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West Cache fault zone, Clarkston fault (Class A) No. 2521a

Last Review Date: 2004-06-01

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

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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 Clarkston fault is the northern 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 FRANKLIN COUNTY, IDAHO
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:50,000 scale. *Comments:* Fault traces simplified from 1:50,000-scale mapping of Solomon (1999 #4395). Location of the fault north of the Stateline between Utah and Idaho is from Kaliser (1976 #5343), which apears to largely follow Cluff and others (1974 #4617).
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 21 km of a total fault length of 59 km.
Average strike	N38°W (for section) versus N31°W,N38°W,N38°W (for whole fault)
Sense of movement	Normal
Dip	49°-70° E. *Comments:* Measured in alluvial-fan deposits at Winter Canyon trench site (Black and others, 2000 #4778) and from well-developed fault breccia on faceted spurs north of Cold Water Canyon (60-65? E.), along the east flank of Clarkston Mountain (Biek and others, 2003 #6758).
Paleoseismology studies	A trench excavated across a scarp of the Clarkston fault just north of the mouth of Winter Canyon (site 2521-2) exposed evidence for one surface-faulting earthquake (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.
Geomorphic expression	The Clarkston fault consists of a single, sinuous fault strand with discontinuous down-to-the-east normal fault scarps, except near Hammond Flat, where two faults diverge northward from the single range-front fault (Solomon, 1999 #4395). South of the divergence, the Clarkston fault mostly juxtaposes upper to middle Pleistocene fan alluvium and Tertiary sedimentary rock in the hanging wall against Paleozoic sedimentary rock in the footwall; the fault is covered by upper Holocene and uppermost Pleistocene fan alluvium and debris flows at canyon mouths. An east-west transverse fault in Short Divide at the south end of the fault forms the segment boundary between the Clarkston and Junction Hills faults. Black and others (2000 #4778) indicate a displacement of 3.1-3.7 m from the most recent event.
Age of faulted surficial	Holocene

deposits	
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Radiocarbon age estimates show the most recent event on the Clarkston fault occurred between 3.6 and 4.0 ka (Black and others, 2000 #4778).
Recurrence interval	5-20 k.y. (<16.8 ka) *Comments:* Consensus recurrence-interval range reported in Lund (2004 #6733), based on two to three events on the Clarkston fault following the Bonneville highstand. Lacking direct evidence for the penultimate event, Black and others (2000 #4778) estimate a mean recurrence interval between 6.6 and 13.2 ky, assuming one to two additional earthquakes between the youngest event and the timing of the Bonneville shoreline (16.8 ka). Both recurrence-interval estimates infer that the oldest earthquake occurred shortly after abandonment of the Bonneville shoreline; however, no direct evidence exists for the number or timing of events preceding the most recent event, as reflected in the broad recurrence-interval range of Lund (2004 #6733).
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Black and others (2000 #4778) indicate a maximum long-term paleoseismic slip rate of 0.68 mm/yr for the Clarkston fault, using 9 m of displacement in the 13.2 ky interval between the most recent event (3.8 ka) and the minimum age of the Bonneville shoreline (16.8 ka). However, Black and others (2000 #4778) note that the true slip rate is likely much lower and possibly similar to that of the Richmond section of the East Cache fault zone ([2352a], 0.25-0.5 mm/year). Lund (2004 #6733) indicates a paleoseismic slip rate of 0.4 mm/yr (preferred), and a consensus minimum-maximum range of 0.1-0.7 mm/yr, based on the most recent and penultimate events.
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. #4617 Cluff, L.S., Glass, C.E., and Brogan, G.E., 1974, Investigation and evaluation of the Wasatch fault north of Brigham City and Cache Valley faults, Utah and Idaho—A guide to land-use planning with recommendations for seismic safety: Technical report to U.S. Geological Survey, Menlo Park, California, under Contract 14-08-001-13665, 147 p., scale 1:12,000. #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. #5343 Kaliser, B.N., 1976, Final report to the U.S. Geological Survey Earthquake Hazard Reduction Program, U.S.G.S Grant no. 14-080001-G-166: Utah Geological and Mineral Survey Report of Investigation 108, 231 p., 5 pls. #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. #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.

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