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Quaternary Fault and Fold Database of the United States

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East Paradise fault zone (Class A) No. 2040

Last Review Date: 2015-02-19

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

citation for this record: **Personius, S.F., and Haller, K.M., compilers, 2015, Fault number 2040, East Paradise 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 02:22 PM.**

Synopsis	The East Paradise fault zone is one of several north-trending normal faults that form a wide zone of displacement across the interior of the Albuquerque-Belen basin; the East Paradise fault zone also forms the eastern margin of a wide graben that confines the Albuquerque Volcanoes volcanic field. The down-to-the-west, normal fault is not well expressed in the landscape, probably because of high rates of eolian sand deposition and slow rates of deformation. North of Arroyo de las Calabacillas, the fault is poorly expressed as isolated, west-facing scarps on pre-late Pleistocene piedmont alluvium. A single west-facing, approximately 5-m-high scarp on piedmont alluvium is visible on 1967 vintage (pre-development) air photos just north of the Rio

	Rancho Golf Course, but this scarp is no longer preserved. The location of the fault can be identified by aligned drainages and eroded scarps northward from the golf course to the southern edge of Arroyo de las Montoyas. No evidence of the fault has been found north of the arroyo. South of Arroyo de las Calabacillas, most of the fault trace has been destroyed by development of Paradise Hills Golf Course and housing in the surrounding communities. A detailed fault study in a housing development on the north side of Arroyo de las Calabacillas indicated that the most recent surface faulting on the East Paradise fault zone fault zone occurred in the past 75 k.y.
Name comments	A probable exposure of the East Paradise fault zone was originally recognized and mapped by Bjorklund and Maxwell (plate 1a, 1961 #1285) in Arroyo de las Calabacillas; the fault was included on some subsequent maps (Baltz, 1976 #1431), but not others (Kelley, 1977 #1106; Hawley and Haase, 1992 #1304; Hawley and others, 1995 #1301). The fault was rediscovered by John Hawley (oral commun., 1996) in exposures opened during construction of a housing development on the north side of Arroyo de las Calabacillas. The fault was informally named the Paloma del Sol fault zone by Personius (1996 #1412), but this name was dropped and superseded by Hawley and Whitworth (1996 #1303), who mapped both this fault and a parallel down-to the-west fault, located approximately 2.5 km to the west, as the Paradise fault zone. Herein we use "East Paradise fault zone" and "West Paradise fault zone" [2042] for the eastern and western strands of the Paradise fault zone of Hawley and Whitworth (1996 #1303).
County(s) and State(s)	SANDOVAL COUNTY, NEW MEXICO BERNALILLO COUNTY, NEW MEXICO
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:100,000 scale. *Comments:* Location of fault from field and air-photo mapping by the compiler (S.F. Personius, unpublished data, 1996–1997). As mapped, the East Paradise fault zone has a minimum length of 13 km. The fault zone extends from Arroyo de las Montoyas, in the City of Rio Rancho on the north, to about 6 km south of Arroyo de las Calabacillas, where the fault disappears beneath the

	Holocene floodplain of the Rio Grande in Albuquerque.
Geologic setting	The East Paradise fault zone is one of several north-trending intrabasin faults in the northern part of the Albuquerque-Belen basin. The fault forms the eastern margin of a wide graben that confines the Quaternary basalt flows of the Albuquerque Volcanoes volcanic field. The association of the fault zone with the volcanic field suggests that some faults in the graben may be associated with magmatic activity.
Length (km)	13 km.
Average strike	N6°E
Sense of movement	Normal
Dip	70°–80° W. *Comments:* In the near surface, the fault dips 70°–80° to the west, as measured in an exposure in a housing development excavation (site 2040-1) on the north side of Arroyo de las Calabacillas (S.F. Personius, unpublished data, 1996–1997). There, the fault zone is 2-m-wide fault zone and in middle Pleistocene alluvial and eolian.
Paleoseismology studies	Site 2040-1. Personius (1996 #1412; 1997 #1414;) and Personius and Mahan (2000 #7238) report a detailed trench investigation of several exposures of the East Paradise fault zone in a housing excavation on the north side of Arroyo de las Calabacillas in 1996. The approximately 2-m-wide fault zone consists of two main fault strands, which is exposed in three walls of the excavation. The fault zone offsets a sequence of arroyo alluvial sands and silts, interbedded with eolian sand deposits; the thickness of this sequence is 2.75 m. Two or possibly three colluvial wedges consisting primarily of windblown sand were observed in the main exposure; these deposits consist of a faulted wedge apparently related to movement on the easternmost strand, and an overlying younger wedge that was preserved unfaulted against the westernmost strand. The exposure was truncated by a sequence of compacted fill. If the wedge thicknesses approximate the vertical displacements caused by the faulting events (Personius, 1996 #1412; Personius and Mahan, 2000 #7238), then the earliest event in the exposure had a vertical displacement of about 1.0 m. The amount of vertical displacement that accompanied the later event(s) is less certain, because an

	unknown amount of sediment was removed from the top of the section during construction. If only two events were recorded in the exposure, then the second event had a vertical displacement of about 1.75 m; however, if there are two events represented in the remaining 1.75 m of vertical displacement, Personius and Mahan (2000 #7238) distribute the slip as 0.5 m and 1.25 m to the middle and penultimate earthquakes, respectively. Five thermoluminescence (TL) ages were obtained from this exposure; only the youngest dates are considered reliable. A TL age of 285.6±25.8 ka was obtained on pre-faulting eolian sand that was exposed in both the hanging wall and the footwall. An additional TL age of 208.4±25.2 ka was obtained from the older colluvial wedge and 75.0±7.0 ka was obtained from the younger wedge. The colluvial wedges in this exposure apparently formed primarily by eolian processes soon after faulting (Personius, 1996 #1412), so TL ages probably closely approximates the time of surface rupture. A fourth TL sample from the overlying compacted fill did not contain a stable TL signal, thus confirming that this deposit is construction fill, consisting of a mixture of sediment of various ages.
Geomorphic expression	Where fault scarps are not obscured by development, the East Paradise fault zone is poorly expressed as isolated offsets, aligned drainages, and eroded, west-facing escarpments on middle Pleistocene piedmont alluvium between Arroyo de las Calabacillas and Arroyo de las Montoyas (Personius and Mahan, 2000 #7238). A single west-facing, approximately 5-m-high scarp on middle (?) Pleistocene piedmont alluvium is visible on 1967 (pre-development) air photos just north of the Rio Rancho Golf Course. South of Arroyo de las Calabacillas, the trace of the East Paradise fault zone has been completely obscured by development, but on 1967 (pre-development) air photos, the fault zone can be mapped as aligned drainages and small scarps on alluvial deposits (S.F. Personius, unpub. data, 1996–1997).
Age of faulted surficial deposits	The East Paradise fault zone offsets late Pleistocene arroyo alluvium along Arroyo de las Calabacillas and Arroyo de las Montoyas. The fault also offsets middle Pleistocene piedmont alluvium north of Arroyo de las Calabacillas as well as sediment underlying the Segundo Alto terrace (Lambert, 1968 #1396; Machette, 1985 #1267) along the Rio Grande south of Paradise Hills.
Historic	

earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* The timing of the youngest surface-faulting earthquake is poorly constrained but probably occurred in the late Pleistocene. Timing is constrained by one thermoluminescence (TL) date of 75±7 ka (site 2040-1) from a stratigraphic position below the event horizon for the most recent surface displacement. Personius and Mahan (2000 #7238) interpret the poor geomorphic expression of the East Paradise fault zone as evidence that the most recent event probably predates the Holocene.
Recurrence interval	90–133 ka (<286 ka) *Comments:* The timing of earthquakes interpreted at this site is based on five thermoluminescence (TL) samples from colluvial-wedge deposits. Only the youngest samples yielded reliable ages. The timing of the exposed oldest event is bracketed between 285.6±25.8 ka and 208.4±25.2 ka. The age of the second event is bracketed between 208.4±25.2 ka and 75±7 ka; the age of the third event is constrained only in that it postdates 75.0±7.0 ka. These data yield a single recurrence interval of 133±26 k.y.; Personius and Mahan (2000 #7238) conclude recurrence intervals are highly variable because the two youngest events occurred in less than 75 ka in contrast to the long (133±26 k.y.) recurrence interval preceding the youngest two events. In addition, they propose an average recurrence interval of 90±10 k.y. calculated from average vertical displacement per event and rate of vertical displacement.
Slip-rate category	Less than 0.2 mm/yr *Comments:* A low slip-rate category is assigned based on thermoluminescence (TL) ages and offsets near Arroyo de las Calabacillas (site 2040-1). Personius and Mahan (2000 #7238) conclude that the post-middle Pleistocene vertical-displacement rate is 0.01±0.001 mm/yr based on vertical offset of 2.75±0.1 m since 286±26 ka. Total vertical displacement is 2.75 m and estimated on thickness of post-faulting deposits with error of ±0.25 m per event, which is distributed (from oldest to youngest) as 1 m, about 0.5 m, and about 1.25 m. The reported average displacement per event is 0.9 m; Personius and Mahan (2000 #7238) do not report single-event vertical-displacement rates due to the large uncertainties in the number and timing of surface

	displacement as well as slip per event.
Date and Compiler(s)	2015 Stephen F. Personius, U.S. Geological Survey Kathleen M. Haller, U.S. Geological Survey
References	#1431 Baltz, E.H., 1976, Seismotectonic analysis of the central Rio Grande rift, New Mexico—A progress report on geologic investigations: U.S. Geological Survey Administrative Report, 93 p., 2 pls. #1285 Bjorklund, L.J., and Maxwell, B.W., 1961, Availability of ground water in the Albuquerque area, Bernalillo and Sandoval Counties, New Mexico: New Mexico State Engineer Technical Report 21, 117 p. #1304 Hawley, J.W., and Haase, C.S., compilers, 1992, Hydrogeologic framework of the northern Albuquerque basin: New Mexico Bureau of Mines and Mineral Resources Open-File Report 387, 1 pl., scale 1:100,000. #1303 Hawley, J.W., and Whitworth, T.M., compilers, 1996, Hydrogeology of potential recharge areas for the basin- and valley-fill aquifer systems, and hydrogeochemical modeling of proposed artificial recharge of the upper Santa Fe aquifer, northern Albuquerque basin, New Mexico: New Mexico Bureau of Mines and Mineral Resources Open-File Report 402-D, 575 p. #1301 Hawley, J.W., Haase, C.S., and Lozinsky, R.P., 1995, An underground view of the Albuquerque basin, *in* Ortega-Klett, C.T., ed., The water future of Albuquerque and Middle Rio Grande basin: New Mexico Water Resources Research Institute Technical Report, p. 37–77. #1106 Kelley, V.C., 1977, Geology of Albuquerque basin, New Mexico: New Mexico Bureau of Mines and Mineral Resources Memoir 33, 60 p., 2 pls. #1396 Lambert, P.W., 1968, Quaternary stratigraphy of the Albuquerque area, New Mexico: Albuquerque, University of New Mexico, unpublished Ph.D. dissertation, 329 p., 3 pl., scale 1:48,000. #1267 Machette, M.N., 1985, Calcic soils of the southwestern United States, *in* Weide, D.L., ed., Soils and Quaternary geology

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