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Permian rocks of north-central New Mexico

D. L. Baars, 1974, pp. 167-169

in:

Ghost Ranch, Siemers, C. T.; Woodward, L. A.; Callender, J. F.; [eds.], New Mexico Geological Society 25th Annual Fall Field Conference Guidebook, 404 p.

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PERMIAN ROCKS OF NORTH-CENTRAL NEW MEXICO

by
 D. L. BAARS
 Ft. Lewis College
 Durango, Colorado

INTRODUCTION

Permian rocks in the north-central region of New Mexico (Fig. 1) are largely colorful redbeds that contribute much to the scenic beauty of the country. The stratigraphy of the Permian System is not simple, however, and should probably be categorized into three distinctive provinces. The primary source for the red, arkosic clastic sediments is the southern Uncompahgre uplift, or the San Luis uplift of some authors. This first distinctive province, the source region, lies approximately between Santa Fe on the south and Pagosa Springs, Colorado to the northwest and beyond, and was high in Early Permian time following an earlier growth history (Baars, 1966). A second stratigraphic province lies adjacent to the source region and consists of coarse-grained arkosic redbeds that cannot be separated into natural smaller formations. This

undifferentiated accumulation of continental, mostly fluvial, clastics is probably best referred to the Cutler Formation. South of approximately San Pedro Mountain, east of Cuba, New Mexico, a series of distinctive formations appears in the system, marking the northernmost incursion of marine environments. This sequence becomes, in the southern Nacimiento Mountains, the typical New Mexico Permian section including the Abo, Yeso, Glorieta, and San Andres formations of the third province.

CUTLER FORMATION

The region from near El Vado eastward and south to almost Santa Fe was the source region for the reddish brown, arkosic clastics of the Cutler Formation. The largely fluvial deposits thicken abruptly adjacent to the uplift to about 1500 feet

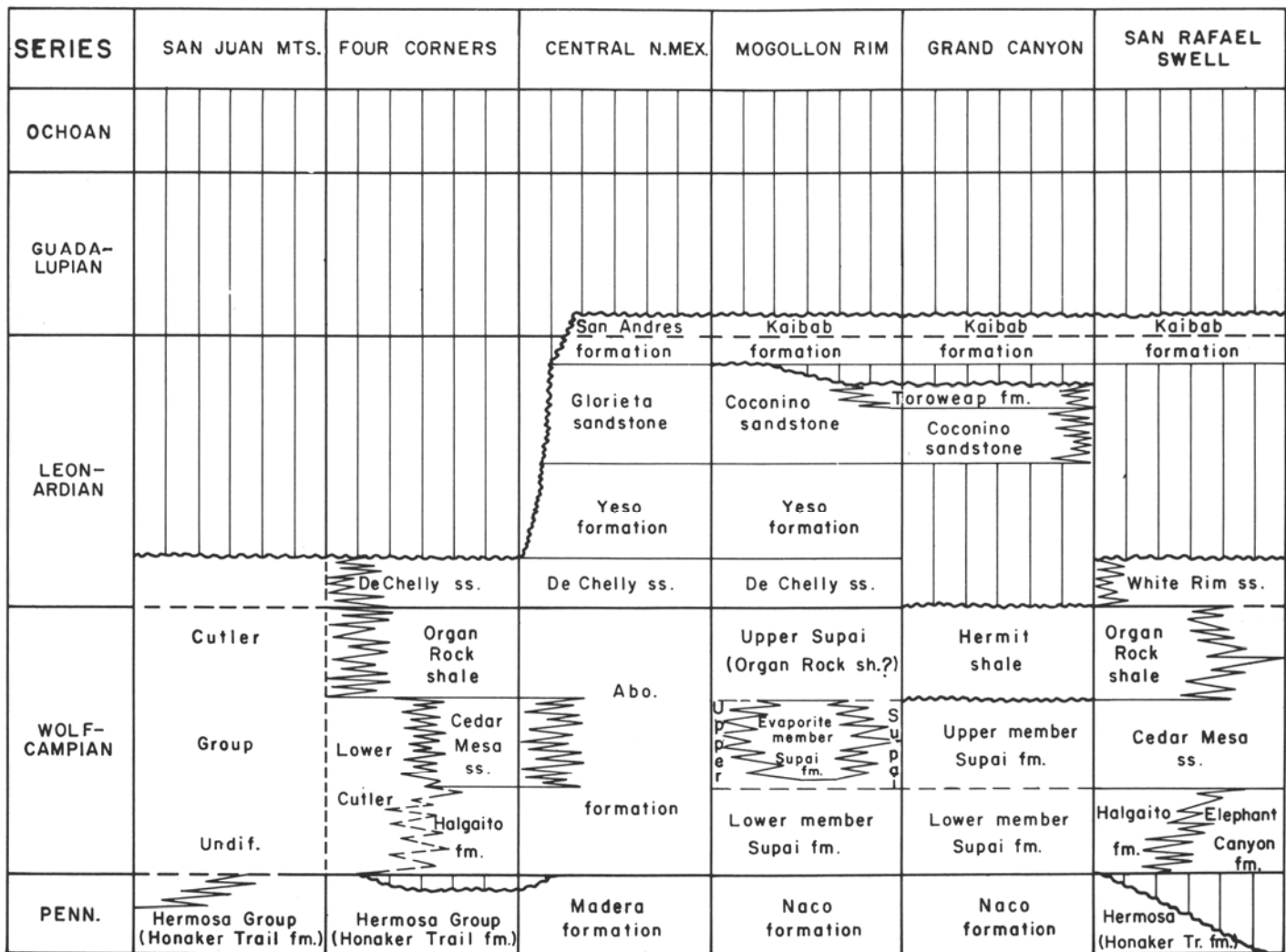


Figure 1. Permian correlation chart—proposed terminology and correlations (after Baars, 1962).

between Santa Fe and the Nacimiento Mountains and to as much as 2500 feet north of San Pedro Mountain (Baars, 1962). The sequence grades, in large part, to the Abo Formation south of about San Pedro Mountain and Santa Fe. The next overlying formation, the Yeso Formation including its lower Meseta Blanca Sandstone Member (the De Chelly Sandstone equivalent) and its upper San Ysidro Member of Wood and Northrop (1946) grade into the upper Cutler facies in the northern and central Nacimiento Mountains. This coarse-grained facies marks the marginal sedimentary province adjacent to the major source region of the southern Uncompahgre uplift and becomes finer in grain-size and thinner with increasing distance from the source.

THE SOUTHERN PROVINCE

South of about Santa Fe and south and southwest of about San Pedro Mountain, the Permian section can be differentiated into several formations that are well known throughout central New Mexico. The lower unit, the Abo Formation, is essentially the extension of the Cutler Formation. The next younger unit, the Yeso Formation, has historically been lumped together into a single formation with two members, but Baars (1962) suggested that the two members are sufficiently distinctive to merit separation into the lower DeChelly Sandstone (a correlative) and the upper mappable unit, the Yeso Formation (restricted). These two rock-stratigraphic units grade northward and northeastward into Cutler arkosic equivalents, above the Abo redbeds. Younger formations of the Glorieta Sandstone and San Andres Formation pinch out northward above the DeChelly and Yeso units and appear to have no correlative strata in the Cutler Formation.

Abo Formation

The Abo Formation is lithologically similar to the Cutler Formation and is obviously the stratigraphic equivalent of most of the Cutler section. It is typically an interbedded sequence of reddish brown siltstone, shale, and sandstone, often arkosic, that becomes coarser and more arkosic to the north and northeast towards the source. It is the obvious stratigraphic equivalent of the pre-DeChelly Cutler interval of the Colorado Plateau Province (Baars, 1962). The Abo was deposited under varying environmental conditions, but is predominantly fluvial in origin. Its close geographic proximity to Wolfcampian marine strata in southern New Mexico and the many geographically widespread mudstone units within the formation suggest the possibility of widespread intertidal conditions occurring periodically throughout Abo time.

The Abo Formation is easily dated as Early Permian (Wolfcampian) on the basis of interfingering fusulinid-bearing marine limestones of the Red Tanks Member in the vicinity of the Lucero uplift and the Bursum Formation at the type section in Abo Canyon northeast of Socorro (Baars, 1962). The Abo interfingers southward with the Early Permian Hueco Formation of southern New Mexico.

Yeso Group(?)

The overlying units south of about San Pedro Mountain east of Cuba, New Mexico have been compressed by many authors into the two-member Yeso Formation. Baars (1962) demonstrated that the lower reddish-colored sandstone unit, usually

known as the Meseta Blanca Sandstone Member, is correlative with the DeChelly Sandstone of the Four Corners region, and should be referred to as that formation. This member, or formation if you wish, grades northward into the upper Cutler arkoses in the northern Nacimiento Mountains. It is a red ferruginous sandstone with prominent large scale cross-stratification that suggests an eolian environment of deposition, forming massive red cliffs in the southern Nacimiento Mountains.

The upper unit of the original Yeso Formation was variously called the Los Vallos Member in the Lucero uplift by Kelley and Wood (1946) and the San Ysidro Member by Wood and Northrop (1946) in the Nacimiento Mountains. In the Luccro uplift the upper member, or Yeso Formation (restricted) of Baars (1962), consists of more than 1000 feet of reddish-colored siltstones, shales, and sandstones, with thin beds of limestone and gypsum. In the southern Nacimiento Mountains, the equivalent strata are composed of only a thin bed of dolomite and no gypsum with the reddish clastic sediments. The fine-grained reddish sediments accompanied by local evaporites are probably indicative of a marginal marine, largely intertidal environment of deposition. The obviously marine carbonates of the correlative Yeso Formation of southern New Mexico are lower Leonardian in age (Baars, 1962).

Glorieta Sandstone

The light-colored, cliff-forming unit overlying the Yeso Formation is the Glorieta Sandstone of late Leonardian age. It is usually a white, fine- to medium-grained, siliceous sandstone that displays thin to medium cross-stratification sets that are planar at the upper surface, with dips ranging from 10 to 20 degrees. The nature of the cross-stratification suggests subaqueous depositional conditions for most of the formation, but upper neritic to coastal eolian environments may locally be identified. The formation thins gradually northward to a feather-edge in the central Nacimiento Mountains, but is quite uniform in lithology and thickness throughout central New Mexico (Baars, 1962). The Glorieta is the shallow marine equivalent of the eolian Coconino Sandstone of northern Arizona and apparently overlies the Cutler Formation to the north.

San Andres Formation

The San Andres Formation, the eastern equivalent of the Kaibab Formation, is a complex shallow shelf deposit of latest Leonardian or earliest Guadalupian age. It consists of carbonates and sandstones in the Zuni Mountains but changes abruptly to redbeds toward the north and evaporites toward the southeast. A single thin dolomite bed within thin redbeds marks the formation in the southern Nacimiento Mountains south of its pinchout in the central Nacimiento region. This wedge-out is probably the approximate depositional edge of the Kaibab-San Andres shallow shelf carbonate-evaporite complex that developed across central New Mexico and Arizona in Middle Permian time (Baars, 1962).

PALEOTECTONIC IMPLICATIONS

The Pennsylvanian Madera Formation may be seen to onlap an obvious paleo-positive feature from south to north through the Nacimiento Mountains. The overlap culminates in a condition where the Cutler-Abo redbeds directly overlie Precam-

brian rocks on San Pedro Mountain, thus the high terrain was buried by Early Permian sedimentation. The total Permian System and many of its component formations also thin over the Nacimiento-San Pedro region, the thinning culminating at San Pedro Mountain (Baars, 1962). These conditions indicate that an elongate, north-south trending positive element was present in the Nacimiento-San Pedro Mountain vicinity in Pennsylvanian time and continued its slow growth into Permian time. The feature must have been of low relief, for there is no obvious indication that much clastic material was ever shed from the uplift.

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