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Quaternary Fault and Fold Database of the United States

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San Felipe fault zone, Santa Ana section (Class A) No. 2030a

Last Review Date: 2016-06-28

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

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Synopsis	**General:** The San Felipe fault zone is a broad zone of normal faults that offset basalts of the San Felipe volcanic field and underlying Santa Fe Group sedimentary rocks. The fault zone is best expressed where individual fault strands offset the volcanic tablelands of Santa Ana Mesa. The fault zone is primarily a graben, centered on the westernmost of two north-trending eruptive centers in the volcanic field. This structure, the San Felipe graben, is bound on the west by the down-to-the-east Luce and Santa Ana faults, and on the east by the down-to-the-west

	Algodones fault. Most of these faults offset the 2.4–2.6 Ma basalt flows of the San Felipe volcanic field. Average displacements on most faults are 15–30 m, although some of the larger structures, such as the Luce fault, have as much as 90–120 m of vertical displacement. **Sections:** This fault has 2 sections. Wong and others (1995 #1155) used the polarity of faults in the San Felipe fault zone to delineate two sections: down-to-the-east faults that form the western margin of the San Felipe graben (Santa Ana and Luce faults) are included in the Santa Ana section, and down-to-the-west faults that form the eastern margin of the graben (Algodones fault) are include in the Algodones section. They assumed that one of these sections is a "master fault" that controls both sections, but they did not have enough subsurface data to support either scenario.
Name comments	**General:** This complex of numerous, generally north-trending normal faults near Santa Ana Mesa was first mapped in detail by Soister (1952 #1418). Kelley (1954 #1222) followed Soister's mapping closely in his compilation, and applied the name San Felipe fault zone to these structures. Later maps by Smith and others (1970 #1125), Kelley (1977 #1106), and Kelley and Kudo (1978 #1307) show similar fault patterns. Kelley (1977 #1106) named many of the more prominent structures in the zone, such as the Santa Ana, Luce, Cocida, and Algodones faults and the San Felipe graben. In their compilation, Wong and others (1995 #1155) used the name "San Felipe fault zone". **Section:** The Santa Ana section includes the Santa Ana, Luce, and Cocida faults of Kelley (1977 #1106), the Tamaya fault of Personius (2002 #7526), and numerous smaller displacements, generally down-to-the-east faults that form the west flank of the San Felipe graben. This section also includes an unnamed, west-dipping fault of uncertain origin about 8 km west of the main fault zone (Pazzaglia and others, 1997 #7525).
County(s) and State(s)	SANDOVAL COUNTY, NEW MEXICO
Physiographic province(s)	BASIN AND RANGE SOUTHERN ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:24,000 scale.

	Comments: Fault locations are good where faults cut volcanic rocks, but locations are poor in the less resistant Santa Fe Group rocks. Fault traces are from 1:24,000-scale maps of Pazzaglia and others (1997 #7525), Connell (1998 #7502), Chamberlin and others (1999 #7524), Personius (2002 #7526), and Kempter and others (2007 #7429).
Geologic setting	The San Felipe fault zone is located in the western part of the Santo Domingo basin of the Rio Grande rift as defined by Smith and others (2001 #7438). The Santo Domingo basin links the en echelon Albuquerque and Española basins, and kinematic and paleostress evidence suggests that the basin functions as a relay that began to narrow in Plio-Pleistocene time (Minor and others, 2013 #7437). The fault zone forms a north-trending graben within the San Felipe volcanic field. Although Wong and others (1995 #1155) conclude that this graben is a minor sub-basin within the Rio Grande rift, the narrowing of the fault zone within the volcanic field indicates that the geometry of the fault zone may be in part controlled by volcanic activity (for example, van Wyk de Vries and Merle, 1996 #1422).
Length (km)	This section is 44 km of a total fault length of 48 km.
Average strike	N5°E (for section) versus N1°E (for whole fault)
Sense of movement	Normal
Dip	60°E–90° *Comments:* An exposed section of the Luce fault along highway 44 west of Bernalillo yielded an east dip of 82° (Kelley, 1977 #1106). Connell (1998 #7502) reported east dips of 67–80° on the Luce fault in the Bernalillo 7.5-minute quadrangle, and Chamberlin and others (1999 #7524) reported east to southeast dips of 65–70° for the Cocida fault near Borrego Canyon in the Loma Creston quadrangle. Reported dips for the Santa Ana fault range from 65–80° toward the east or southeast (Chamberlin and others, 1999 #7524). Numerous fault exposures in Santa Fe Group rocks in the Santa Ana Pueblo quadrangle have dips of 45–85°E (Personius, 2002 #7526).
Paleoseismology studies	

Geomorphic expression	The Luce and other faults that cut the basalt flows of the San Felipe volcanic field are well preserved as escarpments covered by basalt talus. The Santa Ana fault and other faults that are only located in Santa Fe Group rocks are poorly expressed, except where they are marked in places by clastic dikes (Soister, 1952 #1418) or strongly cemented zones (Minor and Hudson, 2006 #7246). Soister (1952 #1418) and Kelley (1977 #1106) measured average displacements of 15–30 m in basalts on most structures in the fault zone, and as much as 90–120 m on larger structures such as the Luce fault.
Age of faulted surficial deposits	Faults in the Santa Ana section offset the 2.4-2.6 Ma (Bachman and Mehnert, 1978 #1265; Smith and Kuhle, 1998 #1771) basalts of the San Felipe volcanic field and underlying Santa Fe Group sedimentary rocks. Soister (1952 #1418) describes offset of his early Pleistocene Mesita Alta gravel and surface, which overlies San Felipe basalt flows in several places.
Historic earthquake	
Most recent prehistoric deformation	undifferentiated Quaternary (<1.6 Ma) *Comments:* No detailed studies of the age of most recent movement have been conducted. However, 90–120 m of post-San Felipe basalt displacement on some structures in this fault zone indicates a history of recurrent fault movements that probably continued at least into the early Pleistocene.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Wong and others (1995 #1155) estimated slip rates of 0.01–0.04 mm/yr based on 90–120 m of displacement that has occurred on the Luce fault since deposition of the San Felipe basalt (2.4–2.6 Ma) and similar data. They also concluded that it is likely that some of the major faults within the San Felipe fault zone act as independent rupture segments, but could not rule out the possibility that some faults rupture together.
Date and Compiler(s)	2016 Stephen F. Personius, U.S. Geological Survey Andrew P. Jochems, New Mexico Bureau of Geology & Mineral Resources

	Keith I. Kelson, William Lettis & Associates, Inc.
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