Unravelling Connectivity Issues Using High Resolution 3-D Facies Models: The Upper Wilcox Group in the Stones Field

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Abstract

The Stones field was discovered in 2005 in Block 508 in the Walker Ridge area of the Gulf of Mexico. Stones is the world's deepest oil and gas project, operating in 9,500 ft of water. The field is producing oil and gas from high pressure (>19,000psi) Lower Tertiary deep-water deposits some 28,500 ft below sea level. The ultra-deepwater project started production in 2016 using a floating production, storage and offloading facility (FPSO) and the reservoirs are estimated to hold more than a billion barrels of oil equivalent (BoE). The lower Palaeogene, Upper Wilcox Group forms the interval of interest within the field. It comprises a 1500 ft thick succession of sediments deposited in a variety of deep-water environments, most commonly as unconfined lobe and channel-lobe systems. The succession is subdivided into 7 "Hydraulic Units" and a total number of 16 "Reservoir Sand Packages" by a number of fieldwide shales. The Reservoir Sand Packages probably represent individual fan lobe bodies. Overall the well and performance data suggests that the sediments form relatively continuous bodies over the field area. Observations of well performance indicate that the low reservoir permeability (for Gulf of Mexico turbidites) and reservoir architecture create a more complex drainage story. There are several possible sedimentological causes, the presence of baffles and barriers related to the development of breccia conglomerates and slump bodies in channel bodies, the development of stratigraphic complexity related to lobe stacking architectures, and the pinch out of sediment bodies. Several high-resolution, deterministic facies models have been built

using 3-D modelling package JewelSuite Subsurface Modeling, to investigate and better understand connectivity patterns within the succession. These have been designed to address uncertainties related to facies interpretation from well-log and associated body geometry. These models are based on detailed correlations of the available well data (up to 12 penetrations in total). To create the deterministic facies model the correlation markers are mapped through the reservoir volume thereby defining the distribution of bodies down to a facies level. The models that have been built comprise up to 290 individually mapped facies bodies. The unique 3D structure building with JewelGrid, combine with its powerful stratigraphic modelling and thickness map tools, allows the user to build a wide range of realistic sedimentary architectures and fully realise their sedimentological concepts. Two main deterministic cases have been built; both are lobe dominated but one contains many more channels that cut through underlying these bodies and potentially subdivide them into discrete small-scale stratigraphic compartments. In addition, several other cases have been created with different channel geometries and positions and different shale architectures.