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Geologic Reservoir Characterization of the Willard Unit in the San Andres Wasson Field, West Texas

The Willard unit has produced 199 MMBO out of 450 MMBO originally in place. Enhanced oil recovery methods are necessary to acquire sustainable amounts of the remaining 54%. The Willard Unit is located on the northeast limb of a broad domal paleostructure that localized the Wasson field and created arid ramp-setting conditions favorable to carbonate production. Three facies complexes are defined: (1) hypersaline peritidal/sabkha, (2) inner ramp, and (3) outer ramp. Vertical heterogeneity of facies reflects parasequences deposited in a transgressive/regressive cycle related to long-term, relative sea-level rise and fall. Lateral heterogeneity is caused by variations in water depth produced by paleotopography and by relative facies position on the ramp. The highest reservoir quality and most continuous reservoirs are in the dolomitized, inner-ramp restricted lagoon (mean porosity is 8.4%, geometric mean permeability is 1.0 md) and moderate-energy shoal (mean porosity is 8.5%, geometric mean permeability is 1.78 md) facies.

The dolostone pore network consists of vuggy, moldic, and interparticle pores reduced by several forms of anhydrite. Because of strong lateral and vertical variations in facies and diagenesis, there are significant variations in reservoir quality. Several field-scale permeability barriers are in the section. There appears to be no direct method to develop high-quality, porosity/permeability transforms because of the complex history of diagenesis, effects of anhydrite cement on measurements in small core plugs, and the probable poor cleaning of relatively low reservoir-quality rocks. This is a limiting factor in log analysis and modeling of the field for defining an enhanced recovery program.