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Quaternary Fault and Fold Database of the United States

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Southern Oquirrh Mountains fault zone (Class A) No. 2399

Last Review Date: 2004-06-01

Compiled in cooperation with the Utah Geological Survey

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Synopsis	These are well studied late Quaternary normal faults that bound the western flank of the southern Oquirrh Mountains. Trenching, radiocarbon and thermoluminescence analyses have been performed along the fault zone. The earthquake-timing, recurrence-interval, and displacement-rate estimates for the Southern Oquirrh Mountains fault zone reflect the consensus values of the Utah Quaternary Fault Parameters Working Group (Lund, 2004 #6733). Preferred values reported in 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. Confidence limits incorporate both epistemic (*e.g.*, data limitation) and aleatory (*e.g.*, process variability) uncertainty (Lund, 2004 #6733).
Name comments	As defined by Olig and others (1999 #4399), the zone includes the Mercur, West Eagle Hill, Soldier Canyon, and Lakes of Kilarney faults. **Fault ID:** Includes Hecker's (1993 #642) fault number 7-14 (the Mercur fault).
County(s) and State(s)	TOOELE COUNTY, UTAH
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:50,000 scale. *Comments:* Mapped or discussed by Everitt and Kaliser (1980 #4524), Barnhard and Dodge (1988 #429), and Olig and others (2000 #5002, 2001 #5003). Fault traces from mapping by Olig and others (1999 #4399).
Geologic setting	En echelon down-to-the-west normal faults bounding the western flank of the southern Oquirrh Mountains. The Oquirrh Mountains are the easternmost and highest of three distinctive north-south mountain ranges in the Basin and Range west of the high central part of the Wasatch Range. Late Quaternary sedimentation along the southwestern side of the Oquirrh Mountains (which are mainly Pennsylvanian-Permian Oquirrh Formation) is dominated by alluvial-fan sediments and deposits of Pleistocene Lake Bonneville.
Length (km)	24 km.
Average strike	N25°W
Sense of movement	Normal
Dip Direction	W
Paleoseismology	Everitt and Kaliser (1980 #4524) excavated a trench near the

studies	southern end of the Mercur fault (site 2399-1), about 4.5 km west of Fivemile Pass and just south of where the scarp intersects the Bonneville shoreline. Trench stratigraphy revealed evidence for repeated surface faulting during the late Pleistocene, and a 2-foot-high (0.6 m) scarp was interpreted as indicating post-Bonneville displacement. Barnhard and Dodge (1988 #429) reinterpreted Everitt and Kaliser's trench data, analyzed fault-scarp morphology from 11 profiles, and excavated a shallow trench just south of Everitt and Kaliser's (1980 #4524) trench; they found no evidence of post-Bonneville surface faulting. Neither of these two studies included radiometric dating. Olig and others (2001 #5003) trenched three traces of the Mercur fault where it crosses alluvial-fan deposits about 30 km south of Tooele, near the intersection of Utah Highway 73 and Mercur Canyon Road (site 2399-2). The trenching revealed evidence for five to seven surface-faulting events since about 92 ka. Radiocarbon and thermoluminescence age estimates from deposits exposed in the trenches provide good to poor constraint on timing of faulting events. Paleoseismic evidence indicates basinward migration of faulting and possible coseismic rupture with the Oquirrh fault [2398] to the north.
Geomorphic expression	The Mercur and West Eagle Hill faults comprise 17 km of the total along-strike length of 25 km for the Southern Oquirrh Mountain fault zone, and show repeated Quaternary movement and displacement in late Pleistocene alluvial fans and terraces (Olig and others, 1999 #4399). The Soldier Canyon and Lakes of Killarney faults comprise the remaining 8 km and are primarily evident in bedrock or as bedrock-alluvial contacts. Barnhard and Dodge (1988 #429) indicate the Mercur scarps show displacements of 1.8 to 5.6 m and appear younger than the Sheeprock [2405] and Stansbury [2395] scarps, but older than the Topliff Hill [2407] scarps. Faulted alluvium exposed in a mining shaft, and an uplifted bedrock pediment, suggest a minimum of 60 m of Quaternary displacement on the Mercur fault (Everitt and Kaliser, 1980 #4524). Olig and others (1999 #4399) indicate net vertical displacements of intermediate-age surfaces average 5.3 to 6.3 m and 1.0 to 2.0 m on the Mercur and West Eagle Hill faults, respectively; maximum displacements are 21.7 and 2.8 m, respectively. Displacement patterns indicate faulting has shifted basinward and most Quaternary displacement was partitioned on the Mercur fault, though coseismic rupture on both faults is a possibility.

Age of faulted surficial deposits	Latest Quaternary.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Olig and others (2001 #5003) determined that the most recent event on the fault zone occurred shortly after 4.6±0.2 ka and the penultimate event occurred sometime between 20 and 50 ka. Additional older events occurred shortly after 42±8 ka, shortly after 75±10 ka, and close to (likely shortly after) 92±14 ka. Displacement patterns indicate faulting has shifted basinward and most Quaternary displacement was partitioned on the Mercur fault, though coseismic rupture on both faults is a possibility. Lund (2004 #6733) reports the following paleoearthquake chronology, based on Olig and others' (2001 #5003) interpretation of five to seven surface-faulting earthquakes identified in trenches across three traces (west [W], east [E], center [C]) of the Mercur fault: ZsubW shortly after 4.6±0.2 ka and well before 1.4±0.1 ka YsubW between 20 and 50 ka XsubW shortly after 42±8 ka may or may not correlate with earthquakes VsubC or WsubE WsubW shortly after 75±10 ka may or may not correlate withearthquakes VsubC and WsubE, although event VsubC is probably older VsubW around (shortly after ?) 92±14 ka Olig and others (2001 #5003) consider the above five earthquakes to be well established in the west trench, although the timing and correlation to earthquakes in the other trenches is poorly constrained. Specifically, earthquakes VsubC and WsubE may correlate with one or more earthquakes in the west trench, or they may represent separate earthquakes, resulting in the possibility of five to as many as seven surface-faulting events on the Southern Oquirrh Mountains fault zone. Olig and others (2001 #5003) believe that the Southern Oquirrh Mountains fault zone and Oquirrh fault zone to the north [2398] may have ruptured coseismically, at least during the Holocene and late Pleistocene.
Recurrence interval	20 k.y. (preferred); minimum 5 k.y., maximum 50 k.y. *Comments:* Consensus recurrence-interval range reported in Lund (2004 #6733), based on a review of available paleoseismic data,

	including Mercur fault trench investigations that indicate five to seven earthquakes between 92±14 and 4.6±0.2 ka, with a mean recurrence of 12–25 k.y. (Olig and others, 2001 #5003). The broad uncertainty reflects interevent recurrence intervals that are highly variable, ranging from less than a few thousand years to as much as 46 k.y. (Olig and others, 2001).
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* The average vertical displacement rate across the entire Mercur fault for the past four to six complete seismic cycles is 0.09–0.14 mm/yr (Olig, 2001 #5003). Lund (2004 #6733) indicates a higher paleoseismic displacement rate (which is the basis of the slip-rate category assignment herein) of 0.2 mm/yr (preferred), and a consensus minimum-maximum range of 0.05–0.4 mm/yr, based on the past four to six interevent intervals over 90 k.y. for the entire Mercur fault. The broad range reflects uncertainties associated with possible large variations in vertical displacement through time.
Date and Compiler(s)	2004 Bill D. Black, Utah Geological Survey Christopher B. DuRoss, Utah Geological Survey Greg N. McDonald, Utah Geological Survey Michael D. Hylland, Utah Geological Survey Suzanne Hecker, U.S. Geological Survey
References	#429 Barnhard, T.P., and Dodge, R.L., 1988, Map of fault scarps formed on unconsolidated sediments, Tooele 1° x 2° quadrangle, northwestern Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1990, 1 sheet, scale 1:250,000. #4524 Everitt, B.L., and B.N., K., 1980, Geology for assessment of seismic risk in the Tooele and Rush Valleys, Tooele County, Utah: Utah Geological and Mineral Survey Special Studies 51, 33 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. #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.

	#4399 Olig, S.S., Gorton, A.E., and Chadwell, L., 1999, Paleoseismic investigation of the Mercur fault and its implications to seismic hazard along the Wasatch Front urban corridor: Technical report to U.S. Geological Survey, Reston, Virginia, under Contract 1434-HQ-97-GR-03154, June 1999. #5002 Olig, S.S., Gorton, A.E., Black, B.D., and Forman, S.L., 2000, Evidence for young, large earthquakes on the Mercur fault—Implications for segmentation and evolution of the Oquirrh-East Great Salt Lake fault zone, Wasatch Front, Utah: Geological Society of America Abstracts with Programs, v. 32, no. 7. #5003 Olig, S.S., Gorton, A.E., Black, B.D., and Forman, S.L., 2001, Paleoseismology of the Mercur fault and segmentation of the Oquirrh-East Great Salt Lake fault zone, Utah: Technical report to U.S. Geological Survey, Reston, Virginia, under Contract 98HQGR1036, January 25, 2001, variously paginated.