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Owens Valley fault zone, Keough Hot Springs section (Class A) No. 51a

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Compiled in cooperation with the California Geological Survey

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Synopsis	**General:** This historically active, major Basin and Range dextral-normal fault zone is located in Owens Valley, its namesake. For this compilation, the Owens Valley fault zone is divided into two sections (Keough Hot Springs [51a] and 1872 Rupture [51b]) principally based on the location and extent of the great 1872 Owens Valley earthquake. The Owens Valley earthquake, which caused about 100 km of surface rupture (Beanland and Clark, 1994 #103), has been assigned various magnitudes ranging from M_W7.5–7.7 by Beanland and Clark (1994 #103) to about M_S8 based on earthquake intensity (Wells and Coppersmith, 1994

#546). At the time of this compilation, there were seven detailed study sites along the Owens Valley fault zone that are summarized herein. Little is know about the prehistoric earthquake history for the Keough Hot Springs section [51a] although Envicom (1976 #5609) excavated trenches across scarps on Holocene alluvium and documented Holocene vertical displacement. This section may have a dextral component of displacement based on geomorphic expression, but the amount of displacement is not known. The 1872 Rupture section [51b] extends from near Klondike Lake to south of Owens Lake. Beanland and Clark (1994 #103) documented average dextral-normal offset of 6.1±2.1 m associated with the 1872 earthquake. They inferred a Holocene slip rate of 2±1 mm/yr and a middle to late Quaternary (0–300 ka) slip rate of 1.5±1 mm/yr. Martel and others (1989 #5620) and Zehfuss and others (2001 #5623) calculated a vertical displacement rate of 0.24±0.04 mm/yr for past 300 k.y. for the associated Fish Springs fault, a normal fault that is part of the northern 1872 Rupture section [51b]. Lubetkin and Clark (1988 #144) reported a Holocene slip rate of 0.4–1.3 mm/yr for the Lone Pine fault, a strand of the 1872 Rupture section [51b] near Lone Pine. Lee and others (2001 #5611) reported a dextral displacement rate between 1.2±0.1 and 3.6±0.2 mm/yr, based on measured deflections of a stream channel near site 51-7, although Bacon and others (2001 #5612) have disputed the tectonic origin of these stream deflections. Beanland and Clark (1994 #103) and Lubetkin and Clark (1988 #144) identified two prehistori, in addition to 1872, surface-rupturing earthquakes in thesince 10–21 ka. Lee and others (2001 #5611) reported that the penultimate event occurred between 3.3±0.3 ka and 3.8±0.3 ka based on OSL dating at site 51-5. Recurrence intervals for the 1872 Rupture section [51b] are not well constrained. Beanland and Clark (1994 #103) reported a preferred recurrence interval of about 5 k.y. based on observations that two events occurred prior to the 1872 earthquake, probably in Holocene time. Lee and others (2001 #5611) reported a preferred recurrence interval of 3–4.1 k.y. based on sream deflections, the age of the penultimate event at site 51-5, and an assumed uniform temporal recurrence of events. Bacon and others (2001 #5612) argue that structural and stratigraphic evidence is certain for only two earthquakes (including the 1872 event).

Sections: This fault has 2 sections. The northern section, here named the Keough Hot Springs section [51a], extends from just south of Bishop south to the vicinity of Klondike Lake, which is

	considered the northern extent of surface faulting associated with the 1872 Owens Valley earthquake (Beanland and Clark, 1994 #103). The southern section, here named the 1872 Rupture section [51b], extends from the Klondike Lake area south to just south of Owens Lake and is defined by the 1872 Owens Valley surface fault rupture.
Name comments	**General:** The Owens Valley fault zone was recognized by Whitney (1872 #5641) and Gilbert (1884 #3355) largely as a result of their studies of surface rupture associated with the 1872 Owens Valley earthquake. Traces of the fault zone were first mapped in the Lone Pine area by Johnson (shown in Hobbs, 1910 #5615) and in the Independence area by Knopf (1918 #5616). The fault zone appears to have been first referred to as the Owens Valley fault system by Pakiser (1960 #5622), but he also included the White Mountains fault zone [47] in the system. Slemmons (cited in Hill, 1972 #1207) referred to the fault zone as both the mid-Owens Valley fault zone and mid-Valley fault zone. The Owens Valley fault zone is the most commonly used name in current literature and is used in this compilation. Other named branches or strands of the Owens Valley fault zone include the Fish Springs fault (southwest of Big Pine), probably first named by Martel (1984 #5619), and the Lone Pine fault (west of Lone Pine) first named by Lubetkin (1980 #5618). The Owens Valley fault zone extends for >125 km across the floor of Owens Valley from near Bishop to south of Owens Lake. **Section:** Keough Hot Springs section, informally named in this compilation, extends from the town of Bishop south to the vicinity of Klondike Lake (about 5 km north of Big Pine), which is thought to be the northern extent of surface faulting associated with the 1872 Owens Valley earthquake (Beanland and Clark, 1994 #103). **Fault ID:** Refers to fault numbers 212 (Owens Valley fault) and 212A (Lone Pine fault) of Jennings (1994 #2878) and fault OWV of Piety (1995 #915).
County(s) and State(s)	INYO COUNTY, CALIFORNIA
Physiographic province(s)	BASIN AND RANGE CASCADE-SIERRA MOUNTAINS
Reliability of location	Good Compiled at 1:62,500 scale.

	Comments: Locations based on digital revisions to Jennings (1994 #2878) using original mapping by Bryant (1984 #5589) at 1:48,000 scale, and mapping by Bateman (1965 #5587) at 1:62,500 scale.
Geologic setting	The Owens Valley fault zone is a major, north to north-northwest striking, high-angle, predominantly dextral strike-slip fault zone that extends for more than 125 km across the floor of Owens Valley from near Bishop to south of Owens Lake. Owens Valley is a major structural depression within the Inyo-Mono block of the Walker Lane belt (Stewart, 1988 #1654). The northern end of the Owens Valley fault zone locally borders the Sierra Nevada range front along the Coyote Warp, a zone of mountain-side-(west) down normal faults distributed between the Owens Valley fault zone and the Round Valley fault [45] (Bateman, 1965 #5587). Dawers and others (2002 #5646) suspect that the Coyote Warp may be a fault-propagation fold at the northern tip of the Sierra Nevada extensional fault system. The Owens Valley fault zone is in the western portion of the Basin and Range province, an area characterized by oblique extensional tectonics resulting in both dextral strike-slip and normal dip-slip displacement. Total vertical displacement across the Owens Valley fault zone is 2.5 km, based on gravity data (Hollett and others, 1991 #5617). Total dextral offset has been estimated to be a few kilometers, based on the apparent correlation of the Independence dike swarm (Moore and Hopson, 1961 #5621) and correlation of two Cretaceous plutons (Ross, 1962 #1627). Beanland and Clark (1994 #103) argued that 20–30 km of dextral offset is permissible based on the data of Moore and Hopson (1961 #5621) and Ross (1962 #1627). The 1872 Owens Valley earthquake caused average dextral-normal oblique displacement of 6.1±2.1 m and maximum displacement of 11 m along the 1872 Rupture section [51b] of the Owens Valley fault zone (Beanland and Clark, 1994 #103).
Length (km)	This section is 21 km of a total fault length of 136 km.
Average strike	N2°E (for section) versus N7°W (for whole fault)
Sense of movement	Normal *Comments:* Sense of movement is not well constrained. Traces of the Keough Hot Springs section exhibit mountain-side-down (west-side-down) vertical displacement (Bateman, 1965 #5587; Envicom, 1976 #5609; 1984 #5589; Bryant, 1984 #5597; 1984

	#5598). There is probably a component of dextral strike-slip displacement.
Dip Direction	W *Comments:* Envicom (1976 #5609) reported steeply west-dipping faults in trench exposures.
Paleoseismology studies	Site 51-1: Envicom (1976 #5609) excavated three fault normal trenches across northeast-striking traces of the northern Keough Hot Springs section and exposed faulted Holocene alluvium. No paleoseismic parameters were determined from this study, other than Holocene offset.
Geomorphic expression	Traces of the Keough Hot Springs section are marked by geomorphic features indicative of Holocene displacement, such as scarps on latest Pleistocene and Holocene alluvial surfaces, linear vegetation contrasts on Holocene alluvium, beheaded drainages, ponded alluvium, and closed depressions (Bryant, 1984 #5589).
Age of faulted surficial deposits	The faults offset dissected older alluvial-fan deposits of Pleistocene age, Holocene (Recent age of Bateman, 1965 #5587) alluvial-fan and fluvial deposits (Bateman, 1965 #5587; Envicom, 1976 #5609; 1984 #5589; Bryant, 1984 #5597; 1984 #5598).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Timing of the most recent paleoevent is poorly dated. Bateman (1965 #5587) observed faults that offset latest Pleistocene to Holocene alluvium. Bryant (1984 #5589; 1984 #5597; 1984 #5598) reported linear tonal contrasts and scarps on Holocene alluvial surfaces. Envicom (1976 #5609) reported that faults offset Holocene alluvium.
Recurrence interval	
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* Keough Hot Springs section is the northern part of the Owens Valley fault zone. Therefore it is assumed that the slip rate for Keough Hot Springs section is similar to the slip rate for the

	1872 Rupture section [51b].
Date and Compiler(s)	2002 William A. Bryant, California Geological Survey Thomas L. Sawyer, Piedmont Geosciences, Inc.
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