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Mission Ridge fault system, More Ranch section (Class A) No. 88a

Last Review Date: 2017-02-19

citation for this record: **Bryant, W.A., compiler, 2017, Fault number 88a, Mission Ridge fault system, More Ranch 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 03:14 PM.**

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 More Ranch section is adopted from the More Ranch segment described by Keller and Gurrola (2000). The More Ranch section extends on land from the Ellwood Mesa area eastward through the Goleta Basin separating the Goleta and Santa Barbara basins. The section boundary is at the complex junction with the Mission Ridge section [88b] where the More Ranch fault truncates several northwest-striking faults. Keller and

	Gurrola (2000) reported that the More Ranch section continues west offshore and is expressed as a bathymetric high. The More Ranch section includes the North Branch Western More Ranch, South Branch Western More Ranch, More Ranch, Northeast More Ranch, East More Ranch, and Isla Vista faults (Minor and others, 2009). **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
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 to1:24,000-scale maps by Gurrola (2006), Keller and Gurrola (2000), Dibblee (1987 #7930, 1987 #7931), and Minor and others (2009).
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	Reverse, Left lateral *Comments:* Dibblee (1966) described displacement along the More Ranch fault as predominantly south-side up vertical, probably with a steep southerly dip. Dibblee (1966) assumed that More Ranch fault has a probable sinistral component of displacement, based on the east-west strike that is similar to the sinistral Santa Ynez fault zone [87].
Dip	25–45° S. *Comments:* Dibblee (1966) reported that dip is poorly constrained. More Ranch fault exposed in a sea cliff exposure at Ellwood Mesa has an apparent dip of about 40° S.(Keller and Gurrola, 2000). Trench exposure at the Ellwood Mesa site (88-1) showed 25° S. dip steepening to about 45° S. (Keller and Gurrola, 2000).
Paleoseismology studies	Ellwood Mesa site (88-1) – One trench was excavated across a fold scarp delineating a southern splay of the North Branch Western More Ranch fault in order to evaluate and characterize the earthquake history (Keller and Gurrola, 2000). Trench revealed a 3- to 4-m thick marine terrace sequence that is vertically deformed and offset by strands of the North Branch Western More Ranch fault. Fault offsets 47 ka marine terrace deposits and alluvium younger than 36 ka (Keller and Gurrola, 2000; Gurrola, 2006).

Geomorphic expression	More Ranch section is mostly blind along its strike (Keller and Gurrola, 2000). Dibblee (1966) reported that the More Ranch fault locally is delineated by a youthful, north-facing scarp. More Ranch section is delineated by north-facing fold and fault scarps in Stage 3a marine terrace surfaces and associated synclinal basins (Keller and Gurrola, 2000). Vertical displacement along More Ranch fault has uplifted, from west to east, the Ellwood Mesa, Isla Vista Mesa (U.C. Santa Barbara), and More Mesa.
Age of faulted surficial deposits	Fault offsets wave cut platform developed on Miocene Monterey Formation and the overlying marine terrace deposits. Maximum age of faulted basal terrace deposits at the Ellwood Mesa site is 47±1.5 ka (radiocarbon years) based on detrital charcoal (Keller and Gurrola, 2000; Gurrola, 2006). Offset alluvial units overlying the marine terrace deposits at the Ellwood Mesa site are about 37 ka (radiocarbon years). A strand of the More Ranch fault offsets deposits younger than 36 ka (Keller and Gurrola, 2000). Dibblee (1966) reported that fault offsets late Pleistocene fanglomerate.
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* The most recent event is not well-constrained. Keller and Gurrola (2000) reported that the most recent event at the Ellwood Mesa site (88-1) occurred since 36 ka.
Recurrence interval	*Comments:* Keller and Gurrola (2000) identified three events at the Ellwood Mesa site (88-1). The most recent event occurred since 36 ka, but a minimum age of faulting was not established. The penultimate event occurred about 37 ka, and the pre-penultimate event occurred between 47 ka and 37 ka.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Keller and Gurrola (2000) calculated a vertical rate of folding of 0.22±0.03 mm/yr and a dip slip rate of 0.3 mm/yr at the Ellwood Mesa site (88-1), based on an approximately 14 m vertically offset 47 ka wave-cut platform. Gurrola (2006) reported a dip slip rate of 0.4 mm/yr at the Ellwood Mesa site. This is a minimum rate because the 47 ka age is a maximum age based on 14C dating of detrital charcoal and the fact that the rate does not

	account for the South Branch Western More Ranch fault. Clark and others (1984) reported a preferred minimum vertical displacement rate of 0.3 mm/yr at Goleta, based on a vertically offset 40–60 ka marine wave-cut platform, dated by amino acid racemization and paleontology. Rate is minimum because wave-cut platform not identified on footwall.
Date and Compiler(s)	2017 William A. Bryant, California Geological Survey
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