Linkages between Geomorphology and Sedimentology along a Reef-Rimmed Shelf: Crooked-Acklins Platform, Southern Bahamas

Fikril Hakiki and Eugene C. Rankey[1]

[1]*Kansas University*

Project Purpose

Reef-rimmed shelves of many carbonate platforms are characterized by morphological rims, such as barrier reefs, and can have variable sedimentology and morphology. Characterizing the spatial heterogeneity of their sediments in modern carbonate systems is one means to better understand the potential complexity of ancient analogs. However, the details of spatial geomorphic and sedimentologic patterns on reef-rimmed shelves have not been widely documented or quantified. By integrating sedimentologic and remote sensing data, this study aims to describe and evaluate the depositional patterns and processes that influence sedimentary and geomorphic patterns on a reef-rimmed shelf on part of Crooked-Acklins Platform in the southern Bahamas.

Scope of Work

This project will evaluate sedimentologic data, detailed bottom observation and bathymetric data collected in the field. The preliminary results of laboratory analyses of these data, including petrographic analysis, show granulometric pattern of the sediments, as influenced by the geometry and morphology of the reef margin. In the near future, hydrodynamic measurements will be collected to explore processes (waves and tides) that influence facies heterogeneity in this area. The results will be integrated with the sedimentologic data and remote sensing analyses to better describe and understand the morphology and geometry of the shelf and the reef margin.

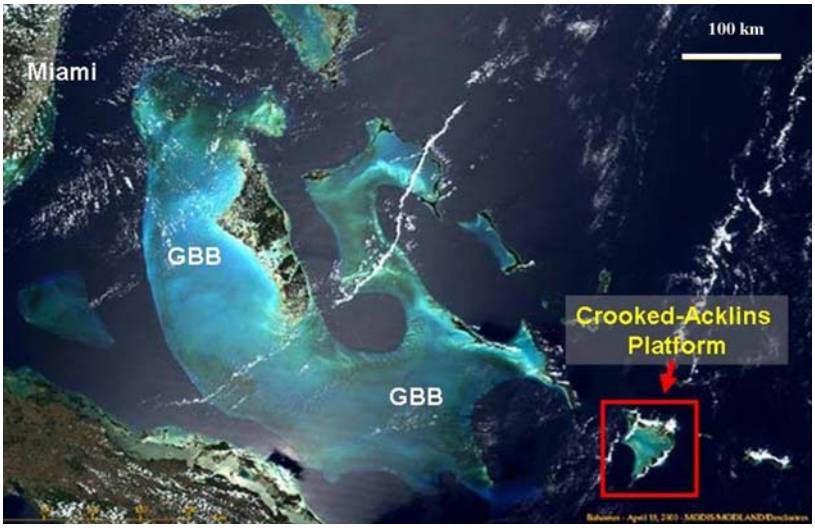

Figure 1: General location map of Crooked-Acklins Platform study area.

Key Deliverables

This study will provide the result of field observation and sedimentologic analyses of sediments on a reef-rimmed shelf on part of Crooked-Acklins Platform in the southern Bahamas. Further analyses on hydrodynamic and remote sensing data will provide information on the depositional processes and facies heterogeneity of sediments, including geomorphology of reef margin, in the study area. This information can provide an example of the potential heterogeneity of reservoir analogs.

Project Description

Reef-rimmed shelves are common geomorphic part of carbonate system in modern and ancient reef complexes. In ancient deposits, they can form important hydrocarbon reservoirs, in part because they commonly have thick porous sediment and permeable sediments (e.g., James and Ginsburg 1979; Pomar and Ward, 1999). To better understand these important, several Holocene reef complexes have been studied, mainly by drilling (e.g. Yamano et al., 2001; Tudhope and Scoffin, 1984). These studies focused on the mineralogy and the internal structure of back-reef facies but did not take into account spatial context, which is very important for understanding the scale, trends, and interrelationships of facies in the geologic framework. Additionally, to fully understand the facies heterogeneity in reef-rimmed shelves, the physical process influencing the sedimentation, spatial geomorphic and sedimentologic pattern from various back-reef systems must be better understood.

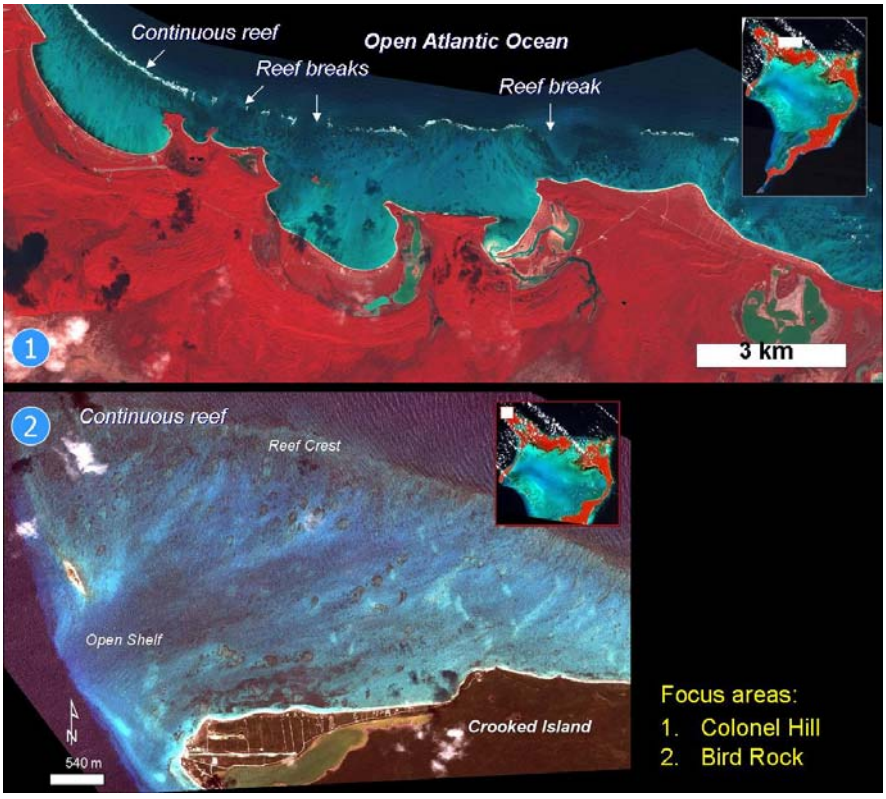

Figure 2: Two focus areas in the Crooked-Acklins Platform: (1) Colonel Hill area and (2) Bird Rock area

To capture the range of geomorphic variability, two focus areas will be closely examined (Figure 2). The first area is located offshore of the middle part of the Crooked Island, and has a reef margin facing to the north-northeast. The second area is located in the northwesternmost point of the platform, includes a well-developed reef margin facing northeast to north, but is open (unrimmed) to the west.

Roughly 200 superficial sediment samples, and bathymetric data, have been acquired in the study area. Sedimentologic and petrographic analyses characterize granulometric pattern and distribution of different types of sediments. The results can be compared with high-resolution (2.4 m resolution) QuickBird to provide information about general sedimentologic patterns and their relationship to the morphology of the barrier reefs and water depth. Field and laboratory analyses suggest that the sediment properties vary along and across the shelf margin, and are related to the continuity of the reef margin (Figure 3).

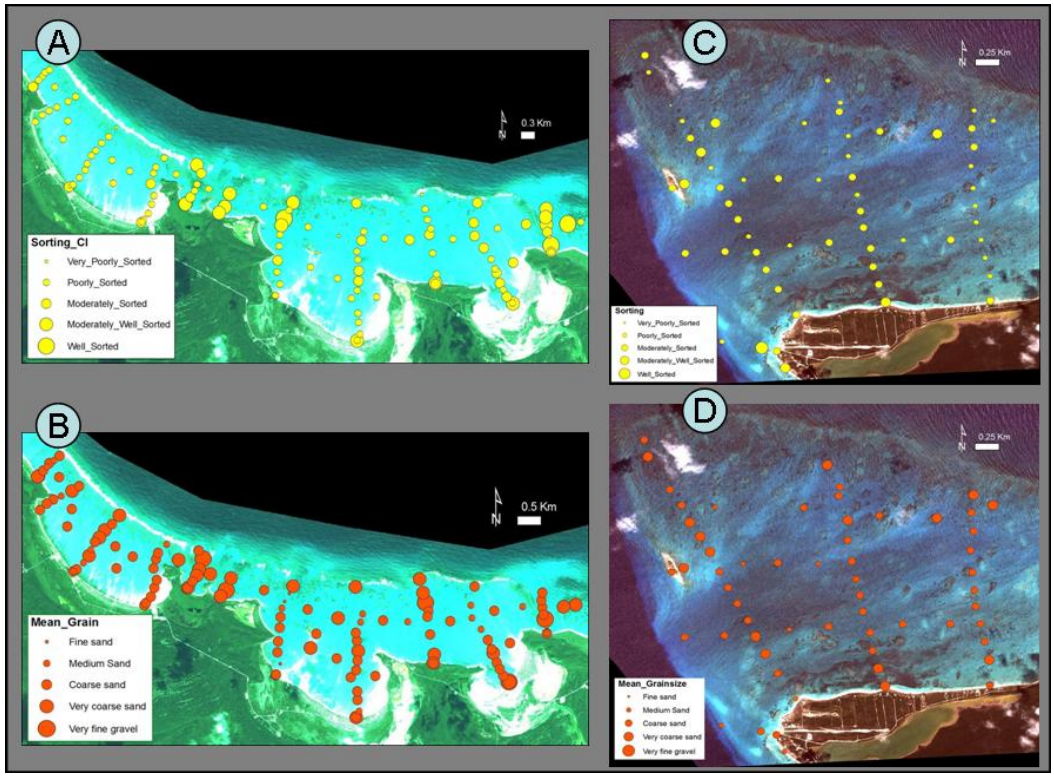

Figure 1: Granulometric characteristic of sediment in the study area: (A) Sediment sorting in Colonel Hill area, (B) Grain size distribution of sediments in Colonel Hill area, (C) Sediment sorting in Bird Rock area and (D) Grain size distribution of sediment in Bird Rock area.

This year, the study will be continued by characterizing wave and current patterns in one part of the shelf, testing concepts concerning the hydrodynamic process that might control the sedimentary patterns. Furthermore, these data will be integrated with remote sensing analysis to understand the relations among grain properties of sediments to geographic factors or spatial context.

Expected Results

By integrating sedimentologic, petrographic, and remote sensing analyses, this study will provide insights for the controls on the distribution and nature of reef margin and back-reef shelf sedimentology. We also expect to find that hydrodynamic processes, influenced by different reef margin morphology, exert a strong control on bottom morphology and granulometric properties of sediments. Furthermore, from these observations and interpretations, we expect to develop testable models that could be used for prediction in subsurface analogs.

References

James, N.P., and Ginsburg, R.N., 1979, The seaward margin of Belize barrier and atoll reefs, International Association of Sedimentologists Special Publication No. 3, 191p

Pomar, L., and Ward, W.C., 1999. Reservoir-scale heterogeneity in deposition packages and diagenetic patterns on a reef-rimmed platform, Upper Miocene, Mallorca, Spain. American Association of Petroleum Geologists Bulletin, 83, 1759-1773

Tudhope, A.W., and Scoffin, T.P., 1984, The effect of *Callianassa* bioturbation on the preservation of carbonate grains in Davies Reef Lagoon, Great Barrier Reef, Australia. Journal of Sedimentary petrology, 54, 1091-1096

Yamano, H., Kayanne, H., and Yonekura, N., 2001. Anatomy of a modern coral reef flat: a recorder of storms and uplift in the late Holocene. Journal of Sedimentary Research, 71, 295-304.