

# 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](#).

## Eastern Bear Lake fault, central section (Class A) No. 2364b

Last Review Date: 2010-07-20

## Compiled in cooperation with the Idaho Geological Survey

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### Synopsis

**General:** Long, range-front, normal fault that bounds the west side of the Bear Lake Plateau and Pruess Range. The fault zone contains multiple strands in some locations, and defines the eastern edge of the Bear Lake graben, an 80-km-long, north-trending topographic low that extends from Idaho into Utah. The history of this fault is defined by reconnaissance mapping along the northern two sections and additional detailed site studies, including trenching, along the southern section. Late Pleistocene slip rates increase from south to north along the eastern Bear Lake fault zone, which is consistent with the tectonic geomorphology.

However, slip rates on the southern part of the fault zone have apparently decreased over the past 50 k.y. Earthquake-timing, recurrence-interval, and slip-rate estimates for the southern section of the eastern Bear Lake fault as reported in this compilation reflect the consensus values of the Utah Quaternary Fault Parameters Working Group (Lund, 2005 #6733). The preferred values reported in Lund (2005 #6733) approximate mean values based on available paleoseismic-trenching data, and the minimum and maximum values approximate two-sigma (5th and 95th percentile) confidence limits. The confidence limits incorporate both epistemic (data limitation) and aleatory (process variability) uncertainty (Lund, 2005 #6733).

**Sections:** This fault has 3 sections. McCalpin (1990 #4419) divides the fault into a northern, central, and southern segments on the basis of fault-rupture patterns, strike of fault scarps, youthfulness of fault scarps, and subsurface geophysical data; this subdivision is used in this compilation.

**Name  
comments**

**General:** The earliest known name for this fault is "Bear Lake fault" (Mansfield, 1927 #4416); in this publication Mansfield notes that "there seems therefore little doubt that this part of the valley wall is determined by fault." But on Plate 1, the fault is shown only extending about 9 km south of Dingle. The name "eastern Bear Lake fault" came into use only after detailed fault studies were completed and the nearby western Bear Lake fault [622], which bounds the west side of the valley, was recognized (McCalpin, 1990 #4419). Evans (1991 #4425) uses the name "East Bear Lake fault." The fault, as mapped and described by McCaplin (1990 #4419) extends along the west edge of the Bear Lake Plateau and Preuss Range from about 3.5 km northeast of Georgetown, Idaho, to about 3.6 km south of Laketown, Utah.

**Section:** We follow the names established by McCalpin (1990 #4419) for the three parts of the eastern Bear Lake fault; also called the C segment in McCalpin (1993 #796). Section extends from about 0.4 km north of U.S. Highway 89, east of Montpelier, Idaho, to the northeast end of Bear Lake. The southern boundary is characterized by a complex zone of left-stepping short echelon fault scarps near Bear Lake Hot Springs.

**Fault ID:** Refers to fault number 24 ("fault east side Bear Lake [east side of graben]") of Witkind (1975 #320) in Idaho. Section 2364c in this compilation refers to fault number 11-8 ("southern segment of the eastern Bear Lake fault") of Hecker (1993 #642).

<b>County(s) and State(s)</b>	BEAR LAKE COUNTY, IDAHO
<b>Physiographic province(s)</b>	MIDDLE ROCKY MOUNTAINS
<b>Reliability of location</b>	<p>Good Compiled at 1:24,000 scale.</p> <p><i>Comments:</i> Fault location south of latitude 42.4° N is based on the 1:50,000-scale map of Reheis (2005 #7008). Location of the northern part of the fault is based on the approximately 1:475,000-scale map of McCalpin (1990 #4419), and its location is 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 1km (1,000 meters).</p>
<b>Geologic setting</b>	<p>West-dipping normal (possibly listric) fault bounding the west side of the Bear Lake Plateau in Utah and Preuss Range in Idaho. This fault and the complimentary western Bear Lake fault [622] define the Bear Lake graben, an asymmetric basin as much as 3-km deep extending from Idaho into Utah. These faults are part of a belt of right-stepping en-echelon faults that extend from the northern Wasatch Range in Utah to the Yellowstone area in Wyoming (McCalpin, 1990 #4419). Interpretation of high-resolution seismic-reflection profiles adjacent to the southern part of the fault shows changes in the location of depocenters adjacent to the master fault through time, which probably mirrors the general pattern of slip on the fault (Colman, 2006 #7012). Net Tertiary slip is 1.9–4.0 km (Evans, 1991 #4425).</p>
<b>Length (km)</b>	This section is 24 km of a total fault length of 78 km.
<b>Average strike</b>	N5°W (for section) versus N1°W (for whole fault)
<b>Sense of movement</b>	<p>Normal</p> <p><i>Comments:</i> (McCalpin, 1990 #4419)</p>
<b>Dip</b>	<p>W</p> <p><i>Comments:</i> Interpretations of the fault geometry vary. Some investigators document the fault as having a high angle (Mansfield, 1927 #4416; Williams and others, 1962 #4409;</p>

	<p>Armstrong and Cressman, 1963 #4417), and others maintain that it is listric and soles into the Meade thrust at depth (Evans, 1991 #4425). Coogan and Royse (1990 #7006) suggest that the fault to dips 65 degrees at the surface and becomes flat at a depth of 5.8 km below sea level.</p>
<b>Paleoseismology studies</b>	
<b>Geomorphic expression</b>	<p>Youthful scarps "10 to 20 ft high" (3-6 m; Robertson, 1978 #4418) are present along most of this part of the fault including across the Bear River alluvium near Dingle, Idaho (McCalpin, 1990 #4419, Reheis and others, 2009 #7004). Mason (1992 #463) further states that there are 1.5- to 6.0-m-high scarps on late Pleistocene and Holocene alluvium along the "middle segment," which are inferred in this report to be the central section. Several strands of the fault are known to splay off to the north-northeast into bedrock where they show little or no evidence of late Quaternary displacement (Reheis, 2005 #7008). Elsewhere the fault is coincident with steep bedrock escarpments; aligned hot springs, lakes, and ponds.</p>
<b>Age of faulted surficial deposits</b>	
<b>Historic earthquake</b>	
<b>Most recent prehistoric deformation</b>	<p>latest Quaternary (&lt;15 ka)</p> <p><i>Comments:</i> McCalpin (1993 #796) documents the presence of Holocene scarps along this part of the fault, but no further studies have been completed. McCalpin further suggests the possibility that the rupture of this section could have been coincident with the most recent rupture of the southern section (2.6-4.6 k.y. ago).</p>
<b>Recurrence interval</b>	
<b>Slip-rate category</b>	<p>Less than 0.2 mm/yr</p> <p><i>Comments:</i> Little data is available for this part of the fault. The lowest slip-rate category is assigned based on the large difference in scarp height reported for this and the southern section [2364c].</p>

	<p>Fault scarps along this section are 1.5- to 6-m high as opposed to greater than 14-m-high scarps on the southern section of the eastern Bear River fault. Slip rates for the southern section are not well constrained, but are reported to be 0.25-0.8 mm/yr.</p>
<p><b>Date and Compiler(s)</b></p>	<p>2010  Kathleen M. Haller, U.S. Geological Survey  Reed S. Lewis, Idaho Geological Survey</p>
<p><b>References</b></p>	<p>#4417 Armstrong, F.C., and Cressman, E.R., 1963, The Bannock thrust zone southeastern Idaho: U.S. Geological Survey Professional Paper 374-J, 22 p., 4 pls.</p> <p>#7012 Colman, S.M., 2006, Acoustic stratigraphy of Bear Lake, Utah-Idaho Late Quaternary sedimentation patterns in a simple half-graben: <i>Sedimentary Geology</i>, v. 185, p. 113-125.</p> <p>#7006 Coogan, J.C., and Royse, F., Jr., 1990, Overview of recent developments in thrust belt interpretation, <i>in</i> Roberts, S., ed., <i>Geologic field tours of western Wyoming and parts of adjacent Idaho, Montana, and Utah</i>: Geological Survey of Wyoming Public Information Circular, v. 29, p. 89-124.</p> <p>#4425 Evans, J.P., 1991, Structural setting of seismicity in northern Utah: Utah Geological Survey Contract Report 91-15, 37 p.</p> <p>#642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000.</p> <p>#6733 Lund, W.R., 2005, Consensus preferred recurrence interval and vertical slip rate estimates—Review of Utah paleoseismic-trenching data by the Utah Quaternary Fault Parameters Working Group: Utah Geological Survey Bulletin 134, compact disk.</p> <p>#4416 Mansfield, G.R., 192, Geography, geology, and mineral resources of part of southeastern Idaho: U.S. Geological Survey Professional Paper 152, 453 p., 12 pls.</p> <p>#463 Mason, D.B., 1992, Earthquake magnitude potential of active faults in the Intermountain seismic belt from surface parameter scaling: Salt Lake City, University of Utah, unpublished M.S. thesis, 110 p.</p>

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#7008 Reheis, M.C., 2005, Surficial geologic map of the upper Bear River and Bear Lake drainage basins, Idaho, Utah, and Wyoming: U.S. Geological Survey Scientific Investigations Map 2890.

#7004 Reheis, M.C., Laabs, B.J.C., and Kaufman, D.S., 2009, Geology and geomorphology of Bear Lake Valley and upper Bear River, Utah and Idaho, *in* Rosenbaum, J.G., and Kaufman D.S., eds., *Paleoenvironments of Bear Lake, Utah and Idaho, and its catchment*: Geological Society of America Special Paper 450, p. 15-48.

#4418 Robertson, G.C., III, 1978, Surficial deposits and geologic history, northern Bear Lake Valley, Idaho: Logan, Utah State University, unpublished M.S. thesis, 162 p., 2 pls.

#4409 Williams, J.S., Willard, A.D., and Parker, V., 1962, Recent history of Bear Lake Valley, Utah-Idaho: *American Journal of Science*, v. 260, p. 24-36.

#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.

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