TRANSGRESSIVE VALLEY FILL SEQUENCES: IMPLICATIONS TO SEQUENCE STRATIGRAPHY AND PETROLEUM EXPLORATION

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Large amounts of hydrocarbons have been discovered in association with valley fill deposits. The lateral and vertical distribution of siliciclastic rock types in transgressive valley fill deposits is governed by the stratigraphic sequence. The sequence stratigraphy is controlled primarily by the interaction of subsidence, eustacy, and volume of sediments.

During periods when eustatic sea level decline exceeds the rate of subsidence, much or all of a basin may become exposed, and a lowstand surface of erosion will develop forming a stratigraphic sequence boundary. In deeper basins such as the Gulf Coast Basin, the lowstand erosion surfaces are confined to the shelves at the margins of the basin.

When the sedimentation rate is less than the sum of the rate of subsidence and eustatic sea level change, a transgressive sequence develops over the lowstand surface with deeper water facies overlying shallower water and/or nonmarine facies. Reservoir potential siliciclastics accumulate in valley fill, estuarine, and wave reworked transgressive deposits. Differences in the spectrum of transgressive deposits can be attributed to variations in the rate of eustatic sea level rise, subsidence, and sediment supply.

Rapid rates of subsidence and/or eustatic sea level rise relative to sediment supply result in an abrupt landward shift in facies and valleys filled primarily with estuarine muds. Examples include the Opeche formation of the Powder River Basin and the lower Wilcox and Yegua formations of the Texas Gulf Coast. The valley fill mudstones in these units trap hydrocarbons in laterally adjacent facies.

Slower rates of relative sea level rise, or increased sediment supply, result in valley fill sequences with thicker basal fluvial deposits overlain by estuarine to marine sands and muds. Petroleum is produced from fluvial–estuarine reservoirs within this type of valley fill in the Morrow Formation in southeast Colorado and southwest Kansas and the Doig Formation of western Alberta.

Complex valley fill sequences consisting of multiple backstepping progradational parasequences occur in association with varying rates of eustatic sea level rise or subsidence relative to sediment supply. Examples from the Muddy Sandstone of the Powder River Basin illustrate such complexities. Petroleum has been produced from fluvial, bayhead delta, and barrier island facies of the Muddy Sandstone valley fills.

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