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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.

Black Mesa fault zone (Class A) No. 2006

Last Review Date: 2015-09-14

Compiled in cooperation with the New Mexico Bureau of Geology & Mineral Resources

citation for this record: **Kelson, K.I., and Koning, D.J., compilers, 2015, Fault number 2006, Black Mesa fault zone, 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 02:23 PM.**

Synopsis	The Black Mesa fault zone is comprised mainly of a northeast-striking, down-to-the-southeast normal fault (herein referred to as the west Black Mesa fault) that displaces Pliocene basalts along the western side of Black Mesa. It coincides with the western boundary of the Velarde graben and was more active 9–20 (?) Ma than since 9 Ma (Koning and others, 2013 #7265). Other faults included in the larger fault zone are found at the north end of Black Mesa, where west-down and east-down faults 1–3 km long bracket the northern tip of the Velarde graben (sensu Koning and others, 2004 #7546). No evidence of younger displacement has been observed because there is no local record of Quaternary deposition aside from latest Quaternary eolian sand sheets, which

	are not offset. Late Quaternary graben-fill deposits may possibly be present within fault zone on the surface of Black Mesa. Access to the fault zone is limited.
Name comments	Faults within the Black Mesa fault zone were mapped but not named by Kelley (1978 #1107), Machette and Personius (1984 #1113), and Personius and Machette (1984 #1124). Wong and others (1995 #1155) refer to the fault zone as "Faults of Black Mesa". Herein the name has been simplified to the "Black Mesa fault zone," after the prominent mesa that is crossed by the faults directly north of the confluence of the Rio Grande and the Rio Chama. Koning and others (2013 #7265) apply the name "Black Mesa fault" just to the aforementioned west Black Mesa fault. The west Black Mesa fault, which forms the prominent east-down scarp near the west side of the mesa, can be mapped 5 km beyond the north edge of the mesa to a point 8 km southeast of the town of Ojo Caliente (Koning and Aby, 2003 #7544). No outcrop evidence for faulting is found south of Vallito Peak, located 10 km west-southwest of the town of Velarde. The west Black Mesa fault coincides with a major east-down gravity gradient (Ferguson and others, 1995 #1158; Koning and others, 2004 #7546), and this gradient continues south of Vallito Peak to the southern end of Black Mesa. Koning and others (2013 #7265) continues the Black Mesa fault as a concealed, east-down fault to the north end of the Santa Clara fault zone.
County(s) and State(s)	RIO ARRIBA COUNTY, NEW MEXICO
Physiographic province(s)	SOUTHERN ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:250,000 scale. *Comments:* Fault location is based on field mapping compiled at scale of 1:125,000 by Kelley (1978 #1107), modified at a scale of 1:250,000 by Machette and Personius (1984 #1113) and Wong and others (1995 #1155).
Geologic setting	The Black Mesa fault zone is directly related to the Velarde graben of Koning and others (2004 #7546), which underlies Black Mesa and the adjoining Rio Grande valley to the east. The west Black Mesa fault coincides with the western margin of the Velarde graben, whereas the Velarde fault (part of the southern

	Embudo fault system) is interpreted to bound the east side of the Velarde graben (Koning and others, 2013 #7265). This graben and adjoining faults are a major component of the accommodation zone between the east-tilted San Luis basin and the west-tilted Española basin of the northern Rio Grande rift (Manley, 1979 #1117; Koning and others, 2004 #7546). In contrast to north-striking faults within the San Luis basin to the north and the Española basin to the south, the Black Mesa fault zone strikes northeast and is subparallel to the southern Embudo fault [2007]. Most of the total throw (1500–2000 m) across the Black Mesa fault occurred prior to 9 Ma (Koning and others 2013 #7265)
Length (km)	18 km.
Average strike	N39°E
Sense of movement	Normal *Comments:* Koning and others (2004 #7546)
Dip Direction	NW; SE *Comments:* Surface and subsurface data are lacking for this fault zone. Linear traces of the faults across substantial topographic relief suggest near-vertical dips at the ground surface. It is uncertain which border fault, if any, may be a master fault at depth.
Paleoseismology studies	
Geomorphic expression	Prominent southwest- and northeast-facing topographic scarps are present across basalt flows that form Black Mesa. Wong and others (1995 #1155) report the presence of a 19-m-high scarp on 3.65 Ma basalt on Black Mesa and that the cumulative total of scarp heights across the zone regardless of sense (both NW and SE facing) is about 52 m. Koning and others (2004 #7546) report that the west Black Mesa fault has vertically offset the capping Servilleta Basalt by 18–40 m. These values were estimated from topographic maps with 20 ft (6 m) contours, and thus are poorly constrained. The fault zone has little or no geomorphic expression where fault traces cross easily eroded Tertiary rift-fill deposits north and south of Black Mesa, suggesting a lack of recency of movement.

Age of faulted surficial deposits	The Black Mesa fault zone displaces basalt dated at 3.65 Ma by Laughlin and others (1993 #1782), which were previously dated at 2.78 Ma by Manley (1976 #1115). No evidence of younger displacement was reported by Wong and others (1995 #1155) because of lack of Quaternary surficial deposits. However, possible late Quaternary graben-fill deposits may be present within the fault zone on Black Mesa surface.
Historic earthquake	
Most recent prehistoric deformation	undifferentiated Quaternary (<1.6 Ma) *Comments:* Timing of the most-recent event is unknown. The temporal distribution of that slip is not known, but 18–40 m of vertical movement occurred after emplacement of the 3.65 Ma Servilleta Basalt. Based on the new Plio-Pleistocene boundary value of 2.6 Ma, it is likely that the fault moved during the Pleistocene.
Recurrence interval	 *Comments:* No paleoseismologic data are available.
Slip-rate category	Less than 0.2 mm/yr *Comments:* Wong and others (1995 #1155) considered a range in slip rate of 0.01 to 0.21 mm/yr, based on analysis of rates throughout the Rio Grande rift; however, they used a preferred value of 0.02 mm/yr. The preferred value seems reasonable based on scarp height data presented in Wong and others (1995 #1155). Thus, we categorize the fault zone as having a slip rate less than 0.2 mm/yr. Koning and others (2013 # 7265) Provide long-term vertical-displacement rates on the Black Mesa fault after 3.5–3.8 Ma of 9–11 m/m.y.; slightly more than rates between 3.5 and 10 Ma of 3–7 m/m.y.
Date and Compiler(s)	2015 Keith I. Kelson, William Lettis & Associates, Inc. Daniel J. Koning, New Mexico Bureau of Geology & Mineral Resources
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