Cuttings-Based Sequence Stratigraphic Model of a Transition Zone Mixed Carbonate-Siliciclastic Continental Shelf Succession in a Boundary Current-Swept Setting, Paleogene, North Carolina, USA

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ABSTRACT

Analysis of thin sectioned well cuttings (3-5 m sample spacing) from the 0 to 450m thick Paleogene succession was integrated with available seismic and log data to generate a sequence stratigraphic model for these mixed carbonate-siliciclastic continental shelf units. Deposition was initiated following a Late Cretaceous deep submergence of the shelf, which generated a distinctive profile consisting of a shallow inner shelf, inner shelf break, deep shelf, and shelf-continental slope break. The Paleogene succession consists of deep shelf marls overlain by bryozoan-rich carbonates that are overlain in turn by coarse siliciclastic-dominated units. The succession contains several supersequences made up of smaller scale sequences, which were mapped across the basin.

Downdip, supersequence lowstands were mapped on seismic as onlapping lobate packages. Although untested in wells, these geometries are interpreted to be dominated by siliciclastic material. Much of the inner shelf was exposed during lowstands, and the upper continental slope underwent erosion by seaward-displaced boundary currents.

Updip, sequence lowstands are dominated by regional siliciclastic-dominated skeletal sand sheets. These variably-consolidated units are thin and often are overlain by phosphatized hardgrounds. Transgressive systems tracts of sequences on the inner shelf are bryozoan-echinoderm-facies that backstep onto shallow shelf quartzose molluscan facies. On the deep shelf, the ancestral Gulf Stream remolded fine grained sediment units. Early highstand systems tracts on the inner shelf consist of fine wackestone-mudstone and downdip planktonic and spiculitic marls that are overlain by progradational bryozoan-echinoderm grainstone and packstone units. In near-shore locations, sea level fall caused these to be overlain by prograding back-barrier silts and shell beds, coastal sands, and sandy molluscan shoreface deposits. On the deep shelf the ancestral Gulf Stream reworked fine-grained sediments into elongate, shelf-parallel lobes, with local complete removal.

The warm water biotas (mollusks, larger forams) suggest that these carbonates formed in the transition zone between subtropical to warm temperate waters, rather than cool water, which reflects their more southerly position relative to present day, the influence of the warm ancestral Gulf Stream, and overall warmer climates of the early Paleogene in the region.