Reservoir Architecture and Stratigraphic Evolution Channelized Deep-Water Depositional Systems

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ABSTRACT

Deep-water channel connectivity and facies variability pose significant technical and business challenges to reservoir characterization and development. Outcrop analogs suggest that the stratigraphic evolution of deep-water channel systems results in a heterogeneous arrangement of facies, which is commonly below the resolution of industry seismic-reflection data. A detailed understanding of stratigraphic architecture and evolution is fundamentally important to reduce uncertainty about connectivity and facies distribution.

To gain a better understanding of deep-water channel system architecture and evolution, we interpret the field-scale (225 sq. km) stratigraphy of a Miocene subsurface interval offshore Angola, and employ synthetic seismic forward models to evaluate fine-scale details of channelized reservoir elements. These deposits commonly appear at or below tuning. Our interpretations suggest that channelized turbidites were confined to a large-scale deep-water slope valley (~200 m thick; 2-3 km wide), which comprises channel belts bounded by large-scale (>50 ms TWTT relief) composite erosional surfaces. The depositional system evolves from laterally offset channel elements that truncate remnant channel deposits to vertically stacked, more continuous, levee-bounded channel deposits. This evolution reflects an initial phase of incision and bypass of sediment gravity flows, followed by channel-levee aggradation and increased preservation of channel deposits, possibly as a result of a change in flow conditions.

Our results from synthetic seismic modeling show that fine-scale connectivity and facies variability are unclear, which underscores the value of higher-resolution outcrop and seafloor records to reduce uncertainty. We place our interpretations into an architectural hierarchy, and consider the impact of reservoir compartmentalization and heterogeneity on fluid flow behavior during hydrocarbon production. Our interpretations inform the modeling and prediction of 3D heterogeneity of deep-water reservoirs and illustrate the importance of characterization at a very fine scale to understand reservoir connectivity.