

Quaternary Fault and Fold Database of the United States

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

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Compiled in cooperation with the California Geological Survey

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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

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.

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,

	<p>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).</p> <p>Section: Lenwood section proposed in this compilation, based on fault source modeling by Petersen and others (1996 #4860). Section extends from the town of Lenwood southeast to the northern front of the San Bernardino Mountains.</p> <p>Fault ID: Refers to numbers 381 (Lenwood fault), 365 (Lockhart fault), and 366 (unnamed fault west side Harper Lake) of Jennings, (1994 #2878).</p>
<p>County(s) and State(s)</p>	<p>SAN BERNARDINO COUNTY, CALIFORNIA</p>
<p>Physiographic province(s)</p>	<p>BASIN AND RANGE</p>
<p>Reliability of location</p>	<p>Good Compiled at 1:62,500 scale.</p> <p><i>Comments:</i> Locations based on digital revisions to Jennings (1994 #2878) using original mapping by Dibblee (1960 #6638; 1964 #1249; 1964 #6639; 1967 #6614; 1970 #6640) at 1:62,500; geomorphic mapping by Morton and others (1980 #6636) and Manson (1986 #6642) at 1:24,000.</p>
<p>Geologic setting</p>	<p>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,</p>

	based on modeling.
Length (km)	This section is 74 km of a total fault length of 142 km.
Average strike	N31°W
Sense of movement	Right lateral <i>Comments:</i> Dibblee (1960 #6638; 1964 #1249; 1964 #6639; 1967 #6614; 1970 #6640). Dokka and Travis (1990 #3188) documented 1.5 to 3 km of dextral displacement of Miocene detachment terrane.
Dip Direction	V <i>Comments:</i> Dibblee (1960 #6638; 1964 #1249; 1964 #6639; 1967 #6614; 1970 #6640)
Paleoseismology studies	Site 111-1 by Padgett (1994 #6643) involved the excavation of two fault normal trenches across the trace of the Lenwood fault at the Soggy Lake playa in order to constrain the timing and size of past large surface faulting earthquakes. The size of prior surface rupture events was estimated based on surveying of dextrally offset stream channels. Eleven detrital charcoal samples were dated using AMS 14C methods and dendrochronologically corrected.
Geomorphic expression	Lenwood fault is delineated by moderately to well defined geomorphic features indicative of Holocene dextral slip such as dextrally offset drainages, linear drainages, sidehill benches, shutter ridges, closed depressions, linear scarps and vegetation contrasts on late Pleistocene and Holocene alluvium, and offset alluvial fans (Bull, 1978 #6613; Morton and others, 1980 #6636; Manson, 1986 #6642; Padgett, 1994 #6643).
Age of faulted surficial deposits	Fault offsets Mesozoic crystalline basement rocks, Miocene sedimentary rocks, Pleistocene and Holocene alluvium (Dibblee, 1960 #6638; 1964 #1249; 1964 #6639; 1967 #6614; 1970 #6640). Padgett (1994 #6643) identified offset Holocene and late Holocene deposits (1.8 ka to 8.2 ka) along the Lenwood fault at the Soggy Lake paleoseismic site (111-1).
Historic earthquake	

<p>Most recent prehistoric deformation</p>	<p>latest Quaternary (<15 ka)</p> <p><i>Comments:</i> Padgett (1994 #6643) identified the most recent paleoevent as occurring 1.8 ± 0.2 ka. The penultimate event occurred 6.4 ± 0.2 ka, but probably was a triggered slip event similar to the slip observed on the Lenwood fault following the 1992 $M_w 7.3$ Landers earthquake (Padgett, 1994 #6643).</p>
<p>Recurrence interval</p>	<p>about 6 k.y.</p> <p><i>Comments:</i> Padgett (1994 #6643) identified 3 paleoevents at the Soggy Lake paleoseismic site (111-1) in the past 8.2 k.y., not including the 5 cm dextral triggered slip from the 1992 Landers earthquake (Hart and others, 1993 #3356). The event chronology interpreted by Padgett (1994 #6643) is: Historic 5 cm triggered slip associated with 1992 $M_w 7.3$ Landers earthquake Event 1 1.8 ± 0.2 ka Event 2 6.4 ± 0.2 ka Event 3 8.2 ± 0.2 ka Events 1 and 3 were large surface rupturing earthquakes and Padgett (1994 #6643) interpreted Event 2 to be a triggered slip event similar to the 1992 Landers event. An approximately 6,000 yr recurrence interval for large surface-rupturing earthquakes is indicated</p>
<p>Slip-rate category</p>	<p>Between 0.2 and 1.0 mm/yr</p> <p><i>Comments:</i> Padgett (1994 #6643) estimated Holocene slip rate of about 0.5 mm/yr. This is based on the recurrence interval of about 6 k.y. and estimated slip per event of 3 m. The slip per event is based on surveys of 7 dextrally offset stream channels. These displacement values clustered at 3 m, with additional poorly constrained slip values clustering at 6 m, 9 m, and 15 m. Petersen and Wesnousky (1994 #6024) estimated a preferred long-term slip rate of 0.8 mm/yr (0.05 mm/yr to 1.5 mm/yr), based on 1.5 km to 3.0 km dextral offset of Kane Springs fault and initiation of slip between 2 Ma and 20 Ma. 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).</p>
<p>Date and Compiler(s)</p>	<p>2000 William A. Bryant, California Geological Survey</p>
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