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Freds Mountain fault (Class A) No. 1657

Last Review Date: 1999-03-30

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Synopsis	This prominent zone has range-front faults bounding east front of Freds Mountain and of an unnamed mountain block to the south, and has piedmont and intra basin faults in Bedell Flat, western Antelope Valley and in central Lemmon Valley. Reconnaissance photogeologic mapping of the fault and detailed geologic mapping in the region along with two scarp profiles on the Freds Mountain fault in Antelope Valley are the sources of most of the data. Two trenches were excavated on the southern extension of a prominent splay of Freds Mountain fault zone.
Name comments	Refers to faults mapped by Rush and Glancy (1967 #3602), Slemmons (1968, unpublished Reno 1? X 2? sheet), Bell (1981 #2875; 1984 #105), Szecsody (1983 #3604), Cordy (1985 #2448; 1985 #2449), Nitchman and Ramelli (1991 #2551), and Garside (1993 #3600) along east side of Freds Mountain, in western Antelope Valley and Bedell Flat, and in central Lemmon Valley.

	Refers to the Freds Mountain fault as generally defined by Nitchman and Ramelli (1991 #2551) and includes the "Airport fault" of Bell (1981 #2875), Szecsody (1983 #3604), and Cordy (1985 #2448; 1985 #2449); the Freds Mountain name is adopted herein. **Fault ID:** Refers to fault number R2 (Freds Mountain fault) by dePolo (1998 #2845).
County(s) and State(s)	WASHOE COUNTY, NEVADA
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:100,000 scale. *Comments:* Fault locations are based on 1:250,000-scale map of Bell (1984 #105); mapping is from photogeologic analysis of 1:40,000-scale low sun-angle aerial photography, supplemented with 1:12,000-scale aerial photography of selected areas, several low-altitude aerial reconnaissance flights, and field reconnaissance of major structural and stratigraphic relationships. Fault locations are also based on map 1:24,000-scale maps of Cordy (1985 #2448; 1985 #2449) and Garside (1993 #3600), and 1:62,500-scale map of Nitchman and Ramelli (1991 #2551).
Geologic setting	This prominent zone has range-front faults bounding east front of Freds Mountain and of an unnamed mountain block to the south, and has piedmont and intra basin faults in Bedell Flat, western Antelope Valley and in central Lemmon Valley (Bell, 1981 #2875; 1984 #105; Cordy, 1985 #2448; 1985 #2449; Nitchman and Ramelli, 1991 #2551; Garside, 1993 #3600).
Length (km)	28 km.
Average strike	N3°E
Sense of movement	Normal *Comments:* Not studied in detail; sense of movement from Szecsody (1983 #3604), Cordy (1985 #2448; 1985 #2449) and Nitchman and Ramelli (1991 #2551) and is inferred from topography.

Dip Direction	E; NW
Paleoseismology studies	Two backhoe trenches were excavated across the southern extension of the Freds Mountain fault zone in northern Lemmon Valley by Szecsody (1983 #3604). Soil development and stratigraphic relationships were used to determine the movement history of the Freds Mountain fault zone. Site 1657-1: (trench 2 of Szecsody, 1983 #3604) was excavated across a 2.4-m-high scarp with a maximum slope of 6?. A Churchill-correlative soil (~35 k.y.) blankets the scarp but is not displaced. A zone of near-vertical fractures and infilled fissures in alluvial deposits are the only definitive evidence of faulting noted in the trench. A sand lens pinches out at, and was not evident on the downthrown side of, a fissure consistent with fault offset (Szecsody, 1983 #3604; Cordy, 1987 #2450). Site 1657-2: (trench 1 of Szecsody, 1983 #3604) was excavated to the south of site 1657-1 across a 1.5-m-high scarp with a maximum slope of 7?. A Churchill-correlative soil (~35 k.y.) blankets the scarp but is not displaced. A sand lens is possible offset 0.3 m across an approximately 5-m-wide zone of near-vertical fractures and infilled fissures. Based on the discrepancy between the apparent offset in this trench (0.3 m) and the scarp height at the site (1.5 to 2.4 m), Szecsody (1983 #3604) concluded that the scarp was formed by multiple movements of the fault, with the most recent event resulting in 0.3 m of apparent vertical offset. The most recent event is interpreted to be post 60 ka and prior to the initiation of soil development at 35 ka (Szecsody, 1983 #3604; Cordy, 1987 #2450).
Geomorphic expression	Range-front faults are expressed as discontinuous scarps on late Quaternary piedmont-slope deposits along the entire zone and as abrupt escarpments with faceted spurs (e.g., Nitchman and Ramelli, 1991 #2551). These faults commonly juxtapose Quaternary deposits against bedrock, although this contact is often concealed. East of the range-front in Antelope Valley is a continuous curvilinear fault that locally juxtaposes an outlying bedrock bench against Quaternary and late Quaternary deposits. Intrabasin faults are marked by scarps on Quaternary alluvium. The "Airport fault", the principal intra basin fault in the zone, is expressed as an approximately 37-m-high scarp on Tertiary sediments overlain Quaternary alluvium that bisects Lemmon Valley and bounds west side of Lemmon Valley playa; however, the scarp may be in part of lacustrine origin (Bell, 1981 #2875;

	1984 #105; Cordy, 1985 #2448; Nitchman and Ramelli, 1991 #2551; Garside, 1993 #3600). Two scarp profiles on the easternmost piedmont fault in Antelope Valley show a 0.8-m-high probably early to middle Holocene scarp with a maximum slope angle of 13? and 7.0-m-high late Pleistocene scarp with a maximum slope angle of 28? (Nitchman and Ramelli, 1991 #2551). dePolo (1998 #2845) reports a maximum preferred basal fault facet height of 110 m (92-124 m).
Age of faulted surficial deposits	Quaternary; Tertiary. Cordy (1985 #2448; 1985 #2449) and Garside (1993 #3600) mapped faults that juxtapose Quaternary deposits against Tertiary bedrock.
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* The timing of most recent event is not well constrained. Trenching studies by Szecsody (1983 #3604) suggest a late Quaternary time (late to middle Pleistocene by their definition) for the fault in Lemmon Valley; however, younger faulting is suggested by reconnaissance field mapping by Nitchman and Ramelli (1991 #2551) for the fault in Antelope Valley. An undifferentiated Pleistocene time is suggested by mapping of Bell (1981 #2875; 1984 #105), Cordy (1985 #2448; 1985 #2449), Garside (1993 #3600), and Dohrenwend and others (1996 #2846). the age-category assignment is based on the evidence presented by Szecsody (1983 #3604) and Cordy (1987 #2450) suggesting faulting probably occurred between 35 and 60 ka.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Not studied in detail. Nitchman and Ramelli (1991 #2551) reported a late Quaternary slip rate of 0.09 to >0.2 mm/yr and a Holocene slip rate of 0.08 to 0.16 mm/yr. dePolo (1998 #2845) and dePolo and Anderson (2000 #4471) recalculated the late Quaternary rate based on scarp-height data presented by Nitchman and Ramelli (1991 #2551) and revised their age estimate. This results in a preferred slip rate of 0.22 mm/yr (0.9-0.36 mm/yr). The results of the majority of slip rate calculations

	for this fault are less than 0.2 mm/yr; thus, the lowest slip-rate category is assigned here.
Date and Compiler(s)	1999 Janet E. Sawyer, Piedmont Geosciences, Inc.
References	#2875 Bell, J.W., 1981, Quaternary fault map of the Reno 1° by 2° quadrangle, Nevada-California: U.S. Geological Survey Open-File Report 81-982, 62 p., http://pubs.er.usgs.gov/publication/ofr81982. #105 Bell, J.W., 1984, Quaternary fault map of Nevada—Reno sheet: Nevada Bureau of Mines and Geology Map 79, 1 sheet, scale 1:250,000. #2448 Cordy, G.E., 1985, Earthquake hazards map, Reno NE quadrangle: Nevada Bureau of Mines and Geology Map 4Ci, scale 1:24,000. #2449 Cordy, G.E., 1985, Geologic map, Reno NE quadrangle: Nevada Bureau of Mines and Geology Map 4Cg, scale 1:24,000. #2450 Cordy, G.E., 1987, Geology and earthquake hazards Reno NE quadrangle: Nevada Bureau of Mines and Geology Open-File Report 87-5, 78 p. #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. #4471 dePolo, C.M., and Anderson, J.G., 2000, Estimating the slip rates of normal faults in the Great Basin, USA: Basin Research, v. 12, p. 227-240. #2846 Dohrenwend, J.C., Schell, B.A., Menges, C.M., Moring, B.C., and McKittrick, M.A., 1996, Reconnaissance photogeologic map of young (Quaternary and late Tertiary) faults in Nevada, *in* Singer, D.A., ed., Analysis of Nevada's metal-bearing mineral resources: Nevada Bureau of Mines and Geology Open-File Report 96-2, 1 pl., scale 1:1,000,000. #3600 Garside, L.J., 1993, Geologic map of the Bedell Flat quadrangle, Nevada: Nevada Bureau of Mines and Geology, Field Studies Map 3, 1 sheet, scale 1:250,000.

#2551 Nitchman, S.P., and Ramelli, A.R., 1991, Freds Mountain fault: Nevada Bureau of Mines and Geology Evaluation Report, 7 p., 2 scarp profiles, scale 1:62,500.

#3602 Rush, F.E., and Glancy, P.A., 1967, Water-resources appraisal of the Warm Springs-Lemmon Valley area, Washoe County, Nevada: Nevada State Department Conservation and Natural Resources Water Resources Reconnaissance Survey Report 43, 70 p.

#3604 Szecsody, G.C., 1983, Earthquake hazards of the Reno NE quadrangle—Part I, Geology; Part II, Earthquake hazards: Final Technical Report, U.S. Geological Survey, 69 p., scale 1:24,000.