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Camp Rock-Emerson-Copper Mountain fault zone, Emerson section (Class A) No. 114b

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Compiled in cooperation with the California Geological Survey

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Synopsis	**General:** Major historically active dextral strike-slip fault zone located in the central Mojave Desert. Sections included in this compilation include: Camp Rock section, Emerson section, Copper Mountain section. Most of the Camp Rock and the northern half of the Emerson fault ruptured in the 1992 Landers earthquake (Hart and others, 1993 #3356; Sieh and others, 1993 #3406). The southern half of the Emerson fault and entire Copper Mountain fault did not rupture in 1992 (Hart and others, 1993 #3356; Sieh and others, 1993 #3406). Maximum 1992 surface rupture (4.9–5.3 m) occurred on the Emerson fault (Hart and

	others, 1993 #3356; Sieh and others, 1993 #3406; McGill and Rubin, 1999 #6652). Detailed reconnaissance-level geologic and geomorphic mapping for the fault zone includes Bader and Moyle (1960 #6644), Dibblee (1964 #1249; 1964 #6639; 1967 #1342; 1967 #6614; 1968 #6708; 1970 #6640), Hawkins (1976 #6650), Morton and others (1980 #6636), Manson (1986 #6651), and Bryant (1986 #6645; 1994 #6646). Rubin and Sieh (1997 #6655) excavated a trench across 1992 surface ruptures delineating the central part of the Emerson fault. Rubin and Sieh reported that two large surface-rupturing earthquakes have occurred prior to 1992 and after 15 to 24 ka, indicating a recurrence interval of 7.4–12 k.y. for the Emerson fault. The most recent paleoevent on the Emerson fault occurred about 9 ka (Rubin and Sieh, 1997 #6655). Rubin and Sieh (1997 #6655) estimated a Holocene slip rate of between 0.2 mm/yr and 0.7 mm/yr, based on observed vertical components of displacement from the 1992 Landers earthquake and the most recent paleoevent. C. Rubin (figure 14 in Rockwell and others, 2000 #6654) observed evidence of 3 events prior to the 1992 Landers earthquake along the Camp Rock fault at the Camp Rock graben site. Rockwell and others (2000 #6654) estimated an average late Pleistocene recurrence interval of 5–7 k.y. for the Camp Rock fault. **Sections:** This fault has 3 sections. There is insufficient data to delineate seismogenic segments. The separately named Camp Rock, Emerson, and Copper Mountain faults are grouped as a single fault zone in this compilation. The section names are Camp Rock, Emerson, and Copper Mountain. The section boundary between the Camp Rock and Emerson faults is generally located at the approximately 2-km-wide right-releasing step-over about 4 km northwest of Bessemer Mine. The section boundary between the Emerson and Copper Mountain faults is located near Sand Hill where the Emerson fault changes from a northwest to a north-south strike. It is possible to further section the Emerson fault into two sections: the northern approximately half of the fault that ruptured in the 1992 Mw7.3 Landers earthquake, and the southern half of the fault zone that did not rupture in 1992. However, the Emerson fault will be designated as one section for this compilation.
Name comments	**General:** The Camp Rock, Emerson, and Copper Mountain faults here are grouped into the Camp Rock-Emerson-Copper Mountain fault zone. The Camp Rock and Emerson faults were first mapped by Gardner (1940 #6648) and named by Dibblee (1964 #6639). The Copper Mountain fault was first mapped by Dibblee (1967

	#6657; 1968 #6708) and named by Morton and others (1980 #6636). **Section:** Section is based on location of Emerson fault. Emerson fault extends from right-releasing step-over from Camp Rock fault (about 5 km west of Bessemer Mine) southeast to near Sand Hill where the Emerson fault changes to a more southerly strike. **Fault ID:** Refers to numbers 380 (Camp Rock fault), 416 (Galway Lake fault), 420 (Emerson fault), and 423 (Copper Mountain fault) of Jennings (1994 #2878).
County(s) and State(s)	SAN BERNARDINO COUNTY, CALIFORNIA
Physiographic province(s)	BASIN AND RANGE PACIFIC BORDER
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 (1964 #6639; 1967 #1342; 1967 #6614) at 1:62,500; mapping by Morton and others (1980 #6636), Manson (1986 #6651), and Bryant (1994 #6646) at 1:24,000.
Geologic setting	Historically active, predominantly dextral strike-slip fault zone located in the central Mojave Desert. The north to northwest-striking Camp Rock-Emerson-Copper Mountain fault zone is part of a series of subparallel dextral strike-slip faults in the central Mojave Desert. Camp Rock-Emerson-Copper Mountain fault zone is part of the eastern California shear zone (Dokka and Travis, 1990 #3188). The Camp Rock fault extends from about 10 km southwest of the Barstow-Daggett county airport southeast along the southwestern side of the Rodman Mountains, steps right across an approximately 2 km right releasing step to the Emerson fault about 5 km west of Bessemer Mine. The Emerson fault extends southwest bordering the western side of Emerson Lake (dry) to the vicinity of Sand Hill. Here the strike of the fault changes to a more southerly direction and slip transfers to the Copper Mountain fault. The Copper Mountain fault extends south to southeast along the southwestern side of Copper Mountain and terminates near the sinistral Pinto Mountain fault zone [118]. Estimates of total dextral slip along the Camp Rock fault vary

	from 0.95 km (Manson, 1986 #6651) to 3.75 km (Miller, 1980 #6653). Dokka and Travis (1990 #3188) reported 1.5 to 4.0 km of dextral slip for the Camp Rock-Emerson fault zone. Cumulative offset for the Copper Mountain fault is not known.
Length (km)	This section is 61 km of a total fault length of 93 km.
Average strike	N25°W
Sense of movement	Right lateral *Comments:* Geomorphic expression of Emerson fault is consistent with dextral strike-slip offset (Morton and others, 1980 #6636; Manson, 1986 #6651; Bryant, 1994 #6646). Surface fault rupture associated with the 1992 Landers earthquake had a maximum of 6 m of dextral slip (Hart and others, 1993 #3356; Sieh and others, 1993 #3406).
Dip Direction	V
Paleoseismology studies	Site 114-1 by Rubin and Sieh (1997 #6655) involved the excavation of one fault normal trench across a 5.5- to 15-m-wide zone of surface faulting associated with the 1992 Landers earthquake. Strands of the Emerson fault at the site offset latest Pleistocene and Holocene lacustrine, colluvial, and alluvial deposits. Rubin and Sieh (1997 #6655) reported evidence of two paleoearthquakes and used AMS radiocarbon dates on detrital charcoal and pedogenic carbonate to constrain the ages of the offset deposits.
Geomorphic expression	The Emerson fault is delineated by geomorphic features indicative of latest Pleistocene and Holocene dextral strike-slip offset such as dextrally deflected drainages, sidehill benches, linear scarps on late Pleistocene alluvium (pre-1992 scarps often eroded), linear trenches on late Pleistocene and Holocene alluvium, truncated ridges, shutter ridges, aligned saddles, closed depressions, and linear vegetation contrasts in late Pleistocene and Holocene alluvium (Morton and others, 1980 #6636; Manson, 1986 #6651; Bryant, 1994 #6646).
Age of faulted surficial deposits	Prior to 1992, strands of the southern part of the Emerson fault offset early Holocene alluvium reported to be about 9 ka, based on AMS 14C dates on detrital charcoal (Rubin and Sieh, 1997 #6655).
Historic	

Historic earthquake	Landers earthquake 1992
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Rubin and Sieh (1997 #6655) reported that the most recent paleoevent along the Emerson fault occurred about 9 ka, based on trench exposures of faulted lacustrine, colluvial, and alluvial deposits. AMS radiocarbon ages of post-penultimate deposits constrain the age of the most recent paleoevent to about 9 ka.
Recurrence interval	7.4–12 k.y. (<24 ka) *Comments:* Rubin and Sieh (1997 #6655) identified two events that occurred prior to the 1992 Landers earthquake. One event occurred about 9 ka, based on 14C dates on detrital charcoal sampled from post-event sediments. An earlier event occurred between 14.8 and 24.2 ka, based dates of pedogenic carbonate developed in sediments that bracket the event.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Rubin and Sieh (1997 #6655) reported a minimum Holocene dextral slip rate of 0.2 mm/yr, based on the assumption that the vertical separation observed in the 9 ka event was similar to the vertical component of the 1992 net slip measured at the playa site (site 114-1). The 1992 dextral slip at the playa site was about 2 m. However, 6 km to the north the maximum observed 1992 dextral slip was about 6 m. Similar geomorphic expression of the Emerson fault at both of these localities is consistent with an approximately 9 ka recurrence interval, allowing a slip rate of about 0.7 mm/yr to be calculated. Rubin and Sieh (1997 #6655) argue that the 2 m slip observed in 1992 should be considered a minimum because the playa area is very close to the step-over between the Emerson and Homestead Valley [116] faults and deformation near this step-over is probably distributive and other faults may have accommodated some of the slip. 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 William A. Bryant, California Geological Survey
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