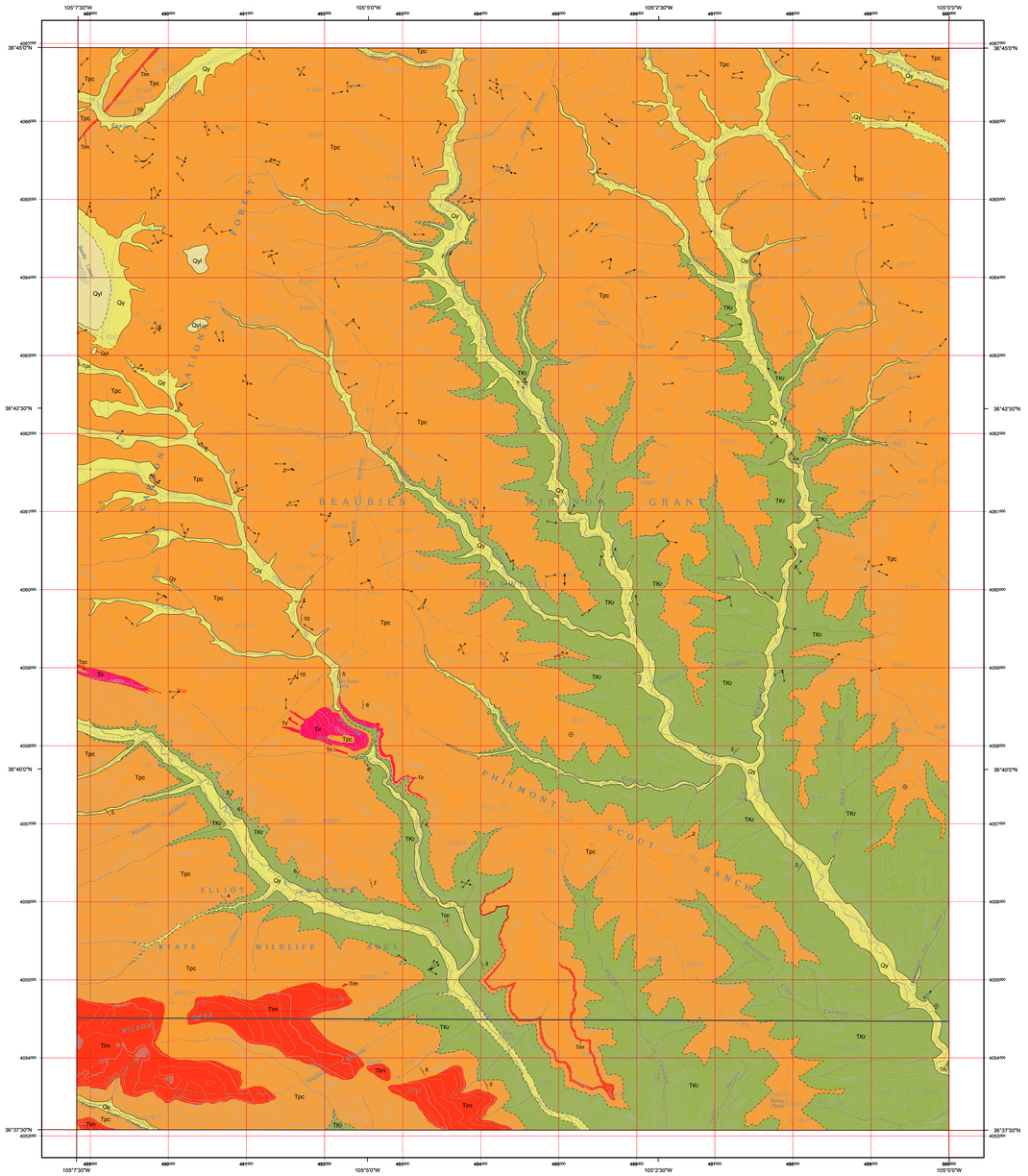
NMBGMR Open-file Geologic Map 122
Last Modified 07 August 2008



Base map from U.S. Geological Survey 1984, from photographs taken 1976, field checked in 1976, edited in 1984.
1927 North American datum, UTM projection—zone 13N
1000-meter Universal Transverse Mercator grid, zone 13, shown in red

QUADRANGLE LOCATION

Magnetic Declination
Month, Year
9° 29' 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

This draft geologic map is preliminary and will undergo revision. It was produced from either scans of hand-drafted originals or from digitally drafted original maps and figures using a wide variety of software, and is currently in cartographic production. It is being distributed in this draft form as part of the bureau's Open-file map series (OFGM), due to high demand for current geologic map data in these areas where STATEMAP quadrangles are located, and it is the bureau's policy to disseminate geologic data to the public as soon as possible.

After this map has undergone scientific peer review, editing, and final cartographic production adhering to bureau map standards, it will be released in our Geologic Map (GM) series. This final version will receive a new GM number and will supercede this preliminary open-file geologic map.

DRAFT

New Mexico Bureau of Geology and Mineral Resources
Open-file Geologic Map 122

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, (Dr. Peter A. Scholle, *Director and State Geologist*, Dr. J. Michael Timmons, *Geologic Mapping Program Manager*).

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This and other STATEMAP quadrangles are (or soon will be) available for free download in both PDF and ArcGIS formats at:

http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/home.html

Geologic map of the Abreu Canyon quadrangle, Colfax County, New Mexico.

May 2006

by
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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

Quaternary

Qyl **Lacustrine deposits (Holocene)** – This unit is composed mostly of silt and clay, with interbeds of fine to coarse sand where exposed in gullies and mud cracks. Some granular gypsum is exposed in deposits to the west in the northeast part of the Baldy Mountain 7.5' quadrangle. This unit represents mostly fine-grained lake deposits that filled small and large depressions in the Poison Canyon Formation.

Qy **Alluvial deposits (Holocene)** – These deposits are composed of interbedded fine-grained silts and sands, and coarser layers of sand and cobbles. Coarser layers are exposed more in the deeper parts of gullies and most surface deposits are fine-grained. A few coarser layers up to about 20 cm thick separate thick fine-grained layers over a meter thick, and may represent channel deposits. Several soil horizons are visible in the deeper gullies, and are defined by darker organic horizons overlying clay-rich B-horizons exhibiting columnar ped structure. As mapped, these deposits fill the modern valley floors.

Tertiary

Tir **Rhyolite sills and dikes (Tertiary)** – This hypabyssal intrusive rock contains phenocrysts of subhedral feldspar (K-feldspar?), quartz, and euhedral books of biotite all up to about 3 mm across. Locally contains sparse amphibole laths and large, subhedral to euhedral, zoned, light gray K-feldspar phenocrysts up to 2 cm across.

Tim **Intermediate to mafic sills and dikes (Tertiary)** – These shallow intrusive bodies are composed of mostly subhedral light gray plagioclase and about 10% pyroxene. On weathered surfaces the cores of the plagioclase phenocrysts weather out and are locally stained pinkish gray. At first glance the ferromagnesian minerals resemble biotite because some exhibit hexagonal profiles. However, some also show octagonal profiles and none show the basal cleavage of biotite. Most of the ferromagnesian minerals form short prismatic columns, mostly less than 1 mm, though some are up to 1 cm long. They are black to dark green, glassy, and show mostly concoidal-like cleavage.

Tpc **Poison Canyon Formation (Paleocene)** – This unit is composed of tan arkosic sandstone and pebbly conglomerate. Sand grains are angular to subrounded and moderately to poorly sorted. Beds are typically between 10 and 120 cm thick. Planar cross-bedding is abundant. Slopes are underlain by finer-grained sandstone and minor shale. Overall this unit is coarser grained than the Raton Formation (map unit TKr), though in many ares the two units appear very similar. The poison Canyon Formation contains widespread conglomeratic interbeds composed of medium to coarse sand and subrounded to well rounded pebbles of vein quartz and gray quartzite up to about 1-2 cm across. The size of the pebbles increases to the west into the Baldy Mountain 7.5' quadrangle. This unit tends to form small blocky cliffs that have a slight orange tint, in contrast to the more yellowish, more thinly bedded sandstone cliffs of the Raton Formation.

Tertiary and Cretaceous

TKr **Raton Formation (Cretaceous and Tertiary)** – This unit contains interbedded fine- to medium-grained sandstone, siltstone, shale and coal. Light yellow cliff-forming sandstone layers are composed mostly of fine- to medium-grained, moderately well sorted, angular to subrounded quartz ± feldspar sand. The percentage of feldspar is difficult to estimate as these grains also resemble milky quartz. Trough cross-beds 20 to 100 cm thick are common. Very few pebbles or granules are seen. The base of sandstone beds is sharp and undulatory and commonly overlies carbonaceous shale. Slopes generally show poor exposures, but where exposed reveal interbedded greenish tan shale and fine-grained sandstone in beds 10 to 50 cm thick. Detrital muscovite flakes are locally very common and give some bedding exposures a shiny sheen. Both the shale and sandstone contain abundant plant fragments as both impressions and as carbonized remains. Some plants are identifiable as palm fronds and deciduous leaves.

Cretaceous

Kv **Vermejo Formation (Cretaceous)** – Interbedded tan to greenish gray sandstone, greenish gray shale, and coal. Nearly identical to the Raton Formation and not easily distinguished from it except for its position atop the Trinidad Sandstone where it forms a generally recessive slope or series of ledges. Not exposed in the map area. Only shown in cross section.

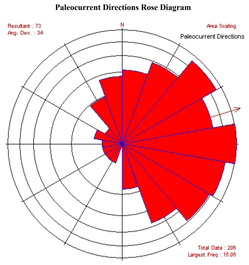
Kt **Trinidad Sandstone (Cretaceous)** – This unit contains fine- to medium-grained, moderately well sorted, angular to subrounded quartz ± feldspar sand. This unit is similar in appearance to the light yellow sandstone beds of the Raton Formation, though is generally lighter gray to white and is very clean. Not exposed in the map unit but forms an obvious cliff above greenish gray Cretaceous shales north of Cimarron. Only shown in cross section.

Kp **Pierre Shale and Niobrarra Formation, undivided (Cretaceous)** – Greenish gray fissle shales. Not examined in detail, and not exposed in the map area. Only shown in cross section.

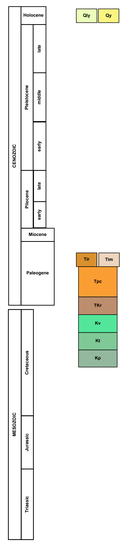
Explanation of Map Symbols

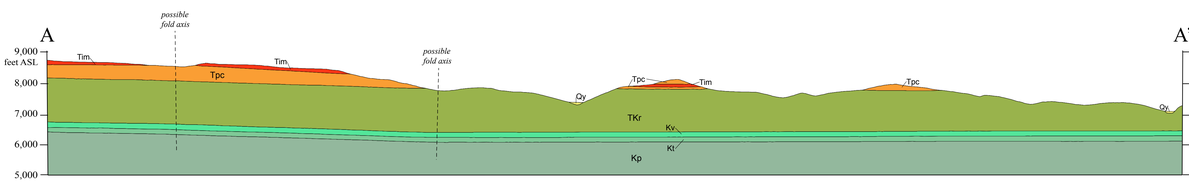
- A — A' Location of geologic cross section.
- Geologic contact. Solid where certain, dashed where approximate.
- Ryholite dikes / sills.
- Sills of *Tim*.
- Strike and dip of inclined bedding.
- Horizontal bedding.
- Paleocurrent measurement.
- Paleochannel with unknown flow direction.

Paleocurrent Directions Rose Diagram



Correlation of Map Units





Discussion of Geologic History

INTRODUCTION

The Abreu Canyon quadrangle is located just east of the southwestern margin of the Raton Basin (Cather, 2004) in northeastern New Mexico, about 15-20 miles northwest of the town of Cimarron. The area lies on the northeastern side of the Cimarron Range, part of the southernmost Rocky Mountains. Elevations range from about 7100 feet (2165 m) along North Ponil Creek in the southeast corner of the map to over 8600 feet (2622 M) in the southwest corner of the map. Several major drainages, including Poñil Creek and North Poñil Creek, slice deeply down through the area and are floored along most of their length by mostly fine-grained Holocene alluvial deposits. Most of the southeastern part of the map lies within the Philmont Scout Ranch, while the southwest corner lies within the Elliot Barker State Wildlife Area. The northern half of the map is mostly part of the old Beaubian and Miranda Land Grant. Most of the quadrangle is covered with sparse to relatively dense Ponderosa-juniper-piñon-oak forests.

The quadrangle is dominated by a relatively flat-lying sequence of mostly late Cretaceous to early Tertiary (Paleocene) sedimentary units deposited as part of a large wave-influenced delta/alluvial fan in the Raton Basin. Outcrops of Raton Basin sediments are exposed from the imposing cliffs immediately north and west of the town of Cimarron, in the south, past the town of Walsenburg over 100 km to the north in Colorado. The distal parts of the fan complex are apparently eroded away and the current eastern margin of the basin is defined by a series of cliffs facing eastward out over the Great Plains. The western margin of the basin has also been extensively eroded and is presently defined by an angular unconformity on older Pennsylvanian (?) conglomeratic red beds (named the conglomerate of Mills Divide by Ferguson and Skotnicki, in prep). The western margin of the basin is also defined locally by a large northeast-southwest striking west-dipping normal fault that likely originally developed as a reverse fault during the Laramide orogeny (see Ferguson and Skotnicki, in prep).

At least two distinct sets of dikes and sills intrude the older sedimentary rocks: crystal-poor rhyolite, and crystal-rich intermediate (to marginally mafic) intrusive rocks. No cross-cutting relationships between the two types are exposed in the Abreau Canyon quadrangle, but in the neighboring Baldy Maountain quadrangle immediately to the west, each appears to cut the other locally, indicating that the two types were relatively coeval. Many of the intermediate dikes appear to radiate from the, in part, coarser-grained intrusion immediately north of Baldy Mountain itself, suggesting the area may have at one time been a volcanic center.

As pointed out by Cather (1994) the K-T boundary exposed in the Raton basin (dated at 65.4 ± 0.1 Ma; Obradovich, 1993) is the only precise age constraint for Cretaceous through Paleocene strata in the Raton basin.

PREVIOUS WORK

Many geologists have studied the rocks in the Raton Basin. Among them, Baltz (1965), Johnson and Wood (1959), Pillmore (1969, 1990), Pillmore and Flores (1987, 1990) and Pillmore and others (1984) examined the stratigraphy and depositional environments of the Raton Basin, and examined the areas at and near the Cretaceous-Tertiary boundary localities. Flores (1987), Flores and Tur (1982) and Tyler et al. (1995) studied the Trinidad Sandstone, which they interpreted as part of a prograding delta and barrier island complex. Work in the Abreu Canyon 7.5' quadrangle was performed concurrently with detailed mapping in the adjacent Baldy Mountain 7.5' quadrangle to the west (Ferguson and Skotnicki, in prep).

STRATIGRAPHY

The Raton Formation

The oldest deposits exposed on the Abreu Canyon 7.5' quadrangle are those of the Raton Formation (map unit TKr). The sedimentary deposits are composed of interbedded grayish green shale and sandstone interbedded with light yellow, well sorted quartz± feldspar sandstone. Organic matter is abundant both as thin seems of coal typically a few centimeters up to ~20 cm thick and as plant remains. Much of the plant material occurs as carbonized fragments, but also occurs as moulds and hollow casts, and locally abundant leaf impressions in sandstone. Deciduous leaf and palm-frond impressions were both observed.

The light yellow sandstone layers are typically fine-grained and rarely medium- to coarse-grained. These beds typically stand out as obvious yellow cliffs several meters to tens of meters high, while the grayish green shale and sandstone layers typically form recessive colluvium-covered slopes. At first glance the cliff-forming sandstone beds appear to be mappable units. However, they disappear under colluvium and/or pinch out rapidly. In contrast to the Poison Canyon Formation, trough cross bedding is common in the Raton Formation. Individual troughs are between about 30 cm and 1.5 meters wide and about 20-50 cm deep. The orientation of the trough axes in the few troughs were direction was discernable is northwest-southeast.

Although the yellow cliff-forming sandstones of the Raton Formation are mostly rather clean and well-sorted the interbedded grayish green shale and sandstone beds contain abundant quartz, feldspar and mica grains. Locally, the mica grains are so abundant on bedding planes that the rock resembles mica schist. The grayish green color of the deposits and their association with abundant plant remains and coal suggest these deposits were laid down in a reducing environment, probably in stagnant water.

The Poison Canyon Formation

The overlying Poison Canyon Formation (Tpc) within the Abreu Canyon quadrangle is rather monotonous mostly medium- to coarse-grained quartz sandstone and arkosic sandstone. The largest sized clasts are subangular to well rounded quartz and gray quartzite up to about 2 cm across. The larger gravel clasts commonly occur in discrete gravelly layers surrounded by a matrix of coarse arkosic sand. Trough cross bedding is rare in the Poison Canyon Formation. Planar cross-bedding is dominant, is very abundant and forms forsets from 10 to about 120 cm thick. At each location the paleocurrent direction of the forsets, as well as its dip angle and thickness, were measured. A rose diagram showing a summary of all the paleocurrent directions is shown in Figure 1. Exposures of the Poison Canyon Formation at first glance appear very similar to those of the underlying Raton Formation. However, and although subtle, the rocks of the former typically form light orange to light tan-colored blocky cliffs that form step-like terraces on the upper slopes of valleys, while the Raton Formation tends to form more light greenish tan exposures and more gentle slopes.

Pillmore (1990) grouped the Raton Formation and the Poison Canyon Formation together. That may be justified considering that north of the Abreu Canyon quadrangle coal-bearing rocks similar to the Raton Formation appear at higher elevations similar to where the Poison Canyon Formation crops out in the map area. However, the contact between the Raton Formation and the overlying Poison Canyon Formation in the central part of the Abreu Canyon quadrangle was pinpointed with confidence at three places (along Metcalf Canyon and North Poñil Creek), and could be easily followed visually downstream for some distance. However, it is possible that the contact actually interfingers and is not as simplistic as is shown on the map.

DIKES/SILLS

Two distinct sets of dikes intrude the Paleocene rocks of the Raton Basin: (1) rhyolite, and (2) diorite. The rhyolitic rocks (Tir) contain phenocrysts of quartz, feldspar, and biotite, and form northwest-trending dikes and one small sill in the southwest part of the quadrangle. The diorite to monzonitic rocks (Tim) form larger sills that intruded parallel to and slightly discordant to bedding in the Poison Canyon Formation in the southwest part of the map, and also as near-vertical northeast-trending dikes in the northwest corner of the map. Both of these rocks are more extensive to the west in the Baldy Mountain quadrangle, where apparently dikes of each cross-cut the other, indicating a similar age for both sets of dikes.

LAKE DEPRESSIONS AND QUATERNARY DEPOSITS

A series of closed depressions dot the landscape in the northwest part of the quadrangle northward for several miles. One of the largest is one of the Beatty Lakes which is about 1 mile across. These depressions are filled (at the surface) mostly with fine-grained silt and clay, and minor sand (Qyl). Mud cracks and salt crusts are common. The margins of the basins are composed of coalesced low-relief (probably late Holocene) alluvial fans (bajadas) composed of silt, sand, and gravel shed from the bordering hills. The head of Bonita Canyon approaches to within a hundred meters or so of the Beatty Lakes but is separated from these units by a low bedrock divide.

How these closed depressions formed is uncertain. They all formed within the underlying Poison Canyon Formation, which contains much less shale than the Raton Formation and is generally much more resistant to erosion. These basins are likely not karst depressions (dolines) because no carbonate rocks have been described in the subsurface. It is possible the depressions represent blowouts created by removal of loose fine-grained sediments by wind. However, most of the Poison Canyon Formation is medium to coarse sand that would only have been carried away by traction or saltation.

Although the stream valleys are typically very narrow and steep-sided the valley floors themselves are flat-floored. Most of the deposits (of Qyl) in the valley floors appear to be late Holocene in age. There are small remnants of older deposits resting on some of the sides of the canyons as terraces raised up to 3 meters or so above the valley fill, but these are very minor and have weak soil development indicating they are also Holocene in age. The shape of the valleys and the age of the deposits suggests that these valleys were originally cut deeper by erosion, have V-shaped profiles, and then were subsequently back-filled during the Holocene to their present form.

STRUCTURE

Most bedding in the Raton Basin deposits within the Abreu Canyon quadrangle dips less than about 4□. Because of this, and because it is difficult to find a good vantage point to measure a true dip, there is some uncertainty to the actual attitude of the beds. As mentioned above, the contact between the Raton Formation and the overlying Poison Canyon Formation was pinpointed with confidence at three places, and could be easily followed visually downstream for some distance. At each of these three localities (along North Ponil Creek and Metcalf Canyon) the contact was placed very nearly at 7800 feet elevation. Since the three sites are between 1-3 miles apart, the beds seem to be nearly horizontal in this area (at least the northwestern ¼ of the map. However, several good exposures along Bonita Canyon, and in the northwest corner of the map along the north side of Seally Canyon, show dips of 10□ to the east. Also, the sills in the southwest corner of the map appear to intrude along bedding (see cross-section) where they also dip gentle eastward. There are not quite enough measurements to draw the axis of a fold in this area, but based on steeper eastward dips to the west, in the southeast part of the Baldy Mountain quadrangle, it seems likely that the axis of a very broad syncline may project southward somewhere through middle of the Abreu Canyon quadrangle. This is roughly consistent with the position of La Veta Syncline, the axis of the Raton Basin, as interpreted by Tyler et al (1995) and Cather (2004).

REFERENCES

Baltz, E. H., 1965, Stratigraphy and history of Raton basin and notes on San Luis basin, Colorado-New Mexico: Bulletin of the American Association of Petroleum Geologists, v. 49, p. 2041-2075.

Cather, S. M., 2004, Laramide Orogeny in central and northern New Mexico and southern Colorado, in Mack, G.H., and Giles, K. A., (eds.), The Geology of New Mexico, a geologic history: New Mexico Geological Society Special Publication 11, p. 203-248.

Ferguson, C. A., and Skotnicki, S. J., in prep., Geology of the Baldy Mountain 7.5' Quadrangle, Taos and Colfax Counties, New Mexico: New Mexico Bureau of Geology and Mineral Resources map.

Flores, R. M., 1987, Sedimentology of Upper Cretaceous and Tertiary siliciclastics and coals in the Raton Basin: New Mexico Geological Society, 38th Filed Conference, Guidebook, p. 255-264.

Flores, R. M., and Tur, S. M., 1982, Characteristics of deltaic deposits in the Cretaceous Pierre Shale, Trinidad Sandstone, and Vermejo Formation, Raton Basin, Colorado: The Mountain Geologist, v. 19, p. 25-40.

Johnson, R. B., and Wood, G. H., Jr., 1956, Stratigraphy of Upper Cretaceous and tertiarY rocks of Raton basin, Colorado and New Mexico: Bulletin of the American Association of Petroleum Geologists, v. 40, p. 707-721.

Obradovich, J. D., 1993, A Cretaceous time scale, in Caldwell, W. G. E., and Kauffman, E. G., eds., Evolution of the Western Interior basin: Geological Association of Canada, Special paper 39, p. 379-396.

Pillmore, C. L., 1969, Geology and coal deposits of the Raton basin coal field, Colfax County, New Mexico: The Mountain Geologist, v. 6, p. 125-142.

Pillmore, C. L., 1990, Cretaceous and Paleocene rocks of the Raton basin, New Mexico; stratigraphic-environmental framework: New Mexico Geological Society, 41st Field Conference, Guidebook, p. 333-336.

Pillmore, C. L., and Flores, R. M., 1987, Stratigraphy and depositional environments of the Cretaceous-Tertiary boundary clay and associated rocks, Raton basin, New Mexico and Colorado, in Fassett, J. E., and Rigby, J. K., Jr., eds., The Cretaceous-Tertiary boundary in the San Juan and raton Basins, New Mexico and Colorado: Geological Society of America, Special paper 209, p. 111-130.

Pillmore, C. L., and Flores, R. M., 1990, Cretaceous and Paleocene rocks of the Raton basin, New Mexico and Colorado—Stratigraphic-environmental framework: New Mexico Geological Society, 41st Field Conference, Guidebook, p. 333-336.

Tyler, R., Kaiser, W. R., Scott, A. R., Hamilton, D. S., and Ambrose, W. A., 1995, Geologic and hydro-logic assessment of natural gas from coal; greater Green River, Piceance, Powder River, and Raton Basins, western United States: Texas Bureau of Economic Geology, Report of Invesigations no. 228, 291 p.