Triassic rocks of northwestern New Mexico and southwestern Colorado

Sherman A. Wengerd, 1950, pp. 67-75

in:

This is one of many related papers that were included in the 1950 NMGS Fall Field Conference Guidebook.

Annual NMGS Fall Field Conference Guidebooks

Since 1950, the New Mexico Geological Society has held an annual Fall Field Conference that visits some region of New Mexico (or surrounding states). Always well attended, these conferences provide a guidebook to participants. Besides detailed road logs, the guidebooks contain many well written, edited, and peer-reviewed papers. These books have set the national standard for geologic guidebooks and are an important reference for anyone working in or around New Mexico.

Free Downloads

The New Mexico Geological Society has decided to make our peer-reviewed Fall Field Conference guidebook papers available for free download. Non-members will have access to guidebook papers, but not from the last two years. Members will have access to all papers. This is in keeping with our mission of promoting interest, research, and cooperation regarding geology in New Mexico. However, guidebook sales represent a significant proportion of the societies' operating budget. Therefore, only research papers will be made available for download. Road logs, mini-papers, maps, stratigraphic charts, and other selected content will remain available only in the printed guidebooks. This will encourage researchers to purchase the printed guidebooks, which are essential references for geologic research in New Mexico and surrounding areas.

Copyright Information

Publications of the New Mexico Geological Society, printed and electronic, are protected by the copyright laws of the United States. No material from our website or printed and electronic publications may be reprinted or redistributed without our permission. Contact us for permission to reprint portions of any of our publications.

One printed copy of any materials from our website or our print and electronic publications may be made for individual use without our permission. Teachers and students may make unlimited copies for educational use. Any other use of these materials requires permission.
This page is intentionally left blank to maintain order of facing pages.
TRIASSIC ROCKS
OF NORTHWESTERN NEW MEXICO AND
SOUTHWESTERN COLORADO

By Sherman A. Wengerd
University of New Mexico

Regional Setting

Triassic rocks of the "Four Corner" area thicken westward and southwestward from the Uncompahgre highland in southwestern Colorado and north-central New Mexico. No Triassic rocks are present on the higher parts of the Uncompahgre highland, and the lithology of conglomerate lenses in Chinle, Shinarump, and Dolores strata indicate that the highland area was a prominent source of sediments during most of Triassic time (see map).

In early Triassic time, the Cordilleran seaway to the west, in western Utah and Nevada, was the site of marine Moenkopi deposition comprising gray shale and limestone. Continental clastic sediments were being supplied to the Moenkopi sea from the Uncompahgre highland on the east, hence the interfingering of continental clastics and marine limestone is a common feature of Moenkopi strata in central Utah (Stokes 1949, p. 79). Toward the end of Moenkopi time, virtually the entire area was subjected to subaerial erosion which is now evident in the form of local discordance between Shinarump and Moenkopi strata, particularly in southeastern Utah and northeastern Arizona.

Lithofacies and isopachous data now indicate that the Shinarump conglomerate is an extremely widespread clastic formation lying unconformably upon the Moenkopi formation, but grading eastward and upward into Chinle shale of late Triassic age. This gradation has led to the inference that the Shinarump conglomerate is, with the Chinle shale, of late Triassic age. The widespread post-Moenkopi peneplanation, and differential erosion of the Moenkopi beds in response to variable uplift in the "Four Corner" area probably occurred in middle Triassic time (Stokes 1949, p. 79). Deposition of Shinarump pediment gravels probably began in certain areas as early as mid-Triassic time. Variations in thickness, coarseness, and sorting of Shinarump sediments are a function of differential uplift on the Uncompahgre highland, variations in rainfall, condition of the post-Moenkopi pediment slope, and durability of the supplying terranes to the east and northeast. The Shinarump conglomerate, typically a pediment gravel in a large area west of the Uncompahgre Uplift, is better developed as a poorly sorted, gritty sandstone southwest of the Uncompahgre Uplift, in northwestern New Mexico. This difference of lithology, and lack of sufficient deep drilling in the San Juan Basin, coupled with conflicting vertebrate faunal evidence from shales beneath the Agua Zarca-Poleo sandstone complex in New Mexico, have to date precluded final correlation of the basal Upper Triassic sandstone beds in New Mexico with the type Shinarump beds of Arizona and Utah.

Throughout late Triassic time, Chinle shale and sandstone were deposited over broad, westward-sloping, swampy, alluvial plains, by alluviating streams which debouched into the California sea in Nevada. Volcanic activity, probably far to the northwest, added bentonite to Chinle strata. Thickness and fineness of grain of Chinle strata, and lack of sharp local discordances (with the exception of cross bedding and channelling) indicate the gentle continuous subsidence of this subaerial alluvial plain throughout late Triassic time in the "Four Corner" area.

Formation Descriptions
(Arranged alphabetically for ease of reference)

Agua Zarca sandstone. Upper Triassic (?) reddish-buff to light-gray conglomeratic sandstone, with some siltstone and silty shale, probably equivalent to the Shinarump conglomerate. Named after Agua Zarca Creek, west of Coyote, Rio Arriba County, north-central New Mexico, by Wood and Northrop in 1946. 0-380 feet thick.

Chinle formation. Upper Triassic, red, purple, lavender, and green shale, chocolate-colored sandy shale, red shaly sandstone, and bluish-gray limestone conglomeratic sandstone. Contains abundant bone "scrap" and petrified wood. Named after Chinle in the Chinle Valley, Apache County, northeastern Arizona by Gregory in 1915. 0-1400 feet thick.

Correo sandstone member of the Chinle shale. Upper Triassic, dark-brown to reddish-buff, massive, cross-bedded sandstone. Named after Correo, south edge of Mesa Gigante, Valencia County, New Mexico, by Kelley and Wood in 1946. 0-120 feet thick.

Dolores formation. Upper Triassic and possibly in part Jurassic, red to brown quartzose sandstone and conglomerate with red shale and limestone conglomerate containing abundant vertebrate bones. Named after the Dolores River, eastern San Miguel County, Colorado, by Cross in 1899. 0-600 feet thick.

THICKNESS OF TRIASSIC ROCKS
Northwestern New Mexico — Southwestern Colorado

LEGEND

- SURFACE OR SUBSURFACE SECTIONS WITH THICKNESS IN FEET.
- ISOPACHS
- ISOPACHOUS INTERVAL 100 FEET

NOTE: THIS MAP IS A SMALL SECTION OF A PRELIMINARY ISOPACHOUS MAP OF THE SOUTHERN ROCKY MOUNTAIN AND COLORADO PLATEAU PROVINCES BASED ON SECTIONS MEASURED BY THE U.S. GEOLOGICAL SURVEY, AND UNPUBLISHED SUBSURFACE DATA FROM COMMERCIAL SOURCES.

SCALE

0 6 12 18 24 30 MILES
Poleo sandstone member of the Chinle shale.  
Upper Triassic, gray to buff massive sandstone. Named for Mesa Poleo, eastern Rio Arriba County, New Mexico, by von Huene in 1911. 0-115 feet thick.

Salitral shale member of the Chinle shale.  
Upper Triassic, varicolored shale with limestone concretions. Named after Salitral Creek, west of Coyote, Rio Arriba County, New Mexico, by Wood and Northrop in 1946. 0-105 feet thick.

Senorito sandstone lentil of the Chinle shale.  
Equivalent to Agua Zarca sandstone. Named for Senorito Canyon, Nacimiento Mountains, western Sandoval County, New Mexico, by Renick in 1931.

Shinarump conglomerate.  
Upper Triassic (?), gray to buff coarse-grained sandstone and conglomerate containing abundant petrified wood. Named after the Shinarump Cliffs, south of the Vermilion Cliffs in southern Kane County, Utah, by Gilbert in 1875. 0-200 feet thick where identified as Shinarump.

Correlations

The Problem

Study of the Triassic rocks in the southwestern United States is complicated by the following conditions:

1. Sedimentational variations caused by continental conditions of deposition and geographic differences in the amount of rainfall during Triassic time.

2. Highly variable sources of Triassic sediments controlled in part by:
   A. Irregular uplift and differential rock terranes in the source areas (Cross 1899) (Cross and Spencer 1905) (Cross and Larsen 1913).
   B. Irregular ancient topographic spurs and reentrants on the west and southwest flank of the Uncompaghre Uplift (See Isopachous map).


In view of these difficulties, a short summary is presented for each area where Triassic rocks have been studied in some detail. Arizona and Utah Triassic stratigraphy is not discussed here owing to the relatively fewer Triassic problems where Triassic beds are thicker and more continuously exposed.

Southwestern Colorado

Cross first described Triassic rocks in the Telluride area and named the red sandstone, grit, conglomerate, and shale the Dolores formation (1899). He measured 1550 feet of Triassic beds and noted that the coarse sediments were derived from Algonkian and Paleozoic rocks of the San Juan continental area (Cross 1899, p. 2). Later study of vertebrate and plant fossils showed the Triassic beds to be only 400 feet thick, his earlier measurements having included Permian beds (Cross and Spencer 1905). Owing to the nearness of this area to the major sources for Triassic sediments, subdivision of the Dolores section was not attempted; in fact, Jurassic sandstone beds were included. Later work on the Animas Canyon section and other nearby Triassic exposures indicated a late Triassic age for these strata.

Eckel's lithologic descriptions and stratigraphic position of the beds suggest, however, that the basal sandstone and shale section totaling 273 feet in Animas Canyon, Colorado, may be equivalent to the Poleo sandstone, Salitral shale, and Agua Zarca sandstone in the Nacimiento Mountains as described by Wood and Northrop (1946). As it will be shown later in this report that the Agua Zarca sandstone is probably equivalent to the Shinarump sandstone, it is very likely that close lithologic study will prove the existence of Shinarump equivalents in the Animas Canyon section.

Moenkopi strata were encountered in a deep well drilled on the McElmo anticline in Montezuma County and in other wells in southwestern Colorado, but correlative strata are absent east of Durango. It is possible that certain sections now called Dolores formation may contain Chinle, Shinarump, and Moenkopi equivalents.

Triassic rocks in southwestern Colorado are overlain by Jurassic sandstone beds of the Glen Canyon and San Rafael groups, and underlain by Cutler strata of Permian age.
Zuni Mountains, New Mexico

Darton's early work on the red beds of New Mexico indicated that Shinarump and Moenkopi beds were present in the Zuni Mountain area (1928). Later work by Baker and Reeside (1929) and Reiche in 1942 cast doubt on the existence of Moenkopi beds in northwestern New Mexico based on rates of thinning in eastern Arizona, and the presence of abundant silicified wood in purple shale beneath a 100-foot white sandstone at the approximate stratigraphic position of the Shinarump sandstone (Bates 1942, p. 45). Despite this meager unsupported evidence, no valid Upper Triassic fossils have been found in the purple shale beneath the white sandstone. Regional correlations, lithologic examination, and isopachous study of each formation carried into New Mexico from Arizona and Utah, suggest strongly that Shinarump and Moenkopi beds are present off the northwest plunge of the Zuni anticline, and possibly throughout a great part of the deeper San Juan Basin. Additional evidence is presented by Kelley and Wood in the discovery of a thick Shinarump section in Mesa Lucero, southeast of the Zuni Mountains (1946). The drilling of additional wells in the basin will aid in solving this problem of whether Moenkopi beds are present in the San Juan Basin and the possibility of the Shinarump sandstone being directly correlative with the Agua Zarca sandstone in the Nacimiento Mountains. Triassic rocks in the Zuni area are overlain by Wingate strata of Jurassic age, and underlain by San Andres strata of Permian age.

Archuleta Area, Colorado

The name "Dolores" as applied by Cross to Triassic beds in southwestern Colorado has been carried into Archuleta County where the classical tripartite division of the Triassic system cannot be applied. Surface sections in Piedra Canyon and subsurface sections in wells drilled in Archuleta County vary greatly in thickness and lithology (Wood, Kelley, and McAlpin 1948) (Read, et al. 1949). The Dolores formation is believed to be of late Triassic age, but possibly includes some Jurassic beds. Where the formation is very thin, the lithology appears similar to that of the Poleo and basal Agua Zarca sections in the Nacimiento Mountains to the south. Typical Chinle shale is generally present in the Triassic section only where it is thicker than 200 feet. This facies change is probably controlled by nearness to the source of Triassic sediments as represented by the Triassic wedge-edge on the flank of the Uncompahgre Uplift. It is notable that the Triassic clastics in the area appear to be largely Permian debris in contrast to Triassic coarse clastics of Paleozoic and pre-Cambrian origin which are present in Utah and Arizona, great distances from the Uncompahgre highland.

Dolores beds lie on rocks ranging from Permian to pre-Cambrian age, on the southwest flank of the Uncompahgre highland. These strata are overlain by Entrada sandstone of Jurassic age which formerly extended over a great part of the nearby highland area.

Chama Basin - Nacimiento Mountains, New Mexico

The Triassic system in this area is represented by the Chinle formation which has been divided as follows:

- Upper shale member 235-953 feet (?)
- Poleo sandstone lentil 0-115 feet
- Salitral shale tongue 0-105 feet
- Agua Zarca sandstone member 90-400 feet (?)

(Wood and Northrop 1946)

The Poleo sandstone thins from Mesa Poleo southward, whereas the Agua Zarca sandstone thins northward from its thickest development near San Ysidro. What is now named Agua Zarca sandstone was called the Poleo sandstone by Renick (1931), but surface tracing of the beds proved the existence of a shale now known as the Salitral tongue. Where the Poleo sandstone is absent, the Salitral tongue cannot be differentiated from the main body of the Chinle shale (Wood and Northrop 1946).

The conglomeratic sandstone at the base of the Chinle shale in the Chama Basin is probably the Poleo sandstone as defined by von Huene in 1911, although the Salitral shale may be absent and both the Agua Zarca and Poleo sandstone may be present (See Regional Stratigraphic Section). This conclusion is based on thickness, and the presence of abundant basal conglomerate lentils in the Poleo sandstone in the Chama Basin.

In 1922, Darton stated that the Poleo sandstone was equivalent to the Shinarump conglomerate and further, that the shale beneath the sandstone was probably Lower Triassic Moenkopi (quoted by Northrop 1950). Baker and Reeside later showed that the shale beneath the Poleo sandstone was late Triassic in age, based on vertebrate fossils (1929). This discovery led to their suggestion that the Poleo sandstone is younger than the Shinarump conglomerate of Arizona. It may be inferred that these Upper Triassic fossils came from the shale called the Salitral by Wood and Northrop; which does not disprove the suggestion that the Agua Zarca sandstone (formerly called Poleo through miscorrelation by Renick in 1931) is possibly a direct time and lithologic equivalent of the Shinarump beds present at Mesa Lucero, north flank of the Zuni Uplift, and near Chinle, west of Canyon de Chelly, Arizona.

The Chinle shale of the Ghost Ranch country (Chama Basin) contains at least six fossil zones, yielding bones of amphibians, phytosaurs, small dinosaurs, and fresh water clams (Colbert 1950). The Chinle section represents two phases of sedi-
mentation comprising a basal massive sandstone, which Colbert also suggests may be the Shinarump equivalent (1950, p. 60), and the soft varicolored shale above. Lower Triassic Moenkopi strata are absent on the outcrops along the east side of the San Juan Basin and in the Chama Basin.

Triassic rocks overlie Cutler, Yeso, and San Andres strata, and are overlain by the Wingate (Entrada) sandstone of Jurassic age, in the east and northeast sectors of the San Juan Basin.

The Triassic correlations of the "Four Corner" area, based on a survey of the literature, subsurface and surface work, and certain as yet unvalidated inferences, are shown on the correlation chart and the regional stratigraphic section.

Oil and Gas Possibilities

Triassic rocks of the San Juan Basin are entirely of non-marine origin and only slight shows of petroleum have been found.

The Byrd-Frost et al. Macintosh No. 1 in Section 25, T 36 N, R 18 W, Montezuma County, Colorado, was completed in August, 1948, as a carbon dioxide well making between 150,000 and 500,000 cubic feet of gas per day from the Shinarump conglomerate. A dry-ice plant will shortly be in operation.

The nature of the Triassic sediments and lack of thick marine, source beds subjacent or superjacent to excellent reservoir rocks such as the Shinarump conglomerate, Agua Zarca sandstone, Polo sandstone, and the Correo sandstone, appear to preclude Triassic oil and gas production in the San Juan Basin. Under certain special conditions of timing, fracturing, and sealing, small quantities of oil and gas may move into Triassic rocks from Pennsylvanian rocks below. In the northeastern part of the San Juan Basin, Dolores sandstone beds probably overlap Pennsylvanian marine source beds, but the timing of oil origin and migration, in relation to deposition of the potential reservoir sandstone beds appears incorrect for the formation of oil and gas pools.

Selected References


Reeside, J. B., Jr. (1929) Triassic-Jurassic 'Red Beds' of the Rocky Mountain region: Jour Geol., vol. 37, No. 1.


NOTES