INDONESIAN PETROLEUM ASSOCIATION
Proceedings of the International Symposium on Sequence Stratigraphy in SE Asia, May 1995

SOME NEW DEVELOPMENTS IN SEQUENCE STRATIGRAPHY AND VARIATIONS ON THE GENERAL SEQUENCE MODEL

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ABSTRACT

Sequence stratigraphic concepts have evolved significantly in recent years. Although originally developed on the basis of multi-channel seismic observations, sequence stratigraphy has been successfully applied using higher resolution data sets such as borehole and outcrop data. Based on these data, significant variations on the general model have been identified. These include the effects of tectonics, sediment flux variations, and physiographic setting, which have produced stratigraphic geometries that bear little resemblance to the general model. Specific stratigraphic units associated with some of these recently described variations include stranded shelfal lowstand shorelines associated with the process of forced regression and healing phase wedge deposits associated with shoreline transgression. Outcrop and subsurface examples from the Cretaceous of the western United States and the Gulf of Mexico will be described and their implications to exploration and field development discussed.

These examples clearly show that stratigraphic architecture is a function of several variables, including tectonics, physiography, sediment influx, as well as eustasy. The dominant factor will not always be eustasy, as suggested in early sequence stratigraphy publications.

Stranded or isolated shorelines deposited in distal settings are common in basins characterized by gently sloping or ramp margins. This type of physiography can characterize any tectonic setting though it is most common in foreland basins and least common in basin with narrow shelves and associated steep slopes. These types of deposits present favorable exploration targets insofar as they represent reservoir sediments normally deposited in mud-prone environments that can provide both source and seal.

The healing phase wedge can represent a significant portion of the sediment budget associated with the transgressive systems tract. These sediments are derived from the erosion by shoreface processes of coastal plain/delta plain during shoreline transgression. Deposition of the winnowed finer-grained sediments occurs seaward of the 'last clinoform' of the immediately preceding progradational phase deposits. This stratigraphic unit commonly comprises a relatively sand-poor component of the transgressive systems tract that can be mistaken for relatively sand-rich lowstand systems tract deposits.

The tectonic setting of a sedimentary basin can strongly influence local physiography as well a sediment flux and subsidence profiles and hence stratigraphic architecture. Tectonic settings which produce basin margins with a ramp physiography are characterized by rapid regressions and transgression and relatively thin sequences. This is in contrast with tectonic settings that produce deep basins with discrete shelf/slope breaks where significant accommodation due either to sediment loading or accelerated subsidence at the shelf edge fosters significant aggradation and comparatively low rates of regression and transgression. In the latter setting, thicker sequences, usually with more complex architecture, are observed.

The role of the tectonic setting in influencing sequence architecture can be illustrated in foreland basins. Such basins, formed by flexural loading of the crust by folding and thrusting, are characterized by subsidence that increases towards the fold and thrust belt (i.e., towards the primary source of sediment). One of the effects of this subsidence patterns is that accommodation increases in the landward direction and as a result, fluvial sedimentation may continue unabated in the proximal setting despite the fact that sea level rises and falls may characterize the shoreline, producing a succession of unconformity-bounded sequences distally.

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