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Helendale-South Lockhart fault zone, South Lockhart section (Class A) No. 110a

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citation for this record: **Bryant, W.A., and Perry, S., compilers, 2002, Fault number 110a, Helendale-South Lockhart fault zone, South Lockhart section, 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 02:19 PM.**

Synopsis	**General:** Major Holocene active dextral strike-slip fault zone located in the Central Mojave Desert. Fault zone is divided into sections for this compilation and includes: the South Lockhart, Helendale, and Northern San Bernardino Mountains sections. Detailed reconnaissance level geologic and geomorphic mapping of the fault zone includes Dibblee (1958 #6627; 1960 #6628; 1960 #6629; 1960 #6630; 1964 #1343; 1967 #1345; 1967 #6614; 1968 #6631), Page and Moyle (1960 #6637), Morton and others (1980 #6636), Manson (1986 #6635), Bryant (1986 #6611; 1987 #6626), and Bryan (1995 #6625). Holocene slip rate has not been determined for the Helendale fault. Clark and others (1984 #2876) reported a long term (Miocene) slip rate of about 1 mm/yr, based on 1–2 km dextrally offset pluton boundary (Miller and Morton,

	1980 #6618). Onset of displacement is poorly constrained between 2 Ma and 20 Ma. Petersen and Wesnousky (1994 #6024) reported a preferred slip rate of 0.8 ? 0.7 mm/yr based on 3 km dextral offset of petrologically distinct pluton reported by Dokka (1983 #6632) and Dokka and Travis (1990 #3188) and assumed initiation of offset between 2 Ma and 20 Ma. Bryan (1995 #6625) excavated three trenches (sites 110-1 and 110-2, herein) across traces of the Helendale fault in the Lucerne Valley and exposed evidence of as many as three earthquakes since about 16.5 ka. Most recent paleoevent occurred post 2.3 ka, based on calibrated 14C age of offset alluvium reported by Bryan (1995 #6625), perhaps within the last 1–2 ka. **Sections:** This fault has 3 sections. There is insufficient data to designate seismogenic segments. Wesnousky (1986 #5305) proposed three segments for the Helendale fault (from north to south: Helendale A, B, and C) and considered the South Lockhart a separate fault. Page and Moyle (1960 #6637) inferred that the South Lockhart fault was the northern-most extension of the Helendale fault. Petersen and others (1996 #4860) combined the Helendale fault zone north of the San Bernardino Mountains and the South Lockhart fault. This compilation will delineate 3 sections: The South Lockhart section, which incorporates the South Lockhart fault; the Helendale section, which includes the principal active traces of the Helendale fault zone; and the Northern San Bernardino Mountains section, which includes the Helendale and North Branch Helendale faults south of the North Frontal thrust system [109].
Name comments	**General:** Helendale fault first mapped by Vaughn (1922 #5801) and named by Bowen (1954 #6624). South Lockhart fault first mapped and named by Dibblee (1958 #6627; 1968 #6631). **Section:** South Lockhart section proposed in this compilation, in part based on modeling by Petersen and others (1996 #4860). Section extends from its presumed junction with the Lockhart fault [111] about 10 km northwest of Highway 395 southeast to south-southeast where the south-southeast striking fault changes to a southeast strike and is concealed by late Holocene fluvial deposits of the Mojave River, about 15 km northwest of Highway 15. The south-southeast striking South Lockhart fault may delineate a large right step-over to the Lockhart fault [111] (Page and Moyle, 1960 #6637). **Fault ID:** Refers to numbers 365 (South Lockhart fault), 382

	(Helendale fault), and 413 (Helendale fault (southeast extension)) of Jennings (1994 #2878) and number 42 (Helendale fault) of Ziony and others (1985 #5931).
County(s) and State(s)	KERN COUNTY, CALIFORNIA SAN BERNARDINO 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 Dibblee (1958 #6627; 1960 #6628; 1968 #6631) and Page and Moyle (1960 #6637) at 1:62,500 and geomorphic mapping by Bryant (1987 #6626) at 1:62,500 and 1:24,000.
Geologic setting	Major Holocene active dextral strike slip fault zone located in the central Mojave Desert. The northwest-striking Helendale-South Lockhart fault zone is the westernmost of a series of sub-parallel dextral strike-slip faults in the central Mojave Desert and is part of the eastern California shear zone (Dokka and Travis, 1990 #3188). The Helendale-South Lockhart fault zone extends from its presumed junction with the Lockhart fault zone [111] about 10 km northwest of Highway 395 along the South Lockhart fault [110a] south-southeast to about 15 km northwest of Highway 15 where the South Lockhart fault may form a large right step-over to the Helendale fault. The Helendale fault bounds the southwest side of the Sidewinder Mountains, through the Lucerne Valley and into the northern San Bernardino Mountains. The complex junction between the Helendale-South Lockhart fault zone and North Frontal thrust system [109] is poorly understood. Some have mapped the Helendale fault [110b] as through-going into the San Bernardino Mountains, offsetting the North Frontal thrust system [109] (e.g. Dibblee, 1964 #1343; Hollenbaugh, 1968 #6634), while others map the North Frontal thrust system [109] as continuous across the Helendale fault [110b] (e.g. Bryant, 1986 #6611; Miller, 1987 #6617). Cumulative dextral displacement across the Helendale-South Lockhart fault zone may total 3 km, based on an offset 75 Ma pluton (Dokka and Travis, 1990 #3188). Miller and Morton (1980 #6618) argue that this offset pluton is dextrally offset only about 1 to 2 km. Garfunkel (1974 #6633) estimated that 10 to 15 km of dextral offset has occurred along the

	fault zone, based on locations of Paleozoic marine sedimentary rocks north and east of Victorville.
Length (km)	This section is 50 km of a total fault length of 135 km.
Average strike	N27°W
Sense of movement	Right lateral *Comments:* Sense of displacement is not well constrained, but the variable sense of apparent vertical displacement along strike and dextrally deflected drainages is indicative of predominantly dextral offset (Bryant, 1987 #6626).
Dip Direction	V *Comments:* Dip is poorly constrained due to lack of surficial exposures and lack of well-located seismicity.
Paleoseismology studies	
Geomorphic expression	South Lockhart fault is poorly defined at its northern and southern ends, but the central portion is delineated by generally well-defined geomorphic evidence of latest Pleistocene to Holocene dextral displacement such as dextrally displaced drainages, linear scarps in latest Pleistocene to Holocene alluvium, linear troughs and graben in alluvium, ponded alluvium, and a closed depression (Bryant, 1987 #6626).
Age of faulted surficial deposits	Age of faulted deposits is poorly constrained. Fault offsets Mesozoic crystalline basement rocks, Pleistocene alluvium, and, locally, Holocene alluvium (Dibblee, 1958 #6627; 1960 #6628; Page and Moyle, 1960 #6637; 1968 #6631; Bryant, 1987 #6626).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Timing of most recent event is poorly constrained. Geomorphic expression of central part of South Lockhart fault is consistent with Holocene dextral strike-slip displacement (Bryant, 1987 #6626).
Recurrence	

interval	
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Slip rate is not known for the South Lockhart fault, but geomorphic expression is similar to other faults in Mojave Desert with slip rates of about 0.5 mm/yr. Slip rate assigned by Petersen and others (1996 #4860) for combined South Lockhart and Helendale faults for probabilistic seismic hazard assessment for the State of California was 0.6 mm/yr (with minimum and maximum assigned slip rates of 0.2 mm/yr and 1.0 mm/yr, respectively.
Date and Compiler(s)	2002 William A. Bryant, California Geological Survey Sue Perry, Southern California Earthquake Center/U.S. Geological Survey
References	#6624 Bowen, O.B., Jr., 1954, Geology and mineral deposits of Barstow quadrangle, San Bernardino County, California: California Division of Mines Bulletin 165, 208 p., 8 pls., scale 1:125,000. #6625 Bryan, K.A., 1995, Comparison of brittle vs. ductile surface deformation in an Alquist-Priolo earthquake fault zone-Example from the Helendale fault, San Bernardino County, California: San Diego, Calif., San Diego State University, unpublished M.S. thesis, 64 p., 3 pls. #6611 Bryant, W.A., 1986, Eastern North Frontal fault zone and related faults, southwestern San Bernardino County: California Division of Mines and Geology Fault Evaluation Report FER-182, microfiche copy in California Division of Mines and Geology Open-File Report 90-14, 20 p., scale 1:24,000. #6626 Bryant, W.A., 1987, Recently active traces of the Blackwater, Harper, Lockhart and related faults near Barstow, San Bernardino County: California Division of Mines and Geology Fault Evaluation Report FER-189, microfiche copy in California Division of Mines and Geology Open-File Report 90-14, 17 p., scale 1:24,000. #2876 Clark, M.M., Harms, K.H., Lienkaemper, J.J., Harwood, D.S., Lajoie, K.R., Matti, J.C., Perkins, J.A., Rymer, M.J., Sarna-Wojcicki, A.M., Sharp, R.V., Sims, J.D., Tinsley, J.C., III, and Ziony, J.I., 1984, Preliminary slip rate table and map of late

Quaternary faults of California: U.S. Geological Survey Open-File Report 84-106, 12 p., 5 plates, scale 1:1,000,000.

#6627 Dibblee, T.W., Jr., 1958, Geologic map of the Boron quadrangle, Kern and San Bernardino Counties, California: U.S. Geological Survey Mineral Investigations Field Studies Map MF 204, scale 1:62,500.

#6628 Dibblee, T.W., Jr., 1960, Geologic map of the Hawes quadrangle, San Bernardino County, California: U.S. Geological Survey Mineral Investigations Field Studies Map MF 226, scale 1:62,500.

#6629 Dibblee, T.W., Jr., 1960, Preliminary geologic map of the Apple Valley quadrangle, California: U.S. Geological Survey Mineral Investigations Field Studies Map MF-232, scale 1:62,500.

#6630 Dibblee, T.W., Jr., 1960, Preliminary geologic map of the Victorville quadrangle, San Bernardino County, California: U.S. Geological Survey Mineral Investigations Field Studies Map MF 229, scale 1:62,500.

#1343 Dibblee, T.W., Jr., 1964, Geologic map of the Lucerne Valley quadrangle San Bernardino County, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-426, 6 p. pamphlet, 1 sheet, scale 1:62,500.

#1345 Dibblee, T.W., Jr., 1967, Geologic map of the Morongo Valley quadrangle San Bernardino and Riverside Counties, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-517, 4 p. pamphlet, 1 sheet, scale 1:62,500.

#6614 Dibblee, T.W., Jr., 1967, Geologic map of the Old Woman Springs quadrangle, San Bernardino County, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-518, scale 1:62,500.

#6631 Dibblee, T.W., Jr., 1968, Geology of the Fremont Peak and Opal Mountains quadrangles, California: California Division of Mines and Geology Bulletin 188, scale 1:62,500.

#6632 Dokka, R.K., 1983, Displacements on late Cenozoic strike-slip faults of the central Mojave Desert, California: Geology, v. 1,

p. 305-308.

#3188 Dokka, R.K., and Travis, C.J., 1990, Late Cenozoic strike-slip faulting in the Mojave Desert, California: Tectonics, v. 9, p. 311-340.

#6633 Garfunkel, Z., 1974, Model for the late Cenozoic tectonic history of the Mojave Desert, California and for its relation to adjacent areas: Geological Society of America Bulletin, v. 85, p. 1931-1944.

#6634 Hollenbaugh, K.M., 1968, Geology of a portion of the north flank of the San Bernardino Mountains, California: University of Idaho, Ph.D. thesis, 109 p., 1 pl., scale l:12,000.

#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.

#6635 Manson, M., 1986, Helendale fault, San Bernardino County: California Division of Mines and Geology Fault Evaluation Report FER-176, microfiche copy in California Division of Mines and Geology Open-File Report 90-14, 13 p., scale 1:24,000 and 1:62,500.

#6617 Miller, F.K., 1987, Reverse-fault system bounding the north side of the San Bernardino Mountains, *in* Recent reverse faulting in the Transverse Ranges, California: U.S. Geological Survey Professional Paper 1339, p. 83-95, scale 1:48,000.

#6618 Miller, F.K., and Morton, D.M., 1980, Potassium-Argon geochronology of the eastern Transverse Ranges and southern Mojave Desert, Southern California: U.S. Geological Survey Professional Paper 1152, 30 p., 1 pl., scale approximately 1:512,800.

#6636 Morton, D.M., Miller, F.K., and Smith, C.C., 1980, Photoreconnaissance maps showing young-looking fault features in the southern Mojave Desert, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1051, 7sheets, scale 1:24,000 and 1:62,500.

Questions or comments?