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Quaternary Fault and Fold Database of the United States

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West Cache fault zone, Wellsville fault (Class A) No. 2521c

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Compiled in cooperation with the Utah Geological Survey

citation for this record: **Black, B.D., DuRoss, C.B., Hylland, M.D., and Hecker, S., compilers, 2004, Fault number 2521c, West Cache fault zone, Wellsville fault, 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 02:55 PM.**

Synopsis	**General:** Zone of three related east-dipping faults along the western side of Cache Valley in northern Utah and southern Idaho. All the faults show evidence for recurrent late Quaternary activity. The earthquake-timing, recurrence-interval, and slip-rate estimates for the West Cache fault zone reflect the consensus values of the Utah Quaternary Fault Parameters Working Group (Lund, 2004 #6733). The preferred values of Lund (2004 #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 (e.g., data limitation) and aleatory (e.g., process variability) uncertainty (Lund, 2004 #6733). **Sections:** This fault has 3 sections. This fault zone has been divided into sections from north to south: the Clarkston fault [2521a], the Junction Hills fault [2521b], and the Wellsville fault [2521a] by Black and others (2000 #4778). Bedrock faults in three nearby areas may be associated with the West Cache fault zone, but are not included by Solomon (1999 #4395) due to a lack of demonstrable continuity with the fault zone and a lack of paleoseismic data. They are: (1) the Dayton fault [2370], 11 km east of the Clarkston fault in north-central Cache Valley; (2) the Hyrum fault [2374], on the southwest side of Cache Valley in the southern Wellsville Mountains; and (3) several faults near the town of Mantua [2373], in the interior of the Wellsville Mountains and Wasatch Range southwest of the Hyrum fault.
Name comments	**General:** **Section:** The Wellsville fault is the southern section of the West Cache fault zone as defined by Black and others (2000 #4778). **Fault ID:** Refers to fault number 6-15 in Hecker (1993 #642).
County(s) and State(s)	CACHE COUNTY, UTAH
Physiographic province(s)	BASIN AND RANGE MIDDLE ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:50,000 scale. *Comments:* Fault traces simplified from 1:50,000-scale mapping of Solomon (1999 #4395).
Geologic setting	Generally north-trending normal faults along the west side of Cache Valley. Cache Valley is adjacent to the boundary between the Basin and Range and Middle Rocky Mountains structural provinces, and is a north-south structural basin formed by repeated movement on the west-dipping East Cache fault zone [2352] and east-dipping West Cache fault zone [2521]. The valley was occupied intemittently by Pleistocene Lake Bonneville until about 17 ka, when a substantial volume of water drained from the

	lake due to failure of the Red Rock Pass threshold at its north end.
Length (km)	This section is 20 km of a total fault length of 59 km.
Average strike	N33°W (for section) versus N31°W,N38°W,N38°W (for whole fault)
Sense of movement	Normal
Dip	60°-61°E *Comments:* Measured in alluvial-fan deposits at the Deep Canyon trench site (Black and others, 2000 #4778).
Paleoseismology studies	A trench excavated across a scarp of the Wellsville fault just north of the mouth of Deep Canyon (site 2521-3) exposed evidence for two surface-faulting earthquakes (Black and others, 2000 #4778). Radiocarbon age estimates on bulk-soil samples from a colluvial wedge and underlying paleosol provide limiting ages for the most recent event on the fault. A radiocarbon age estimate from small pieces of degraded detrital charcoal in alluvial-fan sediments that predate the penultimate event provides a maximum limiting age for the penultimate event.
Geomorphic expression	The Wellsville fault consists of two large subparallel, left-stepping, down-to-the-east normal faults, and several smaller normal faults. The western fault is expressed as a sinuous, north-trending trace on the east side of the Wellsville Mountains which marks a sharp boundary between Oquirrh Formation dip slopes and Tertiary and Quaternary deposits (Solomon, 1999 #4395). The eastern fault is covered by Quaternary deposits between bedrock outcrops, and displaces a narrow wedge of Tertiary sedimentary rocks in the hanging wall from Paleozoic sedimentary rocks in the footwall (Solomon, 1999 #4395). Two areas of possible Quaternary displacement were noted by Solomon (1999 #4395): (1) south of Deep Canyon, where Oviatt (1986 #4630) reported 15 m of displacement in middle to upper Pleistocene alluvial-fan deposits; and (2) at Pine Canyon where several small faults and tilted beds are exposed in the wall of a gravel pit which Solomon (1999 #4395) believes may be due to landsliding. Black and others (2000 #4778) indicate scarp-profile measurements north of Deep Canyon show 6.6 m of displacement, likely from the last three events on the fault.

Age of faulted surficial deposits	Late Pleistocene
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Lund (2004 #6733) reports the following paleoearthquake chronology, based on the trench investigations of Black and others (2000 #4778): Z 4400-4800 cal yr BP Y 15-25 ka
Recurrence interval	10-25 k.y. *Comments:* Consensus recurrence-interval range reported in Lund (2004 #6733), based on available paleoseismic data. Black and others (2000 #4778) estimate the recurrence interval between the most recent and penultimate events to be between 10.2-20.6 k.y.; however, the timing of the penultimate event is poorly constrained, and the length of the interval is uncertain.
Slip-rate category	Less than 0.2 mm/yr *Comments:* Lund (2004 #6733) indicates a slip rate of 0.1 mm/yr (preferred), and a consensus minimum-maximum range of 0.05-0.2 mm/yr, based on available paleoseismic information. The broad slip-rate range reflects uncertainty in the elapsed time between the most recent and penultimate events. Black and others (2000 #4778) estimate a paleoseismic slip rate of 0.1-0.2 mm/yr, based on 1.9 m of slip during the most recent event and an interevent time of 10.2-20.6 ky. The long-term geologic slip rate, calculated from displaced late Pleistocene fan alluvium south of Deep Canyon, is 0.13 mm/yr.
Date and Compiler(s)	2004 Bill D. Black, Utah Geological Survey Christopher B. DuRoss, Utah Geological Survey Michael D. Hylland, Utah Geological Survey Suzanne Hecker, U.S. Geological Survey
References	#6758 Biek, R.F., Oaks, R.Q., Jr., Janecke, S.U., Solomon, B.J., and Swenson Barry, L.M., 2003, Geologic maps of the Clarkston and Portage quadrangles, Box Elder and Cache Counties, Utah and Franklin and Oneida Counties, Idaho: Utah Geological Survey Map 194, 41 p. pamphlet, scale 1:24,000.

#4778 Black, B.D., Giraud, R.E., and Mayes, B.H., 2000, Paleoseismic investigation of the Clarkston, Junction Hills, and Wellsville faults, West Cache fault zone, Cache County, Utah: Utah Geological Survey Special Study 98, 23 p., http://ugspub.nr.utah.gov/publications/special_studies/SS-98.pdf.

#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.

#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.

#4630 Oviatt, C.G., 1986, Geologic map of the Honeyville quadrangle, Box Elder and Cache Counties, Utah: Utah Geological and Mineral Survey Map 88, 13 p. pamphlet, scale 1:24,000.

#4395 Solomon, B.J., 1999, Surficial geologic map of the West Cache fault zone and nearby faults, Box Elder and Cache Counties, Utah: Utah Geological Survey Map 172, 20 p. pamphlet, 2 sheets, scale 1:50,000.