Holocene and Pleistocene Cycle-Thickness on Great Bahama Bank: The Missing Correlation between Facies, Cycle Thickness and Waterdepth

Rieneke Weij[3], John J. Reijmer[1], Peter K. Swart[2], and Gregor P. Eberli[2]

[1]College of Petroleum Engineering and Geosciences, KFUPM, Dhahran, Eastern Province, Saudi Arabia.
[2]Marine Geology and Geophysics, Rosenstiel School of Marine and Atmospheric Science, Miami, FL, United States.
[3]School of Earth Sciences, University of M

ABSTRACT

Cyclic facies variations in shallow-water carbonate platform are often interpreted to reflect the sedimentary response to variations in sea-level related to climatic variations linked to orbital variations, the Milankovitch frequencies. Often it is also proposed that these shallow-marine carbonates tend to completely infill accommodation space through time. Hence, it is assumed that sediment thickness of a single depositional cycle is a direct measure of the amplitude of relative sea-level change. However, new shallow seismic data from Great Bahama Bank reveal that the accommodation space created during the Holocene sea-level rise is not filled in a regular way. Three distinct seismic horizons could be identified: the seabed, the Pleistocene top, and a lower Pleistocene karst level. Depth surface and thickness maps of the Holocene and Pleistocene layers were combined with 326 in-situ water-depth measurements to assess the limits of the present accommodation space. The analysis showed that no correlation existed between accommodation space and Holocene sediment thickness as well as the water depth. The energy distribution across the shallow-water platform appears to control the type of facies and not accommodation space. Mud-dominated sediments prevail in shallow low-energy areas that are protected by a topographic barrier, whereas mud-free coarse-grained sediments mainly occur in deeper areas with a high hydrodynamic energy induced by strong tidal currents, ocean-water influx and winds. The uneven energy distribution leads to uncertainties in the thickness of a carbonate-cycle on the platform, and shows that the cycle to thickness link cannot be used to reconstruct the amplitude of suborbital sea-level change during highstands in sea level. In addition, the actual water depth and the inner platform facies distribution did not show a direct correlation, which contrasts with a rule of thumb used by many when studying fossil inner platform carbonate deposits.