High-Frequency Sequence Stratigraphic Controls on Stratal Architecture of an Upper Pennsylvanian "Regressive Limestone" (Bethany Falls Limestone), Mid-Continent, USA

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The Early Missourian (Upper Pennsylvanian) Bethany Falls Limestone (BFL) is the highstand-falling stage carbonate member of the Swope high frequency sequence as developed on the northern platform of the Mid-continent Basin. It is underlain by the condensed Hushpuckney Shale (maximum flooding surface) and is overlain by the Galesburg Shale (lowstand of the Dennis sequence). The Swope sequence is a significant hydrocarbon reservoir in the subsurface of western Kansas with outcrops of excellent reservoir analog lithofacies exposed in eastern Kansas and adjacent states. Although the BFL is often considered a uniform shallowing-upward carbonate system, we hypothesize that traceable flooding and erosion surfaces can be recognized within the BFL and that these surfaces define basinward-stepping carbonate clinothems. Recognizing this internal architecture is critical for understanding the potential controls on the deposition and diagenesis of oolite facies developed across the region within the BFL.

Flooding surfaces within the BFL are recognized by mudrock (clay-rich shale) partings throughout the carbonate succession. Distinctive conodont biofacies collected from these mudrocks aid in correlation and provide some confidence in mapping these surfaces across the region, although not without some ambiguity. Correlations indicate that basinward stepping clinothem packages can be recognized within the BFL.

Conodont abundances and species occurrences also shed light on the depositional environments of the flooding surfaces. Proximal occurrences of the mudrock partings contain a lower abundance, lower diversity fauna compared to more distal locations along a clinoform profile. Surprising faunas with the presence of "deepwater" genera and high overall abundances in the lower BFL are noted at some locations. These occurrences appear to coincide with structural highs and may represent a transitional facies with the underlying condensed horizon.

Distinctive lithofacies offsets and internal exposure surfaces indicate the presence of high frequency sequence boundaries within the BFL. These offsets are mappable and, like the flooding surfaces, define clinothem packages. The distribution of carbonate lithologies within these stratal packages is consistent with basinward progradation of facies throughout clinothem deposition. Using this combined knowledge it is possible to identify high frequency sequence boundaries (HFSB) within this forced regressive package.