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Pinto Mountain fault zone (includes Morongo Valley fault) (Class A) No. 118

Last Review Date: 2000-05-05

Compiled in cooperation with the California Geological Survey

citation for this record: **Bryant, W.A., compiler, 2000, Fault number 118, Pinto Mountain fault zone (includes Morongo Valley fault), in Quaternary fault and fold database of the United States: U.S. Geological Survey website, https://earthquakes.usgs.gov/hazards/qfaults, accessed 12/14/2020 02:16 PM.**

Synopsis	Major Holocene active sinistral strike-slip fault along the boundary between the Transverse Ranges and the Mojave Desert. Detailed reconnaissance level mapping based on groundwater data and geologic mapping by Bader and Moyle (1960 #6644), geologic mapping by Dibblee (1967 #1342; 1967 #1345; 1968 #6708), Bacheller (1978 #6675), Grimes (1987 #6680), and Hopson (1996 #6686), and geomorphic mapping by Bryant (1986 #6645). No detailed studies have been completed for the Pinto Mountain fault, although several unpublished consulting reports have documented evidence of latest Pleistocene and Holocene

	displacement. Holocene slip rate and recurrence-interval data have not been reported for the Pinto Mountain fault zone. Anderson (1979 #6674), Bird and Rosenstock (1984 #6183), Wesnousky (1986 #5305), and Petersen and Wesnousky (1994 #6024) assign long-term slip rates of 0.3 to 5.3 mm/yr to the Pinto Mountain fault. Minor triggered slip associated with the Mw 7.3 Landers earthquake was observed along traces of the Pinto Mountain fault zone (Bryant, 1992 #6658; Hart and others, 1993 #3356).
Name comments	The Pinto Mountain fault was first recognized by Vaughn (1922 #5801). Hill (1928 #4959) first mapped the fault and named it the Pinto Mountain fault. Later workers have referred to the fault variously as the Pinto fault (Miller, 1938 #6684), the Warrens Well fault (Hill and Dibblee, 1953 #923), and the Base Line fault (Hewett, 1955 #6681). Allen (1957 #4787) first recognized that a branch of the Pinto Mountain fault extended west along the northwest side of Morongo Valley into Big Morongo Creek, where it merges with the Mission Creek fault [1i] at a low angle. Previous workers had mapped the Pinto Mountain fault along the southeast side of Morongo Valley. Dibblee (1967 #1345) first named the fault along the southeast side of Morongo Valley the Morongo Valley fault. Both the Pinto Mountain fault and Morongo Valley fault are considered in this compilation to comprise the Pinto Mountain fault zone. **Fault ID:** Refers to numbers 425 (Pinto Mountain fault) and 451 (Morongo Valley fault) of Jennings (1994 #2878).
County(s) and State(s)	RIVERSIDE COUNTY, CALIFORNIA SAN BERNARDINO COUNTY, CALIFORNIA
Physiographic province(s)	PACIFIC BORDER 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 Bader and Moyle (1960 #6644) and Dibblee (1967 #1342; 1967 #1345; 1968 #6708) at 1:62,500; mapping by Bryant (1986 #6645) and Bacheller (1978 #6675) at 1:24,000; mapping by Grimes (1987 #6680) at 1:12,000.
Geologic setting	A major east-trending Holocene active sinistral, strike-slip fault

	that forms the boundary between the Mojave Desert and Transverse Ranges geomorphic provinces. The Pinto Mountain fault zone extends from the area east of Twentynine Palms west to the San Andreas fault [1] and generally forms a south-facing escarpment along the south margin of the elevated eastern San Bernardino Mountains (Dibblee, 1992 #6679). Near the western end of Yucca Valley the fault zone splays into two major strands along a significant dilatational step, the Pinto Mountain fault to the north and the Morongo Valley fault to the south. These two splays bound Morongo Valley which is considered a pull-apart basin by Hopson (2000 #6682). East of Yucca Valley the Pinto Mountain fault is generally delineated by a single strand, although the fault trace is locally complex in detail. The Pinto Mountain fault zone is complex and locally poorly defined as it approaches the northwest-striking Mesquite Lake fault [123]. The extension of the Pinto Mountain fault east of the Mesquite Lake fault [123] is somewhat conjectural. Dibblee (1992 #6679) inferred that the Pinto Mountain fault does not extend east of the Mesquite Lake fault [123], while Bacheller (1978 #6675) and Howard and others (in press #6683) map the fault about 5 km east of the Mesquite Lake fault [123]. Bryant (1986 #6645) interpreted the Pinto Mountain fault to extend about 2.5 km east of the Mesquite Lake fault [123], but farther east the fault lacks geomorphic evidence of latest Pleistocene offset. Cumulative sinistral displacement may total 16 km (Dibblee, 1975 #6678) to 19 km (Bacheller, 1978 #6675). Dibblee (1968 #6677; 1975 #6678) stated that the magnitude of sinistral displacement diminishes westward from 16 km near the central fault zone to up-to-the-north vertical displacement in the western part of the study area. Minor triggered slip associated with the June 27, 1992, Mw 7.3 Landers earthquake occurred along traces of the Pinto Mountain fault zone (Bryant, 1992 #6658; Hart and others, 1993 #3356).
Length (km)	82 km.
Average strike	N85°E
Sense of movement	Left lateral *Comments:* Dibblee (1975 #6678) reported that the Pinto Mountain fault is characterized by a maximum of 16 km of sinistral offset. Bacheller (1978 #6675) stated that Pinto Mountain displaces Mesozoic crystalline bedrock up to 19 km in a sinistral sense. Dibblee (1968 #6677) mapped an approximately 9.6 km offset of Pleistocene(?) quartzite- and basalt-bearing fanglomerate

	along the Pinto Mountain fault. Geomorphic expression of the fault is consistent with Holocene sinistral strike-slip offset (Bryant, 1986 #6645). Dibblee (1967 #1345) depicted a down-to-northwest vertical component of displacement along the Morongo Valley fault.
Dip	50° N to vertical *Comments:* Dibblee (1975 #6678) reported that exposures of the Pinto Mountain fault indicate that it is nearly vertical. Bryant (1986 #6645) reported exposures of the fault that locally dip from 50? to 70? N.
Paleoseismology studies	Several unpublished consulting reports on file with the California Geological Survey (C file reports) document the location and relative activity of the Pinto Mountain fault, based on trenching studies. Estimates of Holocene age for the oldest alluvium offset is based on relative soil profile development, degree of preservation of constructional geomorphic surfaces, and rock varnish and desert pavement development (Bryant, 1986 #6645).
Geomorphic expression	The Pinto Mountain fault zone is delineated by moderately to well defined geomorphic features indicative of Holocene sinistral, strike-slip displacement such as sinistrally deflected drainages, beheaded drainages, linear scarps in late Pleistocene and Holocene alluvium, pressure ridges, shutter ridges, closed depressions, and well defined linear tonal contrasts and springs in Holocene alluvium (Allen, 1957 #4787; Bryant, 1986 #6645). Significant portions of the Pinto Mountain fault zone are concealed by late Holocene alluvium.
Age of faulted surficial deposits	Pinto Mountain fault zone offsets Mesozoic crystalline basement rocks, late Pleistocene Campbell Hill Formation (Bacheller, 1978 #6675), and Holocene alluvium (Rasmussen, 1977 #6685 cited in Bryant, 1986 #6645). The age of the Campbell Hill Formation is probably less than 500 ka, based on the presence of Rancho-labrean mammalian fauna (Bacheller, 1978 #6675). The age of faulted Holocene alluvium is based on poorly developed soil profile development (Rasmussen, 1977 #6685; Bryant, 1986 #6645).
Historic earthquake	

Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* The timing of the most recent paleoevent has not been determined. Alluvial deposits with poorly developed soil profiles indicative of undifferentiated Holocene age are offset, but significant lengths of the fault zone are concealed by late Holocene alluvium (Bryant, 1986 #6645).
Recurrence interval	
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* Reported slip rates for the Pinto Mountain fault are poorly constrained with respect to amount and timing of displacement. Dibblee (1975 #6678) reported a maximum cumulative sinistral displacement of 16 km of Mesozoic crystalline basement rocks. Anderson (1979 #6674) used this data to infer a long-term slip rate of 1-2 mm/yr. Bird and Rosenstock (1984 #6183) reported a sinistral slip rate of 5.3 mm/yr, based on the reported 9.6 km offset of Pleistocene(?) fanglomerate. Wesnousky (1986 #5305) and Petersen and Wesnousky (1994 #6024) reported a slip rate of 0.3-5.3 mm/yr and a preferred slip rate of 1 mm/yr, based on the 9.6 km offset reported by Dibblee (1968 #6677) and assumptions of the age of the offset fanglomerate that ranged from Pleistocene to Miocene. Slip rate assigned by Petersen and others (1996 #4860) for probabilistic seismic hazard assessment for the State of California was 2.5 mm/yr (with minimum and maximum assigned slip rates of 0.5 mm/yr and 4.5 mm/yr, respectively).
Date and Compiler(s)	2000 William A. Bryant, California Geological Survey
References	#4787 Allen, C.R., 1957, San Andreas fault zone in San Gorgonio Pass, southern California: Geological Society of America Bulletin, v. 68, no. 3, p. 315-350. #6674 Anderson, J.G., 1979, Estimating the seismicity from geologic structure, for seismic-risk studies: Bulletin of the Seismological Society of America, v. 69, p. 135-158. #6675 Bacheller, J., III, 1978, Quaternary geology of the Mojave Desert-eastern Transverse Ranges boundary in the vicinity of Twentynine Palms, California: Los Angeles, University of

California, unpublished M.S. thesis, 157 p., scale 1:24,000.

#6644 Bader, J.S., and Moyle, W.R., 1960, Data on water wells and springs in the Yucca Valley-Twentynine Palms area, San Bernardino and Riverside Counties, California: California Department of Water Resources Bulletin 91-2, 163 p., scale 1:62,500.

#6183 Bird, P., and Rosenstock, R.W., 1984, Kinematics of present crust and mantle flow in southern California: Geological Society of America Bulletin, v. 95, p. 946-957.

#6645 Bryant, W.A., 1986, Pinto Mountain, Mesquite Lake, Copper Mountain, and related faults, San Bernardino County, California: California Division of Mines and Geology Fault Evaluation Report, FER-181 (microfiche copy in California Division of Mines and Geology Open-File Report 90-14), scale 1:24,000.

#6658 Bryant, W.A., 1992, Surface fault rupture along the Johnson Valley, Homestead Valley, and related faults associated with the Ms 7.5 28 June 1992 Landers earthquake: California Department of Conservation, Division of Mines and Geology Fault Evaluation Report FER-234, 21 p., scale 1:24,000.

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#6677 Dibblee, T.W., Jr., 1968, Evidence of major lateral displacement on the Pinto Mountain fault, southeastern California [abs.]: Geological Society of America Special Paper 115, 322 p.

#6708 Dibblee, T.W., Jr., 1968, Geologic map of the Twentynine Palms quadrangle, San Bernardino and Riverside Counties, California: U.S. Geological Survey Miscellaneous Investigations Map I-561, 1 sheet, scale 1:62,500.

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#6679 Dibblee, T.W., Jr., 1992, Geology and inferred tectonics of the Pinto Mountain fault, eastern Transverse Ranges, California, *in* Richard, S.M., ed., Deformation associated with the Neogene eastern California shear zone, southeastern California and southwestern Arizona: San Bernardino County Museum, Special Publication 92-1, Workshop on the Eastern California shear zone, southeastern California and southwestern Arizona, Proceedings, p. 28-31.

#6680 Grimes, G.J., 1987, Geology at the convergence of the Pinto Mountain fault and Morongo Valley fault, southern California: Los Angeles, California State University, unpublished M.S. thesis, 102 p., scale 1:12,000.

#3356 Hart, E.A., Bryant, W.A., and Treiman, J.A., 1993, Surface faulting associated with the June 1992 Landers earthquake, California: California Geology, v. 46, p. 10-16.

#6681 Hewett, D.F., 1955, Structural features of the Mojave Desert region, *in* Poldervaart, A., ed., Crust of the earth: Geological Society of America Special Paper 62, p. 377-390.

#923 Hill, M.L., and Dibblee, T.W., Jr., 1953, San Andreas, Garlock, and Big Pine faults, California: Geological Society of America Bulletin, v. 64, p. 443–458.

#4959 Hill, R.T., 1928, Southern California geology and Los Angeles earthquakes: Los Angeles, Southern California Academy of Sciences, 232 p.

#6686 Hopson, R.F., 1996, Basement rock geology and tectonics of the Pinto Mountain fault, San Bernardino County, southern California: Los Angeles, CA, California State University, unpublished M.S. thesis, 132 p.

#6682 Hopson, R.F., 2000, The origin of Morongo Valley, a pull-apart basin in the Transverse Ranges, southern California: Geological Society of America, Abstracts with Programs, v. 33, no. 3, p. 65.

#6683 Howard, K.A., Bacheller, J., Fitzgibbon, T.T., Powell, R.E., and Allen, C.M., 1995, Geologic map of the Valley Mountain 15-minute quadrangle, San Bernardino and Riverside Counties, California: U.S. Geological Survey Open-File Report 95-528, scale 1:62,500.

#2878 Jennings, C.W., 1994, Fault activity map of California and adjacent areas, with locations of recent volcanic eruptions: California Division of Mines and Geology Geologic Data Map 6, 92 p., 2 pls., scale 1:750,000.