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Quaternary Fault and Fold Database of the United States

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Red Rock Hills fault, Monument Hill section (Class A) No. 648a

Last Review Date: 2011-01-21

Compiled in cooperation with the Montana Bureau of Mines and Geology

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Synopsis	**General:** Most of this fault remains unstudied. Regalla and others (2006 #7033, 2007 #7032) mapped the northern part of the fault and summarized its characteristics. Johnson (1981 #30) discussed but did not map the fault, and Ostenaa and Wood (1990 #318) questioned some of Johnson's conclusions. **Sections:** This fault has 3 sections. Sections are based on presumed age difference between northern section and other two sections, and the lack of continuous expression between southern two sections.

Name comments	**General:** An early reference to the Red Rock Hills fault is Scholten and others (1955 #69), who described the discontinuous fault as extending from near southern end of Clark Canyon Reservoir (north) to northeast of Lima, Montana (south). The northern part of fault described by Scholten is an older structure (Quaternary?) and is not coincident with the Monument Hill (Ostenaa and Wood, 1990 #318) section [648a] described in this compilation; Regalla and others (2006 #7033, 2007 #7032) refer to the northern part of the fault as the Monument Hill fault system. Discontinuous fault scarps shown here extends from Maurer Creek southeastward to Buck River. **Section:** Defined as the Monument Hill segment by Ostenaa and Wood (1990 #318). It extends about 11 km southeastward from Maurer Creek and consists of three parallel, synthetic, west-dipping fault strands.
County(s) and State(s)	BEAVERHEAD COUNTY, MONTANA
Physiographic province(s)	NORTHERN ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Location of scarps is based on 1:24,000-scale mapping of Regalla and others (2006 #7033, 2007 #7032).
Geologic setting	The fault is expressed as several widely separated, northwest-trending, down-to-the-southwest fault scarps that bound the southwest side of the Red Rock Hills. Johnson (1981 #30) considered it to be an antithetic fault to the Red Rock fault [641], which bounds the west side of Red Rock graben, and to have an equivalent amount of total throw of 1 km (Johnson, 1981 #313). In contrast, based on length-scaling relationships for normal faults, Regalla and others (2007 #7032) suggest that the total throw is about 400 m.
Length (km)	This section is 11 km of a total fault length of 38 km.
Average strike	N36°W (for section) versus N46°W,N36°W,N36°W (for whole fault)
Sense of movement	Normal

	Comments: Orientation of extension fractures in clasts associated with presently inactive northwestern extension of this section suggests postlate Pliocene sinistral or sinistral-oblique movement (Hurlow, 1995 #1063). Regalla and others (2007 #7032) also suggest that displacement on this section is normal oblique.
Dip Direction	SW
Paleoseismology studies	
Geomorphic expression	This part of the fault is characterized by 3- to 4-m-high scarps on alluvium, aligned springs, and faceted spurs along much of its trace. The 3-km-long southwestern fault strand has scarps near Buck Creek that suggest a history of multiple Quaternary ruptures. Scarp heights on the oldest mapped alluvial deposit average twice the height (2-7 m) of scarp heights on the next younger deposit (1-2 m; Regalla and others, 2007 #7032). Regalla and others (2007 #7032) further conclude that single-event offsets on the main strand of the Monument Hill section are about 3.5 m whereas single-event offsets on the basinward strands are about 1 m.
Age of faulted surficial deposits	Upper Pleistocene alluvium (Ostenaa and Wood, 1990 #318; Regalla and others, 2007 #7032; 2006 #7033).
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* Timing of the most recent faulting event is poorly constrained and is based on inferred age of alluvial surfaces based on position of deposits in the landscape and morphologic modeling (Ostenaa and Wood, 1990 #318; Regalla and others, 2007 #7032). All three strands offset the two oldest alluvial-fan deposits, but they do not offset the two youngest fan deposits, indicating to Regalla and others (2006 #7033) a late Pleistocene age for the most recent surface rupture. A scarp profile suggests that faulting might be contemporaneous with most recent faulting on the Timber Butte section [641b] of Red Rock fault. The profiled scarp may be the result of one or towo faulting events (Ostenaa and Wood, 1990 #318.

Recurrence interval	>140 k.y. *Comments:* Regalla and others, 2007 #7032) conclude that two earthquake clusters at 22-32 ka and possibly > prior to 160 ka are suggested by the age of offset alluvial surfaces and morphologic modeling of the fault scarps.
Slip-rate category	Less than 0.2 mm/yr *Comments:* Inferred low slip rate based on data presented by Ostenaa and Wood (1990 #318) and Regalla and others (2007 #7032) of scarps less than 7-m high on late Pleistocene alluvial fans.
Date and Compiler(s)	2011 Kathleen M. Haller, U.S. Geological Survey
References	#1063 Hurlow, H.A., 1995, Late Pliocene or younger paleostress directions from fractured clasts, Sixmile Creek Formation, lower Red Rock Valley, SW Montana: Geological Society of America Abstracts with Programs, v. 27, no. 4, p. 16. #30 Johnson, P.P., 1981, Geology of the Red Rock fault and adjacent Red Rock valley, Beaverhead County, Montana: Missoula, University of Montana, unpublished M.S. thesis, 88 p., 2 pls. #313 Johnson, P.P., 1981, Geology of the Red Rock fault and adjacent Red Rock valley, Beaverhead County, Montana, *in* Tucker, T.E., ed., Guidebook to southwest Montana: Montana Geological Society, 1981 Field Conference and Symposium, p. 245-251. #318 Ostenaa, D., and Wood, C., 1990, Seismotectonic study for Clark Canyon Dam, Pick-Sloan Missouri Basin Program, Montana: U.S. Bureau of Reclamation Seismotectonic Report 90-4, 78 p., 1 pl. #7032 Regalla, C.A., Anastasio, D.J., and Pazzaglia, F.J., 2007, Characterization of the Monument Hill fault system and implications for the active tectonics of the Red Rock Valley, southwestern Montana: Journal of Structural Geology, v. 29, p. 1339-1352. #7033 Regalla, C.A, Reyman, D.K.S., Anastasio, D.J., and Pazzaglia, F.J., 2006, Bedrock and surficial geologic map of the

	Red Rock 7.5° quadrangle, Beaverhead County, southwestern Montana: Montana Bureau of Mines and Geology Open File Report 533, 22 p., 1 plate, scale 1:24,000. #69 Scholten, R., Keenmon, K.A., and Kupsch, W.O., 1955, Geology of the Lima region, southwestern Montana and adjacent Idaho: Geological Society of America Bulletin, v. 66, p. 345-404.