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Rock Creek fault (Class A) No. 729

Last Review Date: 2011-02-22

citation for this record: **McCalpin, J.P., and Haller, K.M., compilers, 2011, Fault number 729, Rock Creek fault, 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 02:03 PM.**

Synopsis	The Rock Creek fault is a north-striking, high-angle, down-to-the-west normal fault within the Tunp Range. The fault is located approximately 24 km west of Kemmerer, Wyo., near Fossil Butte National Monument. Scarps are present along much of the length of this fault. Morphologic studies of the scarps have been conducted and one trench that was excavated that demonstrates the most recent even occurred in the late Holocene. See Case and others (2002 #7162) for additional characterization.
Name comments	Name originally appears on plate 1 of Rubey and others (1975 #816), but is not mentioned in the text. It is also shown as the Beck Creek fault (Blackstone and DeBruin, 1987 #820). The fault extends from about 1.5 km west of headwaters of Mayfield Creek southward to about 2 km west of headwaters of Bullpen Creek (5.3 km south of U.S. Highway 30N). According to Rubey and others (1980 #814), the fault extends 2 km farther north to West Branch Hams Fork.

	Fault ID: Refers to number 16 (Rock Creek fault) in Witkind (1975 #819), shown but unnamed by Gibbons and Dickey (1983 #821).
County(s) and State(s)	LINCOLN COUNTY, WYOMING
Physiographic province(s)	MIDDLE ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Fault location from 1:62,500-scale mapping of Rubey and others (1975 #816, 1980 #814) as modified by unpublished 1:24,000-scale mapping of the compiler. Chambers (1988 #818) also mapped the extent of fault scarps at a scale of 1:63,360. Location of fault is further constrained by satellite imagery and topography at scale of 1:24,000. Reference satellite imagery is ESRI_Imagery_World_2D with a minimum viewing distance of 1 km (1000 m).
Geologic setting	High-angle, down-to-the-west normal fault within the Tunp Range bounding the western side of Dempsey Ridge. The fault forms the eastern boundary of a graben that parallels the trend of decollement structures of the Overthrust Belt (Anders and LaForge, 1983 #836) and may sole into the Laramide-age Tunp thrust fault. Stratigraphic throw of Eocene and older units ranges from 300–500 m (Rubey and others, 1975 #816).
Length (km)	41 km.
Average strike	N5°E
Sense of movement	Normal *Comments:* (Rubey and others, 1975 #816)
Dip Direction	W *Comments:* Rubey and others (1975 #816) stated that data are insufficient to determine the fault's dip and geometry, but they showed the fault schematically in plate 2 as having a dip of 60° W.
Paleoseismology studies	Site 729-1. McCalpin and his students excavated a trench across a 6.4-m-high fault scarp at Cook Canyon (McCalpin, 1993 #796); total stratigraphic throw is more than 11 m at this site (McCalpin and Warren, 1992 #817). Nine radiocarbon ages were obtained, mainly from buried soils intercalated with alluvium on the downthrown block. These radiocarbon ages constrain

	the timing of a late Holocene event and define a minimum time for an earlier event because the older deformed colluvial wedge is older than about 4,470 14C yr BP. However, the earlier history of faulting could not be fully reconstructed because the bottom of the trench was in the thick Holocene alluvium deposited against the fault scarp on the downthrown block (McCalpin and Warren, 1992 #817). A charcoal sample from a buried soil under scarp-derived colluvium exposed in a stream cut bank in Cook Canyon (nearly the same location as site 729-1) in an earlier study (Chambers, 1988 #818) indicated that the older event is younger than 4,780?260 14C yr BP. Thus, the timing of the earlier event is inferred to be middle Holocene and constrained by these two radiocarbon ages (more than 4,470 14C yr BP and less than 4,780?260 14C yr BP). The timing of the penultimate event is approximately 4.6?0.2 ka.
Geomorphic expression	The fault is characterized by scarps on steep colluvial slopes along most of its length. Rubey and others (1975 #816) indicated that scarps are as much as 15 m high, Witkind (1975 #819) indicated they are less than 20 m high, but McCalpin (1993 #796) stated that some scarps are as much as 25 m high. Isolated scarps on alluvium are 6–8 m high (McCalpin and Warren, 1992 #817; McCalpin, 1993 #796). Chambers (1988 #818) measured fault scarp profiles at seven locations; Anders and LaForge (1983 #836) did not field check the scarps.
Age of faulted surficial deposits	Holocene and Pleistocene landslide deposit and Tertiary bedrock (Rubey and others, 1975 #816) are offset; however, most of the length of the fault is mapped at the alluvium-bedrock contact (Rubey and others, 1975 #816; 1980 #814). In contrast to the available geologic mapping, McCalpin (1993 #796) stated that most of fault is in colluvium.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* The most recent event is bracketed by radiocarbon ages of 3,280?70 and 3,880?60 14C yr BP (McCalpin and Warren, 1992 #817), or roughly 3.6±0.3 ka, whereas the penultimate (older) event is about 4.6?0.2 ka. Although Witkind (1975 #819) inferred historic (<100 yr) movement of this fault, the basis for this inference is unclear and appears unfounded.
Recurrence interval	>3.3 k.y. (0 to 3.6?0.3 ka), 0.6–1.5 k.y. (3.3–4.8 ka), >10 k.y. (4.6±0.2 to 15 ka) *Comments:* McCalpin (1993 #796) provided these minimum and maximum

	recurrence intervals based on the occurrence of the two most recent paleoearthquakes at 3.6?0.3 ka (3,280–3,880 14C yr BP) and possibly 4.6?0.2 ka (4,470–4,780 14C yr BP). This equates to a permissible recurrence interval of about 0.6–1.5 k.y. However, the late Quaternary recurrence interval must be quite variable: it has been about 3.6?0.3 k.y. since the last event and it was at least 10 k.y. before the penultimate event at 4.6?0.2 ka (15 ka is the inferred time of deposition of older faulted deposit at trench site).
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* On the basis of a 2.5-m-thick colluvial wedge, McCalpin and Warren (1992 #817) calculated a displacement of 4–5 m for the most recent event at 3.6±0.3 ka; however, this amount may reflect both backtilting and displacement at the fault (*i.e.*, a maximum amount of offset). This large slip is associated with a recurrence interval of only 0.6–1.5 k.y. This short recurrence interval suggests an earthquake cluster (two closely spaced events) that may not be typical of the longer late Quaternary history of the fault. Permissible vertical displacement rates derived from these data seem unreasonable for any significant geologic time interval (*i.e.*, the Holocene), and are contrary to the 3.6±0.3 k.y. interval of non-rupturing since the most recent event. A slower slip rate is obtained from 11 m of stratigraphic separation of deposits with a preferred age of 15 ka as reported by McCalpin and Warren (1992 #817). Considering the above discussion and the evidence for an earthquake cluster in the middle Holocene, we categorize the Rock Creek fault in the 0.2–1.0 mm/yr bracket and recognize that it may have considerably faster slip rates over short intervals of geologic time (several thousand years). A similar treatment was afforded the nearby Greys River fault [728].
Date and Compiler(s)	2011 James P. McCalpin, GEO-HAZ Consulting, Inc. Kathleen M. Haller, U.S. Geological Survey
References	#836 Anders, M.H., and LaForge, R.C., 1983, Seismotectonic study for Big Sandy and Eden Dams Eden Project, Wyoming: U.S. Bureau of Reclamation Seismotectonic Report 83-5, 18 p. #820 Blackstone, D.L., Jr., and DeBruin, R.H., 1987, Tectonic map of the overthrust belt, western Wyoming, northeastern Utah, and southeastern Idaho, showing oil and gas fields and exploratory wells in the overthrust belt and adjacent Green River Basin, *in* Miller, W.R., ed., The thrust belt revisited: Wyoming Geological Association, 38th Annual Field Conference, Jackson Hole, Wyoming, September 8-11, 1987, Guidebook. #7162 Case, J.C., Toner,R.N., and Kirkwood, R., 2002, Basic seismological

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#821 Gibbons, A.B., and Dickey, D.D., 1983, Quaternary faults in Lincoln and Uinta Counties, Wyoming, and Rich County, Utah: U.S. Geological Survey Open-File Report 83-288, 1 sheet, scale 1:100,000.

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#816 Rubey, W.W., Oriel, S.S., and Tracey, J.I., Jr., 1975, Geology of the Sage and Kemmerer 15-minute quadrangles, Lincoln County, Wyoming: U.S. Geological Survey Professional Paper 855, 18 p., 2 pls.

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#824 West, M.W., 1989, Neotectonics of the Darby-Hogsback and Absaroka thrust pls., Uinta County, Wyoming and Summit County, Utah with applications to earthquake hazard assessment: Golden, Colorado School of Mines, unpublished Ph.D. dissertation, 450 p., 17 pls.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

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