



## ***Excerpts from: Stratigraphy of outcropping Permian rocks in parts of northeastern Arizona and adjacent areas***

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*This is one of many related papers that were included in the 1967 NMGS Fall Field Conference Guidebook.*

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EXCERPTS FROM:

STRATIGRAPHY OF OUTCROPPING PERMIAN ROCKS IN PARTS OF NORTHEASTERN ARIZONA, AND ADJACENT AREAS<sup>1</sup>

By

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EDITOR'S NOTE

In the spring and early summer of 1950 Read and Wanek undertook an investigation of the outcropping Permian rocks in northeastern Arizona, northwestern New Mexico, and parts of southern Utah. Their work has as its specific objective the establishing of correlations of Permian rocks in the Zuni uplift, Defiance uplift, and Monument Valley upwarp. The determination of these relations, it was believed, would be of aid to the activities of the Geological Survey in the Navajo Reservation which had as objectives the investigation of the mineral fuels and water resources of the area.

Only the part of the paper by Read and Wanek that applies to the Permian in the northern part of the Zuni Mountains and the southernmost part of the Defiance uplift is reported in this summary.

NOMENCLATURE

The nomenclature for Permian strata used by Read and Wanek followed to a considerable degree that proposed by Baker and Reeside (1929, p. 1441, 1445). However, some modifications were suggested as a result of their work. These modifications are shown in table 1.

LOWER AND UPPER LIMITS OF THE PERMIAN SYSTEM

In the Zuni uplift the lower limit of the Permian system has been placed at the base of the Abo formation (see Table 1) although it is possible that the lowermost strata in this formation are locally Pennsylvanian in age. At some points in the Zuni uplift, a thin sequence of argillaceous limestone, shale, and sandstone beds underlies the Abo formation. These strata, although sparingly fossiliferous, have failed to yield material that will permit precise dating. Tentatively, they are assigned to the Pennsylvanian system.

The upper limit of the Permian system in the Zuni uplift has been a subject of some discussion. Darton (1928, p. 140-142) briefly described the sequence of rocks in the Zuni uplift and referred the Permian strata to the

1. Read, C. B. and Wanek, A. A., 1961, Stratigraphy of Outcropping Permian Rocks in Parts of Northeastern Arizona and Adjacent Areas: U.S. Geol. Survey Prof. Paper 374-H, p. 1-10.

TABLE 1.—Nomenclature of Permian strata in the Zuni uplift, Defiance uplift, and Monument Valley upwarp

A. Zuni uplift, New Mexico					
Baker and Reeside (1929, p. 1438)			This report		
Permian	Chupadera formation		Triassic	Lower part Shinarump member of the Chinle formation	
			Permian	San Andres limestone	
				Glorieta sandstone	
				Yeso formation	San Ysidro member
Meseta Blanca sandstone member					
Abo formation			Abo formation		
B. Defiance uplift, Arizona and New Mexico					
Baker and Reeside (1929, p. 1438)			This report		
Permian	Cutler formation	De Chelly sandstone member	Permian	De Chelly sandstone	Upper member
		Red beds <sup>1</sup>			Lower member
					Supai formation

Manzano group, which consists of the Abo formation at the base and the Chupadera formation of former usage at the top. Above this group are strata that Darton (1928, p. 143) correlated with the Moenkopi formation. These are overlain by a conglomeratic sandstone that was identified as the Shinarump conglomerate, and this in turn is overlain by red beds assigned to the Chinle formation.

A year later, Baker and Reeside (1929, p. 1433) reviewed the sequence of rocks in the Zuni uplift and classified the strata that Darton had correlated with the Moenkopi formation as the upper part of the Chupadera formation of former usage. This assignment of the Moenkopi of Darton in the Zuni uplift to the Chupadera formation was based on the belief that inasmuch as the Moenkopi formation does not extend east of the vicinity of St.

<sup>1</sup> The name Supai was used in earlier reports but was not accepted by Baker and Reeside.

Johns, Arizona, it is unlikely that it is present in the Zuni area.

In 1941 the senior author reviewed the Zuni sequence and collected fossil plants from the unit called Moenkopi by Darton and referred to the Chupadera by Baker and Reeside. The species noted are identical with fossils collected from the Chinle formation at localities near Holbrook, Arizona, and described by Daugherty (1941). On the basis of this paleontological data as well as on stratigraphic grounds that are outside the scope of this report, the rocks in question are here assigned to the Upper Triassic and are placed in the Chinle formation. The conglomerate identified as the Shinarump by Darton (1928, p. 143-144) and by Baker and Reeside (1929, p. 1433) also is assigned to the Chinle formation. A conglomeratic sandstone that is locally present but which was not earlier reported lies at the base of the Chinle formation and is now correlated with the Shinarump member of the Chinle in Arizona.

The upper limit of the Permian in the Zuni uplift is here placed at the top of the San Andres limestone. This accords with sequences farther east in New Mexico as well as those along the Mogollon Rim in Arizona where the Kaibab limestone is the youngest formation of Permian age that is preserved (Darton, 1925, p. 96, 203).

#### COTTONWOOD CREEK, NEW MEXICO, TO BLACK CREEK, ARIZONA

The sequence of Permian strata in the northern part of the Zuni Mountains, New Mexico, is illustrated on plate 1. These sections were measured at Cottonwood Creek (sec. 3) and in the vicinity of the settlement of McGaffey (sec. 2). At both points clastic strata that are assigned to the Abo formation at the base of the Permian sequence rest on metamorphic and plutonic rocks believed to be of Precambrian age. At Cottonwood Creek 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 ranges in thickness from 305 feet to approximately 790 feet but is similar in lithology. It consists of a monotonous sequence of alternating brown or brownish-orange fine-grained sandstone and arkose, several beds of limestone pellet conglomerate in one zone at Cottonwood Creek, and major intervals of siltstone. The basal contacts of sandstone on siltstone are commonly irregular, and bedding planes of the strata are marked by ripples, pits, mounds, and vague impressions of stems and leaves of terrestrial plants. The latter are characteristic of the Supai flora.

The basal strata of the Yeso formation rest evenly on the Abo formation in the Zuni Mountains and consist of a few feet of thinly bedded brownish-red siltstone that are overlain by 80 feet or more of intricately cross-laminated and lenticularly bedded sandstone. These strata, the few feet of siltstone and the overlying massive cross-laminated sandstone, constitute the basal member of the

Yeso formation and are termed the Meseta Blanca sandstone member (Wood and Northrop, 1946). This member, coarse to medium-grained at Cottonwood Creek (sec. 3) and fine-grained to silty at McGaffey (sec. 2), is generally present in northern New Mexico. Analyses of directions of dip of foreset laminae indicate a preferred orientation toward the east or southeast. In the northern part of the Zuni Mountains the Meseta Blanca is overlain by 225 to 300 feet of evenly bedded fine-grained sandstone and siltstone of similar composition, interbedded with two or three thin layers of dense gray dolomitic limestone. At Cottonwood Creek the limestone beds have yielded poorly preserved specimens of *Dictyoclostus*, sp. aff. *D. ivesi*. These evenly bedded brownish-orange clastic strata and the inter-bedded dolomitic limestone layers constitute the San Ysidro member of the Yeso formation (Wood and Northrop, 1946), which rests conformably and apparently gradationally on the underlying Meseta Blanca member.

Conformably overlying the San Ysidro member of the Yeso formation is a cliff-forming light-gray tangentially cross-laminated lenticularly bedded quartzose sandstone that has been correlated with the Glorieta sandstone, which is typically developed in north-central New Mexico at Glorieta Mesa (Read and others, 1945). Earlier reports (Read and others, 1945; Kelley and Wood, 1946; Wood and Northrop, 1946; Wilpolt and others, 1946; Wilpolt and Wanek, 1951) have classified the Glorieta sandstone as a member of the San Andres limestone in northern New Mexico. Although the Glorieta grades southward into beds of San Andres lithology the distinction between the two is so great that the authors consider the Glorieta sandstone a formation.

The Glorieta sandstone is 280 feet thick at Cottonwood Creek and is 300 feet thick at McGaffey. The foreset laminae generally dip to the southwest. The Glorieta is, in turn, conformably overlain by gray medium- to thick-bedded porphyroblastic, dolomitic limestone beds that constitute the San Andres limestone. Like the Glorieta sandstone, this unit has been treated in the past as an unnamed member of the San Andres limestone (Read and others, 1945; Kelley and Wood, 1946; Wood and Northrop, 1946; Wilpolt and others, 1946; Wilpolt and Wanek, 1951), but is now recognized as formational in rank. These strata are as much as approximately 100 feet in thickness in the northern part of the Zuni Mountains, and are limited above by a very irregular erosional surface that is characterized by solution breccia, steep-walled buried depressions, collapsed blocks, and other features not unlike those observed in modern karst areas. The basal strata of the Upper Triassic rest upon this old and irregular surface with profound disconformity.

The sequence of strata at Black Creek (sec. 1) in the Defiance uplift, Arizona, is dominantly clastic and generally similar to that of the Zuni uplift. The pre-Permian core of the Defiance uplift is not exposed at Black Creek and the oldest rocks are rather regularly bedded siltstone and sandstone that are chiefly brownish-orange and are

replete with so-called salt hoppers—sand casts and molds of halite crystals. Two thin beds of porphyroblastic, dolomitic limestone lie in the upper part of this sequence. Overlying these strata is a cliff-forming tangentially cross-bedded gray to brownish-gray quartzose sandstone with foreset laminae inclined to the southwest in most places. The Permian sequence is truncated at this level by coarsely conglomeratic strata that are assigned to the Shinarump member of the Chinle formation of late Triassic age.

The lower dominantly brownish-orange fine-grained clastic strata and interbedded dolomitic limestone of the Black Creek area are correlative with the San Ysidro member of the Yeso formation in the Zuni uplift. For geographic reasons, they are assigned, however, to the Supai formation (Hager, 1924, p. 167, 423; Darton, 1925, p. 85, 91, 207).

The overlying gray or brownish-gray quartzose sandstone in the Black Creek area is similarly correlated with the Glorieta sandstone in the Zuni Mountains and is classified as the upper member of the De Chelly Sandstone and the De Chelly is given formation rank. The names Glorieta and De Chelly are both firmly established in the literature, and the change from one to the other takes place in the subsurface. Therefore, no serious conflict arises from the use of the two names.

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