

Derisking Reservoir Quality in Pennsylvanian-Aged Mixed Carbonate Clastic Reservoirs on the Central Basin Platform, Permian Basin

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Abstract

Pennsylvanian reservoirs on the Central Basin Platform are mixed highstand carbonates and lowstand clastics that are highly stratigraphically compartmentalized. This study integrates 3-D seismic, petrophysical analysis, drill cuttings analysis, well log correlation to help derisk reservoir quality in this interval. An up-hole recompletion campaign in 2018 tested these concepts, and had a significant impact on production in a legacy field producing from the underlying Devonian 31 formation at Block 31 field in Crane County, Texas. Carbonate reservoirs in the Missourian Canyon Formation and Desmoinian Strawn Formation are extensively diagenetically altered. These limestones were deposited in shelfal environments on the Central Basin Platform, but were exposed to long periods of meteoric diagenesis due to high frequency and high amplitude eustatic changes (Saller et al., 1999). Drill cuttings from the Canyon and Strawn Limestones at Block 31 are dominantly silty wackestones to packstones or mud dominated packstones with secondary moldic porosity. A geobody with increased porosity was recognized on the paleo-windward side of the Block 31 structure. Porosity development occurs in lenses that are 8-10 feet thick and are preferentially developed at the top of shallowing upward cycles interpreted from well logs. Permeability indicators were recognized through invasion profiles interpreted on resistivity logs. The geobody was interpreted as a shoal complex, and multiple recompletions that tested the geobody produced oil at initial rates greater than 100 barrels of oil

per day. Clastic reservoirs in the Virgillian Cisco Formation and the Atokan Atoka Formation were deposited in alluvial-fluvial systems at Block 31 were shed from the emergent Fort Stockton high and deposited during eustatic lowstands. Spectral decomposition of the 3-D seismic volume shows channelized features that where encountered by well penetrations have porosity development of 10-15% and calculated water saturations are typically 40-70%. Drill cuttings analysis of the Atoka and Cisco sandstones showed abundant microporous chert in these intervals that is likely sourced from the underlying Devonian Thirtyone Formation. This microporous chert has a high proportion of capillary bound water, and multiple recompletions that tested these channels produced at water-oil ratios of less than 0.5. This integrated subsurface characterization approach allowed exploitation of behind-pipe pay that was previously under appreciated in a legacy field in the Permian Basin. Detailed correlation and integration of multiple datasets allowed the team to derisk reservoir quality in a highly stratigraphically compartmentalized mixed-system in the Pennsylvanian section on the Central Basin Platform.