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Quaternary Fault and Fold Database of the United States

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Joes Valley fault zone (Class B) No. 2453

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Compiled in cooperation with the Utah Geological Survey

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Synopsis	Normal-fault-bounded graben, consisting of parallel, en echelon, and locally overlapping, north- to northeast-trending faults, which extend along the east side of the Wasatch Plateau (Foley and others, 1986 #1165). The northern Joes Valley fault zone is characterized by linear graben-bounding bedrock escarpments and fault scarps on Quaternary deposits. The southern Joes Valley fault zone has less stratigraphic throw and generally no scarps on Quaternary deposits. There is no net slip across the entire Joes Valley fault zone, and the seismogenic potential of the individual faults is poorly understood. The recurrence-interval estimates for the Joes Valley fault zone reflect the consensus values of the Utah

	Quaternary Fault Parameters Working Group (Lund, 2004 #7002). The preferred value of Lund (2004 #7002) approximates the "mean" 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 #7002).
Name comments	**Fault ID:** Previously treated as four separate fault zones: Hecker's (1993 #642) fault numbers 13-5,13-6, 13-7, and 13-8 (2454, 2453, 2455, and 2456, respectively, in Black and others [2003 #5828]).
County(s) and State(s)	SANPETE COUNTY, UTAH EMERY COUNTY, UTAH SEVIER COUNTY, UTAH
Physiographic province(s)	COLORADO PLATEAUS
Reliability of location	Good Compiled at 1:155,000 scale. *Comments:* Mapping from Foley and others (1986 #1165).
Geologic setting	Joes Valley is a long, straight, north-trending graben that splits the Wasatch Plateau, which is capped mainly by Tertiary Flagstaff Limestone. Faults forming the graben are subdivided into the northern and southern Joes Valley fault zones, based on the relative timing of fault movement. The northern Joes Valley graben is bounded by the east and west Joes Valley fault zones, which have the greatest amount of bedrock displacement near the center of the graben, with slip decreasing toward the north and south. Several intragraben faults on unconsolidated Quaternary alluvium exist, including the Middle Mountain fault and the Bald Mountain fault (Foley and others, 1986 #1165). The southern Joes Valley graben is bounded by the Muddy and Paradise faults, and several intragraben faults, which have very limited evidence for Quaternary movement.
Length (km)	84 km.
Average strike	N6°E
Sense of movement	Normal

Dip Direction	E; W
Paleoseismology studies	Fault trench studies are limited to the northern Joes Valley fault zone. Along the east Joes Valley fault a trench was excavated on the southeast side of Scad Valley, at the north end of the Straight Canyon section (site 2453-1). Stratigraphic and structural relations indicate at least four surface-faulting events since 150–300 ka, which is the interpreted age (based on amino acid racemization of snail shells) of the oldest unit exposed in the trench. The four events appear to have involved both brittle rupture and monoclinal folding. Two bulk-soil samples and one charcoal sample from the modern (unfaulted) soil profile yielded radiocarbon age estimates that place a minimum limiting age on the most recent event. Several trenches excavated across the Middle Mountain fault (site 2453-2), within the intragraben fault zone, exposed stratigraphic evidence for at least two surface-faulting events (Foley and others, 1986 #1165). The trenches were located east of the mouth of Reeder Canyon where two parallel en echelon scarps cross the three oldest of four upper Pleistocene alluvial fans (site 2453-2). Radiocarbon age estimates from three bulk-soil samples of an unfaulted, organic-rich paleosol A horizon provide a minimum limiting age for the most recent event. Foley and others (1986 #1165) excavated a trench on the Seely section of the west Joes Valley fault, about 270 m north of Littles Creek near the north end of a 450-m-long scarp crossing the highest of three alluvial terraces (site 2453-3). Stratigraphic relations indicate a minimum of two surface-faulting events. Radiocarbon age estimates from a bulk-soil sample and charcoal derived from unfaulted colluvium provide a minimum age of the most recent event. Geomorphic relations and soils data provide additional broad constraints on earthquake timing. An additional trench (site 2453-4) across the inferred southern extension of the Middle Mountain fault (west-facing scarps on the west side of Joes Valley Reservoir) indicated multiple small (< 1 m) displacements (Foley and others, 1986 #1165).
Geomorphic expression	Within the northern Joes Valley graben, the west fault is divided into the Huntington, Seely, and Dugway Hollow sections (from north to south, 4, 42, and 7.5 km long) based on relative age and displacement (Foley and others, 1986 #1165). Fault throw varies from less than 500 m across an eroded bedrock escarpment, partially buried by Pinedale (~11–14 ka) terminal moraines on the Huntington section, to ~150 m across the Dugway Hollow fault section, marked by a deeply incised scarp on colluvial veneer and

bedrock. The Seely section has an undetermined amount of throw across two en echelon faults in Quaternary deposits. Scarps along the longer (en echelon) fault are 8–12 m high on latest Pleistocene (<30 ka) deposits, and 12–14 m high on latest Pinedale (11–14 ka) deposits along the shorter (en echelon) fault. Foley and others (1986 #1165) divide the east fault (based on relative age and displacement) into the Miller Flat, Straight Canyon, and Ferron sections (from north to south, 8, 42, and 5 km long). Both the Miller Flat and Ferron sections have evidence for up to 100 m of total stratigraphic throw in bedrock. The Ferron section is expressed as a deeply incised scarp on colluvial veneer and bedrock, whereas a steep linear escarpment with up to 900 m of throw across bedrock and unconsolidated deposits marks the Straight Canyon section. Only the Straight Canyon section has significant inferred late Quaternary (<150 ka) displacement. The youngest measured displacement (2.5 m) is apparently due to monoclinal folding and may be the result of several small events. Intragraben faults within the northern Joes Valley graben include the Bald Mountain faults, consisting of two horst-bounding scarps on upper Pleistocene deposits, and unfaulted Late Pleistocene moraines to the north and south. The Middle Mountain fault consists of several en-echelon, down-to-the-west scarps; the faults may be antithetic to the west Joes Valley fault based on similarities in movement histories. Trenches across the Middle Mountain fault expose two surface-faulting events separated by a soil inferred to be 14–30 ka in age; the events show measured displacements of <1 m for the most recent event and about 3 m for the earlier event. The southern Joes Valley graben is bounded by the Muddy fault on the west and the Paradise fault on the east, with numerous smaller intragraben faults in between. Faults in the southern Joes Valley fault zone have less total stratigraphic throw, less topographic definition, and lower Quaternary activity rates than faults bounding the northern Joes Valley graben. Late Quaternary displacement on the faults is restricted to two short grabens. Gravels inferred to be more than 150 ka in age are displaced about 30 m in the grabens, but show no net tectonic displacement. The estimated maximum credible earthquake for individual ruptures of faults within the Joes Valley fault zone (e.g., the west Joes Valley fault in the northern Joes Valley fault zone) is 7.5 (Ms). However the seismogenic nature of the faults is questionable, due to a lack of net slip across the entire graben and presently unidentified rupture pathways to the base of the seismogenic crust.

Age of faulted surficial deposits	Holocene to Middle Pleistocene.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Based on fault trench investigations and both radiocarbon dating and the relative ages of displaced deposits in the northern Joes Valley fault zone (Foley and others, 1986 #1165). The east Joes Valley fault experienced a minimum of four earthquakes in 250 k.y., whereas the west Joes Valley and intragraben faults have each experienced a minimum of two earthquakes in the past ~30 k.y. Individual earthquake timing is poorly constrained. Within the southern Joes Valley fault zone, the timing of the most recent paleoevent is estimated to be between the middle and late Quaternary (<750 ka).
Recurrence interval	10 k.y. (preferred); minimum 5 k.y. maximum 50 k.y. (<30–300 ka) *Comments:* Consensus recurrence-interval range reported in Lund (2004 #7002), based on a review of available fault-trench data for the northern Joes Valley fault zone by Foley and others (1986 #1165). The intentionally broad range reflects high uncertainty in the timing of events (Lund, 2004 #7002). Includes broadly constrained recurrence interval estimates for the Middle Mountain fault (10–15 k.y.) and west Joes Valley fault (10-20 k.y.) over a ~30 k.y. period of fault record, and the east Joes Valley fault (<60 k.y.) estimated over a ~250 k.y. period of record (Foley and others, 1986 #1165).
Slip-rate category	Less than 0.2 mm/yr *Comments:* Foley and others (1986 #1165) report no net slip across the Joes Valley graben, and question the seismogenic capability of the fault zone. Consequently, Lund (2004 #7002) did not estimate a slip rate range for the Joes Valley fault zone. Existing slip-rate estimates are limited to individual faults in the northern Joes Valley fault zone. Fault scarps at five localities along the Seely section of the west Joes Valley fault indicate about 12 m of displacement in deposits ranging in age from 11–30 ka, suggesting a long-term geologic slip rate of 0.4–1.1 mm/yr.

	The northern part of the section appears to have the largest Holocene displacement, where 12–14-m-high scarps are in Pinedale (11–14 ka) moraines. Geologic slip-rate estimates for the Middle Mountain fault (since ~30 ka) and east Joes Valley fault (since 150–300 ka) range from 0.1 to 0.3 mm/yr.
Date and Compiler(s)	2006 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	#5828 Black, B.D., Hecker, S., Hylland, M.D., Christenson, G.E., and McDonald, G.N., 2003, Quaternary fault and fold database and map of Utah: Utah Geological Survey Map 193DM, CD-ROM, ISBN 1-55791-593-8, 1pl., scale 1:500,000. #1165 Foley, L.L., Martin, R.A., Jr., and Sullivan, J.T., 1986, Seismotectonic study for Joes Valley, Scofield and Huntington North Dams, Emery County and Scofield Projects, Utah: U.S. Bureau of Reclamation Seismotectonic Report 86-7, 132 p., 3 pls. #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. #7002 Lund, W.R., 2004, Utah Quaternary Fault Parameters Working Group review of Utah paleoseismic-trenching data and determination of consensus recurrence-interval and vertical slip-rate estimates: Salt Lake City, Utah Geological Survey, unpublished Final Technical Report for the U.S. Geological Survey, National Earthquake Hazards Reduction Program, Contract No. 03HQGR0033, variously paginated.