U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS MAP 3033
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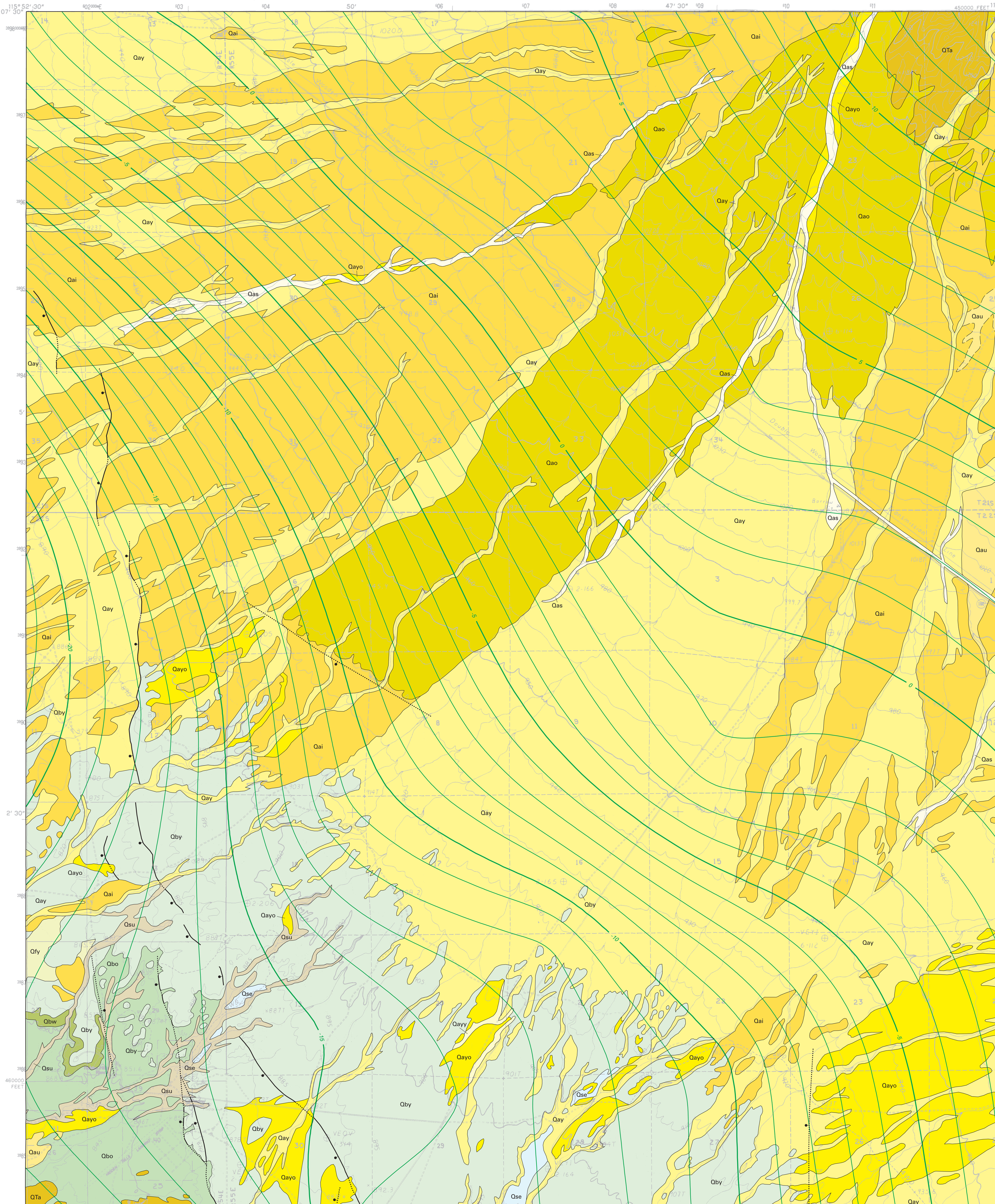

Base from U.S. Geological Survey, 1984
Universal Transverse Mercator Projection
10,000-foot grid based on Nevada coordinate system, east zone
1,000-meter Universal Transverse Mercator grid ticks, zone 11
1927 North American Datum

APPROXIMATE MEAN DECLINATION, 1984

SCALE 1:24 000

CONTOUR INTERVAL 10 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

Geology mapped by Jeremiah B. Workman in 1997–1998
Digital database prepared by Jeremiah B. Workman
Editing and digital cartography by Gayle M. Dumonceaux, Denver Publishing Service Center
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GEOLOGIC MAP OF THE HIDDEN HILLS RANCH QUADRANGLE, CLARK COUNTY, NEVADA

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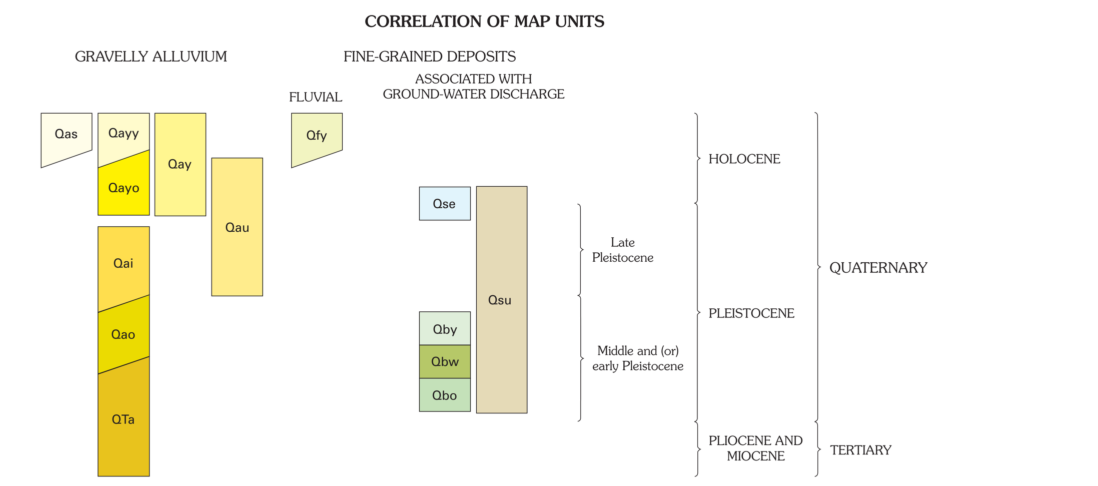
CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

[Pedogenic carbonate stages from Gile and others, 1966]

GRAVELLY ALLUVIUM

Qas **Active stream alluvium (Holocene)**—Noncemented fluvial stream gravel, with interbedded sand; poorly to moderately well sorted; massive to well bedded; clast-supported to weakly matrix-supported. Gravel is angular to subrounded, ranging in size from granules to boulders, and composed predominantly of Paleozoic carbonate clasts and subordinate Mesozoic and Paleozoic siliceous clasts derived from erosion of the adjacent Spring Mountains (fig. 1) (Burchfiel and others, 1974) and from older Quaternary deposits described below. Bar-and-swale depositional morphology is prominent. Desert pavement, soil development, and etching on surficial limestone clasts are absent. Rock varnish is absent except for relict rock varnish not abraded during transport. The contact with other units ranges from sharp where the unit is incised (along cliff contacts) to gradational where adjacent units are only partially reworked. The unit includes a manmade diversion ditch parallel to Highway 160 along the east edge of the map area. Unit thickness is unknown

Qayy **Youngest alluvium (Holocene)**—Noncemented alluvial gravel, with interbedded sand and mud; poorly to moderately well sorted; massive to well bedded; clast-supported to matrix-supported. Gravel is angular to subrounded, ranging in size from granules to boulders, and composed predominantly of Paleozoic carbonate clasts with subordinate Mesozoic and Paleozoic siliceous clasts derived from erosion of the adjacent Spring Mountains (Burchfiel and others, 1974) and from older Quaternary deposits described below. Interbedded sand and mud is mostly composed of reworked, fine-grained basin-fill of Browns Spring deposits described below. Includes deposits of modern channels that cut canyons up to 15 m deep through older basin fill units and that are too narrow (less than 30 m) to map separately, as well as Holocene deposits between modern channels. Etching on surficial limestone clasts ranges from absent on deposits of modern channels to incipient and sparse on deposits between modern channels. Bar-and-swale depositional morphology ranges from prominent in modern channels to variably modified and muted by addition of eolian sediment in areas between modern channels. Desert pavement ranges from absent on deposits of modern channels to loosely packed and weakly developed on deposits between active channels. Rock varnish, which is rare on limestone clasts, is generally very weakly developed to absent on siliceous clasts (including siliceous carbonate clasts) except for relict rock varnish not abraded during transport. Typical noncemented and weak soil development is characterized by the presence of stage I secondary carbonate morphology (mostly thin coats on clast undersides), and by a gradual increase of sand toward the surface through the upper 10–30 cm of the unit. The surficial sand component includes a pedogenically mixed and infiltrated eolian sediment deposited after fluvial deposition of fan gravel. This unit grades into partly correlative fine-grained facies mapped as Qfy. Minimum thickness is 1–2 m; base of unit is generally not exposed

Qay **Young alluvium (Holocene and latest Pleistocene)**—Noncemented alluvial-fan and wash gravel, with interbedded and intermixed sand; poorly to moderately well sorted; massive to well bedded; clast-supported to matrix-supported. Gravel is angular to subrounded, ranging in size from granules to boulders, and composed predominantly of Paleozoic carbonate clasts with subordinate Mesozoic and Paleozoic siliceous clasts derived from erosion of the adjacent Spring Mountains (Burchfiel and others, 1974) and from older Quaternary deposits described below. Includes deposits in modern channels that are too narrow (less than 30 m wide) to map separately, as well as Holocene and locally latest Pleistocene (younger than 15 ka) deposits between modern channels. Etching on surficial limestone clasts ranges from absent on deposits of modern channels to incipient and sparse to moderately developed and common on deposits between modern channels. Bar-and-swale depositional morphology is predominant in modern channels, but is variably modified and muted by addition of eolian sand in areas between modern channels; however, relict depositional morphology remains a characteristic feature. Even in the most muted cases, cobbles and boulders protrude from eolian sand cover, and relict depositional microrelief is evident on aerial photographs. Desert pavement ranges from absent on gravel clasts in modern channels to loosely packed and weakly developed (especially in areas of relatively low dust-flux, as on the upper part of the fan) to moderately well packed in areas of higher dust flux, such as at the toe of the fan in the southwestern part of the quadrangle where the unit forms a thin veneer over older, fine-grained, eolian-source basin-fill of Browns Spring (unit Qby) described below. Rock varnish, which is rare on limestone clasts, is generally weakly developed to absent on more siliceous clasts (including siliceous carbonate clasts) except for relict rock varnish not abraded during transport. Typical non-cemented and weak soil development is characterized by a cambic Bw horizon, by the presence of stage I–II secondary carbonate morphology (mostly thin carbonate coats on clast undersides), and by a gradual increase of sand toward the surface through the top 0.5 m of the deposit. The surficial sand component is considered to be a pedogenically mixed and infiltrated eolian sediment deposited after fluvial deposition of fan gravel. Development of both desert pavement and soil increase downslope to the southwest toward the fine-grained, basin-fill deposits that are the primary source of eolian sand in the Pahrump Valley. Age control in the Las Vegas 1:100,000-scale quadrangle indicates the map unit is predominantly Holocene (Page and others, 2004). In the Gass Peak Southwest and Tule Springs Park quadrangles, to the east in the Las Vegas Valley, correlative alluvium with similar characteristics to Qay either overlies or is inset within fine-grained deposits with abundant radiocarbon dates ranging from 8 to 12 ka (Haynes, 1967; Quade, 1986; Quade and others, 1995; Bell and others, 1998), so it is likely that most alluvium at the surface of Qay is Holocene. Qay includes deposits correlative to active stream alluvium (Qas), youngest alluvium (Qayy), and deposits older than Qayy; Qas is delineated separately only where there is a markedly greater proportion of modern channels and interchannel areas with minimal development of surface etching, varnish, pavement, and soil; Qayy is delineated separately where the fine-grained component contains significant amounts of reworked basin-fill deposits of Browns Spring and where there is a markedly greater proportion of modern channels and interchannel areas with minimal development of surface etching, varnish, pavement, and soil. Along the western edge of the quadrangle, Qay onlaps a series of north to north-northwest-trending fault scarps which cut unit Qai. Qay is not cut by any faults within the map area. Minimum thickness of Qay ranges from less than 1 m to at least 3 m, as exposed in borrow pits; base of unit is generally not exposed

Qayo **Older young alluvium (Holocene and latest Pleistocene)**—Noncemented alluvial-fan gravel, with interbedded sand; poorly to moderately well sorted; massive to well bedded; clast-supported to matrix-supported. Gravel is angular to subrounded, ranging in size from granules to boulders, and composed predominantly of Paleozoic carbonate clasts with subordinate Mesozoic and Paleozoic siliceous clasts derived from erosion of the adjacent Spring Mountains (Burchfiel and others, 1974) and from older Quaternary deposits described below. Found on surfaces from 2 to 8 m above modern channels. Etching on surficial limestone clasts is moderately developed and common. Bar-and-swale depositional morphology ranges from absent to strongly modified and muted by addition of eolian sediments. Desert pavement is moderately well packed. Rock varnish, which is rare on limestone clasts, is weakly to moderately developed on more siliceous clasts (including siliceous carbonate clasts) except for relict rock varnish not abraded during transport. Typical noncemented and weak soil development is characterized by a cambic Bw or incipient Btj horizon, by the presence of stage I–II secondary carbonate morphology (mostly thin coats on clast undersides), and by a gradual increase of sand toward the surface through the top 0.5 m of the deposit. The surficial sand component is considered to be a pedogenically mixed and infiltrated eolian sediment deposited after fluvial deposition of fan gravel. Development of both desert pavement and soil increase downslope to the southwest towards the fine-grained basin-fill deposits that are the primary source of eolian sand in the Pahrump Valley. Minimum thickness of Qayo ranges from less than 1 m to at least 3 m, as exposed in borrow pits; base of unit is generally not exposed

Qau **Undivided alluvium (Holocene and late Pleistocene)**—Cemented and noncemented alluvial-fan and pediment gravel, with interbedded sand; poorly to moderately well sorted; massive to well bedded; clast-supported to matrix-supported. Gravel is angular to subrounded, ranging in size from granules to boulders, and composed predominantly of Paleozoic carbonate clasts with subordinate Mesozoic and Paleozoic siliceous clasts derived from erosion of the adjacent Spring Mountains (Burchfiel and others, 1974) and from older Quaternary deposits described below. Qau represents areas in which young alluvium (Qay), including common intermittent active channels, occurs as discontinuous, but common (30–50 percent of Qau), thin (<1 m) veneers over intermediate alluvium (Qai; described below) in patches that are too narrow to map separately

Qai **Intermediate alluvium (late and middle(?) Pleistocene)**—Cemented alluvial-fan and pediment gravel, with interbedded sand; poorly to moderately well sorted; massive to well bedded; clast-supported to matrix-supported. Gravel is angular to sub-rounded, ranging in size from granules to boulders, and composed predominantly of Paleozoic carbonate clasts with subordinate Mesozoic and Paleozoic siliceous clasts derived from erosion of the adjacent Spring Mountains (Burchfiel and others, 1974) and from older Quaternary deposits described below. Includes modern channels too narrow to map separately. Surface between modern channels is rounded by erosion where it is more than 1 m above grade of adjoining channels. Surface between modern channels is characterized by a moderately to tightly packed desert pavement and smooth surface, which generally lacks bar-and-swale depositional morphology. Depositional microrelief is minimal relative to other alluvial units. Though nonsiliceous limestone clasts do not have rock varnish, more siliceous clasts possess dark varnish, which imparts a darker tone to this unit on aerial photographs. This surface morphology is associated with a soil that typically includes a reddish-brown argillic (Bt) horizon and cemented stage II–IV carbonate morphology. Within the soil profile, the upward decrease in proportion of gravel is due to the addition of eolian material concurrent with pedogenesis. Within and beneath the zone of maximum pedogenic carbonate development, limestone gravel generally is distinctly more cemented than in younger Holocene alluvium. East of the map area, in the Las Vegas Valley (fig. 1A), thermoluminescence data from the eolian part of a buried soil at 2 m depth within a correlative alluvium to Qai indicated an age range from 100 to 120 ka (Lundstrom and others, 1998). North of the map area, at Yucca Mountain (fig. 1A), thermoluminescence and U-series data constrain the deposition of correlative alluvium to Qai (Lundstrom and others, 1995) from 50 to 130 ka (early late Pleistocene, during the last interglacial). A sample taken approximately 1 km west of the northwestern corner of the map area by Lundstrom and others (2003), where the unit is buried by younger fine-grained deposits, yielded a U-series date of 87.22±13 ka. Along the western edge of the map area, Qai, along with Qby, is cut by a series of north to north-northwest-striking normal faults. These faults are expressed as 1–3 m scarps with post-tectonic young alluvium (Qay) deposited against the downthrown side of the scarps in onlapping relationships. Exposed minimum thickness of unit ranges from less than 1 m to at least 5 m; base of unit not exposed

Qao **Old alluvium (middle and early(?) Pleistocene)**—Well-cemented gravel and sand of partly eroded alluvial fan remnants and terraces with well-developed, but degradational soil; poorly to moderately well sorted; massive to well bedded; clast-supported to matrix-supported. Gravel is angular to subrounded, ranging in size from granules to boulders, and composed predominantly of Paleozoic carbonate clasts with subordinate Mesozoic and Paleozoic siliceous clasts derived from erosion of the adjacent Spring Mountains (Burchfiel and others, 1974) and from older Quaternary deposits described below. The erosional upper surface consists of broadly rounded, low-relief, accordant ridges that are gradational basinward to less deeply dissected, broader surfaces. Depositional microrelief is absent. Generally well-packed surface pavement includes variable but often darkly varnished clasts, and abundant clasts of pedogenic calcite and calcite-cemented gravel; these calcite clasts impart a lighter surface tone to this unit compared to adjoining surfaces of younger map units. Soil typically includes a laminar (stage IV), but partially eroded, K horizon at least 0.5 m thick; an overlying argillic horizon of variable thickness and expression is commonly present. The surface characteristics indicate that the original upper depositional surface of Qao has been partially eroded. The pavement, and at least some of the soil, clearly was formed after the latest erosional episode. Qao forms surfaces topographically higher, steeper, and more deeply eroded than adjacent surfaces of Qai. The accordant surface defined by Qao ridge tops is inset within older QTa (described below) where these units are juxtaposed in the northeastern part of the quadrangle. Age of Qao is constrained by map relationships; no direct dating method has been applied. Because the accordant ridge tops of Qao can be traced to areas within a few meters of the grade of Qai, which has yielded late Pleistocene dates, we infer that Qao includes middle and late Pleistocene sediments. In the center of the map area, the foot of the large fan of old alluvium (Qao) is truncated by a northwest-striking fault entirely concealed by unit Qai. The fault is shown only at this location where the evidence for its existence is strongest, but it can be inferred that this fault extends approximately 5 km to the southeast where it intersects a north-striking normal fault of similar age and 8–10 km to the northwest where it juxtaposes younger fine-grained deposits against unit Qby (Lundstrom and others, 2003). Minimum exposed thickness of Qao is at least 4 m; base of unit is generally not exposed

QTa **Gravelly basin-fill alluvium (early Pleistocene(?) to late Miocene)**—Well-cemented, sandy alluvial gravel; poorly to moderately well sorted; massive to well bedded; clast-supported to matrix-supported; poorly exposed. Gravel is angular to subrounded, ranging in size from granules to boulders, and composed predominantly of Paleozoic carbonate clasts with subordinate Mesozoic and Paleozoic siliceous clasts derived from erosion of the adjacent Spring Mountains (Burchfiel and others, 1974). In the southwest corner of the map area, gravel includes sparse granitic and volcanic clasts, probably derived from the Kingston Range (fig. 1), 30 km to the south (McMackin, 1999). Paleozoic limestone clasts in these southwestern exposures may be partially derived from the Nopah Range to the west. Within the Stump Spring quadrangle to the south (McMackin, 1999), better exposures of deformed gravelly sediments beneath the basin-fill of Browns Spring include abundant and lithologically varied volcanic clasts in beds that strike northwest and dip northeast, overlain by less steeply dipping gravels with abundant limestone clasts. South of the map area, Malmberg (1967) reported a white to light-green tuff underlying this gravel, but no good exposures of the gravel or underlying stratigraphy were noted in this quadrangle. McMackin (1999) reports an $^{40}Ar/^{39}Ar$ date of 10.76±0.09 Ma on a lapilli tuff associated with these gravels. QTa in the subsurface is considered here to include basin-fill that may be equivalent to parts of the Miocene Muddy Creek and Horse Spring Formations, which are not exposed in this quadrangle, but are exposed and described east of the Spring Mountains (Bohannon, 1984; Maldonado and Schmidt, 1990). Erosional upper surface consists of discordant rounded ridges (ballenas of Peterson (1981)). The flanks of gravel-covered hills are draped with thick colluvium that includes a younger eolian sand component. QTa is distinguished from old alluvium (Qao) where Qao is clearly inset within and less deeply dissected than QTa. Bedding in QTa is exposed only in the northeast corner of the quadrangle where recent drainage has cut a 10–15 m deep canyon through the unit. Maximum thickness of 2,200 m estimated from gravity studies (Blakely and others, 1999)

FINE-GRAINED DEPOSITS

Qfy **Intermittently active fluvial fine-grained alluvium (late Holocene)**—Brown to gray sand, silt, mud, and interbedded gravel. Includes deposits partly correlative with units F and G of Haynes (1967) and distal facies of alluvial fans. Erosional and depositional fluvial bar and channel morphology ranges from fresh to muted. Unit represents a thin pedimented veneer over older basin-fill of Browns Spring (described below). Unit grades upwash to more coarse, gravelly youngest alluvium (Qayy) and grades downwash beyond the map area to the west into the modern playa deposits mapped by Lundstrom and others (2003). Thickness ranges from less than 50 cm to greater than 150 cm; base of the unit not exposed

Qse **Unit E of Haynes (1967) and Quade (1986) (early Holocene to latest Pleistocene)**—Young fine-grained deposits associated with past ground-water discharge. Light-gray to light-brown unconsolidated gravel, silty sand, sandy silt, and mud. Weak meter- to decimeter-scale bedding is defined by upward-fining sequences and upward color change from light-grayish brown to light-brown (more oxidized). The entire unit becomes more fine-grained upwards. Unit includes eolian/phreatophyte flat facies of Quade and others (1995) containing thin beds of carbonized wood and small mollusk fossils and discontinuous lenses of black mat material. A fossilized mammoth tusk is exposed in the outcrop just north of Cathedral Canyon in the southwest corner of the map area. Radiocarbon dates from carbonized wood in this outcrop range from 8.5 to 11 ka (Spaulding and Quade, 1996). Lundstrom and others (2003) determined a thermoluminescence date of about 20 ka at the base of the unit approximately 1 km west of the map area where it conformably overlies older units. A radiocarbon date of 10.27 ka was determined by DePolo and others (1999) northwest of the map area in the Pahrump quadrangle. In the map area, unit is inset into older basin-fill of Browns Spring, described below. The base of Qse is an erosional contact overlain by a 1-m-thick graded gravel bed with internal channel structure. The underlying, unmapped, thin (< 1 m), resistant, light-gray, calcareous mud may be the top of Unit D of Haynes (1967) and Quade (1986) mapped to the west in the adjacent Mound Spring quadrangle by Lundstrom and others (2003). Minimum exposed thickness is 5 m; top of unit has been removed by erosion

Qsu **Undivided fine-grained deposits (Holocene and Pleistocene)**—Fine-grained brown to whitish-tan mud and marl, that probably includes units Qse, Qby, Qbw, and Qbo, as well as other undivided fine-grained deposits associated with past ground-water discharge. Mapped in drainages near Hidden Hills Ranch where the paleo-spring deposits are inset within each other and highly dissected by recent erosion, hampering unit correlation and thickness measurement

Basin-fill of Browns Spring (Pleistocene)—Fine-grained sand, bedded mud, marl, and limestone with minor interbedded gravel. Unit is subdivided into upper, middle, and lower parts based on position relative to resistant middle white limestone bed (Qbw) described below. Spaulding and Quade (1996) reported Rancholabrean fossils in unit near Stump Spring (fig. 2) to the south of the quadrangle indicating a Pleistocene age. More recent thermoluminescence and U-series dates reported by Lundstrom and others (2003) confirm the Pleistocene age as described below. Unit may include small areas of younger fine-grained deposits associated with past ground-water discharge that we have not recognized within the map area

Qby **Upper part of basin-fill of Browns Spring (middle Pleistocene)**—Fine-grained brown to whitish tan mud, marl, and fine sand, interbedded with minor 10- to 80-cm-thick beds of pebble gravel. Gravel is subangular to subrounded and composed of limestone clasts probably derived from the Paleozoic and Mesozoic rocks of the Spring Mountains. Gravels probably represent the distal ends of alluvial fans interbedded with the fine-grained deposits. Fine-grained beds are variably cemented with calcite and include beds interpreted to include pre-Wisconsinan ground-water discharge cycles (Spaulding and Quade, 1996). Unit is generally poorly exposed and unconformably overlain by Holocene to late Pleistocene alluvium. At Browns Spring (fig. 2), just west of the quadrangle, Lundstrom and others (2003) obtained thermoluminescence dates of 211–284 ka from a mud about 3 m above the top of the resistant middle white limestone (Qbw). Minimum exposed thickness is about 200 m; top of unit is not exposed

Qbw **Middle white limestone of basin-fill of Browns Spring (middle Pleistocene)**—Massive 2–4-m-thick densely cemented limestone that forms a resistant escarpment that extends to the northwest from Hidden Hills Ranch. Included in this unit is an upper calcite-cemented limestone-pebble gravel 30–60 cm thick which immediately overlies a massive limestone bed. Just west of the quadrangle at Browns Spring, the gravel is interbedded with the top of the massive limestone (Lundstrom and others, 2003). Lundstrom and others (2003) report a robust U-series date of 370 ka from the limestone. Thickness of unit is about 5 m

Qbo **Lower part of basin-fill of Browns Spring (middle and early(?) Pleistocene)**—Fine-grained, brown to whitish-tan mud and marl, interbedded with minor pebble gravel. Marl forms resistant ledges in escarpment below Qbw; includes plant casts (stems of unknown taxa), and probably represents intervals of ground-water discharge. Occasional interbedded lenses and channels of pebble gravel are composed of limestone clasts. Just east of Hidden Hills Ranch, an exposed fault scarp cuts across the mouth of Cathedral Canyon in the southwest corner of the map area cutting both Qby and Qbo. A thin apron of much younger material reworked from both Qby and Qbo skirts the foot of this scarp, particularly where the scarp has been eroded back from the fault line. Due to the stratigraphic position of this material and its identical appearance to surrounding, poorly-consolidated to unconsolidated exposures of Qbo, it has been mapped as Qbo and the fault has been shown as concealed by Qbo in these locations; however, it is inferred that movement on this fault is post-depositional relative to the basin-fill of Browns Spring. Lundstrom and others (2003) obtained thermoluminescence dates of 275–400 ka from mud beds between more resistant marl beds within Qbo to the west of the map area. Exposed thickness of unit is at least 40 m; base of unit is not exposed

STRUCTURAL SETTING

The prominent structural feature in the Pahrump Valley is the right-lateral Pahrump-Stewart Valley fault system (PSV) (Anderson and others, 1995b), which is the central segment of the State Line fault system as defined by Blakely and others (1998). The main trace of this fault system, as shown in figure 1A, strikes northwest along the California-Nevada state line through Pahrump and Stewart Valleys (Anderson and others, 1995b). Hoffard (1991) describes three separate segments of the PSV within the Pahrump Valley (fig. 1B). The East Nopah fault zone (ENFZ) is a narrow band of right lateral, strike-slip faults along the eastern front of the Nopah Range. The Pahrump Valley fault zone (PVFZ) is a wider band of right-oblique-slip faults through the center of the Pahrump Valley and extending northwest into the Stewart Valley fault zone (SVFZ). The West Spring Mountains fault zone (WSMFZ) is a band of high-angle normal faults that strike north along the western front of the Spring Mountains and may represent a splay of the PVFZ.

The north to north-northwest striking faults along the western edge of the map area all have west facing scarps indicating a west-dipping fault plane and normal sense of offset, but the left-stepping nature of the faults is highly suggestive of a right-lateral component of offset and the location of these features at the intersection of the WSMFZ and PVFZ (fig. 1B) structurally supports a right-oblique sense of offset (Hoffard, 1991; Anderson and others, 1995a; 1995b). The youngest unit cut by these faults is intermediate fan alluvium (Qai), so the most recent surface rupture was late Pleistocene (Anderson and others, 1995a). The northwest striking fault that truncates the large area of old alluvium (Qao) near the center of the quadrangle is inferred to extend approximately 5 km to the southeast and from 8 to 10 km to the northwest (fig. 2). West of the map area, on strike with this fault, middle Pleistocene deposits of the basin-fill of Browns Spring (Qby) appear to be juxtaposed against an area of younger, late Pleistocene fine-grained deposits mapped by Lundstrom and others (2003) as units C and D of Haynes (1967) and Quade (1986). Within the map area, unit Qao (early(?) and middle Pleistocene) is clearly cut by this fault whereas the adjacent unit Qai (middle(?) and late Pleistocene) is not. If the fault extends to the southeast as proposed, it may have controlled deposition of unit Qai in the southeastern corner of the map area, but the map relationships here are unclear. The fault certainly did not cut or control deposition of unit Qay in any location and appears to predate the faulting along the west edge of the map area which implies most recent surface rupture was late Pleistocene and more likely middle Pleistocene. The age of this fault and its location suggest that it may have been active during deposition of the fine-grained basin-fill of Browns Spring. In fact, it is likely that this fault acted as a paleospring discharge site, creating the marshy environment downslope necessary for the Browns Spring deposits to form (Quade and others, 1995). Near its northwestern end, the fault continues to channel groundwater to the surface at Mound Spring (fig. 2) to the west of the map area. The down-to-the-west, concealed normal fault in the southeastern corner of the map area projects southward into an east facing erosional scarp exposed south of the map area. The indicated sense of offset is supported by the gravity data. We infer that this fault was active during the deposition of the basin-fill of Browns Spring (Qby) and, like the northwest striking fault, acted as a paleospring discharge site as well as creating a west-facing buttress against which the fine-grained basin-fill deposits collected. The more resistant, carbonate-rich units (Qby) on the downthrown side of the fault were eroded slower than the weakly consolidated alluvial gravels (Qay and Qayo) on the upthrown side creating the present east facing scarp. There is no evidence of the northwest striking fault extending to the east of this north striking fault and the north striking fault may extend farther to the north than mapped (faults shown in red on fig. 2).

The exposures of older basin-fill alluvium (QTa) in the southwest corner of the map area contain volcanic and granitic clasts derived from the Kingston Range to the south, unlike the exposures of QTa in the northeast corner of the map area that are composed entirely of clasts derived from the adjacent Spring Mountains. Gravity data shows a ridge (west of the map area) through the center of the Pahrump Valley (fig. 2) indicating a northwest trending, fault bounded horst block within basement rocks (Morin and others, 1999; Lundstrom and others, 2003). The crest of this horst block corresponds to a ridge of QTa exposures, which includes the exposures in the southwest corner of the map area. The fault bounding this horst block to the northeast dies out just west of the map area as indicated by a saddle in the gravity data (Morin and others, 1999). The fault bounding the block to the southwest passes just to the southwest of the map area (Lundstrom and others, 2003).

The lack of any early(?) to middle Pleistocene basin-fill deposits within this horst block suggest that it was a topographic high during the Browns Spring depositional episode. The fine-grained basin-fill of Browns Spring was deposited into a basin defined by the northwest-striking fault to the north, the north-striking fault to the east, and the northwest trending horst block to the southwest (fig. 2). The northwestern edge of the basin is unclear and defined only by the extent of basin-fill deposits at the surface. The other gravity-defined basins in the adjacent parts of the Pahrump Valley may contain fine-grained middle Pleistocene basin-fill deposits at depth, but all surface exposure is limited to late Pleistocene and Holocene basin-fill deposits (Page and others, 2004; Lundstrom and others, 2003; dePolo and others, 1999.

EXPLANATION

Contact—Dashed where approximately located

Normal fault—Dotted where concealed; bar and ball on downthrown side

Gravity contour—Gravity anomaly data contoured at 1 mgal contour interval

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CONVERSION FACTORS

Multiply	By	To obtain
centimeters (cm)	0.394	inches (in.)
meters (m)	3.281	feet (ft)
kilometers (km)	0.621	miles (mi)

To convert Celsius (°C) to Fahrenheit (°F), use formula (°C x 1.8) + 32

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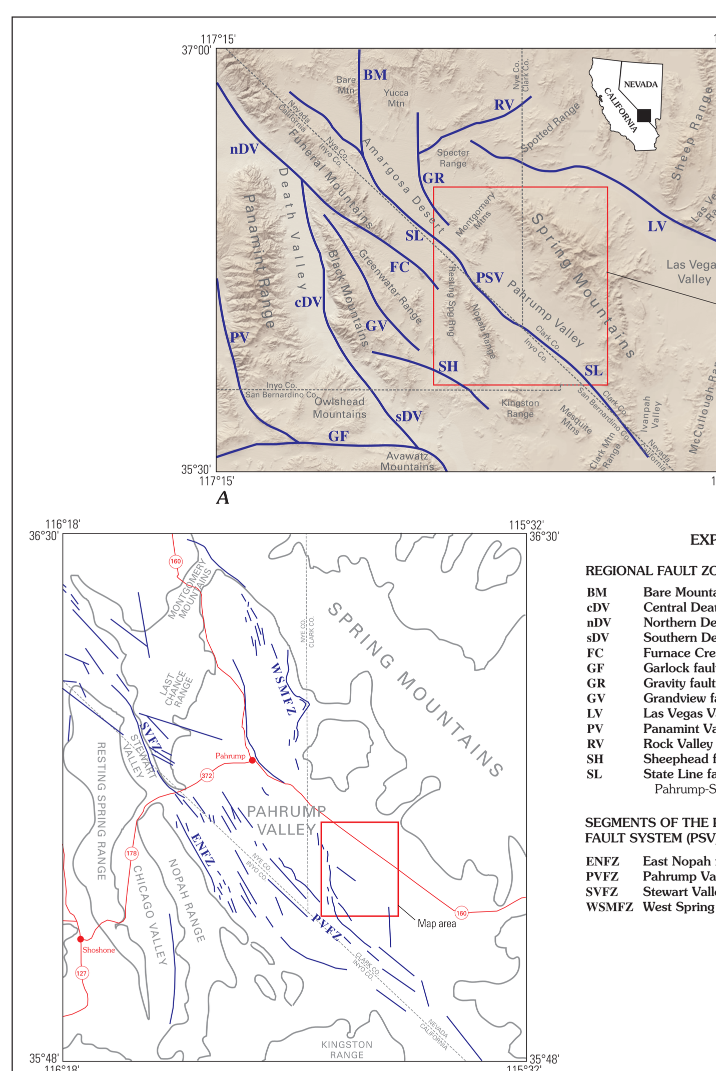


EXPLANATION

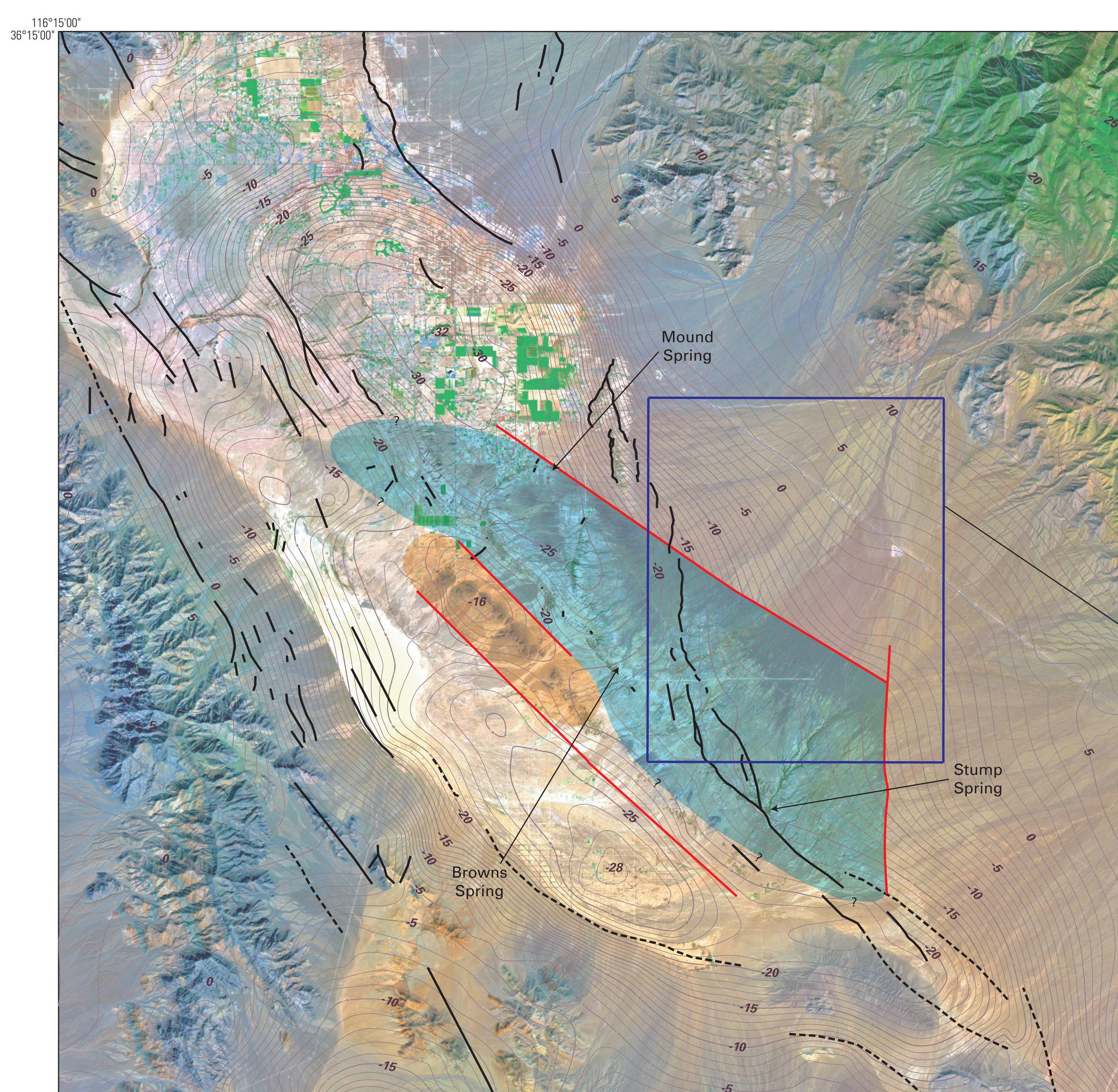
REGIONAL FAULT ZONES (shown in blue above)

BM	Bare Mountain fault
cDV	Central Death Valley fault zone
nDV	Northern Death Valley fault zone
sDV	Southern Death Valley fault zone
FC	Furnace Creek fault zone
GF	Garlock fault
GR	Gravity fault
GV	Grandview fault
LV	Las Vegas Valley shear zone
PV	Panamint Valley fault zone
RV	Rock Valley fault zone
SH	Sheephead fault
SL	State Line fault system—Includes the Pahrump-Stewart Valley fault system (PSV)

SEGMENTS OF THE PAHRUMP-STEWART VALLEY FAULT SYSTEM (PSV) (faults shown in blue to left)

ENFZ	East Nopah fault zone
PVFZ	Pahrump Valley fault zone
SVFZ	Stewart Valley fault zone
WSMFZ	West Spring Mountains fault zone

Figure 1. Index of major structures within the region. *A*, Major Cenozoic high-angle fault zones within the region. These fault zones are shown schematically and are generally composed of discontinuous faults with varying offset. *B*, Cenozoic faults within the Pahrump Valley associated with the Pahrump-Stewart Valley fault system. The overall sense of motion across the valley is northwest-southeast-oriented dextral shear with east-west-oriented extension. Fault data from Workman and others (2002).



EXPLANATION

Horst block—Northwest-trending basement ridge as defined by Lundstrom and others (2003)

Basin—Northwest-trending basin of middle Pleistocene age defined by gravity data, extent of middle Pleistocene basin-fill units, and proposed middle Pleistocene age structures

High-angle fault—Solid where certain as mapped in this report and by Page and others (2004), Lundstrom and others (2003), and Workman and others (2002); dashed where inferred from gravity anomaly data (Workman and others, 2002)

Middle Pleistocene high-angle fault—Extent of middle Pleistocene basin bounding faults as proposed in this report

Gravity contour—Gravity anomaly data contoured at 1 mgal interval

Figure 2. Middle Pleistocene structures in the southern Pahrump Valley. Base from Landsat 7 data processed by J. Dohrenwend and D. Sawyer. Gravity data from R. Blakely.