

Organic Geochemistry and Biomarker Compositions of Crude Oils from Eastern and Central Montana, USA

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ABSTRACT

Several compositionally distinctive groups of oils are recognized in the Williston Basin in eastern Montana and Big Snowy Trough in central Montana. Detailed biomarker analyses indicate that oils from the Montana portion of the Williston Basin can be classified into two separate genetic oil families that were initially identified in the northern Williston Basin. Oils found predominantly in Ordovician reservoirs display geochemical characteristics known to be unique for Ordovician-sourced oils worldwide and are included into oil Family A. Oils occurring in the Mississippian Madison Group reservoirs belong to oil Family C or have intermediate compositions indicating the mixing of oils from multiple sources with a significant Family C component. Similarly, compositions of a few oils from Nisku reservoirs appear to have resulted from mixing of hydrocarbons, although a separate single source for these oils could be possible. In central Montana, the majority of oils produced from Pennsylvanian Tyler-Amsden strata show many compositional similarities. Although these oils can be grouped into one broad category based on the composition of their light hydrocarbon fraction, the distribution of terpane and sterane biomarkers is more variable, indicating some differences in source organic facies or possible contributions from more than one source. Oils found predominantly in Mesozoic reservoirs display different geochemical characteristics, both in their gasoline range and biomarker compositions, and fall into two separate compositional categories, the Cat Creek and Crooked Creek types. In contrast to oils from the Tyler-Amsden reservoirs, these oils are found in fields located more towards the marginal parts of the Big Snowy Trough. Their unique biomarker signatures and high maturity suggest different source rocks, though compositional change during secondary migration or post-migrational alteration in the reservoirs would have to be considered.