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# Quaternary Fault and Fold Database of the United States

**As of January 12, 2017, the USGS maintains a limited number of metadata fields that characterize the Quaternary faults and folds of the United States. For the most up-to-date information, please refer to the interactive fault map.**

## Red Rock fault, northern section (Class A) No. 641a

**Last Review Date: 2011-01-21**

## Compiled in cooperation with the Montana Bureau of Mines and Geology

***citation for this record:*** **Haller, K.M., compiler, 2011, Fault number 641a, Red Rock fault, northern 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 03:03 PM.**

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| **Synopsis** | **General:** Trenching at one site on the southern part of the fault, along with clear differences in fault-scarp morphology, geologic relations between faulted and unfaulted deposits, and basin geometry defined by Residual Bouguer gravity data indicate that the three parts of the fault probably have different faulting histories. The northern part, as shown in this compilation by a valleyward echelon step in the fault at its southern end, has been the subject of little study.<br><br>**Sections:** This fault has 3 sections. Sections are defined by the |

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| | apparent differences in the times of the most recent prehistoric deformation. The two southern sections were first identified by Stickney and Bartholomew (1987 #85). They defined segments from geomorphic data of Johnson (1981 #30) even though Johnson divided this part of the fault into four segments (it is unclear if Johnson meant seismogenic segments). Later studies (Greenwell, 1997 #7035; Harkins and others, 2005 #7034) suggested alternative segment boundaries leading to segments as short as 8-km long (see figure 2 Harkins and others, 2005 #7034). In contrast, Bartholomew and others (2004 #6899) suggest that the two, more active sections of the fault [641b and 641c] rupture together. |
| **Name comments** | **General:** The source of the name Red Rock fault is probably from Pardee (1950 #46), who defined the fault as extending from near Clark Canyon Reservoir to southwest of Lima, Montana, along the east flank of the Tendoy Montains. Pardee also referred to this structure as the Lima fault, whereas Scholten and others (1955 #69) used Red Rock fault zone. The fault, as shown in this compilation, extends from about 2 km north of Limekiln Canyon southward to near Birch Creek. Other compilations show only the southern two-thirds of the fault shown in this compilation (Witkind, 1975 #317; Stickney and Bartholomew, 1987 #242).<br><br>**Section:** This section of the fault extends from northern end of Tendoy Mountains, north of Limekiln Canyon, southeast to near Kelmbeck Creek. The southern end of the section is at a prominent echelon step in the range front. Bartholomew and others (2009 #7041) suggest the northern part of the Red Rock fault is shorter than shown in this compilation; however, its location is not shown on any of their figures.<br><br>**Fault ID:** Refers to number 8 (Red Rock fault zone) of Witkind (1975 #317); number 4 (Red Rock fault) of Stickney and Bartholomew (1987 #85); and Timber Butte and Sheep Creeks segments of Red Rock fault in Montana Bureau of Mines and Geology digital database (Stickney, written commun., 1992) and Stickney and Bartholomew (1987 #242). |
| **County(s) and State(s)** | BEAVERHEAD COUNTY, MONTANA |
| **Physiographic province(s)** | NORTHERN ROCKY MOUNTAINS |
| **Reliability of** | Poor |

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| **location** | Compiled at 1:250,000 scale.<br><br>*Comments:* Location of fault generally based on range-front topography; scarps on alluvium have not been observed. Lonn and others (2000 #7055) show a fault buried by old Quaternary fans east of the location depicted in this compilation. |
| **Geologic setting** | High-angle, down-to-the-northeast, range-front normal fault bounding northeast side of Tendoy Mountains. There is no evidence of young faulting south of mapped trace even though the mountain front extends farther south. The total vertical separation may be 1 km based on gravity data (Johnson, 1981 #313) and displacement?length relations (Harkins and others, 2005 #7034). Hurlow (1995 #1063) also suggests about 1 km of structural relief. However, Bartholomew and others (2009 #7041) state that the Red Rock basin is smaller and very shallow (3,600-m deep) compared to other basins of the northern Basin and Range; in addition, the basin does not contain a thick sequence of Eocene-Miocene sediments. |
| **Length (km)** | This section is 14 km of a total fault length of 41 km. |
| **Average strike** | N23°W (for section) versus N34°W,N33°W (for whole fault) |
| **Sense of movement** | Normal<br><br>*Comments:* Sense of movement assumed to be same as is to the south as indicated by Witkind (1975 #317). |
| **Dip Direction** | NE |
| **Paleoseismology studies** | |
| **Geomorphic expression** | Northern section is characterized by straight mountain front and an absence of recognizable fault scarps on alluvium (Johnson, 1981 #30). |
| **Age of faulted surficial deposits** | |
| **Historic earthquake** | |
| **Most recent** | undifferentiated Quaternary (<1.6 Ma) |

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| **prehistoric deformation** | *Comments:* Faulting history of the northern section is poorly known; reconnaissance studies indicate no evidence of scarps on uppermost Quaternary deposits (Johnson, 1981 #30; Haller, 1988 #27). The timing of the most recent event is inferred in this compilation to be possibly Quaternary based on the young movement to the southeast. To date, no studies have investigated this section of the fault. |
| **Recurrence interval** | |
| **Slip-rate category** | Less than 0.2 mm/yr<br><br>*Comments:* Low slip rate is inferred based on absence of scarps. |
| **Date and Compiler(s)** | 2011<br>Kathleen M. Haller, U.S. Geological Survey |
| **References** | #7041 Bartholomew, M.J., Greenwell, R.A., Wasklewicz, T.A., Stickney, M.C., 2009, Alluvial fan—Sensitive tectonic indicators of fault-segmentation and tectonic regime partitioning along the Red Rock fault, south-western Montana, USA: Northwest Geology, v. 38, p. 41-66.<br><br>#6899 Bartholomew, M.J., Stickney, M.C., and Wasklewicz, T.A., 2004, Interaction between the northern Basin and Range and the Yellowstone stress fields near the Red Rock fault, southwestern Montana: Geological Society of America Abstracts with Programs, v. 36, no. 4, p. 12.<br><br>#7035 Greenwell, R.A., 1997, Alluvial fan development, the key to segmentation of the Red Rock fault, southwestern Montana: University of South Carolina, unpublished M.S. thesis.<br><br>#27 Haller, K.M., 1988, Segmentation of the Lemhi and Beaverhead faults, east-central Idaho, and Red Rock fault, southwest Montana, during the late Quaternary: Boulder, University of Colorado, unpublished M.S. thesis, 141 p., 10 pls.<br><br>#7034 Harkins, N.W., Anastasio, D.J., Pazzaglia, F.J., 2005, Tectonic geomorphology of the Red Rock fault, insights into segmentation and landscape evolution of a developing range front normal fault: Journal of Structural Geology, v. 27, p. 1925-1939. |

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#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.

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#7055 Lonn, J.D., Skipp, B., Ruppel, E.T., Janecke, S.U., Perry, W.J., Jr., Sears, J.W., Bartholomew, M.J., Stickney, M.C., Fritz, W.J., Hurlow, H.A., and Thomas, R.C., 2000, Preliminary geologic map of the Lima 30' X 60' quadrangle, southwest Montana: Montana Bureau of Mines and Geology Open-File Report 408, 49 p., 1:100,000 scale, http://www.mbmg.mtech.edu/mbmgcat/public/ListCitation.asp?pub_id=11279&.

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#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.

#242 Stickney, M.C., and Bartholomew, M.J., 1987, Preliminary map of late Quaternary faults in western Montana: Montana Bureau of Mines and Geology Open-File Report 186, 1 pl., scale 1:500,000.

#85 Stickney, M.C., and Bartholomew, M.J., 1987, Seismicity and late Quaternary faulting of the northern Basin and Range province, Montana and Idaho: Bulletin of the Seismological Society of America, v. 77, p. 1602-1625.

#317 Witkind, I.J., 1975, Preliminary map showing known and

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| | suspected active faults in western Montana: U.S. Geological Survey Open-File Report 75-285, 36 p. pamphlet, 1 sheet, scale 1:500,000. |