REPORT

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A classic Caribbean algal ridge, Holandés Cays, Panamá: an algal coated storm deposit

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Abstract Twenty-seven radiocarbon dates of cores recovered from six drill holes indicate that the relief of the ridge on the seaward edge of the Holandés Cays, San Blas, off the Caribbean coast of Panamá, was formed by storm deposits about 2,000 to 2,800 years ago. Although crustose coralline algae are a dominant component of the surface cover on this outer ridge, they played a minor role in the construction of the framework of this bioherm, which therefore cannot be classified as an algal ridge. The framework of the ridge consists dominantly of Agaricia/Millepora rubble that is extensively lithified by micritic submarine Mg-calcite cement. The present-day surface of this area in the Holandés Cays is primarily one of widespread bioerosion with very little indication of substrate accumulation over the past 2,000 years.

Keywords Algal ridge · Storm deposits · Submarine lithification · Crustose coralline algae

Introduction

Up until the 1970s, it was generally thought that algal ridges did not occur in Caribbean reefs (e.g., Stoddart 1969). It was the field work of Adey and his colleagues (Adey 1975, 1978; Adey and Burke 1976, 1977; Steneck and Adey 1976; Adey et al. 1977) that focused attention on the algal ridges of this area. Although these studies reported the locations of many new algal ridges in the Caribbean, it was Glynn (1973) who was the first to describe the Holandés Cays outer ridge system as an algal ridge that “conclusively confirms the existence of an algal ridge formation in this part of the Caribbean Sea” (p. 285). Milliman (1974) even went further to suggest that this Holandés ridge complex is an “algal-ridge system in the coral reefs off Panamá that apparently is very similar to those in the Indo-Pacific” (p. 166).

Adey (1978), in a review of the Caribbean–West Indian algal ridges, demonstrated that the distribution of algal ridges in this area is directly related to what he refers to as the “seasonal wind effect” (p. 366), which is derived by multiplying the percent of wind constancy by the Beaufort wind strength. In his graph of algal ridge frequency versus seasonal wind effects, he noted that “the strong development of algal ridges in the Holandés Cays in Panama is anomalously high for that region” (p. 361).

In this study we recovered cores from the internal structure of the Holandés Cays outer ridge to study its late Holocene history and to evaluate the contribution of crustose coralline algae to the relief of this ridge system.

Setting

The Holandés coral reef, a bank barrier system, located about 15 km off the northeast coast of Panamá (Fig. 1), is one of the most exposed areas to wave assault in the San Blas region. With the reef front facing towards the north, seaward reef zones are fully exposed to north and northeast open ocean waves. Northeast trade winds are especially well developed during the dry season, buffeting this coastal area from December through April. High seas also develop unpredictably and for shorter periods during the wet season (May to November).
Tropical storms and hurricanes do not often occur at Panamá’s low latitudinal position (9°-10°N; Stoddart 1971; Glynn 1973). During the past 120 years, only a single hurricane has moved across the northwest coast of Panamá (Clifton et al. 1997). Although relatively far from the coast, the seaward bottom topography slopes gradually toward the north with the 200-m isobath located about 2.5 km offshore. The reef flat is typically shallow (1–3 m) and quite broad, ranging between 1 and 2 km in width.

Methods

Fieldwork for this project was carried out in June and July of 1993. Working on the outer ridge of Holandés Cays was a very difficult undertaking. Of the 10 days that we spent on the site, there were only 2 days in which the surf was low enough to allow us to set up our drilling equipment to collect cores. All members of our drill team were swept off their feet at one time or another.

Our research transect was located across the outer ridge at the east end of Holandés Cays (Fig. 1) where we could find safe anchorage for our research vessel, the M/Y Catyani. A total of six core holes were drilled, three on the outer ridge and three on the shallow reef flat directly leeward of the ridge (Fig. 1). The cores, which have a diameter of 54 mm, were collected with a hand-operated hydraulic drill (Macintyre 1978) using a tripod for support (Fig. 2). The hydraulic power unit and the water pump were placed on a specially constructed six-barrel barge that was hauled out from the research vessel across the shallow back reef and anchored in the lee of the ridge. The deepest core hole was drilled to a depth of 4.8 m and core recovery ranged from 100% in well-litified sections to no recovery in sandy sections.

Following the drilling, the topography, location of core holes, and distribution of bottom communities were surveyed along the research transect. Surface samples were also collected at core-hole sites. Bottom cover was determined at core-hole sites 1–3 by counting the organisms and sediment type in contact with chain links (3.5 cm/link) laid in straight lines of 10 m length on both sides and perpendicular to the drilling transect. Dead coral was classified as limestone substrate.

Thin sections for both petrographic and crustose coralline algal studies were prepared from each of the cores at intervals selected to represent the dominant subsurface lithologies. All thin sections with coralline algae were examined with a microscope and every identifiable fragment was identified to genus or species. The taxonomic scheme of Adéy (1970) was used. Taxonomic characteristics identified in Adéy and Macintyre (1973) were evident in most thin sections (Braga et al. 1993). When only generic determinations could be made, they were included in the total species count if other species of that genus had not been found in the cores (e.g., Titanoderma and Mesophyllum) or if there was a distinguishing feature that indicated that it was a different species (e.g., Lithophyllum “unbranched” is morphologically and taxonomically distinct from Lithophyllum congestum). Four other specimens that could only be identified to genus (Hydroolithion, Neogoniolithion, Paragononiolithion, and Lithothamnion) may represent taxa already identified and thus are not counted in the species