East Crater Flat faults (ECR)

Plate or figure: Figure 3.

References: Y-19: Swadley and Hoover, 1983; Y-26: Swadley and others, 1984 (their Faults S, T, U, and V); Y-29: Hamilton, 1988; Y-141: Crowe and Carr, [1980]; Y-144: Carr and others, 1986; Y-182: Carr, 1984; Y-224: Frizzell and Shulters, 1990 (show the Black Cone faults, Faults S and T, and one north–northwest–striking fault between the Black Cone and west lava faults, but not the west lava fault); Y-238: Reheis and Noller, 1991 (pl. 3); Y-396: Scott, 1990; Y-616: Carr, [1982]; Y-1042: O'Neill and others, 1992 (pl. 1. They show possible tectonic lineaments west of the Windy Wash fault (parts of Faults S? and T? of Y-26). Their map does not include the area of the other faults included in ECR.); Y-1196: Faulds and others, 1991 (They show the Black Cone and the west lava faults of Y-1201 and Y-1230, plus several other approximately north–striking faults between the two. They also portray several other faults west of the Windy Wash fault. These faults may correlate with Faults S and T of Y-26.); Y-1201: Ramelli and others, 1991 (They show their Black Cone fault, as well as the west lava fault of Y-1230 (p. 1-64, fig. 2, p. 1-74). They also show faults west of the Windy Wash fault. These faults may correlate with Faults S, T, and U of Y-26.); Y-1230: Bell and others, 1990 (They show their west lava fault (fig. 2, p. [8]), an unnamed fault located 1 km northeast of Black Cone (fig. 3, p. [9]) that they correlate with Fault V of Y-26 and that appears to correlate with the Black Cone fault of Y-1201, and faults west of the Windy Wash fault. The faults west of the Windy Wash fault probably correlate with Faults S, T, and U of Y-26.) An extension of the west lava fault of Y-1230 (fig. 2, p. [8]) south of lat 36°45'N. is not shown by Swadley and Carr (1987, Y-65) along an outcrop of Pliocene basalt (the Basalt of Crater Flat of Y-65).

Location: ECR includes three faults along the eastern side of Crater Flat and west of the Windy Wash fault: Faults S, T, and U of Y-26. ECR also includes two faults in eastern Crater Flat: the west lava fault (WL) and the Black Cone fault (BLK) of Y-1201 and Y-1230. (A portion of Fault V of Y-26 appears to correlate with BLK.) Locations are shown below in order of increasing distance from the site.

For Fault S: 4 km/279° (distance and direction of closest point from YM) at lat 36°51'N. and long 116°31'W. (location of closest point).

For Fault T: 5 km/270° (distance and direction of closest point from YM) at lat 36°50'N. and long 116°32'W. (location of closest point).

For BLK: 7 km/255° (distance and direction of closest point from YM) at lat 36°49'N. and long 116°33'W. (location of closest point).

For WL: 7 km/218° (distance and direction of closest point from YM) at lat 36°46'N. and long 116°31'W. (location of closest point).

For Fault U: 16 km/209° (distance and direction of closest point from YM) at lat 36°43'N. and long 116°32'W. (location of closest point).

USGS 7-1/2' quadrangle: Big Dune, Crater Flat, East of Beatty Mtn.

Fault orientation: Most of Fault S strikes north–northeast; its southern end strikes north–northwest (Y-26, pl. 1, p. 17). Fault T generally strikes north–northeast (Y-26, pl. 1, p. 17). BLK consists of a zone of north–northwest– or northwest–striking traces (Y-26, pl. 1, p. 17; Y-1201, p. 1-65; Y-1230, p. [7]). WL strikes north–northeast and is vertical where exposed at one locality (Y-1196; Y-1201, p. 1-64). Fault U strikes northeast (Y-26, pl. 1, p. 17).

Fault length: Y-26 (pl. 1, p. 17) noted that the length of Fault S is about 12 km. Y-26 (p. 17) stated that Fault T is 7 km long. BLK forms a zone 3.5 to 6.5 km long as estimated from Y-1196 and Y-1201 (fig. 2, p. 1-74). (The longer value is measured if a north–striking trace east and southeast of Black Cone is included in BLK.) The portion of BLK that is shown by Y-26 (pl. 1, their Fault V) is about 1 km long. WL is about 8 km long as estimated from Y-1201 (fig. 2, p. 1-74) and Y-1230 (fig. 2, p. [8]). The portion of Fault U that has definite surficial expression is noted by Y-26 (p. 17) to be 0.2 km long; the fault apparently continues to the southwest as a lineament on aerial photographs another 0. 3 km (Y-26, p. 17) for a total length of about 0.5 km.

East Crater Flat faults (ECR) — Continued

Style of faulting: Displacement on Fault S (Y-26, pl. 1, p. 17) is down to the east at the southern end of the fault and down to the west at the northern end. Displacement on Fault T (Y-26, pl. 1, p. 17) is down to the west. BLK consists of scarps that are chiefly east–facing, but some are west–facing (Y-26, pl. 1, p. 17; Y-224; Y-1201, p. 1-65; Y-1230, p. [10]). WL has west–side–down displacement (Y-1201, p. 1-64). Displacement on Fault U (Y-26, pl. 1, p. 17) is down to the west.

Scarp characteristics: Y-26 (p. 17) measured a topographic profile across a scarp along Fault T and concluded that the maximum scarp–slope angle is 11°, the scarp height is 1 m, and the surface offset is 0.7 m. (This scarp is on surfaces of early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9).)

Y-1201 (p. 1-65) and Y-1230 (p. [4]) interpreted lineaments associated with BLK as small scarps a few centimeters high. However, they noted that these lineaments are visible on aerial photographs only under certain low–sun–angle conditions and that they are difficult to locate on the ground.

By viewing low–sun–angle aerial photographs, Y-1201 (p. 1-64) recognized a "subdued" scarp associated with WL. This scarp, which is located on a late Pleistocene surface (their Late Black Cone surface) north of the outcrop of Pliocene basalt that is bounded in part by WL, is <1 m high.

Displacement: The only report of displacement on these faults is that of Y-1201 (p. 1-64), who noted that the late Pleistocene displacement on WL is <1 m. (This is the displacement on their Late Black Cone surface.)

Age of displacement: Y-26 (pl. 1, p. 17) noted that the southern 1.1 km of Fault S displaces early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9). They also suggested that middle Pleistocene deposits (their Q2c unit with an estimated age of 270 ka to 800 ka; fig. 3, p. 9) appear to be deposited along the scarps on the QTa surfaces. A map by Y-1230 (fig. 5, p. [14]) shows two northeast–striking faults west of the Windy Wash fault. One of these two, both of which are portrayed as "recently active," is probably correlative with Fault S of Y-26.

Y-26 (p. 17) indicated that Fault T displaces early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9) and that it also displaces these deposits against Tertiary volcanic rocks. A map by Y-1230 (fig. 5, p. [14]) shows two northeast–striking faults west of the Windy Wash fault. One of these two, both of which are portrayed as "recently active," might be correlative with Fault T of Y-26.

Y-1042 (pl. 1) noted several primarily north–trending lineaments, chiefly topographic or geomorphic features but also some drainage alignments, west of the Windy Wash fault. Some of these lineaments may correspond to the northern portions of Faults S and T as mapped by Y-26 (pl. 1). Y-1042 (p. 4) concluded that these lineaments are associated with "minor northwest–trending dike–filled fractures" and that they "define a diffuse zone of minor faulting that lies west of the main strand of the Windy Wash fault."

East Crater Flat faults (ECR) — Continued

Y-26 (p. 17) concluded that their Fault V (part of BLK of Y-1201) displaces early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9). They reported that this part of BLK is also visible on aerial photographs as a vegetation lineament where the fault crosses surfaces of middle Pleistocene deposits (their Q2c unit with an estimated age of 270 ka to 800 ka; fig. 3, p. 9). They could not determine if the fault actually displaces the middle Pleistocene deposits or if the lineament is the result of vegetation following fractures in the underlying QTa deposits. Y-1201 (p. 1-65) reported that BLK is expressed as "sharp lineations" on Pleistocene or early Holocene surfaces (their Little Cones surface that Y-1196 (p. 1-56) reported to be bracketed by rock varnish dates of 6.6 ka and 11.1 ka). Y-1230 (p. [4, 10]) noted that BLK is expressed on low–sun–angle and other high–contrast, black–and–white aerial photographs as indistinct tonal lineaments. Both Y-1201 (p. 1-65) and Y-1230 (p. [4, 10]) interpreted the lineaments to be small scarps a few centimeters high. However, Y-1201 (p. 1-65) noted that these lineaments are visible only under certain low–sun–angle conditions, and Y-1230 (p. [10]) reported that the features were difficult to find on the ground, partly because the scarps are preserved on fluvial gravel bars but have been modified by flow in the adjacent swales. Y-1201 (p. 1-65) stated that "[f]ield inspection neither definitely confirms nor disproves a Holocene surface–rupture origin for these features, but recent surface faulting appears to be the most plausible origin." Y-1201 (p. 1-65) and Y-1230 (p. [10]) concluded that the size, morphology, and possible age of these scarps indicate that the youngest rupture on BLK is similar in size and age to those interpreted by Whitney and others (1986, Y-12) for the Windy Wash fault (about 10 cm of displacement in deposits with an estimated age of 3 ka to 6 ka).

WL bounds the western side of the largest outcrop of Pliocene basalt in eastern Crater Flat (Y-1201, p. 1-64). Y-1201 (p. 1-64) noted one exposure where the fault is a "vertical contact between the Pliocene basalt and cemented Quaternary alluvium." Y-1201 (p. 1-64) identified a scarp associated with WL on a late Pleistocene surface (their Late Black Cone surface with its age bracketed by rock varnish dates of 17.3 ka and 30.3 ka as reported by Y-1196, p. 1-56).

Fault U was reported by Y-26 (p. 17) to displace early Pleistocene to latest Pliocene deposits (their QTa unit with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9) against Tertiary volcanic rocks. They also noted that Fault U to the southwest is partly covered by early Holocene alluvium (their Q1c unit with an estimated age of 7 ka to 9 ka; fig. 3, p. 9).

Y-238 (pl. 3) showed parts of Faults S and T, the portion of BLK portrayed as Fault V by Y-26, and Fault U as faults that are in Quaternary deposits and that were identified from previous mapping.

Slip rate: Using the <1 m of displacement on a surface with an estimated age of 17.3 ka to 30.3 ka as reported by Y-1201 (p. 1-64), the maximum apparent vertical slip rate on WL is 0.03 to 0.06 mm/yr during the last 17,000 yr or 30,000 yr.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished information (Y-26, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000; Y-1201, p. 1-62) and vertical aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000). Measurement of topographic profiles across fault scarps (Y-26, p. 6).

Relationship to other faults: Y-1042 (p. 4) suggested that the north–trending lineaments west of the Windy Wash fault represent minor geologic structures (Faults S? and T? of Y-26), if they indeed reflect normal fault displacements at all, and that these faults may merge with the Windy Wash fault south of West Ridge (Y-1042, pl. 1).

Because vegetation lineaments, but no fault scarps, are recognized by Y-1201 (p. 1-66) on a middle Pleistocene surface (their Yucca surface that Y-1196 (p. 1-56) reported to be bracketed by rock varnish dates of 360 ka and 370 ka) between the scarps of BLK and the Bare Mountain piedmont, Y-1201 (p. 1-66) concluded that "the recent activity of the Black Cone fault [BLK] reactivated a small portion of a more extensive northwest–trending structure."

East Crater Flat faults (ECR) — Continued

The northern end of WL as mapped by Y-1201 (fig. 2, p. 1-74) and by Y-1230 (fig. 2, p. [8]) nearly intersects the western splay of the Windy Wash fault as portrayed by Y-1042 (pl. 1).

Y-182 (fig. 29, p. 67, 70) suggested that faults on the eastern side of Crater Flat may be related to calderas buried beneath Crater Flat, his Crater Flat caldera to the south and his Prospector Pass caldera to the north, so that the *en echelon* faults on the eastern side of Crater Flat are reactivated ring fracture faults that were oriented favorably to younger stresses (Y-144, p. 27). He (Y-182, p. 72) based this conclusion in part on the correlation of suspected Quaternary faults and his proposed location of the caldera margins (or ring fractures), which he determined by fault patterns, basalt distribution, gravity studies, and aeromagnetic maps, and by an apparent relationship between the timing of Quaternary fault displacements and basaltic volcanism in Crater Flat (Y-26). Y-396 (p. 276-277) summarized arguments both for and against the presence of calderas beneath Crater Flat.

Y-616 (p. 7) reasoned that the occurrence of outcrops of Tertiary volcanic tuff in Crater Flat west of the eastern margin of the basin as defined by alluvium suggests that the eastern margin of Crater Flat is not controlled by "large–scale youthful faulting." Y-616 (p. 7) further concluded that the abrupt termination of 3.75–Ma basalts and tuffs slightly east of the center of Crater Flat indicates "that an important fault or fault zone may lie nearly along the north–south axis of the basin." This inferred fault is shown on his fig. 2 (p. 4) and by Y-141 (fig. 1, p. 4) as a down–to–the–west fault concealed beneath Quaternary and late Tertiary alluvium (his QTa deposits). He (Y-616, p. 7) also noted that gravity studies by Snyder and Carr (U.S. Geological Survey, written commun., 1981, *cited by* Y-616, p. 7) suggest that volcanic and alluvial deposits extend to a depth of at least 2,500 m (8,200 ft) beneath central Crater Flat. The East Crater Flat faults described here all appear to be east of the concealed fault proposed by Y-616 (fig. 2, p. 4) and Y-141 (fig. 1, p. 4), from which the map of Y-616 was taken. The difference in location implies that the East Crater Flat faults are probably not the surficial expression of their concealed fault. However, the structural relationships between the East Crater Flat faults and the proposed fault concealed beneath Crater Flat are not known. For example, Y-616 (fig. 2, p. 4) and Y-141 (fig. 1, p. 4) both showed a concealed fault between Black Cone and a small outcrop of Miocene tuff, lava, and sedimentary rocks (their Tt deposits) northeast of Black Cone. BLK as portrayed by Y-1196 appears to be located east of this outcrop of Tertiary rocks. This implies that BLK is probably not the surficial expression of the concealed fault of Y-141 and Y-616.

Y-1201 (p. 1-66) concluded that surface faults in the Yucca Mountain area are characterized by a dense system of interconnected faults and that the system extends from Yucca Wash to the southern end of Crater Flat, an area about 30 km by 15 km.

Y-29 (p. 55) suggested that a low–angle (about 30°) detachment fault surface extends beneath Crater Flat. However, the relationship between the higher–angle faults and this surface is not known.

East Magruder Mountain fault (EMM)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 2). Not shown by Albers and Stewart, 1972 (Y-407) nor by Dohrenwend and others, 1992 (Y-853).

Location: 113 km/305° (distance and direction of closest point from YM) at lat 37°26'N. and long 117°29'W. (location of closest point). EMM is located along the southeastern side of Magruder Mountain.

USGS 7-1/2' quadrangle: Lida, Magruder Mountain, Tule Canyon.

Fault orientation: EMM strikes northeast (Y-238).

Fault length: The length of EMM is 7 km as estimated from Y-238.

Style of faulting: No information.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: EMM is portrayed by Y-238 as a lineament along a linear range front.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: EMM is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat, such as the Montezuma Range fault (MR) along the western side of the Montezuma Range north of EMM, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges northwest of EMM, the Gold Mountain fault (GOM) along the western side of Gold Mountain southeast of EMM, and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains immediately northwest of EMM. EMM differs from these faults in that it apparently has down–to–the–southeast displacement instead of the fairly consistent down–to–the–northwest displacement exhibited by most of the other northeast–striking faults in the region (Y-10, p. 60). EMM is also approximately parallel to northeast–striking faults within basins, such as the Stonewall Flat faults (SWF) within Stonewall Flat northeast of EMM, the Palmetto Mountains–Jackson Wash faults (PMJW) in the valley northeast of Palmetto Mountains immediately northeast of EMM, and the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range north of EMM (Y-238; Y-853). The structural relationships among all these faults are not known.

Y-238 (p. 3) speculated that the northeast–striking faults in the area around EMM could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) suggested that these faults are rooted in a detachment fault at depth.

East Nopah fault (EN)

Plate or figure: Plate 2.

References: Y-69: McKittrick, 1988; Y-161: Burchfiel and others, 1983; Y-222: Streitz and Stinson, 1974; Y-238: Reheis and Noller, 1991; Y-696: Hoffard, 1991 (pls. 1 and 2; name from this reference, pl. 1, p. 3; part of her Pahrump fault system, p. 3); Y-706: Wright, 1989; Y-806: Hoffard, 1990 (her Nopah Range fault zone); Y-1020: Jennings, 1992. Not shown by Malmberg, 1967 (Y-845).

Location: 85 km/159° (distance and direction of closest point from YM) at lat 36°08'N. and long 116°07'W. (location of closest point). EN is located about 0.5 km east of the Nopah Range along the southwestern edge of Pahrump Valley.

USGS 7-1/2' quadrangle: Nopah Peak, Sixmile Spring, Stewart Valley.

Fault orientation: Y-696 (table 1, p. 28, 41) noted that the overall strike of EN is N. 33° W. The strike of the southern 9 km, which is composed of five *en echelon* segments, is N. 16° W. to N. 30° W. (Y-696, p. 41). Fault traces that splay to the southeast away from the main trace of EN strike between N. 18° W. and N. 8° E. (Y-696, p. 41).

Y-696 (p. 33) suggested that EN is probably nearly vertical because surface traces remain straight and linear across changes in topography.

Fault length: The minimum length of EN is between 17 km (Y-238; Y-696, table 1, p. 28) and 19 km (estimated from Y-69). The southern end of EN extends to lat 36°N. as portrayed by Y-696 (pl. 1). This is the southern edge of her map area, so that EN may continue south of this. In addition, EN may extend northward and include strong vegetation lineaments along the western side of Stewart Valley (Y-696, p. 30). However, no evidence has been found for fault displacement through Chicago Pass (between Pahrump and Stewart valleys), and Y-696 (p. 30) suggested that it is likely that EN terminates at the northern end of a series of north–striking, left–stepping, east–side–down normal fault traces near the northern end of the Nopah Range. Individual fault traces within EN are between 1.8 and 3 km long (Y-696, p. 41).

Style of faulting: Y-696 (p. 33, 38, 48) inferred right–lateral displacement on EN by the fault's straight and narrow trace, scarps that face both east and west, juxtaposition of alluvial–fan deposits of different ages, possible right–lateral displacement of alluvial–fan remnants, lack of topographic expression, possible right–lateral displacement of drainages, and a left–stepping, *en echelon* fault pattern. Preservation of horsts, grabens, and low hills interpreted to be alluvial–fan remnants that have been deformed by compression also suggests right–lateral displacement (Y-696, p. 33). However, Y-696 (p. 37-38) admitted that possibly displaced drainage channels do not show consistent right–lateral displacement as interpreted from aerial photographs.

Y-696 (p. 48) concluded that there is no evidence that suggests a component of vertical displacement during the most–recent activity on EN. The ratio between lateral and vertical displacement is not known for older events (Y-696, p. 48).

Scarp characteristics: Y-696 (p. 32, 47) noted that scarps are readily visible on aerial photographs, but appear subdued from the ground. Scarps are both east– and west–facing and apparently juxtapose laterally displaced alluvial–fan remnants (Y-696, p. 38). A scarp at one locality is 3 m high; scarps on early Pleistocene and (or) late Tertiary surfaces (QT surfaces of Y-69) are 8 m high (Y-696, p. 40). The highest scarps are preserved where older alluvial–fan remnants are juxtaposed against younger fan remnants (Y-696, p. 40). Alluvium has ponded against west–facing (uphill–facing) scarps (Y-696, p. 33). EN is also expressed as *en echelon* and subparallel lineaments (Y-238; Y-696), dark lines that are commonly fractures or cracks on strongly carbonate–cemented surfaces (Y-696, p. 33).

East Nopah fault (EN) — Continued

Displacement: Scarps on early Pleistocene and (or) late Tertiary surfaces (QT surfaces of Y-69 thought to be older than 300 ka to 500 ka) indicate 8 m of apparent vertical displacement (Y-696, p. 40). Vertical displacement across many of the scarps is difficult to estimate from scarp height because surfaces of different ages are preserved on opposite sides of the scarps (Y-696, p. 47). The amount of lateral displacement has not been estimated.

Age of displacement: The youngest faulting event on EN is estimated by Y-696 (p. 47) to have occurred probably in the middle to late Pleistocene. The youngest surfaces displaced by abundant faults are late and (or) middle Pleistocene age (Qf2 surfaces of Y-69 thought to be older than 10 ka and younger than 300 ka to 500 ka) (Y-696, p. 46-47). Older surfaces (Qf1 and QTf surfaces of Y-69 thought to be older than 300 ka to 500 ka) are also displaced (Y-69; Y-696). Early Holocene and (or) latest Pleistocene surfaces (Qf3 surfaces of Y-69) may be displaced at one locality (Y-69). Early to late Holocene surfaces (Qf4 surfaces of Y-69) are not displaced (Y-69; Y-696, p. 47).

Y-696 (p. 47) noted that scarp morphology is difficult to use to estimate age of displacement because scarps are on surfaces cemented by pedogenic carbonate, which influences scarp morphology and erosion rates. In addition, scarps may juxtapose surfaces of different ages as a result of a lateral component of displacement (Y-696, p. 47). Strong, *en echelon* vegetation lineaments on youngest Holocene sediments along the northwestern edge of the Pahrump playa may indicate middle to late Holocene displacement (Y-696, p. 47). However, these lineaments trend north to northeast and the relationship between any fault directly associated with these lineaments and EN is not known.

Y-1020 showed EN as having Quaternary (since 1.6 Ma as defined by Y-1020) displacement, based on an assessment by Jennings (1985, Y-415).

Slip rate: An apparent vertical slip rate of 0.006 to 0.06 mm/yr was estimated by Y-696 (p. 48) at one locality along a north–striking trace of EN, using a 3–m–high scarp on a middle to late Pleistocene surface (Qf2 surface of Y-69 with an estimated age of 50 ka to 500 ka).

Recurrence interval: No information.

Range-front characteristics: EN is located about 0.5 km east of the Nopah Range front (Y-696). Tectonic features along this range front have not been evaluated.

Analysis: Conventional and low–sun–angle aerial photographs (Y-69; Y-161; Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-696, p. 8-9, scales 1:12,000 (low–sun–angle) and 1:80,000). Field examination of several fault traces in EN (Y-161; Y-696, p. 9). Analysis of seismic reflection lines (Y-696).

Relationship to other faults: EN is the westernmost fault in the Pahrump fault system of Y-696 (p. 3). This system also includes the Pahrump fault (PRP; her Pahrump Valley fault zone) and the West Spring Mountains fault (WSM; her West Spring Mountains fault zone). EN has been included with the Pahrump fault by other investigators (e.g., Y-238).

Weakly expressed lineaments and a linear contact between alluvial–fan deposits and playa deposits in Pahrump Valley are subparallel to and 1 to 2.5 km east of EN. These features may indicate that additional fault traces exist east of EN as it is shown on plate 1 of this compilation.

East Pintwater Range fault (EPR)

Plate or figure: Plates 1 and 2.

References: Y-404: Tschanz and Pampeyan, 1970 (pl. 3; the northern 22 km of EPR is shown as their Pintwater fault); Y-671: Guth, 1990; Y-813: Reheis, 1992 (pls. 2 and 3); Y-852: Dohrenwend and others, 1991. Not shown by Ekren and others, 1977 (Y-25).

Location: 81 km/86° (distance and direction of closest point from YM) at lat 36°53'N. and long 115°32'W. (location of closest point). EPR is located along the eastern side of the Pintwater Range at its junction with Three Lakes Valley (unlabeled on pls. 1 and 2 of this compilation).

USGS 7-1/2' quadrangle: Black Hills NW, Dog Bone Lake South, Heavens Well, Quartz Peak, Southeastern Mine, Tim Spring.

Fault orientation: EPR strikes generally north (Y-813; Y-852). The fault is portrayed by Y-813 and Y-852 as discontinuous, curving traces with strikes ranging between northwest and northeast.

Fault length: EPR is discontinuous over a length of about 58 km as estimated from Y-852 south of lat 37°N. and from Y-813 north of this latitude.

Style of faulting: Displacement on EPR north of lat 37°N. is shown as down to the east by Y-404 (pl. 3) and by Y-813 (pl. 2). Displacement on EPR south of lat 37°N. is portrayed by Y-813 (pl. 3) as also down to the east.

Scarp characteristics: No information.

Displacement: No information

Age of displacement: Scarps are noted at only one locality by Y-852 and are shown on depositional or erosional surfaces that are possibly early to middle Pleistocene (their Qi? surfaces with estimated ages between 130 ka and 1.5 Ma). The map by Y-813 shows EPR primarily as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping. This map also portrays short (generally ≤1 km) sections as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits and as weakly expressed to prominent lineaments or scarps on surfaces of Tertiary deposits. Y-404 portrayed the northern 22 km as a faulted contact between pre–Tertiary rocks and Pleistocene(?) older alluvium (their Qol deposits).

Faults and lineaments that branch from EPR are portrayed by Y-813 as having expression on surfaces of Tertiary deposits only. These branch faults are omitted from plates 1 and 2 of this compilation.

Slip rate: No information

Recurrence interval: No information

Range-front characteristics: Most of EPR has been portrayed by Y-852 as a fault juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of the eastern side of the Pintwater Range is similar to that along a major range–front fault in that it is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, EPR is significantly less extensive and fault scarps are substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852). Portions of EPR are also shown by Y-813 as a topographic lineament bounding a linear range front.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000). Field mapping (Y-404, p. 2).

East Pintwater Range fault (EPR) — Continued

Relationship to other faults: EPR is one of several north–striking faults bounding range fronts directly east of Yucca Mountain and north and northwest of Las Vegas. Other north–striking faults in this area are the West Pintwater Range fault (WPR), the Sheep Range fault (SHR), the Sheep Basin fault (SB), and the Sheep–East Desert Ranges fault (SEDR). Y-671 (p. 242) suggested that these faults are related to an inferred major detachment system (his Sheep Range detachment), but that the style of displacement along these faults changes somewhere between SEDR and his inferred Dog Bone Lake fault (not shown on pls. 1 and 2 of this compilation) along the western side of the Desert Range. Faults west of this change have caused less rotation of rocks than have the faults to the east, have been localized by Mesozoic structures, and have developed along the western edges of ranges so that the faults define structural blocks that include the next range to the west (Y-671, p. 242). However, EPR differs from these faults because it bounds the eastern side of the Pintwater Range (Y-813, p. 5).

EPR has a strike similar to those of faults within the Pintwater Range. These faults are shown by Y-813 as faults that are in Tertiary deposits and that were identified from previous mapping. They are not shown on plates 1 and 2.

The southern end of the Pintwater Range (along with the southern end of the Spotted Range to the west) bends to the southwest as it approaches east–striking faults to the west, such as the Cactus Springs fault (CAC) and the South Ridge faults (SOU). These east–striking faults have been interpreted to be part of the Las Vegas shear zone by Y-813 (p. 5). EPR, as a range–bounding fault, correspondingly bends. Y-813 (p. 5) suggested that EPR appears to merge with the northeast–striking, left–lateral faults of the Spotted Range–Mine Mountain section of the Walker Lane.

Several northeast–trending, down–to–the–west, <2–km–long fault scarps are shown by Y-852 within Three Lakes Valley about 5 km east of the Pintwater Range (pl. 2). These scarps are shown by Y-852 to be on depositional or erosional surfaces that are early to middle Pleistocene (their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma) and latest Pleistocene and (or) Holocene (their $Q_{2\text{-}3}$ surfaces with estimated ages of less than 30 ka). The structural relationship of these scarps to EPR is not known.

The northward extension of EPR is unclear. Fault traces along the western side of the northern Desert Range (the North Desert Range fault; NDR) are directly north of and approximately coincident with EPR (pl. 1). However, displacement on NDR is down to the west rather than down to the east as it is for EPR. In addition, the southern part of NDR strikes northeast and appears to cut across any northward extension of the north–striking EPR. Furthermore, the northwest–striking Three Lakes Valley fault (TLV) nearly intersects both NDR and EPR in this area (pl. 1). The structural relationships among these faults are not known.

A map by Y-671 (fig. 3, p. 240) shows an inferred north–northeast–striking, down–to–the–west fault that is concealed along the eastern side of Three Lakes Valley where the valley merges with the Desert Range. He called this the Dog Bone Lake fault and inferred that such a fault must exist because more than 5 km of vertical displacement is needed in order to juxtapose Precambrian and Ordovician rocks (Y-671, p. 242). This fault has been inferred to "have reactivated the ramp in the basal decollement for Sevier thrusts* * *" (Y-671, p. 242).

East Reveille fault (ERV)

Plate or figure: Plate 1.

References: Y-5: Ekren and others, 1971; Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pl. 1); Y-853: Dohrenwend and others, 1992; Y-1020: Jennings, 1992; Y-1032: Schell, 1981 (pls. 7 and 8; name from his table A2, fault #110; he extended ERV north of lat 38°N.).

Location: 112 km/14° (distance and direction of closest point from YM) at lat 37°49′N. and long 116°08′W. (location of closest point). ERV is located along the western side of the Reveille Range at its junction with the Reveille Valley.

USGS 7-1/2′ quadrangle: Reveille Peak, Reveille Peak NW, Reveille Peak SE.

Fault orientation: ERV strikes generally north–northwest (Y-5; Y-232; Y-813; Y-853).

Fault length: The total length of ERV is noted to be 22 km by Y-1032 (table A2, p. A20). The length of ERV is also 22 km as estimated from Y-232 and Y-813. The length of ERV is 19 km as estimated from Y-853, who does not extend ERV south of Reveille Peak as does Y-813. The length of ERV is 36 km as estimated from Y-5, which includes an extension of the fault southeast into Monotony Valley to the eastern boundary of their map area at long 116°W. ERV intersects the edges of the map areas of Y-232, Y-813, and Y-853 at lat 38°N. and the edge of the map area of Y-5 at lat 37°52′30″N.

Style of faulting: ERV is shown by Y-813 and Y-1032 primarily as a down–to–the–west fault.

Scarp characteristics: Scarps associated with ERV that were identified by Y-813 are primarily west–facing.

Displacement: No information.

Age of displacement: The age of the youngest displacement along ERV is noted by Y-1032 (table A2, p. A20) as probably late Pleistocene (defined as 15 ka to 700 ka by Y-1032, p. 29). This age estimate is based on a short segment at the southern end of the Reveille Range where the fault displaces his old–age alluvial–fan deposits (A5o; table A2, p. A20) with an estimated age of 700 ka to 1.8 Ma (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A20) with an estimated age of <15 ka (table 3, p. 23).

ERV is portrayed by Y-813 as faults that are in Quaternary, primarily, and Tertiary deposits and that were identified from previous mapping and as weakly expressed to prominent lineaments and scarps on surfaces of Tertiary deposits. She also showed portions of ERV at scattered localities as weakly expressed lineaments or scarps on surfaces of Quaternary deposits. ERV is also indicated by Y-853 to be one of the major range–front faults in the area, all of which, they noted, display evidence for Quaternary activity. In contrast, the map by Y-5 shows ERV as concealed by Pliocene through Holocene alluvium and colluvium (their QTa deposits), and Y-232 indicated that ERV is concealed by Quaternary basalt (his Qb unit). The map by Y-232 shows that ERV juxtaposes Miocene Tuff of White Blotch Spring (his Twb unit) against Quaternary alluvium (his Qal deposits), Miocene dacite and rhyodacite (his Td unit), or Oligocene/Miocene tuff (his Tw unit).

Slip rate: No information.

Recurrence interval: No information.

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

East Reveille fault (ERV) — Continued

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1020, p. 15-16, scales ~1:25,000 and ~1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-5). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: ERV is approximately parallel to other north–northeast– and north–northwest–striking, major range–bounding faults in the area. These faults include the Hot Creek–Reveille fault (HCR) along the eastern side of the Kawich Range west of ERV, the Kawich Range fault (KR) along the western side of the Kawich Range west of ERV, the Belted Range fault (BLR) along the western side of the Belted Range immediately south of ERV, and the West Railroad fault (WR) along the eastern side of the Reveille Range (Y-5; Y-232; Y-813; Y-853). ERV is also approximately parallel to faults within basins in the area. These faults include the Central Reveille fault (CR) within Reveille Valley immediately west of ERV, the East Stone Cabin fault (ESC) in the Stone Cabin Valley west of ERV, and the Cactus Flat fault (CF) within Cactus Flat. The structural relationship among these faults is not known.

ERV has been extended by Y-5 southeast of the Reveille Range front into the central part of the Monotony Valley as a concealed fault. The map by Y-813 shows lineaments and scarps in Monotony Valley, but the relationship between ERV and possible faults in Monotony Valley is not known.

Y-1020 (pl. 8) showed lineaments approximately parallel to ERV preserved west of the range front within Reveille Valley. Their structural relationship to ERV is not known.

East Stone Cabin fault (ESC)

Plate or figure: Plate 1.

References: Y-232: Cornwall, 1972 (pl. 1; He shows a northeast–striking fault in Tertiary rocks south of lat 38°N. This fault is east of the scarps of ESC as shown by Y-853 and Y-1032.); Y-813: Reheis, 1992 (pl. 1; shows only that portion of ESC south of lat 38°N.); Y-853: Dohrenwnd and others, 1992 (show only that portion of ESC south of lat 38°N.); Y-1032: Schell, 1981(pls. 7 and 8; name from his table A2, fault #135).

Location: 115 km/348° (distance and direction of closest point from YM) at lat 37°50′N. and long 116°42′W. (location of closest point). ESC is located along the eastern side of Stone Cabin Valley.

USGS 7-1/2′ quadrangle: Stinking Spring, Stinking Spring NW, Stone Cabin Ranch NE, Stone Cabin Ranch SE, Stone Cabin Ranch SW, Warm Springs Summit.

Fault orientation: ESC generally strikes northeast (Y-1032), but a trace near its southern end strikes north (Y-853; Y-1032).

Fault length: The length of ESC is noted to be 35 km by Y-1032 (table A2, p. A25). Branching and subparallel scarps and lineaments shown by Y-813 would make ESC nearly 7 km wide.

Style of faulting: Displacement on fault traces is shown by Y-813, Y-853, and Y-1032 as down to the west or northwest.

Scarp characteristics: Scarps are shown by Y-813, Y-853, and Y-1032 as west– or northwest–facing. ESC is described by Y-1032 (table A2, p. A25) as a highly discontinuous zone of scarps.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along ESC is noted by Y-1032 (table A2, p. A25) as late Pleistocene (defined as >15 ka to <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i, table A2, p. A25) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y, table A2, p. A25) with an estimated age of ≤15 ka (table 3, p. 23). The oldest unit displaced is his middle Tertiary volcanic rocks (Tv_2, table A2, p. A25) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

Y-853 portrayed ESC as fault scarps on depositional or erosional surfaces with ages of late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) and early to middle and (or) late Pleistocene (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). These scarps are aligned with fault–related lineaments on Quaternary depositional or erosional surfaces. The map of Y-813 shows ESC as weakly (primarily) to moderately expressed lineaments or scarps on surfaces of Quaternary (primarily) and Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

East Stone Cabin fault (ESC) — Continued

Relationship to other faults: The structural relationship of ESC to faults within Cactus Flat south and west of ESC (e.g., the Cactus Flat–Mellan fault (CFML) and the Cactus Flat fault (CF)) or to faults along the western side of the Kawich Range east of ESC (the Kawich Range fault (KR)) is not known. ESC generally strikes more northeastward than the north–striking CFML (although one trace of ESC strikes northward as shown by Y-853). Because of this apparent difference in strike, the two faults have been separated in this compilation. However, CFML may actually be a southern extension of ESC. ESC as portrayed by Y-813 (pl. 1) does not seem to intersect CF to the west, because the southern end of ESC parallels CF. KR generally strikes northwestward, but its northern end strikes north–northeast and approximately parallels ESC. It is possible that the two faults intersect north of lat 38°N., the northern boundary of plate 1 of this compilation. However, Y-1032, the only reference to extend mapping north of this latitude, does not show KR.

Eleana Range fault (ER)

Plate or figure: Plate 1.

References: Y-90: Szabo and others, [1981]; Y-176: Gibbons and others, 1963; Y-181: Carr, 1974; Y-182: Carr, 1984; Y-224: Frizzell and Shulters, 1990; Y-526: Swadley and Hoover, 1990; Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992; Y-961: Fernald and others, 1968.

Location: 37 km/38° (distance and direction of closest point from YM) at lat 37°05'N. and long 116°11'W. (location of closest point). ER is located along the eastern side of the Eleana Range at its junction with the western edge of Yucca Flat.

USGS 7-1/2′ quadrangle: Rainier Mesa, Tippipah Spring.

Fault orientation: ER strikes northeast to north–northeast. Y-526, Y-813, and Y-853 showed part of ER as several subparallel strands.

Fault length: ER is mapped discontinuously for lengths of 6 km (Y-526), 9 km (Y-813), and 13 km (Y-853). The longer measurement of Y-853 includes a northern extension of ER along a north–northwest–trending drainage (not shown on pl. 1 of this compilation).

Style of faulting: Displacement on ER has been dip slip (normal) and down to the east (Y-181, fig. 7; Y-182, fig. 12, p. 24; Y-224).

Scarp characteristics: At least two short (0.2 to 0.5 km long) scarps on alluvial surfaces are shown by Y-526. One scarp is located just north of Red Canyon and the other is located north of an unnamed drainage north of Red Canyon. Y-853 indicated one sharp, well–defined scarp (0.75 km long) on an alluvial surface.

Displacement: No information.

Age of displacement: The youngest surfaces on which scarps have been mapped by Y-853 are late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka). Y-526 mapped scarps at three other localities on alluvial surfaces: east of Pinyon Butte, east of Captain Jack Spring, and southeast of Captain Jack Spring. Some of these scarps are on surfaces of late and middle Pleistocene deposits (their Qap deposits with ages between about 160 ka and 800 ka). Most of the scarps are on early Pleistocene and Pliocene? surfaces (their QTa deposits thought to be older than 740 ka). Much of the fault is shown by Y-853 as juxtaposing Quaternary alluvium against Permian to late Proterozoic rocks along the Eleana Range front. They portrayed a 4–km–long section of ER as fault–related lineaments on Quaternary surfaces. The map by Y-961 shows east–facing fault scarps on surfaces of Quaternary alluvium and colluvium of two different ages (their older Qtr deposits and their younger Qfr and Qfrg deposits).

Y-90 (table 3, p. 20, 28) obtained dates (uranium–thorium method) of 128 ka ± 20 ka and >5 ka on carbonate in deposits along the eastern side of the Eleana Range. They concluded that the older date predates the present topography (before displacement on ER?) but that it is a minimum value. They further concluded that the younger date post–dates the present topography (after displacement on ER?).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The eastern side of the Eleana Range is indicated by Y-853 as having characteristics similar to those along major range–front faults, except that ER is significantly less extensive and fault scarps are lower, shorter, and less continuous. Y-813 indicated that part of ER is expressed as a lineament bounding a linear range front. Rocks at the range front generally dip to the east–southeast, into Yucca Flat (Y-176).

Analysis: Aerial photographs (Y-526; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000). Limited field examination (Y-526). Uranium–thorium analyses on carbonate samples (their H1 and H2 samples) taken from a trench along the Eleana Range (Y-90).

Eleana Range fault (ER) — Continued

Relationship to other faults: ER is probably related to other faults in Yucca Flat: the Yucca fault (YC), the Carpetbag fault (CB), the Area Three fault (AT), and several short unnamed faults. Y-182 suggested that displacement on all of these faults may have been responsible for the development of Yucca Flat into a structural basin.

Emigrant fault (EM)

Plate or figure: Plate 2.

References: Y-29: Hamilton, 1988; Y-222: Streitz and Stinson, 1974; Y-239: Reheis, 1991 (pls. 1 and 2); Y-390: Hunt and Mabey, 1966; Y-916: Wernicke and others, 1986.

Location: 73 km/245° (distance and direction of closest point from YM) at lat 36°34′N. and long 117°10′W. (location of closest point). EM is located along the western side of Tucki Mountain and east of Emigrant Canyon.

USGS 7-1/2′ quadrangle: Emigrant Canyon, Stovepipe Wells.

Fault orientation: EM strikes generally north (Y-239).

Fault length: The length of EM between Emigrant Canyon and north of Tucki Mountain is 13 km as estimated from Y-239. EM may continue south of Emigrant Canyon, if fault traces mapped by Y-239 in Tertiary deposits are included in EM (not shown on pl. 2 of this compilation).

Style of faulting: Displacement on EM is shown by Y-239 as down to the west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: EM is portrayed by Y-239 as prominent lineaments or scarps on surfaces of Quaternary deposits where a fault in Quaternary deposits was identified from previous mapping. The map of Y-222 shows EM as juxtaposing Pliocene and Pleistocene nonmarine rocks on the west against Precambrian rocks on the east.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: Y-239 (p. 2-3, *citing* Y-29 and Y-916) suggested that EM, along with the north–northeast–striking Towne Pass fault (TP), may be a northern continuation of the Panamint Valley fault (PAN) along the western side of Tucki Mountain. EM as shown by Y-239 appears to intersect TP along the northern side of Tucki Mountain.

Y-390 (p. A116) suggested that a structural valley and trough may have been present in this area along Emigrant Wash during the early Quaternary. These features may have connected Mesquite Flat to the north in Death Valley with Panamint Valley to the south (Y-390, p. A116).

Emigrant Peak faults (EPK)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-182: Carr, 1984; Y-238: Reheis and Noller, 1991 (pl. 1); Y-330: Reheis, 1988 (name from this reference; her Emigrant Peak fault zone); Y-635: Reheis, 1991 (her Emigrant Peak fault is the western fault of EPK); Y-651: Reheis and McKee, [1991]; Y-665: Sawyer, 1990; Y-737: Robinson and others, 1968; Y-853: Dohrenwend and others, 1992 (show only the western trace of EPK); Y-1028: Robinson and others, 1976 (show the western and eastern faults and parts of the two central faults of EPK). Not shown by Albers and Stewart, 1972 (Y-407).

Location: 166 km/310° (distance and direction of closest point from YM) at lat 37°48′N. and long 117°53′W. (location of closest point). EPK includes four approximately parallel faults along the eastern side of Fish Lake Valley north of lat 37°45′N. and along the western side of the Silver Peak Range and associated foothills.

USGS 7-1/2′ quadrangle: Rhyolite Ridge, Rhyolite Ridge NE, Rhyolite Ridge NW, Rhyolite Ridge SW.

Fault orientation: Faults in EPK strike generally north–northeast, but they are curving so that strikes of sections of individual faults range between east–northeast and north (Y-635).

Fault length: The length of the main trace of the western fault in EPK is about 26 km as estimated from Y-635 and Y-853. Between First Wash and Second Wash, a north–striking branch fault extends about 3 km to the south (as estimated from Y-635).

The west–central fault of EPK (north of Middle Wash) is 9.5 to 11.5 km long as estimated from Y-635. This fault may join the main trace of the western fault north of Emigrant Pass Wash.

The east–central fault of EPK is only 2 km long as estimated from Y-635.

The east fault of EPK is composed of a single trace north of about First Wash and two branches to the south of this wash (Y-635). The length of the single trace is 7.5 km as estimated from Y-635. The western branch at the fault's southern end is about 1.5 km long. The eastern branch is about 4.5 km long as estimated from Y-635. (The lengths for the east fault are minimum values because the fault extends to both the north and south edges of her map area.)

Style of faulting: Faults in EPK are generally down to the west (Y-10, p. 58; Y-635) with dip–slip (normal) displacement (Y-635; Y-651, p. 26). The western branch at the southern end of the east fault is shown by Y-635 as down to the east. One section of the western fault, the portion just south of South Wash that extends into the Silver Peak Range, strikes north–northwest and has left–lateral displacement (Y-635). This fault is interpreted by Y-10 (p. 58) to be a tear fault.

Scarp characteristics: The western fault of EPK is shown primarily as west–facing scarps (Y-635; Y-853). A few short traces or short portions of traces are shown as east–facing scarps (Y-635). Minimum vertical offset across scarps along the western fault ranges between 25.7 m and 1 m (Y-635). The higher amount was estimated at a locality about 1.3 km southwest of Middle Wash across a scarp on early Holocene and late Pleistocene alluvium (Qfl deposits of Y-635; date (^{14}C) of 6.55 ka from within these deposits; Y-635). The lower amount was estimated at Second Wash across a scarp on late Holocene alluvium (Qfcm deposits of Y-635). This fault displaces five separate alluvial–fan deposits, and scarps are progressively higher in progressively older deposits (Y-330, p. 223). No fault scarps are shown by Y-635 to be associated with the other three faults of EPK.

Displacement: On the basis of the differences between the elevation of beach sands that contain Bishop ash (740 ka) on the footwall and the present elevation of the pluvial–lake shoreline related to these sands on the hanging wall, Y-651 (p. 41, table 2, p. 37) estimated a minimum vertical displacement of 122 m for the western fault of EPK. Displacement of at least 150 m on the western fault has been estimated by Y-330 (p. 223) for deposits that include tephra tentatively identified as the Tuff of Taylor Canyon (2.2 Ma).

Emigrant Peak faults (EPK) — Continued

On the basis of projections of Glass Mountain tephra (about 1 Ma) that is exposed on the hanging wall but eroded from the footwall, Y-651 (p. 41) estimated a minimum vertical displacement of 213 m for the west–central fault of EPK.

On the basis of a projection of the base of Quaternary and Tertiary gravel (their QTg deposits, fig. 1, p. 25) on the footwall into the fault, Y-651 (p. 41) estimated a minimum vertical displacement of 74 m for the east–central fault. The projection was necessary because the base of the QTg deposits is not exposed on the hanging wall.

Y-651 (p. 41) reported that the vertical displacement across the eastern fault of EPK is not known because the fault juxtaposes QTg deposits against older Tertiary rocks.

Y-651 (p. 41) calculated a minimum cumulative displacement of 409 m since about 2 Ma across the three western faults of EPK.

Y-665 (p. 30) suggested that late–early to middle Pliocene sediments in the present Silver Peak Range between Fish Lake Valley and Clayton Valley have been uplifted at least 900 m since 5.9 Ma (K–Ar date on trachyandesite flows in the sediments). However, Y-665 (p. 30) cited Y-737 as proposing that the present topography in the Silver Peak Range was established by late Pliocene.

Age of displacement: Faults in EPK displace sediments ranging between Holocene and late Pliocene (Y-10, p. 58).

The western fault of EPK is identified by Y-330 (p. 223) as the one fault of EPK that is presently active. The youngest deposits that exhibit scarps along the western fault are shown by Y-635 to be late Holocene (her Qfcm deposits with dates (^{14}C, tephra) that range between about 1 ka and about 1.4 ka (Y-635, table 1)). These scarps are preserved at the mouths of drainages between Third Wash and an unnamed drainage north of South Wash (Y-635). The youngest depositional or erosional surfaces exhibiting scarps along this same fault are indicated by Y-853 to be early to middle and (or) late Pleistocene (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). Y-1028 portrayed the western fault of EPK as scarps along which Pleistocene and Pliocene gravel (their QTg deposits) or older Pleistocene(?) alluvium is now juxtaposed against Holocene(?) alluvial–fan deposits (their Qa deposits).

The three other faults of EPK appear to be older than the western fault and may now be inactive (Y-330, p. 223; Y-635). The three eastern faults are shown by Y-635 to displace early middle Pleistocene to late Pliocene alluvium (her QTg deposits, which contain tephra with ages between 0.7 Ma and 2.2 Ma; Y-635, table 1). These faults are generally portrayed by Y-635 as concealed by early Holocene and late middle Pleistocene alluvium (her Qfy deposits). The eastern fault juxtaposes QTg deposits (0.7 Ma to 2.2 Ma, Y-635; Y-1028) or Pliocene sedimentary rocks (Y-1028) against older Tertiary rocks (Y-635, table 1; Y-651, p. 41; Y-1028).

Slip rate: On the basis of the elevation difference (122 m) of pluvial–lake deposits associated with Bishop ash (740 ka), Y-651 (p. 41, table 2, p. 37) estimated a minimum apparent vertical slip rate of 0.16 mm/yr for the western fault of EPK. Y-651 (p. 41, table 2, p. 37) also estimated a minimum apparent vertical slip rate of about 0.2 mm/yr since about 1 Ma for this fault using the possible displacement (213 m) of a tephra of this age.

However, a minimum apparent vertical slip rate of 0.05 mm/yr for the western fault for the time interval since 2.2 Ma was estimated by Y-330 (p. 223) using 150 m of displacement in alluvial–fan deposits that include tephra tentatively correlated with the Tuff of Taylor Canyon. In addition, a maximum apparent vertical slip rate of 0.5 to 1 mm/yr for the late Holocene was estimated by Y-330 (p. 223) using 1 to 2 m of displacement in deposits estimated to have been deposited about 2 ka. Y-330 (p. 223) concluded that these two rates, plus some unstated ones estimated using alluvial–fan deposits of intermediate age, suggest that the slip rate on the western fault has progressively increased since 2.2 Ma.

For the three western faults in EPK, Y-651 (p. 41) estimated a minimum Quaternary apparent slip rate of 0.2 mm/yr using a minimum cumulative displacement of 409 m since about 2 Ma. On the basis of the minimum amount of 900 m of vertical uplift that was noted by Y-665 (p. 30) for the Silver Peak Range since 5.9 Ma, a long–term apparent vertical slip rate of 0.15 mm/yr can be estimated. This is similar to the minimum Quaternary apparent slip rate estimated by Y-651.

Emigrant Peak faults (EPK) — Continued

Recurrence interval: No information.

Range-front characteristics: The map of Y-853 shows EPK as being a major range–front fault along a range front characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to the range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to the range front."

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-635). Topographic scarp profiles and tephra correlations (Y-635, table 2). Deposit ages estimated using rock varnish, soil development, and surface morphology (Y-635, table 1).

Relationship to other faults: The approximately north–striking faults of EPK are on the opposite side of Fish Lake Valley from the Fish Lake Valley fault (FLV). Y-651 (p. 41; *citing* both Y-10 [p. 59] and Y-665) interpreted EPK as serving "as part of a pull–apart basin that transfers slip on the [FLV] to slip on faults of the Walker Lane to the northeast."

Earthquakes of up to magnitude 5.0 that were recorded between 1931 and 1974 have been located near EPK (Y-10, p. 59; *citing* W.J. Carr, written commun., 1987).

The Silver Peak caldera is located in the Silver Peak Range southeast of EPK (Y-10, p. 59, fig. 1, p. 61; *citing* Y-182). The relationship between this caldera and the faults of EPK is not reported.

Emigrant Valley North fault (EVN)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 2). Not shown by Cornwall, 1972 (Y-232), Ekren and others, 1977 (Y-25), nor by Tschanz and Pampeyan, 1970 (Y-404).

Location: 60 km/43° (distance and direction of closest point from YM) at lat 37°14′N. and long 115°59′W. (location of closest point). EVN is located in Emigrant Valley north of the Halfpint Range, east of the Belted Range, and west of Groom Lake, the Groom Range, and the Papoose Range.

USGS 7-1/2′ quadrangle: Cattle Spring, Groom Mine, Groom Mine NW, Groom Mine SW, Jangle Ridge.

Fault orientation: EVN strikes generally north–northeast to northeast (Y-813).

Fault length: The length of EVN is about 28 km as estimated from Y-813. The width of EVN is up to 12 km as estimated from Y-813. Individual fault traces range in length between about 0.5 to 7 km (Y-813).

Style of faulting: Short, subparallel traces are shown by Y-813 as both down to the northwest and down to the southeast. Down–to–the–northwest displacement seems to predominate (Y-813). A few fault traces are shown by Y-813 to have lateral displacement.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: EVN is portrayed by Y-813 as faults that are in Quaternary deposits and that were identified from previous mapping, as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits, and, rarely, as faults that are in Tertiary deposits and that were identified from previous mapping. Y-813 (p. 6) noted that EVN "includes many scarps formed on late Quaternary fan deposits and possibly on pluvial lake deposits of Groom Lake."

Slip rate: No information.

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: Structural relationships between EVN and surrounding faults are not known. Surrounding faults include the Cockeyed Ridge–Papoose Lake fault (CRPL) south of EVN, the Emigrant Valley South fault (EVS) that includes north–northeast–striking fault traces, lineaments, and scarps in Emigrant Valley south of the Papoose Range, and the Stumble fault (STM) along the western side of the Groom Range that bounds the eastern side of north Emigrant Valley. A north–northwest–striking fault trace that extends south from EVN is shown by Y-813 to nearly intersect CRPL. According to Y-813 (p. 6), EVN may transfer displacement on the north–striking Yucca fault (YC), which is southwest of EVN in central Yucca Flat, to STM, which is east of EVN. Both YC and STM are reported to have experienced Quaternary displacement (*see* description sheets for these faults).

Emigrant Valley South fault (EVS)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 2). Not shown by Ekren and others, 1977 (Y-25) nor by Tschanz and Pampeyan, 1970 (Y-404).

Location: 66 km/63° (distance and direction of closest point from YM) at lat 37°07′N. and long 115°47′W. (location of closest point). EVS is located in Emigrant Valley south and east of the Papoose Range and Groom Lake, west of the Jumbled Hills, and north of the Buried Hills.

USGS 7-1/2′ quadrangle: Fallout Hills, Fallout Hills NW, Groom Range SW, Papoose Lake, Papoose Range.

Fault orientation: EVS strikes north–northeast (Y-813).

Fault length: The length of EVS is about 20 km as estimated from Y-813. The width of EVS could be as much as 9 km, if a north–northeast–trending, east–facing scarp along the eastern side of the Papoose Range is included in EVS. Otherwise, the width of EVS is about 4 km as estimated from Y-813. EVS is arbitrarily confined to north–northeast–striking fault traces and north–northeast–trending lineaments and scarps east of and between about Papoose Lake and Groom Lake within Emigrant Valley.

Style of faulting: Short, subparallel fault traces are shown by Y-813 as both down to the west and down to the east. One fault trace is indicated as having strike–slip displacement (Y-813).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: EVS is portrayed by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits, as faults that are in Quaternary deposits and that were identified from previous mapping, and, rarely, as moderately expressed lineaments and scarps on surfaces of Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: Structural relationships between EVS and surrounding faults are not known. Surrounding faults include the Chert Ridge faults (CHR) southeast of EVS, the Jumbled Hills fault (JUM) east of EVS, the Buried Hills fault (BH) directly south of EVS, and scattered, short faults along the eastern and western sides of the Papoose Range.

Eureka Valley East fault (EURE)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 2; show only that portion of EURE north of about lat 37°18′N. and east of about long 117°53′W.); Y-484: McKee and Nelson, 1967 (show only one 1–km–long trace of EURE at the mouth of Horse Thief Canyon, north of lat 37°15′N. and west of long 117°45′W.); Y-853: Dohrenwend and others, 1992; Y-861: Lustig, 1965; Y-1031: Reheis, 1992 (shows only that portion of EURE north of about lat 37°18′N. and east of about long 117°53′W.); Y-1072: Reheis, 1993.

Location: 110 km/286° (distance and direction of closest point from YM) at lat 37°07′N. and long 117°37′W. (location of closest point). EURE is located along the northeastern side of Eureka Valley at its junction with the Last Chance Range south of Willow Creek and with the Horse Thief Hills north of Willow Creek.

USGS 7-1/2′ quadrangle: Chocolate Mountain, East of Joshua Flats, Hanging Rock Canyon, Horse Thief Canyon, Last Chance Mountain, Last Chance Range SE, Last Chance Range SW, Sand Spring, Soldier Pass, Sylvania Canyon.

Fault orientation: EURE strikes generally north–northwest, but the trace curves and individual sections strike between northwest and northeast (Y-853; Y-1031).

Fault length: The length of EURE is 34 km as estimated from Y-853, but EURE is not shown by them northwest of Willow Creek. Y-1031 indicated fault traces northwest of Willow Creek that are about 6.5 km long, which could make EURE as long as about 50 km. This length would include an apparent gap in surficial expression in the vicinity of Willow Creek.

Style of faulting: Displacement on fault traces north of Willow Creek are shown by Y-1031 as down to the west and down to the southwest.

Scarp characteristics: Scarps are primarily west– or southwest–facing; a few scarps are east–facing (Y-853; Y-1031).

Displacement: No information.

Age of displacement: Fault scarps along EURE south of Willow Wash are shown by Y-853 to be on depositional or erosional surfaces with ages of possibly late Pleistocene (their Q_2? surfaces with estimated ages between 10 ka and 130 ka) and early and middle and (or) late Pleistocene (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma).

Fault scarps north of Willow Wash are shown by Y-1031 to be between Cambrian or late Proterozoic rocks on the upthrown side of EURE and one of the following on the downthrown side of the fault: early Pliocene and late Miocene rhyolite and basalt (her Trb unit), middle Pleistocene older alluvium that contains Bishop ash (740 ka; her Qfo deposits), early Holocene to late middle Pleistocene younger alluvium (her Qfy deposits), or late and middle Holocene alluvium (her Qfc deposits). However, Y-1031 noted that the deposits on the downthrown side of the scarps are commonly not faulted. Thus, the age of youngest rupture is unclear. A 1–km–long fault trace north of Willow Creek is shown by Y-484 to be between Cambrian rocks and Miocene/Pliocene sediments (their Ts deposits) that dip 60° to 70° to the southwest away from the fault trace.

Slip rate: No information.

Recurrence interval: No information.

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

Eureka Valley East fault (EURE) — Continued

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1031). Compilation of unit correlations and age determinations for Quaternary and Tertiary deposits (Y-1031).

Relationship to other faults: EURE nearly connects with the Furnace Creek fault (FC) or the Fish Lake Valley fault (FLV) at Cucomungo Canyon, where Willow Creek enters Eureka Valley. Eureka Valley is connected to Fish Lake Valley at Horse Thief Canyon, where the divide between the two valleys is within Fish Lake Valley, so that Horse Thief Canyon drains into Eureka Valley (Y-861, p. 140).

Several east–northeast–striking faults are mapped by Y-1031 in the Horse Thief Hills east of EURE. The southern one of these faults is shown by Y-1031 as displacing early Holocene to late middle Pleistocene alluvium (her Qfy deposits) and possibly late and middle Holocene alluvium (her Qfc deposits). Two of these east–striking faults (one just south of Red Wash) are portrayed by Y-1031 as having left–lateral oblique displacement and as dipping 75° N. The relationship of these faults to EURE or to FLV along the eastern side of the Horse Thief Hills is not known.

The northern end of EURE nearly connects with the north–northeast–striking Eureka Valley West fault (EURW). However, the structural relationship between these two faults is not known.

Eureka Valley West fault (EURW)

Plate or figure: Plate 1.

References: Y-484: McKee and Nelson, 1967; Y-762: Bryant, 1988; Y-853: Dohrenwend and others, 1992.

Location: 140 km/290° (distance and direction of closest point from YM) at lat 37°17'N. and long 117°54'W. (location of closest point). EURW is located along the northwestern side of Eureka Valley about 2 km from the Inyo Mountains. It may extend to the southwest into the Inyo Mountains and along Cowhorn Valley.

USGS 7-1/2' quadrangle: Joshua Flats, Soldier Pass.

Fault orientation: EURW strikes generally north–northeast; some portions of EURW strike north or northeast (Y-853).

Fault length: The total length of EURW could be as much as 22 km (as estimated from Y-853 east of long 118°W.), if faults in the Inyo Mountains and along Cowhorn Valley are included in EURW. A scarp in northwestern Eureka Valley is 2.5 km long as estimated from Y-484 or as noted by Y-762 (p. 10) or 4 km long as estimated from Y-853. The longer value includes a 2.5–km–long fault–related lineament northeast of the scarp.

EURW could be as wide as 3.5 km, if the faults in the Inyo Mountains are included in EURW.

Style of faulting: No information.

Scarp characteristics: The scarp in northwestern Eureka Valley is shown as northwest–facing at its southwestern end by both Y-484 and Y-853 and as southeast–facing at its northeastern end by Y-484.

Displacement: No information.

Age of displacement: The southwestern end of the scarp in northwestern Eureka Valley is noted by Y-853 to be on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). This end of the scarp is noted by Y-762 (p. 8) to displace older Pleistocene alluvium and lacustrine deposits and is described by him as moderately expressed on aerial photographs. The northeastern end of this scarp is shown by Y-853 as a fault–related lineament on surfaces of Quaternary deposits. This end of the scarp is noted by Y-762 (p. 8) to be poorly defined on aerial photographs. Y-762 (p. 9) thought this end to be concealed by latest Pleistocene to Holocene alluvium.

This same scarp is portrayed by Y-484 to be on Quaternary alluvial fans (their Qf deposits) and between these fans and Quaternary lake beds (their Ql deposits). The lake beds are noted by Y-484 to dip 20° to the southeast, away from the scarp.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: Y-762 (p. 3-4) noted that the northeast–trending scarp that is mapped by Y-484 in Eureka Valley and included in EURW is not associated with the Deep Springs fault (DS), which is northwest of EURW, although the scarp has a similar orientation to that of DS.

EURW is approximately perpendicular to the north–northwest–striking Eureka Valley East fault (EURE) along the eastern side of Eureka Valley.

Fault traces of EURW in the Inyo Mountains have strikes similar to those of faults that are shown by Y-853 in the Inyo Mountains southeast of EURW. These faults are not included in EURW and are not shown on plate 1 of this compilation.

Fallout Hills faults (FH)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 2). Not shown by Ekren and others, 1977 (Y-25) nor by Tschanz and Pampeyan, 1970 (Y-404).

Location: 70 km/72° (distance and direction of closest point from YM) at lat 37°02'N. and long 115°41'W. (location of closest point). FH includes four main faults within the Fallout Hills.

USGS 7-1/2' quadrangle: Fallout Hills.

Fault orientation: FH generally strikes north–northwest, but individual faults curve, so that the strikes of some faults and sections of some faults range between northwest and north–northeast (Y-813). The two western faults and the eastern fault strike northwest to north–northeast. The fourth (east–central) fault strikes north to north–northwest.

Fault length: The lengths of faults within FH vary between 4 and 8 km as estimated from Y-813. FH is up to 5 km wide as estimated from Y-813.

Style of faulting: The map by Y-813 shows the displacement on the northern half of the western fault and on most of the east–central fault as down to the west.

Scarp characteristics: The southern half of the western fault, the west–central fault, and a branch fault that appears to connect the east–central and eastern faults are all shown by Y-813 as west–facing scarps. The eastern fault is shown by Y-813 as northeast–facing scarps.

Displacement: No information.

Age of displacement: Parts of the west–central, east–central, and eastern faults are shown by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits. The southern half of the western fault and parts of the other three faults are shown as weakly to moderately expressed lineaments and scarps on surfaces of Tertiary deposits. Most of the east–central fault is portrayed by Y-813 as a fault that is in Quaternary deposits and that was identified from previous mapping. The northern half of the western fault is portrayed as a fault that is in Tertiary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Short (0.5 to 1.5 km long) portions (e.g., parts of the eastern two faults) of FH are shown by Y-813 as lineaments along a linear range front.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: North–striking fault traces of the Indian Springs Valley fault (ISV) extend northward into the Fallout Hills, and faults of FH may be an extension of ISV. Faults in FH are approximately parallel to faults east of FH along the eastern and western sides of and within the Pintwater Range. These faults include the East Pintwater Range fault (EPR), the Central Pintwater Range fault (CPR), and the West Pintwater Range fault (WPR). Faults in FH are also approximately parallel to faults west of FH along Chert Ridge, which are continued as the Chert Ridge faults (CHR). The structural relationships among these faults have not been reported.

Fatigue Wash fault (FW)

Plate or figure: Figure 3.

References: Y-26: Swadley and others, 1984 (Their Fault K, which they continue north to the southeastern edge of The Prow. This is in contrast to the portrayal of Y-1042 (pl. 1), who show FW cutting the crest of West Ridge.); Y-46: Maldonado, 1985; Y-55: Scott and Bonk, 1984 (name from their pl. 1; portray FW similar to Y-26); Y-74: Hoover, 1989 (includes dates for stratigraphic units described by Y-26); Y-189: Lipman and McKay, 1965; Y-224: Frizzell and Shulters, 1990; Y-238: Reheis and Noller, 1991 (pl. 3); Y-396: Scott, 1990; Y-506: Shroba and others, 1990 (considered FW together with the Windy Wash fault in what they called the Windy Wash–Fatigue Wash system); Y-1042: O'Neill and others, 1992 (show FW cutting the crest of West Ridge and connecting with the Windy Wash fault on the north); Y-1182: Simonds and Whitney, 1993; Y-1201: Ramelli and others, 1991; Y-1230: Bell and others, 1990 (They defined FW, at least for the youngest events, as including Fault M of Y-26. Their FW appears to correspond to the central splay of the Windy Wash fault of Y-1042 (pl. 1).).

Location: 2 km/283° (distance and direction of closest point from YM) at lat 36°51'N. and long 116°30'W. (location of closest point) as portrayed by Y-1042 (pl. 1, p. 4). FW bounds the western side of southern Jet Ridge and crosses the crest of West Ridge.

USGS 7-1/2' quadrangle: Busted Butte, Crater Flat, Pinnacles Ridge.

Fault orientation: FW has a curving strike that varies between north–northeast in its central part and north–northwest at its northern and southern ends (Y-1042, pl. 1). Y-396 (p. 259) reported an average dip for FW of 74°, which was calculated from seven measurements. The map by Y-55 (pl. 1) shows west dips between 71° and 82° on the southern portion of FW.

Fault length: FW is 4.5 km long as estimated from Y-1042 (pl. 1). This includes a scarp about 1 km long. Y-26 (pl. 1, p. 15) reported a length of 7.5 km for their Fault K. Y-506 (p. 83) reported a length of 33 km for their combined Fatigue Wash–Windy Wash system.

Style of faulting: Displacement on FW is shown by Y-26 (pl. 1), Y-55 (pl. 1), and Y-1042 (pl. 1) as down to the west. By its apparent association with the Windy Wash fault, which has received more study, Y-506 (p. 83) suggested that displacement on FW has been chiefly dip slip but could be oblique slip with an undetermined component of left?–lateral slip. Left–lateral slip is suggested at one locality by slickensides that plunge 70° in an orientation south of the fault's dip as noted by Y-55 (pl. 1).

Scarp characteristics: Y-1201 (p. 1-64) and Y-1230 (p. [4]) reported a previously unrecognized scarp along the base of Jet Ridge. This scarp trends away from Jet Ridge and connects with a scarp along Fault M of Y-26 (pl. 1) (or the central splay of the Windy Wash fault of Y-1042, pl. 1). The map of Y-1042 (pl. 1) portrays a section along the western side of the north–trending portion of Jet Ridge as a scarp and identifies other portions of FW to the north and south of this scarp as linear topographic or geomorphic features.

Displacement: Y-1230 (p. [4]) noted that the northern portion of FW displaces Miocene tuffs significantly less that do the adjacent Solitario Canyon and Windy Wash faults (fig. 3). Y-1230 (p. [4]) concluded that displacement along FW increases to the south, so that FW along the southern part of Jet Ridge has a throw of a few hundred meters, similar to the displacements on other faults in the Yucca Mountain area. Y-1201 (p. 1-64) stated that the southern part of the scarp described above has a "throw comparable to other principal faults in the area."

Age of displacement: Y-1201 (p. 1-67) noted a small displaced and modified surface with morphology that they interpreted as indicating a Holocene age. Y-26 (p. 15) suggested that early Pleistocene or latest Pliocene alluvium (their QTa deposits with an estimated age of 1.1 Ma to 2 Ma; fig. 3, p. 9) is faulted against Tertiary volcanic rocks along FW (their Fault K) and that middle and late Pleistocene alluvium (their Q2c deposits with an estimated age of 270 ka to 800 ka; fig. 3, p. 9) overlies the fault. Y-1230 (p. [4]) thought that the scarp along the base of Jet Ridge was the result of reactivation of part of a northeast–striking fault that extends into Tertiary volcanic rocks on the upthrown (east) side of FW.

Fish Lake Valley fault (FLV)

This discussion includes the Fish Lake Valley fault zone of Y-651, the Fish Lake Valley fault zone of Y-665, the northern part of the Northern Death Valley–Furnace Creek fault zone of Y-470, and the northern part of the Death Valley–Furnace Creek fault zone of Y-475. Plate 1 of this compilation shows only that part of FLV east of long 118°W.

Plate or figure: Plate 1.

References: Y-29: Hamilton, 1988; Y-66: Moring, 1986; Y-216: Brogan and others, 1991 (pl. 1; subdivided what they called the Furnace Creek fault zone into twelve segments, four of which are in Fish Lake Valley and part of FLV of this compilation); Y-222: Streitz and Stinson, 1974; Y-236: Reynolds, 1969; Y-328: Sawyer and Slemmons, 1988; Y-355: Ross, 1967; Y-427: Hart and others, 1989; Y-456: Bryson, 1937; Y-468: Noble and Wright, 1954; Y-470: Bryant, 1988; Y-474: Hooke, 1972; Y-475: McKee, 1968; Y-478: Stewart, 1983; Y-479: Wright and Troxel, 1967; Y-482: Krauskopf, 1971; Y-483: McKee, 1985; Y-484: McKee and Nelson, 1967; Y-485: Robinson and Crowder, 1973; Y-486: Stewart and others, 1974; Y-600: Stewart, 1967; Y-647: Sawyer, 1991 (subdivided FLV between long 117°45′W. and long 118°15′W. into four subzones: Northern, Dyer, Eastern, and Western); Y-651: Reheis and McKee, [1991]; Y-652: Reheis and others, [1991]; Y-665: Sawyer, 1990; Y-706: Wright, 1989; Y-746: Wright and Troxel, 1954; Y-853: Dohrenwend and others, 1992; Y-1020: Jennings, 1992 (his fault #211).

Location: 135 km/298° (distance and direction from YM) at 36°33′ and 116°52′ (location of closest point). FLV is located along the eastern front of the White Mountains and within Fish Lake Valley.

USGS 7-1/2′ quadrangle: Chocolate Mountain, Indian Garden Creek, Oasis Divide, Sylvania Canyon.

Fault orientation: FLV generally strikes northwest with an average strike between N. 35° W. and N. 40° W. (Y-665, p. 130). Strikes range between N. 22° W. and N. 55° W. (Y-216, p. 5-13). The very northern about 8 km of FLV north of Indian Creek strikes north–northeast (Y-216, pl. 1A, fig. 1, p. 5). FLV between Wildhorse Creek and the Sylvania Mountains in Fish Lake Valley is composed of a western trace along the front of the White Mountains and an eastern one that traverses alluvial fans within the valley.

Fault length: Y-647 (p. 115) noted that the length of FLV is at least 80 km. The northwestern end of FLV may terminate in folds that extend beyond the fault's trace (Y-600, p. 133-139).

Potential rupture length along FLV is estimated to be at least about 80 km, because no possible rupture endpoints were discovered between the northwestern end of the fault and a bend at Cucomungo Canyon (Y-665, p. 213-228, 237). The youngest event (mid–to–late Holocene) interpreted from trenches at Marble Creek and south of Indian Creek in Fish Lake Valley apparently ruptured at least 20 km of FLV (Y-647, p. 135-136).

Style of faulting: FLV exhibits evidence for oblique right–lateral displacement. The right–lateral separation of geomorphic features of late Pleistocene age or younger (<10 ka) is less than dip separation in most places (Y-216, p. 7, 8, 22, 28). Minor dip–slip displacement may be due to changes in the strike of the fault (Y-216, p. 19).

Scarp height: Table 3 in Y-216 (p. 20-21) lists scarp data collected along their four segments of FLV. Maximum vertical separation is 64 m on a late Pleistocene surface (their Q2 surface; estimated age >10 ka) at Perry Aiken Creek along their Dyer segment (Y-216, table 3, p. 20). This large scarp is probably the result of several ruptures, although no direct evidence of multiple ruptures was found by Y-216 (p. 8).

Displacement (right–lateral): Estimates of right–lateral displacement range between 3 m and 25 km. These estimates are based on a variety of stratigraphic and structural markers, as noted in the following paragraphs in which the displacements are discussed in order of decreasing unit age. Displacements south of Fish Lake Valley are described under the Furnace Creek fault (FC).

Fish Lake Valley fault (FLV) — Continued

In northern Fish Lake Valley, total right–lateral displacement was estimated by Y-651 (p. 36) to be <15 to 25 km. This estimate is based on the northwest–southeast width of the northern part of the valley and on the apparent northwest–southeast separation of a thrust–fault contact that is in Paleozoic rocks and that is preserved on the eastern and northwestern sides of Fish Lake Valley.

Y-475 (p. 509-510, 512) estimated about 48 km (30 miles) of right–lateral displacement in southern Fish Lake Valley since about 160 Ma (Middle Jurassic) by correlating similar–looking granitic rocks in the Sylvania Mountains and the White–Inyo Mountains.

Y-475 (p. 510, 512) estimated about 0.9 km (3,000 ft) of right–lateral displacement on FLV since about 3.5 Ma using relationships between Pliocene deposits and drainages at Horse Thief Canyon, Willow Wash, and Cucomungo Canyon in southern Fish Lake Valley and reconstruction of the Pliocene drainage system.

At Leidy Creek near the northern end of FLV, debris–flow levees on an alluvial fan (described as ballenas or eroded fan remnants by Y-665, p. 126) with an estimated age of about 150 ka show that right–lateral displacement on FLV has been about 92 m (Y-647, p. 126-128, table 2, p. 132; Y-665, p. 166-170, 371-372). (Vertical displacement is negligible at this locality.)

At Indian Creek, north of Leidy Creek in Fish Lake Valley, a channel across an alluvial fan with an estimated age of about 150 ka is displaced by the main trace of FLV about 122 m in a right–lateral direction (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 169-172, 374-375). (Vertical displacement is about 40 m at this locality.)

Right–lateral displacement of about 3 m was noted in a channel on an alluvial fan with an estimated age of 5 ka to 8 ka at Indian Creek near the northern end of FLV (Y-647, p. 131, table 2, p. 132; Y-665, p. 170, 172-173, 375-376).

Displacement (vertical): Estimates of vertical displacement on FLV range between 1 and 750 m in upper Cenozoic deposits as noted in the following paragraphs in which displacements are discussed in order of decreasing deposit age.

Using the elevation difference between a 10–to–12–Ma basalt on Chocolate Mountain and a similar one at the base of a stratigraphic section at Willow Wash, a vertical displacement of about 680 m since 10–12 Ma was estimated by Y-651 (p. 38) for FLV in southern Fish Lake Valley.

In northern Fish Lake Valley, vertical displacement between 540 and 750 m was estimated across the northern FLV by projecting the elevation of a 3–Ma andesite on Davis Mountain to the fault and using the elevation difference between this projection and the present valley (Y-651, p. 40).

At Perry Aiken in central Fish Lake Valley, a minimum vertical displacement of 305 m since about 1 Ma was estimated by using the gradient of the modern surface to project the elevation of alluvium now preserved in the footwall to the present location of the fault (Y-651, p. 39).

At McAfee Creek in central Fish Lake Valley, a minimum vertical displacement of 244 m since about 740 ka was estimated by Y-651 (p. 39) using the difference between the elevation of the base of alluvium that is younger than the Bishop ash (740 ka) and that is preserved in the footwall and the estimated elevation of the pluvial lake in Fish Lake Valley prior to faulting. As much as 488 m of vertical displacement may have occurred since 740 ka, if the estimated elevation of lake sediments beneath Fish Lake Valley is used to calculate the elevation difference (Y-651, p. 39).

In southern Fish Lake Valley, a maximum vertical displacement of 540 m since about 740 ka was estimated by Y-651 (p. 38) using the elevation of gravels that include Bishop ash (740 ka) at Gilbert Summit and the inferred elevation of the Bishop ash beneath Fish Lake Valley.

At Indian Creek, at the northern end of FLV in Fish Lake Valley, a channel across an alluvial fan with an estimated age of about 150 ka is displaced by the main fault trace about 40 m vertically (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 169-172, 374-375). (Right–lateral displacement is about 122 m at this locality.)

At the same locality at Indian Creek just described, vertical displacement across the entire FLV has been estimated to be about 160 m by assuming a once–constant gradient for a displaced alluvial fan with an estimated age of about 150 ka (Y-647, p. 131, table 2, p. 132).

Fish Lake Valley fault (FLV) — Continued

A channel on an alluvial fan with an estimated age of about 5 ka to 8 ka has vertical displacement of about 1 m at the same Indian Creek near the northern end of FLV (Y-647, p. 131, table 2, p. 132; Y-665, p. 170, 172-173, 375-376).

Age of displacement: The youngest displacement on FLV is probably latest Holocene. Y-216 (p. 9-10) noted a 13.7–km–long zone of vegetation lineaments and small scarps along their Horse Thief and Oasis segments. These tectonic features are on the surfaces of young alluvial deposits and may be nearly historical (their surface Q_{1A}; 0 to 200 yr). Using exposures in trenches along FLV (at Marble Creek and south of Indian Creek), Y-647 (p. 135-136) interpreted two significant middle to late Holocene events, the youngest of which occurred between 1.5 ka or 1.0 ka and 0.6 ka.

Elsewhere along FLV, evidence for late Pleistocene to Holocene surface ruptures is common. This evidence includes linear fault scarps, shutter ridges, pressure? ridges, side–hill benches, ridge–crest saddles, linear troughs, vegetation lineaments in playas, deflected drainages, offset drainages, beheaded drainages, faceted spurs, and well–defined tonal lineaments (Y-470, p. 10; Y-665; Y-1020). The map by Y-853 shows FLV as scarps on surficial deposits or erosional surfaces with estimated ages of primarily late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) and early to middle and (or) late Pleistocene (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma).

Sedimentary rocks in the basin along Willow Wash near the southern end of Fish Lake Valley suggest a minimum age of latest Miocene or earliest Pliocene for the beginning of displacement along FLV in southern Fish Lake Valley (Y-651, p. 36). In addition, relationships among stream gravels preserved on divides between Deep Springs, Fish Lake, and Eureka valleys show that streams flowed from the southern White Mountains into Eureka Valley, which implies that southern Fish Lake Valley and Deep Springs Valley did not exist in their present configuration until after 0.7 Ma (Y-651, p. 36).

Slip rate (right–lateral): Estimated long–term, right–lateral slip rates are about an order of magnitude greater than estimated long–term, vertical slip rates on FLV (Y-651, table 2, p. 37; p. 42). At one locality in Fish Lake Valley at the northern end of FLV (Indian Creek), the ratio of right–lateral to vertical displacement is 2:1 to 5:1 in deposits with an estimated age of about 150 ka (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 169-172, 374-375).

Right–lateral slip rates range between 0.3 mm/yr and 6 mm/yr depending upon the age and location of the stratigraphic markers used to estimate the rates, as noted in the following paragraphs listed in the order of decreasing age of the units used to estimate the slip rate.

In northern Fish Lake Valley, a minimum right–lateral slip rate of 1 to 2 mm/yr and a maximum right–lateral slip rate of 2 to 3 mm/yr were estimated by Y-651 (p. 36) using displacement of a thrust–fault contact in Paleozoic rocks and the width of the valley.

Right–lateral slip rates of 0.26 mm/yr since about 3.5 Ma (Pliocene) and 0.3 mm/yr since about 160 Ma (Middle Jurassic) were estimated by Y-475 (p. 510, 512) for FLV in the Cucomungo Canyon area between Fish Lake and Death valleys. Y-651 (p. 27) speculated that this rate, which was estimated for FLV since Middle Jurassic, is a minimum value because displacement on FLV probably did not begin until middle Miocene (Y-29, *cited by* Y-651, p. 23; Y-706, p. 2).

Assuming that the 48 m of displacement recognized by Y-475 (p. 509-510, 512) occurred after 8.2 Ma to 11.9 Ma, Y-651 (p. 36) estimated a right–lateral slip rate of 4 to 6 mm/yr for FLV in southern Fish Lake Valley since that time.

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

In northern Fish Lake Valley at Leidy Creek and Indian Creek, the right–lateral slip rate since about 150 ka is 0.6 and 0.8 mm/yr along one trace of FLV (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 166-172, 371-375).

In northern Fish Lake Valley at Indian Creek, the right–lateral slip rate since 5 ka to 8 ka is 0.4 to 0.6 mm/yr along one trace in FLV (Y-647, p. 131, table 2, p. 132; Y-665, p. 170, 172-173, 375-376).

Slip rate (vertical): Vertical slip rates for FLV range between 0.05 mm/yr and 1.6 mm/yr in Fish Lake Valley.

The post–Miocene vertical slip rate (10.8 Ma to 0.74 Ma), although poorly constrained, appears to range between 0.05 and 0.2 mm/yr along FLV (Y-651, p. 26, 42).

In southern Fish Lake Valley near Chocolate Mountain, displacement of a basalt yields a vertical slip rate of 0.06 to 0.07 mm/yr since 10 Ma to 12 Ma (Y-651, p. 38).

In northern Fish Lake Valley near Davis Mountain, the vertical slip rate since about 3 Ma has apparently been between 0.15 to 0.2 mm/yr and 0.2 to 0.25 mm/yr (Y-651, p. 40).

At Perry Aiken Creek in central Fish Lake Valley, a minimum vertical slip rate of 0.3 mm/yr was estimated by Y-651 (p. 39) since about 1 Ma.

The vertical slip rates since 0.74 Ma (deposition of Bishop ash) range between 0.3 and 0.7 mm/yr on several parts of FLV (e.g., 0.7 mm/yr at McAfee Creek in the central part of the valley and at Gilbert Summit in the southern part of the valley; Y-651, p. 26, 38, 39, 42). These rates are much higher than the post–Miocene rates (Y-651).

In northern Fish Lake Valley at Indian Creek, the vertical slip rate across one trace of FLV is about 0.3 mm/yr (Y-647, p. 126, 129, table 2, p. 132; Y-665, p. 169-172, 374-375).

At the same locality at Indian Creek in Fish Lake Valley, the vertical slip rate estimated across the entire FLV is 0.8 to 1.6 mm/yr since about 150 ka (Y-647, p. 131, table 2, p. 132).

The vertical slip rate since 5 ka to 8 ka for one trace of FLV at Indian Creek in Fish Lake Valley has been estimated to be 0.1 to 0.3 mm/yr (Y-647, p. 131, table 2, p. 132; Y-665, p. 170, 172-173, 375-376).

Recurrence interval: On the basis of interpretations in four trenches in Fish Lake Valley (two between Indian and Leidy creeks in northern Fish Lake Valley and two south of Cottonwood Creek in southern Fish Lake Valley), Y-665 (pls. I, IIB, IIC, IIE; table 10, p. 188; p. 231-232) concluded that three ruptures had occurred since about 2.5 ka and that the recurrence between events has been about 1,100 ± 600 yr, although the recurrence could be as long as 3,000 yr or as short as 500 yr.

Range-front characteristics: The map by Y-853 shows FLV along the southwestern side of Fish Lake Valley through the Cucomungo Canyon–Last Chance Canyon area as being a major range–front fault with a range front characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to the range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to the range front."

Analysis: Aerial photographs, including low–sun–angle, at scales of 1:12,000 (Y-216, p. 3; Y-470, p. 8; Y-665), 1:20,000 (Y-470, p. 8), 1:24,000 to 1:30,000 (Y-470, p. 8), 1:48,000 (Y-665, p. 8-11), 1:60,000 (Y-665, p. 8-11), and 1:115,000 to 1:124,000 (Y-853). Scarp profiles (Y-216, p. 5; Y-665, p. 8-11). Field examination (Y-216, p. 5; Y-470, p. 8; Y-665, p. 8-11). Estimates of ages of faulted and unfaulted surfaces using relative-age parameters (e.g., desert varnish, pavement development, surface preservation and morphology, position above active channels, and soil descriptions; Y-216, p. 5; Y-665, p. 8-11; Y-853). ^{14}C ages on alluvial surfaces in Fish Lake Valley (Y-328; Y-647) were used to establish a chronology of surface morphology. Surveys of geomorphic features using a Wild theodolite and trench interpretations to estimate displacements (Y-665, p. 8-11). Pseudo–segmentation was done based on fault orientation, apparent age of faulting, the width of the fault zone, the pattern of faulting, and the position of the fault relative to the range front (Y-216).

Fish Lake Valley fault (FLV) — Continued

Relationship to other faults: FLV may be the northern extension of the northwest–striking Furnace Creek fault (FC). However, the exact relationship between the two faults has not been determined.

Freiburg fault (FR)

Plate or figure: Plate 1.

References: Y-404: Tschanz and Pampeyan, 1970 (name from their pl. 3); Y-1032: Schell, 1981 (pl. 9; his fault #47). Not shown by Ekren and others, 1977 (Y-25).

Location: 133 km/35° (distance and direction of closest point from YM) at lat 37°49′N. and long 115°35′W. (location of closest point). FR is located along the eastern side of the Worthington Mountains (sometimes called the Freiberg Range; e.g., Y-404, p. 96) at their junction with Garden Valley.

USGS 7-1/2′ quadrangle: Meeker Peak, Worthington Peak.

Fault orientation: FR has a slightly curving strike that is generally north (Y-404).

Fault length: The length of FR is 19 km as estimated from Y-404 (pl. 3). The length of FR is noted to be 18 km by Y-1032 (table A2, p. A10).

Style of faulting: Displacement on FR is shown by Y-404 as down to the east.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along FR is noted by Y-1032 (table A2, p. A10) as indeterminate, but suspected of being Quaternary. Scarps are prominent, but their age could not be determined by Y-1032 (pl. 9) because young stratigraphic units are not present along the fault. The youngest unit definitely displaced by FR is Paleozoic rocks (Y-1032, table A2, p. A10). The oldest unit not displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A10) with an estimated age of 15 ka to probably 200 ka (table 3, p. 23). Y-404 portrayed FR as a post–Laramide structure that is inferred or concealed by Pleistocene(?) older alluvium (their Qol deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The eastern front of the Worthington Mountains appears relatively linear on topographic maps at scales of 1:250,000 and 1:500,000; this linearity could suggest influence by fault displacement. An evaluation of the characteristics of this range front has not been done.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: FR is approximately parallel to other north–striking faults along range fronts in the area. These fault include the northern part of the Penoyer fault (PEN), which bounds the western side of the Worthington Mountains immediately west of FR, the Garden Valley fault (GRD) along the western side of unnamed hills at the southeastern edge of Garden Valley southeast of FR, the Golden Gate fault (GG) along the eastern side of the Golden Gate Range east of FR, the West Railroad fault (WR) along the eastern side of the Reveille Range west of FR, and the East Reveille fault (ERV) along the western side of the Reveille Range. The northern end of PEN curves around the northern end of the Worthington Mountains and appears to nearly intersect FR. FR is approximately perpendicular to the east–northeast–striking Tem Piute fault (TEM) south of FR. The structural relationships among these faults are not known.

Frenchman Mountain fault (FM)

Plate or figure: Plate 2.

References: Y-852: Dohrenwend and others, 1991; Y-1073: Anderson and O'Connell, 1993 (name from this reference).

Location: 146 km/120° (distance and direction of closest point from YM) at lat 36°13'N. and long 115°01'W. (location of closest point). FM is located east of Las Vegas, Nevada, along the western sides of Frenchman Mountain on the south and Sunrise Mountain on the north at their junction with Las Vegas Valley.

USGS 7-1/2' quadrangle: Las Vegas NE.

Fault orientation: FM has a curving strike. The southern portion strikes northwest; the northern portion strikes northeast (Y-852; Y-1073, fig. 2-1).

Fault length: The length of FM is about 20 km as estimated from Y-852. The surficial expression of FM is noted by Y-1073 (p. 42) to be about 18 km from Nellis Air Force Base on the north to just north of Las Vegas Wash on the south.

Style of faulting: No information.

Scarp characteristics: Scarps are shown by Y-852 as northwest–facing or southwest–facing. Scarps on a Q1 surface of Y-1073 have surface offsets of 6.6 and 8.9 m with maximum scarp–slope angles of 20.5° and 21.5°, respectively, at two localities where scarp profiles were measured by Y-1073 (p. 42, appen. D). A scarp on a younger, Q2 surface of Y-1073 is about 2 m high and has been interpreted by Y-1073 (p. 49) to possibly record surface rupture during the most–recent event along FM.

Displacement: No information.

Age of displacement: The youngest scarps along FM are shown by Y-852 to be on possibly late Pleistocene depositional or erosional surfaces (their Q2? surfaces with an estimated age between 10 ka and 130 ka). Scarps are also shown by Y-852 on depositional or erosional surfaces with ages of early to middle and (or) late Pleistocene (their Q1-2 surfaces with estimated ages between 10 ka and 1.5 Ma) and possibly early to middle Pleistocene (their Q1? surfaces with estimated ages between 130 ka and 1.5 Ma).

Y-1073 (p. 49, 101) stated that their best guess for the age of the youngest rupture along FM is late Quaternary (<130 ka), but this event could be as young as early Holocene. Scarps are preserved on surfaces of their Q1 and Q2 deposits with estimated ages of 30 ka to >500 ka(?). The only deposits that they noted to overlie FM are their Q3 deposits, which could be as young as late to middle Holocene (1 ka to 7 ka, Y-1073, appen. C).

Slip rate: No information.

Recurrence interval: By inferring that a 9–m–high scarp on ≤500 ka deposits formed during multiple events each causing 1 to 2 m of surface displacement, Y-1073 (p. 101) concluded that "the recurrence of surface faulting events could be tens to possibly hundreds of thousands of years."

Range-front characteristics: Most of FM is portrayed by Y-852 as a fault juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of the western sides of Frenchman and Sunrise mountains would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, FM would be significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852).

Frenchman Mountain fault (FM) — Continued

Analysis: Aerial photographs (Y-852, scale 1:58,000; Y-1073, p. 1, scale 1:58,000). Field reconnaissance (Y-1073, p. 1). Low–sun–angle aerial overflight (Y-1073, p. 1). Scarp profiles (Y-1073, p. 42, appen. D). Soil descriptions (Y-1073, appen. C).

Relationship to other faults: No information.

Furnace Creek fault (FC)

FC includes the southern part of the northern Furnace Creek fault zone of Y-651 and the southern part of the Northern Death Valley–Furnace Creek fault zone of Y-470.

Plate or figure: Plates 1 and 2.

References: Y-29: Hamilton, 1988; Y-66: Moring, 1986 (His Furnace Creek fault segment of the Death Valley-Furnace Creek fault zone. He shows FC between Grapevine Canyon and Last Chance Canyon at the northern end of Death Valley.); Y-216: Brogan and others, 1991 (pls. 1 and 2; Their Furnace Creek fault zone includes the Fish Lake fault (FLV) of this compilation to Chiatovich Creek in Fish Lake Valley. They subdivided FC into twelve segments, seven of which are in Death Valley.); Y-222: Streitz and Stinson, 1974; Y-236: Reynolds, 1969 (his Death Valley–Furnace Creek fault zone (fig. 41, p. 235)); Y-262: Stewart and others, 1968; Y-355: Ross, 1967; Y-389: Drewes, 1963; Y-390: Hunt and Mabey, 1966 (show FC between long 116°45'W. and 117°15'W.); Y-397: Pistrang and Kunkel, 1964; Y-421: McAllister, 1970; Y-427: Hart and others, 1989; Y-456: Bryson, 1937; Y-468: Noble and Wright, 1954; Y-470: Bryant, 1988; Y-474: Hooke, 1972; Y-475: McKee, 1968; Y-478: Stewart, 1983; Y-479: Wright and Troxel, 1967 (part of their Death Valley-Furnace Creek fault zone); Y-482: Krauskopf, 1971; Y-483: McKee, 1985; Y-484: McKee and Nelson, 1967; Y-485: Robinson and Crowder, 1973; Y-486: Stewart and others, 1974; Y-596: Wright and Troxel, 1970; Y-600: Stewart, 1967 (his Death Valley–Furnace Creek fault zone); Y-603: Butler, 1984; Y-651: Reheis and McKee, [1991]; Y-652: Reheis and others, [1991]; Y-683: Cemen and others, 1985; Y-706: Wright, 1989; Y-746: Wright and Troxel, 1954; Y-853: Dohrenwend and others, 1992; Y-880: Curry, 1938; Y-1020: Jennings, 1992 (his Northern Death Valley–Furnace Creek fault zone in Death Valley and his Furnace Creek fault along Furnace Creek Wash (includes the southern part of the Fish Lake Valley fault (FLV) of this compilation, that part of FLV in California); his fault #211); Y-1026: Oakes, 1987; Y-1027: Snow and Wernicke, 1988.

Location: 50 km/230° (distance and direction from YM) at lat 36°33'N. and long 116°52'W. (location of closest point). FC is located in northern Death Valley north of Furnace Creek Wash. Y-479 (p. 947) extended FC southeastward across the Amargosa Desert where they suggested that it may connect with a northwest–striking fault that extends into the Resting Spring Range or that it may splay to the south into normal faults in the Amargosa Valley (part of the Ash Meadows fault (AM) of this compilation) and terminate against the northwest–striking Sheephead fault (not shown on pls. 1 and 2 of this compilation). Y-468 (pl. 7) and Y-683 (p. 128) extended FC to the southeast into the Amargosa Valley, where FC strikes north–northwest southeast of Death Valley Junction and may merge with dip-slip (normal) faults in the valley. Y-478 (p. 155, fig. 3) portrayed FC as ending abruptly west of the Resting Spring Range.

USGS 7-1/2' quadrangle: Beatty Junction, Chloride City, Dry Bone Canyon, East of Tin Mountain, Echo Canyon, Fall Canyon, Furnace Creek, Grapevine Peak, Grotto Canyon, Hanging Rock Canyon, Last Chance Mountain, Last Chance Range SE, Mesquite Flat, Nevares Peak, Ryan, Sand Spring, Scottys Castle, Stovepipe Wells NE, Thimble Peak, Tin Mountain, Tule Canyon, Ubehebe Crater, West of Furnace Creek, West of Gold Mountain.

Fault orientation: FC strikes generally northwest. FC northwest of Grapevine Canyon strikes north-northwest (Y-66).

Furnace Creek fault (FC) — Continued

Fault length: The minimum length of FC is 105 km from Last Chance Canyon at the northern end of Death Valley to Salt Springs as estimated from Y-216 (pl. 1, p. 11-13). If FC continues to the mouth of Furnace Creek Wash and merges with the Death Valley fault (DV) in Death Valley, then the length of FC is 115 km (estimated from plates 1 and 2 of this compilation). Y-236 (p. 36-37) reported a length of about 160 km (about 100 miles) for FC between near Furnace Creek Wash to Fish Lake Valley. If FC extends to near Death Valley Junction in the Amargosa Valley as suggested by Y-468 (pl. 7) and Y-683 (p. 128), then the length of FC is 165 km. If FC continues southeast of the Amargosa Valley to terminate in the Resting Spring Range as proposed by Y-479 (p. 934-935, fig. 1), then FC is 175 km long. Y-651 (p. 26) stated that the length of FC is >250 km (includes the possible extension of FC north into Fish Lake Valley; the Fish Lake Valley fault (FLV) of this compilation). Y-600 (p. 131) noted that the length of FC is at least 400 km (250 miles). Y-880 (p. 1875) noted that individual fault traces are continuous for 32 km (20 miles) or more.

Style of faulting: Right–lateral displacement predominates for Holocene and late Pleistocene ruptures in most places (Y-216, p. 19). Minor dip–slip displacement observed at some localities may be due to changes in strike of the fault (Y-216, p. 19). In general, dip–slip (normal) displacement is limited to northeast-striking faults that splay from the main trace of FC (Y-216, p. 5).

Right-lateral displacement has been recognized on FC by Y-475 (p. 509), Y-479 (p. 937), Y-600 (p. 131), and Y-683 (p. 134-135). Right–lateral displacement in Death Valley north of Furnace Creek is indicated by displaced alluvial fans and drainages, shutter ridges, drag folds, horizontal slickensides, trenches, pressure ridges, and sag ponds (Y-880, p. 1875). Y-66 inferred right-lateral displacement on FC from the presence of both east– and west–facing fault scarps.

Y-683 (p. 139) noted that clast composition of the Pliocene Furnace Creek Formation as observed by Y-421 suggests that vertical displacement has occurred on FC along Furnace Creek Wash southeast of the Furnace Creek Inn.

Scarp height: Both east– and west–facing scarps are preserved in northern Death Valley (Y-66). Y-216 (table 3) noted scarps heights of 23 m on a Pleistocene surface near Red Wall Canyon, 0.3 to 2 m on middle and early Holocene (2 ka to 10 ka) surfaces, and 0.3 to 1.8 m on late Holocene (0.2 ka to 2 ka) surfaces. The maximum scarp–slope angle for the 23–m–high scarp is 33° (Y-216, table 3). The maximum scarp–slope angles for a 1.5–m–high scarp on a middle and early Holocene surface is 10° (Y-216, table 3). The maximum scarp–slope angle for a 1.8–m–high scarp on a late Holocene surface is 27° (Y-216, table 3).

Displacement (right–lateral): Estimates of right–lateral displacements on FC range between 128 km and 0.6 m, based on a variety of stratigraphic and structural markers, as shown in the following paragraphs in which displacement is discussed in order of decreasing unit age.

Y-389 (p. 56) suggested that FC had experienced 24 to 48 km (15 to 30 miles) of right–lateral displacement. Y-468 (p. 157) implied that right-lateral displacement on FC has been at least 19 km (12 miles). Y-683 (p. 128) stated that the development of Furnace Creek basin "requires no more than 10 km of right-lateral slip in the area of Furnace Creek Wash."

Y-596 estimated that the maximum right–lateral displacement on FC about 150 km northwest of Bat Mountains north of the northern end of Death Valley has been 50 km on the basis of greater extension on the southwestern side of the fault than on the northeastern side. They also concluded that displacement progressively increases northwestward on FC.

Y-600 (p. 133, 135) estimated about 80 km (50 miles) of right–lateral displacement on FC based on interpretation of isopach lines that indicate abrupt changes in facies and thicknesses of Upper Precambrian and Lower Cambrian rocks. He interpreted these changes to be the result of fault displacement.

Furnace Creek fault (FC) — Continued

On the basis of the alignment of linear features (e.g., stratigraphic contacts, a mineralization zone, distribution of distinctive facies) in Precambrian and Cambrian rocks, Y-479 (p. 945-947) suggested that right–lateral displacement along FC south of the Furnace Creek Ranch in Death Valley (along the Funeral Mountains) has been limited to "no more than a few miles" (p. 947), possibly <2 miles (about 3 km).

Three major northeast–striking Mesozoic thrust faults were correlated on the basis of geometric properties (e.g., size, vergence, order, spacing) independent of stratigraphy (Y-1027). Y-1027 used these correlations to suggest that 68 ± 4 km of apparent right–lateral displacement had occurred along FC between the Cottonwood and Funeral mountains.

Y-262 (p. 1411) interpreted 80 to 128 km (50 to 80 miles) of right–lateral displacement on FC in northern Death Valley using isopach lines and facies of Devonian and Silurian rocks and the distribution of Mississippian rocks.

Y-1026 estimated 32 km of right–lateral displacement by interpreting a granitic stock in the northern Grapevine Mountains as once continuous with a similar stock in the Last Chance Range that has been dated at 7.3 Ma to 7.9 Ma (Y-483, *cited by* Y-1026).

Y-390 (p. A103, A115) noted that the Funeral Formation (Pliocene and Pleistocene(?)) in the Salt Creek Hills in northern Death Valley has several hundred feet of structural relief.

Y-470 (p. 10) noted a minimum amount of late Cenozoic right–lateral displacement of about 5.3 km in the Cucomungo Canyon–Last Chance Canyon area between FC and FLV based on the apparent displacement of Cucomungo Canyon.

Y-236 (p. 238) reported right–lateral displacement of 46 m (150 ft) of an alluvial fan with well–developed desert varnish and pavement and an estimated Pleistocene age (Q_4; Y-236, p. 155-157) in the area northwest of Red Wall Canyon. Displacement is indicated by the fan margins and by drainages offset in the direction opposite to the regional slope (Y-236, p. 238). Y-470 (p. 8) assumed that this fan was deposited about 20 ka, based on the possible early Holocene age of younger fan deposits that partially bury the displaced fan and occur as terraces upstream of the displaced fan margin. Holocene gravel deposits (Q_1 and Q_2; Y-236, table 9, p. 156) overlie the fault (Y-236, p. 159-161).

Y-880 (p. 1875) measured right–lateral displacements of at least 9 m (30 ft), but he thought that larger displacements, although not measured by him, had probably occurred.

The maximum right–lateral displacement noted by Y-216 (table 3) on a Pleistocene surface (their Q2 unit) is 21 m on their Grapevine Canyon section. The maximum right–lateral displacement noted by them on middle and early Holocene surfaces (their Q1C unit) is 8.5 m on their Grapevine Canyon section, although most displacements are between 1.5 and 2.7 m. Right-lateral displacements observed by Y-216 (table 3) on late Holocene surfaces (their Q1B unit) are <0.6 and 1.8 m. The highest value occurs on their Beatty Junction section.

Displacement (vertical): Y-236 (p. 238) noted 0.6 to 1.5 m (2 to 5 ft) of east–side–down vertical displacement in a gravel deposit with an estimated Holocene age in northern Death Valley (NW1/4, sec. 34, T. 13 S., R. 44 E.).

Age of displacement: The youngest displacement on FC is latest Holocene (Y-216, table 3, p. 20). Y-216 (table 3) noted scarps on late Holocene surfaces (0.2 ka to 2 ka; their Q1B surfaces) at several localities. The map by Y-853 shows FC as scarps on surficial deposits or erosional surfaces with estimated ages of primarily late Pleistocene (Q2; 10 ka to 130 ka) and early to middle and(or) late Pleistocene (Q1-2; 10 ka to 1.5 Ma).

The map by Y-1020 shows most of FC in Death Valley as Holocene (≤10 ka). The part of FC along Furnace Creek Wash is portrayed by Y-1020 either as undifferentiated Quaternary (defined by him as <1.6 Ma) or as concealed (e.g., the portion of FC east of Ryan, California).

Y-880 (p. 1875) noted that parts of FC are "marked by a churned–up furrow in the recent alluvium."

Furnace Creek fault (FC) — Continued

The oldest undisplaced surfaces noted by Y-216 (table 3, p. 20) along most of FC are latest Holocene (<200 yr; their Q1A unit). However, they recognized no displacement of late Holocene surfaces (0.2 ka to 2 ka; their Q1B unit) northwest of Grapevine Canyon. Similarly, Y-66 portrayed FC between Grapevine Canyon and the north end of Death Valley as displacing deposits no younger than Pleistocene (age not further specified). Y-421 (p. 8, pl. 1) shows a surface above Navel Springs about 15 km southeast of the Furnace Creek Inn that extends across FC and is not displaced. The surface is capped by gravel with an estimated age of older Pleistocene (his Qoa unit).

Slip rate: A right–lateral slip rate of 2.3 mm/yr is estimated by Y-470 (p. 8-9) for FC in northern Death Valley, using the 46 m of right–lateral displacement noted by Y-236 (p. 238) and estimating that the displaced alluvial fan was deposited about 20 ka.

For FC between the northern Grapevine Mountains and the Last Chance Range, an area 5 to 10 km south of the Cucomungo Canyon area studied by Y-475, Y-1026 estimated a right–lateral slip rate of 4.1 to 4.4 mm/yr since 7.3 Ma to 7.9 Ma, a rate about 16 times that of the rates (0.26 and 0.3 mm/yr) estimated by Y-475 for Pliocene and Middle Jurassic rocks the Cucomungo Canyon area.

Recurrence interval: Y-216 (p. 19) concluded that four to six separate events have occurred on FC during the Holocene (≤10 ka). This number of events suggests that the recurrence interval between events is 1,700 yr to 2,500 yr.

Range-front characteristics: Most of FC is located in the central part of Death Valley and is not directly associated with a major range front.

Analysis: Aerial photographs, including low–sun–angle, at scales of 1:12,000 (Y-216, p 3; Y-470, p. 8; Y-665), 1:20,000 (Y-470, p. 8), 1:24,000 to 1:30,000 (Y-470, p. 8), and 1:115,000 to 1:124,000 (Y-853). Aerial photographs (no scale given; Y-236, p. 13). Scarp profiles (Y-216, p. 5). Field examination (Y-216, p. 5; Y-236, p. 13, work completed between 1961 and 1963; Y-470, p. 8). Estimates of ages of faulted and unfaulted surfaces, using relative-age parameters (e.g., desert varnish, pavement development, surface preservation and morphology, position above active channels, soil descriptions, and correlation to Lake Manly shorelines) (Y-216, p. 5; Y-853). It is not apparent from reading the text whether or not scarp diffusion models were utilized for actual age derivation (Y-216). Pseudo–segmentation was done based on fault orientation, apparent age of faulting, the width of the fault zone, the pattern of faulting, and the position of the fault relative to the range front (Y-216). Geologic mapping at a scale of about 3 inches per mile (enlarged from the Grapevine Peak 15–minute quadrangle; Y-236, p. 13).

Relationship to other faults: FC is probably related to the Fish Lake Valley fault (FLV), the Death Valley fault (DV), the Southern Death Valley fault (SDV), the Keane Wonder fault (KW), and the Grapevine fault (GV). The exact relationships among these faults are not known, however.

Right–lateral displacement on SDV is estimated to be <8 km using Precambrian units (Wright and Troxel, 1970 (Y-596); Davis, 1977 (Y-592)), which is much less than the approximately 80 km of right–lateral displacement estimated on FC using units of similar age (Y-600, p. 133). Y-478 (p. 154, 156-157) hypothesized that this large difference can be explained by about 80 km of northwestward movement of the Panamint Range from an original position adjacent to the Resting Spring and Nopah ranges along one or more low–angle detachment faults some time after the Mesozoic.

Y-600 (p. 133) proposed that FC may terminate on the south in a "gigantic" fold, but noted that there is no structural evidence for such a fold.

Furnace Creek fault (FC) — Continued

Y-600 (fig. 1, p. 133, 135) portrayed FC as intersecting SDV (his Death Valley fault zone) at the northern end of the Black Mountains, so that FC northwest of this point is his Death Valley–Furnace Creek fault zone and southeast of this point FC is his Furnace Creek fault zone. Y-236 (p. 236-237) suggested that FC merges with DV near Furnace Creek Wash.

Y-421 (p. 8) suggested that FC may curve southward adjacent to Furnace Creek Wash about 10 km southeast of Furnace Creek Wash and merge into a northeast–striking fault that crosses Furnace Creek Wash (the Cross-valley fault of Y-683 (p. 136), the Mont Blanco of Y-389, the valley crossing fault of Y-421 (p. 8); fault shown but not labeled on plate 2 of this compilation). Y-421 (p. 8) speculated that this northeast–striking fault may connect FC to the northwest–striking Grand View fault along the southwest side of the Furnace Creek basin.

Garden Valley fault (GRD)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-1032: Schell, 1981 (pl. 9; shows a short fault at approximately the same position of GRD as shown by Y-25). Not shown by Tschanz and Pampeyan, 1970 (Y-404).

Location: 126 km/40° (distance and direction of closest point from YM) at lat 37°42'N. and long 115°31'W. (location of closest point). GRD is located along the western side of an unnamed ridge at the southern end of Garden Valley.

USGS 7-1/2' quadrangle: Meeker Peak, Monte Mountain.

Fault orientation: GRD is curving, but generally strikes north (Y-25).

Fault length: The length of GRD is about 12 km as estimated from Y-25. Y-25 continued GRD another about 3 km to the north as a concealed fault beneath Garden Valley (not shown on pl. 1 of this compilation).

Style of faulting: Displacement on GRD is shown by Y-25 as down to the west. Pliocene and Miocene debris (their Tda deposits, <24 Ma) along the western side of GRD "is interpreted [by Y-25] as having been formed during a period or periods of intense strike–slip faulting," which implies that older displacements on GRD may have been different from younger displacements.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along GRD is noted by Y-1032 (pl. 9) as indeterminate, but suspected of being Quaternary. Scarps are described as prominent, but their age could not be determined by Y-1032 (pl. 9), because young stratigraphic units are not present along the fault.

About 3.5 km of GRD are shown by Y-25 as a faulted contact between Oligocene welded tuff (their Tt2 unit) and Holocene to Pliocene alluvium and colluvium (their QTa deposits). The northernmost 3 km of GRD are portrayed by Y-25 as concealed by their QTa deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: The northern end of GRD intersects an east–striking, 1.5–km–long, down–to–the–north fault shown by Y-25. This east–striking fault is portrayed by Y-25 as a faulted contact between Tertiary volcanic rocks and Holocene to Pliocene alluvium and colluvium (their QTa deposits). The relationship between this fault and GRD is not known.

The southern end of GRD intersects a east–northeast–striking trace of the Tem Piute fault (TEM). Displacement on TEM is primarily left–lateral. The relationship between TEM and GRD is not known.

GRD is approximately parallel to other north–striking faults along range fronts in the area. These fault include the northern part of the Penoyer fault (PEN), which bounds the western side of the Worthington Mountains west of GRD, the Freiburg fault (FR) along the eastern side of the Worthington Mountains northwest of GRD, and the Golden Gate fault (GG) along the eastern side of the Golden Gate Range northeast of GRD. The structural relationships among these faults are not known.

General Thomas Hills fault (GTH)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 1; show only that part of GTH along the General Thomas Hills); Y-853: Dohrenwend and others, 1992. Not shown by Albers and Stewart, 1972 (Y-407).

Location: 137 km/320° (distance and direction of closest point from YM) at lat 37°47'N. and long 117°25'W. (location of closest point). GTH is located along the eastern sides of the General Thomas Hills and Paymaster Ridge at their junction with the valley surrounding Alkali Lake.

USGS 7-1/2' quadrangle: Klondike, Paymaster Canyon, Paymaster Ridge.

Fault orientation: GTH has a curving strike that is north–northwest on the south along Paymaster Ridge and northeast on the north along the General Thomas Hills (Y-238; Y-853).

Fault length: The length of GTH is 11 km as estimated from Y-238 and 26 km as estimated from Y-853. This difference in length results because the map by Y-238 shows only that part of GTH along the General Thomas Hills.

Style of faulting: No information.

Scarp characteristics: Scarps along GTH are shown by Y-238 as primarily southeast–facing. A few scarps are portrayed by Y-238 and Y-853 as northwest–facing.

Displacement: No information.

Age of displacement: GTH is shown by Y-853 as scarps on Quaternary depositional or erosion surfaces. Most of GTH is portrayed by Y-238 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits. Two sections of GTH are shown by Y-238 as faults that are in Quaternary deposits and that were identified from previous mapping. However, Y-10 (p. 60) noted that "[f]aults along the General Thomas Hills appear inactive."

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: GTH along the eastern side of Paymaster Ridge is portrayed by Y-853 as faults juxtaposing Quaternary alluvium against bedrock and adjacent to a range front that is characterized by "fault scarps and lineaments on surficial deposits along or immediately adjacent to the range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." GTH is associated with a range front that is less extensive and fault scarps that are lower, shorter, and less continuous than those along a major range–front fault (Y-853).

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

Relationship to other faults: GTH is approximately parallel to other north– and northeast–striking major range–bounding faults west of Cactus Flat. These faults include the Emigrant Peak faults (EPK) along the western side of the Silver Peak Range west of GTH, the Montezuma Range fault (MR) along the western side of the Montezuma Range south of GTH, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges immediately west of GTH, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain south of GTH, and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains south of GTH (Y-10, p. 57; Y-238; Y-853).

General Thomas Hills fault (GTH) — Continued

GTH is also approximately parallel to northeast–striking faults within basins in the area. These faults include the Lone Mountain fault (LMT) in Big Smoky Valley west of GTH, the Stonewall Flat fault (SWF) within Stonewall Flat southeast of GTH, the Palmetto Mountains–Jackson Wash fault (PMJW) in the valley northeast of the Palmetto Mountains south of GTH, the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and the Montezuma Range immediately south of GTH, and the Clayton Valley fault (CV) in Clayton Valley southwest of GTH (Y-10, p. 57; Y-238; Y-853). GTH along the General Thomas Hills is similar to other faults within basins in the area in that the fault traces composing GTH are short and apparently displace surfaces of only one age (Y-10, p. 58). Unlike other intrabasin faults, fault traces within GTH primarily exhibit down–to–the–southeast displacement (similar to traces in LV along the southeastern side of the Palmetto Mountains) instead of down–to–the–northwest displacement. The structural relationships among all these faults are not known.

Y-238 (p. 3) speculated that northeast–striking faults in the area around GTH could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred that the faults could be rooted in a detachment fault at depth.

Ghost Dance fault (GD)

Plate or figure: Figure 3.

References: Y-26: Swadley and others, 1984 (their Fault F, which includes both the Ghost Dance fault and the Abandoned Wash fault of Y-55 and Y-1042); Y-46: Maldonado, 1985; Y-55: Scott and Bonk, 1984 (name from their pl. 1; they portrayed GD and the Abandoned Wash fault as nearly continuous structures; they included only the northern half of the Abandoned Wash fault as shown by Y-1042); Y-182: Carr, 1984; Y-189: Lipman and McKay, 1965; Y-224: Frizzell and Shulters, 1990; Y-238: Reheis and Noller, 1991 (pl. 3; They showed only an unnamed fault along the western side of Middle Crest. This unnamed fault was interpreted by Y-1042 as one of several traces of GD south of Dune Wash.); Y-396: Scott, 1990; Y-1042: O'Neill and others, 1992 (show GD as a single trace north of Dune Wash and as several traces south of Dune Wash); Y-1201: Ramelli and others, 1991 (their Ghostdance fault); Y-1227: Ramelli and others, 1989; Y-1230: Bell and others, 1990; Y-1239: Wesling and others, 1992 (continued GD north of Drill Hole Wash to Azreal Ridge).

Location: 0 km (distance of closest point from YM) at lat 36°50′N. and long 116°27′W. (location of closest point). GD is located along the eastern side of Yucca Crest between at least Drill Hole Wash (Y-1042, p. 6) or Azreal Ridge (Y-1239, p. 45) on the north and an unnamed ridge south of Whale Back Ridge (Y-1042, pl. 1; Y-1239, p. 45) on the south. Y-1042 (p. 6-7) suggested that GD splits into several traces on the south: an unnamed fault trace along the western side of Middle Crest, the Abandoned Wash fault (AW) between Yucca Crest and Middle Crest, an unnamed fault trace along the western side of East Crest, and two parallel fault traces along the eastern side of East Crest.

USGS 7-1/2′ quadrangle: Busted Butte.

Fault orientation: The single trace of GD north of Dune Wash strikes north (Y-26, pl. 1; Y-55, pl. 1; Y-1042, pl. 1). For the splays south of Dune Wash, the unnamed fault on the western side of Middle Crest generally strikes north–northwest (Y-1042, pl. 1). AW has a curving strike that is north–northwest on the south and north–northeast on the north (Y-26, pl. 1; Y-1042, pl. 1). The unnamed fault traces along the eastern and western sides of East Crest strike north–northwest (Y-1042, pl. 1).

Y-55 (pl. 1) noted dips on GD of 84° W. and 89° W. Y-396 (p. 259) reported a dip of 77° W. for GD, where the fault is exposed at the ground surface. He (Y-396, p. 50) interpreted a dip of 50° W. for this same fault trace on the basis of a shear zone exposed in a drill hole that was located about 0.4 km west of the surface expression of GD. South of Whale Back Ridge just north of where GD strikes north–northeast as portrayed by Y-55 (pl. 1), they noted a dip of 86° E. for GD. Y-55 (pl. 1) indicated that AW dips 75° W. to 76° W.

Fault length: The following lengths for the various traces of GD have been estimated from Y-1042 (pl. 1). The trace of GD north of Dune Wash is 2.5 km long. The unnamed fault trace along the western side of Middle Crest is 6.5 km long. AW is 3.5 km long. The unnamed fault trace along the western side of East Crest is 3.5 km long. The two unnamed fault traces along the eastern side of East Crest are 2 and 3.5 km long.

Fault F of Y-26, which includes GD and AW of Y-1042, is 9 km long as estimated from Y-26 (pl. 1). The lengths of GD and AW are estimated as 3 km each, using Y-55 (pl. 1).

Style of faulting: Displacement on GD is shown as normal and down to the west by Y-26 (pl. 1), Y-55 (pl. 1), and Y-189. Y-1239 (p. 45) noted that disrupted marker horizons indicate that displacement on GD has been down to the west.

Scarp height: No information.

Displacement: Y-396 (p. 259) reported >25 m of displacement on a fault trace that he noted to be a southern extension of GD.

Ghost Dance fault (GD) — Continued

Age of displacement: Y-1201 (p. 1-63) stated that GD "transects the repository site and may have Quaternary movement." Y-1227 (p. [6]) noted a lack of evidence for Quaternary displacement on GD, but concluded that GD is structurally connected to other faults in the Yucca Mountain area that have evidence for Quaternary rupture, so that "the possibility of future displacement [on GD] cannot be dismissed." Y-1230 (p. [3]), summarizing prior work, reiterated the lack of evidence for Quaternary displacement on GD, but implied that this may be because of a lack of middle to early Quaternary deposits in association with the fault.

Y-26 (p. 14) discussed one trench (Trench 4) across GD and two others (Trenches 6 and 9) across AW as mapped by Y-55 and Y-1042 (Fault F of Y-26). These trenches were dug across projections of fault traces that had been mapped in Tertiary volcanic rocks (Y-26, table 1, p. 5, 25, 26, 28). Y-26 (p. 14) recognized no tectonic features in any of these trenches. In Trench 4 (across GD) and Trench 6 (across AW), Y-26 interpreted Holocene alluvium (their Q1c deposits with an estimated age of 7 ka to 9 ka; fig. 3, p. 9) as overlying projections of the two fault traces. Thus, they (Y-26, table 1, p. 5) concluded that no displacements had occurred on either GD or AW since at least 7 ka.

Trench 9 was dug across a north–northeast–striking continuation of AW as shown by Y-26 (pl. 1) and by Y-55 (pl. 1), but not as shown by Y-1042 (pl. 1). By interpreting deposits exposed in this trench, Y-26 (table 1, p. 5) noted that middle Pleistocene alluvium (their Q2c deposits with an estimated age of 270 ka to 800 ka; fig. 3, p. 9) overlies the fault's projection. Thus, Y-26 (table 1, p. 5) concluded that no fault displacement had occurred on this part of AW since at least 270 ka.

Y-1042 (p. 6) noted that, although GD is readily visible on the ground, it is less obvious on aerial photographs (they used 1:12,000–scale photographs). They did report some linear topographic features that cut across the east–trending ridges of Tertiary volcanic rocks east of Yucca Crest (Y-1042, p. 6). In contrast, Y-1239 (p. 45) reported "well–expressed," north–trending lineaments that correspond to GD as mapped by Y-55 (pl 1; north of about Whale Back Ridge) and interpreted these lineaments (which include tonal contrasts, linear drainages, bedrock scarps, topographic saddles, and displaced units) as the surface expression of GD (they used 1:60,000–scale photographs). Y-1042 (p. 6) noted surficial expression of the multiple traces of GD south of Dune Wash. They reported that the southern end of the unnamed fault trace along the western side of Middle Crest is marked by small scarps and that the northern end of this trace is marked by topographic lineaments and tonal contrasts. They also recognized that AW is delineated by pronounced topographic lineaments, that the unnamed fault trace along the western side of East Crest is delineated on the south by small, west–facing scarps and on the north by fractures in Tertiary volcanic rocks, and that the two parallel fault traces along the eastern side of East Crest are delineated by topographic lineaments, tonal contrasts, minor fractures, and displaced Tertiary volcanic rocks (Y-1042, p. 6). It is not clear that any of these lineaments cross Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished information (Y-26, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000) and conventional aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-1239, p. 3, scales 1:6,000, 1:12,000, and 1:60,000). Mapping of surficial deposits and field investigations in Midway Valley (Y-1239, p. 3). Trenches (4, 6, and 9, which are summarized in Y-26, table 1, p. 5, 25–26, 28).

Relationship to other faults: Y-1042 (p. 10) concluded that GD is a minor structure compared to the other north–striking faults in the Yucca Mountain area. Y-396 (p. 259) interpreted the flattening of dip of GD with depth as indicating that GD has a listric geometry.

Gold Flat fault (GOL)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pls. 1 and 2). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 65 km/345° (distance and direction of closest point from YM) at lat 37°23′N. and long 116°38′W. (location of closest point). GOL is located along the northwestern side of Gold Flat.

USGS 7-1/2′ quadrangle: Gold Flat West, Mount Helen, Triangle Mountain.

Fault orientation: GOL strikes primarily northeast (Y-813). A few fault traces of GOL strike north–northwest (Y-813).

Fault length: GOL is about 16 km long as estimated from Y-813. The lengths of individual fault traces range between 0.5 and 4 km as estimated from Y-813.

Style of faulting: No information.

Scarp characteristics: Scarps along GOL are shown by Y-813 as primarily west–facing or northwest–facing.

Displacement: No information.

Age of displacement: Most fault traces of GOL are portrayed by Y-813 as weakly and moderately expressed lineaments or scarps on surfaces of Quaternary deposits. A couple of traces are shown by Y-813 as moderately expressed lineaments or scarps on surfaces of Tertiary deposits.

Y-813 (p. 9) suggested that faults in Gold Flat have been relatively quiescent during the Quaternary and Tertiary, similar to faults in Sarcobatus Flat southwest of GOL, to faults along the Cactus Range northwest of GOL, and to faults at greater distances in Las Vegas Valley and along the Spring Mountains.

Slip rate: No information.

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: The traces of GOL that strike north–northwest could be a southern extension of north–northwest–striking faults along the Lizard Hills, Gold Mountain, Triangle Mountain, Gabbard Hills, and Trappman Hills as shown by Y-813 (part of the Cactus Flat–Mellan fault (CFML) on pl. 1 of this compilation).

Gold Mountain fault (GOM)

Plate or figure: Plate 1.

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

Location: 90 km/303° (distance and direction of closest point from YM) at lat 37°18′N. and long 117°17′W. (location of closest point). GOM is located along the northern side of Gold Mountain at its junction with the valley of Oriental Wash.

USGS 7-1/2′ quadrangle: Gold Mountain, Gold Point, Gold Point SW, West of Gold Mountain.

Fault orientation: GOM strikes generally east–northeast, but GOM curves so that portions strike northeast (Y-238; Y-853).

Fault length: The length of GOM is 17 km as estimated from Y-853 and 18 km as estimated from Y-238.

Style of faulting: No information.

Scarp characteristics: Scarps along GOM are shown by both Y-238 and Y-853 as north–facing.

Displacement: No information.

Age of displacement: GOM is portrayed by Y-853 as scarps on depositional and erosional surfaces with ages of late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) and early to middle and (or) late Pleistocene (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). GOM is shown by Y-238 as weakly expressed to prominent lineaments and scarps chiefly on surfaces of Quaternary deposits and as prominent lineaments and scarps on surfaces of Tertiary deposits. Short sections of the western end of GOM are portrayed by Y-407 as faults in Tertiary volcanic tuff with an age of about 11 Ma.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: GOM is shown by Y-853 as juxtaposing Quaternary alluvium against bedrock, and the northern side of Gold Mountain, which is adjacent to GOM, is a range front that is characterized by "fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to the range front." These characteristics are similar to those along major range–bounding faults except that GOM is less extensive and fault scarps are substantially lower, shorter, and less continuous that those along a major range–front fault (Y-853).

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

Relationship to other faults: A 1.5–km–long fault trace at the western end of GOM and immediately south of GOM is portrayed by Y-238 as striking nearly north, approximately parallel to lineaments and scarps that are on Quaternary surfaces along the eastern side of Death Valley south of GOM (pl. 1). This fault trace is also nearly parallel to a north–northeast–striking fault mapped by Y-238 in Quaternary deposits at the western end of Slate Ridge (the Tule Canyon fault (TLC) of this compilation). TLC extends northward from the lineaments and scarps along the eastern side of Death Valley. The structural relationships among these faults are unknown.

GOM has a slightly more northerly strike than east–striking faults along Slate Ridge (the Slate Ridge faults; SLR). It is not known if GOM and SLR intersect or merge.

Gold Mountain fault (GOM) — Continued

GOM (except for the western 1.5 km as mapped by Y-238) has a slightly more easterly strike than north–northeast– and northeast–striking faults along range fronts that predominate west of Cactus Flat. These north–northeast–striking and northeast–striking faults include the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain northwest of GOM, the Montezuma Range fault (MR) along the western side of the Montezuma Range north of GOM, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges northwest of GOM, and the Grapevine Mountains fault (GM) along the western side of the Grapevine Mountains southeast of GOM.

GOM also has a slightly more easterly strike than north–northeast– and northeast–striking faults within basins in the area around GOM. These faults include the Stonewall Flat fault (SWF) within Stonewall Flat northeast of GOM, the Palmetto Mountains–Jackson Wash fault (PMJW) in the valley northeast of Palmetto Mountains north of GOM, the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and the Montezuma Range northwest of GOM, and the Clayton Valley fault (CV) in Clayton Valley also northwest of GOM (Y-238; Y-853). The structural relationships among these faults are unknown.

Golden Gate faults (GG)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show only the fault within Coal Valley); Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3; name from their pl. 3 for the fault along the range front); Y-1032: Schell, 1981 (pl. 9; shows only the faults within the Golden Gate Range).

Location: 144 km/40° (distance and direction of closest point from YM) at lat 37°50′N. and long 115°24′W. (location of closest point). GG includes faults at three locations: (1) a fault along the eastern side of the Golden Gate Range at its junction with Coal Valley, (2) several faults within the Golden Gate Range, and (3) a fault in Coal Valley 1.5 to 4 km east of the Golden Gate Range.

USGS 7-1/2′ quadrangle: Coal Valley Reservoir, Murphy Gap, Murphy Gap NW, Murphy Gap SE.

Fault orientation: The fault along the Golden Gate Range front curves, but has a general north–northeast strike (Y-404). The faults within the Golden Gate Range include two that strike north–northeast and parallel the range front and three that strike northeast (Y-404; Y-1032). The fault in Coal Valley strikes northeast, slightly more eastward than does the fault along the range front (Y-25; Y-404).

Fault length: The length of the fault along the Golden Gate range front is 23 km as estimated from Y-25 and about 24 km as estimated from Y-404 (pl. 3). However, this fault extends to the northern edge of both of their map areas at lat 38°N., so that these lengths are minimum values.

The faults in the Golden Gate Range are 3 to 5 km long as estimated from Y-404 (pl. 3).

The part of the fault in Coal Valley that is south of lat 38°N. (shown on pl. 1 of this compilation) is 6 to 8 km long as estimated from Y-404 (pls. 2 and 3). The maps of Y-404 (pls. 2 and 3) show an additional fault trace in Coal Valley north of lat 38°N. (not shown on pl. 1). This trace is about 6.5 km long. The total length of the fault in Coal Valley could be about 23 km if both of these traces are combined (includes a gap in surficial expression between the traces).

Style of faulting: Displacement on the fault along the Golden Gate Range front is shown by Y-25 and Y-404 as down to the east; displacement on the fault in Coal Valley is shown as down to the southeast. Displacements on the faults within the Golden Gate Range are shown by Y-404 and Y-1032 as both down to the southeast and down to the northwest.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Y-404 (pl. 3) portrayed the fault along the Golden Gate Range front as a post–Laramide structure. They (pl. 3) indicated that this fault is either inferred in or concealed by Quaternary and Tertiary gravel, alluvium, and undeformed lake beds (their QT deposits). The geologic map by Y-404 (pl. 2) does not include this fault, which implies that the fault along the range is concealed by older Pleistocene alluvium (their Qol deposits).

The probable age of youngest displacement on the faults within the Golden Gate Range is noted by Y-1032 (pl. 9) as indeterminate, but suspected of being Quaternary. Y-1032 (pl. 9) reported prominent scarps, but he could not determine their age because he found that young stratigraphic units are not present along the faults. These faults are shown by Y-404 (pl. 3) as post–Laramide structures.

The fault in Coal Valley is shown by Y-404 as a probable or inferred fault in Pleistocene(?) younger lake beds (their Ql deposits). This fault is noted by Y-404 (p. 85) to be one of the youngest normal faults in Lincoln County, because it cuts Pliocene and early Quaternary valley fill. Y-404 (pl. 3) portrayed this fault as a post–Laramide structure.

Slip rate: No information.

Recurrence interval: No information.

Golden Gate faults (GG) — Continued

Range-front characteristics: The eastern side of the Golden Gate Range is noted to be steep by Y-404 (p. 95), and it appears to be relatively linear on the 1:250,000–scale topographic map. No range front is associated with the fault in Coal Valley or with those within the Golden Gate Range.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: The structural relationships among the faults of GG are not known. These faults have been arbitrarily grouped into GG.

Drainages in Garden Valley west of the Golden Gate Range flow through the range at four places and empty into the Coal Valley playa east of the range (Y-404, p. 95). It is not known if this drainage pattern developed as a result of displacement on any of the faults included in GG.

Grapevine fault (GV)

Plate or figure: Plates 1 and 2.

References: Y-236: Reynolds, 1969 (his Grapevine fault zone); Y-239: Reheis, 1991 (pl. 1); Y-390: Hunt and Mabey, 1966; Y-755: Reynolds, 1976; Y-917: Mabey, 1963. Not shown by Hart and others (1989; Y-427).

Location: 58 km/260° (distance and direction of closest point from YM) at lat 36°46′N. and long 117°05′W. (location of closest point). GV is located along the southwestern side of the Grapevine Mountains and along the northeastern side of Death Valley between about Titanothere Canyon on the south and north of Red Wall Canyon on the north.

USGS 7-1/2′ quadrangle: Fall Canyon, Thimble Peak.

Fault orientation: GV has a curving, generally northwest strike. Y-236 (p. 224) noted that individual fault traces strike N. 30° W. to N. 35° W., which is parallel to the front of the Grapevine Mountains and nearly parallel to the Furnace Creek fault (FC), located about 3 km southwest of GV in the central part of northern Death Valley.

Fault length: The total length of GV between Titanothere Canyon and north of Red Wall Canyon is 20 km as estimated from Y-239 (pl. 1). Y-755 (p. 21) reported that alluvium adjacent to the Grapevine Mountains is not faulted south of Titanothere Canyon to at least Boundary Canyon, but that the alluvium in this area is locally warped. The length of this section is about 10 km, so that the total length of GV could be close to 30 km.

Style of faulting: Although Y-236 (p. 227) concluded that displacement on GV occurred primarily on a single fault trace, he noted that GV does include many closely spaced, northwest–striking fault traces and that total displacement is likely cumulative across these. Displacement on these traces is dominantly dip slip (normal) and down to the southwest. Evidence for horizontal displacement on GV is rare. Horizontal slickensides were observed by Y-236 (p. 227) on fault surfaces at two localities.

The main trace of GV is dominantly west–dipping; traces thought to be antithetic to the main trace are east–dipping (Y-236, p. 224, 226).

Scarp characteristics: Y-755 (p. 24) reported that fault scarps slope 44° to 75° toward Death Valley (to the southwest) and that antithetic fault scarps slope into the Grapevine Mountains (to the northeast).

Displacement: Y-236 (p. 228) reported that the total vertical separation on GV could be at least 4,270 m (14,000 ft). This estimate assumes that the oldest Cenozoic rocks on the hanging wall in Death Valley are correlative with the Titus Canyon Formation, which is now at elevations >1,220 m (>4,000 ft) in the Grapevine Mountains on the footwall. He (Y-236, p. 234) suggested that displacement is greatest at the southern end of GV, where the vertical separation is reported to be up to 427 m (1,400 ft) by Y-236 (p. 227), and decreases northwestward toward Red Wall Canyon. Y-755 (p. 24) suggested that warping has accounted for a substantial portion of the structural relief along the front of the Grapevine Mountains. Likewise, Y-236 (p. 228) concluded that folding along the range front and at the edge of Death Valley accounts for some of the displacement across GV. According to Y-755, (p. 24) and Y-917, the vertical separation on a pre–Tertiary surface between Death Valley and the Grapevine Mountains may be at least 4.3 km (down to the west), an estimate that is based on the distribution of Tertiary rocks in the southern part of the Grapevine Mountains along with gravity data. Y-755 (p. 24) concluded that the apparent vertical separation on GV diminishes north of Fall Canyon, where right–lateral displacement becomes more important on faults within the Grapevine Mountains. Y-236 (p. 226) noted that displacements on small faults vary between a few meters to about 76 m (a few feet to 250 ft).

Y-236 (p. 227, 232) noted that evidence of horizontal displacement is rare and has apparently been insignificant. He (Y-236, p. 227) reported a demonstrable horizontal separation on GV of at most about 2 m (8 ft). This value is based on slickensides observed on fault surfaces at two localities.

Grapevine fault (GV) — Continued

Age of displacement: Y-239 (pl. 1) interpreted part of GV as moderate to prominent lineaments or scarps on surfaces of Quaternary deposits. Y-755 (p. 21) inferred recurrent Quaternary displacement on different sections of GV between Titanothere and Red Wall canyons, because Quaternary alluvium that was subdivided into at least four different age groups by Y-390 and Y-236 is faulted against the range front at some localities and deposited against fault scarps at other localities.

Y-236 (p. 231) concluded that displacement on GV, especially on the fault's southern end, occurred primarily during the late Pliocene and early Pleistocene, but has recurred throughout the Quaternary. He based this conclusion on (1) the steepness of the front of the Grapevine Mountains; (2) the small size of the alluvial fans on the eastern side of Death Valley compared to the size of those on the western side; (3) the possible Pliocene gravels that overlap Cambrian rocks along the range front, which suggests pre–Pliocene(?) displacement on GV, but that are tilted by post–Pliocene displacement on GV; (4) the Pleistocene and Holocene alluvial deposits that are faulted against older rocks along GV south of Titus Canyon; and (5) the location of Pleistocene and Holocene playa sediments against the front of the Grapevine Mountains (Y-236, p. 230-231). Y-755 (p. 21) also noted the eastward migration of playa sediments toward the Grapevine Mountains, which he concluded was the result of the eastward tilt of Death Valley by displacement on GV.

North of Red Wall Canyon, rocks of possible Pliocene age are noted by Y-236 (p. 234) to overlie GV. Y-755 (p. 21) reported that alluvium adjacent to the Grapevine Mountains south of Titanothere Canyon is not displaced by GV although this alluvium is warped.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Part of GV is shown by Y-239 (pl. 1) as a topographic lineament bounding the front of the Grapevine Mountains.

Analysis: Compilation of geologic mapping (Y-755, p. 19). Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000). Field examination (Y-236). Field mapping (Y-755, p. 19). Analyses of gravity data (Y-917).

Relationship to other faults: GV is located about 3 km northeast of the northwest–striking, chiefly right–lateral strike–slip Furnace Creek fault (FC) in the central part of northern Death Valley. Y-755 (p. 21) reported that Death Valley between Titus and Titanothere canyons (adjacent to the southern part of GV) appears to have been tilted downward to the east toward the Grapevine Mountains. Several north– to north–northwest–striking fault traces have been mapped by Y-239 (pl. 1) on surfaces of Quaternary deposits in Death Valley between GV and FC. GV may continue to the northwest along the same strike into the Grapevine Mountains or the fault may step westward and join FC (Y-239, pl. 1). The exact structural relationship between GV and FC has not been determined.

Y-236 (p. 224) concluded that GV "is superimposed across [an] older fold system and appears to truncate [a] set of north–south–[striking] Cenozoic faults characteristic of the" northeastern Grapevine Mountains. He (Y-236, p. 231) also suggested that GV is a "structural hinge" between Death Valley to the west and the Grapevine Mountains to the east. He (p. 232) noted that displacement along GV may "represent surficial failure under gravity in response to arching which accompanied uplift of the mountain block relative to the Death Valley block," which is described below.

Grapevine fault (GV) — Continued

Y-236 (p. 233-234) proposed that GV bounds the eastern side of a triangular block (Death Valley) that is bounded on the south by an east–northeast–striking fault mapped by Y-390 (the Towne Pass fault (TP) of this compilation) and on the west by a fault along the western side of the Cottonwood Mountains (unnamed in this compilation). The triangular block is lowest both structurally and topographically at its southern end, where Death Valley is the widest, and slopes upward to the north, where Death Valley is the narrowest (Y-236, p. 234). Y-236 (p. 234) further proposed that strike–slip displacement on FC, in combination with northeast–southwest–directed regional compression, has resulted in normal displacement along GV and on the other two faults bounding the Death Valley block. Furthermore, the normal displacement on these three faults has resulted in the triangular–shaped valley as a pull–apart basin (Y-236, p. 235-236).

GV is located about 15 km northwest of the Keane Wonder fault (KW) that has a strike and sense of displacement similar to those of GV. Several northwest–trending, down–to–the–northeast (uphill–facing) lineaments and scarps are preserved between GV and KW near Mud Canyon as reported by Y-239 and by Reheis and Noller (1991, Y-238, pl. 3). The exact structural relationship between GV and KW has not yet been determined.

Grapevine Mountains fault (GM)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 2); Y-239: Reheis, 1991 (pl. 1); Y-407: Albers and Stewart, 1972; Y-853: Dohrenwend and others, 1992.

Location: 67 km/294° (distance and direction of closest point from YM for the southern trace) at lat 37°06′N. and long 117°07′W. (location of closest point); 70 km/295° (distance and direction of closest point from YM for the northern trace) at lat 37°07′N. and long 117°09′W. (location of closest point). GM includes two main traces along the northwestern end of the Grapevine Mountains at their junction with Grapevine Canyon.

USGS 7-1/2′ quadrangle: Bonnie Claire Lake, Bonnie Claire SW, Grapevine Peak, Scottys Castle.

Fault orientation: The southern trace of GM strikes north–northeast on its southern end and northeast on its northern end (Y-238; Y-239). The northern trace of GM strikes northeast (Y-238).

Fault length: The length of the southern trace of GM is approximately 9 km as estimated from Y-853 and 23 km as estimated from Y-238 and Y-239. The length of the northern trace of GM is approximately 13 km as estimated from Y-853 and 21 km as estimated from Y-238.

Style of faulting: Displacement on both traces of GM is shown by Y-238, Y-239, and Y-853 as dip slip (normal?) and down to the west. Displacement on a 1.5–km–long section at the eastern end of the northern trace is shown by Y-238 as down to the east.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Portions of both the southern and northern traces of GM are shown by Y-853 as faults that juxtapose Quaternary alluvium against bedrock. Quaternary displacement is also implied by Y-238 and Y-239, because they show most of both traces as topographic lineaments (subtle to prominent) on surfaces of Quaternary deposits. Short sections of both traces are indicated by Y-238 and Y-239 to be lineaments or scarps on surfaces of Tertiary deposits.

Portions of the northern trace of GM are portrayed by Y-853 as scarps on depositional or erosional surfaces with ages of early to middle Pleistocene (their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma) and possibly late Pleistocene (their Q_2? surfaces with estimated ages between 10 ka and 130 ka).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The Grapevine Mountains along portions of both the southern and northern traces are shown by Y-853 to have characteristics (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, subparallel systems of high–gradient, narrow, steep–sided canyon perpendicular to range front) similar to those along major range–front faults, except that the portions of GM are less extensive, and scarps are lower, shorter, and less continuous.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-239, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Grapevine Mountains fault (GM) — Continued

Relationship to other faults: GM is one of several northeast–striking faults that bound the northwestern and southeastern sides of ranges in the area. These faults include the Bonnie Claire fault (BC) along the hills west of Bonnie Claire Flat immediately northwest of GM, the East Magruder Mountain fault (EMM) along the southeastern side of Magruder Mountain northwest of GM, and the Lida Valley faults (LV) along the northwestern side of Magruder Mountain and along the southeastern side of part of the Palmetto Mountains also northwest of GM (Y-238, p. 4). Y-10 (p. 59) and Y-238 (p. 4) both speculated that the northeast–striking faults in this area could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternately, Y-10 (p. 59) and Y-238 (p. 4) suggested that these northeast–striking faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding faults east of FC and west of Pahute Mesa, Y-10 (p. 60) inferred that these faults could be rooted in a detachment fault at depth.

Groom Range Central fault (GRC)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show only the northern two traces); Y-813: Reheis, 1992 (pls. 1 and 2). Not shown by Tschanz and Pampeyan, 1970 (Y-404).

Location: 82 km/47° (distance and direction of closest point from YM) at lat 37°20′N. and long 115°46′W. (location of closest point). GRC includes three main, left–stepping traces within the Groom Range.

USGS 7-1/2′ quadrangle: Cattle Spring, Groom Mine, Groom Range, Groom Range SW, White Blotch Springs SE.

Fault orientation: Traces in GRC strike generally north to north–northeast, but the traces curve so that some sections strike north–northwest (Y-813). The left–stepping pattern results in a general north–northwest strike for the entire fault.

Fault length: The total length for GRC is 31 km as estimated from Y-813. The lengths of the northern and central traces are 9 km each; the length of the southern trace is 13 km as estimated from Y-813.

Style of faulting: Displacement on the northern and central traces is shown by Y-25 and Y-813 as down to the west.

Scarp characteristics: Parts of the northern and central traces are expressed as west–facing scarps (Y-25; Y-813). The southern trace is expressed as east–facing scarps (Y-813).

Displacement: Y-25 suggested that a fault (the central trace of GRC) that cuts the western side of the Bald Mountain caldera has had large displacement of an unspecified amount.

Age of displacement: GRC is portrayed by Y-813 as weakly expressed lineaments and scarps on surfaces of Quaternary deposits (the central trace and short sections of the northern trace), as faults that are in Tertiary deposits and that were identified from previous mapping (chiefly the central trace and also the southern end of the northern trace), and as weakly expressed to prominent lineaments and scarps on surfaces of Tertiary deposits (the entire southern trace and one short section of the northern trace). The map by Y-25 shows parts of the northern and central traces as faulted contacts between Holocene and Pliocene alluvium and colluvium (their QTa deposits) and either Miocene ash–flow tuff or pre–Tertiary sedimentary rocks.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Most of the northern trace of GRC is portrayed by Y-813 as a lineament along a linear range front.

Analysis: Aerial photographs (Y-25; Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: GRC is approximately parallel to faults that bound the western and eastern sides of the Groom Range (the Stumble fault (STM) and the Groom Range East fault (GRE), respectively). GRC is also parallel to faults that bound the western side of the Jumbled Hills southeast of the Groom Range (the Jumbled Hills fault (JUM) of this compilation).

GRC may intersect the northeast–striking Tem Piute fault (TEM) along the northern side of the Timpahute Range or the east–northeast–striking portion of the Penoyer fault (PEN) along the southeastern side of Sand Spring Valley.

GRC does not coincide with a fault that was mapped by Y-404 (pls. 2 and 3) and that they called the Main fault. GRC as mapped by Y-813 does coincide in part with faults shown by Y-25. The parts that are coincident are the northern and central traces of GRC and the northern end of the southern trace of GRC.

Groom Range Central fault (GRC) — Continued

Mapping by Y-25 suggests that the central trace and the northern end of the southern trace of GRC bound, in part, the Bald Mountain caldera. The relationship between the volcanic center and displacement on these traces of GRC is not known. However, Y-25 inferred, on the basis of stratigraphic relationships among volcanic units, that dip–slip displacement occurred along these traces after the volcanic center was active.

Groom Range East fault (GRE)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977 (show only part of GRE as portrayed by Y-813); Y-813: Reheis, 1992 (pl. 2); Y-1109: Ekren and others, 1974. Not shown by Tschanz and Pampeyan, 1970 (Y-404).

Location: 85 km/49° (distance and direction of closest point from YM) at lat 37°20′N. and long 115°44′W. (location of closest point). GRE is located along the eastern side of the Groom Range and Bald Mountain.

USGS 7-1/2′ quadrangle: Groom Range, Groom Range SW.

Fault orientation: GRE curves, but strikes generally north–northeast (Y-813). The northern end of the fault strikes north–northwest (Y-813).

Fault length: GRE has a length of about 20 km as estimated from Y-813.

Style of faulting: Portions of GRE are shown by Y-813 as down–to–the–east fault traces.

Scarp characteristics: Portions of GRE are shown by Y-813 as east–facing scarps.

Displacement: No information.

Age of displacement: GRE is shown by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Tertiary deposits, or as faults that are in Tertiary deposits and that were identified from previous mapping. The map of Y-25 shows GRE as displacing Miocene volcanic units (their Ta3 and Tt3 units), and as concealed by Holocene to Pliocene alluvium and colluvium (their QTa deposits). The northern end of GRE is portrayed by Y-813 as concealed by a Quaternary landslide deposit.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Portions of GRE are shown by Y-813 as lineaments along a linear range front.

Analysis: Aerial photographs (Y-25; Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: GRE is approximately parallel to faults along the western side of and within the Groom Range (the Stumble fault (STM) and the Groom Range Central fault (GRC), respectively). GRE is also nearly parallel to the fault along the western side of the Jumbled Hills southeast of the Groom Range (the Jumbled Hills fault (JUM) of this compilation). Although no Quaternary displacement has been reported along GRE, the fault is included in this compilation because of its similar trend and close geographic association with these other faults for which Quaternary displacement has been noted.

Y-25 (*citing* Y-1109) attributed the absence of tuff from the Bald Mountain caldera in the area east of the Groom Range in part to a left–lateral strike–slip fault that was present before Basin–and–Range displacement. Y-25 noted that this fault probably projects into Tikaboo Valley. The proposed fault apparently does not coincide with GRE as mapped by Y-813. A north–northwest–striking fault shown by Y-25 along the eastern side of Bald Mountain correlates only in part with GRE as mapped by Y-813. One short section of a fault south of Bald Mountain as portrayed by Y-25 also coincides with GRE as mapped by Y-813.

Hidden Valley–Sand Flat faults (HVSF)

Plate or figure: Plate 2.

References: Y-239: Reheis, 1991 (pl. 1). Not shown by Streitz and Stinson, 1974 (Y-222).

Location: 87 km/256° (distance and direction of closest point from YM) at lat 36°39′N. and long 117°24′W. (location of closest point). HVSF includes five main faults that bound Hidden Valley, Ulida Flat, and Sand Flat in the Panamint Range north of Hunter Mountain: (1) a fault along the eastern sides of Hidden Valley and Ulida Flat, (2) a fault along the southern sides of Ulida Flat and Sand Flat, (3) a fault along the southeastern side of Sand Flat, (4) a fault along the northeastern side of Sand Flat, and (5) a fault along the western side of Ulida Flat.

USGS 7-1/2′ quadrangle: Harris Well, Jackass Canyon, Sand Flat, Ubehebe Peak.

Fault orientation: Variable (Y-239, pl. 1). The fault along the eastern sides of Hidden Valley and Ulida Flat, the fault along the southeastern side of Sand Flat, and the fault along the western side of Ulida Flat all strike approximately north to north–northeast. The fault along the southern sides of Ulida and Sand flats and the fault along the northeastern side of Sand Flat both strike approximately northwest.

Fault length: Variable. The following lengths were estimated from Y-239 (pl. 1). (1) The fault along the eastern sides of Hidden Valley and Ulida Flat is about 12 km long. This fault is composed of two traces: a northern one along the eastern side of Hidden Valley is 6.5 km long and a southern one along the eastern side of Ulida Flat is 3.5 km long. The two traces may be connected by a northeast–striking trace about 1.5 km long. (2) The fault along the southern sides of Ulida and Sand flats is 9 km long. (3) The fault along the southeastern side of Sand Flat has a length of about 10 km. This fault is composed of two traces that are separated by a right step. The northern trace is about 5.5 km long; the southern trace is about 4 km long. (4) The fault along the northeastern side of Sand Flat is 7.5 km long. (5) The fault along the western side of Ulida Valley is 3 km long.

Two additional faults extend north of Sand Flat toward White Top Mountain. The eastern fault is 13 km long; the western one is 7.5 km long. It is not clear how these faults relate to faults in HVSF. For example, the eastern fault could be a northern extension of the fault along the southeastern side of Sand Flat. These two faults may be separated by a left step along the fault along the northeastern side of Sand Flat.

Style of faulting: Displacement on portions of the fault along the eastern sides of Hidden Valley and Ulida Flat and on portions of the fault along the southeastern side of Sand Flat are shown by Y-239 as down to the west. Displacement on the fault along the southern sides of Ulida Flat and Sand Flat is portrayed by Y-239 as down to the northeast. Displacement on most of the fault along the northeastern side of Sand Flat is shown by Y-239 as down to the southwest. Displacement on the fault on the western wide of Ulida Flat is portrayed by Y-239 as down to the east.

Scarp characteristics: Portions of the fault on the eastern sides of Hidden Valley and Ulida Flat and portions of the fault along the southeastern side of Sand Flat are portrayed by Y-239 as west–facing scarps. The fault along the northeastern side of Sand Flat is shown by Y-239 as southwest–facing scarps.

Displacement: No information.

Hidden Valley–Sand Flat faults (HVSF) — Continued

Age of displacement: At least a portion of each of the faults grouped into HVSF has expression on surfaces of Quaternary deposits or along a linear range front that could have formed by Quaternary fault rupture (Y-239). (1) The fault along the eastern sides of Hidden Valley and Ulida Flat is shown primarily as moderately expressed scarps or lineaments on surfaces of Quaternary deposits. Short sections of this fault are shown as moderately expressed scarps or lineaments on surfaces of Tertiary deposits or as faults that are in Tertiary deposits and that were identified from previous mapping. (2) The fault along the southern sides of Ulida and Sand flats has a 0.5–km–long section portrayed as a moderately expressed scarp or lineament on surfaces of Quaternary deposits; the remainder of this fault is portrayed as a topographic lineament along a linear front. (3) The faults along both the southeastern and northeastern sides of Sand Flat are portrayed as moderately expressed to prominent scarps or lineaments on surfaces of Quaternary deposits. (4) The fault along the western side of Ulida Flat is portrayed as a topographic lineament along a linear front.

Of the faults north of Sand Flat and south of White Top Mountain, the western fault and the southern 5 km of the eastern fault are shown by Y-239 as faults that are in Tertiary deposits and that were identified from previous mapping. The northern 8 km of the eastern fault is shown by Y-239 as a fault that is in Quaternary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Range fronts adjacent to two faults in HVSF, both the fault along the southern sides of Ulida Flat and Sand Flat and the fault along the western side of Ulida Flat, are portrayed by Y-239 (pl. 1) as linear.

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000). Limited field examination (Y-239, p. 2).

Relationship to other faults: The structural relationships among the five faults grouped into HVSF are not known. The north– or north–northeast–striking faults along the eastern sides of Hidden Valley and Ulida Flat, along the eastern side of Sand Flat, and along the western side of Ulida Flat approximately parallel the Racetrack Valley faults (RTV) west of HVSF and the Tin Mountain fault (TM) northwest of HVSF (pl. 2 of this compilation). The northwest–striking faults along the southern sides of Ulida Flat and Sand Flat and along the northeastern side of Sand Flat are approximately perpendicular to RTV and TM, but are approximately parallel to the Hunter Mountain fault (HM) to the south in Panamint Valley. The north–northeast–striking fault along the western side of Ulida Flat may connect with the north–northeast–striking faults along the eastern side of Racetrack Valley along a north–northwest–striking, down–to–the–northeast fault that is about 4 km long (Y-239, pl. 1).

Of the two faults north of Sand Flat and south of White Top Mountain, the eastern fault appears to terminate against the fault along the northeastern side of Sand Flat, whereas the western fault appears to merge with the fault along the northeastern side of Sand Flat.

Hiko fault (HKO)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970 (name from their pl. 3); Y-1032: Schell, 1981 (pl. 9, his fault #90, table A2; shows only that portion of HKO north of lat 37°30'N.).

Location: 131 km/53° (distance and direction of closest point from YM) at lat 37°33'N. and long 115°15'W. (location of closest point). HKO is located along the western side of the Hiko Range and along the eastern side of the Pahranagat Valley. The northern end of HKO parallels the White River.

USGS 7-1/2' quadrangle: Fossil Peak, Hiko, Mail Summit, Mount Irish SE.

Fault orientation: HKO has a curving, but generally north–northwest strike (Y-25; Y-404; Y-1032). The northern end of HKO, which is about 3 km wide (Y-1032, pl. 9), strikes generally northeast.

Fault length: The length of HKO is 45 km as estimated from Y-404 (pl. 3) and 47 km as estimated from Y-25. Both of these lengths include an approximately 20–km–long section between Crystal Springs, Nevada, and north of Alamo, Nevada, that has no surficial expression. The length of HKO is noted to be 15 km by Y-1032 (table A2, p. A17), but his map includes only the northern part of the Hiko Range and HKO (north of lat 37°30'N.).

Style of faulting: Displacement on HKO is portrayed by both Y-25 and Y-1032 as both down to the east and down to the west.

Scarp characteristics: Y-1032 (table A2, p. A17) reported a maximum scarp height of 9 m and a maximum scarp–slope angle of 15°.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement that was noted by Y-1032 (table A2, p. A17) is late Pleistocene (defined as >15 ka to <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A17) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A17) with an estimated age of ≤15 ka (table 3, p. 23). The oldest unit displaced is his late Tertiary volcanic rocks (Tv_3; Y-1032, table A2, p. A17) with an estimated age of 6 Ma to 17 Ma (table A1, p. A1).

North of Crystal Springs, parts of HKO (primarily the northeast–striking northern end) are shown by Y-25 to displace Holocene and Pliocene alluvium and colluvium (their QTa deposits). South of about Alamo, the southern end of HKO is portrayed by Y-25 as a faulted contact between Miocene ash–flow and air–fall tuff (their Tt4 unit) and unconsolidated Quaternary and Tertiary gravel and alluvium (their QTa deposits). Portions of this part of HKO are shown by Y-25 to be inferred or concealed by their QTa deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: HKO approximately parallels other north–northwest–striking faults in the area. These faults include the Hiko–South Pahroc faults (HSP) east of HKO, the Pahroc fault (PAH) also east of HKO, the Sheep Range fault (SHR) south of HKO, the Sheep Basin fault (SB) also south of HKO, and the Badger Wash faults (BDG) west of HKO.

Hiko fault (HKO) — Continued

HKO is approximately perpendicular to other faults in the area, such as the northeast–striking Pahranagat fault (PGT) on the south and to the east–striking Tempahute lineament (expressed as the Tem Piute fault (TEM)) on the north.

HKO is also approximately parallel to the southern part of the Southeast Coal Valley fault (SCV) and the southern part of the Seaman Pass fault (SPS), both north of HKO. However, the northern end of HKO strikes northeast, which is oblique to these faults and approximately parallel to the Six–Mile Flat fault (SMF) east of HKO.

Hiko–South Pahroc faults (HSP)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3); Y-1032: Schell, 1981 (pl. 9; shows only those fault traces north of about lat 37°25′N., which is the southern edge of his map area).

Location: 130 km/68° (distance and direction of closest point from YM) at lat 37°17′N. and long 115°06′W. (location of closest point). HSP includes two main faults that bound the eastern and western sides of an unnamed valley located between the Hiko and South Pahroc ranges and between the Pahranagat fault on the south and Pahroc Valley (or Sixmile Flat) on the north.

USGS 7-1/2′ quadrangle: Alamo NE, Alamo SE, Hiko SE.

Fault orientation: HSP strikes north–northwest (Y-25; Y-404).

Fault length: The length of HSP is 27 km as estimated from Y-25 and Y-404.

Style of faulting: Displacement on the fault along the eastern side of the unnamed valley is shown by Y-25 as primarily down to the west. Displacement on the fault along the western side is shown by Y-25 as primarily down to the east.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The age of the youngest displacement along faults of HSP north of about lat 37°25′N. (the extent of his map area) is shown by Y-1032 (pl. 9) as indeterminate, but suspected of being Quaternary. Scarps along HSP are noted by Y-1032 (pl. 9) as prominent, but their age could not be determined by him because young stratigraphic units are not preserved along the faults.

Portions of faults within HSP are shown by Y-25 as faulted contacts between Miocene volcanic tuff (their Tt3 and Tt4 units) and Holocene to Pliocene alluvium and colluvium (their QTa deposits). Y-404 (pl. 3) portrayed faults of HSP as post–Laramide structures. Parts of these faults are shown by them to be faulted contacts between Tertiary volcanic rocks and Pleistocene(?) older alluvium (their Qol deposits; Y-404, pl. 2).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: Faults in HSP are approximately parallel to other north–northwest–striking faults in the area. These faults include the Hiko fault (HKO) west of HSP, the Badger Wash faults (BDG) also west of HSP, the Pahroc fault (PAH) east of HSP, the Sheep Range fault (SHR) south of HSP, and the Sheep Basin fault (SB) southwest of HSP.

HSP is approximately perpendicular to northeast–striking faults in the area, such as the Six–Mile Flat fault (SMF) west of HSP and the Pahranagat fault (PGT) immediately south of HSP. HSP may intersect PGT.

Hot Creek–Reveille fault (HCR)

Plate or figure: Plate 1.

References: Y-5: Ekren and others, 1971 (show only that part of HCR south of lat 37°52′30″N., which is the northern edge of their map area); Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pl. 1); Y-853: Dohrenwend and others, 1992 (Y-232, Y-813, and Y-853 show only that part of HCR south of lat 38°N., which is the northern edges of their map areas.); Y-1032: Schell, 1981 (pls. 7 and 8; name from his table A2, fault #50; shows HCR between lat 38°30′N. and about lat 37°45′N., which is the southern edge of his map area).

Location: 103 km/6° (distance and direction of closest point from YM) at lat 37°45′N. and long 116°18′W. (location of closest point). South of lat 38°N. and north of Cedar Pass, HCR is located along the eastern side of the Kawich Range at its junction with Reveille Valley. North of lat 38°N. and south of Hot Creek Canyon at about lat 38°30′N., HCR is located along the eastern side of the Hot Creek Range at its junction with the Hot Creek Valley (this part of HCR is north of the area shown on pl. 1 of this compilation).

USGS 7-1/2′ quadrangle: Georges Well, Kawich Peak, Kawich Peak NE, Kawich Peak SW.

Fault orientation: HCR strikes generally north–northwest (Y-5; Y-232; Y-813; Y-853; Y-1032).

Fault length: The total length of HCR is reported by Y-1032 (table A2, p. A10) as 83 km. The length of HCR south of lat 38°N. (the area shown on pl. 1 of this compilation and by each of these references) is 29 km as estimated from Y-853, 30 km as estimated from Y-813, and 32 km as estimated from Y-232.

Style of faulting: Displacement on HCR is shown primarily as down to the northeast (Y-5; Y-232; Y-813).

Scarp characteristics: HCR is portrayed by Y-813, Y-853, and Y-1032 as primarily northeast–facing scarps. A maximum scarp height of <134 m (<440 ft) is reported by Y-1032 (table A2, p. A10) with a maximum scarp–slope angle of 27°.

Displacement: Stratigraphic throw across a normal fault on the eastern side of the Kawich Range (part of HCR?) is reported by Y-232 (p. 32) to be 458 m (1,500 ft). The stratigraphic unit involved is not noted by Y-232.

Age of displacement: The probable age of the youngest displacement along HCR is noted by Y-1032 (table A2, p. A10) to be late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A10) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). Y-1032 (p. 33) reported that HCR is primarily preserved at the contact between bedrock and alluvium, but he suggested a late Pleistocene age for the fault's youngest displacement on the basis of minor displacement of his A5i deposits where the fault crosses the mouths of drainages (Y-1032, p. 33). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A10) with an estimated age of ≤15 ka (table 3, p. 23). The oldest unit displaced is his middle Tertiary volcanic rocks (Tv_2; Y-1032, table A2, p. A10) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

On the basis of a geomorphic analysis, Y-1032 (p. 35, table A2, p. A10) concluded that the high (<134 m) scarp at Empire Canyon represents multiple surface ruptures on HCR and speculated that at least four episodes of displacement have occurred at this locality during and since the late Tertiary.

HCR is portrayed by Y-853 as scarps on depositional or erosional surfaces with ages of possibly late Pleistocene (their Q_2? surfaces with estimated ages between 10 ka and 130 ka) and possibly early to middle and (or) late Pleistocene (their Q_{1-2}? surfaces with estimated ages between 10 ka and 1.5 Ma). The map by Y-853 also shows HCR as fault–related lineaments on Quaternary depositional or erosional surfaces.

Hot Creek–Reveille fault (HCR) — Continued

HCR is portrayed by Y-813 as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping, as weakly expressed lineaments and scarps on surfaces of Quaternary deposits, and as weakly to moderately expressed lineaments or scarps on surfaces of Tertiary deposits. However, HCR is shown by Y-5 as concealed beneath Pliocene through Holocene alluvium and colluvium (their QTa deposits) and as fault traces juxtaposing Miocene Tuff of White Blotch Spring (their Tws unit) against Miocene lava and tuff (their Td and Tzt units). HCR is portrayed by Y-232 as concealed beneath Quaternary alluvium (his Qal deposits) at some localities and as juxtaposing Miocene Tuff of White Bloch Spring against Quaternary alluvium (his Qal deposits), primarily, and against Miocene dacite and rhyodacite (his Td unit) and against Pliocene ash–fall and ash–flow tuff (his Tt unit).

Slip rate: No information.

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-5; Y-813, p. 4, scales 1:62,500 to 1:80,000 and 1:58,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field mapping (Y-5). Field reconnaissance (Y-1032, p. 17-18). Topographic scarp profiles (Y-1032, p. 18-20). Gravity analyses (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: HCR is approximately parallel to other north–, north–northeast–, and north–northwest–striking faults bounding range fronts and within basins in the area. These faults include the Belted Range fault (BLR) along the western side of the Belted Range southeast of HCR, the East Reveille fault (ERV) along the western side of the Reveille Range east of HCR, the West Railroad fault (WR) along the eastern side of the Reveille Range also east of HCR, the Central Reveille fault (CR) in Reveille Valley immediately east of HCR, the Kawich Range fault (KR) along the western side of the Kawich Range immediately west of HCR, and the Cactus Flat fault (CF) and the Cactus Flat–Mellan fault (CFML) both within Cactus Flat west of HCR (Y-813; Y-853; Y-1032). The structural relationships among these faults have not been reported.

Y-5 (p. 72) noted that the Kawich Range is a horst. In addition to the range–bounding faults, HCR on the east and KR on the west, numerous normal faults are present in the range (Y-5, p. 72). These faults have displacements of a few meters to 153 m (a few feet to 500 ft) and create a sequence of randomly dipping, tilted fault blocks (Y-5, p. 72).

Hunter Mountain fault (HM)

Plate or figure: Plate 2.

References: Y-29: Hamilton, 1988; Y-222: Streitz and Stinson, 1974; Y-239: Reheis, 1991 (pls. 1 and 2; shows only that part of HM east of about long 117°35'W.; her extension of HM south to about Towne Pass in northern Panamint Valley is shown as HM? on pl. 2 of this compilation); Y-356: McAllister, 1956 (shows only those portions of HM along Hunter Mountain, adjacent to Grapevine Canyon, and in Saline Valley east of long 117°45'W.); Y-399: Hopper, 1947; Y-427: Hart and others, 1989; Y-494: Smith, 1976; Y-518: Smith and Pratt, 1957; Y-697: Zhang and others, 1990; Y-698: Smith, 1975; Y-864: Burchfiel and others, 1987; Y-900: Ellis and others, 1989; Y-906: MIT 1985 Field Geophysics Course and Biehler, 1987 (discusses only that part of HM in northern Panamint Valley and adjacent to Hunter Mountain); Y-909: Schweig, 1989; Y-916: Wernicke and others, 1986; Y-1020: Jennings, 1992 (his fault #244, p. 16, name from this reference); Y-1148: Zellmer, 1980 (shows only that portion of HM along the southern edge of Saline Valley; his Grapevine Canyon fault zone; fig. 3.1, p. 20, 22); Y-1274: Blakely and others, 1994.

Location: 95 km/238° (distance and direction of closest point from YM) at lat 36°24'N. and long 117°20'W. (location of closest point). HM is located along the southwestern side of Hunter Mountain and adjacent to Grapevine Canyon between Panamint and Saline valleys, and along the northeastern side of the Nelson Range at its junction with the southern edge of Saline Valley. HM may extend southeastward along the southwestern side of the Cottonwood Mountains and the Panamint Range to nearly Towne Pass in northern Panamint Valley (Y-239).

USGS 7-1/2' quadrangle: Emigrant Pass, Jackass Canyon, Lee Wash, Nova Canyon, Panamint Butte, The Dunes.

Fault orientation: HM in northern Panamint Valley and adjacent to Hunter Mountain strikes north–northwest. Y-864 (p. 10,422) noted a strike of N. 6° W. for HM near Panamint Butte in northern Panamint Valley. Y-494 (p. 175) and Y-698 (p. 113) both noted a strike of N. 55° W. for a near–vertical fault trace at Grapevine Pass southwest of Hunter Mountain between Panamint and Saline valleys.

HM strikes west–northwest between Hunter Mountain and Daisy Canyon along the southern edge of Saline Valley. Y-1148 (p. 20) reported a strike of N. 60° W. for HM in Saline Valley.

Fault length: The total length of HM may be about 85 km from about Towne Pass to the western edge of Saline Valley. This length includes about 78 km as estimated from Y-239 (pls. 1 and 2) and from Y-356, which is only for that portion of HM east of long 117°45'W. Y-1148 (fig. 3.1) extended HM to the western edge of Saline Valley for an additional about 7 km.

Style of faulting: On the basis of geomorphic evidence, Y-427 (p. 6) suggested that right–lateral displacement has predominated on HM. Y-239 (pls. 1 and 2) indicated both right–lateral and dip–slip (normal) displacement for HM. Vertical displacement is portrayed by Y-239 (pls. 1 and 2) as both down to the northeast and down to the southwest at different localities along the fault.

The southern portion of HM in northern Panamint Valley is shown by Y-239 (pl. 2) as having right–lateral and down–to–the–southwest displacement. HM adjacent to Hunter Mountain and between Panamint and Saline valleys is portrayed by Y-239 (pl. 2) as having right–lateral and down–to–the–northeast displacement. Y-356 portrayed the portion of HM between Hunter Mountain and San Lucas Canyon in Saline Valley as principally down to the northeast, but he showed some traces as down to the southwest.

Y-1148 (p. 25) noted that HM in Saline Valley has variable types of displacement: predominantly right lateral at Grapevine Pass at the southeastern end of Saline Valley and predominantly vertical (normal) at Daisy Canyon at the southwestern corner of Saline Valley (the northwestern end of HM). Y-1148 (p. 29) interpreted the pattern of scarps on alluvial fans at the mouth of Grapevine Canyon at the southeastern end of Saline Valley as suggesting right–lateral displacement.

Hunter Mountain fault (HM) — Continued

Y-698 (p. 112-113) suggested that HM along Hunter Mountain has experienced thrust displacement on a fault that dips 17° to 35°NE. beneath the mountain. To the northwest at Grapevine Pass, Y-698 (p. 113) observed horizontal slickensides that he interpreted as indicating right–lateral displacement on this portion of the fault.

Y-356 concluded that HM may be a scissors fault with a pivot near the head of Grapevine Canyon. He suggested this in order to explain the down–to–the–northeast displacement in Saline Valley and the down–to–the–southwest displacement in Panamint Valley.

Scarp characteristics: Y-1148 (p. 25) noted that scarps on both alluvial and bedrock surfaces in Saline Valley commonly have heights of ≥20 m. He (Y-1148, p. 30, 32) measured scarp heights of 15 and 23 m at two localities along HM in southeastern Saline Valley and noted that the scarps at these localities have been oversteepened by erosion. On the basis of bevels interpreted from a scarp profile measured at one locality near the southeastern end of Saline Valley (his profile site P3), Y-1148 (p. 35) concluded that at least three, and perhaps five or more, surface ruptures have occurred on HM.

Displacement: Y-356 reported a maximum throw on HM of "at least several thousand feet" where HM is opposite the highest part of the Nelson Range in Saline Valley. However, Y-356 noted that the throw on HM at the head of Grapevine Canyon is close to zero.

Y-864 (p. 10,424) estimated right–lateral displacement of 8 to 10 km and down–to–the–southwest vertical displacement of 0 to 2 km on HM in the area of Panamint Butte in northern Panamint Valley. This estimate was made using outcrops of a N. 7° W.–striking, near–vertical contact as piercing points. This contact is between early Jurassic Hunter Mountain batholith and an unconformity at the base of Miocene/Pliocene volcanic rocks (Y-864, p. 10,422-10,423). The contact is preserved across HM on both sides of northern Panamint Valley at two localities: southeast of Hunter Mountain on the eastern side of the valley and on the northeastern edge of the Darwin Plateau on the western side of the valley (Y-864, fig. 2, p. 10,424). Y-697 (p. 4,858, *citing* Y-864) reported that a 4–Ma, well–defined piercing point is displaced 9.3 ± 1.4 km by HM. (I could not find this amount of displacement reported in Y-864.)

On the basis of displaced stream channels, Y-1148 (p. 25, 34) estimated total lateral displacement of between 700 m and 2,000 m on HM in Saline Valley. He (Y-1148, p. 43) speculated that right–lateral displacement at the northwestern end of HM in Saline Valley at San Lucas Canyon may be nearly 1,000 m. In Saline Valley between San Lucas and Daisy canyons, Y-1148 (p. 42) observed a total cumulative lateral displacement on HM of 22 m in lacustrine deposits. Stream channels in this area are displaced laterally by smaller amounts (Y-1148, p. 42). Displacements (lateral?) in individual events in Saline Valley range between 2 and 7 m (Y-1148, p. 42).

Y-1274 (p. 38) noted that the displacement of a prominent magnetic anomaly centered over Hunter Mountain indicates right–lateral displacement of at least 6 km along HM, which supports the suggestions made by others on the basis of geologic mapping.

Y-1148 (p. 25) reported a vertical displacement of "perhaps tens of meters" on HM in southeastern Saline Valley at Grapevine Pass and a vertical displacement of at least 6,000 m on HM in southwestern Saline Valley at Daisy Canyon. He (Y-1148, p. 25) estimated these amounts of displacement from the elevation difference between the Inyo Mountains and the depth of fill in Saline Valley that was inferred from gravity data of Mabey (1963, Y-917). Y-1148 (p. 35) reported a vertical displacement of about 50 m that was estimated from topographic profiles measured across fault scarps in southeastern Saline Valley. Utilizing profiles measured across scarps associated with a splay of HM in southeastern Saline Valley, Y-1148 (p. 36-39) noted vertical displacements of 4.5 m in one event, 16 m in four to six events, and 30 m in at least four events. Y-864 (p. 10,423) interpreted a steep escarpment at the northern end of Panamint Valley as corresponding to HM. This escarpment, which trends N. 6° W., has 1 to 1.5 km of topographic relief that is assumed to reflect the minimum vertical displacement on HM.

Hunter Mountain fault (HM) — Continued

Along the northwest–striking section that may be part of either PAN (Y-399; Y-698) or the Hunter Mountain fault (shown as HM? on pl. 2 of this compilation), Y-399 (p. 399) reported observing evidence for right–lateral displacement on nineteen stream channels south of Highway 19. This evidence includes the development of shutter ridges. Y-399 (p. 399) estimated right–lateral displacements of 24 to 61 m (80 to 200 ft) and apparent vertical displacements (southwest side up) of about 12 m (40 ft). In this same area but north of the highway, Y-698 (p. 113) noted 183 m (600 ft) of right–lateral displacement estimated on the basis of the juxtaposition of a late Quaternary alluvial–fan deposit composed of clasts of Precambrian and Paleozoic rocks against a 61–m (200–ft) hill of Tertiary volcanic rocks.

About 3 km (2 miles) southeast of Highway 19, right–lateral displacement of older alluvial–fan deposits totals 305 to 610 m (1,000 to 2,000 ft; Y-698, p. 114).

About 11 km (7 miles) south–southeast of Highway 19, near the mouth of Wildrose Canyon, a "sheet of monolithologic (landslide) breccia" is displaced right laterally 3,050 to 4,575 m (10,000 to 15,000 ft) from a source at Wildrose Canyon (Y-698, p. 114).

Y-1148 (p. 50) speculated that as much as 2.5 km of extension may have occurred on HM in Saline Valley. Y-906 (p. 10,437) estimated extension of about 6 to 10 km on a low–angle fault beneath northern Panamint Valley assuming that the 5–to–9–km–wide area over which lower Pliocene basalts are absent beneath the valley has been the result of displacement that has separated the Darwin Plateau and the Panamint Range in a direction parallel to HM.

Age of displacement: The map by Y-1020 shows part of HM as having Holocene (≤10 ka) displacement and part as having Quaternary (defined by him as <1.6 Ma) displacement. Y-427 (p. 6) called HM "a major late Quaternary fault." Most of HM in Panamint Valley is shown by Y-239 (pl. 2) as prominent lineaments or scarps on surfaces of Quaternary deposits. HM adjacent to Hunter Mountain is shown by Y-239 (pls. 1 and 2) as a fault that is in Quaternary deposits and that was identified from previous mapping. Part of HM in Saline Valley is portrayed by both Y-222 and Y-356 as displacing Holocene and (or) Pleistocene alluvium. The northwestern and southeastern ends of HM are noted by Y-239 (p. 4) to be two of the most active faults in this area.

Late Cenozoic basalts (4.0 Ma to 4.3 Ma, K–Ar dates reported by Larson, 1979, Y-1241) capping Panamint Butte east of northern Panamint Valley were correlated by Y-864 (p. 10,422-10,423) to basalts in the Argus Range and on the Darwin Plateau both on the western side of northern Panamint Valley. On the basis of this correlation, Y-864 (p. 10,422-10423) inferred that northern Panamint Valley must have formed after eruption of these lower Pliocene basalts. In support, Y-697 (p. 4,858) noted that if Panamint Valley were older than this, then the basalts should have filled the valley. Interpretation of gravity data by Y-906 (p. 10,437) suggests that the basalts are absent beneath most of northern Panamint Valley. Similarly, on the basis of correlation of a displaced tuff near Hunter Mountain, Y-1148 (p. 28) suggested that displacement on HM in Saline Valley began after 3 Ma. On the other hand, Y-909 (p. 657-658) concluded that formation of northern Panamint Valley (along with other topographic features in the area) had occurred by 7 Ma to 8 Ma, because (1) alluvial–fan deposits thought to be from the Panamint Range (east of Panamint Valley) were deposited before 7.7 Ma to 6.1 Ma, (2) exposures in Rainbow Canyon (northern Argus Range, west side of Panamint Valley) suggest that some faults are terminated by volcanic units that were deposited between 5.8 Ma and 6.1 Ma, and (3) the oldest basalt in the Rainbow Canyon area was extruded about 7.7 ± 0.5 Ma (extrusion probably related to regional? extension).

Y-698 (p. 112-113) interpreted Quaternary displacement on a west–northwest–striking fault (HM?), because crystalline rocks have been thrust over talus along the southern side of Hunter Mountain. Y-698 (p. 113) inferred that this fault trace is presently inactive because "streams have dissected it to a depth of [61 m] 200 ft" and younger displacement has probably occurred on a parallel fault trace that is about 2.5 km (1.5 miles) southwest of the inactive trace.

Y-1148 (p. 36-39) estimated a minimum age of 280 ka and 380 ka for surface rupture on a splay of HM in southeastern Saline Valley. This estimate was based on a comparison of characteristics of the fault scarps in Saline Valley to the characteristics of fault scarps presented by Wallace (1977, Y-1118).

Hunter Mountain fault (HM) — Continued

Slip rate: By assuming that a maximum age of 3 Ma for the formation of Saline Valley reflects the age of inception of HM at the northern end of Panamint Valley and that net slip on HM is reflected by 8 to 10 km of lateral slip and 0 to 2 km of vertical slip, Y-864 (p. 10,424) calculated a minimum average slip rate of 2 to 3.2 mm/yr for HM. Y-864 (p. 10,423-10,424) further assumed that the displacement on this part of HM is equal to the amount of extension in both northern Panamint Valley and in Saline Valley, so that the slip rate of 2 to 3.2 mm/yr corresponds to minimum rates of extension in this area.

Y-900 (p. 465) suggested that the average Pliocene slip rate for HM is about 2 to 3 mm/yr in a direction of N. 60° W.

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

Recurrence interval: No information.

Range-front characteristics: A portion of HM is shown by Y-239 (pl. 2) as a topographic lineament bounding the linear front of the Cottonwood Mountains. No other information is available.

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000; Y-697; Y-1148, p. 1, 9, scales 1:20,000, 1:37,400, and 1:60,000). Detailed geologic mapping (Y-864, p. 10,422; Y-909, p. 652). Examination of volcanic and alluvial stratigraphy (Y-909, p. 652). Topographic profiles of fault scarps in Saline Valley (Y-1148, p. 2, 55). Gravity data, seismic refraction lines, resistivity profiles, and magnetotelluric measurements in northern Panamint Valley (Y-906, p. 10,428-10,434). Measurement and analysis of joints at Hunter Mountain (Y-1148, p. 95-108).

Relationship to other faults: Y-697 (p. 4,858) suggested that HM may extend southward along the Panamint Valley fault (PAN), which strikes north–northwest and has down–to–the–west, dip–slip (normal) displacement. Alternately, Y-239 (p. 2-3, *citing* Y-29 and Y-916) noted that splays of PAN may continue northward along the Towne Pass fault (TP) and Emigrant fault (EM), both of which strike north–northeast along the western side of Tucki Mountain. Thus, she (Y-239, p. 3, *citing* Y-29) concluded that PAN is "probably a continuation and (or) a reactivation of the Tucki Mountain detachment fault." Alternatively, Y-239 (p. 2-3) noted that HM may intersect PAN near Wildrose Canyon and that this intersection "is marked by a large complex of faults and lineaments on the floor of Panamint Valley" (Y-239, p. 1). Y-239 (p. 3) suggested that this complex may be the surface expression of stresses resulting from the intersection of HM and PAN, and that "[s]ome of the northwest–[striking] faults and lineaments in this cluster are arranged in a left–stepping, *en echelon* pattern, suggesting a component of right–lateral movement in this area."

Y-698 (p. 113) concluded that it is unlikely that HM and PAN are continuous, so that right–lateral displacement on PAN results in horizontal shortening between northern Panamint Valley and Hunter Mountain.

Y-239 (p. 3) speculated that HM may be "connected to" the northwest–striking, right–lateral Furnace Creek fault (FC) by north–northeast–striking, possible Quaternary faults, such as the Racetrack Valley faults (RTV) and the Tin Mountain fault (TM; pl. 2 of this compilation).

Y-222 mapped two west–northwest–trending lineaments on surfaces of granitic rocks on the northern side of Hunter Mountain. These lineaments parallel HM, and Y-239 (p. 3, *citing* Reheis and Noller, 1991, Y-238) concluded that these lineaments "may be shear zones like those in granitic rocks of the Sylvania Mountains to the north that are adjacent to the [Death Valley fault]."

Y-864 (p. 10,422) noted that HM links Panamint Valley and Saline Valley. They interpreted these two valleys as paired pull–apart basins that formed as the result of late Pliocene to Holocene extension on HM, which acted as a transfer fault (Y-864, p. 10,423).

Hunter Mountain fault (HM) — Continued

Y-900 (p. 465) noted that HM is linked with PAN through a bend of 70° and proposed that the lack of a deep basin in this area may be because uplift at the northwestern end of PAN is approximately equal to subsidence at the southeastern end of HM.

Y-864 and Y-906 both proposed that the formation of northern Panamint Valley is the result of extension on a low–angle, west–dipping detachment or normal fault or faults. By restoring the pre–valley configuration of basalts (4 Ma to 4.3 Ma) now preserved on the Darwin Plateau on the western side of Panamint Valley and on Panamint Butte on the eastern side of the valley, Y-864 (p. 10,424) inferred that such a low–angle fault exists, dips 0 to 15° west, and is expressed at the ground surface along the eastern side of northern Panamint Valley. On the basis of their interpretation of geophysical data, Y-864 (p. 10,424) and Y-906 (p. 10,440) concluded that Paleozoic rocks are at shallow depths (primarily 100 to 200 m, Y-906 (p. 10,440)) beneath northern Panamint Valley and that the lower Pliocene basalts are not preserved beneath most of the valley. These conclusions are supported by Y-518, who noted only 111 m (365 ft) of Cenozoic fill above Paleozoic rocks in a drill hole (their Panamint Drill Hole #2, fig. 1, p. 2, 54-57, pl. 1) in the central part of northern Panamint Valley. These two interpretations are cited by both Y-864 (p. 10,424) and Y-906 (p. 10,437) to support their models of a low–angle fault beneath northern Panamint Valley. Y-906 (p. 10,437) noted that the absence of basalt remnants in northern Panamint Valley makes extension on steep faults unlikely. Y-864 (p. 10,424) concluded that the absence of basalts suggests that these hanging–wall rocks have been completely removed from the footwall beneath the valley, which supports their interpretation of displacement along a low–angle fault. Because the total extension (6 to 10 km) across northern Panamint Valley inferred by Y-906 (p. 10,437) is comparable to the amount of lateral displacement (8 to 10 km) suggested by Y-864 for HM, Y-906 (p. 10,438) concluded that the low–angle fault is probably not older than either HM or northern Panamint Valley (both features are supposedly younger than 3 Ma to 6 Ma) and that reactivation of an older fault that experienced large displacement before formation of northern Panamint Valley is unlikely. Y-864 (p. 10,425) concluded that displacement on the low–angle fault "is directly responsible for the present Basin and Range topography that characterizes the Panamint Butte–Darwin Plateau area" and that this fault is still active.

Indian Springs Valley fault (ISV)

Plate or figure: Plates 1 and 2.

References: Y-813: Reheis, 1992 (pls. 2 and 3); Y-852: Dohrenwend and others, 1991. Not shown by Ekren and others, 1977 (Y-25) nor by Tschanz and Pampeyan, 1970 (Y-404).

Location: 67 km/82° (distance and direction of closest point from YM) at lat 36°55′N. and long 115°42′W. (location of closest point). ISV is located along the western side of Indian Springs Valley at its junction with the Spotted Range.

USGS 7-1/2′ quadrangle: Fallout Hills, Quartz Peak NW, Quartz Peak SW.

Fault orientation: ISV generally strikes north–northwest (Y-813; Y-852). Individual traces of the fault strike between northwest and northeast (Y-813; Y-852).

Fault length: The length of ISV is about 23 km as estimated from Y-852 or about 28 km as estimated from Y-813. These lengths include a 5–km–long section at the northern end of ISV that extends into the Fallout Hills (labeled ISV? on pl. 1 of this compilation).

Style of faulting: Displacement on parts of ISV, primarily at the northern end of the Indian Springs Valley, is portrayed by Y-813 as chiefly down to the east. ISV consists of subparallel, *en echelon* traces with a general left–stepping pattern (Y-813; Y-852).

Scarp characteristics: Scarps along parts of ISV are portrayed by Y-813 as primarily east–facing.

Displacement: No information.

Age of displacement: Parts of ISV are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock and as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary (primarily) and Tertiary deposits. Branches and subparallel fault traces shown by Y-813 only within Tertiary rocks of the Spotted Range have been omitted from plate 1 of this compilation.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Portions of ISV are shown by Y-813 to be expressed as lineaments along a linear range front. Portions of ISV are shown by Y-852 to have morphological characteristics similar to those of fronts along a major range–front fault (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front), except that "associated fault systems are significantly less extensive and fault scarps are substantially lower, shorter, and less continuous."

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Relationship to other faults: ISV is parallel to and aligned with the north–northwest–striking faults in the Fallout Hills (Fallout Hills faults; FH) north of ISV. However, displacement on faults in FH is generally down to the west, whereas displacement on ISV is generally down to the east. Consequently, ISV and FH are shown separately on plate 1 of this compilation.

ISV is approximately parallel to faults west of ISV, including the Spotted Range faults (SPR) along the western side of the Spotted Range, the Chert Ridge faults (CHR) that bound Chert Ridge, and the Buried Hills fault (BH) that bounds part of the Buried Hills. ISV is also parallel to faults east of ISV, including the East Pintwater Range fault (EPR), the Central Pintwater Range fault (CPR), and the West Pintwater Range fault (WPR), all three associated with the Pintwater Range.

Jumbled Hills fault (JUM)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-813: Reheis, 1992 (pl. 2). Not shown by Tschanz and Pampeyan, 1970 (Y-404).

Location: 77 km/65° (distance and direction of closest point from YM) at lat 37°08'N. and long 115°39'W. (location of closest point). JUM is located along the western side of the Jumbled Hills at their junction with the southern Emigrant Valley.

USGS 7-1/2' quadrangle: Fallout Hills, Fallout Hills NW, Quartz Peak NW.

Fault orientation: JUM strikes generally north, but the fault curves, so that short sections strike between northwest and north–northeast (Y-25; Y-813).

Fault length: The length of JUM is 27 km as estimated from Y-813.

Style of faulting: Displacement on part of JUM is shown by Y-813 as primarily down to the west. Some portions of JUM are composed of multiple, subparallel or branching strands (Y-813).

Scarp characteristics: Several short (<2 km long) traces are shown by Y-813 as west–facing scarps.

Displacement: No information.

Age of displacement: JUM is portrayed by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary (mainly) and Tertiary deposits and as fault traces that are in Tertiary (mainly) and Quaternary deposits and that were identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Y-813 (pl. 2) portrayed two sections near the northern end of JUM as lineaments along a linear range front.

Analysis: Aerial photographs (Y-25; Y-813, p. 4, scales 1:62,500 to 1:80,000). Field mapping (Y-25).

Relationship to other faults: JUM is approximately parallel to north–striking faults in the area. These faults include the Fallout Hills faults (FH) in the Fallout Hills south of JUM, the Groom Range East fault (GRE), the Groom Range Central fault (GRC), and the Stumble fault (STM). These last three faults are located in and along the Groom Range northwest of JUM.

The northern end of JUM nearly intersects with the northeast–striking Emigrant Valley South fault (EVS) west of JUM.

The map by Y-25 shows a fault concealed beneath Holocene through Pliocene alluvium and colluvium (his QTa deposits) between the southern end of JUM and the northern end of the West Pintwater Range fault (WPR). The actual relationships among these faults are not known.

Kawich Range fault (KR)

Plate or figure: Plate 1.

References: Y-5: Ekren and others, 1971; Y-10: Reheis and Noller, 1989; Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pls. 1 and 2); Y-853: Dohrenwend and others, 1992 (show only the southern portion of KR along Cathedral Ridge and the southern Kawich Range).

Location: 57 km/0° (distance and direction of closest point from YM) at lat 37°20′N. and long 116°27′W. (location of closest point). KR is located along the western side of the Kawich Range, including Cathedral Ridge, at the range's junction with Cactus Flat on the north and Gold Flat on the south.

USGS 7-1/2′ quadrangle: Apache Tear Canyon, Breen Creek, Cedar Pass, George's Well, Gold Flat East, Kawich Peak, Kawich Peak SW, Quartzite Mountain, Silent Butte, Stinking Spring, West of Quartzite Mountain, Wild Horse Ranch.

Fault orientation: The strike of KR is variable (Y-5; Y-813; Y-853). The southern portion of KR between Silent Butte and Quartzite Mountain strikes generally northeast. The section between Quartzite Mountain and Cedar Pass, including the part along Cathedral Ridge, strikes north–northwest. The section between Cedar Pass and Kawich Peak strikes northwest. The northern section of KR between Kawich Peak and the northern edge of the map area at lat 38°N. strikes north–northeast. One fault trace directly west of Silent Butte at the southern end of KR along the range front strikes northeast (Y-813). Fault traces near and east of Silent Butte within the Kawich Range strike north (Y-813; Y-853).

Fault length: The total length of KR is about 80 km as mapped by Y-232, but KR extends to the northern edge of his map area at lat 38°N. A similar total length of the fault, 84 km, is estimated from Y-813 (pls. 1 and 2) between the northern edge of her map area at lat 38°N. and Silent Butte.

The southern section of KR, which is between Quartzite Mountain and Cedar Pass and consists of overlapping, parallel fault traces, is about 20 km long as estimated from Y-813 (pls. 1 and 2). The north–northwest–striking section along the Kawich Range front between Quartzite Mountain and Cedar Pass is composed of nearly continuous fault traces. This section is about 25 km long as estimated from Y-813 (pl. 1). A 13–km–long portion of this section between Cedar Pass and the central part of Cathedral Ridge is shown by Y-813 (pl. 1) to lack surficial expression except for a 1–km–long fault trace just south of Cedar Pass. The northwest–striking section, which is along the range front between Cedar Pass and Kawich Peak, is about 30 km long. The north–northeast–striking portion, which is north of Kawich Peak, is about 6 km long and consists of overlapping, subparallel fault traces (Y-813).

Style of faulting: Displacement on parts of KR is shown by Y-5 and Y-813 as down to the west or southwest. About half (about 45 km) of KR consists of one fault trace or, in places, two approximately parallel fault traces (Y-5; Y-232; Y-813). The northern end of KR (north of about Kawich Peak) is a relatively wide (about 5 km or more) zone of subparallel and branching fault traces. These traces may extend into Cactus Flat as portrayed by Y-813.

Scarp characteristics: Portions of KR are shown by Y-813 as west– or southwest–facing scarps.

Displacement: Stratigraphic throw on the portion of KR along the northern Kawich Range is reported by Y-232 (p. 32) to be 915 m (3,000 ft). Stratigraphic throw of at least 1,220 m (4,000 ft) was measured by Y-5 (p. 71) in Precambrian Stirling Quartzite across a north–striking fault trace west of Quartzite Mountain along the southern Kawich Range.

Age of displacement: Along the southern portion of KR at one locality west of Quartzite Mountain, the fault is shown by Y-853 to be expressed as scarps on depositional or erosional surfaces of early to middle Pleistocene and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). Y-813 portrayed KR as weak or moderate lineaments or scarps on surfaces of Quaternary deposits, as weak or moderate lineaments or scarps on surfaces of Tertiary deposits, and as a fault that is in Tertiary deposits and that was identified from previous mapping.

In contrast, KR is portrayed by Y-5 as concealed by Pliocene through Holocene alluvium and colluvium (their QTa deposits) along most of the fault's length. Similarly, most of KR is shown by Y-232 (pl. 1) as concealed by Pleistocene and Holocene alluvium (his Qal deposits). The only surficial expression of KR that is portrayed by Y-232 (pl. 1) is along two sections in Tertiary volcanic rocks, one south of Quartzite Mountain at the southern end of KR and the other north of Silverbow, Nevada, at the northern end of KR. Some sections of KR between Kawich Peak and Cedar Pass are shown by Y-232 to have surficial expression in Tertiary rocks.

Y-813 (p. 10) suggested that the northwest–striking section of KR along the northern Kawich Range shows little or no evidence for Quaternary displacement.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Y-853 noted that KR between just north of Trailer Pass along Cathedral Ridge and Grass Spring Canyon along the southern Kawich Range has characteristics (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, subparallel systems of high–gradient, narrow, steep–sided canyon perpendicular to range front) similar to those along other major range–front faults. Y-813 portrayed part of KR as a lineament bounding a linear range front.

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

Relationship to other faults: The southern half of KR (south of Cedar Pass) parallels other north–striking faults in the region: the Kawich Valley fault (KV) along the western side of Kawich Valley and the eastern side of the Kawich Range, the Belted Range fault (BLR) that bounds the western side of the Belted Range east of KR, the East Belted Range fault (EBR) along the eastern side of the Belted Range east of KR, and the Cactus Flat–Mellan fault (CFML) in the central part of Cactus Flat west of KR. The northern half of KR (north of Cedar Pass) parallels other north–northwest–striking faults in the area. These faults include the Hot Creek–Reveille fault (HCR) along the eastern side of the northern Kawich Range immediately east of KR, the East Reveille fault (ERV) along the western side of the Reveille Range east of KR, the Central Reveille fault (CR) in central Reveille Valley east of KR, and part of the East Stone Cabin fault (ESC) west of KR.

Lineaments and scarps with a general north–northeast orientation west of the Kawich Range front and in Cactus Flat are grouped into the East Stone Cabin fault (ESC) of this compilation. The relationship of these lineaments and scarps, which are up to 10 km west of the Kawich Range front, and KR, which is immediately adjacent to the front, is not known.

Y-813 (p. 10) noted that the lack of evidence for Quaternary displacement on the northwest–striking portion of KR along the northern Kawich Range is similar to other northwest–striking faults in the area (Carr, 1984, Y-182, p. 20; Y-813, p. 10) and is consistent with least principal stress in a northwest–southeast direction as proposed by Carr (1974, Y-181, p. 10-11, fig. 3). Y-813 (p. 10) suggested that the northwest–striking faults in this area were active during early and middle Miocene.

The relationship between the central portion of KR and the Cathedral Ridge caldera is not known. This caldera is centered around Cathedral Ridge and extends between Gold Reed Pass on the south and north of Cedar Pass on the north (Y-5, pl. 1, p. 72; Y-232, pl. 1). A northwest–striking fault trace of KR just north of Cedar Pass may coincide with the caldera rim (Y-232, pl. 1). Y-5 (p. 72) and Y-232 (p. 32) both reported that the caldera may be filled with at least 2,135 m (7,000 ft) of Fraction Tuff (Miocene) as a result of simultaneous subsidence of the caldera and extrusion of the tuff. The western margin of the caldera is interpreted by Y-5 (p. 72) to be faulted downward along fault traces that are included in KR of this compilation. This margin is now buried by basin–fill deposits in Gold Flat.

Kawich Range fault (KR) — Continued

Y-5 (p. 71-72) subdivided the Kawich Range–Quartzite Mountain block into three *en echelon* structural segments between Saucer Mesa (south of Quartzite Mountain) and the northern edge of their map area at lat 37°52′30″N. The southern segment extends between Saucer Mesa and Cathedral Ridge over about 19 km (12 miles) and includes Quartzite Mountain; this segment is predominately composed of pre–Tertiary (primarily Precambrian) sedimentary rocks. The central segment extends from Gold Reed Pass to Cedar Pass and is *en echelon* to the southern segment. The central segment includes the Cathedral caldera and is almost entirely composed of Tertiary igneous rocks. The northern segment extends between about White Ridge (just south of Cedar Pass) and the northern edge of the map area. It is predominantly composed of Tertiary igneous rocks that are older than those of the central segment, and it is interpreted by Y-5 to be a horst block. The effect of these structural segments on possible Quaternary displacements along KR has not been addressed. Y-813 (p. 10) suggested that evidence for Quaternary displacement on the northern part of KR, which approximately corresponds to the northern segment of Y-5, is sparse or absent, which may imply that displacement on this segment is older than it is on the segments to the south.

Kawich Valley fault (KV)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pls. 1 and 2); Y-853: Dohrenwend and others, 1992 (show only the southern cluster of fault traces). Not shown by Cornwall, 1972 (Y-232) nor by Ekren and others, 1971 (Y-5).

Location: 61 km/14° (distance and direction of closest point from YM) at lat 37°24′N. and long 116°17′W. (location of closest point). KV includes three clusters of fault traces: (1) a northern one near the middle of northern Kawich Valley, (2) a central one along the western side of central Kawich Valley near Gold Reed, Nevada, and (3) a southern one along the western side of southern Kawich Valley (labeled KV? on pl. 1 of this compilation).

USGS 7-1/2′ quadrangle: Apache Tear Canyon, Cedar Pass, Dead Horse Flat, Quartet Dome, Quartzite Mountain, Rhyolite Knob.

Fault orientation: The northern portion of KV strikes northeast; the central portion of KV strikes generally north–northeast; the southern portion of KV strikes approximately north (Y-813; Y-853).

Fault length: If all three clusters of fault traces are included, then the total length of KV is about 43 km as estimated from Y-813.

The length of the northern portion of KV in northern Kawich Valley is about 9 km as estimated from Y-813. This portion of KV includes a cluster of traces that is about 2.5 km wide, but could be as wide as 8 km if a scarp or lineament that intersects Cedar Well along White Ridge west of the main cluster is included in this portion of KV.

The length of the central portion of KV is about 8 km.

The length of the southern portion of KV is about 15 km. Fault traces in the southern portion of KV are 0.5 to 1.5 km long as estimated from Y-813.

Style of faulting: No information.

Scarp characteristics: Most of KV is shown by Y-813 as primarily southeast– or east–facing scarps.

Displacement: No information.

Age of displacement: The northern portion of KV is portrayed by Y-813 as weakly expressed lineaments and scarps on surfaces of Quaternary deposits. The central portion is shown by Y-813 as weakly expressed lineaments and scarps on surfaces of Tertiary deposits. The southern portion of KV is portrayed by Y-813 as weakly expressed lineaments and scarps on surfaces of Quaternary deposits and by Y-853 as fault–related lineaments on Quaternary depositional or erosional surfaces.

Slip rate: No information.

Recurrence interval: No information.

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

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

Relationship to other faults: The relationship between KV and the north–striking Belted Range fault (BLR) along the western front of the Belted Range is not known. The northern end of KV strikes northeastward toward the northern end of BLR.

The southern portion of KV aligns with and has a strike similar to those of faults on Pahute Mesa, immediately south of Kawich Valley. These faults are shown by Y-813 and Y-853 to be in Tertiary deposits or to be expressed as scarps or lineaments on surfaces of Tertiary deposits. Y-813 identified some of these faults from previous geologic mapping. The faults on Pahute Mesa are not shown on plate 1 of this compilation, because evidence for Quaternary displacement has yet to be recognized on them. The relationship between KV and these faults is not known.

Keane Wonder fault (KW)

Plate or figure: Plate 2.

References: Y-216: Brogan and others, 1991 (not shown on their maps, but is mentioned on p. 5 of their report); Y-222: Streitz and Stinson, 1974; Y-238: Reheis and Noller, 1991 (pl. 3); Y-336: Cemen and Wright, 1988; Y-390: Hunt and Mabey, 1966 (pl. 1); Y-468: Noble and Wright, 1954 (name from this reference); Y-525: Wright and others, 1989 (their geologic cross section shows KW); Y-746: Wright and Troxel, 1954; Y-1020: Jennings, 1992 (his fault #244A); Y-1357: Wright and Troxel, 1993. Not shown by Hart and others (1989, Y-427).

Location: 43 km/230° (distance and direction of closest point from YM) at lat 36°37′N. and long 116°48′W. (location of closest point). KW is located in Death Valley along the western side of the Funeral Mountains (or Amargosa Range) between about Boundary Canyon on the north and Winters Peak on the south.

USGS 7-1/2′ quadrangle: Beatty Junction, Chloride City, Nevares Peak.

Fault orientation: KW is curving, but strikes generally northwest (Y-238). KW is shown by Y-238 as several subparallel, curving strands along part of its length.

Fault length: The total length of KW is 25 km as estimated from Y-238 (pl. 3) between just south of Death Valley Buttes (south of Boundary Canyon) and Winters Peak.

Style of faulting: Displacement along KW is shown by Y-238 as down to the southwest. Y-390 (p. A118) suggested that KW dips 25° to 40° into Death Valley, which is similar to the dips of the Precambrian rocks in the Funeral Mountains.

Y-1357 concluded that displacement on KW has been right–lateral strike slip, which was accompanied by northeast tilting of the Funeral Mountains. Their map shows the southeastern end of KW as a low–angle normal fault with lateral displacement. Y-336 (p. 149) also mentioned right–lateral displacement on KW.

Scarp characteristics: No information.

Displacement: Y-1357 reported about 5 km of right–lateral displacement on the southeastern end of KW. They estimated this amount from displaced, northeast–trending axes of folds in Proterozoic rocks.

Age of displacement: Y-216 (p. 5) completed an aerial reconnaissance of KW and concluded that it lacks "geomorphic expression of youthful faulting." However, a few short sections of KW have been portrayed as affecting Quaternary deposits or surfaces.

A fault trace that is southwest of the front of the Funeral Mountains at the northwestern end of KW is shown by Y-238 as a prominent lineament or scarp on surfaces of Quaternary deposits. This trace is 4.5 km long. Y-1357 portrayed two sections at the southeastern end of KW, each about 0.3 km long, as faulted contacts between Late Proterozoic rocks on the northeast and Pleistocene alluvial–fan deposits (their Qg_1 and Qg_2 units). Although the map by Y-468 (pl. 7) portrays most of KW as juxtaposing Precambrian or Cambrian rocks on the northeast against Tertiary volcanic rocks of at least two different ages (their To and Ty units), it also shows KW juxtaposing the older rocks against Quaternary alluvium (their Qa unit) at two localities: at Cow Creek at the southeastern end of the fault and near Boundary Canyon at the northeastern end. Y-238 (pl. 3) indicated north–striking fault traces at the southeastern end of KW as either Quaternary faults identified from previous mapping or as weakly or moderately expressed scarps or lineaments on surfaces of Quaternary deposits. Y-1357 also recognized these traces, showing them as displacing Pleistocene alluvial–fan deposits (their Qg_2 unit) or Pliocene(?) and Miocene Furnace Creek Formation (their Tfc unit). Y-1020 showed KW as a probable Quaternary fault, which he defined as one having evidence for displacement since 1.6 Ma. He based this assessment on interpretations by Y-238. Y-746 (p. 30) noted that KW along the base of the Funeral Mountains separates pre–Tertiary rocks on the east from Tertiary and Quaternary rocks on the west.

Keane Wonder fault (KW) — Continued

In contrast, Y-238 portrayed most of KW as concealed, as lineaments or scarps on surfaces of Tertiary deposits, or as faults that are in Tertiary deposits and that were identified by previous mapping. Y-1357 portrayed and described the northwestern end of KW as separating Proterozoic rocks from Tertiary sedimentary rocks on the southwest. They suggested that most of the rest of KW is a complex zone of faulting and folding in pre–Tertiary rocks. Y-390 (p. A118) suggested that KW has displaced Titus Canyon(?) Formation (Oligocene?) downward against Precambrian rocks. Y-238 (p. 4) proposed that KW was a range–bounding fault during the late Tertiary or early Quaternary.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: About half of KW is shown by Y-238 as a topographic lineament bounding the front of the Funeral Mountains.

Analysis: Aerial photographs (Y-216, p. 3, scale ~1:12,000 (low–sun–angle); Y-238, p. 2, scales 1:24,000 to 1:80,000). Aerial reconnaissance (Y-216, p. 5).

Relationship to other faults: KW is located about 3 km northeast of the northwest–striking, chiefly right–lateral strike–slip Furnace Creek fault (FC) in Death Valley. KW is about 15 km southeast of the Grapevine fault (GV), which has a strike and, possibly, sense of displacement similar to those of KW. Several northwest–trending lineaments and several northwest–trending, down–to–the–northeast (uphill–facing) scarps are preserved between KW and GV near Mud Canyon (Y-238, pl. 3). The structural relationships among these three faults has not been specifically addressed.

Y-390 (p. A118) proposed that Precambrian rocks in the Funeral Mountains form a dissected turtleback surface that dips 25° to 40° into Death Valley. This surface is continuous with thrust faults at Boundary Canyon and at Echo Mountain. Y-390 (p. A118) speculated that the relationship between KW and this turtleback is similar to the relationships between other turtleback surfaces and the Emigrant fault (EM) along the western side of Tucki Mountain or the Death Valley fault (DV) at Mormon Point. From this, Y-390 (p. A118) concluded that the histories of these turtlebacks may also be similar.

On the basis of a variety of observations, Y-1357 concluded that KW is spatially separated from the Boundary Canyon fault, which is located near the northwestern end of KW in Boundary Canyon. Y-336 (p. 149) suggested KW may be at least in part controlled by Mesozoic thrust fault surfaces.

La Madre fault (LMD)

Plate or figure: Plate 2.

References: Y-813: Reheis, 1992 (pl. 3); Y-824: Sowers, 1985; Y-852: Dohrenwend and others, 1991 (show only the west–northwest–striking northern end of LMD as portrayed by Y-813); Y-894: Sowers, 1986. (Y-824 and Y-894 include a geomorphic map of the large alluvial fan that issues from Kyle Canyon at the central part of LMD and descriptions of geomorphic surfaces, soil development, and ages. Neither reference directly addresses displacements on LMD.)

Location: 82 km/129° (distance and direction of closest point from YM) at lat 36°23′N. and long 115°45′W. (location of closest point). LMD is located along the eastern side of the Spring Mountains between Bonanza Peak on the north and La Madre Mountain on the south.

USGS 7-1/2′ quadrangle: Angel Peak, Charleston Peak, Cold Creek, La Madre Spring.

Fault orientation: LMD strikes generally northwest but its trace curves (Y-813, pl. 3). The northern end of LMD strikes west–northwest; the central portion strikes north–northwest (Y-813, pl. 3). The very southern end of LMD strikes nearly north (Y-813).

Fault length: The total length of LMD is about 33 km as estimated from Y-813 (pl. 3). The west–northwest–striking northern portion of LMD (between Lee Canyon and Bonanza Peak) is 10 km long as estimated from Y-813 and Y-852. The north–northwest–striking central portion of LMD (between Lee Canyon and La Madre Mountain) is about 23 km long as estimated from Y-813.

Style of faulting: Displacement on a short section of the west–northwest–striking northern portion of LMD is shown by Y-813 as down to the north.

Scarp characteristics: Parts of the northern and central portions of LMD are portrayed by Y-813 as north–facing or northeast–facing scarps.

Displacement: No information.

Age of displacement: Two sections of LMD, one 5 km long and the other 3 km long, are portrayed by Y-813 as moderately expressed lineaments or scarps on surfaces of Quaternary deposits. LMD at the mouths of Kyle Canyon, Lee Canyon, and North Fork Deer Creek is shown by Y-813 as concealed. The map by Y-852 indicates that the northern 4 km of LMD is expressed as a fault–related lineament on Quaternary depositional or erosional surfaces. Y-813 (p. 10) suggested that LMD shows little or no evidence for Quaternary displacement.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Parts of the north–northwest–striking central portion of LMD are portrayed by Y-813 (pl. 3) as topographic lineaments bounding a linear range front.

About 6 km of the west–northwest–striking northern portion is shown by Y-852 as juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of this part of the Spring Mountains front would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, this part of LMD would be significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852).

La Madre fault (LMD) — Continued

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-824, p. 8; Y-852, scale 1:58,000). Soils studies (Y-824, p. 8 (field descriptions, petrographic microscope, x–ray diffraction); Y-894). Quaternary stratigraphy (Y-824, p. 8; Y-894). Field studies (Y-824, p. 8). Paleomagnetics and uranium–thorium analyses on calcrete (Y-824, p. 8, 18-22).

Relationship to other faults: Y-813 (p. 10) noted that the general lack of evidence for Quaternary displacement on LMD is similar to that of other northwest–striking faults in the area (e.g., the Las Vegas shear zone) and is consistent with a least principal stress direction of northwest–southeast as proposed by Carr (1974, Y-181, p. 10-11, fig. 3).

Lee Flat fault (LEE)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-356: McAllister, 1956 (shows only that part of LEE in Lee Flat north of lat 36°30′N.); Y-1148: Zellmer, 1980 (shows only that part of LEE in Lee Flat north of lat 36°30′N., pls. 3.1 and 3.5, his Lee Flat fault zone).

Location: 113 km/253° (distance and direction of closest point from YM) at lat 36°32′N. and long 117°38′W. (location of closest point). LEE includes fault traces within and bordering northern Lee Flat, which is located between the Nelson Range and the Inyo Mountains.

USGS 7-1/2′ quadrangle: Nelson Range, Santa Rosa Flat.

Fault orientation: LEE generally strikes northwest (Y-222; Y-356; Y-1148, pl. 3.5, p. 74).

Fault length: The longest trace of LEE, which is on the eastern side of Lee Flat, is about 7 km long as estimated from Y-1148 (pl. 3.5). The longest trace of LEE on the western side of Lee Flat is about 5 km long as estimated from Y-1148 (pl. 3.5) and about 6.5 km long as estimated from Y-356, but the trace extends to the southern edge of his map area at lat 36°30′N. Other traces have variable lengths; the shortest is about 0.5 km long as estimated from Y-1148 (pl. 3.5).

Style of faulting: Traces of LEE are shown by Y-1148 (pl. 3.5) as primarily down to the southwest; some are portrayed by him as down to the northeast.

Scarp characteristics: One topographic profile measured by Y-1148 (p. 74) across a fault scarp on the surface of a basalt on the eastern side of Lee Flat suggests a slope angle of 5°, a maximum scarp–slope angle of 82°, and a vertical surface displacement of 28 m (profile P23, fig. B.1, p. 152).

Displacement: Y-1148 (p. 74) estimated a vertical displacement of 28 m across the longest trace of LEE on the eastern side of Lee Flat. He based this estimate on one topographic profile measured across a fault scarp on the surface of a basalt.

Age of displacement: Y-356 portrayed LEE as fault traces on surfaces of Quaternary alluvium (his Qal deposits) and as faulted contacts between Paleozoic rocks and Quaternary alluvium. He showed LEE as low scarps on alluvial surfaces. Y-1148 (p. 76) noted that LEE cuts unconsolidated alluvial deposits and basalt flows, but no specific ages are given.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Analysis of aerial photographs (Y-1148, p. 1, 9, scales 1:20,000, 1:37,400, and 1:60,000). Aerial reconnaissance (Y-1148, p. 1). Field reconnaissance (Y-1148, p. 2). Field mapping (Y-356). Topographic profile across one fault scarp (Y-1148, p. 1, 74, 78–86, table 4.1, fig. B.1, p. 152). Detailed (1:50,000) map of fault scarps (Y-1148, pls. 3.1 and 3.5). Study of scarp material (Y-1148, p. 1-2).

Relationship to other faults: Y-1148 (p. 74-77) suggested that LEE, which approximately bounds both sides of northern Lee Flat, aligns with (1) his Western Frontal fault (WF, discussed with the Saline Valley faults (SAL) of this compilation) along the eastern front of the Inyo Mountains in Saline Valley, (2) a graben that crosses at Daisy Canyon into the Inyo Mountains between Lee Flat and Saline Valley, and (3) faults in both Centennial Flat and the Coso Range south of Lee Flat. He (Y-1148, p. 74-74) concluded that all these faults could be the surficial expression of a major tear fault that resulted from the formation of Saline Valley.

LEE is approximately parallel to the northwest–striking Hunter Mountain fault (HM) east of LEE and to the northwest–striking portion of the Owens Valley fault (OWV) west of LEE.

Lida Valley faults (LV)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 2). Not shown by Albers and Stewart, 1972 (Y-407) nor by Dohrenwend and others, 1992 (Y-853).

Location: 115 km/305° (distance and direction of closest point from YM) at lat 37°27′N. and long 117°30′W. (location of closest point). LV includes two main faults: one along the northwestern side of Lida Valley at its junction with the Palmetto Mountains and the other on the southeastern side of Lida Valley at its junction with Magruder Mountain.

USGS 7-1/2′ quadrangle: Lida, Magruder Mountain.

Fault orientation: Both faults of LV strike northeast (Y-238).

Fault length: The length of the northwest fault of LV is 3.5 km as estimated from Y-238. The length of the southeast fault of LV is about 10 km as estimated from Y-238.

Style of faulting: No information.

Scarp characteristics: Most of the northwest fault of LV is shown by Y-238 as southeast–facing scarps. Parts of the southeast fault are shown by Y-238 as northwest–facing scarps.

Displacement: No information.

Age of displacement: Both faults of LV are portrayed by Y-238 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Parts of both faults are shown by Y-238 as lineaments bounding a linear range front.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: LV is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat. These faults include the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain immediately southeast of LV, the Montezuma Range fault (MR) along the western side of the Montezuma Range north of LV, the southern half of the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western side of Clayton Ridge north of LV, and the Gold Mountain fault (GOM) along the western side of Gold Mountain southeast of LV. LV is also approximately parallel to northeast–striking faults within basins. These faults include the Palmetto Mountains–Jackson Wash fault (PMJW) east of Lida Valley and immediately northeast of LV, the Stonewall Flat faults (SWF) within Stonewall Flat northeast of LV, the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and the Montezuma Range north of LV, and the Clayton Valley fault (CV) within Clayton Valley northwest of LV (Y-238; Y-853). All of these northeast–striking faults belong to a wide zone located 10 to 15 km east of the northwest–striking Furnace Creek fault (FC; Y-238, p. 4).

Y-238 (p. 4) speculated that the northeast–striking faults in the area around LV could be conjugate shears to FC. However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 4) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred that these faults could be rooted in a detachment fault at depth.

Lida Valley faults (LV) — Continued

The relationship between LV and the northeast–striking fault traces of the Palmetto Mountains–Jackson Wash fault (PMJW) is unknown. LV aligns with some of these fault traces, but a ridge extends east from the Palmetto Mountains between Lida Valley and the valley of Jackson Wash. This ridge has no reported evidence for possible Quaternary fault surface rupture.

Little Lake fault (LL)

Plate or figure: Plate 2.

References: Y-374: Roquemore, 1988; Y-413: Jennings and others, 1962; Y-415: Jennings, 1985 (Trona sheet); Y-425: Stinson, 1977; Y-427: Hart and others, 1989; Y-542: Roquemore and Zellmer, 1986; Y-640: Duffield and Roquemore, 1988; Y-1020: Jennings, 1992; Y-1035: Roquemore and Zellmer, 1983; Y-1052: Wills, 1988; Y-1056: Roquemore and Simila, 1993; Y-1110: Roquemore, 1981; Y-1111: Roquemore and Zellmer, 1987; Y-1112: Walter and Weaver, 1980; Y-1113: Duffield and Bacon, 1981; Y-1114: Duffield and Smith, 1978; Y-1145: Roquemore and Zellmer, 1983.

Location: 163 km/227° (distance and direction of closest point from YM) at lat 35°50'N. and long 117°45'W. (location of closest point). LL extends southeast from the Sierra Nevada front at the southern end of the Coso Range across Indian Wells Valley where its expression dies out near Ridgecrest, California, or continues to the Garlock fault with little surface expression (Y-1110, p. 10).

USGS 7-1/2' quadrangle: Little Lake, Ninemile Canyon, Pearsonville, Volcano Peak, White Hills.

Fault orientation: LL strikes northwest (Y-1020; Y-1035, p. 198; Y-1052, p. [2]).

Fault length: The length of LL is reported by Y-1110 (p. 27) as ≥24 km, by Y-374 (p. 225) as >30 km, and by Y-1035 (p. 198) and Y-1052 (p. [2]) as about 40 km from west of the town of Little Lake, California, to south of Ridgecrest (includes northwest–striking fault traces in Indian Lake Valley where LL appears to merge with the Airport Lake fault (AIR)). Ground cracks attributed to the 1982 magnitude 5.2 earthquake occur in two areas over a combined length of about 10 km and along four consecutive *en echelon* segments of LL (Y-1035, p. 199).

Style of faulting: Displacement along LL is right–lateral strike slip (Y-1035, p. 198; Y-1052, p. [2]). The northern part of the fault has a narrow, linear pattern; the southeastern part in Indian Wells Valley is composed of widely spaced, discontinuous fault traces that form a series of *en echelon*, monoclinal flexures (Y-1035, p. 198). The flexures are down to the east where LL crosses the western side of the Airport Lake graben, but change to down to the west where LL crosses the eastern side of the graben (Y-1035, p. 198). At its southern end, LL becomes very diffuse and fault traces splay (Y-1110, p. 28).

Y-1110 (p. 12-16) noted a 2–km–long section of LL where geomorphic expression suggests that a thrust fault is associated with right–lateral displacement.

Scarp characteristics: Historical rupture is limited to ground cracks up to 4 mm wide in thick alluvial deposits along LL in Indian Wells Valley (Y-1035, p. 199). The cracks are generally at the crest of flexures or along the face of the flexures (Y-1035, p. 199). Trenches revealed "open cracks to a depth of about 0.5 m and wider, filled cracks extending to at least 5 m, but there was no indication of direct fault rupture within the alluvial and lacustrine deposits exposed in the trench" (Y-1035, p. 199). Y-1110 (p. 10, 27) noted that the surficial expression of LL includes aligned springs, shutter ridges, hillside troughs, linear troughs, sag ponds, and pressure ridges.

Displacement: Y-1110 (p. 10, 27) reported that young (not dated but probably Holocene) alluvium and landslide debris are displaced right–laterally 30 m at the northern end of LL where the fault merges with the Sierra Nevada fault. Southeast of the Owens River, a basalt flow dated (K-Ar) at 399 ka ± 45 ka (~400 ka; Y-1113, their Qb1 unit of the Basalt Southeast of Little Lake) is reported to be displaced right–laterally about 250 m by Y-542, ≥250 m by Y-1110 (p. 10, 12), and 400 m by Y-1052 (p. [5]). A channel of the Pleistocene Owens River is cut into this flow and is filled with another flow dated (K-Ar) at 140 ka ± 89 ka (Y-1113, their Basalt East of Little Lake).

Y-1110 (p. 2) noted that Pliocene and Pleistocene sediments have been warped into an anticline >25 m high.

Little Lake fault (LL) — Continued

Age of displacement: The youngest displacement on LL is historical. Ground cracks in Indian Wells Valley are attributed to the 1982 magnitude 5.2 earthquake (Y-427, p. 6; Y-1035, p. 198). Prior to this, the youngest displacement noted by Y-1110 (p. 42) in a trench appears to extend to the ground surface. A unit exposed in this trench 1 to 3 m below the surface contains open fracture fillings, liquefaction features, and probably "mud volcanoes" that are thought to have a tectonic origin. The radiocarbon date on carbonized twigs and charcoal from this unit is 2,545 ± 160 yr (Y-1110, p. 42). Thus, Y-1110 (p. 42) concluded that a major earthquake occurred on LL since about 2.5 ka.

A displaced basalt flow in a channel of the Owens River has an estimated age of about 22 ka based on assuming a constant downcutting rate along the river between 10 ka and 130 ka (Y-1114, table, p. 406).

Slip rate: Y-1052 (p. [2-3]) suggested a "loosely constrained" lateral slip rate between 0.6 and 1.8 mm/yr for LL on the basis of a reinterpretation of the 250 m of apparent lateral displacement of a channel wall of the Owens River (Y-1110, p. 10). The age of the displacement is bracketed by the basalt (the upper flow of basalt southeast of Little Lake, Qb1 of Y-1113, basalt of Lower Little Lake Ranch of Y-1114, p. 405) dated at 399 ka ± 45 ka into which the channel is cut and an intra–canyon flow dated at 140 ka ± 89 ka (basalt east of Little Lake, Qbe of Y-1113). Y-374 (p. 225) suggested that the lateral slip rate on LL may be "as high as 1 mm/yr or greater based on most recent evaluation of fault morphology." Y-1052 (p. [5], [8]) calculated a maximum lateral slip rate of 1 mm/yr for LL on the basis of 400 m of displacement in a basalt flow with an age of 400 ka.

The 30 m of displacement of suspected Holocene alluvium and landslide debris reported by Y-1110 (p. 10, 27) yields a minimum Holocene slip rate of 3 mm/yr. Using ≤250 m of displacement of the basalt with an estimated age of 51 ka to 229 ka (Y-1113; Y-1052), an apparent maximum (lateral?) slip rate is estimated to be between 1.1 and 4.9 mm/yr.

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

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

Analysis: Aerial photographs (Y-1052, p. [5], scales 1:24,000 and 1:12,000; Y-1110, p. 8, scales 1:6,000 to 1:60,000). Field evaluation (Y-1052, p. [5]; Y-1110, p. 8). Evaluation of fault morphology (Y-374). Topographic profiles across ground cracks formed in 1981 (Y-1035, p. 199). Trench (Y-1110, p. 39-42).

Relationship to other faults: LL may be related to the Airport Lake fault (AIR) to the southeast and to the Sierra Nevada fault (SNV) or the Owens Valley fault (OWV) to the northwest.

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

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

Little Lake fault (LL) — Continued

LL may merge with the SNV on the northwest (Y-1110, p. 10). However, although Y-374 (p. 224) noted that LL comes close to SNV near Little Lake, both Y-374 (p. 224) and Y-1052 reported no evidence that the two faults actually merge. Y-374 (p. 224) suggested that LL may continue northward separate from SNV and merge with the southern part of the Owens Valley fault (OWV). Y-427 (p. 6) speculated that LL is a right–lateral southern extension of OWV.

LL aligns with the Blackwater fault to the south and with the southern OWV to the north and may provide "a pathway for the Mojave shear zone into Indian Wells and Owens Valleys" (Y-1056). Y-1056 suggested that the Indian Wells/Coso area may be "the most likely site for the next large earthquake within the Mojave shear zone."

Lone Mountain fault (LMT)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 1); Y-407: Albers and Stewart, 1972; Y-853: Dohrenwend and others, 1992; Y-1032: Schell, 1981 (pl. 7, his fault #8, Millers Pond fault; he shows only that part of LMT north of about lat 38°05'N., which is north of the area shown on pl. 1 of this compilation); Y-1069: Yount and others, 1993 (name from this reference); Y-1070: Yount and others, 1993.

Location: 165 km/319° (distance and direction of closest point from YM) at lat 37°57'N. and long 117°40'W. (location of closest point). LMT is located along the southeastern side of Big Smoky Valley and along the northwestern side of Lone Mountain, which is north of lat 38°N. (north of the area shown on pl. 1 of this compilation).

USGS 7-1/2' quadrangle: North of Silver Peak, Weepah.

Fault orientation: LMT strikes northeast (Y-238; Y-853).

Fault length: The length of LMT is 9 km as estimated from Y-238, 15 km as estimated from Y-853, and 70 km as estimated from Y-407. LMT extends to the edge of the map areas (at lat 38°N.) of both Y-238 and Y-853. The map by Y-407 covers the entire Big Smoky Valley.

Style of faulting: Predominate vertical displacement on LMT was inferred by Y-1069 (p. 388) on the basis of the sinuous character and large heights of the associated scarps. Y-407 (p. 53) noted that displacements on the fault traces are down to the north. In addition, right–lateral displacements of stream channels at two localities were reported by Y-1069 (p. 388).

Scarp characteristics: LMT is shown by Y-238, Y-407, and Y-853 as primarily northwest–facing scarps. One scarp south of lat 38°N. is portrayed by Y-238 and Y-853 as southeast–facing. Y-1032 (table A2, p. A3) reported a maximum scarp height of 5 m along LMT north of about lat 38°05'N. and a maximum scarp–slope angle of 21.5°.

Displacement: Y-1069 (p. 388) noted that Holocene surfaces are displaced about 1 m. Y-1069 (p. 388) and Y-1070 (p. 406) both reported that middle and late Pleistocene surfaces are displaced up to 5 m.

Y-407 (p. 53) stated that the "dip separation displacement" across the fault scarps associated with LMT ranges between a few meters and about 12 m (a few feet to about 40 ft).

Age of displacement: Scarps on surfaces of Holocene to probably early Pleistocene deposits are described by Y-1069 (p. 388) as spectacular. LMT is shown by Y-407 as faults in Holocene colluvium, alluvium, and playa deposits (their Qal deposits) and as faults that juxtapose Qal deposits on the northwest against older Pleistocene or Holocene alluvium (their Qoa deposits). Y-407 (p. 53) reported that the scarps on Holocene alluvium can be traced about 24 km (15 miles) and have an arcuate trend. LMT is portrayed by Y-1069 (p. 407) as displacing Holocene and late Pleistocene alluvial–fan deposits.

LMT is portrayed by Y-853 as scarps on depositional or erosional surfaces of late Pleistocene age (their Q_2 surfaces with estimated ages between 10 ka and 130 ka), early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma), and early to middle Pleistocene age (their Q_1 surfaces with estimated ages between 130 ka and 1.5 Ma). LMT is portrayed by Y-238 as weakly to moderately expressed lineaments and scarps chiefly on surfaces of Quaternary deposits and as faults that are in Tertiary deposits and that were identified from previous mapping.

For portions of LMT north of about lat 38°05'N. (north of the area covered by pl. 1), Y-1032 (table A2, p. A3) estimated that the probable age of the youngest rupture is Holocene "based on strong geomorphic expression of [the] scarp." The youngest unit displaced in this area (and also the oldest unit not displaced) is his intermediate–age alluvial–fan deposits (Y-1032, table A2, p. A3) with an estimated age of 15 ka to probably about 200 ka (Y-1032, table 3, p. 23).

Lone Mountain fault (LMT) — Continued

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Only part of LMT, that along the northwestern side of Lone Mountain, appears to bound a range front. The characteristics of this front have not been reported.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Compilation by Y-407 of unpublished geologic mapping by Moiola (1962) and by Albers, Stewart, and McKee (1960-1962). Field examination (Y-1032, p. 17-18). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: LMT is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat. These faults include part of the Emigrant Peak fault (EPK) along the western side of the Silver Peak Range west of LMT, the northern part of the General Thomas Hills fault (GTH) along the eastern side of the General Thomas Hills east of LMT, the Montezuma Range fault (MR) along the western side of the Montezuma Range southeast of LMT, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges east of LMT, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain south of LMT, and the Lida Valley faults (LV) between the Palmetto Mountains and Magruder Mountain south of LMT. LMT is also approximately parallel to northeast–striking faults within basins. These faults include the Stonewall Flat faults (SWF) within Stonewall Flat southeast of LMT, the Palmetto Mountains–Jackson Wash faults (PMJW) in the valley northeast of Palmetto Mountains and southeast of LMT, the Clayton Valley fault (CV) within Clayton Valley south of LMT, and the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range southeast of LMT (Y-238; Y-853). In contrast, LMT is nearly perpendicular to the Weepah Hills fault (WH) along the southern side of the Weepah Hills immediately south of LMT.

Y-238 (p. 4) speculated that the northeast–striking faults in the area around LMT could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Reheis and Noller (1989, Y-10, p. 60) inferred that these faults could be rooted in a detachment fault at depth.

Y-1069 (p. 388-389) speculated that LMT may transfer right–lateral displacement associated with the northwest–striking Fish Lake Valley fault (FLV), located in Fish Lake Valley about 50 km west of LMT, to the northwest–striking Cedar Mountain fault (CM), located about 40 km northwest of LMT.

McAfee Canyon fault (MAC)

Plate or figure: Plate 1.

References: Y-216: Brogan and others, 1991 (pl. 1A; show only that portion of MAC in Fish Lake Valley and east of their Oasis section of the Furnace Creek fault); Y-238: Reheis and Noller, 1991 (pl. 1); Y-853: Dohrenwend and others, 1992.

Location: 155 km/300° (distance and direction of closest point from YM) at lat 37°33′N. and long 117°56′W. (location of closest point). The northern part of MAC is located along a portion of the western front of the northern Silver Peak Range (south of Piper Peak) at its junction with Fish Lake Valley. The southern portion of MAC is located within Fish Lake Valley.

USGS 7-1/2′ quadrangle: Indian Garden Creek, Piper Peak.

Fault orientation: MAC strikes generally north; a central portion strikes north–northwest (Y-238; Y-853).

Fault length: The length of MAC is about 14 km as estimated from Y-853 and about 17 km as estimated from Y-238.

Style of faulting: Displacement is down to the west on the part of MAC that is shown by Y-238 as a previously mapped fault.

Scarp characteristics: Scarps, which are along part of MAC, are shown by Y-238 and Y-853 as west–facing.

Displacement: No information.

Age of displacement: Part of the southern portion of MAC (in Fish Lake Valley) is shown by Y-853 as scarps on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). This same portion of the fault is portrayed by Y-238 as weakly or moderately expressed lineaments or scarps on surfaces of Quaternary deposits and as a fault that is in Quaternary deposits and that was identified from previous mapping. Y-216 (pl. 1A, p. 8) indicated that this portion of MAC is a prominent set of vegetation lineaments on surfaces for which no age estimate was given.

The northern portion of MAC (along the Silver Peak Range front) is portrayed by Y-853 as juxtaposing Quaternary alluvium against bedrock. Y-238 showed this same portion of the fault as a topographic lineament along a linear range front, as a strongly expressed lineament or scarp on surfaces of Tertiary deposits, and as a fault that is in Tertiary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The southern part of the western front of the Silver Peak Range along MAC is shown to be linear by Y-238. The morphology of this range front is noted by Y-853 to be similar to that along major range–front faults (e.g., characterized by "a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front"), except that MAC is "significantly less extensive and fault scarps are substantially lower, shorter, and less continuous."

Analysis: Aerial photographs (Y-216, scale 1:12,000; Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

McAfee Canyon fault (MAC) — Continued

Relationship to other faults: The southern end of MAC nearly intersects the northwest–striking, primarily right–lateral strike–slip Fish Lake Valley fault (FLV) in Fish Lake Valley. Y-238 (p. 2-3) speculated that MAC, along with other north–striking and north–northeast–striking, primarily dip–slip faults east of the main trace of FLV, may be related to displacement on FLV. In addition, they (Y-238, p. 3) noted that both the northwest–striking faults and the north– to north–northeast–striking faults "are consistent with an east–west direction of least principal stress." They (Y-238, p. 3) suggested that the north– and north–northeast–striking faults "in northern Fish Lake Valley may function as pull–apart faults in a giant right step between the northern end of the right–lateral [FLV] and the northern part of the right–lateral Walker Lane, which ends about 40 km to the north."

Mercury Ridge faults (MER)

Plate or figure: Plate 2.

References: Y-62: Barnes and others, 1982; Y-671: Guth, 1990; Y-813: Reheis, 1992 (pl. 3; shows only the northwest fault); Y-852: Dohrenwend and others, 1991.

Location: 48 km/110° (distance and direction of the closest point of the northwest fault of MER from YM) at lat 36°41'N. and long 115°56'W. (location of closest point of the northwest fault); 51 km/109° (distance and direction of the closest point of the southeast fault of MER from YM) at lat 36°41'N. and long 115°55'W. (location of closest point of the southeast fault). MER includes two main faults: one along the northwestern side of Mercury Ridge and the other along the southeastern side of Mercury Ridge.

USGS 7-1/2' quadrangle: Mercury, Mercury NE.

Fault orientation: The two faults of MER strike generally northeast (Y-813; Y-852).

Fault length: The northwest fault is 9 km long (Y-813) to 10 km long (Y-852). Two short traces, each 1 to 1.5 km long, compose the southwestern end of this fault (Y-852; these traces are not shown separately on pl. 2 of this compilation). The southeast fault is 3 km long (Y-852).

Style of faulting: The northwest fault is shown by Y-62 and Y-813 as having oblique displacement with the dip–slip portion being down to the northwest. The strike–slip portion is portrayed by Y-813 as left lateral and by Y-62 as right lateral.

The southeast fault is shown by Y-62 as having oblique displacement with the dip–slip portion as down to the southeast and the strike–slip portion as left lateral. Y-62 noted that the evidence for dip–slip displacement is primarily topographic in that the existing topographic relief across the fault cannot be explained entirely by differential erosion of different rock types on opposite sides of the fault.

Scarp characteristics: No information.

Displacement: Y-62 reported about 1 km of left–lateral displacement in Mississippian rocks along the southeast fault of MER. Right–lateral displacement across the northwest fault of MER is noted by Y-62 as up to 0.5 km.

Age of displacement: Both faults of MER are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock. Y-62 portrayed both faults as juxtaposing Oligocene rocks against pre–Tertiary rocks and as concealed by Quaternary and Tertiary alluvium. The map of Y-813 (pl. 3) shows about 1 km of the northwest fault as a fault that is in Tertiary deposits and that was identified by previous mapping.

Slip rate: No information.

Recurrence rate: No information.

Range-front characteristics: Both faults of MER are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock, but not as major range–front faults. The morphology of the northwestern and southeastern sides of Mercury Ridge would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." Although the morphology of the sides of Mercury Ridge is similar to that along major range–front faults, the "associated fault systems are significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous" (Y-852). All but about 1 km of the northwest fault is shown by Y-813 (pl. 3) as a topographic lineament bounding a linear range front.

Analysis: Aerial photographs (Y-671; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Mercury Ridge faults (MER) — Continued

Relationship to other faults: MER may be the southwestern extension of the Spotted Range faults (SPR). However, the Ranger Mountains and the Sandy Wash Valley separate MER from SPR to the east. The strike of MER is similar that of the Rock Valley fault (RV), which is located about 8 km north of MER. The strike of MER is also similar to that of the faults in Crossgrain Valley (CGV) and the South Ridge faults (SOU), both of which are located south of MER.

The Ranger Mountains faults (RM), located immediately north of MER, strike at an oblique angle to MER.

Mine Mountain fault (MM)

Plate or figure: Plate 1.

References: Y-62: Barnes and others, 1982; Y-104: Ekren and Sargent, 1965 (show only the southwestern part of MM south of lat 36°52'30"N. and east of long 116°15'W.); Y-181: Carr, 1974; Y-182: Carr, 1984 (name from his fig. 7); Y-192: Marvin and others, 1970; Y-205: Orkild, 1968 (shows only that part of MM between Mine Mountain and Shoshone Mountain); Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 3; show only one lineament or scarp along Shoshone Mountain that may align with MM as portrayed by Y-205 and Y-232); Y-301: Fleck, 1970; Y-314: Ekren, 1968; Y-1107: Carr, 1974.

Location: 19 km/87° (distance and direction of closest point from YM) at lat 36°50'N. and long 116°14'W. (location of closest point). MM is located along the southern side of Mine Mountain and in Mid Valley. It extends into the northern edge of Jackass Flats.

USGS 7-1/2' quadrangle: Mine Mountain, Skull Mountain, Yucca Lake.

Fault orientation: MM strikes generally northeast, but the fault curves, so that its strike ranges between north–northeast and northeast (Y-232).

Fault length: The length of MM is about 16 km as estimated from Y-104 and Y-205 between Mine Mountain and south of Shoshone Mountain, 22 km as estimated from Y-232, and about 27 km as estimated from Y-182 (fig. 7). The lineament or scarp that is shown by Y-238 along Shoshone Mountain is about 3 km long.

Style of faulting: Displacement on MM may be oblique, because the displacement is shown by Y-104, Y-205, and Y-232 as down–to–the–southeast dip slip and left–lateral strike slip.

Scarp characteristics: No information.

Displacement: Y-182 (p. 61) and Y-205 both suggested that left–lateral displacement of the Paintbrush and Timber Mountain tuffs (about 11.5 Ma to 13.5 Ma) has been about 1 km along MM south of Mine Mountain. However, Y-182 (p. 61) noted that lateral displacement is difficult to measure because of the lack of correlative units across MM.

Age of displacement: The 3–km–long section along Shoshone Mountain and west of Barren Spot is shown by Y-238 (pl. 3) as a weakly to moderately expressed lineament or scarp on surfaces of Quaternary deposits and as a topographic lineament along a range front or in bedrock. Parts of this same section of MM are portrayed by Y-205 as displacing older Quaternary alluvium (his Qoa deposits) against Miocene Wahmonie Formation (his Tw unit). The youngest unit shown by Y-232 (pl. 1) as displaced by MM is a combination of Pliocene Timber Mountain Tuff, Miocene Paintbrush Tuff, and tuff of Crater Flat (his Tp unit). This unit is faulted against Devonian rocks southeast of Mine Mountain (Y-232).

The map by Y-205 shows most of MM in and adjacent to Mid Valley as concealed by older Quaternary alluvium (his Qoa deposits) and younger Quaternary alluvium and colluvium (his Qal and Qac deposits). Similarly, maps by both Y-104 and Y-232 portray MM as concealed by Quaternary alluvium (their Qa and Qal deposits).

The Spotted Range–Mine Mountain structural zone (SRMM), a zone of northeast–striking faults of which MM may be a part, is considered by Y-182 (p. 44, 61) to be seismically active because of the numerous earthquakes in the area. However, Y-62 (*citing* Y-301) suggested that most of the displacement on SRMM may have occurred between 5 Ma and 7 Ma during the late Miocene and early Pliocene. In addition, Y-182 (p. 64) concluded that much of SRMM had developed and considerable erosion had occurred before middle Oligocene. This conclusion is based on the age of the oldest Tertiary rocks in SRMM (correlated with the Horse Spring Formation dated at slightly greater than 29 Ma (K–Ar) by Y-192, tables 1 and 2, sample locality #19, p. 2663, 2665).

Slip rate: Based on 1 km of left–lateral displacement that was noted by Y-182 (p. 61) and Y-205 in volcanic tuffs that erupted between 11.5 Ma and 13.5 Ma, the average apparent lateral slip rate on MM since late Tertiary is 0.07 to 0.09 mm/yr.

Mine Mountain fault (MM) — Continued

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-232; Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: MM is one of four main faults that have been grouped into the 30–to–60–km–wide Spotted Range–Mine Mountain structural zone (SRMM), which is characterized by northeast–striking, left–lateral faults that have experienced relatively small amounts of displacement (Y-181, p. 9; Y-182, p. 56). The other three faults in SRMM are the Cane Spring fault (CS), the Rock Valley fault (RV), and the Wahmonie fault (WAH). These faults have been interpreted to be "first–order structures that form a conjugate system with the northwest–striking, right–lateral faults of the Las Vegas Valley shear zone" (Y-62, *citing* Y-1107). Y-314 (p. 16-17) suggested that displacement along faults in SRMM resulted from what he called rotary slippage during right–lateral displacements along the Las Vegas Valley shear zone (LVS). However, Y-182 (p. 63) noted that neither the LVS nor the northwest–striking La Madre shear zone crosses SRMM and that significant curving or bending of faults in SRMM, which would be required if such rotation had occurred, is lacking. Y-181 concluded that the northwest–striking faults and flexure zones with right–lateral displacement or bending north of LVS (e.g., the Frenchman flexure; Y-181, fig. 11, p. 34) and the faults of SRMM are probably related because faults in the two zones mutually displace one another as indicated by field relationships (W.J. Carr, unpublished data, 1976, *cited by* Y-181, p. 9) and because both zones are locally active as indicated by associated seismicity (Y-181, p. 9).

Displacements on faults in SRMM are thought by Y-182 (p. 62) to have been conjugate to displacements on faults in the northwest–trending Walker Lane.

Both the similarity in types of displacement and the alignment of surficial expression suggested to Y-182 (p. 62) that SRMM may be connected to the Pahranagat fault (PGT) to the northeast (the Pahranagat shear zone of Y-182). However, 70 km separates SRMM and PGT and no northeast–trending structures have been recognized in the Paleozoic rocks that are exposed in numerous places within this gap, which includes the north– and north–northwest–trending Spotted, Pintwater, and Desert ranges (Tschanz and Pampeyan, 1970 (Y-404); Ekren and others, 1977 (Y-25); Y-182, p. 62).

The northeastern end of MM may terminate at or near the north–northwest–striking Yucca Lake fault (YCL).

Monitor Hills East fault (MHE)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 1). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 125 km/343° (distance and direction of closest point from YM) at lat 37°56′N. and long 116°51′W. (location of closest point). MHE is located along the eastern side of the Monitor Hills and in the adjacent area of Cactus Flat.

USGS 7-1/2′ quadrangle: Monitor Peak, Reeds Ranch.

Fault orientation: MHE generally strikes north. Individual fault traces on the western side of MHE strike north or north–northwest; individual fault traces on the east strike north–northeast (Y-813).

Fault length: The length of MHE is about 8 km as estimated from Y-813.

Style of faulting: No information.

Scarp characteristics: Scarps along MHE are shown by Y-813 as primarily east–facing. One scarp at the southern end of MHE is portrayed by Y-813 as west–facing.

Displacement: No information.

Age of displacement: Most of MHE is portrayed by Y-813 as weakly expressed lineaments and scarps on surfaces of Quaternary deposits. The northern end of MHE is shown by Y-813 as weakly expressed lineaments and scarps on surfaces of Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: MHE is approximately parallel to other north–striking faults in the area. These faults include the Monitor Hills West fault (MHW) that bounds the western side of the Monitor Hills immediately west of MHE, the Cactus Flat fault (CF) in Cactus Flat east of MHE, the East Stone Cabin fault (ESC) along the eastern side of Cactus Flat, and the Mud Lake–Goldfield Hills fault (MLGH) that "may be a continuation of the north–[striking] faults characteristic of the Basin and Range to the north and east of the Walker Lane" (Reheis and Noller, 1991, Y-238, p. 3).

Monitor Hills West fault (MHW)

Plate or figure: Plate 1.

References: Y-813: Reheis, 1992 (pl. 1). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 124 km/341° (distance and direction of closest point from YM) at lat 37°55'N. and long 116°53'W. (location of closest point). MHW is located along the western side of the Monitor Hills at their junction with the Ralston Valley.

USGS 7-1/2' quadrangle: Monitor Peak, Reeds Ranch.

Fault orientation: MHW strikes north to north–northwest. Individual fault traces strike between north–northwest and northeast (Y-813).

Fault length: The length of MHW is about 12 km as estimated from Y-813 to the northern edge of her map area at lat 38°N. It is not known if MHW continues north of this latitude. If a northeast–trending alignment of lineaments and scarps shown by Y-813 in Ralston Valley south of the Monitor Hills is part of MHW, then the length of MHW is about 15 km as estimated from Y-813.

Style of faulting: No information.

Scarp characteristics: Scarps associated with MHW are shown by Y-813 as primarily west–facing.

Displacement: No information.

Age of displacement: MHW is portrayed by Y-813 as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: MHW is approximately parallel to other north–striking faults in the area. These faults include the Monitor Hills East fault (MHE) that bounds the eastern side of the Monitor Hills immediately east of MHW, the Cactus Flat fault (CF) in Cactus Flat east of MHW, the East Stone Cabin fault (ESC) along the eastern side of Cactus Flat, and the Mud Lake–Goldfield Hills fault (MLGH) that "may be a continuation of the north–[striking] faults characteristic of the Basin and Range to the north and east of the Walker Lane" (Reheis and Noller, 1991, p. 3, Y-238).

MHW aligns with the north–striking northern portion of the Cactus Range–Wellington Hills fault (CRWH), which is directly south of MHW along the western side of the Cactus Range. A gap in surficial expression of at least 10 km separates the two faults.

Montezuma Range fault (MR)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 1); Y-853: Dohrenwend and others, 1992; Y-1032: Schell, 1981 (pl. 8; name from his table A2, fault #11; shows only the northern part of MR, which extends to the southern edge of his map area at about lat 37°40'N.). Not noted by Albers and Stewart, 1972 (Y-407).

Location: 121 km/310° (distance and direction of closest point from YM) at lat 37°33'N. and long 117°27'W. (location of closest point). MR is located along the northwestern side of the Montezuma Range at its junction with an unnamed valley.

USGS 7-1/2' quadrangle: Alkali, Lida Wash, Montezuma Peak, Montezuma Peak SW, Paymaster Ridge, Split Mountain.

Fault orientation: MR strikes generally northeast, but the fault curves so that individual sections strike between northwest and northeast (Y-238; Y-853).

Fault length: The length of MR is 29 km as estimated from Y-238 and 33 km as estimated from Y-853. Unlike Y-238, Y-853 extended MR northeast of Montezuma Range. Y-1032 (table A2, p. A3) reported a length of at least 18 km for MR; however, he shows only the northern portion of the fault.

Style of faulting: On the basis of observations from aerial photographs and field reconnaissance, Y-10 (p. 57-58) inferred that MR has dip–slip (normal) displacement and a steep (70° to 90°) northwest dip.

Scarp characteristics: Scarps associated with MR are shown by Y-238, Y-853, and Y-1032 as primarily northwest–facing.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along MR is noted by Y-1032 (table A2, p. A3) to be late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A3) with an estimated age of 15 ka to probably about 200 ka (Y-1032, table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (A5y; Y-1032, table A2, p. A3) with an estimated age of ≤15 ka (Y-1032, table 3, p. 23). The oldest unit displaced is his old–age alluvial–fan deposits (A5o; Y-1032, table A2, p. A3) with an estimated age of 700 ka to 1.8 Ma (Y-1032, table 3, p. 23).

At one locality near the fault's southern end, MR is shown by Y-853 as a scarp on a depositional or erosional surface with an early to middle and (or) late Pleistocene age (their Q_{1-2} surface with estimated ages between 10 ka and 1.5 Ma). Portions of MR are portrayed by Y-238 as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits. Most of MR is shown by Y-853 to be one of the major range–front faults in the area, all of which they noted display evidence for Quaternary activity.

Slip rate: No information.

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Magnetometer surveys (Y-1032, p. 16-17). Gravity analysis (Y-1032, p. 16).

Montezuma Range fault (MR) — Continued

Relationship to other faults: MR is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat. These faults include the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of Clayton and Paymaster ridges west of MR, the General Thomas Hills fault (GTH) along the eastern side of the General Thomas Hills north of MR, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain south of MR, and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains south of MR. MR is also approximately parallel to northeast–striking faults within basins. These faults include the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range immediately west of MR, the Clayton Valley fault (CV) in Clayton Valley west of MR, the Lone Mountain fault (LMT) along the southeastern side of Big Smoky Valley northwest of MR, the Stonewall Flat faults (SWF) within Stonewall Flat east of MR, and the Palmetto Mountains–Jackson Wash faults (PMJW) in the valley northeast of the Palmetto Mountains east of MR (Y-238; Y-853).

Y-238 (p. 4) speculated that the northeast–striking faults in the area around MR could be conjugate shears to the northwest–striking Furnace Creek fault (FC) to the southwest. However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred the faults could be rooted in a detachment fault at depth.

Mud Lake–Goldfield Hills fault (MLGH)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 1). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 113 km/330° (distance and direction of closest point from YM) at lat 37°46′N. and long 117°05′W. (location of closest point). MLGH is located along the western side of Mud Lake and extends into the northeastern portion of the Goldfield Hills.

USGS 7-1/2′ quadrangle: East of Goldfield, Goldfield, McMahon Ridge, Mud Lake NW, Mud Lake South.

Fault orientation: Fault traces in MLGH are left stepping, so that the strike of the MLGH is north–northwest (Y-238). Most fault traces within MLGH strike north to north–northwest (Y-238). A few fault traces strike north–northeast (Y-238).

Fault length: The length of MLGH is 33 km as estimated from Y-238. This is a minimum value because MR extends to the edge of their map area at lat 38°N.

Style of faulting: One 2–km–long section of MLGH is shown by Y-238 as a graben.

Scarp characteristics: Scarps associated with MLGH are shown by Y-238 as primarily east–facing. Some scarps are shown by Y-238 as west–facing.

Displacement: No information.

Age of displacement: Most of MLGH is portrayed by Y-238 as moderately expressed to prominent lineaments and scarps on surfaces of Tertiary deposits. The map by Y-238 shows two sections in the central part of MLGH west of Mud Lake, each about 2 km long, as faults that are in Quaternary deposits and that were identified from previous mapping. In addition, one section at the southern end of MLGH (about 3.5 km long) and two sections northwest of Mud Lake (1 km and 4 km long) are mapped by Y-238 as weakly expressed scarps on surfaces of Quaternary deposits. The two scarps northwest of Mud Lake were noted by Y-238 (p. 3) to be "degraded and only offset relatively old Pleistocene deposits." They interpreted these characteristics to indicate "that this area is now quiescent" (Y-238, p. 3).

Slip rate: No information.

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000).

Relationship to other faults: MLGH is approximately parallel to other north–striking to north–northwest–striking faults in the area. These faults include the Monitor Hills East (MHE) and the Monitor Hills West (MHW) faults that bound the eastern and western sides of the Monitor Hills east of MLGH, the Cactus Flat fault (CF) that is in central Cactus Flat east of MLGH, and the northern part of the Clayton Ridge–Paymaster Ridge fault (CRPR) that bounds the western side of Paymaster Ridge west of MLGH. Y-238 (p. 3) noted that the north– to north–northeast–striking MLGH "may be a continuation of the north–[striking] faults characteristic of the Basin and Range to the north and east of the Walker Lane."

MLGH is immediately north of and aligns with the north–northeast–striking Stonewall Flat fault (SWF). The relationship between these two faults has not been reported.

North Desert Range fault (NDR)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970; Y-813: Reheis, 1992 (pl. 2).

Location: 61 km/67° (distance and direction of closest point from YM) at lat 37°07′N. and long 115°35′W. (location of closest point). NDR is located along the western and northern sides of the northern Desert Range. The southern end of NDR is adjacent to Emigrant Valley. The northern end of NDR is adjacent to the Jumbled Hills on the west or to Tikaboo Valley on the east. Some traces included in NDR are located 0.5 to 1 km west of the Desert Range.

USGS 7-1/2′ quadrangle: Fallout Hills NE, Groom Range SE, Southeastern Mine.

Fault orientation: NDR generally strikes north, but the fault curves (Y-813). Parts of its northern and southern ends strike northeast or north–northwest (Y-813). NDR includes branching, anastomosing, and subparallel traces (Y-813).

Fault length: The length of NDR along the front of the Desert Range is 24 km as estimated from Y-813. The length of fault traces that are located 0.5 to 1 km west of the range front is 3.5 km (also estimated from Y-813).

Style of faulting: Parts of NDR along the front of the Desert Range (chiefly the northern and southern ends of NDR) are shown by Y-813 as down–to–the–west (primarily) faults.

Scarp characteristics: Parts of NDR along the front of the Desert Range (chiefly the central part of NDR) are shown by Y-813 as primarily west–facing scarps. Parts of the fault traces located 0.5 to 1 km west of the range front are portrayed by Y-813 as both east–facing and west–facing scarps.

Displacement: No information.

Age of displacement: NDR is shown by Y-813 as weakly expressed to prominent lineaments and scarps on surfaces of Quaternary deposits and as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Parts of NDR are shown by Y-813 as lineaments along a linear range front.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000). Field mapping (Y-404, p. 2).

Relationship to other faults: Most of NDR is approximately parallel to other north–striking faults in the area. These faults include the Jumbled Hills fault (JUM) along the western side of the Jumbled Hills immediately west of NDR; the East Pintwater Range fault (EPR) and the Central Pintwater Range fault (CPR) immediately south of NDR; the West Pintwater Range fault (WPR) along the western side of the Pintwater Range immediately southwest of NDR; the Tikaboo fault (TK) in Tikaboo Valley east of the northern Desert Range and NDR; the Stumble fault (STM), the Groom Range East fault (GRE), and the Groom Range Central fault (GRC) along the eastern and western sides of and within the Groom Range northwest of NDR; the Fallout Hills faults (FH), the Chert Ridge faults (CHR), and the Buried Hills fault (BH), all southwest of NDR.

North Desert Range fault (NDR) — Continued

Neither EPR nor CPR extend north of the southern end of NDR (pl. 1) as shown by Y-813. This end of NDR strikes northeast; it is portrayed by Y-813 (pl. 2) as a previously identified fault in Tertiary deposits. The north–striking central portion of NDR aligns with the north–striking northern end of EPR. However, displacement is in opposite directions (down to the west for NDR and down to the east for EPR), and is of apparently different ages (primarily in Quaternary deposits or on Quaternary surfaces for the central part of NDR and as a fault previously identified in Tertiary deposits for EPR). In contrast, WPR extends north of the western projection of NDR (Y-813). The northern end of WPR is portrayed by Y-813 as fault traces in both Quaternary and Tertiary deposits. The northwest–striking Three Lakes Valley fault (TLV) does not appear to extend northwest of the southern end of NDR (pl. 1). The map by Y-813 portrays the 0.5–km–long, northwestern end of TLV as concealed and connecting with the southern end of NDR. The actual structural relationships among these faults are not known.

One section near the northern end of NDR strikes northeast across the northern end of the Desert Range (pl. 1) and is shown by Y-813 (pl. 2) as a down–to–the–northwest fault trace in Tertiary deposits. This section "connects" the down–to–the–west, north–striking portion of NDR along the western front of the northern Desert Range to a fault trace that strikes north and north–northwest with down–to–the–east displacement at the very northern end of what may be NDR along the western edge of Tikaboo Valley. The fault trace in Tikaboo Valley is parallel to and has a similar sense of displacement as the north–northwest–striking traces combined into the Tikaboo fault (TK of this compilation) east of the northern Desert Range. The structural relationship between NDR and TK is not known.

Two fault traces 2.5 to 3.5 km west of the northern Desert Range front and adjacent to the Jumbled Hills are each 2 km long as estimated from Y-813. The actual relationship of these traces to NDR is not known, although these traces are included in NDR in this compilation for discussion purposes.

Oak Spring Butte faults (OAK)

Plate or figure: Plate 1.

References: Y-50: Barnes and others, 1963 (show only a portion of one fault in OAK, the Butte fault (BT) south of Oak Spring Butte (south of lat 37°15'N.)); Y-181: Carr, 1974; Y-212: Rogers and Noble, 1969 (OAK includes their Butte fault); Y-232: Cornwall, 1972 (pl. 1; fig. 2, p. 29; showed the Yucca fault and the Butte fault as a singe fault trace); Y-693: Barosh, 1968 (p. 209-210; suggested that the Butte fault joins the north–striking Yucca fault, which is immediately south of BT in Yucca Flat); Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992.

Fault traces shown on plate 1 of this compilation have been taken from Y-853 (primarily) and Y-212. Maps by Y-212, Y-813, and Y-853 all show more faults in this area than are indicated on plate 1. Only those faults that are portrayed by at least one reference as having possible Quaternary displacement are included in this compilation. Y-853 indicated faults in Tertiary rocks northeast of Wheelbarrow Peak, but these faults are not shown by Y-813 and so are not included in OAK. Individual fault traces shown by Y-813, Y-181 (fig. 7), Y-212, and Y-232 (pl. 1) do not coincide.

Location: 57 km/39° (distance and direction of closest point from YM) at lat 37°14'N. and long 116°03'W. (location of closest point). OAK is located along the eastern side of the Belted Range, west of northern Emigrant Valley, and north of Yucca Flat.

USGS 7-1/2' quadrangle: Groom Mine NW, Groom Mine SW, Jangle Ridge, Oak Spring, Oak Spring Butte, Wheelbarrow Peak.

Fault orientation: OAK strikes generally north, but individual faults strike between north–northeast and north–northwest (Y-50; Y-212; Y-813; Y-853).

Fault length: The total length of faults considered part of OAK in this compilation is about 19 km as estimated from Y-853 and about 21 km as estimated from Y-813. The lengths of individual faults range between 2 and 11 km as estimated from Y-853 or between 0.5 and 13 km as estimated from Y-813. Y-693 (p. 209), who suggested that BT joins the Yucca fault (YC) to the south, noted that the combined length of these faults is 40 km (25 miles).

Style of faulting: Displacement on faults in OAK is portrayed by Y-212 and Y-813 as both down to the east and down to the west. Displacement on BT has been down to the east (Y-50; Y-212).

Scarp characteristics: The one scarp shown by Y-853, which is along the northern part of the Butte fault, is east–facing. Scarps shown by Y-813 along portions of faults in OAK are both east–facing and west–facing.

Displacement: Y-693 (p. 210) reported vertical displacement of nearly 458 m (1,500 ft) in Tertiary volcanic rocks (his Grouse Canyon Member of the Belted Range Tuff) along BT.

Age of displacement: The youngest fault in OAK appears to be BT, which is portrayed by Y-853 as a scarp on depositional or erosional surfaces of possible late Pleistocene age (their Q_2? surfaces with estimated ages between 10 ka and 130 ka). Y-813 portrayed BT as a topographic lineament bounding a linear range front (primarily), as weakly expressed lineaments or scarps on surfaces of Quaternary deposits, and as faults that are in Tertiary deposits and that were identified from previous mapping. However, BT is shown by Y-50 and Y-212 as concealed by Quaternary alluvium and colluvium (their Qac deposits). The map by Y-50 portrays the southern part of BT as juxtaposing Tertiary volcanic units (their Tb, Tigl, Tits, and Tiz units) against each other and against older rocks (e.g., Ordovician Eureka Quartzite (Oe)). The map by Y-232 shows BT in a similar manner. Y-693 (p. 209) noted that BT displaces bedrock, but "passes beneath the alluvium" to the north.

Oak Spring Butte faults (OAK) — Continued

Most faults in OAK, other than BT, are portrayed by Y-813 as faults that are in Tertiary deposits and that were identified from previous mapping. Short sections of faults in OAK are portrayed by Y-813 as weakly to moderately expressed lineaments or scarps on surfaces of Tertiary deposits. These same faults are shown by Y-853 as scarps and (or) prominent topographic lineaments on surfaces of Tertiary volcanic or sedimentary rocks or as faults juxtaposing Quaternary alluvium against bedrock. Portions of faults in OAK are shown by Y-212 as faulted contacts either between different Tertiary volcanic tuff units (chiefly Miocene Belted Range Tuff; their Tba, Tbg, Tbts) or between these Tertiary tuffs and Quaternary alluvium and colluvium (their Qac deposits).

Faults in OAK occur between two faults, the north–striking Yucca fault (YC) in Yucca Flat on the south and the north–northeast–striking Emigrant Valley north fault (EVN) in northern Emigrant Valley on the north. Because of these relationships and because both YC and EVN have probably experienced Quaternary displacement, Y-813 (p. 7) reasoned that faults in OAK, although preserved primarily in Tertiary rocks, have probably experienced Quaternary displacement.

Y-232 (p. 32, *citing* Ekren and others, written commun., 1966) suggested that two ages of faults occur within the Belted Range. The older faults strike northeast and northwest and displace Tertiary rocks older than the late Miocene Belted Range Tuff. The younger faults strike north and occur within the Belted Range and immediately adjacent to it. These faults displace Pliocene to Holocene deposits. Because of their orientation and their displacement of the tuff, faults of OAK may belong to the younger set of faults defined by Y-232.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Part of the eastern front of Oak Spring Butte adjacent to BT is suggested by Y-813 to be linear. Other faults in OAK do not bound range fronts.

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

Relationship to other faults: Faults in OAK have the same strike as the Yucca fault (YC) in Yucca Flat immediately south of OAK (pl. 1). BT nearly aligns with and has the same direction of displacement as YC, so that BT could be a northern extension of YC as suggested by Y-232 (pl. 1, fig. 2) and Y-693 (p. 209). Y-232 (pl. 1, fig. 2) showed YC and BT as a single, continuous fault. Y-693 (p. 209) suggested that BT joins YC at the northern end of Yucca Flat. In contrast, Y-813 (p. 7) noted that the northern end of YC in Yucca Flat consists of several splays in Quaternary alluvial–fan deposits around Oak Spring Butte.

Y-813 (p. 7) suggested that the north–striking faults in Tertiary volcanic rocks north and east of YC (faults of OAK of this compilation) connect YC to the north–northeast–striking to northeast–striking Emigrant Valley North fault (EVN). YC and EVN are prominent faults, both of which have apparently experienced Quaternary displacement. The strikes of faults in OAK are similar to that of YC and more northerly than that of EVN.

The northeast–striking Boundary fault (BD) at the northern end of Yucca Flat may connect with BT as shown by Y-50, Y-181 (fig. 7), and Y-853. The structural relationships among OAK, BT, YC, and BD are not known.

Y-181 (fig. 2) portrayed the northwest–trending edge of the Gold Meadow caldera as crosscutting faults of OAK. The relationship of OAK to the caldera is not known.

BT, and what is perhaps its northern extension, is mapped by Y-853 at the boundary between Quaternary deposits and older rocks and as a scarp or prominent lineament on surfaces that are possibly late Pleistocene (about 160 ka to 800 ka).

Oasis Valley faults (OSV)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pl. 3); Y-813: Reheis, 1992 (pl. 2); Y-1223: Bell and others, 1989 (fig. 2, p. 1-9). Not shown by Cornwall, 1972 (Y-232) nor by Dohrenwend and others, 1992 (Y-853).

Location: 24 km/290° (distance and direction of closest point from YM) at lat 36°55'N. and long 116°42'W. (location of closest point) for faults along the eastern side of Oasis Valley (Eastern faults); 30 km/304° (distance and direction of closest point from YM) at lat 37°00'N. and long 116°44'W. (location of closest point) for faults along the western side of Oasis Valley (Western faults). Faults of OSV bound part of Oasis Valley between Beatty, Nevada, on the south and Thirsty Canyon on the north.

USGS 7-1/2' quadrangle: Beatty Mountain, Thirsty Canyon SE.

Fault orientation: Faults in OSV strike north–northeast.

Fault length: Faults along the eastern side of Oasis Valley are about 16 km long as estimated from Y-238, Y-813, and Y-1223 (fig. 2). This length includes northern traces that are 5 to 7 km long, a gap in surficial expression that is about 4 km long, and southern traces that are about 7 km long.

Faults along the western side of the valley are about 7 km long. This length includes two fault traces each 2.5 to 3 km long as estimated from Y-238 and Y-813. These traces are separated by a 3–km–long gap.

A graben shown in the northern part of the Oasis Valley by Y-813 does not clearly align with the faults along either side of the valley, but would add about 3.5 km to the total length of OSV.

Style of faulting: Displacement on faults along the eastern side of Oasis Valley is primarily down to the west as shown by Y-238, Y-813, and Y-1223 (fig. 2). Displacement on faults along the western side of the valley is portrayed by Y-813 as both down to the east and down to the west.

Scarp characteristics: Scarps associated with fault traces on the eastern side of Oasis Valley are shown by Y-238 and Y-813 as west–facing. Fault scarps on the eastern side of Oasis Valley are portrayed by Y-1223 (fig. 2) as primarily west–facing; a few at the southern end of Oasis Valley are shown by them as east–facing. Scarps associated with the graben at the northern end of Oasis Valley are portrayed as both east–facing and west–facing (Y-813).

Displacement: Y-10 (p. 58) reported that one fault along the eastern side of Oasis Valley displaces Quaternary and Tertiary alluvial–fan deposits (QTa deposits of Hoover and others, [1981], Y-73, fig. 2, p. 9) about 4 m down to the east.

Age of displacement: Y-10 (p. 58) reported that faults along the eastern side of Oasis Valley may displace Pleistocene alluvium (Q2b or Q2c deposits of Y-73). Y-73 (p. 24-26) estimated these deposits to be older than 27 ka to 35 ka and younger than 730 ka. Taylor (1986, Y-264, p. 14, appen. G, p. 192) obtained dates (uranium–trend) that range between 145 ka to 430 ka.

Y-10 (p. 58) also noted that Quaternary and Tertiary alluvial–fan deposits (QTa deposits of Y-73) are displaced by one fault along the eastern side of Oasis Valley. These deposits are estimated to be older than 730 ka and younger than about 3 Ma by Y-73 (p. 2, 26). On the basis of volcanic ashes found near Yucca Mountain and in the Amargosa Desert, Y-264 (table 1, p. 15, appen. G, p. 192) estimated an age of 1.1 Ma to 2 Ma for these deposits.

Fault scarps mapped by Y-1223 (fig. 2, p. 1-9) along the eastern side of Oasis Valley are interpreted by them to be probably Quaternary.

Of the two fault traces bounding the western side of Oasis Valley, the southern one is on surfaces of Quaternary deposits and the northern one is on surfaces of Tertiary deposits (Y-813).

Faults bounding the narrow graben at the northern end of the Oasis Valley displace Pleistocene alluvium (Q2b or Q2c deposits of Y-73; older than 27 ka to 35 ka, younger than 730 ka (Y-73, p. 24, 26)) and may be inset into a larger graben that displaces older deposits (Y-10, p. 58).

Oasis Valley faults (OSV) — Continued

Slip rate: Using the 4 m of displacement that was noted by Y-10 (p. 58) in QTa deposits of Y-73 and an estimated age for these deposits of 730 ka to 3 Ma (Y-73, p. 2, 26), an apparent slip rate of 0.001-0.005 mm/yr is estimated for one fault along the eastern side of Oasis Valley since early Quaternary or latest Tertiary.

Recurrence interval: No information.

Range-front characteristics: No range front is directly related to faults on either side of Oasis Valley.

Analysis: Aerial photographs (Y-10; Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-1223, p. 1-8, low–sun–angle (morning) photos, scale 1:12,000).

Relationship to other faults: Y-1223 (p. 1-8) suggested that the fault scarps in Oasis Valley do not seem to be part of a throughgoing geologic structure. Y-232 (p. 34, *citing* F.M. Byers, Jr. and others, written and oral commun., 1968) postulated that a caldera related to the eruption of the Ammonia Tanks Member of the Timber Mountain Tuff (Pliocene) is located beneath alluvium in Oasis Valley. If such a caldera exists, its influence on the origin of or displacement along the faults included in OSV is not known.

Owens Valley fault (OWV)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-415: Jennings, 1985 (Death Valley sheet); Y-426: Stinson, 1977; Y-427: Hart and others, 1989; Y-694: Beanland and Clark, in prep.; Y-869: Nelson, 1966; Y-1020: Jennings; 1992; Y-1025: Lubetkin and Clark, 1988; Y-1046: Bryant, 1988; Y-1055: Beanland and Clark, 1993; Y-1115: Ross, 1962; Y-1116: Pakiser and others, 1964; Y-1117: Carver, 1970; Y-1362: Savage and Lisowski, 1980; Y-1363: Savage and others, 1975.

Location: 126 km/244° (distance and direction of closest point from YM) at lat 36°19′N. and long 117°42′W. (location of closest point), if the northwest–striking fault traces in Lower Centennial Flat are included as part of OWV (shown as OWV? on pl. 2 of this compilation); 132 km/250° (distance and direction of closest point from YM) at lat 36°25′N. and long 117°49′W. (location of closest point), if the north–striking fault traces near Owens Lake are used as the closest point of OWV to Yucca Mountain. OWV is located between the Sierra Nevada on the west and the White–Inyo Mountains on the east. Only the Owens Valley segment of Y-1046 (p. 8) is within the area covered by plate 2 of this compilation. This is the southern segment of eleven into which OWV has been subdivided as summarized in Y-1046 (p. 9-12). Y-427 (pl. 1) shows OWV along the western side of Owens Lake only. He did not include any of the fault traces along the eastern side of the lake or within Lower Centennial Valley.

USGS 7-1/2′ quadrangle: Centennial Canyon, Cerro Gordo Peak, Coso Peak, Dolomite, Haiwee Reservoirs, Keeler, Owens Lake, Talc City Hills, Upper Centennial Flat, Vermillion Canyon.

Fault orientation: OWV has a north to northwest strike (Y-1046, p. 2). The overall strike of OWV is 340°; its dip is 80° ± 15° ENE. (Y-1055).

Fault length: The length of OWV is about 100 km between Owens Lake on the south and north of Big Pine, California, on the north (Y-427, p. 6; Y-1046, p. 2; Y-1055). Surface rupture length in 1872 (M7.8, March 26) occurred on 90 to 110 km of OWV between Owens Lake and north of Big Pine, essentially the entire mapped length of OWV (Y-1046, p. 2; Y-1055).

Style of faulting: Displacement on OWV has been primarily right lateral, with a minor component of down–to–the–east, dip–slip (normal) displacement (Y-427, p. 6; Y-1046, p. 2, *citing* Y-694). However, the dip–slip component may be significant locally (Y-427, p. 6). In the Owens Valley area, the ratio of horizontal to vertical displacement during the Holocene is estimated to be 6:1 (Y-1046, p. 13, *citing* Y-694).

Scarp characteristics: Y-1025 (p. 765) reported maximum slope angles of 30° to 38° for the youngest pre–1872 scarps and maximum slope angles of about 70° to 90° for the 1872 portions of the scarps.

Displacement: On the basis of his conclusion that two Cretaceous plutons (his Santa Rita Flat pluton in the Inyo Mountains and his Tinemaha Granodiorite in the Sierra Nevada) are correlative, Y-1115 (p. D88) inferred that lateral displacement on OWV "is limited to a few miles at most since emplacement of the Sierra Nevada batholith."

Y-1046 (p. 2) noted a maximum right–lateral displacement on OWV of about 20 km. He based the estimate on the correlation of Y-1115 and work by Y-694.

Y-1116 (p. 54) inferred a total vertical displacement of about 5,800 m (19,000 ft), which is "the difference in altitude between the summit of Mount Whitney and the buried pre–Tertiary floor of Owens Valley east of Lone Pine."

On the basis of gravity data interpreted by them, Y-1116 (p. 50) reported that the Cenozoic rocks that are faulted against pre–Tertiary rocks in the Inyo Mountains south of Independence, California, are about 1,830 to 3,050 m (8,000 ± 2,000 ft) thick. Y-1046 (p. 2, *citing* Y-1116) noted a maximum vertical displacement on OWV of about 2,400 m near Lone Pine.

In the 1872 earthquake, the right–lateral component of displacement on the main trace of OWV averaged 6 ± 2 m with a maximum displacement at Lone Pine of about 10 m (Y-1055). The vertical component of displacement, which was normal and variable in sense, averaged 1 ± 0.5 m (Y-1055). The average net oblique displacement in 1872 was 6.1 ± 2.1 m with a maximum net oblique displacement of 11 m (Y-1055).

Y-1025 (p. 766) reported that the horizontal component of slip in the 1872 earthquake on the Lone Pine fault, a secondary fault trace of OWV up to 1.4 km west of and approximately parallel to the main trace of OWV at Lone Pine, is 4 to 6 m. Adding this amount of displacement to that experienced along the main trace of OWV at Lone Pine (2.7 to 4.9 m), Y-1025 (p. 766) indicated that the maximum horizontal component of slip in 1872 was 7 to 11 m. In addition, Y-1025 (table 2, p. 763, 766) reported a dip–slip component of 1 to 2 m on the Lone Pine fault in 1872.

Age of displacement: The youngest rupture on OWV is historical. Most of OWV experienced surface rupture during an earthquake on March 26, 1872 (M7.8) with an epicentral location near Lone Pine (Y-1046, p. 2; Y-1055). Elsewhere along OWV, evidence of Holocene surface rupture predominates (Y-1046, p. 8).

Y-1025 (p. 764) reported that pre–1872 fault scarps are preserved on alluvial fans that they estimated were latest Pleistocene on the basis of the degree of weathering of granitic boulders, soil–oxidation color, and fan surface morphology. They suggested a range of 10 ka to 21 ka for these surfaces, but thought it likely that the age is close to 10 ka.

Some features attributed to the 1872 earthquake in the area near Owens Lake may be the result of slumping or liquefaction (Y-1046, p. 7, 13-14, *citing* Y-1117).

Slip rate: Y-427 (p. 6) reported a late Quaternary slip rate of about 3 mm/yr. Y-1046 (p. 2 *citing* Y-694) noted an average net slip rate on OWV of approximately this same amount, but emphasized that the strike–slip component is not well defined. Y-1055 reported an average net slip rate of 1.5 ± 1 mm/yr at one site on OWV since about 300 ka. They also examined several other sites, where data yielded an average Holocene (≤10 ka) net slip rate that is estimated to be 2 ± 1 mm/yr (Y-1055).

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

Using an estimate of the average total slip/event (4.3 to 6.3 m) and a range of recurrence intervals (5,000 to 10,500 yr), Y-1025 (p. 766) calculated an average late Quaternary (oblique) slip rate of 0.4 to 1.3 mm/yr for the Lone Pine fault, one of several traces of OWV. Because they thought an age at the younger end of their estimated range was better for the disrupted pre–1872 alluvial fans, they favored the higher slip–rate estimate.

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

Recurrence interval: Y-1055 suggested that OWV has experienced three major earthquakes during the Holocene, although these events are not precisely dated. These data suggest a minimum average recurrence interval is 5,000 yr along the Lone Pine fault and an average recurrence interval of 3,300 to 5,000 yr elsewhere along OWV (Y-1055). Y-1055 (p. 756, 766) concluded that the average late Quaternary recurrence interval for an earthquake similar to the one that occurred in 1872 is 5,000 to 10,500 yr, on the basis of three events since 10 ka to 21 ka (p. 764).

Y-1025 (p. 765) speculated that the recurrence interval along the Lone Pine fault since 10 ka to 21 ka has been 5,000 to 10,500 yr. They based this on an interpretation of topographic scarp profiles, which they thought indicated three earthquakes since this time.

Range-front characteristics: No information.

Owens Valley fault (OWV) — Continued

Analysis: Compilation of existing information (Y-415; Y-427, p. 2). Aerial photographs (Y-427, p. 2; Y-1046, p. 8, scales 1:54,000; 1:24,000; 1:12,000; and 1:10,000). Field reconnaissance (Y-427, p. 2). Field examination (Y-1046, p. 8; Y-1115, p. D86; Y-1116, p. 23). Topographic profiles across fault scarps (Y-1025, p. 757). Seismic surveys (Y-1116, p. 42-43). Aeromagnetic surveys (Y-1116, p. 39). Rock mineralogy and chemistry (Y-1115, p. D86-D87). Geophysical surveys (Y-1116, p. 23). Gravity measurements (Y-1116, p. 23-24). Interpretation of gravity data (Y-1116, p. 25-26).

Relationship to other faults: Y-1055 suggested that OWV "accommodates some of the relative motion (dextral shear) between the North American and Pacific plates." They further concluded that "in Owens Valley, displacement is partitioned between [OWV] and the nearby, subparallel, and purely normal range–front faults of the Sierra Nevada" (Sierra Nevada fault (SNV) of this compilation; Y-1055). These range–front faults are noted by Y-1055 to be very discontinuous and have lower Holocene displacement rates (0.1 to 0.8 mm/yr) than that estimated for OWV.

Y-427 (p. 6) noted that SNV, which is along the eastern front of the Sierra Nevada, is closely associated with OWV and may be partly coincidental with it.

Y-427 (p. 6) speculated that the Little Lake fault (LL) may be a southern extension of OWV.

Pahranagat fault (PGT)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-181: Carr, 1874; Y-332: Jayko, 1988; Y-395: Jayko, 1990 (name from this reference); Y-404: Tschanz and Pampeyan, 1970 (their Pahranagat shear system; also their Arrowhead Mine fault, Buckhorn fault, and Maynard Lake fault); Y-614: Wernicke and others, 1988; Y-632: Wernicke and others, 1988; Y-969: Shawe, 1965; Y-1032: Schell, 1981 (pl. 9; table A2, his fault #32, the Maynard Lake fault zone, and his fault #34, the Buckhorn fault zone); Y-1107: Carr, 1974; Y-1119: Liggett and Ehrenspeck, 1974; Y-1120: Wernicke and others, 1984; Y-1121: Hamblin, 1965.

Location: 106 km/75° (distance and direction of closest point from YM) at lat 37°06′N. and long 115°18′W. (location of closest point). PGT is located in the southern end of the Pahranagat Valley between the East Pahranagat Range on the north and the Sheep Range on the south. It extends eastward into the southern Delamar Valley.

USGS 7-1/2′ quadrangle: Alamo, Alamo SE, Badger Spring, Delamar 3 NE, Delamar 3 NW, Delamar 3 SE, Delamar 3 SW, Delamar Lake, Desert Hills NE, Desert Hills SE, Gregerson Basin, Lower Pahranagat Lake, Lower Pahranagat Lake NW, Lower Pahranagat Lake SE, Lower Pahranagat Lake SW.

Fault orientation: The strike of PGT is approximately N. 50° E. (Y-395, p. 225). PGT is composed of three major traces with this strike, which have been called (north to south): the Arrowhead Mine fault (ARM), the Buckhorn fault (BUC), and the Maynard Lake fault (MAY) (Y-395, p. 225-226; Y-404, p. 83). A splay at the northeastern end of BUC, named the Nine Mile fault, strikes N. 20-30° E. (Y-395, p. 227).

Fault length: The length of PGT is 40 to 45 km; its width is about 13 km (Y-395, p. 225).

The length of ARM is about 14 km as estimated from Y-25 and 15 km as noted by Y-395 (p. 227-228). However, Y-404 suggested that the total length of ARM may be as much as about 66 km. This includes a 6.5–km–long section of ARM that they show as having post–Laramide displacement (estimated from pls. 2 and 3 of Y-404). In addition, they inferred a 39–km–long westward continuation of ARM to the Papoose Range (estimated from pl. 3 of Y-404).

The length of BUC is 20 to 25 km (Y-395, p. 227-228), 27 km (Y-1032, table A2, p. A7), 40 km (estimated from Y-25), or about 42 km (estimated from Y-404, pl. 3).

MAY is the longest fault trace in PGT (Y-1032, table A2, p. A7). The length of MAY is about 40 km (Y-395, p. 227-228), 44 km (estimated from Y-25), or ≥45 km (Y-1032, table A2, p. A7). The portion of MAY experiencing Laramide displacement is 45 km long as estimated from Y-404 (pls. 2 and 3). A northeastward continuation of MAY beneath Tertiary volcanic rocks is inferred by Y-404. This continuation would add 46 km (estimated from pl. 3 of Y-404) to MAY, so that the total length of MAY could be as much as 91 km.

Style of faulting: Fault traces constituting PGT generally dip steeply northwest and have had oblique displacement that includes a major component of dip slip as well as left–lateral strike slip (Y-25; Y-395, p. 227; Y-404). On the basis of dips of Tertiary beds, Y-395 (p. 227) suggested that PGT is listric to the north. Y-404 (p. 84) proposed that Laramide displacement along ARM and perhaps MAY may have been right lateral. Y-1032 (table A2, p. A7) suggested that abundant low–angle slickensides along MAY indicate "complex–oblique slip movement, possibly strike–slip."

Scarp characteristics: No information.

Displacement: Displacement on PGT is noted to be "on the order of 9 to 16 km" by Y-395 (p. 227, *citing* Y-1119) and "as great as 10 miles [16 km]" as measured on a spheroidally weathered ignimbrite (Y-404, p. 84). Y-25 also noted 16 km of displacement on PGT.

On the basis of displacement of Tertiary rocks, Y-395 (p. 227) inferred a maximum vertical displacement along ARM of at least 0.5 km in the Pahranagat Valley area. Lateral displacement along ARM is "on the order of 2 km, if the west–dipping normal faults that bound Paleozoic and Tertiary strata north and south of [ARM] are correlative" (Y-395, p. 227). On the basis of a spheroidally weathered ignimbrite, Y-404 (p. 100) inferred an apparent post–Miocene displacement on ARM of about 8 km (about 5 miles).

Pahranagat fault (PGT) — Continued

A minimum of 1 to 2 km of left-lateral displacement along BUC is suggested by displaced fault traces in the Pahranagat Range (Y-395, p. 228). Apparent post–Miocene left-lateral displacement along BUC is about 5 km (3 miles), if the tilting of the Tertiary strata occurred before lateral displacement (Y-395, p. 228).

Displacement across MAY of "not more than 5 to 6 km" between the Pahranagat Range and the northern Sheep Range has been inferred by Y-395 (p. 228) on the basis of the distribution of a Tertiary(?) conglomerate. Left–lateral displacement appears to have been the dominant component of lateral displacement across MAY, but some right–lateral displacement has also been inferred from the geometry of folds near the fault.

Age of displacement: Y-25 portrayed MAY, BUC, and ARM all as faulted contacts between Tertiary volcanic or sedimentary rocks and either Holocene to Pliocene alluvium and colluvium (their QTa deposit) or Holocene to Miocene older gravels (their QTg deposits). These relationships suggest Quaternary displacement along all three faults. Y-332 (p. 171) noted that "prominent scarps in raised, dissected alluvial–fan deposits in the southern part of Tikaboo Valley, and significant deflection of drainages in younger alluvial deposits within the valley, suggest possible Quaternary tectonic activity" on PGT. In addition to these scarps, Y-332 (p. 171) noted scarps along the northern side of the Sheep Range and numerous small–magnitude earthquakes in the vicinity of PGT. He concluded that these all suggest continuing activity on PGT. Y-395 (p. 227, 234, *citing* unpub. data of Jayko, Sarna–Wojcicki, and Myers) noted that significant displacement along PGT apparently did not occur until after 7.7 Ma (latest Miocene or early Pliocene), which is the youngest age for interbedded tuffs and alluvium that conformably overlie displaced middle Oligocene to upper Miocene volcanic rocks.

Fault scarps are also preserved on alluvial deposits north of ARM (Y-395, p. 227), but their relationship to ARM is unclear.

The probable age of youngest displacement along BUC is noted by Y-1032 (table A2, p. A7) as indeterminate, but suspected of being Pliocene. Determination of the age of displacement is difficult, because young stratigraphic units are not present along the fault trace (Y-1032, table A2, p. A7). The youngest unit definitely displaced is his middle Tertiary volcanic rocks (Tv_2, table A2, p. A7) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1). The oldest unit not displaced is his intermediate–age alluvial–fan deposits (Y-1032, table A2, p. A7) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). According to Y-1032 (table A2, p. A7), BUC has strong magnetic expression but no evidence for Quaternary surface displacement.

Quaternary activity on at least one trace of PGT, MAY, is interpreted from prominent fault scarps on dissected alluvial deposits at the northern end of the Sheep Range and by contemporary seismicity in the Pahranagat area (Y-332; Y-395, p. 227). The probable age of the youngest displacement along MAY is noted by Y-1032 (table A2, p. A7) to be Pleistocene. He bases this estimate on a minor scarp of probable late Pleistocene age in Pahranagat Valley. This scarp is on his intermediate–age alluvial–fan deposits (A5i, table A2, p. A7) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). Y-1032 noted no evidence for Quaternary displacement elsewhere along MAY, where his intermediate–age alluvial–fan deposits (his A5i deposits, table A2, p. A7) have not been displaced. The oldest unit that he recognized as displaced is middle Tertiary volcanic rocks (Tv_2, table A2, p. A7) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

Slip rate: No information.

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-395; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field mapping (Y-395; Y-404, p. 2). Field reconnaissance (Y-1032, p. 17-18). Gravity analyses (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Pahranagat fault (PGT) — Continued

Relationship to other faults: Y-395 (p. 225) suggested that PGT "generally forms the boundary between an actively extending area to the north and a previously extended area to the south." Y-25 noted that fault traces included in PGT align with northeast–striking, left–lateral traces of the Rock Valley fault (RV) and the Cane Spring fault (CS) to the east (pls. 1 and 2). However, the fault traces are not continuous between these two major systems of northeast–striking faults and are separated by several mountain ranges (e.g., the Desert Range, the Pintwater Range). Y-395 (p. 227) could not find any evidence suggesting that ARM, BUC, or MAY continue westward through Paleozoic rocks of the Desert Range or the northern Pintwater Range. Although he (Y-395, p. 227) noted that several east–striking faults do exist in the East Desert Range, he concluded that none of these has experienced a large enough lateral displacement to be a southwestern extension of PGT. Y-25 noted that the faults in both systems have similar characteristics and that they may be aligned "along a broad zone of structural weakness that predates the Tertiary volcanic activity" (Y-25). Y-25 (*citing* Y-181, Y-969, and Y-1107) suggested that these left–lateral faults are probably "part of a conjugate system that includes the northwest–trending, right–lateral Las Vegas Valley shear zone, the Walker Lane, and other right–lateral faults."

ARM and, perhaps, MAY are inferred by Y-25 and Y-404 (p. 83-84) to have been part of major right–lateral shear zone during the Laramide. This inference is based on facies and thickness changes in Paleozoic rocks and on possible displacement of Laramide fold and thrust belts that occur north and south of PGT. For example, Y-404 (p. 83-84) estimated 48 km (30 miles) of right–lateral displacement across ARM between the Pahranagat/Spotted Range thrust and a buried fault south of the Papoose Range. On the basis of a tentative correlation of the Delamar Range fold and thrust belt and the Highland Range thrust, Y-404 (p. 83-84) suggested a similar amount of right–lateral displacement across MAY.

Strike slip on PGT has probably been accompanied by folding of Tertiary rocks. These folds, dominantly trending N. 35° E. and plunging northeast, probably began "as monoclinal flexures that formed over deep–seated, blind normal faults and are a type of fault–bend fold or drag fold" (Y-395, p. 229, *citing* Y-1121). The folds were probably "tightened by drag folding associated with the lateral component of displacement within [PGT]" (Y-395, p. 229).

PGT has been interpreted by Y-395 (p. 233) to be within the Escalante zone, a broad zone of geographic, geologic, and geophysical features that trends southwest from the Wasatch fault zone into the Pahranagat area and that probably terminate at the Walker Lane. PGT has also been interpreted by Y-395 (p. 234, *citing* Y-1119 and Y-1120) to be a tear or transfer fault "that accommodates extension (connects detachment faults) between Delamar–Dry Lake valleys and the Desert Valley as suggested by previous workers." Y-395 (p. 234) also suggested that PGT is part of what has been called the Death Valley normal–fault system (*citing* Y-614 and Y-632).

A close spatial association seems to occur between left–lateral faults (including PGT) and Tertiary basaltic volcanism (which probably occurred between 17 Ma and 6 Ma) or volcanic centers, although the exact relationships are not known (Y-25). The Kane Springs Wash and Caliente volcanic centers occur at the intersections between northeast–striking, left–lateral faults and northwest–striking, possibly right–lateral faults (Y-25). The northeast–striking faults (including those of PGT) appear to terminate (in a northeast direction) at the volcanic centers (Y-25).

The map by Y-25 portrays the Kane Springs Wash fault, southeast of the Kane Springs Wash volcanic center in the southern Delamar Mountains, and the Burnt Springs Range faults, northwest of the Caliente volcanic center northeast of the Kane Springs Wash volcanic center, as having strikes similar to that of PGT and as experiencing left–lateral, oblique displacement (both faults are east of the area shown by pls. 1 and 2 of this compilation). Y-25 concluded that scarps on alluvial surfaces in the valley of Kane Springs Wash indicate that the Kane Springs Wash fault has experienced Holocene displacement. It is not known if these faults are part of or genetically related to PGT. The Burnt Springs Range fault is slightly north of the northeast projection of PGT, but it lies along the projection of the Timpahute lineament (Y-25).

Pahroc fault (PAH)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3; name from their pl. 3); Y-1032: Schell, 1981 (table A2, fault #33).

Location: 144 km/62° (distance and direction of closest point from YM) at lat 37°27′N. and long 115°00′W. (location of closest point). The southern portion of PAH is located along the eastern side of the South Pahroc Range. It extends northward across the North Pahroc Range and along the eastern side of the Seaman Range at its junction with the valley of the White River.

USGS 7-1/2′ quadrangle: Alamo NE, Hiko NE, Hiko SE, Pahroc Spring, Weepah Spring, White River Narrows.

Fault orientation: PAH has a curving strike that varies between north–northeast and north–northwest (Y-25; Y-404; Y-1032).

Fault length: The length of PAH is 59 km as estimated from Y-25. Y-404 (p. 94) reported that the total length of PAH is 74 km (46 miles). The length of PAH is noted to be 42 km by Y-1032 (table A2, p. A7), but he does not include an approximately 15–km–long section of PAH that is shown by Y-25.

Style of faulting: Displacement on PAH is portrayed by Y-25 and Y-404 as down to the east.

Scarp characteristics: No information.

Displacement: Y-404 (p. 94) reported that the stratigraphic separation in volcanic rocks across PAH and the White River fault, which is parallel to and east of PAH and which bounds the western side of the North Pahroc Range, "is less than a few hundred feet where it can be measured."

Age of displacement: The probable age of the youngest displacement along PAH is noted by Y-1032 (table A2, p. A7) to be middle to early Pleistocene (defined as >200 ka and <1.8 Ma by Y-1032, p. 30). The youngest unit displaced is his old–age alluvial–fan deposits (A5o; Y-1032, table A2, p. A7) with an estimated age of 700 ka to 1.8 Ma (table 3, p. 23). This displacement is along the northern portion of PAH.

The rest of PAH is shown as a faulted contact between bedrock and alluvium or as a fault within bedrock (Y-1032, table A2, p. A7). The oldest unit not displaced is his intermediate–age alluvial–fan deposits (A5i; Y-1032, table A2, p. A7) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit displaced is Paleozoic rocks (Y-1032, table A2, p. A7).

Portions of PAH are shown by Y-25 as faulted contacts between Miocene volcanic rocks and either Miocene to Holocene older gravels (their QTg deposits) or Holocene to Pliocene alluvium and colluvium (their QTa deposits). Other portions of PAH are shown by Y-25 as concealed by their QTg and QTa deposits. Y-404 portrayed PAH as a post–Laramide structure and showed sections as faulted contacts between Tertiary volcanic rocks and either Pleistocene(?) older alluvium (their Qol deposits) or Pliocene(?) and Pleistocene(?) older gravels (their QTg deposits). Portions are also shown by Y-404 as concealed by their Qol and QTg deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: The southern end of PAH nearly intersects the eastern end of the northeast–striking Pahranagat fault (PGT) to the south. PAH is approximately parallel to the Hiko–South Pahroc faults (HSP) to the west along the western side of the South Pahroc Range. Y-1032 (table A2, p. A17) noted that the northeast–striking Six–Mile Flat fault (SMF) is located between PAH on the east and the north–northeast–striking Hiko fault (HKO) on the west. However, the relationships among these faults are not known.

Maps by Y-25, Y-404, and Y-1032 all show east–striking faults in the South Pahroc Range. These faults seem to terminate at PAH, but the exact relationship among these faults is not known.

The main part of the Seaman Range volcanic center is located west of the northern end of PAH (Y-25). The relationship between PAH and this volcanic center is not known.

Pahrock Valley faults (PV)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970. Not shown by Schell, 1981 (Y-1032, pl 9).

Location: 155 km/48° (distance and direction of closest point from YM) at lat 37°45′N. and long 115°08′W. (location of closest point). PV includes two faults: an eastern fault along the eastern side of the Seaman Range and a western fault along a ridge within Pahrock Valley.

USGS 7-1/2′ quadrangle: Seaman Wash, White River Narrows.

Fault orientation: Both faults in PV strike north–northeast (Y-25; Y-404).

Fault length: The length of the western fault in PV is about 11 km as estimated from Y-25 and Y-404. The length of the eastern fault is 9 km as estimated from Y-25 and Y-404.

Style of faulting: No sense of displacement is indicated by either Y-25 or Y-404 for either fault in PV. However, stratigraphic relationships as mapped by Y-25 and Y-404 suggest that displacement on the western fault has been down to the east and that displacement on the eastern fault has been down to the west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Parts of both faults in PV are shown by Y-25 as faulted contacts between Miocene lavas or pre–Tertiary sedimentary rocks and Holocene to Miocene older gravels (their QTg deposits). Part of the western fault is portrayed by Y-404 as a faulted contact between pre–Tertiary rocks and Pliocene(?) and Pleistocene(?) older gravels (their QTg deposits). Part of the eastern fault is shown by Y-404 as a faulted contact between Pliocene basalt and their QTg deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000). Compilation of existing structural and stratigraphic information (Y-25). Field reconnaissance (Y-404, p. 2).

Relationship to other faults: PV approximately aligns with the north–northwest–striking northern portion of the Pahroc fault (PAH). The southern ends of the faults in PV are directly east of and nearly intersect with the southeastern end of the north–northwest–striking Seaman Pass fault (SPS) in Coal Valley. The relationships among these faults are not known.

PV is located southeast of the main part of the Seaman Range volcanic center (Y-25), but the relationship of PV to the center is not known.

Pahrump fault (PRP)

Plate or figure: Plate 2.

References: Y-9: Fox and Carr, 1989; Y-137: Carr, 1988; Y-161: Burchfiel and others, 1983 (their Stewart Valley fault may correspond to the northern part of PRP); Y-182: Carr, 1984 (his Stewart Valley fault (fig. 7, p. 16) may correspond to PRP); Y-232: Cornwall, 1972 (shows only the northern part of PRP in Stewart Valley within Nye County, Nevada; the part of PRP north of about lat 36°10′N.); Y-238: Reheis and Noller, 1991 (pls. 3 and 4); Y-262: Stewart and others, 1968 (their Stewart Valley fault may correspond to the northern part of PRP); Y-614: Wernicke and others, 1988; Y-672: Carr, 1990; Y-695: Donovan, 1991; Y-696: Hoffard, 1991 (her Pahrump Valley fault zone; part of her Pahrump fault system, p. 5); Y-706: Wright, 1989 (his Pahrump fault zone); Y-806: Hoffard, 1990 (her Stateline–Pahrump Valley fault zone); Y-813: Reheis, 1992 (pl. 3; her Pahrump fault zone, p. 3, 8); Y-845: Malmberg, 1967; Y-852: Dohrenwend and others, 1991; Y-887: Schweickert, 1989 (his Stewart Valley–Stateline fault); Y-888: Stewart, 1988 (his Pahrump fault zone); Y-889: Liggett and Childs, 1973 (their Pahrump fault zone); Y-892: Claassen, 1985; Y-1105: MIT Field Geophysics Course, 1985 (geophysical investigation of Mesquite Valley, which is south of PRP; pl. 2 of this compilation).

Location: 70 km/160° (distance and direction of closest point from YM) at lat 36°16′N. and long 116°10′W. (location of closest point) for the northern extent of PRP in Stewart Valley as mapped by Y-696; 42 km/175° (distance and direction of closest point from YM) at lat 36°28′N. and long 116°24′W. (location of closest point) for the northern extent of PRP in Ash Meadows as shown by Y-238. PRP is located in central Pahrump Valley and along the eastern side of Stewart Valley. It may extend to the north through Ash Meadows and the Amargosa Desert (Y-238). PRP approximately parallels the California–Nevada border.

USGS 7-1/2′ quadrangle: Blackwater Mine, Calvada Springs, Green Monster Mine, Hidden Hills Ranch, High Peak, Horse Thief Springs, Mound Spring, Nopah Peak, Pahrump, Pahrump NE, Sixmile Spring, Stewart Valley, Stump Spring, West of Shenandoah Peak.

Fault orientation: The overall strike of PRP is N. 45° W. (Y-696, table 1, p. 28). Between lat 36°05′N. and lat 36°00′N., two main traces strike N. 45° W., but minor traces strike between N. 45° W. and N. 30° E. (Y-696, p. 74). To the north in Stewart Valley, fault traces strike N. 25° W. to N. 30° W., which Y-696 (p. 77) attributed possibly to structural control of the Montgomery Mountains. A northwest–striking fault in Stewart Valley, which they called the Stewart Valley fault, is shown by Y-161 (fig. 2) to have a more westerly strike than that of PRP in Stewart Valley as mapped by Y-238 and Y-696 (pls. 1 and 5).

Fault length: Y-888 (p. 694) suggested that PRP has a length of 130 km. Individual lineaments and scarps along the southern part of PRP are >15 km long; other traces are >6 km long (Y-696, p. 74).

The length of PRP between Black Butte at the southern end of Pahrump Valley and the northern end of Stewart Valley is 50 km (Y-696, table 1, p. 28, 49). Y-696 (p. 49) suggested that the southern end of PRP dies out north of Mesquite Valley near Black Butte, because Y-1105 (p. 8689) reported that they found no topographic expression that would indicate a fault that has experienced Holocene or late Quaternary displacement. A northwest–trending topographic break that is preserved on an alluvial surface and that may be associated with PRP extends 45 km southeast from the southern Montgomery Mountains (Y-161, p. 1,371, *citing* Y-889). The map by Y-845 (pl. 1) shows PRP concealed within Pahrump Valley and 24 km long.

If PRP extends north of Stewart Valley, then the length of PRP is 65 to 70 km as estimated from Y-238 and Y-813 between the Hidden Hills in Pahrump Valley (lat 36°N.) and an east–northeast–trending lineament in the Amargosa Desert along which PRP may terminate (Y-238, p. 6).

Pahrump fault (PRP) — Continued

Style of faulting: Right–oblique displacement along PRP was interpreted by Y-696 from (1) west–facing scarps combined with seismic refraction profiles that indicate down–to–the–west displacement of disrupted basin–fill sediments (Y-696, p. 78), and (2) a westward shift in the locus of deposition of alluvium in Pahrump Valley across PRP and a left–stepping pattern of fault traces, both of which indicate a right–lateral component of displacement (Y-696, p. 94; Y-806). Other workers have also suspected a right–lateral component because of (1) the left–stepping, *en echelon* fault traces and possible right–lateral offset of a stream (Y-889, *cited in* Y-696 and Y-161, p. 1371) and (2) the weak topographic expression of faults within the valley (Y-238, p. 6).

A right–lateral component of displacement on the Stewart Valley fault has been inferred by Y-161 (p. 1371, 1374) from the oblique angle between this fault and folds within the Resting Spring Range and Montgomery Mountains and by the stratigraphic relationships in the Montgomery Mountains on opposite sides of the fault. However, the direction of displacement on individual fault traces is not known (Y-238, p. 6).

Y-696 (p. 49) subdivided PRP into two sections: one south of lat 36°05′N. (but north of lat 36°00′N.) and one north of this latitude.

Scarp characteristics: South of lat 36°05′N. (but north of lat 36°00′N.), the main escarpment is up to 15 m high and is consistently west side down (Y-696, p. 53). Lineaments to the west of this main escarpment show no vertical displacement (Y-696). North of lat 36°05′N., maximum scarp height is 5 m, consistently west side down (Y-696, p. 78). No evidence for lateral displacement was observed by Y-696, and no clear surface displacement is exhibited along many of the fault traces (Y-696).

Displacement: A minimum vertical displacement of about 300 m (about 1,000 ft) along PRP was estimated by Y-845 (p. 18, 21) on the basis of this amount of erosion of basin–fill sediments from the upthrown block of the fault. Right–lateral displacement of greater than about 16 to 19 km has been estimated by Y-888 (p. 694) from relationships among Precambrian and Paleozoic rocks.

Age of displacement: The age of the most–recent displacement along PRP is Quaternary. However, the exact ages of displacements are not known because deposits associated with PRP have not been dated. Y-696 (table 1, p. 28) suggested that the youngest geomorphic surfaces displaced are middle to late Holocene at the northern end of PRP and late Pleistocene(?) at the fault's southern end. The timing of the initial displacement is unknown, but Y-706 suggested that the scarps and lineaments that are presently observable are the result of renewed displacement on an older (middle Miocene?) fault. He based this conclusion on elongate northwest–trending gravity anomalies beneath Pahrump Valley that coincide with PRP and that suggest that displacement occurred contemporaneously with development of sedimentary basins. Y-614 proposed that Pahrump basin initially formed between 10 Ma and 15 Ma with the beginning of displacement on the Death Valley fault (DV of this compilation).

South of lat 36°05′N. (but north of lat 36°00′N.), the youngest deposits clearly displaced are QT deposits of Y-696 (p. 78-79; these are the QTol deposits of Y-845), which are probably Pliocene or Pleistocene (Y-696, p. 29). The highly sinuous and dissected character of an escarpment that is >8 m high suggests that no major displacement has occurred "in quite some time," but the age of this displacement is not known (Y-696, p. 79). The map by Y-852 does not show this escarpment. Younger sediments inset into the QT deposits are also displaced, but their age is also unknown (Y-696). Sand dunes that are probably Holocene (≤10 ka) bury the escarpment and do not appear to be displaced (Y-696, p. 80). Y-696 (p. 80) concluded that terrace deposits dated at 800 ± 50 yr (^{14}C date, J. Quade, personal commun., 1989, *cited in* Y-696, p. 80) are not displaced.

North of lat 36°05′N., numerous scarps are present on surfaces of playa sediments (Qya deposits of Y-845; these are the "op" deposits of Y-696), which are younger than the QT deposits of Y-696, but their age is not known (Y-696, p. 81). Y-845 suggested that these playa deposits may be late Quaternary. The scarps are inferred by Y-696 (p. 60, 81) to be probably late Pleistocene. This inference is based on the geomorphically youthful appearance of the scarps despite being on surfaces of unconsolidated clay and silt that would be easily eroded. These scarps are linear and have a distinctive appearance on aerial photographs (Y-696).

Y-696 (p. 81-82) suggested that the youngest deposits in Stewart Valley that are displaced by PRP are probably late Pleistocene to early Holocene because (1) the deposits are in the same area as modern playa deposits, (2) the deposits are only shallowly dissected by modern drainages, (3) the deposits are only a few meters higher than the modern playa deposits, and (4) the soils on the deposits are weakly developed. Scarps on the surfaces of these deposits have a geomorphically youthful appearance, are linear, and are distinct on aerial photographs (Y-696, p. 82). Y-161 inferred that their Stewart Valley fault is older than a possible continuation of the fault to the south in Pahrump Valley. Y-161 suggested that the Stewart Valley fault dates from a period of deformation during the early Cenozoic or perhaps the late Mesozoic that was contemporaneous with folding in the northern Resting Spring Range and Montgomery Mountains. At the northern end of the Resting Spring Range, the Stewart Valley fault is overlain by Cenozoic deposits and is cut by younger faults (Y-161).

Slip rate: The slip rate on PRP is estimated by Y-696 (p. 82) to be low (an exact rate is not specified) because of (1) the distributed nature of fault traces in northern Pahrump Valley and in Stewart Valley and (2) the absence of fault traces on some of the younger inset alluvial fans in southern Pahrump Valley.

Recurrence interval: No information.

Range-front characteristics: No range front is associated with the fault traces in Pahrump Valley. PRP borders the western side of the Montgomery Mountains in Stewart Valley, but range–front characteristics have not been evaluated.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-696, p. 8-9, scales 1:12,000 (low–sun–angle) and 1:80,000; Y-813, p. 4, scales 1:62,000 to 1:80,000). Field examination (Y-161; Y-696, p. 9; Y-845, p. 4). Analysis of seismic reflection lines (Y-696, p. 97-111; Y-806). Analysis of gravity data (Y-672; Y-706; Y-1105, p. 8685). Topographic scarp profiles (Y-696, p. 60, figs. 27 and 28, p. 64-65, figs. 31 and 32, p. 70-71).

Relationship to other faults: PRP is part of the Pahrump fault system as defined by Y-696 (p. 3), along with the East Nopah fault (EN) and the West Spring Mountains fault (WSM; pl. 2).

All or parts of PRP have been called the Pahrump Valley–Stateline fault zone (Y-806), the Pahrump fault zone (Y-238; Y-706; Y-889), and the Stewart Valley fault (Y-161; Y-892). PRP may extend as far north as the southernmost east–northeast–striking fault trace that may be part of the Rock Valley fault zone (RV) in the Amargosa Desert north of Ash Meadows. If extended this far northward, then PRP would include the Ash Meadows and Amargosa River faults of Y-695 and the Stewart Valley fault of Y-892 in the Amargosa Valley (Y-9; Y-238). PRP may extend to the south and include the State Line fault (SL; Y-9, p. 43).

PRP has been interpreted by Y-813 (p. 8) to be the western boundary of the Spring Mountains section of the Walker Lane that extends to the east to the Las Vegas shear zone. PRP has also been interpreted to be the northeastern boundary of a structural "rift" zone, such as the Amargosa Desert rift zone of Y-706 (p. 2-3; fig. 4, p. 8), an unnamed dextral strike slip fault described by Y-887 (Y-696, p. 21, called this the Stateline–Crater Flat shear zone from R. Schweickert, personal commun., *cited in* Y-696, p. 21), and the Kawich–Greenwater volcano–tectonic rift of Y-137 and Y-672. This structural "rift" zone supposedly extends to and includes the Death Valley fault (DV; Y-706) and may extend northward under both Ash Meadows and Crater Flat to Yucca Mountain (Y-137; Y-672; Y-706, p. 2-3; Y-887).

PRP has also been interpreted to be a right–lateral strike–slip fault that has been offset from the Furnace Creek fault (FC) by left–lateral displacement along the Rock Valley fault (RV; Y-9; Y-238, p. 6). This was proposed because FC and PRP have parallel strikes, because both faults terminate against fault traces that may be a southwestern extension of RV, and because late Cenozoic sediments in Ash Meadows could have been severely folded and faulted as a result of compression at a left step in the combined right–lateral fault system (Y-9; Y-238, p. 6). Y-887 (p. A90) proposed a minimum right separation of about 26 m using a distinctive fold–thrust system of the CP thrust as piercing points. Because surface expression of this fault is lacking, Y-887 (p. A90) inferred that most displacement occurred before ash–flow tuffs in the region were deposited between 10 Ma and 14 Ma.

Pahrump fault (PRP) — Continued

Seismic reflection lines interpreted by Y-696 (p. 108-111) show a large horst block beneath PRP that extends to at least the southern end of Pahrump Valley (the boundary of her study area). She interpreted this as a zone of high–angle faulting, where PRP has behaved as a broad oblique shear disrupting basin stratigraphy and possibly downdropping originally continuous basin reflectors in a fault–bounded graben or half–graben. In addition, this broad shear may be aligned along a hinge surface of a broad anticlinal fold.

Y-161 (p. 1371) suggested that folds at the northern end of the Resting Spring Range may "represent renewed strain along the Stewart Valley fault zone but unaccompanied by surficial faulting." They also suggested that valleys in the area may "owe their origin as much to folding as to faulting" (Y-161, p. 1371).

Pahute Mesa faults (PM)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992; Y-922: Hamilton and others, 1972.

Location: 48 km/354° (distance and direction of closest point from YM) at lat 37°17'N. and long 116°32'W. (location of closest point). PM includes scattered faults on Pahute Mesa. The only ones shown on plate 1 of this compilation are faults that either have been mapped on surfaces of Quaternary deposits or align with those mapped on surfaces of Quaternary deposits. The above references show more faults in this area. These fault are primarily in Tertiary deposits.

USGS 7-1/2' quadrangle: Black Mountain, Pack Rat Canyon, Tolicha Peak, Tolicha Peak NE, Tolicha Peak NW, Trail Ridge.

Fault orientation: Variable.

Fault length: The lengths of individual faults of PM range between 0.5 and 4 km as estimated from Y-813 (pl. 2). The longest series of aligned, *en echelon*, and overlapping fault traces is about 9 km long as estimated from Y-813 (pl. 2).

Style of faulting: Faults of PM are primarily shown by Y-813 to have primarily vertical displacements (direction is variable). Y-813 (p. 7) suggested that the displaced features along some faults that occur on Tertiary volcanic rocks and the apparent lack of major vertical scarps suggest right–lateral displacement. Y-10 (p. 59, *citing* Y-922) noted that earthquakes triggered by underground nuclear explosions on Pahute Mesa have produced both dip–slip and right–lateral components of displacement on north– to north–northeast–striking faults. However, right–lateral displacement on faults on Pahute Mesa has not been confirmed by field mapping (Y-10, p. 59).

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Faults of PM are shown by Y-813 (pl. 2) as weak to prominent lineaments or scarps on surfaces of Quaternary deposits (e.g., the east–striking ones east of Black Mountain). Some of these lineaments or scarps extend onto surfaces of Tertiary deposits (Y-813, pl. 2).

Many faults on Pahute Mesa (most are not shown on pl. 1 of this compilation) are portrayed by Y-813 and Y-853 as weak to prominent lineaments or scarps on surfaces of Tertiary deposits or as faults that are in Tertiary deposits, volcanic rocks, or sedimentary rocks and that have been identified from previous mapping. Y-232 also showed faults in Tertiary deposits on Pahute Mesa.

Slip rate: No information.

Recurrence interval: No information.

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

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

Relationship to other faults: Y-10 (p. 59) speculated that north–striking faults on Pahute Mesa are a continuation of north–striking faults of the Basin and Range province (e.g., the Kawich Range fault (KR) and the Belted Range fault (BLR) of this compilation, both of which are located north of Pahute Mesa) and may be, in part, strike–slip conjugate shears.

Paintbrush Canyon fault (PBC)

Plate or figure: Figure 3.

References: Y-8: Fox and Carr, 1988; Y-26: Swadley and others, 1984 (show only that portion of PBC north of the southern end of Fran Ridge); Y-31: Scott and Whitney, 1987 (their Busted Butte–Paintbrush Canyon normal fault zone); Y-46: Maldonado, 1985; Y-55: Scott and Bonk, 1984 (name from their pl. 1; show only that portion of PBC north of the southern end of Fran Ridge; includes their Fran Ridge fault along the southern end of Fran Ridge); Y-189: Lipman and McKay, 1965; Y-217: Gibson and others, 1991 (show only that portion of PBC north of the southern end of Fran Ridge); Y-224: Frizzell and Shulters, 1990 (extend PBC north of Yucca Wash); Y-238: Reheis and Noller, 1991 (pl. 3); Y-298: Gibson and others, 1990; Y-396: Scott, 1990; Y-575: Whitney and Muhs, 1991 (their Paintbrush Canyon–Stagecoach Road fault system, which they subdivided into 5 segments; assume that their segment along Busted Butte is part of PBC); Y-577: Wesling and others, 1991; Y-1042: O'Neill and others, 1992 (found no evidence for PBC north of Yucca Wash); Y-1098: Swan and others, 1993 (discuss only a western splay of PBC in Midway Valley); Y-1239: Wesling and others, 1992.

Location: 3 km/117° (distance and direction of closest point from YM) at lat 36°49′N. and long 116°25′W. (location of closest point). PBC is located along the eastern side of Midway Valley and along the western sides of Alice Point and Fran Ridge.

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

Fault orientation: PBC has a curving, but generally north–northeast strike (Y-26, pl. 1; Y-55, p. 1; Y-217, p. 50; Y-224; Y-1042, pl. 1). The map by Y-55 (pl. 1) shows westward dips of 55° on PBC north of Alice Point and westward dips of 61° to 86° adjacent to Fran Ridge (their Fran Ridge fault). Along the western side of Fran Ridge, PBC is expressed as a brecciated zone that is about 4 m wide and that dips 60° to 70° W. (Y-1042, p. 13). A western splay of PBC in Midway Valley strikes N. 30° E. to N. 45° E. and dips about 78° W. (Y-1098, p. 153). Y-396 (p. 259) reported an average dip of 69° for PBC on the basis of fourteen measurements.

Fault length: PBC is noted by Y-26 (p. 13) to be about 18 km long. Y-217 (p. 50) suggested that PBC is about 25 km long as estimated from Y-46 and Y-224. Y-217 (p. 50, 52) noted that PBC extends about 11 km north of Yucca Wash as mapped by Y-224. Segments of the Paintbrush Canyon–Stagecoach Road fault system of Y-575 (p. A119) have lengths of 3 to 4 km. PBC could be as long as 30 km if it connects to the Stagecoach Road fault (SCR) to the south (Y-575, p. A119).

Style of faulting: Displacement of Miocene volcanic rocks along PBC is shown as dip slip (normal) and down to the west and northwest (Y-26, pl. 1, p. 13; Y-55, pl. 1; Y-224). Left–lateral displacement on PBC adjacent to Fran Ridge has been inferred by Y-575 (p. A119) and by Y-1042 (p. 13) from slickenlines that are preserved on Tertiary fault breccia and that plunge 39° to 47° to the southwest. Y-575 (p. A119) and Y-1042 (p. 20) interpreted deflected and displaced stream channels that cross Fran Ridge as suggesting Quaternary left–oblique displacement on PBC.

Scarp characteristics: No information.

Displacement: Y-26 (p. 13) noted that fractures exposed in Trenches A1 and A2 near Yucca Wash are difficult to assess because bedding features are scarce, but that displacements in middle and late Pleistocene deposits have apparently been minor (less than a few centimeters). Likewise, fractures in deposits of similar age exposed in Trench 16B west of Fran Ridge (called the Fran Ridge fault by Y-217, p. 53) are interpreted by Y-26 (p. 13) "as indicating minor offset on the fault in the underlying bedrock that produced fractures with no visible offset in the unconsolidated sand of unit Q2e" (estimated age of 700 ka to 750 ka; Y-26, fig. 3, p. 9). Total displacement across the Fran Ridge fault, which Y-217 (p. 52) included as a splay of PBC, is about 300 m.

At Busted Butte, Y-575 (p. A119) reported an apparent maximum vertical displacement of 4.1 m for the deepest of several buried soils (maximum age of 700 ka) developed in sand ramps. Assuming oblique displacement of 45°, Y-575 (p. A119) calculated a total oblique displacement of 5.8 m since the beginning of middle Pleistocene. Y-1042 (p. 8) noted that there is no expression of the fault at this locality on aerial photographs, but they recognized small fractures directly south of the fault exposed at Busted Butte.

As noted in Y-217 (table 4-1, p. 46), who were using data from Y-298, PBC has apparent vertical separations of 200 m in the Tiva Canyon Member of Paintbrush Tuff (12.9 Ma ± 1.1 Ma; K–Ar), 90 m in Waterpipe Butte rhyolite (9.6 Ma; stratigraphic relationships to dated units), 70 m in Dome Mountain basalt (9.3 Ma to 9.6 Ma; stratigraphic relationships to dated units), 45 m in Thirsty Canyon tuff (7.5 Ma ± 0.6 Ma; K–Ar), and 4.1 m in alluvium (Q2e deposits; 500 ka from uranium–trend or <700 ka from stratigraphic relationships with deposits containing Bishop ash).

As noted in Y-217 (table 4-2, p. 48), stratigraphic dip separation on PBC in the Topopah Spring Member of the Paintbrush Tuff (13.1 ± 0.8 Ma; K–Ar) is 220 ± 5 m as estimated from cross section A–A′ of Y-55 (Y-217, fig. 4-10, p. 63), which is drawn across the central part of Fran Ridge, and is 515 ± 5 m as estimated from cross section B–B′ of Y-55 (Y-217, fig. 4-11, p. 66), which is drawn across the northern end of Fran Ridge.

Along a western splay of PBC, Y-1098 (p. 153) estimated a cumulative dip–slip displacement of about 170 to 270 cm in middle Pleistocene deposits. They (Y-1098, p. 153) also estimated a vertical displacement of about 15 cm during the youngest rupture along this splay. They estimated a vertical displacement per event of 40 to 85 cm for all but the youngest event.

Age of displacement: Y-575 (p. A119) concluded that sand ramps west of Busted Butte have been displaced at least four times since about 700 ka. Y-575 (p. A119) estimated that the youngest rupture at Busted Butte probably occurred during late Quaternary. On the basis of correlation of stratigraphic units, Y-26 (table 4, p. 21) inferred an age of 270 ka to 700 ka for the youngest displacement on PBC. In contrast, PBC is shown as concealed over much of its length by Y-224. Y-1042 (p. 9) noted that a large slump block along the northwestern side of Fran Ridge appears to overlie the trace of PBC. Although surficial mapping by Y-26 (p. 13) revealed no evidence for Quaternary ruptures along PBC, exposures in trenches do suggest Quaternary displacement.

Of four trenches located on PBC, Y-26 (table 1, p. 5) noted that the youngest rupture recorded in the two trenches west of Fran Ridge (the Fran Ridge fault of Y-217, p. 53) occurred between 700 ka and 270 ka as interpreted from Trench 16B (displacement of Q2e deposits with an estimated age of 700 ka to 750 ka, but no displacement of Q2s deposits with an estimated age of 270 ka to 700 ka; Y-26, fig. 3, p. 9). On the basis of exposures in Trench 17, Y-26 (table 1, p. 5) interpreted the youngest rupture as older than 700 ka (no displacement of Q2e deposits). Y-26 (table 1, p. 5) noted that the youngest rupture that is recorded in the two trenches near Yucca Wash near the northern end of PBC occurred either between 700 ka and 160 ka as interpreted from Trench A1 (displacement of Q2e deposits and Q2e soil, but no displacement of Q2b deposits with an estimated age of 160 ka to 250 ka; Y-26, fig. 3, p. 9) or between 270 ka and 800 ka as interpreted from Trench A2 (displacement of Q2c deposits with an estimated age of 270 ka to 800 ka, but no displacement of Q2c soil or Q2b deposits).

Y-577 (p. A119) identified lineaments of possible tectonic origin on colluvial and alluvial surfaces along PBC in Midway Valley. Y-1042 (p. 8) noted north–trending fault scarps along the western sides of Alice Point, Fran Ridge, and Busted Butte. Photolineaments that are preserved on surfaces of colluvial and alluvial units and that are of possible tectonic origin are located along PBC (Y-577). Y-1239 (p. 45) suggested that PBC is "moderately well expressed as alignments of north–trending lineaments" and that these lineaments "are associated primarily with the bedrock/alluvium contact along the margins of bedrock highs or within colluvial aprons that have local bedrock exposures."

On the basis of faulted and unfaulted colluvial units exposed in a trench, Y-1098 (p. 153) inferred a late Pleistocene age for the most–recent displacement along a western splay of PBC.

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

Paintbrush Canyon fault (PBC) — Continued

Using amounts of vertical displacement in dated Tertiary volcanic units, Y-217 (fig. 4-13, p. 72) estimated an apparent vertical slip rate of 0.035 mm/yr for PBC between about 13 Ma and 9 Ma and a rate of 0.006 mm/yr between about 9 Ma and 700 ka.

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

Recurrence interval: On the basis of buried soils in faulted sand ramps at Busted Butte, Y-575 (p. A119) interpreted five events since about 700 ka. Using this conclusion of five events and adding one more event for the present interval, the average recurrence interval for events on PBC at Busted Butte since the beginning of middle Pleistocene ranges between 117,000 and 140,000 yr.

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

Range-front characteristics: No information.

Analysis: Compilation of published and unpublished information (Y-26, p. 1; Y-217, p. 1). Lineament analyses using low–sun–angle aerial photographs (Y-1042, p. 2, scale 1:12,000) or conventional aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-1239, p. 3, scales 1:6,000, 1:12,000, and 1:60,000). Trenches (Y-26, p. 3, table 1, p. 5, figs. A12-A16, p. 35-39, Trenches 16, 16B, 17, A1, and A2; Y-1098, p. 153). Surficial mapping and field investigations (Y-26, p. 3; Y-1042, p. 2; Y-1239, p. 3). Analysis of stream patterns (Y-575, p. A119). Study of 20–m–deep exposures in arroyos along Busted Butte and Fran Ridge (Y-575, p. A119). Where obscured by alluvium, PBC has been located using geophysical anomalies detected on aeromagnetic and electromagnetic surveys (Y-55; Y-217, p. 45, 52).

Relationship to other faults: PBC is one of the major north–striking faults in the Yucca Mountain area (Y-1042, p. 8). Both Y-575 (p. A119) and Y-1042 (p. 8) suggested that PBC curves southeastward and merges with the Stagecoach Road fault (SCR). Alternately, Y-1042 (p. 10) suggested that PBC may continue southward and connect to a north–striking reverse fault cutting Busted Butte. Y-31 (p. 332) suggested that the combined fault zone of PBC and SCR forms an arcuate breakaway zone related a detachment fault underlying the Yucca Mountain area. Y-217 (p. 52) noted that the Fran Ridge fault is one of several splays of PBC in southern Midway Valley. They further suggested that the Fran Ridge fault and PBC may rejoin to the south in the Dune Wash area, as shown by Y-224.

Palmetto Mountains–Jackson Wash fault (PMJW)

Plate or figure: Plate 1.

References: Y-10: Reheis and Noller, 1989; Y-238: Reheis and Noller, 1991 (pls. 1 and 2). Not shown by Albers and Stewart, 1972 (Y-407) nor by Dohrenwend and others, 1992 (Y-853).

Location: 112 km/309° (distance and direction of closest point from YM) at lat 37°30′N. and long 117°24′W. (location of closest point). PMJW is located in the valley of Jackson Wash northwest of Mount Jackson along the eastern sides of the Palmetto Mountains and the Montezuma Range.

USGS 7-1/2′ quadrangle: Lida, Montezuma Peak SE, Montezuma Peak SW.

Fault orientation: The northern end of PMJW strikes northeast (Y-238). The southern end of PMJW strikes north to north–northeast (Y-238).

Fault length: The length of PMJW is about 12 km as estimated from Y-238 (pls. 1 and 2).

Style of faulting: PMJW is composed of short, subparallel, and overlapping fault traces on which displacement has been both down to the east and down to the west (Y-238). PMJW is up to 1 km wide (Y-238).

Scarp characteristics: Scarps are both east– or southeast–facing and west– or northwest–facing (Y-238).

Displacement: No information.

Age of displacement: PMJW is portrayed by Y-238 as weakly expressed to prominent lineaments and scarps chiefly on surfaces of Quaternary deposits and as faults that are in Quaternary deposits and that were identified by previous mapping. Y-10 (p. 58) reported multiple displacements in alluvial–fan deposits with an estimated age of middle to late Pleistocene.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No range front is directly associated with PMJW. PMJW is approximately parallel to the fronts of the Palmetto Mountains and the Montezuma Range, but is 1 km or more east of these fronts.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24:000 to 1:80,000). Field observations for the part of PMJW northeast of the Palmetto Mountains (Y-238, p. 3).

Relationship to other faults: PMJW is approximately parallel to other northeast–striking major range–bounding faults west of Cactus Flat, such as the Montezuma Range fault (MR) along the western side of the Montezuma Range west of PMJW, the Clayton Ridge–Paymaster Ridge fault (CRPR) along the western sides of the Clayton and Paymaster ridges west of PMJW, the East Magruder Mountain fault (EMM) along the eastern side of Magruder Mountain southwest of PMJW, and the Lida Valley faults (LV) along the southeastern side of the Palmetto Mountains west of PMJW. PMJW is also approximately parallel to northeast–striking faults within basins, such as the Stonewall Flat faults (SWF) within Stonewall Flat east of PMJW, the Clayton Valley fault (CV) within Clayton Valley west of PMJW, and the Clayton–Montezuma Valley fault (CLMV) in the valley between Clayton Ridge and Montezuma Range northwest of PMJW (Y-238).

Y-238 (p. 4) speculated that these northeast–striking faults could be conjugate shears to the northwest–striking Furnace Creek fault (FC). However, on the basis of the limited field work completed by them and others, Y-238 (p. 3) noted that the evidence for the left–lateral displacement that would be expected if the northeast–striking faults are conjugate shears has not been documented. Alternatively, Y-238 (p. 3) suggested that these faults could be an expression of dip–slip displacement perpendicular to a northwest direction of least principal stress. On the basis of the fairly consistent down–to–the–northwest displacement along the northeast–striking, range–bounding and intrabasin faults east of the FC and west of Pahute Mesa, Y-10 (p. 60) inferred that these fault could be rooted in a detachment fault at depth.

Palmetto Mountains–Jackson Wash fault (PMJW) — Continued

Unlike regional, intrabasin faults that are short and on surfaces of only one age, Y-10 (p. 58) suggested that the faults east of Montezuma Range (part of PMJW) define the Palmetto graben. "These faults appear to offset one fan and two graben–fill deposits which are middle to late Pleistocene in age; offsets are successively smaller with decreasing age of the deposit" (Y-10, p. 58).

Extension of PMJW to the southwest as the Lida Valley faults (LV) or as the East Magruder Mountain fault (EMM) or both is possible, but the relationships among these faults are not known.

Palmetto Wash faults (PW)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pls. 1 and 2); Y-853: Dohrenwend and others, 1992; Y-1031: Reheis, 1992 (shows only the western traces of PW, those in and adjacent to Fish Lake Valley). Not shown by Brogan and others, 1991 (Y-216).

Location: 131 km/302° (distance and direction of closest point from YM) at lat 37°28'N. and long 117°41'W. (location of closest point). PW is located along the southwestern front of the southern Silver Peak Range and in the valley containing Palmetto Wash. Northwest–striking fault traces within Fish Lake Valley to the southwest (shown as PW? on pl. 1 of this compilation) may be part of PW.

USGS 7-1/2' quadrangle: Lida Wash SW, Oasis Divide, Sylvania Canyon, Sylvania Mountains.

Fault orientation: Faults included in PW generally strike north–northwest or northwest (Y-238; Y-853). Fault traces that are in Fish Lake Valley and that may be part of PW (labeled PW? on pl. 1) strike north.

Fault length: The total length of faults included in PW, but not those in Fish Lake Valley (PW? on pl. 1), is about 8 km as estimated from Y-238 or about 10 km as estimated from Y-853. The section labeled PW? would extend PW 6 km to the south (Y-238), for a total length of 14 to 16 km.

The width of PW is about 13 km (Y-238) or 7 km (Y-853, who does not show all the traces that are shown by Y-238).

Style of faulting: Displacement on fault traces in and adjacent to Fish Lake Valley is shown by Y-1031 as both down to the east and down to the west. Displacement on fault traces north of Palmetto Wash is portrayed by Y-238 as primarily down to the east, but displacement on a couple of traces is shown as down to the west.

Scarp characteristics: Scarps are both east–facing and west–facing (Y-238; Y-853; Y-1031)

Displacement: No information.

Age of displacement: Faults in PW are portrayed by Y-238 as weakly to moderately expressed scarps and lineaments on surfaces of Quaternary deposits and as faults that are in Quaternary deposits and that were identified from previous mapping. Faults in PW that are immediately north of Palmetto Wash are shown by Y-853 as scarps on depositional or erosional surfaces of early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). The eastern faults of PW are expressed as fault–related lineaments on depositional or erosional surfaces of Quaternary age (defined as <1.5 Ma; Y-853. The map by Y-1031 shows that faults that are possibly part of PW (the fault traces in Fish Lake Valley) displace alluvial–fan deposits of early Holocene to late middle Pleistocene age (her Qfl, Qfi, and Qfy deposits), but are concealed by late and middle Holocene alluvium (her Qfc deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The morphology of the western front of the Silver Peak Range along PW is noted by Y-853 to be similar to that along a major range–front fault (e.g., characterized by "a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front"), except that PW is "significantly less extensive and fault scarps are substantially lower, shorter, and less continuous." Y-238 showed two faults of PW as topographic lineaments bounding the eastern and western sides of a linear ridge at the western edge of the Silver Peak Range.

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

Palmetto Wash faults (PW) — Continued

Relationship to other faults: The section shown as PW? nearly intersects the Fish Lake Valley fault (FLV) in Fish Lake Valley (Y-238; Y-1031). Y-238 (p. 4) speculated that displacement along north–striking faults in Fish Lake Valley may be related to right–lateral displacement along the Furnace Creek fault (FC).

Two fault traces immediately west of the Palmetto Mountains at the eastern side of PW strike nearly due north and align with a north–striking fault trace that is located about 7 km to the north between the Palmetto Mountains and the northeast–striking Clayton Valley fault (CV). The structural relationships among these faults are not known.

Panamint Valley fault (PAN)

Plate or figure: Plate 2.

References: Y-29: Hamilton, 1988; Y-222: Streitz and Stinson, 1974; Y-239: Reheis, 1991 (pl. 2); Y-356: McAllister, 1956; Y-399: Hopper, 1947; Y-427: Hart and others, 1989: Y-458: Hall, 1971; Y-489: Murphy, 1932; Y-494: Smith, 1976; Y-591: Albee and others, 1981; Y-614: Wernicke and others, 1988; Y-632: Wernicke and others, 1988; Y-697: Zhang and others, 1990 (discuss only the southern portion of PAN between Ballarat and Wingate Pass); Y-698: Smith, 1975; Y-864: Burchfiel and others, 1987; Y-866: Maxon, 1950; Y-868: Smith, 1979; Y-900: Ellis and others, 1989; Y-901: Hodges and others, 1989; Y-909: Schweig, 1989; Y-910: Sternlof, 1988; Y-912: Walker and Coleman, 1987; Y-915: Wernicke and others, 1989; Y-916: Wernicke and others, 1986; Y-1020: Jennings, 1992 (his fault #247, p. 16); Y-1153: Noble, 1926 (name from this reference, p. 425).

Location: 95 km/227° (distance and direction of closest point from YM) at lat 36°16'N. and long 117°13'W. (location of closest point). PAN is located along the western side of the Panamint Range and the eastern edge of Panamint Valley.

USGS 7-1/2′ quadrangle: Ballarat, Copper Queen Canyon, Emigrant Pass, Jail Canyon, Manly Fall, Manly Peak, Nova Canyon, Panamint Butte, Sourdough Spring, The Dunes, Wingate Pass.

Fault orientation: PAN strikes north and northwest. Along the section between Ballarat and Goler Wash, PAN strikes between N. 10° W. and N. 30° W. (Y-697, p. 4859).

Fault length: The total length of PAN is about 80 km as estimated from fig. 2 of Y-697 (p. 4859). Y-868 (p. 411) noted that PAN extends 100 km northwest of the Garlock fault along the western front of the Panamint Range. The minimum length of scarps interpreted to have formed during the most–recent prehistoric earthquake south of Ballarat is 25 km; the maximum rupture length along this portion of PAN is about 30 km (Y-697, p. 4859).

Style of faulting: Displacement type varies among different sections of PAN. Along the central section (between Ballarat and Wildrose Canyon) dip–slip (normal), down–to–the–west displacement has been dominant (Y-239). Fault traces dip between 60° W. and 90° W. (Y-489, p. 354).

Along the southern section (south of Ballarat), fault traces at the range front also have dip–slip (normal), down–to–the–west displacement (Y-697, p. 4858). However, right–lateral displacement has been dominant along fault traces several hundred meters west of the range front on this portion of PAN. Y-697 (p. 4869) noted that oblique–slip on the southern portion of PAN is "partitioned between strike–slip and dip–slip faults, and * * * dip–slip faults are commonly restricted to the range front while strike–slip faults are off the range front." Y-868 (p. 412) also recognized that along a 20-km-long section of PAN between Ballarat and Goler Wash right-lateral displacement is confined to the westernmost fault trace with dip-slip displacement observed on other traces that have west-facing scarps. This is a style of late Cenozoic and modern deformation that they concluded characterizes the Death Valley region.

Scarp characteristics: Between Ballarat and Goler Wash along the southern section of PAN, one set of scarps is present along the range front and another set crosses alluvial fans west of the range front (the range–front fault and the fan–slope fault of Y-697, p. 4859). At Goler Wash Canyon, the height of a southwest–facing scarp that is located 1.5 km west of the range front along the fan–slope trace varies between 0.1 to 0.4 m (Y-697, p. 4860). At Manly Peak Canyon along the southern section, Y-697 (p. 4861) noted that an east–facing scarp is preserved, but concluded that displacement has been dominantly right lateral. Y-868 (p. 413) observed that scarps between Ballarat and Goler Wash are between 0.6 and 1.8 m high and have maximum scarp-slope angles primarily between 27° and 31°. However, some scarps have short, vertical sections. He (Y-868, p. 414) suggested that these scarps probably represent single-event displacement that was subsidiary to displacement on the main trace of PAN. He further concluded that scarps 2 to 6 m high probably formed during multiple ruptures (Y-868, p. 414). Y-866 (p. 104) noted that scarps at Wildrose Canyon at up to 61 m (200 ft) high.

Displacement: Average right–lateral displacement during the most–recent event on the southern section (south of Ballarat) is 3.2 ± 0.5 m as indicated by scarps at six localities along the fan–slope trace (Y-697, p. 4862-4863). At Goler Wash, displacement is about 4 m (Y-697, p. 4862-4863). Ridges are displaced in a right–lateral sense 24 ± 4 m, 27 ± 4 m, and 37 ± 4 m during this and older events as indicated at two localities (near Manly Peak Canyon and just north of Goler Wash Canyon). Scarps from older events show right–lateral displacements of 6 to 7 m for possibly two events (between Goler Wash and Manly Peak Canyons) and 11 ± 2 m for three to four events (near Manly Peak Canyon; Y-697, p. 4861-4862). Total right–lateral displacement is reported to be 8 to 10 km (Y-427, p. 6, *citing* Y-864).

Y-868 (p. 412-413) noted that most measurements of right-lateral displacement along a 20-km-long section of PAN between Ballarat and Goler Wash are in the range of 2.0 ± 0.6 m, which he suggested characterizes the last surface-rupturing event along this section of the fault. A minimum right-lateral displacement of 0.9 to 1.4 m is reported by Y-868 (p. 413) for PAN at Goler Wash. The maximum right-lateral displacement that was observed by Y-868 (p. 413) is 20 m for mudflow levees at the mouth of Manly Peak Canyon.

Dip–slip displacement from the most–recent event on the southern section of PAN is 0.4 to 1.2 m along the range–front fault as shown at one locality (Goler Wash Canyon; Y-697, p. 4859).

Along the northwest–striking section that may be part of either PAN (Y-399; Y-698) or the Hunter Mountain fault (shown as HM? on pl. 2 of this compilation), Y-399 (p. 399) reported observing evidence for right–lateral displacement on nineteen stream channels south of Highway 19. This evidence includes the development of shutter ridges. Y-399 (p. 399) estimated right–lateral displacements of 24 to 61 m (80 to 200 ft) and apparent vertical displacements (southwest side up) of about 12 m (40 ft). In this same area but north of the highway, Y-698 (p. 113) noted 183 m (600 ft) of right–lateral displacement estimated on the basis of the juxtaposition of a late Quaternary alluvial–fan deposit composed of clasts of Precambrian and Paleozoic rocks against a 61–m (200–ft) hill of Tertiary volcanic rocks.

About 3 km (2 miles) southeast of Highway 19, right–lateral displacement of older alluvial–fan deposits totals 305 to 610 m (1,000 to 2,000 ft; Y-698, p. 114).

About 11 km (7 miles) south–southeast of Highway 19, near the mouth of Wildrose Canyon, a "sheet of monolithologic (landslide) breccia" is displaced right laterally 3,050 to 4,575 m (10,000 to 15,000 ft) from a source at Wildrose Canyon (Y-698, p. 114).

The total pre–Quaternary dip–slip across the zone of faults bounding the eastern side of Panamint Valley, which includes the modern trace of PAN, is 9,150 m (30,000 ft) that has occurred in a step–wise, down–to–the–west pattern (Y-399, p. 426; Y-698, p. 112). Total vertical displacement on PAN is reported to be about 1.8 km by Y-427 (p. 6). Displacement of Mesozoic and lower Paleozoic rocks suggests maximum extension of 300 m (300%) in an east–west direction (Y-614; Y-632).

Age of displacement: Most of PAN is shown as having Holocene (≤10 ka) displacement; some parts are portrayed as having late Quaternary (<700 ka) displacement or Quaternary (<1.6 Ma) displacement. The most–recent event on the southern section (south of Ballarat) is noted by Y-697 (p. 4859) and by Y-868 (p. 413-414) to be "young" and is estimated to have occurred during the last few hundred years based on the fresh appearance of the scarps (sharp, uneroded, sparsely vegetated, and little or no desert varnish). Y-1153 (p. 428) inferred that fault scarps along PAN, some of which are 6.1 m (20 ft) high, "must be very recent features indeed, for even in that dry region they could not stand up long in the unconsolidated materials that make the fans."

Y-697 (p. 4866) inferred that shorelines from the last high stand of Lake Panamint (estimated to have occurred about 17 ka ± 4 ka) are displaced by more than the most–recent event on the southern section of PAN, possibly by 6 to 14 events, assuming single–event displacements of about 3 m. The most active fault traces along the central section are south of Hall Canyon, where the modern playa is located along the range front (Y-239, p. 4).

The Panamint Range and the Darwin Plateau may have been covered by a continuous sequence of basalts (age of their upper part is about 4 Ma) before extension began (Y-697, p. 4858, *citing* Y-910).

Panamint Valley fault (PAN) — Continued

Slip rate: Y-697 calculated lateral slip rates for the southern section of PAN (south of Ballarat) on the basis of data obtained at two localities. Based on 37 ± 4 m of right–lateral displacement of ridges with a maximum age of 17 ± 4 ka (may be younger than 12 ka or 13 ka) near the southern extent of scarps at Goler Wash Canyon, Y-697 (p. 4865–4866) estimated a minimum Holocene and latest Pleistocene right–lateral slip rate of 2.36 ± 0.79 mm/yr (range of 1.57 to 3.15 mm/yr). Based on 24 ± 4 m and 27 ± 4 m of right–lateral displacement of ridges with a maximum age of 17 ± 4 ka (may be younger than 12 ka or13 ka) near Manly Peak Canyon 5.3 km north of Goler Wash Canyon, Y-697 (p. 4865) calculated a minimum Holocene and latest Pleistocene right–lateral slip rate of 1.74 ± 0.65 mm/yr (range of 1.09 to 2.38 mm/yr). Y-697 (p. 4871) noted that these rates are similar to the rate (2 to 2.7 mm/yr) since about 4 Ma as determined from a basalt along the northwest–striking Hunter Mountain fault (HM) in northern Panamint Valley.

Y-900 (p. 465) suggested that the lateral slip rate on the southern portion of PAN since 15 ka has been about 2.5 mm/yr in a direction of N 20° W.

Recurrence interval: Assuming single–event right–lateral displacements of about 3 m (3.2 ± 0.5 m) and a right–lateral slip rate of 2.36 ± 0.79 mm/yr, the average recurrence interval for the southern section of PAN was estimated by Y-697 (p. 4868) to be 860 yr to 2,360 yr during the Holocene and latest Pleistocene.

Y-868 (p. 415) suggested that the mean recurrence interval between surface-rupturing events on the 20-km-long section of PAN between Ballarat and Goler Wash is "on the order of 700 to 2,500 years." This estimate assumes that all events produced right-lateral displacement of 1.4 to 2.6 m, so that the total displacement of 20 m represents eight to fourteen events since the deposits with these displacements were buried by strandlines of pluvial Lake Panamint between 10 ka and 20 ka. Y-868 (p. 415) further concluded that desert varnish developed on multiple-event fault scarps between Ballarat and Goler Wash suggests that dip-slip displacement recurred "only every 1,000 years or more."

Range-front characteristics: No evaluation of tectonic geomorphology of the Panamint Range front has been done. The range front near Ballarat is described by Y-489 (p. 353) as "unusually steep and rugged" with triangular facets. Large landslides are preserved along the front and east of the range–front trace (Y-239; Y-591). Because these landslides are associated with Quaternary faults, Y-239 (p. 3) speculated that they may be related to rapid uplift of the Panamint Range. A central valley topographic high is marked by the Wildrose graben at Wildrose Canyon (Y-697, p. 4858).

Analysis: Interpretation of conventional and low–sun–angle aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000; Y-697, p. 4859). Field examination (Y-399, p. 395; Y-697, p. 4860). Detailed mapping of displaced topographic features at several localities along the southern section of PAN using plane table and alidade (Y-697, p. 4860).

Relationship to other faults: PAN may extend northward along the Hunter Mountain fault (HM), which strikes N. 60° W., in northern Panamint Valley and Saline Valley (pl. 2 of this compilation). Alternately, PAN may intersect HM at Wildrose Canyon, and splays of PAN may continue northward along the north–northeast–striking Towne Pass fault (TP) and Emigrant fault (EM) along the western side of Tucki Mountain (Y-239, p. 2-3, *citing* Y-29). Y-239 (p. 3) suggested that PAN "consists mainly of normal faults that are probably a continuation and (or) a reactivation of the Tucki Mountain detachment fault [of Y-29]."

Y-900 (p. 465) noted that HM is linked with PAN through a bend of 70° and proposed that the lack of a deep basin in this area may be because uplift at the northwestern end of PAN is approximately equal to subsidence at the southeastern end of HM.

Faults that are parallel to PAN are present within the Panamint Range. These faults displace Pliocene and Quaternary megabreccias as mapped by Y-591, but Y-239 (p. 2) concluded that these faults have apparently been inactive during the late Quaternary. Y-698 (p. 112) noted that the modern trace of PAN is the westernmost of a "family of faults" that bound the eastern side of Panamint Valley.

Panamint Valley fault (PAN) — Continued

Y-239 (p. 3) noted that north– and northeast–striking fault traces at two localities extend across Panamint Valley between PAN and the north–northwest–striking Ash Hill fault (AH) along the western side of the valley. The exact structural relationship between PAN and AH is not known.

Penoyer fault (PEN)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970 (name from their pl. 3); Y-813: Reheis, 1992 (pl. 1); Y-1032: Schell, 1981 (pl. 9). The map by Y-813 shows only the southwestern end of PEN. Y-404 and Y-1032 both show the northern portion of PEN along the Worthington (or Freiburg) Mountains. This portion is not shown by either Y-25 or Y-813. Y-1032 included in PEN an east–striking fault trace in southern Sand Spring Valley. This trace is not shown by Y-25, Y-404, or Y-813.

Location: 97 km/30° (distance and direction of closest point from YM) at lat 37°36'N. and long 115°53'W. (location of closest point). PEN is located along the eastern and southeastern sides of Sand Spring Valley at its junction with the Worthington Mountains on the north and near its junction with the Timpahute Range on the south.

USGS 7-1/2' quadrangle: Honest John Well, McGutchen Spring, Quinn Canyon Springs, Tempiute Mountain North, Tempiute Mountain South, White Blotch Springs, White Blotch Springs NE, White Blotch Springs NW, White Blotch Springs SE, Worthington Peak SW.

Fault orientation: The southern half of PEN has a curving, north–northeast to northeast strike. The northern half of PEN, along the Worthington Mountains, has a north to north–northwest strike (Y-1032).

Fault length: The length of PEN is noted by Y-1032 (table A2, p. A18) as 56 km. This length includes the east–striking section in Sand Spring Valley that is shown only by Y-1032. PEN is about 35 km long as estimated from Y-404 (pl. 3). This length includes the north–striking section along the western side of the Worthington Mountains, but not the east–striking section in Sand Spring Valley. PEN is about 25 km long as estimated from Y-25.

Style of faulting: Displacement on PEN is shown by Y-25, Y-404, Y-813, and Y-1032 as down to the west or northwest.

Scarp characteristics: Y-1032 (table A2, p. A18) noted a maximum scarp height of 9 m and a maximum scarp–slope angle of 22°.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along PEN is noted by Y-1032 (table A2, p. A18) as late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit displaced is his intermediate–age alluvial–fan deposits (A5i, table A2, p. A18) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is also his intermediate–age alluvial–fan deposits (A5i, table A2, p. A18). The oldest unit displaced is his middle Tertiary volcanic rocks (Tv_2, table A2, p. A18) with an estimated age of 17 Ma to 34 Ma (table A1, p. A1).

The southern half of PEN is portrayed by Y-25 as a faulted contact either between Miocene ash–flow tuff (their Tt3 unit) and Holocene to Miocene alluvium and colluvium (their QTa deposits) or between Holocene to Miocene older gravels (their QTg deposits) and their QTa deposits. This section of PEN is shown by Y-404 as a faulted contact primarily between Pleistocene(?) and Pliocene(?) gravels (their QTg deposits) and older Pleistocene(?) alluvium (their Qol deposits). The southwestern end of the northeast–striking portion of PEN is indicated by Y-813 as faults that are in Quaternary and Tertiary deposits and that were identified from previous mapping and as weakly to moderately expressed lineaments and scarps on surfaces of Quaternary deposits.

The northern half of PEN, the part along the Worthington Mountains, is shown by Y-404 (pl. 1) as a Laramide structure that is inferred or concealed by Quaternary and Tertiary gravel, alluvium, and undeformed lake beds (their QT deposits).

Slip rate: No information

Recurrence interval: No information.

Penoyer fault (PEN) — Continued

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: Faults in and along the Groom Range south of PEN (e.g., the Stumble fault (STM), the Groom Range Central fault (GRC), and the Groom Range East fault (GRE)) terminate near the southwestern end of PEN (Y-25). The structural relationships among these faults are not known.

The southwestern end of PEN nearly intersects with the southwestern end of the Tem Piute fault (TEM) south of PEN. Y-25 portrayed the western end of the Tem Piute fault (TEM) as having a more westerly strike than that portrayed by Y-1032, so that PEN and TEM appear as if they may coincide east of Sand Spring Valley as shown by Y-25. This end of PEN also strikes toward the Chalk Mountain fault (CLK) west of PEN. The exact structural relationships among these faults are not known.

The northern end of PEN as mapped by Y-1032 (pl. 9) curves eastward around the northern side of the Worthington Mountains and nearly intersects with the north–striking Freiburg fault (FR) along the eastern side of the mountains. The northeast–striking northern portion of PEN is approximately parallel to the Quinn Canyon fault (QC) northwest of Sand Spring Valley and to the Golden Gate faults (GG) along the eastern side of the Golden Gate Range east of PEN. The structural relationships among these faults are not known.

Plutonium Valley–North Halfpint Range fault (PVNH)

Plate or figure: Plate 1.

References: Y-181: Carr, 1974 (shows several north–northwest–striking faults buried beneath Plutonium Valley in addition to faults along the eastern side of Paiute Ridge, along the western side of Slanted Butte, and along the eastern side of Banded Mountain); Y-232: Cornwall, 1972; Y-813: Reheis, 1992 (pls. 2 and 3, shows only the southern part of PVNH along and south of Paiute Ridge). Not shown by Swadley and Hoover, 1990 (Y-526).

Location: 46 km/74° (distance and direction of closest point from YM) at lat 36°58′N. and long 115°57′W. (location of closest point). PVNH is located along the western side of the northern Halfpint Range at its junction with Plutonium Valley and Yucca Flat. Traces of PVNH bound the eastern and western sides of Paiute Ridge, the western side of Slanted Butte, and the eastern side of Banded Mountain.

USGS 7-1/2′ quadrangle: Jangle Ridge, Oak Spring, Paiute Ridge, Plutonium Valley, Yucca Flat.

Fault orientation: PVNH generally strikes north–northwest (Y-232; Y-813). Fault traces curve slightly so that short sections of PVNH strike north–northeast (Y-813).

Fault length: The length of PVNH is about 15 km as estimated from Y-813 (pls. 2 and 3) and 26 km as estimated from Y-232. The longer estimate includes the northern portion of PVNH north of Paiute Ridge.

Style of faulting: Displacement on the northern traces of PVNH is portrayed by Y-232 as down to the east. Displacement on portions of fault traces along and south of Paiute Ridge is shown by Y-813 as both down to the east and down to the west.

Scarp characteristics: Sections of fault traces along and south of Paiute Ridge are portrayed Y-813 as scarps, all of which are west–facing.

Displacement: No information.

Age of displacement: Short sections along the portion of PVNH adjacent to and south of Paiute Ridge are shown by Y-813 (pls. 2 and 3) as weakly expressed lineaments and scarps on surfaces of Quaternary (chiefly) and Tertiary deposits. Other sections of this portion of PVNH, especially east of Camera Station Butte and along Paiute Ridge, are portrayed by Y-813 (pl. 2) as faults that are in Tertiary deposits and that were identified from previous mapping. The map by Y-232 (pl. 1) shows this portion of PVNH as a fault within Miocene and Pliocene Timber Mountain and/or Paintbrush tuffs (his Tp unit) and as concealed by Quaternary alluvium (his Qal deposits).

Sections of the portion of PVNH along Paiute Ridge and Banded Mountain are shown by Y-232 (pl. 1) as a faulted contact between pre–Tertiary rocks and Quaternary alluvium (his Qal deposits). Other sections of this portion of PVNH are shown by Y-232 (pl. 1) as a fault within Miocene and Pliocene Timber Mountain and/or Paintbrush tuffs (his Tp unit).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Portions of PVNH adjacent to and south of Paiute Ridge are portrayed by Y-813 as lineaments along a linear range front.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000).

Relationship to other faults: PVNH strikes at an oblique angle to the north–striking, right–lateral strike–slip Yucca fault (YC) in central Yucca Flat west of PVNH. PVNH is approximately parallel to the Cockeyed Ridge–Papoose Lake fault (CRPL) along the eastern side of the northern Halfpint Range. The strike of PVNH is slightly more westerly than the strikes of faults along and within ranges to the east (e.g., the Belted Range fault (BH), the Chert Ridge fault (CHR), and the Spotted Range faults (SPR)). A northeastern projection of the Cane Spring fault (CS) would intersect the southern end of PVNH. The structural relationships among these faults are not known.

Quinn Canyon fault (QC)

Plate or figure: Plate 1.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970; Y-1032: Schell, 1981 (pls. 6 and 9; name from his table A2, fault #102).

Location: 127 km/22° (distance and direction of closest point from YM) at lat 37°55′N. and long 115°53′W. (location of closest point). QC is located within the Quinn Canyon Range. Part of QC bounds the western side of a valley along Quinn Canyon.

USGS 7-1/2′ quadrangle: Quinn Canyon Springs, Quinn Canyon Springs NW.

Fault orientation: QC is curving, but strikes generally northeast (Y-25; Y-404).

Fault length: The length of QC is noted to be 19 km by Y-1032 (table A2, p. A19). The length of QC is 16 km as estimated from Y-404 and 18 km as estimated from Y-25. Y-25 mapped fault traces further to the southwest than does Y-404. Both Y-25 and Y-404 showed a continuous fault trace to the northern edges of their map areas at just north of lat 38°N. QC intersects the western edge of the map area of Y-25 along the Lincoln County line west of long 115°45′W.

Style of faulting: Displacement on QC is shown by Y-25 as down to the east. According to Y-1032 (table A2, p. A19), displacement along QC occurs entirely within a mountain block.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along QC is noted by Y-1032 (table A2, p. A19) to be Pleistocene (defined as >15 ka and <1.8 Ma by Y-1032, p. 29-30). The youngest unit displaced is his old–age alluvial–fan deposits (A5o; Y-1032, table A2, p. A19) with an estimated age of 700 ka to 1.8 Ma (table 3, p. 23). Y-1032 (table A2, p. A19) gives no information on the age of the oldest unit not displaced along QC. The oldest unit that he noted to be displaced is Paleozoic rocks (Y-1032, table A2, p. A19).

Y-25 portrayed part of QC (about 7 km) as a faulted contact between Oligocene welded tuff (their Tt4 unit) and Quaternary alluvium (their Qa deposits). Y-404 showed part of QC as a faulted contact between Tertiary volcanic rocks (their Tvy unit) and older Pleistocene(?) alluvium (their Qol deposits).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-25; Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17). Compilation of geologic mapping (Y-25).

Relationship to other faults: QC is approximately parallel to faults along the eastern side of the Reveille Range (the West Railroad fault; WR) west of QC and to faults along the western sides of the Worthington Mountains and Timpahute Range (the Penoyer fault; PEN) and along the eastern side of the Golden Gate Range (the Golden Gate fault; GG), both faults east of QC.

Y-25 recognized the Quinn Canyon Range as a volcanic center that has been the source of several ash–flow tuffs. The relationship between volcanism and displacement on QC is not known.

Racetrack Valley faults (RTV)

Plate or figure: Plate 2.

References: Y-239: Reheis, 1991 (pl. 1); Y-356: McAllister, 1956; Y-1148: Zellmer, 1980 (pl. 3.1, maps only those fault scarps at the very southern end of Racetrack Valley).

Location: 97 km/264° (distance and direction of closest point from YM for the fault along the eastern side of Racetrack Valley) at lat 36°45′N. and long 117°30′W. (location of closest point) for the fault along the eastern side of Racetrack Valley; 102 km/265° (distance and direction of closest point from YM for the fault along the western side of Racetrack Valley) at lat 36°45′N. and long 117°33′W. (location of closest point) for the fault along the western side of Racetrack Valley. RTV includes two faults: one along the eastern side of Racetrack Valley and the other along the western side of Racetrack Valley. Parts of both faults bound the fronts of unnamed mountain ranges.

USGS 7-1/2′ quadrangle: Jackass Canyon, Ubehebe Peak, Teakettle Junction.

Fault orientation: The faults of RTV generally strike north–northeast. Some individual traces strike between north–northeast and north–northwest (Y-239).

Fault length: The eastern fault has a total length of about 22 km between Lost Burro Gap at the northern end of Hidden Valley and Grapevine Canyon west of Hunter Mountain (pl. 2). This fault, as shown by Y-239, is composed of two sections that are separated by a right step about 0.5 km long at a northwest–striking fault that extends into Racetrack Valley from the unnamed mountain range to the east. The southern section of the eastern fault, south of this step, is 14 km long; the northern section is 7 km long as estimated from Y-239. Y-239 portrayed the eastern fault as extending about 11 km south of the main topographic expression of Racetrack Valley (pl. 2).

The fault along the western side of Racetrack Valley is shown by Y-239 as discontinuous with *en echelon* traces that extend for about 22 km between near Teakettle Junction and Saline Valley (estimated from Y-239). Similar to the eastern fault, the western fault is shown by Y-239 as extending about 8 km south of the topographic expression of Racetrack Valley (pl. 2). The southern 4 km of this fault bounds the southeastern end of Saline Valley.

Style of faulting: Displacement along the southern section of the eastern fault is shown by Y-239 as down to the west. Displacement along most of the western fault is down to the east (Y-239). Displacement on the southern 6.5 km of the western fault, which bounds the southeastern end of Saline Valley, is shown by Y-239 as down to west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: Parts of both the eastern and western faults are thought to be Quaternary by Y-239 (defined by her to be <1.8 Ma). Sections of the western fault and the northern section of the eastern fault are shown by Y-239 (pl. 1) as moderately expressed to prominent lineaments or scarps on surfaces of Quaternary deposits. The southern 6 km of the eastern fault south of Racetrack Valley is portrayed by Y-239 as a fault that is in Quaternary deposits and that was identified from previous mapping.

Slip rate: No information.

Recurrence rate: No information.

Range-front characteristics: Portions of both the eastern and western faults are portrayed by Y-239 as topographic lineaments bounding a linear range front.

Analysis: Aerial photographs (Y-239, p. 2, scales 1:24,000 to 1:80,000; Y-1148, p. 1, 9-10, scales 1:37,400 and 1:60,000). Aerial reconnaissance (Y-1148, p. 1). Field reconnaissance (Y-1148, p. 2). Detailed (1:50,000) map of fault scarps (Y-1148, pl. 3.1, includes only the very southern end of RTV).

Racetrack Valley faults (RTV) — Continued

Relationship to other faults: The two faults of RTV are approximately parallel to the faults bounding the eastern sides of Hidden Valley, Ulida Flat, and Sand Flat (part of the Hidden Valley–Sand Flat faults (HVSF) of this compilation) east of RTV. The eastern fault in RTV aligns with the Tin Mountain fault (TM) north of Racetrack Valley. Both the eastern and western faults have strikes similar to that of TM. RTV and TM could be related; they are separated by an *en echelon* right step. RTV and TM together extend between the northwest–striking Hunter Mountain fault (HM) on the south and the northwest–striking Furnace Creek fault (FC) on the north. The southern ends of both the eastern and western faults of RTV nearly intersect HM in the vicinity of Grapevine Canyon.

Ranger Mountains faults (RM)

Plate or figure: Plate 2.

References: Y-671: Guth, 1990; Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991.

Location: 49 km/105° (distance and direction of closest point from YM) at lat 36°44'N. and long 115°55'W. (location of closest point). RM includes faults on both the northern and southern sides of and within the Ranger Mountains.

USGS 7-1/2' quadrangle: Frenchman Lake, Frenchman Lake SE, Mercury, Mercury NE.

Fault orientation: The two faults north of the Ranger Mountains strike northeast and east–northeast (Y-852). The four faults in the southern Ranger Mountains strike generally northeast (Y-852) or north–northeast to northeast (Y-813).

Fault length: The two faults north of the Ranger Mountains are 3 and 5 km long (estimated from Y-813 and Y-852). The four faults in the southern Ranger Mountains are 3 and 4 km long (estimated from Y-813 and Y-852).

Style of faulting: One fault north of the Ranger Mountains and one fault in the southern Ranger Mountains are indicated by Y-813 to be down to the northwest and down to the west.

Scarp characteristics: No information.

Displacement: No information.

Age of displacement: The two faults north of the Ranger Mountains and three of the faults in the southern Ranger Mountains are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock. Part of one of the faults north of the mountains is shown by Y-852 as a fault–related lineament on surfaces of Quaternary depositional or erosional surfaces. Part of one of the faults north of the mountains is portrayed by Y-813 as a weakly expressed lineament or scarp on surfaces of Tertiary deposits.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: The two faults north of the Ranger Mountains and three of the faults in the southern Ranger Mountains are shown by Y-852 as juxtaposing Quaternary alluvium against bedrock, but not as major range–front faults. The morphology of the adjacent fronts or ridges of the Ranger Mountains would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valley, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). Although this morphology is similar to that of major range–front faults, the "associated fault systems are significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous" (Y-852). Portions of one of the faults north of the mountains and one fault in the southern Ranger Mountains are shown by Y-813 as topographic lineaments along linear range fronts.

Analysis: Aerial photographs (Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000).

Relationship to other faults: The relationships of some of the faults grouped in RM to the northeast–striking Rock Valley fault (RV) north of RM, to the northeast– and east–striking Mercury Ridge faults (MER) south of RM, or to the north– and north–northeast–striking Spotted Range faults (SPR) east of RM are not known.

Rock Valley fault (RV)

Plate or figure: Plate 2.

References: Y-20: Yount and others, 1987; Y-62: Barnes and others, 1982; Y-68: Swadley, 1983; Y-70: Swadley and Huckins, 1989; Y-90: Szabo and others, [1981]; Y-177: Hinrichs, 1968; Y-181: Carr, 1974; Y-182: Carr, 1984; Y-218: Sargent and Stewart, 1971; Y-224: Frizzell and Shulters, 1990; Y-226: Swadley and Huckins, 1990; Y-232: Cornwall, 1972; Y-238: Reheis and Noller, 1991 (pl. 3); Y-314: Ekren, 1968; Y-526: Swadley and Hoover, 1990; Y-695: Donovan, 1991; Y-809: Donovan, 1990; Y-813: Reheis, 1992 (pl. 3); Y-852: Dohrenwend and others, 1991.

Location: 27 km/130° (distance and direction of closest point from YM) at lat 36°41′N. and long 116°12′W. (location of closest point), if the southwestern end of RV is at the Specter Range; 24 km/158° (distance and direction of closest point from YM) at lat 36°39′N. and long 116°20′W. (location of closest point), if southwestern end of RV extends into the Amargosa Desert (the portion shown as RV? on pl. 1 of this compilation). RV is located in Rock Valley between the Specter Range (or the Amargosa Desert) and Frenchman Flat.

USGS 7-1/2′ quadrangle: Camp Desert Rock, Frenchman Lake, Frenchman Lake SE, Mercury, Mercury NE, Skull Mountain, South of Lathrop Wells, Specter Range NW, Striped Hills.

Fault orientation: RV strikes northeast. It dips 70° SE. near the central portion of the fault (Y-70).

Fault length: RV is portrayed with various lengths. RV "proper" extends from the Specter Range to Frenchman Flat along a length of about 32 km (Y-224). However, the length of RV as portrayed by Y-20 is only 19 km, because they did not show fault traces along Frenchman Flat to be part of the RV. Alternatively, Y-68, Y-238, and Y-695 (p. 39-40) extend RV about 33 km southwest of the Specter Range into the Amargosa Desert to section 33, T. 16 S., R. 49 E., for a total length for RV of about 65 km between the Amargosa Desert and Frenchman Flat.

Style of faulting: Displacement on RV is noted by Y-238 (p. 5) to be left–lateral strike slip and by Y-20 to be left–lateral oblique slip.

Scarp characteristics: Scarps, vegetation lineaments, and offset drainages are preserved along RV (Y-20; Y-181; Y-218; Y-238; Y-813). Scarps are primarily along traces in the central part of the fault (Y-20; Y-70; Y-177), where scarp heights range between <1 m and 2.5 m (Y-70) with maximum slope angles of 8° (Y-90). Scarps at two trenches in the central part of RV are about 0.5 m high (Y-20). Scarps along the possible southwestern extension of RV into the Amargosa Desert face both northwest and southeast and have maximum slope angles of 5° to 14° (Y-695, p. 41, appen. A).

Displacement: Total lateral displacement on RV is estimated by Y-62 to be a few kilometers. No large amount of vertical displacement is suspected on RV since 10 Ma because no deep structural basins, except for Frenchman Flat, are associated with RV (Y-182, p. 61). Vertical displacement at trench sites located in the central part of RV is 2.5 to 3 m down to the north (Y-20) in their Unit E (QTa deposits of Hoover and others ([1981], Y-73) thought to be older than 740 ka. Vertical displacement in Unit C of Y-20 (31 ka to 38 ka) is 10 to 32 cm down to the north (Y-20). No information on amount of lateral displacement was determined from these trenches.

Age of displacement: At trench sites near the center of RV, Y-20 interpreted the youngest displacement along RV to have occurred after 31 ka to 38 ka (based on uranium–trend analyses on their Unit C, which is displaced vertically 10 to 32 cm), but a minimum age for this displacement could not be estimated by Y-20. An additional faulting event may have occurred between 180 ka (after their Unit D was deposited) and 31 ka to 38 ka (before their Unit C was deposited), but the observed stratigraphic discontinuities can also be explained by a large component of lateral displacement (Y-20).

Rock Valley fault (RV) — Continued

Fault scarps in the central part of RV are reported by Y-70 to be on surfaces of Quaternary deposits ranging in age between Pleistocene–Pliocene? (their QTa deposits; estimated by them to be >740 ka) and older Holocene (their Q1a deposits; estimated by them to be ≤10 ka). Y-70 noted that younger Holocene units (their Q1b deposits) are deposited against fault scarps on surfaces of their Q2bc deposits (estimated by them to be about 160 ka to 740 ka).

Scarps along Frenchman Flat at the northeastern end of RV are shown by Y-852 on depositional or erosional surfaces of possible late Pleistocene age (their Q_2? surfaces with estimated ages between 10 ka and 130 ka) and on surfaces of early to middle and (or) late Pleistocene age (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma). An earthquake (magnitude 3 to 4) on February 19, 1973, located 1.6 km northeast of Frenchman Lake playa (Y-181, p. 36, *citing* F.G. Fischer, oral commun., 1973) near the northeastern end of RV, may have produced two cracks in the playa deposits (Y-181).

The youngest deposits that are shown to be displaced (Q1s and Q1c deposits of Y-68) along the possible southwestern extension of RV in Amargosa Desert are Holocene (≤10 ka; Y-68; Y-90; Y-695).

Slip rate: On the basis of 10 to 32 cm of vertical displacement of deposits estimated to be 31 ka to 38 ka as interpreted from the trenches by Y-20, an apparent vertical slip rate of 0.003–0.01 mm/yr since 31 ka to 38 ka can be estimated for the central part of RV.

The amount of lateral displacement has not been determined.

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-695, p. 3, 37, 39, scale 1:12,000 (low–sun–angle) and 1:60,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-852, scale 1:58,000). Scarp profiles along the southwestern extension of RV (Y-695, p. 41, appen. A, profiles P4 through P8). Trenches along the central part of RV (Y-20) and along the southwestern part of RV (Y-695, p. 37, Trenches TR1 and TR2).

Relationship to other faults: RV was reported by Y-182 (p. 56-64) and Y-695 (p. 11, 39) to be part of the northeast–striking, 55–km–long, dominantly left–lateral Spotted Range–Mine Mountain structural zone that cuts across the northwest–trending Walker Lane. The Spotted Range–Mine Mountain zone as defined by Y-695 (p. 39) also includes the Mine Mountain fault (MM), the Cane Spring fault (CS), and the Wahmonie fault (WAH).

Rocket Wash–Beatty Wash fault (RWBW)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pl. 3); Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992. Not shown by Cornwall, 1972 (Y-232).

Location: 19 km/318° (distance and direction of closest point from YM) at lat 36°58′N. and long 116°35′W. (location of closest point). RWBW is located between Rocket Wash on the north and Beatty Wash on the south and west of Timber Mountain.

USGS 7-1/2′ quadrangle: Beatty Mountain, East of Beatty Mountain, Thirsty Canyon SE, Thirsty Canyon SW.

Fault orientation: RWBW strikes generally north (Y-813; Y-853). Traces at the southern end strike north–northeast (Y-238).

Fault length: The length of RWBW is about 17 km as estimated from Y-238 and Y-813 or about 5 km as estimated from Y-853, who show only some of the fault traces shown by Y-238 and Y-813.

Style of faulting: Displacement on some traces of RWBW is portrayed by Y-813 as primarily down to the west.

Scarp characteristics: Scarps are shown by Y-238 and Y-813 as generally west–facing.

Displacement: No information.

Age of displacement: Parts of traces of RWBW are shown by Y-238 and Y-813 as moderately expressed lineaments or scarps on surfaces of Quaternary deposits. Other parts are portrayed by Y-238, Y-813, and Y-853 as weakly expressed to prominent lineaments and (or) scarps on surfaces of Tertiary deposits. Other parts are shown by Y-238 and Y-813 as faults that are in Tertiary deposits and that were identified from previous mapping.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-813, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: RWBW is approximately parallel to other north–striking faults mapped on and around Pahute Mesa, including the north–striking Oasis Valley faults (OSV), which are located about 8 km west of RWBW (Y-232; Y-238; Y-813; Y-853). Unlike RWBW and OSV, which are expressed at least in part on Quaternary surfaces, many of the other north–striking faults on and around Pahute Mesa are expressed only in Tertiary deposits. These faults are not included on plate 1 of this compilation. One of these faults, which is about 20 km long, is located about 2 km east of RWBW. It extends north to Pahute Mesa and is indicated by Y-813 (pl. 2) as having left–lateral displacement. The structural relationship between this fault and RWBW is not known.

RWBW approximately aligns with the Bare Mountain fault (BM) located directly south of RWBW. The structural relationship between these two faults is not known.

Saline Valley faults (SAL)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-355: Ross, 1967 (presents generalized geology of the entire Saline Valley); Y-356: McAllister, 1956 (shows north–striking faults on the eastern side of Saline Valley and south of lat 36°45'N.; the East Side fault zone of Y-1148); Y-415: Jennings, 1985 (Death Valley sheet); Y-417: Burchfiel, 1969; Y-864: Burchfiel and others, 1987; Y-906: MIT Field Geophysics Course and Biehler, 1987; Y-1148: Zellmer, 1980 (shows fault scarps in Saline Valley south of lat 36°45'N., pl. 3.1; SAL includes his Western Frontal fault zone (WF) along the Inyo Mountain front, his East Side fault zone (ES) on the eastern side of Saline Valley adjacent to the Panamint Range, and his Central Valley fault zone (CEN) within central Saline Valley); Y-1240: Lombardi, 1963; Y-1241: Larson, 1979; Y-1247: Ross, 1968.

Location: 108 km/261° (distance and direction of closest point from YM) at lat 36°41'N. and long 117°37'W. (location of closest point). SAL includes faults within and bordering Saline Valley (except for the Hunter Mountain fault along the southern side of the valley). It includes the faults delineated by Y-1148: WF along the eastern front of the Inyo Mountains north of Daisy Canyon, ES along the eastern side of Saline Valley adjacent to the Panamint Range, and CEN in the playa within Saline Valley.

USGS 7-1/2' quadrangle: Craig Canyon, Lower Warm Springs, New York Butte, Pat Keyes Canyon, West of Ubehebe Peak.

Fault orientation: Variable. Y-1148 (p. 20) noted that WF strikes N. 40° W., that ES strikes north, and that CEN strikes northwest to west. Y-1148 (p. 53) reported that WF, where it is exposed in granitic rock near Beveridge Canyon, is nearly vertical.

Fault length: Variable. The length of the WF is 21 km as estimated from Y-222. Y-1148 (p. 60) reported a length of 13.5 km for WF. Individual fault traces in ES are 0.5 to 2 km long as estimated from Y-356. These traces are concentrated into two groups, one about 5 km long and the other about 6 km long. Fault traces in CEN have lengths between about 1 km and 17 km as estimated from Y-222. The total length of CEN is about 20 km.

Style of faulting: Y-1148 (p. 50) noted that WF, which is along the front of the Inyo Mountains, has experienced primarily dip–slip (normal) displacement. He recognized no evidence for lateral displacement along WF.

Y-1148 (p. 62) reported that displacement along ES, which includes a system of grabens, has been chiefly vertical. Y-864 (p. 10,423) noted that normal slip has predominated along ES, but that some fault traces also have evidence for right–lateral displacement. Y-356 portrayed fault traces in ES as primarily down to the west.

Y-1148 (p. 62) reported that CEN is a zone of fault traces with principally dip–slip (normal) displacement and inconclusive evidence for lateral displacement.

Scarp characteristics: Y-1148 (p. 61) suggested that at least three surface ruptures are recorded by fault scarps at several localities along WF.

Y-1148 (p. 63) reported scarps on surfaces of alluvial, lacustrine, and eolian deposits along ES. He (Y-1148, p. 63) also noted that the heights of these scarps range between 2 and 12 m and that the shapes of topographic profiles measured across two scarps suggest that the scarps were formed by up to three events on ES.

Displacement: On the basis of the elevation difference between the height of the Inyo Mountains and the depth of fill within Saline Valley as determined from gravity data, Y-1148 (p. 50) estimated a total vertical displacement on WF of at least 6,000 m. At least 32 to 35 m of vertical displacement on WF is recorded by scarps on alluvial fans (Y-1148, p. 51, 60, 65). The maximum vertical surface displacement across a scarp associated with WF at Beveridge Canyon is 15 m (Y-1148, p. 54). Alluvial fans near Keynot Canyon have maximum vertical displacements of about 8 m as measured across scarps associated with WF, and some older fans in this area may have been uplifted as much as about 32 m (Y-1148, p. 55). A natural levee in Keynot Canyon is displaced about 1.5 m by WF (Y-1148, p. 57-58).

Saline Valley faults (SAL) — Continued

Age of displacement: Y-1148 (p. 55) noted that scarps along WF are on all but the youngest alluvial fans. He (Y-1148, p. 70-71) reported that the floor of Saline Valley is being tilted to the west along WF (and the Hunter Mountain fault, HM) toward the Inyo Mountains. He based this conclusion on evidence from Y-1240 that playa deposits in southern Saline Valley have been uplifted and tilted to the west. The present drainage pattern within the valley also supports this conclusion (Y-1148, p. 70-71). WF is shown by Y-222 as a faulted contact between pre–Quaternary rocks and Holocene alluvium (their Qal deposits).

Y-356 portrayed faults of ES as displacing Pleistocene or Holocene alluvial fans (his Qal deposits). Y-1148 (p. 63-64) concluded that the age of the youngest event on ES ranges between 170 yr and 27 ka on the basis of a comparison of the steepness of these scarps with those reported by Wallace (1977, Y-1118). He (Y-1148, p. 65) also used the lack of varnish on scarp faces, the presence of scarps on all but the most–recent surfaces and active channels, the presence of fewer and smaller creosotes on scarp faces than on stable surfaces, and the disruption of drainages to support the conclusion that displacement on ES is likely relatively young.

Fault traces of CEN are portrayed by Y-222 as displacing Holocene alluvium (their Qal deposits), Holocene dune sand (their Qs deposits), Holocene/Pleistocene? sand deposits (their Qst deposits), and Quaternary lake deposits (their Ql deposits). Y-415 (p. 136, 138, note #17, *citing* Y-1240) and Y-1148 (p. 12, *citing* Y-1240) both reported that fault traces within Saline Valley displace Quaternary deposits. Y-1148 (p. 70) inferred that displacement along CEN has been relatively recent because fault traces are preserved on the surfaces of fine–grained, and frequently wet, playa deposits. He assumed that these traces could not be preserved for very long on the playa surfaces. He (Y-1148, p. 70-72) also suggested that displacement on CEN may be continuing because Y-1240 observed tilt of the playa floor and because a northwest–trending lineament that Y-1148 interprets to have a tectonic origin is sharper on photographs (approximate scale of 1:117,000) taken during aerial reconnaissance in 1979 than it is on aerial photographs (scale of 1:37,400) taken in 1947. He interpreted the better expression in 1979 when compared to that in 1947 as being due to increased displacement during the intervening 32 yr.

Y-864 (p. 10,423, *citing* Y-355, Y-415, Y-1241, and Y-1247) concluded that Saline Valley did not begin to form until after extrusion of the oldest basalts (3.8 Ma to 2.8 Ma) that are preserved in the Saline Range (Y-417, Y-1241), which is located north of Saline Valley.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: No information.

Analysis: Analysis of aerial photographs (Y-1148, p. 1, 9, scales 1:20,000, 1:37,400, and 1:60,000). Aerial reconnaissance (Y-1148, p. 1). Field reconnaissance (Y-1148, p. 2). Detailed geologic mapping (Y-864, p. 10,422). Topographic scarp profiles of fault scarps (Y-1148, p. 1, 78–86, table 4.1). Detailed (1:50,000) map of fault scarps (Y-1148, pls. 3.1, 3.1a, 3.2, 3.3, and 3.4). Study of scarp material (Y-1148, p. 1-2).

Relationship to other faults: Y-1148 (p. 109-113) interpreted Saline Valley as a rhombochasm between two northwest–striking, right–lateral faults (the Hunter Mountain fault (HM) on the south and an unnamed fault to the north) and between two north–northwest–striking principally dip–slip (normal) faults (WF on the west and ES on the east). WF intersects the western end of HM at an angle of greater than 90° at the southwest corner of Saline Valley.

In contrast to models suggested by Y-864 and by Y-906 that northern Panamint Valley is relatively shallow and was likely formed by extension on a low–angle, west–dipping detachment or normal fault, Y-864 (p. 10,425-10,426) concluded that a low–angle fault cannot be responsible for extension in Saline Valley. They noted several types of evidence that suggest that extension in Saline Valley probably occurred along closely spaced planar faults. This evidence includes (1) the numerous, northeast–striking, west–dipping normal faults that project into Saline Valley from the surrounding ranges (Y-355; Y-417), (2) the continuous exposure of Pliocene volcanic rocks across ranges adjacent to Saline Valley, and (3) the great depth of Saline Valley as interpreted from gravity data.

Sarcobatus Flat fault (SF)

Plate or figure: Plate 1.

References: Y-238: Reheis and Noller, 1991 (pls. 1 and 2); Y-813: Reheis, 1992 (pl. 2); Y-853: Dohrenwend and others, 1992; Y-1071: Weiss and others, 1993. Not shown by Cornwall, 1972 (Y-232).

Location: 52 km/305° (distance and direction of closest point from YM) at lat 37°07'N. and long 116°55'W. (location of closest point). SF is located along the northeastern side of Sarcobatus Flat and along the western edge of Pahute Mesa.

USGS 7-1/2' quadrangle: Scottys Junction, Scottys Junction NE, Springdale NW, Springdale SW, Stonewall Spring, Tolicha Peak SW.

Fault orientation: SF strikes generally north–northwest, but the fault curves, so that short sections strike north and northeast (Y-238; Y-813).

Fault length: The total length of SF is 27 km as estimated from Y-853. This includes a 15–km–long section with surficial expression at the fault's northern end, an 8.5–km–long gap in surficial expression, and a 4–km–long section with surficial expression at the fault's southern end.

The total length of SF is 51 km as estimated from Y-238 and Y-813. This includes a 5.5–km–long gap in surficial expression, where Y-813 interprets lineaments on either side of the gap to be related (the dotted portion of SF on pl. 1 of this compilation).

Style of faulting: Displacement on fault traces for which such information is given is shown by Y-238 and Y-813 as generally down to the west. The fault traces in part overlap and branch.

A 3–to–4–km–long left step occurs in the fault's trace at Stonewall Mountain near the northern end of SF (Y-238; Y-813; Y-853). The map by Y-238 (pl. 2) shows a northeast–striking, down–to–the–southeast trace at this step.

Scarp characteristics: Portions of some fault traces are portrayed by Y-238 and Y-813 as fault scarps. These scarps are west–facing, primarily. A few are east–facing.

Displacement: No information.

Age of displacement: Short sections of SF are shown by Y-238 and Y-813 as moderate to prominent lineaments or scarps on surfaces of Quaternary deposits. Y-853 showed most of the fault traces in SF as juxtaposing Quaternary alluvium against bedrock. In contrast, north–northwest– and northwest–trending lineaments that bound the western edge of Pahute Mesa are noted by Y-813 (p. 7) to be subdued, which Y-813 (p. 7) interpreted as suggesting that SF has experienced little of no Quaternary displacement.

Portions of SF are portrayed by Y-238 and Y-813 as prominent lineaments on surfaces of Tertiary deposits and as fault traces that are in Tertiary deposits and that have been identified from previous mapping. Y-238 (pl. 2) showed a northeast–striking, down–to–the–southeast fault trace expressed as a moderate and prominent lineament on surfaces of Tertiary rocks at the left step in SF near Stonewall Mountain.

Displacement rate: No information.

Return period: No information.

Range-front characteristics: Portions of SF, which bounds the western edge of Pahute Mesa, are shown by Y-853 to have characteristics similar to those of major range–front faults (e.g., a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to the range front), except that the front is less extensive than those along major range–front faults. Scarps are noted by Y-853 to be lower, shorter, and less continuous than those along a major range-front fault. Y-238 and Y-813 portrayed much of SF as a topographic lineament bounding a linear range front.

Sarcobatus Flat fault (SF) — Continued

Analysis: Aerial photographs (Y-238, p. 2, scales 1:24,000 to 1:80,000; Y-813, p. 4, scales 1:62,500 to 1:80,000; Y-853, scales 1:115,000 to 1:124,000 and 1:58,000).

Relationship to other faults: SF is parallel to other fault traces that bound the southwestern side of Pahute Mesa along and south of Tolicha Peak, the Tolicha Peak fault (TOL). SF is nearly parallel to the northwest–striking Furnace Creek fault (FC) located about 50 km west of SF in northern Death Valley.

SF is perpendicular to the Stonewall Mountain fault (SWM) along the northern side of Stonewall Mountain at the northern end of SF (Y-238; Y-853; pl. 1 of this compilation). Y-238 (pl. 1) showed that the southwestern end of the east–northeast–striking SWM curves to a nearly north strike and aligns with SF. The exact structural relationship between these two faults is not known. Both SF and SWM correlate with a boundary that was noted by Y-1071 (fig. 2, p. 355) to separate an area to the west that has undergone marked deformation since middle Miocene (includes Death Valley) and one to the east that has undergone little deformation since middle Miocene (includes the southwestern Nevada volcanic field). Y-1071 (p. 362) noted that the "prominent west–facing scarps south of Stonewall Mountain, forming the west edge of Pahute Mesa [SF], mark the eastern limit of [a] period of faulting [that occurred after deposition of the 7.6–Ma Spearhead Member of the Stonewall Flat Tuff] and define the eastern margin of the Sarcobatus Flat structural basin." At its northern end, SF bounds the western side of the Stonewall Mountain volcanic center (Y-1071, fig. 2).

Seaman Pass fault (SPS)

Plate or figure: Plate 1.

References: Y-404: Tschanz and Pampeyan, 1970 (pls. 2 and 3; name from their pl. 3); Y-1032: Schell, 1981 (pl. 9; shows short faults coincident with and near SPS as mapped by Y-404). Not shown by Ekren and others, 1977 (Y-25).

Location: 153 km/47° (distance and direction of closest point from YM) at lat 37°47'N. and long 115°09'W. (location of closest point). SPS is located within Coal Valley and in the Seaman Range along Seaman Wash.

USGS 7-1/2′ quadrangle: Coal Valley Reservoir, Murphy Gap SE, Oreana Spring, Seaman Wash.

Fault orientation: SPS has a curving trace: its northern part strikes north; its central part strikes north–northwest; its southern part strikes northwest (Y-404). The map by Y-1032 shows two north–northeast–trending lineaments thought to be fault–related just east of the northern part of SPS as mapped by Y-404. Y-1032 also showed one northwest–striking fault and one north–northwest–striking fault at the southern end of SPS as mapped by Y-404.

Fault length: The portion of SPS with surficial expression is 22 km long, but the fault is portrayed by Y-404 as concealed for another 12 km along Seaman Wash. Thus, the total length of SPS may be as much as 34 km as estimated from Y-404. However, SPS extends to the northern edge of their map area at lat 38°N., so that this would be a minimum estimate of total fault length.

Style of faulting: No type or direction of displacement for SPS is shown by Y-404.

Scarp characteristics: Y-1032 indicated both east– and west–facing scarps near the southern end of SPS.

Displacement: No information.

Age of displacement: The youngest displacement along SPS is probably on a 1.5–km–long portion in the central part of the fault. The probable age of this displacement is noted by Y-1032 (pl. 9) to be Pleistocene (defined as about 15 ka to 1.8 Ma by Y-1032, pl. 9).

Faults near the southern end of SPS are shown by Y-1032 (pl. 9) as indeterminate in age, but he suspected them of having Quaternary displacement because of the prominent scarps preserved along this portion of the fault. However, the age of these scarps cannot be determined because young stratigraphic units are not present along the fault trace (Y-1032, pl. 9).

Y-404 portrayed SPS as a post–Laramide structure (1) in Pleistocene(?) older lake beds (their Qol deposits), (2) as a faulted contact between Pleistocene(?) younger lake beds (their Ql deposits) and their Qol deposits, or (3) as concealed by their Qol deposits and by Pliocene older lake beds (their Tl deposits).

Slip rate: No information.

Recurrence interval: No information.

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

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: The southern end of SPS nearly intersects the north–northeast–striking Pahrock Valley faults (PV). The northern end of SPS is approximately parallel to and aligns with the Southeast Coal Valley fault (SCV) at the southern end of Coal Valley. This end of SPS is also approximately parallel to part of the Golden Gate fault (GG) along the western side of Coal Valley. The structural relationships among these faults are not known.

Sheep Basin fault (SB)

Plate or figure: Plates 1 and 2.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970; Y-671: Guth, 1990 (name from his fig. 3, p. 240); Y-852: Dohrenwend and others, 1991; Y-918: Longwell, 1930 (may have been the first to recognize fault scarps along the western side of the Sheep Range); Y-1032: Schell, 1981 (pl. 11; shows a few fault traces along the range front north of lat 36°45'N.).

Location: 112 km/93° (distance and direction of closest point from YM) at lat 36°46'N. and long 115°12'W. (location of closest point). SB is located along the western side of the northern Sheep Range at its junction with Sheep Basin (name from Y-918, p. 2). An additional fault trace is located along the western side of Mule Deer Ridge.

USGS 7-1/2' quadrangle: Hayford Peak, Mormon Well, Mule Deer Ridge, Mule Deer Ridge NE, Mule Deer Ridge NW, Mule Deer Ridge SE.

Fault orientation: The part of SB that is immediately adjacent to the Sheep Range front is curving. The northern portion strikes north–northwest; the central portion strikes north; the southern portion strikes northeast (Y-671, fig. 3, p. 240, p. 243; Y-852).

Fault traces up to 5 km west of the range front within Sheep Basin and along the western side of Mule Deer Ridge strike north (Y-852).

Fault traces between those along Mule Deer Ridge and those along the Sheep Range front strike northeast (Y-852). Two parallel fault surfaces are exposed in an eroded drainage. The western (younger) one dips 50° W. (Y-918, p. 11), and the eastern (older) one dips 68° W. (Y-918, p. 12).

Fault length: The part of SB that is along the Sheep Range front is about 35 km long as estimated from Y-852, but the fault extends north of their map area at lat 37°N. Y-918 (fig. 2, p. 3) extended SB along the base of the Sheep Range about 7 km north of lat 37°N., so that the total length of SB is at least 42 km. The range front continues about 12 km north of this latitude, so that the total length could be as much as 47 km.

The north–striking fault traces 5 km west of the range front along Mule Deer Ridge are in a zone 18 km long.

The northeast–striking fault traces west of the range front are in a zone 3.5 km long (Y-852).

Style of faulting: Displacement along SB is shown by Y-671 (fig. 3, p. 240, section AA', p. 246) as generally down to the west. Displacement along fault traces that are along the range front and the north–striking fault traces 5 km west of the Sheep Range front along Mule Deer Ridge is shown as down to the west by Y-852.

Scarp characteristics: Scarps associated with the northeast–striking fault traces west of the range front are shown by Y-852 as down to the northwest. Y-918 (p. 5) noted a maximum scarp height of 34 m (110 ft) on a west–facing scarp on an alluvial fan near the middle of the part of SB that is along the range front. The height of this scarp decreases to the north and south of this point. A lower east–facing scarp forms a graben along another portion of SB (Y-918, p. 8).

Displacement: Using the elevation difference between the floor of Sheep Basin and a pass at the northern end of the Sheep Range, Y-918 (p. 4) estimated a minimum of 366 m (1,200 ft) of subsidence of the basin. He also inferred that westward–sloping surfaces preserved in what is now part of the Desert Range west of Sheep Basin are about 458 m (1,500 ft) above the basin floor and are pediments that once connected to the western side of the Sheep Range 16 to 18 km (10 to 11 miles) to the east but have been faulted below the present floor of the basin (Y-918, p. 4-5).

Sheep Basin fault (SB) — Continued

Age of displacement: The youngest scarps on the part of SB that is adjacent to the Sheep Range front are shown by Y-852 to be on depositional or erosional surfaces that are possibly late Pleistocene age (their Q_2? surfaces with estimated ages between 10 ka and 130 ka). Other scarps along the range front are portrayed by Y-852 on depositional or erosional surfaces that are early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). Y-1032 portrayed a short section of these scarps as Pleistocene (defined by him to be between about 15 ka and 1.8 Ma). Y-918 (p. 5-7) concluded that, although the highest scarp is eroded by small gullies, the scarps "preserved between canyons appear remarkably fresh" given the unconsolidated character of the alluvial–fan deposits. He (Y-918, p. 7) suggested that displacement probably occurred not "more than a few hundred years ago." Y-918 (p. 13) concluded that the morphology of the scarp interpreted to have formed during the youngest rupture "suggests that faulting is still in progress."

The youngest north– and northeast–trending scarps within Sheep Basin are portrayed by Y-852 on depositional or erosional surfaces that are latest Pleistocene and (or) Holocene age (their Q_{2-3} surfaces with estimated ages of less than 30 ka). Other scarps along this portion of SB are shown by Y-852 to be on depositional or erosional surfaces that are late Pleistocene age (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) or early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma).

The youngest scarps along Mule Deer Ridge are shown by Y-852 to be on depositional or erosional surfaces that are possibly late Pleistocene age (their Q_2? surfaces with estimated ages between 10 ka and 130 ka). They also portrayed scarps on depositional or erosional surfaces that are early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: About half of SB is portrayed by Y-852 as being along a tectonically active front of a major mountain range that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." Y-918 (p. 4) described the western front of the northern Sheep Range as "precipitous" and suggested that it "would be recognized as an eroded scarp even without direct evidence of recent movement at its base."

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-671, p. 237; Y-852, scale 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field examination (Y-671, p. 237; Y-918, p. 1, 5; Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Topographic profiles on alluvial fans across fault scarps (Y-918, p. 7-8, fig. 6). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Relationship to other faults: SB is one of several primarily north–striking faults that bound range fronts east of Yucca Mountain and north and northwest of Las Vegas. SB merges with both the north–striking Wildhorse Pass fault within the Sheep Range west of SB and the Mormon Pass fault within the Sheep Range southeast of SB (Y-671, p. 243, fig. 3, p. 240). Y-671 (p. 243) suggested that the Mormon Pass fault forms the eastern boundary of an inferred major detachment system (his Sheep Range detachment). Other north–striking faults in this area are the Sheep Range fault (SHR) along the eastern side of the northern Sheep Range directly east of SB, the Sheep–East Desert Ranges fault (SEDR) along the western sides of the Desert Range and the southern Sheep Range directly west of SB, and the East Pintwater Range fault (EPR) and the West Pintwater Range fault (WPR) along the eastern and western sides of the Pintwater Range west of SB. The structural relationships among these fault are not known.

Y-671 (p. 243) reported that SB forms the northwestern boundary of the main structural block of the Sheep Range.

Sheep-East Desert Ranges fault (SEDR)

Plate or figure: Plate 2.

References: Y-671: Guth, 1990; Y-852: Dohrenwend and others, 1991.

Location: 104 km/95° (distance and direction of closest point from YM) at lat 36°45′N. and long 115°18′W. (location of closest point). SEDR is located along the western sides of the southern Sheep Range and the East Desert Range. It also includes a fault trace along the eastern side of the Black Hills west of the range front.

USGS 7-1/2′ quadrangle: Black Hills, Corn Creek Springs, Dead Horse Ridge, White Sage Flat.

Fault orientation: SEDR has a general north–northeast, curving strike. The southern end of SEDR strikes northwest (Y-852). North of this, the strike of SEDR ranges between north–northeast and north–northwest.

Fault length: SEDR is about 45 km long as estimated from Y-852. The fault trace along the Black Hills is about 10 km long as estimated from Y-852.

Style of faulting: No information.

Scarp characteristics: Scarps associated with SEDR are shown by Y-852 as primarily west–facing.

Displacement: No information.

Age of displacement: Scarps at four localities, both immediately at the range front and 1 to 2 km west of the front, are shown by Y-852 to be on depositional or erosional surfaces that are early to middle and (or) late Pleistocene age (their Q_{1-2} surfaces with estimated ages between 10 ka and 1.5 Ma). Part of SEDR along the range front is shown by Y-852 as fault–related lineaments on depositional or erosional surfaces of Quaternary age, which they define as <1.5 Ma.

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Y-852 indicated that most of SEDR bounds a tectonically active front of a major mountain range that is characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front." The fault trace along the Black Hills, which juxtaposes Quaternary alluvium against bedrock, is not shown by Y-852 as a major range–front fault. The morphology of the eastern side of the Black Hills would be similar to that along a major range–front fault, but would be significantly less extensive and fault scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852).

Analysis: Aerial photographs (Y-671; Y-852, scale 1:58,000).

Relationship to other faults: SEDR is one of several generally north–striking faults bounding range fronts east of Yucca Mountain and north and northwest of Las Vegas. Other north–striking faults in this area are the Sheep Basin fault (SB) along the western side of the northern Sheep Range directly east of SEDR, the Sheep Range fault (SHR) along the eastern side of the northern Sheep Range east of SEDR, and the East Pintwater Range fault (EPR) and the West Pintwater Range fault (WPR) along the eastern and western sides of the Pintwater Range west of SEDR. The structural relationships among these faults are not known.

Sheep Range fault (SHR)

Plate or figure: Plates 1 and 2.

References: Y-25: Ekren and others, 1977; Y-404: Tschanz and Pampeyan, 1970; Y-671: Guth, 1990; Y-852: Dohrenwend and others, 1991; Y-1032: Schell, 1981 (pls. 9 and 11; name from his table A2, fault #27);

Location: 122 km/95° (distance and direction of closest point from YM) at lat 36°45′N. and long 115°06′W. (location of closest point). SHR is located along the eastern side of the Sheep Range at its junction with Coyote Spring Valley.

USGS 7-1/2′ quadrangle: Hayford Peak SE, Mormon Well, Mule Deer Ridge NE, Mule Deer Ridge SE.

Fault orientation: SHR strikes generally north (Y-852).

Fault length: SHR is discontinuous over a length of about 50 km as estimated from Y-852, but SHR extends north beyond the boundary of their map area at lat 37°N. Scarps are continuous over a length of 20 km as estimated from Y-852. The length of SHR is noted to be 30 km by Y-1032, but he did not extend SHR south of about lat 36°50′N. (pl. 11, table A2, p. A6).

Style of faulting: No information.

Scarp characteristics: Scarps at the range front are shown as east–facing by Y-852.

Displacement: No information.

Age of displacement: The probable age of the youngest displacement along SHR is noted by Y-1032 (table A2, p. A6) to be late Pleistocene (defined as >15 ka and <700 ka by Y-1032, p. 29). The youngest unit that Y-1032 recognized as displaced is his intermediate–age alluvial–fan deposits (table A2, p. A6) with an estimated age of 15 ka to probably about 200 ka (table 3, p. 23). The oldest unit not displaced is his young–age alluvial–fan deposits (table A2, p. A6) with an estimated age of ≤15 ka (table 3, p. 23). The oldest unit that Y-1032 noted as displaced is Paleozoic rocks (table A2, p. A6).

The youngest scarps along SHR recognized by Y-852 are on depositional or erosional surfaces that are latest Pleistocene and (or) Holocene (their $Q_{2\text{-}3}$ surfaces with estimated ages of 30 ka or younger). Y-852 also showed scarps on depositional or erosional surfaces that are late Pleistocene (their Q_2 surfaces with estimated ages between 10 ka and 130 ka) and early to middle and (or) late Pleistocene (their $Q_{1\text{-}2}$ surfaces with estimated ages between 10 ka and 1.5 Ma).

Slip rate: No information.

Recurrence interval: No information.

Range-front characteristics: Part of SHR has been portrayed by Y-852 as a fault juxtaposing Quaternary alluvium against bedrock, but not as a major range–front fault. The morphology of the eastern side of the Sheep Range would be similar to that along a major range–front fault and may be characterized by "fault juxtaposition of Quaternary alluvium against bedrock, fault scarps and lineaments on surficial deposits along or immediately adjacent to range front, a general absence of pediments, abrupt piedmont–hillslope transitions, steep bedrock slopes, faceted spurs, wineglass valleys, and subparallel systems of high–gradient, narrow, steep–sided canyons orthogonal to range front" (Y-852). However, SHR would be significantly less extensive and faults scarps would be substantially lower, shorter, and less continuous than those along a major range–front fault (Y-852).

Analysis: Aerial photographs (Y-404, p. 2, scale 1:60,000; Y-671; Y-852, scale 1:58,000; Y-1032, p. 15, scales ~1:25,000 and ~1:60,000). Field reconnaissance (Y-1032, p. 17-18). Field mapping (Y-404, p. 2). Gravity analysis (Y-1032, p. 16). Magnetometer surveys (Y-1032, p. 16-17).

Sheep Range fault (SHR) — Continued

Relationship to other faults: SHR is one of several generally north–striking faults bounding range fronts east of Yucca Mountain and north and northwest of Las Vegas. Other north–striking faults in this area are the Sheep Basin fault (SB) along the western side of the northern Sheep Range directly west of SHR, the Sheep–East Desert Ranges fault (SEDR) along the western sides of the Desert Range and the southern Sheep Range west of SHR, and the East Pintwater Range fault (EPR) and the West Pintwater Range fault (WPR) along the eastern and western sides of the Pintwater Range west of SHR. The northern end of SHR nearly intersects the east–northeast–striking Maynard Lake fault (MAY), the southern trace of the Pahranagat fault (PGT). The structural relationships among these faults are not known.

Sierra Nevada fault (SNV)

Plate or figure: Plate 2.

References: Y-222: Streitz and Stinson, 1974; Y-413: Jennings and others, 1962; Y-425: Stinson, 1977; Y-427: Hart and others, 1989 (name from their southern segment); Y-1020: Jennings, 1992; Y-1052: Wills, 1988; Y-1054: Wills, 1989 (his Haiwee segment of the Sierra Nevada fault); Y-1055: Beanland and Clark, 1993; Y-1110: Roquemore, 1981.

Location: 154 km/245° (distance and direction of closest point from YM) at lat 36°14'N. and long 117°59'W. (location of closest point). SNV includes only the southern end of this fault, where it bounds the eastern front of the Sierra Nevada. SNV includes fault traces on alluvial fans <1.5 km east of the Sierra Nevada front in the Haiwee–Rose Valley area.

USGS 7-1/2' quadrangle: Coso Junction, Haiwee Reservoirs, Little Lake, Ninemile Canyon, Pearsonville, Volcano Peak.

Fault orientation: SNV strikes generally north–northwest (Y-1054, fig. 1).

Fault length: The length of SNV is about 25 km as estimated from Y-1054 (fig. 1).

Style of faulting: Fault traces of SNV are shown by Y-425 (his cross sections) as dip slip (normal), down to the east, and steeply dipping. A right–lateral component of displacement is interpreted by Y-1054 (p. [2]) on the basis of a left–stepping, *en echelon* pattern of scarps at one locality and by a deflected drainage at another locality.

Scarp characteristics: Scarps are generally portrayed by Y-1054 (p. [2]) as east–facing, but a few are west–facing. Scarps are reported by Y-1054 (p. [2]) "to be low and erosionally degraded except near springs where spring sapping may have steepened the scarps. Lateral stream erosion also has steepened some scarps."

Displacement: No information.

Age of displacement: Y-425 portrayed fault traces of SNV as displacing Holocene deposits, his Qf and Qal deposits (alluvium, eolian sand, alluvial–fan deposits), along the eastern side of the portion of the Sierra Nevada that borders the western side of Rose Valley and the western side of Haiwee Reservoir.

In contrast, Y-1054 (p. [2-3]) subdivided the Qf deposits of Y-425 into older and younger Pleistocene alluvium with minor Holocene alluvium in stream channels. Low, degraded scarps are preserved in the older Pleistocene alluvium at at least two localities. Y-1054 inferred that this alluvium is equivalent to Tahoe–stage glacial deposits or older (estimated age of 60 ka to 100 ka) on the basis of the pitting and weathering of granitic boulders and on soil development (7.5YR colors and well–developed B horizons). The younger alluvium contains no scarp at one locality. At another locality the younger alluvium contains a scarp that is visible on aerial photographs but that could not be located on the ground by Y-1054. The younger alluvium is thought to be equivalent to Tioga–stage glacial deposits of latest Pleistocene age on the basis of the color of the unweathered deposits and on the pitting, spalling, and weathering of granitic boulders. Y-1054 (p. [4]) suggested that these latest Pleistocene deposits are not displaced.

Y-1020 indicated that displacement along SNV is late Quaternary, which he defines as <700 ka.

Slip rate: Y-1055 (p. 7) concluded that faults along the Sierra Nevada front (part of SNV of this compilation?) have experienced a vertical slip rate of 0.1 to 0.8 mm/yr during the Holocene.

Recurrence interval: No information.

Range-front characteristics: The southern front of the Sierra Nevada along SNV is noted by Y-1054 (p. [2]) to be straight and high.

Analysis: Aerial photographs (Y-1054, p. [2], scales 1:30,000 and 1:12,000). Field reconnaissance (Y-1054, p. [2]).

Sierra Nevada fault (SNV) — Continued

Relationship to other faults: The northwest–striking Little Lake fault (LL) may merge with this portion of SNV near Little Lake (Y-1052, *citing* Y-1110). However, Roquemore, 1988 (Y-374) suggested that although the two faults are close together at one point, he found no evidence that would indicate that the two faults actually merge.

Y-427 (p. 6) noted that SNV is closely associated with the Owens Valley fault (OWV), which is located north of SNV between the Sierra Nevada and the White–Inyo Mountains. They suggested that SNV may be partly coincidental with OWV.