Second-Order Accommodation Cycles and Points of Stratigraphic Turnaround:

Implications for High-Resolution Sequence Stratigraphy and Facies Architecture of the Haynesville and Cotton Valley Lime Pinnacle Reefs of the East Texas Salt Basin.

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Recent advances in high-resolution sequence stratigraphy of carbonate ramp systems have direct application to enhancing our understanding of Late Jurassic stratigraphy of the East Texas salt basin. Currently, the East Texas salt basin is enjoying a revival via the recent Cotton Valley lime pinnacle reef play. This play element complements the existing traditional Cotton Valley lime/Haynesville oolite shoal play type. Consideration of Gulf of Mexico regional Mesozoic sequence stratigraphy and paleogeography aids in linking the two plays together in an integrated chronostratigraphic framework, thus providing some predictive capability for reservoir distribution and quality.

Although the pinnacle play is currently perceived as a 3-D seismic play, regional sequence stratigraphic analysis assists greatly in locating favorable play trends and high-grading existing op-portunities. In this study, I present a high-resolution sequence stratigraphic analysis from the western shelf of the East Texas salt basin derived from the integration of 2-D and 3-D seismic, with well log and facies information obtained from cuttings.

The Middle Jurassic-Early Cretaceous stratigraphy in the East Texas salt basin consists of four major second-order supersequences of approximately 15 m.y. duration. These are defined as large, regionally correlative, retrogradational to aggradational/progradational accommodation packages. Each exhibits systematic vertical stacking patterns and associated lateral facies shifts within subordinate third-order sequences lasting between 1-3 m.y., with related facies and systems tracts. The four supersequences are: Supersequence 1(SS1)-Late Bathonian to Early Kimmeridgian (158.5-144 m.y.); SS2-Early Kimmeridgian to Berriasian (144-128.5 m.y.); SS3-Late Valanginian to Early Aptian (128.5-112 m.y.); SS4-Early Aptian to Late Albian (112-98 m.y.).

The Late Jurassic Smackover-Buckner-Cotton Valley lime-Haynesville-Bossier formational stratigraphy make up parts of two second-order supersequences, SS1 and SS2 (Figure 1). The Smackover represents the second-order, late transgressive systems tract (TST) and highstand systems tract (HST) of SS1; the Buckner evaporite/red bed facies depicts latest HST condition of SS1 and lowstand systems tract (LST) development of SS2. The Haynesville/Cotton Valley lime paired ramp-shoal carbonate and offshore detached pinnacle reef facies marks the second-order TST of SS2, and the overlying Bossier equates to the second-order interval of maximum flooding.

Within the above framework, the second-order HST of SS1 (Smackover-Buckner carbonate-evaporite facies) consist of four to five regionally correlative third-order sequences, 250-350 ft thick and 1 m.y. duration, which systematically stack in a progradational fashion such that successive ramp margins are progressively offset downdip. In detail, each successive sequence is thinner than the underlying one and each is progressively enriched in blocky highstand carbonates and proximal evaporite-red bed facies.

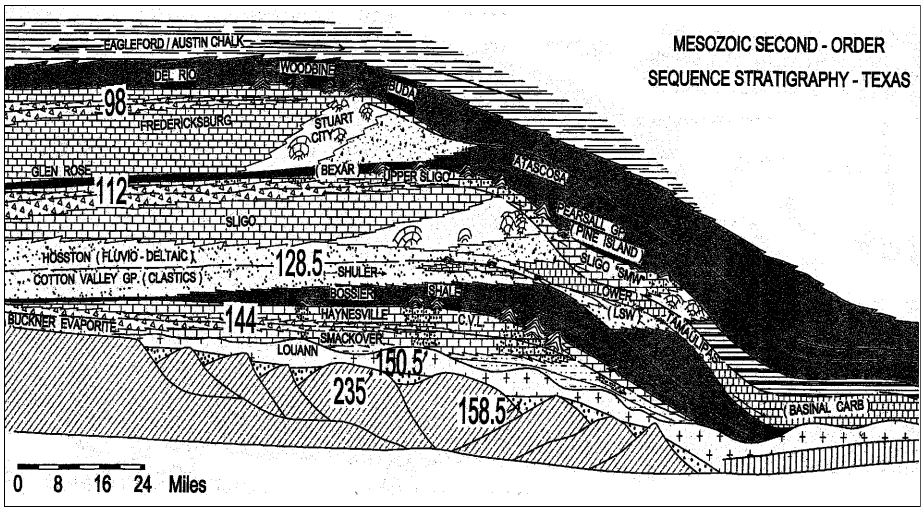

Figure 1 *Schematic regional cross-section for the Mesozoic of the Texas Gulf Coast. Schematic based on regional 2-D seismic, well log cross-sections, core/cuttings information from Texas subsurface and outcrop data from Northeast Mexico.*

A typical sequence contains an updip anhydrite facies and a ramp margin, high-energy grainstone belt composed of a series of higher-frequency, offlapping, clinoforming shoal packages beneath each third-order sequence boundary. There is little, if any, pinnacle reef development linked to these sequences.

The 144 m.y. supersequence boundary marks a zone of minimum second-order accommodation (a point of stratigraphic turnaround) and serves as a regional stratigraphic datum useful for hanging well log cross-sections. This surface is recognized in well logs by analyzing the vertical stacking patterns of third-order sequences, as recorded by overall thickness trends, and the ratio of blocky highstand carbonates