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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.

Bitterroot fault (Class A) No. 663

Last Review Date: 1994-06-14

Compiled in cooperation with the Montana Bureau of Mines and Geology

citation for this record: **Haller, K.M., compiler, 1994, Fault number 663, Bitterroot 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 02:04 PM.**

Synopsis	Little is known about the Quaternary history of this fault. Ross (1947 #772) speculated that no range-front fault is present along the eastern flank of the Bitterroot Mountains. The majority of studies (a few of which are cited here) have focused on the prominent mylonite zone along the range front. Isolated scarps on predominately upper Quaternary deposits are known (Barkmann, 1984 #809); however, scarps are not recognized on adjacent older deposits.
Name comments	Name is probably from Lindgren (1904 #769); even though he discusses this fault at length, he uses the name only in passing on p. 115. Fault, as shown here, extends from about 4 km northwest of Lolo, Montana, southward to about 2.2 km southeast of West

	Fork of Bitterroot River. **Fault ID:** Refers to number 88 (Bitterroot fault) of Witkind (1975 #317).
County(s) and State(s)	MISSOULA COUNTY, MONTANA RAVALLI COUNTY, MONTANA
Physiographic province(s)	NORTHERN ROCKY MOUNTAINS
Reliability of location	Poor Compiled at 1:250,000 scale. *Comments:* Trace compiled from 1:500,000-scale map of Witkind (1975 #317). The extent and character of the fault is shown in a variety of ways by different authors. Lindgren (1904 #769) and Pardee (1950 #46) indicate that the fault extends from near Lolo Peak at least as far south as Grantsdale, Montana, or possibly to Boulder Creek, a tributary of West Fork Bitterroot River. McMurtrey and others (1972 #770) show four left-stepping echelon traces that extend along and into the range from near Florence to south of Victor, Montana. Toth (1983 #776) shows the fault extending from west of Darby, Montana, southward to West Fork Bitterroot River, and continuing westward parallel to that river and the Nez Perce Fork to about 5 km west of Watch Tower Creek; even though this map extends north of Florence, Montana, the fault is not shown in the northern part of the map area. Barkmann (1984 #809) documents the presence of two scarps on alluvium (neither of which are shown here), one near Lake Como and the other at the mouth of Bear Creek.
Geologic setting	High-angle, down-to-east, range-front normal fault bounding the east side of Bitterroot Mountains. No recent estimates of depth to basement and stratigraphic throw are known, but Lindgren (1904 #769) suggests a minimum vertical offset of 1.2-1.8 km. Old gravity data suggest that the valley fill is about 600 m thick (Manghnani and Hower, 1961 #773); however, more recent data suggest that magnetic basement is 1.6 km deep (Lankston, 1975 #811). Generalized bedrock topography derived from data of Lankston suggests a maximum throw is approximately 3.3 km (Barkmann, 1984 #809).
Length (km)	98 km.
Average strike	N1°E

Sense of movement	Normal *Comments:* (Lindgren, 1904 #769)
Dip	45°-90° E *Comments:* Lindgren (1904 #769) reports the fault dipping 45? E at a depth of 150 m in the Curlew Mine. McMurtrey and others (1972 #770) indicate the fault dips from 45? to vertical but do not document where or on what measurements were obtained.
Paleoseismology studies	
Geomorphic expression	In general, fault is poorly expressed. Quaternary scarps include a 2-km-long scarp near the mouth of Bear Creek, a 5-km-long scarp south of Lake Como (Barkmann, 1984 #809), and a short, "historic" scarp near the Curlew Mine (Lindgren, 1904 #769). The range-front morphology is generally characterized by 18-26? slopes (Lindgren, 1904 #769) on mylonite that is as much as 1 km thick (Chase and others, 1983 #771). Various authors speculate that mylonitization may be related to early extension (Garmezy and Sutter, 1983 #774; House and others, 1993 #775). Lindgren (1904 #769) indicates that streams draining the Bitterroot Range have a notable increase in gradient (from about 40 m/km to 80 m/km) within 1.6 km of the fault on upthrown block that is related to faulting.
Age of faulted surficial deposits	Locally pre-Bull Lake and Bull Lake till (Barkmann, 1984 #809)
Historic earthquake	
Most recent prehistoric deformation	undifferentiated Quaternary (<1.6 Ma) *Comments:* A conservative estimate is used here, even though localized historical and late Quaternary displacement is reported in the literature. Lindgren (1904 #769) documents historical (1898) movement along nearly 500 m of the fault near the Curlew Mine (Witkind, 1975 #317). However, local newspapers make no mention of a significant earthquake occurring at that time (Qamar and Stickney, 1983 #58), thus, ground failure due to some nonseismogenic cause is possible (Barkmann, 1984 #809).

	Surficial slip was 30-60 cm and, in places, the disrupted ground surface has a partly open fissure (Lindgren, 1904 #769). The interpretation of historical seismically induced movement is questionable; therefore, it is not indicated in this compilation. Witkind (1975 #317) shows the rest of the fault as late Cenozoic on his map, but his accompanying text suggests that parts of the fault are Quaternary. Barkmann (1984 #809) indicates the presence of a 70-m-high scarp on middle Quaternary (pre-Bull Lake) till and 7-m-high scarp on upper Quaternary (Bull Lake) till; no scarps are known on ~15 ka (Pinedale) deposits. These relations are apparent at two locations (near Bear Creek and south of Lake Como); however, the lack of continuous scarps justifies a conservative estimate.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Inferred low slip rate is based on ~7 m slip on upper Quaternary (<130 ka) deposits.
Date and Compiler(s)	1994 Kathleen M. Haller, U.S. Geological Survey
References	#809 Barkmann, P.E., 1984, A reconnaissance investigation of active tectonism in the Bitterroot Valley, western Montana: Missoula, University of Montana, unpublished M.S. thesis, 84 p., 5 pls. #771 Chase, R.B., Bickford, M.E., and Arruda, E.C., 1983, Tectonic implications of Tertiary intrusion and shearing within the Bitterroot dome, northeastern Idaho batholith: Journal of Geology, v. 91, p. 462-470. #774 Garmezy, L., and Sutter, J.F., 1983, Mylonitization coincident with uplift in an extensional setting, Bitterroot Range, Montana-Idaho: Geological Society of America Abstracts with Programs, v. 15, p. 578. #775 House, M.A., Isachsen, C.E., Hodges, K.V., and Bowring, S.A., 1993, Geochronologic evidence for a complex, post-extensional thermal structure in the Bitterroot dome metamorphic complex, MT.: Geological Society of America Abstracts with Programs, v. 25, p. A-411.

#811 Lankston, R.W., 1975, Depth to magnetic basement in the northern Bitterroot Valley and Sapphire Mountains in western Montana: Geological Society of America Abstracts with Programs, v. 7, no. 5, p. 620.

#769 Lindgren, W., 1904, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho: U.S. Geological Survey Professional Paper 27, 123 p.

#773 Manghnani, M.H., and Hower, J., 1961, Structural significance of a gravity profile in the Bitterroot Valley, Ravalli County, Montana [abs.]: Geological Society of America Special Paper 68, p. 93.

#770 McMurtrey, R.G., Konizeski, R.L., Johnson, M.V., and Bartells, J.H., 1972, Geology and water resources of the Bitterroot Valley, southwestern Montana: U.S. Geological Survey Water-Supply Paper 1889, 80 p., 1 pl., scale 1:125,000.

#46 Pardee, J.T., 1950, Late Cenozoic block faulting in western Montana: Geological Society of America Bulletin, v. 61, p. 359-406.

#58 Qamar, A.I., and Stickney, M.C., 1983, Montana earthquakes, 1869-1979—Historical seismicity and earthquake hazard: Montana Bureau of Mines and Geology Memoir 51, 79 p., 3 pls.

#772 Ross, C.P., 1947, Eastern front of the Bitterroot Range near Hamilton, Montana: Geological Society of America Bulletin, v. 58, p. 1222.

#776 Toth, M.I., 1983, Reconnaissance geologic map of the Selway-Bitterroot Wilderness, Idaho County, Idaho, and Missoula and Ravalli Counties, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1495-B, 1 sheet, scale 1:125,000.

#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.

Questions or comments?