

GEOLOGIC MAP OF THE SANTA ANA PUEBLO QUADRANGLE, SANDOVAL COUNTY, NEW MEXICO

below basalt-capped Santa Ana Mesa. Locally includes small slump blocks and basalt-rich deposits that have slumped and remobilized as debris flows. Most deposits are characterized by strongly developed (stage III and IV) calcic soils. Thickness 1–5 m

of basalt (unit **Tb**). Deposits mantle steep hillslopes

Seven map units were identified in these two quadrangles, but all units are not present in both quadrangles. Alluvial units from both quadrangles are included in the "Correlation of Map and Subsurface Units" to aid in unit correlation between quadrangles. To aid in regional correlation, table 1 includes probable correlations with Jemez River alluvial units mapped by Alluvium 6 of Jemez River (Holocene)—Light-yellowish-(10YR 6/3), 10-cm-thick interbeds of sandy silt and rare pebbly zones. Deposits underlie fill terrace 4 m above modern channel 2 km west of Jemez Canyon Dam, but probably also underlie extensive 4- to 6-m-high terraces covered with eolian sand (unit **Qesy**) on south side of Jemez River. Correlative with units Qt7, Qt8, and Qt9 of Rogers (1996) and Rogers and Smartt (1996), with units Qt5 and Qt6 of Formento-Trigilio and Pazzaglia (1998), and Pazzaglia and others (1998), and with units Alluvium 5 of Jemez River (upper to middle(?) Pleisto**cene**)—Varicolored sand, pebbly sand, pebble and cobble gravel, and silty clay. Upper part consists of about 15 m of yellowish-brown, fine to medium sand and pebbly sand, interbedded with moderately sorted to well sorted pebble and cobble gravel in channel fills 1-2 m thick, and minor thin (10-cm-thick) beds of red and green silty clay. Gravel clasts are subangular to round and well imbricated, show south-southeast $(140^{\circ}-180^{\circ})$ transport directions, and are chiefly pink granite, petrified wood, Paleozoic limestone, Mesozoic sandstone, Pedernal Chert Member of Abiquiu Formation, and intermediate to mafic volcanic rocks, consistent with source areas to northwest. Contains a few charcoal fragments and reworked pumice pebbles in pebbly sand beds near base of upper part; pumice is chemically correlated with 1.6-Ma (Izett and Obradovich, 1994) lower Bandelier Tuff (sample locality MRGB-17-BNW; A. Sarna-Wojcicki, mottled red and green silty clay in beds 10–50 cm thick; gypsum as much as 20 cm in length. Well-developed bedding, clast lithologies, rounding, and sorting indicate deposition by Jemez River. Exposures are conformably overlain in places by 1-2 m of basalt-rich cobbly arroyo alluvium (unit **Qalo**) containing stripped, stage II–III Bk horizons; lower contact is not exposed but extends at least to present level of Jemez River channel. Preserved as irregular remnants underlying arroyo fan surfaces Personius, 2002); no clearly correlative alluvial deposit Pazzaglia, 1998; Pazzaglia and others, 1998), although the unit may be correlative with a minor strath terrace fill Formento-Trigilio and Pazzaglia, 1998) in the upper Alluvium 3 of Jemez River (middle Pleistocene)—Pebbly

sand and sandy pebble and cobble gravel; moderately sorted, moderately to well bedded. Clasts are subangular $(110^{\circ}-120^{\circ})$ transport directions, and are chiefly pink granite, petrified wood, Paleozoic limestone, Mesozoic consistent with source areas to northwest. Unit well preserved as 4- to 10-m-thick fill deposits underlying prominent terrace remnants north of Jemez River in adjacent Bernalillo NW quadrangle, but in Santa Ana deposit along west edge of quadrangle. Deposit overlies a bedrock strath about 30 m above present channel of Jemez River and is in turn overlain by 4 m of basalt-rich angular cobble and boulder gravel (unit Qalo) derived deposits of Rogers (1996), Rogers and Smartt (1996).

moderately to well bedded. Clasts are subangular to round and well imbricated, show southeast transport directions, and are dominated by rocks attributable to Sierra Nacimiento and Jemez Mountains source areas to northwest. Unit poorly preserved as 1- to 2-m-thick deposits in small hills and beneath fans and remnants of basalt-rich, angular cobble and boulder gravel (unit Qalo) north of Jemez River. Deposits overlie bedrock straths Probably correlative with unit **Qt2** deposits of Rogers (1996), Rogers and Smartt (1996), Formento-Trigilio and Pazzaglia (1996, 1998), Formento-Trigilio (1997), mapped upstream of quadrangle; unit Qt2 deposits are inset 25-50 m below unit Qt1 deposits that contain Lava Creek B ash, so unit **Qai1** deposits are inferred to be younger than the ≈ 640 -ka tephra age (Lanphere and others, 2002) attributed to these higher, older deposits.

Pliocene)—Dark-gray olivine basalt; forms single and multiple flows that cap Santa Ana Mesa (Kelly and Kudo 1978); K/Ar and Ar/Ar dating of these rocks in various places unit is covered by 0.5-2 m of eolian sand (units Qesy and Qeso). Thickness best expressed around rim of Santa Ana Mesa or in fault scarps; individual flows are 6-10 m thick along western and southern margins of the mesa. Thickness much greater near eruptive centers

along San Felipe graben in central part of mesa

spatter, scoria, and dikes. Forms cinder cones, small shield volcanoes, depressions, and ring dikes and plugs at eruptive centers; after Kelley and Kudo (1978). Cones form an elongate array that trends north-south. in general alignment with numerous normal faults that offset the surface of Santa Ana Mesa (Kelley and Kudo, 1978). Thickness unknown Santa Fe Group Significant revisions of the Santa Fe Group have recently been proposed by Connell and others (1999) in the northern Albuquerque basin.

Basalt cinder and intrusive centers, San Felipe volcanic field (upper Pliocene)—Vent-related basaltic cinder

However, this nomenclature is preliminary, and other recent studies have suggested alternative terminology (for example, Chamberlin and others, 1999; Pazzaglia and others, 1999; Tedford and Barghoorn, 1999). Herein I retain some of the proposed stratigraphic revisions of the Santa Fe Group of Connell and others (1999) because the reference sections are located nearby, but such usage should not be interpreted as an endorsement of this stratigraphic terminology outside of the Santa Ana Pueblo quadrangle

Cochiti Formation (Pliocene to upper Miocene)—Very

pale brown, fine to coarse sandstone and sandy pebble

cobble, and local boulder conglomerate; poorly indurated; poorly to moderately well sorted. Massive to moderately bedded. Clasts are subangular to subrounded and primarily consist of volcanic rocks derived from Jemez Mountains to north; pumice-rich zones and obsidian clasts ("Apache tears") are common. A preliminary 40Ar/39Ar analysis on one pumice bed (sample SPT9/15/97–4) yielded an age of $7.01\pm.06$ Ma (M.J. Kunk, oral commun., 1999), indicating these tephra are probably reworked from Peralta Tuff (Bailey and others, 1969), which has been dated at $\approx 6.75-7.0$ Ma elsewhere in the region (Smith and others, 1991; McIntosh and Quade, 1995). Sparse clast orientation measurements indicate southerly (140°-215°) transport directions. Poor exposure prevents accurate determination of conglomerate-to-sandstone ratios, but conglomerate probably makes up less than 10 percent of lower section, and is greater than 70 percent in some places near upper part of section below rim of Santa Ana Mesa in better exposures north of Santa Ana Pueblo quadrangle. As mapped herein, unit is consistent with redefinition of Cochiti Formation proposed by Smith and Lavine (1996). Unit interfingers with northwest-derived sandstone and conglomerate of unit Tou; some beds of unit **Tou** conglomerate are included in unit **Tc**. Exposures are confined to northwest corner of Santa Ana Pueblo quadrangle and adjacent Loma Creston quadrangle (Chamberlin and others, 1999), but deposits are probably present beneath northern rim of Santa Ana Mesa throughout quadrangle. Time-correlative with Upper Buff Member of Santa Fe Formation of Bryan and McCann (1937), Ceja member of Santa Fe Formation of Kelley (1977), Sierra Ladrones Formation of Machette (1978), upper Santa Fe Group units of Personius and others (2000) in Loma Machete quadrangle, Cochiti Formation of Smith and Lavine (1996) and Chamberlin and others (1999), and Ceja and Loma Barbon Members of Arroyo Ojito Formation of Connell and others (1999). Previously mapped as Bodega Butte member of the Santa Fe Formation by Soister (1952), as pumicious upper part of lower member of lower unnamed formation of Santa Fe Group by Spiegel (1961), as Cochiti Formation by Smith and others (1970), and as undivided Santa Fe Formation by Kelley (1977). Faulting complicates estimation of unit thickness but probably is maximum of 200 m at northern

margin of quadrangle and pinches out to south Cochiti Formation, cemented (Pliocene to upper Miocene)—Very pale brown, fine to coarse volcaniclastic sandstone and sandy pebble, cobble, and local boulder conglomerate; pervasively cemented with silica and (or) calcium carbonate in footwall of fault in northwestern part of quadrangle. Exposed thickness 30 m Fluvial deposits of ancestral Rio Grande (Pliocene to upper Miocene)—Pinkish-white, medium to coarse sandstone and sandy pebble and sparse cobble conglomerate; poorly indurated, moderately well sorted. Clasts are subround to round and primarily consist of gray quartzite and rhyolitic volcanic rocks. Sorting and clast lithologies suggest a northeasterly ancestral Rio Grande source. Very poorly exposed in one location directly beneath basalt (unit **Tb**) near southern end of Algodones fault in southeast corner of quadrangle, but outcrops to east and northeast indicate similar pebbly sand interfingers with units Tou and Tc (Cather and Connell, 1998; Smith and Kuhle, 1998). Timecorrelative with Upper Buff Member of Santa Fe Formation of Brvan and McCann (1937), Ceja member of Santa Fe Formation of Kelley (1977), Sierra Ladrones Formation of Machette (1978), axial facies of Sierra Ladrones Formation (Smith and Kuhle, 1998), upper Santa Fe Group units of Personius and others (2000) in the Loma Machete quadrangle, and Ceja and Loma Barbon Members of Arroyo Ojito Formation of Connell and others (1999). Previously mapped as Cochiti

nonvolcanic clast assemblage suggests different nomenclature is appropriate (Smith and Lavine, 1996). Also mapped as Santa Ana member of the Santa Fe Formation by Soister (1952), as red (upper) member of lower unnamed formation of Santa Fe Group by Spiegel (1961), and as undivided Santa Fe Formation by Kelley (1977). Exposed thickness about 15 m Arroyo Ojito Formation Ceja and Loma Barbon Members of Connell and

Formation by Smith and others (1970), but mostly

others (1999), undivided (Pliocene to upper Miocene)—Light-gray to pale-brown to red sandstone and sandy pebble and minor cobble conglomerate; poorly indurated; poorly to moderately well sorted. Massive to moderately bedded. Clasts are subangular to subrounded and primarily consist of rocks derived from northwestern New Mexico (Sierra Nacimiento and Jemez Mountains) sources; common lithologies include pink granite, petrified wood, Paleozoic limestone, Mesozoic sandstone, Pedernal Chert Member of Abiquiu Formation, and intermediate to mafic volcanic rocks. Largest clasts are generally 20–30 cm long, although boulders 50 cm or longer are present locally. Sparse clast orientation measurements indicate easterly to eastsoutheasterly $(75^{\circ}-120^{\circ})$ transport directions. Also contains minor thin (2-10 cm) beds of light red silt. Thin beds (5–20 cm) of reworked rhyolitic pumice are common in the lower part of section. Preliminary

40Ar/39Ar analyses on two samples from one pumice

bed (sample site SPT8/27/97-1) yielded indistinguishable ages of 7.09 ± 0.04 and 7.08 ± 0.04 Ma (M.J. Kunk, oral commun., 1999), indicating these tephra are probably reworked from the Peralta Tuff (Bailey and others, 1969), which has been dated at $\approx 6.75-7.0$ Ma elsewhere in the region (Smith and others, 1991; McIntosh and Quade, 1995). Unit contains less conglomerate and more silt near base, which is not exposed; exposures of a distinctive 20- to 30-cm-thick, fissile, gray, very fine sandstone near the base of unit aids in mapping in the southern part of sec. 4, T. 14 N., R. 3 E. in northwestern part of quadrangle. Unit interfingers with volcaniclastic sandstone and conglomerate of Cochiti Formation (unit Tc) in northwestern part of quadrangle and is in fault contact with units Ton and Tzcc along Tamaya fault in west half of quadrangle. Poor exposure prevents accurate determination of conglomerate-to-sandstone ratios, but conglomerate probably makes up less than 10 percent of lower section and is greater than 50 percent in upper part of section in places below rim of Santa Ana Mesa. Upper part of section contains several well developed, 1-m-thick buried stage III and IV calcic soils representing periods of landscape stability and hiatuses in deposition. Deposited by shallow, east-southeasterly flowing streams of ancestral Jemez River drainage, with only minor input from south-flowing ancestral Jemez Mountains drainages. Time-correlative with Upper Buff Member of Santa Fe Formation of Bryan and McCann (1937), Ceja member of Santa Fe Formation of Kelley (1977), Sierra Ladrones Formation of Machette (1978), upper Santa Fe Group units of Personius and others (2000) in Loma Machete quadrangle, and Ceja and Loma Barbon members of Arroyo Ojito Formation of Connell and others (1999) in Bernalillo NW quadrangle (Koning and Personius, 2002). Previously mapped as Cochiti Formation by Smith and others (1970), but mostly nonvolcanic clast assemblage suggests different nomenclature is appropriate (Smith and Lavine, 1996). Also mapped as Santa Ana member of Santa Fe Formation by Soister (1952), as red (upper) member of lower unnamed formation of Santa Fe Group by Spiegel (1961), and as undivided Santa Fe Formation by Kelley

thickness, but exposed thickness is about 300 m and correlative rocks are >420 m thick in adjacent Bernalillo guadrangle (Connell and others, 2000) Ton Navajo Draw Member of Connell and others (1999) (Miocene)—Pink (5YR 7/3), very pale brown (10YR 8/2) to light-gray (10YR 7/1), fine to medium sandstone, containing minor pale red (2.5 YR 7/3) to red (2.5 YR 5/6) siltstone and claystone, and rare thin pebble to cobble beds of pumice and rhyolitic nonwelded tuff; poorly indurated. Also contains several poorly sorted, poorly to moderately bedded sandy pebble and cobble conglomerate beds, 0.5-2 m thick. Conglomerate beds are less well bedded, are more poorly sorted. and have higher percentages of volcanic clasts than conglomerates in overlying unit **Tou**. Deposits are highly variable along strike and are preserved only in a structurally complex zone between the Santa Ana and Tamaya fault zones in northwestern part of quadrangle. Most of unit was deposited as fluvial (overbank) sediment by sluggish, south- and (or) southeast-flowing streams, but large-scale (sets 0.5–1 m high), crossbedded eolian sand deposits are locally present. Probably correlative with upper part of Middle Red Member of the Santa Fe Formation of Bryan and McCann (1937) and Kelley

(1977). Faulting complicates estimation of unit

parts of middle Santa Fe Group units of Personius and others (2000), and Navajo Draw Member of Arroyo Ojito Formation of Connell and others (1999) in Bernalillo NW quadrangle (Koning and Personius, 2002). Mapped as Chamisa Mesa Member of Santa Fe Formation by Soister (1952) and as Zia Member of Santa Fe Formation by Kelley (1977); also mapped as Cochiti Formation by Smith and others (1970), but mostly nonvolcanic clast assemblage suggests different nomenclature is appropriate (Smith and Lavine, 1996). In fault contact with overlying unit **Tou** at Tamaya fault. Mostly in fault contact with underlying unit Tzcc at Santa Ana fault and at west-northwest-trending fault zone in sec. 3 and 4, T. 14 N., R. 3 E., east of southern end of prominent exposure of Santa Ana fault. Faulting and poor exposure complicate estimation of unit thickness, but exposed thickness probably <200 m Santa Fe Group, undivided (Pliocene(?) to Miocene)— Sedimentary rocks correlative with Santa Fe Group, mapped where surface access was restricted in southwestern part of quadrangle. Probably consists of Loma Barbon Member of Arroyo Ojito Formation (unit Tou) east of Tamaya fault and Navajo Draw Member of Arroyo Ojito Formation (unit Ton) and Cerro Conejo Member of Zia Formation (unit Tzcc) west of Tamaya fault. Thickness unknown Zia Formation Cerro Conejo Member of Connell and others (1999) (Miocene)—Pale-brown to yellowish-red, fine- to medium-grained, parallel bedded sandstone; light-gray to very pale brown, lithic-rich, fine- to coarse-grained eolian crossbedded sandstone; and brown and red siltstone and claystone; unit weakly indurated. Sandstone is moderately to well sorted; eolian crossbedded sandstone in large (1- to 2-m-high) sets; parallel bedded sandstone in beds 0.5-2 m thick, interbedded with rare thin (5-10)

thin (2-20 cm), but some as much as 1-1.5 m thick. One thin (≤ 10 cm), discontinuous ash bed is mapped in footwall of Tamaya fault just north of Jemez River. Mapped as Chamisa Mesa member of Santa Fe Formation by Soister (1952), as lower member of lower unnamed formation of Santa Fe Group by Spiegel (1961), as Santa Fe Formation by Smith and others (1970), and as Zia member of Santa Fe Formation by Kelley (1977). Probably correlative with unnamed member of Zia Formation of Tedford (1982) and Tedford and Barghoorn (1997), lower part of middle Santa Fe Group unit of Personius and others (2000), and Cerro Conejo Member of Zia Formation of Connell and others (1999) in Bernalillo NW quadrangle (Koning and Personius, 2002). In fault contact with unit Ton at Santa Ana fault and with unit Tou at Tamaya fault. Poor exposure and faulting complicates estimation of unit thickness, but apparent exposed thickness about 600 m Cerro Conejo Member of Connell and others (1999), cemented (Miocene)—Undivided very pale brown (10YR 8/2) fine- to medium-grained, crossbedded, well-sorted sandstone, pervasively cemented with silica and calcium carbonate in footwall of Santa Ana fault in northwest corner of quadrangle. Exposed thickness 35 m Chamisa Mesa and Piedra Parada Members, undivided (lower Miocene)—Shown on cross section only. Consists of red, yellow, and buff, guartzose fluvial and silty sandstone of Chamisa Mesa member, and pink, gray, and yellow, fine- to coarse-grained, quartzose eolian sandstone and minor muddy interdune sandstone of Piedra Parada member, mapped elsewhere in the region (Galusha, 1966; Gawne, 1981; Koning and others, 1998; Pazzaglia and others, 1998, 1999). Thickness about 700 m in Santa Fe Pacific #1 well, located about 5 km southwest of southwest corner of map area in adjacent Loma Machete quadrangle (Personius and others, 2000), but may thin to east Older bedrock

Cretaceous Menefee Formation, Point Lookout Sandstone, and Mancos Shale. Penetrated in Santa Fe Pacific # 1 well, located about 5 km southwest of southwest corner of map area in adjacent Loma Machete quadrangle; total thickness of interval in well is 595 m (Black and Hiss, 1974) ------ Contact—Dashed where approximately located **Fault**—Bar and ball on downdropped side (where known); tic indicates amount and direction of dip. Dashed where approximately located, dotted where concealed Aeromagnetic anomaly—Analysis by authors of highresolution aeromagnetic data from U.S. Geological Survey and SIAL Geosciences, Inc. (1997); linear anomalies mark probable locations of faults buried by surficial deposits (Grauch and Millegan, 1998; Grauch, _____ Strike and dip of inclined bedding Qesy/Qalo Thin surficial deposit (upper symbol) covering older unit SPT 9/15/97-4 Chronological sample locality—Number referenced in text

Tephra deposit

DISCUSSION The Santa Ana Pueblo quadrangle is located in the northern part of the Albuquerque basin, which is the largest basin or graben within the Rio Grande rift in New Mexico. The quadrangle is underlain by poorly consolidated sedimentary rocks of the Santa Fe Group and is dominated by Santa Ana Mesa, a volcanic tableland underlain by basalt flows of the San Felipe volcanic field. The San Felipe volcanic field is the largest area of basaltic lavas exposed in the Albuquerque basin (Kelley and Kudo, 1978)

STRUCTURE The structural fabric of the quadrangle is dominated by dozens of generally north striking, east- and west-dipping normal faults associated with the Neogene Rio Grande rift. Many of these faults form resistant fault scarps where they offset basalt flows underlying Santa Ana Mesa, but most faults in the underlying Santa Fe Group sedimentary rocks are poorly expressed. Exceptions are the Santa Ana fault and an unnamed fault in the northwestern part of the quadrangle, where prominent ridges mark the surface expression of the fault due to enhanced silica and (or) calcium carbonate cementation in the footwall. Another major fault is the down-to-the-east Tamaya fault, herein informally named after the local term for the nearby old Santa Ana Pueblo. This fault was not previously identified, but rather was mapped as a contact between contrasting subunits of Santa Fe Group rocks (Soister, 1952; Spiegel, 1961; Smith and others, 1970; Kelley, 1977). The Tamaya and Santa Ana faults are related en echelon structures; the Santa Ana fault dies out in the adjacent Bernalillo NW quadrangle (Koning and Personius, 2002), just south of a complex fault stepover with the Tamaya fault. The Tamaya fault can be traced in numerous exposures southward to the Jemez River and is mapped continuously beyond the southern quadrangle boundary on the basis of a prominent anomaly in high-resolution aeromagnetic data (U.S. Geological Survey and SIAL Geosciences. Inc., 1997). The Tamava tault is exposed in a roadcut along U.S. Highway 550, where it has been erroneously mapped as the Luce fault (Kelley, 1977; Pazzaglia and others, 1999; Connell and others, 2000). The Tamaya fault has the most offset of any fault in the

guadrangle, although absence of correlative units exposed across the structure prevent measurement of total throw. The fault may also cut Quaternary deposits, because it coincides with a 5-m-high, east-facing scarp in old arroyo alluvium (unit **Qalo**) about 500 m north of the Jemez River. The age of this alluvium is unknown, but probably is middle Pleistocene or younger, because the deposit underlies a fan that covers old deposits of the Jemez River (unit **Qaj1**) that probably are younger than deposits containing the ≈640-ka (Lanphere and others, 2002) Lava Creek B ash in the headwaters of the Jemez River (Rogers, 1996; Rogers and Smartt, 1996). Other prominent structures in the quadrangle are the Luce and Algodones faults, which form the western and eastern margins, respectively, of the San Felipe fault zone (Kelley, 1954) or San Felipe graben (Kelley, 1977). These faults are part of a series of faults that offset the basalt flows underlying Santa Ana Mesa. There appears to be little net throw across the San Felipe graben, although the Luce fault has apparent down-to-the-east offset of 90–120 m (Soister, 1952; Kelley, 1977) and the Algodones fault has apparent down-to-the-west offset of 50–60 m (Personius and others, 1999). These relatively large offsets in

the 2.4- to 2.6-Ma (Bachman and Mehnert, 1978; Smith and Kuhle, 1998) basalts of the San Felipe volcanic field indicate a history of recurrent movement that may have extended into the early Pleistocene (Wong and others, 1995; Machette and others, 1998; Personius and others, 1999). However, displacements on some or all of the faults on Santa Ana Mesa may be related to volcano-tectonic processes (Personius and others, 1999); the narrowing of the fault zone near the center of the volcanic field supports this inference (for example, van Wyk de Vries and Merle, 1996). If most of the displacement on faults in the San Felipe graben is related to basalt eruption, then earthquakes associated with these faults may have smaller magnitude than those associated with tectonic faults (Smith and others, 1996). Numerous eruptive centers (unit Tbc) in the volcanic field are aligned in northerly patterns that mimic the fault strikes, but these features do not appear to be controlled by mapped faults and thus may be related to older structures (Kelley and Kudo,

1978).

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MISCELLANEOUS FIELD STUDIES MAP MF-2405 Version 1.1

Table 1. Correlation chart for alluvial deposits of the Jemez River
 (upstream is to left), indicated by map unit symbols. [Units in bold type shown on this map. Leaders (--) indicate deposit not mapped in quadrangle]

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	Ponderosa quadrangle ¹	Jemez Pueblo and San Ysidro quadrangles ²	Bernalillo NW quadrangle ³	Santa Ana Pueblo quadrangle
	Qt9	Qt6	Qaj6b	Qaj6
	Qt7, Qt8	Qt5	Qaj6a	Qaj6
	Qt5?	Qt4a?	Qaj5	Qaj5
	Qt5?	Qt5a, Qt4a?	Qaj4	
	Qt4	Qt4	Qaj3	Qaj3
	Qt3	Qt3	Qaj2	
	Qt2	Qt2		Qaj1
1 2	Sources: Rogers (199 Sources: Formento-T	96) and Rogers and Sm Frigilio and Pazzaglia (19	artt (1996) 996, 1998), Formento-Ti	rigilio (1997),

Pazzaglia (1998), and Pazzaglia and others (1998) ³Source: Koning and Personius (2002)

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centimeters (cm)	0.3937	inches (in.)
meters (m)	3.281	feet (ft)
kilometers (km)	0.6214	miles (mi)

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(1977), lower member of lower unnamed formation of Santa Fe Group of Spiegel (1961), upper and middle

cm) granule pebble gravel beds. Mudstones generally

Lower Tertiary and Cretaceous rocks, undivided (Eocene and Cretaceous)—Shown on cross section only. Sedimentary rocks of Eocene Galisteo Formation, upper