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Sierra Madre fault zone, Cucamonga section (Class A) No. 105h

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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:** Fault was recognized along this section by Eckis (1928 #6087) and the name was in use as early as Eckis (1934 #5957); section extends eastward from San Antonio Canyon to Lytle Creek area (Morton and Matti, 1987 #6099); Etiwanda Avenue scarp is sometimes included as part of the fault zone; Morton and Matti (1987 #6099) discuss possibility that Cucamonga fault, itself, is segmented.

	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)	SAN BERNARDINO COUNTY, CALIFORNIA
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Location transferred by inspection from 1:24,000 map of Morton and Matti (1987 #6099).
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 22 km of a total fault length of 128 km.
Average strike	N78°E (for section) versus N86°W (for whole fault)
Sense of movement	Thrust *Comments:* No evidence found for lateral component (Matti and others, 1982 #6097); slickensides are consistently downdip (Morton and Matti, 1987 #6099).
Dip	43–60° N. *Comments:* Mean of 43° N. (reported as 0–80°) in near surface

	(Morton and Matti, 1987 #6099), 50–60° N. at depth inferred from seismicity (Cramer and Harrington, 1987 #6084), 45° N. estimated by Petersen and others (1996 #4860).
Paleoseismology studies	Sites 105-2, 105-3, 105-4 Day Canyon-East Etiwanda Canyon: trenches across several strands of the fault zone established repeated Holocene rupture events with an average of 2-m vertical offset per event; age control from soil development profiles on successive fan surfaces. This may be the most active part of this section (Matti and others, 1982 #6097; Morton and Matti, 1987 #6099).
Geomorphic expression	Scarps across alluvial fan surfaces; abrupt mountain front.
Age of faulted surficial deposits	Holocene alluvial fan and stream deposits (Matti and others, 1982 #6097); Holocene and Pleistocene alluvial fans (Morton and Matti, 1987 #6099).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Last event on strand C (most recently active strand) occurred before deposition of alluvium estimated to be 700±200 yr old (based on soil development), but after deposition of approximately 1,000 yr old alluvium (Matti and others, 1982 #6097).
Recurrence interval	625 years *Comments:* Recurrence interval estimated by Morton and Matti (1987 #6099) based on well-constrained cumulative Holocene offset and utilizing soil-stratigraphic correlation with other 14C-dated soil profiles; 700 year mean recurrence proposed earlier by Matti and others (1982 #6097) based on 10 events in about 7000 yr.
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* Represents middle of slip-rate range; minimum slip rate of 4.5 mm/yr for past 13 ka per Morton and Matti (1987 #6099); 4.5–5.5 mm/yr (Dolan and others, 1995 #5965); 4.0±2.0 (Working Group on California Earthquake Probabilities, 1995 #4945); Dolan and others (1996 #6086) estimate 2.5–5.0 mm/yr

	for strand C alone, with possible 1–2 mm/yr for strand B; 1–3 mm/yr vertical separation rate (Walls and others, 1997 #6110) provides minimum; 2.9–6.4 mm/yr vertical component (Wesnousky, 1986 #5305). Slip rate assigned by Petersen and others (1996 #4860) for probabilistic seismic hazard assessment for the State of California was 5.0 mm/yr (with minimum and maximum assigned slip rates of 3.0 mm/yr and 7.0 mm/yr, respectively).
Date and Compiler(s)	2000 Jerome A. Treiman, California Geological Survey
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