Reservoir Modeling of Deepwater Lobes: Impact on Connectivity and Production

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ABSTRACT

Depositional lobes are the building blocks of many economically important deepwater reservoirs. We compiled a database of lobe geometries, bed-scale heterogeneity features, facies proportions, and reservoir properties to build an event-based geostatistical reservoir model. The event-based model was constructed to account for three important geologic concepts observed in deepwater lobe outcrops. In particular we focus on lobe hierarchy, lithofacies distribution related to longitudinal flow transformation, and bed amalgamation. Simplified flow behavior was simulated in end-member reservoir models to investigate the impact of bed-scale stacking patterns, and facies and associated rock property information on production behavior of deepwater depositional lobes. Two end-member reservoir models were constructed: 1) a complex of 'homogeneous' lobe elements, and 2) a complex of 'heterogeneous' lobe elements. The homogeneous model includes only sandstone and mudstone facies. In this model, individual lobe elements are composed of sandstone facies which lack spatial continuity of porosity and permeability. The heterogeneous model includes a complex of lobe elements that are constructed from individual sedimentation units. Individual sedimentation units are populated with facies and property trends based on subsurface and outcrop data and sedimentological conceptual models. Flow diagnostic tools show that lobe heterogeneity has significant impacts on flow: 1) intra-element flow is limited by proximal to distal trends in bed amalgamation and rock properties; and 2) inter-element flow is limited by the vertical stacking of amalgamated, relatively high-quality (porosity and permeability) sandstone of proximal lobes. Thus, integration of bed-scale trends of stacking patterns, and lithofacies and rock property distributions is important to predict the production behavior of deepwater depositional lobe reservoirs.