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Great Valley thrust fault system, Orestimba (GV 07) section (Class A) No. 28g

Last Review Date: 2017-05-08

citation for this record: **Bryant, W.A., compiler, 2017, Fault number 28g, Great Valley thrust fault system, Orestimba (GV 07) 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 02:51 PM.**

Synopsis	**General:** The Great Valley thrust fault system is a seismically active blind thrust fault and fold belt that marks the boundary between the Coast Ranges and the Great Valley. The Great Valley thrust fault system can be described as a complex system of east vergent, shallow-dipping blind thrust faults and associated west-vergent shallow to moderately dipping backthrust faults. Quaternary deformation in the western Sacramento Valley is characterized by uplift, tilting, asymmetric folding, and, locally, by both west and east-vergent thrust faulting (Unruh and Moores, 1992). Significant seismic events associated with the Great Valley thrust fault system include: 1892 earthquake series (up to Mw6.5 based on shaking intensities) that probably occurred along the Gordon Valley thrust [28d2] (O'Connell and others 2001); 1982 Mw5.5 New Idria earthquake that occurred along the Great Valley 12 section [28l] (Ekström and others 1992); 1985 Mw6.5

	Coalinga earthquake that occurred along the Coalinga section [28m] (Ekström and others 1992); and the 1985 Mw6.1 Kettleman Hills-North Dome earthquake that occurred along the Kettleman Hills-North Dome section [28n] (Ekström and others 1992). Wong and others (1988) summarized these events and additional seismicity along the Great Valley thrust fault system. Slip rate estimates for the thrust fault system generally are based on uplift rates of specific stratigraphic horizons and fault dips, which are sometimes measured from deep seismic reflection lines, and sometimes from structural modeling. A paleoseismic study at the Lone Tree Creek site (403-1) involving trench excavations exposed deformed terraces deposits, but did not expose faulting along the San Joaquin fault [403], which may be the near surface expression of the Orestimba section [28g]. Estimated late Quaternary dip-slip rates along the Great Valley thrust fault system range from about 0.1 mm/yr for the Great Valley 01 section, 1–3 mm/yr for the Mysterious Ridge [28c] section, 0.4–0.6 mm/yr for the Orestimba [28g] section, and about 3 mm/yr for the Kettleman Hills-North Dome [28n] section. **Sections:** This fault has 14 sections. From north to south the section names are: Great Valley 01 [28a], Great Valley 02 [28b], Mysterious Ridge (GV 03) [28c], Trout Creek (GV 04a) [28d1], Gordon Valley (GV 04b [28d2], Orestimba (GV 07) [28g], Quinto (GV 08) [28h], Laguna Seca (GV 09) [28i], Panoche Hills (GV 10) [28j], Great Valley 11 [28k], Great Valley 12 [28l], Coalinga (GV 13) [28m], and Kettleman Hills-North Dome (GV 14) [28n]. The blind Great Valley thrust fault system originally was divided into 14 sections by WGNCEP (Working Group on Northern California Earthquake Potential, 1996) and Petersen and others (1996) in order to model the fault system for purposes of seismic hazard assessment. Subsequent probabilistic seismic hazard assessment models (UCERF 2-Wills and others 2008) revised the sections, replacing GV 05 [028e] with the Mt. Diablo thrust (blind) [353] and GV 06 [028f] with the Midland fault [506] and Pittsburg-Kirby Hills fault zone [246]. Wakabayashi and Smith (1994) first proposed dividing the Great Valley thrust fault system into between 18 and 25 segments, based on structural geology, geomorphology, and historical seismicity.
Name comments	**General:** Refers to the blind thrust fault and fold belt that is located along the west side of the Great Valley. Has been referred to as the Coast Range-Sierra Nevada boundary zone by Wong and others (1988), Coast Range-Central Valley boundary zone by Wakabayashi and Smith (1994) (they also refer to this structure as

	the Coast Range-Central Valley thrust system in their Figure 1), and the Great Valley thrust fault system by WGNCEP (Working Group on Northern California Earthquake Potential, 1996). Great Valley thrust fault system will be used in this compilation. **Section:** Orestimba section proposed by Anderson and Piety (2001) generally corresponds with most of GV 07 and northern half of GV 08 as defined by Petersen and others (1996) and WGNCEP (Working Group on Northern California Earthquake Potential, 1996). GV 07 generally corresponds with the southern half of segment 8 and segment 9 of Wakabayashi and Smith (1994). GV 08 generally corresponds with segments 10 and 11 of Wakabayashi and Smith (1994). GV 07 delineated by Petersen and others (1996) extends from just north of Corral Hollow south to the vicinity of Salada Creek. GV 08 delineated by Petersen and others (1996) and WGNCEP (Working Group on Northern California Earthquake Potential, 1996) extends from the vicinity of Salada Creek southeast to the vicinity of San Luis Reservoir. Anderson and Piety (2001) differed from Petersen/WGNCEP in that they did not see any justification for a segment boundary in the vicinity of Salada Creek. They postulated the existence of two buried thrust faults within the vicinity of Petersen and others GV 07 and GV 08. The northern section extends for about 55–65 km from Corral Hollow southeast to Garzas Creek (their Orestimba blind thrust [28g]). An approximately 5 km-wide right step over delineates the southern boundary of the Orestimba thrust. The Orestimba thrust may correspond to the San Joaquin fault [403] delineated by Lettis (1982), Noller and others (1993) and Sowers and others (1993a, 1993b). To the south Anderson and Piety (2001) mapped a 19-km long blind thrust fault they name the Quinto thrust [28h). **Fault ID:** Refers to numbers GV 01 to GV 14 of WGNEP (Working Group on Northern California Earthquake Potential, 1996).
County(s) and State(s)	SAN JOAQUIN COUNTY, CALIFORNIA
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Compiled at 1: 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 Anderson and Piety (2001). The near surface expression of the Orestimba and Quinto thrusts is assumed by Anderson and Piety (2001) to correspond to traces of the San Joaquin fault [403] mapped by Lettis (1982), Noller and others (1993), and Sowers and others (1993a, 1993b). However, the depth to the top of the rupture plane was not stated in Anderson and Piety (2001).
Geologic setting	The Great Valley thrust fault system delineates the boundary between the Coast Ranges and the Great Valley (also referred to as the Central Valley). The Great Valley thrust fault system as defined in this compilation extends for about 475 km along the west side of the Great Valley. The fault system is complex and consists of both shallow west-dipping blind thrust faults and associated east-dipping shallow to moderate dipping thrust and reverse faults. Both fault-bend folding and fault-propagation folding have been hypothesized for the Great Valley thrust fault system and it is likely that one or the other model best explains the data for any specific fault section. For example, the Coalinga section [28m] is best explained by the fault-bend fold model (Namson and Davis, 1990; Guzofski and others 2007), while O'Connell and others (2001) consider that the fault-propagation fold model best explains deformation along the Mysterious Ridge [28c], Trout Creek [28d1], and Gordon Valley [28d2] sections. Maximum structural relief is about 7–10 km for the fault sections along the west side of the Sacramento Valley (sections [28c], [28d1 and 28d2]; O'Connell and others 2001).
Length (km)	This section is 76 km of a total fault length of km.
Average strike	134
Sense of movement	Thrust *Comments:* WGNCEP (Working Group on Northern California Earthquake Potential, 1996); Anderson and Piety (2001).
Dip	20° SW. *Comments:* Anderson and Piety (2001) assume a dip of 20°. It is not clear what data they used for the assumed dips for the Orestimba buried thrust fault, but they do cite personal communication of R.H. O'Connell for the Laguna Seca thrust

	(blind) [28i] located farther south.
Paleoseismology studies	Lone Tree Creek site (403-1). Sowers (1998) conducted a topographic survey and excavated 2 fault-normal trenches across an east-facing scarp on alluvial terraces in order to document presence, activity, and uplift rates of the San Joaquin fault [403] (northern part of Anderson and Piety's Orestimba thrust). Trenches exposed evidence of warping of the alluvial deposits, but faulting was not observed. Two terrace surfaces were vertically deformed and terrace ages were established by dating pedogenic carbonate rinds using U-isotopic-series and radiocarbon isotopic methods, soil profile development and degree of surface weathering.
Geomorphic expression	Anderson and Piety (2001) reported that the Orestimba fault is delineated by east–facing fold scarps along the boundary between the Diablo Range and the San Joaquin Valley. These east-facing fold scarps also have been attributed to the San Joaquin fault [403] (Lettis, 1982; Noller and others,1993, Sowers and others, 1993a, 1993b). The steepest part of the range front, where the Mesozoic Great Valley Sequence is closest to the range front and the Tertiary stratigraphic section is thinnest is located near the center of the Orestimba section (30 km north of Garzas Creek) near the mouth of Del Puerto Canyon.
Age of faulted surficial deposits	Lettis (1982) and Anderson and Piety (2001) mapped uplifted Los Banos alluvial surfaces. The deformed Middle Los Banos surface is estimated to be 250±50 ka, based on soil profile development and relative weathering characteristics (Anderson and Piety, 2001). Sowers (1998) identified two younger deformed surfaces, a 55–83 ka terrace surface and a 2-47 ka terrace surface. A younger 16–32 ka surface is not deformed.
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* The timing of the most recent paleoevent is not well constrained. Sowers (1998) Sowers and Ludwig (2000) identified two deformed terraces surfaces and a younger, non-deformed surface. The youngest deformed terrace surface reported by Sowers (1998) and Sowers and Ludwig (2000) is the T5 surface from 29–47 ka. The undeformed T3 surface is 16-32 ka, and the

	older T 7 surface is 55–83 ka.
Recurrence interval	*Comments:* Sowers (1998) and Sowers and Ludwig (2000) identified two deformed terrace surfaces that show progressive deformation. The 29-47 ka T 5 terrace exhibits monoclinal warping of 2 m (vertical) and the 55-83 ka T 7 surface is vertically warped 5.5 m.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Sowers (1998) and Sowers and Ludwig (2000) determined a vertical uplift rate of 0.08–0.27 mm/yr, based on scarp heights of monoclinally deformed terrace surfaces at the Lone Tree Creek site (403-1). Assuming a fault dip ranging from 30–60°, Sowers (1998) reported a preferred slip rate of 0.13 mm/yr, based on 0.11 mm/yr uplift rate and a 60° dip. Anderson and Piety (2001) reported that maximum uplift rate for Orestimba fault is based on location of remnants of a middle Los Banos-age deposit uplifted about 60 m. Age of deposit of 250±50 ka, based on soil profile development, relative position of terrace surface and weathering, yields uplift rate of 0.2–0.3 mm/yr. Based on the assumption that the fault dips 30°, Anderson and Piety (2001) calculated a slip rate of 0.4–0.6 mm/yr.
Date and Compiler(s)	2017 William A. Bryant, California Geological Survey
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