

Quaternary Fault and Fold Database of the United States

As of January 12, 2017, the USGS maintains a limited number of metadata fields that characterize the Quaternary faults and folds of the United States. For the most up-to-date information, please refer to the [interactive fault map](#).

Berrocal fault zone (Class A) No. 57

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Compiled in cooperation with the California Geological Survey

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Synopsis

The Berrocal is a late Quaternary southwest-dipping, reverse-dextral oblique slip fault zone that forms a part of what McLaughlin and others (1996 #5434) refer to as the Southwestern Santa Clara Valley thrust belt. The Berrocal fault zone, which is commonly associated with the Monte Vista-Shannon fault zone [56], offsets sediment of the Pliocene-Pleistocene Santa Clara Formation and probably deforms late Pleistocene fluvial and alluvial fan deposits (Hitchcock and others, 1994 #5450). Bedrossian (1980 #5444) concluded that the Berrocal fault zone lacks evidence of Holocene displacement. Late Quaternary slip rate is poorly constrained and the recurrence interval is not known. The amount of uplift of late Pleistocene terraces (about

	<p>250 ka) of ancestral Los Gatos Creek suggests a post-250 ka incision rate of 0.6 mm/yr (McLaughlin and others, 1996 #5434). Minor distributed coseismic contractional deformation in the urbanized areas along the northeastern flank of the Santa Cruz Mountains associated with the 1989 Loma Prieta earthquake locally was coincident with the general trend and locations of the Berrocal and Monte Vista-Shannon [56] faults (Haugerud and Ellen, 1990 #5448; Hitchcock and others, 1994 #5450; Langenheim and others, 1997 #5453; Hitchcock and Kelson, 1999 #5451).</p>
<p>Name comments</p>	<p>Berrocal fault zone was first mapped in detail and named by Bailey and Everhart (1964 #5443). The Berrocal fault zone has been associated with the Sargent fault zone [58] (Sargent-Berrocal fault zone of McLaughlin, 1974 #5431; Sorg and McLaughlin, 1975 #5442; Hay and others, 1980 #5429). The Berrocal fault has also been associated with the Monte Vista-Shannon fault zone [56]. Collectively these faults have been referred to as the Foothills thrust belt (Burgmann and others, 1994 #5445), the Foothills thrust system (Hitchcock and Kelson, 1999 #5451), the Berrocal-Monte Vista fault system (Hilley and others, 1997 #5449), the Santa Cruz Mountains thrust/fold belt (Lajoie, 1996 #5452), and the Southwestern Santa Clara Valley thrust belt (McLaughlin and others, 1996 #5434; Roering and others, 1996 #5456).</p> <p>Fault ID: Refers to number 195 (Berrocal fault) of Jennings (1994 #2878).</p>
<p>County(s) and State(s)</p>	<p>SAN MATEO COUNTY, CALIFORNIA SANTA CLARA COUNTY, CALIFORNIA</p>
<p>Physiographic province(s)</p>	<p>PACIFIC BORDER</p>
<p>Reliability of location</p>	<p>Good Compiled at 1:250,000 scale.</p> <p><i>Comments:</i> Locations are based on digital revisions to Jennings (1994 #2878) using original mapping by Sorg and McLaughlin (1975 #5442), Brabb and Dibblee (1979 #4799), McLaughlin and others (1971 #5455; 1991 #5433), Rogers and Armstrong (1971 #5457), Dibblee and Brabb (1978 #4844), McLaughlin and others (1988 #5388), and Dibblee (1973 #4827), (1980 #4838) at 1:24,000 scale.</p>

Geologic setting	<p>The Berrocal fault zone is located in a complex contractional system of generally northeastward-vergent thrust and reverse faults that bound the eastern side of the Santa Cruz Mountains (Schwartz and others, 1990 #5441; Cotton and others, 1994 #5447; McLaughlin and others, 1997 #5435). This thrust system has been described by McLaughlin and others (1997 #5435) as an eastward-propagating half-flower structure that roots southwestward into the San Andreas fault zone [1]. The Berrocal fault zone is comprised of predominantly southwest-dipping reverse to dextral-reverse-oblique slip faults that extend along the northeastern margin of the Santa Cruz Mountains from near Monte Vista southeast to its complex intersection with the Sargent fault zone [58], a few kilometers north of Mt. Madonna State Park. The Berrocal fault zone is closely associated with the Monte Vista-Shannon fault zone [56]. McLaughlin and others (1996 #5434) referred to these faults as a complexly interwoven system of generally southwest-dipping reverse faults that collectively can be considered as a belt of faulting they termed the Southeastern Santa Clara Valley thrust belt. Cumulative displacement along the Berrocal fault is not well constrained. McLaughlin and others (1996 #5434) estimated that about 3 km of uplift, 3 km of shortening, and 4 km of reverse slip has occurred between the San Andreas fault [1] and the Southwestern Santa Clara Valley thrust system in the past 3 m.y. Minor distributed coseismic contractional deformation associated with the 1989 Loma Prieta earthquake occurred in the urbanized area along the northeastern flank of the Santa Cruz Mountains. This coseismic deformation locally was coincident with the general trend and locations of the Berrocal, and Monte Vista-Shannon [56] faults (Haugerud and Ellen, 1990 #5448; Hitchcock and others, 1994 #5450).</p>
Length (km)	57 km.
Average strike	N46°W
Sense of movement	<p>Reverse</p> <p><i>Comments:</i> Berrocal fault zone is a complex zone of both reverse (up-to-southwest) and dextral-reverse-oblique slip faults (McLaughlin, 1974 #5431; Sorg and McLaughlin, 1975 #5442; McLaughlin and others, 1996 #5434; 1997 #5435).</p>
Dip	20° SW to 90°

	<p><i>Comments:</i> The dip has been reported as variable 20° SW to locally steeply NE by McLaughlin (1974 #5431), Sorg and McLaughlin (1975 #5442), and McLaughlin and others (1988 #5388; 1991 #5433).</p>
Paleoseismology studies	
Geomorphic expression	<p>The Berrocal fault zone is marked by moderately defined geomorphic evidence of late Quaternary offset such as scarps along the range front, linear depressions, benches, saddles, and linear vegetation contrasts (Bedrossian, 1980 #5444; Hitchcock and others, 1994 #5450). Longitudinal stream profiles of fluvial terraces along Saratoga Creek show anomalous gradients coincident with the mapped trace of an anticline northeast of the Berrocal fault zone (Hitchcock and others, 1994 #5450).</p>
Age of faulted surficial deposits	<p>The Berrocal fault zone thrusts Mesozoic Franciscan Complex rocks over sediment of the Pliocene-Pleistocene Santa Clara Formation (Cotton and others, 1994 #5447). Hitchcock and others (1994 #5450) reported that Pleistocene fluvial and alluvial-fan deposits (units Qf1st and Qt1lg) are offset by the Berrocal fault. Bedrossian (1980 #5444) reported that several trench excavations done in compliance with Santa Clara County ordinances (similar to the Alquist-Priolo Earthquake Fault Zoning Act (Hart and Bryant, 1997 #4856)) revealed faulted Mesozoic Franciscan Complex and Pliocene-Pleistocene Santa Clara Formation, but Holocene alluvial and colluvial deposits were not offset.</p>
Historic earthquake	
Most recent prehistoric deformation	<p>undifferentiated Quaternary (<1.6 Ma)</p> <p><i>Comments:</i> Timing of most recent paleoevent is unknown. Hitchcock and others (1994 #5450) reported that terraces and alluvial fans along Saratoga Creek show evidence of late Pleistocene deformation across the Berrocal fault. McLaughlin (personal commun., 1993, in Hitchcock and others, 1994 #5450) stated that multiple lineaments on older and younger surfaces adjacent to the range front and possible faulting of fluvial deposits associated with the highest terrace near Los Gatos suggest probable late Pleistocene displacement along the Berrocal fault.</p>
Recurrence	

interval	
Slip-rate category	<p>Between 0.2 and 1.0 mm/yr</p> <p><i>Comments:</i> Burgmann and others (1994 #5445), (1994 #5446) modeled uplift of the Santa Cruz Mountains and suggested that the long-term uplift rate is about 1 mm/yr. McLaughlin and others (1996 #5434) stated that the slip history of the Southwestern Santa Clara Valley thrust belt has been episodic. The amount of uplift of late Pleistocene terraces (about 250 ka) of ancestral Los Gatos Creek suggest a post-250 ka incision rate (equals uplift rate?) of 0.6 mm/yr (McLaughlin and others, 1996 #5434). Wesnousky (1986 #5305) assigned a preferred slip-rate of 1 mm/yr for the Sargent-Berrocal fault zone.</p>
Date and Compiler(s)	<p>2000</p> <p>William A. Bryant, California Geological Survey</p>
References	<p>#5443 Bailey, E.H., and Eberhart, D.L., 1964, Geology and quicksilver deposits of the New Almaden district, Santa Clara County, California: U.S. Geological Survey Professional Paper 360, p. 206.</p> <p>#5444 Bedrossian, T.L., 1980, Berrocal fault, northern segment: California Division of Mines and Geology Fault Evaluation Report FER-98, microfiche copy in California Division of Mines and Geology Open-File Report 90-11, scale 1:24,000.</p> <p>#4799 Brabb, E.C., and Dibblee, T.W., Jr., 1979, Preliminary geologic map of the Castle Rock Ridge quadrangle, Santa Cruz and Santa Clara Counties, California: U.S. Geological Survey Open-File Report 79-659, 1 sheet, scale 1:24,000.</p> <p>#5446 Burgmann, R., Arrowsmith, R., Dumitru, R., and McLaughlin, R.J., 1994, Rise and fall of the southern Santa Cruz Mountains, California, from fission tracks, geomorphology, and geodesy: Journal of Geophysical research, v. 99, no. B10, p. 20,181-20,202.</p> <p>#5445 Burgmann, R., Segall, P., Arrowsmith, R., and Dumitru, T., 1994, Slip rates and earthquake hazard along the Foothills thrust belt in the southern Santa Cruz Mountains, California [abs.]: Geological Society of America Abstracts with Programs, v. 26, no. 7, p. 191.</p> <p>#5447 Cotton, W.R., Cole, W.F., and Wallace, J.M., 1994,</p>

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#5429 Hay, E.A., Cotton, W.R., and Hall, N.T., 1980, Shear couple tectonics and the Sargent-Berrocal fault system in northern California: California Division of Mines and Geology Special Report 140, 41-49 p.

#5449 Hilley, G.E., Arrowsmith, R.R., and Burgmann, R., 1997, Investigation of active deformation using a landscape development model and field examination of landforms and geology along the northeastern margin of the southern Santa Cruz Mountains [abs.]: Geological Society of America Abstracts with Programs, v. 29, no. 6, p. 324.

#5451 Hitchcock, C.S., and Kelson, K.I., 1999, Growth of late Quaternary folds in southwest Santa Clara Valley, San Francisco Bay area, California: Implications of triggered slip for seismic hazard and earthquake recurrence: *Geology*, v. 27, no. 5, p. 391–394.

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