan deposits (his Tf3, QTf3, and Qf1 deposits), and is concealed by Holocene alluvium (Y-458, p. 58).

The structural relationships among these faults are not known.

Tule Canyon fault (TLC)

Plate or figure: Plate 1.

References: Y-216: Brogan and others, 1991 (pl. 1B; show scarps and lineaments that may be a southern extension of TLC east of Sand Spring in Death Valley); Y-238: Reheis and Noller, 1991 (pl. 2); Y-853: Dohrenwend and others, 1992. Not shown by Albers and Stewart, 1972 (Y-407).

Location: 104 km/295° (distance and direction of closest point from YM) at lat 37°14'N. and long 117°30'W. (location of closest point). TLC is located at the western end of Slate Ridge, and along and east of Tule Canyon. Its southern end may extend into Death Valley.

USGS 7-1/2' quadrangle: Gold Point SW, Lida, Magruder Mountain, Tule Canyon.

Fault orientation: TLC strikes generally north–northeast (Y-238; Y-853). The southern end of TLC strikes north to north–northwest.

Fault length: The length of TLC is 10 km as estimated from Y-853 and about 14 km as estimated from Y-238. These lengths are for the north–northeast–striking fault traces north of the mouth of Oriental Wash at the eastern edge of Death Valley. If the north– and north–northwest–striking traces in Death Valley south of Oriental Wash are included, the length of TLC would be about 26 km as estimated from Y-238 and Y-853.

Style of faulting: Displacement along traces of TLC is shown by Y-238 (pl. 2) as primarily down to the west.

Scarp characteristics: Scarps associated with TLC are shown by Y-216, Y-238, and Y-853 as both east–facing and west–facing.

Displacement: No information.

Age of displacement: TLC is portrayed by Y-853 as scarps on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their Q_{1-2} deposits with estimated ages between 10 ka and 1.5 Ma). TLC is shown by Y-238 as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits. At its southern end, TLC is shown by Y-238 as fault traces that are in Quaternary deposits and that were identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Part of TLC is portrayed by Y-853 as a fault juxtaposing Quaternary alluvium against bedrock and adjacent to a range front that is characterized by "fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." This part of TLC is associated with a range front that is less extensive and fault scarps that are lower, shorter, and less continuous than those along a major range–front fault (Y-853).

Analysis: Aerial photographs (Y-216, p. 3, scale about 1:12,000 (low–sun–angle photographs); Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000). Field reconnaissance (Y-216, p. 3).

Relationship to other faults: If TLC extends south of the mouth of Oriental Wash into Death Valley, then it nearly intersects the northwest–striking, right–lateral Furnace Creek fault (FC). Y-238 (p. 3-4) speculated that north– and north–northeast–striking, dip–slip faults east of both FC (includes TLC) and the northwest–striking Fish Lake Valley fault (FLV) in Fish Lake Valley may be related to displacement on both FC and FLV. The (Y-238, p. 4) suggested that the spatial relationship between, the orientations of, and the types of displacement on these north–striking and northwest–striking fault in these areas "are consistent with an east–west direction of least principal stress and a north–south direction of greatest principal stress."

Wahmonie fault (WAH)

Plate or figure: Plate 2.

References: Y-104: Ekren and Sargent, 1965; Y-181: Carr, 1974; Y-182: Carr, 1984 (name from his fig. 7); Y-226: Swadley and Huckins, 1990 (show fault traces along the northwestern side of Skull Mountain some of which align with WAH as mapped by Y-104); Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 3); Y-314: Ekren, 1968; Y-1107: Carr, 1974.

Location: 22 km/108° (distance and direction of closest point from YM) at lat 36°47′N. and long 116°13′W. (location of closest point). WAH is located along the northwestern side of Skull Mountain at its junction with Jackass Flats, in Wahmonie Flat, and along both sides of an unnamed ridge that extends south from Lookout Peak.

USGS 7-1/2′ quadrangle: Skull Mountain.

Fault orientation: WAH strikes generally northeast, but its trace curves so that the strike of WAH ranges between north and northeast (Y-232).

Fault length: The length of WAH is about 14 km as estimated from Y-104 and about 15 km as estimated from Y-232. Individual fault traces as mapped by Y-226 range in length between 0.2 and 2 km.

Style of faulting: Displacement on WAH is shown by Y-226 as down to the northwest. Displacement on the southwestern end of WAH is portrayed by Y-232 as down to the northwest; displacement on the northeastern end is shown as down to the southeast. Y-104 and Y-238 both portrayed WAH as down to the northwest along Skull Mountain and along the northwestern side of the unnamed ridge south of Lookout Peak and as down to the southeast along the southeastern side of the unnamed ridge.

Scarp characteristics: Northwest–facing scarps were mapped by Y-226 at the southwestern end of WAH along Skull Mountain. The heights of these scarps range between <1 to 3 m (Y-226).

Displacement: No information.

Age of displacement: The youngest displacement along WAH is probably Pleistocene. The youngest scarps that are shown by Y-226 are on surfaces of late and middle Pleistocene deposits (their Q2c/QTa deposits with an estimated age between 270 ka and 740 ka). Scarps and lineaments are also shown by Y-226 on surfaces of early Pleistocene and Pliocene? deposits (their QTa deposits with an estimated age of >740 ka) and on surfaces of Tertiary rocks or deposits (their Tr unit). Fault traces are portrayed by Y-226 as concealed by both Holocene alluvium (their Q1c and Q1ab deposits; ≤10 ka) and late and middle Pleistocene alluvium (their Q2bc and Q2c deposits with estimated ages between 160 ka and 740 ka).

Weakly expressed to prominent scarps or lineaments on surfaces of Quaternary deposits are shown by Y-238 along the southwestern end of WAH on the northwestern side of Skull Mountain. The traces along the unnamed ridge south of Lookout Peak at the northeastern end of WAH are shown by Y-238 as faults in Tertiary deposits identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Only one trace of WAH parallels the northwestern front of Skull Mountain (Y-104; Y-226). No information on the morphology of this range front was noted.

Analysis: Aerial photographs (Y-226; Y-238, p. 2, scales 1:24,000 to 1:80,000).

Wahmonie fault (WAH) — Continued

Relationship to other faults: WAH is one of four main faults that have been grouped into the 30–to–60–km–wide Spotted Range–Mine Mountain fault zone (SRMM), which is characterized by northeast–striking, left–lateral faults that have experienced relatively small amounts of displacement (Y-181, p. 9; Y-182, p. 56). The other faults in SRMM are the Cane Spring fault (CS), the Mine Mountain fault (MM), and the Rock Valley fault (RV). These faults have been interpreted by Barnes and others (1982, Y-62, *citing* Y-1107) to be "first–order structures that form a conjugate system with the northwest–[striking] right–lateral faults of the Las Vegas Valley shear zone." Y-314 (p. 16-17) suggested that left–lateral displacement along faults in SRMM resulted from what he called rotary slippage during right–lateral displacements along the Las Vegas Valley shear zone (LVS). However, Y-182 (p. 63) noted that neither the LVS nor the northwest–trending La Madre shear zone crosses SRMM and that significant curving or bending of faults in SRMM, which would be required if such rotation had occurred, is lacking. In contrast, northwest–striking faults and flexure zones with right–lateral displacement or bending north of LVS (e.g., the Frenchman flexure; Y-181, fig. 11, p. 34) and faults of SRMM are probably related because faults in the two zones mutually displace one another as indicated by field relationships (Y-181, p. 9, *citing* W.J. Carr, unpub. data, 1967) and because both zones are locally active as indicated by associated seismicity (Y-181, p. 9).

Displacements on faults in SRMM are thought by Y-182 (p. 62) to have been conjugate to displacements on faults in the northwest–trending Walker Lane.

The similarity in types displacement and alignment of surficial expression both suggested to Y-182 (p. 62) that SRMM may be connected to the Pahranagat fault (PGT) to the northeast (the Pahranagat shear zone of Y-182). However, 70 km separates the SRMM and PGT and no northeast–trending structures have been recognized in the Paleozoic rocks that are exposed in numerous places within the gap, which includes the north– and north–northwest–trending Spotted, Pintwater, and Desert ranges (Tschanz and Pampeyan, 1970 (Y-404); Ekren and others, 1977 (Y-25); Y-182, p. 62).

Weepah Hills fault (WH)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 1). Not shown by Dohrenwend and others, 1992 (Y-853) nor by Albers and Stewart, 1972 (Y-407).

Location: 145 km/320° (distance and direction of closest point from YM) at lat 37°51'N. and long 117°30'W. (location of closest point). WH is located along the southern side of the Weepah Hills and the northern side of Clayton Valley.

USGS 7-1/2' quadrangle: Goat Island, North of Silver Peak, Silver Peak, Weepah.

Fault orientation: WH strikes generally west–northwest (Y-238).

Fault length: The length of WH is 15 km as estimated from Y-238.

Style of faulting: Displacement on traces of WH is shown by Y-238 as primarily down to the southwest. Displacement on one trace at the northwestern end of WH is shown by Y-238 as down to the northeast.

Scarp characteristics: No information

Displacement: No information.

Age of displacement: One 3–km–long trace of WH is portrayed by Y-238 as a fault that is in Quaternary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Most of WH is portrayed by Y-238 as lineaments along a linear range front or in bedrock. They (Y-238, p. 2) suspected that these lineaments suggest Quaternary fault displacement.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: The west–northwest strike of WH is markedly different from the north and northeast strikes of faults that dominate the area along range fronts and within basins. WH is approximately perpendicular to and its eastern end nearly intersects with the north–northeast–striking Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges. The western end of WH is oblique to the northeast–striking Lone Mountain fault (LMT) in Big Smoky Valley.

WH is approximately parallel to and overlaps with faults in Tertiary deposits and lineaments on Tertiary surfaces along the northern side of the Silver Peak Range south of WH. These faults and lineaments are mapped by Y-238 (pl. 1), but are not shown on plate 1 of this compilation because of their expression is entirely within deposits or on surfaces of Tertiary age.

West Pintwater Range fault (WPR)

Plate or figure: Plates 1 and 2.

References: Y-25: Ekren and others, 1977; Y-671: Guth, 1990 (WPR may include his curving, north–striking, down–to–the–west Pintwater fault, which he shows only in pre–Tertiary rocks (p. 240-241)); Y-813: Reheis, 1992 (pls. 2 and 3); Y-852: Dohrenwend and others, 1991. Not shown by Tschanz and Pampeyan, 1970 (Y-404).

Location: 76 km/87° (distance and direction of closest point from YM) at lat 36°53′N. and long 115°35′W. (location of closest point). WPR is located along the western side of the Pintwater Range at its junction with Indian Springs Valley.

USGS 7-1/2′ quadrangle: Fallout Hills, Heavens Well, Indian Springs NW, Quartz Peak, Quartz Peak NW, Quartz Peak SW, Southeastern Mine, Tim Spring.

Fault orientation: WPR strikes generally north, but its trace curves, so that the southern end of WPR strikes north–northeast and the northern portion strikes north–northwest (Y-852). WPR has been portrayed by Y-852 as composed of curving, overlapping, and branching traces with strikes ranging between north–northwest and northeast.

Fault length: WPR has a length of about 60 km as estimated from both Y-852 (south of lat 37°N.) and from Y-813 (north of lat 37°N.). Scarps west of the range front at two localities are up to 1 km long (Y-852).

Style of faulting: Displacement on short sections of WPR is shown by Y-813 as down to the west.

Scarp characteristics: Scarps associated with WPR are portrayed by Y-813 and Y-852 as primarily west–facing.

Displacement: No information.

Age of displacement: The youngest scarps recognized by Y-852 are on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). WPR is shown by Y-813 as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary (primarily) and Tertiary deposits and as faults that are in Quaternary and Tertiary (primarily) deposits and that were identified from previous mapping. Y-25 portrayed two sections at the very northern end of WPR as faulted contacts between pre–Tertiary rocks and Holocene to Pliocene alluvium and colluvium (their QTa deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Most of WPR is noted by Y-852 to bound a tectonically active front of a major mountain range that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." Portions of WPR have been shown by Y-813 (pl. 3 mainly) as a topographic lineament bounding a linear range front.

Analysis: Aerial photographs (Y-25; Y-671; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000). Compilation of structural and stratigraphic information (Y-25).

West Pintwater Range fault (WPR) — Continued

Relationship to other faults: WPR is one of several north–striking faults bounding range fronts east of Yucca Mountain and north and northwest of Las Vegas. Other north–striking faults in this area are the East Pintwater Range fault (EPR) east of WPR, the Central Pintwater Range fault (CPR) within the Pintwater Range directly east of WPR, the Sheep–East Desert Ranges fault (SEDR) along the eastern sides of the Desert Range and the southern Sheep Range, the Sheep Basin fault (SB) along the western side of the Sheep Range east of WPR, the Sheep Range fault (SHR) along the eastern side of the Sheep Range east of WPR, the Indian Springs Valley fault (ISV) along the western side of Indian Springs Valley immediately west of WPR, and the Spotted Range faults (SPR) along the western side of the Spotted Range west of WPR. Y-671 (p. 242) suggested that these faults were related to an inferred major detachment system (his Sheep Range detachment), but that the style of displacement changes between SEDR and his inferred Dog Bone Lake fault (not shown on pls. 1 and 2 of this compilation) along the western side of the Desert Range. Faults west of this change have caused less rotation of rocks than faults to the east, have been localized by Mesozoic structures, and have developed along the western edges of ranges to define structural blocks that include the next range to the west (Y-671, p. 242), which is the Spotted Range for WPR.

The strike of WPR is similar to those of faults within and adjacent to the Pintwater Range. These faults are shown by Y-813 (pl. 3) as faults that are in Tertiary deposits and that were identified by previous mapping. One of these may be the Pintwater fault shown by Y-404 (pl. 3) and Y-671 (fig. 3, p. 240).

The southern end of the Pintwater Range (along with the southern end of the Spotted Range to the west) bends to the southwest as it approaches east–striking faults from the east, such as the Cactus Springs fault (CAC) and the South Ridge faults (SOU). These east–striking faults have been interpreted to be part of the Las Vegas shear zone by Y-813 (p. 5). WPR, as a range–bounding fault, correspondingly bends. Y-813 (p. 5) suggested that WPR appears to merge with northeast–striking, left–lateral faults that have been interpreted by her to be part of the Spotted Range–Mine Mountain section of the Walker Lane.

The northern end of WPR extends north of the northeast–striking southern end of the North Desert Range fault (NDR). Y-25 suggested that the northern end of WPR may connect with a fault along the western side of the Jumbled Hills, the Jumbled Hills fault (JUM) of this compilation, as shown by the dotted line between the two faults. The structural relationships among these faults are not known.

West Railroad fault (WR)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 1); Y-853: Dohrenwend and others, 1992; Y-1032: Schell, 1981 (pls. 7 and 8; name from his table A2, fault #101). Not shown by Cornwall, 1972 (Y-232) nor by Ekren and others, 1971 (Y-5).

Location: 112 km/15° (distance and direction of closest point from YM) at lat 37°49'N. and long 116°07'W. (location of closest point). WR is located along the eastern side of the Reveille Range at its junction with Railroad Valley.

USGS 7-1/2′ quadrangle: Freds Well, Reveille Peak, Reveille Peak NW, Reveille Peak SE.

Fault orientation: WR curves but has a general north strike. WR north of Fang Ridge strikes north–northwest; WR south of the ridge strikes north–northeast (Y-813; Y-853).

Fault length: The length of WR is noted as 42 km by Y-1032 (table A2, p. A19), who extends WR from the southern end of the Reveille Range to the southern end of the Pancake Range (north of the area of plate 1 of this compilation). The length of WR is 19 km as estimated from Y-853 and 23 km as estimated from Y-813. However, WR intersects the northern edges of both map areas at lat 38°N.

Style of faulting: No information.

Scarp characteristics: Scarps associated with WR are shown primarily as east–facing by Y-813, Y-853, and Y-1032. Y-1032 (table A2, p. A19) noted a maximum scarp height of 10 m along WR and a maximum scarp–slope angle of 12.5°.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along WR is noted by Y-1032 (table A2, p. A19) as late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit displaced along WR is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A19) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A19) with an estimated age of 15 ka or younger (table 3, p. 23). The oldest unit displaced is latest Tertiary volcanic rocks (Tv_4; Y-1032, table A2, p. A19) with an estimated age of 1.8 Ma to 6 Ma (table A1, p. A1).

The youngest scarps along WR that are shown by Y-853 are on depositional or erosional surfaces of late Pleistocene age (their Q2 surfaces with estimated ages between 10 ka and 130 ka). Scarps are also noted by Y-853 on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their Q1-2 surfaces with estimated ages between 10 ka and 1.5 Ma). WR is shown by Y-813 as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits. One section of WR is portrayed by Y-853 as a fault juxtaposing Quaternary alluvium against bedrock.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

West Railroad fault (WR) — Continued

Relationship to other faults: WR is approximately parallel to other north–northeast– and north–northwest–striking faults along major ranges and within basins in the area. These faults west of WR include the East Reveille fault (ERV) along the western side of the Reveille Range; the Central Reveille fault (CR) within Reveille Valley; the Hot Creek–Reveille fault (HCR) along the eastern side of the Kawich Range, the Kawich Range fault (KR) along the western side of the Kawich Range; the Cactus Flat fault (CF), the East Stone Cabin fault (ESC), and the Cactus Flat–Mellan fault (CFML) all within Cactus Flat; the Monitor Hills East fault (MHE) and the Monitor Hills West fault (MHW) along the eastern and western sides of the Monitor Hills. These faults east of WR include the Monotony Valley fault (MV) southeast of Railroad Valley; the Freiburg fault (FR) and the Penoyer fault (PEN) along the eastern and western sides of the Worthington Mountains; and the Groom Range East fault (GRE), the Stumble fault (STM), and the Groom Range West fault (GRW) along the eastern and western sides of and within the Groom Range. The East Belted Range fault (EBR) and the Belted Range fault (BLR), which are along the eastern and western sides of the Belted Range, are immediately south of WR. The structural relationships among these faults are not known.

West Spring Mountains fault (WSM)

Plate or figure: Plate 2.

References: Y-161: Burchfiel and others, 1983; Y-182: Carr, 1984 (his Grapevine fault, fig. 7, p. 16); Y-232: Cornwall, 1972 (shows only the northwestern end of WSM within Nye County, that part that is west of about long 115°55'W.); Y-238: Reheis and Noller, 1991 (pl. 4); Y-696: Hoffard, 1991 (name from her pl 1, p. 3); Y-706: Wright, 1989; Y-806: Hoffard, 1990 (her Spring Mountains range front fault zone); Y-813: Reheis, 1992 (pl. 3); Y-845: Malmberg, 1967; Y-852: Dohrenwend and others, 1991.

Location: 53 km/136° (distance and direction of closest point from YM) at lat 36°30'N. and long 116°02'W. (latitude and longitude of closest point). WSM bounds the western side of the northern Spring Mountains at their junction with Pahrump Valley. The southern end of WSM may extend into Pahrump Valley.

USGS 7-1/2' quadrangle: Hidden Hills Ranch, Horse Spring, Mound Spring, Mount Schader, Mount Stirling, Pahrump, Pahrump NE, Wheeler Well.

Fault orientation: The general strike of WSM is N. 12° W., but WSM is arcuate and the strike of individual traces ranges between N. 10° E. and N. 50° W. (Y-696, p. 83). Much of WSM is shown by Y-696 and Y-813 as a single trace along the range front, but WSM about 10 km north of Wheeler Wash includes short traces subparallel to the range front (Y-696; Y-813; Y-852).

Fault length: WSM is about 30 km long, which includes a nearly continuous, 12–km–long section along the range front (Y-696, p. 83). WSM is about 36 km long as estimated from Y-238 and Y-813. If north–trending traces in Pahrump Valley between Hidden Hills and Manse, Nevada, are considered part of WSM, then WSM would extend another 25 km to the south for a total length of about 60 km as estimated from Y-238 and Y-813.

WSM is about 15 km long, including the north–trending traces in Pahrump Valley, as estimated from Y-852, but WSM extends to the southern and western edges of their map area.

Style of faulting: Y-696 (p. 86-87) noted that dip–slip (normal) and down–to–the–west displacement on WSM is indicated by bedrock relationships in the Spring and Montgomery mountains (the Grapevine fault of Y-161) and by scarps (Y-696, p. 86-87; Y-813; Y-852). Y-696 (p. 84-85) suggested that sharp bends in the fault's trace preclude a significant lateral component of displacement. Y-813 (p. 9) noted that the pattern of fault traces indicates that WSM has been "predominantly dip slip with little or no strike slip." Several grabens are preserved along the range front (Y-696, pl. 1; Y-852), but no compressional features have been noted by Y-696 (p. 85-86).

WSM generally follows the range front, but scarps are also preserved 2 to 3 km west of the front, especially near the northern end of the fault (Y-238; Y-696; Y-852). These scarps are subparallel to WSM, exhibit both down–to–the–east and down–to–the–west displacement, and are 8 km long (Y-852).

Fault traces in Pahrump Valley between Hidden Hills and Manse exhibit dip slip, but a left–stepping fault pattern suggests some right–lateral displacement (Y-696).

Scarp characteristics: Y-696 (p. 85) noted that scarps appear to remain similar in height across bends in the fault's trace. Scarps are dissected at several localities (e.g., Hidden Springs, Stump Springs, Brown Spring) by southwest–trending arroyos up to 15 m deep (Y-845). One graben near the mouth of Wheeler Wash has an minimum surface displacement of 12 m (Y-696, p. 86-87). Scarps on Younger Quaternary alluvium of Y-845 (his Qya deposit with estimated ages of 120 ka? or >730 ka?) are noted by Y-696 as >20 m high. Older surfaces along WSM have higher scarps (Y-696, p. 86). Scarps in Pahrump Valley between Hidden Hills and Manse exhibit as much as 12 m of dip slip (Y-696, p. 87, 89).

Displacement: On the basis of the relationships of stratigraphic units between the Spring Mountains and the Montgomery Mountains to the west along their Grapevine fault, which may be an extension of WSM, Y-161 suggested at least 3,500 m of west–side–down (Montgomery Mountains side) displacement.

A graben just north of Wheeler Wash has a minimum displacement of 12 m (Y-696, p. 87-88, loc. 23, pl. 1).

West Spring Mountains fault (WSM) — Continued

Age of displacement: Traces in WSM have strong geomorphic expression (Y-238; Y-696; Y-813; Y-852). Y-813 and Y-238 portray much of WSM as prominent (mainly) to weakly expressed lineaments and scarps on surfaces of Quaternary deposits. The youngest geomorphic surfaces with scarps along the western front of the Spring Mountains have morphologic characteristics that are similar to those of a surface at Kyle Canyon on the eastern side of the Spring Mountains estimated to be about 120 ka by Y-894 (Sowers, 1986). However, the surfaces along WSM have been eroded into a ballena topography that is present only on an older surface at Kyle Canyon with an estimated age of >730 ka (Y-696, p. 86). Consequently, Y-696 (p. 86) concluded that the youngest surfaces displaced by WSM may be older than 120 ka.

The youngest scarps along the Spring Mountains range front noted by Y-852 are on depositional or erosional surfaces of late Pleistocene age (their Q_2 surfaces with estimated ages between 10 ka and 130 ka). Other scarps are shown by them on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma).

The youngest scarps 2 to 3 km west of the front near the northern end of WSM are noted by Y-852 to be on depositional or erosional surfaces of late Pleistocene age (their Q_2 surfaces with estimated ages between 10 ka and 130 ka). Scarps are also preserved on depositional or erosional surfaces of early to middle Pleistocene age (Y-852, their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma). The northern end of WSM is shown by Y-232 (pl. 1) to displace Quaternary alluvium.

Some fault traces in Pahrump Valley between Hidden Hills and Manse cut possibly paludal sediments of probable late Pleistocene to Holocene age (<130 ka?; Y-696, p. 91, loc. 30, pls. 1 and 3). Fault scarps on alluvial fans in this same area "have steep faces and appear young" (Y-696, p. 94).

Slip rate: Y-696 (p. 87) estimated an average apparent vertical slip rate on WSM of 0.06 mm/yr, assuming an age of 200 ka for a surface containing a graben near the mouth of Wheeler Wash and a minimum of displacement of 12 m across the graben. Y-696 (p. 87) also estimated an apparent vertical slip rate of 0.02 to 0.2 mm/yr for WSM at this same locality, using a range of 50 ka to 500 ka for the age of the displaced surface.

Recurrence interval: No information.

Range-front characteristics: The western front of the Spring Mountains adjacent to WSM is shown by Y-852 as a tectonically active front that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to the range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, subparallel systems of high–gradient narrow steep–sided canyons orthogonal to the range front."

Analysis: Conventional aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-696, p. 83, scale 1:80,000; Y-813, p. 4, scales 1:62,500 to 1:80,000). Field examination (Y-161; Y-696). Analysis of seismic reflection lines (Y-696). Topographic scarp profiles (Y-696, p. 86-87, fig. 36, p. 89).

Relationship to other faults: WSM is part of the Pahrump fault system as defined by Y-696 (p. 3), along with the East Nopah fault (EN) and the Pahrump fault (PRP; the Pahrump Valley fault zone of Y-696). WSM was previously called the Spring Mountains range front fault zone by Y-806.

WSM strikes toward and is likely an extension of the northwest–striking Grapevine fault (not shown on pl. 2 of this compilation), which is inferred by Y-161 to separate the Spring Mountains from the Montgomery Mountains to the west. The northern end of WSM along the front of the Spring Mountains is a mineralized zone at the contact between bedrock and alluvial–fan deposits. This zone has been interpreted by Y-696 (p. 84) to possibly be the Grapevine fault. Displacement on the Grapevine fault may have coincided with displacement on the north–striking Paddys fault of Y-161 (not shown on pl. 2 of this compilation).

West Spring Mountains fault (WSM) — Continued

It is not clear if north–striking fault traces in Pahrump Valley between Hidden Hills and Manse are indeed part of WSM. Y-696 (p. 91) suggested that the scarps in this area have characteristics similar to those associated with both WSM and of PRP. Thus, the north–trending scarps in Pahrump Valley may be related to a fault that is transitional between WSM to the north and PRP to the south. Seismic reflection lines and gravity data have been interpreted by Y-696 to suggest that the locus of deposition for a basin within Pahrump Valley has been against the Spring Mountains and that the western boundary of this basin is the eastern side of a horst block that coincides with PRP.

Wilson Canyon fault (WIL)

Plate or figure: Plate 2.

References: Y-413: Jennings and others, 1962; Y-415: Jennings, 1985 (Trona sheet); Y-1020: Jennings, 1992 (name from his map); Y-1110: Roquemore, 1981; Y-1112: Walter and Weaver, 1980; Y-1122: von Huene, 1960 (his Wilson fault, p. 49).

Location: 140 km/214° (distance and direction of closest point from YM) at lat 35°48′N. and long 117°20′W. (location of closest point). WIL extends from the western side of the Coso Basin on the west, across the Argus Range, to Searles Lake in Searles Valley on the east. In the Argus Range, WIL is in or near two canyons, both named Wilson Canyon. One canyon drains west into Indian Wells Valley; the other drains east into Searles Valley (Y-1122, p. 49).

USGS 7-1/2′ quadrangle: Airport Lake, Burro Canyon, Mountain Springs Canyon, Trona East, Trona West.

Fault orientation: WIL strikes generally northwest (Y-413; Y-1020). The southeastern end of WIL strikes north–northwest (Y-1020). Y-1122 (p. 49) reported that WIL is nearly vertical.

Fault length: WIL is about 42 km long as estimated from Y-1020. Of this length, the western 7 km in the Coso Basin and the eastern 21 km north and east of Searles Lake in Searles Valley are shown as concealed (Y-1020). The eastern portion of WIL has been inferred from geophysical evidence (Y-415, p. 191, note #16, *citing* G.I. Smith, U.S. Geological Survey, personal commun., 1973). Y-1122 (p. 49) noted that WIL is about 29 km (18 miles) long.

Style of faulting: Y-1110 (p. 79) noted that displacement on WIL has been left lateral.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Y-1020 portrayed the entire 42 km of WIL as having Quaternary (he defined as <1.6 Ma) displacement. Y-413 showed the western end of WIL in the Coso Basin as displacing Holocene alluvium (their Qal deposits). WIL is noted by Y-415 (p. 191, note #27, *citing* Y-1122) to cut Pleistocene volcanic rocks. The eastern portion of WIL north and east of Searles Lake is not exposed at the ground surface but is reported to affect Quaternary sediments at depth as inferred from geophysical data (Y-415, p. 191, note #16, *citing* Moyle, (1967, Y-1361) and G.I. Smith, (U.S. Geological Survey, personal commun., 1973)).

Y-1110 (p. 79, *citing* Y-1112) noted that WIL is seismically inactive. Y-1110 (p. 79) concluded that WIL has not been active during the Quaternary.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished literature (Y-415; Y-1020). Aerial photographs (Y-1122, p. 8, scale 1:12,000). Detailed geologic mapping (Y-1122, p. 8). Gravimetric data (Y-1122, p. 8).

Relationship to other faults: The western end of WIL appears to terminate at north–striking fault traces of the Airport Lake fault (AIR). The southeastern end of WIL has a more northerly strike than the rest of the fault and this end parallels the Tank Canyon fault, a curving north– and northeast–striking fault with recognized Holocene displacement (Y-1020, his fault #268; shown, but not labeled by name, on pl. 2 of this compilation). The very northern end of the Tank Canyon fault only is shown near the southern edge of plate 2 of this compilation along the western side of the Slate Range near long 117°15′W.

Windy Wash fault (WW)

Plate or figure: Figure 3.

References: Y-12: Whitney and others, 1986; Y-19: Swadley and Hoover, 1983; Y-26: Swadley and others, 1984 (their northern Fault N is a splay of WW along the West Ridge as mapped by Y-1042; their Faults P and Q (with Trenches CF-2 and CF-3) correspond to part of the western splay of Y-1042; their Fault M (with Trench CF-1) corresponds to part of the central splay of Y-1042; their Fault J corresponds to a short section of the eastern splay of Y-1042); Y-55: Scott and Bonk, 1984 (name from their pl. 1; show only the northern part of WW, the part along the West Ridge, and a short section of the central splay of Y-1042; include only that part of WW east of long 116°30'W.); Y-113: Harding, 1988; Y-224: Frizzell and Shulters, 1990; Y-238: Reheis and Noller, 1991 (pl. 3); Y-396: Scott, 1990; Y-576: O'Neill and others, 1991; Y-701: Whitney, 1992; Y-1042: O'Neill and others, 1992 (show WW north of about lat 36°45'N. as consisting of three splays: east, central, and west); Y-1182: Simonds and Whitney, 1993; Y-1196: Faulds and others, 1991 (include only that portion of WW west of long 116°30'W., which includes part of WW along West Ridge, the southern section of the eastern splay of Y-1042, the northern and southern sections of the central splay of Y-1042, and the western splay of Y-1042); Y-1201: Ramelli and others, 1991 (primarily discuss what they call the southern Windy Wash fault, which is the portion of WW south of Windy Wash that includes Trenches CF-2 and CF-3 of Y-26).

Location: 3 km/283° (distance and direction of closest point from YM) at lat 36°51'N. and long 116°31'W. (location of closest point). According to Y-1042 (p. 4, 10), WW is a single trace in the southern Yucca Mountain area, but it splits into at least three splays north of about lat 36°45'N.

USGS 7-1/2' quadrangle: Big Dune, Busted Butte, Crater Flat, East of Beatty Mountain, Pinnacles Ridge.

Fault orientation: The southern end of WW strikes north (Y-1042, p. 4). Of the three splays of northern WW, the western one strikes north–northwest, the central one strikes north to north–northwest, and the eastern one strikes northeast (Y-1042, pl. 1, p. 4). WW dips 48° W. to 72° W. (Y-55, pl. 1; Y-1196 for the southern portion of WW along West Ridge). Y-396 (p. 259) reported an average dip of 59° for WW. This was calculated from twelve measurements.

Fault length: Y-701 reported a length of about 14 km for WW. The length of WW is about 25 km as estimated from the map by Y-396 (p. 256). Scarps are discontinuous on alluvial surfaces along a section about 2.4 km long as portrayed by (Y-55, pl. 1). WW is shown as concealed over much of its length by Y-224 and Y-396 (fig. 3, p. 256-257).

Style of faulting: Displacement on WW is shown by Y-12 and Y-701 as dip slip (normal) with a left–lateral component of an undetermined amount. A left–lateral component of displacement has also been interpreted by Y-1042 (p. 17, 20) from observed geomorphic features (e.g. offset streams, pressure ridges, changes in apparent displacement along strike, and rhomboid–shaped fault patterns). Y-1042 (p. 17) also reported slickenlines that plunge 43° to 47°, which they interpreted as indicating a component of left–lateral slip. Displacement on WW is shown by Y-55 (pl. 1) and Y-224 as down to the west.

Y-1042 (p. 17, 20) suggested that the western splay has experienced scissor–type displacement (down to the west on the south and down to the east on the north). They based this conclusion on field examination that revealed subtle surface displacements of different types.

Scarp characteristics: Y-1042 (p. 4) reported that the central splay of WW is a series of right– and left–stepping, *en echelon* scarps on alluvial surfaces. Y-26 (p. 15) noted that a scarp on their Fault M (the central splay of Y-1042, pl. 1) is 1.5 m high and has a maximum slope angle of 7° on early Pleistocene and (or) latest Pliocene alluvial surfaces (their QTa deposits with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9). Y-26 (p. 15) reported a second scarp to the south along their Fault M. This scarp has a surface displacement of 1 m and a maximum slope angle of 9°.

Windy Wash fault (WW) — Continued

Y-1042 (p. 4) noted that the western splay of WW is expressed as aligned scarps, tonal contrasts, and linear drainage segments. The southern end of the western splay is a wedge–shaped area bounded on the east and west by linear scarps (Y-1042, p. 4). At Trench CF-2 along their Fault Q (the western splay of Y-1042, pl. 1), Y-26 (p. 16) measured a scarp height of 4 m, a surface offset of 1.5 m, and a maximum scarp–slope angle of 12°.

Displacement: On the basis of exposures in Trenches CF-2.5 and CF-3 (on the western splay of Y-1042, pl. 1), Y-12 (p. 787) interpreted an apparent vertical displacement of about 40 cm of a 270–ka gravel and an apparent vertical displacement of <10 cm in a 6.5–ka to 3–ka (Holocene) silt that records the youngest event. The maximum cumulative displacement observed in Trench CF-3 for the last four events (since about 300 ka) is 1.5 to 2.0 m (Y-701). On the basis of exposures in Trench CF-1 (on the central splay of Y-1042, pl. 1), Y-26 (p. 15) concluded that the soil developed in early Pleistocene and (or) latest Pliocene alluvium (their QTa deposits with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9) has been displaced 2.5 m down to the west.

Y-1201 (p. 1-64) reported a topographic separation of about 40 m in Pliocene basalts (2.5 Ma to 3.7 Ma) along their southern Windy Wash fault (the western splay? of Y-1042, pl. 1). Y-1201 (p. 1-64) concluded that this separation is a minimum vertical displacement since the Pliocene because the basalts may dip eastward. On the basis of the tectonic tilt of volcanic units (Paintbrush Tuff of 13.5 Ma to 13 Ma and Timber Mountain Tuff of 11.5 Ma), Y-396 (table 2, p. 275) estimated that a vertical displacement of 140 m occurred between 13 Ma and 11.5 Ma and that a vertical displacement of 260 m occurred between 11.5 Ma and the present.

Age of displacement: On the northern portion of WW, along the western side of West Ridge, Y-26 (p. 15; their Fault N) noted that early Pleistocene and (or) latest Pliocene alluvium (their QTa deposits) was faulted against Tertiary volcanic rocks and that early Holocene alluvium (their Q1c deposits with an estimated age of 7 ka to 9 ka; Y-26, fig. 3, p. 9) overlies WW. Y-55 (pl. 1) showed this same portion of WW as cutting alluvium and colluvium of Quaternary or Tertiary age.

Y-12 (p. 787) interpreted exposures in Trench CF-2 to indicate that at least seven Quaternary faulting events have occurred on the southern portion of WW (western splay of Y-1042, pl. 1). They concluded that three of these events occurred before 300 ka (age based on a basaltic ash that occurs in fractures and that is correlated to a basaltic cone dated (K–Ar) at 300 ka). Y-701 speculated, on the basis of rock varnish dates on faulted surfaces, that the oldest faulted surface is <700 ka. Y-12 (p. 787) suggested that event 4 exposed in Trench CF-2 occurred around or just before 300 ka. On the basis of uranium–trend analyses on alluvial deposits exposed in Trench CF-3, Y-12 (p. 787) concluded that event 5 occurred between 270 ka and 190 ka, that event 6 occurred between 190 ka and 40 ka, and that event 7 occurred after 40 ka. Thermoluminescence (TL) age determinations indicate that the youngest faulted unit, an eolian silt, was deposited between 6.5 ka and 3 ka, so that event 7 occurred during the last several thousand years.

The map by Y-1196 implies late Pleistocene or Holocene displacement along their southern WW (the western splay? of Y-1042, pl. 1), because fault traces are shown on middle and late Pleistocene surfaces (their late Black Cone surfaces with ages of 17.3 ka to 30.0 ka on rock varnish). Fault traces are also shown on middle Pleistocene surfaces (their early Black Cone surfaces with ages of 130 ka to 190 ka on rock varnish; Y-1196).

On the basis of relationships between volcanic ash and fractures exposed in Trench CF-1 along the southern portion of WW (their Fault M; the central splay of Y-1042, pl. 1), Y-26 (p. 15-16) concluded that displacement of early Pleistocene and (or) latest Pliocene alluvium (their QTa deposits with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9) occurred about 1.2 Ma.

Slip rate: Y-1201 (p. 1-67) estimated average vertical slip rates of 0.001 to 0.03 mm/yr for their southern WW (western splay of Y-1042, pl. 1) for the late Pleistocene and Holocene, using the interpretations of Y-12 for exposures in Trenches CF-2 and CF-3 (40 cm of vertical displacement in 270–ka deposits and 10 cm of vertical displacement in 3–to–6–ka deposits). Y-396 (table 2, p. 275) listed a vertical slip rate of 0.0015 mm/yr on WW since 270 ka; this rate was calculated on the basis of the 40 cm of vertical displacement interpreted by Y-12 from Trench CF-2.

Y-1201 (p. 1-67) concluded that the topographic separation of Pliocene basalts (2.5 Ma to 3.7 Ma) along their southern WW (western splay? of Y-1042, pl. 1) suggests a Quaternary apparent vertical slip rate "on the order of 0.01 mm/yr." Using estimates of 25 to 100 m of vertical displacement of the Pliocene basalts, Y-1201 (p. 1-67) concluded that long–term apparent vertical slip rates on the southern WW range between 0.01 to 0.04 mm/yr and are probably about 0.02 mm/yr. Y-396 (p. 273, table 2, p. 275) reported an apparent vertical slip rate of 0.07 mm/yr on WW between 13 Ma and 11.5 Ma. This rate assumes that about 0.14 km of vertical displacement occurred during this 1.5–million–yr interval. In addition, Y-396 (p. 274, table 2, p. 275) reported an apparent vertical slip rate of 0.026 mm/yr since 11.5 Ma. This rate assumes that about 0.26 km of vertical displacement has occurred since 11.5 Ma and that Cenozoic displacement rates have varied in a step–wise manner in which rates sharply decreased about 11.5 Ma (p. 273).

Recurrence interval: On the basis of four faulting events since 300 ka (interpreted from exposures in Trench CF-3), Y-12 (p. 787) and Y-701 noted an average recurrence interval between surface–rupturing events of 75,000 yr.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished information (Y-26, pl. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000) and conventional aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000). Field examination (Y-1042, p. 2). Interpretation of trenches CF-2, CF-2.5, and CF-3 (Y-12, p. 787; Y-19; Y-26, p. 3, table 1, p. 5). Measurement of topographic scarp profiles (Y-26, p. 6).

Relationship to other faults: Y-1042 (p. 4, 10, pl. 1) speculated that the eastern splay of WW is structurally linked to the Solitario Canyon fault (SC) by left–stepping, *en echelon* fault scarps and by a rhomboid–shaped breccia zone. Y-1042 (p. 4, pl. 1) also noted that the Fatigue Wash fault (FW) appears to merge northward with WW west of West Ridge. Y-1182 (p. A-141) proposed that the three faults on the western side of Yucca Mountain (FW, SC, and WW) are interconnected along strike and possibly at depth. Y-396 (p. 279) concluded that steep dip–slip (normal) faults at Yucca Mountain, like WW, sole into a low–angle normal fault or faults at depths of 1 to 4 km.

Yucca fault (YC)

Plate or figure: Plate 1.

References: Y-50: Barnes and others, 1963; Y-60: Colton and McKay, 1966; Y-181: Carr, 1974 (name from his fig. 7); Y-182: Carr, 1984; Y-224: Frizzell and Shulters, 1990; Y-232: Cornwall, 1972; Y-526: Swadley and Hoover, 1990; Y-688: Fernald and others, 1968; Y-690: Ekren and others, 1968; Y-693: Barosh, 1968 (included the Butte fault as part of YC); Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992; Y-961: Fernald and others, 1968; Y-1106: Shroba and others, 1988.

Location: 40 km/65° (distance and direction of closest point from YM) at lat 37°00′N. and long 116°03′W. (location of closest point). YC is located in central Yucca Flat.

USGS 7-1/2′ quadrangle: Oak Spring, Yucca Flat.

Fault orientation: YC strikes generally north and dips east (Y-813, p. 6). Y-693 (p. 210) portrayed YC as a series of north–northwest–striking and north–northeast–striking traces. YC is shown as branching by Y-60 and Y-526 or as a single, slightly sinuous strand by Y-50, Y-181 (fig. 7), Y-224, Y-813 (pl. 3, p. 7), and Y-853. YC splits into several traces on Quaternary alluvial fans at its northern end near Oak Spring Butte (Y-224; Y-813, pl. 3, p. 7; Y-853). YC dips 75° E. to 80° E. at the surface and probably flattens to dips of 55° to 65° at depth (Y-181, p. 26). Y-181 (p. 32) noted dips of 50° E. to 60° E. on the southern half of YC.

Fault length: The total length of YC is about 22 km as estimated from Y-813 (pl. 2) and from Y-853, about 25 km as estimated from Y-526, and at least 24 km and possibly as much as 32 km as noted by Y-181 (p. 26). The longest values include the Butte fault (BT) as part of YC. BT is located in bedrock north of Yucca Flat. Y-232 and Y-693 (p. 209) concluded that YC is continuous with BT, which is shown as part of the Oak Spring Butte faults (OAK) on plate 1 of this compilation. Similarly, Y-693 (p. 209) inferred a length of about 34 km (21 miles) for YC and reported that the total length of YC may be about 40 km (25 miles) if the 6.5–km–long (4 miles) BT is included with YC.

A prehistoric fault scarp associated with YC is about 20 km long as estimated from Y-224. Its length is reported by Y-1106 (p. 2) to be 21 km and by Y-181 (p. 26) to be at least 24 km long and probably 32 km. Underground nuclear testing may have caused displacement along an additional 4.5 km of the fault at the southern end of YC (Y-224) or along a northeast–striking splay fault, or both (Y-181, fig. 7).

Style of faulting: Displacement on YC is shown by Y-50, Y-60, Y-224, and Y-526 to be dip slip (normal) and down to the east. Y-693 (p. 215) concluded that displacements on YC that have resulted from underground explosions have been almost entirely vertical but that the resulting pattern of fractures indicates a "very slight right–lateral component" of displacement. Y-181 (p. 27) speculated that "minor departures from the nearly vertical displacements caused by explosions are * * * due to shoving and jostling of the alluvium by ground motion." Y-182 suggested that YC belongs to a set of north–striking faults with right–oblique displacement. Y-181 (p. 27-28, fig. 9A) concluded that the left–stepping, *en echelon* pattern of scarps associated with YC suggests right–lateral displacement. Y-181 (p. 26) noted that erosion has probably destroyed any evidence for lateral displacement.

Scarp characteristics: Y-693 (p. 201) noted that YC is "marked for most of its length by a low scarp." This scarp is noted to be "several hundred feet east of older buried parts of the fault zone" (Y-181, p. 26). A scarp on an alluvial surface at the fault's northern end is noted by Y-693 (p. 209) to be more than 12 m (40 ft) high and by Y-688 (p. 50) to be about 15 m (50 ft) high. The height of the scarp associated with YC is reported by Y-693 (p. 209) to be commonly 1.5 to 6 m (5 to 20 ft). Y-181 (p. 26) did not find any evidence for multiple ruptures on at least the southern 16 km of the scarp associated with YC. Y-693 (p. 209) reported low, east– and west–facing secondary scarps adjacent to the main scarp along YC at a few places in central Yucca Flat.

Cracks and scarps that formed during underground explosions are also preserved on YC and branch faults adjacent to YC on the east (Y-693, p. 210-211). These scarps slope 70° E. or are vertical (Y-693, p. 211).

Yucca fault (YC) — Continued

Displacement: Y-181 (p. 27) reported a vertical displacement of ≥200 m in Tertiary volcanic tuff. Y-688 (p. 50) recognized displacement of about 15 m (50 ft) of an alluvial surface at the northern end of YC. Y-688 (p. 50) and Y-693 (p. 209) noted that surface displacement progressively decreases to the south along YC until the fault disappears near Yucca Lake. In Yucca Flat, alluvium in the south–central part of the basin and east (the lower side) of YC is >610 m (2000 ft) thick (Y-688, p. 50). Similarly, Y-693 (p. 201) reported that alluvial and lacustrine deposits in Yucca Flat are 305 to 610 m (1,000 to 2,000 ft) thick on the downthrown side of YC as determined from geophysical studies and drilling. Y-693 (p. 214) noted that displacements along fractures produced by underground explosions vary between 0 and 3 to 5.5 m (10 to 18 ft), with the higher amounts occurring immediately adjacent to the explosion site.

Y-181 (p. 29) reported that Paleozoic rocks may be displaced laterally "several thousand feet" on YC. He (Y-181, p. 27) also noted that the lateral component of displacement in Tertiary volcanic tuff may be equal to or greater than the amount of vertical displacement (≥200 m). YC may account for 150 m of horizontal extension, assuming that the fault dips 60° (Y-181, p. 32). Y-813 (p. 6) concluded that relative amounts of the different types of displacement on YC are unknown, but that the "persistence of the fault in a valley–floor position suggests that the amount of lateral offset must be at least as much as the amount of vertical offset, if not more."

Age of displacement: Y-181 (p. 26) called YC "the youngest natural fault scarp in the test site region." Y-693 (p. 201, 216) concluded that the low scarp along YC "demonstrates the very recent age of the fault and there is no reason not to consider it an active fault." Y-688 (p. 50) reported that drainage development in Yucca Flat has been disrupted by displacement on YC, which they concluded is still active. Y-181 (p. 26) noted that the scarp associated with YC has been modified by erosion, but concluded on the basis of a comparison of the scarp associated with YC to 100–yr–old scarps in Owens Valley that it probably formed between 1 ka and 10 ka.

Y-853 portrayed YC as fault scarps on depositional or erosional surfaces of possible late Pleistocene age (their Q2? surfaces with estimated ages between 10 ka and 130 ka) suggesting a late Pleistocene or Holocene age for surface rupture. Y-1106 (p. 2) reported a minimum age of 35 ka for one of the younger events on YC. This age was estimated by Knauss (1981, Y-1242, *cited in* Y-1106, p. 5) on the basis of uranium–series analyses on a carbonate–rich fracture filling along YC (Y-1106, p. 2). Y-526 noted that YC displaces their Qap deposits (~160 ka to 800 ka) and their QTa deposits (>740 ka) along most of YC. Displacement at the southern end of YC has been induced by underground nuclear testing (Y-181; Y-224). Y-526 showed short portions of YC as concealed by Holocene alluvium (≤10 ka). They also portrayed Holocene alluvium as deposited against two scarps on surfaces of their Qap deposits (Y-526).

The formation of Yucca Flat, which may be related, at least partially, to displacement on YC, occurred after extrusion of Timber Mountain Tuff (~11.5 Ma) and before deposition of Thirsty Canyon Tuff (~8 Ma; Y-690). However, Timber Mountain Tuff does not thicken in depressions beneath Yucca Flat, as do alluvial deposits, suggesting that the depressions formed after the tuff was deposited (Y-181).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with YC. YC lies near the center of and bisects Yucca Flat, a structural basin (Y-182, p. 21). Within Yucca Flat, as in other basins in southern Nevada, the rate of subsidence has apparently nearly balanced the rate of alluviation so that only moderate relief is present on the bordering mountain fronts (Y-182, p. 25).

Analysis: Compilation and summary of published and unpublished work (Y-181, p. 1-2; Y-182, p. 4). Aerial photographs (Y-526; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000). Limited field examination (Y-526).

Yucca fault (YC) — Continued

Relationship to other faults: Y-1106 (p. 15) suggested that seismic shaking associated with YC may have triggered one or more episodes of minor displacement on the Carpetbag fault (CB), which is located about 3.5 km west of YC. YC may also be related to other right–oblique faults within Yucca Flat: the Area Three fault (AT) to the east, the Eleana Range fault (ER) to the west, and short, unnamed faults (Y-182, p. 21; Y-813, p. 6). All of these faults may have contributed to the formation of Yucca Flat (Y-182, p. 21). Y-182 (p. 21) concluded that formation of the Yucca Flat is the result of a combination of faulting and subsidence of small areas that have sagged more than adjacent parts of the basin. He (Y-182, p. 25) further suggested that fault displacement resulted in formation of a fairly young structural basin medial to an existing basin.

Y-693 (p. 201) reported that YC joins the Butte fault (BT) at the northern end of Yucca Flat (*see* Fault length).

Yucca Lake fault (YCL)

Plate or figure: Plate 1.

References: Y-181: Carr, 1974 (shows two northwest–striking, buried faults approximately parallel to, but probably east of, YCL as mapped by Y-232); Y-182: Carr, 1984 (his Yucca–Frenchman shear zone (figs. 7 and 8, p. 16, 17) that may coincide with the northwestern end of YCL as mapped by Y-232); Y-232: Cornwall, 1972. Not shown by Reheis and Noller, 1991 (Y-238, pl. 3), by Reheis, 1992 (Y-813, pl. 2; does show several short faults east of YCL as mapped by Y-232 and west of the Yucca fault), nor by Swadley and Hoover, 1990 (Y-526)

Location: 36 km/67° (distance and direction of closest point from YM) at lat 37°01′N. and long 116°05′W. (location of closest point). YCL is located along the southwestern side of Yucca Flat between Syncline Ridge on the north and the CP Hills on the south.

USGS 7-1/2′ quadrangle: Tippipah Spring, Yucca Flat, Yucca Lake.

Fault orientation: YCL strikes generally north–northwest (Y-232).

Fault length: The total length of YCL is about 17 km as estimated from Y-232 (pl. 1). This includes a 4–km–long section at the southeastern end of YCL that is shown as concealed by Y-232. This section is not shown on plate 1 of this compilation.

Style of faulting: Displacement along YCL is portrayed by Y-232 as down to the northeast.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: About 13 km of YCL (all but the concealed portion) is shown by Y-232 (pl. 1) as displacing Quaternary alluvium (his Qal deposits). Y-181 (p. 14) stated that "the Yucca fault is the only youthful–appearing pre-nuclear testing fault scarp in the test site area." This statement implies that a similar scarp is not preserved along YCL, which is only 3 km southwest of the Yucca fault (YC).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: YCL is not associated with a range front.

Analysis: Aerial photographs (Y-232).

Relationship to other faults: The relationships between YCL and other faults within and around Yucca Flat, such as the Carpetbag fault (CB) to the north, the Yucca fault (YC) to the northeast, and the Boundary fault (BD) to the north, are not known. If both the north–striking YC and the northwest–striking YCL are extended southward, then they would nearly intersect southwest of Yucca Lake (Y-232, pl. 1). A northwest–striking, concealed fault that is east of and parallel to YCL as mapped by Y-232 is about 30 km long. This fault is shown by Y-181 (fig. 7) as terminating at a concealed, north–striking, southern section of CB.

APPENDIX 3: LIST OF ABBREVIATIONS FOR FAULT NAMES

The following abbreviations for faults are used in this compilation. Most faults are shown on plates 1 and 2 and have description sheets in appendix 2. There are a few exceptions. Faults noted by * are included with other faults as indicated; they are shown on the plates, but do not have separate description sheets. Faults marked with ** are faults within about 5 km of the potential nuclear waste repository at Yucca Mountain (site faults); these faults are shown only on figure 3. The State Line fault (SL) and the Cedar Mountain fault (CM), indicated by ***, are shown only on figure 1.

Abbreviation	Fault Name
AH	Ash Hill fault
AIR	Airport Lake fault
AM	Ash Meadows fault
AR	Amargosa River fault
ARM	Arrowhead Mine fault* (part of PGT)
AT	Area Three fault
AW	Abandoned Wash fault* (part of GD)
BC	Bonnie Claire fault
BD	Boundary fault
BDG	Badger Wash faults
BH	Buried Hills fault
BLK	Black Cone fault* (part of ECR)
BLR	Belted Range fault
BM	Bare Mountain fault
BR	Bow Ridge fault**
BS	Beatty scarp
BT	Butte fault* (part of OAK)
BUC	Buckhorn fault* (part of PGT)
BUL	Bullfrog Hills faults
CAC	Cactus Springs fault
CB	Carpetbag fault
CEN	Central Valley fault* (part of SAL)
CF	Cactus Flat fault
CFML	Cactus Flat–Mellan fault
CGV	Crossgrain Valley faults
CHR	Chert Ridge faults
CHV	Chicago Valley fault
CLK	Chalk Mountain fault
CLMV	Clayton–Montezuma Valley fault
CM	Cedar Mountain fault***
CP	Checkpoint Pass fault
CPR	Central Pintwater Range faults
CR	Central Reveille fault
CRPL	Cockeyed Ridge–Papoose Lake fault

Abbreviation	Fault Name
CRPR	Clayton Ridge–Paymaster Ridge fault
CRWH	Cactus Range–Wellington Hills fault
CS	Cane Spring fault
CSM	Central Spring Mountains faults
CV	Clayton Valley fault
DS	Deep Springs fault
DV	Death Valley fault
EBR	East Belted Range fault
ECR	East Crater Flat faults**
EM	Emigrant fault
EMM	East Magruder Mountain fault
EN	East Nopah fault
EPK	Emigrant Peak faults
EPR	East Pintwater Range fault
ER	Eleana Range fault
ERV	East Reveille fault
ES	East Side fault* (part of SAL)
ESC	East Stone Cabin fault
EURE	Eureka Valley East fault
EURW	Eureka Valley West fault
EVN	Emigrant Valley North fault
EVS	Emigrant Valley South fault
FC	Furnace Creek fault
FH	Fallout Hills faults
FLV	Fish Lake Valley fault
FM	Frenchman Mountain fault
FR	Freiburg fault
FW	Fatigue Wash fault**
GD	Ghost Dance fault**
GG	Golden Gate faults
GM	Grapevine Mountains fault
GOL	Gold Flat fault
GOM	Gold Mountain fault
GRC	Groom Range Central fault
GRD	Garden Valley fault
GRE	Groom Range East fault
GTH	General Thomas Hills fault
GV	Grapevine fault
HCR	Hot Creek–Reveille fault
HKO	Hiko fault
HM	Hunter Mountain fault
HSP	Hiko–South Pahroc faults
HVSF	Hidden Valley–Sand Flat faults
ISV	Indian Springs Valley fault
JUM	Jumbled Hills fault

Abbreviation	Fault Name
KR	Kawich Range fault
KV	Kawich Valley fault
KW	Keane Wonder fault
LEE	Lee Flat fault
LL	Little Lake fault
LMD	La Madre fault
LMT	Lone Mountain fault
LV	Lida Valley faults
MAC	McAfee Canyon fault
MAY	Maynard Lake fault* (part of PGT)
MER	Mercury Ridge faults
MHE	Monitor Hills East fault
MHW	Monitor Hills West fault
MLGH	Mud Lake–Goldfield Hills fault
MM	Mine Mountain fault
MR	Montezuma Range fault
MV	Monotony Valley fault
NDR	North Desert Range fault
OAK	Oak Spring Butte faults
OSV	Oasis Valley faults
OWV	Owens Valley fault
PAH	Pahroc fault
PAN	Panamint Valley fault
PBC	Paintbrush Canyon fault**
PEN	Penoyer fault
PGT	Pahranagat fault
PM	Pahute Mesa faults
PMJW	Palmetto Mountains–Jackson Wash fault
PRP	Pahrump fault
PV	Pahrock Valley faults
PVNH	Plutonium Valley–North Halfpint Range fault
PW	Palmetto Wash faults
QC	Quinn Canyon fault
RM	Ranger Mountains faults
RTV	Racetrack Valley faults
RV	Rock Valley fault
RWBW	Rocket Wash–Beatty Wash fault
SAL	Saline Valley faults
SB	Sheep Basin fault
SC	Solitario Canyon fault**
SCR	Stagecoach Road fault**
SCV	Southeast Coal Valley fault
SDV	Southern Death Valley fault
SEDR	Sheep–East Desert Ranges fault
SF	Sarcobatus Flat fault

Abbreviation	Fault Name
SHR	Sheep Range fault
SIL	Silver Peak Range fault
SL	State Line fault***
SLR	Slate Ridge faults
SMF	Six–Mile Flat fault
SNV	Sierra Nevada fault
SOU	South Ridge faults
SPR	Spotted Range faults
SPS	Seaman Pass fault
STM	Stumble fault
SWF	Stonewall Flat fault
SWM	Stonewall Mountain fault
SYL	Sylvania Mountains fault
TEM	Tem Piute fault
TK	Tikaboo fault
TLC	Tule Canyon fault
TLV	Three Lakes Valley fault
TM	Tin Mountain fault
TOL	Tolicha Peak fault
TP	Towne Pass fault
WAH	Wahmonie fault
WF	West Frontal fault* (part of SAL)
WH	Weepah Hills fault
WIL	Wilson Canyon fault
WL	West Lava fault* (part of ECR)
WPR	West Pintwater Range fault
WR	West Railroad fault
WSM	West Spring Mountains fault
WW	Windy Wash fault**
YC	Yucca fault
YCL	Yucca Lake fault

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