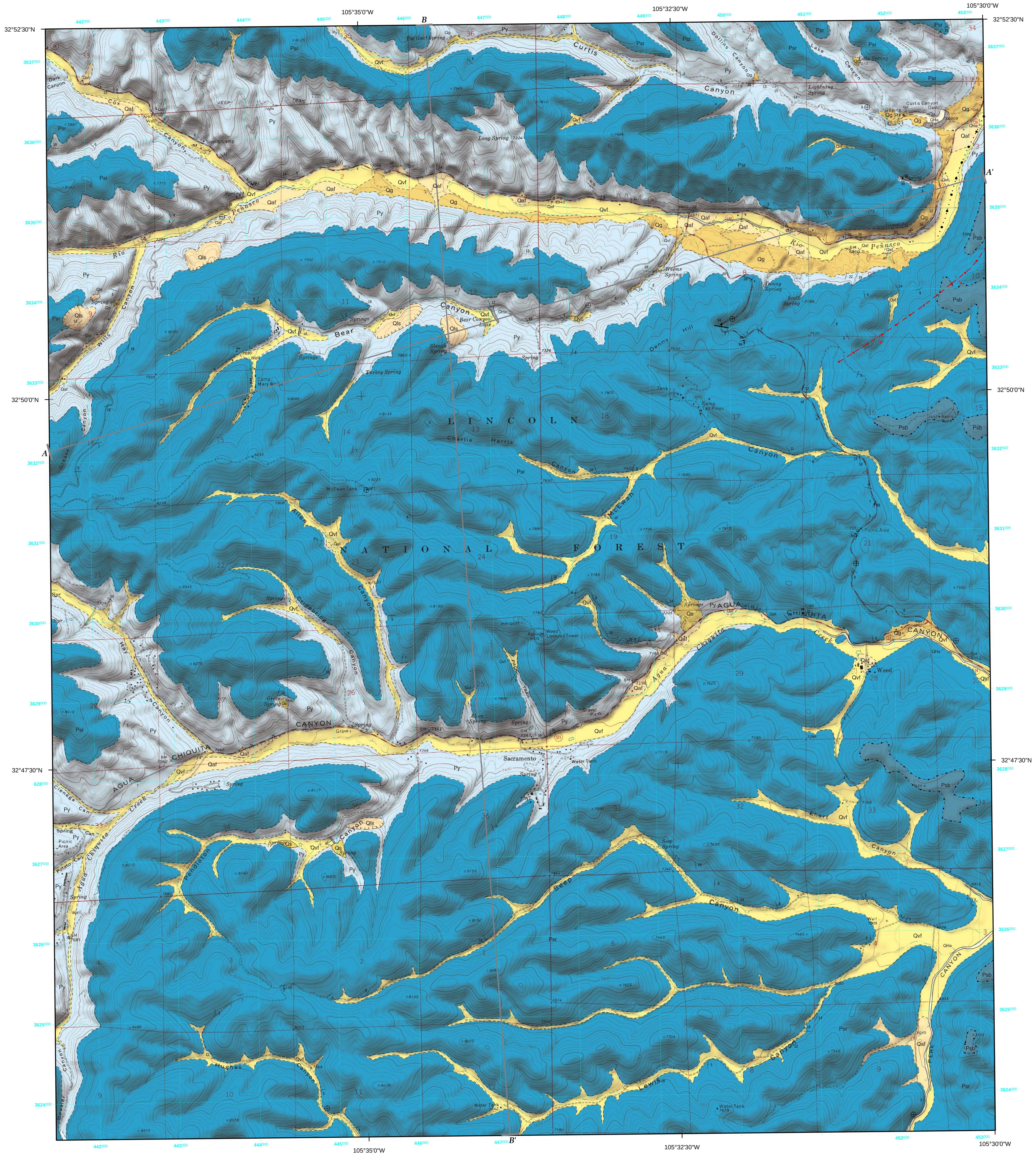
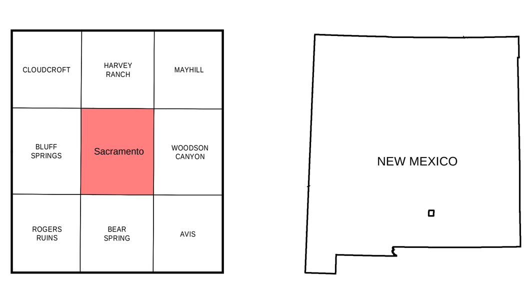



Base map from U.S. Geological Survey 1970, from photographs taken 1965, field checked in 1970, edited in 1993.
1927 North American datum, UTM projection -- zone 13N
1000-meter Universal Transverse Mercator grid, zone 13, shown in blue.




QUADRANGLE LOCATION


Magnetic Declination
May 2006
9º 5' East
At Map Center

1:24,000

1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

# Geologic map of the Sacramento quadrangle, Otero County, New Mexico.

June 2007

by

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**New Mexico Bureau of Geology and Mineral Resources**
**Open-file Geologic Map 156**

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**This and other STATEMAP quadrangles are available for free download in both PDF and ArcGIS formats at:**

***http://geoinfo.nmt.edu***

Mapping of this quadrangle was funded by a matching-funds grant from the STATEMAP program of the National Cooperative Geologic Mapping Act, administered by the U. S. Geological Survey, and by the New Mexico Bureau of Geology and Mineral Resources, (L. Greer Price, *Director and State Geologist*, Dr. J. Michael Timmons, *Geologic Mapping Program Manager*).

## 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map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation.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.

## Description of Map Units

**Anthropogenic Deposits**

af — Artificial fill for water impoundments and highway embankments.

**Quaternary and Tertiary Surficial Deposits**

QHa — **Alluvium (Holocene to Historic)–**Unlithified gravel and poorly to moderately sorted clay, silt, and sand in active stream channels. Generally present in gullies incised into Qvf . Only mapped where extensive and obvious on aerial photographs; unit is otherwise mapped with Qvf. Thickness: 0 to 4 (?) meters.

Qs — **Spring deposits – (Pleistocene (?) to Holocene–**Vegetation-covered mounds formed at spring outlets by precipitation of tuffaceous carbonate. Deposits are white to pale-gray, chalky and friable, and have abundant incorporated organic debris. Springs do not appear to be presently depositing carbonate. Only the largest mounds are mapped, many smaller ones exist. Thickness: 0 to 10 (?) meters.

Qvf — **Valley fill (upper Pleistocene to Holocene)–**Unlithified valley fill composed of poorly sorted clay, silt, and sand, commonly with angular to subrounded cobbles of local bedrock. Matrix material is light to dark brown, reflecting soil development processes. Grades into minor alluvial and colluvial fans on toes of hillslopes. Often incised by active drainages, floored by sand and cobble to boulder gravel of QHa. Anthropogenic disturbance common in developed areas. Largely mapped from aerial photographs. Thickness: 0 to12 (?) meters.

Qaf — **Alluvial fan deposits (middle to upper Pleistocene)–**Alluvial fans composed of poorly sorted cobbles, boulders, sand, silt, and clay. Fans head in short, steep tributary canyons and interfinger with and/or spread out onto valley bottom deposits. Stabilized by vegetation and apparently no longer active, and locally incised by drainages floored with QHa. Only mapped along major drainages where geomorphic expression is clear on aerial photos. Thickness: 0 to 10 (?) meters.

Qg — **Stream gravel deposits (lower to middle (?) Pleistocene)–**Poorly to well-lithified pebble to boulder gravel. Deposit forms eroded and locally incised terraces and bluffs in Rio Penasco Canyon and Curtis Canyon. Gravel pit exposure east of the NM 24 – NM 130 intersection shows meter-scale interbedding of well-cemented pebble to cobble gravel and silty sand. Clasts are well-rounded and are composed of carbonates derived from the San Andres and Yeso Formations. Grades laterally into alluvial fan deposits and colluvium, which have much cruder bedding and more angular clasts. Postdates incision of modern drainages. Thickness: 0 to 40 (?) meters.

Qls — **Landslide and slump deposits (lower to middle (?) Pleistocene)–**Landslide and colluvium complexes. Deposits on slopes in Rio Penasco Canyon, Wills Canyon and Bear Canyon are composed of poorly sorted angular to subrounded blocks of San Andres limestone some of which are back-rotated towards the cliff. Deposits in Bear canyon are poorly exposed and recognizable only by blocks of Glorieta Sandstone at significantly lower elevations than elsewhere in the canyon. Thickness: 0 to 60 (?) meters.

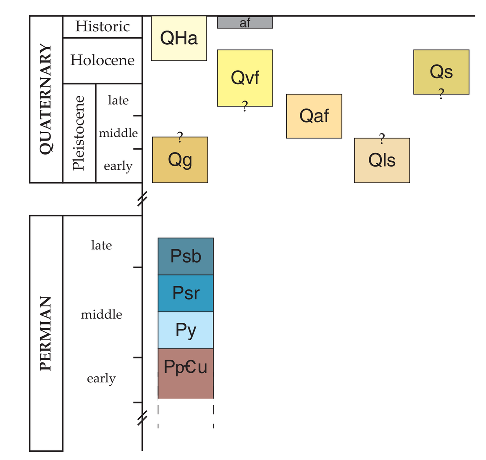
**Paleozoic Sedimentary Rocks**

Psr, Psb — **San Andres Formation (middle to upper Permian)–**Light to dark gray and bluish gray limestone and dolomite. Limestones and dolomites range from thin to very thick bedded, and are carbonate mudstones, wackestones, and grainstones. Freshly broken surfaces are darker gray than weathered surfaces and often fetid. Silty and sandy beds are common. Float is nearly everywhere present but good outcrop is sparse and the unit is generally poorly exposed where tree cover is dense, generally to the west and at high elevations. Subdivision of the San Andres into the lower dominantly thick-bedded Rio Bonito Member (Psr) and upper dominantly medium- to thin-bedded Bonney Canyon member (Psb, Kelley, 1971) was based on aerial photograph interpretation. The two members cannot be reliably distinguished in the field within this quadrangle. On aerial photographs they can be distinguished based on average bed thickness and continuity, which is revealed by vegetation patterns that give the Bonney Canyon member a distinctly striped appearance. Where the average vegetation density increases greatly, such as on north facing slopes and the higher elevations in the central and western portions of the quadrangle, the two units cannot be distinguished on aerial photographs; thus the outcrop of the Bonney Canyon member may be more extensive than is mapped here. The Glorieta Sandstone Tongue is composed of gray and light to medium brown fine- to medium-grained sandstone consisting of frosted and well-rounded quartz grains. Semi-continuous outcrop and/or float and distinctive appearance makes this an easily recognizable marker unit and the basis for mapping the San Andres – Yeso contact formational contact, which occurs 12 to 25 m beneath the Glorieta Tongue. Commonly there is a break in slope above the Glorieta sandstone that is another useful criteria for identifying the base of the San Andres Formation. Thickness: Rio Bonito member: ~ 183 meters; Bonney Canyon member: top not exposed, at least 46 meters exposed in the Woodson Canyon quadrangle to the east; Glorieta Sandstone: 0 to 5 meters.

Py — **Yeso Formation (middle Permian)–**Yellow to tan siltstone and fine sandstone, red to pink muddy siltstone and fine sandstone, gray to tan silty limestone and dolomite. Siltstone and sandstones are thin to medium bedded and friable. Muddy siltstones and sandstones are laminated to very thin bedded. Limestones are very thin to thin bedded, rarely medium to thick bedded. In general, they are thinner bedded than overlying basal San Andres beds. Meter scale interbedding of carbonate, siltstone, and sandstone is common. A vertically continuous medium-bedded carbonate section that forms cliffs along the canyon bottoms near the junction of Upper Rio Penasco, Will's, and Cox Canyons is traceable east and west for several miles. This section is about 400 feet below the top of the Yeso and probably corresponds to the thick limestone near the middle of the formation described by Kelly (1971) and Pray (1961). However in general, bedding dips are usually chaotic due to dissolution of gypsum and (and carbonates?) and individual beds are generally not traceable laterally for more than a few 10s of meters. Natural exposures are poor except in road and stream cuts and very steep slopes and the upper contact is usually mantled by colluvium and/or landslides from the overlying San Andres Formation. Thickness: Base not exposed; ~550 meters based on unit thickness in the Cloudcroft Unit #1 oil test well in the Bluff Springs quadrangle to the west.

Pp₵u — **Permian to Proterozoic rocks–**Paleozoic sedimentary rocks and Proterozoic igneous and metamorphic rocks, undivided (cross section only). Thickness of Sub-Yeso approximately 740 meters in the Cloudcroft Unit #1 oil test well in the Bluff Spring quadrangle to the west.

## Correlation Diagram




Exposure of the contact of the Rio Bonito Member (**Psb)** of the San Andres Formation (**Psa**) with the underlying Yeso Formation (**Py**) on the road to the Weed Lookout. Grey limestone of the Rio Bonito member form a sharp contact with yellow and brown, crinkly-bedded fine sandstones and siltstones of the Yeso Formation (under hammerhead). Hammer is 42 cm long.

Moderately lithified gravels of unit **Qg** form a buttress unconformity against limestones and fine sandstones of the Yeso Formation (**Py**). Exposure is in a roadcut along NM 130 east of the intersection with NM 24.

## Explanation of Map Symbols

A — A' Location of geologic cross section

Geologic contact,solid where exposed and identification is certain, dashed where approximately located and identification is certain, dashed with ball where approximately located and identification is probable,queried where identification and location are uncertain.

Buried normal fault, ball and bar on downthrown side.

50 Dip and dip direction of bedding

50 Dip and dip direction of joints

Dip and dip direction of vertical joints

10 Small fault, normal offset, arrow shows dip and dip direction.

Monocline, identification is probable, dashed where approximately located.

Monocline, identification is probable, dashed where approximately located.

Landslide or slump block. Headscarp indicated by hachures with ticks, toe indicated by dotted line.