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Depositional Systems, Facies Variability, and their Relationship to Reservoir Quality in the Jurassic Cotton Valley Group, Texas, Louisiana, and Mississippi Onshore Gulf Coast

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ABSTRACT

Whole cores from four wells in the Jurassic Cotton Valley Group from northeastern Texas to southern Mississippi display a variety of facies and depositional systems that provide a context for understanding reservoir quality, defined in this study as porosity and permeability. Although some cores are from areas with established oil and gas production (Texas and Louisiana), others are in less-productive areas (southern Mississippi), where facies interpretations of these cores could be used as a guide for future exploration and development. Cores in northeastern Texas and northern Louisiana are located in the Terryville Bar Trend, which includes an extensive, east-west belt of tight-gas (low-permeability) sandstones. These cores display a suite of shallow-marine facies (lowerand upper-shoreface, beach, washover-fan, and tidal-channel) within a wavedominated depositional setting. Sandstone beds in these cores have low permeability values, ranging from 0.001 to less than 1 millidarcys (md). Porosity values range from 2 to 12%. This study shows that little variation in permeability exists among shallowmarine facies in the Terryville Bar Trend, although muddy lower-shoreface and innershelf facies are less permeable by one to two orders of magnitude than sandy shoreface and tidal-channel facies.

Cotton Valley sandstones in southern Mississippi, located in an off-axis area of the ancestral Mississippi Delta, contain a variety of coarse-grained fluvial channel-fill and muddy floodplain facies. Channel-fill deposits in coarse-grained meanderbelt facies in this trend record multiple episodes of channel-fill with variable grain-size profiles.

These sandy channel-fill deposits are contrasted with variably colored and mottled over-bank/floodplain facies with insect burrows, root traces, and nodular textures that record pedogenesis.

Cotton Valley sandstone reservoirs of shallow-marine origin in the Bay Springs Field in southern Mississippi have greater reservoir quality than those of fluvial origin, with porosity values from 15 to 20% and permeability values ≥100 md. Vertical sandstone-bed continuity in upper-shoreface facies in the Bay Springs Field is great and comparable to that of thick (≥100 ft [≥30.5 m]), aggradational, upper-shoreface sandstones in the Pictured Cliffs Formation in the San Juan Basin in New Mexico and Colorado. This study shows that differences in the degree of facies complexity in Cotton Valley depositional trends should be considered in future reservoir development strategies, where facies complexity is great in the Texas-Louisiana Terryville Bar Trend and the Mississippi fluvial trend, but less in aggradational, upper-shoreface sandstone beds such as those in the Bay Springs Field.

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