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Carbonate Reservoir Facies Associated with Paleotopographic Features: Examples from the Upper Jurassic (Oxfordian) Smackover Formation, U.S. Gulf Coastal Plain

The Upper Jurassic (Oxfordian) Smackover Formation is one of the most prolific carbonate reservoirs in the U.S. Gulf Coastal Plain producing hydrocarbons from different types of structural and stratigraphic settings. Petroleum traps result from the onlap and pinchout of shallow marine carbonate sediments against pre-Jurassic paleohighs that represent the southernmost extensions of the Appalachian Mountains. These features are found in proximal areas of an inner carbonate ramp located to the north of a regional peripheral fault trend that was formed as a result of halokinesis. These paleohighs are associated with major basement ridges that segmented the internal ramp into isolated sub-basins characterized by restricted environmental conditions.

Thick Smackover intervals in these areas are evidence of the continued generation of accommodation space during sediment accumulation as a result of an overall eustatic sea level rise combined with tectonic and isostatic subsidence.

Reservoir intervals of the Smackover Formation are linked to the depositional facies. Main reservoirs consist of thrombolitic doloboundstone associated with microbial reefal buildups, grainy nonskeletal dolostone accumulated in a shoreface environment, and ooid-peloidal dolograinstone-packstone layers representing shoal deposits. The first two facies were deposited during the catch-up phase of a carbonate depositional system, while the shoal facies are part of the keep-up stage of the carbonate system. Diverse diagenetic events that were initiated early after sediment deposition have modified the original composition and texture of the Smackover rocks.

Thickness, distribution and quality of Smackover reservoirs associated with basement structures in the U.S Gulf Coastal Plain are controlled by paleotopography, eustasy, tectonic and isostatic subsidence, environmental conditions and diagenesis.