EVOLUTION OF A MODERN OOID SAND ISLAND - SOUTH JOULTER CAY, GREAT BAHAMA BANK

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PROJECT OBJECTIVES

- To complete acquisition of high-resolution drone imagery and a DTM for better delineation of the morphology of Holocene ooid sand ridges forming South Joulter Cay (SJC) allowing a detailed interpretation of the processes that formed the island.
- To further calibrate the timing of key depositional events within the island's history by select radiometric dating.

PROJECT RATIONALE

The Joulters ooid sand body covers some 400km^2 of Great Bahama Bank north of Andros Island. It is famous as a site for the study of high-energy carbonate sediments and is a central analog for understanding oolitic grainstone reservoirs due to the clearly observable interplay between vast stabilized sand flats and active ooid bars (Harris, 2019). The geological story of the three Joulter Cays (low lying islands), however, deserves equal attention. The Joulter Cays, built of lightly cemented oolitic and peloidal sediments, form along the eastern, windward-facing margin of the ooid sand body. Previous field mapping and local coring placed island development within the story of sand body development and established they are a very recent feature with radiocarbon dating showing ages from ~2000 ybp to present (Harris, 1979). These islands, while small in areal extent, act to extensively modify the distribution of energy across the top of the Joulters sand body, blocking wave energy from the open ocean to the east, and confining tidal flow to the channels that lie to the south, the north, and between each island (Fig. 1). This aspect of an energy barrier introduces a sudden shift towards muddy facies in the immediate lee of the islands and isolates ooid production to tidal channels and their associated ebb and flood lobes.

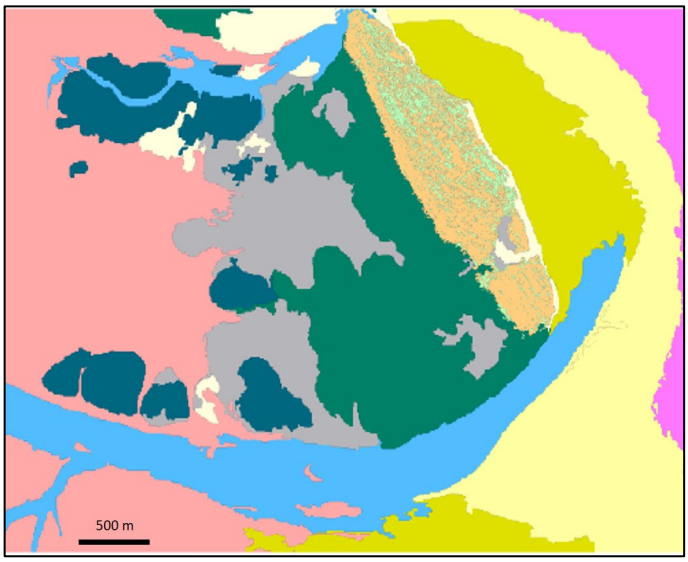

Figure 1. Facies map for SJC and surroundings. The island is bounded at the south by the largest and deepest tidal channel observed within the Joulters sand body and fronted by an active ooid sand shoal. Variably vegetated muddy sandflats develop on the lower energy, lee side of the island. Map generated by Purkis Partnerships Ltd for Chevron ETC.

APPROACH

Our ongoing examination of SJC, the largest of the islands, targets a better delineation of the timing

and processes that formed the island. High resolution imagery and a DTM constructed from a drone survey improve on previous maps. Historically, SJC records a period of higher ooid accumulation rate than occurs locally in the sand body today; ooid sand production was greater than the system's ability to hydrodynamically redistribute these sediments. Ridge topography on the island suggests that active sand bars locally built to beaches and back-beach dune ridges formed repeatedly. A scenario for island development based on existing data (Fig. 2) emphasizes growth stages reflecting variations in dispersal of ooid sands by tidal channels, wind and wave energy, and longshore and storm-related currents. Topographic profiles extracted from the DTM show that higher than average beach ridges are associated with the initiation of each of the island's growth stages, suggesting that the island's morphological evolution is closely integrated into the wider evolution of sediment generation and transport within the overall sand body.

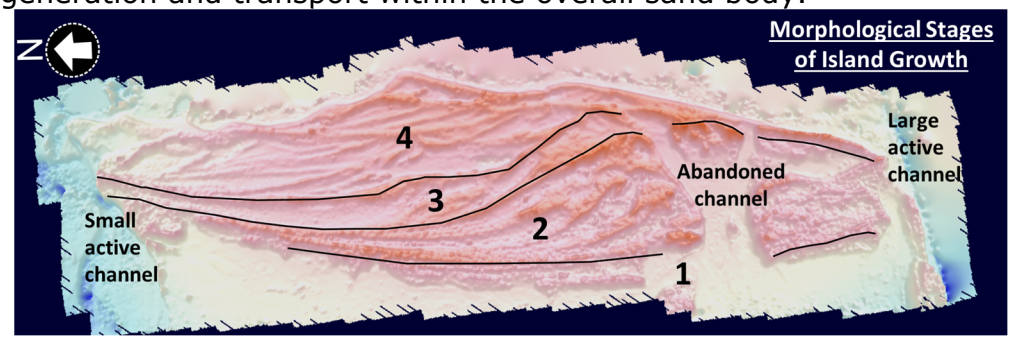

Figure 2. DEM of South Joulter Cay showing and describing growth stages based on ridge morphology.

SIGNIFICANCE

This study focuses specifically on the process by which a key facies transition occurs, namely the nucleation and growth of islands within accommodation-restricted sand bodies. It has particular impact on facies interpretation and correlation within subsurface grainstone reservoirs as well as the interpretation of their sequence stratigraphic and diagenetic development. The islands, and SJC in particular, introduce a new suite of Holocene facies (beach, back-beach storm ridges, tidal flats) into the dominantly subtidal record of the overall sand body. Their presence also armors the sand body at its most energetic margin and the topography of the islands significantly influences the local water movement and thus depositional patterns. As such, the most recent geologic record shows a facies transition that, if seen out of context, may be misinterpreted as being caused by a sudden increase in water depth, when the truth is exactly the opposite. The development of islands like Joulters also introduces an element of spatially constrained meteoric diagenesis (cementation and dissolution) contemporaneous to sand generation and deposition (Halley and Harris, 1979).

REFERENCES

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