The Upper Triassic Chinle Formation in north-central New Mexico

Robert B. O'Sullivan, 1974, pp. 171-174

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.

This page is intentionally left blank to maintain order of facing pages.

THE UPPER TRIASSIC CHINLE FORMATION IN NORTH-CENTRAL NEW MEXICO

by

ROBERT B. O'SULLIVAN
U.S. Geological Survey
Denver, Colo. 80225

INTRODUCTION

The Chinle Formation of Late Triassic age crops out at several places (Fig. 1) in the Ghost Ranch-San Ysidro area of north-central New Mexico. It is exposed over a fairly large area along the Rio Chama north of the Jemez Mountains, in a thin discontinuous belt of outcrop along the west side of the Nacimiento and San Pedro Mountains, and in small outliers in the southern part of the Jemez Mountains. In the Ghost Ranch-San Ysidro area, the Chinle Formation is 400-1,300 feet (122-396 m) thick (Fig. 1) and is bounded at the base and top by regional unconformities. The unconformities separate Upper Triassic rocks of the Chinle Formation from overlying Upper Jurassic rocks and from underlying Lower Permian rocks. This report briefly describes the stratigraphy of the Chinle Formation in north-central New Mexico, describes the Chinle Formation in the type locality in northeast Arizona, and discusses the correlation of units between those areas.

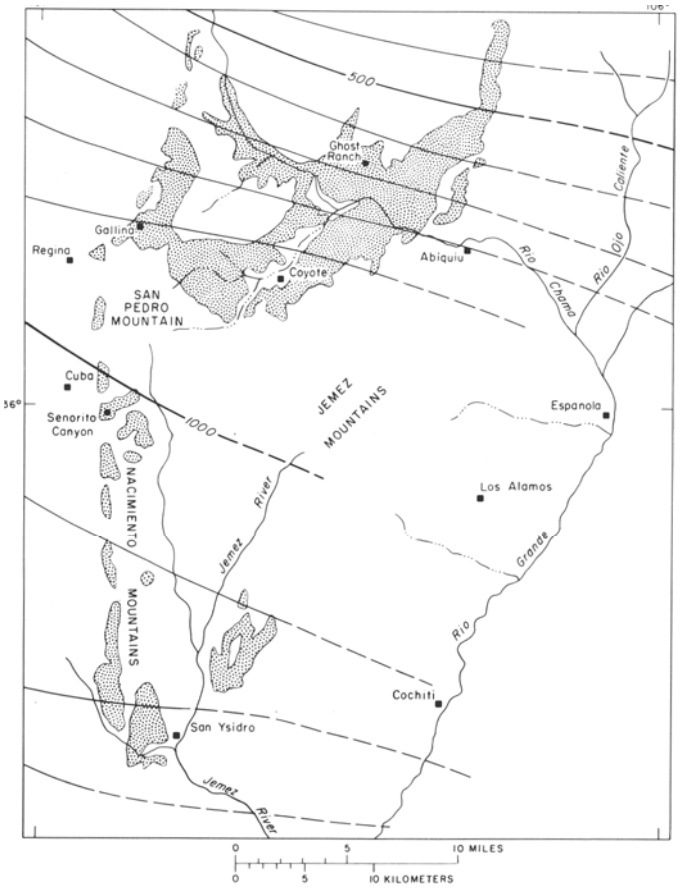

Figure 1. Map of north-central New Mexico showing distribution and thickness of the Chinle Formation. Stippling shows outcrop of Chinle Formation. Isopach interval 100 feet (30.5 m). Compiled from Dane and Bachman (1956) and Stewart, Poole, and Wilson (1972).

CHINLE FORMATION IN NORTH-CENTRAL NEW MEXICO

The Chin le Formation consists of, in ascending order, Agua Zarca Sandstone Member, sandstone member, Salitral Shale Tongue, Poleo Sandstone Lentil, Petrified Forest Member, and siltstone member. Three of these members, the Agua Zarca, Salitral, and Poleo, have been named for exposures west of Coyote. The previous nomenclature of the Chinle Formation in north-central New Mexico and adjacent states has recently been summarized by Breed and Breed (1972). The following description of the Chinle Formation in north-central New Mexico is derived almost entirely from the carefully detailed report by Stewart, Poole, and Wilson (1972).

Agua Zarca Sandstone Member

The Agua Zarca Sandstone Member is locally as much as 115 feet (35 m) thick. The member is recognized throughout the area north of the Jemez Mountains and the area west of San Pedro Mountains. It is apparently present at places in the western foothills of the northern half of the Nacimiento Mountains.

The Agua Zarca consists of sandstone and lesser amounts of conglomerate, siltstone, and shale. The sandstone is red, purple, and light gray, very fine to very coarse grained; it contains variable amounts of granules to cobbles of quartz, quartzite, and chert. The sandstone beds are lenticular and crossbedded and were deposited by streams that flowed to the south and southwest.

Sandstone Member

The sandstone member is as much as 165 feet (50 m) thick near San Ysidro. The member is recognized at the base of the Chinle Formation throughout most of the Nacimiento Mountains. In the northern part of the Nacimiento Mountains it locally overlies the Agua Zarca Sandstone Member.

The sandstone member in general is similar to the Agua Zarca and has been mapped previously as the Agua Zarca by Wood and Northrop (1946). However, the sandstone member differs from the Agua Zarca in that it tends to be much lighter colored, and finer grained, and it contains smaller pebbles. Furthermore, the sandstone member was deposited by streams that flowed north to northeast, suggesting an entirely different source area for the sandstone member as compared to the Agua Zarca.

Salitral Shale Tongue

The Salitral Shale Tongue is as much as 115 feet (35 m) thick in the northern part of the Nacimiento Mountains. The

Salitral thins and pinches out eastward in the direction of Abiquiu. Inasmuch as the tongue separates the Agua Zarca or sandstone member from the overlying Poleo, it is almost coextensive with the Poleo Sandstone Lentil.

The Salitral Tongue consists of red, brown, purple, and greenish-gray shale and siltstone with numerous limestone nodules (Northrop, 1950, p. 35). Locally, very fine to coarse-grained lenticular sandstone beds are present. The tongue lithologically resembles the Petrified Forest Member and cannot be separately distinguished where the intervening Poleo Sandstone Lentil is absent. The Salitral intertongues extensively with the underlying Agua Zarca and sandstone member.

Poleo Sandstone Lentil

The Poleo Sandstone Lentil attains a maximum thickness of about 160 feet (49 m) near Abiquiu. The Poleo is present throughout the area north of the Jemez Mountains. From that area it thins rapidly to the south, but has been recognized southward along the west side of the Nacimiento Mountains to a locality about 8 miles (12.9 k) northwest of San Ysidro (Wood and Northrop, 1946).

The ledge-forming Poleo consists of yellowish-gray fine- to medium-grained sandstone, conglomerate, and some siltstone and shale. The conglomerate is composed mainly of quartz, quartzite, and red and orange chert granules and pebbles. At places, conglomerate is sparse, but at other localities it constitutes as much as 20 percent of the lentil. The lower contact of the Poleo is a surface of erosion; the upper contact is gradational. The Poleo was deposited by streams that flowed to the north and northwest.

Petrified Forest Member

The Petrified Forest Member is as much as 710 feet (216 m) near Coyote. The member occupies the interval from the top of the Poleo Sandstone Lentil to the base of the overlying Jurassic rocks in most of the area north of the Jemez Mountains and throughout most of the belt of outcrop along the San Pedro and Nacimiento Mountains. The name Petrified Forest was first applied to this interval in this area by Stewart, Poole, and Wilson (1956, p. 171).

The Petrified Forest Member consists mainly of variable silty shale and siltstone that is variegated reddish-brown, red, greenish-gray, and purple. Much of the shale is bentonitic and dominantly montmorillonitic, and was derived from the alteration of volcanic debris. Layers of limestone nodules are present at several levels within the member. A few very fine to medium-grained sandstone beds comprise a minor lithology in the Petrified Forest. The sandstone beds are red and light gray and tend to form ledges. Generally the sandstone beds are thin but locally they are as much as 20 feet (6.1 m) thick. The sandstone is locally conglomeratic and contains granules and pebbles of siltstone and limestone.

Siltstone Member

The siltstone member is as much as 230 feet (70 m) near Ghost Ranch, and at that locality it is underlain by about 200 feet (61 m) of beds assigned to the Petrified Forest Member. The siltstone member is present in only a small area north of the Jemez Mountains and grades laterally to the southwest into the Petrified Forest Member between Ghost Ranch and Coyote.

The siltstone member forms a steep slope and consists of light-brown and reddish-brown siltstone and shaly siltstone. Bedding is generally obscured, but viewed from a distance a few horizontal bedding plane-s are apparent. The upper part of the siltstone member contains a few layers of limestone nodules. The lower contact is conformable and separates the dominantly brown siltstone from the dominantly red shale of the underlying Petrified Forest Member.

CHINLE FORMATION IN NORTHEAST ARIZONA

The Chinle Formation was first named and described by H. E. Gregory for exposures along Chinle Wash in the vicinity of the settlement of Chinle in northeast Arizona. Gregory (1917, p. 42-43) recognized four units of the Chinle Formation which he referred to as divisions D, C, B, and A, in ascending order.

Division D is now named the Monitor Butte Member and consists of a sequence of continental deposits of reddish-purple to grayish-red mudstone and siltstone intermixed with lighter colored sandstone and conglomerate resting conformably on the Shinarump Member. The Monitor Butte Member is further characterized by numerous intraformational slumps, folds, and faults formed before consolidation.

Division C is called the Petrified Forest Member and is like the Petrified Forest Member in the field conference area. Over a wide area of northeast Arizona and adjacent parts of northwest New Mexico, the Petrified Forest Member is split into upper and lower parts by the conspicuous Sonsela Sandstone Bed. The Sonsela is a light-yellowish-gray crossbedded sandstone containing conglomerate and interbedded siltstone and shale. The conglomerate is composed of quartz, quartzite, chert, and volcanic granules and pebbles; locally, conglomerate constitutes 25 percent of the bed (Repenning and others, 1969, p. B-22). The Sonsela Sandstone Bed was deposited by streams that flowed to the north.

Division B is now recognized as the Owl Rock Member and consists mainly of pink and red shale spotted light greenish gray. The shale is generally silty and calcareous and forms slopes that are interrupted by several ledge-forming beds of cherty limestone, sandstone, and siltstone.

Division A of Gregory (1917, p. 42) was originally defined by Gregory as the highest strata of the Chinle. It consists of reddish-orange and reddish-brown siltstone and very fine grained sandstone that is spotted light greenish gray. Beds in division A are as much as 20 feet (6.1 m) thick and form a series of ledges and slopes. In the type locality near Chinle, division A (Fig. 2) has been removed from the Chinle Formation and assigned to the overlying Upper Triassic Wingate Sandstone as the lowest member, the Rock Point Member (Harshbarger and others, 1957, p. 8). In the area near Kayenta, also in northeastern Arizona, division A is retained in the Chinle Formation as the Church Rock Member.

CORRELATION

The correlation of the Chinle Formation from its type locality in Chinle Valley in northeast Arizona to the field conference area in north-central New Mexico is shown on Figure 2. M. E. Cooley (1959, p. 71) and J. D. Strobel!, Jr. (U.S. Geol. Survey, 1964, p. 100) have previously suggested the correlation of the Sonsela Sandstone Bed with the Poleo Sandstone Lentil. The Poleo is absent in an area around the southern part

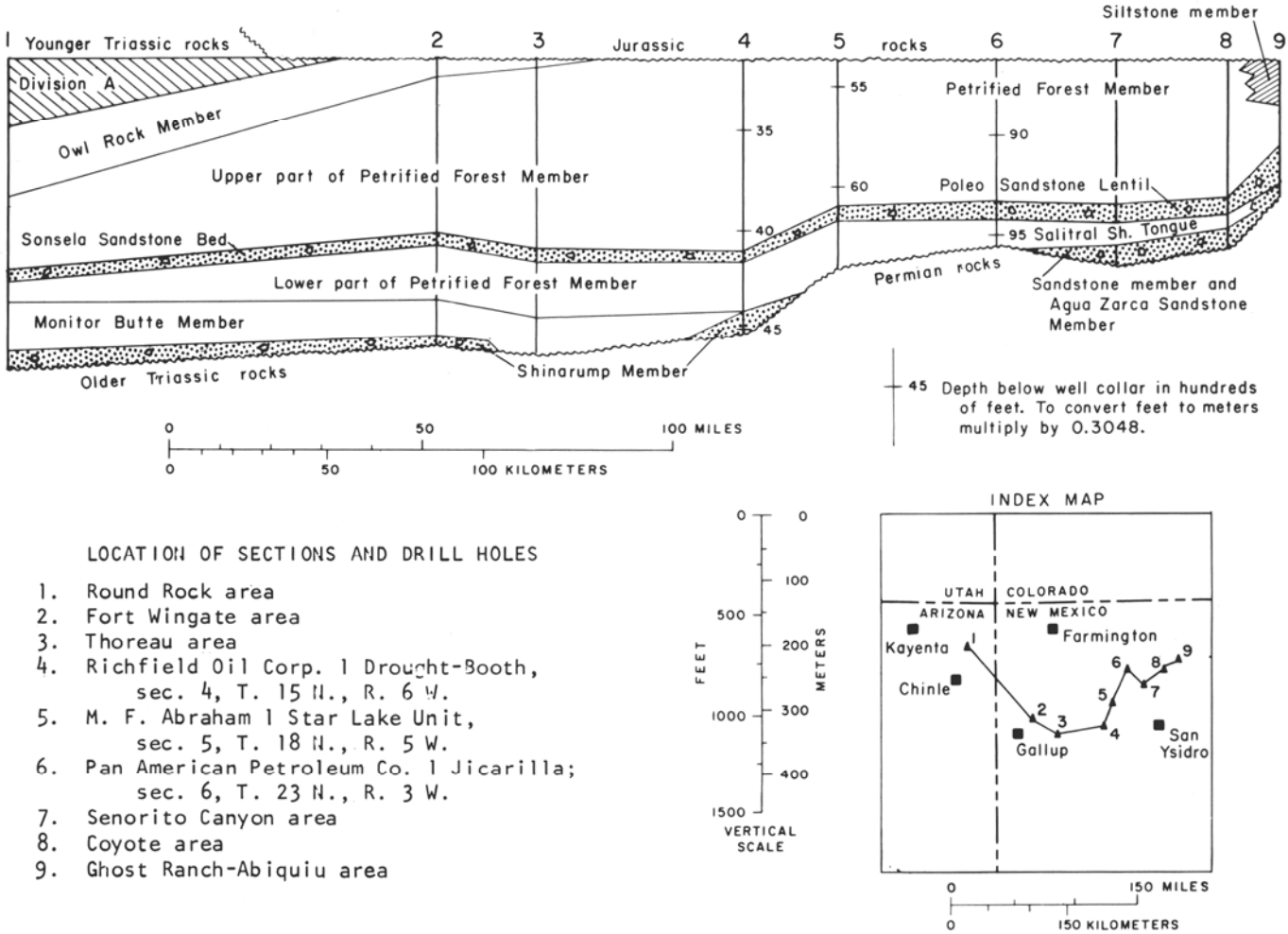

Figure 2. Stratigraphic diagram showing correlation of the Chinle Formation from northeast Arizona to north-central New Mexico. In part from Repenning, Cooley, and Akers (1969) and Stewart, Poole, and Wilson (1972).

of the Nacimiento Mountains both at the surface and in the subsurface. However, the Poleo can be traced through wells to the north of this area. Strobell indicated that the Sonsela and Poleo represented deposition by streams draining into a possible lake near Four Corners, where equivalent beds are limy. The area where the Poleo is absent may represent high areas adjacent to streams draining into that lake. The possible origin of such a widespread unit of fluvial origin is discussed in detail elsewhere (Stewart and others, 1972, p. 90-92).

The Chinle Formation below the Sonsela and Poleo has a greater thickness in Arizona and western New Mexico than it does in the field conference area. The Monitor Butte Member cannot be recognized in the subsurface east of Thoreau. Therefore, it appears that both the Monitor Butte and underlying Shinarump Members were deposited in and restricted to the deeper part of the Chinle basin of deposition. A correlation of the Salitral Shale Tongue and lower part of the Petrified Forest Member is indicated both by lithology and by position immediately beneath the Poleo Sandstone Lentil and Sonsela Sandstone Bed. The Salitral Tongue, Agua Zarca Member, and sandstone member are partly equivalent because they intertongue, and for this reason the period of deposition of the Agua Zarca and sandstone member may well have been contemporaneous with at least some of the Petrified Forest Member in Arizona. A correlation of the Agua Zarca and the Shinarump is tenuous for several reasons. The two members are not physically continuous from northeast Arizona to the field conference area; the two members are somewhat different lithologically, and stream directions in the two units, as indicated by crossbed studies, are different (Stewart and others, 1972, p. 23). Furthermore, the Shinarump Member lies below the Monitor Butte Member, whereas the Agua Zarca lies below the Salitral Shale Tongue which is probably correlative to the lower part of the Petrified Forest Member. The sandstone member is closely associated with the Agua Zarca and Salitral and also does not appear to correlate with the Shinarump.

The Chinle Formation of northeast Arizona above the Sonsela Sandstone Bed is only partly represented in the field conference area. The Petrified Forest Member in north-central New Mexico is equivalent only to the upper part of the Petrified Forest Member in northeast Arizona. The siltstone member in the Ghost Ranch area may represent a tongue of the Triassic Dolores Formation extending into north-central New Mexico from southwest Colorado. The Owl Rock Member and division A of Gregory are both beveled out by the unconformity at the base of the overlying Jurassic rocks between northeast Arizona and the Thoreau area; no representatives of these two units are present in the field conference area.

REFERENCES

Breed, C. S., and Breed, W. J., 1972, Investigations in the Triassic Chinle Formation: Mus. Northern Arizona Bull. 47, 103 p.

Cooley, M. E., 1959, Triassic stratigraphy in the State line region of west-central New Mexico and east-central Arizona, *in* New Mexico Geol. Soc. Guidebook 10th Field Conf., west-central New Mexico, 1959: p. 66-73.

Dane, C. H., and Bachman, G. O., 1965, Geologic map of New Mexico: New Mexico Bur. Mines and Mineral Resources, New Mexico Univ. and U.S. Geol. Survey.

Gregory, H. E., 1917, Geology of the Navajo country—A reconnaissance of parts of Arizona, New Mexico, and Utah: U.S. Geol. Survey Prof. Paper 93, 161 p.

Harshbarger, J. W., Repenning, C. A., and Irwin, J. H., 1957, Stratigraphy of the uppermost Triassic and the Jurassic rocks of the Navajo country [Colorado Plateau] : U.S. Geol. Survey Prof. Paper 291, 74 p.

Northrop, S. A., 1950, General geology of northern New Mexico, *in* New Mexico Geol. Soc. Vertebrate Paleontology Guidebook 4th Field Conf., northwestern New Mexico, 1950: p. 26-46.

Repenning, C. A., Cooley, M. E., and Akers, J. P., 1969, Stratigraphy of the Chinle and Moenkopi Formations, Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah: U.S. Geol. Survey Prof. Paper 521-B, 34 p.

Stewart, J. H., Poole, F. G., and Wilson, R. F., 1956, Triassic studies [Colorado Plateau], *in* Geologic investigations of radioactive deposits, semiannual progress report for June 1-November 30, 1956: U.S. Geol. Survey Rept. TEI-640, p. 161-176.

Stewart, J. H., Poole, F. G., and Wilson, R. F., 1972, Stratigraphy and origin of the Chinle Formation and related Upper Triassic strata in the Colorado Plateau region, *with a section on* Sedimentary petrology by R. A. Cadigan, *and a section on* Conglomerate studies by William Thordarson, H. F. Albee, and J. H. Stewart: U.S. Geol. Survey Prof. Paper 690, 336 p.

U.S. Geological Survey, 1964, Geological Survey research 1964: U.S. Geol. Survey Prof. Paper 501-A, 367 p.

Wood, G. H., Jr., and Northrop, S. A., 1946, Geology of Nacimiento Mountains, San Pedro Mountain, and adjacent plateaus in parts of Sandoval and Rio Arriba Counties, New Mexico: U.S. Geol. Survey Oil and Gas Inv. (Prelim.) Map 57.