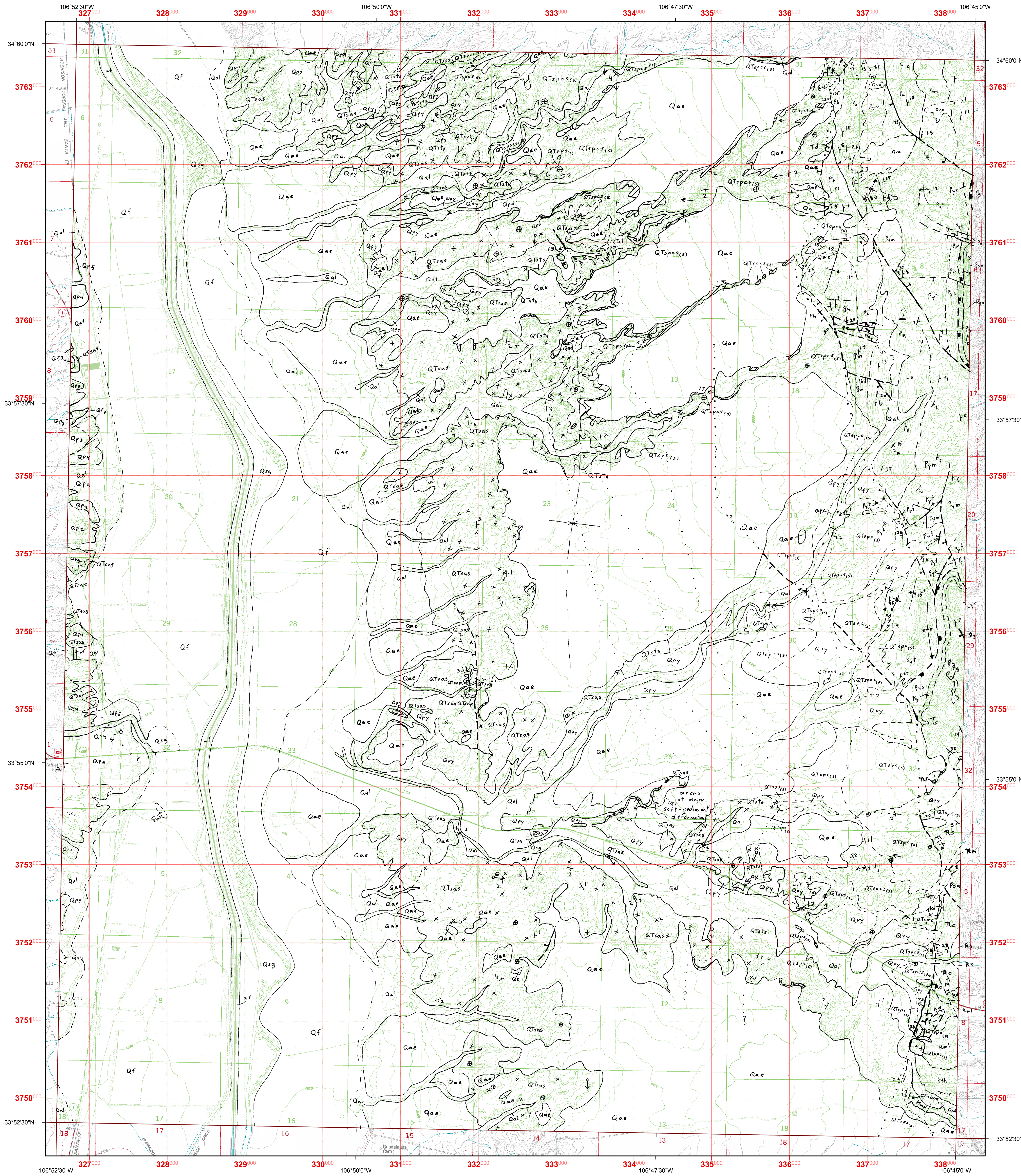
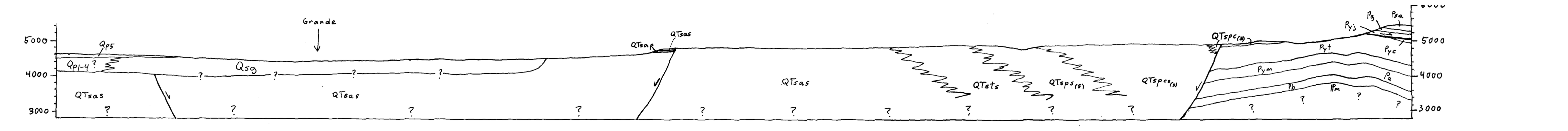
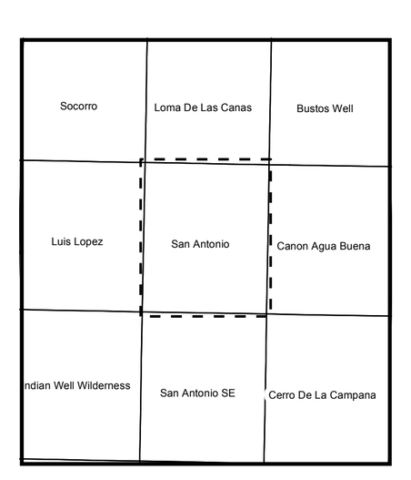
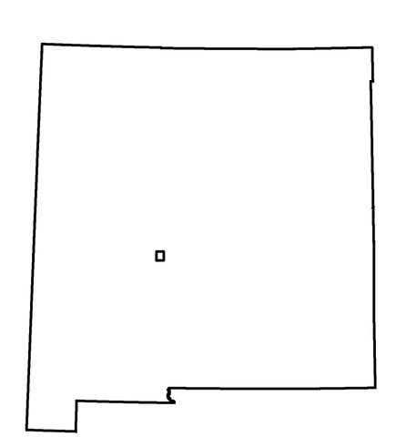




Base from U.S.Geological Survey 1981, from photographs taken 1972 and field checked in 1975.
Map edited in 1981
1927 North American datum, UTM projection -- zone 13N
1000- meter Universal Transverse Mercator grid, zone 13, shown in red





Magnetic Declination
May, 2005
9º 50' East
At Map Center

Geologic Map of the San Antonio 7.5 - minute Quadrangle

by
Steven M. Cather

June 2005

1:24,000

CONTOUR INTERVAL 20 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

DRAFT

NMBGMR OF-GM 58

COMMENTS TO MAP USERS

A geologic map displays information on the distribution, nature, orientation, and age relationships of rock and deposits and the occurrence of structural features. Geologic and fault contacts are irregular surfaces that form boundaries between different types or ages of units. Data depicted on this geologic quadrangle map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation. Locations of contacts are not surveyed, but are plotted by interpretation of the position of a given contact onto a topographic base map; therefore, the accuracy of contact locations depends on the scale of mapping and the interpretation of the geologist(s). Any enlargement of this map could cause misunderstanding in the detail of mapping and may result in erroneous interpretations. Site-specific conditions should be verified by detailed surface mapping or subsurface exploration. Topographic and cultural changes associated with recent development may not be shown.

Cross sections are constructed based upon the interpretations of the author made from geologic mapping, and available geophysical, and subsurface (drillhole) data. Cross-sections should be used as an aid to understanding the general geologic framework of the map area, and not be the sole source of information for use in locating or designing wells, buildings, roads, or other man-made structures.

The map has not been reviewed according to New Mexico Bureau of Geology and Mineral Resources standards. The contents of the report and map should not be considered final and complete until reviewed and published by the New Mexico Bureau of Geology and Mineral Resources. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the State of New Mexico, or the U.S. Government.

This work was performed under the STATEMAP component of the USGS National Cooperative Geologic Mapping Program. Funding for geological mapping was provided by the U.S. Geological Survey and the New Mexico Bureau of Geology and Mineral Resources, a division of New Mexico Tech. The New Mexico Office of the State Engineer is providing funding for the compilation effort as well as the hydrologic investigation underway.

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http://geoinfo.nmt.edu/statemap

or contact:
NMBGMR Publications -- [505] 835-5410
NMBGMR Geologic Information Center -- [505] 835-5145

This draft geologic map was produced from scans of hand-drafted originals from the author(s). It is being distributed in this form because of the demand for current geologic mapping in this important area. The final release of this map will be made following peer review and redrafting in color using NMBGMR cartographic standards. The final product will be made available on the internet as a PDF file and in a GIS format.

DESCRIPTION OF UNITS

(Middle Pleistocene–Holocene)

af artificial fill

Qsg Sand and gravel (Holocene). Sand, gravel, and minor mud in modern active arroyo channels and in the channel of the Rio Grande. 0-30 m thick.

Qal Alluvium (Holocene). Sand, gravel, and mud adjacent to modern arroyo and river channels. Alluvium is typically at or near grade of modern channels, except in local areas where cutting of toes of piedmont slopes by the Rio Grande has caused arroyos to incise deeply (1-3 m). 0-30 m thick.

Qf Mud and sand (Holocene). Deposits on the modern floodplain of the Rio Grande.

Qe Eolian deposits (upper Pleistocene-Holocene). Eolian sands and loessic silts; deposits are stabilized by vegetation in most areas, but active dunes are present on lee sides of hills in some areas. Includes thin, discontinuous eolian veneers on stable upland surfaces that are intimately intertongued with alluvium. 0-10 m thick.

Qpy Younger piedmont alluvium (upper Pleistocene). Gravel, sand, and mud deposited at low elevations (less than about 30 m) above modern stream grade, east of the Rio Grande. Alluvium is representative of deposition in a variety of piedmont environments, including alluvial fans, paleovalley and arroyo fills, strath terraces, fill terraces, and pediments. At least two aggradational episodes are represented by **Qpy**. 0-25 m thick.

Qpo Older piedmont alluvium (middle to lower(?) Pleistocene). Gravel, sand, and mud deposited at higher elevations (more than about 30 m) above modern stream grade east of the Rio Grande. Range of depositional environments is similar to **Qpy**. At least two aggradational episodes are represented by **Qpo**. 0-40 m thick.

Qp_{1-5} Volcaniclastics gravels, sands, and minor muds (middle to late Pleistocene). Paleovalley and strath fills fill terraces, and alluvial fan deposits inset beneath upper aggradational surface of Santa Fe Group west of the Rio Grande. Deposits are classified by their relative landscape position (**Qp_1** oldest and least inset, **Qp_5** youngest and most deeply inset). 0–30 m thick.

SANTA FE GROUP

(lower Miocene–middle Pleistocene)

Sierra Ladrones Formation (Pliocene to middle Pleistocene) (thickness unknown, facies subdivisions after Cather, 1997)

$QTspc_{(s)}$ Conglomeratic piedmont facies. Characterized by conglomerate/sandstone ratio greater than 2/1. Conglomerate is typically nonvolcaniclastic, poorly sorted and clast supported. Sandstone is typically medium to very coarse and crossbedded or horizontally stratified. Matrix-supported debris-flow deposits are common. Mudstone is rare. **QTspc** includes gravelly veneers on pediment surfaces.

$QTspcs_{(s)}$ Conglomerate-sandstone piedmont facies. Characterized by conglomerate/sandstone ratio between 2/1 and 1/2; this is the volumetrically dominant piedmont facies within the Sierra Ladrones Formation. Conglomerate is mostly nonvolcaniclastic and is mostly clast-supported and poorly sorted. Sandstone is typically medium to very coarse-grained, commonly pebbly, and exhibits crossbedding or horizontal stratification. Mudstone is minor.

$QTsps_{(s)}$ Sandstone-dominated piedmont facies. Characterized by conglomerate/sandstone ratio of less than 1/2. Conglomerate is clast-supported and occurs in tabular or lenticular units <2 m thick. Sandstone is very fine to very coarse grained and exhibits a dominance of horizontal stratification. Mudstone is common and occurs as tabular units which locally compose as much as 20% of the unit. Calcareous paleosols are locally well-developed.

QTsa Axial-river facies. Channel and floodplain deposits of ancestral Rio Grande consisting of variable proportions of sandstone, mudstone, and conglomerate. Sandstone is typically crossbedded and poorly indurated. Clasts in conglomerate consist of well-rounded to sub-rounded pebbles of quartzite, chert, granite, gneiss, sandstone, volcanic lithics, siltstone, schist, phyllite, limestone, obsidian, and pumice. Mudstone ranges in color from reddish brown to greenish gray. Paleoflow was to the south. *Crosses* (x) on map indicate selected exposures of axial sandstone and conglomerate used to delineate areal extent of axial-river facies (**QTsa**) and transitional axial-piedmont facies (**QTst**).

QTst Transitional axial-piedmont facies. Intertongued axial river deposits and piedmont deposits. Transitional deposits are defined as the zone of overlap between the *basinward* extent of piedmont sand and gravel and the *mountainward* extent of axial river sand and gravel. Mudstone is commonly ambiguous as to its former position within the facies tract (i.e. piedmont vs. axial), and thus is not a factor in delineating the transitional facies.

QTsap Volcanic ash and pumice. Water-reworked rhyolitic pumice and ash derived from Otowi Member of Bandelier Tuff (1.61 Ma).

CRETACEOUS

Kmd **D-Cross Tongue of Mancos Shale (Upper Cretaceous)**—Dark gray to black marine shale and sandy shale. Forms slopes and valleys. About 300 ft thick.

Khd **Tres Hermanas Formation (Upper Cretaceous)**—Consist of basal regressive shoreface-related sandstone and mudstone (**Atarque Member**), medial continental mudstone, sandstone, and coal (**Carthage Member**), and upper, transgressive, shoreface-related sandstone and mudstone (**Fite Ranch Member**). Forms ridges. Total thickness 265 ft.

Kml **Lower Mancos Shale (Upper Cretaceous)**—Dark gray marine shale with rare sandstone and limestone beds. Forms slopes and valleys. About 440 ft thick.

Kd **Dakota Sandstone (Upper Cretaceous)**—White to yellowish-gray, shoreface-related sandstone, pebbly sandstone, and minor mudstone. Sandstone is commonly crossbedded. Forms ridges. Thickness about 65 ft.

TRc **Chinle Formation (Upper Triassic)**—Red, gray and maroon fluvial mudstone with subordinate sandstone and limestone-pebble conglomerate. Forms slopes and valleys. About 540 ft thick.

TRs **Santa Rosa Sandstone (Upper Triassic)**—Brown, maroon, and gray fluvial sandstone, siliceous conglomerate and mudstone. About 235 ft thick.

TRm **Moenkopi Formation (Middle and Lower Triassic)**—Red-brown, brown, and buff continental mudstone, sandstone and siltstone-cobble conglomerate. Lower part of unit may contain beds correlative with the Permian Artesia Formation (e.g. Fagrelius, 1982). Forms slopes and valleys. About 100 ft thick.

PALEOZOIC ERATHEM

Permian System

Psa **San Andres Formation (Upper Permian)**—Gray marine limestone, minor sandstone and mudstone in lower part totalling about 220 ft thick. Forms prominent ridges. Upper part is white, bedded gypsum and subordinate buff mudstone about 50 ft thick.

Pg **Glorieta Sandstone (Upper Permian)**—White to orangish-gray quartzose sandstone, commonly crossbedded. 130 ft thick.

Pyj **Joyita Member of the Yeso Formation**—Brown, buff, gray, and pink sandstone and minor mudstone. Forms a slope. About 155 ft thick.

Pyc **Las Cañas Member of Yeso Formation (Upper Permian)**—Limestone, mudstone, gypsum, and minor sandstone, commonly brecciated due to karst development. Less than about 100 ft thick due to truncation of top of unit by low-angle normal faulting.

Pyt **Torres Member of Yeso Formation (Upper Permian)**—Red brown to buff calcareous sandstone and mudstone and gray marine limestone. About 455 ft thick.

Pym **Meseta Blanca Member of Yeso Formation (Upper Permian)**—Red brown, maroon, and gray sandstone and mudstone. About 295 ft thick.

Pa **Abo Formation (Upper Permian)**—Red and maroon fluvial mudstone, sandstone, and minor conglomerate. Forms slopes and valleys. About 370 ft thick.

Pb **Bursum Formation (Upper Permian)**—Purplish-red and maroon mudstone, arkosic sandstone and conglomerate, and thin marine limestone beds. About 195 ft thick.

Pennsylvanian System

IPm **Atrasado Formation of Madera Group (Upper Pennsylvanian)**—Gray marine limestone with subordinate calcareous mudstone and arkosic sandstone. Forms cuestas and ridges. At least 190 ft in thickness.

EXPLANATION OF MAP SYMBOLS

Contact between geologic units or facies within Santa Fe Group. Dashed where approximately located. Dotted where concealed (Santa Fe lithofacies only).

Fault showing direction and dip of fault plane. Dashed where approximately located; dotted where concealed. Bar and ball on downthrown block. Square teeth on upper plate of low-angle normal fault; triangular teeth on upper plate of reverse fault.

Anticline showing trace of axial plane and plunge direction. Dashed where approximately located, dotted where concealed.

Syncline showing trace of axial plane and plunge direction. Dashed where approximately located, dotted where concealed.

14 Strike and dip of bedding.

Vertical bedding.

Horizontal bedding.

Selected exposure of axial sand or gravel in Sierra Ladrones Formation used to delineate areal extent of QTsa or QTst.

Paleocurrent direction in piedmont deposit based on pebble imbrication or crossbedding.

Paleocurrent direction in axial river deposit based on pebble imbrication or crossbedding.

Erosional remnants of aggradational surface at top of Santa Fe Group (Las Cañas surface and Sedillo Hill surface of McGrath and Hawley, 1987). Characterized by well-developed calcareous paleosols.