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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.

Elephant Back fault zone (Class A) No. 754

Last Review Date: 2011-02-03

citation for this record: **Pierce, K.L., and Haller, K.M., compilers, 2011, Fault number 754, Elephant Back fault zone, 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	Three to ten subparallel scarps trend northeast across Elephant Back Mountain where they are expressed in the Elephant Back rhyolite flow, which is about 150 ka. In places, the faults form trench-like valleys about 100 m wide. These faults are in the center of the Yellowstone caldera that erupted the 0.63-Ma Lava Creek Tuff and parallel the long axis of the caldera and also parallels the axis of historic doming as shown by Pelton and Smith (1982 #2270). These faults trend southwest between the axial grabens of the Sour Creek and Mallard Lake domes (Christiansen, 2001 #1784). Small magnitude earthquakes may be generated on these faults because the brittle layer of the crust is only 3-5 km thick inside the caldera (Smith and Braile, 1993 #2271). Joint inversion of InSAR, GPS, and leveling data shows shallow (6-8 km) changes in volume within the Yellowstone caldera that are spatially associated with the Elephant Back fault zone between Mallard Lake dome to beyond Sour Creek dome

	(Vasco and others, 2007 #7044), which suggests that this fault may control or at least influence deformation within the caldera.
Name comments	Referred to as Elephant Back fault zone by Christensen (2001 #1784). This group of faults is comprised of 3-10 subparallel faults on Elephant Back Mountain, northwest of Yellowstone Lake in the central part of the Yellowstone caldera.
County(s) and State(s)	PARK COUNTY, WYOMING TETON COUNTY, WYOMING
Physiographic province(s)	MIDDLE ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:125,000 scale. *Comments:* Mapped at 1:62,500 scale by Christiansen and Blank (1975 #2269) and Christiansen, (1974 #2266). Fault traces. Location of scarps further constrained by LiDAR data (http://opentopo.sdsc.edu/gridsphere/gridsphere?cid=standarddems) and topography at scale of 1:24,000.
Geologic setting	The Elephant Back fault zone is associated with one of the most active parts of the Yellowstone caldera that extends between the axial grabens of the Sour Creek and Mallard Lake domes. The strike of the Elephant Back fault zone is parallel to the axis of the Snake River Plain and to the general alignment of major late Cenozoic calderas from the eastern Snake River Plain through the long axis of the 0.63-Ma Yellowstone caldera and the axis of historic uplift and subsidence (Pelton and Smith, 1982 #2270; Dzurisin and others, 1990 #3799; Wicks and others, 1998 #3806; Christensen, 2001 #1784). The faults may be associated with the inflation-deflation cycles of the Yellowstone caldera.
Length (km)	28 km.
Average strike	N47°E
Sense of movement	Normal *Comments:* The faults may have some fissure-like, purely extensional (normal) offset because the width of trench-like valleys is much greater than their vertical offset.
Dip Direction	NW; SE

	Comments: Dip may be steep, or even fissure-like, owing to shallow brittle-ductile transition at 3-5 km and their location above cooling magma chamber.
Paleoseismology studies	
Geomorphic expression	Generally strong geomorphic expression on rhyolite of Elephant Back Mountain. Fault traces locally form trenches that are more than 100 m wide. This makes the amount of offset of rhyolite flows difficult to estimate. There may be poorly expressed post-glacial scarps on sandy debris on the much larger mostly bedrock escarpment of the trench walls. Scarps on surficial materials are not definitive, although there are increases in slope on sandy alluvial fans where they cross the projected position of the fault. These poorly expressed, scarp-like features suggest the possibility of post-glacial (<15 ka) offset (K.L. Pierce, field notes, 1994, locality 94P30).
Age of faulted surficial deposits	Elephant Back rhyolite flow has a K-Ar age of 153?2 ka (Obradovich, 1992 #2268).
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* This timing is considered certain by R.L. Christiansen (oral commun., 1998) based on offset of rhyolite flows at 153?2 ka. Although younger than the flow, the most recent movement appears to be late Quaternary (<130 ka) on the basis of strong geomorphic expression. Poorly expressed, scarp-like features on surficial materials suggest possible post-glacial (<15 ka) offset.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* A low late Quaternary slip rate is assigned here based on 3-30 m of surface relief across faults in a 150-ka rhyolite flow.
Date and Compiler(s)	2011 Kenneth L. Pierce, U.S. Geological Survey, Emeritus

	Kathleen M. Haller, U.S. Geological Survey
References	#2266 Christiansen, R.L., 1974, Geologic map of the West Thumb quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic quadrangle Map GQ-1191, scale 1:62,500. #1784 Christiansen, R.L., 2001, The Quaternary and Pliocene Yellowstone Plateau volcanic field of Wyoming, Idaho, and Montana: U.S. Geological Survey Professional Paper 729-G, 145 p., 3 pls., scale 1:125,000. #2269 Christiansen, R.L., and Blank, H.R., 1975, Geologic map of the Canyon Village quadrangle, Yellowstone National Park, Wyoming: U.S. Geological Survey Geologic quadrangle Map GQ-1192, scale 1:62,500. #3799 Dzurisin, D., Savage, J.C., and Fournier, R.O., 1990, Recent crustal subsidence at Yellowstone caldera, Wyoming: Bulletin of Volcanology, v. 52, p. 247-270. #2268 Obradovich, J.D., 1992, Geochronology of the late Cenozoic volcanism of Yellowstone National Park and adjoining areas, Wyoming and Idaho: U.S. Geological Survey Open-File Report 92-408, 45 p. #2270 Pelton, J.R., and Smith, R.B., 1982, Contemporary vertical surface displacements in Yellowstone National Park: Journal of Geophysical Research, v. 87, no. B4, p. 2745-2761. #2271 Smith, R.B., and Braile, L.W., 1993, Topographic signature, space-time evolution, and physical properties of the Yellowstone-Snake River plain volcanic system—the Yellowstone hotspot, *in* Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., eds., Geology of Wyoming: Geological Survey of Wyoming, Memoir No. 5, p. 694-754. #7044 Vasco, D.W., Puskas, C.M., Smith, R.B., and Meertens, C.M., 2007, Crustal deformation and source models of the Yellowstone volcanic field from geodetic data: Journal of Geophysical Research, v. 112, B07402, doi:10.1029/2006JB004641. #3806 Wicks, C.J., Thatcher, W., and Dzurisin, D., 1988, Migration of fluids beneath Yellowstone caldera inferred from

	satellite radar interferometry: Science, v. 282, p. 458-462.

Questions or comments?