

The modern carbonate contourite drift of the Little Bahama Bank: a geophysical, sedimentological and biostratigraphic study

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Abstract: We focus on a major sedimentary body situated of the northwestern slope of the Little Bahama Bank (LBB), the second largest carbonate bank of the Bahamian archipelago. Our objectives are (1) to determine sediment export processes from the shallow-water bank to the northern slope of LBB, which is exposed to prevailing winds (windward side) and (2) to evaluate sediment deposition related to variations in the regional Antilles Current. This work focused on two marine cores located on the western side of the northern slope of LBB in combination with high-resolution bathymetric and very-high resolution seismic data (Chirp) collected during the CARAMBAR cruise (2010). Off-bank processes are the major sedimentary processes during sea-level highstands, resulting in high accumulation rates of foraminifera-rich carbonate ooze deposits. Interglacial clay-rich deposits may be related to a slowdown of currents, allowing clay-size particles to settle within the contourite system, and an increase of clay production and export from continental areas. Glacial deposits are less massive and show a bioturbated coarsening-up unit succeeded by a bioturbated fining-up unit. The presence of coral mound and non-deposition areas and/or erosion is an additional evidence of bottom current circulation shaping the northward-elongated hemi-conical contourite body

Key words: contourites, sediment export, Antilles Current, sea level, carbonate slopes

INTRODUCTION

Contourite deposits are generally associated with dense currents related to thermohaline circulation (Heezen et al., 1966) and are widely documented in the scientific literature. However, few studies have also highlighted the importance of intermediate contour bottom-currents along carbonate slopes. In the vicinity of the Bahamas five modern carbonate contourite drifts are developed: the Pourtales Drift, the Santaren Drift, the Cay Sal Drift, the Great Bahama Bank (GBB) Drift, and the Little Bahama Bank (LBB) Drift (Mullins et al., 1980; Anselmetti et al, 2000; Bergman, 2005).

The Bahama Banks are a modern carbonate system with very limited terrigenous clastic input except for particles carried by wind and oceanic currents. The Bahama platforms are situated on a passive margin, and the sedimentation is mainly controlled by changes in relative sea level and biogenic production with no major influence from regional tectonics. In this study, we focus on the major sedimentary body situated on the northwestern part of Little Bahama Bank (LBB) slope. Our objectives are to study the sediment export processes from the bank to the northern LBB slope (windward side) and to assess sediment distribution related to the regional surface current, the Antilles Current, that partly controls sedimentation at the sea floor near the core locations (Fig. 1).

DATA AND METHODS

This study focused on: (1) two marine cores CARKS-20 and CARKS-21 located at the western side of the northern slope of LBB; (2) high-resolution bathymetric; and (3) very-high resolution seismic data (Chirp). All data were collected during the CARAMBAR cruise in 2010 (Mulder et al., 2012).

The stratigraphy is based on planktonic foraminifera and coccoliths assemblages, radiometric dating, $\delta^{18}\text{O}$ on planktonic foraminifera and strontium signal from XRF. Sedimentary analyses include photospectrometer-colorimetry, grain-size measurements, thin sections, XRF and Scanning Electron Microscopy (SEM) analyses.

RESULTS

Bathymetric and seismic data show the external and internal architecture of the LBB drift. The LBB drift present a hemi-conical shape with scattered coral mounds. A circular scarp visible on the sea floor testifies of past submarine landslide not entirely filled.

Analysis of the spatial sediment distribution shows an asymmetric configuration around coral mounds. This suggests that the distribution of fine grain sizes is modified by bottom currents that are locally confined against escarpments. These processes produce non-deposition areas and/or erosion.

In both marine cores, the $\delta^{18}\text{O}$ curve correlates well with the strontium signal. Stratigraphic results indicate continuous deposition from the present-day down to marine isotope stage 11 (MIS 11; $\sim 424\text{kyr}$) and highlight perturbation in the sedimentation from MIS 12 to MIS 15-25.

The carbonate sediment in both marine cores is a mixture of planktonic foraminifers, calcareous nannofossils, aragonite needles, some pteropods and benthic foraminifers. Both marine cores contain white to light grey fine-grained beds (mudstones) interrupted by coarser-grained beds (wackestone). Coarse-grained sediments show a bioturbated coarsening-up unit succeeded by a bioturbated fining-up unit, which is interpreted as a current related deposit.

XRF results indicate three peaks of terrigenous elements such as Si, Fe, Ti, K and Zr. The two most recent ones are well dated and correspond to short time intervals in interglacial periods MIS 7 and MIS 11.

DISCUSSION AND CONCLUSIONS

Off-bank processes are the major sedimentary processes during sea-level highstands, resulting in high accumulation rate deposits of foraminifera-bearing carbonate periplatform ooze. Clay-rich deposits may be related to a slowdown of currents, allowing clay-sized particle to settle on the contourite system topography, combined with an increase of clay production and/or export from continental areas such as North America (Hüggensberg and Füchtbauer, 1988), Cuba and Hispaniola (Eberli et al., 1997), or Africa (Eaton, 1986).

Glacial periods and sea-level lowstands correspond to exposure of the bank and relate to low production and sediment export and reduced sediment deposition on the Bahamian slope. Current-related deposits dominate during sea-level lowstands on the northern Bahamas slope over the last 424kyr. The merging of the Antilles current with the Florida current shapes the northward-elongated hemi-conical contourite body.

ACKNOWLEDGEMENTS

Ludivine Chabaud's PhD project is supported by a grant from TOTAL E&P (Pau, France).

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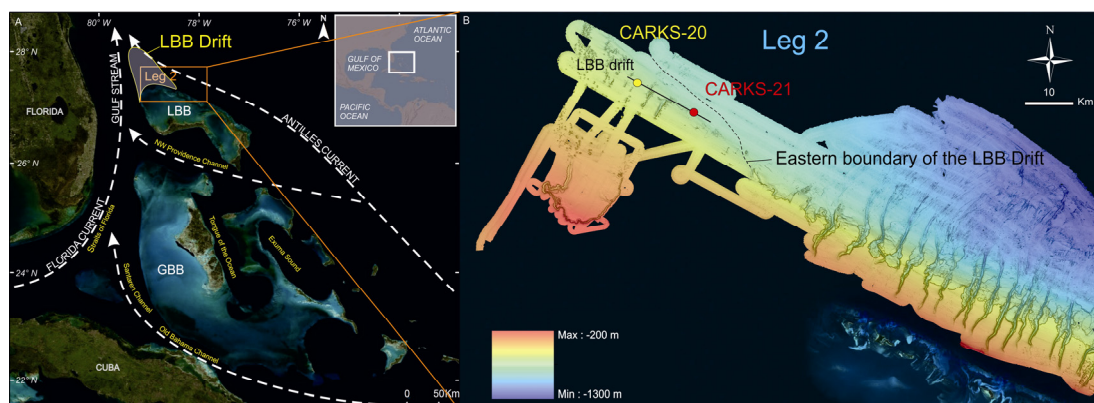


FIGURE 1. A: Location of the study area (CARAMBAR leg 2). White dashed arrows are trajectories of the main oceanic currents around the Bahamian archipelago. LBB: Little Bahama Bank; GBB: Great Bahama Bank. B: Bathymetric map (leg 2) of the LBB slope and location of core CARKS-20: yellow dot; CARKS-21: red dot (MULDER et al., 2012).