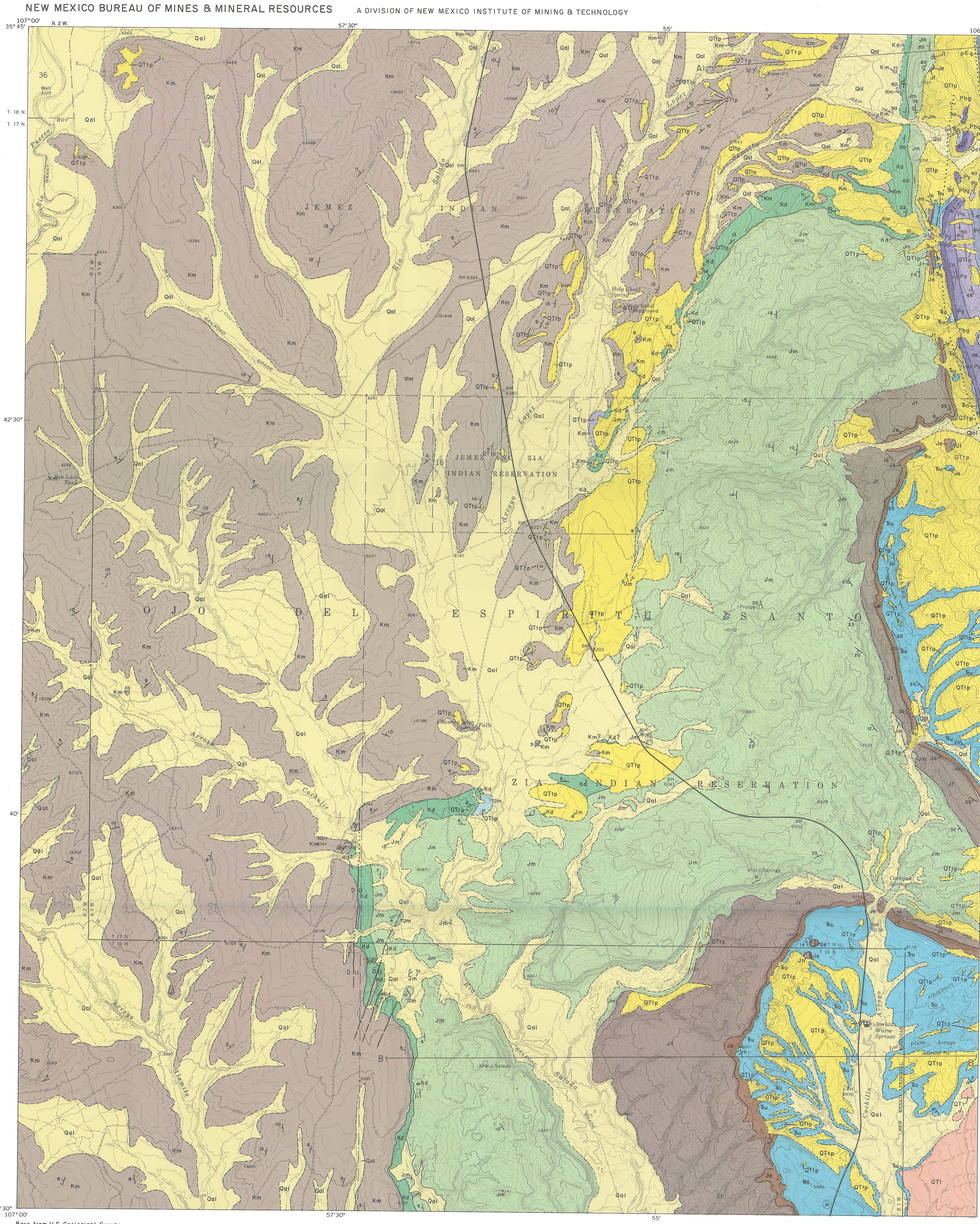


Base from U.S. Geological Survey

Geology by Lee A. Woodward and Ruben Martinez, 1971–1972

EXPLANATION

Qal — **Alluvium**
Clay, silt, sand, and gravel, mostly along valleys; includes some colluvium; to 25(?) ft thick

QTt — **Travertine**
Light tan, thin- to thick-bedded; to 30(?) ft thick

QTtp — **Terrace and pediment deposits**
Mostly boulder gravel with clasts of Precambrian age, or, locally, of Paleozoic and Mesozoic age; includes some sand, stream gravel, and caliche; to 30(?) ft thick

QUATERNARY — TERTIARY

Km — **Mancos Shale**
Black shale with subordinate, thin-bedded, light-gray and buff sandstone, gray limestone, and yellowish limy concretions; approximately 2000 ft thick

Kd — **Dakota Formation**
Mostly black, fissile, carbonaceous shale in lower part; upper part is gray to black shale and fine- to medium-grained gray sandstone with minor, brown-weathering calcareous concretions; about 80 ft thick

CRETACEOUS

Jm — **Morrison Formation**
Lower member: reddish-brown and maroon-brown mudstone and very fine-grained, gray sandstone. Westwater Canyon Member: thick-bedded, cliff-forming, feldspathic sandstone. Brushy Basin Member: red and green mudstone with sandstone interbeds. Upper member: whitish, kaolinitic sandstone and minor green mudstone. Total thickness 740 to 900(?) ft

Jt — **Todilto Formation**
Basal limestone; brown, laminated, 4 to 5 ft thick, overlain by about 100 ft of white gypsum with locally, as much as 2 ft of thin-bedded limestone at top

Je — **Entrada Sandstone**
Light orange-tan, white, and pale-yellow, fine- to medium-grained sandstone, massive bedded; 120 ft thick

JURASSIC

Chinle Formation

Ћu — **Upper member**
Brownish-maroon and red-orange shale with minor green shale, reddish and green sandstone, brown clastic limestone, and small-pebble conglomerate; 1000(?) ft thick

Ћa — **Agua Zarca Member**
White to buff, very thick-bedded, medium- to very coarse-grained, quartzose sandstone, grit, and locally conglomeratic sandstone; 175 ft thick

TRIASSIC

Pbg — **Bernal Formation and Glorieta Sandstone, undivided**
Bernal: reddish-brown, very fine- to medium-grained, thin-bedded sandstone; 80 ft thick. Glorieta: white to tan, fine- to coarse-grained, thick-bedded sandstone, locally has minor gypsum near base; 100 ft thick

Py — **Yeso Formation**
Tan-brown and orange-buff, even-bedded, fine- to very fine-grained sandstone with minor, gray, thick-bedded limestone; 430 ft thick

Pa — **Abo Formation**
Reddish-brown mudstone and lenticular arkose and sandstone; subordinate light-gray sandstone, arkose, and nodular limestone; about 400 ft thick

PERMIAN

IPm — **Madera Formation**
Thick-bedded, gray limestone, containing some clasts of quartz and crystalline rock; very coarse grained to conglomeratic, thick-bedded arkose; reddish- to grayish-maroon shale; true stratigraphic thickness cannot be determined in this quadrangle, probably about 750 ft thick

PENNSYLVANIAN

p€g — **Gneissic granite**
Pink, fine- to medium-grained, has weak to strong lenticular foliation; composed of microcline with subordinate quartz and plagioclase

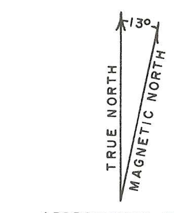
PRECAMBRIAN

Contact of surficial deposit

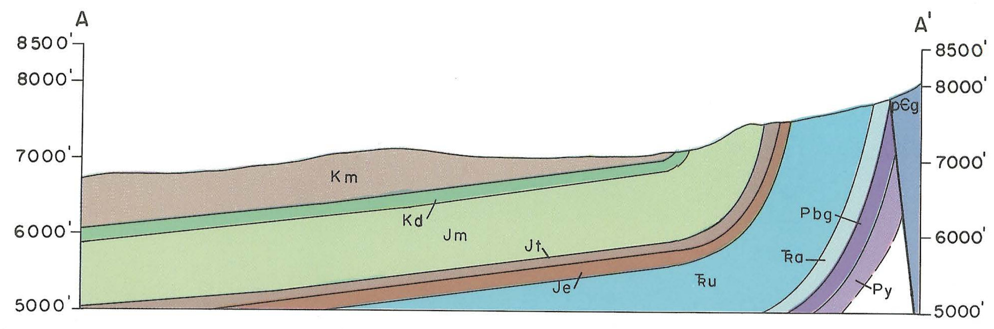
Bedrock contact, dashed where approximate

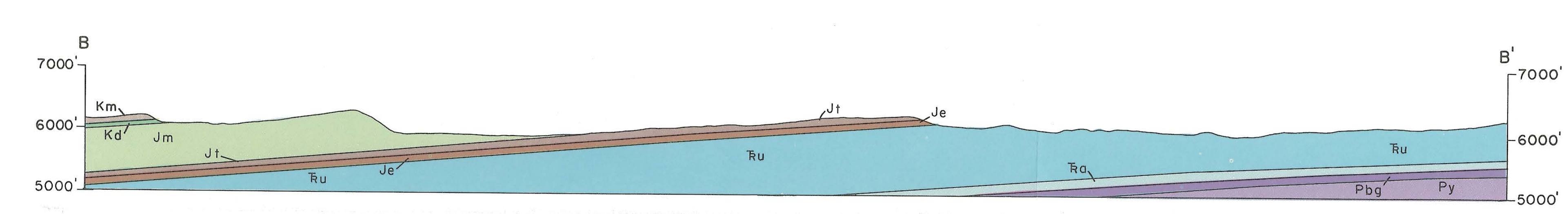
Fault, dashed where approximate, dotted where concealed; U, up, D, down

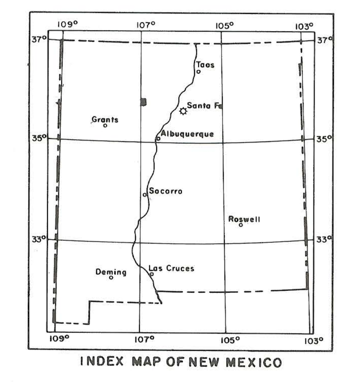
Strike and dip of bedding



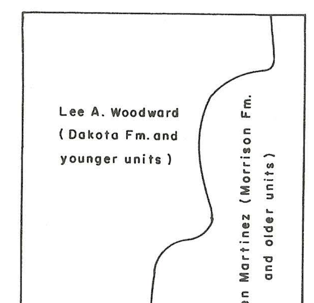
APPROXIMATE MEAN DECLINATION 1970







INDEX MAP OF NEW MEXICO



GEOLOGIC MAP AND SECTIONS OF HOLY GHOST SPRING QUADRANGLE, NEW MEXICO

by Lee A. Woodward and Ruben Martinez, 1974

Scale 1:24,000

0 — 1 — 2 MILES

PREVIOUS WORK

Reconnaissance maps including the Holy Ghost Spring quadrangle were published by Renick (1931) and Wood and Northrop (1946).

STRATIGRAPHY

A complete section of the Madera Formation (Pennsylvanian) is not present in this quadrangle; however, a measured section half a mile east of this quadrangle shows that the Madera is at least 750 ft thick. At this latter locality the Madera Formation contains much more arkose than at any other observed locality in the region of the Sierra Nacimiento.

Four members can be recognized in the Morrison Formation. The lowest member consists of reddish-brown and maroon-brown mudstone and very fine grained gray sandstone; this member is probably correlative with the Summerville Formation and the Recapture Member of the Morrison Formation as described in the Grants, New Mexico area. The overlying Westwater Canyon Member is about 100 ft thick and is composed of cliff-forming, feldspathic sandstone. Above the Westwater Canyon Member is the Brushy Basin Member, composed of red and green mudstone with sandstone interbeds. The upper member consists of whitish, kaolinitic sandstone correlated with the Jackpile sandstone of the Laguna area (Woodward and Schumacher, 1973).

The Dakota Formation changes facies rapidly within this quadrangle. At the north, this unit consists of about 5 ft of sandstone at the base, a middle member of black shale, and an upper member of thick-bedded sandstone. Southward the lower sandstone disappears and the upper sandstone thins and becomes thin bedded.

Travertine occurs in the southeastern part of the quadrangle on top of terrace and pediment gravels and within stream valleys near warm mineral springs. The travertine grades upward from calcite-cemented gravel to pure travertine. Deposition of the travertine probably began during the Tertiary and has continued until the present, with minor deposition now occurring near the warm springs.

STRUCTURE

The major structural features are Laramide in age and consist of the Nacimiento uplift in the northeast corner of the quadrangle and the San Juan basin to the west, separated by a belt of steeply dipping and faulted beds (structure section *A–A'*). The Pajarito fault is the principal fault in this belt, but is covered by postorogenic sediments (Quaternary-Tertiary terrace and pediment deposits) in this quadrangle. The Pajarito fault, where exposed at other localities, is a high-angle reverse fault dipping steeply to the east. Structural relief between the uplift and basin is at least 7,000 ft.

A strike fault in the upper member of the Chinle Formation in the northeastern part of the quadrangle is inferred on the basis of the very narrow width of outcrop of the upper member there.

Evidence of right-shift between the uplift and basin, during their early development, is seen in northwest-plunging en echelon folds along the eastern margin of the San Juan Basin (Kelley, 1955; Baltz, 1967); several of the folds occur in the area of this quadrangle.

The large, nearly equidimensional, dome in the southeastern part of the quadrangle near Warm Springs (structure section *B–B'*) may be unrelated to the folds noted above. This dome has no well-defined axis and is characterized by numerous warm springs, suggesting that the dome may have been caused by igneous intrusion at depth. The well near Warm Springs was drilled to a total depth of 2,008 ft, where it encountered a large amount of hot mineral water in the Abo Formation (Wood and Northrop, 1946).

About ¾ mile northwest of Warm Springs are two small gravity-slide plates composed of Jurassic rocks. These plates rotated slightly as they slid. One is unconformably overlain by terrace and pediment deposits. Thus, the slides occurred after doming of the beds, and prior to deposition of the terrace and pediment deposits.

ECONOMIC GEOLOGY

During the late 1950s 395 tons of ore containing 0.13 percent U_3O_8 were mined from sandstones of the Brushy Basin Member of the Morrison Formation (Jurassic) in the central-eastern part of the quadrangle (Chenoweth, 1974). Chenoweth (1974) also reports the occurrence of uranium in the Westwater Canyon Member of the Morrison and several airborne radioactive anomalies in the area of the uranium production.

A dip slope on the Todilto Formation west of Warm Springs exposes large amounts of gypsum which could be readily mined by surface methods. Proximity to State Highway 44 provides easy access.

An excellent source of aggregate is provided by the Tertiary-Quaternary terrace and pediment deposits composed of clasts of Precambrian crystalline rocks. The most suitable deposits are those near the mountain front in the northern part of the quadrangle. Elsewhere, the deposits consist of clasts of Paleozoic and Mesozoic rocks that are less desirable for aggregate. Most of the terrace and pediment deposits are thin, 2 to 10 ft, but those near the foot of the mountains may be up to 30 ft thick. Some of these deposits have been used for road surfacing and pit-run subbase.

Travertine (QTt) suitable for building stone occurs in the southeastern part of the quadrangle within half a mile of State Highway 44.

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