



## ***Petroleum Systems International***

Interpretive and Analytical Services

### **South-Central Oklahoma SCOOP Plays: Select Petroleum System Elements and Processes**

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The multiple high flowing hydrocarbon zones in the south-central Oklahoma SCOOP plays provide opportunities that rival those being exploited in the Permian Basin, but at a significantly lower entry and operation cost. This is attributed to a favorable geologic column that provides stacked source rock in the same acreage with opportunities for oil, wet gas, and dry gas production. The geologic diversity contributes to hybrid traits that can be documented in the unconventional resources, as well as enables drillers to use the same pads to develop the diverse resources. The major liquid-rich plays are in the Devonian-Mississippian dual-bench Woodford-Meramec and Mississippian Springer Formations, with additional resources being developed in the Mississippian Sycamore / Osage, Caney, and Springer Formations. Future activity is forecast to develop in the black shales of Pennsylvanian age, as well as the Ordovician Viola Formation, but these are expected to be niche plays with limited geographic distribution.

This presentation reviews select petroleum system elements and processes within the SCOOP plays. It includes the oil-source rock assignment with geographic-stratigraphic distribution of over 400 oils, with the identification of key source rock variables (i.e., quantity and quality) that impose primary control on reservoir energy. A specific example includes the separation of the Woodford petroleum system into clay-rich and clay-poor (i.e., siliceous or carbonate) organic facies, along with calculating sample specific thermal stress. The thermal stress analysis often includes multiple molecular weight ranges (e.g., gas isotopes vs. adamantanes vs. biomarkers) to identify indigenous vs. migrated (i.e., mixed) charges within a converging interpretation scheme. When this information is compared to the host rock properties, the migration vector can be quantified using a 3-D basin modeling study. Within the Woodford oil phases, it is documented that the clay-poor organic facies reach peak hydrocarbon generation at a lower degree of thermal stress in a total oil window profile that is narrower, compared to the clay-rich organic facies. This type of input variable is critical to the correct calibration of kerogen kinetics for basin modeling. Reservoir energy can also change by secondary alteration mechanisms such as secondary gas charge (i.e., increase GOR), phase separation (i.e., increase or decrease), and top seal leakage (i.e., decrease GOR). The devolatilization is documented to be most common along structural trends (e.g., fractures in brittle rock facies), but this variable can also be investigated using fluid inclusion stratigraphic methods. This latter item is demonstrated by using the systematic variation in the mass spectrometry signatures in context of the rock properties to quantitate the top seal integrity, with leakage proven using isotopic analysis of hydrocarbon-filled gas inclusions. The components impacting reservoir energy, as well as other mass spec data, are further analyzed across multiple wellbores using newly developed 3D visualization products which are particularly beneficial for analysis of unconventional reservoirs. Collectively, the petroleum system puzzles can be solved with systematic strategies, analytical programs, and integrated / converging interpretation methods.