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Panamint Valley fault zone, southern Panamint Valley section (Class A) No. 67c

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Compiled in cooperation with the California Geological Survey

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Synopsis	**General:** Major Holocene active oblique-slip range-front fault zone characterized by both Holocene normal dip-slip and dextral strike-slip offset (Smith, 1976 #1646; Bryant, 1989 #1459; Zhang and others, 1990 #199). Panamint Valley fault zone is divided into sections in this compilation, from north to south: Northern Panamint Valley [67a], Wildrose [76b], Southern Panamint Valley [67c], and Brown Mountain [67d]. The fault zone extends from the complex left compressional step over to the Hunter Mountain-Saline Valley fault zone [66] southeast along the eastern side of Panamint Valley and complexly intersects with the Garlock fault

	zone [69] along the Brown Mountain fault. Reheis (1991 #1602) suggested that the southern end of the Hunter Mountain fault zone extended into northern Panamint Valley and ends just north of Wildrose graben. Smith (1976 #1646) and Zellmer (1980 #1705) considered the junction between the Hunter Mountain [67] and Panamint Valley faults to be at the northern end of Panamint Valley south of Hunter Mountain. In this compilation the northern end of the Panamint Valley fault zone is considered to be delineated by the shallow northeast-dipping thrust fault along the south side of Hunter Mountain mapped by Smith (1976 #1646). The Panamint Valley fault zone is delineated by well-defined geomorphic features indicative of Holocene dextral and normal faulting (Smith, 1979 #1647; Bryant, 1989 #1459; Zhang and others, 1990 #199). Burchfiel and others (1987 #1454) reported a long term slip rate of 2-3.2 mm/yr for the Hunter Mountain-Saline Valley fault zone, based on dextral displacement of Hunter Mountain batholith contact. Zhang and others (1990 #199) reported latest Pleistocene to Holocene minimum dextral slip rates of 1.74?0.65 mm/yr and 2.36?0.79 mm/yr for the Panamint Valley fault zone (Southern Panamint Valley section [67c]), although ages of offset deposits are not well-constrained. Zhang and others (1990 #199) reported that large surface-rupturing earthquakes may occur as characteristic 3-m events, based on their observations of dextrally offset stream channels in multiples of 3 m. Zhang and others (1990 #199) concluded that the average recurrence interval for large surface-rupturing earthquakes on the Southern Panamint Valley section [67c] is between 860 yr and 2,360 yr, based on an assumed 3.2?0.5-m characteristic event and a Holocene slip rate of 2.36?0.79 mm/yr. **Sections:** This fault has 4 sections. There is insufficient evidence to delineate seismogenic segments. The sections defined in this compilation are based on geomorphic expression, style of faulting, and geometry. From north to south the sections are: Northern Panamint Valley [67a], Wildrose [67b], Southern Panamint Valley [67c], and Brown Mountain [67d].
Name comments	**General:** Panamint Valley fault zone was first described and named by Noble (1926 #1592), who considered the fault to be a normal dip-slip range-front fault. The Brown Mountain fault was first mapped and named by Muehlberger (1954 #6065). **Section:** Section name proposed in this compilation. Section extends from the vicinity of Ballarat south-southeast to the vicinity west of Brown Mountain. The northern part of the

	Southern Panamint Valley section joins with the Wildrose section along a 4-km-wide right-releasing bend near Ballarat. The southern end of the Southern Panamint Valley section [67b] may complexly join with the Brown Mountain fault along a compressional left step-over along the southern side of Brown Mountain. **Fault ID:** Refers to numbers 247 (Panamint Valley fault) and 269 (Brown Mountain fault) of Jennings (1994 #2878).
County(s) and State(s)	SAN BERNARDINO COUNTY, CALIFORNIA INYO COUNTY, CALIFORNIA
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:62,500 scale. *Comments:* Locations based on digital revisions to Jennings (1994 #2878) using original mapping by Johnson (1957 #6513), Carranza (1965 #6512), Smith and others (1968 #6456), Moyle (1969 #6514), and Bryant (1989 #1459) at 1:62,500.
Geologic setting	Major oblique-slip fault characterized by both dextral strike-slip and normal dip-slip faults. Panamint Valley fault zone is located within the Death Valley extension region, the most active part of the southern Basin and Range province (Zhang and others, 1990 #199). The Panamint Valley fault zone is a Holocene active range-front fault that extends from the northern Panamint Valley southeast to the Garlock fault zone [69]. Dextral slip is probably transferred northward to the Hunter Mountain-Saline Valley fault zone [66] along a complex compressional left step at the northern end of Panamint Valley indicated by north-dipping Quaternary thrust faults (Smith, 1975 #1219; Smith, 1976 #1646). Reheis (1991 #1602) suggested that the southern end of the Hunter Mountain fault zone [66] extended into northern Panamint Valley and ended just north of Wildrose graben. Smith (1976 #1646) and Zellmer (1980 #1705) considered the junction between the Hunter Mountain [66] and Panamint Valley faults to be at the northern end of Panamint Valley south of Hunter Mountain. In this compilation, the northern end of the Panamint Valley fault zone is considered to be delineated by the shallow northeast-dipping thrust fault along the south side of Hunter Mountain mapped by Smith (1976 #1646). To the southeast, the Panamint Valley fault

	zone complexly joins the sinistral strike-slip Garlock fault zone [69] along the dextral Brown Mountain fault [67d]. Late Quaternary and Holocene displacement is characterized by both normal dip-slip and dextral strike-slip displacement. Dip-slip faults commonly occur along the range front and dextral strike-slip faults occur west of the range front. Johnson (1957 #6513) estimated that cumulative down-to-west vertical displacement may total as much as 1,800 m. Smith (1979 #1647) reported that 300-600 m of Quaternary dextral offset and as much as 3-4.5 km of cumulative dextral strike-slip displacement characterize the Panamint Valley fault zone. Normal dip-slip displacement may total as much as 10 km (Smith, 1976 #1646). Burchfiel and others (1987 #1454) reported that cumulative dextral strike-slip displacement may total as much as 8-10 km since late Miocene time.
Length (km)	This section is 54 km of a total fault length of 104 km.
Average strike	N16°W (for section) versus N22°W,N36°W (for whole fault)
Sense of movement	Right lateral, Normal *Comments:* Zhang and others (1990 #199) stated that this section of the Panamint Valley fault zone is characterized by oblique dextral-normal displacement that is partitioned between dip-slip faults commonly restricted to the range front and dextral strike-slip faults that are west of the range front.
Dip Direction	V; W
Paleoseismology studies	One study to date has addressed amount of slip an d slip rate. No trenches were excavated, but Zhang and others (1990 #199) completed geomorphic analysis and documentation of stream channel displacements by constructing detailed topographic maps at a scale of approximately 1:300 of dextrally displaced stream channels at Goler Wash Canyon (site 67-2) and Manly Peak Canyon (site 67-1). Zhang and others (1990 #199) identified dextral displacements of 3 m to 37 m for progressively older alluvial fan features, suggesting a characteristic surface-rupturing event of about 3 m. Zhang and others (1990 #199) used this data, along with the history of pluvial Lake Panamint developed by Smith (1976 #1646) to estimate dextral slip rates for the Panamint Valley fault zone.
Geomorphic	The Southern Panamint Valley section is delineated by well-

expression	defined geomorphic evidence characteristic of both dextral strike-slip and normal dip-slip displacement along north to northwest-striking faults. Panamint Valley fault zone along this section locally is delineated by two or more parallel traces. The eastern strands are characterized by geomorphic features indicative of normal dip-slip offset such as well-defined scarps on latest Pleistocene and Holocene alluvial fans along the prominent west-facing bedrock range front, vertically offset drainages, and faceted spurs (Bryant, 1989 #1459). Western strands are delineated by geomorphic features indicative of Holocene dextral strike-slip offset such as dextrally deflected drainages including consistent 3 m dextral offset of minor stream channels in Holocene alluvium (Zhang and others, 1990 #199), linear ridges, sidehill benches, closed depressions, ponded alluvium, well-defined linear scarps on Holocene alluvium, linear toughs, and linear tonal contrasts on Holocene alluvium (Bryant, 1989 #1459).
Age of faulted surficial deposits	Fault offsets alluvium that is post-latest desiccation of pluvial Lake Panamint (15?5 ka; Smith, 1976 #1646). Bryant (1989 #1459) observed an approximately 2.5-m-high scarp on young alluvium of Manly Peak Canyon. Here dextral strike-slip faults offset alluvium characterized by well-preserved constructional surfaces, unweathered granitic clasts, surfaces that lack desert pavement and rock varnish that suggest mid- to late Holocene age (Bryant, 1989 #1459). Several minor stream channels cut into young alluvial fan surfaces between Manly Peak Canyon and Goler Wash are dextrally offset about 3 m. The age of this alluvial fan surface is not known, but a mid- to late Holocene age was inferred by Bryant (1989 #1459), based on the preservation of constructional surfaces, lack of desert pavement, weakly developed rock varnish, 6-cm-thick Av horizon, and weakly developed Stage I CaCO3 soil horizon.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Timing of the most recent paleoevent is not well constrained. Zhang and others (1990 #199) reported that this section of the Panamint Valley fault zone may rupture in characteristic earthquakes with about 3 m of dextral offset, based on observations of offset stream channels that seem to be in multiples of 3. Zhang and others (1990 #199) reported that

	alluvial ridges dextrally displaced about 24-27 m are 17?4 ka, based on a lack of lacustrine deposits from the last desiccation of pluvial Lake Panamint. Several minor stream channels cut into young alluvial fan surfaces are dextrally offset about 3 m. The age of this alluvial fan surface is not known, but a mid- to late Holocene age was inferred by Bryant (1989 #1459), based on the preservation of constructional surfaces, lack of desert pavement, weakly developed rock varnish, 6-cm-thick Av horizon, and weakly developed Stage I CaCO3 soil horizon. Smith (1979 #1647) reported that the age of the most recent event is not known, but speculated that it probably occurred at least several hundred years ago.
Recurrence interval	*Comments:* Zhang and others (1990 #199) identified dextral displacements in multiples of 3: the youngest offset is 3 m and dextral offsets of 6 m and 12 m were observed at many places between Manly Peak Canyon and Goler Wash Canyon. Zhang and others (1990 #199) concluded that the average recurrence interval for large surface-rupturing earthquakes on the Southern Panamint Valley section is between 860 and 2,360 yr, based on a 3.2?0.5 m characteristic event and a Holocene slip rate of 2.36?0.79 mm/yr. Smith (1979 #1647) estimated a mean recurrence interval of about 700-2,500 yr, based on an assumed 1.4-2.6 m offset per event and 20 m total offset in the past 10 ka-20 ka.
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* Clark and others (1984 #2876) reported a preferred oblique slip rate of 2 mm/yr, based on offset alluvial features at Manly Peak Canyon. Zhang and others (1990 #199) reported latest Pleistocene to Holocene minimum dextral slip rates of 1.74?0.65 mm/yr and 2.36?0.79 mm/yr. The 1.74?0.65 mm/yr slip rate is based on 24?4 m to 27?4 m dextrally displaced alluvial ridges measured just south of Manly Peak Canyon. Age of offset deposits is not well constrained. Zhang and others (1990 #199) estimated that the age of the offset alluvial ridges is younger that Smiths (1976 #1646) I-stage Lake Panamint high stand. Zhang and others (1990 #199) concluded that the maximum age of the offset alluvial ridges can be constrained to 17?4 ka. The 2.36?0.79 mm/yr slip rate is based on a 37?4 m dextral offset of an alluvial fan edge near Goler Wash Canyon. Zhang and others (1990 #199) assumed similar age relationships interpreted for the Manly Peak

	Canyon alluvial features. The minimum Holocene slip rate calculations reasonably agree with the long term dextral slip rate of 2-3.2 mm/yr reported by Burchfiel and others (1987 #1454) for the Hunter Mountain fault zone [66]. Petersen and others (1996 #4860) assigned a slip rate of 2.5 mm/yr (with minimum and maximum assigned slip rates of 1.5 mm/yr and 3.5 mm/yr, respectively) to the entire fault for probabilistic seismic hazard assessment for the State of California.
Date and Compiler(s)	2000 William A. Bryant, California Geological Survey
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