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Quaternary Fault and Fold Database of the United States

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Centennial fault, western Centennial Valley section (Class A) No. 643a

Last Review Date: 2010-12-09

Compiled in cooperation with the Montana Bureau of Mines and Geology

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Synopsis	**General:** Until recently, most published discussions on this fault were based on the data of Witkind (1975 #296). Petrik (2008 #7031) completed a comprehensive fault reconnaissance study, which included relocating the fault using field GPS measurements, geologic mapping, and analysis of fault scarps. This recent work identifies scarps on Holocene and upper Pleistocene deposits preserved along most of the Centennial fault. Revised age categories are based on the most recent work. Earlier published data often cited conflicting evidence regarding the recency and rate of activity of this fault.

	Sections: This fault has 4 sections. Three segments of the Centennial fault are shown in the original mapping of Witkind (1975 #296), and other authors (Johns and others, 1982 #259; Stickney and Bartholomew, 1987 #85; Ostenaa and Wood, 1990 #318) have retained the nomenclature. However, it is unclear if the original intent was to identify independent seismogenic segments. Thus, sections of the fault that have similar characteristics are discussed here. Section boundaries are located where scarps on distinctly different age deposits are present or where the fault trace takes echelon steps. The Centennial Valley segment of Witkind (1975 #296) is divided into 2 sections in this compilation, and Witkins's Red Rock Pass and Henrys Lake segments are discussed as 2 additional sections.
Name comments	**General:** The source of the name is probably Pardee (1950 #46), who describes the fault as extending from near Monida, Montana, eastward to Henrys Lake basin. The fault, as shown here, extends from about 2 km southwest of Mud Lake eastward to 2 km east of the southeastern shore of Henrys Lake. The extent of fault has been shown in various forms in previous compilations. **Section:** Shown as the Western Centennial Valley segment by Stickney and Bartholomew (1987 #242) and Centennial Valley and East Centennial Valley segments in Stickney and Bartholomew (written commun. 1992 #556). Preference is given here to earlier name. Section includes approximately the western half of Centennial Valley segment of Witkind (1975 #296) and number 1 (Centennial Valley segment) of Johns and others (1982 #259). Extends from 1 km south of Mud Lake eastward to near 7 L Ranch (0.6 km east of Curry Creek), beyond which the fault is mostly buried (Witkind, 1975 #296). **Fault ID:** Refers to fault number 4 (Centennial fault) of Witkind (1975 #317); fault numbers 1 (Centennial fault-Centennial Valley segment) and 35 (Centennial fault-Red Rock Pass-Henrys Lake segment) of Johns and others (1982 #259); fault number 9 (Centennial fault) of Stickney and Bartholomew (1987 #85); and Centennial fault of Stickney and Bartholomew (1987 #242; written commun. 1992 #556).
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 is based on 1:24,000-scale map of Petrik (2008 #7031) 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. Petrik (2008 #7031) shows numerous faults that extend into bedrock; this compilations shows only the major range-bounding fault and 2 km-long scarp south of Mud Lake from M. Stickney (written commun., 2011).
Geologic setting	High-angle, down-to-the-north, range-front normal fault bounds the north side of Centennial Mountains. The eastern and western parts of the Centennial fault are expressed by nearly continuous scarps on bedrock and Quaternary deposits; whereas the central part of the fault is composed of left-stepping echelon faults. Ross and Nelson (1964 #249) speculate that this fault continues to the east-trending intrabasin scarps formed during the Hebgen Lake earthquake south of Hebgen Lake [659] through Targhee Pass, which they contend is a modified structural depression; however, Fraser and others (1964 #628) argue to the contrary, citing the diminishing amount of displacement from west to east that appears to die out near Henrys Lake, an interpretation supported by Petrik (2008 #7031). Available gravity data suggest that the Centennial fault terminates in the Madison Valley (Schofield, 1981 #314). Sonderegger and others (1982 #297) report a minimum offset of 1.5-1.8 km of the 2-Ma Huckleberry Ridge Tuff and possibly 3 km of vertical displacement in the past 10 m.y.
Length (km)	This section is 23 km of a total fault length of 62 km.
Average strike	N47°E (for section) versus N78°W (for whole fault)
Sense of movement	Normal *Comments:* (Witkind, 1975 #296; Petrik, 2008 #7031)
Dip Direction	N
Paleoseismology studies	
Geomorphic	East-trending, nearly continuous scarps; surface offset of late

expression	Pleistocene alluvial fans range from 0.8-13.6 m (Petrik, 2008 #7031). Witkind (1975 #296) reported larger scarps (5- to 22-m high, generally 12-m high). Scarps on alluvial deposits are steep with reported maximum slope angles of 22?-54?, (Ostenaa and Wood, 1990 #318). More recent studies (Gilbert and others, 1983 #434; Petrik, 2008 #7031) indicate that scarps are more extensive than shown by Witkind (1975 #296). Numerous springs are present along the trace of the fault (Honkala, 1960 #654).
Age of faulted surficial deposits	Scarps are shown on maps on undifferentiated Quaternary deposits; however, reported to be on Pinedale-equivalent deposits (Petrik, 2008 #7031)
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* All studies agree that faulting along this part of the Centennial fault is within the assigned category. Petrik (2008 #7031) indicates that the fault cuts latest Pleistocene deposits. Stickney and Bartholomew (1987 #85; 1987 #242; written commun. 1992 #556) indicate that the most recent faulting event occurred in the early Holocene based on stratigraphic relations. Ostenaa and Wood (1990 #318) also suggest Holocene faulting based on brief reconnaissance of the western part of the fault. Faulting of this section of the Centennial fault may be temporally related to that on the Lima Reservoir fault [646] (Ostenaa and Wood, 1990 #318).
Recurrence interval	2-25 k.y. (<25 ka) *Comments:* Ostenaa and Wood (1990 #318) indicate two events occurred in the past 25 k.y. The most recent event is Holocene, and the penultimate event occurred between 12 and 25 ka based on stratigraphic relations. Recurrence interval given here is assumed from their discussion. Mason (1992 #463) indicates that the recurrence interval is greater than 7?3 k.y. for an unspecified period of time based on data from Stickney and Bartholomew (1987 #85); however, supporting documentation in Mason (1992 #463) suggests that this is the interval of time since the most recent event.
Slip-rate category	Between 0.2 and 1.0 mm/yr

	Comments: Based on about 25 scarp profiles, Petrik (2008 #7031) estimates that the average slip rates for the western part of the Centennial fault is 0.76 mm/yr if young offset deposits are assumed to be 12 ka or 0.65 mm/yr if young offset deposits are assumed to be 14 ka. Reilinger and others (1977 #479) show a vertical crustal velocity of approximately 1 mm/yr in this area based on leveling data from 1934 and 1964 surveys. Gravity data suggest 3 km of vertical movement presumed to have occurred in the past 10 m.y. (Sonderegger and others, 1982 #297), which yields a long-term vertical slip rate within the assigned slip rate category.
Date and Compiler(s)	2010 Kathleen M. Haller, U.S. Geological Survey
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4, 78 p., 1 pl.

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#297 Sonderegger, J.L., Schofield, J.D., Berg, R.B., and Mannick, M.L., 1982, The upper Centennial Valley, Beaverhead and Madison Counties, Montana: Montana Bureau of Mines and Geology Memoir 50, 53 p., 4 pls.

#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.

#556 Stickney, M.C., and Bartholomew, M.J., 1992 written commun., Preliminary map of late Quaternary faults in western

	Montana (digital data): Montana Bureau of Mines and Geology (digital version of MBMG Open-File Report 186), 1 pl., scale 1:500,000. #296 Witkind, I.J., 1975, Geology of a strip along the Centennial fault, southwestern Montana and adjacent Idaho: U.S. Geological Survey Miscellaneous Investigations Map I-890, 1 sheet, scale 1:62,500. #317 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in western Montana: U.S. Geological Survey Open-File Report 75-285, 36 p. pamphlet, 1 sheet, scale 1:500,000.