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Quaternary Fault and Fold Database of the United States

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Hansel Valley fault (Class A) No. 2358

Last Review Date: 2004-06-01

Compiled in cooperation with the Utah Geological Survey

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Synopsis	Range-front fault along the southwestern margin of Hansel Valley. The fault produced Utah's only historical surface-faulting earthquake in 1934. Paleoseismic investigations show evidence for multiple late Pleistocene events along northeast-trending scarps several kilometers east of the Hansel Mountains range front. The northern half of the fault is a single continuous trace, whereas the southern half is a wide zone of several short, en-echelon fault traces. The most-recent prehistoric event on the fault produced a total displacement of 2.2-2.6 m; the 1934 earthquake produced a maximum vertical displacement of 0.5 m. The recurrence-interval and slip-rate estimates for the Hansel Valley fault 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	McCalpin and others' (1992 #613) Hansel Valley southwestern-margin fault, which is herein simplied to be the Hansel Valley fault. **Fault ID:** Refers to fault number 6-1 of Hecker (1993 #642).
County(s) and State(s)	BOX ELDER COUNTY, UTAH
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:50,000 scale. *Comments:* Mapped or discussed by Walter (1934 #4431), McCalpin (1985 #3378), Robison (1986), dePolo and others (1989 #122), Doser (1989 #4430), and McCalpin and others (1992 #613). Fault traces simplified from 1:24,000-scale mapping of Robison (1986 #4486).
Geologic setting	North-trending east-dipping normal fault in southwestern Hansel Valley. Hansel Valley is in an aggregation of low, north-trending ranges and narrow valleys in northern Utah between Curlew Valley on the west and the Malad River Valley on the east. The ranges show few outcrops of bare rock, which is typical of weathering and erosion of the Permian Oquirrh Formation; valleys show great accumulations of gravel and sand along Lake Bonneville shorelines.
Length (km)	13 km.
Average strike	N9°E
Sense of movement	Normal *Comments:* The 1934 event appears to have had a strike-slip focal mechanism (Doser, 1989 #4430), although only secondary

	amounts of strike-slip motion (0.25 m at one location) were seen at the surface (dePolo and others, 1989 #122; Walter, 1934 #4431).
Dip Direction	E *Comments:* Near vertical dip based on focal mechanism from inversion of regional and teleseismic body waveforms (Doser, 1989). Scarp at surface was also near vertical.
Paleoseismology studies	McCalpin (1985 #3378) logged a gully exposure (West Gully site 2358-1) near the northern end of the Hansel Valley southwestern margin fault scarp (results summarized in McCalpin and others, 1992 #613). Stratigraphy, sedimentology, ostracode assemblages, and thermoluminescence dating provide a framework within which to interpret faulting events within the context of pluvial lake cycles. The exposure reveals complex faulting patterns indicating multiple events of unknown displacement since about 140 ka. These include one or more events between 13 and 15 ka (based on dating of deformed lake deposits, interpreted as probable lateral spreads) and an event shortly before deposition of Bonneville transgressive gravels about 26 ka. Post-Bonneville alluvium truncates all exposed faults at the West Gully site, indicating no Holocene events, including the 1934 earthquake, have induced surface rupture at this location.
Geomorphic expression	Northeast-trending scarps several kilometers east of the Hansel Mountains range front. The northern half of the fault is a single continuous trace, whereas the southern half is a wide zone of several short, en-echelon fault traces. The most-recent prehistoric event on the fault produced a total displacement of 2.2-2.6 m. The 1934 earthquake, which ruptured the southern few kilometers of the Hansel Valley fault, produced a maximum vertical displacement of 0.5 m (Walter, 1934 #4431; dePolo and others, 1989 #122).
Age of faulted surficial deposits	Late Pleistocene lacustrine deposits (McCalpin, 1985 #3378).
Historic earthquake	Hansel Valley earthquake 1934
Most recent	latest Quaternary (<15 ka)

prehistoric deformation	*Comments:* The Hansel Valley fault produced a ML 6.6 historical surface-faulting event in 1934. The prehistoric earthquake chronology, constrained by the timing of pluvial lake cycles, includes several events based on a logged natural exposure: two earthquakes at approximately 13 ka and 14-15 ka, and at least one event between 26 and 58 ka (McCalpin and others, 1992 #613). No evidence for earthquake activity exists between 58 and 72 ka; however, multiple earthquakes may have occurred between 72 and 140 ka (McCalpin and others, 1992 #613).
Recurrence interval	10-16 k.y. (<26 ka) *Comments:* Recurrence and displacement data suggest clustering of large events when deep lakes occupied the Bonneville Basin in late Quaternary times, and less frequent smaller events during times of shallow or no lakes.
Slip-rate category	Less than 0.2 mm/yr *Comments:* Lund (2004 #6733) indicates a geologic slip rate of 0.1 mm/yr (preferred), and a consensus minimum-maximum range of 0.06-0.2 mm/yr, based on 1-4 m of displacement since approximately 17 ka (J.P. McCalpin, verbal communication in Lund, 2004 #6733). Based on 2.2-2.6 m of prehistoric displacement and a 10-16 k.y. recurrence interval, the paleoseismic slip rate is approximately 0.1-0.2 mm/yr. The paleoseismic slip rate based on displacement in the 1934 event (and a recurrence of 10-15 k.y.) would be much lower.
Date and Compiler(s)	2004 Bill D. Black, Utah Geological Survey Christopher B. DuRoss, Utah Geological Survey Greg N. McDonald, Utah Geological Survey Suzanne Hecker, U.S. Geological Survey
References	#122 dePolo, C.M., Clark, D.G., Slemmons, D.B., and Aymard, W.H., 1989, Historical Basin and Range province surface faulting and fault segmentation, *in* Schwartz, D.P., and Sibson, R.H., eds., Proceedings of conference XLV—Fault segmentation and controls on rupture initiation and termination: U.S. Geological Survey Open-File Report 89-315, p. 131-162. #4430 Doser, D.I., 1989, Extensional tectonics in northern Utah—southern Idaho, U.S.A., and the 1934 Hansel Valley sequence: Physics of the Earth and Planetary Interiors, v. 54, p. 120-134.

#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.

#3378 McCalpin, J., 1985, Quaternary fault history and earthquake potential of the Hansel Valley area, north-central Utah: U.S. Geological Survey Final Technical Report, 37 p.

#613 McCalpin, J., Robison, R.M., and Garr, J.D., 1992, Neotectonics of the Hansel Valley-Pocatello Valley corridor, northern Utah and southern Idaho, *in* Gori, P.L., and Hays, W.W., eds., Assessment of regional earthquake hazards and risk along the Wasatch front, Utah: U.S. Geological Survey Professional Paper 1500, p. G1-G18.

#4486 Robison, R.M., 1986, The surficial geology and neotectonics of Hansel Valley, Box Elder County, Utah: Logan, Utah State University, unpublished M.S. thesis, 120 p., scale 1:24,000.

#4431 Walter, H.G., 1934, Hansel Valley, Utah, earthquake: The Compass of Sigma Gamma Epsilon, v. XIV, no. 4, p. 178-181.