Evolution of the Shallow Pleistocene Carbonates of New Providence Island, Bahamas — Using GPR and Outcrop Data

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Abstract

The sedimentology and stratigraphy of New Providence Island, Bahamas, are analyzed using a Digital Elevation Model (DEM), outcrops, high precision 2D ground penetrating radar (GPR), and core data. The shallow Pleistocene carbonates that form the island were deposited during a series of sea level highstands, with most of the island forming during the last interglacial highstand - Marine Isotope Stage (MIS) 5e. Outcrops in the western part of the island reveal a complex carbonate succession of MIS 5e deposits and an exposure horizon that indicates a sea level oscillation within the MIS 5e highstand. Six main lithofacies that range from eolianite to beach and to variable subtidal deposits can be correlated to the detailed GPR data. The combined GPR and outcrop data delineates the distribution of the carbonate facies in map view. Placing the facies distribution on a digital elevation model produces a refined view of facies distribution. An exposure horizon identified on outcrop as a hardened caliche crust within MIS 5e subtidal deposits separates early MIS 5e bioturbated subtidal grainstone facies from late MIS 5e trough-cross bedding and foreset bedding that are typical for a subtidal bar. This horizon, which can be traced across most of the GPR lines (28 km of 250 MHz GPR data), records a 10+ m fall of sea-level and notably subdivides the highstand into early and late substages. Additional evidence supporting the sea level oscillation within MIS 5e, and suggesting a difference in position of sea level between the two highstands, is the local juxtaposition of late MIS 5e subtidal facies on top of the early MIS 5e eolianites. Heights and geometries of different ridges are captured with the digital elevation model (DEM) as well as by

the topography along the GPR lines (z-coordinate). The DEM shows a series of high ridges, which were interpreted as beach facies by previous workers. Outcrop and GPR show the relatively lower ridges instead to be subtidal bars, whereas the relatively higher ridges are eolianite deposits. This finding prompts a revision of the notion of down-stepping beach ridges with the onset of the glaciation at the end of MIS 5e but is rather a forced regression of shoal ridges.