Comparing Source Rock Maturity with Pore Size Distribution and Fluid Saturation in the Bakken-Three Forks Petroleum System of the Divide County, Williston Basin, North Dakota

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ABSTRACT

With the continuous demand for fossil fuel and advancement in technology, the unconventional petroleum resources have come into limelight. The Bakken-Three Forks Petroleum System consisting of carbonate and clastic sediments in the Williston basin is an unconventional petroleum accumulation with a technically recoverable oil resources of 7.38 billion barrels. However, understanding the relationship between oil saturation with respect to source rock maturity and pore size distribution in the reservoir lithofacies are challenging.

Four wells from Ambrose, West Ambrose and Colgan fields within an area of 65 sq. miles will be utilized for this study. Preliminary physical core description and wireline logs were used to identify lithofacies and correlate them across all wells. Seven lithofacies were identified in the Three Forks Formation. They are: 1) Massive mudstone, 2) Massive dolostone 3) Laminated mudstone and dolostone 4) Mottled dolostone 5) Mottled mudstone 6) Brecciated mudstone and 7) Conglomerated mudstone.

The source rock maturity will be evaluated with the Weatherford SRA TOC-TPH method by running a programmed pyrolysis analysis on crushed samples taken at an interval of 1ft through the lower Bakken Formation. Pyrolysis analysis provides information on geochemical parameters of source rock such as TOC, S1, S2, S3, Tmax, HI, OI and PI. These parameters indicates thermal maturity, organic richness and kerogene types.

The bulk volume of each lithofacies will be precisely measured with a 3D laser scanner while pore volumes will be measure with a helium porosimeter before saturating in a NaCl brine solution at 100 psi for 30 days. Porosity analysis and pore sizes distribution will be acquired from NMR transverse relaxation (T2) analysis with Oxford Instruments GeoSpec2 core analyzer coupled with Green Imaging Technology software. Nuclear Magnetic Resonance relaxation time results will be used to estimate pore size distributions and classify them into micropores, mesopores and macropores. The reservoir lithofacies within the study area are expected to have different T2 relaxation time based on varying pore geometry, clay content and grain sizes. Integrating published T2 cut off values and results from this study will be used to establish a relationship between pore size distribution and fluid saturation.

AAPG Search and Discovery Article #90321 © 2018 AAPG Foundation 2018 Grants-in-Aid Projects