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East Franklin Mountains fault (Class A) No. 900

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

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Synopsis	The East Franklin Mountain fault forms a series of range-front scarps along the eastern base of the Franklin Mountains, primarily in West Texas. Studies of scarp morphology, reconnaissance mapping of faulted and unfaulted Quaternary deposits, and trenching at one location are the sources of data for this fault. No significant work has been done on the part of the fault in Mexico where its age and southern extent are poorly understood.

Name comments	Named by Machette (1987 #847); the fault extends from the northeast margin of the Franklin Mountains in southern New Mexico, south through Texas along the Franklin Mountains and across the Rio Grande along the southeast margin of the Sierra de Juarez in Chihuahua, Mexico. **Fault ID:** Referred to as fault 6 by Machette (1987 #847).
County(s) and State(s)	EL PASO COUNTY, TEXAS DOÑA ANA COUNTY, NEW MEXICO
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:50,000 scale. *Comments:* The location of the fault between 31°52'30" and 32°02'30" is based on 1:24,000-scale map of Harbour (1972 #849) and mapping by Machette (1987 #847). The location of the remainder of the fault is based on maps of Sayre and Livingston (1945 #850), Morrison (1969 #848), Collins and Raney (1991 #846; 1993 #852), Keaton (1993 #851), and Raney and Collins (1994 #872; 1994 #873) further constrained by satellite imagery and topography at scale of 1:24,000. Reference satellite imagery is ESRI_Imagery_World_2D with a minimum viewing distance of 1 km. Inferred locations are poorly constrained.
Geologic setting	Down-to-east, range-front fault bounding east side of the Franklin Mountains and Sierra de Juarez. This fault is part of a longer system that includes the Artillery Range [2051], Organ Mountains [2052], and San Andres [2053] faults in New Mexico.
Length (km)	45 km.
Average strike	N2°E
Sense of movement	Normal *Comments:* Sense of movement inferred from topography and from trench exposures (Keaton and Barnes, 1996 #944; McCalpin, 2006 #6988).
Dip	76°E *Comments:* Dip measured in shallow excavation across northern end of

	fault (Keaton and Barnes, 1996 #944).
Paleoseismology studies	Site 900-1. A trench was excavated across the northern part of the fault in January 1995 by AGRA Earth and Environmental, on contract to the U.S. Geological Survey. Preliminary results of this trenching were published by Keaton and others (1995 #877), Keaton and Barnes (1996 #944), Barnes and others (1995 #909), and Scherschel (1995 #916). All interpretations suggest 3 or 4 surface rupturing events since middle Pleistocene time (past 130 k.y.) on the basis of relations between colluvial materials, soils, and faults in the exposure. Two radiocarbon ages from colluvial wedges (10.9 ka and 15.6 ka) were reported by Keaton and Barnes (1996 #944). At the trench site, the Jornada II alluvium (late middle Pleistocene) is estimated to be offset vertically 8.5 m (Scherschel, 1995 #916) to as much as 9.8–10.6 m (Keaton and others, 1995 #877). Colluvium shed from the scarp formed from the most recent event has a radiocarbon age of 10.9 ka (Keaton and Barnes, 1996 #944). The radiocarbon age of colluvium that was eroded from the scarp of the penultimate event is 15.6 ka (Keaton and Barnes, 1996 #944). These ages from colluvium indicate approximate minimum times for the two last scarp-forming events. Site 900-2. Reexcavation of Keaton and Barnes' (1996 #944) primary trench across the East Franklin Mountain fault resulted in an alternative interpretation (McCalpin, 2006 #6988). The age of faulted deposits, now constrained by luminescence ages, indicate the hanging-wall stratigraphy is about half as old as assumed by Keaton and Barnes (1996 #944). Furthermore, the exposed hanging-wall stratigraphy is about half as old as the footwall stratigraphic sequence because the hanging wall is buried by younger alluvium. The height of the scarp is less than the net vertical displacement of the footwall stratigraphic units. Similar to the earlier study, McCalpin (2006 #6988) concludes that the trench exposes evidence for three unambiguous surface-faulting events and probably one older event. The minimum net vertical displacement estimate is 11.2 m at the trench site composed of single event displacements of 3–4.5 m. Site 900-3. McCalpin (2006 #6988) deepened a natural exposure (also documented in Keaton and Barnes, 1996 #944) north of site 900-2; the scarp at the site is 5–6 m high. McCalpin (2006 #6988) does not provide an interpretation of the exposure because the colluvial-wedge sequence is composed of gravels that subsequently have been indurated by calcium carbonate, which obscures the original stratigraphy.
Geomorphic	Distinct scarps are from 2 to 60 m high (Machette, 1987 #847; Collins

expression	and Raney, 1991 #846). Some scarps have compound slopes indicating young morphology superposed on older scarps. Steepest slope-angles are 13–23° depending on height. Scarps are well dissected by streams draining the Franklin Mountains. The fault consists of multiple strands with scarps and grabens along the mountain front. Urbanization of El Paso and Juarez (Mexico) and young alluvium of the Rio Grande cover most of the southern part of the fault.
Age of faulted surficial deposits	Mostly Quaternary alluvium along the eastern piedmont of the Franklin Mountains and Sierra de Juarez (Raney and Collins, 1994 #872; Raney and Collins, 1994 #873). Reconnaissance investigations of faulted alluvium indicate deposits at least as young as late Pleistocene are faulted (Machette, 1987 #847; Collins and Raney, 1991 #846; Collins and Raney, 1993 #852; Collins and Raney, 1994 #853; Scherschel and others, 1995 #876; Keaton and others, 1995 #877; Barnes and others, 1995 #909; Scherschel, 1995 #916). Holocene (?) or upper Pleistocene deposits have been faulted during the two most recent events.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Timing based on trenching by Keaton and Barnes (1996 #944) and McCalpin (2006 #6988) and morphometric analysis of small (single-event) scarps by Machette (1987 #847). Keaton and Barnes (1996 #944) reported that the likely age range for the most recent event is 8–12 ka based on scarp morphology and a radiocarbon date of 10.9 ka from scarp-derived colluvium. McCalpin (2006 #6988) suggests the timing of the most recent event is 13–17 ka. Additionally, soil studies by Monger (unpublished data, 1995) suggested that the oldest unfaulted deposits adjacent to the trench site are correlative to the Organ (Holocene) alluvium, which may be as old as 8 ka. However, Barnes and others (1995 #909), Keaton and others (1995 #877), Scherschel and others (1995 #876), and Scherschel (1995 #916) suggested that the most recent event is older than the Isaack's Ranch alluvium, which is considered to be latest Pleistocene in age
Recurrence interval	9–22 k.y. (<130 ka) *Comments:* The most recent work on the East Franklin Mountains fault suggests the three most recent surface-faulting earthquakes occurred since 64.1±5.7 ka; the timing of individual earthquakes is poorly constrained but estimated to have occurred before 13–17 ka (McCalpin, 2006 #6988). The average recurrence interval is

	approximately 13.8–18.9 k.y., with a mean of 16.4 k.y. Conclusions from earlier work suggest that the recent short episodes of faulting with surface rupture recurring every 9–22 k.y., alternating with long stable intervals of 75–100 k.y. at least for the late Pleistocene (Keaton and others, 1995 #877; Barnes and others, 1995 #909). However, Scherschel (1995 #916) suggested recurrence intervals of about 30 k.y. for an unspecified period of time. Keaton and Barnes (1996 #944) used three probable vertical-displacement rates and a characteristic displacement value to estimate average recurrence intervals of about 8–40 k.y. Collins and Raney (1993 #852) estimated that the average recurrence interval for large surface ruptures since middle Pleistocene time (<130 ka) may be 15-30 k.y. These values are based on (1) estimated number of inferred large-displacement (1- to 2-m-high) surface ruptures since middle Pleistocene time, (2) assumption that faulted middle Pleistocene (Jornada I) deposits are approximately 250–500 ka, and (3) greater than 25–32 m scarps on middle Pleistocene surfaces reflect the throw on fault.
Slip-rate category	Less than 0.2 mm/yr *Comments:* The short-term slip rate is thought to be higher than the long-term rate due to clustering of events during late Quaternary time. McCalpin (2006 #6988) provides several vertical-displacement rates but acknowledges that the rates could overestimate the true rate due to backtilting of the hanging-wall stratigraphy toward the fault. The timing of the past four earthquakes inferred from the trench exposure is so poorly constrained that single-event displacement rates would be highly uncertain, and, therefore, are not reported. McCalpin (2006 #6988) does suggest rates of 0.18–0.25 mm/yr from 10.4 m of vertical displacement over a period of 41.4–56.8 k.y. (between 13–17 ka and 64.1±5.7 ka). The height of fault scarps supplemented by drillhole data provide first-approximations of vertical displacement for approximately 500-ka datums suggesting minimum average vertical displacement rate of 0.145 mm/yr; McCalpin (2006 #6988) indicates a preference for the latter vertical-displacement rate and offers an alternative of 0.18 mm/yr as suitable for fault-source characterization. Alternative vertical-displacement rates from older studies of the fault are highly uncertain because the age of offset deposits is poorly constrained. Keaton and Barnes (1996 #944) suggested a vertical-displacement rate of 0.3 mm/yr for the past 3 events (less than about 30 ka), but a long-term (<500 ka) vertical-displacement rate of 0.1 mm/yr is also consistent with the data. Scherschel (1995 #916) suggested an even lower long-term vertical-displacement rate of 0.065 mm/yr. A long-term vertical-displacement rate of less than or equal to 0.25 mm/yr since middle Pleistocene time was inferred on the basis of less

	than 25–32 m of throw in the past 130 k.y. (Collins and Raney, 1993 #852). Most of the proposed vertical-displacement rates are within the assigned slip-rate category even though some considerations of the data suggest the slip rate may exceed the assigned category.
Date and Compiler(s)	2015 E.W. Collins, Bureau of Economic Geology, The University of Texas at Austin Kathleen M. Haller, U.S. Geological Survey Michael N. Machette, U.S. Geological Survey, Retired
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