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Lost River fault, Mackay section (Class A) No. 601d

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Compiled in cooperation with the Idaho Geological Survey

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Synopsis	**General:** The Lost River fault is a 130-km-long, southwest-facing, normal fault along the southwestern base of the Lost River Range. Most investigators agree that the main fault has six segments, but the extent to which large ruptures of various ages have crossed or stopped at the various segment boundaries remains unresolved. Accordingly, the Lost River fault was divided into sections based on mapping, morphological study, dating, and trenching of scarps and the surfaces they offset—the six sections (a–f) correspond to the segments that make up the main fault. The seventh section consists of a complex of

	discontinuous scarps [601g] that link the main Lost River fault to the smaller, antithetic Lone Pine normal fault [604] to the west. Work during the years following the 1983 Borah Peak earthquake concentrated on the northern sections where surface ruptures formed during the earthquake, whereas work during the late 1960s and 1970s, followed by additional studies during the 1990s concentrated on the southern sections. All but the northernmost and the two southernmost sections show evidence of latest Quaternary surface ruptures. The few determinations of individual recurrence intervals of large surface ruptures vary from 1 to nearly 100 k.y. Slip rates determined at specific points along the fault vary between less than 0.1 mm/yr to approximately 0.2 mm/yr, and the southern sections appear to have had slower late Quaternary rates than the middle sections. Paleoseismic data suggest that the three central parts of the fault possibly ruptured within a few thousands of years of each other during the early Holocene. **Sections:** This fault has 7 sections. Scott and others (1985 #76) defined segmentation of Lost River fault and is the source of section names except northernmost segment [601a], which was renamed by Crone and others (1985 #18; 1987 #19) to be consistent with other segment names. Scarps formed during Borah Peak earthquake across Willow Creek hills [601g] are included as part of this fault. The on-trend, discontinuous scarps south of range (as mapped by Kuntz and others, 1984 #293) are described separately as part of the Idaho Rift systems fault [3501].
Name comments	**General:** Anderson (1934 #595) first reported that the southwest side of the Lost River Range was bounded by a fault. However, Baldwin (1951 #427) later recognized Basin and Range style faulting in this area, as well as recent movement and large amounts of throw across this and nearby faults. Baldwin's 1951 article is probably one of earliest to use the name Lost River fault for this structure, which extends along the entire length of the southwest flank of Lost River Range from near Arco, Idaho, on the south to near Challis, Idaho, on the north **Section:** This part of the fault was originally defined and named by Scott and others (1985 #76). The section as shown here extends from Elkhorn southeastward to near Swauger Gulch. Both segment boundaries have been located at several places along the fault by various authors. The southern boundary of Janecke (1993 #6550) is used, which coincides with a prominent

	bedrock salient and structural complexity in the footwall at Swauger Gulch. The northern boundary, at the prominent 60? bend at the range front, is characterized by a broader zone of cross faults (Susong and others, 1990 #196; Janecke, 1993 #6550). However, Janecke (1993 #6550) clearly illustrates that the structural complexities that are probably what define a segment boundary occupy a few kilometers to tens of kilometers along strike.
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 scarps is based on 1:24,000-scale maps of Crone (unpublished data), 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 Lost River fault is a high-angle, down-to-the-southwest, range-front normal fault, with a minor sinistral component of slip. The fault bounds the southwest side of the Lost River Range and separates the range from Round Valley, Antelope Flat, Thousand Springs Valley, Barton Flat, and the Big Lost River. In its north-central portion, the Lost River fault is joined from the west by the much shorter, northeast-dipping Lone Pine fault [604]. The two normal faults bound an intervening graben. The much greater length and larger topographic relief of the Lost River fault indicate that it is probably the master fault, and that the Lone Pine fault probably terminates against it at depth. Hypocentral locations and focal mechanisms of earthquakes in 1983 and 1984 and their numerous aftershocks support this suggestion (Doser and Smith, 1985 #276; Jackson, 1994 #833). Densmore and others (2005 #7016) suggest that maximum throw across the Lost River fault is 4–6 km.

Length (km)	This section is 23 km of a total fault length of 127 km.
Average strike	N57°W (for section) versus N35°W (for whole fault)
Sense of movement	Normal *Comments:* (Scott and others, 1985 #76)
Dip Direction	SW
Paleoseismology studies	Three trenches at two sites about 16 km apart have been excavated on the Mackay section. Trench 601-10 (Schwartz and Crone, 1988 #75) is north of Lower Cedar Creek, near north end of section, on pre-15-ka fan. The most recent event offsets Mazama ash (6.7 ka). Trench 601-3 (Hait and Scott, 1978 #277; Scott and others, 1985 #76) and Trench 601-11 (Schwartz and Crone, 1988 #75), north of Lone Cedar Creek, near south end of section, on pre-15-ka fan. At this site, Glacier Peak ash (11.3 ka) is displaced by one event, presumably the same as the event observed at Trench 601-10.
Geomorphic expression	Generally continuous, morphologically young fault scarps on alluvium are present along entire length of section (Crone and Haller, 1991 #186).
Age of faulted surficial deposits	Holocene to middle Pleistocene fan alluvium (Scott, 1982 #278).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Collectively, trenching data indicate one faulting event has occurred in the past 11 k.y., timing of which was between 4 and 6.8 ka. Faulted Mazama ash (approximately 6.7 ka) was found in trenches at both ends of section (Crone and Haller, 1991 #186). Radiocarbon age of organic matter buried by scarp-derived colluvium in Trench 601-3 indicates that the most recent event occurred about 4 ka (Scott and others, 1985 #76). Trench 601-11 contained Glacier Peak ash (11,300 yr), which is displaced by only one event (Schwartz and Crone, 1988 #75).

Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Scott and others (1985 #76) do not provide values for slip rate on the Mackay section; they indicate that long-term rate may be lower than the rate for Thousand Springs section [601c]. The lowest slip-rate category is assigned here based on trenching studies that indicate only one event has occurred in the past 11 k.y. Payne and others (2008 #7017) report high rates of right-lateral shear resulting from high strain rates in the undeforming Snake River Plain to low strain rates north of the central part of the Lost River and Lemhi Ranges and the Beaverhead Mountains based on the results of campaign GPS surveys, and furthermore, they characterize the rate of differential slip within the Centennial shear zone as increasing from 0.9 ?0.3 mm/yr near the Lost River fault [601] to 1.7 ?0.2 mm/yr near the Beaverhead fault [603]. The rate of slip may continue to increase northeastward to the Centennial fault [643]. However, Puskas and Smith (2009 #7018) argue against the high velocities; they conclude the differential motion across this boundary is less than 0.5 mm/yr.
Date and Compiler(s)	2010 Kathleen M. Haller, U.S. Geological Survey Russell L. Wheeler, U.S. Geological Survey, Emeritus
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