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Facies architecture of Miocene subaqueous clinoforms of the New Jersey passive margin: Results from IODP-ICDP Expedition 313

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The preserved, laterally correlative sedimentary record of continental erosion on passive margins has been used to reconstruct past sea level changes. However, the detailed nature of a basic clinothem progradational pattern observed on many of these margins is still poorly known. This paper describes the sedimentary facies and interprets the depositional environments and the architecture of the clinothems of the New Jersey shelf to depict the origin and controls of the distribution of the sediment on the margin. We analyze 612 cores totaling 1311 m in length collected at three sites 60 km offshore Atlantic City, New Jersey, USA during IODP-ICDP Expedition 313. The three sites sampled the Lower to Middle Miocene passive margin sediments of the New Jersey shelf clinothems. We also collected wireline logs at the three sites and tied the sedimentary architecture to the geometry observed on seismic profiles. The observed sediment distribution in the clinoform complex differs from current models based on seismic data, which predict a progressive increase in mud and decrease in sand contents in a seaward direction. In contrast, we observe that the clinoforms are largely composed of muds with sands and coarser material concentrated at the rollover, the bottomset and the toe of the slope. The shelf clinothem topsets are storm-influenced mud whereas the foreset slope is composed of a mud wedge largely dominated by low density turbidites and debrites. The architecture of the clinothem complex includes a composite stack of approximately 30 m thick clinothem units each composed of four systems tracts (TST, HST, FRWST, LST) building individual T-R sequences. The presence of mud-rich facies during highstands on the topset of the clinoform, 40 to 60 km offshore from the sand-prone shoreface deposit (observed in the New Jersey onshore delta plain) and the lack of subaerial erosion (and continental depositional environments) points to a depositional model involving a subaerial delta (onshore) feeding a distant subaqueous delta. During forced regressions, shelf edge deltas periodically overstep the stacks of flood-influenced, offshore-marine mud wedges of the New Jersey subaqueous delta bringing sand to the rollover building up the large-scale shelf-prism clinothems. The clinothem complex develops on a gently dipping platform with a ramp-like morphology (apparent dip of 0.75-0.5°) below mean storm wave base, in 30-50 m of water depth, 40-60 km seaward of the coastal area. Its shape depends on the balance between accommodation and sedimentation rates. Subaqueous deltas show higher accumulation rates than their subaerial counterparts and prograde three times further and faster than their contemporaneous shoreline. The increase in the intensity of waves (height, recurrence intervals) favors the separation between subaqueous and subaerial deltas, and as a consequence, the formation of a flat topset geometry, the decrease in flood events, and fluvial discharge, the overall progressive decrease in sediment grain size (from sequence m5.45, approximately 17.8-17.7 Ma, onwards) as well as the increase in sedimentation rates on the foresets of the clinoforms. All of these are recognized as preliminary signals that might characterize the entry in the Neogene icehouse world.