Jump to Navigation

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Long Valley fault zone, northern section (Class A) No. 628a

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Compiled in cooperation with the Idaho Geological Survey

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Synopsis	**General:** The Long Valley fault zone forms the western margin of a large graben that confines Long Valley in western Idaho. The graben lies along the easternmost extent of Miocene Columbia River Basalts, and is floored by a thick sequence of Tertiary and Quaternary sediments deposited in at least two subbasins. Mesozoic metamorphic and intrusive igneous rocks are unconformably overlain by Miocene Columbia River Basalts in West Mountain, which forms the footwall of the Long Valley fault zone. The fault zone is part of the western Idaho fault belt.

	Sections: This fault has 2 sections. Sections are defined following the segmentation model of Knudsen and others (1996 #5889). The northern section defines the northwestern margin of the graben, and the southern section defines the southwestern margin of the graben. The two sections also are delineated by paired subbasins in Long Valley that show different amounts of accumulated sediment. The northern section has the highest long-term (post-Miocene) slip rates (0.3-0.6 mm/yr) and equivocal evidence of post Bull-Lake pre-Pinedale (thus, between 14 and 150 ka) displacement. The southern section has the lower long-term (post-Miocene) slip rates (0.1-0.3 mm/yr), little if any evidence of post Bull-Lake displacement, and some evidence of pre-Bull Lake (Plio-Pleistocene) deformation.
Name comments	**General:** The fault zone that defines the western margin of Long Valley was originally mapped and named after the valley by Capps (1941 #5895). **Section:** This section consists of the Northern segment of the Long Valley fault of Knudsen and others (1996 #5889). **Fault ID:** These structures are part of fault numbers 207 and 219 in the fault compilation of Witkind (1975 #320).
County(s) and State(s)	ADAMS COUNTY, IDAHO VALLEY COUNTY, IDAHO
Physiographic province(s)	NORTHERN ROCKY MOUNTAINS
Reliability of location	Poor Compiled at 1:100,000 scale. *Comments:* Fault locations are from 1:250,000-scale mapping of Knudsen and others (1996 #5889) 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 (1000 m).
Geologic setting	The Long Valley fault zone forms the western margin of a large graben that confines Long Valley in western Idaho. The graben lies along the easternmost extent of Miocene Columbia River Basalts, and is floored by a thick sequence of Tertiary and Quaternary sediments. Mesozoic metamorphic and intrusive igneous rocks are unconformably overlain by Miocene Columbia River Basalts in West Mountain, which forms the footwall of the

	Long Valley fault zone (Schmidt and Mackin, 1970 #512; Newcomb, 1970 #3761; Mitchell and Bennett, 1979 #5894; Fitzgerald, 1982 #5886). The fault is part of the western Idaho fault belt of Hamilton (1963 #6040), a system of north-striking normal faults formed along the western margin of the Idaho batholith.
Length (km)	This section is 34 km of a total fault length of 60 km.
Average strike	N8°W (for section) versus N9°W (for whole fault)
Sense of movement	Normal *Comments:* Faults in this section are mapped as normal faults (Schmidt and Mackin, 1970 #512; Newcomb, 1970 #3761; Mitchell and Bennett, 1979 #5894; Fitzgerald, 1982 #5886).
Dip Direction	E *Comments:* No actual dip measurements have been published, but Knudsen and others (1996 #5889) used dips of 60? and 70? in their analysis of the earthquake potential associated with the Long Valley fault.
Paleoseismology studies	
Geomorphic expression	The northern section of the Long Valley fault zone forms a steep, linear, 1000-m-high escarpment that divides the western margin of Long Valley and the eastern margin of West Mountain. The adjacent graben or subbasin has the thickest Tertiary-Quaternary fill deposits along the Long Valley fault zone (Kinoshita, 1962 #5897). The central and southern parts of the section are marked by triangular facets, described as either "weakly developed, poorly preserved" (Gilbert and LaForge, 1990 #5888) or "prominent, well-developed" (Knudsen and others, 1996 #5889). The section splays into several strands at its north end so the range front there is less well defined. No fault scarps on last-glacial-maximum (Pinedale-equivalent Pilgrim Cove) deposits have been described in the numerous investigations of this fault zone (Schmidt and Mackin, 1970 #512; Gilbert and LaForge, 1990 #5888; Personius, 1998 #3508). Some investigations found no evidence of faulting in older Bull-Lake-equivalent Timber Ridge deposits (Schmidt and Mackin, 1970 #512; Gilbert and LaForge, 1990 #5888; Personius, 1998 #3508), but Knudsen and

	others (1996 #5889) observed several short scarps in Bull-Lake-equivalent deposits a few kilometers west and southwest of McCall, Idaho, on the valley floor several hundred meters east of the mapped trace of the main range front fault. The scarps parallel mapped moraine crests (Schmidt and Mackin, 1970 #512; Knudsen and others, 1996 #5889) and thus could be glacial features, but Knudsen and others (1996 #5889) favor a tectonic origin because they are colinear and cross drainage divides. Gilbert and LaForge (1990 #5888) and Knudsen and others (1996 #5889) also noted the possible tectonic significance of Bull-Lake-equivalent outwash deposits at two elevations near the trace of the fault zone near Hait Reservoir as mapped by Schmidt and Mackin (1970 #512). No fault scarps were identified (Schmidt and Mackin, 1970 #512; Gilbert and LaForge, 1990 #5888; Personius, 1998 #3508), but Knudsen and others (1996 #5889) used the elevation differences as possible evidence of post-Bull-Lake faulting. Given the lack of scarps and the fact that detailed mapping of Schmidt and Mackin (1970 #512) show these deposits as unfaulted, the difference in elevation of these deposits probably can best be explained by glacial stream deposition at slightly different levels during Bull-Lake time.
Age of faulted surficial deposits	The northern section substantially offsets Miocene Columbia River Basalt rocks, but no fault scarps on last-glacial-maximum (Pinedale-equivalent Pilgrim Cove) deposits have been described in the numerous investigations of this fault zone (Schmidt and Mackin, 1970 #512; Gilbert and LaForge, 1990 #5888; Personius, 1998 #3508). Some investigations found no evidence of faulting in older Bull-Lake-equivalent Timber Ridge deposits (Schmidt and Mackin, 1970 #512; Gilbert and LaForge, 1990 #5888; Personius, 1998 #3508), but Knudsen and others (1996 #5889) observed several short scarps on Bull-Lake-equivalent deposits a few kilometers west and southwest of McCall on the valley floor several hundred meters east of the mapped trace of the main range front fault. The scarps parallel mapped moraine crests (Schmidt and Mackin, 1970 #512; Knudsen and others, 1996 #5889) and thus could be glacial features, but Knudsen and others (1996 #5889) favor a tectonic origin because they are colinear and cross drainage divides. Gilbert and LaForge (1990 #5888) and Knudsen and others (1996 #5889) also used the difference in elevation of Bull-Lake-equivalent outwash deposits near the trace of the fault zone as possible evidence of post-Bull-Lake faulting.
Historic	

earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* No scarps on Pinedale-equivalent Pilgrim Cove and McCall deposits have been described, so faulting must predate the 14-20 ka age (Colman and Pierce, 1986 #5896) of these deposits. Knudsen and others (1996 #5889) observed several short scarps on Bull-Lake-equivalent deposits a few kilometers west and southwest of McCall on the valley floor several hundred meters east of the mapped trace of the main range front fault. The scarps parallel mapped moraine crests (Schmidt and Mackin, 1970 #512; Knudsen and others, 1996 #5889) and thus could be glacial features, but Knudsen and others (1996 #5889) favor a tectonic origin because they are colinear and cross drainage divides. Knudsen and others (1996 #5889) also used the difference in elevation of Bull-Lake-equivalent outwash deposits near the trace of the fault zone near Hait Reservoir as possible evidence of post-Bull-Lake faulting, although a depositional origin of the elevation difference may be more likely. The Bull-Lake-equivalent Timber Ridge glacial sediments in Long Valley are thought to have been deposited about 140-150 ka (Colman and Pierce, 1986 #5896). The section is mapped as a major late Quaternary (<130 ka) structure by Breckenridge and others (2003 #5878).
Recurrence interval	1,700-7,000 years *Comments:* Knudsen and others (1996 #5889) used long-term slip rates of 0.3-0.6 mm/yr to estimate a range of recurrence of 1,700-3,000 years for 1 m displacements and 2,000-7,000 years for 1-2 m displacements on the northern section, but no events have occurred since 14-20 ka.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Several estimates of offset of Columbia River Basalt rocks across the northern section using mapping of Schmidt and Mackin (1970 #512) and gravity data of Kinoshita (1962 #5897) have been described. The estimated thickness of the basin fill from the gravity data and height of the range front escarpment yield estimated offsets of 3,050-3,100 m at the latitude of Donnelly, Idaho (Schmidt and Mackin, 1970 #512; Knudsen and others, 1996 #5889), and projections of dipping surface exposures of Columbia River Basalt rocks yield fault-displacement estimates of 4,600-7,000 m (Gilbert and others, 1983 #5887) and

	6,100 m (Knudsen and others, 1996 #5889). The age of fault initiation is poorly known, but estimates range from 14.7 Ma to about 10 Ma (Fitzgerald, 1982 #5886; Knudsen and others, 1996 #5889). Knudsen and others (1996 #5889) used Columbia River Basalt offsets of 3,100-6,100 m and an age of fault initiation of 10 Ma to estimate long-term slip rates of 0.3-0.6 mm/yr. Knudsen and others (1996 #5889) also used possible offsets of 12-15 m of Bull-Lake-equivalent deposits to estimate a post-Bull-Lake slip rate of approximately 0.1 mm/yr, but the evidence for tectonic offset of these deposits is equivocal. Vetter and Piety, 2001 #6722 assign a slip rate of 0.4-0.7 mm/yr to the fault for use in probabilistic hazard assessment.
Date and Compiler(s)	2010 Stephen F. Personius, U.S. Geological Survey Reed S. Lewis, Idaho Geological Survey
References	#5878 Breckenridge, R.M., Lewis, R.S., Adema, G.W., and Weisz, D.W., 2003, Miocene and younger faults in Idaho: Idaho Geological Survey Map 8, 1 sheet, scale 1:1,000,000. #5895 Capps, S.R., 1941, Faulting in western Idaho and its relation to the high placer deposits: Idaho Bureau of Mines and Geology Pamphlet 56, 20 p., 1 pl., scale 1:500,000. #5896 Colman, S.M., and Pierce, K.L., 1986, Glacial sequence near McCall, Idaho: Weathering rinds, soil development, morphology, and other relative-age criteria: Quaternary Research, v. 25, p. 25-42. #5886 Fitzgerald, J.E., 1982, Geology and basalt stratigraphy of the Weiser Embayment, west-central Idaho, *in* Bonnichsen, B., and Breckenridge, R.M., eds., Cenozoic geology of Idaho: Idaho Bureau of Mines and Geology Bulletin 26, p. 103-128. #5888 Gilbert, J.D., and LaForge, R.C., 1990, Seismotectonic study for Deadwood Dam, Boise project, Idaho: U.S. Bureau of Reclamation Seismotectonic Report 90-2, 40 p., 2 pl. #5887 Gilbert, J.D., Piety, L., and LaForge, R., 1983, Seismotectonic study for Black Canyon Dam, Boise project, Idaho: U.S. Bureau of Reclamation Seismotectonic Report 83-7, 73 p., 8 pl. #6040 Hamilton, W., 1963, Metamorphism in the Riggins region,

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#6722 Vetter, U., and Piety, L., 2001, Screening-level seismotectonic and ground motion evaluation for Deadwood Dam, Boise Project, Idaho: U.S. Bureau of Reclamation Technical Memorandum No. D8330-96-17.

#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.

Questions or comments?

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