

The Role of Sequence Stratigraphy in Exploration and Production

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Sequence stratigraphy is the study of stratigraphic relationships within a time-stratigraphic framework. It combines detailed analysis of sedimentary facies and depositional geometries, and defines a hierarchy of stratigraphic units that stack into progressively larger-scale cycles. Each cycle is composed of four systems tracts represented by the sediment deposited during relative changes in accommodation space, identified as changes in relative sea level and called the transgressive, highstand, falling, and lowstand systems tracts. Paleogeographic maps of each systems tract provide a template for predicting the distribution of depositional facies useful in evaluating the potential source rock, reservoir rock, seal rock, and trapping elements of the petroleum system. Each systems tract has the potential to contain organic-rich rocks and porous and AI permeable reservoir rocks. However, specific depositional environments within some systems tracts are likely to have higher probability of an effective source, reservoir, and trap system. This paper includes 2-D and 3-D seismic-scale examples of proven petroleum systems with highstand and lowstand siliciclastic reservoirs.

The lowstand systems tract is deposited during relative decrease, minimal and very early increase in accommodation space along the basin margin, resulting in most sediment accumulating toward the basin center. Lowstand reservoir facies are dominantly regressive to aggradational with significant basin-centered, gravity-flow depositional systems in close proximity to potential source rock facies. These lowstand deposits are subsequently transgressed with regional shales providing optimal top and lateral seal. A critical risk factor is updip trapping along the sediment transport avenue.

The highstand systems tract is deposited during relative increase, maximum and decreasing accommodation space along the basin margin, resulting in significant deposition on the shelf and coastal plain. However, during the decrease in accommodation of late highstand and falling phases of relative sea level, updip deposits are cannibalized and transported basinward, resulting in relatively thin but widespread reservoir facies. Deposition of effective top seal requires a major transgression on the next rise in relative sea level. A critical risk factor is effective trapping of the laterally extensive reservoirs, usually requiring well-defined structural closure.