OVER THE EDGE: LINKING ON-PLATFORM PROCESSES TO OFF-PLATFORM DEPOSITION ON GREAT BAHAMA BANK

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PROJECT OBJECTIVES

- Conduct a sediment budget analysis of the Great Bahama Bank (GBB).
- Sesimically quantify volumes of Holocene sediment along GBB's slopes.
- Reconcile off-platform deposits with platform-top sediment production and resuspension volumes to estimate sediment export.

PROJECT RATIONALE

Roughly 25 billion kg of sediment is produced annually atop the Great Bahama Bank (GBB), with up to 250% of it remobilized on the platform top alone (Lopez-Gamundi et al., *in prep*). While the quantity of sediment that is delivered over the platform margin and onto the slopes is unknown, cascading density currents are understood to be the dominant mode of transport (Wilson and Roberts, 1995). These hyperpycnal flows are challenging to observe in the field or through remote sensing. Fortunately, seismic data (Fig. 1) offers a way by which the volume of sediment shed by the platform can be quantified. The resulting sediment budget has three plausible permutations: (1) the volume of sediment on the GBB's flanks exceeds that which is being produced atop the platform, (2) these volumes are balanced, or (3) off-platform volumes fall short of the ability of the platform to shed sediment over its margin. Each possibility elucidates a different, yet non-unique, dynamic for GBB in the last 6 kyr since it last flooded. If (2) is true, then the GBB is a self-contained isolated platform, self-regulating and stable. However, if (1) is true, then either off-platform deposits are receiving additional sedimentary contributions from more distant sources, or sediment production was much higher in the geological past. But, if (3) is true, sediment is exported far beyond the margin itself, else modern production rates are greater than those experienced at the onset of the last sea-level transgression. The sedimentary surplus or deficit proposed by (1) or (3) could also

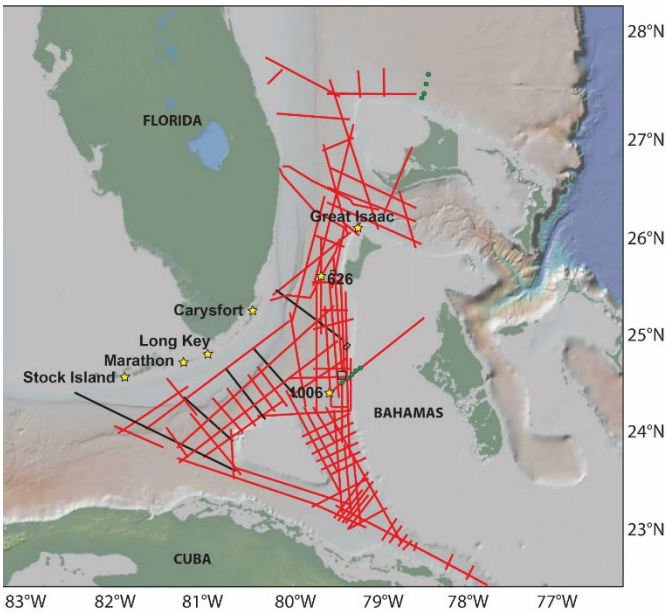

Figure 1. Available 2D seismic surveys on the western margin of the Great Bahama Bank. Datasets will be used to assess off-platform sediment volumes and facies.

intimate either the existence of an unaccounted-for production mechanism, such as seawater precipitation of carbonate, or substantial dissolution, neither of which have yet been quantified in a budget before.

Seismic analysis of slope deposits not only sheds light on the overall balance between on- and off-platform processes, but also hints at the inner workings behind fine-scale facies heterogeneity. Along strike variability of slope sedimentary facies often reflects the different export pathways transited by exiting platform-derived sediments (Mulder et al., 2012). Previous hydrodynamic modeling suggests that fine sediment can travel substantial distances (>1000 km) from sources within the platform interior before escaping through different "leak points" along the GBB's margins (Lopez-Gamundi et al., 2022). Upon reaching the slope, sediments of differing shapes and sizes, once only reflecting their initial sources, are subject to winnowing and redistribution by deeper contouring currents. Analysis of these slope seismic facies coupled with hydrodynamic modeling elevates our understanding of the drivers responsible for facies heterogeneity on the flanks of carbonate platforms.

APPROACH

High-resolution seismic data on the GBB's flanks and adjacent contourite drifts will be analyzed in order to: (1) assess total Holocene sediment volumes in order to audit the GBB's sediment budget, and (2) decipher the causes behind slope facies heterogeneity. This new facet in our research will leverage previous work on sediment production estimates, total suspended sediment analysis, and hydrodynamic modeling; thereby offering a more integrated and complete view of platform top and slope evolution.

SIGNIFICANCE

Understanding the accumulation of sediment beyond the GBB's margin is the final step of our comprehensive sediment budget analysis. Such budgetary audits are key to understanding the fundamental dynamics of source-to-sink relationships, contourite formation, and the overall evolution of carbonate platforms over time.

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