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Lemhi fault, Big Gulch section (Class A) No. 602c

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Compiled in cooperation with the Idaho Geological Survey

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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 "Big Gulch segment" is used by Turko (1988 #4642) and Turko and Knuepfer (1991 #227); Baltzer (1990 #432) uses the same name for generally same part of fault, but the location of northern boundary (that used here) differs from Turko

	and Knuepfer (1991 #227). The segment as defined by Baltzer (1990 #432) extends from near Big Creek on the north, to between Bear Canyon and Sawmill Canyon on the south. The Big Gulch segment of Baltzer (1990 #432) contains all of the Goldburg and northern part of the Sawmill Gulch segment of Haller (1988 #27) and Crone and Haller (1991 #186). Janecke (1993 #6550) agrees with the possibility that a significant boundary may be located near Summit Reservoir based on the coincidence of several cross faults that occupy an area up to 14 by 6 km. The discussion of part of this section in Stickney and Bartholomew (1987 #85) is under the name of the Goldburg scarp and the Bear Mountain scarp. It is also shown as Goldburg segment and Bear Canyon segment in Montana Bureau of Mines and Geology digital database (Stickney, written commun., 1992). **Fault ID:** Refers to number 115 ("unnamed series of faults along southwest flank Lemhi Range") in Witkind (1975 #320).
County(s) and State(s)	CUSTER COUNTY, IDAHO
Physiographic province(s)	NORTHERN ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:24,000 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 1:24,000. 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 27 km of a total fault length of 136 km.

Average strike	N60°W (for section) versus N51W (for whole fault)
Sense of movement	Normal
Dip	83° S, 78° S *Comments:* Both dip values of the fault are from trench exposures at Summerhouse Canyon (sites 602-3 and 602-4 in this compilation) (Baltzer, 1990 #432).
Paleoseismology studies	Two trenches have been excavated across this part of the fault; they are about 0.3 km apart. The trenches were located at the northern end of the southernmost echelon strand near Summerhouse Canyon. Trench 602-3 (located approximately 350 m south of Summerhouse Canyon) exposed structural and stratigraphic evidence of either one or two surface ruptures of a Holocene terrace, with a total vertical stratigraphic separation of 3 m (Baltzer, 1990 #432). The second trench (located approximately 50 m south of Summerhouse Canyon) exposed two or three stacked colluvial wedges that could have formed in a single or multiple surface ruptures of a late Pinedale surface. Total vertical stratigraphic separation in trench 602-4 is 3.3 m. Baltzer (1990 #432) notes that the colluvial wedges in both trenches lack intervening soil horizons or other evidence that the wedges are of different ages. Accordingly, Baltzer attributed the several wedges to complex fissuring during a single earthquake, with a vertical stratigraphic separation of 3 m in one trench and 3.3 m in the second.
Geomorphic expression	Section is characterized by at least four echelon strands (Baltzer, 1990 #432) and discontinuous scarps on alluvium and bedrock.
Age of faulted surficial deposits	Early Holocene and older alluvium and colluvium; bedrock (Baltzer, 1990 #432)
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Baltzer (1990 #432) interprets trenching data to indicate that the most recent faulting event occurred during the

	early to mid-Holocene although no datable material was recovered from either trench. The preferred interpretation is based on the presence of scarp on Holocene tectonic terrace.
Recurrence interval	*Comments:* Baltzer (1990 #432) documents a recurrence interval of 10-20 k.y. in the abstract, but the data are not presented, so the recurrence value cannot be confirmed. Baltzer's interpretation of the complex stratigraphic relations in the two trenches concludes that only one faulting event was recorded (Baltzer, 1990 #432).
Slip-rate category	Less than 0.2 mm/yr *Comments:* Scott and others (1985 #76) suggested a slip rate of 0.3 mm/yr for central part of Lemhi fault based on an analogy with the central part of the Lost River fault [601] along which 4 m of offset has occurred in the past 15 k.y. More recent, fault-specific geomorphic studies suggest that this part of the fault has a low slip rate; scarp profiles at Summerhouse Canyon by Haller (1988 #27) suggest that multiple surface ruptures produced 4.6 m of surface offset since 25 ka.
Date and Compiler(s)	2010 Kathleen M. Haller, U.S. Geological Survey Russell L. Wheeler, U.S. Geological Survey, Emeritus
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