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Quaternary Fault and Fold Database of the United States

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Red River fault zone (Class A) No. 2019

Last Review Date: 2016-06-21

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

citation for this record: **Kelson, K.I., Personius, S.F., and Jochems, A.P., compilers, 2016, Fault number 2019, Red River 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 Red River fault zone is a northwest-striking series of normal faults that are 6–13 km west of the Southern Sangre de Cristo fault [2017] in the southern San Luis basin. The faults have down-to-the-northeast senses of displacement that are antithetic to the Sangre de Cristo fault system. Individual faults are less than 6 km long, form a left-stepping en echelon pattern in map view, and displace late Pliocene basalt exposed in the Rio Grande and Red River gorges. The faults are marked by scarps on basalt and Pleistocene alluvium that pre-dates incision of the gorges.
Name comments	The Red River fault zone was originally identified by McKinlay (1957 #1389) and Lambert (1966 #1112), and later mapped and

	named the Red River fault zone by Peterson (1981 #1388) on the basis of displaced volcanic flows within the Red River and Rio Grande gorges west and southwest of Questa. Dungan and others (1984 #1181), Machette and Personius (1984 #1113), and Personius and Machette (1984 #1124) mapped the fault zone based on Peterson (1981 #1388). Menges (1987 #1436) and Wells and others (1987 #1129) summarized unpublished mapping by Menges, who revised details of the fault traces and measured topographic scarps developed on basalt and alluvium. Heffern (1990 #1172) also presented a map of the Red River fault zone based on Wells and others (1987 #1129). Most recently, the fault zone was mapped by Kelson and others (2008 #7537) on their geologic map of the Guadalupe Mountain 7.5-minute quadrangle. The Red River fault zone consists of several parallel, northwest-trending faults that lie 8 km east of the village of Questa. The fault zone extends from Cerro Chiflo southward to the southern margin of Red River gorge near the Red River State Fish Hatchery.
County(s) and State(s)	TAOS COUNTY, NEW MEXICO
Physiographic province(s)	SOUTHERN ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Fault traces from 1:24,000-scale map of Kelson and others (2008 #7537).
Geologic setting	The Red River fault zone is in the southern San Luis Basin, and strikes slightly more northwesterly than the rift-margin Southern Sangre de Cristo fault [2017] to the east. The fault zone forms the southern boundary of the Sunshine Valley-Costilla Plain subbasin of the San Luis basin (Ruleman and others, 2013 #7253). The limited length of the fault zone and sub-parallelism with the Southern Sangre de Cristo fault suggest that the Red River fault zone may be an antithetic structure to the main rift-margin fault, comparable to antithetic structures interpreted by Kluth and Schaftenaar (1994 #1183) and Brister and Gries (1994 #1178) in the San Luis basin in southern Colorado.
Length (km)	10 km.
Average strike	N30°W

Sense of movement	Normal
Dip	80° E.–90° *Comments:* There are no deep structural data published for the Red River fault, so the down-dip geometry is unknown. Geologic mapping (Peterson, 1981 #1388; Wells and others, 1987 #1129; Heffern, 1990 #1172; Kelson and others, 2008 #7537) shows linear fault traces across the Rio Grande and Red River gorges, suggesting near-vertical dip. Menges (1987 #1436) describes exposures of the fault in the Red River and Rio Grande gorges that dip greater than 60°, and commonly dip 80°–90°.
Paleoseismology studies	No detailed paleoseismic studies have been conducted on the Red River fault zone. Menges (1987 #1436) briefly describes unpublished scarp morphology data on some of the Red River fault strands.
Geomorphic expression	The Red River fault zone has prominent geomorphic expression from the Red River gorge to the northwestern side of the Rio Grande gorge, where it displaces resistant Servilleta Basalt flows at the surface. A southwest-facing scarp developed on Quaternary alluvium on the southeast side of the Rio Grande was mapped by several workers (C.M. Menges, unpublished data, 1983; Heffern, 1990 #1172) and could mark an antithetic fault strand within the fault zone. However, Ruleman and others (2013 #7253) state that no Pleistocene surficial deposits are displaced in the fault zone. Geomorphic expression diminishes to the south from the Red River gorge, where fault scarps on basalt are either not preserved or buried by late Pleistocene alluvial-fan deposits shed from the Sangre de Cristo Mountains.
Age of faulted surficial deposits	The total vertical separation of upper Servilleta Basalt (4.5–2.8 Ma) across the Red River fault zone is 30–40 m (Peterson, 1981 #1388; C.M. Menges, personal communication, 1983; Menges, 1987 #1436), although different strands show different amounts of displacement of flows in the Servilleta Basalt (Peterson, 1981 #1388). Quaternary surficial deposits are generally not present across the strands of the Red River fault. Menges (unpublished data, 1983; 1987 #1436) identified an antithetic scarp developed on Quaternary alluvium on the southeast side of the Rio Grande, as shown by Heffern (1990 #1172). The age of this alluvium is unknown, although correlative deposits have been estimated to be

	middle Pleistocene (~400–500 ka) in age based on tentative correlation with marine oxygen-isotope stages (Ruleman and others, 2007 #7538; Ruleman and others, 2013 #7253). However, Ruleman and others (2013 #7253) state that no Pleistocene surficial deposits are displaced in the fault zone.
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* The age of displaced alluvium overlying the Pliocene Servilleta Basalt is unknown. Menges (unpublished data, 1983, 1987 #1436) identified an antithetic scarp developed on Quaternary alluvium of unknown age on the southeast side of the Rio Grande, and described fault scarp morphology data on several strands of the fault that suggested a late Pleistocene (20–50 ka) age of faulting. In contrast, Ruleman and others (2013 #7253) state that Pleistocene surficial deposits are not offset.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Low slip-rate category assigned based on the 30-to 40-m-high scarp on upper Servilleta Basalt and an assumed age of 2.8 Ma (Peterson, 1981 #1388; Wells and others, 1987 #1129).
Date and Compiler(s)	2016 Keith I. Kelson, William Lettis & Associates, Inc. Stephen F. Personius, U.S. Geological Survey Andrew P. Jochems, New Mexico Bureau of Geology & Mineral Resources
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Questions or comments?