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Architecture of passive margin sediments and sea level changes: New Jersey IODP Expedition 313 preliminary results

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In May-July 2009, IODP Expedition 313 used an ECORD "mission-specific" jack-up platform 45-67 km off the coast of New Jersey, in 35 m of water, to core and log Upper Paleogene and Neogene sequences. The goal was to estimate the amplitudes, rates and mechanisms of sea-level change and to evaluate sequence stratigraphic facies models that predict depositional environments, sediment compositions, and stratal geometries in response to sea-level change. Despite the difficulties of coring the sandy material of the shallow NJ shelf, we collected 612 cores at three sites (M0027, M0028 and M0029) with 80% recovery totaling 1311 m in length. The deepest hole (M0029A) reached 757 mbsf; the oldest sediment (uppermost Eocene) was recovered in Hole M0027A. These three holes drilled through the mid-shelf clinoforms and complement the coastal plain (ODP Legs 150X, 174AX) and slope (Leg 150) core datasets, building up a large “New Jersey transect” across the US Atlantic passive margin. Besides the cores, we collected wireline logs at the three sites – gamma ray, resistivity, magnetic susceptibility, sonic, acoustic televiewer and vertical seismic profiles – which, together with multisensor core logs on unsplit cores, provide very precise ties between core-logs and seismic profiles. More than 16 surfaces and/or seismic sequence bounding unconformities mapped around the regional seismic grid are now confidently tied to the cores.

The lithostratigraphic description of split cores shows silt-rich supply systems that reveal a notable depletion in clays and a marked difference between the top and the toe of the clinoform bodies. The topset facies succession shows well sorted silts and sands deposited in offshore to shoreface, mixed wave to river-dominated shelf environments giving rise to the toe of slope silts and silty clays deposited below wave base. These sediments are typically interbedded with poorly-sorted silts and sands deposited by continuous down-slope gravity transport processes such as sandy debris flows and turbidity currents during periods of clinoform slope/rollover degradation. The open shelf experienced frequent cycles of dysoxia. In situ and reworked glauconite is a common component of top-set and toe-set strata that also show sharp changes in pore water salinity.

Sr-isotopic ages measured on molluscs and forams, reliable biostratigraphic zonation of multiple fossil groups (foraminifers, dinocysts and nannofossils), magnetic reversal chronology and specific pollen markers verify a nearly continuous record of c.1 myr sea-level cycles and climate variations that may explain facies changes along the slopes of the clinoforms. We found no evidence of sea-level drop below the clinoform inflection point – i.e. depositional shelf break – but the occurrence of shoreface deposits along the slope of the clinoforms and of deep water facies on their topsets suggest large changes in amplitude of relative sea level in the range of 60 m. Stratigraphic backstripping, including calculation of sediment compaction and crustal loading, must be made to derive a more precise estimate of the magnitude of eustatic sea-level change and its role in changes of passive margin sediment architecture.