

## **Lower Permian Supersequences and Evolving Sequence Architectures of the Eastern Shelf, Midland Basin, Texas**

**Peter Holterhoff**

*Texas Tech University*

The Early Permian was a time of significant global climate change. The earliest Permian (Asselian and Sakmarian; Wolfcampian) was the acme of the Late Paleozoic icehouse, characterized by extensive glacial deposits across most of the Gondwanan sub-continent. This icehouse interval gave way to an essentially ice-free Gondwana during the middle portion of the Early Permian (Artinskian; early Leonardian). This non-glacial interval was followed by a period of late Early Permian (Kungurian; late Leonardian) glaciation in Australia and portions of Siberia that lingered into the Middle Permian, after which few glacial deposits are recognized.

Three Permian supersequences are recognized on the Eastern Shelf of the Midland Basin that appear to roughly correlate to the climate episodes observed on Gondwana. The upper Cisco Group is an extensive progradational package of Wolfcampian age representing a complex set of high-frequency sequences. These HF sequences are characterized by abrupt vertical facies transitions, thin but well-developed open marine carbonates during maximum transgression, and well-developed low-stand incised valley fills, all of which are characteristic of extreme changes in shelf accommodation space driven by glacial eustasy.

The Cisco is overlain by the Albany Group, which is a transgressive sequence set displaying significant platform aggradation and coastal onlap. The thick carbonate-dominated sequences of the Albany are characterized by stepped vertical facies transitions, thick packages of marginal to open marine carbonate-clastic facies couplets, and poorly developed lowstand lithofacies packages. These characteristics appear to be quite similar to sequences from ice-free, greenhouse climates and appear to be coeval with the Artinskian non-glacial episode on Gondwana.

The overlying Clear Fork Group is a complex of aggradational platform top coastal plain systems and progradational shelf margin systems of the Midland Basin. The Clear Fork is a highstand sequence set, and the Albany and Clear Fork together compose the second Lower Permian supersequence of the Eastern Shelf.

The overlying Duncan Sandstone of the San Angelo Formation represents a significant basinward shift in facies; thus it is the platform top expression of the lowstand systems tract of the overlying third Lower-Middle Permian supersequence. The timing of this lowstand roughly coincides with the Kungurian glacial episode of Australia and Siberia and may represent significant loss of accommodation space on the Eastern Shelf driven by the onset of this glacial interval.