

GEOLOGY OF VETEADO MOUNTAIN QUADRANGLE,
CATRON AND CIBOLA COUNTIES, NEW MEXICO

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ABSTRACT

During the spring of 1984, New Mexico Bureau of Mines and Mineral Resources conducted geologic mapping and resource assessment of Veteado Mountain quadrangle in west-central New Mexico. The quadrangle is in a structurally simple area along the border of the Datil-Mogollon Volcanic Field and the Mogollon Slope. Exposures include Upper Cretaceous Moreno Hill Fm., Eocene Baca Fm., Oligocene Spears Fm. and Miocene Fence Lake Fm. These consist primarily of mudstones, sandstones and conglomerates deposited in meandering and braided stream environments. The sediments are cut by a series of Tertiary intrusives, predominantly basaltic in composition.

Veteado Mountain quadrangle contains no resources of significance. Coal deposits are abundant to the west and may be present here at depth. However, these would be covered by some 500 to 1500 feet of sediments.

INTRODUCTION

During the spring of 1984, New Mexico Bureau of Mines and Mineral Resources conducted a geologic survey of Veteado Mountain quadrangle. The work was done as part of a larger, joint effort between New Mexico Bureau of Mines and Mineral Resources and U.S. Geological Survey to study the Salt Lake coal field and the surrounding area. The purpose of the study was to map the

quadrangle in detail to obtain knowledge of stratigraphy, structure and resource potential. In addition, the map will be used in compilation of a geologic map of the Fence Lake 1:50,000 scale quadrangle (in prep.).

Location and Access

The Veteado Mountain 7.5 minute quadrangle is located in west-central New Mexico along the eastern perimeter of the Salt Lake coal field (fig. 1). The quadrangle lies some 15 miles north of Quemado and 22 miles south of Fence Lake. Primary access to the area is via state highways 117 and 36. These in turn can be reached from Interstate 40 in the Grants-Gallup area to the north or from U.S. 60 in the Quemado-Springerville area south of the quadrangle. There are no railroads or commercial airports in the vicinity.

Most of the land is under private ownership. Roughly 25% of the quadrangle is owned by the state or federal governments; this land however, is under lease to private concerns.

Regional Geology

Veteado Mountain quadrangle is situated along the boundary of the Datil-Mogollon Volcanic Field and the Mogollon Slope (Fitzsimmons, 1959). Strata in the region are nearly flat-lying, showing very slight regional dips to the south

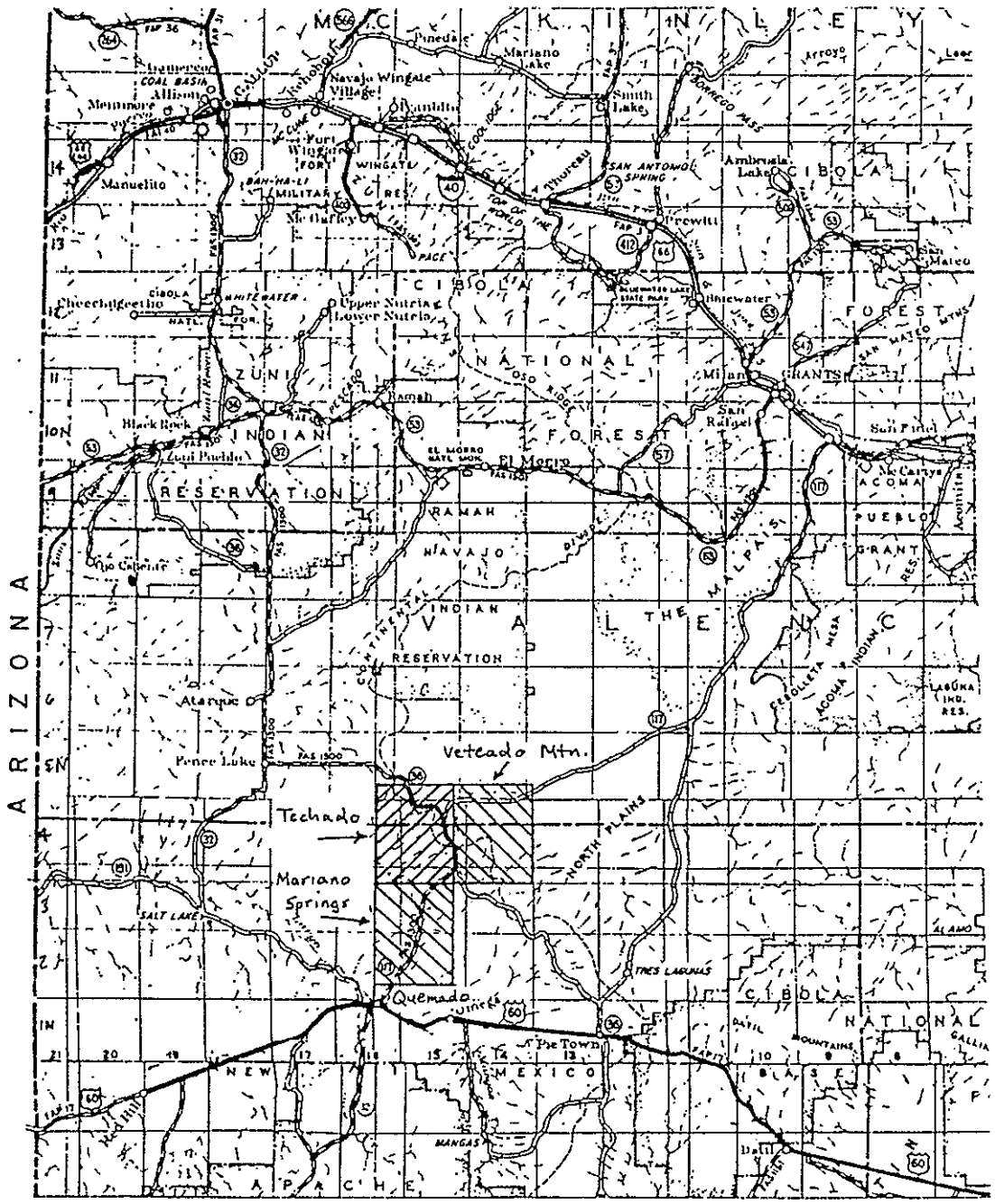


Fig. 1 — Map of west-central New Mexico showing location of Techado, Veteado Mountain and Mariano Springs quadrangles.

and east. Exposures are primarily of Cretaceous and Tertiary age. During the Late Cretaceous, an epihercynian sea covered much of New Mexico and the Veteado Mountain area was periodically inundated. These sea-level fluctuations resulted in a complex series of interfingering marine and nearshore continental deposits belonging to the Dakota Sandstone, Mancos Shale, Tres Hermanos Formation and Mesaverde Group. The Latest Cretaceous/Early Tertiary was primarily a period of erosion and non-deposition brought about by Laramide tectonic activity. This left a series of topographic basins into which coarse sandstones and conglomerates of the Baca Formation were deposited. The remainder of the geologic history has been characterized by periods of rifting and volcanism, covering much of the area with volcanics and volcanoclastics of the Datil Group and Fence Lake Formation.

STRUCTURE

Veteado Mountain quadrangle is characterized by simple structure. Strata are either flat-lying or dip very gently (1 to 2 degrees) eastward. Minor deformation is apparent around some of the intrusives, however, most of the rocks surrounding intrusives are surprisingly undeformed.

The large dike in the southwest portion of the quadrangle (plate 1) follows a major strike-slip fault. This fault is of

regional extent, running northwesterly from Pie Town to at least Fence Lake, a distance of about 50 miles. (Beyond Fence Lake, the fault is covered by Quaternary basalt.) Displacement along each segment varies greatly throughout its length; in Veteado Mountain quadrangle, displacement is on the order of 500 to 1500 feet. With the exception of right-lateral displacement, there is no apparent structural deformation in the surrounding rocks. The dike system appears to have been calmly emplaced along a pre-existing suture zone. This suggests a pre-Oligocene age for the fault (see discussion of dike).

STRATIGRAPHY

Upper Moreno Hill Formation (Kmhu)

The oldest exposures in the quadrangle belong to the Upper Member of the Moreno Hill Formation. The unit outcrops sparsely in a semi-circular pattern around the northern fringe of Veteado Mountain (plate 1). Due to the limited outcrops, the reader is referred to Campbell (1981), Roybal (1982) or Arkell (1984) for detailed descriptions of the unit. Where exposed, the Upper Moreno Hill consists of red, gray and tan claystones and siltstones with thin interbeds of white to brown sandstone. Beds are lenticular and often grade laterally or vertically into different lithologies. No coal or carbonaceous sediments were noted. Studies in the adjacent Techado quadrangle (Arkell, 1984)

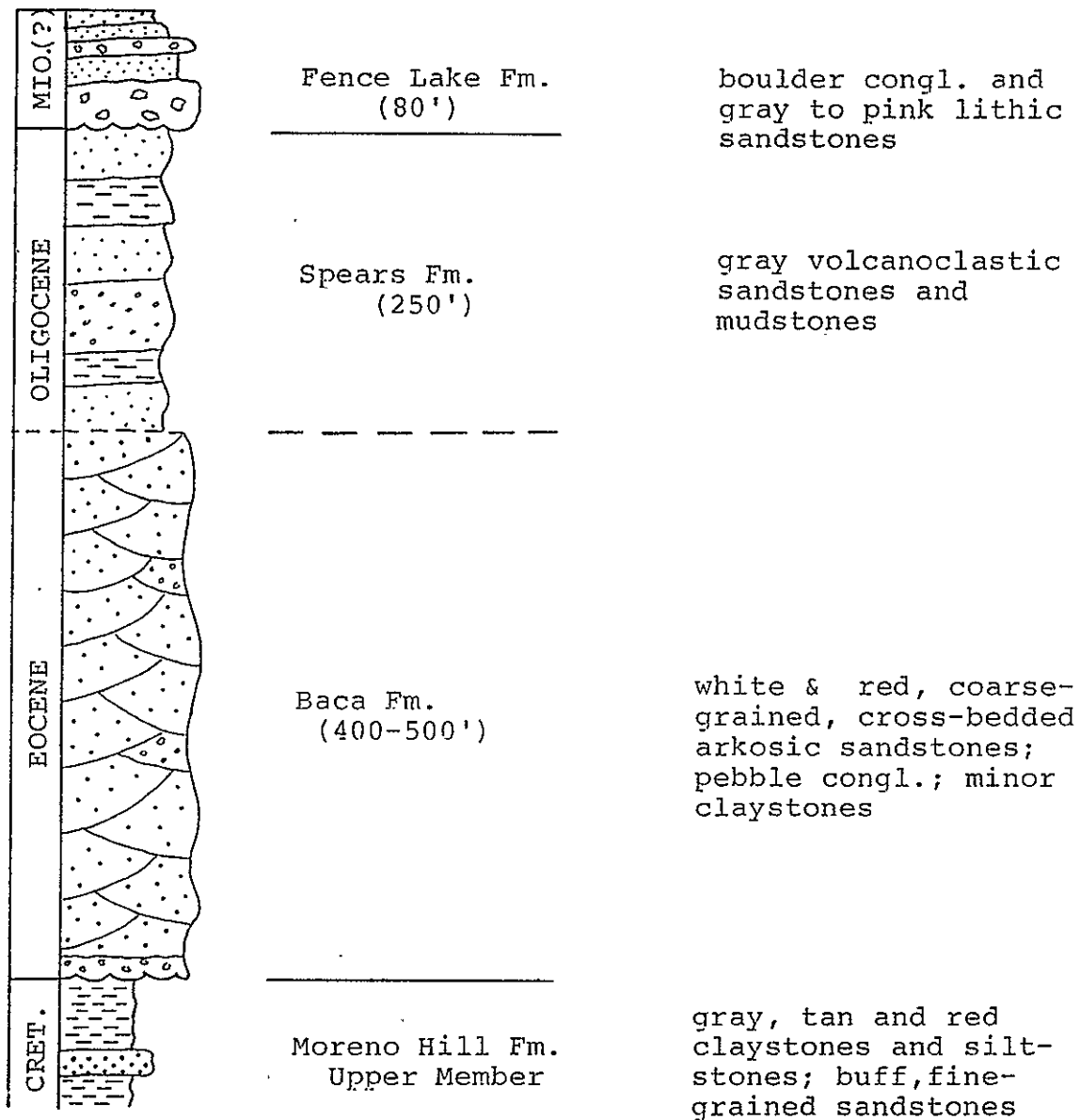


FIG. 2 - Generalized stratigraphic column for Veteado Mountain quadrangle.

indicate the Upper Moreno Hill Formation was deposited in meandering stream environments.

Baca Formation (Tbc)

Unconformably overlying the Moreno Hill Formation is the Eocene Baca Formation. The Baca outcrops extensively throughout the quadrangle. The unit is thickest in the southern parts of the quadrangle where (based on mapping to the west) it appears to be 400 to 500 feet thick. The unit thins to the north and northwest due to both depositional thinning and pre-Fence Lake Formation erosion.

The Baca is composed primarily of white and red sandstones with some interbedded conglomerates and mudstones. In cross-section, these sediments occur as a sequence of stacked and multi-lateral lense-shaped deposits. Sandstones are usually trough cross-bedded and exhibit abundant erosional features. Sandstones are arkosic to subarkosic in composition, containing mainly quartz and feldspar with some rock fragments. These sandstones generally have a quartz-calcite cement and little or no matrix. Texturally, most sandstones are medium- to very coarse-grained, angular to subangular, with moderate sorting. Conglomerate beds occur frequently. Pebbles are well rounded pieces of chert, quartzite, petrified wood, sandstone, claystone and minor igneous rocks, all generally less than 3 inches in diameter. Conglomerate beds are especially prolific along the

base of the Baca where they can usually be used to identify the contact with the Moreno Hill Formation.

The general lithologic characteristics, geometry of deposits, stratigraphic associations and sedimentary structures indicate the Baca was deposited in a braided stream environment.

Spears Formation (Tds)

Conformably overlying the Baca Formation is a series of light gray volcanoclastics belonging to the Spears Formation. The Spears Formation is considered to be Oligocene (33 to 39 m.y.) in age (Osburn and Chapin, 1983; Guilinger, 1982). On Veteado Mountain quadrangle, the Spears is present only on Veteado Mountain, where it obtains a thickness 250 feet. Elsewhere in the quadrangle, the unit has been stripped away by erosion.

The Spears Formation is composed mainly of volcanoclastic sandstones and mudstones. Sandstones are generally fine- to medium-grained, poorly sorted, with subrounded to angular grains. They contain mainly volcanic rock fragments and plagioclase feldspar with lesser quartz, hornblende, biotite, iron oxides, pyroxene and volcanic glass. Sedimentary structures are generally non-existent; however, some soft sediment deformation is present. Interbedded with the sandstones are tuffaceous mudstones and very poorly sorted mudflow breccias.

Fence Lake Formation

Unconformably overlying the Spears Formation is the Miocene(?) Fence Lake Formation. The formation is present in a small area near the top of Veteado Mountain where it reaches a thickness of about 80 feet (plate 1). Elsewhere, the hard boulders of the Fence Lake conglomerates form a conspicuous gravel lag which covers most of the eastern half of the quadrangle. Thus, at one time the Fence Lake Formation probably covered a much larger area and has since been stripped away by erosion.

On Veteado Mountain, the Fence Lake Formation consists of two thick conglomerate beds interbedded with sandstones and sandy siltstones. The conglomerate beds are quite lenticular and vary greatly in thickness and extent. Conglomerates are composed of large (0.5 - 3.0 ft. dia.), rounded boulders of vesicular basalt along with pebbles of chert, quartzite, sandstone, rhyolite and andesite. These are held together by a gray to white, quartzose, silty sand matrix. Where the conglomerates are missing, the interval is filled with gray to white sandstones and sandy siltstones. Sandstones range from very fine- to very coarse-grained, subrounded to well-rounded and poorly to moderately sorted. They are composed primarily of quartz (60-80%) and feldspar (15-25%) with subordinate rock fragments (5-15%), mafic minerals (1-3%) and in some instances, volcanic glass (1-3%). The rock

fragments are mainly volcanic in origin. Sandstones and siltstones are usually moderately indurated and very calcareous. For the most part, these are crudely bedded and occasionally exhibit trough cross-bedding. It is interesting to note that the sandstones and siltstones within the Fence Lake Formation show striking similarities to those of the Spears Formation in terms of composition, texture and depositional environments.

The overall lithologic characteristics, sedimentary structures and cross-sectional profile indicate the Fence Lake Formation was deposited in a braided stream environment. McLellan et al. (1982) believe the Fence Lake may be part of a post-Oligocene, northwest-trending alluvial fan system originating in the Datil Mountains region. However, the very large, vesicular basalt boulders suggest a local source, perhaps related to the Oligocene volcanic vents in the region (such as Techado Dome).

En Echelon Dike (Tb)

An en echelon series of dikes trends approximately N 45 W through the southwest part of Veteado Mountain quadrangle. As mentioned earlier, this dike has been emplaced along a strike-slip fault zone of regional proportions. The dike system runs from Pie Town to Fence Lake and has been discussed by Laughlin et al. (1979) and Campbell (1981). It is a black to gray, olivine basalt with a micro- to cryptocrystalline texture. In

places, the dike is highly magnetic. K/Ar dating yielded an age of 27.67 +/- 0.59 million years B.P., placing the dike in the Oligocene (Laughlin et al., 1979).

Techado Mountain Basalt (Tb)

Techado Mountain (plate 1) is a volcanic dome of basaltic composition. The dome is steep-sided, roughly circular in plan and slightly convex at the top. Fan-like, near vertical flow banding can be seen in some areas around the perimeter.

The core of Techado Dome is composed of dense, black diabase. This is surrounded by a zone of microcrystalline basalt and basalt breccia. Within this zone are inclusions of the country rock (possibly Baca Fm.) and large, tilted blocks of crudely bedded basalt, agglomerate and mudflows. The top of the dome consists of red, vesicular basalt with abundant cavities. The foothills surrounding Techado Mountain are partly covered with a rubble of basalt boulders and bombs; however, no signs of lava flows remain.

Techado Dome cuts sediments of Baca Formation, indicating it is at most Eocene in age. In general, igneous activity in the area began in the Oligocene. Thus, an Oligocene or later age is probably more accurate.

Veteado Mountain Basalt (Tb)

The core of Veteado Mountain is a basaltic volcanic neck. The basalt is a dense, black, cryptocrystalline rock with abundant volcanic glass crystals and a few phenocrysts of plagioclase. The hard, resistant basalt forms a steep-sided, elliptical structure rising some 250 feet above the surrounding sediments. The neck is characterized by crudely developed vertical to sub-vertical jointing. Along the perimeter of the neck are sporadic zones of brecciated basalt, probably the result of successive magma pulses in the conduit.

The age of Veteado Neck is still in question. The neck cuts deposits of Fence Lake Formation, indicating a maximum age of Miocene.

Diorite/Basalt Stock (Td/Tb)

The southeast corner of Veteado Mountain quadrangle contains a zoned diorite/basalt stock. The intrusive crops out in a low-lying, kidney-shaped fashion surrounded by sediments of Baca Formation. The perimeter of the stock is a black basalt. The basalt is essentially cryptocrystalline except for some subhedral plagioclase (15-25%) and volcanic glass (5-15%). Towards the center, the intrusive grades abruptly into a diorite. The diorite is light gray to brown with a granular, fine-grained, phaneritic texture. The rock is composed primarily of plagioclase (60-80%), often sericitized, pyroxene (15-25%),

chlorite (5-10%) and opaque minerals (5%) with subordinate hornblende and biotite. Throughout the central portions of the stock are contact metamorphosed inclusions of Baca Formation. These inclusions indicate a post-Eocene, probably Oligocene age for the intrusive.

Quaternary Basalt (Qb)

A Quaternary basalt flow is present along the northern edge of the quadrangle (plate 1). This flow is the southernmost portion of McCartys Basalt flow, a huge flow covering some 119 square miles between Interstate 40 and the Veteado area. The flow is very recent, estimated to be about 1000 years old (Nichols, 1946). The basalt is grayish-black, highly vesicular, with an aphanitic texture. It contains abundant volcanic glass and a few phenocrysts of plagioclase and olivine.

Quaternary Alluvium (Qal)

Quaternary alluvial deposits were mapped where sufficiently thick and extensive to totally obscure bedrock. These deposits include all types of unconsolidated gravels, sands and clays. Alluvium covers most of the flat, low-lying areas of the quadrangle. It is thickest along the northern and eastern flanks of Veteado Mountain and along major drainages. In these areas, the alluvium may reach up to 50 feet in thickness.

ECONOMIC GEOLOGY

The resource potential (exclusive of oil and natural gas) of Veteado Mountain quadrangle was surveyed simultaneously with mapping. In general, the area has no significant resource potential. However, because of discoveries in surrounding areas, certain resources need mention.

Large coal deposits have been discovered west of Veteado Mountain quadrangle. Coal occurs primarily in the Lower Member of the Moreno Hill Formation, where three horizons contain significant coal deposits (Campbell, 1981; Roybal, 1982). The Upper Member of Moreno Hill Formation contains only thin, uneconomic coal beds and, based on depositional environments, it does not appear to have any resource potential in this area (Arkell, 1984). Roybal and Campbell (1981) reported some 359 million tons demonstrated resources in the Moreno Hill Formation about 10 miles west of Veteado Mountain quadrangle. Eastward however, the coal dips down below the depth that is presently economic to mine. In Veteado Mountain quadrangle, the coal horizons are covered by a sequence of Baca and Upper Moreno Hill Formations ranging from 500 to well over 1000 feet thick. This is well below economical stripping range. Furthermore, it is unlikely underground mining would be feasible given the present and near-term future coal market. Thus, for all practical purposes, any coal existing in the quadrangle would be too deep to be profitably extracted.

Sporadic uranium mineralization has been reported in the region. The mineralization occurs mainly at the Tertiary-Cretaceous boundary and is mostly low grade and of limited extent (Guilinger, 1982). During the middle to late 1970's, various private concerns conducted uranium exploration, including drilling, in the area. However, no significant discoveries were made and judging by present market trends, there is no potential for uranium development in the area.

A small amount of scoria is present in sporadic zones on Techado Mountain. However, the limited tonnage and erratic distribution would eliminate any possibility of mining it.

Areas of weathered Baca Formation often represent potential sources of sand and gravel. Baca conglomerates often weather to leave significant accumulations of coarse gravel and quartz sand. Though the deposits are not large, they may be sufficient for local uses.

SUMMARY

Veteado Mountain quadrangle contains a series of flat-lying Cretaceous and Tertiary sediments cut by Tertiary intrusives. The oldest exposures are of Cretaceous Upper Moreno Hill Formation. These are mudstones and sandstones deposited in meandering stream environments. Unconformably overlying the

Cretaceous rocks is the Eocene Baca Formation, a series of braided stream deposits composed primarily of coarse sandstones and conglomerates. The Baca Formation is conformably overlain by volcanoclastic sandstones, mudstones and conglomerates comprising the Oligocene Spears Formation. The uppermost sedimentary unit is the Miocene(?) Fence Lake Formation. This is a series of conglomerates and sandstones deposited by braided streams. The sediments are intruded by a basalt volcanic neck at Veteado Mountain, a basalt volcanic dome at Techado Mountain, an en echelon series of basalt dikes and a zoned diorite/basalt stock.

Veteado Mountain quadrangle contains no significant resource potential. Coal deposits occur some 10 miles west of the quadrangle; however, due to an easterly dip, the coal-bearing horizons are well below stripping range.

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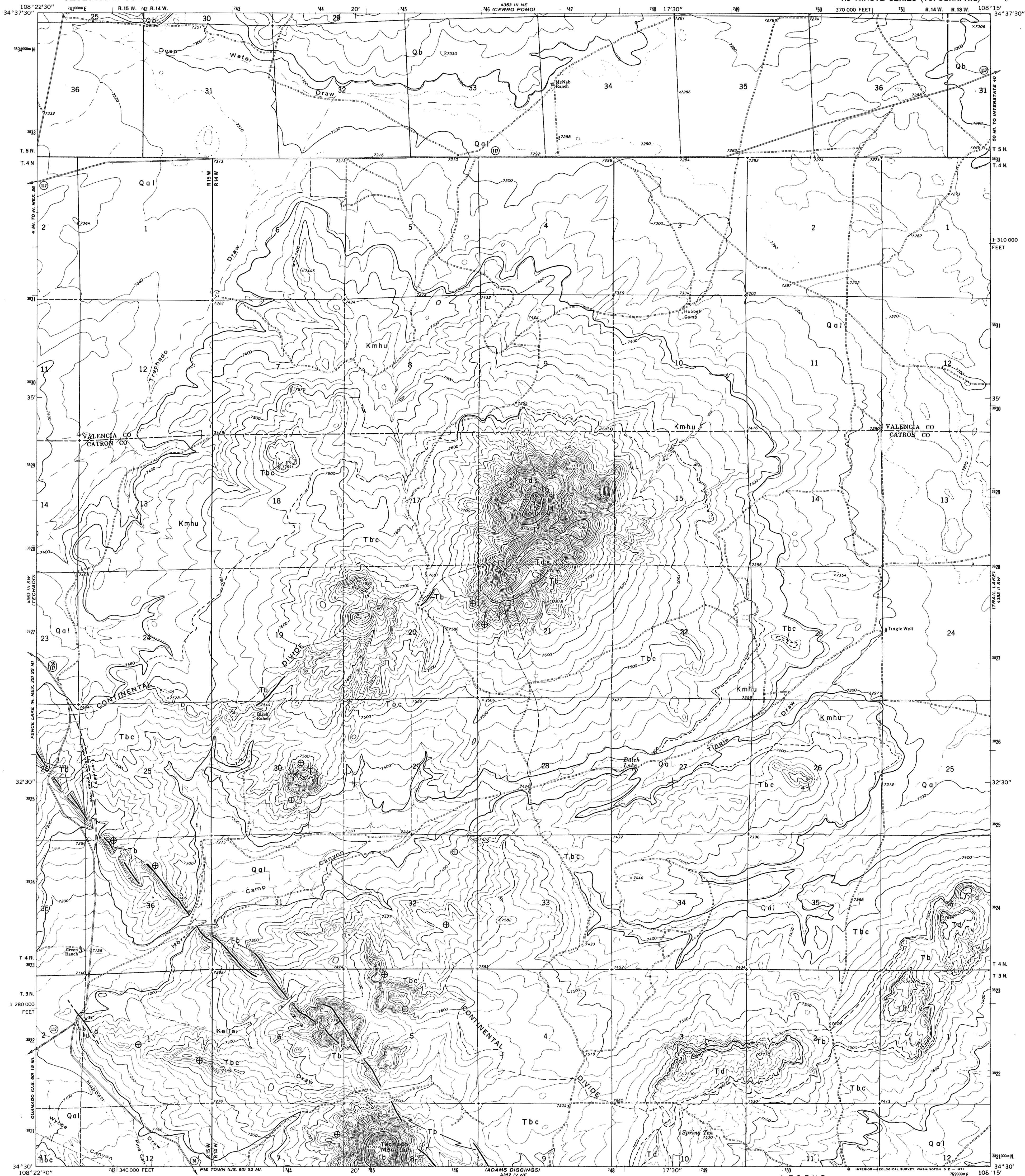
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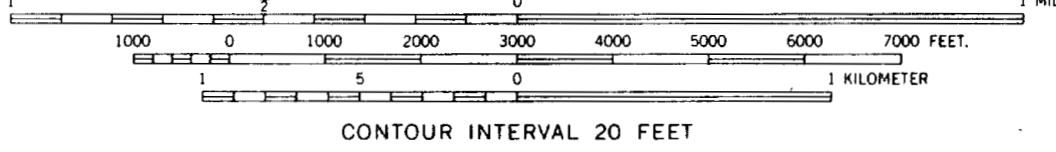
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base from U.S.G.S., 1967

(ADAMS DIGGINGS)
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- LEGEND**
- Qal = Quat. alluvium
 - Qb = Quat. basalt
 - Tbc = Tert. basalt
 - Tb = Tert. basalt
 - Tds = Tert. diorite
 - Tfl = Tert. Fence Lake Fm.
 - Tds = Tert. Spears Fm.
 - Tbc = Tert. Baca Fm.
 - Kmhu = Cret. Upper Moreno Hill Fm.
 - ⊕ = horizontal strata

GEOLOGIC MAP OF VETEADO MOUNTAIN QUADRANGLE, WEST-CENTRAL NEW MEXICO

by: Brian Arkell, N.M.B.M.R., 1984

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