Stratigraphic Models of the Franklin Mountains, Texas and New Mexico

LeMONE, DAVID V., The University of Texas at El Paso, PMB 3, El Paso, Texas 79968

The stratigraphic section exposed in the Franklin Mountains is essential for the comprehension of the regional stratigraphy and paleogeography. Additionally, it exposes several important outcrop models utilizable for the exploration and exploitation of hydrocarbons. Four eras are represented in the stratigraphic sequence: Mesoproterozoic (Ectasian to Stenian periods, 1.17-1.26 Ga); Paleozoic (Lower Ordovician to Lower Permian, 500-270 Ma); Mesozoic (Cretaceous [Albian to Turonian], 110-88 Ma); and Cenozoic (Pliocene to Holocene, 2.68-0.00 Ma).

The metamorphosed marine to continental marbles, siliciclastics, flows, and ignimbrites of the Mesoproterozoic are 1614m (5295 ft) thick. The most important model developed in this era is J. M. Seeley's sequence stratigraphic studies of the Lanoria Formation. This formation consists of over 700m of metamorphosed sandstones, siltstones, and subordinate mudstones. Seeley divides the Lanoria into six depositional member sequences containing multiple parasequences. Additionally, he recognizes an unrelated, laterally overlying, northern unit (East Cottonwood Springs Formation) which is in the process of being formalized. The lower two member are retrogradational transgressive with the overlying members representing partial to complete filling of the basin punctuated by eustatic events. He proposes a model for this formation as being on the southwestern margin of Laurentia. The formation was deposited in a previously rifted basin of a NW-SE orientated seaway open to an eastern ocean. What is important about this sequence is its lack of bioturbation and the pristine preservation of primary sedimentation structures. It is not disturbed by the soft-bodied metazoans of the bedding-parallel trace fossils of the Neoproterozoic and earliest Phanerozoic of the shallow marine facies. It is not disturbed by the following increasingly efficient vertically directed bioturbation observed in Phanerozoic Cambrian, Paleozoic and Modern paleofaunas.

The 2717m (8910 ft) thick Paleozoic sequence is divisible into two major suites (Tobosa basin- and Orogrande basin-related sediments) that consist of nine easily recognizable depositional sequences. The lower primarily equatorial to tropical marine carbonates of the Tobosa basin-related rocks include five depositional sequences; they are, in ascending order: Bliss Sandstone-El Paso Group (Lower Ordovician), Montoya Group (Upper Ordovician), Fusselman Dolomite (Silurian), Canutillo Formation (Middle Devonian), and Percha Shale (upper Devonian). These Tobosa basin-related rocks are closely allied to equivalent Lower Paleozoic producing units in the Permian Basin. The El Paso Group section along Scenic Drive in the section has been utilized by Goldhammer and others as a classic example of the concept of cyclostratigraphy. The recognition of this medial Ordovician [27 Ma] karst was pioneered by Lucia and the Shell group. The importance and relationship of the karst to Permian basin Ellenberger karst production was formulated by C. Kerans. The Franklin outcrops also exhibit karst features developed in the 40 Ma interval between the Middle Silurian and the Middle Devonian which is related to Fusselman production in the Permian basin in such fields as Dollarhide.

Collision tectonics along the now southern border of the continent resulted in a reconfiguration of the tectonic elements of the region with the final formation of the Permian Basin and the local regional formation of the related Orogrande basin. The Orogrande basin sequence can be subdivided into four discrete, genetically-related, sedimentary units; they include, in ascending order: Las Cruces, Rancheria, Helms formations (Middle-Upper Mississippian); Magdalena Group (Lower-Middle Pennsylvanian); Panther Seep Formation Upper Mississippian), and Hueco Group (Lower Permian).

The basal Orogrande basin sequence Las Cruces Formation consists of deep basin, distal, carbonate turbidites which become more shallow and proximal in the overlying Rancheria Formation. The uppermost Helms Formation is primarily shales with minor carbonates in the upper part. A sporadically developed paleosol on the top of the unit sharply marks the unconformable contact between the slope-forming Helms and the overlying basal cliff-forming Magdalena Group.

The Magdalena is primarily cliff-forming carbonates at the base that become increasing more slope-forming clastics towards the top of the group. Cyclic sedimentation and excellent phylloid algal banks and chaetetid sponge biostromes are of particular interest. The unconformable contact between this group and the overlying, very poorly exposed, clastic and evaporitic Panther Seep Formation is clearly marked by a basal distinct chert pebble conglomerate.

The 766m (2514 ft), primarily marine carbonates, of the three formations of the Hueco Group represents one of the finest Lower Permian (Wolfcampian) sections exposed in the southwest. Rocks assigned to the Leonardian Upper Permian are not recognized in the Franklin Mountains.

The Tethyan-related Cretaceous of the Sierras Juarez and Franklin Mountains reaches a thickness of 1401m (4596 ft). The Cretaceous is exposed in several minor localities along the western margin of the rifted Franklins. Across the Rio Grande in New Mexico at Cristo Rey a partial section is exposed. Locally, the best exposures are observed to the south in the Chihuahua trough sequence of the thrusted Sierra Juarez, Mexico. Correlation to the east of the Franklins is possible from the extensive Cretaceous exposures in West Texas. Well-developed related exposures to the west of El Paso also may be observed in the boot heel of New Mexico (e.g., Big Hatchet Mountains) and in southeastern Arizona (e.g., Bisbee basin). The greatest interest in these sedimentary rocks is in the exposed coral and rudist bioherms and biostromes.

The Cenozoic Pliocene to Holocene clastics of the Fort Hancock and Camp Rice formations contain an excellent vertebrate fauna which records the late Cenozoic tectonic and sedimentation history of the Franklins region.