Geologic Parameters to Better Understand Mudrock (Shale) Reservoirs

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Abstract

In the last ten years, tremendous progress has been made in the exploration and development of unconventional gas world-wide, especially in North America. The application of horizontal drilling and hydrological fracture stimulation technologies provide economic gas flow in extremely low porosity and permeability reservoirs. Numerous oil and gas plays in organic-rich mudrock ("shale") are actively being developed across North America. In the United States shale gas production has risen from negligible quantities in 2000 to 7.5 trillion cubic feet (Tcf) in 2011 accounting for more than 30% of production, and is predicted to rise to 50% by 2040. In the northern Appalachia basin in the eastern United States of America, the organic-rich shale units the Ordovician Point Pleasant-Utica and Middle Devonian Marcellus Shale of the northern Appalachian basin are some of the most active shale gas/oil plays in the world.

To date, successful mudrock plays have been primarily a function of drilling intensity and cost reductions and application of new technology (e.g., steerable rotary bits). Understanding of key reservoir engineering and geoscience parameters have lagged and represent important areas that can contribute to improved well architecture and optimal lateral placement. Subtle changes in mudrock reservoir properties include; the distribution of organic content, the "fracability" of the unit (mineralogy and containment), structural discontinuities (faults), the present and past stress regimes, and the thermal maturity. In addition to dictating type of hydrocarbon fluid or gas present, thermal maturity has a critical influence on the development of the reservoir porosity and permeability sys-tem.

Recently, established classification systems of pore structures for the Point Pleasant-Utica and Marcellus are compared considering types of fluid flow, development of pores, and production of reservoirs. The goal is to understand pore structure in mudrock reservoirs in order to evaluate the reservoir and predict the storage capacity and productivity. Migration of hydro-carbons from the matrix to the well bore is investigated from a geologic perspective.