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Quaternary Fault and Fold Database of the United States

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East Cache fault zone, northern section (Class A) No. 2352a

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Compiled in cooperation with the Idaho Geological Survey and the Utah Geological Survey

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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 east of Preston, Idaho, southward to Green Canyon (McCalpin, 1987 #4999; 1994 #4414). McCalpin (1987 #4999) also identified this as segment A; 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)	FRANKLIN COUNTY, IDAHO CACHE COUNTY, UTAH
Physiographic province(s)	BASIN AND RANGE MIDDLE ROCKY MOUNTAINS
Reliability of location	Poor Compiled at 1:250,000 scale. *Comments:* Location of faults from 1:50,000 scale mapping of McCalpin (1989 #760). Poor designation is because the fault is poorly expressed; therefore, it is approximately located in original mapping.
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 41 km of a total fault length of 79 km.
Average strike	N2°E (for section) versus N1°W (for whole fault)
Sense of movement	Normal
Dip	40–60°W *Comments:* Seismic reflection data indicate the fault dips 70° at the north end of the fault zone (Evans, 1991 #4425). Additional interpretations of 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).

Paleoseismology studies	
Geomorphic expression	The section consists of subparallel, normal faults that are a few kilometers apart. The range front is less youthful appearing than along the central section [2352b], with only three or four recognizable facets sets (McCalpin, 1987 #4999; 1994 #4414). There are no fault scarps on latest Quaternary surfaces (McCalpin, 1994 #4414), and McCalpin (1987 #4999; 1994 #4414) reports only one fault scarp (20 m high) preserved on a pre-Bonneville pediment surface located on the western strand at the extreme southern end of the section. At this location, McCalpin (1994 #4414) states that the "fault is marked by a broad, subdued ramp" probably suggesting that the scarp is quite old. The western strand of the fault defines a low relief range front on Tertiary sedimentary rocks, and the eastern strand is along a higher relief straighter range front on Paleozoic rocks.
Age of faulted surficial deposits	The western strand is shown as concealed along most its entire length (McCalpin, 1989 #760); at the south end of the segment this strand is shown to offset pre-Bonneville alluvium. The easternmost strand is generally within bedrock, except near the south end of the segment where it follows the bedrock-alluvium contact.
Historic earthquake	
Most recent prehistoric deformation	undifferentiated Quaternary (<1.6 Ma) *Comments:* Time of most recent movement is not well constrained. McCalpin (1987 #4999; 1994 #4414) states that there is no evidence of latest Quaternary movement (less than 15-17 ka); even though Mason (1992 #463) uses data from McCalpin and Forman (1991 #299) to suggest that the most recent event occurred at or before 13.4 ka. The best estimate of the time of the last event is from McCalpin (p. 27 1987 #4999) of "at least early Pleistocene". Thus, the age assignment used here. McCalpin (1987 #4999; 1994 #4414) documents evidence of latest Quaternary surface deformation at the High Creek gravel pit and another site about 1 km to the south, which is located near this section of the fault. There was clear evidence of faults extending from the bottom of the exposure through sediments from the Provo lake level, which would point to faulting occurring between 12.8 and 13.4 ka. However, he believes that this surface

	deformation is likely lateral spreading features due to shaking from the penultimate event on the central section. These failure planes are not primary surface faulting features along the northern part of the fault. Fault is shown as a lesser Tertiary structure by Breckenridge and others (2003 #5878).
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* McCalpin (1987 #4999; 1994 #4414) reports a slip rate of 0.05–0.1 mm/yr based on the 20-m-high scarp on the pre-Bonneville surface. In addition, he reports a long term (Quaternary) slip rate of 0.25–0.5 mm/yr based on 500 m of offset of early Quaternary (1–2 Ma) pediments. He also notes that obviously the higher rate has not been maintained into the late Quaternary. Evans (1991 #4425) reports that the northern part of the fault is characterized by an average slip rate of 0.15 mm/yr for the past 10 m.y. However, on Table 3 he indicates that the post 17–10 Ma slip rate is 0.27–0.45 (respectively) mm/yr based on 4.5 km of net slip, or 0.16–0.36 (respectively) mm/yr based on 3.6 km of net slip. The lowest slip-rate category is indicated here because field relations suggest that late Quaternary rates do not exceed 0.2 mm/yr.
Date and Compiler(s)	2004 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
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