Jump to Navigation

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.

East Cache fault zone, central section (Class A)
No. 2352b

Last Review Date: 1999-10-01

Compiled in cooperation with the Utah Geological Survey

citation for this record: **Black, B.D., Hylland, M.D., Haller, K.M., and Hecker, S., compilers, 1999, Fault number 2352b, East Cache fault zone, central 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 02:57 PM.**

Synopsis	**General:** Normal fault zone that separates Cache Valley from the Bear River Range to the east. The fault zone is at the boundary between the Basin and Range and the Middle Rocky Mountains physiographic provinces. The East Cache fault zone is one of several north-trending, northeast stepping, late Quaternary, normal faults that lie between the Wasatch fault zone in Utah and the Teton fault in Wyoming. **Sections:** This fault has 3 sections. Informally named sections

	defined here follow McCalpin (1987 #4999; 1994 #4414). McCalpin (1994 #4414) describes physiographic sections because the faulting history cannot be constrained well enough to define seismogenic segments. The sections are differentiated based on fault zone complexity, tectonic geomorphology, and expression of surface fault scarps . Bailey (1927 #5186) alludes to the same sectioning of the fault based on gross differences in the range-front morphology. The central section of the fault is the most active in the latest Quaternary; the northern and southern sections are less active and show evidence of only middle to late Pleistocene activity. The morphology of faceted spurs along the range front suggests that the boundary between the northern and central sections has shifted southward several kilometers during the middle to late Quaternary, probably along with development of a younger, western fault strand in the northern section (McCalpin, 1994 #4414; 1989 #4999). Similarities in the structure of faceted spurs and the absence of a gravity-defined boundary between the central and southern sections suggest that they may have behaved as a single 44-km-long seismogenic section during much of the late Cenozoic. However, the last two events on the East Cache fault zone were limited to the 20-km-long central section, leading McCalpin (1994 #4414; 1989 #4999) to suggest that paleoearthquake magnitudes were in the range of 6.6 to 7.1. The south end of the southern section abuts the northeast-trending James Peak fault [2378].
Name comments	**General:** Early workers in the area referred to this fault as the Bear River Range fault (Bailey, 1927 #5187; 1927 #5186) and Bear River fault (Peterson, 1936 #5184). More recent studies use the name East Cache fault or East Cache fault zone. Fault extends from east of Preston, Idaho, southward to its intersection with the James Peak fault [2378] southeast of Avon, Utah. **Section:** Informal section names and are as defined by McCalpin (1994 #4414); this section extends from Green Canyon southward to Blacksmith Fork Canyon (McCalpin, 1987 #4999; 1994 #4414). McCalpin (1987 #4999) also identified this as segment B; however, even in this paper he does not suggest that these are necessarily seismogenic segments. **Fault ID:** Refers to fault number 11-3 (East Cache fault zone, southern segment) of Hecker (1993 #642).
County(s) and State(s)	CACHE COUNTY, UTAH

Physiographic province(s)	MIDDLE ROCKY MOUNTAINS BASIN AND RANGE
Reliability of location	Good Compiled at 1:50,000 scale. *Comments:* Fault traces from 1:50,000 scale mapping of McCalpin (1989 #760).
Geologic setting	Generally north-trending range-front normal fault along the western base of the Bear River Range in eastern Cache Valley. The East Cache fault zone and opposing West Cache fault zone [2521] bound an intermontane graben forming Cache Valley (McCalpin, 1987 #4999). Faulting here probably had begun by at least late Eocene to early Oligocene (Brummer and Evans, 1989 #5185; Brummer and McCalpin, 1995 #4394). Oaks and others (1999 #5157) indicate that the vertical throw across the southern part of the East Cache fault zone is 7,750 m. Evans (1991 #4425) estimates net slip ranges from 2.7 km near the Idaho border to 8.1 km in southern Cache Valley; he indicates that in central Cache Valley, net slip is about 4.5–6.4 km. Brummer (1989 #5185) indicates that total net vertical offset is on the order of 2.7–3.0 km. Earlier estimates by Zoback (1983 #213) indicate that total late Cenozoic slip is 3.4–4.5 km. Faulting has resulted in a pronounced escarpment rising 1000 m above Cache Valley.
Length (km)	This section is 17 km of a total fault length of 79 km.
Average strike	N°7E (for section) versus N1°W (for whole fault)
Sense of movement	Normal
Dip	45°W to near vertical *Comments:* Seismic reflection data indicate the fault dips at 60° near the surface, flattening at depth to 45–55° between 3.5 and 4.0 km (Smith and Bruhn, 1984 #4561), and probably cuts the Sevier-age Paris thrust (Evans and Oaks, 1990 #4411). Near surface dips from the Bonneville trench (site 2352b-2) south of Logan are 65–75° near the trench floor, steepening to near vertical at the surface reported by (McCalpin, 1989 #760).
Paleoseismology studies	Two trenches were excavated across the central section of the East Cache fault zone.

	Site 2352-1. The first trench excavated by McCalpin and variously referred to as the "Bonneville trench" (McCalpin, 1994 #4414), the "East Cache trench" (McCalpin, 1987 #4999), the 1985 "Logan trench" (McCalpin and Forman, 1991 #299). The trench was located 0.9 km south of Logan Canyon in Lake Bonneville deposits that were offset 2.4 m across a broad deformation zone. The trench revealed evidence for two surface-faulting earthquakes (McCalpin, 1987 #4999; 1989 #760; McCalpin and Forman, 1991 #299; McCalpin, 1994 #4414). Within the main fault zone, quantitative pedogenic soil analysis, thermoluminescence age estimates on shallow lacustrine sand and silty colluvial deposits, and an AMS radiocarbon age on gastropod shells within a beach-sand deposit provide limiting ages for the penultimate event and poorly constrain the timing of the most recent event. Calculated displacements for penultimate event at the trench site is 179 cm and 76 cm in the most recent event (McCalpin, 1994 #4414). Site 2352-2. To better constrain the age of the most recent faulting event, the "Provo trench" was excavated about 1 kilometer north of the Bonneville trench, at the Logan Country Club golf course (McCalpin, 1989 #760; 1994 #4414). This trench exposed stratigraphic evidence for the most recent surface-faulting event, and radiocarbon age estimates were obtained from bulk-soil samples of crack-fill material, debris-facies colluvium, and a paleosol beneath the colluvium that better constrain the age of the youngest event. Single-event displacement at this trench site is 1.15 m (McCalpin, 1994 #4414).
Geomorphic expression	Early work by Peterson (1936 #5184) documented scarps on Bonneville and probable Provo-age deposits. Two post-Bonneville highstand surface-faulting earthquakes on the central section created composite fault scarps with 0.36–4.17 m of surface offset over a distance of at least 8 km along the northern half of the section (McCalpin, 1987 #4999; 1994 #4414). Unlike the northern and southern sections, the fault is expressed as a single trace along this section. The range front is abrupt with well-developed triangular facets (Bailey, 1927 #5186; Bailey, 1927 #5187; McCalpin, 1987 #4999; McCalpin, 1994 #4414) on the Paleozoic bedrock of the mountain range. Isolated, higher scarps (up to 10 m) are preserved along the trace of the fault (McCalpin, 1987 #4999; 1994 #4414) The fault is buried by landslide deposits along the southern half of the section (McCalpin, 1987 #4999; 1994 #4414).

Age of faulted surficial deposits	Fault scarps are mapped predominately on Lake Bonneville (upper Pleistocene) deposits; however, at a few locations, younger alluvium colluvium and lake deposits are faulted (McCalpin, 1989 #760). McCalpin (1987 #4999; 1994 #4414) indicates there are isolated scarps on pre-Bonnevile deposits.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Three radiocarbon ages from the Provo trench constrain the timing of the most recent event to between 4.0 and 4.2 ka (McCalpin, 1994 #4414). Thermoluminescence ages from the Bonneville trench supports timing for the event, which places it between 2.5 and 8.7 ka (McCalpin and Forman, 1991 #299). McCalpin and Forman (1991 #299) inferred that the most recent event occurred about 4 ka based on the thermoluminescence ages and the time he estimated for soil formation on the penultimate wedge. Using data from McCalpin and Forman (1991 #299), Mason (1992 #463) suggests the most recent event occurred 5±2 thousand years ago.
Recurrence interval	9.0–11.5 k.y. (<15.5 ka) *Comments:* Recurrence interval is from McCalpin (1994 #4414) based on permissable constraining age estimates of the two most recent events. The preferred timing of the most recent event is 4 ka, and the preferred timing of the penultimate event is 13–15.5 ka. Using data from McCalpin and Forman (1991 #299), Mason (1992 #463) suggests an average recurrence time of 8±2.5 k.y.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* McCalpin (1994 #4414) calculates a post Bonneville vertical displacement rate of 0.28 mm/yr based on 4.2 m of offset of Bonneville age deposits, which is used here to select the slip-rate category. However, he also reports that vertical displacement rates of 0.02–0.13 may be characteristic for scarps on the pre-Bonneville surfaces. Longer-term slip (?) rates are provided by Evans (1991 #4425). He indicates in the text that post-17-Ma slip (?) rates are 0.32–0.54 mm/yr, but reports values of 0.29–0.54 mm/yr in Table 3.
Date and	1999

Compiler(s)	Bill D. Black, Utah Geological Survey Michael D. Hylland, Utah Geological Survey Kathleen M. Haller, U.S. Geological Survey Suzanne Hecker, U.S. Geological Survey
References	#5186 Bailey, R.W., 1927, The Bear River Range fault, Utah: American Journal of Science, v. XIII, p. 496-502. #5187 Bailey, R.W., 1927, A contribution to the geology of the Bear River Range, Utah: Chicago, Illinois, University of Chicago, unpublished M.S. thesis, 63 p. #4394 Brummer, J., and McCalpin, J., 1995, Geologic map of the Richmond quadrangle, Cache County, Utah, and Franklin County, Idaho: Utah Geological Survey Miscellaneous Publication 95-3, 22 p. pamphlet, 2 sheets, scale 1:24,000. #5185 Brummer, J.E., and Evans, J.P., 1989, Evidence for the onset of extensional tectonics, western Bear River Range, Utah: Geological Society of America Abstracts with Programs, v. 21, no. 5, p. 60. #4425 Evans, J.P., 1991, Structural setting of seismicity in northern Utah: Utah Geological Survey Contract Report 91-15, 37 p. #4411 Evans, J.P., and Oaks, R.Q., Jr., 1990, Geometry of Tertiary extension in the northeastern Basin-and-Range Province superimposed on the Sevier fold and thrust belt, Utah, Idaho, and Wyoming: Geological Society of America Abstracts with Programs, v. 22, no. 6, p. 10. #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. #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. #760 McCalpin, J., 1989, Surficial geologic map of the East Cache fault zone, Cache County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-2107, 1 sheet, scale 1:50,000.

#299 McCalpin, J., and Forman, S.L., 1991, Late Quaternary faulting and thermoluminescence dating of the East Cache fault zone, north-central Utah: Bulletin of the Seismological Society of America, v. 81, p. 139-161.

#4999 McCalpin, J.P., 1987, Late Quaternary tectonics and earthquake hazard in Cache Valley, Utah: Technical report to U.S. Geological Survey, Reston, Virginia, under Contract 14-08-0001-G1091, July 1987, 187 p., 2 pls.

#4414 McCalpin, J.P., 1994, Neotectonic deformation along the East Cache fault zone, Cache County, Utah: Utah Geological Survey Special Study 83, 37 p., http://ugspub.nr.utah.gov/publications/special_studies/ss-83.pdf.

#5157 Oaks, R.Q., Jr., Smith, K.A., Janecke, S.U., Perkins, M.E., and Nash, W.P., 1999, Stratigraphy and tectonics of Tertiary strata of southern Cache Valley, north-central Utah, *in* Spangler, L.E., and Allen, C.J., eds., Geology of northern Utah and vicinity: Utah Geological Association Publication 27, p. 71-110.

#5184 Peterson, V.E., 1936, The geology of a part of the Bear River Range and some relationships that it bears with the rest of the range: Logan, Utah State Agricultural College, unpublished M.S. thesis, 71 p.

#4561 Smith, R.B., and Bruhn, R.L., 1984, Intraplate extensional tectonics of the western U.S. Cordillera-Inferences on structural style from seismic-reflection data, regional tectonics and thermal-mechanical models of brittle-ductile deformation: Journal of Geophysical Research, v. 89, no. B7, p. 5733-5762.

#213 Zoback, M.L., 1983, Structure and Cenozoic tectonism along the Wasatch fault zone, Utah, *in* Miller, D.M., Todd, V.R., and Howard, K.A., eds., Tectonic and stratigraphic studies in the eastern Great Basin: Geological Society of America Memoir 157, p. 3-27.

Design Ground MotionsSeismic Hazard Maps & Site-Specific DataFaultsScenarios
EarthquakesHazardsDataEducationMonitoringResearch
Search...
Search
HomeAbout UsContactsLegal