THE UPPER PALEOZOIC SANGRE DE CRISTO FORMATION, SOUTHWESTERN SAN MIGUEL COUNTY, NEW MEXICO: STRATIGRAPHY, AGE AND SEDIMENTOLOGY

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In southwestern San Miguel County, New Mexico, the upper Paleozoic Sangre de Cristo Formation is ~ 300 m thick. Most of the lower-middle parts of the formation are poorly exposed, but the base of the formation crops out as extrabasinal conglomerate resting with evident disconformity on the Middle Pennsylvanian Porvenir Formation. The upper 160 m of the Sangre de Cristo Formation are continuously exposed, and are mostly red-bed, non-fissile mudstone, and less common sandstone, conglomerate and calcrete. We can divide these strata into two intervals, a lower unit A, about 60-80 m thick, and an upper unit B, about 50-80 m thick. Units A and B are distinguished by the relative abundance in unit B of thin, laterally extensive sheet sandstone bodies that display abundant climbing ripple lamination. Unit A, which is composed of mudstone with intercalated crossbedded conglomerate and sandstone, contains the majority of known fossil bone localities, whereas the tetrapod footprint and fossil plant localities are from unit B. Most of the sandstones of the Sangre de Cristo Formation are subarkose to arkose, and a few sandstones and pebbly sandstones containing abundant reworked carbonate grains are classified as lithic arenites. The contact of Yeso Group strata on Sangre de Cristo Formation strata is conformable, as is the Abo-Yeso contact to the south. The Sangre de Cristo grades laterally southward to finer grained red beds of the Abo Formation. Trace fossils of invertebrates and vertebrates (mostly arthropod and tetrapod walking traces) are locally common in the upper part of the Sangre de Cristo Formation. The tetrapod ichnofauna is quite similar to vertebrate trace fossil assemblages described from the Abo Formation of central New Mexico. Plant fossils are sparse in the Sangre de Cristo Formation and are mostly macrofossil foliar remains preserved as impressions. The flora of the Sangre de Cristo Formation red beds appears to be much the same as its finer grained equivalents (Abo and Robledo Mountains formations) to the south, and likely indicates seasonally dry climates and that much of Early Permian New Mexico was covered with conifer forests of great extent and low biodiversity. The fossil vertebrate assemblage from the upper Sangre de Cristo Formation encompasses xenacanth sharks, lungfishes, lepospondyl and temnospondyl amphibians, diadectomorphs and eupelycosaurs and represents a mixture of aquatic, semi-aquatic, semi-terrestrial and terrestrial fauna. The tetrapod footprints and vertebrate body fossils indicate a late Wolfcampian age. The Sangre de Cristo Formation comprises sediments that were deposited on a broad alluvial plain in response to tectonic movements of the Ancestral Rocky Mountain deformation. In southwestern San Miguel County, these sediments are nonmarine red beds dominated by fine-grained deposits of the overbank environment and subordinately composed of coarser deposits of sandstone sheets that represent isolated broad, shallow channels of low gradient and low stream power.