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Quaternary Fault and Fold Database of the United States

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Hilton Creek fault (Class A) No. 44

Last Review Date: 1995-10-01

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Synopsis	The Hilton Creek fault is a significant range-bounding normal fault along the eastern side of the Sierra Nevada and is one of the most studied faults within the Sierra Nevada-Basin and Range boundary zone. However, Berry's (1990 #5582) Quaternary geologic study of the fault zone is the sole source of exploratory trenching information. The fault is characterized by down-to-the-east normal displacement and it offsets late Tioga lateral moraines and outwash deposits. Surface-fault rupture was associated with four Mw>6 earthquakes that occurred in May 1980 (Taylor and Bryant, 1980 #5586). Latest Pleistocene vertical slip rates range from 0.9 mm/yr to 4.2 mm/yr (Berry, 1990 #5582; Clark and Gilliespie, 1993 #5584).
Name comments	The Hilton Creek fault was first mapped and named by Rinehart and Ross (1964 #5585). The fault extends from Davis Lake north along Hilton Creek to Long Valley caldera where the fault splays in a complex zone across the western part of Long Valley caldera

	to its complex step over to the Hartley Springs fault zone [43]. **Fault ID:** Refers to number 202 (Hilton Creek fault) of Jennings (1994 #2878) and fault number MA7 (Hilton Creek fault) of dePolo (1998 #2845).
County(s) and State(s)	MONO COUNTY, CALIFORNIA
Physiographic province(s)	CASCADE-SIERRA MOUNTAINS BASIN AND RANGE
Reliability of location	Good Compiled at 1:62,500 scale. *Comments:* Locations based on digital revisions to Jennings (1994 #2878) using original mapping by Rinehart and Ross (1964 #5585), Taylor and Bryant (1980 #5586), and Bryant (1981 #5583) at 1:62,500 scale.
Geologic setting	This high-angle, down-to-east normal fault bounds the eastern front of Sierra Nevadas. Minor surface rupture occurred along the Hilton Creek fault during the May 1980 Mammoth Lakes earthquake sequence (Taylor and Bryant, 1980 #5586). Quaternary vertical displacement across the fault is thought to be about 1,100 m (Rinehart and Ross, 1964 #5585; Bailey and others, 1976 #5581); however, cumulative vertical displacement is significantly less where the fault extends north into the Long Valley caldera.
Length (km)	30 km.
Average strike	N12°W
Sense of movement	Normal
Dip Direction	E
Paleoseismology studies	McGee Creek (site 44-1). Berry (1990 #5582) excavated a trench into a 19-m-high scarp on a Tioga recessional moraine along the Sierra Nevada range front at McGee Creek. The trench exposed scarp-derived colluvial deposits but did not expose the Hilton Creek fault due to U.S. Forest Service restrictions on trench placement. Berry (1990 #5582) assessed the timing of the most recent paleoevent using radiocarbon and thermoluminescence dating, and soil development.

Geomorphic expression	The fault forms a steep 1,500-m-high, east-facing escarpment that is characterized by faceted spurs and "wine-glass" drainage canyons. Well-defined scarps as much as 19 m high are preserved on glacial deposits. The zone of faulting becomes broad (4–6 km wide) and distributive as it enters the Long Valley caldera from the south. The fault complexly steps left to the Hartley Springs fault [43].
Age of faulted surficial deposits	Holocene alluvium, late Pleistocene (Tioga- and Tahoe-stage) moraines, and 0.75-Ma Bishop tuff (Rinehart and Ross, 1964 #5585; Berry, 1990 #5582; Clark and Gilliespie, 1993 #5584).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Berry's (1990 #5582) preferred estimate for the minimum age of the most recent paleoevent at McGee Creek is 3.5 ka based on radiocarbon dating and 12 ka based on thermoluminescence dating.
Recurrence interval	
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* Clark and Gillespie (1993 #5584) determined that slip rates along the Hilton Creek fault decrease southward (away from Long Valley caldera) from studies at four sites: (1) the vertical slip rate at Tabacco Flat is 1.1–2.0 mm/yr; (2) at McGee Creek the rate since 10–15 ka is 1.3–2.5 mm/yr, since 13–20 ka it is 1.4–2.6 mm/yr, since 25–40 ka is 1.4–4.2 mm/yr, and since 65–140 ka it is 1.1–3.5 mm/yr; (3) at Hilton Lakes the rate is 0.1–0.8 mm/yr; and (4) near the south end of the fault the rate is 0.1–0.4 mm/yr. Berry (1990 #5582) estimated three preferred rates: (1) 0.9–1.1 mm/yr based as much as 17 m of vertical separation of a Tioga recessional moraine (10–20 ka); (2) 1.0–1.3 mm/yr from up to 26 m separation of a Tioga lateral moraine (15–25 ka); and 3) 0.9–1.0 mm/yr based on 91–130 m separation of Tahoe moraine (60–140 ka). Berry (1990 #5582) also noted that fault activity decreases away from the caldera. Rinehart and Ross (1964 #5585) and Bailey and others (1976 #5581) proposed about 1,100 m of Quaternary normal displacement across the fault, suggesting an average Quaternary rate less than 1 mm/yr.

Date and Compiler(s)	1995 Thomas L. Sawyer, Piedmont Geosciences, Inc.
References	#5581 Bailey, R.A., Dalrymple, G.B., and Lanphere, M.A., 1976, Volcanism, structure, and geochronology of Long Valley caldera, Mono County, California: Journal of Geophysical Research, v. 81, no. 5, p. 725-744. #5582 Berry, M.E., 1990, Soil-geomorphic analysis of late-Quaternary glaciation and faulting, eastern escarpment of the central Sierra Nevada, California: Boulder, University of Colorado, unpublished Ph.D. dissertation, 365 p. #5583 Bryant, W.A., 1981, Hilton Creek fault and northwest extensions: California Division of Mines and Geology Fault Evaluation Report FER-107, microfiche copy in California Division of Mines and Geology Open-File Report 90-14, 9 p., scale 1:24,000. #5584 Clark, M.M., and Gillespie, A.R., 1993, Variations in late Quaternary behavior along and among range-front faults of the Sierra Nevada, California: Geological Society of America Abstracts with Programs, v. 25, no. 5, p. 21. #2845 dePolo, C.M., 1998, A reconnaissance technique for estimating the slip rate of normal-slip faults in the Great Basin, and application to faults in Nevada, U.S.A.: Reno, University of Nevada, unpublished Ph.D. dissertation, 199 p. #2878 Jennings, C.W., 1994, Fault activity map of California and adjacent areas, with locations of recent volcanic eruptions: California Division of Mines and Geology Geologic Data Map 6, 92 p., 2 pls., scale 1:750,000. #4860 Petersen, M.D., Bryant, W.A., Cramer, C.H., Cao, T., Reichle, M.S., Frankel, A.D., Lienkaemper, J.J., McCrory, P.A., and Schwartz, D.P., 1996, Probabilistic seismic hazard assessment for the State of California: California Department of Conservation, Division of Mines and Geology Open-File Report 96-08 (also U.S. Geological Open-File Report 96-706), 33 p. #5585 Rinehart, C.D., and Ross, D.C., 1964, Geology and mineral deposits of the Mount Morrison quadrangle, Sierra Nevada, California: U.S. Geological Survey Professional Paper 150, 106

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