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Determining the Reservoir Potential of Lower Cretaceous Carbonates and Evaporites of Northeastern Mexico using High-Resolution Sequence Stratigraphic Interpretations

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Two large carbonate platform systems developed during the Cretaceous around the western part of the Tethys providing excellent analogues for hydrocarbon reservoirs not only in the region but also worldwide. These platform carbonates and evaporites formed as a result of two second-order sea-level cycles spanning from the Hauterivian to the Lower Aptian and from the Lower Aptian to the Upper Albian. The platform interior settings of both platforms were studied in northeastern Mexico in order to establish a high-resolution sequence stratigraphic framework and determine their reservoir potential.

Lithofacies of the carbonate platform interior, which formed during the first supersequence, is composed of carbonates deposited in a peritidal setting behind a shelf-margin grainstone shoal/ rudist reef. Retrogradational backstepping and termination of this platform occurred during the transgressive systems tract of the second supersequence. Platform interior lithofacies of the second supersequence is composed of carbonates and evaporites deposited in a shallow lagoon and formed during the highstand systems tract of the second supersequence. Lithofacies of each supersequence exhibits systematic vertical stacking patterns and associated lateral facies shifts of composite sequences (third-order sequences, ~1-3 myr duration and hundreds of meters thick), which in turn are composed of high-frequency sequences (fourth-order sequences, ~1 myr duration and tens of meters thick). The high-frequency sequences consist of individual meter-scale cycles, which are the smallest genetic units. The cycles of the lower supersequence are composed of peritidal cycles shallowing upward from peloidal grainstones to tidal flat mudstone/laminites, while the cycles of the upper supersequence shallow upward from mixed carbonates and evaporites to low-angle cross-laminated packstones/grainstones occasionally overlain by tidal-flat laminites.

Reservoir quality layers in the lower supersequence are associated with the transgressive part and the early highstand phase of the defined sequences with increased deposition of packstones/ grainstones. Compartmentalization increases during the late highstand phase of the sequences where tidal flat laminites and mudstones are more common. Reservoir quality layers in the upper supersequence are associated with the regressive portion, the late highstand phase when carbonate deposition was interpreted to have dominated. Compartmentalization is associated to increased evaporite deposition during the transgressive part of the examined sequences. This kind of detailed sequence stratigraphic interpretation enhances our understanding of platform evolution around the Gulf of Mexico. In addition, it provides valuable analogues for subsurface exploration and prediction of good quality reservoirs and compartmentalization in a peritidal and mixed carbonate-evaporite platform interior setting.