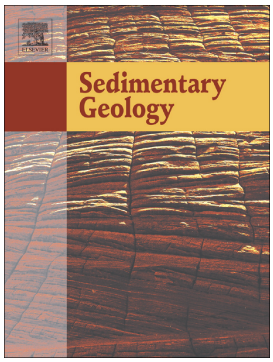

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Quantifying the Relationship Between Water Depth and Carbonate Facies

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Abstract

Carbonate facies often are used to define meter-scale parasequence (or cyclic) structure in ancient sedimentary basins. These parasequences constitute the fundamental stratigraphic unit in many studies of ancient climate and life on Earth. Of interest is the uncertainty associated with the assumptions that underpin the parasequence definition and interpretation. This work presents a method that uses modern maps of bathymetry and the geographic distribution of facies atop the Great Bahama Bank to extract a signal of water depth change from facies transitions in vertically stacked carbonate strata. This probabilistic approach incorporates the observed complexity in the water depth distribution of immediately adjacent modern carbonate environments, and results in an impartial and explicit interpretation of stratigraphic data with quantified uncertainties. Specifically, this analytical tool can distinguish sequences of facies that are likely to record information about changing water depths from sequences of facies that do not. Additionally, the quantitative signal extracted from sequences of discrete, or qualitative data, can be used for the correlation of stratigraphic sequences. By quantifying geologic observations through a lens of modern data, the reproducibility and accuracy of sedimentary interpretations can be improved to build a more authentic picture of Earth history.

Keywords: Great Bahama Bank, carbonates, water depth, hidden markov models