North American Explorationists Meeting, March 24

Sequence Stratigraphic and Facies Architecture of the Cotton Valley Lime/Haynesville of the East Texas Salt Basin

by Robert K. Goldhammer

Recent advances in high-resolution sequence stratigraphy of carbonate ramp systems enhance our understanding of the Upper Jurassic stratigraphy of the East Texas Salt Basin (ETSB). The ETSB is enjoying a revival via the recent Cotton Valley Lime (CVL) "pinnacle reef" play. This play complements the existing traditional CVL/Haynesville "oolite shoal" play type. Consideration of Gulf of Mexico (GOM) regional Mesozoic sequence stratigraphy and paleogeography aids in linking the two play types together in an integrated chronostratigraphic framework, thus providing some predictive capability for reservoir distribtion and reservoir quality. Although currently perceived as a 3-D seismic play, regional sequence stratigraphic analysis assists greatly in locating favorable trends and high-grading existing opportunities.

The Middle Jurassic-Lower Cretaceous stratigraphy of the GOM consists of five major second-order (approximately 15 m yr duration) supersequences, defined as large regionally correlative, retro gradational-aggradational/progradational accomodation packages. Each exhibits systematic vertical/lateral stacking patterns of subordinate third-order sequences (1-3 myr duration) and component lateral/vertical facies and systems tracts. The five supersequences are: Supersequence 1 (SS 1) - Upper Bathonian to Lower Kimmeridgian (158.5 - 144 mya); SS 2 - Lower Kimmeridgian to Berriasian (144 - 128.5 mya); SS 3 - Upper Valanginian to Lower Aptian (128.5 - 112 mya); SS 4 - Lower Aptian to Upper Albian (112 - 98 mya); and SS 5 - Upper Albian to Santonian (98 - 84 mya).

The Upper Jurassic Smackover-Buckner-CVL-Bossier formational stratigraphy makes up part of SS 1 and SS 2. The Smackover represents the second-order, late transgressive systems tract (TST) and highstand systems tract (HST) of SS 1; the Buckner evaporite/red bed facies depicts latest HST conditions of SS 1 and lowstand systems tract (LST) development of SS 2. The Haynesville/Cotton Valley Lime paired ramp-shoal carbonate and offshore detached "pinnacle" facies marks the second-order TST of SS 2, and the overlying Bossier equates to the second-order interval of maximum flooding.

Within the above framework, Smackover-Buckner carbonate-evaporite facies tracts consist of several regionally correlative third-order sequences (250-350 ft. thick on average; 1 ma duration on average) that systematically stack in a progradational fashion throughout the ETSB. In detail, each successive sequence is thinner than the underlying one, and each is progressively enriched in "blocky" highstand carbonates, plus proximal evaporite-red bed sequences. The "144" ma supersequence boundary marks a zone of minimum second-order accomodation (a point of stratigraphic "turnaround") and serves as a regional stratigraphic datum useful for hanging well-log cross-sections. Above this horizon, Haynesville/CVL sequences stack as a series of retrogradational third-order sequences (each approximately 50 to 150 ft. thick; approx. 1 ma in duration). Each sequence contains an updip, proximal evaporite-red bed facies, a ramp-margin "oolite shoal" belt (traditional Haynesville reservoirs), and a paired downdip "pinnacle reef" facies stranded in the overall second-order TST of SS 2. Regionally, several sequences of third-order TST and ST are recognized, and updip "oolite shoals" reservoirs can be correlated directly with time-equivalent "pinnacle reef" reservoirs, thus casting light on mechanisms for porosity development. The top of the CVL/Haynesville carbonate is a diachronous surface characterized by appreciable depositional topography, onlapped by the Bossier shale along a well-documented submarine condensed section. Little evidence exists for a significant relative sea-level drop at this surface.

Biographical Sketch

Bob Goldhammer received his Ph.D. in 1987 from the Johns Hopkins University and worked for nearly eight years for Exxon Production Research Co. on a variety of carbonate-related topics. He was an AAPG "Distinguished Lecturer" in 1995 and received the SEPMs "Outstanding Paper Award" from the Journal of Sedimentary Research in 1994. He currently lives in Austin, Texas. ■