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# Quaternary Fault and Fold Database of the United States

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# Lenwood-Lockhart fault zone, Lockhart section (Class A) No. 111a

**Last Review Date: 2000-09-20**

# Compiled in cooperation with the California Geological Survey

***citation for this record:*** **Bryant, W.A., compiler, 2000, Fault number 111a, Lenwood-Lockhart fault zone, 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 02:18 PM.**

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| **Synopsis** | **General:** Major Holocene active dextral strike-slip fault zone located in the Central Mojave Desert. Fault zone is divided into two sections for this compilation; the Lockhart and Lenwood sections. Detailed reconnaissance-level geologic and geomorphic mapping of the fault zone includes Dibblee (1958 #6627; 1960 #6628; 1960 #6638; 1964 #1249; 1964 #6639; 1967 #6614; 1968 #6631; 1970 #6640), Page and Moyle (1960 #6637), Morton and others (1980 #6636), Manson (1986 #6642), Bryant (1987 #6626), and Padgett (1994 #6643). Traces of the Lenwood fault at Soggy Lake had up to 5 cm of triggered dextral displacement |

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| | associated with the 1992 Mw 7.3 Landers earthquake (Hart and others, 1993 #3356). Minor historic fault creep has been reported on the northern Lenwood fault in the town of Lenwood (D. Morton and C. Gray, personal communication in Manson, 1986 #6642), although Manson (1986 #6642) was not able to verify evidence of systematic fault creep. Padgett (1994 #6643) excavated two fault normal trenches across traces of the Lenwood fault at Soggy Lake and exposed evidence of 3 paleoearthquakes in the past 8.2 ka. Padgett's (1994 #6643) event chronology identified large surface-faulting events 1.8±0.2 ka and 8.2±0.2 ka, suggesting a recurrence interval of about 6,000 yrs. An additional event at 6.4±0.2 ka was interpreted by Padgett to be a small displacement event, probably similar to the triggered slip observed along the Lenwood fault after the 1992 Landers earthquake. Padgett (1994 #6643) concluded that the Lenwood fault ruptures in 3-m displacement events and estimated a Holocene slip rate of about 0.5 mm/yr. Petersen and Wesnousky (1994 #6024) estimated a preferred long term slip rate of 0.8 mm/yr (0.05–1.5 mm/yr), based on 1.5–3.0 km dextral offset of the Kane Springs fault and initiation of slip between 2 Ma and 20 Ma.<br><br>**Sections:** This fault has 2 sections. There is insufficient data to designate seismogenic segments. Petersen and others (1996 #4860)(1996) combined the Lockhart, Lenwood, and Old Woman Springs [117] faults as a single seismic source and termed this the Lenwood-Lockhart fault zone. This nomenclature is adopted in this compilation, but the Old Woman Springs [117] is considered separately. The section boundary between the Lockhart fault to the north and the Lenwood fault to the south is located near the town of Lenwood. Southeast of Lenwood, the Lenwood-Lockhart fault zone strikes about N. 30° W. and is delineated by generally well defined geomorphic evidence of Holocene dextral displacement. Northwest of Lenwood the fault zone strikes N. 55–60° W. and, though locally there is geomorphic evidence of Holocene dextral slip, the fault zone generally lacks geomorphic evidence of Holocene displacement (Manson, 1986 #6642; Bryant, 1987 #6626). |
| **Name comments** | **General:** Lenwood fault was first mapped (partly) by Vaughn (1922 #5801) and first named and completely mapped by Dibblee (1960 #6638; 1964 #1249; 1964 #6639; 1967 #6614; 1970 #6640). Lockhart fault was first mapped and named by Dibblee (1958 #6627; 1960 #6628; 1968 #6631). Petersen and others (1996 #4860) modeled a Mw 7.3 earthquake along the Lenwood, |

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| | Lockhart, and Old Woman Springs [117] faults and termed this fault zone the Lenwood-Lockhart fault zone. Lenwood-Lockhart fault zone in this compilation includes the North Lockhart fault (Dibblee, 1968 #6631) and an unnamed fault on west side of Harper Lake (Bryant, 1987 #6626).<br><br>**Section:** Lockhart section proposed in this compilation, based on fault source modeling by Petersen and others (1996 #4860). Section extends from about 17 km southeast of Fremont Valley (Garlock [69] fault) southeast to near the town of Lenwood.<br><br>**Fault ID:** Refers to numbers 381 (Lenwood fault), 365 (Lockhart fault), and 366 (unnamed fault west side Harper Lake) of Jennings, (1994 #2878). |
| **County(s) and State(s)** | KERN COUNTY, CALIFORNIA<br>SAN BERNARDINO COUNTY, CALIFORNIA |
| **Physiographic province(s)** | BASIN AND RANGE |
| **Reliability of location** | Good<br>Compiled at 1:62,500 scale.<br><br>*Comments:* Locations based on digital revisions to Jennings (1994 #2878) using original mapping by Dibblee (1958 #6627; 1960 #6628; 1960 #6638; 1968 #6631) at 1:62,500; geomorphic mapping by Bryant (1987 #6626) is at 1:62,500 and 1:24,000. |
| **Geologic setting** | Holocene active dextral strike slip fault zone located in the central Mojave Desert. The northwest-striking Lenwood-Lockhart fault zone is part of a series of subparallel dextral strike-slip faults in the central Mojave Desert and is part of the eastern California shear zone (Dokka and Travis, 1990 #3188). The Lenwood-Lockhart fault zone extends from about 17 km southeast of Fremont Valley (Garlock fault zone [69]) southeast across the Mojave River, along the northeastern side of Stoddard Valley, through the central Ord Mountains, and terminates about 1 km north of the northern San Bernardino Mountains where it probably complexly merges with the North Frontal thrust system [109]. Cumulative dextral displacement along the Lenwood fault is about 1.5–3 km, based on displacement of Miocene detachment (Dokka and Travis, 1990 #3188). Garfunkel (1974 #6633) estimated about 15–20 km dextral offset along the Lenwood fault, based on modeling. |

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| **Length (km)** | This section is 69 km of a total fault length of 142 km. |
| **Average strike** | N46°W |
| **Sense of movement** | Right lateral<br><br>*Comments:* Dibblee (1958 #6627; 1960 #6628; 1960 #6638; 1968 #6631) |
| **Dip Direction** | V<br><br>*Comments:* Dibblee (1958 #6627; 1960 #6628; 1960 #6638; 1968 #6631) |
| **Paleoseismology studies** | |
| **Geomorphic expression** | Lockhart fault is generally poorly defined and is delineated by geomorphic evidence of late Quaternary dextral slip such as linear ridges in bedrock and Quaternary alluvium, dextrally deflected drainages, and dissected scarps in Quaternary alluvium (Bryant, 1987 #6626). A short, approximately 10-km-long section of the Lockhart fault is delineated by geomorphic features indicative of Holocene dextral displacement including a linear scarp and tonal contrasts in late Pleistocene alluvium, dextrally deflected drainages, and a sidehill bench (Bryant, 1987 #6626). A previously unmapped, 11-km-long fault along the west side of Harper Lake is delineated by linear vegetation contrasts and a subtle east-facing scarp in Holocene alluvium (Bryant, 1987 #6626) |
| **Age of faulted surficial deposits** | Fault offsets Mesozoic crystalline basement rocks, Pleistocene alluvium, and, locally, Holocene alluvium according to Dibblee (1958 #6627; 1960 #6628; 1960 #6638; 1968 #6631), Page and Moyle (1960 #6637) and Bryant (1987 #6626). |
| **Historic earthquake** | |
| **Most recent prehistoric deformation** | latest Quaternary (<15 ka)<br><br>*Comments:* Timing of the most recent paleoevent is not known. The Lockhart fault zone locally exhibits geomorphic evidence of Holocene dextral slip, but mostly lacks geomorphic features associated with Holocene dextral slip and is concealed by Holocene alluvium (Bryant, 1987 #6626). |

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| **Recurrence interval** | *Comments:* Wesnousky (1986 #5305) estimated a recurrence interval of 1,742 yr, based on a long-term geologic slip rate. Late Pleistocene and Holocene recurrence intervals have not been determined. |
| **Slip-rate category** | Between 0.2 and 1.0 mm/yr<br><br>*Comments:* Wesnousky (1986 #5305) estimated a long term (Miocene) dextral slip rate of 0.9–2.5 mm/yr for the Lockhart fault, based on dextral displacements reported in Garfunkel (1974 #6633). Slip rate assigned by Petersen and others (1996 #4860) 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)** | 2000<br>William A. Bryant, California Geological Survey |
| **References** | #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.<br><br>#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.<br><br>#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.<br><br>#6638 Dibblee, T.W., Jr., 1960, Geologic map of the Barstow quadrangle, San Bernardino County, California: U.S. Geological Survey Mineral Investigations Field Studies Map MF 233, scale 1:62,500.<br><br>#1249 Dibblee, T.W., Jr., 1964, Geologic map of the Ord Mountains quadrangle San Bernardino County, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I- |

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#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.

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#6637 Page, R.W., and Moyle, W.R., Jr., 1960, Data on water wells in the eastern part of the middle Mojave Valley area, San Bernardino County, California: California Department of Water Resources Bulletin 91-3, 223 p., 2 pls.

#6024 Petersen, M.D., and Wesnousky, S.G., 1994, Fault slip rates and earthquake histories for active faults in southern California: Bulletin of the Seismological Society of America, v. 84, no. 5, p. 1,608-1,649.

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#5801 Vaughn, R.E., 1922, Geology of San Bernardino Mountains north of San Gorgonio Pass: Berkeley, California, University of California Publications in Geological Sciences, v. 13, no. 9, p. 319-411.

#5305 Wesnousky, S.G., 1986, Earthquakes, Quaternary faults, and seismic hazards in California: Journal of Geophysical Research, v. 91, no. B12, p. 12,587-12,631.

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