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Map and data for Quaternary faults and folds in Wyoming

By
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by

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Earthquake Reduction Program (ERP) project
UNITED STATES MAP OF QUATERNARY FAULTS AND FOLDS
In cooperation with the International Lithosphere Program's
Task Group II-2, World Map of Major Active Faults
Michael N. Machette, Co-Chairman

Introduction

The "World Map of Major Active Faults" Task Group is compiling a series of digital maps for the United States and other countries in the Western Hemisphere that show the locations, ages, and activity rates of major earthquake-related features such as faults and fault-related folds; the companion database includes published information on these seismogenic features. The Western Hemisphere effort is sponsored by International Lithosphere Program (ILP) Task Group II-2, whereas the effort to compile a new map and database for the United States is funded by the Earthquake Reduction Program (ERP) through the U.S. Geological Survey. The maps and accompanying databases represent a key contribution to the new Global Seismic Hazards Assessment Program (ILP Task Group II-0) for the International Decade for Natural Disaster Reduction.

Guidelines for the compilation of the Quaternary fault and fold maps for the United States were published by Haller and others (1993 #655) at the onset of this project. The compilation of Quaternary surface faulting and folding in Wyoming and adjacent bordering parts of Montana, Idaho, and Utah is the sixth of many similar state and regional compilations that are planned for the U.S. These reports published to date include West Texas (U.S. Geological Survey Open-File Report 96-002; Collins and others, 1996 #993), New Mexico (U.S. Geological Survey Open-File Report 98-521; Machette and others, 1998, #2848), Arizona (Arizona Geological Survey Open-File Report 98-24; Pearthree, 1998 #2945), Colorado (Colorado Geological Survey Open-File Report 98-8; Widmann and others, 1998 #3441), and Montana (Montana Bureau of Mines Special Publication 114; Stickney and others, 2000 #1750).

This compilation is presented as a digital map product and catalog of data (both in Adobe Acrobat pdf formats). The catalog provides referenced data on a variety of geographic, geologic, and paleoseismologic parameters. The senior authors (Michael Machette and Kenneth Pierce, USGS; and James McCalpin, GEO-HAZ Consultants, Inc.) compiled the fault data as part of ongoing studies of Quaternary faulting in Wyoming. The U.S. Geological Survey is responsible for organizing and integrating State and regional products under the national project, including the coordination and oversight of contributions from individuals and groups (Michael N. Machette), database design and management (Kathleen M. Haller), and digitization and analysis of map data (Richard L. Dart).

Strategy for Map and Database

The primary intention of this compilation is for use in seismic-hazard evaluations. For studies of regions of low to moderate seismicity, it is particularly important to incorporate geologic information on discrete faults that have evidence of Quaternary movement. Paleoseismic studies, which evaluate the history of surface faulting or deformation along a given structure, provide a long-term perspective that helps augment the relatively short historic records of seismicity in many regions. In particular, the frequency and location of large-magnitude earthquakes in many parts of the U.S. are poorly defined by the historic record of seismicity. Thus, an understanding of the seismogenic characteristics of prehistoric (Quaternary) faults may prove vital to improving seismic-hazard assessments in critical regions having low to moderate levels of historic seismicity.

The map and database have been designed for the few well-studied faults that are present in the United States. However, the bulk of seismogenic structures are relatively poorly studied, thus giving the appearance that the database is incomplete (*i.e.*, unnamed faults, fields that have no data or sparse descriptions). Nevertheless, the fault map and database parameters provide a systematic basis for which these structures can be assessed as potential seismic sources and yet allows us to expand the database with the completion of new studies. Thus, we are assembling a dynamic database (one that will be augmented and updated through time); this report is the first iteration of the data for Wyoming.

The map shows faults and folds that exhibit evidence of Quaternary surface movement related to faulting, including data on timing of most recent movement, sense of movement, slip rate, and continuity of surface expression. Fault traces were taken from original sources and compiled on 1° x 2° quadrangles (1:250,000-scale), 1/2° x 1° quadrangles (1:100,000-scale), or 1:62,500-125,000 scale base maps in the National Park areas. The traces were digitized for use in *Arc/Info—Geographic Information System (GIS) software that permits rescaling, output in a wide variety or projections, and attribution (assigning colors, line weights, and symbols). In addition to location and style of faulting, the map shows the time of most recent movement and slip-rate category (as a proxy for fault activity) for each structure. These data, as well as name and affiliation of the compiler, date of compilation, and geographic and other paleoseismologic parameters are included in the database. Published data or publicly available data (NEHRP contract reports, theses, etc.) are referenced extensively throughout the report. Citations are in standard USGS format, with the exception that we include a database reference number (e.g., Haller and others, 1993 #655). When the computer version of the database is implemented, the user will be able to search for data in a specific field or a combination of fields.

For purposes of map presentation, the timing of most recent fault movement (*i.e.*, surface rupture) is depicted by one of five categories: historic (date), Holocene and latest Pleistocene (<15 ka), late Quaternary (<130 ka), late and middle Quaternary (<750 ka), and Quaternary or suspected Quaternary (<1.6 Ma). These categories permit defining a maximum time of movement without constraining the minimum time, which typically requires more detailed studies. This strategy allows estimates to be made where published data are sparse or where there are conflicts in evidence for timing. For example, if Holocene (<10 ka) movement is suspected but only late Pleistocene (10-130 ka) movement can be documented, then the inclusive late Quaternary (<130 ka) category is used for the time of the most recent movement. In terms of this map, no faults in Wyoming are known to have had surface-rupturing earthquakes in historic time. However, in 1959 the Hebgen Lake earthquake struck southwestern Montana, just west of Yellowstone National Park and caused about 34 km of surface rupturing along the Hebgen and Red Canyon faults, thereby showing that the region has the potential for large earthquakes. In addition to known surface faults, some Quaternary faults that are suspected or inferred from subsurface or other data are shown as dotted lines (*i.e.*, buried structures). Conversely, structures with known late Tertiary (or older) movement are not shown unless there is sufficient evidence of Quaternary movement (geomorphology, offset surficial deposits, etc.). This conservative depiction of faults yields a map with defensible potential sources of future ground rupturing based on Quaternary history (1.6 million years), whereas a less con-

* Use of trade or brand names, such as Arc/Info, is for descriptive purposes and does not constitute endorsement by the U.S. Geological Survey or the Department of Interior.

servative depiction would yield a “neotectonic map” that may or may not be of use for seismic-hazards analyses. One should note that we do not consider seismicity associated with or aligned along pre-Quaternary (*i.e.,* Neogene) faults or buried faults to be compelling enough evidence (alone) to add these structures to our map and database.

For the purposes of this database, we defined four categories of faults (Classes A-D, table 1) based on demonstrable evidence of tectonic movement during the Quaternary (known or presumed to be associated with large-magnitude earthquakes). Only Class A and B features are shown on the map and described in the database, although the names of Class C features are listed in table 2.

Table 1. Categories of faults

Category	Definition
A	Geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin, whether the fault is exposed by mapping or inferred from liquefaction or other deformational features.
B	Geologic evidence demonstrates the existence of Quaternary deformation, but either (1) the fault might not extend deeply enough to be a potential source of significant earthquakes, or (2) the currently available geologic evidence is too strong to confidently assign the feature to Class C but not strong enough to assign it to Class A.
C	Geologic evidence is insufficient to demonstrate (1) the existence of tectonic faulting, or (2) Quaternary slip or deformation associated with the feature.
D	Geologic evidence demonstrates that the feature is not a tectonic fault or feature; this category includes features such as joints, landslides, erosional or fluvial scarps, or other landforms resembling fault scarps but of demonstrable non-tectonic origin.

We use slip rate as a graphical representation of fault activity on the map. Fault slip rates (and uplift rate for folds) are depicted on the map by categories (and shown by line thickness) that comprise all geologic slip rates on a national scale. Four slip-rate categories have been defined for this project: less than 0.2 mm/yr, 0.2-1 mm/yr, 1-5 mm/yr, and greater than 5 mm/yr. These broad categories segregate most intraplate structures (<1 mm/yr) from major plate-bounding structures (generally >5 mm/yr). The 1-5 mm/yr slip-rate category typically includes major normal intraplate faults such as the Teton fault [768] in northwestern Wyoming and the Wasatch fault zone [fault 2351] in Utah. All of the described faults in Wyoming are characterized by published or inferred slip rates of less than 5 mm/yr: three faults [faults 730, 766, and 768c] have published or inferred rates 1.0-5.0 mm/yr, and ten faults have published or inferred rates 0.2-1.0 mm/yr. If no published slip rate exists (*i.e.*, "unknown"), the compiler has assigned the fault to an appropriate slip-rate category as determined from his or her impressions of the activity of this and other associated structures in the region based on geologic data. This assignment to a unique slip-rate category is necessitated by the map’s line-thickness portrayal of fault activity. Where available, the length of time for which the estimated slip rate applies is shown in the database. The absence or presence of recent movement over some time interval may be a basis for estimating a crude slip rate and one can use a variety of geomorphic and geologic relations to place a fault in its most likely most recent movement (time) category. For example, a normal fault that does not cut latest Pleistocene (10-15 ka) deposits probably has an average slip rate of less than 1 mm/yr because during this time interval (10-15 k.y.) at least 10-15 m of potential slip would be expected to accumulate at average rates of 1 mm/yr (or greater); this amount of accumulated slip most likely would be released in several large surface-rupturing earthquakes. An exception to this generalization is faults that show evidence of temporal clustering; that is, episodes of movement (several faulting events) separated by longer intervals of tectonic quiescence. In such cases, the average slip rate could be considerably less than that calculated for an intra-cluster interval of time. Cases such as this are becoming more apparent in the literature as researchers conduct paleoseismic studies of faulting, especially in intraplate regions.

The database includes a number of fields that provide supporting information on the previously mentioned parameters, as well as additional descriptive information on geologic and paleoseismologic parameters not depicted on the map. The descriptive information includes fault name and number, a brief synopsis, compilation information, and physical location of the structure. Because the project will integrate data from the entire United States, the database requires that each structure have a unique number (in the text, a fault's number is enclosed by square brackets, such as [750]). In general, most of the structures in a given state or region are sequentially numbered on a geographic basis. Names are determined from the literature and/or common usage and although some structures in different regions have the same name or a similar name, no attempt was made to avoid such duplications. Geologic data include geologic setting, geomorphic expression, and age of faulted deposits, all in descriptive form. Additional paleoseismologic data include descriptions of detailed studies (*i.e.*, trenching) that we are aware of and estimates of recurrence intervals. Field names are shown in bold and are defined in Definition of Terms (see also, general guidelines published by Haller and others, 1993 #655). When the computer database version is implemented, the user will be able to search for data in a specific field or a combination of fields. Non-searchable fields, such as "Comments", document the source of data and any provisions that might exist about its use.

Compilations such as this one provide a useful tool for making comparisons of spatial and temporal patterns of faulting at local, regional, and national scales. However, a database is a powerful tool only if it represents a systematic collection of data, which must inherently rely heavily on the knowledge of the compiler. With this in mind, we favor published or publicly accessible data and reference it as completely as possible. An effort has been made to include all pertinent data, especially where conflicts may be apparent. Where multiple interpretations exist in the literature, we use a hierarchy that defines what data will be presented in the primary database fields in order to achieve some level of consistency. We give highest priority to fault-related studies, particularly those addressing the Quaternary history of a fault (*i.e.*, paleoseismic investigations), over general geologic studies (*i.e.*, bedrock mapping). In most cases, more recent studies are given priority, although some older studies (pre-1970s) are quite helpful and authoritative. Faults and folds based on detailed mapping (*e.g.*, 1:24,000 scale) are given priority over those based on less detail (*e.g.*, 1:250,000 scale). Thus, even though we give the most weight to recent topical studies of Quaternary faulting (*i.e.*, paleoseismology), alternative interpretations based on other types of studies are provided in the appropriate "Comments" field.

The majority of the 58 Quaternary Class A and B faults that we have described for Wyoming (table 2, table 3 on accompanying map) are characterized by rather limited investigations; however, as previously mentioned the database is designed for well-studied faults in regions of high seismicity and historical faulting, such as California and Nevada. In order to accommodate large differences in the level of study from fault to fault, we established three types of fault descriptions to simplify data compilation and readily convey the level of current knowledge. All structures are described as either simple, or having sections. In general, simple faults are poorly known, have few or no paleoseismologic studies, are characterized by a single time and slip-rate category for their entire length, and are typically less than 20-30 km in length. At the other end of the spectrum are segmented faults—those comprised of seismogenic and structural entities (segments) that are known to act independently of one another during large surface-rupturing earthquakes on the basis of detailed studies. By our standards (and definitions), the timing of surface-rupturing events on segments of a fault must be well established through trenching and dating studies or the presence of historical surface ruptures, and there should be supporting geomorphologic and geologic data (scarp morphology, stratigraphic control on times of faulting, geologic structures that may control physical segmentation, *etc*.). In some cases, pronounced contrasts in the geomorphic expression of faulting along strike combined with paleoseismic studies that define the chronology of the youngest events on the fault are sufficient to permit discussion of the structure in terms of segments. However popular the use of the term segment is, we have decided to treat all faults that previously have been segmented as sections in this compilation. Thus, no faults in Wyoming are described herein as having segments, but 11 of the 58 faults are described as having sections. Sections may be defined on the basis of relative-age criteria, by fault geometry, by the presence, morphology or preservation of scarps, from a single trench, or from other geologic data (gravity, structure, *etc*.). The remaining 47 simple (i.e., non-sectioned) faults are shown on the map and listed in the database by a three-digit numeric identifier (*e.g.*, [750]). The 11 sectioned faults are identified by an additional lowercase alpha character (*e.g.*, [726a], [726b], [726c], etc.). The alpha characters (a-c) are unique to each of the sections; "a" is assigned to the northernmost (or westernmost) section and last letter ("c" in this example) " is assigned to the southernmost (or easternmost) section.

Synopsis of Quaternary Faults and Folds in Wyoming

Previous compilations of Quaternary faults in Wyoming are included within nationwide compilations by Howard and others (1978 #312) and Nakata and others (1982 #147), and in regional compilations by Witkind (1975 #819) and Case (1997 #3449, 1997 #3450). These compilations are traditional map products that show the location and age of youngest known displacement. The majority of the previously compiled data for Wyoming came from seismic-hazard assessment studies of dams for the U.S. Bureau of Reclamation (Geomatrix, 1988 #2073, 1988 #2980). The regional compilations of faulting by Witkind (1975 #819) and Case (1997 #3449; 1997 #3450) are at 1:500,00 and 1:1,000,000 scales (respectively), and include narrative descriptions of the faults, but only limited information on the amount and age of offset deposits. However, we have not included faults of the oldest categories (Tertiary or upper Cenozoic) in the regional compilation owing to probable pre-Quaternary movement or lack of demonstrable Quaternary movement. Since these compilations were completed, some additional faults have be recognized in this region and several detailed studies have been performed to better constrain various paleoseismologic characteristics for selected faults. The enclosed database only described faults and folds in Wyoming, whereas the accompanying map shows the traces of these features in Wyoming and adjacent bordering parts of Idaho, Montana and Utah. For descriptions of these nearby faults, one should consult the appropriate state database.

Overview of Quaternary faults and folds

This database includes 58 described Quaternary Class A and B faults, fault zones, and groups of faults having similar characteristics—collectively, there must be at least several hundred individual faults with surface expression. Of the described faults, 47 are classified as simple and 11 are classified as having sections. The 11 sectioned faults have 34 sections, for a total of 82 described faults and fault sections (see table 3 on accompanying map). Of the 58 faults, 11 faults or fault sections are considered to be Class B structures, which have unproven ages or suspect origins (landslide, volcanic, etc). Only the Red Canyon fault [657] has historic movement, but the active trace of this fault [657a] is entirely within Montana. Twenty five (43%) of the Quaternary faults in Wyoming have formed recognizable scarps during the Holocene or latest Pleistocene (past 15 ka). If you assign one large surface-rupturing earthquake to each fault or fault section having Holocene to latest Pleistocene (<15 ka) movement (table 3), this accounts for about 32 large surface-rupturing earthquakes during this time interval because eleven of the faults have multiple <15 ka sections (*i.e.*, Eagle Bay [757a, 757b], Teton [768a-f], and South Granite Mountains [779b, d]). From this rudimentary accounting, one can estimate an average return time for large surface-rupturing earthquakes (M.6.25±0.25) in the western part of Wyoming of about 500 years (32 earthquakes in 15 k.y.). Further detailed investigations that document additional Holocene or latest Pleistocene faults or additional faulting events will probably only lower this calculated return time.

Looking back further in the geologic record, the youngest movement appears to have been late Quaternary (<130 ka) on eight faults (14%), and middle or late Quaternary (<750 ka) movement on ten additional faults (17%). The remaining 15 faults (26%) in Wyoming are classified as Quaternary (<1.6 Ma). To a certain extent, the spatial distribution and evidence for recency of movement on faults are controlled by the age of landforms that the fault crosses. For example, fault scarps preserved on broad isolated surfaces of middle to early Quaternary age will typically be shown as <750 ka, whereas the timing of movement on faults traversing a variety of ages of Quaternary surfaces (late Pleistocene to early Quaternary) can be distinguished more precisely. The relatively high proportion (57%) of latest and late Quaternary (< 15 and <130 ka, respectively) faults in western Wyoming is indicative of high rates of activity associated with the Yellowstone Hotspot and broad expanses of glaciated terrain that can easily record evidence for relatively young surface faulting.

TABLE 2. Alphabetical listing of faults and folds in Wyoming
[Name of structure, database number. NA, not applicable (Class C structure)]

Almy fault zone, 742
Baldy Mountain fault, 770
Bear River fault zone, 730
Buffalo Fork fault, 767
Buffalo Fork fault, Middle section, 767b
Buffalo Fork fault, Northern section, 767a
Buffalo Fork fault, Southern section, 767c
Cedar Ridge fault, 774
Chicken Springs faults, 780
Continental fault, 776
Crooks Mtn. Section, 779a
Duncomb Hollow fault, 743
Eagle Bay fault, 757
East Gallatin-Reese Creek fault system, 746
East Gallatin-Reese Creek fault system, East Gallatin section, 746b
East Gallatin-Reese Creek fault system, Reese Creek section, 746a
East Gros Ventre fault, 756
East Mount Sheridan faults, 766
Eastern Bear Valley fault, 734
Elephant Back fault zone , 754
Elk Mountain fault, 736
Faults along the Lava Creek caldera margin, 763
Faults in boundary region of Yellowstone and Grand Teton National Parks, 764
Faults near Clear Creek, 759
Faults near Trishman and Douglas Knobs, 762
Faults of Brimstone Basin area, 760
Faults on north flank of Phil Pico Mountain, 744
Faults south of Blacktail Butte, 724
Ferris Mountains section, 779d
Flattop fault, NA
Grand Valley fault, 726
Grand Valley fault, Grand Valley section, 726b
Grand Valley fault, Star Valley section, 726d
Grand Valley fault, Swan Valley section, 726a
Grand Valley fault, Unnamed section near Prater Mountain, 726c
Green Mountain section, 779b
Greys River fault, 728
Hoback fault, 772
Hogsback fault, 732
Hogsback fault, Northern section, 732a
Hogsback fault, Southern section, 732b
Lake Hotel faults (graben), 755
Leckie fault, 775
Mallard Lake resurgent dome faults, 753
Mammoth fault, NA
Martin Ranch fault, 731
Middle section, 757b
Mirror Plateau faults, 749
Mol Heron Creek fault, NA
Muddy Gap section, 779c
North Bridger Creek fault, 737
North Granite Mountains fault system, 777
Northern section, 757a
Older Mirror Plateau faults, 749b
Phillips Valley fault, 771
Phillips Valley fault, Middle (Ski Lake) section, 771b
Phillips Valley fault, Northern section, 771a
Phillips Valley fault, Southern (Glory Slide) section, 771c
Porcupine Mountain fault (Utah and Wyo.), 2380
Post-Lava Creek faults in NW Yellowstone National Park, 747
Red Canyon fault, 657
Red Canyon fault, Maple Creek section, 657c
Red Canyon fault, Red Canyon section, 657a
Red Canyon fault, Richards Creek section, 657b
Rock Creek fault, 729
Ryckman Creek fault, 740
Savery-Baggs fault system, NA
Secondary faults in Jackson Hole valley, 725
Seminoe Mountains section, 779e
Shoshone Lake faults, 751
Signal Mountain fault, NA
Snake River caldera faults, 765
Snake River fault, NA
Sour Creek dome faults, 758
South Granite Mountains fault system, 779
Southern section, 757c
Split Rock syncline, 778
Spread Creek fault
Spring Creek fault, 738
Stagner Creek fault, 773
Sublette Flat fault, 733
Teton fault, 768
Teton fault, Avalanche Canyon section, 768e
Teton fault, Granite Canyon section, 768f
Teton fault, Middle section, 768c
Teton fault, Northern section, 768b
Teton fault, Southern section, 768d
Teton fault, Steamboat Mountain section, 768a
The Pinnacle fault, 739
Togwotee Lodge faults, 769
Two Ocean Lake fault
Unnamed faults in the Burnt-Raven Creek area, 750
Unnamed faults near Opal Creek, 748
Unnamed faults south of Owl Creek uplift, NA
Unnamed piedmont fault, 727
Upper Yellowstone Valley faults, 761
Warm Springs fault
Western Bear Valley faults, 735
Western section, 777a
Wheatland-Whalen fault system, NA
Whitney Canyon fault, 741
Wolf Lake fault and nearby faults, 752
Younger Mirror Plateau faults, 749a

Much of the data for northwestern Wyoming is from reconnaissance field studies by K.L Pierce and R.L. Christenson in the Yellowstone and Grand Teton National Parks, and from regional seismic-hazard studies conducted for the U.S. Bureau of Reclamation (Denver). However, 10 faults in Wyoming have been trenched in order to establish their paleoseismic history, which is substantially more than in Montana or Colorado (but less than in Utah). Most of these studies have been in southwestern Wyoming, whereas no trenching has been conducted in Yellowstone National Park and only three sites have been studied in Grand Teton National Park owing to access problems. The faults with detailed studies include the Grand Valley [726d], Greys River [728], Rock Creek [729], Bear River [730], Martin Ranch [731], Hogsback [732b], Whitney Canyon [741], Teton [768b, 768c, 768d], North Granite Mountains [777a] and South Granite Mountains [779b, 799d]. Paleoseismic studies on these faults and others in the adjacent parts of Idaho, Montana and Utah have shown that recurrent movement is prevalent on the Quaternary faults, but that their recurrence intervals may differ by as much as two orders of magnitude (*i.e.*, 1-2 k.y. on the Wasatch fault zone [2351] versus as much as 100-200 k.y. on faults in central Wyoming that have not been active since the middle or late Quaternary). Of the Quaternary faults in Wyoming, some of the most active are probably reactivated Laramide thrusts in the southwestern part of the state (Grand Valley [726c, 726d], Grey's River [728], Rock Creek [729], Bear River [730], Martin Ranch [731], Hogsback [732b], and Whitney Canyon [741]). In addition, other active faults include the range-bounding East Mount Sheridan [766], Teton [768], and Phillips Valley [771] faults, which are close to, but south of the migrating path of the Yellowstone hot spot. Within the Yellowstone caldera, the Lake Hotel [755] and Eagle Bay [756] faults are the most active, perhaps responding to periodic inflation and deflation of the caldera. Many of these faults have been studied in a detailed manner, either involving large-scale (detailed) mapping of the trace and associated Quaternary deposits or through trenching and paleoseismic studies.

Recurrence intervals of >10-20 k.y. are probably characteristic for most of the Wyoming faults, and although these may seem long, they are typical of faults in intraplate regions such as the Basin and Range and Wyoming Basin provinces. However, if one considers that a site may be affected by any of a number of potentially active faults within a certain range (*e.g.*, 50-100 km radius), then the concept of a *composite recurrence interval* should be considered for the sitting of critical facilities, such as dams, powerplants, military facilities, *etc*. For example, if there were 10 faults each having individual average recurrence intervals of 20 k.y. within a certain distance of a critical facility, then the site might be affected by strong ground shaking associated with local surface faulting once every 2,000 years (on average) as a result of an exposure to a large number of low slip-rate faults (and this does not account for the occurrence of background or non-surface rupturing M<6 earthquakes).

Summary

Most Quaternary faults in the western Wyoming have long recurrence intervals (>20 k.y. to 200 k.y.) and low slip rates (<0.2 mm/yr), which are consistent with occurrence of primarily low- to moderate-magnitude earthquakes that have been recorded or felt historically in Wyoming. In general, earthquakes up to magnitude M 5, and occasionally M 6, can (and do) occur anywhere in Wyoming, but surface rupturing earthquakes (M>6.25±0.25) are expected to be associated with normal-slip reactivation of pre-existing Laramide-age thrust faults and Quaternary range-bounding normal faults, most of which are concentrated within the southwestern and northwestern parts of the state, respectively. Our current rough estimate is that such earthquakes have stricken western Wyoming on an average of once every 500 years (at the most) during the past 15 k.y. The abundance and location of Quaternary faults provide a paleoseismic basis for estimating a level of seismic hazard independent of the short record of historic seismicity. The rupture lengths and displacement amounts documented for some of the major faults western Wyoming suggest that they are the result of rare (many century to millennia scale), but major surface-faulting paleoearthquakes that had magnitudes of >6.25 to perhaps as much as 7.5 (M_S). These data also suggest that the 1959 Hebgen earthquake (M_W 7.5, Doser, 1989 #22) on the Red Canyon [657] and Hebgen [656] faults in southwestern Montana is probably a geologically reasonable historic analog for a major surface-rupturing earthquake (*i.e.*, worst-case scenario) elsewhere in the western half of the state.

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Definition of Database Terms

Specialized database fields (shown in bold letters) provide abstracted data, most of which will be in searchable fields when the digital database is released. In addition to the searchable fields, more detailed information is provided in the "Comments" section. If no pertinent information was found in the published literature for a field, we show "none" or "not reported". The following glossary provides definitions of fields (in alphabetic order) and indicates where various information, if known, can be found. Not all terms shown in the glossary are used herein, since the glossary was assembled for descriptions of faults and folds in the entire United States. In-text citations of references are presented in a standard format with the exception of the addition of a reference-specific number at the end. This reference number allows us to omit the traditional alpha character for authors having multi-year publications (*e.g.*, 1988a, b). All fault numbers cited in the text are bounded by brackets [ ] to differentiate them from reference numbers.

Glossary of Terms

Definitions are derived from modern English-language dictionaries, the AGI Glossary of Geology, the Encyclopedia of Geomorphology, Southern California Earthquake Center (SCEC) web pages, and other sources.

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age of faulted surficial deposits [database field]
Includes the ages of faulted deposits at the surface. The geologic time terms used for ages (such as Holocene and Pleistocene) are defined elsewhere in the glossary

alluvium
Loose sediment composed of clay, silt, sand, gravel, and/or larger rocks. Material is transported from highland areas (hills and mountains) and deposited in low areas by streams.

alluvial fan
A low, outspread, relatively flat to gently sloping mass of alluvium that is shaped like an open fan. Commonly deposited by a stream at the place where it issues from a narrow mountain valley upon a plain or broad valley. Other terms that are generally synonymous with alluvial fan are bajada (coalesced alluvial fans) and piedmont slope (broad gently sloping surface mantled by relatively thin alluvium).

Alquist-Priolo Act
California seismic zoning act passed in 1972 in response to the 1971 San Fernando earthquake in order to prevent building across the traces of active faults. More information about the Alquist-Priolo Earthquake Fault Zoning Act and Earthquake Fault Zone maps is available from the California Division of Mines and Geology (http://www.consrv.ca.gov/dmg/rghm/a-p/index.htm).

1° x 2° (AMS) sheet [database field]
The name of the Army Map Service (AMS) sheet in which the structure is located. If the structure is located in more than one AMS sheet, the name of the sheet in which the majority of the structure is located is listed first, followed by the name(s) of other sheets in which the remainder of the structure is located. These sheets were used as base maps because they cover the entire United States, and are at a convenient regional scale of 1:250,000. Within the conterminous United States, the sheets are 1° x 2° (N-S and W-E); however, in Alaska the sheets are 1° x 3°.

average strike [database field]
The average strike of the surface trace of the structure in degrees is computed from Geographic Information System (GIS) software. For this database we have confined the strike of faults and the trends of fold axes to the northwest and northeast quadrants of the compass; they are reported as -90° to 90° values (respectively).

Basin-and-Range structure
A type of geologic structure characterized by generally subparallel fault-bounded mountains

separated by broad alluvium-filled basins. The ranges have been uplifted relative to the valleys along range-front faults and related intrabasin faults.

blind thrust fault

A thrust fault that does not rupture all the way to the ground surface. Movement along the fault produces uplift in the form of an anticline, but a clear or continuous surface rupture is not recognized. Many Quaternary blind thrust faults are thought to be present in southern California. Two examples of known blind thrust faults are the Elysian Park thrust, which runs underneath downtown Los Angeles, and the Northridge thrust along which the 1994 Northridge earthquake occurred.

comments [database field]

Narrative comments are provided for many of the database fields that are limited to numerical data or prescribed choices, such as structure number or time of most recent movement.

compiled or modified by [database field]

The date (year), name and affiliation of the person(s) responsible for compiling or modifying information in the database record.

County [database field]

County or counties in which the structure is located. If the structure is in more than one county, the county containing the majority of the structure is listed first, followed by county name(s) for the remainder of the structure. In cases where the features encompass several states, the counties are listed alphabetically by state.

creep

Relatively slow movement along a fault. It is sometimes called "seismic creep" to distinguish it from the slumping of rock or soil on slopes (which is also known as creep). It is sometimes called "aseismic creep", since it does not trigger events greater than microearthquakes. Creep is only known to occur on strike-slip faults.

date of historic deformation [database field]

Shows dates (as month, day, year both as local and GMT) that historical deformation occurred on structure. Details of deformation shown under historical surface deformation in fault description.

detachment fault

A low-angle to sub-horizontal fault into which more steeply dipping fault(s) commonly merge (sole). The term originally applied to the sole fault of thrust-fault systems in compressional terrains, however, term is now generally associated with normal-fault systems in extensional terrains.

Dip [database field]

The angle between a geologic surface (for example, a fault plane) and the horizontal. The direction of dip can be thought of as the direction a ball would roll if placed upon a tilted surface. Thus, a ball placed on a north-dipping fault plane would roll northward. The dip of a surface is always perpendicular to the strike of that surface.

dip direction [database field]

The general direction of dip of the fault surface (for example, E) or a numerical value of dip or range of dip values of the fault surface if known (for example 50°E) General down-dip direction(s) of the structure are defined by compass octants: north (N), west (W), south (S), east (E), northwest (NW), northeast (NE), southwest (SW), southeast (SE), or vertical (V). If separate faults (or parts of a fault) dip in different directions, multiple directions may be listed, beginning with the dip direction that is the most common along the structure. Values of dip may represent near-surface measurements at specific locations or theoretical subsurface dip values (based on cross sections or geophysical modeling).

dip-slip fault movement

Slip (movement) that is parallel to the dip of the fault. Normal slip and reverse slip are opposite senses of dip-slip movement and describe movement of the hanging wall block down and up the plane of the fault, respectively. (Compare with strike-slip fault movement.)

dextral. See right lateral

early Quaternary
The early part of the Quaternary era. Early Quaternary refers to the time between 1,600,000 years and 750,000 years ago.

epicenter
The point on the Earth's surface directly above the (subterranean) point of origin (hypocenter) of an earthquake, typically located by its latitude and longitude.

faceted spur
A planar surface that truncates a spur (narrow ridge) as a result of faulting and subsequent erosion. Also know as a triangular facet or triangular spur. These features are commonly regarded as neotectonic features, although the rates and actual processes of their formation are poorly understood.

fault
A fracture or zone of fractures along which there has been displacement of the adjacent blocks relative to one another. There are three major types of faults: normal, reverse, and strike-slip.

fault category
For the purposes of this database, we defined four categories of faults (Classes A-D) based on demonstrable evidence of tectonic movement during the Quaternary (known or presumed to be associated with large-magnitude earthquakes). Only Class A and B features are shown on the map and described in the database.

Category	Definition
A	Geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin, whether the fault is exposed by mapping or inferred from liquefaction or other deformational features.
B	Geologic evidence demonstrates the existence of Quaternary deformation, but either (1) the fault might not extend deeply enough to be a potential source of significant earthquakes, or (2) the currently available geologic evidence is too strong to confidently assign the feature to Class C but not strong enough to assign it to Class A.
C	Geologic evidence is insufficient to demonstrate (1) the existence of tectonic faulting, or (2) Quaternary slip or deformation associated with the feature.
D	Geologic evidence demonstrates that the feature is not a tectonic fault or feature; this category includes features such as joints, landslides, erosional or fluvial scarps, or other landforms resembling fault scarps but of demonstrable non-tectonic origin.

fault line
A commonly used term that is synonymous with the surface trace of a fault.

fault strand (or splay)
One of several closely spaced parallel or subparallel faults in a fault zone.

focal mechanism
The three dimensional description of the seismic waves that radiate outward from the focus (hypocenter) of an earthquake. The focal mechanism contains information on the orientation and slip on two perpendicular planes, either of which could represent the fault that ruptured to produce the earthquake. Additional information is needed to select which of the two orientations is correct.

focus
Also known as the hypocenter, the focus of an earthquake is the point on the fault plane where rupture began. Latitude, longitude, and depth define this point.

footwall
The underlying side of a fault. If you walked on the fault plane, your foot would be on this wall. See also hanging wall.

geologic setting [database field]

Generalized description of the geologic setting of the fault in terms of its regional geology and location, amount of total offset, and general age of offset strata.

geomorphic expression

Generalized description of deformational features at the surface that are related to the fault or fold, such as the size and shape of scarps, offset streams, sag ponds, grabens, shutter ridges, and faceted spurs.

GIS

An acronym for geographic information systems, which includes all computer software programs that allow the creation, manipulation, and output of geographically referenced data.

GMT

An acronym for Greenwich Mean Time, which is used as the basis of a standard time throughout the world. All time is measured relative to Greenwich Mean Time. The Greenwich Meridian (or prime meridian of the World) is taken as 0° longitude and it is the line from which all other lines of longitude are measured. Local time in most locations of the United States is 5-9 hours earlier than GMT. Seismologists may refer to UTC (Universal Coordinated Time), which is the same as GMT.

graben

An elongate downdropped block bounded by faults on its long side.

hanging wall

The overlying side of a fault: this is the part that "hangs" above the fault plane (see also footwall).

historical surface deformation [database field]

Time and date, and link to narrative that describes large historical earthquakes that caused surface faulting or other forms of tectonic deformation. In the United States, the vast majority of these earthquakes have occurred in California, Alaska, and Nevada.

Holocene

The most recent epoch of the Quaternary period of geologic time. The Holocene was preceded by the Pleistocene epoch. For this report, the Holocene is considered to span the time interval from 10,000 years ago to the present.

horst

An elongate uplifted block bounded by faults on its long side.

hypocenter

Also known as the focus, the hypocenter of an earthquake is the point on the fault plane where rupture began. This point is defined by latitude, longitude, and depth.

intensity

A measure of the level of earthquake shaking at a specific location. The dominant intensity system used in the U.S. is the Modified Mercalli intensity (MMI) scale. The magnitude of an earthquake is related to the total energy released by the event; an earthquake has only a single magnitude value. The shaking at the earth's surface produced by an earthquake decreases with distance form the epicenter and, therefore, an earthquake can have many different intensities.

isoseismal map

A contour map showing the distribution of intensities for an earthquake. Isoseismal lines divide areas of equal intensity from one another on an isoseismal map.

isoseisms (or isoseismal lines)

Lines connecting points at which the intensity for an earthquake is the same.

ka

An abbreviation for kilo-annum, which is the Latin term for "thousand years" ago. This abbreviation is commonly used when referring to the age of a geologic unit or time of an event with respect to the present time (for example, the event occurred between 2 ka and 4 ka). Note that “ago” is implied by ka, and need not be stated (contrast k.y.).

k.y.

An abbreviation for kilo-years or "thousand years." This abbreviation is commonly used to designate an interval of time in the past (for example, the event occurred 10 k.y. after deposition of the alluvium).

late Quaternary

The latter part of the Quaternary era. Late Quaternary refers to the time between 130,000 years ago and the present (contrast ka).

lateral fault or lateral-slip fault

A fault that slips in such a way that the two sides move laterally with respect one another. These terms are generally synonymous to strike-slip faults.

latitude

The angular distance (in degrees) north or south from the equator of a point on the earth's surface, measured on the meridian (north-south line) to the point (compare longitude).

left lateral

Horizontal displacement along a fault such that, in plan view, the side opposite the viewer appears to have moved to the left. This term is also known as sinistral.

length [database field]

Two types of length data are included: (1) end-to-end length of the Quaternary-age fault or fold axis as measured along a straight line from the most distal ends of the surface trace and (2) the trace length, which is the sum of the lengths of the actual map traces. If a trace is curved, end-to-end length cuts across the curve, whereas trace length follows it. Faults with overlapping strands may have trace lengths that exceed the end-to-end length by a factor of 1.5 or more. In cases where numerous faults are collected under one description, this reported value is a "cumulative length."

lineament

A linear topographic feature, or an alignment of topographic features or other surficial features that may reflect control by the underlying geology. Some lineaments are defined by alignments of vegetation, patterns in drainage systems, subtle color changes visible on aerial photographs, or cultural features such as fence lines or power lines. Some lineaments are associated with faults.

liquefaction

The transformation of loose sediment or soil into a fluid state as a result of increasing the pressure of the fluid in between the grains due to strong ground shaking. Liquefaction typically occurs in poorly consolidated, water-saturated sediment. Liquefaction can cause significant earthquake-related damage because structures located on ground that liquefies can collapse or sink into the ground

longitude

The angular distance (in degrees) east or west on the earth's surface, measured by the angle contained between the meridian (north-south line) of that place and the prime meridian (at Greenwich, England) (compare latitude). See also GMT.

Ma

An abbreviation for mega-annum, which is the Latin term for "millions of years." This abbreviation is commonly used when referring to the age of a geologic unit with respect to the present time; for example, the age of the faulted rock is 10 Ma.

magnitude

A general term for a measure of the total size of an earthquake (contrast with intensity). The size of an individual earthquake can be measured by the strength of the shaking or the duration of the shaking, both of which are directly related to the energy that is released by the earthquake. In modern seismology, the magnitude is determined from seismographic records of an earthquake. Commonly used magnitude measurements include ML, MS, mb, and Mw (see below).

mb (body-wave magnitude)

The magnitude of an earthquake determined by measuring the maximum amplitude of the P-wave on a seismogram of the event. P-waves, or primary waves, are compressional waves that have the highest velocity of all waves generated by earthquakes.

mainshock

The largest earthquake in a series of earthquakes that cluster, both geographically and in time. To be definitively called a mainshock, it should generally be at least half a magnitude unit larger than the next largest earthquake in the series. Otherwise, the series of earthquakes may be more accurately characterized as an earthquake swarm.

middle Quaternary

The middle part of the Quaternary era. Middle Quaternary refers to the time between 750,000 and 130,000 years ago.

ML (local magnitude)

A numerical calculation that defines the strength (magnitude) of an earthquake based on seismograms from stations within 600 km; also commonly known as the Richter magnitude. As initially defined by Charles Richter, ML represented the largest deflection of the needle on a standard seismograph at a distance of 100 km from the epicenter of a shallow earthquake that was recorded in southern California.

Modified Mercalli intensity (MMI) scale

An earthquake intensity scale, originally developed by Italian seismologist Giuseppi Mercalli in 1902, which was later modified in 1931 to reflect conditions in the United States. The scale describes the effects of an earthquake in twelve categories, from I (not felt by people) to XII (total damage) (see intensity).

most recent prehistoric deformation [database field]

Defines one of the four time categories in which the most recent prehistoric surface-rupturing or surface-deforming earthquake occurred based on geologically recognizable evidence of faulting, folding, or liquefaction. The categories are (1) latest Quaternary (<15 ka), (2) late Quaternary (<130 ka), (3) late and middle Quaternary (<750 ka), and (4) Quaternary (<1.6 Ma). This field documents prehistoric events: if there also has been historical surface faulting or folding, it is documented under the database field "Date of Historic Deformation."

MS (surface-wave magnitude)

The magnitude of an earthquake determined from surface waves on a seismogram from a teleseismic earthquake (one located more than 20° away). Surface waves are seismic waves that travel over the surface of the Earth versus than those that travel through the Earth, such as P-waves and S-waves. Ms magnitudes are measured from surface waves that have a period of about 20 seconds.

MW (moment magnitude)

The magnitude calculated from an earthquake's total energy (seismic moment). The seismic moment is a function of the amount of slip on a fault, the area of the fault that slips, and the average strength of the rocks that are faulted. Because Mw is directly related to the energy released by an earthquake, it is a uniform means of measuring earthquake magnitude and has become the standard measure of earthquake magnitude in modern seismology.

m.y.

An abbreviation for "millions of years." This abbreviation is commonly used when referring an interval of time; for example, the Quaternary period lasted 1.6 m.y.

name [database field]

Name of structure (fault, fold, liquefaction feature, or fault section, where appropriate). The earliest reference generally is given preference, except in cases where a more commonly accepted name is widely used in the recent literature. The following comments section typically contains (1) source of the name, (2) other names and the references in which they were used, (3) the geographic limits of the structure as shown in this compilation, and (4) geographic limits from other studies that are different from those shown in this compilation. Minor changes to the original name may be made for reasons of clarity or consistency, where appropriate.

Neogene

A geologic time period corresponding to the later part of the Tertiary era (0-26 Ma); includes the Miocene (26-5 Ma) and Pliocene (5-1.6 Ma) epochs.

Neotectonic

The study of post Miocene (<5 Ma) structures and structural history of the Earth's crust. Commonly considered to be the study of deformation related to the current stress regime.

normal fault

A fault characterized by predominantly vertical displacement in which the hanging wall moves downward with respect to the footwall of the fault. If the fault surface is exposed, the footwall is the side onto which water would drip. Generally, this type of fault is a sign of tectonic extension.

number [database field]

The structure (fault, fold, or liquefaction feature) is assigned a unique number. All faults referred to by number are shown in brackets (*i.e.*, [2015]). If sectioned, a letter (a, b, c, etc) will follow the fault's number with "a" assigned to the most northern or western section of a fault (*e.g.*, fault 207 has three sections: 207a, 207b, 207c).

oblique slip (also oblique fault)

Describes fault or fault motion that has a combination of lateral and vertical slip.

Paleogene

A geologic time period corresponding to the early part of the Tertiary era (65-26 Ma); includes Paleocene, Eocene, and Oligocene epochs.

Paleoseismology

The geologic study of prehistoric earthquakes.

paleoseismologic studies [database field]

Includes a synopsis of detailed site-specific paleoseismological studies, typically those involving exploratory trenching. Sites of geomorphic or geophysical studies or detailed geologic mapping (without trenching) are not included. Study sites are identified by fault number, section letter, and site number (*e.g.*, [601c-3]).

playa

A term used primarily in the southwestern United States to describe a dry, vegetation-free, flat area at the lowest part of an undrained desert basin, underlain by stratified clay, silt, or sand, and commonly by soluble salts. Playa surfaces are occasionally covered by shallow lakes in the wettest parts of the year.

physiographic province [database field]

Identifies the physiographic province in which the structure is located as defined for the conterminous United States by Fenneman and Johnson (1946, Physical divisions of the United States, U.S. Geological Survey) and for Alaska by Wahrhaftig (1965, U.S. Geological Survey Professional Paper 482).

Pleistocene

The earlier of two epochs in the Quaternary period. For the purpose of this compilation, the Pleistocene epoch is considered to have begun about 1.6 million years ago and ended at the beginning of the Holocene epoch, about 10,000 years ago.

Quaternary

The period of geologic time starting about 1.6 million years ago and continuing to the present. It is divided into two epochs: the Pleistocene and the Holocene. Late Quaternary refers to the time between 130,000 years ago and the present day. Pre-Quaternary refers to any time before 1.6 million years ago.

recurrence interval

Time interval between deformation events (faulting, folding, or liquefaction), based on historical data, calendric or calibrated radiocarbon dates. Intervals reported in ^{14}C years based on radiocarbon dates or in k.y. (thousands of years) based on non-numerical methods (such as stratigraphy or geomorphology). Also includes the time period for which this recurrence interval is valid (*e.g.*, 10-130 ka). Other published recurrence intervals, starting with the one that applies to the most recent time interval, are included in "Comments."

references [database field]

Includes complete bibliographic citations for all references for each structure.

reference number and citation. In-text citations of references are presented in a standard USGS format. For authors having multiple publications in the same year, a reference-specific number is added at the end (e.g., Collins, 1988 #1243), in lieu of the traditional alphabetic character for authors having multiple publications in the same year (*e.g.*, Collins, 1988a).

reliability of location [database field]

Reliability of location (Good or Poor) refers to the scale of the source map from which the trace of the structure was taken and to the method by which the trace of the structure was mapped. To qualify as a "good" location, either (1) the trace of the structure was shown on a topographic base map at a scale of 1:250,000 or more detailed and was accurately located on the original map using photogrammetry or similar methods, or (2) the trace of the structure was published on a topographic base map at a scale of 1:100,000 or more detailed, but transferred without photogrammetric methods. Traces that do not meet the above standards (less detailed/smaller scale, planimetric base, transfer by inspection, *etc*.) constitute a "poor" location. Judgments of reliability may not directly relate to line symbols (solid, dashed, dotted) that are used to represent the structure on geologic maps; however, all concealed or inferred faults are considered poorly located.

reverse fault

A fault in which the displacement is predominantly vertical, and the hanging wall moves up with respect to the footwall. The footwall is the side of the fault onto which water would drip if the fault were exposed. If the fault has a dip angle of less than 45 degrees, it is called a thrust fault.

Richter scale

Introduced in 1935 by Charles F. Richter, the Richter scale is based on a logarithmic expression that quantifies earthquake magnitude—typically it refers to local magnitude, but for large earthquakes, it commonly refers to surface-wave magnitude. (Large earthquakes are also commonly assigned a moment magnitude, which is based on seismic moment and is a better measure of the energy of an earthquake than are local or surface-wave magnitudes.) Since the Richter scale is logarithmic, very small earthquakes (microearthquakes) can have a negative magnitude. Although the scale has no theoretical upper limit, the practical upper limit, given the strength of materials in the crust, is just below 9 for local or surface-wave magnitudes and just below 10 for moment magnitudes. (See also ML, local magnitude.)

Riedel shear

A slip surface that develops in the early stage of shearing (faulting). Such shears are typically arranged en echelon, usually at inclinations of 10°-30° to the direction of relative movement.

right lateral

Horizontal displacement along a fault such that, in plan view, the side opposite the viewer appears to have moved to the right. This term is also known as dextral.

sag pond

A small body of water (pond) that occupies an enclosed depression or sag formed where recent fault movement has impounded drainage. Most common along strike-slip faults and in normal-fault grabens.

scarp

A prominent, fairly linear slope or escarpment. Scarps are often produced by faulting, especially that which involves a significant amount of dip slip. However, scarps can also be caused by stream erosion, wave erosion (lake shorelines) or landsliding. Fault scarps separate adjacent ground surfaces that are at different elevations.

seismic moment

A measure of the strength of an earthquake computed from the product of the area of fault rupture, the average amount of slip, and the shear modulus (rigidity) of the rocks offset by faulting. The moment can also be calculated from the amplitude spectra of seismic waves.

seismic zone (or seismic belt)

A region of the Earth's crust, generally an elongated region, associated with active seismicity. It may not be associated with a particular subsurface or surface fault.

seismicity

Usually for a specific geographic area, the seismicity describes the geographic, depth, and magnitude distribution of earthquakes.

seismograph

An instrument that detects, magnifies, and records earthquake and other ground motions.

seismograms

The recording made by a seismograph in response to ground motions caused by an earthquake, explosion, or other source. Old records were recorded mechanically on paper, but modern records are recorded digitally. The seismogram's x-axis usually represents time, whereas the y-axis records ground amplitude, velocity, or acceleration.

sense of movement [database field]

Sense of movement for a fault is based on the angle of dip of the fault and the relative direction of movement across the fault. Terms used to describe sense of movement include normal (N), reverse (R), thrust (T), strike-slip (SS), dextral (D, right-lateral), sinistral (S, left-lateral), and oblique (O).

shutter ridge

A ridge formed by vertical, lateral or oblique displacement on a fault that crosses an area having ridge and valley topography, with the displaced part of the ridge "shutting in" the valley.

Sinistral. See left-lateral.

strike

Trend or bearing of the line marking the intersection of a fault plane (or other planar geologic feature) with a horizontal surface. Strike is always at a right angle to dip.

strike-slip fault movement

Slip (movement) that is parallel to the trace of the fault. Two kinds of strike slip occur: right-lateral (also referred to as dextral) and left-lateral (also referred to as sinistral). Also known as lateral-slip fault movement. (Compare dip-slip fault movement.)

slip rate

The rate of motion obtained when amount of offset is divided by time interval. The common units of measure are mm/yr or m/k.y. (an equivalent unit). The average slip rate at a point along a fault is commonly determined from geodetic measurements, displacement of manmade features, or from offset geologic features whose age can be estimated or measured. Offset is measured parallel to the predominant slip direction or estimated from the vertical or horizontal separation of geologic features. In special cases, interval slip rates may be calculated if the times and amounts of slip of prehistoric earthquake events have been determined. This type of high-quality data is rather sparse.

slip-rate category [database field]

Defines one of four slip-rate categories as determined by the compiler or based on reported slip rates. The categories include (1) less than 0.2 mm/yr, (2) 0.2 to less than 1 mm/yr, (3) 1 to 5 mm/yr, and (4) greater than 5 mm/yr. "Comments" include a brief description of published slip rates and pertinent documentation or the basis for the compiler's selection. Generally, two types of slip rates are reported. The first type is herein termed a "geologic slip rate" and is typically derived from the age and amount of offset of geologic features. These rates are averages of slip over several to many earthquake cycles. The second type defines an interval or paleoseismic slip rate that is calculated on the basis of known times and amounts of slip for two or more prehistoric earthquakes.

State [database field]

State or states where the structure is located. If the structure is in more than one state, the state containing the majority of the structure is listed first, followed by state name(s) for the remainder of the structure. In cases where the features encompass numerous states, the states are listed alphabetically by state. Although "State" does not apply to Puerto Rico, Guam or other United States Territories, we place these names in the state database field for search purposes.

strike-slip fault

A fault in which the dominant sense of motion is horizontal, parallel to the strike of the fault. Also known as a lateral-slip fault. Motion is commonly described as left-lateral (sinistral) or right-lateral (dextral).

surface rupture

The breakage of ground along the surface trace of a fault, caused by the intersection of the part of the fault that ruptured in an earthquake with the Earth's surface.

surface trace

The intersection of a fault with the surface of the Earth. It is sometimes, but not always, expressed at the surface by geomorphic evidence such as scarps, ridges, valleys, saddles, sag ponds, etc. Also called fault line or fault trace.

synopsis [database field]

Contains a concise summary of information that serves as a thumbnail sketch of what is known about the structure.

Tertiary

The earliest of two periods in the Cenozoic era of geologic time. The Tertiary period begins at the end of the Cretaceous period (about 65 million years ago) and ends at the beginning of the Quaternary period (about 1.6 million years ago).

thrust fault

A fault of less than 45° dip in which the hanging wall moves up relative to the footwall.

triggered slip

A poorly understood process which involves slippage on a fault located in the same region as, but not directly associated with, another fault which ruptures in a major earthquake.

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#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

Fault and Fold Database

The following discussion of Quaternary faults and folds in Wyoming are organized by the number we have assigned to the structure. If a fault is present in more than one state, the number was assigned from that state in which the majority of the structure lies. For example, the Red Canyon fault [657] is primarily in Montana, but it is the first numerical listing for a fault in the Wyoming database.

657, Red Canyon fault

Structure Number 657

Comments: Refers to number 7 (Red Canyon fault) of Witkind (1975 #317), number 43 (Red Canyon fault) of Johns and others (1982 #259), number 14 (Red Canyon fault) of Stickney and Bartholomew (1987 #85), and Red Canyon fault of Stickney and Bartholomew (1987 #242; written commun. 1992 #556).

Structure Name Red Canyon fault

Comments: Pardee (1950 #46) noted a strong indication of a fault-controlled range front along the northeastern side of Hebgen Lake but did not report a fault name. The earliest use of this fault name was probably in the numerous publications resulting from the 1959 Hebgen Lake earthquake (Woodard, 1960 #653; Witkind and others, 1962 #633; Witkind, 1964 #247; Myers and Hamilton, 1964 #250; Witkind and others, 1964 #629; Witkind, 1969 #468). Myers and Hamilton (1964 #250) refer to the part of this fault southeast of the mouth of Red Canyon as the "Corey Spring fault zone." Fault extends from about 1 km northeast of the intersection of Kirkwood Creek and Hebgen fault [656] southeastward beyond the Yellowstone Park boundary to Maple Creek.

Synopsis Even though the largest historic earthquake in Montana resulted in surface rupture of part of this fault, little is known about its paleoseismic history. The Hebgen Lake earthquake (Mw 7.5) of 1959 occurred on this fault trend, but was had it's epicenter in Montana (Murphy and Brazee, 1964 #245). The majority of published data are in reports dating from the early 1960s, from studies initiated due to the 1959 Hebgen Lake earthquake. Sections cited herein are defined by distinct changes in the timing of the most recent event along the strike of the fault.

Date of compilation 01/10/93; revised 10/01/2000

Compiler and affiliation Kathleen M. Haller, U.S. Geological Survey; revised by Kathleen M. Haller and Kenneth L. Pierce, U.S. Geological Survey

Geologic setting This high-angle, down-to-southwest, arcuate fault is one in a belt of active faults that extends westward from Yellowstone and that Pierce and Morgan (1992 #539) relate to the easterly track of the Yellowstone hotspot. Fault extends along the southwest flank of Kirkwood Ridge, continuing south along northeastern side of Red Canyon, northern side of Grayling Arm of Hebgen Lake, and extends into the glacial outwash plain west of Yellowstone basin. The fault generally parallels the strike of bedrock (Witkind, 1964 #247; Myers and Hamilton, 1964 #250) and locally along the western section the fault follows the contact between massive limestone and thin-bedded shale (Doser, 1985 #22). Witkind (1964 #247) indicated net cumulative throw is several thousand feet along the central part of main fault section [657a], but the exact amount is indeterminable.

Number of sections 3

Comments: Sections defined herein based on distinct differences in timing of most recent surface faulting along the strike of the fault. The westernmost section [657a] is entirely in Montana and ruptured in the 1959 Hebgen Lake earthquake; the other two sections [657b, 657c] are prehistoric and are located to the east in Wyoming. The central section [657b] has post-glacial offset, and the easternmost section [657c] displaces 0.63 Ma Lava Creek Tuff.

Length End to end (km): 35.3
Cumulative trace (km): 28.8

Average strike (azimuth): N63°W

657a, Red Canyon section

Section number 657a

Section name Red Canyon section
Comments. This section comprises the 1959 rupture along the Red Canyon fault as mapped by (Witkind, 1964 #247; Myers and Hamilton, 1964 #250). The western end of the fault is at Kirkwood Creek about a kilometer northeast of Hebgen Lake, where it intersects the Hebgen fault [656] at a high angle. The Red Canyon fault extends northeast along the north side of Kirkwood Creek, turns southeast and forms the south flank of Kirkwood Ridge and the northeast side of Red Canyon. At the mouth of Red Canyon, the fault turns abruptly to the east along the Grayling Arm of Hebgen Lake, and crosses Grayling Creek above the Parade Rest Ranch. From here, the fault continues about 5 km further in a southeast direction, but it becomes less conspicuous. It crosses U.S. Highway 191 just north of its intersection with U.S Highway 287. The eastern (mapped) limit of the Red Canyon fault is at the eastern boundary of Gallatin County, Montana, which is the western boundary of Yellowstone National Park.

Reliability of location Good
Comments: Location based on 1:62,500-scale map of 1959 deformation (Witkind, 1964 #247; Myers and Hamilton, 1964 #250). Plate 5 of U.S. Geological Survey Professional Paper 435 (1964) suggests that the fault continues eastward from southern terminus shown here.

Scale of digital trace 1:250,000

State Montana

County Montana

State Gallatin

1° x 2° sheet Ashton

Physiographic province Northern Rocky Mountains

Sense of movement normal
Comments: Based on slip from the Hebgen Lake earthquake (Witkind, 1964 #247; Witkind and others, 1964 #629).

Dip 50°-85°SW
Comments: Range in dips from exposures of fault plane (Witkind, 1964 #247); Johns and others (1982 #259) indicated dip is nearly vertical. Geodetic data suggests that the fault dips 50° SW (Barrientos and others, 1987 #269).

Dip direction SW

Geomorphic expression The fault is characterized by 0.1- to 4.6-m-high historical scarps that are locally superimposed on prehistoric scarps (Witkind, 1964 #247; Myers and Hamilton, 1964 #250). Wallace (1980 #657) detailed significant degradation of the 1959 scarp at two locations.

Age of faulted surficial deposits Witkind (1964 #247) indicated that all the scarps are formed on unconsolidated sediments. However, based on geologic mapping shown on plate 5 of USGS Professional Paper 435 (1964), about 30 percent of the length of the scarps are on upper Quaternary (Pinedale and Bull Lake) alluvium and 70 percent on Precambrian, Cambrian, Devonian, and Mississippian bedrock.

Paleoseismologic studies The USGS conducted exploratory trenching of the Red Canyon fault and Hegben [656] fault in the summer of 2000. Although preliminary, the investigations by Haller and others [, 2000 #4603;, 2000 #4606) on the Red Canyon fault should yield information on the timing of the penultimate (prehistoric) event and the amount of throw associated with the faulted Pinedale outwash surface. Their trench site on the Red Canyon fault [657a-1] was located about one-half km east of Parade Rest Ranch, which is near the eastern end of the Red Canyon section [657a] of the fault.

Site 657a-1. This long, deep trench [657a-1] revealed evidence for a single prehistoric faulting event with about 1 m of offset and about 2 m of net offset in deposits related to the most recent glaciation (Pinedale), which is generally considered to have culminated about 15,000 radiocarbon years ago and which was dated here at 11-20 ka (Haller, 2000 #4603) by cosmogenic techniques. Further information on the possible amounts of displacement and timing of events will be forthcoming pending finalization of radiocarbon and cosmogenic isotope dating.;

Year of historic rupture 1959

Most recent prehistoric deformation Holocene or latest Quaternary (<15 ka)

Comments: Woodard (1960 #653) provided detailed descriptions of scarps on this fault. He indicated evidence of post-glacial (Pinedale) faulting at several locations, and thus, an estimate of <15 ka is used here. Other early papers discussing this fault suggested that there is local evidence of prior faulting (Witkind and others, 1962 #633; Witkind, 1964 #247; Myers and Hamilton, 1964 #250) suggesting at least two pre-1959 surface-faulting events at Blarneystone Ranch. 1954-vintage aerial photographs of the Grayling Creek area show clear evidence of a pre-existing scarp on deposits that are now known to be latest Pleistocene in age. Preliminary paleoseismic data on the Red Canyon fault suggest that the penultimate event was <10 ka [Schwartz, 2000 #4607), but unpublished radiocarbon dates obtained by Haller in 2001 suggest that the event occurred at about 3 ka, which is similar to the timing estimates for the adjacent Hebgen fault [656] (Pierce and others, 2000 #4609; Hecker and others, 2000 #4610). Morphologic studies by Nash (1984 #343) estimated the age of prehistoric faulting on nearby intrabasin fault scarps [659] to be 2.8 ± 1.0 k.y. Doser (1985 #22) reported a radiocarbon date of 3,250±850 yr B.P. that is attributed to Nash. Alexander and others (1994 #1252) suggested that the migration of the South Fork of the Madison River meander belt to the east is due to recurrent Holocene faulting.

Recurrence interval 3 k.y. (0-3 ka), 5.4-29.8 k.y. (<0.6-2.0 Ma)

Comments: No recurrence intervals based on dated events are published, although the recent unpublished radiocarbon dates (see Paleoseismologic studies) suggest that the penultimate event occurred at about 3 ka. Haller (2000 #4603) estimates that about 1 m of offset occurred in 1959 at the Grayling Creek trenching site, but this may be considerable more (2 m?) than farther northeast along the more central portions of the fault. Thus, the most recent (and only contrained) recurrence interval is 3 k.y. Conversely, Wheeler and Krystinik (1992 #608) had suggested a recurrence interval of 5.4-29.8 k.y. by considering the maximum age of the fault zone (including the Hebgen fault [656]) to be 0.6-2.0 m.y., the net cumulative throw of 305 m as determined from Witkind's data (1964 #247), and slip events having displacements similar to the 1959 Hebgen Lake earthquake. Ostenaa and Wood (1990 #318) indicated the recurrence interval is <10 k.y. for an unspecified time interval. Pierce and Friedman (1996 #3941) indicated that no more that three surface faulting events including the 1959 earthquake have occurred in about the past 30 k.y. They further suggested that the recurrence interval is 10 k.y. or greater for one or both of the major faults involved in the Hebgen Lake earthquake. Data are poorly constrained and paleoseismic information on individual faults affected by the Hebgen Lake earthquake are not currently available.

Slip-rate category 0.2-1.0 mm/yr

Comments: The preliminary data of Haller and others (2000 #4603) suggests that about 1 m of offset occurred at the Grayling Creek trenching site, but this may be more (2 m?) farther northeast along the more central portions of the fault. Nevertheless, this data suggest a slip rate of about 0.3-0.7 mm/yr (1 to 2 m of offset, 3 k.y. recurrence). Accordingly, the fault is tentatively assigned to the 02-1.0 mm/yr slip rate category. The only other known slip rate published for this fault zone is by Doser (1985 #641) whose estimate of 0.8-2.5 mm/yr is for an unspecified time interval. Based on data that Wheeler and Krystinik (1992 #608) used to determine recurrence intervals, a lower long-term of 0.15-0.5 mm/yr (305 m in 0.6-2.0 Ma) slip rate is suggested for the 1959 rupture zone, which includes the Hebgen fault [656].

Length End to end (km): 18.1

Cumulative trace (km): 24

Average strike (azimuth): N57°W

References

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657b, Richards Creek section

Section number 657b

Section name Richards Creek section
Comments: Named for Richards Creek, which flows parallel to the fault trace. This prehistoric section extends about 4 km westward from Wyoming into Montana.

Reliability of location Good
Comments: Fault traces from surficial geology mapped at 1:62,500 by Pierce (1973 #3805) and bedrock volcanic geology mapped by R.L. Christiansen and compiled at 1:125,000 (2001 #1784) and U.S. Geological Survey (1972 #639).

Scale of digital trace 1:125,000

State Wyoming, Montana

County Park (WY), Gallatin (MT)

1° x 2° sheet Ashton

Physiographic Province Northern Rocky Mountains

Sense of movement normal

Dip not determined

Dip direction S

Geomorphic expression A 3-m-high scarp is formed on the surface of Pinedale outwash gravel (Pierce, 1973 #3805). A fault scarp about 10 feet (3 m) high is formed on Pinedale fan gravel, and further east down faulting appears to have controlled the formation of shallow lakes along Richards Creek.

Age of faulted deposits Offsets an alluvial fan formed by Pinedale outwash gravel.

Paleoseismic studies none

Most recent prehistoric deformation Latest Quaternary (<15 ka)
Comments: Offsets outwash deposited at glacial maximum, which is estimated to be about 20-30 ka.

Recurrence interval not determined
Comments: At least one offset in past 20-30 k.y.

Slip-rate category unknown, probably <0.2 mm/yr

Comments: Offset of 3 m in past 20-30 k.y yields a maximum slip rate that falls within the assigned category.

Length End to end (km): 5.2
Cumulative trace (km): 5.4

Average strike (azimuth): N76°W

References

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#317 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in western Montana: U.S. Geological Survey Open-File Report 75-285, 36 p. pamphlet, 1 sheet, scale 1:500,000.

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657c, Maple Creek section

Section number 657c

Section name Maple Creek section
Comments: Named for Maple Creek, which the fault crosses just east of the floor of West Yellowstone basin. Mapped extent is only about 4 km.

Reliability of location Good
Comments: Mapped at 1:125,000 scale where it offsets the 0.63 Ma Lava Creek Tuff (U.S. Geological Survey, 1972 #639; Christiansen, 2001 #1784). Surficial geology mapped at 1:125,000 scale by Pierce (1973 #3805). Traces of faults digitized from combination of these 1:125,000-scale maps.

Scale of digital trace 1:125,000

State Wyoming

County Park (Wyo.)

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Sense of movement normal

Dip not determined

Dip direction S

Geomorphic expression Bedrock escarpments developed on 0.63 Ma Lava Creek Tuff; fault is mapped as not offsetting Pinedale glacial till (Pierce, 1973 #3805).

Age of faulted deposits 0.63 Ma Lava Creek Tuff

Paleoseismic studies none

Most recent prehistoric deformation middle and late Quaternary (<750 ka)
Comments: Youngest offset not well constrained, and possibly might be post-glacial (<15 ka).

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Lava Creek Tuff (0.63 Ma) is offset as much as 100 m, which yields a maximum long-term slip rate that falls within this category.

Length End to end (km): 4.0
Cumulative trace (km): 5.8

Average strike (azimuth): N73°W

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#468 Witkind, I.J., 1969, Geology of the Tepee Creek quadrangle, Montana-Wyoming: U.S. Geological Survey Professional Paper 609, 101 p., 2 pls.
#317 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in western Montana: U.S. Geological Survey Open-File Report 75-285, 36 p. pamphlet, 1 sheet, scale 1:500,000.
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724, Faults south of Blacktail Butte

Structure Number 724

Structure Name Faults south of Blacktail Butte
Comments: Shown as unnamed faults within the Antelope Blacktail Butte Study Areas on plate 4 of Gilbert and others (1983 #1338).

Synopsis An unnamed zone of faults for a graben about 1.5 km long that extends southward from Blacktail Butte across a loess-mantle late Pleistocene terrace that was deposited early in the last glacial period (the Pinedale). Although the scarp height is locally as much as 5.2 m, the net surface offset across the graben is less than 0.6 m. The small length of the recognized scarps may suggest that these are secondary features (like those near Jackson Hole [725]) to a more major fault in or adjacent to the valley.

Date of compilation Oct. 26, 2001

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Northern Rocky Mountains

Reliability of location Good
Comments: Fault traces based on geologic mapping of at 1:62,5000 scale by Gilbert and others (1983 #1338) and 1:125,000 scale by Love and others (1992 #2289) and Love and Love (1988 #4670).

Scale of digital trace 1:125,000

Geologic setting This fault zone extends south from Blacktail Butte into the central, sediment-filled portion of Jackson Hole and others (Gilbert and others, 1983 #1338; Love and Love, 1988 #4670; Love and others, 1992 #2289). The fault zone is rather short and has little net vertical offset across it, which suggests that it is a secondary feature related to movement on another, yet unidentified fault within the basin (Gilbert and others, 1983 #1338).

Sense of movement N

Dip not determined
Comments Primary faults dip west, whereas antithetic faults generally dip east at unknown angles.

Dip direction W, E

Geomorphic expression The Blacktail Buttes graben is well defined on aerial photographs but somewhat muted on the ground because of the thick loess that mantles the underlying gravel deposits. Gilbert and others (1983 #1338) mapped the scarps over a length of only 1.5 km, although lineaments continue another 0.5 km to the south. They profiled the fault zone and determined a maximum scarp height to be 5.2 m, but the graben only has a net surface displacement of 0.6 m. They said "A series of short, north-trending, en echelon scarps offset the loess in the outwash channel. The zone consists of a series of irregular west-facing scarps with several grabens" (Gilbert and others, 1983 #1338).

Age of faulted deposits The terrace on which the faulting is preserved was probably deposited early during the last glaciation (K.L. Pierce, written commun., 2001). The terrace itself has a loess mantle as thick as 3 m, but no buried soil (indicating depositional stability) was found near the base of the loess, which lies on deposits of the next older (Bull Lake) glaciation. Thus, the terrace is assigned to the early part of the last glaciation (i.e., early Pinedale). This terrace was subsequently undercut by a later Pinedale fluvial terrace on which the Jackson, Wyoming airport is built. Love and Love (1988 #4670) had previously mapped the fault and suggested that a flood associated with the Devils Elbow slide crossed this loess-mantled surface about 5,000 years ago, thus inferring middle Holocene or younger movement.

Paleoseismic studies none

Timing of most recent paleoevent Late Quaternary (<130 ka)
Comments: The fault offsets loess-mantled gravel that probably dates from early in the last glaciation (K.L. Pierce, written., commun., 2001). The maximum scarp angle is 17 degrees (Gilbert and others, 1983 #1338) that may indicate a Holocene age in that the loess mantle is readily erodible, which produces a more muted scarp than for the same age scarp in gravel.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: The scarp height is quite high (5.2 m), but the surface offset is only 0.6 m (Gilbert and others, 1983 #1338). A low-slip rate is inferred by the compiler on basis of small offset of relatively old deposits, and on activity rates on other seemingly secondary late Quaternary faults in adjacent parts of the region (see Gilbert and others, 1983 #1338). However, inasmuch as the faulting appears to be young, further study could lead to assignment of a faster slip rate category. Wong and others (2000 #4484) did not consider these faults in their recent appraisal of late Quaternary faulting of northwestern Wyoming.

Length End to end (km): 1.5
Cumulative trace (km): 1.9

Average strike (azimuth): N9°W

References

#1338 Gilbert, J.D., Ostenaa, D., and Wood, C., 1983, Seismotectonic study of Jackson Lake Dam and Reservoir, Minidoka Project, Idaho-Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-8, 123 p., 11 pl.

#4670 Love, J.D., and Love, J.M., 1988, Geologic road log of part of the Gros Ventre River Valley including the Lower Gros Ventre slide: Wyoming Geological Survey Reprint 46, 14 p.

#2289 Love, J.D., Reed, J.C., Jr., and Christiansen, A.C., 1992, Geologic map of Grand Teton National Park: U.S. Geological Survey Miscellaneous Investigations Map I-2031, scale 1:62,500.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

725, Secondary faults in Jackson Hole valley (Class B)

Structure Number 725

Structure Name Secondary faults in Jackson Hole valley (Class B)
Comments: Shown as unnamed faults within the Potholes, Antelope Flats, and Flat Creek Fan Study Areas on plate 4 of Gilbert and others (1983 #1338) and described as other "north-trending normal faults" by Gilbert and others (1983 #1338). Inasmuch as little is known about these specific structures, we refer to them informally as secondary faults in Jackson Hole valley.

Synopsis This collection of fault-like surficial features are concentrated in short zones in the eastern to northern part of the Jackson Hole valley, north of Jackson, Wyoming. They parallel the Teton fault [768], but display an order of magnitude (or much less) displacement less displacement. The faults have little to almost insignificant net vertical offset on individual strands or across graben-like structures, much like those features south of Blacktail Butte fault [724]. Early geologic mapping, which first noted their presence, suggested a fault origin, but later studies for seismic hazard assessments has suggested that the features might be related to strong ground motion, and thus are secondary features. No detailed studies involving trenching or exposure of the faults has been performed. We consider these features to be Class B structures (unsure origin, but of Quaternary age) pending further investigations.

Date of compilation Oct. 26, 2001

Compiler and affiliation Michael N. Machette and Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Northern Rocky Mountains

Reliability of location Good
Comments: Fault traces based on geologic mapping of at 1:62,5000 scale by Gilbert and others (1983 #1338) and 1:125,000 scale by Love and others (1992 #2289) and Love and Love (1988 #4670).

Scale of digital trace 1:62,500

Geologic setting These widely distributed groups of relatively short scarps are present on alluvial fan sequences that typically rest on fine-grained sediment, much like the lateral spread features that formed near Chilly Buttes as a result of the 1983 Borah Peak, Idaho earthquake. These faults are rather short and have little net vertical offset across them, which suggests that they is a secondary feature related to movement on another, yet unidentified fault within the basin (Gilbert and others, 1983 #1338).

Sense of movement N

Dip not determined

Dip direction W, E

Geomorphic expression The scarps included herein are concentrated in three discrete areas, each of which is shown on plate 4 of Gilbert and others (1983 #1338). From north to south, they are in the Potholes, Antelope Flats, and Flat Creek fan Study Areas. The scarps in the Potholes Study Area are about 2-2.5 km long, trend northeast, and are characterized by subdued slopes. The scarps in the Antelope Flats Creek fan Study Areas are about 4.5-5 km long and trend north-northeast or north-northwest. The scarps in the Flat Creek Study Area are more extensive, forming a zone about 5 km long (N-S) and 1 km wide (at the south end). In each case, there is some indication that the faulted surficial deposits rest or lie on finer-grained sediment at depth. However, no studies of scarp morphology appear to have been conducted at these sites.

Age of faulted deposits At Antelope Creek, the scarps are formed on Burned Ridge age glacial outwash (unit $Qo4_1$), whereas at the Potholes, the scarps are formed on Jackson Lake till (unit $Qo4_2$) (Gilbert and others, 1983 #1338). The scarps on the Flat Creek fan are on undated Holocene deposits (Gilbert and others, 1983 #1338). Recent studies for seismic hazard assessments has suggested that the features might be related to strong ground motion, and thus may be secondary features.

Paleoseismic studies none

Timing of most recent paleoevent Late Quaternary (<130 ka)

Comments: In general, the scarps are formed on terrace or alluvial fan deposits related to the last major glaciation (10-130 ka) or on Holocene deposits (undated). No studies of scarp morphology or trenching have been conducted at these sites in order to narrow the time of most recent faulting.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr

Comments: The heights of scarps associated with the faults is generally small, and the north-trending scarps on late Quaternary deposits at Flat creek suggest that about 0.6 m (2 ft) of late Quaternary displacement has occurred on at least some of these faults (Gilbert and others, 1983 #1338). A low-slip rate is inferred by the compiler on basis of small offset and on activity rates on other seemingly secondary late Quaternary faults in adjacent parts of the region (see Gilbert and others, 1983 #1338). Wong and others (2000 #4484) did not consider these faults in their recent appraisal of late Quaternary faulting of northwestern Wyoming.

Length End to end (km): 33.1
Cumulative trace (km): 13.8

Average strike (azimuth): N5°E

References

#1338 Gilbert, J.D., Ostenaa, D., and Wood, C., 1983, Seismotectonic study of Jackson Lake Dam and Reservoir, Minidoka Project, Idaho-Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-8, 123 p., 11 pl.

#4670 Love, J.D., and Love, J.M., 1988, Geologic road log of part of the Gros Ventre River Valley including the Lower Gros Ventre slide: Wyoming Geological Survey Reprint 46, 14 p.

#2289 Love, J.D., Reed, J.C., Jr., and Christiansen, A.C., 1992, Geologic map of Grand Teton National Park: U.S. Geological Survey Miscellaneous Investigations Map I-2031, scale 1:62,500.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

726, Grand Valley fault

Structure Number 726

Comments: Refers to number 22 (Grand Valley fault, Idaho) of Witkind (1975 #320) and numbers 20 and 21 (Star Valley fault, Wyoming) of Witkind (1975 #819).

Structure Name Grand Valley fault

Comments: Name of fault and its sections are modified from Piety and others (1992 #538). Earlier workers in the area restricted the use of "Grand Valley fault" to the part of the structure in Idaho, the southern extension in Wyoming was known as the "Star Valley fault." Preference for the single name as used by Piety and others (1992 #538) is given here. The Grand Valley fault extends from about 26 km southeast of Pocatello, Idaho, south to about 22 km south of Afton, Wyoming.

Synopsis This long fault extends from Idaho into Wyoming along the western base of the Snake and Salt River Ranges. The fault is a range-bounding structure that we describe in four sections; the southernmost, the youngest and most active, records recurrent Holocene movement. The northern part of the fault is outside the Intermountain Seismic Belt of Smith and Sbar (1974 #160), and the southern part is within this active belt; furthermore, faulting on the northern part is clearly older and less frequent than that to the south.

Date of compilation 03/20/1994, revised 10/15/01

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.; Michael N. Machette, U.S. Geological Survey; Kathleen M. Haller, U.S. Geological Survey

Geologic setting Down-to-west range-front normal fault that extends from near the Snake River Plain southward along the western base of the Snake and Salt River Ranges. Basin fill is estimated to be 2 to 3 km thick based on seismic reflection data (Royse and others, 1975 #4391; Dixon, 1982 #4382).

Number of sections 4

Comments: Detailed mapping and limited trenching suggest that the fault has three segments and an additional poorly characterized part of the fault (Piety and others, 1992 #538). The segments they define are herein considered as sections in accordance with this compilation. From north to south they are the Swan Valley section [726a], the Grand Valley section [726b], an unnamed section [726c], and the Star Valley section 726d], following the segment nomenclature defined by Piety and others (1992 #538). The segments they defined are based on parts of the fault that have different rates of Quaternary displacement and apparently different paleoseismic histories.

Length End to end (km): 135.5
Cumulative trace (km): 164.2

Average strike (azimuth): N22°W

726a, Swan Valley section

Section number 726a

Section name Swan Valley section

Comments: As defined by Piety and others (1992 #538), this section extends from a point about 10 km south from the southern edge of the Snake River Plain (approximately 26 km southeast of Pocatello, Idaho), south to somewhere within the 5-km-long "zone" between Palisades Creek and Sheep Creek. We arbitrarily place the southern boundary of the section midway between these two known geographic locations. Anders (1990 #3912) stated that there is a 400 m drop in the elevation of the basin fill surfaces from southeast to northwest in this area. Anders (1990 #3912) further subdivided this part of the fault into sections (northwestern, central, and southeastern sections) based on geology and physiography, but this finer subdivision is not warranted herein because neither the timing of faulting nor the slip rates seem to vary between his subsections.

Quality of location Poor

Comments: Although the source map for the location of the fault is approximately 1:40,000 scale (plate 1 of Piety and others, 1986 #55), the fault is shown as poorly located because of the absence of scarps. Location of northern part of fault (shown as dotted line) is from general location given in figure 2B in Piety and others (1992 #538) and should also be considered as poorly located. Fault is similarly depicted by Oriel and Moore (1985 #4385), but mapped higher in the range front by Albee and Cullins (1975 #4384).

Scale of digital trace 1:250,000

State Idaho

County Bonneville

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement N
Comments: (Piety and others, 1986 #55; Piety and others, 1992 #538)

Dip not determined
Comments: Piety and others (1992 #538) suggested that the Grand Valley fault is a listric normal fault because it has a curvilinear trace and maintains a uniform distance from the Absaroka thrust—a major regional thrust fault (Armstrong and Oriel, 1965 #4389). On seismic reflection profiles, the Grand Valley fault appears to merge with a ramp of the Absaroka thrust in the subsurface (Royse and others, 1975 #4391; Dixon, 1982 #4382).

Dip direction SW

Geomorphic expression One scarp exists along this part of the fault at Pine Creek; the mountain front is subdued.

Age of faulted deposits 1.5±0.8 Ma Pine Creek basalt (Anders and others, 1989 #408)

Paleoseismic studies none

Time of prehistoric faulting Quaternary (<1.6 Ma)
Comments: Piety and others (1986 #55) indicated the time of the most recent surface rupture on this section of the Grand Valley fault is Quaternary. The only clearly recognized fault scarp (0.6 km long) along the Swan Valley section is on the 1.5±0.8 Ma Pine Creek Basalt (Anders and others, 1989 #408) at Pine Creek (Piety and others, 1992 #538). Elsewhere the fault is buried by 10-70 ka loess. Scarps are absent on upper Pleistocene (<30 ka) deposits (Piety and others, 1986 #55). Anders (1990 #3912) cited Witkind (1975 #320) as indicating that this part of the fault is Holocene; Witkind (1975 #320) labeled the trace of the fault as Holocene, but indicated that it is late Cenozoic in the documentation accompanying the map. A 20-m-high fault scarp south of Rainy Creek (Piety and others, 1986 #55; Anders, 1990 #3912) is covered by unfaulted late Quaternary loess and is probably fluvial in origin. Mason (1992 #463) reinterpreted data presented by Piety and others (1986 #55) to suggest that the most recent event occurred between 15-30 ka (shown as 23±8 ka in table 2 of Mason, 1992, #463). Obviously this age is too young in light of Piety and others (1992 #538) study of the few scarps along this section.

Recurrence interval 100 k.y. (1.5 Ma)
Comments: Piety and others (1992 #538) estimated that the recurrence of 2-m surface faulting events is 100 k.y. (14 events in past 1.5 Ma). However, in an earlier publication they suggested that the recurrence interval may be 50-120 k.y. for the same time interval (Piety and others, 1986 #55). Furthermore, "higher displacement rates indicated by the paleomagnetic data for the 2 m.y. interval before deposition of Pine Creek Basalt may suggest that the events recorded by the 28-m-high scarp at Pine Creek occurred more frequently early in the interval following deposition of the basalt . . ." (Piety and others, 1992 #538). Based on data presented by Piety and others (1986 #55), Mason (1992 #463) suggested that repeat time between earthquakes on this section is greater than the time since the last event (or >23±8 ka). This interval appears to be too short in light of more recent interpretation of the scarps along this section.

Slip-rate category <0.2 mm/yr
Comments: Piety and others (1986 #55) stated that the average Quaternary displacement (slip) rate is 0.019 mm/yr based on the presence of a 28-m-high scarp on 1.5±0.8 Ma Pine Creek basalt. Anders (1990 #3912) and Piety and others (1986 #55) indicated the rate is 0.014 mm/yr for the past 2 m.y. Clearly both sources suggest that the rate would fall within the lowest slip rate category (<0.2 mm/yr) that we define herein. Piety and others (1986 #55) further suggested that the upper bound for the 2 m.y. slip rate could be 0.32 mm/yr because the Pine Creek basalt could be as young as 0.7 Ma (Anders and others, 1989 #408). However, this rate is not considered to be representative of the latest Quaternary history of the fault, since one would expect to observe scarps as much as 5 m high on deposits of 15 ka age along the fault.
Wong and others (2000 #4484) suggested fault slip rates ranging from 0.002 to 1.5 mm/yr, with maximum weighting of 60% on a value of 0.026 mm/yr. These reported slip rates are model dependent and do not represent actual measured values. The late Quaternary characteristics of this fault (overall

geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the slip rate during this period is probably similar to their median value, as is Piety and others (1986 #55) average Quaternary rate. Accordingly, the <0.2 mm/yr slip-rate category has been assigned to this fault.

Length End to end (km): 42
Cumulative trace (km): 42.5

Average strike (azimuth): N41°W

References

#4384 Albee, H.F., and Cullins, H.L., 1975, Geologic map of the Alpine quadrangle, Bonneville County, Idaho, and Lincoln County, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1259, 1 sheet, scale 1:24,000.

#3912 Anders, M.H., 1990, Late Cenozoic evolution of Grand and Swan Valleys, Idaho, *in* Roberts, S., ed., Geologic field tours of western Wyoming: Geological Survey of Wyoming Public Information Circular 29, p. 15-25.

#408 Anders, M.H., Geissman, J.W., Piety, L.A., and Sullivan, J.T., 1989, Parabolic distribution of circumeastern Snake River Plain seismicity and latest Quaternary faulting—Migratory pattern and association with the Yellowstone hotspot: Journal of Geophysical Research, v. 94, no. B2, p. 1589-1621.

#4389 Armstrong, F.C., and Oriel, S.S., 1965, Tectonic development of Idaho-Wyoming thrust belt: Bulletin of the American Association of Petroleum Geologists, v. 49, p. 1847-1866.

#4382 Dixon, J.S., 1982, Regional structural synthesis, Wyoming salient of Western Overthrust belt: American Association of Petroleum Geologists Bulletin, v. 66, p. 1560-1580.

#463 Mason, D.B., 1992, Earthquake magnitude potential of active faults in the Intermountain seismic belt from surface parameter scaling: Salt Lake City, University of Utah, unpublished M.S. thesis, 110 p.

#4385 Oriel, S.S., and Moore, D.W., 1985, Geologic map of the West and East Palisades Roadless Areas, Idaho and Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF-1619-B, 2 sheets, scale 1:50,000.

#538 Piety, L.A., Sullivan, J.T., and Anders, M.H., 1992, Segmentation and paleoseismicity of the Grand Valley fault, southeastern Idaho and western Wyoming, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds., Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179, p. 155-182.

#55 Piety, L.A., Wood, C.K., Gilbert, J.D., Sullivan, J.T., and Anders, M.H., 1986, Seismotectonic study for Palisades Dam and Reservoir, Palisades Project: Bureau of Reclamation Seismotectonic Report 86-3, 198 p., 2 pls.

#4391 Royse, F.J., Warner, M.A., and Reese, D.L., 1975, Thrust belt structural geometry and related stratigraphic problems Wyoming—Idaho—northern Utah, *in* Bolyard, D.W., ed., Deep drilling frontiers of the central Rocky Mountains: Denver, Colorado, Rocky Mountain Association of Geologists—1975 Symposium, p. 41-54.

#160 Smith, R.B., and Sbar, M.L., 1974, Contemporary tectonics and seismicity of the Western United States with emphasis on the Intermountain seismic belt: Geological Society of America Bulletin, v. 85, p. 1205-1218.

#320 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Idaho: U.S. Geological Survey Open-File Report 75-278, 71 p. pamphlet, 1 sheet, scale 1:500,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

726b, Grand Valley section

Section number 726b

Section name Grand Valley section

Comments: This section was defined by Piety and others (1992 #538) as extending from about Palisades Creek south to Dry Creek, which is south of the section boundary as we show it. The northern boundary is arbitrarily taken to be midway between Palisades Creek and Sheep Creek, as explained in section 726a; the southern boundary is at right step in the fault trace at the Greys River instead of further to the south as shown by Piety and others (1992 #538).

Quality of location Poor
Comments: Although the source map for the fault location is approximately 1:40,000 scale (plate 1 of Piety and others, 1986 #55), fault is designated as poorly located because of the absence of scarps.

Scale of digital trace 1:250,000

State Idaho; Wyoming

County Bonneville (ID); Lincoln (WY)

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement N
Comments: (Piety and others, 1992 #538)

Dip 25°-55° SW
Comments: Fault dips 55° at surface and decreases to 25° at a depth of 2.8 km (Anders and others, 1989 #408) based on seismic reflection data; the fault is inferred to be listric (Dixon, 1982 #4382).

Dip direction SW

Geomorphic expression There are no fault scarps or other geomorphic evidence for surface ruptures along this section of the fault. There is also no evidence of discernable tectonic tilt of rocks belonging to the Long Springs Formation, and this part of the fault coincides with the lowest part of the range front.

Age of faulted deposits The trace of the fault along the Grand Valley section is at the contact between Mesozoic or Paleozoic sedimentary rocks of the Snake River Range and Cenozoic basin fill (Anders and others, 1989 #408).

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Although Piety and others (1992 #538) noted the presence of a scarp on a 15-30 ka terrace near Alpine, Wyoming, they concluded that it is a fluvial not tectonic feature, based on the absence of shear fabric along a terrace edge contact that dips about 45° (see fig. 4.4). Furthermore, they inferred that only a small amount of Quaternary displacement has occurred along this part of the fault. Mason (1992 #463) suggested that the time of the most recent movement is less that 30 ka; however, this must reflect his interpretation of data presented earlier by Piety and others (1986 #55) and subsequently reinterpreted (Piety and others, 1992 #538). Anders and others (1989 #408) indicated that no evidence for latest Quaternary surface faulting exists north of Prater Canyon, which we use as the southern boundary of section 726c. The existing data suggest the age assignment for this part of the fault should be Quaternary. Anders (1990 #3912) cited Witkind (1975 #320) as indicating that this part of the fault is Holocene; Witkind (1975 #320) labeled the trace of the fault as Holocene, but indicated that it is late Cenozoic in the documentation accompanying the map. Mason's (1992 #463) interpretation that the most recent event occurred between 15-30 ka (or 23±8 ka in table 2) is obviously too young in light of Piety and others (1992 #538) study of the few scarps along this section.

Recurrence interval not determined
Comments: Based on data presented by Piety and others (1986 #55), Mason (1992 #463) suggested that repeat time between earthquakes on this section is greater than the time since the last event (or >23±8 ka). This interval appears to be too short in light of more recent interpretation of the scarps along this section, and thus, is not cited in above field.**Slip-rate category** Unknown; probably <0.2 mm/yr
Comments: Piety and others (1992 #538) stated that the "Quaternary displacement rate on the Grand Valley segment has been lower than the downcutting rate of the Snake River" and indicated that the displacement rate is lower than that on the adjacent segments (sections Anders and others (1990 #409) suggested that based on the tilt of Miocene and younger basin fill, there was significant pre-latest Quaternary movement on this part of the fault. However, most of the activity appears to have ceased in the Quaternary. Piety and others (1986 #55) suggested that the potential for surface faulting on this part of the fault is very low.

Wong and others (2000 #4484) suggested fault slip rates ranging from 0.002 to 1.5 mm/yr, with maximum weighting of 60% on a value of 0.013 mm/yr, or about half the rate on the section to the north [726a]. These reported slip rates are model dependent and do not represent actual measured values. The late Quaternary characteristics of this fault (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) also suggest the slip rate during this period is probably very low. Although there is no published slip rate for this section of the fault, the <0.2 mm/yr slip-rate category is assigned herein based on the absence of scarps on Quaternary deposits.

Length End to end (km): 30.9
Cumulative trace (km): 43.2

Average strike (azimuth): N29°W

References

#3912 Anders, M.H., 1990, Late Cenozoic evolution of Grand and Swan Valleys, Idaho, *in* Roberts, S., ed., Geologic field tours of western Wyoming: Geological Survey of Wyoming Public Information Circular 29, p. 15-25.

#408 Anders, M.H., Geissman, J.W., Piety, L.A., and Sullivan, J.T., 1989, Parabolic distribution of circumeastern Snake River Plain seismicity and latest Quaternary faulting—Migratory pattern and association with the Yellowstone hotspot: Journal of Geophysical Research, v. 94, no. B2, p. 1589-1621.

#409 Anders, M.H., Rodgers, D.W., McCalpin, J.P., and Haller, K.M., 1990, Late Tertiary and Quaternary faulting north and south of the eastern Snake River Plain, *in* Roberts, S., ed., Geologic field tours of western Wyoming: Geological Survey of Wyoming Public Information Circular 29, p. 1-38.

#4382 Dixon, J.S., 1982, Regional structural synthesis, Wyoming salient of Western Overthrust belt: American Association of Petroleum Geologists Bulletin, v. 66, p. 1560-1580.

#463 Mason, D.B., 1992, Earthquake magnitude potential of active faults in the Intermountain seismic belt from surface parameter scaling: Salt Lake City, University of Utah, unpublished M.S. thesis, 110 p.

#538 Piety, L.A., Sullivan, J.T., and Anders, M.H., 1992, Segmentation and paleoseismicity of the Grand Valley fault, southeastern Idaho and western Wyoming, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds., Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179, p. 155-182.

#55 Piety, L.A., Wood, C.K., Gilbert, J.D., Sullivan, J.T., and Anders, M.H., 1986, Seismotectonic study for Palisades Dam and Reservoir, Palisades Project: Bureau of Reclamation Seismotectonic Report 86-3, 198 p., 2 pls.

#4391 Royse, F.J., Warner, M.A., and Reese, D.L., 1975, Thrust belt structural geometry and related stratigraphic problems Wyoming—Idaho—northern Utah, *in* Bolyard, D.W., ed., Deep drilling frontiers of the central Rocky Mountains: Denver, Colorado, Rocky Mountain Association of Geologists—1975 Symposium, p. 41-54.

#160 Smith, R.B., and Sbar, M.L., 1974, Contemporary tectonics and seismicity of the Western United States with emphasis on the Intermountain seismic belt: Geological Society of America Bulletin, v. 85, p. 1205-1218.

#320 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Idaho: U.S. Geological Survey Open-File Report 75-278, 71 p. pamphlet, 1 sheet, scale 1:500,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

726c, Unnamed section near Prater Mountain

Section number 726c

Section name Unnamed section near Prater Mountain

Comments: Piety and others (1992 #538) do not name this part of the fault or include it in discussions of other segments (sections). They suggested that this part of the fault may have not ruptured with adjacent segments and thus has a unique faulting history. Section as shown herein extends from Greys River (location of northern boundary explained in section 726b) south to Prater Canyon.

Quality of location Poor

Comments: Location of fault poorly located (concealed) on 1:200,000-scale map without topography of Piety and others (1992 #538, fig. 5).

Scale of digital trace 1:250,000

State Wyoming

County Lincoln

1° x 2° sheet Driggs; Preston

Province Middle Rocky Mountains

Sense of movement N

Comments: (Piety and others, 1992 #538)

Dip not determined

Dip direction W

Geomorphic expression

Age of faulted deposits Piety and others (1992 #538) stated that loess-covered alluvial surfaces of about 70 ka age at the range front are not displaced. However, between Prater Canyon and Dry Creek, loess-covered alluvial fans of about 70-130 ka age at the range front are displaced.

Paleoseismic studies none

Time of most prehistoric faulting late Quaternary (<130 ka)

Comments: Age assignment based on data presented by Piety and others (1992 #538) that suggest that at least part of this section has ruptured since 130 ka.

Recurrence interval 40±30 k.y.

Comments: Mason (1992 #463) suggested a repeat time between earthquakes of 40±30 k.y. on this section. This was based on data presented by Anders and others (1989 #408) that indicated the most recent event occurred between 10 k.y. and 70 k.y. This recurrence interval is not constrained on the young side and may not be a representative of an earthquake cycle. In addition, based on the time of most recent movement indicated by Piety and others (1992 #538), the above stated recurrence interval is too short and does not realistically represent the interval since the last event.**Slip-rate category** Unknown; probably <0.2 mm/yr

Comments: Low slip-rate category assigned based on the absence of scarps on 70 ka deposits (Piety and others, (1992 #538).

Length End to end (km): 17.2
Cumulative trace (km): 17.7

Average strike (azimuth): N7°W

References

#408 Anders, M.H., Geissman, J.W., Piety, L.A., and Sullivan, J.T., 1989, Parabolic distribution of circumeastern Snake River Plain seismicity and latest Quaternary faulting—Migratory pattern and association with the Yellowstone hotspot: Journal of Geophysical Research, v. 94, no. B2, p. 1589-1621.

#4382 Dixon, J.S., 1982, Regional structural synthesis, Wyoming salient of Western Overthrust belt: American Association of Petroleum Geologists Bulletin, v. 66, p. 1560-1580.

#463 Mason, D.B., 1992, Earthquake magnitude potential of active faults in the Intermountain seismic belt from surface parameter scaling: Salt Lake City, University of Utah, unpublished M.S. thesis, 110 p.

#538 Piety, L.A., Sullivan, J.T., and Anders, M.H., 1992, Segmentation and paleoseismicity of the Grand Valley fault, southeastern Idaho and western Wyoming, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds., Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179, p. 155-182.

#4391 Royse, F.J., Warner, M.A., and Reese, D.L., 1975, Thrust belt structural geometry and related stratigraphic problems Wyoming—Idaho—northern Utah, *in* Bolyard, D.W., ed., Deep drilling frontiers of the central Rocky Mountains: Denver, Colorado, Rocky Mountain Association of Geologists—1975 Symposium, p. 41-54.
#160 Smith, R.B., and Sbar, M.L., 1974, Contemporary tectonics and seismicity of the Western United States with emphasis on the Intermountain seismic belt: Geological Society of America Bulletin, v. 85, p. 1205-1218.
#320 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Idaho: U.S. Geological Survey Open-File Report 75-278, 71 p. pamphlet, 1 sheet, scale 1:500,000.
#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

726d, Star Valley section

Section number 726d

Section name Star Valley section
Comments: The section was defined by Piety and others (1992 #538) as extending from Prater Canyon south to 1 km north of the Salt River (as shown by Warren, 1992 #837). This part of the fault bounds two distinct structural and physiographic basins of approximately equal size (Piety and others, 1986 #55). Furthermore, the topographic high separating these two basins near "The Narrows" is coincident with a 4-km right step in the trace of the fault. The Star Valley section includes both parts of the Star Valley fault of Witkind (1975 #819) in Wyoming. Piety and others (1986 #55) suggested that the southern 27 km of the Grand Valley fault is characterized by similar faulting histories on either side of the echelon step.

Quality of location Good
Comments: Fault location taken from 1:24,000-scale maps of Warren (1992 #837) and 1:275,000-scale map of Piety and others (1992 #538).

Scale of digital trace 1:250,000

State Wyoming

County Lincoln

1° x 2° sheet Preston

Province Middle Rocky Mountains

Sense of movement N
Comments: (Piety and others, 1986 #55; Piety and others, 1992 #538)

Dip 10°-70° W
Comments: According to cross-section 1 of Webel (1987 #815), the fault dips 70° near the surface, but progressively flattens and merges with the Absaroka thrust fault (dip 10° W) at a depth of about 12 km.

Dip direction W

Geomorphic expression Isolated fault scarps are present on late Quaternary alluvial fans at the mouths of major valleys (Piety and others, 1992 #538). These scarps tend to fall into to one of two size classes: 5-6 m high and 11-15 m high suggesting multiple times of movement on different age landscapes. Elsewhere, the fault is at the abrupt alluvial bedrock contact and few scarps exist beyond the mouths of the narrow channel valleys.

Age of faulted deposits Holocene and late Pleistocene alluvial fans along the eastern margin of Star Valley.

Paleoseismic studies [726d-1] Warren (1992 #837) trenched an 11-m-high scarp 0.8 km south of Swift Creek (the Afton trench site). The exposed stratigraphy suggests that three latest Quaternary earthquakes occurred at about 5540±70 14C yr B.P. (3 m of slip), 8090±80 14C yr B.P. (4 m of slip), and about 12-15 ka (4 m slip). McCalpin (1993 #796) reported that the earliest (third) event at the site occurred between 14 and 15.5 ka.

Time of most prehistoric faulting latest Quaternary (<15 ka)

Comments: Warren (1992 #837) dated the most recent paleoearthquake as mid-Holocene at about 5540 ± 70 14C yr B.P.; these data are reiterated by McCalpin (1993 #796).

Recurrence interval >5.5 k.y (0-5.5 ka); 2.4-2.7 k.y (5.5-8 ka); 4–7 k.y. (8 to 14.5-15 ka)

Comments: Warren (1992 #837) documented two recurrence intervals from his three dated events. The most recent recurrence interval was 2,400-2,700 14C yr, preceded by a less well constrained interval of about 4–7 k.y. However, since most recent event occurred at about 5540±70 14C yr BP, the present interval of quiescent suggests that recurrence intervals can be >5.5 k.y., which appears to be the criteria used by Mason (1992 #463) to suggest that the repeat time between earthquakes on this section is 5±2.4ka based on data presented by Piety and others (1986 #55).

Slip-rate category 0.2-1 mm/yr

Comments: Warren (1992 #837) reported a late Quaternary slip rate of 0.73-0.91 mm/yr. This rate must be derived from the cumulative slip of the two most recent events (7 m) and the time interval between about 5.5 ka and 12-15 ka. Earlier, Piety and others (1986 #55; 1992 #538) and then Anders and others (1990 #409) suggested that the latest Quaternary (<15 ka) slip rate for the Star Valley section is 0.6-1.1 mm/yr based on 8.3-11.6 m high scarps on 11-15 ka deposits. Interestingly the slip rate on this part of the fault is comparable to that on the Swan Valley section during the interval from 2.0-4.4 Ma.

Wong and others (2000 #4484) suggested fault slip rates ranging from 0.026 to 2.3 mm/yr, with maximum weighting of 60% on a value of 1.1 mm/yr. These reported slip rates are based on a combination of data from Anders and others (1990 #409), Piety and others (1986 #55; 1992 #538), and McCalpin (1993 #796). The late Quaternary characteristics of this fault (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the slip rate during this period is probably less than the 1.1 mm/yr that Wong and others (2000 #4484) favored. Because most of the reported slip rates are less than 1 mm/yr (especially the younger ones), we assign the 0.2-1 mm/yr slip-rate category to this section of the Grand Valley fault.

Length End to end (km): 51.5
Cumulative trace (km): 60.9

Average strike (azimuth): N8°W

References

#409 Anders, M.H., Rodgers, D.W., McCalpin, J.P., and Haller, K.M., 1990, Late Tertiary and Quaternary faulting north and south of the eastern Snake River Plain, *in* Roberts, S., ed., Geologic field tours of western Wyoming: Geological Survey of Wyoming Public Information Circular 29, p. 1-38.

#4382 Dixon, J.S., 1982, Regional structural synthesis, Wyoming salient of Western Overthrust belt: American Association of Petroleum Geologists Bulletin, v. 66, p. 1560-1580.

#463 Mason, D.B., 1992, Earthquake magnitude potential of active faults in the Intermountain seismic belt from surface parameter scaling: Salt Lake City, University of Utah, unpublished M.S. thesis, 110 p.

#796 McCalpin, J.P., 1993, Neotectonics of the northeastern Basin and Range margin, western USA: Zeitschrift fuer Geomorphologie N. Folge, v. 94, p. 137-157.

#538 Piety, L.A., Sullivan, J.T., and Anders, M.H., 1992, Segmentation and paleoseismicity of the Grand Valley fault, southeastern Idaho and western Wyoming, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds., Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179, p. 155-182.

#55 Piety, L.A., Wood, C.K., Gilbert, J.D., Sullivan, J.T., and Anders, M.H., 1986, Seismotectonic study for Palisades Dam and Reservoir, Palisades Project: Bureau of Reclamation Seismotectonic Report 86-3, 198 p., 2 pls.

#4391 Royse, F.J., Warner, M.A., and Reese, D.L., 1975, Thrust belt structural geometry and related stratigraphic problems Wyoming—Idaho—northern Utah, *in* Bolyard, D.W., ed., Deep drilling frontiers of the central Rocky Mountains: Denver, Colorado, Rocky Mountain Association of Geologists—1975 Symposium, p. 41-54.

#160 Smith, R.B., and Sbar, M.L., 1974, Contemporary tectonics and seismicity of the Western United States with emphasis on the Intermountain seismic belt: Geological Society of America Bulletin, v. 85, p. 1205-1218.
#837 Warren, G.A., 1992, Quaternary geology and neotectonics of southern Star Valley and the southwest flank of the Salt River Range, western Wyoming: Logan, Utah State University, unpublished M.S. thesis, 96 p., 3 pls., scale 1:24,000.
#815 Webel, S., 1987, Significance of backthrusting in the Rocky Mountain thrust belt, *in* Miller, W.R., ed. The thrust belt revisited: Wyoming Geological Association, 38th Annual Field Conference, Jackson Hole, Wyoming, September 8-11, 1987, Guidebook, p. 37-53.
#320 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Idaho: U.S. Geological Survey Open-File Report 75-278, 71 p. pamphlet, 1 sheet, scale 1:500,000.
#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

727, Unnamed piedmont fault

Structure Number 727
Comments: Not shown on any previous compilation.

Structure Name Unnamed piedmont fault
Comments: Fault scarps were mapped and discussed as part of the Older Star Valley fault by Piety and others (1986 #55). They are located about 5 km east of Freedom, Idaho, at north end of the Star Valley between the North Branch of Cedar Creek and Prater Canyon. This places them on the piedmont about 3 km west of the Grand Valley fault [726] and the front of the Salt River Range in Wyoming.

Synopsis: Poorly studied east- and west-facing piedmont scarps at the north end of Star Valley west of the Grand Valley fault [726] and the front of the Salt River Range in Wyoming.

Date of compilation 03/21/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Lincoln

1° x 2° sheet Preston

Province Middle Rocky Mountains

Reliability of location Good
Comments: Scarps are mapped at 1:28,000 scale on fig. 3-17 of Piety and others (1986 #55) without topographic base. They were transferred to a 1:250,000-scale topographic base map for compilation. Piety and others (1986 #55) discussion suggests the scarps are longer (2.0-2.5 km) than shown on their figure and in this compilation.

Scale of digital trace 1:250,000

Geologic setting The piedmont scarps define a 2-km-wide graben that is 3 km west of the Salt River Range front. They probably are the surficial expression of a more extensive intrabasin fault not recognized on seismic-reflection profiles (Piety and others, 1986 #55).

Sense of movement N
Comments: (Piety and others, 1986 #55)

Dip not determined

Dip direction W, E

Geomorphic expression Subdued north-trending fault scarps on older remnant of alluvial fan. Piety and others (1986 #55) measured profiles across these scarps; the larger west-facing scarps are 5.3- to 6.3-m-high and have maximum scarp-slope angles of 14°-15°. The east-facing antithetic scarps are smaller and less steep.

Age of faulted deposits The fault offsets early upper Pleistocene (Bull Lake?, ca. 130 ka) alluvial-fan deposits and undifferentiated late Quaternary alluvium and colluvium (Piety and others, 1992 #538).

Paleoseismic studies none

Timing of most recent paleoevent Late Quaternary (<130 ka)
Comments: Timing inferred on basis of subdued scarp morphology compared to nearby Holocene-age scarps on the Star Valley section of Grand Valley fault [726d] and regional geologic relations (Piety and others, 1986 #55).

Recurrence interval not determined

Slip Rate unknown, probably <0.2 mm/yr
Comments: Inferred to be low based on maximum scarp heights of about 6 m on early late Pleistocene (ca. 130 ka) deposits. If the scarp height approximates surface offset (i.e., 5-6 m), the late Quaternary slip rate might be as low as 0.04-0.05 mm/yr (5-6 m in <130 k.y.). Piety and others (1986 #55) commented that the slip rate of the Older Star Valley fault (which includes this fault section) is probably lower than that for the Star Valley section [726d] of Grand Valley fault, which shows Holocene movement.

Length End to end (km): 1.6
Cumulative trace (km): 3.1

Average strike (azimuth): N9°W

References

#538 Piety, L.A., Sullivan, J.T., and Anders, M.H., 1992, Segmentation and paleoseismicity of the Grand Valley fault, southeastern Idaho and western Wyoming, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds., Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179, p. 155-182.

#55 Piety, L.A., Wood, C.K., Gilbert, J.D., Sullivan, J.T., and Anders, M.H., 1986, Seismotectonic study for Palisades Dam and Reservoir, Palisades Project: Bureau of Reclamation Seismotectonic Report 86-3, 198 p., 2 pls.

728, Greys River fault

Structure Number 728
Comments: Not shown on any previous compilation.

Structure Name Greys River fault
Comments: Originally mapped but unnamed by Rubey (1973 #822). Name first used by Jones and McCalpin (1992 #813) and informally introduced by McCalpin (1993 #796). Fault extends from about 1 km south of Blind Trail Creek south to the East Fork of the Greys River as shown by Rubey (1973 #822), and Jones (1995 #3910).

Synopsis Complex fault scarps in densely-forested terrain at the base of a steep range front. Data from three trenches at one location indicate that similar amounts of slip have characterized the past two faulting events; however, the history of faulting suggests highly variable recurrence intervals during the late Quaternary.

Date of compilation 03/21/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Lincoln

1° x 2° sheet Preston

Province Middle Rocky Mountains

Quality of location Good
Comments: Comments: Fault location from 1:62,500-scale mapping of Rubey (1973 #822), supplemented by unpublished 1:24,000-scale mapping that was recompiled at 1:48,000 scale by Jones (1995 #3910). Although Rubey's mapping stopped at 43° N, the study by Jones (1995 #3910) supports a northern termination of the Quaternary fault at this same latitude. Fault traces were recompiled at 1:250,00 scale on a topographic base map.

Scale of digital trace 1:250,000

Geologic setting This high-angle down-to-west normal fault bounds the west side of the Wyoming Range. Fault probably soles into the Laramide-age Darby thrust fault. McCalpin (1993 #796) indicated that the fault's throw may be 300-1000 m based on cross sections of Rubey (1973 #822).

Sense of movement N

Comments: Normal movement indicated by Rubey (1973 #822).

Dip 10°-70° W

Comments: According to cross section 1 (fig. 14) of Webel (1987 #815), the fault dips 70° at the surface and joins the Laramide-age Darby thrust at depth of about 2 km, the latter of which flattens progressively to less than 10° at depth of 8.2 km.

Dip direction W

Geomorphic expression Fault scarps generally are 3- to 11-m high (Jones and McCalpin, 1992 #813); along most of the range front, complex step faults are present in bedrock-cored colluvium.

Age of faulted deposits at the surface Upper Triassic and Jurassic bedrock is in fault contact with Permian-Pennsylvanian or lower Triassic bedrock along most of the length of the fault; locally Triassiac bedrock is faulted as mapped by Rubey (1973 #822).

Paleoseismic studies Site 728-1. Jones and McCalpin (1992 #813) excavated three trenches across fault scarps on upper Pleistocene outwash deposits at Sheep Creek, a tributary to the Grey's River. The trenches revealed evidence of one late and one middle Holocene earthquake; their timing is constrained by eight radiocarbon ages. No stratigraphic evidence for earlier earthquakes was present, even though the trenched deposits are thought to be about 15 ka. The most recent faulting event resulted in about 5 m of slip and the earlier event about 4.3 m of slip.

Time of most prehistoric faulting Latest Quaternary (<15 ka)

Comments: The most recent event is late Holocene: it is bracketed by radiocarbon ages of 1910±60 14C yr B.P. and 2110±60 14C yr B.P. (Jones and McCalpin, 1992 #813; McCalpin, 1993 #796).

Recurrence interval 2970-3400 14C yr (about 2.0-5.2 ka)

Comments: Recurrence interval from Jones and McCalpin (1992 #813) based on dated paleoearthquakes at 1910-2110 14C yr B.P. and 5080-5310 14C yr B.P. This short recurrence interval suggests an earthquake cluster (two closely spaced events) that may not be characteristic of the longer late Quaternary history of the fault. However, no displacement occurred between about 5 ka and 15 ka. This 10-k.y. interval of quiescence implies considerable variability in recurrence times (McCalpin, 1993 #796).

Slip-rate category 0.2-1.0 mm/yr (<15 ka)

Comments: No slip rate is published, but the most recent displacement of 5 m occurred after an interval of 2970-3400 14C yrs; the resultant late Holocene slip rate is 1.5-1.7 mm/yr. This short recurrence interval suggests an earthquake cluster (two closely spaced events) that may not be characteristic of the longer late Quaternary slip rate of the fault. In fact, inferred late Quaternary slip rates are much lower because of the variability in the recurrence intervals. The previous 4.3 m of slip occurred over an interval of >10 k.y., which yields a much lower slip rate of <0.4 mm/yr (5-15 ka) and a maximum latest Quaternary (<15 ka) rate of 0.7 mm/yr.

Wong and others (2000 #4484) suggested fault slip rates ranging from 0.04-1.9 mm/yr, each with separate weighting. These reported slip rates are based on data of McCalpin (1992 #813). They place a 60% weighting on a rate of 0.7 mm.yr, which we consider to be a maximum rate for the late Quaternary. Considering the above discussion and the evidence for an earthquake cluster in the middle Holocene, we categorize the Greys River fault in the 0.2-1.0 mm/yr bracket and recognize that it may have considerably faster slip rates over short intervals of geologic time (several thousand years). A similar treatment was afforded the nearby Rock Creek fault [729].

Length End to end (km): 49.4
Cumulative trace (km): 50.2

Average strike (azimuth): N3°W

References

#3910 Jones, L.C.A., 1995, The Quaternary geology of the eastern side of the Greys River Valley and the neotectonics of the Greys River fault in western Wyoming: Logan, Utah State University, unpublished M.S. thesis, 116 p., 7 plates, scale 1:48,000.

#813 Jones, L.C.A., and McCalpin, J.P., 1992, Quaternary faulting on the Greys River fault, a listric normal fault in the overthrust belt of Wyoming: Geological Society of America Abstracts with Programs, v. 24, no. 6, p. 20.

#796 McCalpin, J.P., 1993, Neotectonics of the northeastern Basin and Range margin, western USA: Zeitschrift fuer Geomorphologie N. Folge, v. 94, p. 137-157.

#822 Rubey, W.W., 1973, Geologic map of the Afton quadrangle and part of the Big Piney quadrangle, Lincoln and Sublette Counties, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-686, 2 sheets, scale 1:62,500.

#815 Webel, S., 1987, Significance of backthrusting in the Rocky Mountain thrust belt, *in* Miller, W.R., ed. The thrust belt revisited: Wyoming Geological Association, 38th Annual Field Conference, Jackson Hole, Wyoming, September 8-11, 1987, Guidebook, p. 37-53.

729, Rock Creek fault

Structure Number 729
Comments: Refers to number 16 (Rock Creek fault) in Witkind (1975 #819), shown but unnamed by Gibbons and Dickey (1983 #821).

Structure Name Rock Creek fault
Comments: Name originally appears on plate 1 of Rubey and others (1975 #816), but is not mentioned in the text. Also shown as the Beck Creek fault (Blackstone and DeBruin, 1987 #820). Fault extends from about 1.5 km west of headwaters of Mayfield Creek south to about 2 km west of headwaters of Bullpen Creek (5.3 km south of U.S. Highway 30N). According to Rubey and others (1980 #814), the fault extends 2 km farther north to West Branch Hams Fork.

Synopsis The Rock Creek fault is a high-angle, down-to-west normal fault within the Tunp Range; it may sole into the Laramide-age Tunp thrust fault. Scarps are present along much of the length of this fault. Morphologic studies of the scarps have been conducted and one trench that was excavated constrains the timing of the most recent movement at about 3.3 ka.

Date of compilation 03/21/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Lincoln

1° x 2° sheet Ogden; Preston

Province Middle Rocky Mountains

Quality of location Good
Comments: Fault location from 1:62,500-scale mapping of Rubey and others (1975 #816, 1980 #814) as modified by unpublished 1:24,000-scale mapping of the compiler. Chambers (1988 #818) also mapped the extent of fault scarps at a scale of 1:63,360. Fault traces were recompiled at 1:250,00 scale on a topographic base map.

Scale of digital trace 1:250,000

Geologic setting High-angle, down-to-west normal fault within the Tunp Range bounding west side of Dempsey Ridge. The fault forms the eastern boundary of a graben that parallels the trend of decollement structures of the Overthrust Belt (Anders and LaForge, 1983 #836). The Rock Creek fault may sole into the Laramide-age Tunp thrust fault. Stratigraphic throw of Eocene and older units ranges from 300 m to 500 m (Rubey and others, 1975 #816).

Sense of movement N
Comments: (Rubey and others, 1975 #816)

Dip 60°(?) W

Comments: Rubey and others (1975 #816) stated that data are insufficient to determine the fault's dip and geometry, but they showed the fault schematically in plate 2 as having a 60° W dip.

Dip direction W

Geomorphic expression Most of fault length is characterized by scarps on steep colluvial slopes. Rubey and others (1975 #816) indicated that scarps are ≤15 m high, Witkind (1975 #819) indicated they are < 20 m high, but McCalpin (1993 #796) stated that some scarps are as much as 25 m high. Isolated scarps in alluviated drainages are 6-8 m high (McCalpin and Warren, 1992 #817; McCalpin, 1993 #796). Chambers (1988 #818) measured fault scarp profiles at seven locations, whereas Anders and LaForge (1983 #836) did not field check the scarps

Age of faulted deposits at the surface Holocene and Pleistocene landslide deposit and Tertiary bedrock (Rubey and others, 1975 #816) are offset; however, most of the length of the fault is mapped at the alluvium-bedrock contact (Rubey and others, 1975 #816; 1980 #814). In contrast to the available geologic mapping, McCalpin (1993 #796) stated that most of fault is in colluvium.

Paleoseismic studies Site 729-1. McCalpin and students excavated a trench across a 6.4-m-high fault scarp at Cook Canyon (McCalpin, 1993 #796); total stratigraphic throw is more than 11 m at this site (McCalpin and Warren, 1992 #817). Nine radiocarbon ages were obtained, mainly from buried soils intercalated with alluvium on the downthrown block. These ages constrain the timing of a late Holocene event and define a minimum time for an earlier event because the older deformed colluvial wedge is ≥4470 14C yr B.P. However, the earlier history of faulting could not be reconstructed because the trench did not get through the thick Holocene alluvium that was deposited against the fault scarp on the downthrown block (McCalpin and Warren, 1992 #817). A charcoal sample from a buried soil under scarp-derived colluvium exposed in a stream cut bank in Cook Canyon (nearly the same location as site 729-1) in an earlier study (Chambers, 1988 #818) indicated the older event occurred since 4780±260 14C yr B.P.; this age determination was taken to represent a maximum time for the earlier faulting event. Thus, the timing of the earlier event is inferred to be middle Holocene and constrained by these two radiocarbon ages (≥4470 14C yr B.P. and <4780±260 14C yr B.P). We consider the older (penultimate) event to be 4.6±0.2 ka for the purposes of this discussion.

Time of most prehistoric faulting latest Quaternary (<15 ka)
Comments: The most recent event is bracketed by radiocarbon ages of 3280±70 and 3880±60 14C yrs B.P. (McCalpin and Warren, 1992 #817), or roughly 3.6±0.3 ka, whereas the penultimate (older) event is about 4.6±0.2 ka. Although Witkind (1975 #819) inferrred historic (<100 years) movement of this fault: the basis for this inference is unclear and appears unfounded.

Recurrence interval >3.3 k.y. (0 to 3.6±0.3 k.y.), 0.6-1.5 k.y. (3.3-4.8 ka), >10 k.y. (4.6±0.2 ka to 15 ka)
Comments: McCalpin (1993 #796) provided these minimum and maximum recurrence intervals based on the occurrence of the two most recent paleoearthquakes at 3.6±0.3 ka (3280-3880 14C yr B.P.) and possibly 4.6±0.2 ka (4470-4780 14C yr B.P.). This equates to a permissible recurrence interval of about 0.6-1.5 k.y. However, the late Quaternary recurrence interval must be quite variable: it has been about 3.6±0.3 k.y. since the last event and it was at least 10 k.y. before the penultimate event at 4.6±0.2 ka (15 ka is the inferred time of deposition of older faulted deposit at trench site).

Slip-rate category 0.2-1 mm/yr
Comments: On the basis of a colluvial-wedge thickness of 2.5 m, McCalpin and Warren (1992 #817) calculated a displacement of 4-5 m for the most recent event at 3.6±0.3 ka; however, this amount may reflect both backtilting and displacement at the fault (*i.e.,* a maximum amount of offset). This large slip is associated with a recurrence interval of only 0.6-1.5 k.y. This short recurrence interval suggests an earthquake cluster (two closely spaced events) that may not be characteristic of the longer late Quaternary history of the fault.
If one uses 0.6-1.5 k.y. as the recurrence time during this cluster, then the slip rate is an extremely fast 3-8 mm/yr (4 m/1.5 k.y. to 5 m/0.6 k.y.). These rates seem unreasonable for any significant geologic time interval (i.e., the Holocene), and are contrary to the 3.6±0.3 k.y. interval of non-rupturing since the most recent event.
Conversely, if one uses the 11 m of stratigraphic separation (see above) and a minimum time interval of about 11.5 k.y. (interval between most recent event at 3.6±0.3 ka and 15 ka—the inferred time of

deposition of older faulted deposit), then the slip rate is <0.95 mm/yr (11 m of displacement in 11.5 k.y.) at trench site. This value is probably on the high side for the 15 k.y. record since the displacement is a maximum and the time interval is a minimum.
Considering the above discussion and the evidence for an earthquake cluster in the middle Holocene, we categorize the Rock Creek fault in the 0.2-1.0 mm/yr bracket and recognize that it may have considerably faster slip rates over short intervals of geologic time (several thousand years). A similar treatment was afforded the nearby Greys River fault [728].

Length End to end (km): 40.5
Cumulative trace (km): 41

Average strike (azimuth): N5°E

References

#836 Anders, M.H., and LaForge, R.C., 1983, Seismotectonic study for Big Sandy and Eden Dams Eden Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-5, 18 p.

#820 Blackstone, D.L., Jr., and DeBruin, R.H., 1987, Tectonic map of the overthrust belt, western Wyoming, northeastern Utah, and southeastern Idaho, showing oil and gas fields and exploratory wells in the overthrust belt and adjacent Green River Basin, *in* Miller, W.R., ed. The thrust belt revisited: Wyoming Geological Association, 38th Annual Field Conference, Jackson Hole, Wyoming, September 8-11, 1987, Guidebook,.

#818 Chambers, H.P., 1988, A regional ground motion model for historical seismicity along the Rock Creek fault, western Wyoming: Laramie, University of Wyoming, unpublished M.S. thesis, 102 p.

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#817 McCalpin, J.P., and Warren, G.A., 1992, Quaternary faulting on the Rock Creek fault, overthrust belt, Wyoming: Geological Society of America Abstracts with Programs, v. 24, no. 6, p. 51.

#816 Rubey, W.W., Oriel, S.S., and Tracey, J.I., Jr., 1975, Geology of the Sage and Kemmerer 15-minute quadrangles, Lincoln County, Wyoming: U.S. Geological Survey Professional Paper 855, 18 p., 2 pls.

#814 Rubey, W.W., Oriel, S.S., and Tracey, J.I., Jr., 1980, Geologic map and structure sections of the Cokeville 30-minute quadrangle, Lincoln and Sublette Counties, Wyoming: U.S. Geological Survey Miscellaneous Investigations Map I-1129, 2 sheets, scale 1:62,500.

#4464 West, M.W., 1988, Geologic and tectonic studies in the vicinity of Meeks Cabin and Stateline Dams, *in* Seismotectonic study for Meeks Cabin and Stateline Dams, Lyman Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 88-11.

#824 West, M.W., 1989, Neotectonics of the Darby-Hogsback and Absaroka thrust plates, Uinta County, Wyoming and Summit County, Utah with applications to earthquake hazard assessment: Golden, Colorado School of Mines, unpublished Ph.D. dissertation, 450 p., 17 pls.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

730, Bear River fault zone

Structure Number 730
Comments: Originally shown on compilation of Quaternary faults by Gibbons and Dickey (1983 #821) and shown by Hecker (1993 #642) as fault number 12-18 (Bear River fault zone).

Structure Name Bear River fault zone
Comments: Fault zone was named by West (1984 #823). Fault expressed by echelon scarps that extend from about 3 km southeast of Aspen, Wyoming, south to the Stillwater Fork of the Bear River in Utah.

Synopsis The Bear River fault zone is well studied and is located primarily in southwestern Wyoming, but extends southwest into northeastern Utah. Its surface trace is expressed as numerous echelon scarps ranging from 1-3 km in length and 0.5-15 m in height, most of which face west. The scarps have been mapped in detail and trenching or natural exposures at eight locations (supported by numerous radiocarbon dates) constrain the late Quaternary history of faulting. The west-dipping normal faults are inferred to merge into a ramp of the Laramide-age Darby-Hogsback thrust fault at a depth of about 5-7 km. There is no evidence, at this time, that the fault zone has discrete rupture segments.

Date of compilation 06/01/1994

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.; Bill D. Black, Utah Geological Survey; Suzanne Hecker, U.S. Geological Survey

State Wyoming; Utah

County Uinta (WY); Summit (UT); Uinta (UT)

1° x 2° sheet Ogden; Salt Lake City

Province Middle Rocky Mountains

Quality of location Good

Comments: Location in Wyoming is from 1:24,000-scale mapping by West (1989 #824); the part of the fault in Utah is from Sullivan and others (1988 #4437). Fault also shown by West (1988 #4464; 1994 #4412). Trace recompiled at 1:250,000 scale on topographic base map.

Scale of digital trace 1:250,000

Geologic setting This newly activated fault zone is east of the Bear River and is expressed as short, generally right-stepping, north-trending scarps that abruptly change to east-northeast trend at southern end. The associated west-dipping normal faults are inferred to merge into a ramp of the Laramide-age Darby-Hogsback thrust fault at a depth of about 5-7 km. East-facing scarps are presumed antithetic to the major west-dipping faults. Normal faulting is thought to have recently initiated (about 5 ka, West, 1993 #825) and is supported by a normal throw that is roughly equivalent to the observed displacement of upper Quaternary deposits.

Sense of movement N

Comments: Normal movement is shown by Gibbons and Dickey (1983 #821).

Dip 45°-80° W

Comments: West (1989 #824) documented fault dips of 80°-83° W, near vertical, 53° SW, and 76° E for master faults in his trench exposures. He also noted that the eastward and near vertical dips probably reflect near-surface rotation of the fault due to downslope creep. Fault is shown schematically in cross section by West (1989 #824) as having a dip of about 80° W in the upper 2 km, flattening to 45° W at about 3 km depth.

Dip direction W, E

Geomorphic expression Scarp heights and tectonic displacements increase markedly from north to south along the fault zone. Fault scarps are between 0.5-m and 15-m high on upper Quaternary deposits; sag ponds, beheaded drainages, and antithetic fault scarps are also present. Northern parts of the fault zone in Utah are expressed only as drainage lineaments or are obscured by recent landsliding. The west trend of scarps at the southern end of the zone is sharply discordant with the main, north trend of faulting, perhaps due to the buttressing effect of the Uinta Mountains, or lateral control by a cross fault.

Age of faulted deposits at the surface Holocene deposits, upper Quaternary (Pinedale) alluvium and glacial till and outwash, Paleocene Wasatch Formation (West, 1984 #823; 1989 #824).

Paleoseismic studies The Bear River fault is one of the most well investigated faults within the Rocky Mountains. West (1989 #824) excavated seven trenches across scarps of the fault zone and mapped one natural exposure of the fault (sites [730-1] to [730-5] are in southwestern Wyoming, whereas sites [730-6] to 730-8 are in northeastern Utah). Multiple samples were obtained for radiocarbon analysis and collectively their ages define a best-fit timing scenario for the two most recent earthquakes. The most recent event is thought to have occurred at 2320±860 yr B.P. and the penultimate event at 4120±510 yr B.P. Average displacements of 2.0-5.3 m per event are estimated from the trenches.

Sites 730-1 to 730-8. The northernmost trench [730-1], La Chapelle, was excavated in August 1984 about 850 m south of Short Draw; seven radiocarbon ages constrain the timing of two Holocene earthquakes.

Proceeding south, Lester Ranch trench [730-2] was excavated in 1983 about 50 m north of Blacks Fork Road; five radiocarbon ages constrain the timing of the most recent Holocene earthquake and provide minimum constraint for the earlier event. The nearby Lester Ranch South trench [730-3] was excavated in 1984 about 180 m south of Blacks Fork Road; seven radiocarbon ages constrain the timing of two Holocene earthquakes. The Austin Reservoir scarp is exposed in a ditch bank [730-4] about 250 m south of the road to Austin Reservoir; 2 events, the most recent of which is thought to be late Holocene, are inferred but no radiocarbon ages constrain the timing of the earthquakes. The Sulphur Creek trench [730-5] was excavated in 1984 about 500 m southwest of Austin Reservoir; relations in the trench were not well defined but allow for scenarios of 1-3 faulting events. However, the preferred interpretation is two Holocene events; seven radiocarbon ages constrain the timing of the most recent Holocene earthquake and provide minimum constraint for the earlier event. The Big Burn trench [730-6] was excavated in 1983 across one of the highest (12.3 m) scarps along the fault zone about 550 m south of the East Fork of the Bear River; a single event is evident but another can be inferred. Seven radiocarbon ages constrain the timing of the most recent Holocene earthquake and provide minimum constraint for the earlier event. Along the east-northeast striking part of the fault zone, the Lower Little Burn trench [730-7] provides definitive evidence of at least one Holocene earthquake and possibly two events. This trench was located about 1.5 km west of the East Fork of the Bear River. The southernmost trench, Upper Little Burn [730-8], was excavated in 1984 across two scarps on late Quaternary (early Pinedale or late Bull Lake) lateral moraine deposits about 100 m southwest of Lower Little Burn trench [730-7]; evidence of two earthquakes is present but no material for age determination was recovered at the site.

Time of most prehistoric faulting Latest Quaternary (<15 ka)

Comments: Most recent event is inferred to have occurred 2320±860 yr ago (West, 1989 #824). This time is based on a best fit for the multiple radiocarbon ages obtained from the trenches and inferring that the rupture extended along the entire length of fault zone. Later publications by West (1992 #826; 1993 #825) rounded the above date to indicate that the most recent event occurred 2.4±1.1 ka.

Recurrence interval 1.8-2.2 k.y. (<4.6 ka)

Comments: A reported recurrence interval of 1.8 k.y. is the difference between the mean estimate of the two constrained events at multiple sites (West, 1989 #824). However, West also stated that the maximum recurrence must exceed 2,320 yr (i.e., the interval since the most recent event), and thus the minimum average recurrence for the past 4.1 k.y. is 2.1 k.y. Later publications by West (1992 #826; 1993 #825) indicated faulting events at 2.4±1.1 ka and 4.6±0.7 ka, yielding a recurrence of 2.2 k.y.

Slip-rate category 1-5 mm/yr

Comments: West published a number of slip rates for this fault zone. In his original work, he cited a slip rate of 1.0-3.1 mm/yr (West, 1989 #824); later he cited 0.8-2.7 mm/yr (West, 1992 #826; 1993 #825). However, it appears that the rates are based on total vertical throw and the estimated timing of the earliest event. If one takes his values of single-event throw and the recurrence interval between the two Holocene events, then slip rates of 1.1-2.9 mm/yr are obtained, which are consistent with the assigned slip rate category above. The two closely spaced Holocene events (an earthquake cluster) demand a relatively high slip rate; if one considers a longer time window, the late Quaternary (<130 k.y.) slip rate is probably much less than 1 mm/yr.

Length End to end (km): 33.2
Cumulative trace (km): 68.6

Average strike (azimuth): N11°W

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

#642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls.

#4437 Sullivan, J.T., Ostenaa, D.A., and West, M.W., 1988, Seismotectonic study for Meeks Cabin and Stateline Dams, Lyman Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 88-11, variously paginated, 1 pl., scale 1:100,000.
#823 West, M.W., 1984, Recurrent late Quaternary (Holocene?) faulting, Bear River fault zone, Uinta County, Wyoming and Summit County, Utah: Geological Society of America Abstracts with Programs, v. 16, no. 4, p. 259-260.
#4464 West, M.W., 1988, Geologic and tectonic studies in the vicinity of Meeks Cabin and Stateline Dams, *in* Seismotectonic study for Meeks Cabin and Stateline Dams, Lyman Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 88-11.
#824 West, M.W., 1989, Neotectonics of the Darby-Hogsback and Absaroka thrust plates, Uinta County, Wyoming and Summit County, Utah with applications to earthquake hazard assessment: Golden, Colorado School of Mines, unpublished Ph.D. dissertation, 450 p., 17 pls.
#826 West, M.W., 1992, An integrated model for seismogenesis in the Intermountain seismic belt: Bulletin of the Seismological Society of America, v. 82, p. 1350-1372.
#825 West, M.W., 1993, Extensional reactivation of thrust faults accompanied by coseismic surface rupture, southwestern Wyoming and north-central Utah: Geological Society of America Bulletin, v. 105, p. 1137-1150.
#4412 West, M.W., 1994, Seismotectonics of north-central Utah and southwestern Wyoming: Utah Geological Survey Special Study 82 (Paleoseismology of Utah, volume 4), 93 p., 5 pls.

731, Martin Ranch fault

Structure Number 731
Comments: Shown on compilation of Quaternary faults by Gibbons and Dickey (1983 #821).

Structure Name Martin Ranch fault
Comments: In his original work, West (1989 #824) used the names Absaroka fault and Martin Ranch scarp interchangeably to refer to the part of the Absaroka thrust fault that has normal-slip reactivation in the late Quaternary. In later papers (West, 1992 #826; 1993 #825), the feature is called the Martin Ranch normal fault scarp; in this compilation, we use Martin Ranch as the preferred name of the fault. As shown, the fault extends from near the intersection of Wyoming State Highway 89 and the boundary of T. 13/14 N. south-southwest about 4 km. Its concealed trace may extend another 10 km to the south.

Synopsis Surface expression of the Martin Ranch fault consists of a short fault scarp (about 4 km long) and possible deflection of the Bear River at a point about 10 km south of the scarp. Only the scarp is shown here. The fault scarp is thought to be the expression of extensional normal-slip reactivation of part of the Absaroka thrust that initiated about 2.4 ka, or synchronous with the most recent event on the nearby Bear River fault zone [730]. Two trenches have been excavated across this scarp. West (1993 #825) believed that surface rupture should not be considered independent from that on the Bear River fault zone, but the alternative interpretation can not be precluded with the existing data.

Date of compilation 06/02/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Uinta

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Based on fault mapping at 1:24,000-scale by West (1989 #824) and at 1:100,000-scale by Gibbons and Dickey (1983 #821). Fault traces were compiled at 1:250,000-scale on topographic base map.

Scale of digital trace 1:250,000

Geologic setting setting The well-studied Absaroka thrust fault is a major east-directed structure of the Laramide-age Overthrust Belt. The down-to-the-west (normal) scarp on the floor of Bear River valley represents reactivation of the fault in the opposite sense in response to regional extension. Maximum cumulative normal throw is 1.4 m (West, 1989 #824) in Quaternary deposits.

Sense of movement N
Comments: (West, 1989 #824)

Dip 30°-70° W
Comments: Dip of fault is schematically shown by West (1989 #824; 1992 #826; 1993 #825) as about 70° W in upper 1.5 km and decreases to about 30° W at 2 km depth.

Dip direction W

Geomorphic expression Linear north-trending fault scarp on two ages of Quaternary terrace alluvium. Scarp on upper (older) terrace is 1.45 m high and has a maximum slope angle of 14.5°; on the lower terrace it is 0.75-1.3 m high. West (1989 #824) noted that deflection of the course of Bear River 10 km south of the scarp may be due to tectonic processes, whereas warping of the ground surface is noted north of the scarp. Thus, the total length of deformation may be about 15 km.

Age of faulted deposits at the surface West (1989 #824) reported offset of upper and middle(?) Quaternary alluvium.

Paleoseismic studies West (1989 #824) excavated two trenches across the fault scarp.
Site 731-1. The northernmost Lower Martin Ranch trench [731-1] was located about 700 m from the north end of the scarp and crossed a 1-m-high scarp on the lower of two terraces near the site. The timing of the single event noted in the trench was not constrained by dating, but is interpreted to be middle to late Holocene.
Site 731-2. The southern Upper Martin Ranch trench [731-2] was on a 1.45-m-high scarp on the higher of two faulted terraces about 1.2 km from the north end of the scarp. The most recent event occurred between 700 yr 14C B.P. and 3500 yr 14C B.P and is constrained by three radiocarbon dates. Gibbons and Dickey (1983 #821) excavated one trench near Martin Reservoir; however, their data are not published and location of their trench was not given.

Time of most prehistoric faulting latest Quaternary (<15 ka)
Comments: West (1989 #824; 1992 #826; 1993 #825) inferred that the late Holocene timing of the most recent earthquake is contemporaneous with the most recent event on the Bear River fault zone [730], which is dated at about 2320±860 yr ago. The constraining radiocarbon ages from trench 731-2 allows for this interpretation, but this interpretation is not unique. West believed that the surface faulting at trench 731-1 is coeval with that of trench 731-2, but no datable material was recovered from trench 731–1.

Recurrence interval not determined
Comments: Evidence for a penultimate event predating the late Holocene is inconclusive, thus no recurrence information is available.

Slip-rate category 0.2-1 mm/yr
Comments: West (1989 #824) published a slip rate of 0.6-0.7 mm/yr. However, the interval of time that resulted in the 1.3-1.6 m of late Holocene slip is Unknown; the published slip rate can only be a maximum, if one considers the slip on the prior event to be characteristic and the interval since the last event to be a minimum recurrence interval. Geomorphic evidence indicates that the average late Quaternary slip rate is much less than the rate cited above.

Length End to end (km): 3.7
Cumulative trace (km): 3.7

Average strike (azimuth): N18°E

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

#824 West, M.W., 1989, Neotectonics of the Darby-Hogsback and Absaroka thrust plates, Uinta County, Wyoming and Summit County, Utah with applications to earthquake hazard assessment: Golden, Colorado School of Mines, unpublished Ph.D. dissertation, 450 p., 17 pls.
#826 West, M.W., 1992, An integrated model for seismogenesis in the Intermountain seismic belt: Bulletin of the Seismological Society of America, v. 82, p. 1350-1372.
#825 West, M.W., 1993, Extensional reactivation of thrust faults accompanied by coseismic surface rupture, southwestern Wyoming and north-central Utah: Geological Society of America Bulletin, v. 105, p. 1137-1150.

732, Hogsback fault

Structure Number 732

Structure Name Hogsback fault

Comments: West (1989 #824; 1992 #826) used the name Darby-Hogsback fault to refer to the parts of similarly named thrust faults that exhibit normal reactivation. Isolated scarps and fault-related features were named after local geographic features. From north to south they are Muddy Creek lineament, Meeks Cabin/Thunderbolt Mountains scarps, and Elizabeth Ridge scarps. This structure was also referred to as the Hogsback fault in a later publication (West, 1993 #825). The Hogsback name is used in this compilation owing to prior use of the confusing and multiple Darby-Hogsback term by West, author of the most pertinent research. The fault extends from about 6 km north of Interstate 80 south in southwestern Wyoming to the North Fork Mill Creek, south of Elizabeth Mountain in northeastern Utah.

Synopsis The Hogsback fault is comprised of middle to late Pleistocene(?) age fault scarps near the North Flank and Darby-Hogsback thrust faults in the Uinta Mountains in northeastern Utah and southwestern Wyoming. It is generally poorly expressed by discontinuous scarps and alignment of drainages. One trench was excavated near the southern end of the scarps, but the timing of the most recent movement as well as its Quaternary history is not well constrained. The fault is assigned to the 0.2-1.0 mm/yr slip rate category, which conflicts with its <750 ka time estimate.

Date of compilation: 06/22/94 (Wyoming) and 10/99 (Utah)

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.; Bill D. Black, Utah Geological Survey and Suzanne Hecker, U.S. Geological Survey, Utah.

Geologic setting North-striking fault is generally parallel to and east of Muddy Creek and its tributaries in Wyoming. Down-to-west normal reactivation of the Laramide-age Darby-Hogsback thrust, a major east-directed low-angle thrust fault of the Overthrust Belt, is thought to have occurred during the Quaternary. The northeast- to east-trending scarps at the south end of the fault roughly parallel the Tertiary-age North Flank fault of the Uinta Mountains. Normal faulting may have initiated 250-600 ka with possible maximum vertical displacement of 200 m based on apparent separation of Quaternary surfaces (West, 1989 #824); West indicates that earlier studies indicate similar amounts of separation of the Wasatch Formation (Eocene). However, most of the geomorphic features are lineaments and escarpments that are paralleled by streams, so much of the measured relief could be erosional rather than tectonic.

Number of sections 2

Comments: The fault consists of two unnamed sections based on inferred segmentation of the fault from reconnaissance investigations by West (1989 #824). He mentioned that evidence of faulting is less distinct to the south of Chapman Butte, but also suggested that it is in part due to the presence of glacial deposits and glacial topography in the south. Segments as proposed by West (1989 #824) are based on primarily reconnaissance, thus are herein considered as sections.

Length End to end (km): 52.4
Cumulative trace (km): 136.9

Average strike (azimuth): N7°E

732a, Hogsback fault, northern section

Section number 732a

Section name Northern section

Comments: No name was suggested by West (1989 #824) for the northern part of the fault, but it is considered herein as the northern section of the Hogsback fault. The section extends from about 6 km north of Interstate 80 south to southern end of Chapman Butte, southern end of section approximately located and not shown by West (1989 #824).

Quality of location Good

Comments: Fault traces transferred from 1:100,000-scale map of West (1989 #824).

Scale of digital trace Digitized from compilation at 1:250,000-scale on map with topographic base.

State Wyoming; Utah

County Uinta (WY); Summit (UT)

1° x 2° sheet Ogden; Salt Lake City

Province Wyoming Basin

Sense of movement N

Comments: As shown by West (1989 #824).

Dip 45°-80° W

Comments: Dip of fault is schematically shown by West (1989 #824; 1992 #826; 1993 #825) as 80° W in upper 1 km, flattening to 45° W at 2 km, and subhorizontal at 4 km.

Dip direction W

Geomorphic expression Fault is expresses as linear drainage alignments, lineaments, and subdued west-facing scarps on Pleistocene terrace and pediment surfaces. The amount of east-directed tilt of terrace surfaces increases with increasing age of the surfaces suggesting recurrent movement.

Age of faulted deposits Fault offsets the Bigelow Bench surface (West, 1989 #824), which has been variously described as being 150-600 ka (late middle Pleistocene) to 300-600 ka (middle Pleistocene).

Paleoseismic studies none

Time of most prehistoric faulting Middle and late Quaternary (<750 ka)

Comments: Reconnaissance of this part of the fault zone indicates up to 200 m of down-to-the-west normal slip of the Bigelow Bench, a surface that is inferred to be 150-600 k.y. old (West, 1989 #824) or older. No data are presented to indicate the timing of the most recent event but West believes that surface rupture of this fault occurred before rupture of the Bear River fault zone [730], which is thought to be late Holocene. West (1989 #824) further suggests that the most recent event may be older than late Pleistocene or early Holocene because the geomorphic features seem to be poorly expressed. A conservative estimate of middle and late Quaternary time (<750 ka) is given here.

Recurrence interval not determined

Comments: West (1989 #824) suggested that the late Quaternary recurrence interval might be approximated by that of the nearby Bear River fault zone [730] because of analogous tectonic setting. Thereby, he would suggest a recurrence interval of a few thousand years. Several other faults in the region [728 and 729] also are reported to have similar short recurrence intervals during the Holocene. These likely represent temporal clustering that is not characteristic of the fault's longer-term activity.

Slip-rate category 0.2-1 mm/yr

Comments: Poorly-constrained estimates range from 0.33-1.5 mm/yr (West, 1989 #824) for the entire fault. The highest estimate (1.5 mm/yr) is based on inferring a rate similar to that of the Bear River fault zone [730]. A lower rate of 0.33-1.33 mm/yr is obtained based on 200-m offset of 150-600 ka surface (Bigelow Bench). A later publication suggested that the age of Bigelow Bench surface is 300-600 k.y., which would suggest a slip rate of <1 mm/yr. Thus, the 0.2-1 mm/yr slip-rate category is assigned here due to the recent suggestion that the surface is older then 150 k.y., and because the bulk of the cited rates are <1 mm/yr.

Length End to end (km): 22.4
Cumulative trace (km): 33.9

Average strike (azimuth): N17°E

References

#824 West, M.W., 1989, Neotectonics of the Darby-Hogsback and Absaroka thrust plates, Uinta County, Wyoming and Summit County, Utah, with applications to earthquake hazard assessment: Golden, Colorado School of Mines, unpublished Ph.D. dissertation, 450 p., 17 pls.

#826 West, M.W., 1992, An integrated model for seismogenesis in the Intermountain seismic belt: Bulletin of the Seismological Society of America, v. 82, p. 1350-1372.

#825 West, M.W., 1993, Extensional reactivation of thrust faults accompanied by coseismic surface rupture, southwestern Wyoming and north-central Utah: Geological Society of America Bulletin, v. 105, p. 1137-1150.

732b, Hogsback fault, northern section

Section number 732b
Comments: Includes Hecker's (1993 #642) fault number 12-14 (Elizabeth Ridge scarps).

Section name Southern section
Comments: No name was suggested by West (1989 #824) for the southern part of the fault, but it is considered herein as the southern section of the Hogsback fault. The section extends from southern end of Chapman Butte in Wyoming south to North Fork Mill Creek in Utah; northern end of section approximately located and not shown by West (1989 #824). Includes Hecker's (1993 #642) Elizabeth Ridge scarps in northeastern Utah.

Quality of location Good
Comments: Mapped or discussed by West (1988 #4464, 1989 #824, 1994 #4412), Sullivan and others (1988 #4437), and Piety and Vetter (1999 #4463). Fault traces transferred from 1:100,000-scale map of West (1989 #824).

Scale of digital trace 1:100,000

State Wyoming, Utah

County Uinta (WY), Summit (UT)

1° x 2° sheet Ogden, Salt Lake City

Province Middle Rocky Mountains

Sense of movement N
Comments: (West, 1989 #824)

Dip 45°-80° W
Comments: Dip of fault is schematically shown by West (1989 #824; 1992 #826; 1993 #825) as 80° W in upper 1 km, flattening to 45° W at 2 km, and subhorizontal at 4 km.

Dip direction W

Geomorphic expression The fault is expressed as linear drainage alignments, lineaments, and subdued west-facing scarps on Pleistocene terrace and pediment surfaces. The amount of east-directed tilt of terrace surfaces increases with increasing age of the surfaces suggesting recurrent movement. The southern part of the fault (Elizabeth Ridge scarps) is expressed as southwest-trending scarps, one of which is uphill facing and down to the south; the other two are downhill and north facing. These scarps have apparent displacements of about 1.5-2.5 m and are subparallel to the North Flank thrust fault. The east scarp is on the Gilbert Peak erosion surface, which is cut across the Oligocene Bishop Conglomerate. Trenching revealed no direct evidence for faulting, although geomorphic evidence is more in line with a tectonic rather than an erosional origin. The subdued expression of the scarps (maximum scarp angles of about 5 degrees) suggests that these scarps are substantially older than similar discordant scarps at the south end of the Bear River fault zone [730].

Age of faulted deposits Fault offsets the Bigelow Bench surface (West, 1989 #824) in Wyoming, which has been variously described as being 150-600 ka (late middle Pleistocene) to 300-600 ka (middle Pleistocene).

Paleoseismic studies Site 732b-1. West (1989 #824) excavated one trench, the Elizabeth Ridge trench [732-b-1], which was completed in 1984. The trench was located 1 km north of Elizabeth Pass and crossed a down-to-south, uphill-facing, 2.5-m-high scarp. No datable material was recovered from the trench. Evidence of fault origin was inconclusive, but the preferred interpretation for formation of the scarp is tectonic.

Time of most prehistoric faulting Middle and late Quaternary (<750 ka)
Comments: Inconclusive relations in the trench resulted in limited information on the timing of the most recent event, but West believed that surface rupture of this fault occurred prior to the most recent rupture of the Bear River fault zone [730], which is thought to be late Holocene. West (1989 #824) further suggested that the most recent event on this section of the Darby-Hogsback fault may be middle to late Pleistocene, if the Bigelow Bench surface is as young as 150 ka. A conservative estimate of middle and late Quaternary time (<750 ka) is used here.

Recurrence interval not determined
Comments: West (1989 #824) suggests that the recurrence interval might be approximated by that of the nearby Bear River fault zone [730] because of analogous tectonic setting. Thereby, he infers a recurrence interval of a few thousand years. However, little evidence exits to suggest similar short recurrence intervals during the Holocene.

Slip-rate category 0.2-1 mm/yr
Comments: Poorly constrained estimates of slip rates range from 0.33-1.5 mm/yr (West, 1989) for the entire Hogsback fault. The highest estimate (1.5 mm/yr) is based on inferring similar rate as that of the Bear River fault zone [730]. A lower rate of 0.33-1.33 mm/yr is obtained on the basis of 200-m offset of a 150-600 ka surface (Bigelow Bench). A later publication indicated the age of the Bigelow Bench surface is 300-600 k.y., which would suggest a slip rate of <1 mm/yr. Thus, the 0.2-1 mm/yr slip-rate category is assigned herein due to the recent suggestion that the surface is substantially older than 150 k.y. West (1989 #824) indicated the maximum displacement at the trench site is 1.5-2.5 m based on profile data and his estimated vertical stratigraphic displacement of possible Bishop Conglomerate (Oligocene) also suggests a low slip rate. Black and Hecker (2000 #4336) indicated a lower slip rate, probably <0.2 mm/year, for Elizabeth Ridge scarps that comprise the southernmost part of the Hogsback fault in northeastern Utah.

Length End to end (km): 38.3
Cumulative trace (km): 103.0

Average strike (azimuth): 4°E

References

#4336 Black, B.D., Hecker, S., Jarva, J.L., Hylland, M.D., and Christenson, G.E., 2000, Quaternary fault and fold database and map of Utah: Technical report to U.S. Geological Survey, Reston, Virginia, under Contract 98QGR1029, October 2000, 1pl., scale 1:500,000.

#642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls.

#4463 Piety, L.A., and Vetter, U.R., 1999, Seismotectonic report for Flaming Gorge Dam, Colorado River Storage Project, northeastern Utah: U.S. Bureau of Reclamation Seismotectonic Report 98-2, 78 p.

#4437 Sullivan, J.T., Ostenaa, D.A., and West, M.W., 1988, Seismotectonic study for Meeks Cabin and Stateline Dams, Lyman Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 88-11, variously paginated, 1 pl., scale 1:100,000.

#4464 West, M.W., 1988, Geologic and tectonic studies in the vicinity of Meeks Cabin and Stateline Dams, *in* Seismotectonic study for Meeks Cabin and Stateline Dams, Lyman Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 88-11.

#824 West, M.W., 1989, Neotectonics of the Darby-Hogsback and Absaroka thrust plates, Uinta County, Wyoming and Summit County, Utah, with applications to earthquake hazard assessment: Golden, Colorado School of Mines, unpublished Ph.D. dissertation, 450 p., 17 pls.
#826 West, M.W., 1992, An integrated model for seismogenesis in the Intermountain seismic belt: Bulletin of the Seismological Society of America, v. 82, p. 1350-1372.
#825 West, M.W., 1993, Extensional reactivation of thrust faults accompanied by coseismic surface rupture, southwestern Wyoming and north-central Utah: Geological Society of America Bulletin, v. 105, p. 1137-1150.
#4412 West, M.W., 1994, Seismotectonics of north-central Utah and southwestern Wyoming: Utah Geological Survey Special Study 82 (Paleoseismology of Utah, volume 4), 93 p., 5 pls.

733, Sublette Flat fault

Structure Number 733
Comments: Refers to number 17 (en echelon series of faults) in Witkind (1975 #819).

Structure Name Sublette Flat fault
Comments: The informal name Sublette Flat fault has been applied by J.P. McCalpin to the fault along Sublette Flat, the narrow valley west of the north end of the fault. The fault, as shown here, extends from Grade Creek south to 1 km north of U.S. Highway 30N. The northern 6 km of the fault (between Grade Creek and Pine Creek) was not shown on the map of Rubey and others (1980 #814), but Rubey and others (1975 #816) showed a fault with similar strike extending south of U.S. Highway 30N for more than 30 km along the western flank of Sillem Ridge. Witkind (1975 #819) also shows the fault south of the highway, but only for about 10 km.

Synopsis : Little is known about this poorly expressed, west-dipping normal fault at the eastern margin of Sublette Flat, the narrow valley west of the north end of the fault.

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Lincoln

1° x 2° sheet Preston; Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapped at 1:62,500 scale by Rubey and others (1975 #816; 1980 #814). Location (dotted) of northern 6 km of fault is inferred from topography by compiler, although it was not shown by Rubey (1980 #814). All fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting setting This is one of many west-dipping normal faults that parallel east-directed thrust faults in Mesozoic sedimentary rocks in this part of the Overthrust Belt. The Sublette Flat fault bounds the western side of Rock Creek Ridge and southern part of the Tunp Ran

ge. Total stratigraphic offset is unknown, but cross sections by Rubey and others (1975 #816; 1980 #814) suggest less than 600 m of post-Mesozoic offset.

Sense of movement N
Comments: Shown as normal by Rubey and others (1975 #816; 1980 #814).

Dip 60°-80° W
Comments: Shown in cross sections by Rubey and others (1975 #816) as dipping 60°-80° W; however, they indicate that data are insufficient to determine the dip of this fault. To the north, the fault is shown to dip 60° W (Rubey and others, 1980 #814).

Dip direction W

Geomorphic expression No scarps are preserved at the alluvium-bedrock contact along the southern part of the fault, except for a locality 1.6 km (1 mile) south of latitude 42° N (Rubey and others, 1975 #816).

However, south of 42° N (in the Cokeville 1:100,000-scale quadrangle), Rubey and others (1980 #814) showed poorly located fault scarps on Quaternary-Tertiary alluvium.

Age of faulted deposits at the surface Quaternary-Tertiary gravel (Rubey and others, 1975 #816; 1980 #814); Tertiary, Cretaceous, and Jurassic bedrock (Rubey and others, 1975 #816).

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Timing of most recent event is poorly constrained and based on the presence of scarps on Quaternary-Tertiary gravel (Rubey and others, 1975 #816; 1980 #814). Witkind (1975 #819) indicated the fault is late Cenozoic (on the basis of only Miocene-Pliocene units being faulted), but showed it as late Quaternary on his map. Because there are scarps (albeit poorly expressed) and surficial geologic units of possible Quaternary age are faulted, we show the fault has having Quaternary movement.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category inferred by compiler based on general absence of data to suggest otherwise.

Length End to end (km): 36
Cumulative trace (km): 36.2

Average strike (azimuth): N10°E

References

#816 Rubey, W.W., Oriel, S.S., and Tracey, J.I., Jr., 1975, Geology of the Sage and Kemmerer 15-minute quadrangles, Lincoln County, Wyoming: U.S. Geological Survey Professional Paper 855, 18 p., 2 pls.

#814 Rubey, W.W., Oriel, S.S., and Tracey, J.I., Jr., 1980, Geologic map and structure sections of the Cokeville 30-minute quadrangle, Lincoln and Sublette Counties, Wyoming: U.S. Geological Survey Miscellaneous Investigations Map I-1129, 2 sheets, scale 1:62,500.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

734, Eastern Bear Valley fault (Class B)

Structure Number 734
Comments: Refers to number 18 (unnamed fault east side of graben, west side of Sublette Range) in Witkind (1975 #819).

Structure Name Eastern Bear Valley fault (Class B)
Comments: The informal name Eastern Bear Valley fault has been applied by J.P. McCalpin to the fault that bounds the east side of Bear Valley, Wyoming. Included here is the northern extension of the fault shown by Witkind (1975 #819) along the west margin of the Sublette Range on its northern end. As such, the fault is entirely in Wyoming, but extends from about the latitude of Geneva, Idaho, south to about 1.5 km east of Eli Hill in Wyoming.

Synopsis This is one of many west-dipping normal faults that parallel east-directed thrust faults in this part of the Overthrust Belt. It is generally poorly expressed and is mainly concealed; thus, little is known about its Quaternary history. It is considered to be a Class B structure pending further studies.

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Lincoln

1° x 2° sheet Ogden; Preston

Province Middle Rocky Mountains

Quality of location Poor

Comments: Location of southern 3/4ths of fault is based on 1:63,360-scale mapping of Rubey and others (1975 #816; 1980 #814), whereas the northern 1/4th is from 1:500,000 scale reconnaissance mapping by Witkind (1975 #819). Fault traces recompiled at 1:250,000-scale on map with topographic base. Almost the entire length of the fault is mapped as concealed and thus poorly located; its location is largely inferred from geomorphologic relations.

Scale of digital trace 1:250,000

Geologic setting One of many west-dipping normal faults that parallel east-directed Laramide thrust faults in this part of the Overthrust Belt. Fault bounds eastern side of a structural depression that contains the Bear River.

Sense of movement N
Comments: Shown as normal by Rubey and others (1975 #816; 1980 #814).

Dip 60°-75° W
Comments: Shown in cross sections by Rubey and others (1975 #816) as dipping 60°W; however, they indicated that data are insufficient to determine dip of this fault. To the north, the fault is shown to dip 65°-70° W (Rubey and others, 1980 #814).

Dip direction W

Geomorphic expression Fault is inferred to control the alluvium-bedrock contact on the eastern side of valley, but no scarps are known to exist.

Age of faulted deposits at the surface Rubey and others (1975 #816; 1980 #814) showed almost all of the fault trace as concealed beneath alluvium. At one location Jurassic bedrock is faulted at the surface (Rubey and others, 1980 #814).

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Timing of the most recent movement is not constrained. Witkind (1975 #819) showed this fault as late Cenozoic and Rubey and others (1975 #816; 1980 #814) showed the fault as mainly concealed beneath Quaternary alluvium. However, it is the compiler's opinion that this fault may be as young as the Rock Creek fault [729] (i.e. Holocene) and its inferred young scarps have been buried by aggradation of the Bear River floodplain. Therefore, the fault is considered to be a Class B (supected Quaternary) structure until further studies are completed.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: No data exist to support a slip rate, but the fault is herein considered to be in the <0.2 mm/yr slip-rate category. However, it is the compiler's opinion that the rate could be larger than that of other faults in the vicinity because Cenozoic motion on this fault has created a large, sediment-filled depression (the Bear Valley), whereas others have not. Further work, such as dating of subsurface units needs to be done in order to determine slip rates.

Length End to end (km): 47.2
Cumulative trace (km): 51.8

Average strike (azimuth): N2°E

References

#816 Rubey, W.W., Oriel, S.S., and Tracey, J.I., Jr., 1975, Geology of the Sage and Kemmerer 15-minute quadrangles, Lincoln County, Wyoming: U.S. Geological Survey Professional Paper 855, 18 p., 2 pls.

#814 Rubey, W.W., Oriel, S.S., and Tracey, J.I., Jr., 1980, Geologic map and structure sections of the Cokeville 30-minute quadrangle, Lincoln and Sublette Counties, Wyoming: U.S. Geological Survey Miscellaneous Investigations Map I-1129, 2 sheets, scale 1:62,500.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

735, Western Bear Valley faults

Structure Number 735

Structure Name Western Bear Valley faults
Comments: Although unnamed by Gibbons and Dickey (1983 #821), the informal name Western Bear Valley faults has been applied by J.P. McCalpin to those faults that bound the western side of the Bear Valley.

Synopsis Two short faults were mapped by Gibbons and Dickey (1983 #821) along the western margin of the Bear River floodplain. Little is known about their timing, although they seem to have a low slip rate.

Date of compilation 03/06/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Lincoln

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapped in reconnaissance (1:100,000 scale) by Gibbons and Dickey (1983 #821). Fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting These east-dipping normal faults coincide with the bedrock-alluvium contact; they are possibly antihetic to the larger west-dipping Eastern Bear Valley fault [734] on the opposite side of the Bear River.

Sense of movement N

Dip not determined

Dip direction E

Geomorphic expression Fault forms a somewhat linear bedrock-alluvium contact but no scarps are preserved, thus implying relatively old movement or young burial.

Age of faulted deposits at the surface The compiler considers the broad alluvial fans that lie along the bedrock-alluvial contact in the two fault locations to be of probable middle Pleistocene age. This antiquity explains the general absence of scarps on adjacent alluvial sites along the projection of the fault.

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Timing based on inference that middle Pleistocene age deposits rest against bedrock and are unfaulted.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip rate category inferred from lack of fault scarps on deposits believed to middle Pleistocene or younger age.

Length End to end (km): 12.4
Cumulative trace (km): 5.1

Average strike (azimuth): N21°E

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

736, Elk Mountain fault

Structure Number 736

Structure Name Elk Mountain fault
Comments: Fault unnamed in compilation by Gibbons and Dickey (1983). The informal name Elk Mountain fault has been applied by J.P. McCalpin to this structure after the nearby geographic feature (Elk Mountain). The fault extends from about 0.5 km north of the headwaters of Bullpen Creek southwest to near the headwaters of North Bridger Creek, which forms the northern boundary of the Bear River Divide.

Synopsis One of many west-dipping normal faults that parallel east-directed thrust faults in Mesozoic sedimentary rocks in this part of the Overthrust Belt. Little is known about the two west-dipping normal faults that may be a southern continuation of the Rock Creek fault [729].

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Lincoln

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapped in reconnaissance mapping (1:100,000 scale) by Gibbons and Dickey (1983 #821); northern branch of fault appears to be from 1:62,500-scale map of Rubey and others (1975 #816). Fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting One of many west-dipping normal faults that parallel east-directed thrust faults in Mesozoic sedimentary rocks in this part of the Overthrust Belt. The fault is along western flank of Fossil Ridge and Elk Mountain.

Sense of movement N
Comments: Shown as normal by Gibbons and Dickey (1983 #821).

Dip not determined

Dip direction W

Geomorphic expression No fault scarps are known to exist, but the fault lies at the base of a somewhat linear west-facing escarpment on rocks of the Tertiary Wasatch Formation.

Age of faulted deposits at the surface Northern half of fault is in Tertiary bedrock (Rubey and others, 1975 #816).

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Gibbons and Dickey (1983 #821) suggested Quaternary movement, but no specific justification was given.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category rate is inferred based on absence of scarps and data to indicate otherwise.

Length End to end (km): 7.8
Cumulative trace (km): 11.8

Average strike (azimuth): N20°E

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

#816 Rubey, W.W., Oriel, S.S., and Tracey, J.I., Jr., 1975, Geology of the Sage and Kemmerer 15-minute quadrangles, Lincoln County, Wyoming: U.S. Geological Survey Professional Paper 855, 18 p., 2 pls.

737, North Bridger Creek fault

Structure Number 737

Structure Name North Bridger Creek fault
Comments: Fault unnamed in compilation by Gibbons and Dickey (1983). The informal name North Bridger Creek has been informally applied to the fault by J.P. McCalpin. Fault only extends about 4 km north-northeast from North Bridger Creek and is located between Sillem Ridge and Elk Mountain.

Synopsis One of many short, west-dipping normal faults that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Overthrust Belt. Little is known about this short normal fault that displaces rock of the Tertiary Wasatch Formation and an overlying erosion surface of unknown age.

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Lincoln

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapped in reconnaissance (1:100,000 scale) by Gibbons and Dickey (1983 #821). Fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting One of many short, west-dipping normal faults that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Overthrust Belt. Fault is located between Sillem Ridge and Elk Mountain.

Sense of movement N
Comments: Shown as normal by Gibbons and Dickey (1983 #821).

Dip not determined

Dip direction W

Geomorphic expression No fault scarps are known to exist, but the fault lies at the base of somewhat linear west-facing escarpment on rock of the Tertiary Wasatch Formation.

Age of faulted deposits at the surface Tertiary Wasatch Formation and an overlying erosion surface of unknown age; deformation of Quaternary deposits not documented.

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Gibbons and Dickey (1983 #821) suggested Quaternary movement (probably on the basis of the faults proximity to the escarpment), but no specific justification was given.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category inferred based on absence of scarps and data to indicate otherwise.

Length End to end (km): 4.2
Cumulative trace (km): 4.3

Average strike (azimuth): N17°E

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

738, Spring Creek fault

Structure Number 738

Structure Name Spring Creek fault
Comments: Unnamed in compilation of Gibbons and Dickey (1983). The informal name Spring Creek fault has been applied by J.P. McCalpin to this structure. Fault only extends about 2 km southwest from Spring Creek.

Synopsis One of many short, west-dipping normal faults along west side of Bear River Divide that parallel east-directed thrust faults in Mesozoic sedimentary rocks in this part of the Overthrust Belt. This short normal fault displaces rock of the Tertiary Wasatch Formation and an overlying erosion surface.

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Lincoln

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapped in reconnaissance (1:100,000 scale) by Gibbons and Dickey (1983 #821). Fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting One of many short, west-dipping normal faults along west side of Bear River Divide that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Laramide Overthrust Belt.

Sense of movement N
Comments: Shown as normal by Gibbons and Dickey (1983 #821).

Dip not determined

Dip direction W

Geomorphic expression No fault scarps are known to exist, but the fault lies at the base of somewhat linear west-facing escarpment on rock of the Tertiary Wasatch Formation.

Age of faulted deposits at the surface Tertiary Wasatch Formation and an overlying erosion surface of unknown age; deformation of Quaternary deposits not documented.

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Gibbons and Dickey (1983 #821) suggested Quaternary movement (probably on the basis of the faults proximity to the escarpment), but no specific justification was given.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category inferred based on absence of scarps and data to indicate otherwise.

Length End to end (km): 2.3
Cumulative trace (km): 2.3

Average strike (azimuth): N25°E

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

739, The Pinnacle fault

Structure Number 739

Structure Name The Pinnacle fault
Comments: Fault unnamed in compilation by Gibbons and Dickey (1983). The informal name "The Pinnacle " has been applied by J.P. McCalpin to this fault after a nearby geographic feature. Fault only extends about 2 km southwest from Alkali Creek.

Synopsis One of many short, west-dipping normal faults along west side of Bear River Divide that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Overthrust Belt. This fault displaces rock of the Tertiary Wasatch Formation and an overlying erosion surface.

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Unita

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapped in reconnaissance (1:100,000 scale) by Gibbons and Dickey (1983 #821). Fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting One of many short, west-dipping normal faults along west side of Bear River Divide that parallel east-directed thrust faults in Mesozoic sedimentary rocks in this part of the Laramide Overthrust Belt.

Sense of movement N
Comments: Shown as normal by Gibbons and Dickey (1983 #821).

Dip not determined

Dip direction W

Geomorphic expression No fault scarps are known to exist, but the fault lies at the base of somewhat linear west-facing escarpment on rocks of the Tertiary Wasatch Formation.

Age of faulted deposits at the surface Tertiary Wasatch Formation and an overlying erosion surface of unknown age; deformation of Quaternary deposits not documented.

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Gibbons and Dickey (1983 #821) suggested Quaternary movement (probably on the basis of the faults proximity to the escarpment), but no specific justification was given.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category inferred based on absence of scarps and data to indicate otherwise.

Length End to end (km): 2.3
Cumulative trace (km): 2.3

Average strike (azimuth): N25°W

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

740, Ryckman Creek fault

Structure Number 740

Structure Name Ryckman Creek fault
Comments: Fault unnamed in compilation by Gibbons and Dickey (1983). This informal name has been applied by J.P. McCalpin on the basis of the fault's proximity to Ryckman Creek, which is located due east of the Bear River Divide. The fault consists of two mapped traces, one that is about 1.2-km long centered on Red Rock Fork of Salt Creek and the other that is about 0.2 km long and approximately 1.2 km to the southeast of Salt Creek.

Synopsis This is one of many short, west-dipping normal faults along west side of Bear River Divide that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Laramide Overthrust Belt. Comprised of two short normal faults that create escarpments on rock of the Tertiary Wasatch Formation.

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Unita

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapped in reconnaissance (1:100,000 scale) by Gibbons and Dickey (1983 #821). Fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting One of many short, west-dipping normal faults along west side of Bear River Divide that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Laramide Overthrust Belt.

Sense of movement N
Comments: Shown as normal by Gibbons and Dickey (1983 #821).

Dip not determined

Dip direction W

Geomorphic expression No fault scarps are known to exist, but the fault lies at the base of west-facing escarpment on rock of the Tertiary Wasatch Formation.

Age of faulted deposits at the surface Tertiary Wasatch Formation and an overlying erosion surface of unknown age; deformation of Quaternary deposits not documented.

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Gibbons and Dickey (1983 #821) suggested Quaternary movement (probably on the basis of the faults proximity to the escarpment), but no specific justification was given.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category inferred based on absence of scarps and data to indicate otherwise.

Length End to end (km): 5.3
Cumulative trace (km): 4.2

Average strike (azimuth): N9°W

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

741, Whitney Canyon fault

Structure Number 741

Structure Name Whitney Canyon fault
Comments: Fault unnamed in compilation by Gibbons and Dickey (1983). The informal name Whitney Canyon has been applied by J.P. McCalpin to this fault. The fault has an arcuate trace that extends from mouth of Becks Canyon south to a point about 1 km south of Whitney Canyon.

Synopsis This fault is one of many short, west-dipping normal faults that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Overthrust Belt. The fault forms two separate scarps and displaces Quaternary alluvium as well as rock of the Tertiary Wasatch Formation.

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Unita

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapped in reconnaissance (1:100,000 scale) by Gibbons and Dickey (1983 #821). Fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting This fault is one of many short, west-dipping normal faults that parallel east-directed thrust faults in Mesozoic sedimentary rocks in this part of the Laramide Overthrust Belt. It is comprised of a short, arcuate down-to-west normal fault and 1-km-long antithetic fault along the west side of the Bear River Divide.

Sense of movement N
Comments: Shown as normal by Gibbons and Dickey (1983 #821).

Dip not determined

Dip direction W, E

Geomorphic expression Gibbons and Dickey (1983 #821) mentioned a 2 m-high west-facing fault scarp in the text that accompanies their map. The scarp appears to be on piedmont-slope or alluvial fan deposits to the south of the Whitney Canyon drainage. No morphometric studies have been conducted.

Age of faulted deposits at the surface Not explicitly stated by Gibbons and Dickey (1983 #821). Their criteria was that the fault offset erosion surfaces or materials (soils and deposits) dating from some stage in the development of the present landscape, which implied Quaternary movement.

Paleoseismic studies [Site 741-1]. Gibbons and Dickey (1983 #821) collected charcoal samples from pre- and post-faulting sediment at a site near Whitney Canyon. These samples constrain the most recent paleoearthquake at between 1.2 ka and 2.4 ka. The constraining ages were determined by radiocarbon dating of charcoal samples and amino-acid dating of snail shells. No detailed mapping or stratigraphic relations are included in their discussion.

Time of most prehistoric faulting Late Quaternary (<15 ka)

Comments: Gibbons and Dickey (1983 #821) placed the most recent paleoearthquake at between 1.2 ka and 2.4 ka at Whitney Canyon. No information is available about the timing or amount of offset associated with a penultimate event.

Recurrence interval not determined

Comments: Although the most recent event is dated at 1.2-2.4 ka, no prior events are documented, thus no recurrence information exists.

Slip-rate category Unknown; probably <0.2 mm/yr

Comments: Low slip-rate category inferred on basis of single small (2 m) scarp, unknown recurrence interval, and absence of data to indicate otherwise.

Length End to end (km): 5.5
Cumulative trace (km): 15.4

Average strike (azimuth): N18°W

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

742, Almy fault zone

Structure Number 742

Comments:

Structure Name Almy fault zone

Comments: Unnamed in compilation of Gibbons and Dickey (1983). The informal name Almy fault zone has been applied by J.P. McCalpin to this structure after the nearby town of Almy. The fault has discontinuous traces extending from about Wyoming Highway 89 (in the north) to about 1.5 km south of Thomas Canyon.

Synopsis: The Almy fault zone is comprised of a group of short normal faults on the western side of the Bear River Valley.

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Uinta

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Reliability of location Poor

Comments: Mapped in reconnaissance (1:100,000 scale) by Gibbons and Dickey (1983 #821). Fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting One of many short normal faults that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Overthrust Belt. Fault bounds part of western side of Bear River Valley.

Sense of movement N

Comments: Shown as normal by Gibbons and Dickey (1983 #821).

Dip not determined

Dip direction E

Geomorphic expression Faults are along base of bedrock escarpments in the Tertiary Wasatch Formation.

Age of faulted deposits at the surface Tertiary Wasatch Formation and Quaternary deposits. Gibbons and Dickey's (1983 #821) criteria were that the fault offsets erosion surfaces or materials (soils and deposits) dating from some stage in the development of the present landscape, which implied Quaternary movement.

Paleoseismic studies none

Timing of most recent paleoevent Quaternary (<1.6 Ma)
Comments: Gibbons and Dickey (1983 #821) suggested Quaternary movement, but no specific justification is given.

Recurrence interval not determined

Slip Rate Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category is inferred based on absence scarps and data to indicate otherwise.

Length End to end (km): 10.7
Cumulative trace (km): 12.5

Average strike (azimuth): N3°E

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

743, Duncomb Hollow fault

Structure Number 743
Comments: Originally shown on compilation of Quaternary faults by Gibbons and Dickey (1983 #821), but not shown by West (1989 #824). This short (2.5-km long) fault is east of Duncomb Hollow.

Structure Name Duncomb Hollow fault
Comments: Unnamed by Gibbons and Dickey (1983 #821). The informal name Duncomb Hollow fault has been applied by J.P. McCalpin to this structure after Duncomb Hollow, a valley about 10 km southeast of Medicine Butte.

Synopsis One of many short normal fault scarps that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Overthrust Belt. Little is known about this fault: the sole source of data is Gibbons and Dickey (1983 #821). The fault may be spatially related to the Bear River fault [730], whose nothern (mapped) end is about 16 km to the south.

Date of compilation 06/03/94

Compiler and affiliation James P. McCalpin, GEO-HAZ Consulting, Inc.

State Wyoming

County Unita

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapped in reconnaissance (1:100,000 scale) by Gibbons and Dickey (1983 #821). Fault traces recompiled at 1:250,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting One of many short, west-dipping normal faults along the Bear River Divide that parallel east-directed thrust faults in Mesozoic sedimentary rock in this part of the Laramide Overthrust Belt. The fault may be spatially related to the Bear River fault [730], which is located to the south.

Sense of movement NE
Comments: Shown as normal by Gibbons and Dickey (1983 #821).

Dip not determined

Dip direction E

Geomorphic expression Fault forms a subdued topographic lineament, but no scarps are documented.

Age of faulted deposits at the surface Bedrock is faulted at surface, but deformation of Quaternary deposits was inferred by Gibbons and Dickey (1983 #821).

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: Gibbons and Dickey (1983 #821) indicated this feature has probably experienced Quaternary movement: their criteria were that the fault offsets erosion surfaces or materials (soils and deposits) dating from some stage in the development of the present landscape.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category inferred based on absence of data to indicate otherwise.

Length End to end (km): 2.4
Cumulative trace (km): 2.4

Average strike (azimuth): N44°W

References

#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

#824 West, M.W., 1989, Neotectonics of the Darby-Hogsback and Absaroka thrust plates, Uinta County, Wyoming and Summit County, Utah with applications to earthquake hazard assessment: Golden, Colorado School of Mines, unpublished Ph.D. dissertation, 450 p., 17 pls.

744, Faults on north flank of Phil Pico Mountain

Structure Number 744

Structure Name Faults on north flank of Phil Pico Mountain
Comments: These unnamed faults on the north flank of Phil Pico Mountain were first recognized by Max Crittenden (according to Hansen, 1986, #4483). They are referred to as the scarps on the faults on north flank of Phil Pico Mountain by Piety and Vetter (1999, #4463). Renamed (informally) herein to reflect fault origin and unnamed nature. The scarps extend from about 3 km south of McKinnon (Wyoming) to about 1 km east of Logan Hollow (creek), just north of the Wyoming/Utah border.

Synopsis. The faults on the north flank of Phil Pico Mountain are part of the larger bounding structures of the east-west-trending Uinta Mountains of northern Utah and Colorado. The ca. 30 Ma Gilbert surface, which cuts across the eastern flank of the Uintas, was later covered by the Bishop Conglomerate (late Oligocene to early Miocene?). By about 25 Ma, renewed deformation in the form of north-south-directed extension on the former thrust faults (i.e., backsliding) resulted in moderate tilting of the Gilbert surface. Alternating periods of extensional deformation and landscape stability ensued in the Miocene and through the Pliocene. The fault scarps on the north flank of Phil Pico Mountain and other scattered locations on the margins of the Uintas attest to continued, albeit minor deformation in the Quaternary. The scarps are short (1 km) and discontinuous over an extent of about 4 km, which raises some question as to whether they have a tectonic origin. The scarps appear to be 100 ka or younger on the basis of their morphometric expression, and the faults clearly displace deposits that are >130-150 ka and younger than 500 ka. Deposits of latest Pleistocene age (15 to 30-40 ka) are not displaced. The north flank faults appear to have recurrence intervals of 100 k.y. or more, and slip rates of 0.003 mm/yr (long term average) to 0.007-0.008 mm/yr for the late Quaternary.

Date of compilation 08/22/01

Compiler and affiliation Michael N. Machette, U.S. Geological Survey

State Wyoming

County Sweetwater

1° x 2° sheet Rock Springs

Province Middle Rocky Mountains

Quality of location Good

Comments: Mapped in detail (about 1:40,000 scale) by Piety and Vetter (fig. 4, 1999 #4463). Fault traces compiled by Piety (written commun., 2001) at 1:24,000-scale topographic base map, recompiled at 1:250,000-scale of topographic base map for digitizing.

Scale of digital trace 1:250,000

Geologic setting The faults on the north flank of Phil Pico Mountain are part of the larger bounding structures of the east-west-trending Uinta Mountains of northern Utah and Colorado. During the early Tertiary, the Uinta Mountains (which have Precambrian ancestry) began to be uplifted by north-south-directed compression as part of the Laramide orogeny, which continued in this region until about 30 Ma (Hansen, 1986 #4483; Piety and Vetter, 1999 #4463). The bounding faults on the north and south flanks of the Uintas were thrust or reverse faults at that time. After the Laramide orogeny, the Uintas were subject to a long period of Neogene tectonic stability and erosion that formed a broad surface across the eastern flank of the Uintas. This surface, which was named the Gilbert surface by Hansen (1986 #4483), was later covered by the Bishop Conglomerate (late Oligocene to early Miocene?). By about 25 Ma, renewed deformation in the form of north-south-directed extension on the former thrust faults (i.e., backsliding) resulted in moderate tilting of the Gilbert surface. Alternating periods of extensional deformation and landscape stability ensued in the Miocene and through the Pliocene, but Quaternary deformation along the border faults seems to be of relatively minor extent and amount. Nevertheless, the fault scarps on the north flank of Phil Pico Mountain and other scattered locations on the margins of the Uintas attest to continued deformation in the Quaternary.

Sense of movement N

Comments: Shown as normal faults by Piety and Vetter (1999 #4463), who also mentioned that they found no evidence (geomorphic) of lateral displacement.

Dip not determined

Comments: Faults may dip rather steeply (to north or south) if they sole into the Uinta thrust fault, or may be subparallel to the underlying Uinta thrust fault if they reflect movement on associated south dipping thrusts.

Dip direction N

Geomorphic expression These fault form short (1 km) scarps over an extent of about 4 km. Their short extent caused Piety and Vetter (1999 #4463) to speculate about a landslide origin, but they favor a tectonic origin. Two broad grabens are present along the medial part of the faults. The southern of the two grabens have scarps heights of 8-10 on the main-south fault and 4.5-5 m on the antithetic-north fault. A long scarp profile across the south graben by Piety and Vetter (fig. 4, 1999 #4463) was used to determine that morphometric signature of the graben-bounding faults. Using maximum scarp-slope height and angle, they suggested that the fault scarps may have formed at about 100 ka. However, the large size of the scarps (8-10 m) suggests that they are multiple-event features, and the observed morphometric relations may be misleading (compiler's assertation). Commonly, compound fault scarps resulting from multiple faulting events appear to be older than the most recent event because the maximum scarp-slope angle is driven by the younger event and the scarp height is the product of the combined events (see Machette, 1989 #878). Thus, the faults along the southern graben may be somewhat younger than 100 ka.

Age of faulted deposits at the surface According to detailed mapping by Piety and Vetter (fig. 4, 1999 #4463), middle Pleistocene (250-500 ka) and late middle Pleistocene (130-140 to 250 ka) alluvial deposits are clearly deformed by the faults, whereas latest middle Pleistocene (1330-150 ka, Bull Lake) deposits have lineations that may be associated with <1 m of surface offset which is not recognizable owing to the deposits surface morphology. Younger late Pleistocene (Pinedale) deposits considered to be 13-14 ka to 30-40 ka are not deformed where they overlie the projection of the fault seen in older deposits. The fault also forms lineations in bedrock, east of the recognized scarps.

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<130 ka)

Comments: Piety and Vetter (table 3, 1999 #4463) indicated that the north flank faults were active before 130-150 ka and after 500 ka. They speculate on the possibility that lineaments on 130-150 (Bull Lake) deposits are associated with faulting. Considering the morphology of the faults scarps (see Geomorphic expression), we consider the faults to have been active in the past 130 ka, but before the latest Pleistocene (15-30 ka).

Recurrence interval >100 k.y. (0-500 ka)

Comments: Piety and Vetter (1999 #4463) reported recurrence intervals for surface rupturing could be 100 k.y., or longer for the past 500 k.y.

Slip-rate category <0.2 mm/yr

Comments: Piety and Vetter (1999 #4463) calculated maximum displacement (slip) rates of 0.007-0.008 mm.yr for the past 130-150 k.y., and an average maximum displacement rate of 0.003 for the past 500 k.y. These very low slip rates are bases on small amounts of net vertical offset across the two pronounced grabens that characterize the faults. Thus, we categorize the faults as being <0.2 mm/yr for this database.

Length End to end (km): 4.4
Cumulative trace (km): 5.4

Average strike (azimuth): N83°E

References

#4483 Hansen, W.R., 1986, Neogene tectonics and geomorphology of the eastern Uinta Mountains in Utah, Colorado, and Wyoming: U.S. Geological Survey Professional Paper 1356, 78 p.

#878 Machette, M.N., 1989, Slope-morphometric dating, *in* Forman, S.L., ed., Dating methods applicable to Quaternary geologic studies in the Western United States: Utah Geological and Mineral Survey Miscellaneous Publication 89-7, p. 30-42.

#4463 Piety, L.A., and Vetter, U.R., 1999, Seismotectonic report for Flaming Gorge Dam, Colorado River Storage Project, northeastern Utah: U.S. Bureau of Reclamation Seismotectonic Report 98-2, 78 p.

746, East Gallatin-Reese Creek fault system

Structure Number 746

Comments: Refers to fault number 30 (Reese Creek fault) of Witkind (1975 #317; 1975 #819); and fault numbers 64 (Reese Creek fault), 65 (East Gallatin fault), and 66 (Devils Slide fault) of Johns and others (1982 #259).

Structure Name East Gallatin-Reese Creek fault system

Comments: This group of faults form the high eastern front of the Gallatin Range and extend northward along Reese Creek, but have been referred to by various names. The name East Gallatin-Reese Creek fault system is from Pierce and others (1991 #1055) and is preferred in this compilation because we group the various faults together for convenience. The faults include the East Gallatin and the Devils Slide faults of Ruppel (1972 #470) and the Reese Creek fault of Wilson (1934 #1054). Ruppel (1972 #470) suggested that the faults may extend much further south, beyond Old Faithful and the Upper Geyser Basin and possibly join (or be associated with) the Teton fault [768]. The extent of the fault system shown here is from about 0.5 km east of Corwin Springs south to near the southern end of the Gallatin Range.

Synopsis The East Gallatin-Reese Creek fault system forms the >600-m-high eastern front of the Gallatin Range. At its southern end (the East Gallatin section [726b), a strand of the fault offsets 0.63-Ma Lava Creek Tuff, but along the main range front the tuff is only at the foot of the range in Gardners Hole and is not present on the upthrown side of the fault. The northern part of this fault system, the Reese Creek section [746a], is mapped as having as many as 6 strands. These extensional normal faults offset Eocene rock and younger Cenozoic movement is suspected, but not demonstrated. No scarps are known on Quaternary deposits. La Duke Hot Springs are located along the projection of the Reese Creek section, just north of the Yellowstone River.

Date of compilation 03/18/96

Compiler and affiliation Kathleen M. Haller, U.S. Geological Survey; Kenneth L. Pierce, U.S. Geological Survey

Geologic setting The East Gallatin-Reese Creek fault system is comprised of high-angle to near-vertical, down-to-the-east, normal faults along the eastern side of the Gallatin Range and a northern extension that is associated with a less prominent range front. The northern part of this fault system, the Reese Creek section [746ba], is mapped as having as many as 6 strands (Ruppel, 1972 #470; U.S. Geological Survey, 1972 #639). Various amounts of displacement across this fault are documented, but all are less than 2 km. Hague and others (1899 #1058) suggested more than 1.2 km of offset across the fault system. Later, Iddings (1904 #1059) inferred 1.8 km of offset across the Reese Creek fault. Wilson (1934 #1054) suggested about 1.2 km of offset across the easternmost strand of the system and Fraser and others (1969 #467) suggested a similar amount of offset (1.3 km). Ruppel (1972 #470) summarized previous work suggesting more than 1,200 m of post-Eocene stratigraphic displacement. At its southern end, the fault offsets 0.63-Ma Lava Creek Tuff; along the main range front, the tuff is only at the foot of the range in Gardners Hole and is not present on the upthrown side of the fault.

Number of sections 2
Comments: Two sections are defined based on demonstrable Quaternary movement along the southern part of the fault (Gallatin Range section) and less definitive evidence of Quaternary movement along the northern part (Reese Creek section).

Length End to end (km): 39.6
Cumulative (km) 79.9

Average strike (azimuth): N2°W

746a, East Gallatin-Reese Creek fault system, Reese Creek section

Section number 746a

Section name Reese Creek section
Comments: Section name follows fault name established by Wilson (1934 #1054). Section extends from about 0.5 km east of Corwin Springs south to the Gallatin River.

Quality of location Poor
Comments: All of the northern part of fault trace is mostly inferred and the location of about half of southern part is based on 1:125,000-scale geologic maps (U.S. Geological Survey, 1972 #639; 1972 #1057) based on mapping of Ruppel (1972 #470). The extreme northern end is from mapping by Pierce and others (1991 #1055). Fault traced complied at 1:125,000 scale in Yellowstone National Park at 1:250,000 scale in Montana

Scale of digital trace 1:125,000 (Wyo.) and 1:250,000 (Mont.)

State Wyoming, Montana

County Park (Wyo.), Park (Mont.) (Yellowstone National Park)

1° x 2° sheet Ashton, Bozeman

Physiographic Province Middle Rocky Mountains

Sense of movement Normal
Comments: Shown as normal by Witkind (1975 #317; 1975 #819). Early movement on the fault may have been left lateral (Brown, 1961 #1056).

Dip not determined

Dip direction E

Geomorphic expression Much of the fault system is buried, but it is expressed by the topography from the flank of Little Quadrant Mountain southward to the flank of Mount Holmes (U.S. Geological Survey, 1972 #1057). The topographic relief across the fault along its northern part is less than that to the south as evidenced by the presence of Eocene rocks on Sepulcher Mountain, east of the fault (downdropped side).

Age of faulted surficial deposits Mostly pre-Quaternary rock, including Eocene. One of the strands is mapped as concealed by Lava Creek Tuff (U.S. Geological Survey, 1972 #639), but this unit has been remapped as the 2.0 Ma Huckleberry Ridge Tuff (R.L., Christiansen, written commun., 1998). The fault is reported only as "topographically expressed" on Pinedale till, but it is not shown to offset the till on a companion map (U.S. Geological Survey, 1972 #1057). No offset of glacial deposits was noted by Pierce (1973 #3805) and Pierce and others (1991 #1055).

Paleoseismologic studies None

Most recent prehistoric deformation Quaternary (<1.6 Ma)
Comments: There is no definitive estimate of the time of most recent movement of this fault. The Undine Falls Basalt (~600 ka) is probably not offset, within the limits of detection (about 50 m) (Pierce and others, 1991 #1055). Ruppel (1972 #470) documented post-glacial movement and is the source of the Holocene age assignment in earlier compilations (Witkind, 1975 #317; 1975 #819; Johns and others, 1982 #259), but Pierce and others (1991 #1055) reported that evidence to support post-glacial movement is absent. The age assignment of Quaternary is tentative, as its faulting history prior to 600 ka is not known.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Inferred low-slip rate category based on absence of scarps on late Quaternary deposits.

Length End to end (km): 13.5
Cumulative Trace (km): 46.9

Average strike (azimuth): N5°E

References

#1056 Brown, C.W., 1961, Cenozoic stratigraphy and structural geology, northeast Yellowstone National Park, Wyoming and Montana: Geological Society of America Bulletin, v. 72, p. 1173-1194.

#467 Fraser, G.D., Waldrop, H.A., and Hyden, H.J., 1969, Geology of the Gardiner area, Park County, Montana: U.S. Geological Survey Bulletin 1277, 118 p., 1 pl., scale 1:24,000.

#1058 Hague, A., Iddings, J.P., Weed, W.H., Walcott, C.D., Girty, G.H., Stanton, T.W., and Knowlton, F.H., 1899, Geology of the Yellowstone National Park: U.S. Geological Survey Monograph 32, 882 p.

#1059 Iddings, J.P., 1904, A fracture valley system: Journal of Geology, v. 12, p. 94-105.

#259 Johns, W.M., Straw, W.T., Bergantino, R.N., Dresser, H.W., Hendrix, T.E., McClernan, H.G., Palmquist, J.C., and Schmidt, C.J., 1982, Neotectonic features of southern Montana east of 112°30' west longitude: Montana Bureau of Mines and Geology Open-File Report 91, 79 p., 2 sheets.

#3805 Pierce, K.L., 1973, Surficial geologic map of the Mount Holmes quadrangle and parts of the Tepee Creek, Crown Buttes, and Miner quadrangles, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-640, 1 sheet, scale 1:62,500.

#1055 Pierce, K.L., Adams, K.D., and Sturchio, N.C., 1991, Geologic setting of the Corwin Springs Known Geothermal Resources Area-Mammoth Hot Springs Area in and adjacent to Yellowstone National Park, *in* Sorey, M.L., ed., Effects of potential geothermal development in the Corwin Springs Known Geothermal Resources Area, Montana, on the thermal features of Yellowstone National Park: U.S. Geological Survey Water-Resources Investigations Report 91-4052.

#470 Ruppel, E.T., 1972, Geology of pre-Tertiary rocks in the northern part of Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 729-A, 66 p., 1 pl., scale 1:62,500.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

#1054 Wilson, C.W., 1934, Geology of the thrust fault near Gardiner, Montana: Journal of Geology, v. 42, p. 649-663.

#317 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in western Montana: U.S. Geological Survey Open-File Report 75-285, 36 p. pamphlet, 1 sheet, scale 1:500,000.
#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

746b, East Gallatin-Reese Creek fault system, East Gallatin section

Section number 746b

Section name East Gallatin section
Comments: Section name follows fault name established by Ruppel (1972 #470). Section extends from the Gallatin River south to beyond Winter Creek. Ruppel (p. A51-55, 1972 #470) and Pierce and others (p. C-18, 1991 #1055) summarized previous work and described the fault.

Quality of location Good
Comments: Ruppel (1972 #470) mapped the fault at 1:62,5000 scale and the U.S. Geological Survey (1972 #639; 1972 #1057) portrayed it at 1:125,000 scale. Fault traces recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:125,000

State Wyoming

County Park (Yellowstone National Park)

1° x 2° sheet Ashton

Physiographic Province Middle Rocky Mountains

Sense of movement Normal

Dip 50°E to vertical
Comments: Ruppel (p. A51, 1972 #470) noted "The East Gallatin fault is vertical where it is exposed by the Gardner River, and its straight trace suggests that it remains vertical, or nearly so, both to the north and to the south." Pierce and others (p C18-21, 1991 #1055) suggested that at depth the fault may dip east at 50° and intercept the Norris Mammoth corridor at 10-15 km depth. Extension that had occurred on the East Gallatin fault now occurs in the Norris-Mammoth corridor.

Dip direction E

Geomorphic expression The eastern front of the Gallatin Range is linear, moderately steep, and locally more than 600 m high. Although Ruppel (p. A54, 1972 #470) noted that glacial deposits are displaced minor amounts, Pierce and others (1991 #1055) found no evidence that glacial deposits are offset. The lack of late Quaternary offset on this major structure seems anomalous; one of the compilers (Pierce) has suggested that earlier horizontal extension had extended to the surface on the East Gallatin fault and is now expressed as vertical feeder dikes for the 15 vents and possibly other fissures in the Norris-Mammoth corridor.

Age of faulted deposits Mostly pre-Quaternary rocks, especially Paleozoic. At southern end of the fault, one strand offsets 0.63 Ma Lava Creek Tuff.

Paleoseismologic studies None

Most recent prehistoric deformation Middle and late Quaternary (<750 ka)
Comments: The geomorphic expression of the range front suggests late Cenozoic activity. Post-Eocene rocks and younger movement is suspected, but not demonstrated. Although uncertain, near the southern end of the fault system an eastern splay offsets Lava Creek Tuff (0.63 Ma), whereas near the section boundary (on the north), the easternmost strand does not offset Lava Creek Tuff.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: No offset of glacial deposits has been observed (Pierce, 1973 #3805; Pierce and others, 1991 #1055); thus, the lowest slip-rate category is infered.

Length End to end (km): 26.9
Cumulative trace (km): 33.0

Average strike (azimuth): N13°W

References

#467 Fraser, G.D., Waldrop, H.A., and Hyden, H.J., 1969, Geology of the Gardiner area, Park County, Montana: U.S. Geological Survey Bulletin 1277, 118 p., 1 pl., scale 1:24,000.

#1058 Hague, A., Iddings, J.P., Weed, W.H., Walcott, C.D., Girty, G.H., Stanton, T.W., and Knowlton, F.H., 1899, Geology of the Yellowstone National Park: U.S. Geological Survey Monograph 32, 882 p.

#1059 Iddings, J.P., 1904, A fracture valley system: Journal of Geology, v. 12, p. 94-105.

#3805 Pierce, K.L., 1973, Surficial geologic map of the Mount Holmes quadrangle and parts of the Tepee Creek, Crown Buttes, and Miner quadrangles, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-640, 1 sheet, scale 1:62,500.

#1055 Pierce, K.L., Adams, K.D., and Sturchio, N.C., 1991, Geologic setting of the Corwin Springs Known Geothermal Resources Area-Mammoth Hot Springs Area in and adjacent to Yellowstone National Park, *in* Sorey, M.L., ed., Effects of potential geothermal development in the Corwin Springs Known Geothermal Resources Area, Montana, on the thermal features of Yellowstone National Park: U.S. Geological Survey Water-Resources Investigations Report 91-4052.

#470 Ruppel, E.T., 1972, Geology of pre-Tertiary rocks in the northern part of Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 729-A, 66 p., 1 pl., scale 1:62,500.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

#1054 Wilson, C.W., 1934, Geology of the thrust fault near Gardiner, Montana: Journal of Geology, v. 42, p. 649-663.

#317 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in western Montana: U.S. Geological Survey Open-File Report 75-285, 36 p. pamphlet, 1 sheet, scale 1:500,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

747, Post-Lava Creek faults in NW Yellowstone National Park

Structure Number 747

Structure Name Post-Lava Creek faults in NW Yellowstone National Park
Comments: Includes more than 20 faults in the northwest part of Yellowstone National Park that offset the 0.63-Ma Lava Creek Tuff or are related to faults that do. However, the East Gallatin-Reese Creek fault system [746] and the Red Canyon fault [657] are described separately herein.

Synopsis: Outside the northwest quadrant of the 0.63 Ma Yellowstone caldera there are 20 or more faults that offset 0.63-Ma Lava Creek Tuff or are related to faults that do. These faults generally have <50 m offset in the late and middle Quaternary, and consequently have low long-term slip rates (<0.1 mm/yr). These faults trend north except in the area near West Yellowstone basin, where they trend north to northwest subparallel to the eastern end of the Red Canyon fault [657]. Many of these faults are within the Norris-Mammoth corridor (White and others, 1988 #3797; Pierce and others, 1991 #1055). These faults may relate to volcanism and magmatism associated with the Yellowstone caldera, which erupted catastrophically about 0.63 Ma. Several faults that could be considered to be within this group show evidence of post-glacial movement, but they are described separately as the Wolf Lake fault [752].

Date of compilation March 31, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Park, Teton

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Reliability of location Good
Comments: Faulting of late Cenozoic volcanic rocks was mapped at 1:125,000 scale (Christiansen, in press #1784) and at 1:62,500 scale (unpublished map of Mammoth quadrangle by Christiansen and others; Christiansen and Blank, 1974 #2264; Christiansen and Blank, 1974 #2265; Prostka and others, 1975 #2260). Ruppel(1972 #470) mapped pre-Eocene rocks in the area. Fault traces were recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:125,000

Geologic setting These Quaternary faults northwest of the 0.63 Ma Yellowstone Caldera have a northerly to northwesterly strike, offset Lava Creek Tuff, and may be associated with post-caldera activity.

Sense of movement Normal

Dip not determined

Dip direction E,W

Geomorphic expression The faults are generally expressed as escarpments on or valleys in Lava Creek Tuff (bedrock).

Age of faulted deposits These faults offset the 0.63-Ma Lava Creek Tuff, generally as a result of multiple surface rupturing events. However, mapping of the surficial geology (Pierce, 1973 #3804; Pierce, 1973 #3805; Waldrop and Pierce, 1975 #3803) show no post-glacial fault scarps.

Paleoseismic studies none

Timing of most recent paleoevent Middle and late Quaternary (<750 ka)
Comments: These faults offset the 0.63-Ma Lava Creek Tuff, generally as a result of multiple surface rupturing events. Post-glacial scarps have not been generally recognized along the faults, although these faults were not specifically examined for evidence of offset of surficial materials. However, portions of several faults that approach the Yellowstone caldera show evidence of post-glacial movement, but they are described separately under the Wolf Lake fault [752].

Recurrence interval not determined
Comments: Although undetermined, the minimum recurrence is probably >10-15 k.y. because no post-glacial offset has been noted.

Slip Rate <0.2 mm/yr
Comments: A low slip-rate category is assigned on the basis of generally less than 50 m of offset in the past 0.63 Ma, which results in an average long-term slip rate of 0.08 mm/yr.

Length End to end (km): 49.2
Cumulative trace (km): 212.7

Average strike (azimuth): N23°W

References

#1784 Christiansen, R.L., in press, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 1 pl., scale 1:125,000.

#2264 Christiansen, R.L., and Blank, H.R., Jr., 1974, Geologic map of the Old Faithful quadrangle, Yellowstone, National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1189, scale 1:62,500.

#2265 Christiansen, R.L., and Blank, H.R., Jr., 1974, Geologic map of the Madison Junction quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1190, scale 1:62,500.

#3804 Pierce, K.L., 1973, Surficial geologic map of the Mammoth quadrangle and part of the Gardiner quadrangle, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-641, 1 sheet, scale 1:62,500.
#3805 Pierce, K.L., 1973, Surficial geologic map of the Mount Holmes quadrangle and parts of the Tepee Creek, Crown Buttes, and Miner quadrangles, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-640, 1 sheet, scale 1:62,500.
#1055 Pierce, K.L., Adams, K.D., and Sturchio, N.C., 1991, Geologic setting of the Corwin Springs Known Geothermal Resources Area-Mammoth Hot Springs Area in and adjacent to Yellowstone National Park, *in* Sorey, M.L., ed., Effects of potential geothermal development in the Corwin Springs Known Geothermal Resources Area, Montana, on the thermal features of Yellowstone National Park: U.S. Geological Survey Water-Resources Investigations Report 91-4052.
#2260 Prostka, H.J., Blank, H.R., Jr., Christiansen, R.L., and Ruppel, E.T., 1975, Geologic map of the Tower Junction quadrangle, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Geologic Quadrangle Map GQ-1247, scale 1:62,500.
#470 Ruppel, E.T., 1972, Geology of pre-Tertiary rocks in the northern part of Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 729-A, 66 p., 1 pl., scale 1:62,500.
#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.
#3803 Waldrop, H.A., and Pierce, K.L., 1975, Surficial geologic map of the Madison Junction quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-651, 1 sheet, scale 1:62,500.
#3797 White, D.E., Hutchinson, R.A., and Keith, T.E.C., 1988, The geology and remarkable thermal activity of Norris Geyser Basin, Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 1456, 84 p.

748, Unnamed faults near Opal Creek

Structure Number 748

Structure Name Unnamed faults near Opal Creek
Comments: These unnamed faults form a small graben along the Lamar River Valley near Opal Creek (U.S. Geological Survey, 1972, #639; Pierce, 1974 #2217).

Synopsis: This group of faults is mapped in late Pinedale alluvial deposits of the Lamar Valley, near Opal Creek. The faults generally show as lineaments on aerial photographs and the associated scarps are not easily recognizable in the field. The faults are at the eastern end of the Lamar River fault, which does not appear to offset Lava Creek Tuff and is considered pre-Quaternary; therefore it is not included in this compilation. The Opal Creek faults should be reexamined for further evidence of Quaternary movement.

Date of compilation March 30, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Park

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Reliability of location Good
Comments: Mapped at 1:62,500 scale by Pierce (1974 #2217) and compiled at 1:125,000 scale by the U.S. Geological Survey (U.S. Geological Survey, 1972, #639; U.S. Geological Survey, 1972 #1057).

Scale of digital trace 1:125,000

Geologic setting Located along the southwest side of Lamar River valley. Some authors have inferred a major fault that follows the prominent northwest linear trend of the Lamar Valley, but offset of Absaroka Volcanics across the valley is minimal.

Dip not determined

Dip direction NE
Comments: Main fault presumably dips northeast.

Geomorphic expression Expressed on aerial photographs and forms subdued scarps on late-glacial (Pinedale) gravel and sandy kame deposits.

Age of faulted deposits Faults cut late-glacial (about 15 ka) gravel and sandy kame deposits, which are interpreted by the compiler to be a sandy delta built into a late glacial (Pinedale) lake.

Paleoseismic studies none

Timing of most recent paleoevent latest Quaternary (<15 ka)
Comments: Young movement based on presence of scarps formed on late-glacial (latest Pleistocene, about 15 ka) deposits.

Recurrence interval not determined

Slip Rate Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category inferred from fault scarps that are generally low (<1 m high), where present.

Length End to end (km): 2.5

Cumulative trace (km): 4.4

Average strike (azimuth): N53°W

References

#2217 Pierce, K.L., 1974, Surficial geologic map of the Abiathar Peak and parts of adjacent quadrangles, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-646, scale 1:62,500.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

749, Mirror Plateau faults

Structure Number 749

Structure Name Mirror Plateau faults
Comments: Referred to as the Mirror Plateau faults by Love (p. 1751, 1961 #3801). These faults are mostly on the Mirror Plateau and extend to the southeast.

Synopsis: This group of Quaternary faults form of anastomosing band on and near the Mirror Plateau (fig. 3 and Plate 1, Love, 1961 #3801). The plateau is underlain by Eocene volcanic rocks, partly covered with 0.63-Ma Lava Creek Tuff (U.S. Geological Survey, 1972 #639). The faults are parallel to and 7-11 km outboard of the structural margin of the 0.63-Ma Yellowstone caldera (Christiansen, 2001 #1784), which is the leading edge of the Yellowstone hotspot (Pierce and Morgan, 1992 #539). The faults have strong geomorphic expression and commonly appear to have dammed or offset stream drainages (Love, 1961 #3801). In the Mirror Plateau area, younger faults [749a] that we classify as <15 ka (post-glacial) have generally been mapped as solid across Pinedale till, whereas older faults [749b] classified as <750 have generally been mapped as dashed across Pinedale till. The Pinedale till on U.S. Geological Survey maps (1972 #639) includes Pinedale "rubble veneer" mapped at 1:62,500 scale (Pierce, 1974 #2217; Pierce, 1974 #2238), and which is so thin that nearly all the escarpments are on bedrock rather than on glacial deposits.

Date of compilation March 27, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

Geologic setting These faults are parallel to and 7-11 km outboard of the northeast of the margin the 0.63-Ma Yellowstone caldera (Christiansen, 2001 #1784), which is on the leading edge of the Yellowstone hotspot (Pierce and Morgan, 1992 #539). They form of an anastomosing band on and near the Mirror Plateau (fig. 3 and Plate 1, Love, 1961 #3801), where the bedrock is Eocene volcanic rock partly covered with 0.63 Ma Lava Creek Tuff (U.S. Geological Survey, 1972 #639). P-wave and gravity studies suggest hydrothermal or partially molten material is at depth beneath this area (Smith and Braile, 1993 #2271).

Number of sections 2

Comments: Faults on Mirror Plateau with evidence of <15 ka movement are collectively described as the younger section [749a] and those with evidence of <750 ka movement are collectively described as the older section [749b].

Length End to end (km): 23.5

Cumulative trace (km): 105.5

Average strike (azimuth): N39°W

749a, Mirror Plateau faults, younger section

Section number 749a

Section name Younger section

Comments: This section includes those Mirror Plateau faults with <15 ka activity. They are in the central part of the Mirror Plateau.

Quality of location Good

Comments: Mapped as either solid or long-dashed faults at 1:62,000 scale on surficial geologic quadrangles (Richmond and Waldrop, 1972 #2261; Pierce, 1974 #2217; Pierce, 1974 #2238) and bedrock quadrangles (Prostka and others, 1975 #2259; Prostka and others, 1975 #2260; Prostka and others, 1975 #3802); also shown on Yellowstone Park compilations at 1:125,000 scale (U.S. Geological Survey, 1972 #639). Fault traces recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:125,000

State Wyoming

County Park

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Sense of movement Normal

Dip not determined

Dip direction NE, SW

Geomorphic expression Well expressed as scarps primarily on bedrock that is mantled by thin glacial till and veneer of rubble. Landscape well glaciated and freshness of scarp morphology thought to reflect post-glacial offset. Pierce (1974 #2217) noted that "For a fault scarp 10-50 feet [sic, 3-15 m] high it is difficult to tell whether the till along the fault scarp has been offset a few feet since the Pinedale glaciation or simply deposited on both sides of the fault scarp." Richmond and Waldrop (1972 #2261) indicated offsets and scarp heights in the 15-40 foot (5-12 m) range, but the compiler considers it important to document that not all of this offset is post-glacial, although some faults have sag ponds and offset stream drainages. Existing study of these faults is of a reconnaissance nature.

Age of faulted deposits Inferred to be latest Pleistocene Pinedale till and rubble veneer.

Paleoseismic studies none

Time of most prehistoric faulting Latest Quaternary (<15 ka)

Comments: Freshness of scarp morphology largely results from presence of bedrock in near surface. Local sag ponds and marshy areas and offset drainages indicate a post-glacial timing for offset. However, it is difficult to observe actual offset of thin deposits of Pinedale till and rubble veneer. Pierce (1974 #2217) noted "In one place in the center of the Mirror Plateau, pull-apart cracks with half a foot of vertical offset expose living tree roots indicating recent movements."

Recurrence interval not determined

Comments: An estimate of <15 k.y. can be made if one assumes only a single faulting event in post-glacial time (since about 15 ka). However if, as concluded by Richmond and Waldrop (1972 #2261), some 40-foot (14-m) high scarps are post-glacial, this would require multiple (probably >5 offsets) in post-glacial time, and a recurrence interval more like 3 k.y. The compiler thinks this assertion needs to be demonstrated, rather than inferred.

Slip-rate category Unknown; probably 0.2-1.0 mm/yr

Comments: If 5 m (to 12 m) of offset has occurred during the past 15 k.y., which seems reasonable based on the presence of some sag ponds and the freshness of the scarps, a slip rate of >0.3 mm/yr appears to be a reasonable estimate. On this basis, a slip-rate category of 0.2-1.0 mm/yr is assigned to this group of faults.

Length End to end (km): 18.4
Cumulative trace (km): 56.1

Average strike (azimuth): N36°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#3801 Love, J.D., 1961, Reconnaissance study of Quaternary faults in and south of Yellowstone National Park, Wyoming: Geological Society of America Bulletin, v. 72, p. 1749-1764.

#2217 Pierce, K.L., 1974, Surficial geologic map of the Abiather Peak and parts of adjacent quadrangles, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-646, scale 1:62,500.

#2238 Pierce, K.L., 1974, Surficial geologic map of the Tower Junction quadrangle and part of the Mount Wallace quadrangle, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-647, scale 1:62,500.

#539 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hot spot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds., Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179, p. 1-53, 1 pl.

#2260 Prostka, H.J., Blank, H.R., Jr., Christiansen, R.L., and Ruppel, E.T., 1975, Geologic map of the Tower Junction quadrangle, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Geologic Quadrangle Map GQ-1247, scale 1:62,500.

#3802 Prostka, H.J., Ruppel, E.T., and Christiansen, R.L., 1975, Geologic map of the Abiathar Peak quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1244, 1 sheet, scale 1:62,500.

#2259 Prostka, H.J., Smedes, H.W., and Christiansen, R.L., 1975, Geologic map of the Pelican Cone quadrangle, Yellowstone National Park and vicinity, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1243.

#2261 Richmond, G.M., and Waldrop, H.A., 1972, Surficial geologic map of the Pelican Cone quadrangle, Yellowstone National Park and adjoining area, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-638, scale 1:62,500.

#2271 Smith, R.B., and Braile, L.W., 1993, Topographic signature, space-time evolution, and physical properties of the Yellowstone-Snake River plain volcanic system—the Yellowstone hotspot, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming, Memoir No. 5, p. 694-754.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

749b, Mirror Plateau faults, older section

Section number 749b

Section name Older section

Comments: This section includes faults on Mirror Plateau that locally offset 0.63-Ma Lava Creek Tuff, but which don't show evidence of post glacial (<15 ka) movement. These faults are on the Mirror Plateau, and extend 7 km to the southeast.

Quality of location Good

Comments: Originally studied by Love (1961 #3801). First mapped by USGS at 1:62,000 scale as bedrock geology quadrangles by Prostka and others (1975 #2259; 1975 #2260; 1975 #3802) and surficial geology quadrangles by Pierce (1974 #2217; 1974 #2238) and Richmond and Waldrop (1972 #2261). Later recompiled at 1:125,000 scale on Yellowstone Park Maps (U.S. Geological Survey, 1972 #639; U.S. Geological Survey, 1972 #1057). Fault traces recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:125,000

State Wyoming

County Park

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Sense of movement Normal

Dip not determined

Dip direction NE, SW

Geomorphic expression Scarps recognizable on aerial photographs, but generally less sharply defined than those for faults in the younger section [749a]. Scarps mostly or entirely on bedrock.

Age of faulted deposits Lava Creek Tuff (0.63 Ma) commonly offset along parts of faults.

Paleoseismic studies none

Time of most prehistoric faulting Middle and late Quaternary (<750 ka)

Comments: Commonly along fault length, the 0.63 Ma Lava Creek Tuff is offset. Younger deposits may be offset, especially where closely associated with the Younger Mirror Plateau faults section [749a]. The compiler considers that an age of 130 ka is probable for most of these faults, but conservatively places these faults in the middle and late Quaternary (<750 ka) category.

Recurrence interval not determined

Comments: Limits on recurrence are <600 ka to possibly <100 ka. The 0.63 Ma Lava Creek Tuff is commonly offset along the length of the fault. Younger deposits may be offset (see above), thus a recurrence interval of 100 k.y. or less seems likely.

Slip-rate category Unknown; probably <0.2 mm/yr

Comments: Net vertical offset of perhaps 5 m has occurred on individual faults in the group in the past 100,000 yrs, which would suggest a long-term slip rate of only 0.05 mm/yr, thus, the low slip-rate category inferred by compiler.

Length End to end (km): 23.1
Cumulative trace (km): 49.3

Average strike (azimuth): N43°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#3801 Love, J.D., 1961, Reconnaissance study of Quaternary faults in and south of Yellowstone National Park, Wyoming: Geological Society of America Bulletin, v. 72, p. 1749-1764.

#2217 Pierce, K.L., 1974, Surficial geologic map of the Abiather Peak and parts of adjacent quadrangles, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-646, scale 1:62,500.

#2238 Pierce, K.L., 1974, Surficial geologic map of the Tower Junction quadrangle and part of the Mount Wallace quadrangle, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-647, scale 1:62,500.
#539 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hot spot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds., Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179, p. 1-53, 1 pl.
#2260 Prostka, H.J., Blank, H.R., Jr., Christiansen, R.L., and Ruppel, E.T., 1975, Geologic map of the Tower Junction quadrangle, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Geologic Quadrangle Map GQ-1247, scale 1:62,500.
#3802 Prostka, H.J., Ruppel, E.T., and Christiansen, R.L., 1975, Geologic map of the Abiathar Peak quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1244, 1 sheet, scale 1:62,500.
#2259 Prostka, H.J., Smedes, H.W., and Christiansen, R.L., 1975, Geologic map of the Pelican Cone quadrangle, Yellowstone National Park and vicinity, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1243.
#2261 Richmond, G.M., and Waldrop, H.A., 1972, Surficial geologic map of the Pelican Cone quadrangle, Yellowstone National Park and adjoining area, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-638, scale 1:62,500.
#2271 Smith, R.B., and Braile, L.W., 1993, Topographic signature, space-time evolution, and physical properties of the Yellowstone-Snake River plain volcanic system—the Yellowstone hotspot, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming, Memoir No. 5, p. 694-754.
#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.
#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

750, Unnamed faults in the Burnt-Raven Creek area

Structure Number 750

Structure Name Unnamed faults in the Burnt-Raven Creek area
Comments: This group of faults are between Burnt Creek and Raven Creek in the remote back country of Yellowstone National Park, between the 0.63-Ma Yellowstone caldera and the Mirror Plateau faults [749].

Synopsis: The group of Burnt-Raven Creek faults are just outside of and parallel to the northeast margin of the Yellowstone caldera, which formed when the Lava Creek Tuff was erupted 0.63 Ma. The Burnt-Raven Creek faults are just inside (to the southwest) of the Mirror Plateau faults [749], many of which have post-glacial (<15 ka) activity. The Burnt-Raven Creek faults offset the 0.63 Ma Lava Creek Tuff and, because of its association with the Mirror Plateau faults [749], may have younger activity. Richmond maps three fault strands as offsetting deposits of last (Pinedale) glaciation; two are near the south-east end of this group and one extends through the Hot Spring Basin. No detailed study of fault activity has been made in this remote region.

Date of compilation March 30, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Park

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Reliability of location Good
Comments: Surficial geology mapped at 1:62,500 scale by Richmond and Waldrop (1972 #2261); bedrock geology mapped by Prostka and others (1975 #2259; 1975 #2260) and compiled at 1:125,000

scale by U.S. Geological Survey (1972 #639; 1972 #1057) and Christiansen (2001 #1784). No detailed study of fault activity has been made in this remote region.

Scale of digital trace Digitized from 1:125,000-scale map by U.S. Geological Survey (1972 #1057).

Geologic setting The Burnt-Raven Creek faults are parallel to and <7 km outboard of the northeast margin the 0.63-Ma Yellowstone caldera (Christiansen, 2001 #1784), which is on the leading edge of the Yellowstone hotspot (Pierce and Morgan, 1992 #539). They form of an anastomosing band of faulting on the western side of the Mirror Plateau (fig. 3 and Plate 1, Love, 1961 #3801), where the bedrock is Eocene volcanic rock partly covered with 0.63-Ma Lava Creek Tuff (U.S. Geological Survey, 1972 #639). P-wave and gravity studies suggest hydrothermal or partially molten material is at depth beneath this area (Smith and Braile, 1993 #2271).

Sense of movement Normal

Dip Not reported

Dip direction E to NE and W to SW.

Geomorphic expression Fault offset expressed in geomorphology, but mapped through glacial deposits as short dashed lines (Richmond and Waldrop, 1972 #2261; Pierce, 1974 #2217; 1974 #2238) indicating that faults are older than glacial deposits. Detailed studies or descriptions are not available.

Age of faulted deposits Lava Creek Tuff (0.63 Ma) commonly offset along parts of fault length.

Paleoseismic studies none

Timing of most recent paleoevent middle and late Quaternary (<750 ka)
Comments: The 0.63-Ma Lava Creek Tuff is commonly offset along fault length. Younger deposits may also be offset. G.M. Richmond mapped three fault sections as offsetting deposits of the last glaciation (Pinedale); two are near the south east end of this group and one through the Hot Spring Basin Group.

Recurrence interval not determined

Slip Rate not determined; probably <0.2 mm/yr
Comments: Offset of 0.63-Ma Lava Creek Tuff is generally less than 30-50 m, suggesting these faults are in the low long-term slip rate category of <0.2 mm/yr. However, this area's location between the 0.63-Ma caldera margin and the Mirror Plateau faults [749] may suggest that faulting here is of comparable activity to that of the Mirror Plateau, where post-glacial (<15 ka) faults [749a] are common.

Length End to end (km): 44.8
Cumulative trace (km): 261.6

Average strike (azimuth): N13°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#3801 Love, J.D., 1961, Reconnaissance study of Quaternary faults in and south of Yellowstone National Park, Wyoming: Geological Society of America Bulletin, v. 72, p. 1749-1764.

#2217 Pierce, K.L., 1974, Surficial geologic map of the Abiathar Peak and parts of adjacent quadrangles, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-646, scale 1:62,500.

#2238 Pierce, K.L., 1974, Surficial geologic map of the Tower Junction quadrangle and part of the Mount Wallace quadrangle, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-647, scale 1:62,500.

#539 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hot spot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds., Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179, p. 1-53, 1 pl.

#2260 Prostka, H.J., Blank, H.R., Jr., Christiansen, R.L., and Ruppel, E.T., 1975, Geologic map of the Tower Junction quadrangle, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Geologic Quadrangle Map GQ-1247, scale 1:62,500.

#2259 Prostka, H.J., Smedes, H.W., and Christiansen, R.L., 1975, Geologic map of the Pelican Cone quadrangle, Yellowstone National Park and vicinity, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1243.
#2261 Richmond, G.M., and Waldrop, H.A., 1972, Surficial geologic map of the Pelican Cone quadrangle, Yellowstone National Park and adjoining area, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-638, scale 1:62,500.
#2271 Smith, R.B., and Braile, L.W., 1993, Topographic signature, space-time evolution, and physical properties of the Yellowstone-Snake River plain volcanic system—the Yellowstone hotspot, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming, Memoir No. 5, p. 694-754.
#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.
#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

751, Shoshone Lake faults

Structure Number 751

Structure Name Shoshone Lake faults
Comments: This group of three subparallel faults is near Shoshone Lake for which they are named (Case and others, 1997 #3449; Case, 1997 #3450; Wong and others, 2000 #4484). The two longer (main) faults trend north-south. The third (shorter) fault cuts across low hills that project into the northern part of Shoshone Lake, west of the Cement Hills (see Christiansen, 2001 #1784).

Synopsis: This is a group of three short faults strike north-south on both sides of Shoshone Lake. The two eastern faults from a graben within the south-central part of the 0.63 Ma Yellowstone caldera (U.S. Geological Survey, 1972 #639; Christiansen and Blank, 1974 #2264; 2001 #1784) and offset the Dry Creek rhyolite flow and the tuff of Bluff Point, whose ages are about 160 ka (Christiansen, 2001 #1784). The western fault offsets the Spring Creek rhyolite flow, which is somewhat older than flows dated 160 ka.

Date of compilation October 18, 2001

Compiler and affiliation Michael N. Machette and Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Middle Rocky Mountains

Reliability of location Good
Comments: Faults were mapped at 1:62,500 scale by Christiansen (1974 #2264) and more recently published by Christiansen (2001 #1784) at 1:125,000 scale. Fault traces recompiled at 1:125,000 scale on map with topographic base.

Scale of digital trace 1:125,000

Geologic setting These faults strike north-south and form scarps in Quaternary rhyolitic flows (Spring Creek and Dry Creek rhyolites and tuff of Bluff Point) within the central part of the 0.64 Ma Yellowstone caldera (U.S. Geological Survey, 1972 #639; U.S. Geological Survey, 1972 #1057; Christiansen, 2001 #1784). These rhyolite flows are generally about 160 ka (Christiansen, 2001 #1784).

Sense of movement Normal

Dip not determined
Comments: Considered to be high-angle faults by Wong and others (2000 #4484).

Dip direction not determined

Geomorphic expression The two main (eastern) faults form scarps on rhyolite flows. These two scarps face each other, forming a broad graben east of Shoshone Lake. The third fault forms a scarp on rhyolite north of the lake and east of the graben. No morphometric data or information on scarp heights has been reported.

Age of faulted deposits The eastern fault scarps offset the Dry Creek flow and the tuff of Bluff Point, whose ages are probably about 160 ka (Obradovich, 1992 #2268; Christiansen, 2001 #1784). No post-glacial (<15 ka) materials appear to be offset (Richmond, 1973 #2286).

Paleoseismic studies none

Timing of most recent paleoevent Late to middle Quaternary (<750 ka)

Comments: Faulting is younger than about 160 ka (latest middle Quaternary), and may be late Pleistocene (10-130 ka), although it is probably older than the last major glacial scouring that occurred in the area (Pinedale, 15 ka).

Recurrence interval not determined

Slip Rate <0.2 mm/yr

Comments: Wong and others (2000 #4484) suggested a slip rate of 0.08 mm/yr based on an assumption that the faults had the same activity as the Polecat Creek faults (part of the Snake River caldera faults [765]). A low slip rate is inferred from the relative inactivity of the faults. On the basis of these data, the faults are assigned to the <0.2 mm/yr slip-rate category.

Length End to end (km): 6.0
Cumulative trace (km): 10.2

Average strike (azimuth): N15°W

References

#3450 Case, J.C., 1997, Earthquakes and active faults in Wyoming: Geological Survey of Wyoming Preliminary Hazard Report 97-2, 58 p.

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pls., scale 1:125,000.

#2264 Christiansen, R.L., and Blank, H.R., Jr., 1974, Geologic map of the Old Faithful quadrangle, Yellowstone, National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1189, scale 1:62,500.

#2268 Obradovich, J.D., 1992, Geochronology of the late Cenozoic volcanism of Yellowstone National Park and adjoining areas, Wyoming and Idaho: U.S. Geological Survey Open-File Report 92-408, 45 p.

#2286 Richmond, G.M., 1973, Surficial geologic map of the West Thumb quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-643, scale 1:62,500.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

752, Wolf Lake fault and nearby faults

Structure Number 752

Structure Name Wolf Lake fault and nearby faults

Comments: Named herein for Wolf Lake.

Synopsis: The Wolf Lake fault locally forms a 2.5-m-high scarp on late Pinedale gravel. Also included in this group are two faults about 3 km to the northeast that also appear to have post-glacial movement based on associated sag ponds and small but abrupt escarpments. The mapped post-glacial length of the individual faults is less than 2 km, suggesting either minimal earthquake risk or that post-glacial offset actually extends further or may include other nearby geomorphically well-expressed faults that are mapped (but not proved) to be older. These faults could be considered to be the youngest expression of movement along the generally older post-Lava Creek faults in the northwest part of Yellow-stone National Park [747].

Date of compilation March 30, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Park

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Reliability of location Good
Comments: Mapped by Pierce (1973 #3804) and Richmond and Waldrop (1975 #3800) at 1:62,500 scale and at 1:125,000 scale by Christiansen (2001 #1784) and the U.S. Geological Survey (1972 #1057, #639).

Scale of digital trace 1:125,000

Geologic setting The Wolf Lake fault and two associated faults about 3 km to the northeast appear to have post-glacial movement. These faults are rather short (<2 km), suggesting that they are not associated with large earthquakes or that they are affiliated with other nearby faults (such as [747]), which are considered (but not proved) to be older (middle and late Quaternary, <750 ka).

Sense of movement: Normal

Dip not determined

Dip direction NE

Geomorphic expression A clear scarp as much as 2.5 m high is present along the Wolf Lake fault. (Pierce, 1973, and field notes of July 10, 1975) (Richmond and Waldrop, 1975 #3800).

Age of faulted deposits The Wolf Lake fault offsets a late glacial fluvial terrace.

Paleoseismic studies none

Timing of most recent paleoevent latest Quaternary (<15 ka)
Comments: Based on offset of late glacial age (ca. 15 ka) deposits. Nearby faults to the northeast have sag ponds and strong morphology also suggesting post-glacial (<15 ka) offset. These faults could be considered to be the youngest expression of movement along the generally older post-Lava Creek faults in the northwest part of Yellow-stone National Park [747].

Recurrence interval not determined

Slip Rate not determined, probably <0.2 mm/yr
Comments: About 2.5 m of slip has occurred in the past 15 ka. Since no recurrence has been determined for this slip, a rate cannot be calculated. However, a low slip-rate category is inferred from relatively small (2.5 m) scarps, where present.

Length End to end (km): 6
Cumulative trace (km): 8.2

Average strike (azimuth): N33°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#3804 Pierce, K.L., 1973, Surficial geologic map of the Mammoth quadrangle and part of the Gardiner quadrangle, Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations I-641, 1 sheet, scale 1:62,500.
#3800 Richmond, G.M., and Waldrop, H.A., 1975, Surficial geologic map of the Norris Junction quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-650, 1 sheet, scale 1:62,500.
#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.
#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000

753, Mallard Lake resurgent dome faults (Class B)

Structure Number 753

Structure Name Mallard Lake resurgent dome faults (Class B)
Comments: Name derived from one of two resurgent domes of the 0.63-Ma Yellowstone caldera. Shown by U.S. Geological Survey (1972 #639) as group of about eight anastomosing faults. Referred to as the Mallard Lake faults by Case (1997 #3449; 1997 #3450) and the "zone of faults near Shoshone and Mallard Lakes, Wyoming" by Wong and others (2000 #4484).

Synopsis: The Mallard Lake resurgent dome is broken by an anastomosing band of about eight northwest-trending faults that offset the 150-160 ka (Obradovich, 1992 #2268) Mallard Lake rhyolite flow. Based on ages of faulted and unfaulted rhyolite flows, Christiansen (2001 #1784) [concluded that faulting occurred at about 160 ka. This timing is considerably younger than expected since the caldera erupted the Lava Creek Tuff at 630 ka. Based on interpretation of drill holes where the Lava Creek Tuff is structurally high, Christiansen (2001 #1784) concluded that an earlier phase of resurgent doming probably also occurred about 500 ka. Owing to the thickness of the brittle layer of the crust (only 3-5 km) inside the caldera, earthquakes of only limited magnitude may be generated on these faults (Smith and Braile, 1993 #2271). We assign these faults to Class B, since they may be largely volcanic in origin and may be incapable of generating large magnitude (M>6.5) earthquakes.

Date of compilation March 19, 1998.

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Reliability of location Good
Comments: Mapped at 1:62,500 scale by Christiansen and Blank (1974 #2264; 1974 #2265; Christiansen, 1974 #2266; 1975 #2267), and also published at 1:125,000 scale by U.S. Geological Survey (1972 #639).

Scale of digital trace 1:125,000

Geologic setting One of two resurgent domes of the Yellowstone caldera that erupted the 630 ka Lava Creek Tuff. Discussion of chronology of doming is in Christiansen (2001 #1784).

Sense of movement Normal

Dip not determined

Dip direction NE, SW

Geomorphic expression Fault scarps are well expressed on the 150-160 ka Mallard Lake flow (rhyolitic bedrock).

Age of faulted deposits The faults are present in the Mallard Lake flow, which is about 150-160 ka based on age determinations from the flow and ages from stratigrapically related rhyolite flows (Obradovich, 1992 #2268). The faults do not extend into slightly younger rhyolite flows, suggesting they have not been active in the past 150,000 years.

Paleoseismic studies none

Timing of most recent paleoevent Middle and late Quaternary (<750 ka)

Comments: Uplift and faulting of the Mallard Lake dome occurred about 160 ka (Christiansen, 2001 #1784). Some low level(?) minor fracturing on these faults may be important to upward movement of geothermal waters in the Midway Geyser Basin immediately to the northwest of the Mallard Lake dome (R.B. Smith, oral commun. to compiler, 1998).

Recurrence interval not determined

Comments: The faults associated with the resurgent doming were active about 160 ka (Christiansen, 2001 #1784), and are now inactive or much less active than previously.

Slip Rate Unknown; probably <0.2 mm/yr

Comments: The faults associated with the resurgent doming were active about 160 ka, and are inactive or much less active now. Wong and others (2000 #4484) suggested a slip rate of 0.08 mm/yr based on an assumption that the faults had the same activity as the Polecat Creek faults (part of the Snake River caldera faults [765]). Low slip-rate category is inferred from the relative inactivity of the faults.

Length End to end (km): 11
Cumulative trace (km): 107.4

Average strike (azimuth): N43°W

References

#3450 Case, J.C., 1997, Earthquakes and active faults in Wyoming: Geological Survey of Wyoming Preliminary Hazard Report 97-2, 58 p.

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2266 Christiansen, R.L., 1974, Geologic map of the West Thumb quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1191, scale 1:62,500.

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pls., scale 1:125,000.

#2264 Christiansen, R.L., and Blank, H.R., Jr., 1974, Geologic map of the Old Faithful quadrangle, Yellowstone, National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1189, scale 1:62,500.

#2265 Christiansen, R.L., and Blank, H.R., Jr., 1974, Geologic map of the Madison Junction quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1190, scale 1:62,500.

#2267 Christiansen, R.L., and Blank, H.R., Jr., 1975, Geologic map of the Norris Junction quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1193, scale 1:62,500.

#2268 Obradovich, J.D., 1992, Geochronology of the late Cenozoic volcanism of Yellowstone National Park and adjoining areas, Wyoming and Idaho: U.S. Geological Survey Open-File Report 92-408, 45 p.

#2271 Smith, R.B., and Braile, L.W., 1993, Topographic signature, space-time evolution, and physical properties of the Yellowstone-Snake River plain volcanic system—the Yellowstone hotspot, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming, Memoir No. 5, p. 694-754.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

754, Elephant Back fault zone

Structure Number 754
Comments:

Structure Name Elephant Back fault zone
Comments: Referred to as Elephant Back fault zone by Christensen (2001 #1784). This group of faults is comprised of 3-10 subparallel faults on Elephant Back Mountain, northwest of Yellowstone Lake in the central part of the Yellowstone caldera.

Synopsis: Several (3-10) subparallel faults trend northeast across Elephant Back Mountain where they are in the Elephant Back rhyolite flow, which is about 150 ka. In places, the fault traces form trench-like valleys about 100 m wide. These faults are in the center of the Yellowstone caldera that erupted the 0.63-Ma Lava Creek Tuff. The faults are parallel to the long axis of the caldera and also parallel to the axis of historic doming as shown by Pelton and Smith (1982 #2270). These faults trend southwest from the Sour Creek resurgent dome toward but somewhat east of the Mallard lake resurgent dome. Owing to the thickness of the brittle layer of the crust (only 3-5 km) inside the caldera, earthquakes of only limited magnitude may be generated on these faults (Smith and Braile, 1993 #2271). These faults may be largely volcanic in origin and thus may be incapable of generating large magnitude (M>6.5) earthquakes.

Date of compilation March 19, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Middle Rocky Mountains

Reliability of location Good
Comments: Mapped at 1:62,500 scale by Christiansen and Blank (1975 #2269) and Christiansen, (1974 #2266). Fault traces were recompiled at 1:125,00 scale on a topographic base map.

Scale of digital trace 1:125,000

Geologic setting. This fault zone is associated with one of the most active parts of the Yellowstone caldera. The fault zone trends southwest along the long axis of the 0.63-Ma Yellowstone caldera, and the axis of historic uplift and subsidence (Pelton and Smith, 1982 #2270; Dzurisin and others, 1990 #3799; Wicks and others, 1998 #3806). The faults may be associated with the inflation-deflation cycles of the Yellowstone caldera.

Sense of movement Normal
Comments: The compiler suggests that the faults may have some fissure-like, purely extensional (normal) offset, because the width of trench-like valleys is much greater than their vertical offset.

Dip not determined
Comments: May be steep, or even fissure-like, owing to shallow brittle-ductile transition at 3-5 km and their location above cooling magma chamber.

Dip direction NW, SE

Geomorphic expression Generally strong geomorphic expression on rhyolite of Elephant Back Mountain. Fault traces locally form trenches that are more than 100 m wide. This makes the amount of offset of rhyolite flows difficult to estimate. The compiler thinks that there may be poorly expressed post-glacial scarps on sandy debris on the much larger mostly bedrock escarpment of the trench walls. Scarps on surficial materials are not definitive, although there are increases in slope on sandy alluvial fans where they cross the projected position of the fault. These poorly expressed, scarp-like features suggest the possibility of post-glacial (<15 ka) offset (K.L. Pierce, field notes, 1994, locality 94P30).

Age of faulted deposits Elephant Back rhyolite flow has a K-Ar age of 153±2 k.y. (Obradovich, 1992 #2268).

Paleoseismic studies none

Timing of most recent paleoevent Late Quaternary (<130 ka)

Comments: This timing is considered certain by R.L. Christiansen (oral commun., 1998) based on offset of rhyolite flows at 153±2 ka. Although younger than the flow, the most recent movement appears to be late Quaternary (<130 ka) on the basis of strong geomorphic expression. Poorly expressed, scarp-like features on surficial materials suggest the possibility of post-glacial (<15 ka) offset (compilers assertion).

Recurrence interval not determined

Slip Rate Unknown; probably <0.2 mm/yr

Comments: The compiler calculated an average late Quaternary slip rate of between 0.2 and 0.02 mm/yr based on 3 to 30 m (10 to 100 ft) of surface relief across faults in a 150-ka rhyolite flow. On the basis of the median of this range, the faults appear to belong to the <0.2 mm/yr slip rate category.

Length End to end (km): 28.1
Cumulative trace (km): 98.9

Average strike (azimuth): N47°E

References

#2266 Christiansen, R.L., 1974, Geologic map of the West Thumb quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1191, scale 1:62,500.

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2269 Christiansen, R.L., and Blank, H.R., 1975, Geologic map of the Canyon Village quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1192, scale 1:62,500.

#3799 Dzurisin, D., Savage, J.C., and Fournier, R.O., 1990, Recent crustal subsidence at Yellowstone Caldera, Wyoming: Bulletin of Volcanology, v. 52, p. 247-270.

#2268 Obradovich, J.D., 1992, Geochronology of the late Cenozoic volcanism of Yellowstone National Park and adjoining areas, Wyoming and Idaho: U.S. Geological Survey Open-File Report 92-408, 45 p.

#2270 Pelton, J.R., and Smith, R.B., 1982, Contemporary vertical surface displacements in Yellowstone National Park: Journal of Geophysical Research, v. 87, no. B4, p. 2745-2761.

#2271 Smith, R.B., and Braile, L.W., 1993, Topographic signature, space-time evolution, and physical properties of the Yellowstone-Snake River plain volcanic system—the Yellowstone hotspot, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming, Memoir No. 5, p. 694-754.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#3806 Wicks, C.J., Thatcher, W., and Dzurisin, D., 1998, Migration of fluids beneath Yellowstone caldera inferred from satellite radar interferometry: Science, v. 282, p. 458-462.

755, Lake Hotel faults (graben)

Structure Number 755

Comments:

Structure Name Lake Hotel faults (graben)

Comments: Named for the Lake Hotel rather than “Fishing Bridge” or “Outlet” because the Lake Hotel is closer. Discovered by Otis and others, (1977 #2273). The faults are entirely underwater, and are located over distance of 1.7 km about 1 km south of Lake Hotel and about 2.0-3.5 km south of Fishing Bridge in Yellowstone National Park.

Synopsis: These faults form a north-trending graben in Holocene lake sediment as observed in geophysical reflection studies of Yellowstone Lake (Otis and others, 1977 #2273; Kaplinski, 1991 #2272) with a more accurate location based on Yellowstone Lake surveys in 1999 (Pat Shanks, oral commun. to compiler, 1999). The graben structure is about 1 km wide with a main fault on the western side and as many as three antithetical faults on the east; the observed strike length is about 1.7 km (Kaplinski, 1991 #2272). Extension of these faults either to the north and the south was not observed in geophysical traverses (Otis and others, 1977 #2273, p. 3715; Kaplinski, 1991 #2272). However, Christiansen (2001 #1784) makes a dotted "?" fault connection to the Eagle Bay fault [757], which was studied by Locke and others (1992 #308). Where projected northward onto land, the many geologists who have searched there have found no surface expression for this fault. However, Meyer and Locke (1986 #41) considered a sag in paleoshorelines near the lake outlet to be the northern on-land manifestation of the graben. From diagrams of Meyer and Locke (1986 #41, Fig. 3), the compiler notes that the 7,000 yr B.P. "S2" shoreline is essentially undeformed in the sag area, whereas the 9,500 yr B.P. "S4" shoreline has a 2 m sag and the older "S5" shorelines have a 4 m sag. The seismogenic potential of these faults (or graben) is low compared to many other similar faults in the Western U.S. because the brittle/ductile transition occurs at a shallow depth of only 5 km (Smith and Braile, 1993 #2271, Fig. 25).

Date of compilation March 25, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton, Park

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Reliability of location Good
Comments: Original trace from Kaplinski (1991 #2272) using Mini-Ranger navigation system. Preliminary examination by Ken Pierce of Yellowstone Lake survey directed by Pat Shanks in 1999 suggests fault trace is located about 0.5 km to west of location shown.

Scale of digital trace Digitized from 1:125,000-scale map annotated by compiler. See note above.

Geologic setting Within Yellowstone caldera that erupted the Lava Creek Tuff 0.63 Ma. Similar trend and alignment to the Eagle Bay fault [757] in the southern part of Yellowstone Lake.

Sense of movement Normal
Comments:

Dip not determined
Comments: No direct observations, but broad graben shape and other nearby fissures in the lake bottom lake suggest that the fault dip may be high angle.

Dip direction Graben structure with main(?) fault on west side (dipping east) and perhaps three antithetical faults on east side (dipping west), as mapped by Kaplinski (1991 #2272, plate 3).

Geomorphic expression Scarps 3 to 10 m high on floor of Yellowstone Lake.

Age of faulted deposits Holocene lake-bottom sediment.

Paleoseismic studies none

Timing of most recent paleoevent Latest Quaternary (<15 ka)
Comments: Figure 11 of Otis and others (1977 #2273) shows post-glacial lake sediment are faulted. However, particularly on an eastern graben fault, the draping of sediment into graben and thickening of upper sediment in graben suggest offset may be older than a few thousand years. Microearthquake survey in 1973 (Smith and Shuey, 1977) found seismicity located within 1 km of this graben, which suggests that these features may be associated with contemporary tectonic activity (Otis and others, 1977 #2273).

Recurrence interval not determined

Comments: At least one event in post-glacial time (<12,000 yr B.P.).

Slip Rate Unknown; probably 0.2-1 mm/yr
Comments: Otis and others (1977 #2273, p. 3715) calculated that the western and one of the eastern scarps each have about 10 m of offset, but the eastern antithetic(?) fault (on their fig. 11) only has about 1/3 the offset of the western scarp. Kaplinski (1991 #2272) determined that the western primary fault

has about 5 m offset. Across the 1-km-wide graben structure, stratigraphic offset is difficult to determine, but the net offset is probably a fraction of that suggested by the 10-m-high scarp.

Length End to end (km): 2
Cumulative trace (km): 5.7

Average strike (azimuth): N2°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2272 Kaplinski, M., 1991, Geomorphology and geology of Yellowstone Lake, Yellowstone National Park, Wyoming: Flagstaff, Arizona, Northern Arizona University, unpublished M.S. thesis.

#308 Locke, W.W., Meyer, G.A., and Pings, J.C., 1992, Morphology of a postglacial fault scarp across the Yellowstone (Wyoming) caldera margin and its implications: Bulletin of the Seismological Society of America, v. 82, p. 511-516.

#41 Meyer, G.A., and Locke, W.W., 1986, Origin and deformation of Holocene shoreline terraces, Yellowstone Lake, Wyoming: Geology, v. 14, p. 699-702.

#2273 Otis, R.M., Smith, R.B., and Wold, R.J., 1977, Geophysical surveys of Yellowstone Lake, Wyoming: Journal of Geophysical Research, v. 82, no. 26, p. 3705-3717.

#2271 Smith, R.B., and Braile, L.W., 1993, Topographic signature, space-time evolution, and physical properties of the Yellowstone-Snake River plain volcanic system—the Yellowstone hotspot, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming, Memoir No. 5, p. 694-754.

756, East Gros Ventre fault (Class B)

Structure Number 756
Comments:

Structure Name East Gros Ventre fault (Class B)
Comments: Named for East Gros Ventre Butte, the eastern of two elongate N-S ridges that lie above the alluvial/glacial plain of Jackson Hole. The name first appears to have been used by Love and Taylor (1962 #4671). The fault extends from Jackson north-northeast along the southeast margin of the East Gros Ventre Butte (Gilbert and others, 1983 #434). From here it turns northeast and extends along the northern margin of the Flat Canyon fan and up Long Hollow.

Synopsis: This controversial feature is mainly concealed beneath late Pleistocene to Holocene alluvium north and northeast of Jackson Hole. It lies along the southeastern base of East Gros Ventre Butte, and forms a scarp (tectonic or fluvial) on the west margin of the Flat Creek alluvial fan. The eastern strand is shown as extending farther northeast, along Long Hollow. As much as 46 m to 61 m of offset has been suggested for latest Pleistocene (Pinedale) deposits across the fault scarp, which suggests a very fast slip rate of 4 mm/yr. An alternate, and more likely interpretation seems to be that the scarp is the result of fluvial undercutting at the margin of the Flat Creek alluvial fan, thus forming a high fault-like scarp. In this case, the 46 m mentioned above would only reflect undercutting of Bull Lake recessional outwash by the Flat Creek alluvial fan, mainly in Pinedale time. This Bull Lake outwash is mantled by loess resting on a buried soil and was deposited beyond the outer margin of a receding Flat Creek glacier (Ken Pierce, unpublished mapping., 2001).

Date of compilation Oct. 16, 2001

Compiler and affiliation Michael N. Machette and Kenneth L. Pierce, U.S. Geological Survey

County Teton

1° x 2° sheet Driggs

Province Northern Rocky Mountains

Reliability of location Good

Comments: Trace from 1:125,000-scale geologic mapping based on Love and others (1992 #2289). Originally shown on fig. 3 of Love and Love (1980 #4672) (and further republishings of the same study), and recompiled on topographic base (plate 4) at 1:62,500 scale by Gilbert and others (1983 #434).

Scale of digital trace 1:125,000

Geologic setting This inferred fault bounds the eastern margin of East Gros Ventre Butte, one of two glaciated (Paleozoic-cored) ridges that rise about the alluviated glacial plain of Jackson Hole. The eastern strand continues northeast of the butte where it is represented by a high, steep escarpment in loess mantled outwash of recessional Bull Lake age. The western strand is postulated to explain exposures of Shooting Iron Formation immediately east and below andesite (Love and Taylor, 1962 #4671). The geologic map (Love and others, 1992 #2289) shows Shooting Iron Formation in depositional relation to the andesite, but the western strand is between outcrops of Shooting Iron Formation, which may bring into question the need for faulting on the western strand.

Sense of movement Normal
Comments: Inferred from topography.

Dip not determined

Dip direction SE, E

Geomorphic expression. The fault forms a fault-line escarpment along the eastern base of East Gros Ventre Butte (Paleozoic bedrock), and a tectonic or fluvially undercut scarp on the west margin of the Flat Creek fan. The fault is shown as extending farther northeast, along Long Hollow. Most of the fault location is largely inferred on the basis of topography and thus is shown as concealed.

A western strand is 0.25 km west of (above) U.S. Highway 187 and dies out to the north. The other strand is just east of (below) the highway and extends north along the west margin of the Flat Creek alluvial fan. Late Pleistocene loess is at a higher level above the highway than below the highway and is inferred to be offset (Love and Taylor, 1962 #4671). K.L. Pierce (written commun., 2001) suggests that these two levels of loess may result from draping of the loess across pre-existing beveled topography.

Age of faulted deposits Love and Taylor (1962 #4671) described a locality based on two different levels of loess and a scarp between alluvial gravels. As much as 61 m (Love and Taylor, 1962 #4671) or 46 m (Love and Love, 1997 #4668) of offset has been suggested for latest Pleistocene (Pinedale) deposits across the eastern strand. Based on an inferred offset of 91 m for the west strand and 61 m for the east strand, a total 152 m of Quaternary (1.6 Ma) offset is inferred (Love and Taylor, 1962 #4671). .

Paleoseismic studies none

Timing of most recent paleoevent Latest Quaternary (<15 ka)
Comments: Timing based on Love and Taylor's (1962 #4671) inference of offset Pinedale (latest Pleistocene) loess that contains mollusks dated 13,890 ± 700 and 15,300 ± 500 yr B.P. K.L. Pierce (written commun., 2001) finds that the scarps can be explained by fluvial undercutting, and that a fault explanation is thus not required.

Recurrence interval not determined

Slip Rate Unknown; probably <0.2 mm/yr
Comments: Wong and others (2000 #4484) suggested fault slip rates of 0.1 (Quaternary) mm/yr and 4 mm/yr (post-late Pleistocene). These very discrepant rates are based on Love and Taylor (1962 #4671) and Love and Love's (1980 #4672) estimate of 152 m of offset of Quaternary (1.6 Ma) deposits and Love and Taylor's (1962 #4671) estimate of 46 m of offset of latest Pleistocene (Pinedale, >12 ka) deposits. The late Quaternary characteristics of this fault (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest that the4 mm/yr slip rate during the latest Pleistocene is unrealistically fast. Accordingly, the longer-term (Quaternary) rate is used to assign this inferred fault to the <0.2-mm/yr slip-rate category.

Length End to end (km): 19.5
Cumulative trace (km): 27.2

Average strike (azimuth): N47°E

References

#434 Gilbert, J.D., Ostenaa, D., and Wood, C., 1983, Seismotectonic study Island Park Dam and Reservoir, Minidoka Project, Idaho-Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-1, 37 p., 6 pl.

#4672 Love, J.D., and Love, J.M., 1980, Road log, Jackson to Dinwoody and return: Wymoing Geological Association, 31st Annual Field Conference, September 6-10, 1980, Guidebook, 283-317 p.

#4668 Love, J.D., and Love, J.M., 1997, Geologic road log, Jackson to Dinwoody and return: Wyoming Geological Survey Public Information Circular 20, 38 p.

#2289 Love, J.D., Reed, J.C., Jr., and Christiansen, A.C., 1992, Geologic map of Grand Teton National Park: U.S. Geological Survey Miscellaneous Investigations Map I-2031, scale 1:62,500.

#4671 Love, J.D., and Taylor, D.W., 1962, Faulted Pleistocene strata near Jackson, Northwestern Wyoming, *in* Faulted Pleistocene Strata Near Jackson, Northwestern Wyoming: U.S. Geological Survey Professional Paper 450-Dp. D136-139.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

757, Eagle Bay fault

Structure Number 757

Comments: Refers to fault 238 of Witkind (1975 #819).

Structure Name Eagle Bay fault

Comments: Named the Eagle Bay fault by Locke and others (1992 #308). Previously known as the Yellowstone Lake fault of Witkind (1975 #819).

Synopsis The Eagle Bay fault strikes north-south and crosses the margin of the 0.63-Ma Yellowstone caldera. It has been divided into three sections. The middle section of the Eagle Bay fault [757b] offsets Holocene lake sediment adjacent to and in the Eagle Bay-Flat Mountain Arm area of Yellowstone Lake. Studies concluded that there was only one post-glacial offset event on this section. The main fault scarp is as much as 9 m high and there are multiple antithetic scarps with a combined stratigraphic offset of less than half this amount. Near the northern section of the fault, seismic profiles show offset of post-glacial lake sediment, although the location and trace of the fault are not yet well controlled. The northern section probably connects to the Lake Hotel fault [755]. Offset on the southern section of the fault has formed a bedrock scarp on the 0.63-Ma Lava Creek Tuff.

Date of compilation March 25, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

Geologic setting This is one many north-trending basin and range faults in the area between the 0.63-Ma Yellowstone caldera and the Teton fault [768]. However, it is the only one that cuts across the caldera's structural boundary.

Number of sections 3

Comments: The northern section is beneath the floor of Yellowstone Lake and offsets post-glacial lake sediment. The middle section has documented Holocene offset. Offset on the southern section appears to be older (pre-late Pleistocene).

Length End to end (km): 30.9
Cumulative trace (km): 37.9

Average strike (azimuth): N3°E

757a, Eagle Bay fault, northern section

Section number 757a

Section name Northern section

Comments: This section is aligned with a postulated northward extension of middle segment of the Eagle Bay fault [757b] beneath Yellowstone Lake. Christiansen (2001 #1784) extends the Eagle Bay fault northward beneath Yellowstone Lake to connect with Holocene age Lake Hotel fault [755].

Quality of location Poor
Comments: Shown as a dotted (concealed) fault on the 1:125,000-scale maps by U.S. Geological Survey (1972 #639; U.S. Geological Survey, 1972 #1057), but most accurate trace is shown at 1:125,000 scale by Christiansen (2001 #1784).

Scale of digital trace 1:125,000

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Middle Rocky Mountains

Sense of movement Normal
Comments: Northward extension of Eagle Bay normal fault.

Dip not determined

Dip direction E

Geomorphic expression Not observed in geophysical reflection traverses of Otis and others (1977 #2273) and Kaplinski (1991 #2272). Northward extension from middle section shown on Richmond (1974 #2276) based on alignment of cold-water springs as noted by Smedes (1968 #2262). More recent seismic profiles show offset of lake sediment near the trace of the northern section.

Age of faulted deposits Post-glacial lake sediment (<15 ka).

Paleoseismic studies none

Time of most prehistoric faulting <15 ka
Comments: Seismic profiles show post-glacial faulting, but available location data do not permit a good location for the fault trace.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2-1.0 mm/yr
Comments: Wong and others (2000 #4484) suggested fault slip rates of 0.4 mm/yr (60% wieght) and 1.4 mm/yr (40% weight) for the entire fault based data from Locke and others (1992 #308) from a site along the central section [757b]. However, no data are available on the amount of offset of post-glacial lake sediment along this section of the fault. The moderate slip-rate category is inferred recency of movement, and similar slip rates determined for section [757b] to the south.

Length End to end (km): 12.6
Cumulative trace (km): 12.8

Average strike (azimuth): N5°E

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2272 Kaplinski, M., 1991, Geomorphology and geology of Yellowstone Lake, Yellowstone National Park, Wyoming: Northern Arizona University, unpublished MS thesis.

#308 Locke, W.W., Meyer, G.A., and Pings, J.C., 1992, Morphology of a postglacial fault scarp across the Yellowstone (Wyoming) caldera margin and its implications: Bulletin of the Seismological Society of America, v. 82, p. 511-516.

#2273 Otis, R.M., Smith, R.B., and Wold, R.J., 1977, Geophysical surveys of Yellowstone Lake, Wyoming: Journal of Geophysical Research, v. 82, no. 26, p. 3705-3717.

#2276 Richmond, G.M., 1974, Surficial geologic map of the Frank Island quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-642, scale 1:62,500.

#2262 Smedes, H.W., 1968, Geologic evaluation of infrared imagery, eastern part of Yellowstone National Park, Wyoming and Montana: U.S. Geological Survey Open-File Report.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

757b Eagle Bay fault, middle section

Section number 757b

Section name Middle section
Comments: This section has observed post-glacial offset, whereas southern section seems older.

Quality of location Good
Comments: Location in underwater sections across Eagle Bay and Flat Mountain arm are based on straight-line connection to on-land fault traces. Southern post-glacial part mapped by Locke and others (1992 #308) is about 0.5 km east of trace shown by Richmond (1974 #2276) and Blank and others (1974 #2274). Fault traces were recompiled at 1:125,00 scale on a topographic base map.

Scale of digital trace 1:125,000

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Middle Rocky Mountains

Sense of movement Normal
Comments: Presence of narrow (50 m to 400 m wide) graben suggests predominately normal slip.

Dip not determined

Dip direction E

Geomorphic expression Well-expressed fault scarp as much as 9 m high mostly on gravelly and sandy lake-shore deposits with graben on east side. Locke and others (1992 #308) suggested a late Holocene age based on scarp's morphology, which is less degraded than the Drum Mountains (early Holocene) and Bonneville (latest Pleistocene) scarps.

Age of faulted deposits Holocene and latest Pleistocene (Pinedale) sand and gravel lake-shore deposits are offset along this section. Richmond (1974, # 2276) mapped the fault as offsetting emergent Holocene lake deposits. Locke and others (1992 #308) mapped the fault trace, profiled the fault scarp, and determined the time of faulting in relation to the shorelines of Yellowstone Lake.

Paleoseismic studies none

Time of most prehistoric faulting latest Quaternary (<15 ka)
Comments: Locke (1992 #308) sampled charcoal from a hand-dug pit in scarp colluvium (?) that yielded a 14C age of 4,540 ± 40 yr BP., which is considered to be a minimum time for the scarp-forming event. Locke and Meyer (1994 #2275) concluded that the fault offsets the S5 shoreline (ca. 4.5 ka), whereas the S4 shoreline (ca 3 ka) is eroded into the fault scarp. Locke (1992 #308) determined morphologic age estimates of 3.3 ka for the S5 shoreline and 0.4 ka for the S4 shoreline, although further study may show that these features are considerably older (compilers assertion).

Recurrence interval >7 k.y. (0-12 ka)
Comments: One offset event at about 5 ka and no previous events since 12 ka (Locke and others, 1992 #308). This incomplete recurrence interval is roughly 7 k.y.

Slip-rate category 0.2-1 mm/yr

Comments: Locke and others (p. 515, 1992 #308) concluded that there was >5 m of offset in one event about 5,000 years ago. They also concluded that there was only one event in post-glacial time (past 12,000 years). This incomplete recurrence interval is roughly 7 k.y., which yields a poorly constrained slip rate of 0.7 mm/yr. Working from the same data, Wong and others (2000 #4484) suggested fault slip rates of 0.4 mm/yr (60% wieght) and 1.4 mm/yr (40% weight) for the entire. On the basis of fairly incomplete data, the middle section of the fault appears to belong to the 0.2-1.0 mm/yr slip rate category, although further study may show that the recurrence interval is considerably longer and the slip rate lower.

Length End to end (km): 5.9
Cumulative trace (km): 8.3

Average strike (azimuth): N7°E

References

#2274 Blank, H.R., Jr., Prostka, H.J., Keefer, W.R., and Christiansen, R.L., 1974, Geologic map of the Frank Island quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1209, scale 1:62,500.

#2275 Locke, W.W., and Meyer, G.A., 1994, A 12,000 year record of vertical deformation across the Yellowstone Caldera margin—The shorelines of Yellowstone Lake: Journal of Geophysical Research, v. 99, no. B10, p. 20.079-20.094.

#308 Locke, W.W., Meyer, G.A., and Pings, J.C., 1992, Morphology of a postglacial fault scarp across the Yellowstone (Wyoming) caldera margin and its implications: Bulletin of the Seismological Society of America, v. 82, p. 511-516.

#2276 Richmond, G.M., 1974, Surficial geologic map of the Frank Island quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-642, scale 1:62,500.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

757c, Eagle Bay fault, southern section

Section number 757c

Section name Southern section

Quality of location Good

Comments: Mapped by Blank and others (1974 #2274) at 1:62,600 scale. Also shown at 1:125,000 scale by U.S. Geological Survey (1972 #639) and by Christiansen (2001 #1784). Fault traces were recompiled at 1:125,00 scale on a topographic base map.

Scale of digital trace 1:125,000

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Middle Rocky Mountains

Sense of movement Normal

Dip not determined

Dip direction not determined

Geomorphic expression Expressed as bedrock scarps several hundred meters high on 630-ka Lava Creek Tuff. Main fault dips east, antithetical faults that dip west are too small to show on map.

Age of faulted deposits Faults offset 630-ka (early middle Pleistocene) Lava Creek Tuff a maximum of 300 m offset. No post-glacial offset has been observed.

Paleoseismic studies none

Time of most prehistoric faulting Middle and late Quaternary (<750 ka)
Comments: Most recent event limited to middle and late Quaternary (<750 ka) time on basis of offset of 630-ka Lava Creek Tuff. However, the presence of scarps several hundred meters high demand many tens of small surface rupturing events, some of which may be late Pleistocene in age.

Recurrence interval not determined

Slip-rate category Unknown; probably 0.2-1.0 mm/yr
Comments: Long term rate is calculated to be about 0.4 mm/yr based on a maximum 300 m offset of 0.63 Ma Lava Creek Tuff. Wong and others (2000 #4484) suggested fault slip rates of 0.4 mm/yr (60% wieght) and 1.4 mm/yr (40% weight) for the entire fault based data from Locke and others (1992 #308) from a site along the central section [757b]. However, the apparent lack of post-glacial offset along this section of the fault leads one to wonder if the fault is still this active. On this basis, the southern section of the fault appears to belong to the 0.2-1.0 mm/yr slip rate category, although further study may show that the recent slip rate is even lower.

Length End to end (km): 13.8
Cumulative trace (km): 16.8

Average strike (azimuth): N0°E

References

#2274 Blank, H.R., Jr., Prostka, H.J., Keefer, W.R., and Christiansen, R.L., 1974, Geologic map of the Frank Island quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1209, scale 1:62,500.

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#308 Locke, W.W., Meyer, G.A., and Pings, J.C., 1992, Morphology of a postglacial fault scarp across the Yellowstone (Wyoming) caldera margin and its implications: Bulletin of the Seismological Society of America, v. 82, p. 511-516.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

758, Sour Creek dome faults (Class B)

Structure Number 758
Comments:

Structure Name Sour Creek dome faults (Class B)
Comments: Associated with magmatic uplift of the Sour Creek resurgent dome.

Synopsis: The Sour Creek resurgent dome probably rose within a hundred thousand years or so after the 630 ka Lava Creek Tuff was erupted. Although the faults are known to be younger than 750 ka because they offset the 630 ka Lava Creek Tuff, their activity was probably over by 130 ka (Christiansen, 2001 #1784). Faults within the dome trend both NW and NE, with the NW set being older and more continuous (U.S. Geological Survey, 1972 #639; Christiansen and Blank, 1975 #2269; Christiansen, 2001 #1784). These faults are considered suspect in origin because they are probably related to local uplift of the resurgent Sour Creek dome, rather than deep seated tectonic (crustal) movement. Thus, we assign these faults to Class B, since they may be incapable of generating large magnitude (M>6.5) earthquakes.

Date of compilation March 19, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Park

1° x 2° sheet Ashton

Province Middle Rocky Mountains

Reliability of location Good.
Comments: Mapped at 1:62,500 scale by Christiansen and Blank (1975 #2269). Fault traces were recompiled at 1:125,00 scale on a topographic base map

Scale of digital trace 1:125,000

Geologic setting These faults are associated with the Sour Creek resurgent dome , one of two resurgent domes within the 630-ka Yellowstone caldera. They were formed as part of resurgent dome volcano-magmatic process.

Sense of movement Normal

Dip not determined

Dip direction All
Comments: NW-striking set dips to SW and NE; NE-striking set dips to NW and SE.

Geomorphic expression Well expressed as scarps on rhyolite bedrock of Lava Creek Tuff, but no scarps are present on surficial materials.

Age of faulted deposits Offsets 0.63-Ma Lava Creek Tuff.

Paleoseismic studies none

Timing of most recent paleoevent Middle and late Quaternary (<750 ka)
Comments: Activity probably closer to 630 ka caldera eruption than to present. Christiansen (2001 #1784) argues that their activity was probably over by about 130 ka.

Recurrence interval not determined
Comments: No scarps are known on surficial materials and thus no known post-glacial (<15 ka) offset.

Slip Rate Unknown; probably <0.2 mm/yr
Comments: Either inactive or much less active than time of resurgent doming in caldera, which probably occurred within about hundred thousand years or so of 630 ka Lava Creek Tuff eruption. NE-trending faults may have the youngest activity.

Length End to end (km): 14.9
Cumulative trace (km): 184.3

Average strike (azimuth): N31°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2269 Christiansen, R.L., and Blank, H.R., 1975, Geologic map of the Canyon Village quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1192, scale 1:62,500.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

759, Faults near Clear Creek (Class B)

Structure Number 759
Comments:

Structure Name Faults near Clear Creek (Class B)
Comments: This group of faults are near Clear Creek, north of the Brimstone Basin [760] faults.

Synopsis: North-trending lineaments inferred to be faults in glacial deposits near Clear Creek, in the area on the eastern side of Yellowstone Lake. No detailed studies have been conducted; these features are recognized mainly on aerial photographs. Inasmuch as the lineaments have not been documented as faults, we classify these features as Class B until further studies can be conducted.

Date of compilation March 23, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Park

1° x 2° sheet Ashton

Province Middle Rocky Mountains.

Reliability of location Good
Comments: Mapped at 1:62,500 scale by Richmond and Pierce (1972 #2277) and compiled at 1:125,00 scale from U.S. Geological Survey (1972 #1057) mapping. Fault traces recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:125,00

Geologic setting This group of faults is 3-5 km east of the Yellowstone caldera margin, along the northern extension of the Upper Yellowstone Valley faults [761] and Brimstone Basin faults [760].

Sense of movement Normal

Dip not determined

Dip direction W

Geomorphic expression Described as lineaments on aerial photographs. Richmond and Pierce (1972 #2277) stated that "North of Brimstone Basin, well-defined fault lineaments cut across Pinedale kame deposits and continue northward to Cub Creek, where altered areas and pools of cool acidic water occur." Inasmuch as the lineaments have not been documented as faults, we classify these features as Class B until further studies can be conducted

Age of faulted deposits Pinedale glacial recessional deposits, if faulted.

Paleoseismic studies none

Timing of most recent paleoevent Latest Quaternary (<15 ka)
Comments: Not studied in field, based strictly on aerial photo study of lineaments. Iinferred to cut across Pinedale kame deposits (<15 ka).

Recurrence interval not determined

Slip Rate Unknown; probably <0.2 mm/yr
Comments: No offset noted or measured in field. Low slip-rate category is inferred from the relative inactivity of the faults.

Length End to end (km): 8.5
Cumulative trace (km): 4.5

Average strike (azimuth): N12°E

References

#2277 Richmond, G.M., and Pierce, K.L., 1972, Surficial geologic map of the Eagle Peak quadrangle: U.S. Geological Survey Miscellaneous Geologic Investigations I-637, scale 1:62,500.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

760, Faults of Brimstone Basin area

Structure Number 760
Comments:

Structure Name Faults of Brimstone Basin area

Comments: This group of faults is located in the Brimstone Basin area, between the Clear Creek faults [759] and the Upper Yellowstone Valley faults [761].

Synopsis: The Brimstone Basin is a graben bounded by and including normal faults. The main published information presents an ambiguous situation. Text on the published map suggests deposits of the last glaciation are offset, but the map shows that these same deposits mantle pre-existing scarps. In this compilation, the faults are shown as post-Pinedale (<15 ka) pending further verification. This group of faults extends along the eastern side of the valley of the Yellowstone River, and as such may be a northern extension of the Upper Yellowstone River Valley faults [761].

Date of compilation March 23, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey.

State Wyoming

County Park

1° x 2° sheet Ashton

Province Middle Rocky Mountains

Reliability of location Good
Comments: Mapped at 1:62,500 scale and described by Richmond and Pierce (1972 #2277). Fault traces recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:125,000

Geologic setting Northward extension of faults on east side of upper Yellowstone valley. They are only about 5 km southeast of the eastern margin of the Yellowstone caldera.

Sense of movement Normal

Dip not determined
Comments: Not known, probably near 60°

Dip direction E, W
Comments: Faults dip to east and west in north-south-trending graben.

Geomorphic expression In their text, Richmond and Pierce (1972 #2277) noted that "Pinedale till and kame deposits are locally offset 5-20 feet by these faults", whereas they mapped the faults as "short dashed," which indicated that faults "are topographically expressed but mantled by map unit." In this case, the deposits were shown to be Pinedale till and kame deposits.

Age of faulted deposits Richmond and Pierce (1972 #2277) noted offset of recessional glacial deposits of the most recent glaciation (Pinedale), which ended about 15,000 yrs B.P. The compiler has not confirmed that these deposits are offset.

Paleoseismic studies none

Timing of most recent paleoevent Latest Quaternary (<15 ka)
Comments: Richmond and Pierce (1972 #2277) present an ambiguous situation. Their text indicates deposits of the last glaciation are offset, but the map shows that these same deposits mantle pre-existing scarps. In this compilation, the faults are shown as post-Pinedale (<15 ka) pending further verification.

Recurrence interval not determined

Slip Rate Unknown; probably <0.2 mm/yr
Comments: These faults may offset Pinedale deposits as much as 1.5-6 m (5-20 ft), but the associated recurrence intervals are not known. In addition, the compiler has not confirmed this offset. On the basis of slip rate estimates for other similar faults in the area, these are assigned to the <0.2 mm/yr slip rate category.

Length End to end (km): 7.8
Cumulative trace (km): 22.9

Average strike (azimuth): 17°W

References

#2277 Richmond, G.M., and Pierce, K.L., 1972, Surficial geologic map of the Eagle Peak quadrangle: U.S. Geological Survey Miscellaneous Geologic Investigations I-637, scale 1:62,500.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

761, Upper Yellowstone Valley faults

Structure Number 761
Comments: This large group of faults is described together as a single entity.

Structure Name Upper Yellowstone Valley faults
Comments: These faults are on the eastern and western sides of the Upper Yellowstone Valley in Yellowstone National Park (U.S. Geological Survey, 1972 #639; 1972 #1057), but they also extend south of the park on the Two Ocean 15′ quadrangle (Richmond and Pierce, 1971 #2278; 1972 #2277). They were referred to as the Yellowstone River faults by Case (1997 #3449; 1997 #3450) and the Yellowstone River fault system by Wong and others (2000 #4484). However, we prefer the more descriptive name "Upper Yellowstone Valley faults" for use in this database.

Synopsis: This is a group of en echelon normal faults that offset recessional glacial and younger deposits on both sides of the Upper Yellowstone Valley (Richmond and Pierce, 1971 #2278; 1972 #2277), thereby forming a young graben. Some of these faults extend into bedrock of the Eocene Absaroka Supergroup. These faults were mapped in 1966 prior to general recognition of Quaternary faulting and development of methods of study and measurement of fault scarps in surficial materials; the compiler has reservations about this early vintage mapping. The graben-like morphology of the valley is complicated in that during glacial times (but before and after a thick icecap covered the Yellowstone Plateau), a large glacier flowed northward down the Upper Yellowstone Valley. In doing so, it enhanced the valley's trench-like or U-shaped appearance and scoured well below the present topography; subsequently, this trough was filled with unconsolidated sediment that might compact and produce settlement structures.

Date of compilation March 19, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton and Park

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Reliability of location Good
Comments: Southern part mapped at 1:62,500 scale by Richmond and Pierce (1971 #2278; 1972 #2277) and northern part (within national park) from 1:125,000-scale map by U.S. Geological Survey (1972 #1057). Fault traces recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:125,000

Geologic setting Faults are on both sides of a 1-2 km wide trench of the upper Yellowstone River Valley (called UYV elsewhere) inferred to be a graben in Absaroka Volcanic Supergroup rocks (Richmond and Pierce, 1971 #2278; 1972 #2277; Smedes and others, 1989 #2280). Under full-glacial conditions, ice filled this valley and flowed to the southwest across the Two Ocean Plateau. When the icecap on the Yellowstone Plateau retreated (deglaciation), a glacier flowed northward down this valley from the high terrain in its headwaters. Glacial recession to a position upstream of this fault system had occurred by 11,600±350 yr B.P. (about 13,500 cal. years ago) (p. 96 in Richmond, 1986 #2279). Thus, the faults within the upper Yellowstone River Valley must be post-glacial in age.

Sense of movement: Normal

Dip not determined
Comments: Probably typical normal faults with footwall in Eocene volcanic rocks.

Dip direction E, W

Comments: Presumably normal faults with east-side faults dipping west and west-side faults dipping east, thereby forming a graben.

Geomorphic expression Richmond and Pierce (1971 #2278) reported offset of Pinedale till, kame deposits, and outwash gravel, and neoglacial alluvium. The maximum offset of surficial deposits on both the east and west sides of the valley is reported to be about 5 m.

Age of faulted deposits Late glacial (Pinedale) and Holocene.

Paleoseismic studies none

Timing of most recent paleoevent Latest Quaternary (<15 ka)

Comments: Faulted deposits in this area were mostly deposited near the end of the last major deglaciation (about 13.5 ka). Scarps in late glacial deposits are as high as 5 m, suggesting more than one offset event in the past 13.5 k.y.

Recurrence interval not determined

Slip Rate Unknown; probably <0.2 mm/yr

Comments: Maximum offset associated with individual scarps of the Upper Yellowstone Valley faults is about 5 m in post-glacial time (13,500 calendar years ago), but the associated recurrence intervals are not known. Wong and others (2000 #4484) suggested fault slip rates of 0.4 and 1.4 mm/yr, each with separate weighting. These reported slip rates are model dependent and do not represent actual measured values. The late Quaternary characteristics of this fault (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the slip rate during this period is of a less magnitude. On the basis of slip rate estimates for other similar faults in the area, these are assigned to the <0.2 mm/yr slip rate category.

Length End to end (km): 24.9
Cumulative trace (km): 45.1

Average strike (azimuth): N9°W

References

#3450 Case, J.C., 1997, Earthquakes and active faults in Wyoming: Geological Survey of Wyoming Preliminary Hazard Report 97-2, 58 p.

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2279 Richmond, G.M., 1986, Stratigraphy and chronology of glaciations in Yellowstone National Park, *in* Sibrava, V., Bowen, D.Q., and Richmond, G.M., eds., Quaternary glaciations in the northern hemisphere: Quaternary Science Reviews, v. 5, p. 83-98, 1 pl.

#2278 Richmond, G.M., and Pierce, K.L., 1971, Surficial geologic map of the Two Ocean Pass quadrangle, Yellowstone National Park and adjoining area, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-635, scale 1:62,500.

#2277 Richmond, G.M., and Pierce, K.L., 1972, Surficial geologic map of the Eagle Peak quadrangle: U.S. Geological Survey Miscellaneous Geologic Investigations I-637, scale 1:62,500.

#2280 Smedes, H.W., M'Gonigle, J.W., and Prostka, J.J., 1989, Geologic map of the Two Ocean Pass quadrangle, Yellowstone National Park and vicinity, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1667, scale 1:62,500.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

762, Faults near Trishman and Douglas Knobs

Structure Number 762

Structure Name Faults near Trishman and Douglas Knobs
Comments: This group of faults is near Douglas Knob and Trishman Knob for which they are informally named herein.

Synopsis: This is a group of about 6 short faults that strike northwest from Douglas Knob to Trishman Knob and form a graben near or on the boundary of the 0.63 Ma Yellowstone caldera (U.S. Geological Survey, 1972 #639, 1972 #1057; Christiansen and Blank, 1974 #2264; Christiansen, 2001 #1784). The fault scarps are on the Bechler River rhyolite, whose age is probably 112-124 ka (Obradovich, 1992 #2268). No post-glacial (<15 ka) offset is apparent (Waldrop, 1975 #2281).

Date of compilation April 1, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Middle Rocky Mountains

Reliability of location Good
Comments: Faults were mapped at 1:62,500 scale by Christiansen and Blank (1974 #2264). Fault traces recompiled at 1:125,000 scale on map with topographic base.

Scale of digital trace 1:125,000

Geologic setting These faults strike northwest and form six short traces in volcanic rock and a graben near or on the 0.63 Ma Yellowstone caldera boundary (U.S. Geological Survey, 1972 #639, 1972 #1057; Christiansen and Blank, 1974 #2264; Christiansen, 2001 #1784).

Sense of movement Normal

Dip not determined

Dip direction NE, SW
Comments: Faults dip both directions forming a graben.

Geomorphic expression One escarpment on the 112-124 ka Bechler River rhyolite flow is about 7.6 m high as noted by Waldrop (1975 #2281). Waldrop (1975 #2281) also noted that "Pinedale Till plasters the fault scarps rather than being offset across them."

Age of faulted deposits The fault scarps are on the Bechler River rhyolite flow whose age is probably 112-124 ka (Obradovich, 1992 #2268). No post-glacial (<15 ka) materials appear to be offset (Waldrop, 1975 #2281).

Paleoseismic studies none

Timing of most recent paleoevent Late Quaternary (<130 ka)

Comments: Faulting is older than about 15 ka, and younger than about 120 ka.

Recurrence interval not determined
Comments: Considering the <8 m of offset on 120 ka bedrock, the average recurrence interval for 1-2 m faulting events is probably 15-30 k.y., however there are no data to quantify this value.

Slip Rate <0.2 mm/yr
Comments: Offset of about 8 m in past 120 k.y., which is the age of the lava flow on which the scarp is formed. This data yields a long-term rate of less than 0.1 mm/yr. On the basis of these data, the faults are assigned to the <0.2 mm/yr slip-rate category.

Length End to end (km): 4.3
Cumulative trace (km): 8.7

Average strike (azimuth): N29°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pls., scale 1:125,000.

#2264 Christiansen, R.L., and Blank, H.R., Jr., 1974, Geologic map of the Old Faithful quadrangle, Yellowstone, National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1189, scale 1:62,500.

#2268 Obradovich, J.D., 1992, Geochronology of the late Cenozoic volcanism of Yellowstone National Park and adjoining areas, Wyoming and Idaho: U.S. Geological Survey Open-File Report 92-408, 45 p.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

#2281 Waldrop, H.A., 1975, Surficial geologic map of the Old Faithful quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-649, scale 1:62,500.

763, Faults along the Lava Creek caldera margin (Class B)

Structure Number 763

Structure Name Faults along the Lava Creek caldera margin (Class B)

Comments: This group of faults forms the margin of the 630-ka (middle Quaternary) Lava Creek caldera. Also included are several faults that represent collapse of the northwestern caldera margin. They are probably related largely to eruption and subsequent rapid collapse of the caldera near 630 ka. We assign these faults to Class B, since they may be volcanic in origin and may be incapable of generating large magnitude (M>6.5) earthquakes.

Synopsis: The Lava Creek caldera is the youngest of three large Yellowstone calderas that have formed since about 2.1 Ma. This last catastrophic eruption produced ash that spread across most of the western and central U.S. The Lava Creek ash (630 ka) is a regional marker bed that provides valuable age control for deposits of early to middle Quaternary age. The faults shown here are related to the topographic margin of the caldera, which is probably slightly outward from the true structural wall owing to modest collapse and erosion. The faults are largely concealed beneath moat-filling deposits of the caldera. Although probably not seismogenic, the faults are included here as Class B structure because they control the extent and geometry of other Quaternary faults and may move during major earthquakes on other seismogenic faults in the region.

Date of compilation December 7, 1999

Compiler and affiliation Kenneth L. Pierce and Michael Machette, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Middle Rocky Mountains

Reliability of location Good

Comments: Faults were mapped at 1:62,500 scale by Christiansen and Blank (1974 #2264), Blank and others (1974 #2274). Fault traces recompiled at 1:125,000 scale on map with topographic base.

Scale of digital trace 1:125,000

Geologic setting These faults form the margin of the 630-ka (middle Quaternary) Lava Creek caldera (Prostka and others, 1975 #2259). Also included are several faults that represent gravational collapse of the northwestern caldera margin (Christiansen, 2001 #1784).

Sense of movement Normal

Dip not determined

Dip direction All
Comments: Faults dip toward the interior of the caldera.

Geomorphic expression The position of the concealed faults is based on the preserved topographic wall of the Lava Creek caldera.

Age of faulted deposits The faults cut volcanic rocks and bedrock that predate the eruption of the Lava Creek caldera about 630 ka (Christiansen, 2001 #1784). Younger rhyolite flows bury much of the fault trace.

Paleoseismic studies none

Timing of most recent paleoevent Middle to late Quaternary (<750 ka)
Comments: Faulting is coeval with formation of the Lava Creek caldera (630 ka) (Christiansen, 2001 #1784).

Recurrence interval not determined

Slip Rate unknown, probably <0.2 mm/yr
Comments: Most of these faults are related to the ancient (630 ka) eruption and subsequent collapse of the Lava Creek caldera. As such, their slip during the subsequent middle and late Quaternary has been minimal (no younger deposits have been mapped as being displaced). Thus, the fault slip rates have likely been <0.2 mm/yr since collapse of the Lava Creek caldera, and may have been inactive for the entire late Quaternary.

Length End to end (km): 64.6
Cumulative trace (km): 221.8

Average strike (azimuth): N49°W

References

#2274 Blank, H.R., Jr., Prostka, H.J., Keefer, W.R., and Christiansen, R.L., 1974, Geologic map of the Frank Island quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1209, scale 1:62,500.

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2264 Christiansen, R.L., and Blank, H.R., Jr., 1974, Geologic map of the Old Faithful quadrangle, Yellowstone, National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1189, scale 1:62,500.

#2259 Prostka, H.J., Smedes, H.W., and Christiansen, R.L., 1975, Geologic map of the Pelican Cone quadrangle, Yellowstone National Park and vicinity, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1243.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

764, Faults in boundary region of Yellowstone and Grand Teton National Parks

Structure Number 764

Structure Name Faults in boundary region of Yellowstone and Grand Teton National Parks
Comments: This group of older faults is in the boundary region of southern Yellowstone and northern Grand Teton National Parks. They extend from Heart Lake on the north to both east and west of Jackson Lake on the south, an area about 30 km wide and 60 km long. Younger faults that could be included within this group are described separately as the Snake River caldera faults [765

Synopsis: This group of about 10 older faults offset the 2.1 Ma Huckleberry Ridge Tuff in the boundary region of southern Yellowstone and northern Grand Teton National Parks. They are described collectively because they all have fault scarps are expressed on the 2.1 Ma Huckleberry Ridge Tuff (bedrock), but don't appear to offset younger (middle or late Pleistocene) deposits. Younger faults that could be included within this group are described separately as the Snake River caldera faults [765]. Escarpments on bedrock are as much as 150 m high at the northern end of the Teton Range. This group of faults extends from Heart Lake on the north to Jackson Lake on the south, an area about 30 km wide and 60 km long.

Date of compilation April 1, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Ashton, Driggs

Province Middle Rocky Mountains

Reliability of location Good
Comments: Includes faults in late Cenozoic volcanic rocks as mapped by R.L. Christiansen (U.S. Geological Survey, 1972 #639; Christiansen and others, 1978 #2282; Christiansen, 2001 #1784). Surficial geology mapped at 1:62,500 by Richmond (1973 #2283; 1973 #2284). For digitizing, the faults from within Yellowstone National Park south to latitude 44 degrees were digitized at 1:125,000; those to south were digitized from 1:62,500 scale mapping by Love and others (1992 # 22890. Some of the faults are shown by Ostenaa and others (figs. 6 and 7, 1993 #2290).

Scale of digital trace 1:62,500 and 1:125,000

Geologic setting These faults extend southward from the southern margin of the 2.1 Ma caldera that erupted the Huckleberry Ridge Tuff into Jackson Hole, where the faults generally parallel the Teton fault [768].

Sense of movement Normal

Dip not determined

Dip direction E, W

Geomorphic expression Fault scarps are expressed on Huckleberry Ridge Tuff (bedrock). Scarps that are on the northern projection of the Teton Range are as much as 150 m high (Ostenaa and others, 1993 #2290).

Age of faulted deposits Faults commonly offset 2.1 Ma Huckleberry Ridge Tuff, but some do not offset the 0.63-Ma Lava Creek Tuff.

Paleoseismic studies none

Timing of most recent paleoevent Quaternary (<1.6 Ma)
Comments: These faults are all younger than 2.1 Ma, whereas some are middle Quaternary in as much as they locally displace the 0.63 Ma Lava Creek Tuff (Christiansen, 2001 #1784; Love and others, 1992 #2289). For this compilation, all the faults are shown as Quaternary (<1.6 Ma).

Recurrence interval not determined
Comments: No scarps are documented on surficial material (Richmond, 1973 #2283; 1973 #2284), thus the faults pre-date the last deglaciation (>15 ka).

Slip Rate Unknown; probably low <0.2 mm/yr.
Comments: Bedrock escarpments as high as 150 m on the 2.1 Ma Huckleberry Ridge Tuff suggest a long-term (average) slip rate of <0.07 mm/yr. On the basis of these data, the faults are assigned to the <0.2 mm/yr slip rate category.

Length End to end (km): 50.8
Cumulative trace (km): 151.3

Average strike (azimuth): N8°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2282 Christiansen, R.L., Blank, H.R., Jr., Love, J.D., and Reed, J.C., Jr., 1978, Geologic map of the Grassy Lake Reservoir quadrangle, Yellowstone National Park and vicinity, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1459.
#2289 Love, J.D., Reed, J.C., Jr., and Christiansen, A.C., 1992, Geologic map of Grand Teton National Park: U.S. Geological Survey Miscellaneous Investigations Map I-2031, scale 1:62,500.
#2290 Ostenaa, D.A., Wood, C., and Gilbert, J.D., 1993, Seismotectonic study for Grassy Lake Dam-Minidoka Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 93-3, 68 p., scale 1:24,000.
#2283 Richmond, G.M., 1973, Surficial geologic map of the Huckleberry Mountain quadrangle, Yellowstone National Park and adjoining area, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-639, scale 1:62,500.
#2284 Richmond, G.M., 1973, Surficial geologic map of the Warm River Butte quadrangle, Yellowstone National Park and adjoining area, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-645, scale 1:62,500.
#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

765, Snake River caldera faults

Structure Number 765

Structure Name Snake River caldera faults

Comments: Referred to as faults of the Snake River caldera segment by Christiansen (2001 #1784). Renamed Snake River caldera faults herein to avoid usage of the term segment. This group of faults include the Beulah-Hering Lakes fault, the Polecat Creek faults, the Falls River fault and the Lake of the Woods fault of Ostenaa and others (1993 #2290). These faults are inside the Snake River caldera, which is the eruptive source of the 2.1 Ma Huckleberry Ridge Tuff.

Synopsis: Includes about a dozen generally younger north- to northeast-trending faults near the south entrance to Yellowstone National Park. The faults are just outside the 0.63-Ma caldera boundary, and inside the 2.1-Ma caldera of the Yellowstone volcanic field. They are described collectively here becauese they all offset the 0.63 Ma Lava Creek tuff and the 0.93-0.97 Ma Lewis Canyon rhyolite flow. Conversely, older faults that could be included within this group are described separately "faults in boundary region of Yellowstone and Grand Teton National Parks" [764].

Date of compilation April 1, 1998; revised 10/10/01

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Reliability of location Good

Comments: Traces mapped at 1:125,000 scale by R.L. Christiansen (2001 #1784); those faults entirely within the national park were previously shown at 1:125,000 scale by the U.S. Geological Survey (1972 #639). Those faults in western part of area mapped at 1:62,500 by Christiansen and others, 1978, #2282). Fault traces recompiled at 1:125,000-scale on map with topographic base. The Beulah-Hering Lakes fault, the Polecat Creek faults, the Falls River fault and the Lake of the Woods fault are shown by Ostenaa and others (figs. 6 and 7, 1993 #2290).

Scale of digital trace 1:125,000

Geologic setting These intracaldera faults are just south of the 0.63 Ma Lava Creek (youngest) Yellowstone caldera, but inside a reentrant of the older 2.1 Ma Snake River caldera of the Yellowstone volcano field.

Sense of movement Normal

Dip not determined

Dip direction E
Comments: All faults dip easterly except westernmost fault, which dips northwest.

Geomorphic expression Expressed as bedrock scarps on the Lava Creek tuff and Lewis Canyon Rhyolite. Hering Lake and nearby lakes are bordered by fault scarps that are as much as 90 m high on bedrock (Ostenaa and others, 1993 #2290).

Age of faulted deposits The faulted Lava Creek Tuff is 0.63 Ma and the Lewis Canyon rhyolite is 0.93-0.97 Ma (Obradovich, 1992 #2268). However, the faults near Hering Lake do not offset the 70-ka Pitchstone Plateau rhyolite flow. No offset was observed in surficial deposits by Richmond (1973 #2283, #2284).

Paleoseismic studies none

Timing of most recent paleoevent Middle and Late Quaternary (<750 ka)
Comments: The faults are less than 630 ka. Near Hering Lake, the faults are buried by the 70-ka Pitchstone Plateau rhyolite flow (U.S. Geological Survey, 1972, # 639).

Recurrence interval not determined
Comments: The faults near Hering Lake do not offset the 70-ka Pitchstone Plateau rhyolite flow, indicating a minimum (incomplete) value for recurrence.

Slip Rate Unknown; probably <0.2 mm/yr
omments: The best expressed scarp south of Hering Lake has a height of about 90 m and is on a rhyolite flow that formed about 95 ka, thus indicating a long-term slip rate of about 0.1 mm/yr for this fault. Most of the scarps in the group have lower topographic height and probably have slip rates of <0.1 mm/yr.
Wong and others (2000 #4484) suggested a fault slip rates for a number of separately named faults in the group. These include 0.07 mm/yr for the Beulah-Hering Lakes faults based on 60 m of offset on Lewis Canyon rhyolite (930±10 ka); 0.08 mm/yr for the Polecat Creek faults based on 61 m of offset on these same deposits; 0.02 mm/yr for the Falls River based on a lack of recognition of 1-m-high scarps on 70-150 ka deposits; and 0.001 mm/yr for the Lake of the Woods fault based on a lack of recognition of 1-m-high scarps on the Lewis Canyon rhyolite.
The above mentioned geologic slip rates, along with the late Quaternary characteristics of this fault (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the slip rate during this period has been <0.2 mm/yr.
On the basis of these data, the faults are assigned to the <0.2 mm/yr slip rate category

Length End to end (km): 13.5
Cumulative trace (km): 64.9

Average strike (azimuth): N4°E

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2282 Christiansen, R.L., Blank, H.R., Jr., Love, J.D., and Reed, J.C., Jr., 1978, Geologic map of the Grassy Lake Reservoir quadrangle, Yellowstone National Park and vicinity, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1459, scale 1:62,500.

#2268 Obradovich, J.D., 1992, Geochronology of the late Cenozoic volcanism of Yellowstone National Park and adjoining areas, Wyoming and Idaho: U.S. Geological Survey Open-File Report 92-408, 45 p.

#2290 Ostenaa, D.A., Wood, C., and Gilbert, J.D., 1993, Seismotectonic study for Grassy Lake Dam-Minidoka Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 93-3, 68 p., scale 1:24,000.

#2283 Richmond, G.M., 1973, Surficial geologic map of the Huckleberry Mountain quadrangle, Yellowstone National Park and adjoining area, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-639, scale 1:62,500.

#2284 Richmond, G.M., 1973, Surficial geologic map of the Warm River Butte quadrangle, Yellowstone National Park and adjoining area, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-645, scale 1:62,500.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#1057 U.S. Geological Survey, 1972, Surficial geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-710, 1 sheet, scale 1:125,000.

766, East Mount Sheridan faults

Structure Number 766

Structure Name East Mount Sheridan faults

Comments: Referred to as the East Sheridan fault by Love and Keefer (1975 #2285), but is comprised of a band of 3-4 faults on the eastern slope of Mount Sheridan.

Synopsis: Three or four north-south faults are mapped along the steep, eastern face of Mount Sheridan. About one-third the way up the trail on the eastern slope of Mount Sheridan, the one of these faults has about 5.5 m of local offset above a graben. This may be the same trace that R.L. Christiansen noted as offsetting talus. An additional fault trends along the base of Mt. Sheridan near Rustic Geyser, where glacial moraines have an apparent offset of 31.6 m. Near the north end of Factory Hill, hot springs of the Fissure Group are localized along this trace, and Holocene alluvial-fan deposits are offset about 9.6 m. The amount of offset of 0.63-Lava Creek Tuff and 2.0-Ma Huckleberry Ridge Tuff across the faults indicates long-term basin and range activity at rates approaching 1 mm/yr, and the steep morphology of the range front is consistent with young fault activity. Offset of Pinedale and mid-Holocene(?) suggest a higher slip rate of about 2.4 mm/yr for the past 13.5 ka. This faulting is related to ongoing basin-and-range extension and not caldera formation, because the faults cut across the caldera margin at a high angle as seen in map view. The southern half of the fault offsets the Lava Creek Tuff (630 ka), but its trace is not easily identified. This portion of the fault is shown as being <750 ka, but it could have also had late Quaternary (<130 ka) or younger movement.

Date of compilation August 8, 1998; revised 10/15/01

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Reliability of location Good

Comments: Mapped at 1:62,500 scale by R.L. Christiansen (1974 #2266) and compiled at 1:125,000 (U.S. Geological Survey, 1972 #639). Locally remapped at 1:24,000-scale by Ken Pierce (field notes, Sept. 4, 1998). Recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:125,000

Geologic setting The East Mount Sheridan faults are part of a much larger collection of north-trending basin-and-range normal faults, south of the Yellowstone caldera. The East Mount Sheridan faults are mainly expressed as a large escarpment (as much as 870 m high) primarily on 2.1 Ma Huckleberry Ridge Tuff. In addition, the northern end of these faults form bedrock scarps on the Aster Creek rhyolite flow (about 150 ka). Faulting is related to ongoing basin-and-range extension and not caldera formation, because the faults cut across the caldera margin at a high angle.

Sense of movement Normal

Dip not determined

Dip direction E

Geomorphic expression Factory Hill, which comprises the north end of the Mt. Sheridan mass, has a well-defined fault extending through the "Fissure Group" of sinter-depositing hot springs. Locally, this fault offsets a Holocene debris fan 9.6 m (Ken Pierce, field notes of Sept. 4, 1998). The trace of the active fault extends south along the steep face of Factory Hill where it can be recognized by oversteepening. In these areas, first-order drainages cross the fault scarps causing eroded unvegetated slopes below which are formed by steep cones of modern debris. Further south, about one-third the way up the eastern face of Mt. Sheridan and probably along the same fault trace, there is a scarp (with a graben) that has about 5.5 m of offset on the main fault (Ken Pierce, field notes of Sept. 4, 1998). At the base of Mt. Sheridan, a high linear escarpment truncates glacial moraines of late Pinedale? age that has an apparent surface offset of 31.6 m near Rustic Geyser (Ken Pierce, field notes of Sept. 4, 1998), and continues for more than a kilometer north and south.

Age of faulted deposits. Along the easternmost fault trace, late Pinedale glacial deposits, which are about 13,500 years old, are offset about 30 m. At the Fissure Hotsprings Group along the next trace to the west, a mid (?) Holocene alluvial fan is offset about 10 m. The northern 2 km of three faults have formed scarps with associated grabens on the Aster Creek flow (bedrock), which is about 150 ka.

Paleoseismic studies none

Timing of most recent paleoevent Latest Quaternary (<15 ka)

Comments. The most recent offset forms fault scarps that are as steep as the angle of repose for the surficial deposits (ca. 33°). This relation suggests a probable late Holocene age for the most recent faulting event along the northern half of the fault. Further south, the evidence for the timing of most recent paleoevent is not clear but there is substantial offset of the Lava Creek Tuff (630 ka). Thus, although this portion of the fault is shown as being <750 ka, it could have also had late Quaternary (<130 ka) or younger movement.

Recurrence interval not determined

Comments: A short recurrence interval of <5 k.y. is inferred from the high calculated slip rate and suspected young time of movement (late Holocene). However, no discrete faulting events have been dated .

Slip Rate 1-5 mm/yr

Comments: There is about 10 m of offset of mid Holocene (ca. 5? ka) debris fans. Nearby, there is about 30 m of apparent offset of late Pinedale (ca. 13.5 ka) moraines, suggesting about 20 m of differential offset between 5(?) ka and 13.5 ka, or an interval of about 8.5 k.y. These data yield a latest Quaternary slip rate of about 2.35 mm/yr. For a much longer time span, the Lava Creek Tuff (630 ka) is tilted into the fault as much as 9° and offset perhaps 600 m, suggesting an average slip rate of nearly 1 mm/yr during middle and late Quaternary time.

Wong and others (2000 #4484) suggested fault slip rates ranging from 0.3-2.7 mm/yr, each with separate weighting. These reported slip rates are model dependent but were based on scarp profile data of the compiler that suggested post-glacial offsets that are about 2/3rds of those observed along the Teton fault [768]. The late Quaternary characteristics of this fault (overall geomorphic expression, continuity of scarps, age of faulted deposits, and offset of the three above mentioned datums) suggest that the East Mount Sheridan faults be assigned to the 1-5 mm/yr slip-rate category.

Length End to end (km): 21.4
Cumulative trace (km): 40.9

Average strike (azimuth): N3°W

References

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#2266 Christiansen, R.L., 1974, Geologic map of the West Thumb quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1191, scale 1:62,500.

#2285 Love, J.D., and Keefer, W.R., 1975, Geology of sedimentary rocks in southern Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 729-D, 60 p.

#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds. Geological Society of America Memoir 171, p. 1-53.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.
#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses— Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

767, Buffalo Fork fault

Structure Number 767
Comments: Refers to fault 237 (unnamed) of Witkind (1975 #819).

Structure Name Buffalo Fork fault
Comments: Referred to as the Buffalo Fork thrust (fault) by Love and Keefer (1975 #2285). The Buffalo Fork thrust bounds the east margin of the Two Oceans Plateau and extends from Yellowstone Lake on the north to Togowotee Pass area on the south. The northern part [767a] represents normal-fault reactivation of Buffalo Fork thrust fault. Although this fault was also referred to as the South Arm fault by Wong and others (2000 #4484), the Buffalo Fork fault name has precedence and is used herein.

Synopsis The Laramide Buffalo Fork thrust fault is an important crustal feature that thrusts upper Paleozoic sedimentary rocks westward onto Cretaceous rocks. Parts of this thrust have been reactivated in Cenozoic time with down-to-the-east normal faulting, including one site of observed post-glacial fault scarps and another of tilted late Quaternary lake sediment. This fault is in a remote area seldom visited by geologists that are experienced in neotectonics; thus, evidence of Quaternary movement may have been missed. Because of its older history, this structure might serve to accommodate ongoing tectonic activity. There have been several Quaternary basalt extrusions in the hanging wall of the fault.

Date of compilation March 26, 1998; revised 10/15/01

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey; revised by Michael N. Machette

Geologic setting The Buffalo Fork thrust is a major Laramide structure in northwest Wyoming (Love and Keefer, 1975 #2285). Late Cenozoic extension may have been accommodated along or near this zone of structural weakness (p. D45-46 in Love and Keefer, 1975 #2285). Christiansen (2001 #1784) has recently affirmed this reactivation. Because of its older history, this structure might serve to accommodate ongoing tectonic activity. There have been several Quaternary basalt extrusions in the hanging wall of the fault (U.S. Geological Survey, 1972 #639; Christiansen, 2001 #1784).

Number of sections 3
Comments: Fault divided on basis of young activity in the middle section [767b] and older movement on the ends [northern section, 767a; southern section, 767c].

Length End to end (km): 30
Cumulative trace (km): 34.4

Average strike (azimuth): N1°E

767a, Buffalo Fork fault, northern section

Section number 767a

Section name Northern section
Comments: This northern section of the Buffalo Fork fault extends between Yellowstone Lake and about 5 km (?) north of the southern Yellowstone Park boundary. This section of fault is older than the middle section, where post-glacial activity is recognized.

Quality of location Good
Comments: Mapped by Love and Keefer (1975 #2285) at 1:62,500 scale and Christiansen (2001 #1784) at 1:125,000 scale. Fault traces recompiled at 1:125,000-scale on map with topographic base

Scale of digital trace 1:125,000

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Sense of movement Normal
Comments: Normal fault reactivation of Laramide Buffalo Fork thrust recognized by Love and Keefer (1975 #2285) and more recently affirmed by Christiansen (2001 #1784).

Dip not determined

Dip direction E

Geomorphic expression Near south arm of Yellowstone Lake, forms east-facing scarp on 0.63 Ma Lava Creek Tuff.

Age of faulted deposits Middle Pleistocene (0.63 Ma Lava Creek Tuff)

Paleoseismic studies none

Time of most prehistoric faulting Middle and late Quaternary (<750 ka)
Comments: Locally offsets 0.63 Ma Lava Creek Tuff.

Recurrence interval not determined
Comments: No event have been dated, but the recurrence is probably long (i.e., >10 to 100 k.y.?).

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: The section of the fault has less than 20 m of offset of 0.63 Ma Lava Creek Tuff locally, which yields a long-term rate of 0.03 mm/yr. Conversley, Wong and others (2000 #4484) suggested fault slip rates ranging from 0.4-1.4 mm/yr, each with separate weighting. However, these rates are based on an assumption of activity identical to their appraisal of the Yellowstone Lake (Eagle Bay [757]) fault.

Wong and others' (2000 #4484) reported slip rates are model dependent and do not represent actual measured values. The late Quaternary characteristics of this fault (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the slip rate during this period is of a lesser magnitude. Accordingly, the <0.2 mm/yr slip-rate category has been assigned to this fault.

Length End to end (km): 24.9
Cumulative trace (km): 26.7

Average strike (azimuth): N5°E

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2285 Love, J.D., and Keefer, W.R., 1975, Geology of sedimentary rocks in southern Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 729-D, 60 p.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

767b, Buffalo Fork fault, middle section

Section number 767b

Section name Middle section
Comments: This section of the Buffalo Fork fault is near the southern boundary of Yellowstone Park.

Quality of location Good
Comments: Mapped by Love and Keefer (1975 #2285) at 1:62,500 scale and compiled by Christiansen (2001 #1784) at 1:125,000 scale. However, these faults are in remote backcountry, and the trace is based

on sparse observations of fault scarps and tilted lake sediment (Richmond and Pierce, 1971 #2288). Fault traces recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:125,000

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Sense of movement Normal
Comments: Love and Keefer (1975 #2285) and by Christiansen (2001 #1784) showed this as a Laramide thrust fault with later (Quaternary) normal fault movement.

Dip not determined

Dip direction E

Geomorphic expression This is the only section where scarps have been observed on surficial materials (Richmond and Pierce, 1971 #2288). Near the southern end of section, post-glacial scarps are on Pinedale till; near north end of section late Quaternary lake sediment is tilted 25-30 degrees (Richmond and Pierce, 1971 #2288).

Age of faulted deposits Pinedale, about 15 ka.

Paleoseismic studies none

Time of most prehistoric faulting Latest Quaternary (<15 ka)
Comments: Near southern end of section, post-glacial scarps have been observed on Pinedale till (Richmond and Pierce, 1971 #2288).

Recurrence interval not determined
Comments: At least one event in post-glacial time.

Slip-rate category <0.2 mm/yr
Comments: This section of the fault has scarps estimated to be 3 m high (probably less offset) on materials about 15,000 years old. Conversely, Wong and others (2000 #4484) suggested fault slip rates ranging from 0.4-1.4 mm/yr, each with separate weighting. However, these rates are based on an assumption of activity identical to their appraisal of the Yellowstone Lake (Eagle Bay [757]) fault. Wong and others' (2000 #4484) reported slip rates are model dependent and do not represent actual measured values. The late Quaternary characteristics of this fault (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the slip rate during this period is of a lesser magnitude. Accordingly, the <0.2 mm/yr slip-rate category has been assigned to this fault..

Length End to end (km): 3.2
Cumulative trace (km): 3.2

Average strike (azimuth): N22°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2285 Love, J.D., and Keefer, W.R., 1975, Geology of sedimentary rocks in southern Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 729-D, 60 p.

#2288 Richmond, G.M., and Pierce, K.L., 1971, Surficial geologic map of the Mount Hancock quadrangle, Yellowstone National Park and adjoining areas, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-636, scale 1:62,500.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

767c, Buffalo Fork fault, southern Section (Class B)

Section number 767c

Section name Southern section (Class B)
Comments: This southern section of the Buffalo Fork fault is a southern extension of the fault beyond the middle section that probably has post-glacial scarps. Shown by Love and Christiansen (1985 #2287) and Christiansen (2001 #1784) as having normal fault movement for 18 km south of the Yellowstone National Park boundary.

Quality of location Poor
Comments: Mapped by Love and Christiansen (1985 #2287) at 1:500,000 scale and northernmost part of section is shown by Christiansen (2001 #1784) at 1:125,000 scale. Fault traces recompiled at 1:125,000-scale on map with topographic base. Trace is good for the older thrust fault, but uncertain (poor) for the normal fault.

Scale of digital trace 1:125,000

State Wyoming

County Teton

1° x 2° sheet Ashton

Province Northern Rocky Mountains

Sense of movement Normal
Comments: Love and Keefer (1975 #2285) and Christiansen (plate 3, 2001 #1784) show this as a Laramide thrust fault with later (Quaternary) normal fault movement.

Dip not determined

Dip direction E?

Geomorphic expression No known scarps on surficial material.

Age of faulted deposits Observed mostly in pre-Quaternary bedrock as thrust with subsequent late Cenozoic? reactivation as a normal fault.

Paleoseismic studies none

Time of most prehistoric faulting Quaternary (<1.6 Ma)
Comments: No Quaternary offset has been established, but section included herein based on association with young movement on adjacent (middle) section of Buffalo Fork fault.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Wong and others (2000 #4484) suggested fault slip rates ranging from 0.4-1.4 mm/yr, each with separate weighting. However, these rates are based on an assumption of activity identical to their appraisal of the Yellowstone Lake (Eagle Bay [757]) fault.
Wong and others' (2000 #4484) reported slip rates are model dependent and do not represent actual measured values. The late Quaternary characteristics of this fault (overall geomorphic expression, lack of scarps on Quaternary materials, age of faulted deposits, etc.) suggest the slip rate during this period is of a lesser magnitude. Accordingly, the <0.2 mm/yr slip-rate category has been assigned to this fault.

Length End to end (km): 2.2
Cumulative trace (km): 4.5

Average strike (azimuth): N9°W

References

#1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau Volcanic Field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 156 p., 3 pl., scale 1:125,000.

#2287 Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: State Geologic Map, 3 sheets, scale 1:500,000.

#2285 Love, J.D., and Keefer, W.R., 1975, Geology of sedimentary rocks in southern Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 729-D, 60 p.

#639 U.S. Geological Survey, 1972, Geologic map of Yellowstone National Park: U.S. Geological Survey Miscellaneous Geologic Investigations I-711, 1 sheet, scale 1:125,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

768, Teton fault

Structure Number 768

Structure Name Teton fault

Comments: Referred to as the Teton fault by Love and Reed (1968 #3796). This fault bounds the eastern margin of the Teton Range and Steamboat Mountain (north of Jackson Lake), and extends from Steamboat Mountain on the north to Phillips Creek on the south. Most of the fault trace was compiled on and digitized from a 1:62,500 scale base map of Grand Teton National Park. Gilbert and others (1983 #1338) and Wong and others (2000 #4484) considered the inferred projection of the Hermitage Point fault to be a possible splay or continuation of the Teton fault, but it is not included herein owing to lack of associated scarps and equivocal evidence for its Quaternary activity (Wong and others, 2000 #4484)

Synopsis The Teton fault is a major basin and range fault that bounds the eastern margin of the Teton Range. Its spectacular post-glacial (<15 ka) scarps can commonly be seen from the valley floor owing to their large height, especially when back lighted by the afternoon sun. Post-glacial offset is as much as 30 m (97 feet) along the middle part of the range, but diminishes to the north and south, mimicking the overall height of the range. Although quite active in the latest Quaternary, the fault has been seismically quiet in historic times. Three sections have been defined for main range front, but there is a more northerly section, and two associated subsidiary faults (herein sections) present within the range.

Date of compilation December 7, 1999

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

Geologic setting The Teton fault is a major basin and range fault that forms the eastern margin of the Teton Range. It is temporally associated with the arrival of the Yellowstone hotspot in this part of northwestern Wyoming, where main fault activity began less than 5 Ma (Pierce and Morgan, 1992 #2297).

Number of sections 6

Comments: There are 6 sections defined for fault (4 main sections and 2 sections for subsidiary faults in the range). Some sections have been considered to be segments by previous authors.

Length End to end (km): 58.6
Cumulative trace (km): 76.1

Average strike (azimuth): N19°E

768a, Teton fault, Steamboat Mountain section

Section number 768a

Section name Steamboat Mountain section

Comments: This northernmost section of the Teton fault extends from a point east of Steamboat Mountain (ca. 200 m west of U.S. Highway 89/287) south about 4 km, where it is submerged beneath Jackson Lake. As mapped, the fault does not cross U.S. Highway 89/287, and its southern connection with the northern section [768b] is purely conjectural. Gilbert and others (1983 #1338) and Wong and others (2000 #4484) considered the inferred projection of the Hermitage Point fault to be a possible splay or continuation of this section of the Teton fault, but it is not included herein owing to lack of associated scarps and equivocal evidence for its Quaternary activity.

Quality of location Good

Comments: Compiled at 1:62,5000 scale from Ostenaa and others (sheet 1, 1993 #2290) 1:24,000-scale map. This northernmost extension of the fault, which is on the northeast side of Jackson Lake, has much less structural relief and less offset of deposits of the last glaciation than the northern section [768b] of the main range front fault, west of Jackson Lake (Ostenaa and others, 1993 #2290; Smith and others, 1993 #2294).

Scale of digital trace 1:62,500

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement Normal

Dip >45°E

Comments: Inferred from strike along the Teton Range front to the south, which suggests more than 45-degree dip. However, gravity models suggest a low dip (Behrendt and others, 1968 #3798) and kinematic models suggest a 45-70° dip (Byrd and others, 1994 #2263).

Dip direction E

Geomorphic expression North of Jackson Lake, a scarp can be traced from near the shore north to the east side of Steamboat Mountain (Ostenaa and others, 1993 #2290; Smith and others, 1993 #2294). On more level terrain east and south of Steamboat Mountain, the fault is expressed as a 10-20 m wide graben and backtilted zone. Ostenaa and others (sheet 1, 1993 #2290) measured one scarp profile south of Steamboat Mountain that suggested about 2.8 m of surface offset. At this site, the fault forms a >50 m wide graben: the main scarp is 9.6 m high and has a maximum scarp slope angle of 29°. East of Steamboat Mountain, the fault dies out as a series of <1 m high scarps.

Age of faulted deposits. Although not stated explicitly, Ostenaa and others (sheet 1, 1993 #2290) imply that the scarps are formed on glaciated landscapes that have a thin veneer of Pinedale till (ca. 15 ka) that overlie Huckleberry Ridge Tuff.

Paleoseismic studies none

Time of most prehistoric faulting Latest Quaternary (<15 ka)

Comments: Based on inference of offset Pinedale till (Ostenaa and others, 1993 #2290) and apparent young morphology of scarp measured at one site.

Recurrence interval not determined

Slip-rate category unknown, probably <0.2 mm/yr

Comments: Poorly constrained, but fault section assigned to low slip-rate category based on occurrence of small (2.8 m) offset of Pinedale age (<15 ka) deposits; a faster slip-rate category (0.2-1 mm/yr) is assigned to the section immediately to the south [768b] based on its greater structural relief.

Length End to end (km): 4.6
Cumulative trace (km): 7.7

Average strike (azimuth): N21°E

References

#3798 Behrendt, J.C., Tibbetts, B.L., Bonini, W.E., and Lavin, P.M., 1968, A geophysical study in Grand Teton National Park and vicinity, Teton County Wyoming: U.S. Geological Survey Professional Paper 516-E, 23 p., 3 plates, scale 1:250,000.

#2263 Byrd, J.O.D., Smith, Robert B., and Geissman, John W., 1994, The Teton fault, Wyoming—Topographic signature, neotectonics, and mechanisms of deformation: Journal of Geophysical Research, v. 99, no. B10, p. 20.095-20.122.

#1338 Gilbert, J.D., Ostenaa, D., and Wood, C., 1983, Seismotectonic study of Jackson Lake Dam and Reservoir, Minidoka Project, Idaho-Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-8, 123 p., 11 pl.

#3796 Love, J.D., and Reed, J.R., Jr., 1968, Creation of the Teton landscape: The geologic story of Grand Teton National Park: Grand Teton Natural History Association, 120 p.

#2290 Ostenaa, D.A., Wood, C., and Gilbert, J.D., 1993, Seismotectonic study for Grassy Lake Dam-Minidoka Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 93-3, 68 p., scale 1:24,000.

#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds.,: Geological Society of America Memoir 171, p. 1-53.

#2294 Smith, R.B., Byrd, J.D.O., and Susong, D.D., 1993, The Teton fault, Wyoming—Seismotectonics, Quaternary history, and earthquake hazards, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming Memoir No. 5, p. 628-667.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

768b, Teton fault, northern section

Section number 768b

Section name Northern section

Comments: This is the northern section of the main range-bounding Teton fault; it extends from east of Wilcox Point (on Jackson Lake) south to Moran Bay (on Jackson Lake).

Quality of location Good

Comments: Trace from 1:24,000-scale map of Ostenaa and others' (sheet 1, 1993 #2290) and Smith and others (sheet 1, 1993 #2294), recompiled on 1:62,500-scale base map of Grand Teton National Park. This section, which is entirely west of Jackson Lake, has much more structural relief and offset of deposits related to the last glaciation than the Steamboat Mountain Section [768a] northeast of Jackson Lake (Ostenaa and others, 1993 #2290; Smith and others, 1993 #2294).

Scale of digital trace 1:62,500

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement Normal

Comments: In addition to dip slip movement, there may be left lateral (sinistral) offset similar to middle [768b] and southern [768c] sections, but lateral offset has not been documented for this section.

Dip >45°E

Comments: Strike along mountain front suggests more than 45-degree dip. However, gravity models suggest a low dip (Behrendt and others, 1968 #3798) and kinematic models suggest a 45-70° dip (Byrd and others, 1994 #2263).

Dip direction E

Geomorphic expression Scarps are present on late Pleistocene (Pinedale) glacial moraines and Pleistocene(?) and Holocene colluvium.

Age of faulted deposits Pinedale moraines, Pinedale and Holocene colluvium. Holocene deposits of the Snake River delta have been down dropped and shaken (disturbed) by faulting.

Paleoseismic studies Site 768b-1. Geoarcheological studies of the Snake River delta (distributed sites labeled [768b-1]) suggested a earthquake submergence event occurred about 2,000 years ago and a strong shaking event occurred about 4,000 years ago (Pierce and Good, 1992 #2291).

Time of most prehistoric faulting Latest Quaternary (<15 ka)
Comments: Downdropping on the Teton fault and westward tilting toward the fault best explain the sudden submergence event that is recorded about 2,000 years ago.

Recurrence interval 2 k.y. (0-4 ka)
Comments: Geoarcheological studies of the Snake River delta suggest earthquake events about 2,000 and 4,000 years ago, for a single recurrence interval of about 2,000 years (Pierce and Good, 1992 #2291; Pierce and others, 1998 #2292).

Slip-rate category 0.2-1 mm/yr
Comments: Poorly constrained rate based late glacial deposits (ca. 15 ka) having 11-18 m of fault offset near middle of section at Coulter Canyon (Smith and others, 1993 #2294) and 5.7 m of fault offset near northern end (Ostenaa and others, 1993 #2290). These offsets suggest possible slip rates of about 0.3 to 1.2 mm/yr, but the bulk of the offsets yield slip rates in the 0.2-1 mm/yr category.
Wong and others (2000 #4484) suggested fault slip rates ranging from 0.5-4.0 mm/yr, each with separate weighting. These reported slip rates are the same for all three main fault sections [786ab-d], are model dependent and do not represent actual measured values. Their greatest weight was placed on 1.5-2.2 mm/yr values (70% overall). However, the late Quaternary characteristics of this fault section (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the slip rate during this period is of a lesser magnitude. Accordingly, the 0.2-1 mm /yr slip-rate category has been assigned to this fault.

Length End to end (km): 12.2
Cumulative trace (km): 15.2

Average strike (azimuth): N18°E

References

#3798 Behrendt, J.C., Tibbetts, B.L., Bonini, W.E., and Lavin, P.M., 1968, A geophysical study in Grand Teton National Park and vicinity, Teton County Wyoming: U.S. Geological Survey Professional Paper 516-E, 23 p., 3 plates, scale 1:250,000.

#2263 Byrd, J.O.D., Smith, Robert B., and Geissman, John W., 1994, The Teton fault, Wyoming—Topographic signature, neotectonics, and mechanisms of deformation: Journal of Geophysical Research, v. 99, no. B10, p. 20.095-20.122.

#3796 Love, J.D., and Reed, J.R., Jr., 1968, Creation of the Teton landscape: The geologic story of Grand Teton National Park: Grand Teton Natural History Association, 120 p.

#1338 Gilbert, J.D., Ostenaa, D., and Wood, C., 1983, Seismotectonic study of Jackson Lake Dam and Reservoir, Minidoka Project, Idaho-Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-8, 123 p., 11 pl.

#2290 Ostenaa, D.A., Wood, C., and Gilbert, J.D., 1993, Seismotectonic study for Grassy Lake Dam-Minidoka Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 93-3, 68 p., scale 1:24,000.

#2291 Pierce, K.L., and Good, J.D., 1992, Field guide to the Quaternary geology of Jackson Hole, Wyoming: U.S. Geological Survey Open-File Report 92-504, 54 p.

#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds.,: Geological Society of America Memoir 171, p. 1-53.

#2292 Pierce, K.L., Lundstrom, S., and Good, J.M., 1998, Geologic setting of archeological sites in the Jackson Lake area, Wyoming, *in* Melissa A. Connor, Final report on the Jackson Lake

Archeological Project, Grand Teton National Park, Wyoming: Midwest Archeological Center, Technical Report No. 46, p. 29-48 and p. 222-242.
#2294 Smith, R.B., Byrd, J.D.O., and Susong, D.D., 1993, The Teton fault, Wyoming—Seismotectonics, Quaternary history, and earthquake hazards, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming Memoir No. 5, p. 628-667.
#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

768c, Teton fault, middle section

Section number 768c

Section name Middle section
Comments: This is the middle section of the range-bounding Teton fault; it extends between Moran Bay (on Jackson Lake) and Taggart Lake.

Quality of location Good
Comments: Compiled from Smith and others (sheet 1, 1993 #2294) trace after transfer to 1:62,500 scale base map of Grand Teton National Park.

Scale of digital trace 1:62,500.

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement Sinistral, normal
Comments: Near south end of section on south side of Avalanche Canyon, upper (western) splay of fault offsets a lateral moraine 9 m in a left-lateral (sinistral) sense and 8 m in a vertical (normal) sense (Smith and others, 1993 #2294), for a net oblique offset of about 12 m. The data replicate earlier measurements of K.L. Pierce and J.D. Good (field notes, 1986), which show 9.8 ± 2 m of left-lateral offset and 7 m of vertical surface offset for a net oblique offset of about 12 ± 1.7 m.

Dip >45°E
Comments: Nearly linear strike along mountain front suggests more than 45-degree dip. However, gravity models suggest a low (ca. 33°) dip {Behrendt, 1968) and kinematic models suggest a 45-70° dip (Byrd and others, 1994 #2263).

Dip direction E

Geomorphic expression Nearly continuous scarps on glacial moraines and Pleistocene(?) and Holocene colluvium.

Age of faulted deposits Pinedale (latest Pleistocene) moraines, and Pinedale and Holocene colluvium and alluvium.

Paleoseismic studies Site 768c-1. Although no trenches have been excavated along this section of the fault, a study of submerged shorelines in southwestern Jackson Lake by Pierce and Good (1992 #2291) suggested about 10 post-glacial (<15 ka) earthquake submergence events (strong earthquakes) in the past 15, 000 yrs for the middle section of the fault.

Time of most prehistoric faulting latest Quaternary (<15 ka)
Comments: Latest Pleistocene glacial deposits (ca. 15 ka) are offset as much as 30 m (Byrd and others, 1994 #2263) suggesting multiple faulting events in the past 15 k.y. and the Holoceene. Study of submerged shorelines in southwestern Jackson Lake by Pierce and Good (1992 #2291) suggested about 10 post-glacial earthquake submergence events associated with strong earthquakes on the middle section of the fault in the past 15, 000 yrs.

Recurrence interval 1.5 k.y. (<15 ka)
Comments: Submerged shorelines in southwestern Jackson Lake suggest 10 earthquake submergence events (strong earthquakes) in the past 15, 000 yrs, for an average recurrence interval of 1,500 years.

Two other comparable recurrence intervals are reported for this section: 1) 700-2,000 yrs with average about 1,400 yrs (Gilbert and others, 1983 #1338) and 2) 800-1,800 yrs with average about 1,650 yrs (Doser and Smith, 1983 #460; Smith and others, 1993 #2294).

Slip-rate category 1-5 mm/yr

Comments: Deposits estimated to be 15,000 years old are offset as much as 30 m (Byrd and others, 1994 #2263), suggesting a maximum rate of about 2 mm/yr. The oblique offset of a lateral moraine (see sense of slip discussion) suggests about 12 m of net slip in the past 15 k.y., for an average slip rate of 0.8 mm/yr at the Avalanche Canyon site. Gilbert and others (1983 #1338) estimated an average slip rate of 1.3 mm/yr, whereas Smith and others (1993 #2294) estimated an average displacement rate of 1.0-1.4 mm/yr for the past 2 Ma. Thus, the bulk of slip rate determinations place the fault in the 1-5 mm/yr slip-rate category.

Wong and others (2000 #4484) suggested fault slip rates ranging from 0.5-4.0 mm/yr, each with separate weighting. These reported slip rates are the same for all three main fault sections [786ab-d], are model dependent and do not represent actual measured values. Their greatest weight was placed on 1.5-2.2 mm/yr values (70% overall). The late Quaternary characteristics of this fault section (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the slip rates during this period are of a similar magnitude. Accordingly, the 1-5 mm /yr slip-rate category has been assigned to this fault.

Length End to end (km): 21.3
Cumulative trace (km): 20.1

Average strike (azimuth): N6°E

References

#3798 Behrendt, J.C., Tibbetts, B.L., Bonini, W.E., and Lavin, P.M., 1968, A geophysical study in Grand Teton National Park and vicinity, Teton County Wyoming: U.S. Geological Survey Professional Paper 516-E, 23 p., 3 plates, scale 1:250,000.

#2263 Byrd, J.O.D., Smith, Robert B., and Geissman, John W., 1994, The Teton fault, Wyoming—Topographic signature, neotectonics, and mechanisms of deformation: Journal of Geophysical Research, v. 99, no. B10, p. 20.095-20.122.

#460 Doser, D.I., and Smith, R.B., 1983, Seismicity of the Teton-southern Yellowstone region, Wyoming: Bulletin of the Seismological Society of America, v. 73, p. 1369-1394.

#1338 Gilbert, J.D., Ostenaa, D., and Wood, C., 1983, Seismotectonic study of Jackson Lake Dam and Reservoir, Minidoka Project, Idaho-Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-8, 123 p., 11 pl.

#3796 Love, J.D., and Reed, J.R., Jr., 1968, Creation of the Teton landscape: The geologic story of Grand Teton National Park: Grand Teton Natural History Association, 120 p.

#2291 Pierce, K.L., and Good, J.D., 1992, Field guide to the Quaternary geology of Jackson Hole, Wyoming: U.S. Geological Survey Open-File Report 92-504, 54 p.

#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds.,: Geological Society of America Memoir 171, p. 1-53.

#2294 Smith, R.B., Byrd, J.D.O., and Susong, D.D., 1993, The Teton fault, Wyoming—Seismotectonics, Quaternary history, and earthquake hazards, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming Memoir No. 5, p. 628-667.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

768d, Teton fault, southern section

Section number 768d

Section name Southern section

Comments: This is the southern section of range bounding Teton fault; it extends between Taggart Lake and Phillips Canyon. This section was defined as the south segment of the Teton fault by Susong and others (1987 #2295).

Quality of location Good
Comments: Compiled from Smith and others (sheet 1, 1993 #2294) onto 1:62,500 scale base map of Grand Teton National Park. At south end, aerial photo examination by K. Pierce places the scarp lower on the slope than shown on map by Smith and others (1993 #2294).

Scale of digital trace Compiled and digitized at 1:62,500 scale from Smith and others (1993, #2294).

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement Normal and sinistral
Comments: At Stewart Draw [site 768d-1], 32 m of vertical slip and 26 m of left-lateral slip were reported by Susong and others (1987 #2295) and Smith and others (1993 #2294) for a net slip of about 41 m. At this same site, Pierce and Good (field notes, Aug. 5, 1993) measured left lateral offset of 11 m and 15 m in traverses up and down the moraine crest (respectively) and 13-15 m of vertical offset. The average of these values yields a net slip of about 19 m.

Dip >45°E
Comments: Fairly linear strike along mountain front suggests more than 45-degree dip. However, gravity models suggest a low dip (Behrendt and others, 1968 #3798) and kinematic models suggest a 45-70° dip (Byrd and others, 1994 #2263).

Dip direction E

Geomorphic expression Scarps on glacial moraines and Pleistocene(?) colluvium..

Age of faulted deposits Pinedale (latest Pleistocene) moraines, and Pinedale and Holocene colluvium and alluvium.

Paleoseismic studies. Two studies have been conducted along this section. The first at Stewart Draw [site 768d-1] documents the amount and sense of lateral slip along the fault (see sense of movement). The second site study involves the only trenches excavated in Teton National Park, to date. Trenching at Granite Creek [site 768d-2] yielded evidence for a surface-rupturing event just before 7,150±120 yr B.P.; a postulated second (younger) event is older than 5 ka {(Byrd and Smith, 1990 #191; Smith and others, 1993 #2294; Byrd and others, 1994 #2263).

Time of most prehistoric faulting latest Quaternary (<15 ka)
Comments: Multiple events in the Holocene, the most recent of which is older than 5 ka and younger than about 7,150±120 yr B.P (Byrd and Smith, 1990 #191; Smith and others, 1993 #2294; Byrd and others, 1994 #2263).

Recurrence interval <2,150 yr (0-7.2 ka)
Comments: The most recent recurrence interval is based on a surface-rupturing event just before 7,150±120 yr B.P., and postulated younger event is older than 5 ka (Smith and others, 1993 #2294; Byrd and others, 1994 #2263). However, it has been >5 k.y. since the most recent event, so the <2,150 yr is probably a minimum.

Slip-rate category 0.2-1 mm/yr
Comments: For the four highest scarps at Granite Creek, Byrd (1995, table 3.1) reports a surface offset averaging about 14 m over about 15,000 yrs yields a slip rate of about 0.9 mm/yr. For a site near the Granite Creek trench (see Paleoseismic studies), Smith and others (p. 652, 1993 #2294) calculated a slip rate of 1.6 mm/yr for the interval between 7,175 and 14,000 yrs ago. Thus the bulk of slip rate determinations place the fault in the 0.2-1 mm/yr category.
Wong and others (2000 #4484) suggested fault slip rates ranging from 0.5-4.0 mm/yr, each with separate weighting. These reported slip rates are the same for all three main fault sections [786ab-d], are model dependent and do not represent actual measured values. Their greatest weight was placed

on 1.5-2.2 mm/yr values (70% overall). However, the late Quaternary characteristics of this fault section (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the slip rate during this period is of a lesser magnitude. Accordingly, the 0.2-1 mm /yr slip-rate category has been assigned to this fault.

Length End to end (km): 17.8
Cumulative trace (km): 19.3

Average strike (azimuth): N28°E

References

#3798 Behrendt, J.C., Tibbetts, B.L., Bonini, W.E., and Lavin, P.M., 1968, A geophysical study in Grand Teton National Park and vicinity, Teton County Wyoming: U.S. Geological Survey Professional Paper 516-E, 23 p., 3 plates, scale 1:250,000.

#2263 Byrd, J.O.D., Smith, Robert B., and Geissman, John W., 1994, The Teton fault, Wyoming—Topographic signature, neotectonics, and mechanisms of deformation: Journal of Geophysical Research, v. 99, no. B10, p. 20.095-20.122.

#191 Byrd, J.O.D., and Smith, R.B., 1990, Dating recent faulting and estimates of slip rates for the southern segment of the Teton fault, Wyoming: Geological Society of America Abstracts with Programs, v. 22, no. 6, p. 4-5.

#1338 Gilbert, J.D., Ostenaa, D., and Wood, C., 1983, Seismotectonic study of Jackson Lake Dam and Reservoir, Minidoka Project, Idaho-Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-8, 123 p., 11 pl.

#3796 Love, J.D., and Reed, J.R., Jr., 1968, Creation of the Teton landscape: The geologic story of Grand Teton National Park: Grand Teton Natural History Association, 120 p.

#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds.,: Geological Society of America Memoir 171, p. 1-53.

#2294 Smith, R.B., Byrd, J.D.O., and Susong, D.D., 1993, The Teton fault, Wyoming—Seismotectonics, Quaternary history, and earthquake hazards, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming Memoir No. 5, p. 628-667.

#2295 Susong, D.D., Smith, R.B., and Bruhn, R.L., 1987, Quaternary faulting and segmentation of the Teton fault zone, Grand Teton National Park, Wyoming: EOS, Transactions of the American Geophysical Union, v. 68, no. 44, p. 1244.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

768e, Teton fault, Avalanche Canyon section

Section number 768e

Section name Avalanche Canyon section

Comments: This section represents a subsidiary fault within the Teton Range, about 1.6 km west of the the middle section of the Teton fault [768c]. The Avalanche Canyon section of the Teton fault extends about 7 km through the steep eastern face of the Teton Range.

Quality of location Good

Comments: Compiled at 1:62,500-scale on shaded relief base map (Grand Teton National Park); trace based on photomechanical transfer from 1:250,000 scale map by Gilbert and others (1983 #1338), fitted to topography.

Scale of digital trace 1:62,500

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement Normal

Dip 60°-80°E
Comments: Dip measured in intensely sheared and altered zone in igneous and metamorphic rock (Gilbert and others, 1983 #1338).

Dip direction E

Geomorphic expression Topographic relief thought to represent the faulting is expressed both in till and in granitic bedrock. The associated scarp is 7.9 m high and slopes 26°-27° to the east; if the scarp is fault related, it indicates 5.2-7.0 m of surface offset.

Age of faulted deposits Pinedale (latest Pleistocene) glacial deposits; area deglaciated by 15,000 yr B.P.

Paleoseismic studies none

Time of most prehistoric faulting Latest Quaternary (<15 ka)

Recurrence interval 5.0-7.5 k.y (<15 ka)
Comments: The measured 5.2-7.0 m of surface offset suggests probable multiple (3-4) offsets of 1.5-2 m in past 15,000 yrs (although this is an open-ended time interval). If so, then recurrence is probably in the range of 5.0-7.5 k.y.

Slip-rate category Unknown; probably 0.2-1 mm/yr
Comments: Measured 5.2-7.0 m of post Pinedale surface offset suggests slip rate of 0.3-0.5 mm/yr for past 15,000 yrs (although this is an open-ended time interval). Thus, the section is assigned to the 0.2-1 mm/yr slip-rate category.

Length End to end (km): 7.7
Cumulative trace (km): 7.7

Average strike (azimuth): N21°E

References

#1338 Gilbert, J.D., Ostenaa, D., and Wood, C., 1983, Seismotectonic study of Jackson Lake Dam and Reservoir, Minidoka Project, Idaho-Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-8, 123 p., 11 pl.

#3796 Love, J.D., and Reed, J.R., Jr., 1968, Creation of the Teton landscape: The geologic story of Grand Teton National Park: Grand Teton Natural History Association, 120 p.

#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds.,: Geological Society of America Memoir 171, p. 1-53.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

768f, Teton fault, Granite Canyon section

Section number 768f

Section name Granite Canyon section
Comments: This section represents a subsidiary fault within the Teton Range, 2.6 km west of southern section of the Teton fault [768c]. This section of the Teton fault extends about 4 km, and is centered on Granite Creek.

Quality of location Good
Comments: Compiled at 1:62,500-scale on shaded relief base map (Grand Teton National Park); trace based on photomechanical transfer from 1:250,000 scale map by Gilbert and others (1983 #1338), fitted to topography.

Scale of digital trace 1:62,500

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement Normal

Dip not determined

Dip direction E

Geomorphic expression Gilbert and others (1983 #1338) stated "This branch as mapped by Reed (1973 #2943) is 4 km long. Although not field checked, study of 1:30,000 scale black-and-white aerial photographs suggests that this fault may displace a large debris and talus fan in Granite Creek . . ." Vertical surface displacement appears to be about 5 m down to the east as roughly estimated from aerial photographs. For more information, see Appendix section on Granite Creek area in Gilbert and others (1983 #1338).

Age of faulted deposits A glacier more than 1,000 feet thick scoured the area, and the debris-fan and talus deposits that lie in Granite Canyon are clearly of post-glacial age (younger than 15,000 yrs).

Paleoseismic studies none

Time of most prehistoric faulting Latest Quaternary (<15 ka)

Recurrence interval not determined
Comments: Probably multiple movements in past 15,000 years

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category is inferred from activity on adjacent section of fault [768d], and subsidiary nature of section 768f to the main fault [section 768c].

Length End to end (km): 6
Cumulative trace (km): 6.1

Average strike (azimuth): N30°E

References

#1338 Gilbert, J.D., Ostenaa, D., and Wood, C., 1983, Seismotectonic study of Jackson Lake Dam and Reservoir, Minidoka Project, Idaho-Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-8, 123 p., 11 pl.

#3796 Love, J.D., and Reed, J.R., Jr., 1968, Creation of the Teton landscape: The geologic story of Grand Teton National Park: Grand Teton Natural History Association, 120 p.

#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds.,: Geological Society of America Memoir 171, p. 1-53.

#2943 Reed, J.C., Jr., 1973, Geologic map of the Precambrian rocks of the Teton Range, Wyoming: U.S. Geological Survey Open File Report 73-230.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.

769, Togwotee Lodge faults

Structure Number 769

Structure Name Togwotee Lodge faults
Comments: These faults are informally referred to as the Togwotee Lodge faults for their proximity to Togowotee Lodge on U.S. Highway 26/287, about 15 km west of Togwotee Pass (Angle Mountain 7.5-minute quadrangle). The faults extend both north and south of the highway, but their lateral extent beyond the valley of Blackrock Creek is poorly known owing to forest cover and hilly terrain. Their mapped extent is rather short (250 m to about 2 km); they may extend further north and south than mapped.

Synopsis These recently mapped faults offset glacial deposits just west of Togwotee Lodge and related deposits on the south side of Flagstaff Creek, about 1-2 km west of Togowotee Lodge. The faults form east-facing scarps that range from 6 m of offset of Pinedale moraines (>25 ka) to 21 m offset of 140 ka

Bull Lake moraines. The lateral extent of the faults is poorly established owing to the preliminary nature of the mapping (K.L. Pierce, unpubl. mapping 1989, 1991), the forest cover, and hilly terrain. These scarps are some of the most eastward mapped in the region, and may reflect reactivation of older faults or creation of new faults in association with eastward migration of the Yellowstone hotspot.

Date of compilation December 8, 1999

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Quality of location Good

Comments: Traces are from unpublished 1:24,000-scale mapping of Angle Mountain 7.5-minute quadrangle by Kenneth L. Pierce (1989, 1991), compiled at 1:250,000 on a topographic base map. Locations are well defined where fault offsets Bull Lake or Pinedale moraines. However, the landscape in this area is forested and quite hilly. Extension of the fault further north or south would require careful study.

Scale of digital trace 1:250,000

Geologic setting These faults are about 40 km east of the Teton fault [768] in generally unfaulted terrain. They lie within Pierce and Morgan's (1992 #2297) belt I of "new and reactivated faults."

Sense of movement Normal

Comments: The faults have fairly straight trends across hilly landscape suggesting a high dip.

Dip not determined

Dip direction E

Geomorphic expression Two 1.5-2 km long fault traces (A on the west and B on the east) are present on the margins of Blackrock Creek, west of Togwotee Lodge. Also, three short fault scarps (C) were found south of the eastern trace (B). These scarps are discussed separately below.

A. East scarp. Scarps along the fault were first noted by Love and Love (1983 #2296) and measured by K.L. Pierce (field notes, 1989). A singular fault scarp with sag pond at its base is well expressed 1.2 km west of Togowotee Lodge. This east-facing scarp has the following heights and maximum scarp-slope angles: 8.8 m/44°, 12.6 m/39°, 8.0 m/26°, and 8 m/38.5° (K.L. Pierce, locality 89P75). Scarps that appear to be fault-related were noted along strike 0.5 km and 1.2 km to the south-southeast of the highway.

B. West scarp. About 0.9 km south of Flagstaff Creek, there is a scarp on west-sloping Bull Lake? moraines (140 ka), which are downdropped about 21 m to the east. Another possible fault scarp 0.1 km north of Flagstaff Creek is on west-sloping early Pinedale moraines (>25 ka), which are down dropped about 6 m to the east and have a maximum scarp-slope angle of 14°. Fault trace is clearly defined where it offsets Bull Lake moraines.

C. South scarps. These faults form a graben along ridge crest. Two strands of fault strike NW and have offsets and maximum scarp angles of 8.5 m/30° and 2.2 m/31.5°. To the east, an antithetic fault about 100 m perpendicular to the NW strike has about 3 m offset and a maximum scarp angle of 18-20° (mid-scarp sector) superposed on a gentler scarp, implying multiple movements. A sag pond is preserved on the hanging wall of the fault. Description based on field notes of Ken Pierce, Sept. 16, 1991 (localities 91P43, 44, and 45).

Age of faulted deposits at the surface A variety of glacial deposits are deformed by the three different scarps:

Fault scarp A. Fault offsets Pinedale glacial deposits.

Fault scarp B. Fault offsets Bull lake moraines that have muted morphology; andesitic volcanic rocks within the till have weathering rinds >1 mm thick. These moraines are correlated with 140-ka Bull Lake deposits at West Yellowstone. Fault also offsets Pinedale moraines correlated with Burned Ridge moraines, which are thought to be at least 25 ka.

Fault scarp C. These scarps are above the Pinedale glacial limit, but within area of glacial erratics of Bull Lake age.

Paleoseismic studies none

Time of most prehistoric faulting Latest Quaternary (<15 ka)
Comments: Based on multiple-event offset of Pinedale moraines thought to be at least 25,000 yrs old. Timing supported by steepness of scarp(s) C and preservation of sag pond on the hanging wall of the fault.

Recurrence interval 16-23 k.y. (<140 ka).

Comments: There are no published recurrence intervals, but the following data support the above estimates. Fault B , which has a 6 m offset on Pinedale moraines (>25 ka), is probably a result of more than two events (2-3 m offset per event?), whereas the 21 m offset of 140 ka Bull Lake moraines is probably a result of more than 7-10 events (2-3 m offset per event?). The later data suggest long-term average recurrence at intervals of 16-23 k.y. (6-9 intervals in 140 k.y.)

Slip-rate category <0.2 mm/yr
Comments: For fault B, the <0.2 mm/yr slip-rate category is based on 21 m of offset of 140-ka Bull Lake moraines. This data yields a long-term slip rate of <0.15 mm/yr, whereas 6 m offset of ~25 ka Pinedale moraines yields a rate of <0.24 mm/yr (both estimates are maximum since they have open-ended time intervals for stress accumulation). For fault(s) C, the calculated rate is 0.06 mm/yr based on 8.5 m offset in about 140 ka, although freshness of scarps suggests higher rate or young faulting event. On the basis of these data, the <0.2 mm/yr slip-rate category is defined for these faults.

Length End to end (km): 4.1
Cumulative trace (km): 5.5

Average strike (azimuth): N13°W

References

#2296 Love, J.D., and Love, J.M., 1983, Road log, Jackson to Dinwoody and Return: Wyoming Public Information Circular 20, 33 p.

#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds.: Geological Society of America Memoir 171, p. 1-53.

770, Baldy Mountain fault

Structure Number 770

Structure Name Baldy Mountain fault
Comments: This fault is informally named its proximity to Baldy Mountain, which is about 6.5 km south-southeast of the Blackrock Ranger Station (U.S. Highway 26/287). The 0.8-km-long mapped fault is mainly west and south of Baldy Mountain in the southwest part of the Rosies Ridge 7.5-minute quadrangle.

Synopsis: This north-south, down-to-the-east fault offsets glacial moraines on the crest of Baldy Mountain and forms two sag ponds to the south. The mapped trace is short (only 0.8 km long): extensions of the fault may exist to the north or south through hummocky glacial and landslide topography. Formation of the scarp by ridge-failure-type slumping (sackungen) seems unlikely because the main topographic relief is to the north, west, and south, whereas the trend of the ridge is east-west.

Date of compilation December 9, 1999.

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Northern Rocky Mountains

Reliability of location Good
Comments: Trace is from unpublished 1:24,000-scale mapping of Rosies Ridge 7.5-minute quadrangle by Kenneth L. Pierce in 1984. Location is well defined near crest of Baldy Mountain, however, the landscape in this area is hilly and has been glaciated; extension of the fault further north or south would require further careful study. Fault trace recompiled at 1:125,000-scale on map with topographic base.

Scale of digital trace 1:250,000

Geologic setting setting This fault scarp is 33 km east of the Teton fault [768] in generally unfaulted terrain. It lies within Pierce and Morgan's (1992 #2297) Belt I of "new and reactivated faults". These faults are some of the most eastward mapped in the region, and may reflect reactivation of older faults or creation of new faults in association with eastward migration of the Yellowstone hotspot.

Sense of movement Normal

Comments: Fault trace trends fairly straight across landscape suggesting high dip.

Dip not determined

Dip direction E

Geomorphic expression Well expressed as scarp across Pinedale moraines on crest of Baldy Mountain. A scarp profile at the crest shows about 5 m of offset and has a maximum scarp-slope angle of 23.5°, whereas one scarp 0.6 km to south has about 3 m offset and a 20° maximum angle (field notes of K.L. Pierce, July 24, 1984, localities 84P17, 18).

Age of faulted deposits Pinedale moraines of probable Burned Ridge age (25,000? ka) (see Pierce and Morgan, 1992 #2297, for glacial sequence).

Paleoseismic studies none

Timing of most recent paleoevent Latest Quaternary (<15 ka)
Comments: Post-Burned Ridge (25 ka?) offset of 5 m suggests more than one event in that amount of time. Thus, it seems likely the the youngest event occurred during the past 15 k.y.

Recurrence interval 13-25 k.y. (<25 ka)
Comments: Based on 5 m offset on Pinedale-age (Burned Ridge) moraines. This scarp is probably a result of two events (2-3 m offset per event?) during the past 25 k.y.(?). These data suggest a recurrence interval of <25 k.y. (maximum) to about 13 k.y. (two events in 25 k.y.).

Slip Rate unknown, probably <0.2 mm/yr
Comments: Although there are no dated faulting events, 5 m offset recorded in deposits of about 25 ka age suggest a slip rate of or less. If one infers 2.5 m for the most recent event, then the permissible slip rates are 0.1 (2.5 m/25 k.y.) to 0.2 mm/yr (2.5 m/13 k.y.). Thus, we apply the <0.2 mm/yr slip rate category to this fault.

Length End to end (km): 1.8
Cumulative trace (km): 1.8

Average strike (azimuth): N4°W

References

#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds.: Geological Society of America Memoir 171, p. 1-53.

771, Phillips Valley fault

Structure Number 771

Structure Name Phillips Valley fault
Comments: Referred to as the Phillips Valley fault by Oriel and others (1985 #2298).

Synopsis The Phillips Valley fault starts where the south end of the southern section of the Teton fault [768d] appears to stop, and as such it may be a splay of the Teton fault [768]. Only the 1.5-km-long middle section of the Phillips Valley fault has been observed to offset late Quaternary deposits (Pinedale glacial moraines). Late Quaternary offset may extend to the northern and southern sections, given that sizeable offsets were measured at both ends of the middle section.

Date of compilation July 28, 1997

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

Geologic setting This fault starts where the south end of the southern section of the Teton fault [768d] appears to stop, and as such it may be a splay of the Teton fault [768] that extends behind the Phillips Ridge block.

Number of sections 3
Comments: Sections based on apparent recency of fault movement. The middle section has recognized post-glacial (<15 ka) offset, whereas the north and south sections have not been well examined for young offset.

Length End to end (km): 8
Cumulative trace (km): 12.5

Average strike (azimuth): N44°E

771a, Phillips Valley fault, northern section

Section number 771a

Section name Northern section
Comments: This section extends from the mouth of Phillips Canyon south almost to Ski Lake. No detailed studies of Quaternary faulting have been made, but the fault coincides with a bedrock structure mapped by Love and others (1992 #2289), Oriel and others (1985 #2298), and Schroeder (1972 #2300).

Quality of location Good
Comments: Extension of the fault north of the middle section is based on bedrock fault mapping at 1:62,500 scale (on Grand Teton National Park sheet) by Love and others (1992 #2289) and Oriel and others (1985 #2298), as revised and updated from 1:24,000 scale mapping by Schroeder (1972 #2300). Fault traces recompiled at 1:62,500-scale on map with topographic base.

Scale of digital trace 1:62,500.

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement Normal
Comments: This fault offsets Paleozoic bedrock units about 1.5 km.

Dip not determined

Dip direction SE

Geomorphic expression No detailed studies of Quaternary faulting have been made, but the fault coincides with a bedrock structure. No scarps have been identified from reconnaissance studies.

Age of faulted deposits Paleozoic sedimentary bedrock offset about 1.5 km

Paleoseismic studies none

Time of most prehistoric faulting late Quaternary (<130 ka)
Comments: Activity inferred from middle section [771b] where offset last glacial deposits are present. Not examined for scarps, but if middle segment has two or more post-glacial offsets, this section is likely to have had some late Cenozoic movement.

Recurrence interval not determined

Slip-rate category unknown, probably <0.2 mm/yr
Comments: Rate based on the appearance of lesser activity than for middle section (0.3 mm/yr).

Length End to end (km): 4.4
Cumulative trace (km): 7.4

Average strike (azimuth): N61°E

References

#2289 Love, J.D., Reed, J.C., Jr., and Christiansen, A.C., 1992, Geologic map of Grand Teton National Park: U.S. Geological Survey Miscellaneous Investigations Map I-2031, scale 1:62,500.

#2298 Oriel, S.S., Antweiler, J.C., Moore, D.W., and Benham, J.R., 1985, Mineral resource potential map of the west and east Palisades roadless areas, Idaho and Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF-1619-A, 1 p. pamphlet, scale 1:50,000.

#2300 Schroeder, M.L., 1972, Geologic map of the Rendezvous Peak quadrangle, Teton County, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-980, scale 1:24,000.

771b, Phillips Valley fault, middle (Ski Lake) section

Section number 771b

Section name Middle (Ski Lake) section
Comments: Faulting is well defined by scarps from a point east of Ski Lake for about 1.5 km to the south (Love and others, 1992 #2289; compilation of Bradley Meyers, USGS, dated 6/87; and unpublished field mapping by Ken Pierce, USGS, in 1988).

Quality of location Good
Comments: Trace mapped by Love and others (1992 #2289) on Grand Teton National Park sheet at 1:62,500 scale, supplemented by unpublished mapping by K.L. Pierce at 1:24,00 scale. Fault traces recompiled at 1:62,500-scale on map with topographic base.

Scale of digital trace 1:62,500

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement Normal, right lateral(?)
Comments: Has typical geomorphic expression of a normal fault, but two moraine crests show apparent right lateral offset (K.L. Pierce, field notes, Aug. 4, 1988).

Dip 60°E
Comments: Dip is suspected to be about 60°, but may flatten towards Phillips Ridge and join buried section of Teton fault [768] beneath Phillips Ridge.

Dip direction E

Geomorphic expression Offsets moraines and other deposits of last glaciation; has well expressed, fresh scarps. Only the central section is well located by scarps. This fault may be the surface expression of the Teton fault [768], and Phillips Ridge to the east may represent a large slide block that crosses (lies on) the projected trace of the Teton fault, as briefly discussed in Pierce and Good (1992 #2291). Field notes of Ken Pierce (Aug. 4, 1988) record a traverse along the fault scarp and includes several profiles across the scarp.

Age of faulted deposits Glacial moraines and other deposits of last glaciation (Pinedale)

Paleoseismic studies none

Time of most prehistoric faulting Latest Quaternary (<15 ka)
Comments: Pinedale glacial moraines are offset about 4 m, which suggests more than one event in post-glacial time (past 15,000 years).

Recurrence interval not determined
Comments: May be 5-10 k.y. based on possible multiple movements in the past 15 k.y.

Slip-rate category not determined; probably 0.2-1 mm/yr

Comments: Surface offset near north end of scarp is about 4 m (88P61 notes surface offsets of 3.2 and 4.5 m) and near the south end of scarp is about 5 m (88P63 notes surface offsets of 4.5 and 5.8 m). These 3-6 m offsets of Pinedale (15 ka) deposits suggest that the fault is moving rather slowly, probably within the 0.2-1 mm/yr slip-rate category.

Length End to end (km): 1.1
Cumulative trace (km): 1.1

Average strike (azimuth): N24°E

References

#2289 Love, J.D., Reed, J.C., Jr., and Christiansen, A.C., 1992, Geologic map of Grand Teton National Park: U.S. Geological Survey Miscellaneous Investigations Map I-2031, scale 1:62,500.

#2298 Oriel, S.S., Antweiler, J.C., Moore, D.W., and Benham, J.R., 1985, Mineral resource potential map of the west and east Palisades roadless areas, Idaho and Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF-1619-A, 1 p. pamphlet, scale 1:50,000.

#2291 Pierce, K.L., and Good, J.D., 1992, Field guide to the Quaternary geology of Jackson Hole, Wyoming: U.S. Geological Survey Open-File Report 92-504, 54 p.

771c, Phillips Valley fault, southern (Glory Slide) section (Class B)

Section number 771c

Section name Southern (Glory Slide) section (Class B)
Comments: This section of the fault is projected from terrain where scarps on similar steep slopes are preserved; in this area (Glory Slide), scarps are unlikely to be easily recognized. Extension of the trace to south is uncertain, and south of Trail Creek the fault would cross numerous thrust-belt structures. This fault section is considered to be a Class B structure, until definite proof of Quaternary faulting is found.

Quality of location Poor
Comments: Projected into area on basis of trace of middle section. Fault trace compiled at 1:62,500-scale on map with topographic base, but location is questionable.

Scale of digital trace 1:62,500

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Middle Rocky Mountains

Sense of movement Normal
Comments: Subparallel to Teton fault [768].

Dip not determined

Dip direction E(?)

Geomorphic expression Possible fault trace is on steep slope. About 1.9 km south of Trail Creek, at the obsidian clast locality known as Love Quarry, a ridge is interrupted by a feature interpreted to be a possible graben based primarily on an antithetical fault scarp. The primary fault scarp is on brecciated limestone bedrock more than 40 m high and a slope of 28-30 degrees. The other side of the graben is in limestone bedrock about 10 m high and having a maximum slope of 23 degrees and a nearly horizontal toe slope (Pierce, field notes, Aug. 13, 1996).

Age of faulted deposits not determined

Paleoseismic studies none

Time of most prehistoric faulting Late Quaternary (<130 ka)
Comments: Activity inferred from middle section [771b] where last glacial deposits are offset. Not examined for scarps, but if middle segment has two or more post-glacial offsets, this section may have had some post-glacial movement.

Recurrence interval not determined

Slip-rate category unknown, probably <0.2 mm/yr
Comments: Low slip-rate category is based on lesser appearance of activity than for middle section (<0.2 mm/yr).

Length End to end (km): 2.8
Cumulative trace (km): 4

Average strike (azimuth): N16°E

References

#2298 Oriel, S.S., Antweiler, J.C., Moore, D.W., and Benham, J.R., 1985, Mineral resource potential map of the west and east Palisades roadless areas, Idaho and Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF-1619-A, 1 p. pamphlet, scale 1:50,000.

772, Hoback fault (Class B)

Structure Number 772
Comments:

Structure Name Hoback fault (Class B)
Comments: This fault extends from the narrow valley of Flat Creek (about 2 km southwest of Jackson, Wyoming) south and east to the vicinity of Little Horse Creek. The Hoback normal fault was named by Nelson and Church (1943, p. 163 #4462), but is herein shortened to Hoback fault.

Synopsis: The Hoback fault was active in Miocene time, particularly during deposition of the middle unit of the Camp Davis Formation. The southern part of the fault (not included herein) has sediment of the upper part of the Miocene Camp Davis Formation deposited across it and thus has no evidence for Quaternary movement. However, the northern part of the fault may have been reactivated in the Quaternary. A few scarps are found along the fault north of Game Creek and about 1-2 km farther northwest along the fault, but for the most part the fault has poor Quaternary expression. Talus breccia that was deposited with a west dip is interpreted as dipping into the fault. This possibly reactivated portion of the Hoback fault is southeast of the projection of the strike of the Teton fault [768], which has lost evidence of movement well north of Jackson. Only one short part of the largely concealed Hoback fault has a scarp on Quaternary surficial materials. Thus, we consider the Hoback fault to be a Class B structure because of the general lack of Quaternary expression and possible landslide origin for the small area of known scarps.

Date of compilation April 1, 1998

Compiler and affiliation Kenneth L. Pierce, U.S. Geological Survey

State Wyoming

County Teton

1° x 2° sheet Driggs

Province Northern Rocky Mountains

Reliability of location Good
Comments: The mostly concealed trace of the fault, as shown here, is from 1:24,000-scale quadrangle mapping by Shroeder (1974 #2303), Love and Albee (1977 #2306), and Love, (1978 #2302). The trace of the fault was generalized and recompiled at 1:250,000 scale on a topographic base map.

Scale of digital trace 1:250,000

Geologic setting The Hoback fault is a basin-and-range fault that was activated in the Miocene, particularly during deposition of the middle unit of the Camp Davis Formation. The southern part of the fault has the upper part of the Camp Miocene Davis formation deposited across it (Schroeder, 1974 #2303), and thus has no evidence for Quaternary movement in this area. As such, it is not included on the compiled map nor discussed herein. However, the northern part of the fault may have been reactivated in the Quaternary. This possibly reactivated portion is southeast of where the Teton fault

[768] dies out on the western side of the valley. This interpretation is consistent with the pattern of fault activity outlined by Pierce and Morgan (1992 #2297).

Sense of movement N

Comments: Shown as normal fault on geologic maps by Shroeder (1974 #2303), Love and Albee (1977 #2306), and Love (1978 #2302).

Dip not determined

Comments: Shown with high-angle dip on cross sections by Love and Albee (1977 #2306) and Love (1978 #2302), but no values are listed.

Dip direction SW

Geomorphic expression Scarps are found along about 0.8 km of the fault at Game Creek (Love and Montagne, 1956 #2305). There, Love and Montagne (1956 #2305, p. 173-4) reported that "Loess and silt that overlie reworked Pleistocene glacial debris (in sec. 26, R. 40 N, R. 116 W.) have been displaced as much as 50 feet [sic 14 m] (southwest block downdropped) along the fault, hence movement apparently continued until Recent time." The scarps may be tectonic or may be due to slumping of benches that are about 180 m above the Snake River and underlain by weak Mesozoic shales and unconsolidated Cenozoic deposits. Love (1977 #2306) noted that "Talus breccia of Paleozoic limestone fragments that accumulated along the rising fault scarp and that had a steep initial dip westward was rotated enough to make it dip eastward into the fault" (see also Love and Albee, 1972 #2304; Love and Love, 1978 #2302). Pierce measured slope angles of 27° on scarps about 10 m high.

Age of faulted deposits The scarps are on deposits of the Munger glaciation, which is correlated with the 140 ka Bull Lake glaciation of West Yellowstone.

Paleoseismic studies none

Timing of most recent paleoevent Late Quaternary (<130 ka)

Comments: The scarps, which are as much as 10 m high and may therefore be product of multiple faulting events, are preserved on Bull Lake glacial terrain that formed about 140 ka. Thus, it seems geologically reasonable to assign a late Quaternary (<130 ka) time to their formation. However, the compiler considers the Hoback fault to be a suspect (Class B) structure because of the general lack of Quaternary expression, and because there is only a small area of scarps for which a landslide origin might be possible.

Recurrence interval not determined

Slip Rate unknown, probably <0.2 mm/yr

Comments: If the reported scarps are fault related, this structure probably falls in the low slip-rate category based on Pierce's estimate of 5 m of offset on a landscape (deposits) estimated to be 140 ka. This assessment varies markedly with that presented by Wong and others (2000 #4484) who suggested fault slip rates of 0.2-6.0 mm/yr based on 15 m of offset of loess deposits (Love and Montagne, 1956 #2305) and associated glacial deposits (12-40 ka, Pinedale). However, the late Quaternary characteristics of this fault (overall poor geomorphic expression, poor continuity of scarps, age of faulted deposits, etc.) suggest that the slip rate during this period is of a lesser magnitude than the 0.4 mm/yr preferred value of Wong and others (2000 #4484). Accordingly, the <0.2 mm/yr slip-rate category has been assigned to this fault.

Length End to end (km): 18.2
Cumulative trace (km): 19.2

Average strike (azimuth): N40°W

References

#2306 Love, J.D., 1977, Summary of upper Cretaceous and Cenozoic stratigraphy, and of tectonic and glacial events in Jackson Hole, northwestern Wyoming, *in* Heisey, E.L., Lawson, D.E., Norwood, E.R., Wach, P.H., and Hale, L.A., eds., Rocky Mountain Thrust Belt; geology and resources: Wyoming Geological Association, Twenty-ninth Annual Field Conference, p. 585-593.

#2304 Love, J.D., and Albee, H.F., 1972, Geologic map of the Jackson quadrangle, Teton County, Wyoming: U.S. Geological Survey Miscellaneous Geologic Investigations I-769-A.
#2302 Love, J.D., and Love, C.M., 1978, Geologic map of the Cache Creek quadrangle, Teton County, Wyoming: U.S. Geological Survey Open-File Report 78-480, scale 1:24,000.
#2305 Love, J.D., and Montagne, J.M., 1956, Pleistocene and recent tilting of Jackson Hole, Teton County, Wyoming: Wyoming Geological Association Guidebook, Eleventh Annual Field Conference, 169-178 p.
#2297 Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot—Volcanism, faulting, and uplift, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds.,: Geological Society of America Memoir 171, p. 1-53.
#2303 Schroeder, M.L., 1974, Geologic map of the Camp Davis quadrangle, Teton county, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1160, scale 1:24,000.
#4462 Nelson, V.E., and Church, V., 1943, Critical structures of the Gros Ventre and northern Hoback Ranges, Wyoming: Journal of Geology, v. 51, p. 143-166.

773, Stagner Creek fault

Structure Number 773
Comments: Referred to as normal fault 10 (Stagner Creek) on figure 2-1 of Geomatrix Consultants (1988 #2973).

Structure Name Stagner Creek fault
Comments: The fault was mapped and named by Geomatrix Consultants (1988 #2973) for its proximity to Stagner Creek, a small stream that drains the south face of Stagner Mountain, which is about 50 km north of Riverton, Wyoming, and west of Boysen Reservior. The fault is along the southern margin of the Owl Creek and Bridger Mountains, on the northeastern margin of the Wind River valley. The fault probably extends from Mexican Pass (on the west) to Tough Creek (on the east) as shown by Geomatrix Consultants (1988 #2973).

Synopsis Although no detailed investigations have been made of this fault, reconnaissance studies indicate there has been latest Quaternary movement on the medial 27-km-long portion of the fault. The Stagner Creek fault is a north-northwest-striking fault that forms the southern margin of the Owl Creek uplift. Evidence for surficial deformation along the fault is distributed over a zone as wide as 3 km wide, south of the range front. Although the surficial geology and scarp morphology along the fault have been investigated, no paleoseismic investigations (i.e., trenching) have been performed. Detailed mapping and morphometric studies of scarps along the fault indicate a long period of recurrent movement during the Quaternary. The apparent slip rate is low (<0.2 mm/yr) and recurrence intervals between faulting events may be 8-22 k.y.

Date of compilation May 12, 1999

Compiler and affiliation Michael N. Machette, U.S. Geological Survey

State Wyoming

County Fremont

1° x 2° sheet Thermopolis

Province Wyoming Basin

Reliability of location Good
Comments: Trace of fault scarps and lineaments shown on detailed map (ca. 1:100,000 scale; figure 3-1) of Geomatrix Consultants (1988 #2973). Also shown in generalized form at 1:250,000 scale on plate 2 in Geomatrix Consultants (1988 #2973), and at 1:1,000,000 scale by Case and others (Case and others, 1997 #3449). Only the late Quaternary (medial) portion of the fault is shown; Quaternary displacement is not known for the distal portions of the underlying bedrock fault. Traces of fault scarps (and some linements) transferred from 1:100,000-scale map (fig. 3-1) in Geomatrix Consultants (1988 #2973) and fitted to 1:250,000-scale topographic base map

Scale of digital trace 1:250,000

Geologic setting This generally north-northwest-striking fault forms the southern margin of the Owl Creek uplift, which includes the Owl Creek and Bridger Mountains. The bedrock fault probably extends about 38 km, from Mexican Pass on the west to Tough Creek on the east (Geomatrix Consultants, 1988 #2973), although evidence of Quaternary displacement is only seen on the medial 27-km-long portion of the fault. The Owl Creek uplift, north of the fault, is primarily an asymmetric anticline bordered on the south by the South Owl Creek Mountains thrust (Laramide). The Stagner Creek fault is generally coincident with an unnamed bedrock fault mapped by Tourtelot and Thompson (1948 #3447). Surficial deformation along the fault is distributed over a zone as wide as 3 km west of Boysen Reservoir, and as a single scarp near Birdseye Creek, east of Boysen Reservoir.

Sense of movement Normal

Comments: Predominantly normal, down to the south movement as shown by the aspect of Quaternary fault scarps.

Dip not determined

Comments: Although no subsurface information exists, the linear trace suggests that the fault has a high-angle dip.

Dip direction S

Geomorphic expression A zone of nearly continuous small fault scarps, springs, and lineations are present 0.5 to 4.5 km south of the mountain front, with the majority of scarps being 2-3 km to the south of the mountain front. According to mapping of Geomatrix Consultants (1988 #2973), all but one of the dozen or so scarps face south and down-slope on the piedmont of the Owl Creek Mountains. Geomatrix Consultants (1988 #2973) studied most of the scarps, but only did detailed investigations of the surficial geology and scarp morphology at two locations: 1) Jewel Creek, near the east end of the fairly continuous ruptures 4 km west of Boysen Reservoir; and 2) Birdseye Creek, along an isolated scarp that marks the eastern end of the surficial rupture about 3 km east of Boysen Reservoir.
At Jewell Creek, Geomatrix Consultants' (fig. 3-7 in 1988 #2973) mapping shows scarps having as much as 2.3 m of cumulative net vertical displacement (NVD) on the oldest surficial deposit (Q1) and scarps with 0.5 m NVD on the youngest deformed surface (Q4). Intermediate amounts of displacement on units Q2 and Q3 yield convincing evidence for a long period of recurrent faulting at this study site.
At Birdseye Creek, Geomatrix Consultants' (fig. 3-4 in 1988 #2973) mapping shows scarps having as much as 2.2-2.3 m NVD on the two older surficial deposits (Q1, Q2) and scarps with 0.6 m NVD on the youngest deformed surface (Q4). These results are comparable to those at Jewell Creek, and substantiate their conclusion of a long period of recurrent movement along the fault. Scarp morphology studies at both sites reveal gentle scarp slopes (4.6°-7°) for the 1 m or higher scarps, and their analyses suggest latest Quaternary for their formation.

Age of faulted deposits Five ages of surficial deposits were mapped in two study areas (see discussion of geomorphic expression). These deposits range from Q1 of early(?) late Pleistocene (60-130 ka) age to Q5, which is considered to be of Holocene age (<10 ka). The faults cut units Q4 through Q1, with increasing (albeit small) amounts of cumulative displacement. Geomatrix Consultants (1988 #2973) compared soil properties from these deposits with dated glacial and outwash deposits to estimate numerical ages for deposits Q2-Q5. Although these soil ages have large inherent errors, they provide a reasonable basis for estimating times of surface stablization and placing limits on the times of faulting. Their estimates were as follows: unit Q2, 30-60 ka; unit Q3, 15-40 ka, and unit Q4, 8-20 ka. Unit Q5, which is no where disturbed by the Stagner Creek fault, was considered to be 1-7 ka (Holocene).

Paleoseismic studies none

Timing of most recent paleoevent Latest Quaternary (<15 ka)

Comments: The most recent movement was estimated to be younger than 8-20 ka (latest Pleistocene or early Holocene) on the basis of soil development on faulted unit Q2, and 4-12 ka on the basis of scarp morphology.

Recurrence interval 8-20 k.y. (<30-60 ka)

Comments: Geomatrix Consultants (1988, table 3-1 #2973) summary of displacements and age estimates from the Birdseye and Jewell Creek study areas was used to determine possible recurrence intervals for the fault. Inasmuch as 0.5-m-high scarps were found on the youngest (Q4) faulted surfaces, this value was used to calculate average recurrence intervals of about 8-20 k.y. (4-5 events for 2.2-2.3 m of offset on unit Q2 since 30-60 ka).

Slip-rate category <0.2 mm/yr

Comments: Geomatrix Consultants's (1988 #2973) summary of displacements and age estimates from the Birdseye Creek study area (table 3-1) yielded a variety of data that could be used to calculate slip rates. The net slip rates (using a 60° fault dip) ranged from 0.03 to 0.08 mm/yr, whereas the vertical (component only) slip rates were slightly less at 0.02-0.07 mm/yr. The long and short-term rates showed no particular trend, and thus a value of 0.05±0.03 mm/yr probably describes the probable late Quaternary slip rate for the Stagner Creek fault. These values were used to place the fault in the low slip-rate category of <0.2 mm/yr.

Length End to end (km): 27
Cumulative trace (km): 27.3

Average strike (azimuth): N77°W

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#3447 Tourtelot, H.A., and Thompson, R.M., 1948, Geology of the Boysen area, central Wyoming: U.S. Geological Survey Oil and Gas Investigations Preliminary Map 91, 2 sheets,.

774, Cedar Ridge fault

Structure Number 774

Comments: Referred to as normal fault 1 on figure 2-1 of Geomatrix Consultants (1988 #2973) and fault 191 of Witkind (1975 #819).

Structure Name Cedar Ridge fault

Comments: Named for Cedar Ridge, a low butte on the south side of Copper Mountain or a linear ridge on the south flank of the Bighorn Mountains. The portion of the fault with evidence for a young (Quaternary) trace is restricted to a 1.3-km-long scarp near East Fork Dry Creek, which is located about 22 km east of Boysen Reservoir and 25 km northeast of Shonshoni, Wyoming. This scarp was first recognized by Thaden (1980 #3443). It is a splay of an older, longer bedrock fault (the Cedar Ridge/Dry Fork fault system). The part of the fault that is discussed herein is equivalent to an unnamed fault (no. 191) of Witkind (1975 #819).

Synopsis This fault is part of a generally east-west striking, sinuous fault system that lies along the south flank of the Bridger and Bighorn Mountains. The Cedar Ridge fault probably extends about 56 km, from Copper Mountain on the west to Cedar Gap on the east (Geomatrix Consultants, 1988 #2973), where it is intersected by the Dry Fork fault (ca. 24-km long). Both faults are described as part of the 80-km-long Cedar Ridge/Dry Fork fault system, but only a small portion of the Cedar Ridge fault has conclusive evidence of Quaternary displacement. There is no evidence for Quaternary movement along the Dry Fork fault (Geomatrix Consultants, 1988 #2973), even though it lies in Dry Fork Badwater Creek, which is an extremely linear valley (Gard, 1969, unpublished #3466). Although the surficial geology and scarp morphology along the fault system have been investigated at three sites by (Geomatrix Consultants, 1988 #2973), no paleoseismic investigations (*i.e.*, trenching) have been performed along the Cedar Ridge fault.

Date of compilation May 12, 1999

Compiler and affiliation Michael N. Machette, U.S. Geological Survey

State Wyoming

County Fremont

1° x 2° sheet Arminto

Province Wyoming Basin

Reliability of location Poor
Comments: Trace of short (2.5 km) fault scarp (loc. J) from 1:250,000-scale map in Geomatrix Consultants (1988, pl. 2 #2973). Longer (pre-Quaternary) trace of Cedar Ridge/Dry Fork fault system is shown at 1:500,000 scale by Witkind (1975 #819) and at 1:1,000,000 scale by Case and others (1997 #3449). Trace of fault transferred to 1:250,000-scale topographic base map.

Scale of digital trace 1:250,000

Geologic setting The Cedar Ridge-Dry Fork fault system strikes east-west along the south flank of the Bridger and Bighorn Mountains (respectively) for about 80 km. Witkind (1975 #819) and Case and others (1997 #3449) showed the entire fault system as either late Cenozoic (Witkind) or having sections with evidence for Quaternary movement. The fault system has a moderately sinuous trace within a 3-km-wide zone of folded and faulted Tertiary rocks (Tourtelot, 1955 #3471). Keefer (1970 #3476) and Love (1978 #3444) both suggested that the Cedar Ridge fault may converge with the South Owl Creek Mountains (thrust) fault at depth, and thus be listric. The Cedar Creek fault was apparently active in the latest Early Eocene and initially had down-to-the-south normal displacement (Love, 1978 #3444). Miocene rocks along the fault are deformed by down-to-the-north displacement (Conel and others, 1984, cited in Geomatrix Consultants, 1988 #2980).

Sense of movement Normal
Comments:.

Dip not determined

Dip direction N

Geomorphic expression Evidence for Quaternary faulting is best displayed in the East Fork Dry Creek area (locality J of Geomatrix Consultants, 1988 #2973). Here, the fault forms a 1.3-km-long north-facing scarp that has 1.8- 2.1 m of normal surface displacement. This scarp is formed on a piedmont surface that is 36 m above local drainage—the highest surface in the immediate area. Lower geomorphic surfaces do not appear to be displaced along the projection of the fault. A 7-km long lineament in bedrock, both east and west of the scarp, shows no clear evidence for Quaternary movement, and this is probably the fault shown as no. 191 of Witkind(1975 #819).
At two other localities along the Cedar Ridge-Dry Fork fault system, Geomatrix Consultants (1988 #2973) found no conclusive evidence for Quaternary movement. At locality I, about 1 km southwest of Badwater, Wyoming, there is an east-west trending lineament marked by south-facing scarps, springs, and tonal contrasts (on aerial photographs). Geomatrix Consultants (1988 #2973) found no evidence for displacement of three Quaternary surfaces that cross the lineament, and thus concluded that the lineament is due to differential weathering in bedrock. At locality H, another lineament was also explained to be the result of differential weathering of resistant and nonresistant strata. Thus, of the three localities Geomatrix Consultants (1988 #2973) investigated, only the 1.3-km-long north-facing scarp (locality J) was found to be the result of Quaternary surface rupturing along the Cedar Ridge fault.

Age of faulted deposits The scarp at locality J is formed on a piedmont surface that is 36 m above local drainage (quite high), and is the highest surface in the immediate area. This surface is not preserved in many places, which may explain the absence of scarps elsewhere along the fault. Lower geomorphic surfaces do not appear to be displaced along the projection of the scarp. Conel and others (1984) (cited in Geomatrix Consultants, 1988 #2980) estimated the age of the highest surface along the Owl Creek Mountains as 0.5-1.0 Ma, and, based on the 36-m-high surface's expression, Geomatrix Consultants (1988 #2973) considered it to be at least several hundred thousands of years old. The offset piedmont surface has not been dated directly, but is herein considered to be of middle to early(?) Pleistocene age.

Paleoseismic studies none

Timing of most recent paleoevent Middle and late Quaternary (<750 ka)
Comments: Timing based on Geomatrix Consultants' (1988 #2973) minimum estimate of several hundred thousand years for the offset 36-m-high surface adjacent to East Fork Dry Creek (locality J).

Recurrence interval not determined

Slip-rate category not determined, probably <0.2 mm/yr

Comments: This fault is categorized as having a low-slip rate (<0.2 mm/yr) on the basis of only 1.8-2.1 m net vertical displacement of a probable middle Pleistocene piedmont surface.

Length End to end (km): 1.2
Cumulative trace (km): 1.2

Average strike (azimuth): N74°E

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#3466 Gard, T.M., 1969, unpublished, Tectonics of the Badwater uplift, central Wyoming: University Park, Pennsylvania, Pennsylvania State University, unpublished Ph. D. dissertation, 144 p.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants, I., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.

#3476 Keefer, W.R., 1970, Structural geology of the Wind River basin, Wyoming: U.S. Geological Survey Professional Paper 495-D, 35 p.

#3444 Love, J.D., 1978, Cenozoic thrust and normal faulting, and tectonic history of the Badwater area northeastern margin of Wind River Basin, Wyoming, *in* Boyd, R.G., ed. Resources of the Wind River Basin: Wyoming Geological Association, 30th Annual Field Conference, Casper, Wyoming, September 1978, Guidebook, p. 235-238.

#3443 Thaden, R.E., 1980, Geologic map of the Gates Butte quadrangle, showing chromolithofacies and coal beds in the Wind River Formation, Fremont County, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1538, 1 sheet, scale 1:24,000.

#3471 Tourtelot, H.A., 1955, Geology of the Badwater area, Wyoming: Oil and Gas Investigations Map OM 124, 2 sheets, scale 1:48,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

775, Leckie fault (Class B)

Structure Number 775

Comments: Referred to as normal fault 11 (Leckie) on figure 2-1 of Geomatrix Consultants (1988 #2973).

Structure Name Leckie fault (Class B)

Comments: Although mapped by Love and Christensen (1985 #2287), the fault was named by Geomatrix Consultants (1988 #2973) for its proximity to Leckie Ranch. The fault extends along the southwestern margin of the Wind River uplift, from near the East Fork River (on the northwest) to the northwest side of the Prospect Mountains (on the southeast) as shown by Case and others (1997 #3449).

Synopsis No detailed studies have been performed on this fault, which is considered to be of potential but unproven Quaternary age. The fault cuts Precambrian rocks and a thin veneer of Miocene(?) fanglomerate, with possible Quaternary displacement. Reconnaissance studies show no evidence (aerial or ground-based) for surface rupturing in the latest Quaternary. However, upper Pleistocene and Holocene deposits are not extensive in the area, thus making evaluation of the absence or presence of late Quaternary displacement uncertain. Likewise, on the basis of prominent lineaments, tectonic geomorphic features and associated scarps on both bedrock and the fanglomerate, we cannot preclude Quaternary movement. Thus, we consider the Leckie fault to be a Class B structure, until further studies show its of proven Quaternary age.

Date of compilation May 11, 1999

Compiler and affiliation Michael N. Machette, U.S. Geological Survey

State Wyoming

County Sublette

1° x 2° sheet Lander

Province Wyoming Basin

Reliability of location Good

Comments: Bedrock fault map is shown on plate 2 in Geomatrix Consultants (1988 #2973) at 1:250,000 scale. Also shown, in generalized fashion at 1:1,000,000 scale by Case and others (1997 #3449). Trace of fault (mainly inferred to be Quaternary) transferred and fitted to 1:250,000-scale topographic base map.

Scale of digital trace 1:250,000

Geologic setting This southeast-striking normal fault trends along the southwestern margin of the Wind River uplift and parallels its predominant structural grain. This uplift is 220 km long and about 40 km wide, forming the largest Laramide uplift in Wyoming (Steidtmann and others, 1983 #3456; Geomatrix Consultants, 1988 #2973). The uplift is a broad northwest-trending asymmetric anticline that has been thrust to the southwest over sedimentary rocks of the Green River basin along the Wind River thrust. The timing of initial deformation along the Leckie fault is not well known, but it may be related to the middle Miocene collapse of the Wind River uplift, which is documented by Steidtmann and Middleton (1986 #3453). Love and Christensen (1985 #2287) mapped the fault entirely within Precambrian rock, but Richmond (1983 #3457) showed displacement of Miocene(?) fanglomerate that may be a facies of the upper Miocene to middle Pliocene South Pass Formation. The Leckie fault is subparallel to, but northwest of, the Continental fault [776], which is known to be late Cenozoic and may have Quaternary (but not late Quaternary) movement.

Sense of movement Normal

Comments: Fault sense not well known, but Richmond (1983 #3457) noted normal displacement.

Dip not determined

Dip direction SW

Geomorphic expression The fault is marked by fault-related lineaments that extend about 20 km. They are associated with a narrow linear valley (graben) in Miocene(?) fanglomerate (Richmond, 1983 #3457), as well as with aligned stream valleys, topographic escarpments and saddles, springs, and deflected drainages (Geomatrix Consultants, 1988 #2973). West of Leckie Ranch, several distinct northwest-trending lineaments were identified by Richmond (1983 #3457). Geomatrix Consultants (1988 #2973) reported that the most prominent of these lineaments has an escarpment about 37 m high that faces southwest and trends perpendicular to the Big Sandy River (and thus is not a fluvial scarp). This escarpment forms the northeastern margin of Richmond's graben, and is aligned with several springs and linear stream valleys between the East Fork and Little Sandy Rivers. However, latest Quaternary colluvium and moraines (glacial deposits) at Muddy Lake along the escarpment are not deformed, which suggests that the fault has no latest Quaternary (<35 ka) displacement.

Age of faulted deposits Precambrian rock, Miocene(?) fanglomerate, and possibly pre-latest Quaternary surficial deposits, although these are sparse along the trend of the fault.

Paleoseismic studies none

Timing of most recent paleoevent Quaternary (<1.6 Ma)

Comments: Stratigraphic relations suggest displacement of fanglomerate that is mapped as Micoene(?) by Richmond (1983 #3457) (correlative to upper Miocene to middle Pliocene South Pass Formation). The geomorphology is suggestive of Quaternary displacement. The presence of a deep narrow graben, an escarpment as much as 37 m high, and strong control of stream drainages suggest continuing structural control by the Leckie fault. However, Geomatrix Consultants' (1988 #2973) reconnaissance found no strong evidence for late Quaternary displacement, and they precluded latest Quaternary faulting on the basis of undeformed sediment that lie across the fault. Thus, we consider the Leckie fault to be a Class B structure, until further studies show its of proven Quaternary age.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip-rate category assigned from lack of deformation of latest Quaternary glacial moraine and colluvial deposits.

Length End to end (km): 17
Cumulative trace (km): 17

Average strike (azimuth): N24W°

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2287 Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: State Geologic Map, 3 sheets, scale 1:500,000.

#3457 Richmond, G.M., 1983, Modification of glacial sequence along Big Sandy River, southern Wind River Range, Wyoming: Geological Society of America Abstracts with Programs, v. 15, no. 5, p. 431.

#3456 Steidtmann, J.R., McGee, L.C., and Middleton, L.T., 1983, Laramide sedimentation, folding, and faulting in the southern Wind River Range, Wyoming, *in* Lowell, J.D., ed., Rocky Mountain foreland basins and uplifts: Rocky Mountain Association of Geologists, p. 161-167.

#3453 Steidtmann, J.R., and Middleton, L.T., 1986, Eocene-Pliocene stratigraphy along the southern margin of the Wind River Range, Wyoming—Revisions and implications from field and fission-track studies: The Mountain Geologist, v. 23, no. 1, p. 19-25.

776, Continental fault (Class B)

Structure Number 776
Comments: Referred to as normal fault 4 (Continental) on figure 2-1 of Geomatrix Consultants (1988 #2973).

Structure Name Continental fault (Class B)
Comments: Although undocumented, the name of the fault appears to arise from its proximity to the Continental Divide or Continental Peak, both of which are astride the fault. The bedrock fault extends along the southwestern margin of the Wind River uplift, from near U.S. Highway 187 (on the northwest) to 5 km southeast of Picket Lake (on the southeast; as shown by Witkind (1975 #819) and Case and others (1997 #3449). Only the eastern 60 km of the fault is included herein on the basis of topographic expression, such as impounding of drainages. The western end of this part of the fault is taken as being at North Pacific Creek; the eastern end is as stated above.

Synopsis The fault is considered to be a late Cenozoic normal fault reactivation of an early Eocene tear fault bordering the southern margin of the Wind River thrust fault. This reactivation was in a down-to-the-northeast direction (reversal from previous sense) and may be related to the middle Miocene collapse of the Wind River uplift. Reconnaissance studies show no evidence (aerial or ground-based) for surface rupturing in the late Quaternary or Quaternary. However, some authors argue for Quaternary displacement on the basis of offset high-level terrace gravel and anomalous drainage patterns. No detailed studies have been performed on this fault that prove Quaternary movement. Thus, the fault is considered to be a Class B structure of potential, but unproven Quaternary age.

Date of compilation May 11, 1999

Compiler and affiliation Michael N. Machette, U.S. Geological Survey

State Wyoming

County Fremont, Sublette, Sweetwater

1° x 2° sheet Lander

Province Wyoming Basin

Reliability of location Good
Comments: Only the eastern 60 km of the fault is include herein on the basis of topographic expression and impounding of drainages. Trace from plate 2 in Geomatrix Consultants (1988 #2973) at 1:250,000 scale on a topographic base map. Also shown, in generalized fashion at 1:1,000,000 scale by Case and others (1997 #3449).

Scale of digital trace 1:250,000

Geologic setting This roughly 90-km-long, southeast-striking normal fault strikes along the southwestern margin of the Wind River uplift, which is about 220 km long and about 40 km wide and forms the largest Laramide uplift in Wyoming (Smithson and others, 1978 #3455; Geomatrix Consultants, 1988 #2973). The uplift is a broad northwest-trending asymmetric anticline that has been thrust to the southwest over sedimentary rocks of the Green River basin along the Wind River thrust. The initial deformation along the Continental fault is considered to be as a tear fault related to Laramide motion on the Wind River thrust, but the Continental fault appears to have been reactivated as a normal fault during the middle Miocene collapse of the Wind River uplift (Steidtmann and Middleton, 1986 #3453). The Continental fault is subparallel to, but southwest of, the Continental fault [775], which is known to be late Cenozoic and may have Quaternary (but not late Quaternary) movement.

Sense of movement Normal
Comments: Love and Keefer (1975 #2285) stated that the down-to-the-north (normal) displacement occurred largely during the Pliocene and Pleistocene. The vertical (post-Miocene) displacement ranges from 75-450 m (see table 2-1 in Geomatrix Consultants, 1988 #2973).

Dip not determined
Comments: Steep to the north, probably at high angle.

Dip direction NE

Geomorphic expression The fault is marked by a complex zone of sinuous, relatively continuous traces and straight, discontinuous traces (Steidtmann and others, 1983 #3456). Zeller and Stephens (1969 #3442) noted that a high gravel terrace (unknown age, presumed to be Quaternary) appears to be displaced. Love (see table 2-1 in Geomatrix Consultants, 1988 #2973) suggested that the low gradient and impounding of Pacific Creek, which flows parallel to Utah Highway 28 along the central part of the fault, may reflect Quaternary activity. However no geomorphic features such as scarps or lineations indicative of Quaternary activity were observed in seismotectonic studies by Anders and LaForge (1983 #836), Steidtmann (cited in Geomatrix Consultants, 1988 #2980), or by Geomatrix Consultants (1988 #2973).

Age of faulted deposits Zeller and Stephens (1969 #3442) noted that a high gravel terrace (unknown age, presumed to be Quaternary) appears to be displaced

Paleoseismic studies none

Timing of most recent paleoevent Quaternary (<1.6 Ma)
Comments: Witkind (1975 #819) and Case (1997 #3450) reported that the fault may be a late Cenozoic structure. The relatively continuous trace of the fault, anomalous drainage patterns, and apparent displacement of a high-level terrace deposit are suggestive of Quaternary displacement. However, reconnaissance studies by Anders and LaForge (1983 #836) and Geomatrix Consultants' (1988 #2973) and others found no geomorphic evidence for Quaternary or late Quaternary displacement (respectively). Thus, the fault is considered to be a Class B structure of potential but unproven Quaternary age.

Recurrence interval not determined

Slip-rate category not determined; probably <0.2 mm/yr
Comments: Low slip-rate category assigned on basis of lack of evidence of late Quaternary displacement.

Length End to end (km): 58.7
Cumulative trace (km): 90.0

Average strike (azimuth): N75°W

References

#836 Anders, M.H., and LaForge, R.C., 1983, Seismotectonic study for Big Sandy and Eden Dams Eden Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-5, 18 p.

#3450 Case, J.C., 1997, Earthquakes and active faults in Wyoming: Geological Survey of Wyoming Preliminary Hazard Report 97-2, 58 p.

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants, I., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.

#2285 Love, J.D., and Keefer, W.R., 1975, Geology of sedimentary rocks in southern Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 729-D, 60 p.

#3455 Smithson, S.B., Brewer, J., Kaufman, S., Oliver, J., and Hurich, C., 1978, Nature of the Wind River thrust, Wyoming, from COCORP deep-reflection data and from gravity data: Geology, v. 6, p. 648-652.

#3456 Steidtmann, J.R., McGee, L.C., and Middleton, L.T., 1983, Laramide sedimentation, folding, and faulting in the southern Wind River Range, Wyoming, in Lowell, J.D., ed., Rocky Mountain foreland basins and uplifts: Rocky Mountain Association of Geologists, p. 161-167.

#3453 Steidtmann, J.R., and Middleton, L.T., 1986, Eocene-Pliocene stratigraphy along the southern margin of the Wind River Range, Wyoming—Revisions and implications from field and fission-track studies: The Mountain Geologist, v. 23, no. 1, p. 19-25.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#3442 Zeller, H.D., and Stephens, E.V., 1969, Geology of the Oregon Buttes area Sweetwater, Sublette and Fremont Counties southwestern Wyoming: Geological Society of America Bulletin 1256, 58 p., 2 pls.

777, North Granite Mountains fault system (Class B)

Structure Number 777
Comments: Referred to as normal fault 3 on figure 2-1 of Geomatrix Consultants (1988 #2973) and fault 242 of Witkind (1975 #819).

Structure Name North Granite Mountains fault system (Class B)
Comments: Named for fault's location along the north margin of the Granite Mountains in central Wyoming. Called the North Granite Mountains fault system by Witkind (1975 #819) and most subsequent compilers (Geomatrix Consultants, 1988 #2973; Geomatrix Consultants, 1988 #2980; Case, 1997 #3450). The fault's western end is near Beaver Rim (30 km north-northwest of Jeffery City, Wyoming) and its eastern end is just west of Schrader Flats (about 10 km north of Alcova, Wyoming) as shown by (Geomatrix Consultants, 1988 #2980).

Synopsis This 95-110 km long east-west trending, south-dipping fault system is located along the north margin of the Granite Mountains within the Wyoming basin province of central Wyoming. Two episodes of movement have been documented. The first was near the end of the Eocene when the Granite Mountains were uplifted at least 3 km, and the second was during the Pliocene to Quaternary? when the fault was reactivated in the opposite sense (down-to-the-south), resulting in subsidence of the previously uplifted Precambrian-cored Sweetwater Arch (Granite Mountains). There has been a thorough reconnaissance of the fault and a detailed paleoseismic investigation at one location along its western half (section). These studies revealed no evidence for late Quaternary deformation on the western section of the fault, but could not preclude Quaternary deformation on the basis of discontinuous lineaments, springs, alignment of vegetation, and fault scarps. Thus, we include the western section as a Class B (suspected Quaternary) feature. Conversely, there is no evidence for Quaternary deformation along the eastern half (section) of the fault, and thus it is not discussed in this compilation.

Date of compilation May 19, 1999

Compiler and affiliation Michael N. Machette, U.S. Geological Survey

State Wyoming

County Fremont, Natrona

1° x 2° sheet Casper

Province Wyoming Basin

Geologic setting The North Granite Mountains fault trends east-west along the northern flank of the Granite Mountains. The fault system forms the southern margin of the Sweetwater Arch, a west-northwest-trending asymmetic Laramide-age anticline consisting of a steeply dipping southwestern limb and a gently dipping northeastern limb (Love, (1970 #3445). The central to western portion of the arch is comprised of Precambrian granite, which protrudes as knobs above Miocene to Pliocene sediment. The southern limb is comprised of the South Granite Mountains. After being buried by Eocene conglomerate, the arch started to subside via structural downwarping along the Split Mountain syncline and by normal displacement along the outward-bounding North and South Granite Mountain fault systems. Subsidence continued into the Pliocene, but Quaternary movement has only been documented on three sections of the South Granite Mountains fault system [779]. The system's east-west orientation and normal sense of movement are consistent with the north-south extensional stress regime proposed for the Wyoming foreland by Zoback and Zoback (1980 #176).

Number of sections 2
Comments: Geomatrix Consultants (1988 #2980) divided the fault into two portions: a western half that may be Quaternary (Class B), and an eastern half that is not Quaternary. We herein define these portions of the fault as sections, and name them the western and eastern sections, respectively. The western section [777a] is considered to be of potential Quaternary age and is described herein; the eastern section has no evidence of Quaternary movement and thus is not described herein.

Length End to end (km): 27.9
Cumulative trace (km): 37.9

Average strike (azimuth): N82°E

777a, North Granite Mountains fault, western section (Class B)

Section number 777a

Section name Western section (Class B)
Comments: On the basis of Geomatrix Consultants' (1988 #2980) mapping, this section is taken as being the western part of the North Granite Mountains fault between West Muskrat Basin (sec. 6, T. 31 N., R. 91 W., about 2 km west of the Dry Lakes), east to the East Fork of Sage Hen Creek (sec. 36, T. 32 N., R. 89 W.).

Reliability of location Poor
Comments: Trace based on western part of mapped fault system as shown at about 1:140,000 scale in fig. 4-1 by (Geomatrix Consultants, 1988 #2980). This is a generalization from that shown by Love and others (1979 #3470) and Love and Christiansen (1985 #2287). Geomatrix Consultants (1988 #2980) also showed the fault and older structures at 1:250,000 scale (plate 2) with a topographic-base. The fault is shown in generalized fashion at 1:500,000 scale by Witkind (1975 #819) and Geomatrix Consultants (1988 #2980), and at 1:1,000,000 scale by Case and others (Case and others, 1997 #3449). Trace of fault transferred from 1:140,000-scale map to 1;250,000-scale topographic base map.

Scale of digital trace 1;250,000

Sense of movement N

Comments: Down to the south in Pliocene to Quaternary time; in Eocene, movement was in opposite sense (down-to-the-north) (Love, 1970 #3445). However, some scarps near the Dry Lakes have north-facing scarps, which may imply down-to-the-north movement.

Dip not determined

Comments: According to Love (Love, 1970 #3445), the dip appears nearly vertical.

Dip direction S

Geomorphic expression There is no evidence for deformation of late Quaternary alluvial-fan or terrace deposits along this fault section. However, Geomatrix Consultants (1988 #2980) found many discontinuous lineaments with low scarps, breaks in slope, springs and vegetation lines. They investigated these features in the field and found them to be associated with bedrock faulting. Thus, although no evidence was found for late Quaternary displacement, we suspect that there could be (older) Quaternary displacement along this section of the fault.

Age of faulted deposits No evidence for late Quaternary deformation (Geomatrix Consultants, 1988 #2980), but Quaternary faulting may be present as evidenced by fault-related lineaments along most of the fault section.

Paleoseismic studies Site 777a-1: The Dry Lakes locality. Two excavations, an exploratory trench and a soil pit, were made to examine subsurface materials at The Dry Lakes locality (see fig. 4-1 in Geomatrix Consultants, 1988 #2980). This site contains two closed depressions that are located near the western end of the North Granite Mountains fault. The depressions appear to be eolian deflation basins, but they are associated with nearby east-west trending lineaments south of the main fault. A low north-facing scarp to the east of the largest of the Dry Lakes has been enhanced by fluvial erosion. Geomatrix Consultants (see fig. 4-3 in 1988 #2980) excavated a 52-m-long exploratory trench across this scarp to investigate the possibility that it is related to faulting. Stratigraphic units exposed in the trench indicate that there has been no displacement of these units. However, joints exposed in indurated pebble gravel (Miocene? and Oligocene? conglomerate), both in the trench and in adjacent outcrops, are the likely cause of the east-west trending lineaments in the vicinity of The Dry Lakes. On the basis of the trenching and soil age estimates, Geomatrix Consultants (1988 #2980) concluded that there has been no late Pleistocene or Holocene displacement across lineaments associated with the western section of the North Granite Mountains fault.

Timing of most recent paleoevent Quaternary (<1.6 Ma)

Comments: No evidence for late Quaternary (<130 ka) movement on this section of the fault, but we suspect that there may be Quaternary faulting as evidenced by fault-related lineaments along most of the fault section.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr

Comments: Low slip-rate category is inferred by compiler on basis of a lack of late Quaternary faulting of alluvial-fan or terrace deposits along the section.

Length End to end (km): 27.9
Cumulative trace (km): 37.9

Average strike (azimuth): N82°E

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants Inc., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants Inc., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.
#3445 Love, J.D., 1970, Cenozoic geology of the Granite Mountain area, central Wyoming: U.S. Geological Survey Professional Paper 495-C, 154 p., 10 pls.
#2287 Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: State Geologic Map, 3 sheets, scale 1:500,000.
#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.
#176 Zoback, M.L., and Zoback, M., 1980, State of stress in the conterminous United States: Journal of Geophysical Research, v. 85, no. B11, p. 6113-6156.

778, Split Rock syncline (Class B)

Structure Number 778

Structure Name Split Rock Syncline (Class B)

Comments: Named for Split Rock, a low bedrock knob about 3.5 km northeast of U.S. Highway 287 and 15 km northwest of Three Forks, Wyoming. The name Split Rock is used for a variety of features (ranch and mill) in the area. As shown by Geomatrix Consultants (1988 #2973), the trace of the syncline extends from near Gull Canyon at a point 8 km south of Sweetwater Station (on the west), to the Arkansas Basin at a point about 10 km north of the east end of the Ferris Mountains (on the east).

Synopsis Some indirect evidence exists for continued Quaternary folding along this syncline. The main evidence for Quaternary deformation is based on anomalous drainage patterns. The syncline was formed during the Miocene and peaked in intensity (of folding) in the Pliocene to early Quaternary. No detailed investigations have been made of this syncline.

Date of compilation May 20, 1999

Compiler and affiliation Michael N. Machette, U.S. Geological Survey

State Wyoming

County Carbon, Fremont

1° x 2° sheet Lander, Casper

Province Wyoming Basin

Reliability of location Poor

Comments: The trace of the syncline is poorly defined and based on a reconnaissance map (plate 2) by Geomatrix Consultants (1988 #2973) of the Wyoming Basin at 1:250,000 scale with topographic base. General position is controlled by drainage anomalies and bedding attitudes of pre-Quaternary rock or sediment, hence it is shown as concealed. The syncline was not shown on other regional or state maps at 1:500,000 scale by Witkind (1975 #819) and Geomatrix Consultants (1988 #2980), and at 1:1,000,000 scale by Case and others (1997 #3449).

Scale of digital trace 1:250,000

Geologic setting The Split Rock syncline is long, gently curving asymmetric downwarp that extends north of but subparallel to the South Granite Mountains fault system [779] and along the south side of the Sweetwater Arch. The syncline is about 125 km long and as much as 45 km wide (Love, 1970 #3445). It skirts the northern margins of Crooks Mountain (on the west), the Green Mountains, and the Ferris Mountains (on the east). Its spatial relation with the South Granite Mountains fault system [779] implies a causal relationship, although this has not been proven.

Sense of movement Syncline

Dip (of limbs)

Comments: Axis of fold is generally west-east and south limb is more steeply dipping than north limb.

Dip direction N-S (limbs)

Geomorphic expression Forms gentle fold that controls local drainages. The main evidence for its existence as a Quaternary structure is based on drainage patterns. Many streams flowing north from

Crooks Mountain and the Green Mountains empty into internally drained basins south of the Sweetwater River rather than flowing into the river (Love, cited in Geomatrix Consultants, 1988 #2973). Love interpreted this relationship as showing that the tributary drainages have been influenced by Quaternary deformation (subsidence) of the Split Rock syncline. However, a contrarian position is taken by Geomatrix Consultants (1988 #2980) and Cheryl Jaworowski (written commun., 2000). They argue that the unusual drainage pattern is a result of stream infiltration into underlying poorly consolidated Miocene sandstone and overlying Quaternary deposits and from impoundment by discontinuous eolian deposits that flank the Sweetwater River. On the basis of these contrasting interpretations, we consider the Split Rock syncline to be a suspect, but unproven Class B (Quaternary?) structure.

Age of faulted deposits Miocene and Pliocene rock and (presumably) early Quaternary sediment.

Paleoseismic studies none

Timing of most recent paleoevent Quaternary (<1.6 Ma)

Comments: Based on unusual Quaternary drainage patterns that are inferred to be the result of Quaternary folding.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr

Comments: A slow uplift (or subsidence) rate is inferred by compiler on the basis possible pre-Quaternary movement, on activity rates for other late Quaternary faults in the region and slip rate on the South Granite Mountains fault system [779], which may be spatially related to the syncline.

Length End to end (km): 75.2
Cumulative trace (km): 77

Average strike (azimuth): N82°W

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants, I., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.

#3445 Love, J.D., 1970, Cenozoic geology of the Granite Mountain area, central Wyoming: U.S. Geological Survey Professional Paper 495-C, 154 p., 10 pls.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

779, South Granite Mountains fault system

Structure Number 779
Comments: Referred to as normal fault 3 on figure 2-1 of Geomatrix Consultants (1988 #2973) and fault 242 of Witkind (1975 #819).

Structure Name South Granite Mountains fault system
Comments: Named for its location south of the Granite Mountains. However, the fault is in fact much closer to the mountain chain formed by the Green, Ferris, and Seminoe Mountains, which it borders on their north sides. The fault system is defined by Geomatrix Consultants (1988 #2980) as having five sections; the western end of the system is near Alkali Creek on the western end of the Crook Mountains and the eastern end is at Saylor Creek, north of Horseshoe Ridge at the eastern end of the Seminoe Mountains.

Synopsis This 125-km-long, west-northwest trending, north-dipping fault system is located along the north margin of a low chain of anomalous west-northwest-trending mountain ranges within the Wyoming Basin province of central Wyoming. Two episodes of movement have been documented on the fault system. The first was near the end of the Eocene when the Granite Mountains (to the north) were uplifted at least 3 km, and during the Pliocene to Quaternary when the fault system was reactivated in the opposite sense (down-to-the-north) resulting in subsidence of the previously uplifted Precambrian-cored Sweetwater Arch. Part of this subsidence was accommodated by the Split Rock syncline [778], which lies north of the South Granite Mountains fault system. There has been a thorough reconnaissance of the fault system and detailed paleoseismic investigations at two locations along its middle portion. This study revealed clear evidence for Quaternary deformation on the three central faults (sections) of the system, but Quaternary deformation has not been proven for the distal sections (Class B structures). Pleistocene to Holocene displacement was found in the Green Mountain and Ferris Mountains areas, and minor Quaternary displacement was found in the Muddy Gap area. However, all five sections are considered to be of potential Quaternary age because of the prevalence of lineaments, springs, alignment of vegetation and fault scarps. Trenching has shown that a displacement of about 0.5 m (net vertical) is typical of the average surface-rupturing event on the Ferris Mountains section of the fault system. In addition, using reported average to maximum displacement ratios for historic faulting events, they proposed that the active (late Quaternary) sections of the South Granite Mountains fault system might have a maximum surface faulting event of 1-1.5 m displacement.

Date of compilation May 17, 1999

Compiler and affiliation Michael N. Machette, U.S. Geological Survey

State Wyoming

County Carbon, Fremont

1° x 2° sheet Casper, Lander

Province Wyoming Basin

Geologic setting The South Granite Mountains fault system trends west-northwest along the northern flanks a chain of low mountain ranges comprised of Crooks Mountain (on the west), the Green Mountains, Ferris Mountains, and Seminoe Mountains (on the east). The fault system forms the southern margin of the Sweetwater Arch, a west-northwest-trending asymmetic Laramide-age anticline consisting of a steeply dipping southern limb and a gently dipping northern limb (Love, 1970 #3445). The central to western portion of the arch is comprised of Precambrian granitic knobs that protrude above Miocene to Pliocene sediment. The southern limb is comprised of the South Granite Mountains. After being buried by conglomerate in the Eocene, the arch started to subside via structural downwarping along the Split Mountain syncline and by normal displacement along the North and South Granite Mountain fault systems. Subsidence continued into the Pliocene, but Quaternary movement has only been documented on portions of the South Granite Mountains fault system. The system's east-west orientation and normal sense of movement are consistent with the north-south extensional stress regime proposed for the Wyoming foreland by Zoback and Zoback (1980 #176)(1980).

Number of sections 5

Comments: Geomatrix Consultants (1988 #2980) defined five segments (herein considered as sections) for the South Granite Mountains fault system. From west to east, these are the Crooks Mountain [779a], Green Mountains [779b], Muddy Gap [779c], Ferris Mountains [779d] and Seminoe Mountains [779e] sections. Quaternary movement (Class A structures) has been documented in the Green Mountain area, along the Ferris Mountains, and in the Muddy Gap area. As such, only these three sections are described in detail; the Crooks Mountain (779a) and Seminoe Mountains [779e] sections are considered to be of Class B (potential Quaternary) structures, pending further investigations.

Length End to end (km): 132.5
Cumulative trace (km): 197.8

Average strike (azimuth): N72°W

779a, Crooks Mountain section (Class B)

Section number 779a

Section name Crooks Mountain section (Class B)
Comments: Named for Crooks Mountain. All but the western 7 km of this section is along the northern side of Crooks Mountain. Geomatrix Consultants (1988 #2980) defined the eastern end of this north-northwest trending fault section as at the break between the Green Mountains and Crooks Mountain structural blocks. The western end of the section is slightly east of the Sweetwater River. As such, Geomatrix Consultants (1988 #2980) reported the section to be 34 km long.

Reliability of location Poor
Comments: Trace based on map of entire fault system (fig. 3-1) at about 1:330,000 scale Geomatrix Consultants (1988 #2980). This trace is a generalization from Love and others (1979 #3470) and Love and Christiansen (1985 #2287). Trace transferred from 1:330,000-scale map of Geomatrix Consultants (1988 #2980) to 1:250,000-scale map with topographic-base, Geomatrix Consultants (1988 #2980) also showed the fault and older structures at 1:250,000 scale map (plate 2) with topographic-base. The fault is shown in a generalized fashion at 1:500,000 scale by Witkind (1975 #819) and Geomatrix Consultants (1988 #2980), and at 1:1,000,000 scale by Case and others (1997 #3449).

Scale of digital trace 1:250,000

Sense of movement N
Comments: Down to the north in Pliocene to Quaternary time; in Eocene, movement was in opposite (down-to-the-south) sense (Love, 1970 #3445). Love (1970 #3445) suggested a minimum post-Miocene displacement of 650 m for the fault system.

Dip not determined
Comments: Appears to dip steeply (Love, 1970 #3445).

Dip direction N

Geomorphic expression There is no evidence for deformation of late Quaternary alluvial-fan or terrace deposits along this fault section. However, a few lineaments defined by breaks in slope and vegetation lines were identified along all but the western 7 km of the fault section during photogeologic studies by Geomatrix Consultants (1988 #2980). They investigated these features in the field and found them to be associated with bedrock faulting. Thus, we cannot preclude or prove Quaternary displacement along this section of the fault. This section is considered to be a Class B feature, pending further study.

Age of faulted deposits None reported.

Paleoseismic studies none

Timing of most recent paleoevent Quaternary (<1.6 Ma)
Comments: No evidence for late Quaternary deformation (Geomatrix Consultants, 1988 #2980), but Quaternary faulting may be present as evidenced by fault-related lineaments along most of the fault section. This section is considered to be a Class B feature, pending further study.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr

Comments: Low slip-rate category is inferred by compiler on basis of a lack of late Quaternary faulting of alluvial fan or terrace deposits along the section.

Length End to end (km): 33.6
Cumulative trace (km): 46.3

Average strike (azimuth): N73°W

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants, I., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.

#3445 Love, J.D., 1970, Cenozoic geology of the Granite Mountain area, central Wyoming: U.S. Geological Survey Professional Paper 495-C, 154 p., 10 pls.

#2287 Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: State Geologic Map, 3 sheets, scale 1:500,000.

#3470 Love, J.D., Christiansen, A.C., Earle, J.L., and Jones, R.W., 1979, Preliminary geologic map of the Casper 1° x 2° quadrangle central Wyoming: U.S. Geological Survey Open-File Report 79-961, 13 p., 1 pl., scale 1:250,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#176 Zoback, M.L., and Zoback, M., 1980, State of stress in the conterminous United States: Journal of Geophysical Research, v. 85, no. B11, p. 6113-6156.

779b, Green Mountains section

Section number 779b

Section name Green Mountains section
Comments: Named for the fault's proximity to the Green Mountains. This section of the fault extends west-northwest for roughly 23-km along the north margin of the Green Mountains from Crooks Creek on the west to Willow Creek on the east (Geomatrix Consultants, 1988 #2980). This section coincides with the Green Mountains block, which includes the Owl Hills on the north, Whiskey Peak on the east, and Sheep Mountains on the west.

Reliability of location Poor
Comments: Trace based on map of entire fault system (fig. 3-1) at about 1:330,000 scale by Geomatrix Consultants (1988 #2980) with modifications based on Geomatrix Consultants (1988 #2980) 1:250,000 scale map (plate 2). This trace is a generalization from Love and others (1979 #3470) and Love and Christiansen (1985 #2287). For this database, the trace was transferred to a 1:250,000-scale map with topographic-base. The fault is also shown in generalized fashion at 1:500,000 scale by Witkind (1975 #819) and Geomatrix Consultants (1988 #2980), and at 1:1,000,000 scale by Case and others (1997 #3449). Detailed maps of the fault section are included in Fig. 3-15 (1:100,000 scale) by Geomatrix Consultants (1988 #2980) and in Jaworowski's thesis (1985 #3452) at 1:24,000 scale.

Scale of digital trace 1:250,000

Sense of movement N
Comments: Down to the north in Pliocene to Quaternary time; in Eocene, movement was in opposite (down-to-the-south) sense (Love, 1970 #3445). Love (1970 #3445) suggested a minimum post-Miocene displacement of 650 m for the fault system.

Dip not determined
Comments: Appears to dip steeply (Love, 1970 #3445).

Dip direction N

Geomorphic expression The western (10-km long) portion of the section does not have fault scarps or lineaments indicative of Quaternary faulting, but is included in the section because it is a part of the larger Green Mountains structural block. However, the eastern part of the section is characterized by fault-related features such as scarps, topographic saddles, springs and vegetation lines (see Jaworowski, 1985 #3452). Along this eastern part of the fault (18 km-long), two study areas were studied in detail by Geomatrix Consultants (1988 #2980).

A) West Cottonwood Creek to Copper Creek. In this area, the range bounding fault is defined by aligned springs and vegetation lineaments, and small discontinuous scarps at several locations. A remnant of a high-level (middle Pleistocene) piedmont gravel is displaced by two faults that have minor offset (about 1 m of net vertical). Younger (late Quaternary) surfaces that cross the trace of the range-front fault are not displaced. At McIntosh Ranch, about 5 km north of the range front fault (Owl Hills), there are scarps on late Quaternary and older surfaces. These scarps are present for a distance of about 3 km, to the east and west the ranch (along Middle Cottonwood Creek). The scarps are typically 1-2 m high, form en echelon traces and a graben, but were not profiled by Geomatrix Consultants (1988 #2980) for morphometric analysis.

B) Copper Creek to Willow Creek. This area includes the easternmost evidence for faulting in the Green Mountains section. Numerous short, subparallel lineaments here are defined by aligned springs, vegetation lines and fault scarps. At the eastern end of the section, the fault seems to splay into multiple (five?) scarps that are preserved on mudflow deposits: vertical displacements for these scarps is less than 1 m. A prominent fault scarp is preserved on five different-aged stream terraces at Grieves' Ranch, in the vicinity of Copper Creek. The scarps range from 26 m in height on the oldest (Q2g) profiled surface, to 6.6 m in height on the youngest (Q6g) deformed surface. All of these scarps, including the smallest (4.1 m offset) are the product of multiple, late to middle Pleistocene faulting events. This site was chosen by Geomatrix Consultants (1988 #2980) for detailed investigation using surficial mapping, topographic profiling, and excavation and analysis of five soil pits and one exploratory trench (see detailed studies [site 779b-1]).

Age of faulted deposits Although undated, Geomatrix Consultants (1988 #2980) made a six-fold subdivision of surficial units at the two study areas. Unit Q1g is the oldest and is faulted an undetermined amount. Units Q2g (older) through Q6g (youngest) are faulted from 20.5 to 4.1 m, showing a predictable increase in displacement with relative age. On the basis of soil development, assumptions that the terraces are related to early or late phases of glacial cycles (Jaworowski, 1985 #3452), and comparisons with dated sequences elsewhere in the Rocky Mountains province, Geomatrix Consultants (1988 #2980) made the following age estimates for the three younger faulted units: Q4g, >190 ka (pre-Bull Lake); Q5g, 90-190 ka (Bull Lake); and Q6g, 15-40 ka (Pinedale). Ages estimates (other than relative) were not made for the older units (Q1g, Q2g, and Q3g) owing to erosion or lack of exposure.

Paleoseismic studies Site 779b-1 Grieves' Ranch area. A single exploratory trench (GR-1) was excavated across the fault scarp on unit Q6g, about 50-60 m west of Copper Creek near Grieves' Ranch. At this site, the surface of Q6g is about 5 m above the creek on the uplifted block, and about 2 m above the creek on the downthrown (northern) block. Unit Q6g is the youngest faulted deposit at Grieves' Ranch: it forms a 150-200 m wide terrace (ancient floodplain) on both sides of the creek. Topographic profiling indicated a scarp height of about 6.6 m on Q6g that is associated with about 4.1 m of vertical surface offset. The maximum scarp-slope angle is only 8°, which is relatively gentle for a 4-m high (multiple-event) scarp. Trench GR-1 penetrated the surface of unit Q6g, which is composed of fine- and coarse-grain fluvial deposits that fill a channel over sheared bedrock. Charcoal from about 1.8 m depth in the trench yielded an age of 29.3 ka, which supports Geomatrix Consultants (1988 #2980) estimate of a 15-40 ka (Pinedale) for unit Q6g. There was no evidence of deformation of the fluvial or overlying fine-grained deposits, but the vertical to overturned attitude of the sheared bedrock suggested faulting of the basal surficial deposits. Geomatrix Consultants (1988 #2980) suggested that the younger, scarp-forming fault is down slope from trench GR-1, which seems to be a reasonable inference. However, this proposed fault has not been confirmed. Thus, the trench did not reveal any direct evidence for the timing or amounts of individual faulting events at this site.

Timing of most recent paleoevent Latest Quaternary (<15 ka)

Comments: Although not explicitly stated by Geomatrix Consultants (1988 #2980), we believe that the Grieves' Ranch study suggested that the most recent faulting event occurred in the latest Pleistocene. Clearly, deposits that are 15-40 ka (and at the trench, <29.3 ka) are faulted, and the associated scarp has about 4 m of net vertical offset. If this offset occurred in 2 or more events, if seems reasonable to infer that the most recent event was <15 ka, which is the younger age estimate for the Q6g surface. Although considered to be late Quaternary (<130 ka) by Geomatrix Consultants (1988 #2980), we characterize the most recent event as latest Pleistocene or Holocene for this database.

Recurrence interval not determined

Comments: There are no data on the number or amount of past displacements on the Green Mountain section. However, Geomatrix Consultants (1988 #2980) calculated recurrence intervals of 4.5 k.y. to >12 k.y. for a Ms 6.5-6.75 earthquake using a moment-rate approach.

Slip-rate category <0.2 mm/yr

Comments: Geomatrix Consultants (1988 #2980) calculated slip rates based on displacements and estimated ages of surfaces in the Grieves Ranch study area (see detailed studies), although there are no data on the number or amount of individual displacement events on the Green Mountain section. Their rates (see their table 6-3) range from a minimum dip slip of 0.05-0.15 mm/yr to a maximum dip slip of 0.11-0.35 mm/yr (assumes pure normal dip slip on a 60° fault plane). They concluded that the average net slip rate on the section is probably between 0.1 and 0.2 mm/yr. These rates are slightly more than those calculated for the Ferris Mountains section [779d].

Length End to end (km): 24.3
Cumulative trace (km): 61.9

Average strike (azimuth): N79°W

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants, I., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.

#3452 Jaworowski, C.C., 1985, Geomorphic mapping and trend analysis of Quaternary deposits with implications for late Quaternary faulting, central Wyoming: Laramie, Wyoming, University of Wyoming, unpublished Masters thesis, 109 p.

#3445 Love, J.D., 1970, Cenozoic geology of the Granite Mountain area, central Wyoming: U.S. Geological Survey Professional Paper 495-C, 154 p., 10 pls.

#2287 Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: State Geologic Map, 3 sheets, scale 1:500,000.

#3470 Love, J.D., Christiansen, A.C., Earle, J.L., and Jones, R.W., 1979, Preliminary geologic map of the Casper 1° x 2° quadrangle central Wyoming: U.S. Geological Survey Open-File Report 79-961, 13 p., 1 pl., scale 1:250,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#176 Zoback, M.L., and Zoback, M., 1980, State of stress in the conterminous United States: Journal of Geophysical Research, v. 85, no. B11, p. 6113-6156.

779c, Muddy Gap section

Section number 779c

Section name Muddy Gap section
Comments: Named for Muddy Gap (a geographic feature and small town) along U.S. Highway 287. The section extends west-northwest along the northern side of the Red Hills and western portion of the Ferris Mountains. Geomatrix Consultants (1988 #2980) defined the eastern end of the section as being just west of Cherry Creek (see section 779d) where there is an abrupt change in orientation of the northern front of the Ferris Mountains. The western end of the section is at the eastern end of the Green Mountains block, east of Willow Creek (see section 779b). As such, Geomatrix Consultants (1988 #2980) reported the section as 23 km long.

Reliability of location Poor
Comments: Trace based on map of entire fault system (fig. 3-1) at about 1:330,000 scale by Geomatrix Consultants (1988 #2980), (1988 #2980) with modifications based on Geomatrix Consultants (1988 #2980) 1:250,000 scale map (plate 2). The trace was transferred to 1:250,000-scale map with topographic-base for digitizing. This trace is a generalization from Love and others (1979 #3470) and Love and Christiansen (1985 #2287). The fault is shown in generalized fashion at 1:500,000 scale by Witkind (1975 #819) and Geomatrix Consultants (1988 #2980), and at 1:1,000,000 scale by Case and others (1997 #3449).

Scale of digital trace trace 1:250,000

Sense of movement N
Comments: Down to the north in Pliocene to Quaternary time; in Eocene, movement was in opposite (down-to-the-south) sense (Love, 1970 #3445). Love (1970 #3445) suggested a minimum post-Miocene displacement of 650 m for the fault system.

Dip not determined
Comments: Appears to dip steeply (Love, 1970 #3445).

Dip direction N

Geomorphic expression Discontinuous low fault scarps are present for a few kilometers at the eastern end of the section. The scarp heights decrease to the west, and along the westernmost part of the northern flank of the Ferris Mountains, the trace of the fault is only defined by topographic breaks in slope. From the Ferris Mountains west toward Muddy Gap, there are numerous lithologic (bedrock) lineaments formed by near vertical strata that strike northwest parallel to the fault (Geomatrix Consultants, 1988 #2980). There is no evidence for deformation of late Quaternary alluvial-fan or terrace deposits along the central and western portion of this fault section.

Age of faulted deposits There is no evidence for deformation of late Quaternary deposits along the central and western portion of the fault section, but Geomatrix Consultants (1988 #2980) could not preclude Quaternary faulting owing to the presence of fault-parallel lineaments. Ages of displaced deposits at the eastern end of the section are not cited by Geomatrix Consultants (1988 #2980).

Paleoseismic studies none

Timing of most recent paleoevent Quaternary (<1.6 Ma)
Comments: No late Quaternary faulting has occurred on alluvial fan or terrace deposits along western and central portions of section but there are discontinuous low fault scarps along eastern portion of section. As such, the section is best characterized as having Quaternary movement.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: Low slip rate is inferred by compiler on basis of a lack of late Quaternary faulting of alluvial fan or terrace deposits along western and central portions of section and presence of discontinuous low fault scarps along eastern portion of section. However, if the section boundary is in error, these eastern scarps may be related to the moderately active Ferris Mountains section [779d] rather than the relatively inactive Muddy Gap section [779c].

Length End to end (km): 21.3
Cumulative trace (km): 27.6

Average strike (azimuth): N64°W

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants, I., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.

#3445 Love, J.D., 1970, Cenozoic geology of the Granite Mountain area, central Wyoming: U.S. Geological Survey Professional Paper 495-C, 154 p., 10 pls.

#2287 Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: State Geologic Map, 3 sheets, scale 1:500,000.

#3470 Love, J.D., Christiansen, A.C., Earle, J.L., and Jones, R.W., 1979, Preliminary geologic map of the Casper 1° x 2° quadrangle central Wyoming: U.S. Geological Survey Open-File Report 79-961, 13 p., 1 pl., scale 1:250,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#176 Zoback, M.L., and Zoback, M., 1980, State of stress in the conterminous United States: Journal of Geophysical Research, v. 85, no. B11, p. 6113-6156.

779d, Ferris Mountains section

Section number 779d

Section name Ferris Mountains section
Comments: Named for the fault's proximity to the Ferris Mountains. This section of the fault extends roughly 18 km long in a west-northwest direction along the north margin of the Ferris Mountains, from Cherry Creek on the west to Sand Creek Canyon on the east (Geomatrix Consultants, 1988 #2980). This section coincides with the eastern end of the Ferris Mountains, whereas the western end corresponds with a distinct change in the trend of the mountain front.

Reliability of location Poor
Comments: Trace based on map of entire fault system (fig. 3-1) at about 1:330,000 scale by Geomatrix Consultants (1988 #2980) with modifications based on Geomatrix Consultants (1988 #2980) 1:250,000 scale map (plate 2). This modified trace was transferred to 1:250,000-scale map with topographic-base, and then digitized. The 1:330,000 scale trace is a generalization from Love and others (1979 #3470) and Love and Christiansen (1985 #2287). The fault is shown in generalized fashion at 1:500,000 scale by Witkind (1975 #819) and Geomatrix Consultants (1988 #2980), and at 1:1,000,000 scale by Case and others (1997 #3449). A detailed (1:100,000 scale) map of the fault section is included in Fig. 3-2 by Geomatrix Consultants (1988 #2980).

Scale of digital trace 1:250,000

Sense of movement N
Comments: Down to the north in Pliocene to Quaternary time; in Eocene, movement was in opposite (down-to-the-south) sense (Love, 1970 #3445). Love (1970 #3445) suggested a minimum post-Miocene displacement of 650 m for the fault system.

Dip not determined
Comments: Appears to dip steeply (Love, 1970 #3445).

Dip direction N

Geomorphic expression Along the eastern part of the section, the expression of the fault is one of discontinuous aligned springs and associated vegetation lineaments. Along the western part of the section, the fault is expressed as nearly continuous fault scarps for about 13 km. These fault scarps face north and have vertical surface displacements of about 1-6 m and associated heights of 3-13 m. The scarps are formed on several different-aged geomorphic surfaces that Geomatrix Consultants (1988 #2980) was unable to confidently correlate to other regions. Along this western part of the section, the following three study areas were studied in detail by Geomatrix Consultants (1988 #2980).

A) Cherry Creek (west end of section). This area, characterized by nearly continuous alignment of north-facing scarp, was selected for detailed fault investigations (including trenching, see below Site 779d-1). The faults cut at least three different-aged geomorphic surfaces. The oldest surface (Q1c) has about 4.3 m of displacement, a scarp height of 9.2 m and a 23° maximum slope angle; surface Q2c has about 1.4 m of displacement, a scarp height of 3.8 m and a 23° maximum slope angle; and surface Q3c has scarps with 0.4-1 m of displacement and 13°-15° maximum slope angles on relatively steep alluvial-fan surfaces. The youngest mapped surface (Q4c) is not deformed. No estimates of fault timing were made from these data, but the data show conclusively that the fault has had recurrent activity in middle to late Quaternary time.

B) Pete Creek (west part of section, 6 km west of C). At least three different-aged geomorphic surfaces are displaced by the fault. Two distinct strands of the fault were mapped, and although the relative timing of movement on these traces is uncertain, both exhibit morphology indicative of late Quaternary faulting. The youngest mapped surface (Q4p) is not deformed.

C) East Arkansas Creek (east one-third of section). At least three different-aged geomorphic surfaces are displaced by the fault. The oldest surface (Q1a) has a composite scarp with about 6 m of net displacement and a maximum scarp-slope angle of 13.5°. The youngest mapped surface (Q4a) is not deformed.

Age of faulted deposits Although undated, Geomatrix Consultants (1988 #2980) made a four-fold subdivision of surficial units at the study areas. On the basis of soil development and comparisons with dated sequences elsewhere in the Rocky Mountains province, unit Q2c was estimated at 40-90 ka, unit Q3c at 15-40 ka, and the unfaulted unit Q4c at 2-7 ka.

Paleoseismic studies Site 779d-1 Cherry Creek area. Three trenches (CC-1, CC-2, and CC-3) were excavated in the Cherry Creek area by Geomatrix Consultants (1988 #2980). Trench CC-1 penetrated the surface of unit Q2c and showed >1.9 m of surface displacement of the relict soil that has formed on uneroded portions of Q2c (40-90 ka). However, the number of events and amounts of displacement could not be determined. About 1.6 m of displacement is recorded for three events. Trench CC-2 penetrated surface Q3c (15-40 ka) and showed about 1.0 m of vertical displacement from two discrete surface faulting events, for an average of 0.5 m per event. Trench CC-3 was excavated across the unfaulted surface of unit Q4c mainly to provide evidence for the minimum time of most recent faulting. Geomatrix Consultants (1988 #2980) concluded that a displacement of about 0.5 m (net vertical) is typical of the average surface rupturing event on the Ferris Mountains section of the fault system. In addition, using reported average to maximum displacement ratios for historic faulting events, they proposed that the active (late Quaternary) sections of the South Granite Mountains fault system might have a maximum surface faulting event of 1-1.5 m displacement.

Timing of most recent paleoevent Latest Quaternary (<15 ka)

Comments: This estimate of timing comes from Site 779d-1 (trench CC-2, see detailed studies), where two faulting events have occurred in the past 15-40 k.y. Geomatrix Consultants (1988 #2980) found no displacement of the surface of Q4c, which is considered to be have stablized between 2 and 7 ka. Thus, they concluded that the two most recent faulting events occurred before 2-7 ka and after 40 ka. Although considered to be late Quaternary (<130 ka) by Geomatrix Consultants (1988 #2980), on the basis of suggested recurrence intervals (8-30 ka for the late Quaternary), we characterize the most recent event as latest Pleistocene or Holocene for this database.

Recurrence interval 8-44 k.y (0-90 ka)

Comments: Using surface age estimates, Geomatrix Consultants (1988 #2980) calculated the recurrence of 0.5 m surface-rupturing events on the Ferris Mountains section. Their basic data are 3 surface faulting events since deposition of unit Q2c (40-90 ka), 2 surface faulting events since deposition of unit

Q3c (15-40 ka), and no surface faulting events since deposition of unit Q4c (2-7 ka). Their estimates of recurrence since 40 ka were 8-20 k.y., whereas for the past 90 k.y. they estimated 13-30 k.y. Thus, their range of recurrences is 8-30 k.y.

However, if one considers the most recent event (2-7 k.y.) and the time between deposition and the first faulting event (unknown) on a surface, the range is somewhat larger. The maximum recurrence interval is for 3 faulting events (2 full recurrence intervals) between 90 ka and 2 ka, whereas the minimum recurrence interval is for 2 faulting events (1 full recurrence intervals) between 15 ka and 7 ka. These limits provide 8 k.y. and 44 k.y. as a range of recurrence values. Conversely, Geomatrix Consultants (1988 #2980) assigned recurrence intervals of >5.1 k.y. to >16 k.y. for a Ms 6.5-6.75 earthquake using a moment-rate approach and two possible fault widths (depths).

Slip-rate category <0.2 mm/yr

Comments: Geomatrix Consultants (1988 #2980) calculated slip rates based on displacements and estimated ages of surfaces in the Cherry Creek study area (see detailed studies). This data is summarized in their table 6-3 (note, the geomorphic surfaces shown in this table are mislabeled). Their rates range from a minimum of 0.02-0.03 to a maximum of 0.05-0.08 mm/yr. They concluded that the average net slip rate on the section is probably less than or equal to 0.1 mm/yr. Thus, we placed this section in the <0.2 mm/yr slip-rate category.

Length End to end (km): 18.4
Cumulative trace (km): 25.9

Average strike (azimuth): N68°W

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants, I., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.

#3445 Love, J.D., 1970, Cenozoic geology of the Granite Mountain area, central Wyoming: U.S. Geological Survey Professional Paper 495-C, 154 p., 10 pls.

#2287 Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: State Geologic Map, 3 sheets, scale 1:500,000.

#3470 Love, J.D., Christiansen, A.C., Earle, J.L., and Jones, R.W., 1979, Preliminary geologic map of the Casper 1° x 2° quadrangle central Wyoming: U.S. Geological Survey Open-File Report 79-961, 13 p., 1 pl., scale 1:250,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#176 Zoback, M.L., and Zoback, M., 1980, State of stress in the conterminous United States: Journal of Geophysical Research, v. 85, no. B11, p. 6113-6156.

779e, Seminoe Mountains section (Class B)

Section number 779e

Section name Seminoe Mountains section (Class B)

Comments: Named for the fault's proximity to the Seminoe Mountains. This section of the fault extends west-northwest roughly 36 km long along the north margin of the Seminoe Mountains from Sand Creek Canyon on the west to Corral Creek (or Saylor Creek) on the east (Geomatrix Consultants, 1988 #2980). The eastern end of the section is also the eastern end of the Seminoe Mountains structural block.

Reliability of location Poor

Comments: Trace based on map of entire fault system (fig. 3-1) at about 1:330,000 scale by Geomatrix Consultants (1988 #2980) with modifications based on Geomatrix Consultants (1988 #2980) 1:250,000 scale map (plate 2). The trace was transferred to 1:250,000-scale map with topographic-base, and then digitized This trace is a generalization from Love and others (1979 #3470) and Love and Christiansen (1985 #2287). Geomatrix Consultants (1988 #2980) also showed the fault and older structures at 1:250,000 scale map (plate 2) with topographic-base. The fault is shown in generalized fashion at 1:500,000 scale by Witkind (1975 #819) and Geomatrix Consultants (1988 #2980), and at 1:1,000,000 scale by Case and others (1997 #3449).

Scale of digital trace 1:250,000

Sense of movement N

Comments: Down to the north in Pliocene to Quaternary time; in Eocene, movement was in opposite (down-to-the-south) sense (Love, 1970 #3445). Love (1970 #3445) suggested a minimum post-Miocene displacement of 650 m for the fault system.

Dip not determined

Comments: Appears to dip steeply (Love, 1970 #3445).

Dip direction N

Geomorphic expression Fault forms abundant lineaments, springs, and low discontinuous, isolated scarps that are north facing and have vertical surface displacements of 0.5 m or less. These lineaments are most pronounced in the medial part of the section, although the western 8 km of the fault trace is largely obscured by eolian deposits in the area of Sand Gap. The fault is typically expressed as a linear break in slope related to juxtaposition of uplifted resistant Precambrian rock and less-resistant Miocene sediment. This break in slope is also associated with triangular facets along the northern margin of the Seminoe Mountains. Excavations near the fault reveal Miocene conglomerate just 30 cm below the surface, but deposits in the footwall are deformed 25-30°. These relations suggested to Geomatrix Consultants (1988 #2980) that the lineaments and triangular facets are the products of fault-line retreat owing to differences in erodibility of materials along the fault. In addition, they found no evidence of deformation of upper Quaternary stream terrace and piedmont deposits that cross the fault trace and thus concluded that the Seminoe Mountains section has not been active in the late Quaternary. Nevertheless, on the basis of the above mentioned structural, stratigraphic, and geomorphic relations we cannot preclude or prove Quaternary movement on this section of the fault. This section is considered to be a Class B feature, pending further study.

Age of faulted deposits Precambrian and Miocene rock; upper Quaternary stream terrace and piedmont deposits are not deformed where they extend across the fault.

Paleoseismic studies none

Timing of most recent paleoevent Quaternary (<1.6 Ma)

Comments: No evidence for <130 ka faulting is known, but we cannot preclude or prove Quaternary movement on this section of the fault from reported structural, stratigraphic, and geomorphic relations. This section is considered to be a Class B feature, pending further study.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr

Comments: Low slip rate is inferred by compiler from lack of deformation of deposits that could be as old 130 ka.

Length End to end (km): 35.0
Cumulative trace (km): 36.1

Average strike (azimuth): N68°W

References

#3449 Case, J.C., Larsen, L.L., Boyd, C.S., and Cannia, J.C., 1997, Earthquake epicenters and suspected active faults with surficial expression in Wyoming: Geological Survey of Wyoming Preliminary Hazards Report 97-1, 1 sheet, scale 1:1,000,000.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants, I., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.

#3445 Love, J.D., 1970, Cenozoic geology of the Granite Mountain area, central Wyoming: U.S. Geological Survey Professional Paper 495-C, 154 p., 10 pls.

#2287 Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: State Geologic Map, 3 sheets, scale 1:500,000.

#3470 Love, J.D., Christiansen, A.C., Earle, J.L., and Jones, R.W., 1979, Preliminary geologic map of the Casper 1° x 2° quadrangle central Wyoming: U.S. Geological Survey Open-File Report 79-961, 13 p., 1 pl., scale 1:250,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#176 Zoback, M.L., and Zoback, M., 1980, State of stress in the conterminous United States: Journal of Geophysical Research, v. 85, no. B11, p. 6113-6156.

780, Chicken Springs faults

Structure Number 780

Comments: Referred to as fault 295 of Witkind (1975 #819).

Structure Name Chicken Springs faults

Comments: Named for Chicken Springs, southwest of Bairoil, Wyoming. A variety of names involving Chicken Springs has been used for this group of distributed faults, which are centered about 16 km from Bairoil. We prefer the plural form here, inasmuch as there are at least a dozen separate strands concentrated in an 8 km (N-S) by 15 km (E-W) area.

Synopsis Little is known about these seemingly young faults. They have been shown as Quaternary faults, but no reconnaissance was made of them until the late 1980s. They form both north- and south-facing scarps, at least one of which has an abandoned stream channel captured on the uplifted side of a fault. No topographic profiles or detailed investigations have been published on these faults.

Date of compilation May 17, 1999

Compiler and affiliation Michael N. Machette, U.S. Geological Survey

State Wyoming

County Sweetwater

1° x 2° sheet Casper

Province Wyoming Basin

Reliability of location Good

Comments: Fault traces based on reconnaissance map of Wyoming Basin at 1:250,000 scale with topographic base by Geomatrix Consultants (pl. 2, 1988 #2973). Geomatrix Consultants (1988 #2973; 1988 #2980) showed the fault and older structures on maps at 1:500,000 scale. The faults were also shown in generalized fashion at 1:500,000 scale by Witkind (1975 #819), Love and Christiansen (1985 #2287)and Geomatrix Consultants (1988 #2980), and at 1:1,000,000 scale by Case and others {, 1997 #3449.

Scale of digital trace 1:250,000

Geologic setting The Chicken Springs faults are within the Red Desert portion of the Wyoming Basin, approximately 16 km southwest of Bairoil, Wyoming, and 23 km south of the eastern end of the Green Mountains. Case (cited in Geomatrix Consultants, 1988 #2980) suggested that some of the faults may be as much as 30 km long. However, some lineaments observed on aerial photographs may be related to bedrock jointing rather than surface faulting (Blackstone, cited in Geomatrix Consultants, 1988 #2980).

Sense of movement N
Comments: Reported as normal by Geomatrix Consultants (1988 #2980). Orientation and sense of displacement are consistent with north-south extensional stress regime postulated for the Wyoming foreland by Zoback and Zoback (1980 #176).

Dip not determined

Dip direction N, S

Geomorphic expression Discontinuous faults in this group trend west to northwest, are 3-15 km in length (Love and Christiansen, 1985 #2287), and face both north and south. Case (1997) reported that, at one locality, an abandoned (undated) stream channel is exposed on the uplifted (northern) block of a prominent fault. No evidence of the north-south trending channel is found on the downdropped (southern) block. In addition, soil horizons and the underlying undated alluvium were observed to be displaced by a fault.

Age of faulted deposits Not mentioned by Case (1997 #3450), but he infers that the faulted stream channel is young (i.e., Holocene).

Paleoseismic studies none

Timing of most recent paleoevent Latest Quaternary (<15 ka)
Comments: Case (1997 #3450) considered the faults within this system to have been active in the Holocene on the basis of displaced soil horizons and the abandoned, but uplifted stream channel. However, additional research is required to confirm the time of most recent faulting (Case, 1997 #3450). Witkind (1975 #819) suspected deformation during the late Cenozoic, and Geomatrix Consultants (1988 #2973; 1988 #2980) considered the faults to be active in the Quaternary.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: A low-slip rate is inferred by compiler on basis of activity rates on late Quaternary faults in adjacent parts of the Wyoming Basin province. However, inasmuch as the faulting appears to be young, further study could lead to assignment of a faster slip rate category.

Length End to end (km): 13.7
Cumulative trace (km): 62.0

Average strike (azimuth): N79°W

References

#3450 Case, J.C., 1997, Earthquakes and active faults in Wyoming: Geological Survey of Wyoming Preliminary Hazard Report 97-2, 58 p.

#2973 Geomatrix Consultants, I., 1988, Northwestern Wind River Basin seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 116 p., 3 pls.

#2980 Geomatrix Consultants, I., 1988, Wyoming Basin geomorphic province seismotectonic evaluation: Technical report to U.S. Department of Interior, Bureau of Reclamation, Denver, under Contract 6-CS-81-07310, 167 p., 2 pls.

#2287 Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: State Geologic Map, 3 sheets, scale 1:500,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#176 Zoback, M.L., and Zoback, M., 1980, State of stress in the conterminous United States: Journal of Geophysical Research, v. 85, no. B11, p. 6113-6156.

2380, Porcupine Mountain faults

Structure Number 2380
Comments: Refers to Hecker's (1993 #642) fault number 11-20.

Structure Name Porcupine Mountain faults

Comments: Named for Porcupine Mountain, which bounds the southwestern portion of the Bear River Valley. These faults are primarily in Utah.

Synopsis Poorly understood Quaternary faults along the west and east sides of Porcupine Mountain, east of Coalville. From Utah, the fault extends about 8 km to the northeast into Wyoming.

Date of compilation 10/01/99

Compiler and affiliation Bill D. Black and Mike Hylland (Utah Geological Survey), and Suzanne Hecker (U.S. Geological Survey).

State Utah, Wyoming

County Summit (UT), Uinta (WY)

1° x 2° sheet Ogden

Province Middle Rocky Mountains

Quality of location Good
Comments: Mapping at 1:100,000 scale from Bryant (1990 #4511) and J.C. Coogan and J.K. King (unpublished UGS mapping for the Ogden 30' x 60' quadrangle).

Scale of digital trace 1:100,000

Geologic setting setting North- to northeast-trending normal faults along the west and east sides of Porcupine Mountain. Porcupine Mountain bounds the southwestern portion of the Bear River Valley, which is characterized by a wide flood plain of the Bear River bordered by extensive alluvial slopes.

Sense of movement N

Dip not determined

Dip direction W, E

Geomorphic expression In Utah, the fault is principally in Tertiary and Cretaceous bedrock, but buried locally by landslides and late Quaternary surficial deposits. Along the Wyoming border, fault scarps are found on late Quaternary alluvium.

Age of faulted deposits at the surface Quaternary

Paleoseismic studies none

Time of most prehistoric faulting Late Quaternary (<130 ka)
Comments: Pliocene or Pleistocene gravel deposits are reportedly faulted in Utah. In Wyoming, the northeastern part of the fault has evidence for younger, late Quaternary (<130 ka) movement.

Recurrence interval not determined

Slip-rate category Unknown; probably <0.2 mm/yr
Comments: The lack of clear evidence for late Quaternary displacement in Utah and subdued geomorphic expression of faulting in Quaternary deposits in Wyoming indicate a low slip rate.

Length End to end (km): 34.6
Cumulative trace (km): 55.9

Average strike (azimuth): N18°E

References

#4511 Bryant, B., 1990, Geologic map of the Salt Lake City 30' x 60' quadrangle, northcentral Utah, and Uinta County, Wyoming: U.S. Geological Survey Miscellaneous Investigations Map I-1944, scale 1:100,000.

#642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000.