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

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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	**General:** The Camp Rock, Emerson, and Copper Mountain faults

comments	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 Copper Mountain fault. Section extends from junction with Emerson fault [114b] southeast to the Pinto Mountain fault zone [118]. **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)	PACIFIC BORDER BASIN AND RANGE
Reliability of location	Good Compiled at 1:62,500 scale. *Comments:* Location is based on digital revisions to Jennings (1994 #2878) using original mapping by Bader and Moyle (1960 #6644), Dibblee (1967 #6657; 1968 #6647) at 1:62,500 scale; mapping by Morton and others (1980 #6636), Manson (1986 #6651) and Bryant (1986 #6645) 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 13 km of a total fault length of 93 km.
Average strike	
Sense of movement	Right lateral, Normal *Comments:* Dibblee (1967 #6657; 1968 #6647) characterized displacement along the Copper Mountain fault to be east-side-up vertical (normal). Geomorphic expression of the fault is consistent with normal dip-slip displacement (Morton and others, 1980 #6636; Bryant, 1986 #6645), although the northwest strike of the fault is suggestive of a component of dextral strike-slip offset.
Dip	50° W. to near vertical *Comments:* Bryant (1986 #6645)
Paleoseismology studies	
Geomorphic expression	Copper Mountain fault is delineated by moderately to locally well-defined geomorphic evidence of up-to-east normal dip-slip displacement including well-defined 2-m-high southwest-facing scarps on Holocene alluvium, vertically offset drainage and associated scarp on alluvium, and steep linear bedrock scarp (Morton and others, 1980 #6636; Bryant, 1986 #6645). Linear ridges, both dextrally and sinistrally deflected drainages, and a beheaded alluvial fan infer a component of presumably dextral strike-slip displacement (Morton and others, 1980 #6636; Bryant, 1986 #6645). The southern and northern ends of the Copper Mountain fault do not exhibit geomorphic evidence of latest Pleistocene to Holocene displacement (Bryant, 1986 #6645; Manson, 1986 #6651).
Age of faulted surficial	Copper Mountain fault offsets young alluvial fans that lack cambic or argillic soil horizons and have young constructional

deposits	surface morphology indicating Holocene age (Bull, 1978 #6613; Bryant, 1986 #6645).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* The timing of the most recent paleoevent is not well constrained. Copper Mountain fault offsets alluvial fans that are estimated to be Holocene, based on well-preserved fan surface morphology and lack of cambic or argillic soil horizons (Bull, 1978 #6613; Bryant, 1986 #6645).
Recurrence interval	
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Slip rate is based on structural association with Emerson fault. 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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