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Quaternary Fault and Fold Database of the United States

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La Jencia fault, northern section (Class A) No. 2109a

Last Review Date: 2016-03-14

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

citation for this record: **Machette, M.N., Chamberlin, R.M., and Jochems, A.P., compilers, 2016, Fault number 2109a, La Jencia fault, northern section, 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 02:21 PM.**

Synopsis	**General:** The La Jencia fault is one of a dozen or so faults in the Rio Grande rift that have been investigated in detail. The fault's trace was mapped in detail, more than 50 scarp profiles were measured to document offset and scarp morphology, and four trenches were excavated in the late 1970s to help document the fault's chronology. No radiometric dating was performed, but detailed analyses of soil development were used to estimate times of movement and suggest a segmentation scheme for the fault. New dating techniques such as AMS radiocarbon or luminescence

	could be used to refine the fault's chronology. **Sections:** This fault has 2 sections. This 32-km-long fault was previously divided into 6 segments on the basis of apparent timing of movement. However, these short segments (3–8 km long) probably do not reflect truly independent rupture segments. Therefore, for descriptive purposes, the segments are combined into two sections herein strictly on a geometric basis, the northern section trending north from U.S. Highway 60 and the southern section trending southeast and south from U.S. Highway 60.
Name comments	**General:** First recognized as a young range-bounding fault by Kirk Bryan in 1933 (cited on p. 73 in Loughlin and Koschmann, 1942 #1273), it was shown in a general manner and named the Magdalena fault by Kelley (1954 #1222). It was not mapped in detail until the late 1970s (Machette, 1978 #1223). Machette (Machette and McGimsey, 1983 #1024) renamed it for La Jencia Creek, a stream that drains La Jencia basin, the northern part of the Magdalena Mountains, and the southern part of the Bear Mountains, northwest of Socorro. The fault extends south from a point about 2 km south of Bear Springs Canyon (Sec. 20, T. 1 S., R. 3 W.) and crosses U.S. Highway 60 about 7 km east of Magdalena. The fault can be traced south along the mountain front and associated piedmont to Six Mile Canyon, a distance of 32 km. **Section:** Includes segments D, E, and F of Machette (1988 #1221). This section extends from a point about 2 km south of Bear Springs Canyon (Sec. 20, T. 1 S., R. 3 W.) south to U.S. Highway 60, about 7 km east of Magdalena. **Fault ID:** Fault number 12 of Machette (1982 #1401) and fault number 11 of Machette and McGimsey (1983 #1024).
County(s) and State(s)	SOCORRO COUNTY, NEW MEXICO
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Trace from 1:24,000-scale geologic mapping by Chamberlin and others (2008 #7481) coupled with accurate placement using photogrammetric methods. Older maps show the

	fault at scales of 1:48,000 (Machette, 1988 #1221), 1:187,500 (Kelley, 1954 #1222), and 1:250,000 (Machette and McGimsey, 1983 #1024).
Geologic setting	La Jencia fault bounds the eastern margin of the strongly uplifted and west-tilted Magdalena Mountains and the more subdued Bear Mountains (to the north). Both ranges have embayed range-fronts, suggesting a lack of significant Quaternary faulting. However, La Jencia fault forms the tectonic margin between the mountains to the west and the Cenozoic La Jencia basin to the east. The basin probably has a half-graben geometry, with the eastern part formed by west-dipping rocks of the Socorro and Lemitar Mountains. The Magdalena Mountains are comprised of Precambrian rocks, with an overlying (eroded) section of Paleozoic sedimentary rocks and a thick sequence of intracaldera ignimbrites and volcaniclastic rocks. The Bear Mountains are of similar composition (outflow ignimbrites), but are not so strongly uplifted. Late Cenozoic (<26 Ma) uplift across the La Jencia fault probably exceeds 1,000 m, and may be as much as 1,500 m locally (Machette, 1988 #1221). Chamberlin and Love (2016 #7482, fig.9) estimate as much as 2 km of post-6 Ma throw on the La Jencia fault east of the Bear Mountains.
Length (km)	This section is 14 km of a total fault length of 32 km.
Average strike	N6°E (for section) versus N19°W (for whole fault)
Sense of movement	Normal *Comments:* From trenching and geomorphic relations, Machette (1988 #1221) inferred primarily normal dip-slip movement at the surface.
Dip	70° E to vertical *Comments:* Machette (1988 #1221) showed typical dip angles of 70° E to vertical, all within 3–4 m of the surface. Owing to the strongly backtilted nature of the adjacent ranges, the fault may have a considerably shallower dip in the subsurface.
Paleoseismology studies	Machette (1988 #1221) published a detailed study of the fault that was based on a comprehensive analysis of scarp morphology, soil development, and trenching of four sites. On this section of the fault, he trenched two sites. The northern site (2109-1) is on his

	segment E, whereas the southern site (2109-2) is on his segment D. Site 2109-1. This trench was sited in an area of extensive eolian sand (sheet). The trench yielded evidence for three (?) faulting events, the youngest two of which occurred before 3 ka and about 3 ka. The youngest event may not be truly tectonic, but instead may reflect local slumping of poorly consolidated materials. These time estimates are based on soil development and were not calibrated against similar-age dated deposits, thus they may be in error by as much as 100 percent. The two younger events resulted in about 4.5 m of offset of Holocene eolian sands and older deposits. The penultimate event, estimated to be about 150 ka, resulted in about 1.5 m of offset of middle Pleistocene alluvial and eolian deposits. The resultant time interval between these two phases of activity is a minimum of nearly 100 ka. Site 2109-2. This trench was located about 1/2 km north of U.S. Highway 60, in the southernmost part of the section. The trench yielded evidence for two faulting events, the youngest of which occurred about 33 ka (28–40 ka) and the older about 150 ka. These time estimates are based on the development of moderately to strongly developed soils but calibrated against soils on similar-age deposits. The younger event displaced a 300-ka soil (middle Pleistocene) 3.6–3.8 m and warped it an additional 1.25 m. The penultimate event, estimated to have occurred at about 150 ka, resulted in a 1–2 m high scarp that was almost completely obliterated (degraded) by the time of the most recent event. The resultant time interval between these two phases of activity is roughly 100 ka, without considering error limits on the 150 ka event.
Geomorphic expression	The fault forms prominent, yet low east-facing scarps on alluvial piedmont slopes of the Bear Mountains and northern Magdalena Mountains. The scarps are commonly 3 m to as much as 6 m high, and generally decrease in height to the north. Machette (1988 #1221) measured four scarp profiles near the south end of the section of this section (on his fault segment D) and the plots of maximum scarp-slope angle against scarp height suggested that the scarp was substantially older (40 ka) than those south of U.S. Highway 60 (i.e., the southern section, segments A–C). The scarps north of La Jencia Creek (segment E) are formed on piedmont-slope deposits that are buried beneath a 1- to 3-m-thick cover of Holocene and older eolian sand. These scarps are

	unsuitable from morphologic analysis. Farther north, scarps along segment F are 1–2 m high and have maximum slope angles of only 2°–4° more than the piedmont. These highly degraded scarps, combined with results from a trench across segment E (site description of 2109-1), suggested much older movement, perhaps occurring around 150 ka.
Age of faulted surficial deposits	The piedmont slope that is faulted along this section is believed by Machette (1988 #1221) to be primarily of latest middle Pleistocene age (about 150 ka) on the basis of detailed field and laboratory analyses of soil development. However, no numerical dates were obtained from deposits exposed along the fault. Younger alluvial deposits, inset into the piedmont, and Holocene (?) eolian sands overlying the piedmont are faulted along the southern portion of the section (segments D and E).
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* This section appears to have ruptured at three different times with respect to location along the fault, which originally led Machette (1988 #1221) to suggest the present of three segments. Timing determined from analysis of scarp morphology, trenching investigations, and detailed analyses of soil development on faulted and unfaulted deposits (Machette, 1988 #1221). Estimated time for the most recent paleoevent ranges from 28–40 ka on segment D (southern part of section) to roughly 3 ka on segment E (central part of section), and about 150 ka on segment F (northern part of section). Scarps along segment E may have been formed at the same time as some of those on the southern section (segment A). Nevertheless, the entire northern section is considered to have been active in the late Quaternary (<130 ka). The penultimate event is estimated to be about 150 ka on all parts of the section.
Recurrence interval	110–150 k.y. *Comments:* Depending on the time of most recent rupture along this section (3–40 k.y.), the recurrence interval may vary from 110–150 k.y.
Slip-rate category	Less than 0.2 mm/yr

	Comments: Low slip-rate category assigned based on assuming 5 m of vertical displacement in the late Pleistocene; the likely recurrence interval may range from 110 k.y. to 150 k.y.
Date and Compiler(s)	2016 Michael N. Machette, U.S. Geological Survey, Retired Richard M. Chamberlin, New Mexico Bureau of Geology & Mineral Resources Andrew P. Jochems, New Mexico Bureau of Geology & Mineral Resources
References	#7482 Chamberlin, R.M., and Love D.W., 2016, Block diagrams and cross sections illustrating geologic and tectonic evolution of the Sevilleta National Wildlife Refuge, Rio Grande rift, central New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 579, 16p. #7481 Chamberlin, R.M., Hook, S.C., and Dimeo, M.I., 2008, Geologic map of the Carbon Springs 7.5-minute quadrangle, Socorro County, New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-File Geologic Map 165, scale 1:24,000. #1222 Kelley, V.C., 1954, Tectonic map of a part of the upper Rio Grande area, New Mexico: U.S. Geological Survey Oil and Gas Investigations Map OM-157, 1 sheet, scale 1:190,080. #1273 Loughlin, G.F., and Koschmann, A.H., 1942, Geology and ore deposits of the Magdalena mining district, New Mexico: U.S. Geological Survey Professional Paper 200, 168 p., 5 pls. #1220 Machette, M.N., 1986, History of Quaternary offset and paleoseismicity along the La Jencia fault, central Rio Grande rift, New Mexico: Bulletin of the Seismological Society of America, v. 76, p. 259-272. #1221 Machette, M.N., 1988, Quaternary movement along the La Jencia fault, central New Mexico: U.S. Geological Survey Professional Paper 1440, 82 p., 2 pls. #1024 Machette, M.N., and McGimsey, R.G., 1983, Map of Quaternary and Pliocene faults in the Socorro and western part of the Fort Sumner 1° x 2° quadrangles, central New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1465-A, 12 p. pamphlet, 1 sheet, scale 1:250,000.

	#1223 Machette, M.N., compiler, 1978, Preliminary geologic map of the Socorro 1° by 2° quadrangle, central New Mexico: U.S. Geological Survey Open-File Report 78-607, 1 sheet, scale 1:250,000.