Sequence Stratigraphy of the New Jersey Miocene Transect: Back to Basics

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Abstract

IODP Expedition 313 (New Jersey shallow shelf) cored a 3-hole transect across Miocene seismic clinothems (prograding sigmoidal sequences) in topset, foreset, and bottomset locations, providing an opportunity to integrate seismic, log, and core data into a sequence stratigraphic framework.

Our interpretations of sequences and systems tracts are made independent of any preconceived relative sea-level curves. Rather, we use basic seismic, core, and stratigraphic principles to recognize sequence boundaries, Maximum Flooding Surface, transgressive surfaces, and facies successions within sequences. Sequence boundaries, other stratal surfaces, and systems tracts are recognized on seismic profiles by reflector terminations and independently in the cores by integrating studies of core surfaces, facies successions, facies stacking patterns, benthic foraminiferal water depth changes, downhole and core logs, and chronostratigraphic ages.

We use facies successions and stratal surfaces to subdivide sequences into systems tracts. Sequences were sampled in topset (landward of the clinoform inflection point) and foreset (where sequences are thickest) locations, allowing us to evaluate sequence stratigraphic models. We link seismic sequence boundaries to impedance contrasts, as suggested by long-held tenants of sequence stratigraphy. The transgressive surface and and sequence boundary are merged in the topsets, and are overlain by deepening/fining upward transgressive systems tracts (TST) and coarsening/shallowing upward highstand systems tracts (HST).

Drilling through the foresets yields thin lowstand systems tracts (LST), thin TST, and thick HST, contrasting with previously published seismic stratigraphic predictions of thick LST and thin to absent TST. Transgressive surfaces are recognized by upsection changes from coarsening to fining upward, and maximum flooding surfaces by changes from fining to coarsening upward successions. Despite challenges posed by shallow-water sediments, we derive a chronology using integrated Sr-isotopic and bio- stratigraphy (calcareous nannoplankton, diatoms, and dinocysts), with typical age resolution of ±0.5 Myr. We find little evidence for correlative conformities on the paleoshelf.

We do not resolve the issue of fractal versus hierarchical order, but our data are consistent with arrangement into orders based on Milankovitch forcing on scales driven by eccentricity (400, 100 kyr) and obliquity (1.2 Myr). Sequences are generally 1.2 Myr in duration, but sequence m5.4 (17.7-16.5 Ma) is a composite of three 100-400 kyr-scale sequences. Sequences on the New Jersey shallow shelf were preserved during times when benthic foraminiferal oxygen isotopic variations were dominated by 100 kyr cycles, but tend to be eroded away during 41 kyr-dominated worlds.