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Santa Rosa Range fault system, Quinn River section (Class A) No. 1508b

Last Review Date: 2017-04-13

citation for this record: **Adams, K., Personius, S.F., and Sawyer, T.L., compilers, 2017, Fault number 1508b, Santa Rosa Range fault system, Quinn River 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 02:50 PM.**

Synopsis	**General:** This long fault zone consists of two parts, a northern, northeast-striking zone of distributed faulting, and a north-striking southern part marked by nearly continuous range-bounding and piedmont faults; the latter part forms an escarpment between the western margin of the Santa Rosa Range and the eastern margin of the Quinn River Valley in northern Nevada and southeastern Oregon. The Santa Rosa Range is a major east-tilted fault block and the adjacent Quinn River Valley is a graben filled with thousands of meters of Tertiary-Quaternary fill. The Santa Rosa Range fault system is herein divided into three sections, from north to south, the Owyhee River, Quinn River, and Santa Rosa Peak sections, based on fault geometry and recency of fault movement. At the northern end of the system, faults in the

Owyhee River section form a broad zone of northeast-striking, down-to-the-northwest and down-to-the-southeast fault scarps in Miocene to Pleistocene volcanic rocks. A few faults at the western end of the section have latest Quaternary displacements, but the most-recent event on most faults in the section appears to have occurred in the middle or late Pleistocene. A 7-km-wide gap in Quaternary fault scarps separates the northeast-striking Owyhee River section from the north-striking Quinn River section at the northern end of the Quinn River Valley. The Quinn River section has three distinct parts: 1) a north-striking northern part consisting of the High Peaks fault, which forms the eastern margin of the upper Quinn River Valley, 2) a northwest-striking piedmont fault, the Hot Springs Hills fault, and 3) a southeastern part that parallels the north-trending western flank of the Santa Rosa Range. The freshest fault morphology is found along the High Peaks and Hot Springs Hills faults, so apparently the most-recent fault activity on the fault system has stepped onto the piedmont Hot Springs Hills fault and has abandoned the western margin of the Santa Rosa Range north of Canyon Creek. The most-recent event on this section appears to have occurred in the latest Quaternary. The Quinn River and Santa Rosa Peak sections are separated by an echelon right step and a nearly 90° bend in the range front near Flat Creek in northern Nevada. The Santa Rosa Peak section is primarily characterized by a prominent range front with a secondary piedmont fault zone. The piedmont faults included in the section are expressed as small, west-facing scarps on Lahontan (13 ka) lacustrine deposits and post-Lahontan alluvium on the floor of the Quinn River Valley. The range-front fault oversteepens the base of the range, juxtaposes Quaternary alluvium against older bedrock, and is also characterized by rare west-facing scarps in alluvium. The most-recent event on the Santa Rosa Peak section also appears to have occurred in the latest Quaternary, but it is unknown if the latest events on the two southern sections occurred at the same time. The location and recency of fault movement may indicate that the Santa Rosa Range fault system is the northern extension of the central Nevada seismic belt.

Sections: This fault has 3 sections. Although detailed studies along the entire fault zone have not been completed, three sections are inferred based on geometry of the zone, the northernmost, northeast-striking Owyhee River section, and two north-striking sections, the Quinn River and Santa Rosa Peak sections. The Owyhee River section is separated from the Quinn

	River section by a 7-km-wide gap in Quaternary fault scarps and a sharp change in fault strike near Blue Mountain Pass. The Quinn River and Santa Rosa Peak sections are separated by an echelon right step and a nearly 90° bend in the range front near Flat Creek in northern Nevada. The Quinn River and Santa Rosa Peak sections have range-front and piedmont fault zones, but the Santa Rosa Peak section has a much higher, more abrupt range front. The Owyhee River section is characterized by broad groups of northeast-striking scarps.
Name comments	**General:** **Section:** This section is named after the Quinn River fault zone of Narwold and Pezzopane (1997 #3011). Included in this section are the High Peak and Hot Spring Hills faults of Narwold (2001 #3010). **Fault ID:** These structures are included in fault numbers 50 and 51 of Pezzopane (1993 #3544), fault number 63 of Geomatrix Consultants, Inc. (1995 #3593), and fault numbers MD2A and MD2B of dePolo (1998 #2845). The Nevada portion of this section is fault number MD2A of dePolo (1998 #2845).
County(s) and State(s)	HUMBOLDT COUNTY, NEVADA MALHEUR COUNTY, OREGON
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:250,000 scale. *Comments:* Fault locations are primarily based on 1:48,000-scale mapping of Narwold (2001 #3010) and unpublished 1:100,000-scale mapping of Michetti and Wesnousky (1993 #2540). Both of these projects used the same set of 1:12,000 scale low sun-angle aerial photography that were transferred to the different-scale base maps and field checked. Fault locations were checked against 1:250,000-scale mapping of Dohrenwend and Moring (1991 #284) in Nevada and 1:100,000-scale mapping of Weldon and others (2002 #5648), based on 1:500,000-scale mapping of Pezzopane (1993 #3544), in Oregon.
Geologic setting	This long fault zone consists of two parts, a northern, northeast-striking zone of distributed faulting formed in Pliocene (?) and Miocene volcanic rocks of the Owyhee plateau, and a north-

	striking southern part marked by nearly continuous range-bounding and piedmont fault zones (Michetti and Wesnousky, 1993 #2540; Narwold and Pezzopane, 1997 #3011; Narwold, 2001 #3010) that offset Pliocene (?) and Miocene volcanic rocks of the McDermitt Caldera complex (Walker and Repenning, 1966 #3586; Walker and MacLeod, 1991 #3646). The latter part forms an escarpment between the western margin of the Santa Rosa Range, a major east-tilted fault block (Stewart, 1978 #2866), and the eastern margin of the Quinn River Valley, a graben filled with 1,200 to 2,450 m of Tertiary-Quaternary fill (Erwin and others, 1985 #3009; Erwin, 1988 #3008). The Santa Rosa Range fault system may be a northern extension of the central Nevada seismic belt, a north-trending zone of historic surface ruptures (Pezzopane and Weldon, 1993 #149; Michetti and Wesnousky, 1993 #2540; Pezzopane, 1993 #3544).
Length (km)	This section is 57 km of a total fault length of 141 km.
Average strike	N4°W (for section) versus N15°E (for whole fault)
Sense of movement	Normal *Comments:* Faults in this section are mapped as normal or high-angle faults by Walker and Repenning (1966 #3586), Walker (1991 #3646), Dohrenwend (1991 #284), Michetti and Wesnousky (1993 #2540), and Narwold (2001 #3010). Narwold and Pezzopane (1997 #3011) report a possible component of dextral shear on faults in their Quinn River fault zone, but Narwold (2001 #3010) concluded that the Quinn River fault zone has undergone primarily normal displacement.
Dip	75° W. *Comments:* A single dip measurement of 75° was measured from a fault gouge/bedrock exposure 3.5 km northwest of Little Louse Canyon (Narwold, 2001 #3010).
Paleoseismology studies	
Geomorphic expression	The Quinn River section has three distinct parts (Dohrenwend and Moring, 1991 #284; Michetti and Wesnousky, 1993 #2540; Narwold and Pezzopane, 1997 #3011; Narwold, 2001 #3010): 1) a north-striking northern part consisting of the High Peaks fault of Narwold (2001 #3010), which forms the eastern margin of the

	upper Quinn River Valley, 2) a northwest-striking piedmont fault, the Hot Springs Hills fault of Narwold (2001 #3010), and 3) a southeastern part that parallels the north-trending western flank of the Santa Rosa Range. The freshest fault morphology is found along the High Peaks and Hot Springs Hills faults of Narwold (2001 #3010), so apparently the most-recent fault activity on the fault system has stepped onto the piedmont Hot Springs Hills fault and is abandoning the western margin of the Santa Rosa Range north of Canyon Creek. Narwold and Pezzopane (1997 #3011) and Narwold (2001 #3010) conducted detailed scarp-morphology studies at multiple sites along the section and reported both single-event and compound west-facing scarps with vertical offsets of 0.3 m to 3 m on Holocene or late Pleistocene piedmont-slope deposits and more than 20 m of vertical separation on much older piedmont deposits. Michetti and Wesnousky (1993 #2540) reported an early Holocene rupture that rejuvenates older fault scarps and also cuts Holocene fluvial terraces in the northern part of the section. Weldon and others (2002 #5648) observed lineaments across Quaternary deposits on 1:100,000-scale DEMs of the area. dePolo (1998 #2845) reported a preferred value of 256 m for the maximum fault facet height along this part of the fault.
Age of faulted surficial deposits	Dohrenwend and Moring (1991 #284) reports scarps in early to late Pleistocene alluvium, and Narwold and Pezzopane (1997 #3011) and Narwold (1999 #4035; 2001 #3010) report fault scarps in early to late Pleistocene to Holocene (?) alluvium; Michetti and Wesnousky (1993 #2540) reported offset Holocene fluvial terraces at undisclosed locations along the piedmont fault scarps in the Quinn River section. Pezzopane (1993 #3544) and Pezzopane and Weldon (1993 #149) reported as much as 6 m of offset of Pleistocene-Holocene (?) alluvium at undisclosed locations along the Santa Rosa Range fault system.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Although timing of the most-recent event is not well constrained, a latest Quaternary time was reported by Michetti and Wesnousky (1993 #2540) and Narwold and Pezzopane (1997 #3011). Narwold (1999 #4035; 2001 #3010) used soils and scarp-morphology data to estimate an age of 10 ka for the most-recent event on the Hot Spring Hills part of the Quinn River section.

	Pezzopane (1993 #3544) and Pezzopane and Weldon (1993 #149) reported that the youngest late (?) Holocene stream terraces are offset at undisclosed locations along the Santa Rosa Range fault system, and Madin and others (1996 #3479) map most faults in the section in Oregon as Holocene. Weldon and others (2002 #5648) mapped the High Peaks and Hot Springs Hills faults of Narwold (2001 #3010) as active in the latest Quaternary (<20 ka), and the southeastern part that parallels the western flank of the Santa Rosa Range as active in the Quaternary (<1.6 Ma).
Recurrence interval	11–65 k.y. (sic) and 74–97 k.y. *Comments:* The last three coseismic surface deforming events occurred 125–155 ka, 90–108 ka, and 11–16 ka (Personius and Mahan, 2005 #7764).
Slip-rate category	Less than 0.2 mm/yr *Comments:* Personius and Mahan (2005 #7764) document slow vertical displacement rates including an average rate of 0.03–0.05 mm/yr for the middle- to late-Quaternary history across all faults at the Orovada trench site. Narwold (1999 #4035; 2001 #3010) used field measurements of surface offset and estimated ages based on calcic soil development to estimate minimum vertical displacement rates of 0.01–0.15 mm/yr on several parts of the Quinn River section. Pezzopane (1993 #3544) and Pezzopane and Weldon (1993 #149) used airphoto and limited reconnaissance to infer a vertical rate of 0.5–1.0 mm/yr across a broad zone of faulting from the Steens Mountain/Alvord desert area across the Santa Rosa Range fault system, but how this slip is partitioned on the numerous faults in this area is unknown. dePolo (1998 #2845) assigned a reconnaissance vertical displacement rate of 0.525 mm/yr for the Nevada part of the Santa Rosa fault system based on an empirical relationship between his preferred maximum basal facet height and vertical rate. The size of the facets (tens to hundreds of meters, as measured from topographic maps) indicates they are the result of many seismic cycles, and thus the derived rate reflects a long-term average. However, the more detailed data of Narwold (1999 #4035; 2001 #3010) and Personius and Mahan (2005 #7764) suggests much lower slip rates throughout the Quaternary, so these values to assign the lowest slip-rate category.
Date and Compiler(s)	2017 Kenneth Adams, Piedmont Geosciences, Inc.

	Stephen F. Personius, U.S. Geological Survey Thomas L. Sawyer, Piedmont Geosciences, Inc.
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