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Johnson Valley fault zone, Southern Johnson Valley section (Class A) No. 115b

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Compiled in cooperation with the California Geological Survey

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Synopsis	**General:** Historically active dextral strike slip fault zone located in the central Mojave Desert. Fault zone in this compilation is described as two sections: Northern Johnson Valley [115a] and Southern Johnson Valley [115b] sections. Detailed reconnaissance-level geologic and geomorphic mapping exists for the fault zone (Bader and Moyle, 1960 #6644; Dibblee, 1964 #6639; Dibblee, 1967 #1342; Dibblee, 1967 #6614; Dibblee, 1967 #6657; Morton, 1980 #6636; Bryant, 1986 #6645; Manson, 1986 #6664; Bryant, 1992 #6658; Bryant, 1994 #6646). Rockwell and others (1995 #6667; 2000 #6654) reported that 5 or 6 surface

	rupturing earthquakes have occurred on the Southern Johnson Valley section in the past 25–32 k.y. Herzberg and Rockwell (1993 #6662) reported that three paleoearthquakes along the Northern Johnson Valley section were preserved in the upper 3 m of sedimentary deposits near Melville Lake. The most recent paleoevent along the Northern Johnson Valley section at the Melville Gap site [115a-1] occurred about 5.8 ? 0.3 ka (Rockwell and others, 2000 #6654). Late Pleistocene slip rate for the Johnson Valley fault zone is not known, but geomorphic expression of the fault is similar to the Homestead Valley fault [116], which has a late Pleistocene slip rate of 0.4–0.6 mm/yr (Hecker and others, 1993 #6660). Southern Johnson Valley section is characterized by a late Pleistocene (<25 k.y.) recurrence interval of 5–6 k.y. (Rockwell and others, 2000 #6654). Minor surface rupture associated with the 1979 Homestead Valley earthquake occurred along traces of the Southern Johnson Valley section (Hill and others, 1980 #3360). Up to 3 m of dextral strike-slip surface fault rupture associated with the 1992 M_w7.3 Landers earthquake occurred along traces of the southern Johnson Valley fault (Bryant, 1992 #6658; Sieh and others, 1993 #3406). **Sections:** This fault has 2 sections. In this compilation the Johnson Valley fault zone is divided into two sections based on the change in strike from N. 45? W. for the Northern Johnson Valley section to N. 5° W. for the Southern Johnson Valley section. The boundary is also delineated by the termination of surface rupture associated with the 1992 Landers earthquake. Sowers and others (1994 #6668) divided the Southern Johnson Valley section into three reaches, based on geomorphic expression.
Name comments	**General:** The Johnson Valley fault zone (which includes Upper Johnson Valley fault, West Johnson Valley, Kickapoo fault) was first mapped in part by Vaughn (1922 #5801) (central strands) and Gardner (1940 #6648) (northern strands). Dibblee (1964 #6639) first named the Johnson Valley fault. **Section:** Section name proposed in this compilation. Southern Johnson Valley fault extends from vicinity of Bodick Road near change in strike from N. 45° W. to N. 5° W. and where 1992 Landers surface rupture terminated southeast to Buena Vista Road, about 1.5 km north of the Pinto Mountain fault zone [118]. Faults that comprise the Southern Johnson Valley section include the Johnson Valley fault and several unnamed faults first mapped

	following the 1992 Landers earthquake. The Kickapoo fault, not mapped prior to the 1992 Landers earthquake, was first named by Bryant (1992 #6658) and Ponti (1993 #6666). This north-northeast striking fault was also called the Landers fault by Sieh and others (1993 #3406), but Kickapoo fault is more appropriate because it is a relatively minor fault transferring slip from the Johnson Valley fault zone to the Homestead Valley fault [116]. Also, the hypocenter for the 1992 Landers earthquake occurred on the Johnson Valley fault, so the name Landers fault implies an inaccurate association with the Landers earthquake epicenter and causative fault. **Fault ID:** Refers to number 415 (Johnson Valley fault) of Jennings (1994 #2878).
County(s) and State(s)	SAN BERNARDINO COUNTY, CALIFORNIA
Physiographic province(s)	BASIN AND RANGE PACIFIC BORDER
Reliability of location	Good Compiled at 1:62,500 scale. *Comments:* Location are based on digital revisions to Jennings (1994 #2878) using original mapping by Morton and others (1980 #6636), Manson (1986 #6664) and Bryant (1986 #6645; 1992 #6658) at 1:24,000; original mapping by Dibblee (1967 #1342; 1967 #6657) and Bader and Moyle (1960 #6644) at 1:62,500.
Geologic setting	Historically active dextral strike-slip fault zone located in the central Mojave Desert. The north to northwest-striking Johnson Valley fault zone is part of a series of subparallel dextral strike-slip faults in the central Mojave Desert. Johnson Valley fault zone is part of the Eastern California shear zone (Dokka and Travis, 1990 #3188). The Johnson Valley fault extends from the eastern flank of the Fry Mountains southeast across Johnson and Homestead valleys. These valleys are bajadas underlain by late Pleistocene and Holocene sandy granitic alluvium (Sowers and others, 1994 #6668). The Southern Johnson Valley section is located near the eastern side of the San Bernardino Mountains and extends to about 1.5 km north of the sinistral Pinto Mountain fault zone [118]. Cumulative dextral displacement along the Johnson Valley fault zone is not well constrained. Manson (1986 #6664) reported that the Johnson Valley fault may have as much as 1.6

	km of dextral slip, based on offset bedrock units mapped by Dibblee (1967 #6614) south of Melville Lake. Dokka and Travis (1990 #3188) estimated that the Lenwood fault [111], a dextral strike-slip fault just west of the Johnson Valley fault, has cumulative dextral slip of about 1.5 km.
Length (km)	This section is 24 km of a total fault length of 51 km.
Average strike	N10°E
Sense of movement	Right lateral *Comments:* Fault zone is delineated by moderately to locally well defined geomorphic evidence of dextral strike-slip displacement, although minor vertical components of displacement locally exist (Morton and others, 1980 #6636; Bryant, 1986 #6645; Manson, 1986 #6664; 1992 #6658). Surface fault rupture associated with the 1992 Landers earthquake was predominantly dextral strike slip (Hart and others, 1993 #3356; Sieh and others, 1993 #3406; Hauksson and others, 1993 #6649).
Dip	70° W. to vertical *Comments:* Focal mechanisms reported for 1992 Landers earthquake documented dextral strike-slip along a 70° W. (Dziewonski and others, 1993 #6659) to 90° (Hauksson and others, 1993 #6649) dipping fault. Trench exposures across the Kickapoo fault reported by Murbach (1994 #6665) show steeply dipping to vertical faults. Trench exposures across traces of the Johnson Valley fault reported by Rockwell and others (1995 #6667) show generally steeply dipping to vertical faults.
Paleoseismology studies	Site 115-2 by Lindvall and Rockwell (1993 #6663) and Rockwell and others (1995 #6667; 2000 #6654) involved the excavation of five trenches across a west-facing scarp delineating the Johnson Valley fault at the Hondo site in the Flamingo Heights area. Thermoluminescence and infrared-optically stimulated luminescence ages of scarp-derived colluvial wedges constrained the age of the penultimate event. Rockwell and others (1995 #6667) reported that 5 or 6 events have occurred in the past 25–32 k.y. Rockwell and others (2000 #6654) interpreted five events in the past 25 k.y. Site 115-3 by Murbach (1994 #6665) involved the excavation and detailed logging of six fault-normal trenches across traces of the

	Kickapoo fault that ruptured in the 1992 Landers earthquake in order to understand rupture propagation through unconsolidated and poorly consolidated, poorly stratified alluvium. Murbach (1994 #6665) reported that it often was difficult to identify rupture surfaces in the poorly stratified to massive granular deposits. Site 115-4 by Murbach (1994 #6665) and Rockwell and others (2000 #6654) involved the excavation of one fault-normal trench across the southern traces of the Kickapoo fault that ruptured in the 1992 Landers earthquake at the Batdorf site. Trench 5 exposed a 12-m-wide fault zone that offsets late Pleistocene and Holocene debris-flow and fluvial deposits. Evidence of two earthquakes prior to the 1992 Landers earthquake were observed. Site 115-5 by Rockwell and others (1995 #6667; 2000 #6654) involved the excavation of two fault-normal trenches across the Kickapoo fault at the Bodick Road site. One trench exposed structural and stratigraphic evidence of at least 3 faulting events. Thermoluminescence and infrared-optically stimulated luminescence ages of scarp-derived colluvial wedges and sedimentary deposits constrained the ages of the penultimate and pre-penultimate events.
Geomorphic expression	Strands of the Johnson Valley fault (pre-1992 Landers earthquake) that comprise the Southern Johnson Valley section are delineated by moderately defined geomorphic features that are indicative of latest Pleistocene and possible Holocene dextral strike-slip displacement such as a dissected west-facing scarp in late Pleistocene alluvium, ponded alluvium, dextrally deflected and constricted drainages, a linear trough in Pleistocene alluvium, linear alignment of Pleistocene tufa deposits (Bryant, 1986 #6645; 1992 #6658; Sowers and others, 1994 #6668). The Kickapoo fault is delineated by moderately defined, discontinuous and eroded scarps and truncated Pleistocene alluvium, and faint vegetation lineaments (Bryant, 1992 #6658; Sowers and others, 1994 #6668).
Age of faulted surficial deposits	Fault offsets latest Pleistocene alluvial fan deposits (latest Pleistocene age based on soil-profile development, T. Rockwell, personal communication in Sowers and others, 1994 #6668).
Historic earthquake	

Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* The most recent paleoevent along the Southern Johnson Valley section (Johnson Valley fault) occurred 4–6 ka, based on thermoluminescence and infrared-optically stimulated luminescence ages derived from scarp-derived colluvial wedges (Rockwell and others, 1995 #6667). Rockwell and others (2000 #6654) determined that the penultimate event at the Hondo site (site 115-3) occurred about 4.7±0.7 k.y. ago, based on thermoluminescence and photon-induced luminescence dating of fault-derived colluvial wedge. The most recent paleoevent on the Kickapoo fault occurred about 5.3±0.5k.y. ago, based on relations observed in trench exposures at the Bodick Road site (site 115-5) (Rockwell and others, 1995 #6667; 2000 #6654).
Recurrence interval	*Comments:* Rockwell and others (1995 #6667) reported that the Southern Johnson Valley section has had 3 or 4 1992-Landers earthquake-sized events in the past 15.5–18 k.y. and 5 or 6 events in the past 25–30 k.y. Rockwell and others (2000 #6654) interpreted five Landers-type events in the past 25 k.y., based on the assumption that each event had similar amount of vertical separation. This suggests a long-term average return time of about 5–6 k.y.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Hecker and others (1993 #6660) reported a late Pleistocene rate of 0.4–0.6 mm/yr for the Homestead Valley fault [116]. The geomorphic expression of the Johnson Valley fault zone is similar to the Homestead Valley fault and it is assumed that the late Pleistocene slip rate is similar. Slip rate assigned by Petersen and others (1996 #4860) for probabilistic seismic hazard assessment for the State of California was 0.6 mm/yr (with minimum and maximum assigned slip rates of 0.2 mm/yr and 1.0 mm/yr, respectively.
Date and Compiler(s)	2000 William A. Bryant, California Geological Survey
References	#6644 Bader, J.S., and Moyle, W.R., 1960, Data on water wells and springs in the Yucca Valley-Twentynine Palms area, San Bernardino and Riverside Counties, California: California Department of Water Resources Bulletin 91-2, 163 p., scale 1:62,500.

#6645 Bryant, W.A., 1986, Pinto Mountain, Mesquite Lake, Copper Mountain, and related faults, San Bernardino County, California: California Division of Mines and Geology Fault Evaluation Report, FER-181 (microfiche copy in California Division of Mines and Geology Open-File Report 90-14), scale 1:24,000.

#6658 Bryant, W.A., 1992, Surface fault rupture along the Johnson Valley, Homestead Valley, and related faults associated with the Ms 7.5 28 June 1992 Landers earthquake: California Department of Conservation, Division of Mines and Geology Fault Evaluation Report FER-234, 21 p., scale 1:24,000.

#6646 Bryant, W.A., 1994, Surface fault rupture along the Homestead Valley, Emerson, and related faults associated with the Mw 7.3 28 June 1992 Landers earthquake: California Department of Conservation, Division of Mines and Geology Fault Evaluation Report FER-239, 18 p., scale 1:24,000.

#6639 Dibblee, T.W., Jr., 1964, Geologic map of the Rodman Mountains quadrangle, San Bernardino County, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-430, scale 1:62,500.

#1342 Dibblee, T.W., Jr., 1967, Geologic map of the Joshua Tree quadrangle, San Bernardino and Riverside Counties, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-516, 3 p. pamphlet, 1 sheet, scale 1:62,500.

#6614 Dibblee, T.W., Jr., 1967, Geologic map of the Old Woman Springs quadrangle, San Bernardino County, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-518, scale 1:62,500.

#6657 Dibblee, T.W., Jr., 1967, Geologic map of the Emerson Lake quadrangle, San Bernardino County, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-490, scale 1:62,500.

#3188 Dokka, R.K., and Travis, C.J., 1990, Late Cenozoic strike-slip faulting in the Mojave Desert, California: Tectonics, v. 9, p. 311-340.

#6659 Dziewonski, A.M., Ekstrom, G., and Salganick, M.P., 1993, Centroid moment tensor solutions for April-June 1992: Physical Earth Planet Interiors, v. 77, p. 151-163.

#6648 Gardner, D.L., 1940, Geology of the Newberry and Ord Mountains, San Bernardino County, California: California Journal of Mines and Geology, v. 36, no. 3, p. 257-292, 1 pl., scale approximately 1:250,000.

#3356 Hart, E.A., Bryant, W.A., and Treiman, J.A., 1993, Surface faulting associated with the June 1992 Landers earthquake, California: California Geology, v. 46, p. 10-16.

#6649 Hauksson, E., Jones, L.M., Hutton, K., and Eberhart-Phillips, D., 1993, The 1992 Landers earthquake sequence: Seismological observations: Journal of Geophysical Research, v. 98, no. B11, p. 19,835-19,858.

#6660 Hecker, S., Fumal, T.E., Powers, T.J., Hamilton, J.C., Garvin, C.D., Schwartz, D.P., and Cinti, F.R., 1993, Late Pleistocene-Holocene behavior of the Homestead Valley fault segment—1992 Landers, CA surface rupture [abs.]: Eos, Transactions of the American Geophysical Union, v. 74, no. 43, p. 612.

#6662 Herzberg, M., and Rockwell, R., 1993, Timing of past earthquakes on the northern Johnson Valley fault and their relationship to the 1992 rupture [abs.]: EOS, Transactions of the American Geophysical Union, v. 74, no. 43, p. 612.

#3360 Hill, D.P., Treiman, J.A., Given, J.W., Pechman, J.C., McMillan, J.R., and Ebel, J.E., 1980, Geologic study of the Homestead Valley earthquake swarm of March 15, 1979: California Geology, v. 33, p. 60-67.

#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.

#6663 Lindvall, S.C., and Rockwell, T.K., 1993, Recurrent Holocene faulting along the Johnson Valley portion of the 1992 Landers earthquake surface rupture [abs.]: Geological Society of America Abstracts with Programs, v. 25, no. 5, p. 70.

#6664 Manson, M.W., 1986, Homestead Valley fault, Johnson Valley fault, and associated faults, San Bernardino County, California: California Division of Mines and Geology Fault Evaluation Report FER-180, microfiche copy in California Division of Mines and Geology Open-File Report 90-14, scale 1:24,000.

#6636 Morton, D.M., Miller, F.K., and Smith, C.C., 1980, Photoreconnaissance maps showing young-looking fault features in the southern Mojave Desert, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1051, 7sheets, scale 1:24,000 and 1:62,500.

#6665 Murbach, D., 1994, Characteristics of the 1992 fault rupture adjacent to distressed structures, Landers, California: Earthquake Engineering Research Institute, 1994 NEHRP Professional Fellowship Report, 73 p., 1 appendix.

#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.