Depositional and Diagenetic Controls on Reservoir Quality, Spraberry and Dean Sandstones, Northern Midland Basin

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Spraberry and Dean Sandstones (Leonardian) are major oil producers in the Midland Basin. Reservoir facies are basin-floor turbidite sandstones and coarse siltstones. This study of Spraberry/Dean reservoir facies is based on numerous cores in Dawson, Borden, Lynn, and Garza counties. Spraberry sandstones in the north were deposited in submarine fan channel/lobe complexes and are more lenticular and laterally discontinuous than are the Spraberry sheet turbidites in the south part of the basin. Porosity and permeability, however, are higher in the north than in the south.

The Spraberry and Dean Formations include 7 facies that are prominent in cores: thick-bedded turbidities, thin-bedded turbidites, sandy debris flow, muddy debris flow, carbonate debris flow, laminated siltstone, and organic-rich mudstone. Thick-bedded turbidites have amalgamated sandstone beds greater than 1 ft. thick whereas thin-bedded turbidites are interbedded sandstone and mudstone, having bed thicknesses less than 1 ft. Submarine fan channel-fill facies are composed mostly of thick-bedded turbidites, whereas fan-lobe facies include a mixture of turbidite thicknesses. Laminated siltstones, which are probably the dominant facies on the basin floor, are composed of finely interlaminated silt and organic-rich clay. Laminated siltstones represent the background sedimentation away from active sediment gravity flows.

Debris-flow facies are heterolithic but fall within a spectrum of mud-dominated, sand-dominated, or carbonate-dominated end members. Debris-flow facies are poorly sorted and have coarse sand- and gravel-sized clasts floating in a fine-grained matrix. Debris-flow

facies are either structureless or have deformed lamination. Debris-flow facies are commonly associated with thick-bedded turbidites in submarine fan channels. Sandy debris-flow facies display favorable reservoir quality in some cores. Carbonate debris flows are composed of coarse fragments of platform carbonate and are usually tightly cemented. In the north part of the Midland Basin, Spraberry facies display pervasive deformation, including spectacular folding and faulting observed in core. Debris-flow facies and deformation structures are rare in the Dean, suggesting that depositional setting was more distal than in the overlying Spraberry.

Spraberry and Dean Sandstones contain zones that are tightly cemented with calcite. Areas containing high percentages of calcite cement (typically > 20%) can be distinguished in core by their white or bluish colors, which contrast with the tan to brown colors of sandstones containing less cement. The tightly cemented zones are up to 3 ft thick and commonly have sharp, curved margins. Although the calcite cemented zones are probably concretionary, the concretions may cluster in certain stratigraphic intervals as suggested by correlations between cored wells. Calcite cemented zones can be recognized on wireline logs by high resistivities, densities, or sonic velocities.