
Laminated Lime Mudstone of the Upper Jurassic Smackover Formation: Source of High-Sulfur Oil and Gas

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ABSTRACT

Source depositional environment helps explain why large volumes of high-sulfur oil and gas were generated by the Upper Jurassic Smackover Formation. Smackover hydrocarbons may remain undiscovered in the Gulf Coast, Gulf of Mexico shelf, and in deep-water of the slope (e.g., DeSoto Canyon). The Smackover source rock was deposited in shallow seas adjacent to a vast belt of near-equatorial deserts. The shallow water of the adjacent Smackover Sea was restricted, anoxic, and density-stratified because of high rates of evaporation. Gypsum precipitated in the water column. In this extreme environment, few species of hydrogen-rich algae and microbes bloomed and died at close intervals. Periodically-spaced laminations with high total organic carbon (as much as 60%) are intimately associated with catalytic clays and reactive sulfate that generated high-sulfur oil early, as at Toxey Field. Later during deep burial, thermochemical sulfate reduction drove oxidation of hydrocarbons to carbon dioxide and reduction of sulfate to hydrogen sulfide. An extreme example is gas from Black Creek Field with 78% hydrogen sulfide, 20% carbon dioxide, 1.5% methane, and 0.5% nitrogen at relatively low temperature. Specific areas of source rock show much higher generative potential than the mean, explaining why roughly 1 billion barrels of oil equivalent is concentrated in a small area near Jay Field. Can we predict where the best source rock was deposited and where hydrocarbons may be preserved?