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## ***Stratigraphy of the outcropping Permian rocks in the southern part of the San Juan Basin, New Mexico***

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## STRATIGRAPHY OF THE OUTCROPPING PERMIAN ROCKS IN THE SOUTHERN PART OF THE SAN JUAN BASIN, NEW MEXICO

### INTRODUCTION

The following notes are an effort to summarize some of the findings of several geologists who have carried out, over a period of two decades, investigations of Permian rocks in parts of western New Mexico. This report is restricted to the outcropping Permian rocks in the southern part of the San Juan Basin, inasmuch as that is the general area traversed by the Tenth Annual Field Trip of the New Mexico Geological Society.

The southern part of the San Juan Basin, as referred to in this paper, is the broad southern sub-basin south of Mount Taylor and lying between the Lucero uplift at the east and the Zuni Mountains at the west. The southern limit of this sub-basin is unknown inasmuch as it passes under Cenozoic volcanic rocks in the country generally referred to as the Datil Mountains. The southern part of the San Juan Basin is the area called the Acoma embayment and Mount Taylor syncline by Kelley (1950) and, in part, the area called the Lucero basin by Wengerd (1959).

### PERMIAN ROCKS OF THE LUCERO UPLIFT

The Lucero uplift is a generally north-south trending structurally complex belt extending from the vicinity of Correo, Valencia County, New Mexico, to the Rio Salado near Riley, Socorro County, New Mexico. This feature forms the western margin of the Rio Grande trough and is the eastern limit of the Colorado Plateau province. Outcropping rocks in and adjacent to the uplift range in age from Precambrian to late Cenozoic, but are, in the main, late Paleozoic in age. The Permian strata consist of the Abo formation, Yeso formation, Glorieta sandstone, and San Andres formation.

The Red Tanks member of the Madera formation is tentatively assigned to the Pennsylvanian system (Kelley and Wood, 1946), but it may contain strata of Wolfcamp age. Inasmuch as no thorough faunal analysis of the Red Tanks has been made, it is impractical to attempt any reclassification of the rocks. However, the Red Tanks member and its possible equivalent in the Zuni Mountains are discussed in this report in an effort to cover the stratigraphy of all rocks that may eventually be assigned to the Permian in the area.

The Red Tanks member is as much as 450 feet thick. It consists of strata that are dominantly marine and are composed of limestone alternating with red siltstone and arkosic sandstone. This sequence is quite similar to rocks east of Socorro, New Mexico, which were called the Bursum formation by Wilpolt and others (1946), and assigned to the Wolfcamp series on the basis of their contained fauna. However, a similar fauna has not been reported in the Red Tanks member.

The Abo formation in the Lucero uplift (Kelley and Wood, 1946) consists of brownish red, irregularly bedded sandstone and siltstone 800 to 900 feet thick. Locally some of the lower siltstone beds are clayey. The formation contains rare fossils that suggest its deposition was under dominantly continental conditions in a piedmont environment. These fossils, which are elements of the *Supaia* flora, occur in the upper part of the Abo formation and are believed to be Leonard in age.

Overlying the Abo formation with apparent conformity is the Yeso formation (Kelley and Wood, 1946). In

and adjacent to the Lucero uplift the Yeso formation has been divided into two members. The lower member is the Meseta Blanca sandstone (Kelley and Wood, 1946) and the upper is the Los Vallos member (Kelley and Wood, 1946).

The Mesta Blanca sandstone member varies up to 250 feet in thickness on the Lucero uplift and consists of cross-bedded, medium- to fine-grained red sandstone with some silty interbeds. The Los Vallos member which conformably overlies the Meseta Blanca varies up to approximately 1,000 feet in thickness on the Lucero uplift and consists of siltstone and fine-grained brownish-red sandstone interbedded with dolomite and gypsum. In general gypsum is most abundant in the upper 200 feet of the Los Vallos member.

Overlying the Los Vallos member of the Yeso formation is the Glorieta sandstone (Kelley and Wood, 1946) which is 200 to 225 feet thick and consists of medium-grained light gray sandstone. Near the base brownish-red siltstone is interbedded with typical Glorieta sandstone and this relationship is interpreted as indicative of interfingering between the Glorieta sandstone and the Yeso formation. Locally the Glorieta sandstone contains one or more thin gypsum beds near the middle of the interval.

Conformably overlying the Glorieta sandstone and interfingering with it is the San Andres limestone which is 325 to 350 feet thick in the Lucero uplift (Kelley and Wood, 1946). The San Andres limestone consists of two members. The lower member is as much as 325 feet thick and is composed of alternating dolomitic limestone, gypsum, and silty sandstone. Above the evaporite member is medium to thin bedded dolomitic limestone, 100 to 125 feet thick, containing minor intercalations of gypsum. This interval has been referred to as the limestone member of the San Andres formation.

Thickness and facies variations of Permian rocks in the Lucero uplift (fig. 1) are similar in general to those seen in north to south traverses on the east side of the Rio Grande valley. The Abo formation is fairly constant in thickness, although there are some suggestions that it may thin to the south. The Yeso formation, which overlies the Abo formation, thickens southward and passes into a gypsiferous facies. This is similar to facies changes on the east side of the Rio Grande valley in the vicinity of Socorro, and it is apparent that the Yeso on both sides of the river at this latitude is dominantly an evaporite facies, although clastic sediments are still very conspicuous. At the base of the Yeso section the Meseta Blanca sandstone member diminishes in thickness to the south, although it continues to be a conspicuous unit. Above this is an evaporite facies which is laterally equivalent to the Los Vallos member.

The Glorieta sandstone which overlies the Yeso formation thins southward while the overlying San Andres formation thickens correspondingly. Adequate evidence indicates that this is due to the southward interfingering of the Glorieta sandstone with the overlying San Andres limestone. A local development of considerable amounts of gypsum in the San Andres limestone is noteworthy, but its parallel is found in areas east of the Rio Grande. Thicknesses of the San Andres limestone are highly variable and the formation is beveled to an increasingly greater depth northward as a result of pre-Late Triassic erosion.

### PERMIAN ROCKS OF THE ZUNI UPLIFT

The Zuni uplift is an elongate structural dome that trends northwestward and brings pre-Mesozoic rocks to the surface in parts of McKinley and Valencia Counties, New Mexico. Locally the uplift is complicated by normal faulting, but at no point are these complications severe. Precambrian rocks of a variety of plutonic, igneous, and metamorphic types crop out in several areas in the core of the Zuni uplift. Permian strata and, locally, rocks of possible Pennsylvanian age are disconformable on the basement rocks. On the southeast, east, and northeast flanks of the uplift these strata dip gently into the southern part of the San Juan Basin. On the northwest and southwest flanks where the strata pass under the Gallup and Zuni basins the dips are steep to vertical along the Nutria monocline. In this paper only the Permian strata that are exposed on the northeast, east, and southeast flanks of the Zuni uplift are discussed.

Locally, at the base of the Permian sequence in the Zuni Mountains, there are conglomerates and siltstones alternating with impure limestone beds and marly layers. This interval which rarely exceeds 60 feet in thickness contains invertebrates at a number of localities. On the basis of the invertebrates, stratigraphers have in the past been inclined to regard the sequence as being of Virgil age and hence uppermost Pennsylvanian. However, in view of the fact that the sequence is not unlike the Red Tanks member of the Lucero uplift, it is suggested that the interval should have continued attention until the possibility of correlation with the Red Tanks member has been finally determined. Both are classified as upper Pennsylvanian, but the possibility of their being Wolfcamp in age should not be overlooked.

Permian strata in the northern part of the Zuni Mountains, New Mexico, have been examined in detail at McGaffey and at Cottonwood Canyon. At both points clastic rocks that are assigned to the Abo formation at the base of the Permian sequence rest on Precambrian metamorphic and igneous rocks. At Cottonwood Canyon the contact is irregular and the beds above it are coarse conglomerate. At McGaffey similar conditions probably exist, although the strata at the contact are not well exposed. The Abo at the two localities varies in thickness from 405 feet to approximately 790 feet, but is similar in lithology. The formation consists of a monotonous sequence of alternating brownish or brownish-orange fine-grained sandstone and arkose with several beds of lime pellet conglomerate and major intervals of siltstone. Very few fossils are known in the Abo formation in the Zuni uplift. However, at a few localities in the upper part of the Abo there are small fossil floras which are members of the *Supaia* assemblage (White, 1929) and are believed to indicate a Leonard age for the containing strata.

The basal strata of the Yeso formation rest evenly on the Abo formation in the Zuni Mountains and consist of thinly bedded brownish-red siltstone a few feet thick overlain by intricately cross-laminated limestone 80 feet or more thick. These two units constitute the basal member of the Yeso formation which is termed the Mesa Blanca sandstone member. In the northern part of the Zuni Mountains the Meseta Blanca sandstone member is over-

lain by a sequence 225 to 300 feet thick composed of evenly bedded fine-grained sandstone with two or three thin layers of dense gray dolomitic limestone. At Cottonwood Canyon the limestone beds have yielded poorly preserved specimens of *Dictyoclostus* sp. aff. *D. ivesii*. These evenly bedded brownish-orange clastic strata and interbedded dolomitic limestone layers of the Yeso are correlated with the San Ysidro member which was named by Wood and Northrop (1946) for exposures in the Nacimiento Mountains. The San Ysidro member rests conformably on and apparently is gradational into the underlying Meseta Blanca member.

A cliff-forming, light-gray, tangentially cross-bedded quartzose sandstone that has been correlated with the Glorieta sandstone conformably overlies the San Ysidro member of the Yeso formation. The Glorieta sandstone is 280 feet thick at Cottonwood Canyon and is 300 feet thick at McGaffey. It is overlain conformably by gray, medium to thick bedded, dolomitic limestone which constitutes the San Andres formation. These strata vary in thickness up to approximately 100 feet in the northern part of the Zuni Mountains and are limited above by a very irregular erosional surface which is characterized by solution breccias, steep-walled, sinkhole-like depressions, collapsed blocks, and other features similar to those observed in modern karst areas. Upon this irregular surface the basal Upper Triassic strata rest with profoundly disconformable relations.

The Permian units traced southeastward along the northeast limb of the Zuni uplift exhibit changes in thickness and facies similar to the variations noted along the Lucero uplift. The Abo is constant in thickness or thins slightly to the southeast. The Meseta Blanca sandstone member of the Yeso formation thins gradually and loses its characteristic lithology, and the Los Vallos member which is a clastic facies to the northwest thickens and becomes an evaporite-bearing sequence to the southeast. Similarly, the Glorieta sandstone gradually thins to the southeast as the San Andres formation thickens in the course of interfingering with the Glorieta sandstone.

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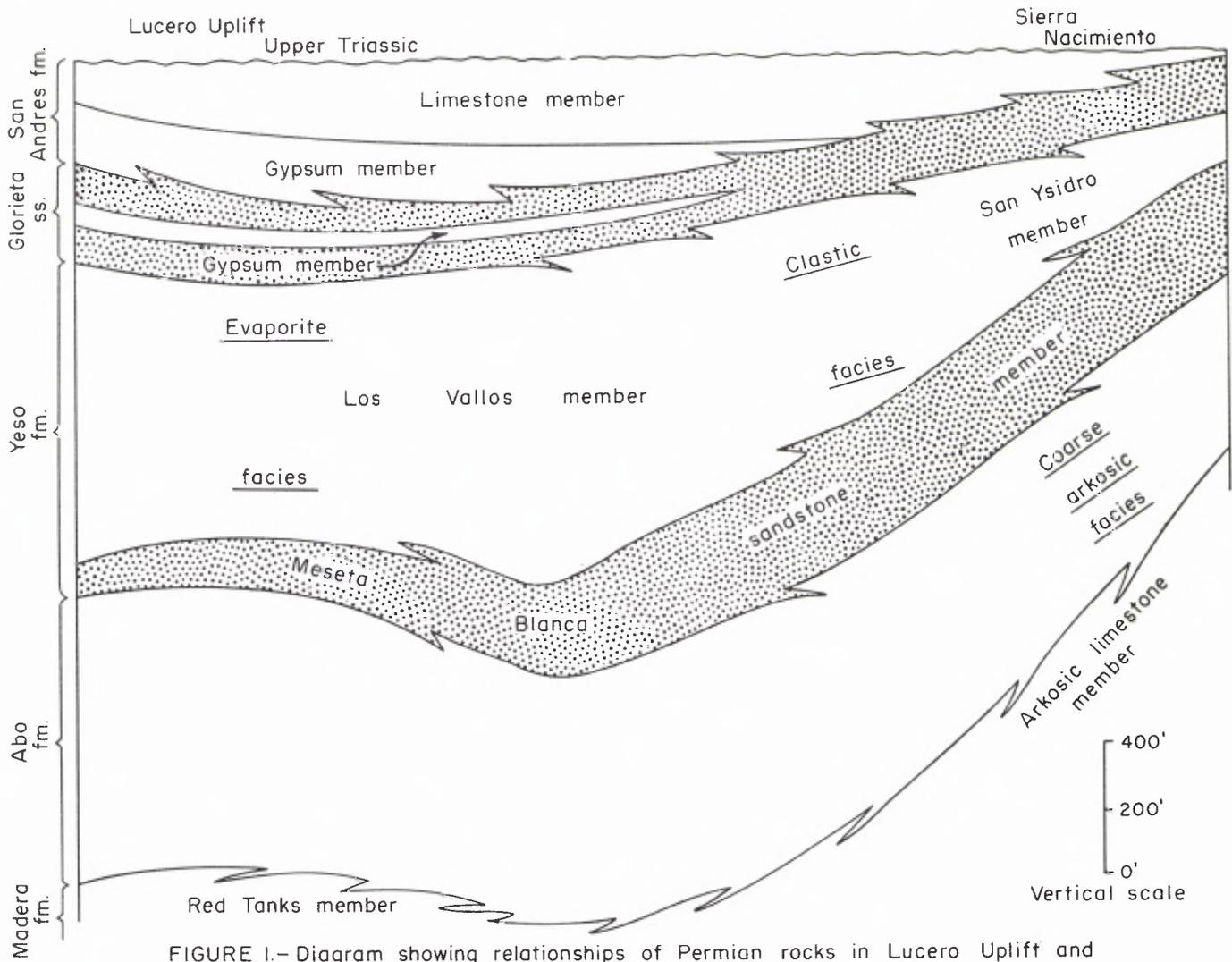


FIGURE 1.—Diagram showing relationships of Permian rocks in Lucero Uplift and southernmost part of Sierra Nacimiento, New Mexico.