Geochemical Fingerprinting and Fluid Phase Behavior of Produced Oils from Meramec and Woodford Reservoirs from the STACK Play, Anadarko Basin

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ABSTRACT

The STACK Play in the Anadarko Basin is one of the most prolific and emerging oil provinces in North America. The STACK Play is a focal point of the petroleum industry due to multiple vertically-stacked hydrocarbon reservoirs across a wide spectrum of hydrocarbon fluid windows. The most prospective petroleum reservoirs in the STACK Play are Woodford and Meramec strata of Devonian to Mississippian age. The geochemical signatures from these oils and hydrocarbon phase behaviors of these fluids are not well investigated.

This article intends to characterize and understand the Total Petroleum Systems (TPS), hydrocarbon composition, migration processes, and fluid behavior, fluid phase, Gas-to-Oil ratio (GOR), source facies of these oils that reservoired in Devonian (e.g. Woodford) and Mississippian (e.g. Meramec) reservoirs. This geochemical investigation across the STACK Play reports and compares source rocks (e.g. TOC, Rock-Eval pyrolysis, vitrinite and solid bitumen reflectance and their equivalents) and it extracts (e.g. extractable bitumen/oil) from core and cuttings, whole oil molecular compositions, saturate and aromatic fractions, carbon isotope compositions, and biomarker ratios of produced oils from Meramec and Woodford reservoirs.

Geochemistry data clearly suggest that oils reservoired in Mississippian (e.g. Meramec and Osage) and Devonian (e.g. Woodford) reservoirs are derived from similar organic-rich marine type II source rocks. These oils are geochemically very homogenous with only minor variations in their molecular composition and biomarker chemistries. These variations are related to variation in the thermal maturity of the reservoir fluids, and multiple charges (e.g. oil and gas lags) in the same reservoirs. These geochemistry data can help explain high GOR anomalies as the result of multiple charging episodes in certain areas. These findings are in agreement with production data. This study can be utilized to understand hydrocarbon fluid windows in the STACK play and assist in predicting well performances.