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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.

Lake Hotel faults (graben) (Class A) No. 755

Last Review Date: 2011-02-23

citation for this record: **Pierce, K.L., and Haller, K.M., compilers, 2011, Fault number 755, Lake Hotel faults (graben), 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 01:59 PM.**

Synopsis	These faults form a north-trending graben on Holocene lake sediment that have been observed from geophysical imaging and reflection studies of Yellowstone Lake (Otis and others, 1977 #2273; Kaplinski, 1991 #2272; Johnson and others, 2003 #7050; Morgan and others, 2007 #7051; Pierce and others, 2007 #7052) and land-based geologic studies by Locke and others (1992 #308). The graben is less than 500 m wide with the main fault on the west side and as many as three antithetic faults on the east (fig. 22 Johnson and others, 2003 #7050); the observed length along strike is less than 2 km (Kaplinski, 1991 #2272). Northward and southward continuations of these faults was not observed in the geophysical data (Otis and others, 1977 #2273, p. 3715; Kaplinski, 1991 #2272); however, the most recent interpretation identifies the Lake Hotel fault is likely an extension of the Eagle Bay fault [757] to the south (Johnson and others, 2003 #7050; Morgan and others, 2007 #7051; Pierce and others, 2007 #7052),

	which contrasts with the mapping of Christiansen (2001 #1784) who shows a queried connection to the Eagle Bay fault. Many geologists have searched the area of the northward projection of the fault on land, but have not found any surface expression of this fault. However, Meyer and Locke (1986 #41) interpreted a sag in the paleoshorelines of the lake near the outlet to be the northern on-land expression of the graben. From diagrams of Meyer and Locke (1986 #41, Fig. 3), the compiler notes that the 7,000 yr BP "S2" shoreline is essentially undeformed in the sag area, whereas the 9,500 yr BP "S4" shoreline has a 2 m sag and the older "S5" shorelines have a 4 m sag. The seismogenic potential of these faults is limited because of the relatively shallow brittle/ductile transition at a depth of only 5 km (Smith and Braile, 1993 #2271, Fig. 25).
Name comments	Named for the Lake Hotel rather than "Fishing Bridge" or "Outlet" because the Lake Hotel is closer. Discovered by Otis and others, (1977 #2273). The faults are entirely underwater, and are located over distance of 1.7 km about 1 km south of Lake Hotel and about 2.0-3.5 km south of Fishing Bridge in Yellowstone National Park.
County(s) and State(s)	TETON COUNTY, WYOMING
Physiographic province(s)	MIDDLE ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Originally mapped by Kaplinski (1991 #2272) using Mini-Ranger navigation system. The location of faults has been revised to reflect their locations based on constrained by three seismic-reflection profiles (Johnson and others, 2003 #7050) that cross the north-trending graben between Stevenson Island and Lake Village; this revised location (Pierce and others, 2007 #7052, fig. 2) places the Lake Hotel fault 800 to 1000 m west of original mapping (Otis and others, 1977 #2273). The horizontal resolution of the reflection data is typically 3 m at 10-m water depth and 13 m at 50-m water depth.
Geologic setting	The Lake Hotel fault in northwestern Yellowstone Lake is the northernmost part of a 25-km-long distributed extensional deformation zone within the Yellowstone caldera, which last

	erupted the Lava Creek Tuff 0.63 Ma.
Length (km)	2 km.
Average strike	N2°W
Sense of movement	Normal
Dip Direction	E; W *Comments:* Fault is near vertical based on geophysical surveys (fig. 22, Johnson and others, 2003 #7050).
Paleoseismology studies	A detailed chronology based on interpretation of seismic-reflection profiles includes 95 cm total offset in the most recent event (2.5-0.1 ka), only 15 cm of total offset occurring 12.5-7.5 ka, and 3 m of total offset occurring 15-12 k.y. ago (Johnson and others, 2003 #7050, Table 1). The total net slip across the zone in each faulting event varies substantially, as well as the length of time between events.
Geomorphic expression	The western bounding fault has a maximum displacement of 6 m; whereas lake beds in the upper 10 m of sediments have a total of about 2 m of vertical displacement across the eastern bounding fault (Morgan and others, 2007 #7051). These displacements probably represent the total amount that is younger than the Glacier Peak ash (13,400 cal yr) record (Johnson and others, 2003 #7050). The vertical resolution of imaged features is 10 cm based on more than 450 km of high-resolution seismic reflection profiles multibeam bathymetric data in the northern part of Yellowstone Lake. Johnson and others (2003 #7050) recognize that the fault, as mapped, is too short to generate a large enough earthquake to yield in an apparent maximum event displacement of 3 m, and suggest that the available data indicate that the Lake Hotel fault zone is part of a zone of north-trending normal faults that extends 25 km. Furthermore, the zone may be characterized as several discontinuous segments that connect at depth.
Age of faulted surficial deposits	Holocene lake-bottom sediment.
Historic earthquake	

Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Timing of the most recent event is constrained to be 2.5-0.1 ka (Johnson and others, 2003 #7050; Morgan and others, 2007 #7051).). Earlier studies suggested post-glacial faulting, but did not provide any further constraints (Otis and others, 1977 #2273). A microearthquake survey in 1973 (Smith and Shuey, 1977) identified seismicity located within 1 km of this graben, which suggests that these features may be associated with contemporary tectonic activity (Otis and others, 1977 #2273).
Recurrence interval	5,000 yr (<15 ka) *Comments:* Johnson and others (2003 #7050) suggest an average earthquake recurrence interval of 5000 yr, but the poorly constrained times of the three reported prehistoric earthquakes is based on interpretation of seismic-reflection data and are inferred to have occurred at 15-12 ka, 12-7.5 ka, and 2.5-0.1 ka (Johnson and others, 2003 #7050; Morgan and others, 2007 #7051). The ages of these earthquakes suggest that the uncertainty in the recurrence interval is large and could be as much as 5,000-7,000 yr.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Johnson and others (2003 #7050) suggest that cumulative net down-to-the-east fault slip across this zone during the three events is 4.1 m, which yields a postglacial slip rate within the assigned category. However, single event slip rates may be highly variable due to the variable net slip across the zone (95, 15, and 300 cm) in each faulting event.
Date and Compiler(s)	2011 Kenneth L. Pierce, U.S. Geological Survey, Emeritus Kathleen M. Haller, U.S. Geological Survey
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