Sediment Production and Transport atop Great Bahama Bank: Insights from Fair and Storm-Weather Conditions on the Andros Platform

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Abstract

Whereas the varied components of the Great Bahama Bank (GBB) sediment factory are relatively well documented, their rates of sediment production and subsequent transport are less well constrained. Biologic lime mud producers include green calcareous algae and seagrass epibionts whilst producers of coarser material include hard corals and complex calcareous benthic organisms (such as mollusks, forams, and echinoderms). Conversely, partially abiotic or microbially-induced producers of fine- and coarse-grained carbonate material are largely limited to whitings and ooid shoals, respectively. Our conservative sediment-production estimates suggest that GBB would fill its accommodation space in roughly 56 kyr. This duration is greater than, yet within the same order of magnitude of, the estimated fill time of 15 kyr, which is based on the projected net sedimentation rate of a uniform ~2.5 m platform-top sediment package developed since the Holocene transgression (6.7 kyr BP). The underfilled nature of GBB suggests that either sediment production rates are insufficient to fill the platform interior, or meaningful sediment volumes are being transported off-platform. The latter process is well documented by thick sedimentary wedges observed on the western slope of GBB. Systematic examination of daily MODIS images suggests that fair-weather platform-top hydrodynamics are too lethargic to loft and transport meaningful quantities of lime mud. However, storm conditions are quite different. Large sediment plumes are observed via satellite on the days immediately following Cat. 4 Hurricane Matthew, which passed over GBB on Oct. 5-6th, 2016. Largescale sediment resuspension is

corroborated by elevated current velocities predicted by hydrodynamic modelling of these storms. Based on both this observational and model-based evidence, we suggest that storm-induced currents may be especially relevant for off-platform transport of sediment. Resuspension and transport of these sediments not only determine the GBB's ability to fill its accommodation space, but also generate facies variability across the platform and down its slope. Therefore, reconciling observations of sediment transport and deposition with hydrodynamic modelling is critical for understanding the role of storms in the carbonate rock record.