A Characterization of the Smackover Source Rock in the Deep-Water Gulf of Mexico and Derived Parameters for Petroleum Systems Modeling

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Abstract

The Upper Jurassic (Oxfordian) Smackover formation has long been proven as a source rock in the onshore and shallow Gulf of Mexico basin. In the last two decades, it has also been proven in the deepwater basin to be present and mature, and it is believed to be sourcing oil accumulations in the underlying Oxfordian Norphlet formation. The Smackover has been encountered in over forty individual penetrations along the border of the Mississippi Canyon and DeSoto Canyon deepwater protraction areas, and the correlative stratigraphy of organic-rich shales and carbonates has been observed across a wide range of thermal maturities. Using a dataset of organic geochemical analyses, PVT analyses, well logs, and rock samples, this study combines lithostratigraphy with organic chemostratigraphy to present a dual-source-interval concept that accounts for variations in organic production and preservation in an evolving Smackover depositional environment. The first source interval, a lower Smackover carbonate, is indicated by a low sterane/hopane ratio (prokaryote dominated), and the second, upper interval is marked by a transition to marine shale and a greater eukaryote input as indicated by a major increase in steranes. Additionally, thin sections are presented that reveal expulsion mechanisms with evidence of petroleum staining along stylolites and within mechanical fractures. Migrated hydrocarbons are compared geochemically to the Smackover source rock organic chemostratigraphy, and the PVT properties are incorporated to demonstrate effects of

source kinetics, organic maturation, and secondary cracking in the reservoir. As a summary, these observations are integrated to derive parameters - namely thickness, total organic carbon content, hydrogen index, and organic facies assignment - for input as a source rock in petroleum systems modeling software packages.