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Quaternary Fault and Fold Database of the United States

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Big Pine fault zone, Eastern Big Pine section (Class A) No. 86b

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Synopsis	**General:** Significant east to northeast-striking fault zone along the northern Transverse Range-southern Coast Range margin. Fault zone has not been studied in detail until recently. Originally thought by Hill and Dibblee (1953 #923) to be a major, through-going sinistral strike-slip fault, but Onderdonk and others (2005 #7913) have shown the fault to consist of three distinct structures: the Western Big Pine, Eastern Big Pine, and Lockwood Valley faults. Only the easternmost Lockwood Valley fault exhibits predominantly sinistral strike-slip offset. The Western Big Pine fault is a north-dipping reverse fault and the Eastern Big Pine fault is characterized by south-dipping reverse displacement. Direct evidence of Holocene displacement has not been observed except for the eastern Lockwood Valley fault near the San Andreas fault (Smith, 1977 #7914; Bryant-Park and Assoc., 1975 #7901). DeLong and others (2007 #7903) inferred that the central

	reach of the Eastern Big Pine fault may have evidence of Holocene displacement. At a site near Camp Scheideck, DeLong and others (2007 #7903) estimated an age of about 14–25 ka for an offset stream terrace, based on OSL dating; the terrace is vertically displaced about 10 m. Using an average dip of 50°, they estimated a dip-slip rate of about 0.9 mm/yr. They argued that the 10 m vertical displacement probably did not occur in a single rupture event but ruptured several times since 14–15 ka. **Sections:** This fault has 3 sections. Following the structural nomenclature of Onderdonk and others (2005 #7913) the Big Pine fault zone is divided into three sections. From west to east the sections are: Western Big Pine section, Eastern Big Pine section, and Lockwood Valley section. The boundary between the Western and Eastern Big Pine sections is delineated at the intersection with the Pine Mountain fault [261] where the fault dip changes from north (Western Big Pine fault) to south (Eastern Big Pine fault). The boundary between the Eastern Big Pine and Lockwood Valley sections marks the change from predominantly south-dipping reverse displacement along the Eastern Big Pine section to predominately sinistral strike-slip displacement along the Lockwood Valley section.
Name comments	**General:** Big Pine fault first mapped and named by Nelson (1925 #7912), based on north-dipping reverse fault along the south side of Big Pine Mountain. Onderdonk and others (2005 #7913) suggested that Big Pine fault zone actually was three distinct faults they termed the Western Big Pine fault, Eastern Big Pine fault, and Lockwood Valley fault. **Section:** The Eastern Big Pine section extends for about 20 km along a NE strike, bounding the southern edge of the Cuyama Badlands. The western end of the Eastern Big Pine section is delineated by a change from a north-dipping fault zone characterizing the Western Big Pine section [86a] to a south-dipping reverse fault at the intersection with the Pine Mountain fault [261] about 5 km SW of the intersection of Highway 33 and Lockwood Valley Road. The eastern end of the Eastern Big Pine section is delineated by a change in displacement from predominantly south-dipping reverse to predominately sinistral strike-slip near the intersection with the San Guillermo fault. Onderdonk and others (2005 #7913) consider the San Guillermo fault to be continuous with the Eastern Big Pine section. **Fault ID:** Refers to numbers 307 (Big Pine fault, western part)

	and 318 (Big Pine fault, eastern part) of Jennings and Bryant (2010 #7904).
County(s) and State(s)	VENTURA COUNTY, CALIFORNIA
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Good Compiled at 1:24,000 and 1:48,000 scale. *Comments:* Digital compilation is based on 1:24,000-scale mapping by Minor (1999 #7908, 2004 #7909); mapping at 1:48,000-scale is based on Vedder and others (1973 #7916).
Geologic setting	The Big Pine fault zone is an east to northeast striking fault zone that extends for about 80 km from the Big Bend of the San Andreas fault zone [1] westward along the boundary between the northern Transverse Ranges and the southern Coast Ranges. Displacement along the Big Pine fault zone originally was thought to have been predominantly sinistral strike-slip displacement (*e.g.*, Hill and Dibblee, 1953 #923). Hill and Dibblee (1953 #923) postulated about 16 km of cumulative sinistral displacement. In contrast, Onderdonk and others (2005 #7913) consider the Big Pine fault zone to consist of three separate structures, from west to east: the Western Big Pine fault, Eastern Big Pine fault, and Lockwood Valley fault. The Western and Eastern Big Pine faults are characterized by predominantly reverse displacement and the Lockwood Valley fault displays predominantly sinistral strike-slip offset (Onderdonk and others, 2005 #7913). Cumulative displacement for the Western Big Pine fault is not known due to the discontinuity in structural grain and stratigraphy across the fault (Onderdonk and others, 2005 #7913). Cumulative displacement across the Eastern Big Pine fault is not well constrained due to incomplete exposures of older units in the footwall and erosion of younger units in the hanging wall, but Onderdonk and others (2005 #7913) estimate between 3 and 4 km of reverse separation has occurred. Cumulative displacement along the Lockwood Valley fault has not been reported.
Length (km)	km.
Average strike	
Sense of	Reverse, Strike slip

movement	*Comments:* Onderdonk and others (2005 #7913). Drag folding and fault straie suggest minor components of both sinistral and dextral displacement. The San Guillermo fault has predominantly reverse displacement with 20–30 percent component of strike slip offset Onderdonk and others (2005 #7913).
Dip	45° S. *Comments:* Average dip as reported by Onderdonk and others (2005 #7913)
Paleoseismology studies	
Geomorphic expression	Weber and others (1975 #7918), Smith (1977 #7914), and Minor (2004 #7909) mapped scarps on Quaternary terrace deposits of the Cuyama River.
Age of faulted surficial deposits	Fault juxtaposes Eocene sedimentary rocks in hanging wall over Miocene through Pliocene sedimentary rocks in the footwall (Minor, 2004 #7909). Fault locally offsets Pleistocene-age stream terrace deposits (Qoa unit of Vedder and others, 1973 #7916); Qoa unit of Minor, 2004 #7909). DeLong and others (2007 #7903) reported the age of alluvium offset by the Eastern Big Pine section to be between 14 and 25 ka, based on OSL dating.
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* Timing of most recent paleoevent is poorly constrained. Minor (2004 #7909) mapped late Pleistocene stream terrace deposits of the Cuyama River as offset by the Eastern Big Pine section.
Recurrence interval	*Comments:* DeLong and others (2007 #7903) speculated that the Eastern Big Pine section may have multiple reverse-slip ruptures in the past 14 ka. This is based on their observation that the fault displaces a 14–25 ka terrace deposit about 10 m. Thus, either a single 10 meter event occurred along the Eastern Big Pine section, or the 10 m is cumulative since deposition of the

	alluvium.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Petersen and Wesnousky (1994 #6024) reported a preferred sinistral slip rate of 4 mm/yr, based on the assumption that the Big Pine fault sinistrally offsets the Ozena fault [256] on the north from the San Guillermo fault on the south about 13–19 km in the last 6–18 Ma (based on Molnar, 1991 #7910). Bird and Rosenstock (1984) estimated a late Pliocene to Quaternary sinistral slip rate of at least 0.8 mm/yr, based on about 4.8 km offset of a 1.8–5.9 Ma deposit (Morales Formation) reported by Kahle (1966 #7905). However, Onderdonk and others (2005 #7913) argue that the Eastern Big Pine section is characterized by predominantly reverse displacement and mapping by Minor (1999 #7908) has shown that the San Guillermo fault is continuous with the Eastern Big Pine section, negating the argument of significant sinistral displacement. DeLong and others (2007 #7903) reported a dip-slip rate of about 0.9 mm/yr for a strand of the Eastern Big Pine section near Camp Scheideck. A 14–25 ka (OSL age) terrace deposit is offset about 10 m (vertical) near the southern margin of the Cuyama structural basin near the Cuyama River. Using a 50° dip, DeLong and others (2007 #7903) calculated a dip-slip separation of about 13 m. Although these values suggest a dip-slip rate of about 0.7 mm/yr, DeLong and others (2007) consider the 25 ka OSL age to be spurious and used 14 ka as the age of the deposit. However, even excluding the 25 ka age for sample OSL11, the remaining samples suggest an average age of about 18 ka for the sandy deposits. What is not known is the age of displacement relative to the terrace deposit.
Date and Compiler(s)	2017 William A. Bryant, California Geological Survey
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#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.

#7904 Jennings and Bryant, W.A., 2010, Fault activity map of California: California Geological Survey Geologic Data Map No. 6, map scale 1:750,000.

#7905 Kahle, J. E., 1966, Megabreccias and sedimentary structures of the Plush Ranch Formation, northern Ventura County, California: Los Angeles, University of California, unpublished M.S. thesis, 125 p.

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#7913 Onderdonk, N.W., Minor, S.A., and Kellogg, K.S., 2005, Taking apart the Big Pine fault—Redefining a major structural feature in southern California: Tectonics, v. 24, TC6002, doi:10.1029/2005TC001817, 11 p.

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	Evaluation Reports Prepared Under the Alquist-Priolo Earthquake Fault Zoning Act, Region 1 – Central California: California Geological Survey CGS CD 2002-01 (2002). #7916 Vedder, J.G., Dibblee, T.W., Jr., and Brown, R.D., Jr., 1973, Geologic map of the upper Mono Creek-Pine Mountain area, California: U.S. Geological Survey Map I-752, scale 1:48,000. #7918 Weber, F.H., Jr., Kiessling, E.W., Sprotte, E.C., Johnson, J.A., Sherburne, R.W., and Cleveland, G.B., 1975, Seismic hazards study of Ventura County, California: California Division of Mines and Geology Open-File Report 76-5 LA, 396 p., 9 plates, scale 1:48,000