PRE-HOLOCENE ISLAND GEOLOGY OF THE CAICOS AND MAYAGUANA (BAHAMAS) PLATFORMS: SIMILARITIES AND DIFFERENCES

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Abstract: The Mayaguana and Caicos platforms are both located in the SE Bahamas. Caicos is one large edifice supporting small islands, whereas Mayaguana is smaller and comprises one island covering most of the bank surface. Providenciales (Caicos) and Mayaguana islands predominantly consist, in different proportion, of reefal framestones and oolitic grainstones dating from the last interglacial period. Oolitic ridges are widely exposed on Providenciales, whereas reefal deposits are confined to the west coast. On this island, the older substrate consists of oolitic and bioclastic eolianites of middle Pleistocene age. On Mayaguana, oolitic ridges are subordinate to the reefs, and the oldest rock units include altered eolianites containing fragments of benthic foraminifers that became extinct in the Pliocene and fine-grained dolostone of possible middle Miocene age. This difference in the distribution of upper Pleistocene facies could be related to the extent of emerged land on platform tops or to the thickness of the water layer covering the latter during the last interglacial highstand. The oolitic and bioclastic substrates exposed on Providenciales are similar to those observed in the northern Bahamas. If confirmed, the pre-Quaternary age of the dolomitic and eolian units on Mayaguana would question some fundamentals of Bahamian geology.

Keywords: Bahamas, Caicos, Quaternary, shallow-water carbonates

INTRODUCTION

The Pleistocene and Holocene geology of stable carbonate islands, such as Bermuda and The Bahamas, provides critical information on the history of climate and sea level prior to the onset of modern civilization that will contribute to better forecasting of future climatic and eustatic changes. Shallow-water carbonates are indeed subtle recorders of environmental conditions and commonly generate reliable indicators of past sea levels (e.g. beachrocks, reefs) whose elevation, in the present case, is not blurred by tectonic activity. During the past two decades, the stratigraphy and sedimentology of many northwestern Bahamian islands have been studied in some details (e.g., Garrett and Gould, 1984; Kindler and Hearty, 1996; Carew and Mylroie, 1997; Hearty and Kaufman, 2000). In contrast, the surface geology of the southeastern portion of the archipelago, including the islands from the Caicos Platform, is less well known. In this paper, we compare the Pleistocene geology of Providenciales (Caicos) and Mayaguana (Bahamas) and suggest that the disparities observed between the two islands could possibly be related to differences in the area of emerged land on platform tops, or to variations in the elevation of the platform tops relative to the last interglacial sea level.

SETTING AND METHODS

The Mayaguana and Caicos platforms are located in the SE Bahamas (Fig. 1A). Caicos is a fairly large (100 x 70 km) edifice supporting small islands mainly along its northern and western margins (Fig. 1B) whereas Mayaguana is smaller (55 x 15 km) and comprises one large island covering most of the platform surface (Fig. 1C). The tectonic stability of the SE Bahamas archipelago is controversial. Many researchers (e.g., Uchupi et al., 1971) consider this part of the archipelago as a subsiding area, with some banks possibly sinking at different rates (Vahrenkamp et al., 1991). Other authors (e.g., Mullins et al., 1992), however, suggested that this area is tectonically more active because of its close proximity to the North-American-Caribbean plate boundary.

Building on earlier work by Wanless and Dravis (1989) on Providenciales, and Cant (1977) and Pierson (1982) on Mayaguana, we examined the sedimentology and petrography of the various stratigraphic units exposed on these two islands. Whole-rock and coral skeleton samples were collected for amino-acid racemization (see methodology in Hearty and Kaufman, 2000), ^{14}C and U-series dating. At this early stage of our investigation, only part of the amino-acid racemization data are available.

PRELIMINARY RESULTS

Providenciales and Mayaguana islands predominantly consist, in different proportion, of reefal framestones and oolitic grainstones of late Pleistocene age. As shown on Wanless and Dravis's (1989) geological map, oolitic ridges including subtidal, beach, and eolian facies and reaching up to 40 m in elevation, are widespread on Providenciales. Coastal exposures form small sea cliffs (Fig. 2) where the transition between subtidal and beach facies, a good indicator of past low-tide level, can usually be observed between 3 and 5 m. The amino-acid content of several

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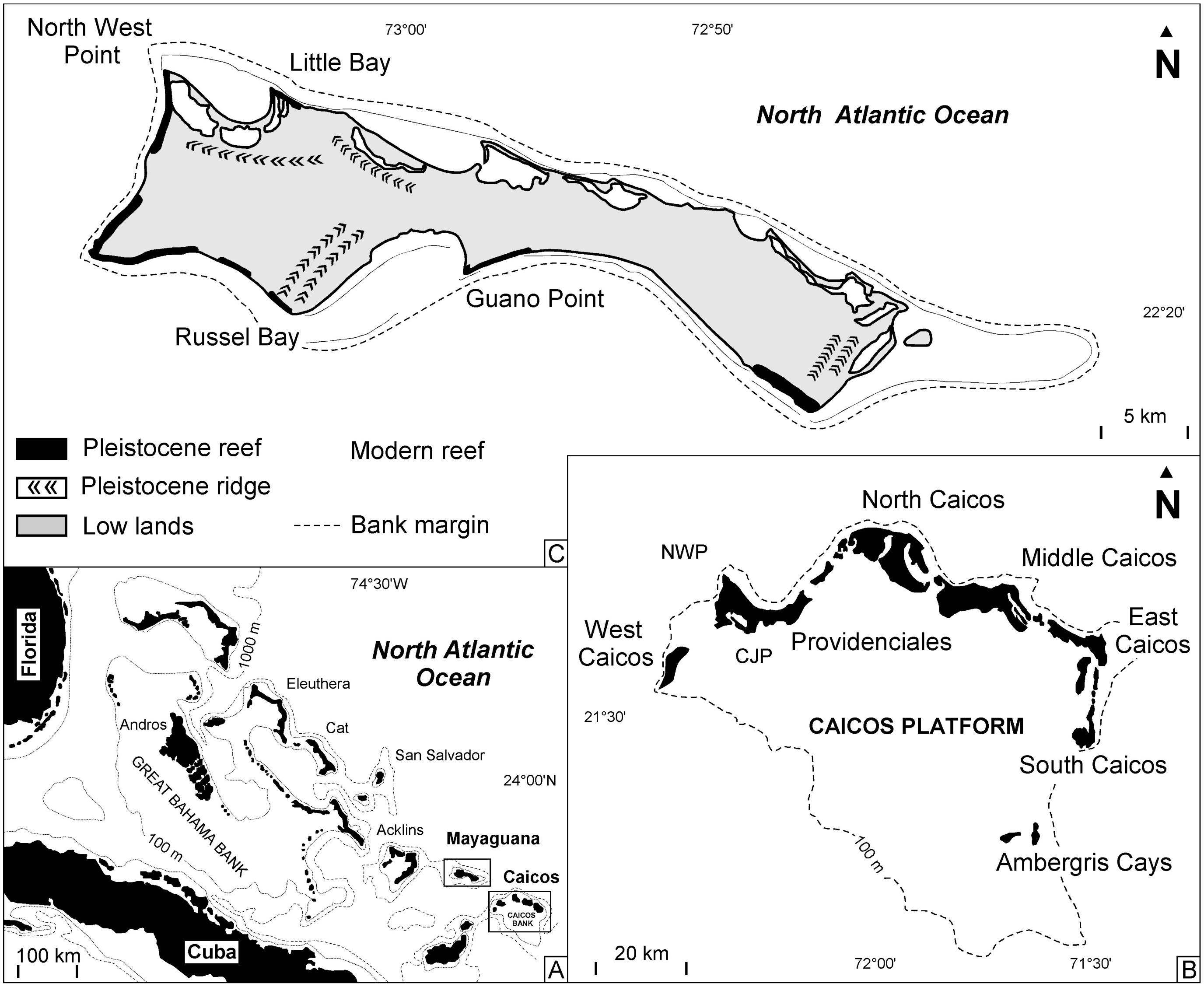

Fig. 1.—**A)** Location map of the Mayaguana and Caicos platforms; **B)** Physiography of the Caicos platform (after Wanless and Dravis, 1989). Small islands occur mostly along the northern and western margin of the bank. NWP = North West Point, CJP = Cooper Jack Point; **C)** Preliminary geological map of Mayaguana based on earlier work by Cant (1977), Pierson (1982), and our personal observations. Note that reefal framestone predominate along the island's shoreline, and that the island occupies most of the platform surface.

samples collected from these ridges suggests they were deposited during the early part of the last interglacial period, Marine Isotope Stage (MIS) 5e. Coeval, low-elevation reef terraces are restricted to the western coast of the island, south of Northwest Point (Wanless and Dravis, 1989). An older substrate, consisting of bioclastic and oolitic eolianites of probable middle Pleistocene age (MIS 7 or 9), can be observed below the reefal framestones near Northwest Point and underlying the MIS 5e oolites at Cooper Jack Point (Fig. 2).

On Mayaguana, fossil reefs, probably dating from the last interglacial period, occur along most of the island shorelines (Fig. 1C), forming low, karstified terraces locally capped by contemporaneous beach deposits (e.g., Guano Point, Russel Bay, Fig. 1C) or Holocene sands (e.g., North West Point, Figs. 1C and 3). High ridges are subordinate to reefs, but one of them, near Little Bay (Fig. 1C), shows lagoonal and beach facies of possible MIS 5e age at an elevation between 7 and 10 m. Older rock units occur along the island's north shore. They comprise altered eolianites containing fragments of benthic foraminifers that became extinct in the Pliocene and fine-grained dolostone, exposed up to 3 m above modern sea level, that could not be dated with the amino-acid racemization method. Ongoing research will show if this dolomitic unit can be correlated with the middle Miocene subsurface dolostone reported by Vahrenkamp et al. (1991) at about 10 m below the island's surface.

DISCUSSION AND CONCLUSIONS

The difference in the distribution of MIS 5e reefal and oolitic facies between Providenciales and Mayaguana islands is striking

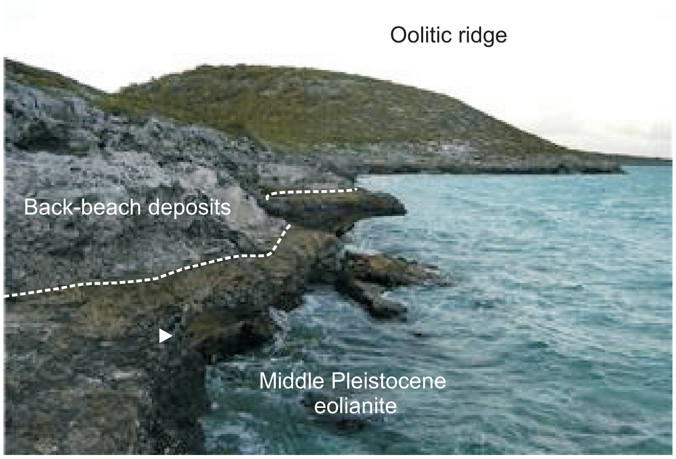

Fig. 2.—Coastal exposure near Cooper Jack Point, Providenciales. This small sea cliff typically consists of oolitic grainstone of MIS 5e age showing a shallowing-upward succession from subtidal to beach deposits, which overlie an older eolianite. Note high oolitic ridge in the background. Elevation of foreground cliff = 2.5 m.

Fig. 3.—Coastal exposure near North West Point, Mayaguana. Such low-elevation, karstified reefal terraces, capped here by Holocene sands, characterize the island coastline; sitting person (near photo center) for scale.

and could be possibly related to (1) the extent of emerged land on platform tops or (2) the depth of the platform tops during the MIS 5e highstand. The Caicos physiography today, i.e., one large bank supporting small islands, is favourable to water circulation and thus to ooid production (Wanless and Dravis, 1989). By contrast, the setting in Mayaguana, i.e., one large island covering most of the platform surface, is more conducive to the growth of fringing or barrier reefs. If conditions were the same during the last interglacial, this difference in physiography could account for the disparities in the geology of these two islands. Alternatively, a relatively shallow depth of the Caicos Platform during the last interglacial could explain the predominance of upper Pleistocene oolites on Providenciales, because ooids form in shallow waters (Bathurst, 1975; Flügel, 2004). In contrast, the Mayaguana bank may have stood at a deeper position during the last interglacial inducing the development of a barrier reef rather than ooid shoals on the platform edge, and thus accounting for the dominance of MIS 5e reefal facies on the actual island.

The oolitic and bioclastic substrates exposed on Providenciales are similar to those observed in the northern Bahamas (Kindler and Hearty, 1996; Hearty and Kaufmann 2000). If confirmed, the pre-Quaternary age of the altered eolianites and the dolomitic unit exposed on Mayaguana would question some fundamentals of Bahamian geology and Caribbean tectonics.

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