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Quaternary Fault and Fold Database of the United States

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Lemhi fault, Ellis section (Class A) No. 602a

Last Review Date: 2010-11-09

Compiled in cooperation with the Idaho Geological Survey

citation for this record: **Haller, K.M., and Wheeler, R.L., compilers, 2010, Fault number 602a, Lemhi fault, Ellis section, 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 03:02 PM.**

Synopsis	**General:** The Lemhi fault is a 135-km-long, southwest-facing, normal fault along the southwestern base of the Lemhi Range. Several workers have defined differing numbers of segments; thus, the extent to which large ruptures of various ages have crossed or stopped at the various proposed segment boundaries remains undetermined. Accordingly, the Lemhi fault was divided into six sections based on mapping, morphological data, dating, and trenching of scarps and the surfaces they offset. The four southern sections are better studied than the two northern sections. All but the two end sections are known to have had Holocene or postglacial surface ruptures. The few determinations of individual recurrence intervals of large surface ruptures vary

	from approximately 6 to 20 k.y. The central part of the fault appears to have had higher slip rates than the end parts. **Sections:** This fault has 6 sections. Numerous investigators have attempted to define segments of Lemhi fault based on a variety of methodologies. Baltzer (1990 #432) defines four segments along the northern 80 km of fault based on trenching studies and mapping of Quaternary deposits, Turko (1988 #4642) and Turko and Knuepfer (1991 #227) define a minimum of six to nine segments based on analysis of scarp-morphology data, Haller (1988 #27) and Crone and Haller (1991 #186) define six segments based on scarp-morphology studies, and Stickney and Bartholomew (1987 #85) provide descriptions of scarps at six localities. The segmentation model of Baltzer (1990 #432) is used in this compilation for the northern part of fault because of its recency and level of detail of the investigation. The middle section boundary of the Lemhi fault, that between sections 602c (Big Gulch) and 602d (Warm Creek), was located in essentially the same place by Haller (1988 #27), Turko (1988 #4642), and Baltzer (1990 #432). South of that section boundary, the three section names of Turko and Knuepfer (1991 #227) and Baltzer (1990 #432) are used. However, for the southern boundaries of these three sections (602d, 602e, and 602f), the locations of Haller (1988 #27) are used, because they are described in the greatest geographic detail and are, therefore, the easiest to identify on topographic maps and in the field for future study and testing. These locations, which Haller (1988 #27) showed on a 1:250,000-scale topographic base, are consistent with those of Turko and Knuepfer (1991 #227) within the spacing of their data points along the Lemhi fault.
Name comments	**General:** Both Anderson (1934 #595) and Baldwin (1951 #427) recognized Basin and Range style of faulting in this area, as well as large amounts of throw across this and nearby faults and the recency of their movement. Baldwin (1951 #427) is probably one of the earliest to use the name Lemhi fault for this structure. The fault extends entire length of Lemhi Range, although study area of Baldwin did not encompass entire fault. **Section:** The name "Ellis segment" appears in Turko (1988 #4642) and Turko and Knuepfer (1991 #227); Baltzer (1990 #432) uses same name for this northernmost segment, but the location of southern segment boundary (as used here) differs from Turko and Knuepfer (1991 #227). The segment as defined by Baltzer (1990 #432) extends from northern terminus of Lemhi

	Range to between Dry Gulch and Spring Gulch, on the south; the southern boundary is at 20? change in strike of fault. Baltzer (1990 #432) concedes that this segment may be part of segment to south because of its short length, low displacement rate, and northward decrease of throw; rupture of this part of fault may occasionally occur in response to earthquake on the segment to south. However, based on structural relations between the Lemhi fault and an older, north-trending intersecting fault (Allison Creek fault), Janecke (1993 #6550) agrees that a structural barrier to rupture propagation should be present at this location. The Ellis section, as used in this record, is the northern part of the May segment of Haller (1988 #27) and Crone and Haller (1991 #186). **Fault ID:** Refers to number 115 ("unnamed series of faults along southwest flank Lemhi Range") in Witkind (1975 #320).
County(s) and State(s)	LEMHI COUNTY, IDAHO
Physiographic province(s)	NORTHERN ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:100,000 scale. *Comments:* Location of the scarps is based on 1:250,000-scale maps of Haller (1988 #27; original mapping at 1:24,000 or 1:62,500), further constrained by satellite imagery and topography at scale of 1:100,000. Reference satellite imagery is ESRI_Imagery_World_2D with a minimum viewing distance of 1 km (1,000 m).
Geologic setting	This part of east-central Idaho and southwest Montana is made of Precambrian and Paleozoic rocks that were shortened by folding and faulting and were thrust northeastward during the late Mesozoic. Mid- to late Cenozoic extension broke the thrust complex into northwest-trending basins and ranges and continues today. The Lemhi fault is a high-angle, down-to-the southwest, range-front normal fault that separates the Lemhi Range to the northeast from the Pahsimeroi and Little Lost River valleys to the southwest.
Length (km)	This section is 12 km of a total fault length of 136 km.
Average strike	N63°W (for section) versus N51W (for whole fault)
Sense of	

Sense of movement	Normal
Dip Direction	SW
Paleoseismology studies	
Geomorphic expression	A single, 10-m-high scarp on pre-Wisconsin alluvium is preserved at Ennis Gulch (Baltzer, 1990 #432). The rest of fault trace defined by bedrock-alluvial contact.
Age of faulted surficial deposits	
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* Time of faulting is not well constrained, but Baltzer (1990 #432) estimates that the faulting predates 80 ka. The single preserved scarp is at contact between pre-Wisconsin (in part, Bull-Lake equivalent) and early Wisconsin alluvium. The assigned age-category is based on the assumption that youngest pre-Wisconsin is faulted.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Assigned slip-rate category based on only line of evidence in the literature; that is of a 10-m-high scarp on deposits that are younger than 80 ka.
Date and Compiler(s)	2010 Kathleen M. Haller, U.S. Geological Survey Russell L. Wheeler, U.S. Geological Survey, Emeritus
References	#595 Anderson, A.L., 1934, A preliminary report on recent block faulting in Idaho: Northwest Science, v. 8, p. 17-28. #427 Baldwin, E.M., 1951, Faulting in the Lost River Range area of Idaho: American Journal of Science, v. 249, p. 884-902. #432 Baltzer, E.M., 1990, Quaternary surface displacement and segmentation of the northern Lemhi fault, Idaho: Binghamton,

State University of New York, unpublished M.S. thesis, 88 p., 2 pl., scale 1:62,500.

#186 Crone, A.J., and Haller, K.M., 1991, Segmentation and the coseismic behavior of Basin and Range normal faults—Examples from east-central Idaho and southwestern Montana, *in* Hancock, P.L., Yeats, R.S., and Sanderson, D.J., eds., Characteristics of active faults: Journal of Structural Geology, v. 13, p. 151-164.

#27 Haller, K.M., 1988, Segmentation of the Lemhi and Beaverhead faults, east-central Idaho, and Red Rock fault, southwest Montana, during the late Quaternary: Boulder, University of Colorado, unpublished M.S. thesis, 141 p., 10 pls.

#6550 Janecke, S.U., 1993, Structures in segment boundary zones of the Lost River and Lemhi faults, east central Idaho: Journal of Geophysical Research, v. 98, no. B9, p. 16,223-16,238.

#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.

#4642 Turko, J.M., 1988, Quaternary segmentation history of the Lemhi Fault, Idaho: Binghamton, State University of New York, M.A. thesis, 91 p.

#227 Turko, J.M., and Knuepfer, P.L.K., 1991, Late Quaternary fault segmentation from analysis of scarp morphology: Geology, v. 19, p. 718-721.

#320 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Idaho: U.S. Geological Survey Open-File Report 75-278, 71 p. pamphlet, 1 sheet, scale 1:500,000.