

A Tale of Three Oil Families: An Appreciation of Carbonate-Rich, Mississippian Source Rocks in the Williston Basin of North America

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Over 350 Williston Basin oils were grouped into families, using multivariate statistics, which share common sources based on genetic-specific biomarkers and stable carbon isotope compositions. Three Oil Families were identified, produced from Madison carbonates, that were also generated from carbonate source rocks. One of the three carbonate families (Family 1) appears to have been the result of mixing of the other two families and oil from Bakken black-shale source rocks.

A number of maturity-sensitive biomarker ratios, not utilized in the genetic classification, were used to calculate vitrinite reflectance equivalent (VRE) values for each oil. This provides insight into the stratigraphic and geographic distribution of source facies and fluid movement, i.e., Migration Happens! The lowest maturity Family 3 oils are the most sulfur-rich and occur in Saskatchewan and northwestern North Dakota. The more mature Family 2 oils, which comprise the most members, commonly occur along the north-south border of Montana and North Dakota. Family 2 oils spatially correlate very well with basal Mission Canyon Lodgepole Formation source-rock richness and maturity maps.