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Greenville fault zone, Arroyo Mocho section (Class A) No. 53c

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Compiled in cooperation with the California Geological Survey

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Synopsis	**General:** Historically active dextral strike-slip faults located in the Diablo Range. Minor surface fault rupturing was associated with the January 1980 Livermore Valley earthquakes (Bonilla and others, 1980 #5366; Hart and others, 1980 #5376; Bolt and others, 1981 #5365). Most of the fault trace is based on geologic and geomorphic evidence from detailed reconnaissance-level mapping by Herd (1977 #5364), Dibblee (1980 #5335, 1980 #5370, 1980 #5371, 1980 #5372), Hart (1981 #5375), and Earth Sciences Associates (1982 #5374) as reported in Wright and others (1982 #5357). Trench investigations along the Marsh Creek-Greenville

	section [53b] document latest Pleistocene and Holocene displacement. Partial late Quaternary slip rates of 0.1–0.7 mm/yr have been reported by Wright and others (1982 #5357) and Sweeney (1982 #5361). Unruh and Sawyer (1995 #5339, 1998 #5360) suggested that the late Quaternary slip rate might be as high as 3 mm/yr on the basis of structural modeling. Sawyer and Unruh (2002 #5362) calculated a Holocene dextral slip rate of 4.1±1.8 mm/yr at the Laughlin Road site. **Sections:** This fault has 4 sections. Wright and others (1982 #5357) defined three segments based on differences in geomorphic expression of the fault zone and different apparent ages of activity. From north to south these segments include the Clayton, Marsh Creek-Greenville, and Arroyo Mocho segments. Unruh and Sawyer (1998 #5360) defined four sections based on differences in geomorphic expression and structural character of the fault zone. From north to south their sections are named Livermore, Arroyo Mocho, San Antonio Valley, and Coyote Creek. The Livermore section of Unruh and Sawyer (1998 #5360) mostly corresponds with the southern Marsh Creek-Greenville segment of Wright and others; the Arroyo Mocho section of Unruh and Sawyer (1998 #5360) generally corresponds with the Arroyo Mocho segment of Wright and others (1982 #5357). The Coyote Creek section of Unruh and Sawyer (1998 #5360) is not considered here because Quaternary displacement has not been demonstrated.
Name comments	**General:** The fault was first mapped by Vickery (1925 #5359), who named it the Riggs Canyon fault. Huey (1948 #5363) was the first to use the name Greenville fault for traces along the eastern side of the Livermore Valley. The Greenville fault zone includes traces of the Marsh Creek and Clayton faults, which were first mapped by Colburn (1961 #5369) and named by Brabb and others (1971 #5368). Colburn (1961 #5369) named the structure along the northeastern side of Mount Diablo the Mount Diablo fault. **Section:** Defined as the Arroyo Mocho segment by Wright and others (1982 #5357) and Unruh and Sawyer (1998 #5360). The northern boundary of this section is marked by a roughly 1-km-wide releasing stepover from the Marsh Creek-Greenville section [53b], located about 4.5 km southeast of Reuss Road. This section extends southeast to the northeastern end of San Antonio Valley. Unruh and Sawyer (1998 #5360) have postulated that some amount of slip at the southern end of the Arroyo Mocho section may be transferred to the Ortigalita [52] fault via the Mt. Oso

	anticline at a significant left-restraining step-over.
County(s) and State(s)	SANTA CLARA COUNTY, CALIFORNIA ALAMEDA COUNTY, CALIFORNIA
Physiographic province(s)	PACIFIC BORDER
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 Earth Sciences Associates (1982 #5374), Hart (1981 #5375), and Unruh and Sawyer (1998 #5360) at 1:24,000 scale, and mapping by Cotton (1972 #5348) at 1:62,500 scale.
Geologic setting	This dextral strike-slip fault zone borders the eastern side of Livermore Valley and is considered to be part of the larger San Andreas fault system in the central Coast Ranges. The fault zone extends from northwest of Livermore Valley along the Marsh Creek and Clayton faults towards Clayton Valley. Unruh and Sawyer (1995 #5339, 1998 #5360) suggested that slip from the Greenville fault is transferred to the Concord fault [38] along the Mt. Diablo fold and thrust belt and that only minimal slip continues to the Clayton fault [53a]. The fault zone extends southeastward into San Antonio Valley, offsets late Mesozoic rocks of the Franciscan Complex. Southeast of Livermore Valley the fault is located within the uplifted Diablo Range and controls the generally linear drainage course of Arroyo Mocho, Colorado, and Sweetwater Creeks. Maximum dextral displacement along the Greenville fault zone is about 8.5–9 km, based on 9 km of dextral offset of a late Mesozoic serpentinite body and about 8.5 km dextral offset of the Tesla fault (Cotton, 1972 #5348; Sweeney, 1982 #5361).
Length (km)	This section is 25 km of a total fault length of 91 km.
Average strike	N23°W (for section) versus N30°W (for whole fault)
Sense of movement	Right lateral *Comments:* Hart (1981 #5375), Wright and others (1982 #5357), and Unruh and Sawyer (1998 #5360) reported that the Arroyo Mocho section is characterized by geomorphic features characteristic of dextral strike-slip displacement. A serpentinite

	body mapped by Cotton (1972 #5348), which is about 160 Ma, is dextrally offset about 8.75 km (Sweeney, 1982 #5361).
Dip Direction	V *Comments:* Fault dip has not be reported, but is assumed to be vertical based on the linear strike of the fault and associated geomorphic features characteristic of dextral strike-slip offset.
Paleoseismology studies	
Geomorphic expression	Arroyo Mocho section is delineated by geomorphic features characteristic of Holocene dextral strike-slip displacement, such as dextrally deflected stream channels, shutter ridges, linear scarps, linear drainages and ridges, aligned benches and saddles, linear side-hill benches, linear troughs, and ponded alluvium (Hart, 1981 #5375; Wright and others, 1982 #5357; Unruh and Sawyer, 1998 #5360).
Age of faulted surficial deposits	Most of the faults in the Arroyo Mocho section offset rocks of the late Mesozoic Franciscan Complex. However, Hart (1981 #5375) mapped surface traces of this section that apparently offset massive landslide deposits. The ages of these landslide deposits are not known, but presumably are late Pleistocene. Wright and others (1982 #5357) reported that dextrally offset stream channels are correlated with 125–180 ka terrace deposits, as estimated from soil development.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Age of most recent paleoevent not determined. Holocene activity is based on geomorphic expression of fault.
Recurrence interval	*Comments:* Wright and others (1982 #5357) estimated a recurrence interval of about 1.2 k.y. based on an assumed ML 6.5 earthquake, an estimated slip rate of 0.5–0.7 mm/yr, and an assumed 0.7 m slip per event.
Slip-rate	Between 1.0 and 5.0 mm/yr

category	*Comments:* Wright and others (1982 #5357) reported a minimum late Quaternary horizontal displacement rate of 0.5–0.7 mm/yr, based on correlation of dextrally offset stream channels and about 90 m offset of a 125–180 ka stream terrace. The timing of offset is not well constrained, and it is possible that the slip rate could be higher. The geomorphic expression along this section is similar to the Marsh Creek-Greenville section [53b], thus the probable 1–5 mm/yr slip-rate category seems reasonable
Date and Compiler(s)	2002 William A. Bryant, California Geological Survey Sereyna E. Cluett, California Geological Survey
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Questions or comments?