San Joaquin Basin Petroleum Systems: New Evidence for Multiple Kreyenhagen and Monterey Source-Rock Organofacies

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Source-related biomarker and stable carbon isotope data for about 200 crude oil samples from throughout the San Joaquin basin in California were evaluated using decision-tree chemometrics. The purpose of the work is to infer source rocks from oil geochemistry and to improve understanding of the effects of variable organofacies and commingling on crude oil composition. Hierarchical cluster analysis and principal components analysis readily identify the well-known Eocene Kreyenhagen and Miocene Monterey formations as the two principal source rocks in the basin. However, enhanced resolution provided by multiple tiers of K-Nearest Neighbor models in a chemometric decision tree identifies multiple source-rock organofacies for both source rocks.

The results show a remarkably strong correlation of the identified oil families with geographic distribution and reservoir rock interval. For example, the data differentiate at least two families of oil samples that originated from different distal marine shale organofacies of the Kreyenhagen Formation. One family is depleted in ^{13}C and shows higher C_{28}/C_{29} steranes than the other. This family occurs almost exclusively in Eocene reservoir rocks within the Coalinga, Guijarral Hills, Kettleman North Dome, and San Joaquin fields. The Miocene Monterey oil samples fall into at least seven genetically distinct families. For example, one family has negative stable carbon isotope ratios and elevated C_{29} steranes compared to the other Miocene oil samples. This family occurs almost exclusively in Pliocene or Upper Miocene reservoir rocks in the Elk Hills field. Another family occurs in the southernmost part of the San Joaquin basin and is characterized by low diasteranes and high 28,30-bisnorhopane. This family occurs in Middle and Upper Miocene reservoir rocks mainly in the Pleito Ranch field.