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Quaternary Fault and Fold Database of the United States

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Alamogordo fault, Sabinata section (Class A) No. 2054b

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

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Synopsis	**General:** The Alamogordo fault is a long range-bounding fault that forms the structural boundary between the Sacramento Mountains (to the east) and the Tularosa Basin (to the west) in the southern Rio Grande rift. Conspicuous, nearly continuous fault scarps extend from near the north end of the Phillips Hills southward to about 22 km northeast of Orogrande, New Mexico. Detailed geolog and geomorphic mapping has been completed along most of the fault north of the McGregor Range. Near Alamogordo, numerous scarp profiles and dating of exposures constrain the timing of 3–5 late Quaternary surface-rupturing earthquakes that resulted in 5–10 m of cumulative slip. In addition, mountain-fro

	morphology and geophysical data are used to identify the Deadman section [2054c], extending south of Alamogordo, as the most active part of the fault. **Sections:** This fault has 4 sections. The northern and southern sections are define herein on the basis of fault location relative to the main escarpment of the Sacramento Mountains as well as continuity and apparent age of scarps. The central two sections are defined based on the frequency of late Quaternary surface ruptures and systematic differences of short- and long-term throw. These differences in throw are measured using fault-scarp height, elevation of stratigraphic markers on the mountain front, the elevation of the crest of the Sacramento Mountains with respect to the base of the mountain front, and estimation of basin-fill depth using geophysical data (Koning, 1999; #5535).
Name comments	**General:** First mapped by Otte (1959 #983) and later by Pray (1961 #984), this fault was initially named the Sacramento fault (Kelly and Thompson, 1964 #7254 but subsequently renamed the Alamogordo fault (Machette, 1987 #847) for its proximity to the town of Alamogordo, New Mexico. The fault is characterized by conspicuous fault scarps that extend from near the north end of the Phillips Hills (about 60 km north of Alamogordo, New Mexico), south through Tularosa and Alamogordo, and into the McGregor Bombing Range. The southernmost scarps end near Otero County Road 506, about 45 km south of Alamogordo. **Section:** The Sabinata section constitutes the main range-bounding fault between Alamogordo and Temporal Creek, the latter being located 12 km north of Tularos This section was part of the Sacramento Mountains section in earlier characterizations of this fault (Machete and others, 1998 #5535), but further work indicates that the Sacramento Mountains section should be subdivided into the Sabinata section and the Deadman section. To the north of the Sabinata section lie the Three Rivers section and to the south lies the Deadman section. The Sabinata section generally corresponds with the Sabinata segment of Koning (1999 #5535) but recent detailed geologic mapping at its north end (Koning and Kelley, 2009 #7333) suggests a longer length than previously interpreted. Two boundary zones are interpreted on either end of the Sabinata section. At Alamogordo to the south, Koning (1999 #5535) proposed a 12 km-long boundary zone between the Sabinat and Deadman sections, encompassing a mountain front re-entrant and salient. In the mountain front embayment corresponding to the Temporal Creek area, a 9 km long boundary zone can be defined between the north end of the Coyote Hills (10 km north of Tularosa) and a northeast-striking transverse fault called the Salinas Draw fault (Koning and Kelley, 2009 #7333). In this 3-4 km wide embayment centered on Temporal Creek, there are two fault zones: one along the mountain front to the east and another 3.5 km basinward (to the west-southwest). The easte scarp is more degraded than the western, and so the western is interpreted to have ruptured more recently (Koning and Kelley, 2009 #7333). For the purposes of the database, we don't differentiate these two boundary zones as unique sections but rather subsume them into adjoining sections. Consequently, the entire Temporal

	Creek embayment is subsumed into the Sabinata section because it is inferred tha the transverse Salinas Draw fault at its northern end is the most significant tecton feature in the boundary zone. On the south end of the Sabinata section, we define the common boundary between the Sabinata and Deadman sections at the salient the Alamogordo boundary zone (north side of the mountain-front re-entrant). The Sabinata section is defined separately from the Deadman section because of its lower displacement values, indicated by lower scarp heights, lower mountain cres and shallower depth of basin fill on the hanging wall. **Fault ID:** Previously referred to as fault 7 on figure 1 and table 2 of Machette (1987 #847), the southernmost part of 2054a and the northern part of 2054b (Machette and others, 1998 #2848).
County(s) and State(s)	OTERO COUNTY, NEW MEXICO
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Location of the fault is based on 1:24,000-scale mapping by Koning and Kelley (2009 #7333), Koning and Frechette (2008 #7340), and Koning and others (2007).
Geologic setting	The Alamogordo fault is a west-down, range-front normal fault forming the structural boundary between the west side of the Sacramento Mountains and the Tularosa Basin. The eastern Tularosa Basin corresponds to a half-graben tilted eastward towards the Alamogordo fault (Healy and others, 1978 #7329; Orr and Myers, 1986 #7338; Seager and others, 1987 #627; Johnson and others, 1989 #7331; Lozinsky and Bauer, 1991 #7336). The Alamogordo fault juxtaposes Quaternary basin fill against Paleozoic bedrock at the foot of the Sacramento Mountains. Due to variable northward and southward components of dip in the mountain block, the particular Paleozoic lithologic unit exposed at the ranges fro Ordovician through Permian (Pray, 1961 #984). Sufficient throw occurred 25 km south of Alamogordo to expose local Proterozoic rock at the base of the mountai (Pray, 1961 #984). North of La Luz, a broad pediment surface has formed largely in erodible strata of the Abo Formation (Otte, 1959 #983). In the Three Rivers are relatively low hills, including the Phillips Hills, are found on the immediate footwall of the fault. Aside from the Godfrey Hills, relatively low relief and shallow Quaternary deposits characterizes the 18- to 23-km-wide area between th northern Alamogordo fault (i.e., the Three Rivers section) east to the imposing western face of Sierra Blanca. South of Bug Scuffle Canyon, the fault forms smal scarps across the piedmont slope and along low-relief bedrock hills. Depth to

	basement in the eastern Tularosa Basin is 200–1,200 m based on geophysical and well data (Hood, 1959 #7330; McLean, 1970 #7337; Healy and others, 1978 #73 Orr and Myers, 1986 #7338; Lanka, 1995 #7335; gravity and aeromagnetic data from R. Keller, pers. comm., 1998; Koning, 1999 #5535).
Length (km)	This section is 62 km of a total fault length of 130 km.
Average strike	N13°W (for section) versus N10°W (for whole fault)
Sense of movement	Normal
Dip	71–80° W. *Comments:* Koning (1999 #5535) shows the fault as a high-angle (74–80°) norma dip-slip fault in figure 52a and steeply plunging slickensides are described on fau exposures that dip 71–74° SW.
Paleoseismology studies	Site 2054-1 (Lab-1, Koning, 1999 #5535 and Koning and Pazzaglia, 2002 #6932; Laborcita Canyon site of Koning, 2014 #7339) is located on the north wall of Laborcita Arroyo. Vertical displacement of about 2 m at the site is attributed to a prehistoric earthquake occurring at 11 ka radiocarbon years BP, bracketed by two conventional radiocarbon ages: 11,200±70 14C yr BP and 10,510±70 14C yr BP (Koning, 1999 #5535; Koning and Pazzaglia, 2002 #6932). Koning (2014 #7339) suggests that the oldest preserved colluvial wedge at the Laborcita Canyon site or the Sabinata section could possibly be associated with one of the large-magnitude earthquakes that occurred within 2000 years prior to 12.6 ka (radiocarbon years) the Deadman section.
Geomorphic expression	The Sabinata section has generally smaller fault scarps than the Deadman section to the south; scarps on early Holocene to late Pleistocene deposits range from abo 3.2–9.1 m in height, with surface offsets of 1–6 m (Koning, 1999 #5535). The scarps have fresh morphologies and are mostly continuous, suggesting that the most recent movement is relatively young. Scarp morphology studies by Machett (1987 #847) and Koning (1999 #5535) suggest that the youngest scarps are latest Quaternary in age (i.e., <15 ka). Otte (1959 #983) discussed evidence for abunda Pleistocene displacement along the fault, including the presence of "piedmont scarps" as much as 7 m in height and isolated gravel that is uplifted 30–60 m abo modern drainages.
Age of faulted surficial deposits	Detailed geologic mapping (Koning, 1999 #5535; Koning and others, 2007 #734 Koning and Frechette, 2008 #7340; and Koning and Kelley, 2009 #7333) demonstrates that post-10 ka alluvial fans overly the fault along the Sabinata section. Preserved scarps are found on late- to mid-Pleistocene alluvial fan surfaces.

Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Based on radiocarbon dating of a charcoal sample found in an exposu at Laborcita Arroyo, the most recent surface rupture occurred 11 ka—as brackete by two conventional radiocarbon ages: 11,200±70 14C yr BP and 10,510±70 14C yr BP (Koning, 1999 #5535; Koning and Pazzaglia, 2002 #6932; Koning, 2014 #7339). Fault scarps with similar morphologies are observed elsewhere along this section of the fault (Machette, 1987 #847; Koning, 1999 #5535).
Recurrence interval	 *Comments:* Koning (1999 #5535, 2014 #7339) and Koning and Pazzaglia (2002 #6932) interpret a temporal clustering for the Alamogordo fault between 15 and 8 ka, with lower recurrence intervals in the late Pleistocene prior to 20–30 ka. This complicates meaningful estimates for recurrence intervals (Koning, 1999 #5535).
Slip-rate category	Less than 0.2 mm/yr *Comments:* The slip rate is unconstrained along this part of the fault. However, Salyards (1991 #1061) suggested a vertical displacement rate of 0.11 mm/yr usin data presented by Machette (1987 #847). Koning and Pazzaglia (2002 #6932) present average vertical-displacement rates of 0.04–0.05 mm/yr to 0.17–0.23 mm/yr mm/yr on the Deadman section to the south. Slip rates would likely be les on the Sabinata section based on systematic short-term and long-term throw variations between the two sections (Koning, 1999 #5535).
Date and Compiler(s)	2016 Daniel J. Koning, New Mexico Bureau of Geology & Mineral Resources Kathleen M. Haller, U.S. Geological Survey Michael N. Machette, U.S. Geological Survey, Retired Keith I. Kelson, William Lettis & Associates, Inc.
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