Controls on Sequence Stratigraphic Architecture of Carbonate Systems: Example from the Pre-Salt Section, Offshore Brazil

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Abstract

Seismic stratigraphic analyses of Early Cretaceous (Aptian) presalt carbonate sections from offshore Brazil reveal the complex stratigraphic architecture of lacustrine carbonate systems developed during late- and post-rift tectonic settings. Despite the simple composition, largely dominated by abiotic and microbial components, lacustrine carbonates formed complex geometries that closely resemble those observed from marine systems, suggesting that a downward tapering carbonate production profile must have occurred. The complexity of the stratigraphic architecture in the presalt system reflects lateral variations in subsidence patterns combined with the interference of the basement rugosity, paleo-wind directions, and basin filling patterns. Well-imaged clinoforms several hundred meters high attest to both the existence of significant lake-bottom topography and the occurrence of deep water at time of deposition of the carbonate units, although rapid variations in base level are predicted. The shape of clinoforms varies from linear to tangential, with an average dip angle varying from 8-12° for depositional, accretionary slopes, 18-20° for bypass slopes, to > 30° for erosional slopes, reflecting differences in antecedent topography, and from tabular to climbing, reflecting varying rates of sediment accumulation in interplatform areas. Closely spaced basement highs formed the nuclei for coalescing systems in the postrift phase when subsidence rates where greatly subdued; margins abutting deep basins developed aggradational and retrogradational stacking patterns with erosional collapse scars and gravity flow deposits at the basin margin. Platform margin trajectory and vertical and lateral architecture of clinoform packages through time reveal distinct sequence boundaries that can be

correlated in detail only locally, demonstrating the large impact of syndepositional tectonics, and possibly the recurrent isolation of smaller lakes during lowstands. Comparative analysis of platform evolution and facies architecture in the Cretaceous presalt Brazil system indicates that laterally-variable tectonic subsidence, rate of clastic deposition at the toe of slope, antecedent topography, oceanographic settings, and changes in carbonate factory type control the evolution, large-scale sequence stratigraphic architecture, and depositional geometry of carbonate platform margins and slopes. Lateral and temporal changes in these parameters result in remarkable vertical and along-strike variability in the observed sequence-stratigraphic architecture and slope profile, even within single platforms. Depositional models from this study fill a gap in current understanding of lacustrine carbonate systems and offer a template for exploration and appraisal of the presalt play and carbonate systems in general.

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