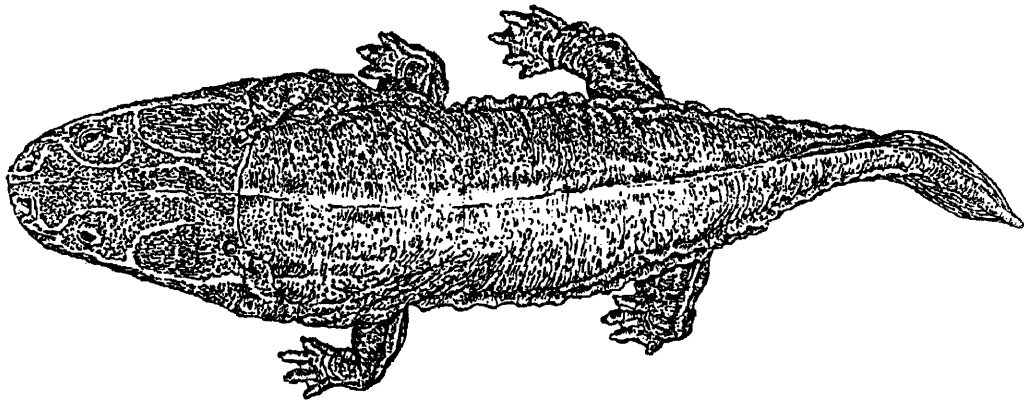


LOCALITIES



LATE TRIASSIC VERTEBRATE LOCALITIES OF THE OWL ROCK MEMBER
(CHINLE FORMATION) IN THE WARD TERRACE AREA OF NORTHERN ARIZONA

RANDY E. KIRBY
Department of Geology
Museum of Northern Arizona
Flagstaff, Arizona 86001

Abstract - A new upper Chinle vertebrate fauna has been collected from nine localities in the upper third of the Owl Rock Member, in the Ward Terrace area of northern Arizona, in association with bivalves, gastropods and abundant coprolites. The new fauna, which includes abundant microvertebrates from two localities, has yielded data on taxonomic composition and abundance in vertebrate-bearing horizons above those of the heavily sampled lower Chinle Formation. Tetrapods include phytosaur and metoposaur taxa, an aetosaur, a rauisuchian, a probable theropod, a fabrosaurid and a new taxon of hybodont shark. Vertebrate occurrences are concentrated within lacustrine-marginal facies suggesting dominantly quiet water deposition. Lithologic data indicate that Owl Rock carbonates and clastics were deposited during alternating lacustrine and fluvial episodes, and punctuation of these episodes by extended periods of soil formation suggests cyclic expansion and contraction of lacustrine environments in the study area. The presence of phytosaur specimens probably referable to the advanced Rutiodon tenuis, and of the aetosaur Typhothorax, indicate a minimum Norian age for Owl Rock Member, which lies beneath the J-O unconformity in the Ward Terrace area.

INTRODUCTION

Late Triassic deposits in the Ward Terrace area produced the first vertebrate fossils known from rocks of this age in Arizona, and subsequently produced many of the more important genera known from these strata in the Colorado Plateau region. Ward (1901, 1905) reported the first fossil localities in this area in exposures of the lower Chinle along Tanner Wash, in a zone latter christened the Ward Bone Bed. Initial collections by Ward from his "Belodon Beds" were described by Lucas (1901, 1904). Von Huene (1926) re-evaluated the systematic of this material and of additional collections made in the Tanner Wash area by Mehl (Mehl 1915a, Mehl et al., 1916). However, despite sporadic collections by Camp (1930) near Kayenta and Round Rock, upper Chinle strata in the Ward Terrace area and elsewhere in Arizona have been little explored for fossil vertebrates until recently.

Interest in the Ward Terrace Chinle outcrop belt was revived during the late 1970's and early 1980's, when exploration of Early Jurassic strata along the Adeii Eechii Cliffs by the Museum of Northern Arizona (MNA), Harvard University and the University of California produced a variety of new taxa, including early mammals (Clark and Fastovsky, 1986). Subsequent exploration by MNA of underlying Chinle deposits in this area established fossil localities at several sites within the Owl Rock Member that have

produced a diverse fauna of reptiles, amphibians and fish (Kirby, 1988). The fauna is presently the subject of ongoing research by the author through the Museum of Northern Arizona. The following report provides a preliminary overview of this research.

LOCATION

This report focuses on material collected from outcrops of the Owl Rock Member exposed along Ward Terrace, east of the Little Colorado River and west of the Moenkopi Plateau, within an area bounded by Moenkopi Wash to the north and the Tloi Eechii Cliffs to the south (Fig. 1). Outcrops occur along a cliff face formed by the erosional scarp of Ward Terrace and along the low-angled dip slope to the east, an area of approximately 140 square miles within the Navajo Indian Reservation.

Vertebrate localities are concentrated within the upper portion of the Owl Rock Member in the study area, and are widely distributed across Ward Terrace along the southeast-to-northwest trending outcrop. Strata associated with the localities form a broad homoclinal surface adjacent to the Kaibab monocline; this surface dips two to three degrees to the northeast and is dissected by several tributary drainages of the Little Colorado River. Detailed location data for the nine Ward Terrace Owl Rock localities described here are on file at the Museum of Northern Arizona. All localities occur in Coconino County, Arizona.

PROJECT BACKGROUND

The initial vertebrate locality in the study area was discovered in 1967 by an amateur collector in Moenkopi Wash near Tuba City, approximately one mile south of Highway 264. Preliminary excavation of this site in 1971 by the MNA Department of Geology produced a nearly complete phytosaur skull with fragmentary associated postcranial elements, fish remains and coprolites. This material is only now being described.

Continued field operations in this area resulted in the discovery in 1980 of a second locality, in the southern part of Ward Terrace approximately nine miles northeast of the Black Falls crossing of the Little Colorado River. Limited excavation of this site by MNA personnel in 1984, under a permit from the Navajo Nation Minerals Department, produced parts of three phytosaur individuals, including one nearly complete skull, two fragmentary skulls, one lower jaw and numerous postcranial elements. Unionid bivalves, abundant microvertebrate remains and coprolites were also recovered.

The present research was undertaken in 1985. Additional reconnaissance in the Ward Terrace area from 1986 to 1988 under permits from the Navajo Nation established the existence of six new macrovertebrate localities at a second stratigraphic level located above the 1980 discovery, and a previously established MNA locality was relocated at this level at the head of Tonahakaad Wash. Wet-screen washing of matrix samples from the upper level also yielded abundant microvertebrate elements and

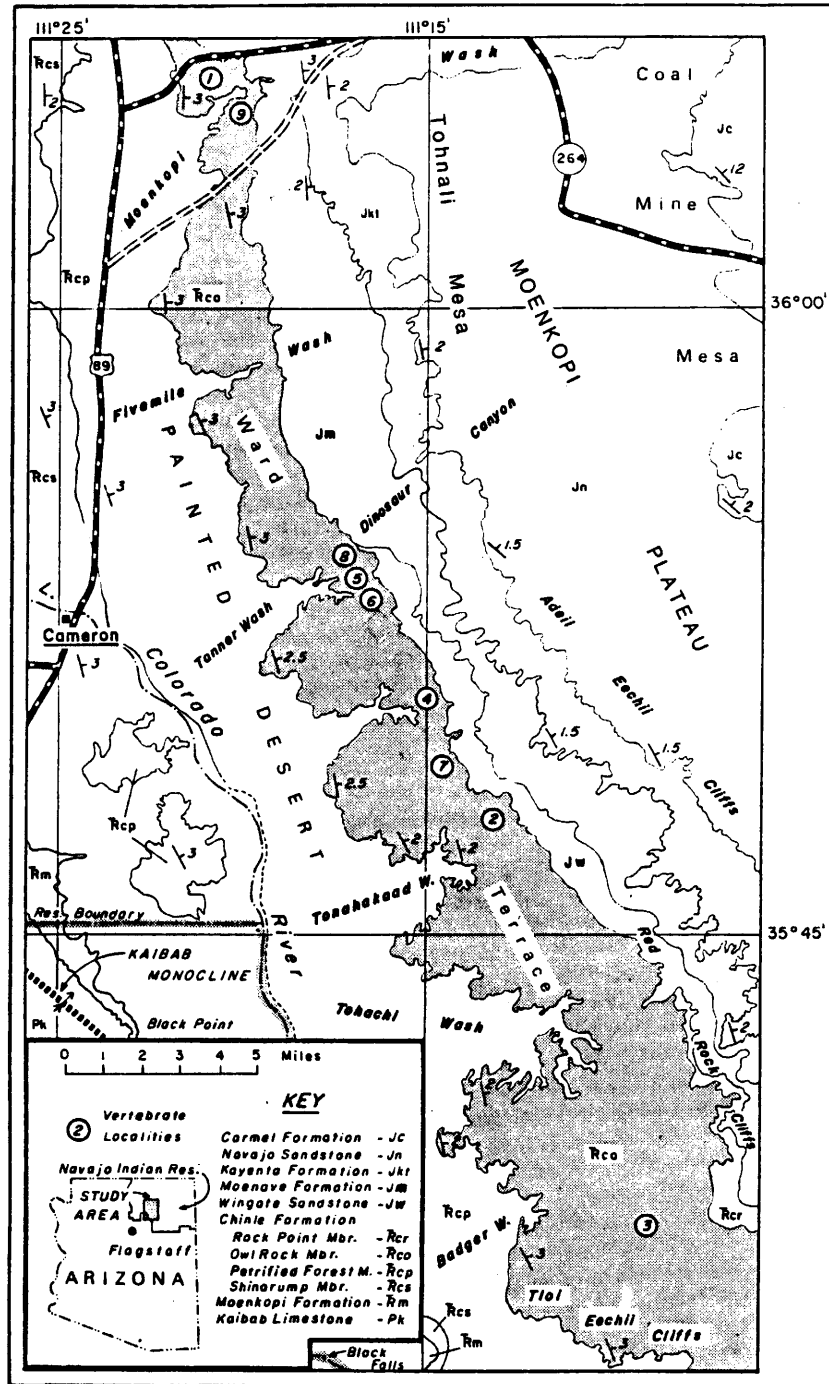


FIGURE 1. Map showing distribution of Owl Rock Member outcrops (shaded) in the Ward Terrace study area, and of vertebrate localities within the unit: (1) MNA 214 (=UCMP V79713), (2) MNA 220 (=UCMP V84248), (3) MNA 360, (4) MNA 791, (5) MNA 851, (6) MNA 852, (7) MNA 853, (8) MNA 908, (9) MNA 1060. Localities are numbered in order of discovery. MNA = Museum of Northern Arizona. UCMP = University of California Museum of Paleontology. [Geology adapted from Cooley et al. (1969); Shinarump and "sandstone and mudstone" members are shown as undivided Trcs.

coprolites. Nine vertebrate localities are now documented within the upper portion of the Owl Rock Member in the study area. Two additional localities have also been discovered within the member in a separate area located approximately 20 miles northwest of the Petrified Forest National Park.

Long and Ballew (1985) and Ballew (1986) briefly cited the Moenkopi Wash phytosaur, but no other vertebrates have previously been reported in the literature from the Owl Rock Member in the field area, although S.P. Welles collected undescribed fragmentary material from the Owl Rock in Moenkopi Wash in 1964. Pelecypods (Gregory, 1917, Stewart et al., 1972) and gastropods (Robinson, 1915; Yen, 1951, Stewart et al., 1972) have been reported from scattered localities within the Owl Rock along Ward Terrace.

STRATIGRAPHY OF THE STUDY AREA

Upper Triassic stratigraphy in the Ward Terrace region requires detailed review beyond the scope of this paper. The wide geographic scope of previous Chinle studies in northern Arizona resulted in necessarily generalized interpretations of depositional environments. These approaches limited recognition of: (1) facies changes within and between members, and (2) temporal relations of facies changes to each other. Correlations of members and of informal units within members are therefore poorly understood.

The Ward Terrace Chinle section comprises (in ascending order) (Fig. 2) the Shinarump, Petrified Forest and Owl Rock members (Repenning et al., 1969). An informal "sandstone and mudstone member" has been recognized in northern Arizona between the Vermilion Cliffs and the Cameron-Gray Mountain area (Phoenix, 1963; Stewart et al., 1972), and questionably equivalent strata have been recognized south of Smith Butte. This unit has been mapped as overlying the Shinarump Member, or the Moenkopi Formation where valley-fill Shinarump deposits are absent, and it underlies the Petrified Forest Member. Stewart et al. (1972, pl. 4) provisionally correlated the "sandstone and mudstone member" with the Monitor Butte Member.

The entire Chinle Formation thins northwestwardly in the vicinity of Lees Ferry and the Echo Cliffs, due in part to truncation of the Petrified Forest and Owl Rock members by a regional unconformity separating the Chinle Formation from the Glen Canyon Group (O'Sullivan, 1970; Pipiringos and O'Sullivan, 1978), and in part to a gradual thinning of the Petrified Forest Member to the northwest (Stewart et al., 1972a, pl. 12). The Petrified Forest Member undergoes a little-studied east-west facies change between Holbrook and Cameron, Arizona (Repenning et al., 1969, pl. 2). Laterally extensive sandstone bodies, including the Sonsela Sandstone Bed, useful for internal correlation of the member in the Defiance Uplift-Petrified Forest National Park area, grade into mudstone-dominated strata northwest of Holbrook. In the Ward Terrace area, the Petrified Forest Member comprises, in ascending order, the informal blue, gray and red units, of uncertain relation to the "classic"