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1964, pp. 82-86. https://doi.org/10.56577/FFC-15.82

in:

Ruidoso Country (New Mexico), Ash, S. R.; Davis, L. R.; [eds.], New Mexico Geological Society 15 th Annual Fall Field Conference Guidebook, 195 p. https://doi.org/10.56577/FFC-15

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GEOLOGIC OUTLINE OF THE JICARILLA MOUNTAINS, LINCOLN COUNTY, NEW MEXICO

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INTRODUCTION

The Jicarilla Mountains are an extension of the north-trending ranges of the Sacramento Mountains and Sierra Blanca which dominate the landscape of south-central New Mexico. Although the highest points in the Jicarillas are not as lofty as Nogal Peak and Sierra Blanca Peak to the south, they stand out as well-developed topographic prominences between the Tularosa Basin to the west and the high plains to the east.

The absence of good quality topographic maps of the Jicarilla Mountains is a disadvantage in making detailed geological investigations. Perhaps the best available in the form of planimetric maps are the semicontrolled mosaics, prepared from aerial photographs by the Soil Conservation Service of the U.S. Department of Agriculture. Four photo-maps, of the NW quarter, SW quarter, SE quarter, and NE quarter, each on an approximate scale of one inch equals one half mile, cover the area between lat 33°45' and 34°00' N. and between long 105°30' and 105°45' W., or what perhaps in the not too distant future will become known as the "Jicarilla 15 minute quadrangle." The Jicarilla Mountains, as used here, will include the area covered by the NW and SW quarter photo-maps.

STRATIGRAPHY

Sediments of Permian, Triassic, Cretaceous and Tertiary age form the bedrock in many parts of the Jicarilla Mountains. The following descriptions will serve to outline the lithologic character and thickness of these beds, and any other characteristics specific to the area.

Permian Rocks

Only the upper part of the Yeso Formation is present in the area. Best exposures are to be found along the right-of-way of old U.S. Highway 54, about 2½ miles northeast of Luna, where gypsiferous siltstones and fine- to medium-grained sandstones of pale-yellow to pale-orange color form the upper 50 feet of this formation.

Rocks belonging to this formation are also present in a narrow north-trending belt between the intrusives of Jack's Peak and the Jicarilla monzonite, but are difficult to recognize among the extensive talus and cliff debris that surrounds the peak. As a consequence of its lithologic characteristics, the Yeso Formation does not form spectacular outcrops, but is usually a slope former.

Investigations in the area show, that in the northern Jicarilla Mountains, the Glorieta Sandstone forms a recognizable unit between the underlying Yeso Formation and the overlying San Andres Formation. Further to the south, in the vicinity of Jicarilla and near Lone Mountain, where doming by intrusives has brought the Permian sequence close to the present erosion surface, intertonguing of Glorieta and San Andres lithologies obscures the contact between these two formations. Northeast of Luna, the Glorieta Sandstone is a 120-foot thick unit consisting mainly of medium-grained, well-sorted quartz sandstone of pink to gray color. Grain size is somewhat variable in individual beds, and in the coarser grained layers, cross-bedding can occasionally be observed.

The uppermost unit of unquestionable Permian age is the San Andres Formation. In the area under discussion the formation consists mostly of a chert-bearing dark-gray porous limestone, with sandstone interbeds near its base, and discontinuous gypsum layers near the top.

Due to its resistant nature to erosive forces, and its considerable thickness, exposures of the San Andres Formation are widespread. Much of the area south of Ancho, and north and south of the Jicarilla monzonite is underlain by this formation. The high plains north and east of Jack's Peak are on a low angle dip slope of San Andres limestone.

Thickness measurements of this important unit are complicated by a lack of relief in critical areas, the intertonguing nature of the underlying Glorieta Sandstone and the San Andres Formation, and the varying importance of gypsum beds in the upper part. Northeast of Luna, where the Glorieta Sandstone can be distinguished as a separate unit, the San Andres Formation is 510 feet thick. To the south, the formation thickens, and 615 feet is thought to be present near the Jicarilla intrusive. In this area, however, Glorieta Sandstone intertongues may increase the thickness considerably.

Overlying the San Andres Formation, and below the Triassic Dockum Group, is found a series of yellow and red sandstone, limestone and gypsum beds, which, in view of their stratigraphic position, are tentatively correlated with the Bernal Formation (Bachman, 1953). A similar unit has been recognized in adjoining quadrangles, and either a Permian or Triassic age has been assigned to these beds.

Outcrops of the Bernal(?) Formation are not plentiful, mainly due to the nonresistant nature of the beds to the forces of weathering and erosion. The soil, derived from this unit, has a fine-grained, sandy texture, and a bright-red color, which makes the San Andres-Bernal(?) contact clearly distinguishable, even if bedrock is not exposed. The red soil color is sufficiently different from the darker hues of red and brown, which characterize the soils of the Triassic Dockum Group sediments.

The lower 185 feet of the Bernal Formation is well exposed along the road, about 0.2 mile east of Ancho. At this locality, which will be visited by the Field Conference, the formation consists mainly of yellow-brown to orange-red siltstones and fine-grained sandstones, with thin beds of limestone.

Total thickness of the Bernal is somewhat variable throughout the area, but usually is between 270 and 320 feet.

Triassic Rocks

Sediments of Upper Triassic age are represented by the Santa Rosa Sandstone and the Chinle Formation, which together make up the Dockum Group. The contact between these two units is gradational, and their total thickness, about 560 feet, is generally about equally divided between the two formations.

The boundary between the Bernal(?) Formation and the Santa Rosa Sandstone is apparently a surface of unconformity, but lack of continuous outcrops obscures the true relationship. The Santa Rosa Sandstone consists of reddish-brown, medium-grained, friable sandstones with interbedded mudstones. Coarser grained layers, where cross-bedding can frequently be observed, are seen to grade into thin lenses of conglomerate, with yellowish-brown and black chert pebbles. The occurrence of such pebbles in the soil in areas of few outcrops is frequently the only indication of the presence of the Santa Rosa Sandstone.

The Santa Rosa Sandstone grades upwards into the mudstones and siltstones of the Chinle Formation. Outcrops of this formation are generally poor, and only in places where the Dakota Sandstone forms a resistant cap of a mesa, can exposures be found on the lower slopes. Red to purple colors are typical of this formation, and also characterize the soil.

Cretaceous Rocks

During the Jurassic and lower Cretaceous, the region of the Jicarilla Mountains was one of erosion and nondeposition. During the Upper Cretaceous period, marine conditions returned and the sediments formed during that period can be subdivided into three groups, which, in comparison with rocks of similar stratigraphic position in other parts of New Mexico, have been named Dakota Sandstone, Mancos Shale, and Mesaverde Group.

The Dakota Sandstone overlies the Triassic Chinle Formation unconformably and due to its resistance to erosion, forms sandstone cliffs and mesa cappings of considerable extent. Several well-cemented quartz sandstone beds occur in the stratigraphic sequence, which also includes some sandy shales and carbonaceous shales. Thickness is variable, and in the Jicarilla Mountains from 120 to 200 feet of Dakota Sandstone is present. A complete section is exposed about two miles east of Ancho, and here the formation consists of massive, medium-grained quartz sandstones, with carbonized and silicified plant remains, and interbedded dark-gray shales.

The Dakota Sandstone is overlain conformably by the Mancos Shale, which underlies large tracts in the southern parts of the Jicarilla Mountains. The medium-gray, calcareous shales, which make up the bulk of this formation, show little resistance to erosion, and outcrops are almost wholly confined to arroyo bottoms. Total thickness of the Mancos Shale can only be computed, and it is estimated that about 410 feet of this formation is present.

Still higher in the stratigraphic section, conspicuous brown sandstone beds begin to occur, and the mixed sequence of sandstone and shales has been correlated with the Mesaverde Group. The base of this formation has been chosen at the first prominent sandstone ledge, which occurs about 410 feet above the Dakota-Mancos contact. The shales of the Mesaverde Group are bluish-gray, calcareous shales with septarian concretions; the sandstones are medium-grained, and buff to brown in color. Several sandstones of the Mesaverde Group are fossiliferous and contain gastropods, pelecypods, and occasionally ammonites. At least 415 feet of Mesaverde Group sediments are present, mostly in the southern part of the area.

Tertiary Rocks

Although the period following the deposition of the Upper Cretaceous Mesaverde Group was dominantly one of tectonism, igneous activity and erosion, remnants of Tertiary sediments are found in a few places.

The high plains, which extend east of the line Luna-Jack's Peak, are part of an old plateau surface, which is partly covered by consolidated gravels. The boulders in these gravels consist of limestone, chert and jasper, igneous rocks, sandstone, some mudstone, and quartzite. The presence of igneous rock fragments in the conglomerate indicates, that at the time of deposition, igneous activity had taken place in the Jicarilla Mountains area, and that certain intrusives had been laid bare by erosion. Many of the fragments of the sedimentary rocks can be directly related to the more resistant members of the pre-Tertiary sequence: limestone derived from the San Andres Formation, chert and jasper from the conglomerate beds of the Santa Rosa Sandstone, sandstone fragments derived from the Dockum Group sandstones, Dakota Sandstone and Mesaverde Group, etc.

Bretz and Horberg (1949) called attention to the fact, that the Ogallala Formation once extended west of the Llano Estacado, into the foothills of the Sacramento Mountains. They report gravel residuals, with pebble counts comparable to those obtained from the consolidated gravels of the Jicarilla Mountains, from eastern Lincoln County and neighboring De Baca County. In the Jicarilla Mountains, two observations tend to refute the idea that the consolidated gravels are a wholly locally derived product, of recent, say Quaternary age: in the first place, the physiographic position of the gravels, several hundreds of feet above the present arroyo bottoms; secondly, a rather high percentage of quartzite pebbles in the conglomerate, which cannot be of local derivation, but which must have come from northerly source areas, such as the Pedernal region.

The matrix of the conglomerate is fine-grained, sandy and calcareous. Usually, cementation is not complete, and it is only rarely, that ledges of conglomerate are exposed.

In view of Bretz and Horberg's extensive investigations (1949) of this formation between the Sacramento Mountains and the Pecos River, the consolidated gravels are considered to be the equivalents of the Pliocene Ogallala Formation. The gravels were deposited as a consequence of uplift of the Central New Mexico mountains, and laid down as a gravel apron east of these ranges, grading further east, in Texas, into the sandstones and shales of the Ogallala Formation. In the Jicarilla Mountains, thickness is variable but may be as much as 50 feet in places. As deposition of the consolidated gravels took place on an erosional surface, they overlie rocks ranging from San Andres Formation to Dakota Sandstone.

PETROLOGY

Igneous rocks of much diversity in composition and form occur in the Jicarilla Mountains. Sills, dikes, stocks, and possibly laccoliths and plugdomes are present; their composition is predominantly of an alkalic character, as far as preliminary petrological observations allow the drawing of such a conclusion.

Monzonite and Related Rock Types

The largest body of monzonitic composition crops out in the vicinity of the village of Jicarilla, and this rock type forms here a pluton of irregular shape, about 7 miles long in a northwest direction, and about four miles northeast. This intrusive, which will be referred to as the Jicarilla monzonite, extends east into the vicinity of Jack's Peak, outside the area presently under discussion.

Along its northern and southern boundaries, the monzonite is in contact with sediments of the San Andres-Glorieta sequence, while east of Jicarilla, Yeso Formation borders the intrusive. Crosscutting relationships between the monzonite and overlying sediments are found along the western boundary of the pluton, and here the contact cuts Bernal, Santa Rosa, and Chinle Formations. Within the monzonite proper, several outliers of San Andres limestone indicate that the present erosion surface is close to the roof of the pluton.

The common rock type is a leucocratic, gray to buff monzonite porphyry with varying amounts of quartz. Plagioclase (oligoclase) in the form of euhedral to subhedral crystals, as much as one inch in length, and anhedral quartz, much corroded and embayed, form phenocrysts. The dark mineral is either hornblende or biotite, but usually only outlines are preserved, and alteration has changed the original phenocrysts into a mixture of chlorite, epidote, calcite, rutile needles, and opaque constituents. The groundmass is fine-grained, and consists mostly of potash feldspar, and some quartz. Sericitization of the feldspars, particularly in the groundmass, is rather intense. Accessory minerals are apatite and zircon.

The pluton has created room for itself in a number of ways: by shouldering aside incompetent Yeso beds, possibly by stopping where the contact trangresses stratigraphic boundaries, and by uplifting and doming of the overlying San Andres and younger formations. This latter effect accounts for the predominant dip of the sediments away from the intrusive. Several satellitic bodies of monzonite, not visibly connected with the main mass, but most likely derived from the same magma source, occur north of the main pluton. These smaller intrusives are roofed by San Andres limestone. A dominant joint direction in the monzonite trends WNW, with a dip to the northeast.

Dikes and sills of monzonitic composition, but of smaller dimensions than the Jicarilla monzonite, are abundant throughout the area, and are particularly numerous in the Cretaceous sequence northeast of White Oaks. Emplacement of these sills at higher levels of the crust is indicated by a very fine-grained groundmass, presence of flow banding, and vesicular character of some of the rocks.

Trachyte and Related Rocks

Along the southern edge of the area, and for the most part situated in the Capitan quadrangle to the south, stands the circular mountain mass of Patos Mountain. Extensive areas of talus surround the precipitous northern slopes, and the first recognizable sedimentary rocks exposed are of the Mesaverde Group.

The igneous rocks of Patos Mountain are predominantly trachytes. Potash feldspar is dominant, constituting more than 75 percent of the mineral components, mafics, either green hornblende or brown biotite, form less than 5 percent. The alignment of tabluar feldspar crystals gives the rock a trachytic texture. In the central part of the mass plagioclase crystals, of sodic andesine composition, are mantled by potash feldspar; the quartz content of these rocks is about 10 percent. Towards the northern boundary, plagioclase disappears as a rock constituent, the rock becomes very leucocratic, and the quartz content increases to 20 percent. Consequently, this rock would be most appropriately referred to as a felsite. Preliminary investigations of this interesting igneous complex tend to indicate, that its main composition is trachyandesitic to trachytic, with more quartz-rich differentiates occurring along its northern edge.

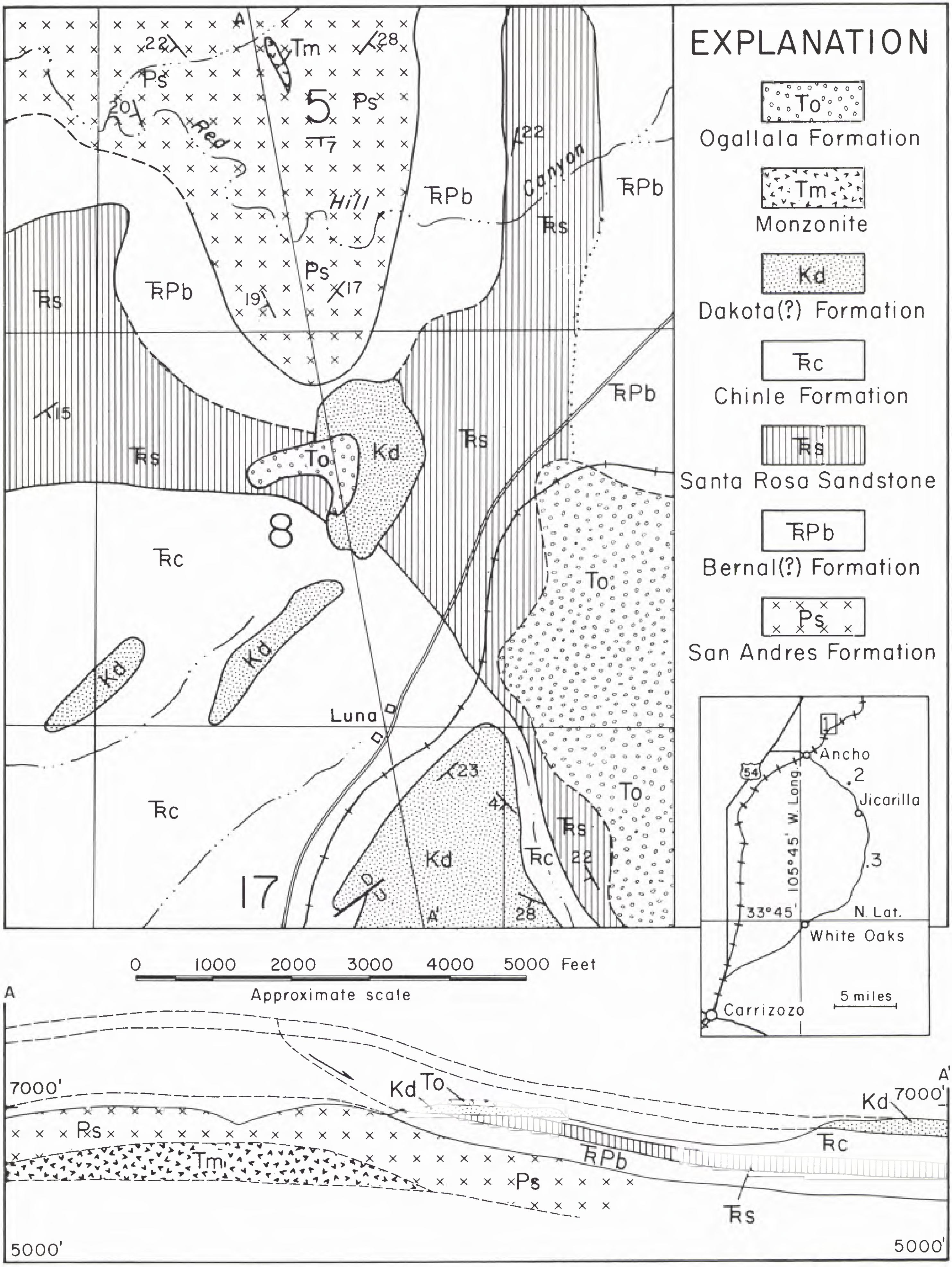
Lamprophyric Dike Rocks

Lamprophyric or basic dikes form a NNE-trending swarm cutting the Mancos Shale in the area northwest of Patos Mountain. Dikes of this nature have been reported from the White Oaks District by Lindgren, Graton, and Gordon (1910), where they are referred to as kensantite-minette. Other noteworthy occurrences of basic dikes are as crosscutting bodies in the Jicarilla monzonite, and as more irregular plugs in the Chinle Formation along the road between Ancho and Luna.

The dike rock is fine-grained, phanerocrystalline, and medium- to dark-gray in color. A thin section from a sample collected along the road two miles east of White Oaks, contains the following mineral constituents: plagioclase (labradorite), 40 percent; alkali feldspar, 35 percent; diopsidic augite, 10 percent; biotite, 10 percent; and accessory and opaque constituents 5 percent.

STRUCTURAL AND IGNEOUS EVOLUTION

After the numerous epeirogenic movements, which controlled the deposition of Paleozoic and Mesozoic sediments, the strongest factors responsible for shaping the structural complexities of the Jicarilla Mountains were the igneous events, which gave rise to the emplacement


EXPLANATION
To
Ogallala Formation
Tm
Monzonite
Kd
Dakota(?) Formation
TRc
Chinle Formation
TRs
Santa Rosa Sandstone
TRPb
Bernal(?) Formation
Ps
San Andres Formation
Red Hill Canyon
Luna
5
8
17
A
A'
Ancho
Jicarilla
White Oaks
Carrizozo
54
105°45' W. Long.
33°45' N. Lat.
5 miles
0 1000 2000 3000 4000 5000 Feet
Approximate scale
7000'
5000'

of the monzonitic intrusives. Rounded or irregular domes, and intervening narrow, doubly plunging synclines, or small structural basins, are the characteristic structures. Faulting is of minor importance; the only fault of any consequence occurs near White Oaks. It trends northerly and follows a broad valley for about one mile, then swings northeast and ends in the incompetent Triassic sequence southwest of the Jicarilla monzonite. This fault, of which the east and southeast side is downthrown, is cut by a monzonite sill in the Mesaverde Group, and by lamprophyric dikes.

The largest structural dome is underlain by the Jicarilla monzonite, and around its periphery, bedding dip is outward. Smaller domes frequently do not expose the underlying intrusive, but the San Andres Formation and younger rocks outline these structures quite well. Under such conditions, it is often striking to note, that domes exhibit steep flanks and relatively flat crests. The intervening synclinal structures, usually well outlined by the outcrop pattern of the resistant Dakota Sandstone, are irregular and branching, plunging synclines with flat bottoms and steep flanks. Examples of such synclines are found east of the railroad tracks between Ancho and Luna, and in a less accessible part of the area, about four miles southwest of Jicarilla.

Tectonic and igneous events followed the deposition of the Mesaverde Group, but detailed evidence of their sequence is lacking. Tectonic stresses, possibly related to the Laramide deformation, caused faulting in the vicinity of White Oaks before the emplacement of the monzonite stocks. This igneous activity occurred prior to the deposition of the Pliocene Ogallala Formation, and initially was of a monzonitic character. During this period, the great stocks of Jicarilla monzonite and satellitic bodies were emplaced. The following event was the intrusion of the lamprophyric dikes, and perhaps also the emplacement of the trachyte plug of Patos Mountain, both of which may represent differentiates of an alkaline olivine basalt magma, part of which, during the Quaternary, reached the surface as the Little Black Peak lava flow.

Igneous activity in the Jicarilla Mountains was accompanied or followed by extensive uplift. The newly formed domes were subject to erosion, and differences in resistance between the pre-Tertiary sediments resulted in the formation of gravitational gliding structures. Around the periphery of many of the domes, large sheets of Dakota Sandstone rest on an erosional surface, underlain by rocks of the Chinle, Santa Rosa and Bernal Formations. Several sheets of Dakota Sandstone are present north and south of the Jicarilla monzonite, and it is likely that these reached their present position as a result of gravitational gliding during the erosion process. One of the best examples of "decoiffement" may be seen about a half mile north of Luna (fig. 1). Details of this particular structure have been described in an article by the author (Budding, 1963). Outliers of the Ogallala gravels cover part of the structure, and a pre-Pliocene age is thus indicated for the gliding process.

Extensive erosion followed this period of uplift, and a clastic debris apron of Ogallala Formation gravels formed east of the Jicarilla Mountains. Later erosion removed most of this cover, but small outliers are still preserved.

MINERAL DEPOSITS

Mining activity in the Jicarilla Mountains has been extensive and diverse in character. At the present time, intermittent exploration work is carried on, and mining is at a standstill. Major areas of mining and minerals are summarized below. For more detailed descriptions, the reader is referred to Griswold (1959).

1) Jicarilla District, located near the hamlet of Jicarilla. Most of the gold, occurring in this area, was recovered from placer deposits, but some lode deposits exist. These vein deposits are presumably the primary source of the placer gold. Pyrite, arsenopyrite, quartz, small amounts of copper minerals, and gold occur as fracture fillings and disseminations in the monzonite. Placer gold has been mined from the sand and gravel fill of many arroyos of the district. It has been reported that most of the gold is contained in the lower few inches of the arroyo fill, and this fact, together with the scarcity of water at this elevation, made gold mining a marginal operation.

2) Many small magnetite-hematite deposits are scattered throughout the area. Their usual occurrence is at the contact of monzonite or related intrusive, and limestone of either the San Andres or Yeso Formations. Major production of the area has been from a series of mining claims west of Jack's Peak and known as the Jack Mines.

3) Gypsum is abundant in the upper part of the San Andres Formation. At Ancho, a plaster mill operated from 1912 to 1922, according to local residents. Gypsum was presumably obtained from outcrops across the Southern Pacific Railroad tracks.

4) During about the same period, a brick plant operated at Ancho. Raw material for this operation was obtained from a mine about 2 miles east of the town, where shale was mined from the Dakota Formation. The clay was shipped to Ancho and fired to an attractive red building brick, marked Ancho No. 1. The foundations of the brick plant, and several thousands of bricks still remain near the railroad siding at Ancho.

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