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San Gregorio fault zone, Sur Region section (Class A) No. 60b

Last Review Date: 1999-01-16

Compiled in cooperation with the California Geological Survey

citation for this record: **Bryant, W.A., and Cluett, S.E., compilers, 1999, Fault number 60b, San Gregorio fault zone, Sur Region section, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, https://earthquakes.usgs.gov/hazards/qfaults, accessed 12/14/2020 03:04 PM.**

Synopsis	**General:** Holocene active, structurally complex transpressional fault zone as much as 5 km wide. The fault zone is mainly located offshore, west of San Francisco Bay and Monterey Bay, with onshore locations at promontories, such as Moss Beach, Pillar Point, Pescadero Point, and Point A?o Nuevo. Cumulative dextral displacement may total about 155 km (Dickinson, 1996 #5397), but a component of west-vergent reverse displacement also characterizes the fault zone (Lewis, 1994 #5405). Simpson and others (1998 #5414) reported a late Pleistocene dextral slip rate of 3.5-4.5 mm/yr along the Seal Cove fault [60a, San Gregorio

	section], based on displaced paleochannel deposits at Moss Beach. This is a partial slip rate because faults offshore to the west are also considered active and may contribute an unknown amount of dextral slip. Weber (1994 #5420) calculated a late Quaternary slip-rate of about 10 mm/yr, based on correlation of dextrally offset marine terrace deposits at Point A?o Nuevo. Conversely, dextrally offset stream channels near Point A?o Nuevo indicate a late Pleistocene slip-rate of 4-10 mm/yr (Weber, 1994 #5420). Alternatively, Sedlock, (1999 #5411) argues that piercing points are not well constrained across dextrally offset stream channels and suggests that a lesser dextral slip rate of 1-3 mm/yr better characterizes the San Gregorio fault zone. Clark and Rosenberg (1999 #5394) estimated late Quaternary and Holocene dextral slip rates of between 0.4 and 3.5 mm/yr, based on offset streams, shoreline angles, and colluvial deposits. The most recent earthquake along the San Gregorio fault zone occurred after 1270 AD to 1400 AD, but prior to the arrival of Spanish missionaries in 1775 AD (Simpson and others, 1997 #5413). **Sections:** This fault has 2 sections. There is insufficient data to document seismogenic segments. Petersen and others (1996 #4860) and Working Group on Northern California Earthquake Potential (1996 #1216) modeled the fault zone with two segments. Their segment boundary was placed in the north-central part of Monterey Bay. Fault segments designated by Petersen and others and Working Group on Northern California Earthquake Potential herein are considered as sections.
Name comments	**General:** The San Gregorio fault zone was first mapped and named by Lawson (1908 #4969) for the on-land portion from Pescadero Point to A?o Nuevo Point, although Graham and Dickinson (1978 #5398) erroneously reported that Branner and others (1909 #5381) first named the fault. The San Gregorio is a complex fault zone that consists of several named faults, including the Seal Cove, Frijoles, Coastways, Greyhound Rock, Carmel Canyon, Denniston Creek, and A?o Nuevo faults. The fault zone extends from Bolinas Lagoon south to the Point Sur region. The Sur and Palo Colorado fault zones (first named by (Trask, 1926 #5416) are herein considered a part of the southern section of the San Gregorio fault zone. Greene and others (1973 #1323) and McCulloch and Greene (1990 #5406) used the name Palo Colorado-San Gregorio fault zone for the fault where it is offshore west and south of Monterey Bay. Jennings (1994 #2878) modified this nomenclature and named the offshore fault south of Monterey Canyon the Palo Colorado fault.

	Section: Section named by Petersen and others (1996 #4860) and Working Group on Northern California Earthquake Potential (1996 #1216). This section is located almost entirely offshore and extends from approximately Monterey Canyon (subsurface feature in Monterey Bay) south to the vicinity of Point Sur. The southern extent of this section of the San Gregorio fault zone is conjectural and structurally complex. Greene and others (1973 #1323) and McCulloch and others (1990 #5406) suggested that the San Gregorio fault zone connects with onland strands of the Palo Colorado fault. Clark and Rosenberg (1999 #5394) postulated that an unknown component of slip is transferred from the San Gregorio (Sur region section) inland along oblique-slip, intra-Silurian block faults. Silver (1978 #5412), Graham and Dickinson (1978 #5398), and Weber (1994 #5420) suggested that the southern end of the San Gregorio (Sur region section) may connect with strike-slip traces of the Sur fault near Point Sur. For this compilation, the southern part of the San Gregorio (Sur region) section includes traces of the Palo Colorado and Sur fault zones. **Fault ID:** Refers to numbers 230 (Palo Colorado fault zone) and 237 (Sur fault zone) of Jennings (1994 #2878) and number A5 (San Gregorio, Sur Region) of Working Group on Northern California Earthquake Potential (1996 #1216).
County(s) and State(s)	MONTEREY COUNTY, CALIFORNIA
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Poor Compiled at 1:250,000 scale. *Comments:* Most of the traces for the Sur Region section are located offshore, hence their locations are poor. Fault locations are based on digital revisions to Jennings (1994 #2878), using original compilation mapping by McCulloch and Greene (1990 #5406) at 1:250,000 scale and Wagner and others (2002 #5418) at 1:100,000 scale. Onshore traces of the Sur fault zone are based on mapping by Gilbert (1971 #5400) and Clark and Rosenberg (1999 #5394) at a scale of 1:24,000, and mapping by Dibblee (1973 #5396) at a scale of 1:62,500.

Geologic setting	Convergent dextral fault predominantly located offshore on the continental shelf of north-central California. The northern end of the fault has a complex interconnection with the San Andreas fault zone [1] over an approximately 15-km-long zone from the Golden Gate north to Bolinas Lagoon. The southern (offshore) extent of the fault zone is conjectural. Greene and others (1973 #1323) projected the southern part of thefault zone into the onshore Palo Colorado fault. Graham and Dickinson (1978 #5398) and Weber (1980 #5419; 1994 #5420) interpreted the San Gregorio fault zone as joining with the Sur fault. The general consensus is that the San Gregorio fault zone is a relatively continuous structure, linking to the south with the Hosgri [81] and San Simeon [80] fault zones (Graham and Dickinson, 1978 #5398; Silver, 1978 #5412; Weber, 1980 #5419; 1994 #5420; Dickinson, 1996 #5397). Alternatively, Clark and Rosenberg (1999 #5394) postulate that a component of slip from the San Gregorio fault zone is distributed onshore along intra-Salinian faults. Cumulative dextral strike-slip displacement along the San Gregorio fault zone since middle Miocene time has been reported to be between 115 km (Graham and Dickinson, 1978 #5398) and 156 km (Clark and others, 1984 #5395; Dickinson, 1996 #5397; 1998 #5393) based on stratigraphic and structural correlations.
Length (km)	This section is 121 km of a total fault length of 241 km.
Average strike	N30°W (for section) versus N26°W (for whole fault)
Sense of movement	Right lateral *Comments:* The Sur Region section is characterized by subparallel faults that exhibit both high-angle strike-slip and east-dipping reverse displacement. Onshore strands of the southern part of the section comprise a complex zone of both dextral strike-slip and west-vergent reverse displacement faults (Gilbert, 1971 #5400; Dibblee, 1973 #5396; Bryant, 1985 #5392; Clark and Rosenberg, 1999 #5394).
Dip	50°E–90° *Comments:* Moderately constrained seismicity data (focal plane solutions and focal depth distributions) indicate an eastward dip of 50? to 70? (McNally and Stakes, 1998 #5407). Gilbert (1971 #5400) and Dibblee (1973 #5396) mapped east-dipping reverse faults and near vertical strike-slip faults. Clark and Rosenberg (1999 #5394) described the Garrapata fault, a strand of the Palo

	Colorado fault zone originally mapped by Dibblee (1973 #5396), as a near vertical fault zone.
Paleoseismology studies	
Geomorphic expression	Most traces of the Sur Region section are offshore. Eittreim and others (1998 #5399) reported that the Sur Region section southwest of Carmel is characterized by two subparallel traces that are clearly expressed on the seafloor, as seen on multibeam bathymetric data. A 10-km-long eastern strand is delineated by geomorphic features indicative of dextral strike-slip displacement, including scarps, linear ridges, shutter ridges, and prominent drag folds in pre-Quaternary bedrock. A western trace, located about 0.5-km west of the eastern trace, is characterized by low linear scarps developed on the modern seafloor and probably represents the most recently active strand of the Sur Region section. Onshore strands of the southern part of the Sur Region section are moderately to poorly defined by geomorphic features indicative of strike-slip offset, such as linear and deflected drainages, linear alignment of saddles and benches and scarps on late Quaternary marine terrace surfaces (Bryant, 1985 #5392; Clark and Rosenberg, 1999 #5394).
Age of faulted surficial deposits	McCulloch and Greene (1990 #5406) reported that the faults offset Holocene sediment. Clark and Rosenberg (1999 #5394) reported that a prominent strand of the Palo Colorado fault zone, the Garrapata fault, juxtaposes two colluvial units that have conventional 14C ages of 1,200?60 years B.P. (organic sediment) and 9,750?60 years B.P. (detrital charcoal).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Linear scarps on the seafloor reported by Eittreim and others (1998 #5399) suggest late Holocene displacement.
Recurrence interval	
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* The slip rate for the San Gregorio (Sur region) section is unknown. Clark and Rosenberg (1999 #5394) estimated late

	Quaternary dextral slip rates of as much as about 3 mm/yr for the Palo Colorado fault. They estimated a Holocene dextral slip rate of 0.4-3.5 mm/yr on the basis of 4 m offset of a colluvial unit along the Garrapata fault. Pleistocene dextral slip-rate estimates based on stream channel offsets range between 0.9 to 3 mm/yr (Hamilton, 1984 #5402; Tuttle, 1985 #5417; Clark and Rosenberg, 1999 #5394). Late Quaternary estimates of dextral slip rates range from 0.42 to 1.35 mm/yr, based on dextral offset of shoreline angles (Tuttle, 1985 #5417; J. Weber, personal commun. in Clark and Rosenberg, 1999 #5394).
Date and Compiler(s)	1999 William A. Bryant, California Geological Survey Sereyna E. Cluett, California Geological Survey
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Questions or comments?