

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](#).

Gillem-Big Crack fault system (Class A) No. 3

Last Review Date: 2000-04-07

Compiled in cooperation with the California Geological Survey

citation for this record: Bryant, W.A., compiler, 2000, Fault number 3, Gillem-Big Crack fault system, 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 02:52 PM.

Synopsis	North-trending system of down-to-east normal faults that offset late Pleistocene volcanic rocks in and north of Lava Beds National Monument. Holocene faulting has not been demonstrated (Bryant, 1990 #5094). Detailed mapping within Lava Beds National Monument by Donnelly-Nolan and Champion (1987 #5095) is at 1:24,000 scale; in areas to the west and east reconnaissance mapping is at 1:62,500 scale (Bryant, 1990 #5094). Detailed paleoseismic studies have not been done. Bryant (1990 #5094) estimated a late Pleistocene slip rate of 0.15 to 0.38 mm/yr for the Gillem fault.
Name	Gillem-Big Crack fault system consists of several generally east-

comments	<p>dipping normal faults. The Gillem fault is the principal stand of this system and was first mapped by Gay and Aune (1958 #4890) and first named by Donnelly-Nolan and Champion (1987 #5095). The Big Crack fault, which is located east of the Gillem fault, was first mapped by Gay and Aune (1958 #4890). Additional faults west of but structurally related to the Gillem fault include the Fleener Place and Crumbs Lake faults, which were first mapped by Gay and Aune (1958 #4890) and named by Bryant (1990 #5094).</p> <p>Fault ID: Refers to numbers 5 (Gillem fault) and 6 (Big Crack fault) of Jennings (1994 #2878), and number NE03 (Gillem-Big Crack) of Working Group on Northern California Earthquake Potential (1996 #1216).</p>
County(s) and State(s)	<p>MODOC COUNTY, CALIFORNIA SISKIYOU COUNTY, CALIFORNIA</p>
Physiographic province(s)	<p>BASIN AND RANGE CASCADE-SIERRA MOUNTAINS</p>
Reliability of location	<p>Good Compiled at 1:250,000 scale.</p> <p><i>Comments:</i> Based on digital revisions to Jennings (1994 #2878) using original mapping by Donnelly-Nolan and Champion (1987 #5095) at 1:24,000, Gay and Aune (1958 #4890) at 1:250,000, and Bryant (1990 #5094) at 1:62,500.</p>
Geologic setting	<p>The Gillem-Big Crack fault system is a 30-km-long and approximately 15-km-wide zone of north-striking extensional faults in the Modoc Plateau geomorphic province. The fault system extends from about 3 km south of the Oregon border south to the northern flank of Medicine Lake volcano. Cumulative vertical displacement is not know, but the east-facing bedrock escarpment delineating the northern Gillem fault is about 295 m high, indicating a minimum of 295 m of post late Tertiary displacement (Bryant, 1990 #5094). A southern strand of the Gillem fault offsets 40-ka to 100-ka Mammoth Crater Basalt about 15 m.</p>
Length (km)	<p>36 km.</p>
Average strike	<p>N5°W</p>
Sense of	<p>Normal</p>

movement	<i>Comments:</i> The Gillem, Fleener Place, and Crumbs Lake faults exhibit classic features of a titled normal fault block (Bryant, 1990 #5094).
Dip	50°-70° E. <i>Comments:</i> Unknown, presumed to be 50?-70? E.
Paleoseismology studies	
Geomorphic expression	The Gillem-Big Crack fault system locally is delineated by geomorphic features indicative of late Pleistocene normal faulting, principally prominent east-facing scarps on late Tertiary and Quaternary volcanic bedrock (Donnelly-Nolan and Champion, 1987 #5095; Bryant, 1990 #5094). The Gillem fault bounds the eastern side of a west-tilted fault block. North of Lava Beds National Monument the Gillem fault lacks geomorphic evidence of recent faulting, but within Lava Beds National Monument the fault is delineated by east-facing scarps locally as high as 15m on late Pleistocene Mammoth Crater basalt (Donnelly-Nolan and Champion, 1987 #5095; Bryant, 1990 #5094). A younger flow unit within the Mammoth Crater basalt flowed across the 15-m-high scarp with minimal to no vertical displacement. Early Holocene Devils Homestead basalt (Donnelly-Nolan and Champion, 1987 #5095) erupted along and locally conceals the Gillem fault (Bryant, 1990 #5094). The Crumbs Lake and Fleener Place faults are delineated by geomorphic features indicative of late Pleistocene normal faulting. Closed depressions and ponded alluvium may be associated with these normal faults, but other constructional volcanic features make this a tenuous association. The Big Crack fault is characterized predominantly by extensional displacement and is delineated by linear, unfilled fissures (Bryant, 1990 #5094).
Age of faulted surficial deposits	The Gillem fault offsets the Mammoth Crater basalt, a volcanic unit that is magnetically normal (<730 ka) but that is overlain by a gravel unit interpreted to be an age equivalent to late Tioga outwash (about 13 ka, Sierra Nevada glacial stage) (Donnelly-Nolan and Champion, 1987 #5095). Donnelly-Nolan and Champion (1987 #5095) prefer an age of 40 ka for the Mammoth Crater basalt. The Gillem fault does not offset the Devils Homestead basalt, which is thought to be approximately 10.5 ka,

	based on paleomagnetic direction that is identical to a basalt flow that has a radiocarbon age of 10.2±0.1 ka (Donnelly-Nolan and Champion, 1987 #5095).
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) <i>Comments:</i> The most recent paleoevent is not dated. The Gillem fault offsets Mammoth Crater basalt as much as 15 m, but a younger flow unit within the Mammoth Crater basalt has flowed across the scarp with no discernible offset (Bryant, 1990 #5094). The Devils Homestead basalt (10.2±0.1 ka, Donnelly-Nolan and Champion, 1987 #5095) has erupted along the Gillem fault and locally conceals traces of the Gillem fault, suggesting that displacement along the Gillem fault probably has not occurred in Holocene time (Bryant, 1990 #5094).
Recurrence interval	
Slip-rate category	Between 0.2 and 1.0 mm/yr <i>Comments:</i> Bryant (1990 #5094) estimated that the Gillem fault is characterized by a slip rate of 0.15 to 0.38 mm/yr based on the 15-m-high scarp on Mammoth Crater basalt. Time of offset is assumed to have occurred between 100 ka and 40 ka, based on age estimates of offset and unfaulted basalts (respectively) by Donnelly-Nolan and Champion (1987 #5095).
Date and Compiler(s)	2000 William A. Bryant, California Geological Survey
References	#5094 Bryant, W.A., 1990, Gillem, Big Crack, and related faults, western Modoc and eastern Siskiyou Counties: California Department of Conservation, Division of Mines and Geology Fault Evaluation Report 224. #5095 Donnelly-Nolan, J.M., and Champion, D.E., 1987, Geologic map of Lava Beds National Monument, northern California: U.S. Geological Survey Miscellaneous Investigations Series Map I-1804, 1 sheet, scale 1:24,000. #4890 Gay, T.E., and Aune, Q.A., 1958, Alturas Sheet: California Division of Mines and Geology Geologic Atlas of California, GAM001, scale 1:250,000.

#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.

#1216 Working Group on Northern California Earthquake Potential (WGNCEP), 1996, Database of potential sources for earthquakes larger than magnitude 6 in northern California: U.S. Geological Survey Open-File Report 96-705, 40 p.

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