(Wolfcampian/Leonardian) Bone Spring Slope and Basin-floor Mudrock Facies, Delaware Basin

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Deep-water mudrock facies of the Bone Spring Fm. comprise coarse-grained to fine-grained silt-bearing mudrock with varying organic-carbon abundances. Generally medium- to fine-grained silt-bearing mudrock deposited on slopes during sea-level highstands overlies carbonate debris-flow complexes and probably records distal siliciclastic-bearing facies deposition during the earliest phase of the ensuing falling relative sea level. During continued lowstand conditions coarse- to medium-grained silt-bearing mudrock was deposited in overbank areas of turbidite complexes and as hemipelagic drapes that separate turbidite complexes. On the basin floor, mudrock is deposited as four general sub-facies: massive to poorly-laminated medium- to coarse-grained siltstone; poorly laminated silty mudrock; mm-scale finely laminated silty mudrock; and massive to laminated black mudrock. Locally present are siliciclastic mud-supported limestone conglomerates. Finely disseminated calcite occurs in all facies but is not ubiquitous; internally laminated burrows occur mainly in poorly laminated facies; vertical linear fluid-escape structures are common in the siltstone-dominated facies; soft-deformation features are most evident where coarser-grained facies overlie the finest-grained facies; ripple structures occur in the coarsest-grained siltstones; and quartz-mineralized fractures are present mainly in the finer-grained facies.

Mudrock units analyzed to date range in TOC from 0.13 to 2.72 %, with calculated R_o values ranging from 0.58 to 0.99.The higher TOC/R_o values occur in a more basinward depositional setting. Petrophysical well-log responses in Bone Spring mudrock are complex, but the massive siltstone sub-facies possess generally low gamma-ray values with corresponding elevated resistivities providing for convenient correlation and mapping. In the darker colored finer-grained facies higher gamma ray values tend to reflect greater abundances of organic carbon, whereas resistivity logs appear to approximate trends of thermal maturity. Core-plug porosity values range from 1.6 in the finer-grained facies to 7.0% in the mud-supported limestone-conglomerate; permeability values range from 0.01 mD in the finer-grained facies to 0.074 mD in the mud-supported limestone-conglomerate. The limestone clasts in basin-floor mud-supported conglomerates constitute the more porous and permeable components of that facies (i.e., the upper porosity/permeability limits of the present data), and appear to be recorded geophysically by separations between shallow- and deep-resistivity logs. Induced or natural fractures may intersect multiple clasts, thus potentially improving productivity of an otherwise tight facies.

Petrographic, geophysical, and chemical investigations of the Bone Spring basin-floor mudrock facies of the Bone Spring Third Sand, in Texas, are in the early stages. Of particular interest are facies relationships to organic carbon content and thermal maturity, potential of siltstone facies to provide conventional reservoirs for hydrocarbons generated in stratigraphically adjacent organic-rich mudrock, and correlation of depositional facies to distinguishing geophysical well-log responses.