Haynesville and Bossier Gas Shales of East Texas and West Louisiana: Intrabasinal Variations in Organic-Rich Facies and Lithology Related to Preexisting Geomorphology and Sea-level Fluctuations

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Upper Jurassic Haynesville and Bossier Shale gas plays of the northwestern Gulf of Mexico Basin (GOM) produce from organic-rich, marine transgressive to highstand mudrocks within mixed carbonate-clastic depositional systems. Modern wireline log suites from ~200 deep wells were used for detailed correlations, and 10+ cores throughout the upper Kimmeridgian to lower Tithonian basin were incorporated into detailed facies, geochemical, and lithologic analyses. The Haynesville Shale lies within a 2nd-order transgressive systems tract (TST) that encompasses back-stepping ramp carbonates (proximal) and marine shales (distal) below a maximum flooding surface (MFS). This shale onlaps retrogradational carbonates and basement highs and is capped by the second-order MFS. Above the Haynesville Shale, Bossier shales and local sandstones prograde basinward, downlapping the MFS and grading upward and updip into thick, highstand (HST), fluvio-deltaic sandstones of the Cotton Valley Group. Distally, organic-rich facies developed in restricted Bossier environments. Several preexisting basement highs in the south and carbonate platforms in the northwest and west restrict and partition the basin, thus influencing deposition of highly organic versus nonorganic and siliciclastic-dominated versus carbonate-dominated lithologies. Haynesville and Bossier shales each compose three upward-coarsening cycles that probably represent third-order sequences within the larger second-order TST and early HST, respectively. Each Haynesville third-order cycle is characterized by unlaminated mudstone grading into laminated and bioturbated mudstone. Most of the three Bossier third-order cycles are dominated by varying amounts of siliciclastics grading from unlaminated into laminated mudstone and capped by siltstones. However, the third Bossier cycle exhibits higher carbonate and organic influence in a southern restricted area (beyond the basinward limits of Cotton Valley progradation), creating another productive gas-shale opportunity. Haynesville and Bossier gas shales are distinctive on wireline logs—high gamma ray, low density, low neutron porosity, high sonic traveltime, moderately high resistivity—and persistence of distinctive log signatures across the study area suggests that favorable conditions for shale-gas production extend beyond established producing areas. Core examinations establish lithologic variations across the basin that need to be considered when exploring shale-gas basins.