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Mission Ridge fault system, Arroyo Parida section (Class A) No. 88c

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Synopsis	**General:** East-striking system of generally moderately to steeply south-dipping reverse to reverse sinistral oblique faults and associated folds. Fault system reported to be mostly blind at the western end (Keller and Gurrola, 2000), but is mostly a surface fault along the eastern extent. Mission Ridge fault system is characterized by late Pleistocene, and locally Holocene displacement (Minor and others 2009; Gurrola, 2006; Keller and Gurrola, 2000; Weber and others, 1975; Chauvel, 1958; Kahle, 1985 #7940; Rockwell and others, 1984). Mission Ridge fault system divided into 4 sections in this compilation, generally following the segmentation first proposed by Keller and Gurrola (2000). The Ellwood Mesa site (88-1) exposed evidence of three events, the most recent occurring after 36 ka. The penultimate event occurred about 37 ka and the pre-penultimate event occurred between 37 ka and 47 ka (Keller and Gurrola, 2000;

	Gurrola, 2006). Gurrola (2006) calculated a minimum dip slip rate of 0.4 mm/yr at the Ellwood Mesa site, based on a vertically offset 47 ka wave cut platform. The Santa Barbara Mission scarp site (88-2) exposed evidence of two events that offset latest Pleistocene to Holocene stream channel and floodplain deposits (Gurrola, 2006). Gurrola and Keller (2003) reported a vertical uplift rate of 0.75 mm/yr at the Sheffield Reservoir site (88-3), based on 90 m uplift of a 125 ka alluvial fan deposit. Assuming a 45° dip for the Mission Ridge section, a dip-slip rate of about 1 mm/yr is indicated. Gurrola and Keller (2003) reported progressive deformation of young fluvial deposits indicating multiple events across the northern limb of the Mission Ridge anticline at the Sheffield Reservoir site (88-3), but no dates or event horizons were determined. **Sections:** This fault has 4 sections. There is insufficient data to delineate seismogenic segments. Keller and Gurrola (2000) defined three segments that define their Mission Ridge fault system based on differences in geometric, geomorphic, and structural style. From west to east they defined the More Ranch segment, Mission Ridge segment and Arroyo Parida segment. The Arroyo Parida segment included the Santa Ana fault. The segments defined by Keller and Gurrola are adopted in this compilation, although they are considered sections and the Santa Ana fault is separated into a forth section.
Name comments	**General:** Mission Ridge fault system first introduced by Gurrola and Keller (1999) and Keller and Gurrola (2000) for the zone of surface faults and near surface blind faults consisting of (from west to east) the More Ranch, Mission Ridge, Arroyo Parida, and Santa Ana faults (referred to by Gurrola and Keller as fault segments). The More Ranch fault was first mapped and named by Hill (1932). The Mission Ridge fault, named for the low, north-facing scarps along the north side of Mission Ridge, was first inferred to be a fault and was named by Dibblee (1966). Arnold (1907) first described the Arroyo Parida fault. Putnam (1942) may have been the first to map the Santa Ana fault. **Section:** The Arroyo Parida section is adopted from the Arroyo Parida segment described by Keller and Gurrola (2000). They included the Santa Ana fault, but for this compilation the Santa Ana fault is considered a separate section [88d]. The Arroyo Parida section extends from its left-stepping junction with the Mission Ridge section [88b] near the dextrally deflected Picay Creek north of Summerland eastward along moderately linear

	drainages, saddles and notches north of Carpinteria, passes south of Snowball Mountain, then changes strike from about 10° south of east to east-west just north of Laguna Ridge, and ends just west of the Ventura River where Holocene traces of the Santa Ana section [88d] extend to the east. **Fault ID:** Refers to numbers 322 (More Ranch fault), 327 (Mission Ridge fault and Arroyo Parida fault) and 329 (Santa Ana fault) of Jennings (1994) and numbers 46 (Mission Ridge–Arroyo Parida fault zone), 47 (More Ranch fault), and 56 (Santa Ana fault) of Ziony and Yerkes (1985).
County(s) and State(s)	SANTA BARBARA COUNTY, CALIFORNIA VENTURA COUNTY, CALIFORNIA
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Location of fault from Qt_flt_ver_3-0_Final_WGS84_polyline.shp (Bryant, W.A., written communication to K.Haller, August 15, 2017) attributed to 1:24,000-scale mapping by Dibblee (1986 #7928, 1987 #7932, 1987 #7933), Minor and others (2009), and Gurrola (2006).
Geologic setting	Mission Ridge fault system is a generally east-striking zone of faults and associated folds that extend on land for about 68 km from the Ellwood Mesa area west of Isla Vista east to the San Cayetano fault [95]. Keller and Gurrola (2000) stated that the Mission Ridge fault system extends offshore west of Ellwood Mesa. Mission Ridge fault system is considered by Keller and Gurrola (2000) to be a major structure of the Santa Barbara Fold Belt, which is located on the south side of the Santa Ynez anticlinorium. Keller and Gurrola characterized the Santa Barbara Fold Belt as a linear zone of active folds located along the southern flank of the western Transverse Ranges. They reported that the Mission Ridge fault system is comprised of shallow subsurface folding developed on the hanging-walls of blind reverse and thrust faults, although generally north-vergent reverse faults locally extend to the surface or very near surface. Farther east the Mission Ridge fault system is expressed by surface faults and folds that offset or deform late Pleistocene alluvium and terrace deposits. Maximum displacement is not well-constrained

	for the Mission Ridge fault system. Chauvel (1958) postulated that the Arroyo Parida section [88c] may have up to 825 m of dip separation and between 0.8 to 1.2 km of sinistral displacement, based on an offset contact between Eocene Coldwater Formation and Oligocene Sespe Formation. Dibblee (1966) reported that the Arroyo Parida section is characterized by up to 300 meters of up on south vertical displacement and a possible, though unknown, component of sinistral displacement. Jackson and Yeats (1982) argue that subsurface data do not support a large component of sinistral offset.
Length (km)	km.
Average strike	
Sense of movement	Left lateral, Reverse *Comments:* Chauvel (1958) inferred up to about 1.2 km of sinistral displacement. Dibblee (1966) reported about 300 meters of vertical offset (south side up) and probably sinistral offset. Keller and Gurrola (2000) noted that the Arroyo Parida section is characterized by reverse-sinistral offset. Gurrola (2006) reported dominantly sinistral strike-slip displacement with minor reverse component, based on orientation of slickensides on an exposed fault plane at Toro Canyon.
Dip	60° N. to near vertical *Comments:* Reported direction of dip is variable. Chauvel (1958) reported that the Arroyo Parida fault dips 60-80° N. Dibblee (1966) reported that a northern dip is exposed in several stream canyons. North dip shown on Dibblee (1966) cross sections G-G’ and H-H’. Jackson and Yeats (1982) point out that displacement of Cenozoic sedimentary rocks along north-dipping fault would be indicative of normal separation, which does not seem likely in this contractional regime. They postulate that the Arroyo Parida fault is a folded reverse fault that originally dipped south. Foxall and Savy (1999) modeled the Arroyo Parida and Santa Ana faults as dipping 70° S. A southern dip or near vertical northerly dip would be more consistent with current stress field.
Paleoseismology studies	
Geomorphic	Chauvel (1958) reported that the Arroyo Parida section was

expression	delineated by a linear topographic low and, locally, sinistrally deflected drainages. Smith (1977) noted moderately linear scarps and linear tonal contrasts in Tertiary Sespe Formation. Gurrola (2006) observed several sinistrally deflected stream channels.
Age of faulted surficial deposits	Chauvel (1958) reported that mid- to late Pleistocene terrace and alluvial deposits are locally tilted, folded and faulted. At its western end the Arroyo Parida fault juxtaposes older alluvium against Eocene Coldwater Formation (Chauvel, 1958). Ages of alluvium and terrace deposits are not well-constrained, except at the eastern end of the Arroyo Parida section.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Most recent paleoevent is not known. Deformed and displaced deposits reported by Chauvel (1958) indicate late Quaternary activity.
Recurrence interval	
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Slip rate is assumed to be similar to the vertical slip rate of 0.35–0.4 mm/yr reported by Clark and others (1984) for the Santa Ana section [88d].
Date and Compiler(s)	2017 William A. Bryant, California Geological Survey
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