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Quaternary Fault and Fold Database of the United States

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Steens fault zone, Crowley section (Class A) No. 856a

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Synopsis	**General:** The nearly 200-km-long Steens fault zone is the most topographically prominent normal fault system in the northern Basin and Range province of west North America. The fault separates the eastern flanks of Steens Mountain and the Pueblo Mountains from the western margins of the Alvord Desert and Pueblo Val southern Oregon and northern Nevada. Steens Mountain and the Pueblo Mountai west-tilted fault blocks comprised of Miocene volcanic rocks, whereas the adjace Alvord Desert and Pueblo Valley are structural basins filled with thousands of me of Tertiary-Quaternary sedimentary fill. **Sections:** This fault has 6 sections. Although detailed studies along the entire fau zone have not been reported, six sections are inferred based on geometry and timi most-recent surface faulting at selected sites (but not on all sections) along the zo Hemphill-Haley and others (1999 #4038) proposed that the Steens fault zone in Oregon be divided into five segments. Herein we retain the five segment names delineated by Hemphill-Haley and others (1999 #4038) as section names, and ad

	sixth, northernmost section based on mapping of Pezzopane (1993 #3544). From to south, these sections are the Crowley [856a], Mann Lake [856b], Alvord [856c Fields [856d], Tum Tum [856e], and Denio [856f] sections. At the north end of th zone, faults in the Crowley section [856a] offset Miocene volcanic rocks a few hundred meters, and may have moved as recently as the middle and late Quaterna Faults in the adjacent Mann Lake section [856b] offset Miocene volcanic rock a minimum of 1600 m, and also may have moved as recently as the middle and late Quaternary. The adjacent Alvord section [856c] forms the steep eastern flank of th High Steens, and has offset Miocene volcanic rock 2–4 km. Trench and fault scar investigations indicate one or more Holocene surface-faulting events along the A section, so both the long-term (Miocene) and Quaternary slip histories indicate th section is the most active part of the Steens fault zone. Slip apparently decreases s of the Alvord section. Faults in the adjacent Fields section [856d] offset Miocene volcanic rock a minimum of 1400 m, and show their youngest movement (latest Quaternary) on short faults that lie on the playa east of the range front. Faults in t Tum Tum section [856e] appear to be slightly older than the youngest movement the playa strands of the Fields section [856d], but are younger than the latest movement on the range front strand of the Fields [856d] and Mann Lake [856b] sections. Trenching of the fault in the Denio section [856d], which is the southern part of the Steens Mountain fault zone, clearly demonstrates Holocene movement
Name comments	**General:** The Steens fault zone forms a steep escarpment between the uplifted St Mountain and Pueblo Mountains, and the western margin of Pueblo Valley and th Alvord Desert. These faults have been mapped by Willden (1964 #3002), Slemm (1966, unpublished Vya 1:250,000-scale sheet), Greene (1972 #3560), Walker an Repenning (1965 #3559), Brown and Peterson (1980 #3585), Hemphill-Haley (19 #3960), Walker and MacLeod (1991 #3646), Dohrenwend and Moring (1991 #28 Pezzopane (1993 #3544), Madin and others (1996 #3479), Weldon and others (20 #5144), and Personius and others (2006 #7386). The fault zone includes faults ma as the Alvord-Steens fault zone of Pezzopane (1993 #3544) and Pezzopane and Weldon (1993 #149), and the Steens fault, Alvord Desert graben, and Pueblo Mo faults of Pezzopane (1993 #3544). Geomatrix Consultants, Inc. (1995 #3593) use name Steens-Alvord Graben faults for all structures in the Alvord Desert area, an delineated three fault source zones: the northern segment, the Western Margin fau zone, and the East Alvord graben fault. The Steens fault zone extends into northe Nevada as the Pueblo Mountains fault zone of dePolo (1998 #2845). Hemphill-H (1987 #3960) named several small structures in the zone (Alvord, Dune Field, Embayment, Kueny Ditch, Serrano Point, Serrano Springs, Smyth Wells, and Wildhorse Creek faults), and included them in a larger Steens fault zone. Hemphi Haley and others (1989 #3958, 1999 #4038) later proposed that the Steens fault z be divided into five segments. Herein we retain the name Steens fault zone for the entire structure in Oregon and Nevada, and use the five segment names delineated Hemphill-Haley and others (1999 #4038) as section names. A sixth, northernmos section is informally defined herein on the basis of mapping by Pezzopane (1993 #3544) and Weldon and others (2002 #5144).

	Section: This section is herein informally named after the community of Crowley Oregon, which lies astride the northern end of the fault zone mapped by Pezzopan (1993 #3544). **Fault ID:** These structures are fault numbers 47, 48, and 49 of Pezzopane (1993 #3544), fault number 62 of Geomatrix Consultants, Inc. (1995 #3593), and fault number V9 of dePolo (1998 #2845).
County(s) and State(s)	MALHEUR COUNTY, OREGON
Physiographic province(s)	COLUMBIA PLATEAU
Reliability of location	Good Compiled at 1:100,000 scale. *Comments:* Location of fault from ORActiveFaults (http://www.oregongeology.org/arcgis/rest/services/Public/ORActiveFaults/MapS downloaded 06/02/2016) attributed to 1:100,000-scale mapping of Ferns and othe (1993 #3561).
Geologic setting	The Steens fault zone is marked by nearly continuous range-bounding faults on th east side of the Pueblo Mountains and Steens Mountain. The fault zone extends fi near Crowley, Oregon, to the southern end of Bog Hot Valley in northern Nevada Pueblo Mountains and Steens Mountain are major west-tilted fault blocks (Stewa 1978 #2866); the adjacent Alvord Desert and Pueblo Valley are structural basins (grabens) filled with 1–2.5 km of Tertiary-Quaternary sedimentary fill (Cleary an others, 1981 #7385, 1981 #5649; Oldow and others, 2005 #7388). The region is underlain by Miocene volcanic rocks, primarily the Steens Basalt (Willden, 1964 #3002; Walker and Repenning, 1965 #3559; Greene and others, 1972 #3560; Bro and Peterson, 1980 #3585; Minor and others, 1987 #3746; Minor and others, 198 #3747; Walker and MacLeod, 1991 #3646). The Steens fault zone is the longest, prominent normal fault zone in the Basin and Range province of eastern Oregon, appears to truncate the southeastern end of the northwest-trending Brothers fault (Lawrence, 1976 #3506). Total Miocene vertical displacement of 1.75±0.25 km is reported for a location near Baltazor Hot Spring (Personius and others, 2007 #738 and Brown and Peterson (1980 #3585) estimated offsets of 2,100–3,000 m in Mio rocks at the southern end of the Alvord section.
Length (km)	This section is 43 km of a total fault length of 197 km.
Average strike	N40°E (for section) versus N12°E (for whole fault)
Sense of	Normal

movement	*Comments:* Faults in this section are mapped as normal or high-angle faults by G (1972 #3560), Walker and MacLeod (1991 #3646), Pezzopane (1993 #3544), and Weldon and others (2002 #5648).
Dip Direction	SE *Comments:* No data on fault dip have been published, but Wong and others (1999 #5654) used an estimated dip of 60° in their analysis of paleo-earthquake magnitu on the Crowley section.
Paleoseismology studies	
Geomorphic expression	Faults in the Crowley section form small basins filled with Quaternary sediments aligned along small (less than a few hundred meters high) northeast-trending, dov the-southeast escarpments on Miocene volcanic rocks (Greene and others, 1972 # Walker and MacLeod, 1991 #3646). No fault scarps on Quaternary deposits have reported.
Age of faulted surficial deposits	No fault scarps on Quaternary deposits have been reported.
Historic earthquake	
Most recent prehistoric deformation	middle and late Quaternary (<750 ka) *Comments:* Pezzopane (1993 #3544) used air photo analysis to infer that latest movement on most faults in the Crowley section occurred in the middle to late Quaternary (<700 ka); Weldon and others (2002 #5648) also inferred youngest movement in the middle to late Quaternary (<780 ka). Wong and others (1999 #5 considered this section to be possibly active, with assigned probabilities of 0.75 b on equivocal evidence for Quaternary displacement.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* No slip studies have been reported, but Wong and others (1999 #565 estimated a vertical slip rate of 0.01 mm/yr for the Crowley section. Offsets of no than a few hundred meters in Miocene volcanic rocks support low rates of long-te slip across faults in this section.

Date and Compiler(s)	2002 Stephen F. Personius, U.S. Geological Survey
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