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An Integrative Approach to Characterize Deepwater Reservoir Architectures.

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ABSTRACT

One of the great challenges in deepwater exploration is characterizing and predicting reservoir architecture, distribution and connectivity of reservoir sands. Deepwater turbidites are sediment gravity flows that initiate off the continental shelf and into the deepwater basin. These systems exhibit sand body architectures that vary from seemingly random stacking of elements to a highly systematic vertical and lateral stacking of patterns that is both organized and predictable. Wireline logs, whole cores, and seismic data are integrated to characterize these deepwater turbidite systems and help predict the distribution of the reservoir sands.

There are two principle types of deepwater depositional systems: sheets and channels. Depending on where in the basin they are deposited, sheet systems can be either confined or unconfined. Unconfined sheets are deposited on basin floors beyond the toe of slope, and are able to stack compensationally. Sheets have three distinct lobe facies: inner sheet, middle sheet and outer sheet elements that are collectively characterized by highly depositional units with minimal erosion. Each lobe system is identified based on the ratio of amalgamated sands to heterolithic finer deposits, with the more proximal inner lobes containing a high degree of amalgamated sands and the outer lobes containing more heterolithic deposits and waning flow deposits such as linked debrites. Collectively, sheet facies are recognized by well-behaved turbidite Bouma sequences and are dominated by suspension fall-out deposits and a high degree of lateral connectivity. Confined sheets are often deposited in intra-slope basins and are not able to stack compensationally and are dominated by inner-sheet like facies with a high degree of amalgamated, structureless sands and generally only thin waning flow deposits.

Based on their internal architectural patterns, channelized reservoirs are divided into two types: organized and disorganized channels. Both systems have distinct wireline log patterns, unique seismic facies, and key sedimentary features and stacking patterns that are key to identifying and characterizing each. Disorganized channel systems display random stacking patterns of channel elements with a high degree of laterally amalgamated sands and low vertical aggradation. Disorganized channel complexes generally exhibit a blocky gamma ray log pattern with a sharp base and a sharp top geometry and are dominated by active channel-fill. These types of channels have a high degree of amalgamated sandy deposits with both suspension fall out and bed load deposits. In contrast, organized channel systems exhibit far more organized and predictable stacking patterns and a high degree of vertical aggradation. These systems tend to have log patterns with sharp bases and gradational tops, and may be dominated by abandonment fill. They are also recognized by more organized, laterally and vertically accreting channel patterns, similar to that of meandering fluvial systems.

Additional features of each system including channel abandonment relief and overbank aggradation rates also play a critical role in defining each system for optimal reservoir characterization for exploration and production purposes.