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Sierra Madre fault zone, Clamshell-Sawpit section (Class A) No. 105e

Last Review Date: 2000-06-01

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Synopsis	**General:** In general the Sierra Madre-Cucamonga fault zone marks the southern margin of uplift of the San Gabriel Mountains, although the Santa Susana fault extends the zone of south-vergent uplift west of these mountains. Only local portions of the fault zone have had detailed paleoseismic investigations, and those have had fairly limited results. Published slip rates vary widely along the fault zone. The best-understood part of the fault is the easternmost section, the Cucamonga fault zone, with excellent geomorphic expression, several trenches, and age control from radiocarbon and soil stratigraphic studies. These studies have demonstrated multiple Holocene events on several strands of the Cucamonga fault and a minimum slip rate of 4.5 mm/yr. Two studies on the central and eastern portions of the Sierra Madre fault zone have indicated that recurrence intervals between large events (M greater than or equal to 7) seem to be long (perhaps 7–

	8 k.y. or longer). The slip rate on the Sierra Madre fault appears to be considerably less than the Cucamonga fault, perhaps as low as 1 mm/yr or less. Studies on the San Fernando fault zone indicate a somewhat shorter recurrence interval of perhaps as much as 4,000 yr. The Santa Susana fault is less well understood, but has been inferred to have a slip rate greater than 5 mm/yr. **Sections:** This fault has 8 sections. The Santa Susana, San Fernando, Sierra Madre and Cucamonga fault zones are four basic units of this fault zone. Santa Susana, itself, has been divided structurally into three parts (Yeats, 1987 #6113; Yeats and others, 1994 #6114, see discussion of section 105a) but is treated here as one section. The Sierra Madre fault zone, along with the San Fernando fault zone, has been divided into three to seven elements. Segmentation of the Sierra Madre fault has been proposed based on the identification of several, convex-to-the-south, "salients" (Proctor and others, 1972 #6100; Ehlig, 1975 #6088; Wesnousky, 1986 #5305; Petersen and Wesnousky, 1994 #5962). However, it has not been demonstrated that rupture would be restricted to an individual segment in an earthquake. Sierra Madre segment A (Wesnousky, 1986 #5305) is not considered by Crook and others (1987 #5956) as part of the Sierra Madre fault zone, but rather is called the Vasquez Creek fault (after Miller, 1928 #5961), a southern branch of the San Gabriel fault. Segments B through E of Wesnousky (1986 #5305) after Proctor and others (1972 #6100) and Ehlig (1975 #6088) are retained in this compilation as sections. Morton and Matti (1987 #6099) discuss possible segmentation of the Cucamonga fault zone (but it is treated here as one section). Walls and others (1997 #6110) suggest at least two and possibly three segments for the San Fernando-Sierra Madre-Cucamonga fault zone (San Fernando, Sierra Madre and Cucamonga) based on differing uplift rates. In support of a lesser number of segments, Tucker and Dolan (2001 #6107) suggest that the entire Sierra Madre section, from Altadena to San Dimas, may rupture in single events.
Name comments	**General:** **Section:** Morton (1973 #6098) refers to Clamshell-Sawpit fault zone; Sawpit Canyon and Clamshell Canyon are separately named strands (e.g. Crook and others, 1987 #5956). Section extends NE from Santa Anita Canyon. **Fault ID:** Refers to numbers 344 (Santa Susana fault), 355 (unnamed faults), 356 (San Fernando fault), 357 (Sierra Madre

	fault), 385 (Clamshell and Sawpit Canyon faults), 395 (Duarte fault), and 399 (Cucamonga fault) of Jennings (1994 #2878). Also refers to numbers 68 (Santa Susana fault), 69 (San Fernando fault), 83 (Sierra Madre fault), 84 (Duarte fault), 85 (Clamshell-Sawpit fault zone), and 86 (Cucamonga fault) of Ziony and Yerkes (1985 #5931).
County(s) and State(s)	LOS ANGELES COUNTY, CALIFORNIA
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Poor Compiled at 1:24,000 and 1:100,000 scale. *Comments:* Location of fault based on 1:24,000-scale mapping of Crook and others (1987 #5956), Dibblee (1998 #7859), and Treiman (2013 #7952), supplemented by 1:100,000-scale mapping of Morton and Miller (2006 #).
Geologic setting	Sierra Madre fault zone, within the eastern part of the Transverse Ranges, refers to the entire 125-km-long complex zone of mechanically related thrust and reverse faults that grossly demarcate the base of the San Gabriel Mountains from San Fernando Pass on the west to Cajon Pass on the east, and also includes the Santa Susana fault to the west (Ehlig, 1975 #6088; Crook and others, 1987 #5956; Morton and Matti, 1987 #6099; Yeats, 1987 #6113). Reverse slip on this fault zone has contributed to the 2–3 km elevation of the mountain range (Walls, 2001 #6109).
Length (km)	This section is 17 km of a total fault length of 128 km.
Average strike	N64°E (for section) versus N86°W (for whole fault)
Sense of movement	Reverse *Comments:* Predominant sense of movement documented as reverse by Morton (1973 #6098) and Ziony and Yerkes (1985 #5931). Focal mechanism of historical seismicity indicates pure reverse displacement (Hauksson, 1994 #6090).
Dip	35–70° NW. *Comments:* Near-surface dips from Morton (1973 #6098); Ziony

	and Yerkes (1985 #5931); 50° NW. at depth based on seismicity (Hauksson, 1994 #6090).
Paleoseismology studies	
Geomorphic expression	Main fault strands controlled initial location of valleys which have subsequently migrated southward (Morton, 1973 #6098).
Age of faulted surficial deposits	Late-Pleistocene alluvium is locally faulted; faults are mostly within Mesozoic bedrock.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Treiman (2013 #7952). Crook and others (1987 #5956) describe faulting of lower unit 3 alluvium (11–200 ka).
Recurrence interval	2.9 k.y. *Comments:* 2890 yr recurrence interval estimated by Dolan and others (1995 #5965)(1995) from assumed slip per event and slip rate, although no geologic evidence points to Holocene surface rupture.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Although no slip rate data exists, Dolan and others (1995 #5965) indicate a rate of 0.5 mm/yr based on geomorphology and seismicity. Slip rate assigned by Petersen and others (1996 #4860) for probabilistic seismic hazard assessment for the State of California was 0.5 mm/yr (with minimum and maximum assigned slip rates of 0 mm/yr and 1.0 mm/yr, respectively).
Date and Compiler(s)	2000 Jerome A. Treiman, California Geological Survey
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