Sequence Stratigraphy of the Upper Jurassic Mixed Carbonate/ Siliciclastic Haynesville and Bossier Shale Depositional Systems in East Texas and North Louisiana

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ABSTRACT

Recent discoveries in the Haynesville and Bossier shales have dramatically increased unconventional gas exploration activity in the mature petroleum provinces of East Texas and North Louisiana. The antecedent topography shaped by underlying carbonates and subsequent sediment budgets strongly influenced (1) facies development and stacking patterns that vary along the northern rim of the young Gulf of Mexico Basin during Haynesville and Bossier time, and (2) the depositional processes, total organic carbon richness, and preservation of the self-sourcing Haynesville and Bossier Shale units.

The Haynesville Shale depositional system is unique in that it contains both retrogradational and progradational facies that are contemporaneous with each other. On the western shelf of the East Texas Salt Basin, the time-equivalent Gilmer (Haynesville) Lime consists of backstepping carbonate facies, whereas to the east strong progradational stacking patterns dominate in the North Louisiana and western Mississippi salt basins due to increased sediment supply from the ancestral Mississippi River which outpace subsidence and eustasy. Hence, major bounding stratigraphic events such as maximum flooding surfaces and condensed sections critical for shale gas exploration appear to be diachronous along depositional strike. During Bossier time, the western carbonates are drowned out and siliciclastics become increasingly dominant, expanding westward from North Louisiana into East Texas and ultimately across most of the northern Gulf of Mexico shelf as the Cotton Valley sandstones and its distal shale equivalents. Depending on paleophysiography, some areas of the Haynesville-Bossier system are restricted and relatively sediment starved. These correspond with areas of total organic carbon enrichment and in turn, lower shale gas exploration risk.

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