GRAIN FACTORIES AND SINKS - SEDIMENT BUDGET OF THE GREAT BAHAMA BANK

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PROJECT OBJECTIVES

- To enhance the understanding of hydrodynamics atop a large isolated carbonate platform and examine their role in directing facies production and accumulation.
- To broadly quantify the GBB sediment budget and link platform-top processes to slope architecture.
- To quantify the importance of uniformitarian versus catastrophic (storm) events on the sedimentary processes of GBB.

PROJECT RATIONALE

Recent studies of Holocene deposits on GBB have focused on mapping sediment distributions, analyzing variable filling of accommodation space, quantifying ooid sand body dimensions, and examining whitings and mud production. Recent work by Purkis et al. (2017) cast these studies in the context of platform-top hydrodynamics using a flow model developed in Mike 3, a simulation now further refined via use of 'SLIM', a numerical ice-ocean model developed at the Université Catholique de Louvain (Belgium).

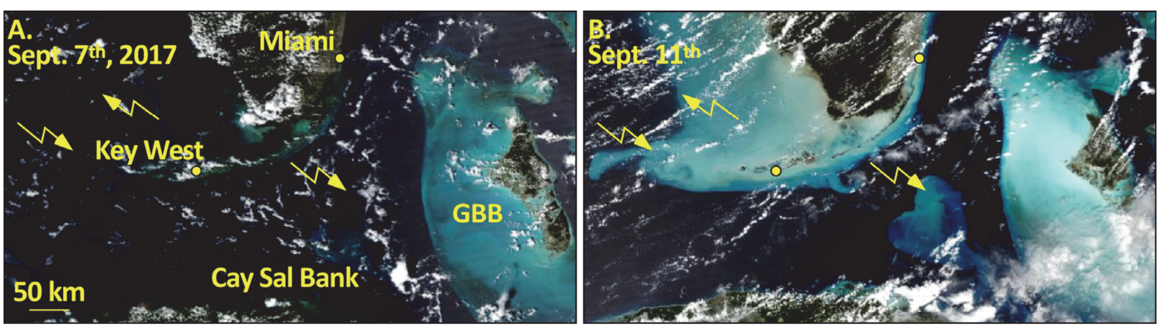

Figure 1. Waters around the southern tip of the Florida Peninsula, Straits of Florida, Great Bahama and Cay Sal Banks before (A. Sept. 7th, 2017) and after (B. Sept. 11th, 2017) the passage of Hurricane Irma (Sept. 9-10th, 2017) as captured by the VIIRS instrument on the NOAA/NASA Suomi NPP satellite. The hurricane is seen to loft vast sediment plumes from the West Florida Shelf, Great Bahama and Cay Sal Banks which become entrained in the Florida Current. It is postulated that during such events, meaningful quantities are lost from the Bahamas platform tops. Hence, hurricanes might exert an important control on the sediment budget of carbonate platforms and shelves alike, when situated in storm belts. Yellow arrows equally positioned in A and B for comparison. North is top.

The rich seam of work conducted on the platform top will be paired with an equally broad portfolio from the CSL and its partners which considers the architecture of the platform's flanks, including its strike-variability (e.g. Anselmetti et al., 2000; Mulder et al., 2012; Schnyder et al., 2018). Links between prevailing sedimentation and current flow patterns on the platform top will be sought with those existing on the slopes. Through this multiple dataset comparison, it will be deciphered whether platform-top facies architecture confers any degree of predictability to the off-platform accumulation of sediments, or whether these two environments, although adjacent, behave largely independent of one another.

APPROACH

Building forward from the GBB-wide facies and bathymetric maps of Purkis and Harris (2016), a map of 'biological depo-centers' (BDCs) will be developed from recently acquired Landsat 8 imagery. Each BDC will be parametrized in terms of potential rates of grain production via a literature meta-analysis. The SLIM hydrodynamic model will then be used to examine the likely fate of grains produced in each BDC, and their possible loss from the platform top during typical daily environmental conditions. This 'uniformitarian' mode of platform-top processes will be compared to those prevailing during short periods of catastrophism, such as during hurricanes, when large quantities of sediment are swept from the platform top onto the slopes, or entirely lost from the system altogether by off-platform current entrainment (e.g. Fig. 1).

SIGNIFICANCE

An understanding of water movement atop the GBB is of paramount importance for understanding sediment production and dispersal. These processes exert physical control over platform-top sedimentation, which, in turn, govern slope architecture variability.

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