Mudrock Reservoir Deposition and Stratigraphy: Not Homogeneous, Not Boring

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Mudrocks comprise any deposit with >50% of grains <62 microns in size. Lithology consists of variable proportions of biogenic quartz, biogenic carbonate, detrital quartz (and feldspar), detrital carbonate, clays, volcanic ash, organic matter, pyrite, dolomite, and/or phosphate. Major influences on composition and deposition include tectonic setting, source terrane, basin physiography, water depth, circulation and upwelling, oxygenation, climate, eustasy, and detrital influx. With such a wide range of parameters, mudrocks are anything BUT homogeneous and definitely are not boring.

Macroscopic core description, integrated with laboratory analyses and petrophysical interpretation, is critical to understanding the controls on composition and texture (rock fabric). A rich diversity of macroscopic facies is discernable in core. Subtle attributes such as graded bedding, scour surfaces, rhythmic couplets, and minute burrows to “cryptobioturbation” are common in mudrock cores. Such features relate directly to depositional processes and sequence stratigraphy. Ultimately all of these features control the distribution and production of hydrocarbons in mudrock reservoirs.

Mudrocks do not simply fill basins passively. Competition between extrabasinal input and intrabasinal biogenic productivity creates the setup for lithologic cycles, clinoform geometries, and water-column stratification. Benthic fauna colonize the seafloor during dysaerobic to aerobic periods, then experience complete terror during times of mass transport. An understanding of these stratigraphic relationships requires regional correlations that commonly cover thousands of square miles.

Depositional patterns from diverse basins of the Rocky Mountains, Gulf of Mexico, and Canada suggest that mudrock reservoirs are associated with distinct sequence-stratigraphic hierarchies. Most prospective mudrock intervals develop during 2nd-order transgressions. In basins with strong extrabasinal influences, the better reservoirs require load-bearing grains and typically form during either 3rd-order highstands or lowstands. By contrast, in basins dominated by intrabasinal biogenic material the best reservoirs often occur in 3rd-order condensed sections. These units characteristically are brittle, with low clay content, high TOC, and abundant microfossils.