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Oxfordian Smackover Carbonate Hydrocarbon Exploration Strategies for the Northeastern Gulf of Mexico Area

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The Upper Jurassic (Oxfordian) Smackover Formation is the major carbonate hydrocarbon reservoir in the northeastern Gulf of Mexico. To date, oil production from this formation is more than 1 billion barrels and natural gas production is more than 4 Tcf. The primary reservoir is peloidal, ooid, oncoidal grainstones/packstones and dolostones at subsurface depths ranging from 10,000 to more than 18,000 feet. Porosity includes depositional interparticle and diagenetic grain moldic, intercrystalline dolomite, vuggy and fracture. Permeability is the major factor in affecting the producibility of these reservoirs.

The Smackover petroleum system is unique in that Smackover carbonates serve as the petroleum source beds, carrier beds and reservoir rocks. Smackover carbonate mudstones are rich in microbial and amorphous kerogen. These beds are effective regional source rocks. Generation of oil was initiated at a level of maturity of 2 TAI (0.55% Ro) in the Early Cretaceous and generation and migration continued into the Tertiary. The major migration pathways were from the basin centers to the updip areas of Smackover deposition. Anhydrites of the Buckner Anhydrite Member of the Haynesville Formation overlie Smackover carbonates and are effective regional seal rocks. Petroleum traps are principally structural and can be categorized into three structural plays, including paleotopographic basement features, extensional fault traps associated with salt movement, and salt pillows, anticlines and diapirs.

Understanding of these three Smackover structural plays and of the distribution of the Smackover grainstones and dolograinstones associated with these structures is critical in designing a successful Smackover exploration strategy. Also, knowledge of the diagenetic processes that have affected these carbonates enhances exploration success. Although diagenesis does not control the distribution of reservoir lithofacies, it does impact hydrocarbon producibility by modifying the architecture of the reservoir, specifically the pore systems and the associated permeability.

The use of 3-D seismic technology has greatly facilitated the strategic targeting of potentially productive Smackover structures. However, additional research is required in the area of delineating and predicting the distribution of potentially productive Smackover shoal lithofacies associated with these prospective structures to aid in risk reduction.