Gallery of Geology: Permian Angular Uncomformity, Robledo Mountains, Dona Ana County, New Mexico

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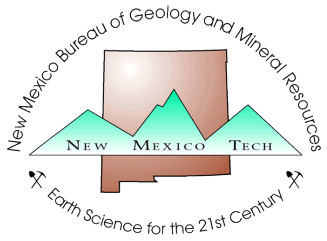

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Gallery of Geology

Permian Angular Uncomformity, Robledo Mountains, Dona Ana County, New Mexico

During the late Paleozoic (Pennsylvanian–Early Permian), the collision of Gondwana and Laurussia (Euramerica) created the Pangean supercontinent. That collision caused extensive tectonism along a then nearly equatorial zone that extended from eastern Europe to western North America. In the United States, from Illinois to Idaho, the Ancestral Rocky Mountains (ARM) formed as a lengthy belt of basement-cored uplifts (e.g., Kluth and Coney 1981; McBride and Nelson 1998; Dickinson and Lawton 2003). In New Mexico, these uplifts were mostly north-south oriented islands surrounded by shallow seas during the Pennsylvanian that were ultimately worn down and buried by alluvial sediments during the Early Permian (Woodward et al. 1999).

Deciphering many aspects of ARM tectonism in New Mexico has been difficult because few late Paleozoic structures are preserved intact (e.g., Woodward et al., 1999). Indeed, most of these structures were reactivated by tectonism during the Late Cretaceous–Eocene Laramide orogeny or during the late Cenozoic tectonism associated with Basin and Range extension, notably of the Rio Grande rift. Perhaps the best documented ARM structures are those described by Bachman and Hayes (1958), Pray (1961) and others in the Sacramento Mountains of Otero County, where folded Pennsylvanian strata are truncated by nearly flat lying Permian red beds.

Here, we document a small ARM structure in the southern Robledo Mountains of Doña Ana County. This structure is within the confines of the Prehistoric Trackways National Monument (PTNM). The PTNM is approximately 2,137 hectares (5,280 acres) of land protected by an act of the U. S Congress primarily because of its world-class Early Permian trace-fossil assemblages (Lucas et al. 2011). The trace fossils come from a lithostratigraphic unit referred to as the Robledo Mountains Formation of the Hueco Group (termed Abo Tongue or Abo Member of the Hueco Formation in older stratigraphic terminology, Seager et al., 2008).

In the PTNM, the Robledo Mountains Formation is composed of approximately two-thirds drab-colored marine limestone and shale interbedded with one-third red terrestrial mudstone, siltstone and sandstone. The formation has an average thickness of 120 m. The siliciclastic red beds yield the trace fossils for which the PTNM was created. Voigt et al. (2013) recently argued that these sediments formed on a coastal floodplain during alternating wet and dry conditions. They based this conclusion on detailed sedimentological and ichnological analysis that indicates most of the trace fossils found in the Robledo Mountains Formation red beds were preserved on mud-draped surfaces within distal crevasse-splay siltstone to fine-grained sandstone. The physical and biological structures recorded in their study support the reconstruction of a freshwater ecosystem dominated

Photograph showing angular unconformity within redbeds of the Robledo Mountains Formation along Apache Canyon (UTM zone 13, 321196E, 3582410N, NAD 83). View is looking south.

Photograph showing detail at contact of steeply dipping siltstone beds truncated by overlying horizontal siltstone beds of Robledo Mountains Formation. Rock hammer is 28 cm long.

by arthropods and tetrapods. Given their proximity to carbonates of unambiguous subtidal origin, Voigt et al. (2013) concluded that the trace-fossil-bearing red beds of the Robledo Mountains Formation formed in distal parts of an extensive coastal floodplain during alternating wet and dry conditions. None of the red beds records evidence of marine or tidal influence; instead, they support the interpretation of a fluvially-controlled freshwater ecosystem with sparse plant cover and predominantly arthropod and tetrapod inhabitants.

In the PTNM, in red beds of the Robledo Mountains Formation, a feature that appears to be related to a late phase of the ARM deformation crops out along the eastern side of Apache Canyon near the center of the W½ of sec. 25, T22S, R1W. Here, limestone in the Robledo Mountains Formation is folded into a small, west-facing monocline, with bedding nearly vertical near the upper hinge. Above the limestone, beds of red siltstone are tilted 20–30° to the southwest, beveled to a flat surface, and overlain by horizontal siltstone like that below. Younger limestone layers pass above these structures without changing dip.

Lucas et al. (1995, fig. 5F) illustrated this outcrop and suggested the steeply dipping strata are delta foresets overlain by nearly horizontal sheetflood deposits. However, delta foresets would dip only 20 to 30 degrees, not nearly vertically; and they would not include limestone. Thus, we prefer a syndepositional tectonic explanation. This explanation identifies the dipping beds truncated by nearly flat-lying beds as an angular unconformity that resulted from Early Permian tilting and subsequent truncation of the steeply dipping strata.

Conceivably, this structure might be the product of slumping or landsliding that took place before the sediments were lithified. However, given the coastal-plain setting and lack of evidence for channels where banks might collapse, we consider such an explanation unlikely. Furthermore, the steeply dipping beds in Apache Canyon are well stratified and show no evidence of soft-sediment deformation, which suggests they were lithified when tilted. No slump or landslide features have been observed by us or reported by other geologists elsewhere in the Permian rocks of the Robledo Mountains.

This likely ARM structure, however, is very small and localized—it crops out over less than 50 meters of strike. Therefore, it is of little significance to interpreting broader issues of ARM tectonics. Nevertheless, it points to active Early Permian tectonism in the area of the Robledo Mountains late in the ARM orogeny.

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