# MOENKOPI FORMATION

**EARLY-MIDDLE TRIASSIC**
**(Spathian to Anisian)**
**245 to 240 Million Years Ago**

**LITHOLOGY:**
Mudstone, sandstone, shale, dark red to brown; gypsum

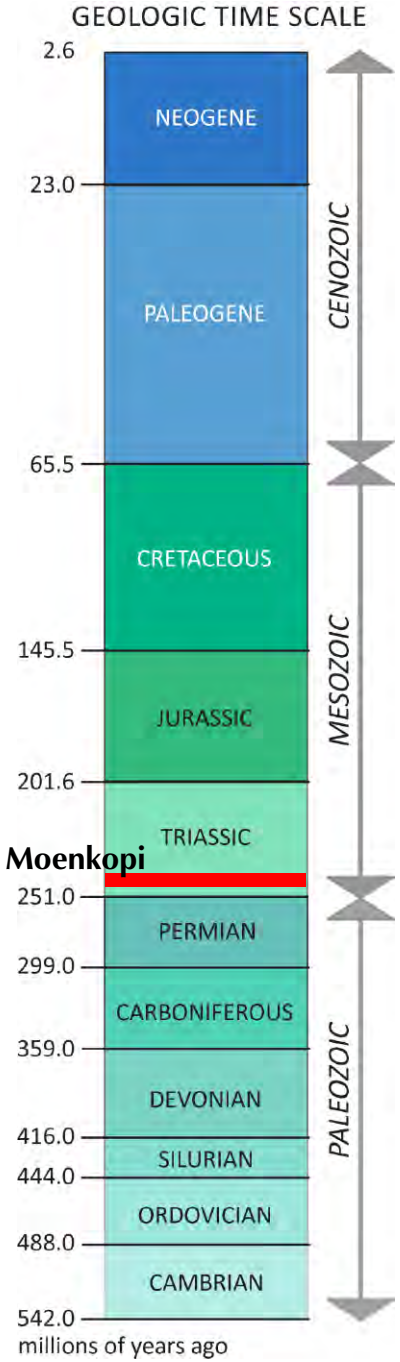
**FOSSILS:**
Amphibians, reptiles, freshwater clams, land plants

**SEDIMENTARY STRUCTURES:**
Mudcracks, salt crystal casts, ripple marks, cross-beds

**DEPOSITIONAL ENVIRONMENT:**
River channels, delta, tidal flat, arid coastal plain where evaporite minerals (salts) are deposited

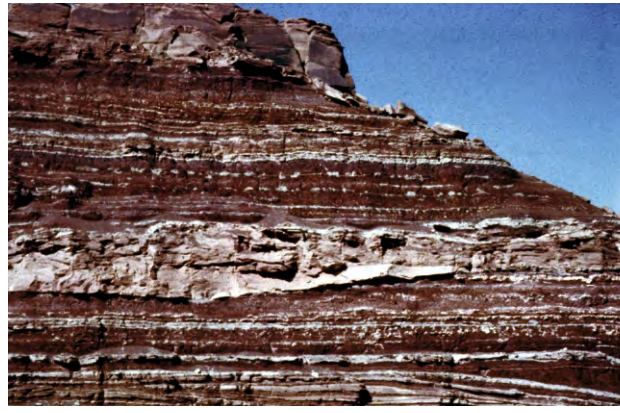
**PALEOGEOGRAPHY/ TECTONIC SETTING:**
Westward-sloping coastal plain of North America

**MISCELLANEOUS:**
The Moenkopi Formation thickens to the west, where it was partly deposited in shallow marine environments in southwestern Utah and Nevada




*(Based on Geological Society of America timescale, 2009)*

**During the early Triassic, the supercontinent Pangaea showed signs of breaking apart, as the North American continent began to separate from Africa and Europe and move westward. The Colorado Plateau was located just above the equator and formed part of a large, flat coastal plain near the edge of the continent. Sediments were carried to this plain by rivers that started as far away as the Appalachians, which at that time, formed the continental divide. The sea also contributed sedimentary deposits through tidal flows and by overrunning the flat-lying plain during periods of sea-level rise. The Moenkopi Formation contains many ripple marks and mudcracks, as well as tracks of reptiles and amphibians, however, few bones have been found. Both marine and terrestrial life forms were challenged during the early Triassic by the depleted biosphere that followed the Permian extinction.**



*Outcrop of Moenkopi Formation near Holbrook, Arizona*

## Evidence of an Aqueous Environment in the Moenkopi Formation

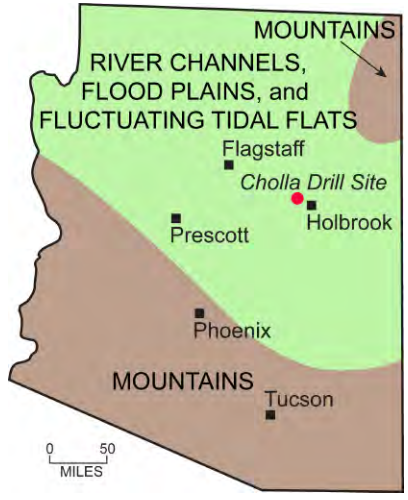
*Casts of mudcracks formed by drying of mud on river flood plains in the Moenkopi Formation*

*Ripple marks formed by waves on tidal flats in the Moenkopi Formation*

*Salt crystal casts in Moenkopi mudstone, the result of evaporation of sea water on tidal flats*

*Tracks of* Cheirotherium, *or "hand-beast," have been found in North America, Europe, and Africa, but no bones for this creature have ever been discovered. The name refers to the outermost toe, which extended to the side like a thumb, and may have provided a firmer grip in mud.*

*Reptiles replaced amphibians as the dominant land-dwelling animal following the Permian extinction. Reptiles produce an egg containing nutrients within a protective shell, which keeps the embryo inside from drying out. This adaptation allowed reptiles to move away from waterside habitats and colonize drier regions, because unlike amphibians, they do not need to return to water to lay their eggs. (Image courtesy of the Lunar and Planetary Institute)*




*Generalized map of environments across Arizona during the early Triassic period, the time of deposition of the Moenkopi Formation. (modified from Blakey, Basham, and Cook, 1993)*

*All images courtesy of Dale Nations, unless otherwise noted.*

*Information provided by WESTCARB at www.westcarb.org*