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Lower Cretaceous Carbonate Petroleum Systems in the Mississippi Interior Salt Basin

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The Lower Cretaceous strata of the Mississippi Interior Salt Basin (MISB) have produced more than 479 million barrels of oil and 2.4 Tcf of gas. Within these strata are tongues of carbonate rocks that extend from the offshore region and pinch out generally in the downdip portion of the basin or just south of the basin. These carbonate tongues are typically associated with transgressive systems tract deposits.

Although the Sligo Formation of Barreman to Early Apian age consists of gray to brown, argillaceous, fossiliferous limestone in the offshore region of coastal Mississippi, the unit is predominantly siliciclastic in the MISB. Production from the Sligo with the MISB is typically from relatively thin sandstone units. The next Lower Cretaceous carbonate unit is the James Limestone of Aptian age. In the MISB area, the James has produced more than 660,000 barrels of oil and 75 Bcf of gas. The James occurs only along the southern margin of the MISB, and merges into the Pine Island Shale updip of its subcrop region. Reservoir rocks in the James are associated with salt-related paleotopographic highs that resulted in a patchy distribution of shoals and reefs. In offshore areas, anhydrites of the Rodessa Formation form seals for James production, but in the southern portion of the MISB, shales form the seals. The Rodessa Formation of late Aptian and early Albian age in the MISB typically consists of sandstones and shales. In the extreme southern portion of the MISB, however, the Rodessa becomes increasingly calcareous and, south of the MISB proper, also includes anhydrite. The Rodessa Formation grades from predominantly siliciclastic sediment to limestone in the central portions of Mobile and Baldwin Counties, Alabama, and along the coast of Mississippi. The Mooringsport Formation of middle Albian age is typically shale in the MISB, but a tongue of carbonate rock occurs in the lower portion of the formation across much of the MISB, including areas beyond the updip limit of the Ferry Lake Anhydrite. This stratigraphic relationship indicates that the more open-marine limestones of the Mooringsport were deposited during a marine transgression following the restricted conditions of the Ferry Lake and, therefore, the Ferry Lake-Mooringsport contact represents a sequence boundary. The Mooringsport consists predominantly of carbonate rock in the region just south of the MISB. Linear belts of lagoonal, reef, and fore-reef facies have been described from the coastal region of Mississippi, where the reef rocks have yielded tremendous volumes of hydrocarbons (more than 2.4 million barrels of oil and 156 Bcf of gas). The Andrew Formation of late Albian age (historically referred to as the “pre-Dantzler Washita-Fredericksburg”) is the youngest Early Cretaceous carbonate unit in the immediate vicinity of the MISB. The carbonate rocks of the Andrew overlying the nonmarine rocks of the Paluxy Formation also indicate a sequence boundary. Production of hydrocarbons has not been definitely established for the carbonate rocks of the Andrew in the immediate area of the MISB, although some lithologic logs describe oil shows. Studies of the Andrew Formation in the offshore region of the northeastern Gulf of Mexico indicate a patchy distribution of reservoir rocks similar to that observed in the James Limestone.

Hydrocarbon maturation plots for wells in the southern portion of Mississippi indicate that oil generation from Smackover (Oxfordian) source rocks was initiated during the Early Cretaceous, but entered into the gas window during the Paleogene. This Smackover gas is interpreted to be the source for the tremendous volumes of gas that has been produced from the Lower Cretaceous reservoirs in the southern portion of the MISB. The oil produced from these reservoirs is either sourced from the Smackover or Lower Cretaceous source rocks.