Jump to Navigation

Quaternary Fault and Fold Database of the United States

As of January 12, 2017, the USGS maintains a limited number of metadata fields that characterize the Quaternary faults and folds of the United States. For the most up-to-date information, please refer to the interactive fault map.

Imperial fault (Class A) No. 132

Last Review Date: 1999-04-01

citation for this record: **Treiman, J.A., compiler, 1999, Fault number 132, Imperial fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, https://earthquakes.usgs.gov/hazards/qfaults, accessed 12/14/2020 02:15 PM.**

Synopsis	The Imperial fault is probably the main element of the San Andreas fault system in the southern Salton Trough, accommodating slip from both the San Andreas [1] and San Jacinto [125] fault zones. However slip-rate studies based on historic earthquakes show that the recent slip in the past 300–550 yr (Thomas and Rockwell, 1996 #6506) is not sufficient to account for the total slip within the San Andreas system. Studies, thus far, reveal only the past 500 yr of surface rupture history in the vicinity of the international border. The surface trace is well-located based on historic surface rupture.
Name comments	Imperial fault was named by Buwalda and Richter (1941 #6497). Imperial fault considered by Sharp (1972 #6504) to be part of the San Jacinto fault zone, but Working Group on California Earthquake Probabilities (1995 #4945) and Petersen and others (1996 #4860) consider it separate, largely because of relation to San Andreas fault zone [1] through the Brawley Seismic Zone

	[124]. **Fault ID:** Refers to numbers 509 (Imperial fault) and 518 (Imperial fault, Baja California) of Jennings (1994 #2878).
County(s) and State(s)	IMPERIAL COUNTY, CALIFORNIA
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Fault location from Official Earthquake Fault Zone maps by California Division of Mines and Geology at a scale of 1:24,000 (Division of Mines and Geology, 1990 #6498; Division of Mines and Geology, 1990 #6499; Division of Mines and Geology, 1990 #6500; Division of Mines and Geology, 1990 #6501; Division of Mines and Geology, 1990 #6358).
Geologic setting	A dominantly dextral strike-slip fault zone, the Imperial fault is the principal element of the San Andreas fault system in the southern Salton trough. There have been at least two coseismic surface ruptures in this century (1940 Mw6.9 and 1979 Mw6.5 Imperial Valley earthquakes). Data from these events suggest a horizontal displacement rate of 15–20 mm/yr for the latest Holocene. Slip is transferred north to the San Andreas fault through the Brawley Seismic Zone [124] and some slip may also be transferred to the San Jacinto fault zone [125], to the south slip is apparently transferred to the Cerro Prieto fault in Baja California. Right steps to the San Andreas [1] and Cerro Prieto faults are probably related to offset spreading centers (Elders and others, 1972 #6356; Fuis and Kohler, 1984 #6359). Local vertical component associated with subsidence of a block northeast of the Imperial fault and west of Brawley fault zone [124] at the location of Mesquite Lake (Johnson and Hadley, 1976 #6362).
Length (km)	46 km.
Average strike	N29°W
Sense of movement	Right lateral *Comments:* Imperial fault is principally dextral strike-slip.

Dip Direction	V
Paleoseismology studies	Site 132-1, All American Canal: trench examined 1940 rupture and evidence for penultimate event attributed to Sharp (1978 #6505) as cited by Clark and others (1984 #2876). Site 132-2, U.S.-Mexico Border: trenches examined 1940 rupture and evidence for penultimate event (Thomas and Rockwell, 1996 #6506).
Geomorphic expression	Scarps, linear vegetation contrasts in Holocene alluvium.
Age of faulted surficial deposits	Fault offsets Historic alluvium and lacustrine deposits; cultural features.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Most recent faulting event is documented by studies near U.S.-Mexico border—pre-historic event about 1670 AD (Thomas and Rockwell, 1996 #6506). Sharp (1978 #6505) saw no evidence for rupture for at least 900–1000 yr prior to 1940 (700 yr as cited by Clark and others, 1984 #2876), but this timeframe is poorly constrained. Historical rupture occurred in 1940 and 1979 (north of the border only) and possibly in 1915 (Toppozada and Parke, 1982 #6507).
Recurrence interval	*Comments:* 40-yr recurrence interval is for 1979-style event on the northern part of the fault zone (Working Group on California Earthquake Probabilities, 1995 #4945); 32±10 yr (Sykes and Nishenko, 1984 #5794) based on 1940 and 1979 events and inferred 1915 rupture. Wesnousky (1986 #5305) uses 32 yr for a 1979-style event and 700 yr for a 1940-style event; Petersen and others (1996 #4860) use 79-yr recurrence. Thomas and Rockwell (1996 #6506) cite some evidence to suggest 270-yr recurrence for 1940-style events, but also suggest that clustering of slip events may complicate estimation of recurrence based on the brief record available. King and Thatcher (1998 #6503) propose recurrence intervals of 40, 137, and 37 yr, respectively, for their northern, central and southern segments of the fault.

Slip-rate category	Greater than 5.0 mm/yr *Comments:* 30 mm/yr adopted by Working Group on California Earthquake Probabilities (1995 #4945); 15-20 mm/yr over the past 300–550 yr determined by Thomas and Rockwell (1996 #6506)—this rate is less than the inferred rate of 35–40 mm/yr (from various sources as cited by Thomas and Rockwell, 1996 #6506) that assumes that slip on the San Andreas [1] and San Jacinto [125] fault zones is combined onto the Imperial fault at the international border. Based on GPS geodetic data, Bennett and others (1996 #6355) suggest a rate of 35±2 mm/yr that may include slip on other unmapped faults. Slip rate assigned by Petersen and others (1996 #4860) for probabilistic seismic hazard assessment for the State of California was 20±5 mm/yr.
Date and Compiler(s)	1999 Jerome A. Treiman, California Geological Survey
References	#6355 Bennett, R.A., Rodi, W., and Reilinger, R.E., 1996, Global positioning system constraints on fault slip rates in Southern California and northern Baja, Mexico: Journal of Geophysical Research, v. 101, no. B10, p. 21,943-21,960. #6497 Buwalda, J.P., and Richter, C.F., 1941, Imperial Valley earthquake of May 18, 1940: Geological Society of America Bulletin, v. 52, no. 12, p. 1944-1945. #2876 Clark, M.M., Harms, K.H., Lienkaemper, J.J., Harwood, D.S., Lajoie, K.R., Matti, J.C., Perkins, J.A., Rymer, M.J., Sarna-Wojcicki, A.M., Sharp, R.V., Sims, J.D., Tinsley, J.C., III, and Ziony, J.I., 1984, Preliminary slip rate table and map of late Quaternary faults of California: U.S. Geological Survey Open-File Report 84-106, 12 p., 5 plates, scale 1:1,000,000. #6500 Division of Mines and Geology, 199, Official map of Earthquake Fault Zones, Calexico quadrangle: California Department of Conservation, Division of Mines and Geology, scale 1:24,000. #6358 Division of Mines and Geology, 1990, Official map of earthquake fault zones, Holtville West quadrangle: California Department of Conservation, Division of Mines and Geology, scale 1:24,000. #6498 Division of Mines and Geology, 1990, Official map of

Earthquake Fault Zones, Bonds Corner quadrangle: California Department of Conservation, Division of Mines and Geology, scale 1:24,000.

#6499 Division of Mines and Geology, 1990, Official map of Earthquake Fault Zones, Brawley quadrangle: California Department of Conservation, Division of Mines and Geology, scale 1:24,000.

#6501 Division of Mines and Geology, 1990, Official map of Earthquake Fault Zones, El Centro quadrangle: California Department of Conservation, Division of Mines and Geology, scale 1:24,000.

#6356 Elders, W.A., Rex, R.W., Meidav, T., Robinson, P.T., and Biehler, S., 1972, Crustal spreading in southern California: Science, v. 178, p. 15-24.

#6359 Fuis, G.S., and Kohler, W.M., 1984, Crustal structure and tectonics of the Imperial Valley region, California, *in* Rigsby, C.A., ed., The Imperial Basin—Tectonics, sedimentation and thermal aspects: Society of Economic Paleontologists and Mineralogists, Pacific Section, Annual Meeting, field trip guidebook, v. 40, p. 1-13.

#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.

#6362 Johnson, C.E., and Hadley, D.M., 1976, Tectonic implications of the Brawley earthquake swarm, Imperial Valley, California: Bulletin of the Seismological Society of America, v. 66, p. 1133-1144.

#6503 King, N.E., and Thatcher, W.R., 1998, The coseismic slip distribution of the 1940 and 1979 Imperial Valley, California, earthquakes and their implications: Journal of Geophysical Research, v. 103, no. B8, p. 18,069-18,086.

#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.

#6504 Sharp, R.V., 1972, Tectonic setting of the Salton Trough, *in* The Borrego Mountain earthquake of April 9, 1968: U.S. Geological Survey Professional Paper 787, p. 3-15.

#6505 Sharp, R.V., 1978, Salton trough tectonics: U.S. Geological Survey, Summaries of Technical Reports, National Earthquake Hazards Reduction Program, v. 5, p. 40-42.

#5794 Sykes, L.R., and Nishenko, S.P., 1984, Probabilities of occurrence of large plate rupturing earthquakes for the San Andreas, San Jacinto, and Imperial faults, California: Journal of Geophysical Research, v. 89, no. B7, p. 5905-5927.

#6506 Thomas, A.P., and Rockwell, T.R., 1996, A 300- to 550-year history of slip on the Imperial fault near the U.S.-Mexico border-Missing slip at the Imperial fault bottleneck.: Journal of Geophysical Research, v. 101, no. B3, p. 5,987-5,997.

#6507 Toppozada, T.R., and Parke, D.L., 1982, Areas damaged by California earthquakes, 1900-1949: California Division of Mines and Geology Open-File Report 82-17, 65 p.

#5305 Wesnousky, S.G., 1986, Earthquakes, Quaternary faults, and seismic hazards in California: Journal of Geophysical Research, v. 91, no. B12, p. 12,587-12,631.

#4945 Working Group on California Earthquake Probabilities, 1995, Seismic hazards in southern California—Probable earthquakes, 1994 to 2024: Bulletin of the Seismological Society of America, v. 85, no. 2, p. 379-439.