Petrographic Studies of the Lower Bakken Shale: Insight from Rock-Eval Pyrolysis, Organic Petrology and SEM Characterization

Adedoyin Adeyilola[1], Stephan Nordeng[2], Chioma Onwumelu[2], Francis Chidi Nwachukwu[2]
[1]Central Michigan University; [2]University of North Dakota

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

The Lower Bakken Shale is a main source rock in the prolific and unconventional Bakken-Three Forks petroleum system. Recent studies in unconventional petroleum accumulations around the world have shown unpredictable lateral trends in oil and gas production. These variations in hydrocarbon production are attributed to varying rock properties. Therefore, understanding geochemical (source rock potential), mineralogy and petrophysical properties of these units is essential in evaluating the hydrocarbon potential for the Lower Bakken Shale. This project applied rock Eval pyrolysis, thin section petrography, X-ray diffraction (XRD) analysis, scanning electron microscopy, helium porosimetry and NMR T2 analysis from four cores to characterize the Lower Bakken Shale. Results showed samples have a total organic content (TOC) ranging from 6 - 23 wt.% with varying maturity from immature to mature using a T_{max} of 435°C maturity benchmark. Dominant minerals from XRD analysis involve illite, muscovite, quartz and feldspar. They occupy over 80% of the bulk mineralogical composition. Mineral grains, clay matrix, organic matter, fossil and fractures were all analyzed with both the petrographic microscope and SEM at varying magnifications. Three categories of pores were identified with the SEM studies. They are mineral matrix pores, organic matter pores and microfracture pores. This research showed that pores in the Lower Bakken Shale are dominantly associated with mineral matrix and generally less than 10 µm in diameter. NMR porosity value range from 2.96% to 4.425 while Helium porosity values range from 2.88% to

4.01%. Integrating T2 cutoff to Pore fluid distribution makes clay bound water (CBW) the dominant fluid. The dominance of the clay bound water in the pore fluids is attributed to the abundance intraparticle pores within the clay minerals and matrix.