

## **Characterization of Rocky Mountain Paleozoic Oils - Not the Usual Suspects!**

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### **ABSTRACT**

Most of the oil in the U. S. Rockies is considered to have been generated from Cretaceous (e.g., Niobrara, Mowry & Greenhorn), Tertiary (Green River), Ordovician (Red River), Devonian (Bakken), and Permian (Phosphoria) sediments. While the geochemistry of several Paleozoic petroleum systems has recently been well- characterized (e.g., Phosphoria, Central Montana Heath, and Williston Basin Bakken, Madison Group and Red River), this presentation addresses the detection and characterization of Paleozoic petroleum systems that have not been the focus of recent exploration efforts. Paleozoic source units have received limited attention because of their depth, but where they exist may represent economically attractive resource opportunities. The presence of an oil sample is indisputable proof that a petroleum system exists, with the source rock generally deeper than the reservoir location of the oil. The molecular and isotopic composition of produced oil may be used to predict various geological and geochemical aspects of the oil's corresponding source rock, including organo-facies, lithology, depositional environment, source rock age, thermal maturity, and, at times, migration distance and relative direction. Biomarkers, such as terpanes and steranes, function as molecular fossils, and even though the oil may have migrated from its source, fossil evidence as to the nature of the source is carried with the oil. A detailed analysis of 242 oil samples that have been generated from Rocky Mountain Paleozoic source rocks is the basis for this study. By evaluating this suite of Paleozoic-sourced oils we have a) documented their presence, b) established and mapped the extent of coverage (footprint), c) determined the character (e.g., %S, oil vs. gas, thermal maturity), d) identified the probable source rock, and e) made an initial assessment of the overall economic significance. This identification resulted from multivariate statistical analyses of genetic-specific terpane and sterane biomarker ratios (molecular fossils) as well as stable carbon isotope values of the C<sub>15</sub>+ hydrocarbon fractions. Examples will be presented from three (of five) study areas that have been evaluated:

- Covenant-like oils in central Utah and northwest Colorado
- Pennsylvanian-sourced oils in southeastern Powder River Basin
- Pennsylvanian and Mississippian-sourced oils in the SE Denver Basin and the Las Animas Arch region