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Sierra Madre fault zone, San Fernando section (Class A) No. 105b

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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:** Section is named for the rupture zone from the 1971 San Fernando earthquake (Wentworth and others, 1971 #6112) and extends from vicinity of Los Angeles Reservoir (site of San Fernando Reservoir) to Big Tujunga Canyon. The rupture zone as originally described included several "segments"—Mission Wells, Sylmar and Tujunga segments (U.S. Geological Survey Staff, 1971 #6108; Wentworth and others, 1971 #6112), with the

	Reservoir segment being added at the western end (named by Weber, 1975 #6111 after the Reservoir fault) and the Lakeview fault segment being distinguished within the eastern end of the Tujunga segment (Kahle, 1975 #6094). "Lakeview thrust fault" was described earlier by Proctor and others (1972 #6100), roughly corresponding to the original Tujunga "segment". San Fernando fault zone also includes Kagel fault, Wildwood fault, Bartholomaus fault (Proctor and others, 1972 #6100), and Sunland fault (Hill, 1930 #6091). **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	Good Compiled at 1:24,000 scale. *Comments:* Location of fault transferred by inspection from 1:18,000 map of Barrows and others (1975 #6082).
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 23 km of a total fault length of 128 km.
Average strike	N85°W (for section) versus N86°W (for whole fault)

Sense of movement	Thrust *Comments:* Thrust and sinistral strike-slip components on various sections described by U.S. Geological Survey Staff, (1971 #6108), Barrows (1975 #6081), Kahle (1975 #6094) and Weber (1975 #6111); reverse left-oblique per Ziony and Yerkes (1985 #5931).
Dip	50° N. *Comments:* 40° is reported by Crook and others (1987 #5956); Ziony and Yerkes (1985 #5931) cite 15–50° near surface with 35° at depth.
Paleoseismology studies	Site 105-1, Oak Hill: trench across 1971 surface rupture exposed evidence for prior displacement; 14C-dated wood fragment provided minimum age for prior event (Bonilla, 1973 #6083). Site 105-5, Sylmar filtration plant: trenches across several secondary faults north of mapped trace indicated latest Pleistocene faulting (<35–40 ka) but older than 5–10 ka (Spellman and others, 1984 #6103). Site 105-9, Bartholomaus Ranch: trenches across 1971 surface rupture found evidence for prior displacement of roughly equal magnitude to 1971; 14C-dated detrital charcoal provided maximum age of penultimate event (Fumal and others, 1995 #6089).
Geomorphic expression	Abrupt mountain front along Tujunga and Lakeview strands; historic and older scarps; drainage constriction and incised drainages; strath terraces in hanging wall block (Walls and others, 1997 #6110).
Age of faulted surficial deposits	Holocene colluvium (Bonilla, 1973 #6083; Fumal and others, 1995 #6089; Lindvall and others, 1995 #6095); late Pleistocene fans (Lindvall and others, 1995 #6095); Pleistocene fans (including Pacoima Formation) and bedrock (including Saugus Formation); Tertiary bedrock (Barrows and others, 1975 #6082)
Historic earthquake	
Most recent	latest Quaternary (<15 ka)

prehistoric deformation	*Comments:* <3.5–4 ka (Fumal and others, 1995 #6089); possibly 100 to 300 yr BP (Bonilla, 1973 #6083); historic event (M6.6) in 1971
Recurrence interval	200–2,000 yrs *Comments:* up to 2000 yrs (average based on two events within past 3.5–4 ka, Fumal and others (1995 #6089); 200 yrs (Working Group on California Earthquake Probabilities (1995 #4945) based on Bonilla data); 455 yr (calculated from assumed slip per event and slip rate, Dolan and others (1995 #5965).
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* 4.0±2.0 mm/yr extrapolated by Working Group on California Earthquake Probabilities (1995 #4945) from the Cucamonga fault (section 105h. Based on faulted and uplifted fluvial terraces, Lindvall and others (1995 #6095) suggested about 2 mm/yr for past 20–30 ka. This was revised to a minimum of about 1 mm/yr uplift rate by Walls and others (1997 #6110) and revised again to 1.1 +1.3/-0.4 mm/yr (Walls, 2001 #6109) based on vertical separation rates of terraces. Slip rate assigned by Petersen and others (1996 #4860) for probabilistic seismic hazard assessment for the State of California was 2.0 mm/yr (with minimum and maximum assigned slip rates of 1.0 mm/yr and 3.0 mm/yr, respectively).
Date and Compiler(s)	2000 Jerome A. Treiman, California Geological Survey
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