Jump to Navigation

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Greenville fault zone, Clayton section (Class A) No. 53a

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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 Clayton segment by Wright and others (1982 #5357). This fault was first mapped by Colburn (1961 #5369), who named it the Mt. Diablo fault. Brabb and others (1971 #5368) renamed this structure the Clayton fault. Bortugno and Wagner (1991 #5367) and Jennings (1994 #2878) also continued the use of the name Clayton fault. The section extends from the vicinity of Black Diamond Road in the southeastern part of Concord southeast to the vicinity of Morgan Territory Road, where the section boundary is marked by an approximately 6-km

	left-restraining step-over to the Marsh Creek-Greenville section [53b].
County(s) and State(s)	CONTRA COSTA 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 of Clayton fault by Colburn (1961 #5369), and Dibblee (1980 #5335; 1980 #5370) at a scale of 1:24,000, and by Brabb and others (1971 #5368) at a scale of 1:62,500.
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 16 km of a total fault length of 91 km.
Average strike	N40°W (for section) versus N30°W (for whole fault)
Sense of movement	Right lateral *Comments:* Wright and others (1982 #5357) reported that displacement in trench excavations generally indicated a northeast-dipping reverse fault. The surface trace of the fault

	mapped by Dibblee (1980 #5335), (1980 #5370) indicates a northeast-dipping fault, although Dibblee did not indicate a sense of movement for this fault. Colburn (1961 #5369) reported that the Mount Diablo fault (Clayton section) is characterized by as much as 6 km of NE-side up vertical displacement, with an unknown but probably smaller amount of dextral strike-slip displacement.
Dip	75° NE. *Comments:* Wright and others (1982 #5357) reported that trench excavations across the Clayton fault showed dips that varied from 23° to 75°. Colburn (1961 #5369) inferred the dip at depth to be between 75° and 80°, based on the configuration of the surface trace. It is assumed that a dip of 75° represents the fault at depth.
Paleoseismology studies	
Geomorphic expression	The Clayton section generally is poorly defined and Wright and others (1982 #5357) reported that fault-related topographic features are poorly developed and differ significantly from the Marsh Creek-Greenville segment [section 53b]. Colburn (1961 #5369) reported that the Clayton section is generally characterized by subdued saddles and subdued hill fronts.
Age of faulted surficial deposits	Woodward-Lundgren (1974 #5358) reported that landslide deposits they estimated to be of probable late Holocene age are offset by traces of the Clayton fault. Generally, however, the fault offsets Cretaceous and some Tertiary sedimentary rocks. Locally, traces of the fault are concealed by late Holocene alluvial deposits (Brabb and others, 1971 #5368; Dibblee, 1980 #5335; 1980 #5370) and trench investigations in Clayton Valley (reported in Wright and others, 1982 #5357) have not shown evidence of Holocene displacement.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Bortugno and Wagner (1991 #5367) show the Clayton fault has Holocene active, based on evidence reported in Wright and others (1982 #5357).

Recurrence interval	*Comments:* Wright and others (1982 #5357) estimated a recurrence of about 3.3 k.y. based on an assumed ML 6.25 earthquake, an estimated slip rate of 0.1-0.2 mm/yr, and an assumed 0.4 m slip per event.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* A late Quaternary slip rate has not been determined for the Clayton section of the Greenville fault. Wright and others (1982 #5357) reported a long-term horizontal deformation rate of 0.1–0.2 mm/yr based on about 1.7 km dextral displacement of Tertiary rocks during the past 10–15 m.y., and the geomorphic expression of this section is suggestive of a fault with a modest late Quaternary slip rate. On the basis of structural modeling, Unruh and Sawyer (1995 #5339) infer that slip is transferred to the Concord [38] fault to the northwest across the Mt. Diablo fold and thrust belt. They argue that recent displacement along the Clayton section dies out north of Livermore Valley.
Date and Compiler(s)	2002 William A. Bryant, California Geological Survey Sereyna E. Cluett, California Geological Survey
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