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Cover photo: *Diploria strigosa*, the common brain coral, preserved in growth position at the Cockburn Town fossil coral reef site (Sangamon age) on San Salvador Island. Photo by Al Curran.

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SURFICIAL GEOLOGY OF RUM CAY, BAHAMA ISLANDS

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ABSTRACT

The surficial rocks of Rum Cay can be assigned to five different lithofacies: (1) Holocene Multiple Beach-Dune Complexes; (2) Pleistocene Poorly Cemented Eolianites; (3) Pleistocene Tidal Creek Pelsparites and Pelmicrites; (4) Pleistocene Coastal Shallow Subtidal Calcarenites; and (5) Pleistocene (oldest) Well-Cemented Eolianites. The widespread distribution of the Tidal Creek Lithofacies suggests that the interior of Rum Cay was inundated during the last very high sea level stand (120,000-125,000 yrs.b.p). A general classification of the Quaternary tidal creeks occurring in the Bahama Archipelago has been developed to assist in the paleo-environmental analysis of the modern and ancient tidal creeks of Rum Cay.

INTRODUCTION

Rum Cay is located in the central Bahamas, approximately 300 kms southeast of Nassau and 30 kms southwest of San Salvador Island (Index Map 1). Rum Cay is a rectangular island, measuring 16 kms east to west and 8 kms north to south (Fig. 1). The island is located on an isolated platform (with a surface area of about 175 square kms) rising 1000 m above the surrounding deep ocean basin. The population of Rum Cay is less than 100, with all inhabitants living in the community of Port Nelson along the southeastern coast of the island. The road system of Rum Cay extends about 2 kms west of Port Nelson to Cotton Field Point, and northwards from Port Nelson to Port Boyd on the north coast (Kings Highway). An overgrown "jeep trail" extends from Bay Pond, on the south coast, due north to the north coast (Queens Highway).

PURPOSE

Published information on the geology of Rum Cay is very limited. The general geology and soils of the island are summarized by Little and others (1977). In addition, the Late Holocene coastline evolution of the island is discussed by Mitchell and Keegan (in press). Recent geological surveys of Great Exuma Island (Mitchell, 1984a), Great Inagua and Mayaguana Islands (Mitchell, 1985a; Pierson, 1982), Long Island (Mitchell, 1984b), New Providence Island (Garrett and Gould, 1984), and San Salvador Island (Thalman and Teeter, 1983; Titus, this volume) indicate that the surficial geology of the central Bahama Islands is dominated by Quaternary eolianite, shallow coastal subtidal, and tidal creek lithofacies. Islands with linear configurations (Long Island and the Exumas) have predominately shallow subtidal bank lithofacies onlapping older eolianites. Rectangular islands (Great Inagua, Mayaguana, New Providence, and San Salvador Islands) more typically have interior tidal creek lithofacies onlapping older eolianites. The shape and topography of Rum Cay suggests that the latter association would be expected.

The purpose of this investigation is to document the classification and importance of Quaternary tidal creek environments in the Bahamas. Field studies indicate that tidal creek-lacustrine transitions (Mitchell, 1984b) form an integral part of the late Quaternary accretion of Rum Cay. In addition to presenting the results of a preliminary geological survey of the island, a classification of Bahamian tidal creeks is included in this paper. The classification has been found to be extremely useful in the paleoenvironmental evaluation of ancient and modern tidal creeks such as those which are responsible for the formation of a significant portion of the rocks and sediments of Rum Cay.

METHODS

A geological reconnaissance of Rum Cay

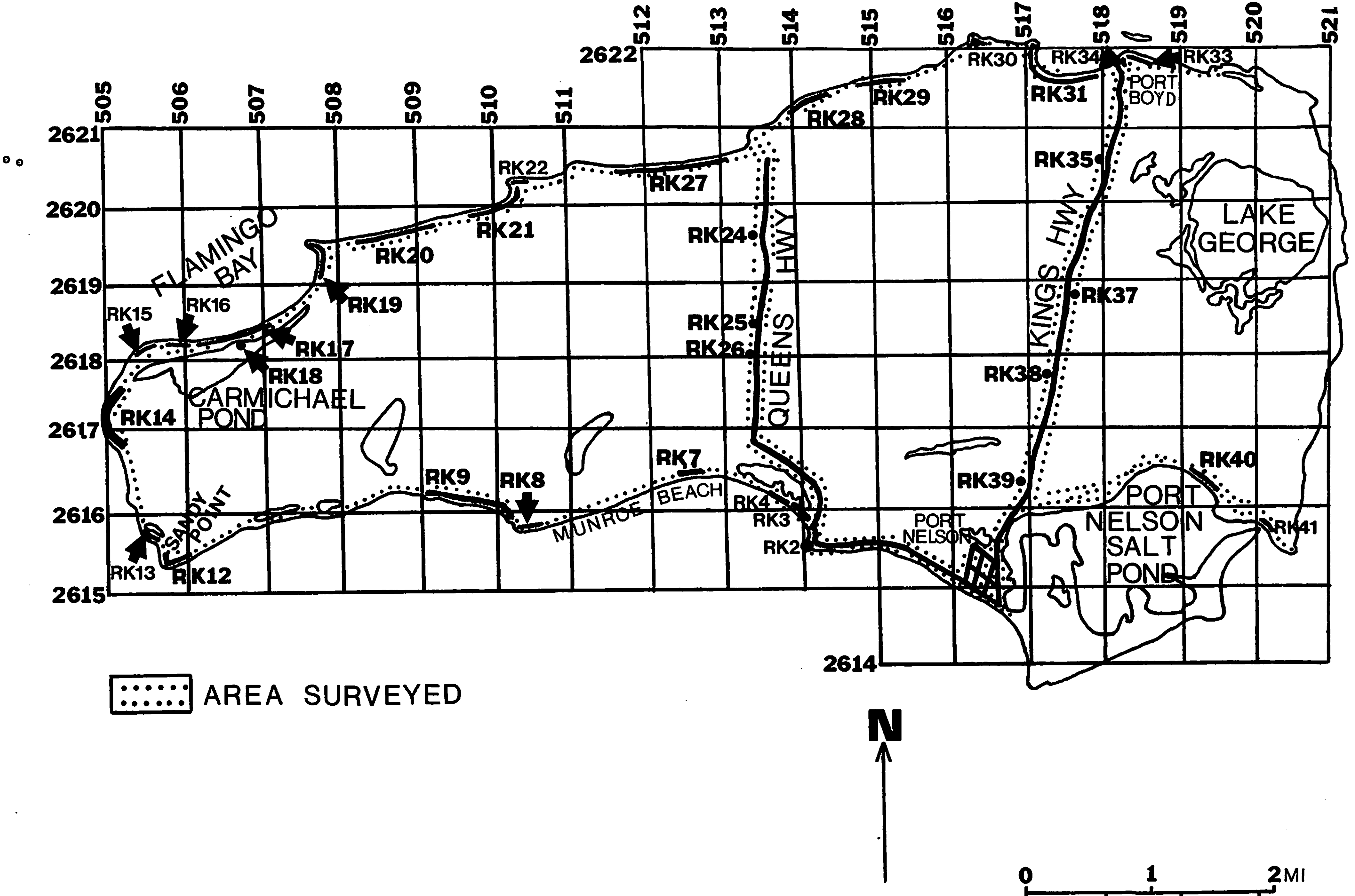

Fig. 1. Map of Rum Cay showing major geographic features, areas surveyed in July 1984, and localities discussed in the text. Universal Tranverse Mercator Grid Coordinates are given (Grid Zone Designation: 18Q WB).

was carried out in July 1984 by backpacking. The areas surveyed are shown in Figure 1 and include all shorelines except the east coast. In addition, two transects were made through the island along Kings Highway from Port Nelson to Port Boyd and Queens Highway from Bay Pond to the north coast. Samples were collected from all major lithologies encountered. Coastal, lake, and tidal creek sediments, as well as microfaunal and water samples were collected. Also, shallow lake cores (up to 1 m in length) were obtained. Fossil collections were made from especially productive stratigraphic horizons when they were encountered. Laboratory analyses included thin section petrology, mechanical sediment analysis, micropaleontologic analysis, X-Ray diffraction analysis, and the calculation of water salinities using a Reichert automatic temperature compensated hand refractometer with an accuracy of 1°/oo.

MAJOR SURFICIAL LITHOFACIES

Five general surficial lithofacies were mapped and sampled during the field survey. Petrographic, sedimentologic, and paleontologic analyses of the samples provide evidence for the age and depositional environments of the lithofacies. The approximate distribution of each lithofacies and the location of major exposures discussed in the text are presented in Figures 1 and 5. The rock units are described below in order of increasing geologic age.

Holocene Multiple Beach-Dune Complex Lithofacies

Since the last lowest sea level stand about 17,000 years ago, rising sea level has generated platform sediments which have been accreted along the margins of Rum Cay. The sediments have been preserved in the form of beach-dune complexes in which upper beach sediments are located between a succession of low subparallel dunes occurring inland from the present coast. The surficial Holocene mutliple beach-dune complexes have, most likely, formed during the past 3,000 years when sea level was very close to present levels (Macintyre, Burke, and Stuckenrath, 1977, p. 752). The beach-dune complexes contain predominantly skeletal sediments, except along the south-central coast of Rum Cay. In this area, ooids were the dominant Holocene sediment type, as at present. At various locations, the Holocene sediments are very poorly cemented. For example. the dune sediments which occur along Munroe Beach at Loc. RK3 (Fig. 3b). Well cemented Holocene beachrock occurs at Locs. RK4, RK17, and RK31 (Fig. 4b). A beachrock composed of large pieces of worn coral is developed in the area of the inlet to Port Nelson Salt Lake (Loc. RK41). Successions of Holocene beach-dune ridges have extended the coastlines of Rum Cay by closing off tidal creeks to form lakes. Examples of these tidal creek-lacustrine transitions are Bay, Yard, and Carmichael Ponds and Lake George (Figs. 2a,b,3a).

Shallow cores from Carmichael Pond (Figs. 2a,b) contained crystals of gypsum up to 5 mm in length. Similar lacustrine gypsum concentrations have been found in lakes on Great Exuma and Long Islands during summers with low rainfall. During years with high rainfall levels, the gypsum apparently dissolves.

Pleistocene Poorly Cemented Eolianite Lithofacies

Following the late Pleistocene highest sea level stand 120,000-125,000 years before present, a series of fairly high sea level stands occurred. When sea level was 35 m or less below present sea level, a series of dune complexes were accreted to the then existing coastline of Rum Cay. Where the relationship is evident, this lithofacies overlies the Pleistocene Tidal Creek or Coastal Shallow Subtidal Lithofacies formed during highest sea level stands (discussed below). Generally, these eolianites are more poorly cemented than older surficial eolianites. Also, individual paleodunes appear to be smaller. Eolianite rock types from this lithofacies vary from oosparite and pelsparite along the southern part of Rum Cay to biosparites along the north coast. The lithofacies was found to be best exposed along the northern coast of the island. The contact with the underlying marine lithofacies types is intermittently exposed in the area of Locs. RK19-RK22 and RK27-RK33. Along the west coast, the contact occurs at the northern end of Loc. RK13 (Fig. 2c). A wide variety of structures typical of Pleistocene eolianites occurs at these locations, including rhizocre-

Fig. 2a. Aerial view of western end of Carmichael Pond and Flamingo Bay, looking north. An unnamed, unsurveyed pond is in the foreground.

Fig. 2b. Ground view of Carmichael Pond at Loc. RK18, looking northeast.

Fig. 2c. Ground view of Pleistocene Coastal Shallow Subtidal Lithofacies along Sandy Point at Loc. RK13, looking north.

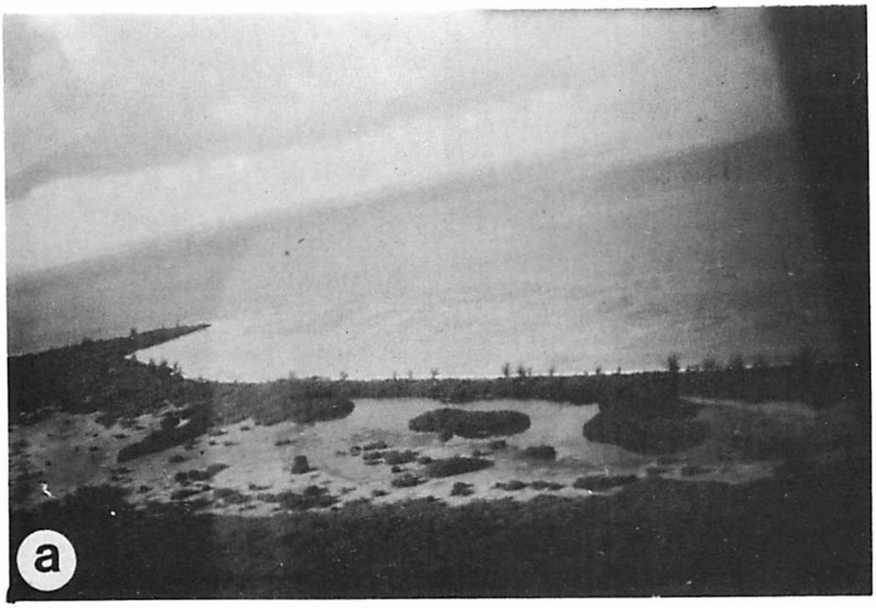

Fig. 3a. Aerial view of Bay Pond and Cotton Field Point, looking southeast.

Fig. 3b. Ground view of very poorly cemented Holocene Beach-Dune Complex Lithofacies along Munroe Beach at Loc. RK3, looking east.

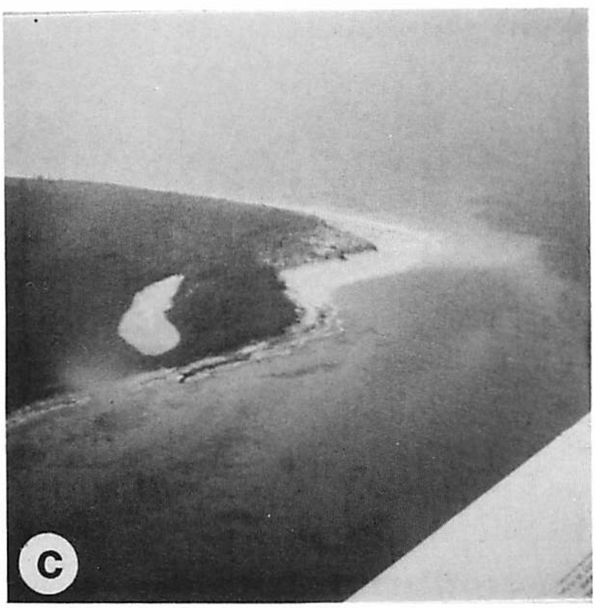

Fig. 3c. Aerial view of Sandy Point, looking southeast.

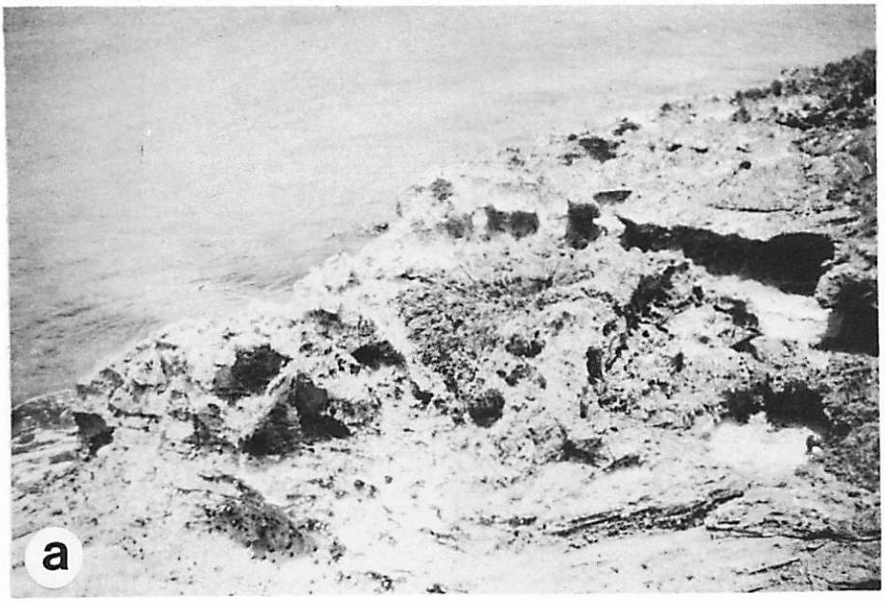

Fig. 4a. Ground view of fossil reef in Pleistocene Shallow Subtidal Lithofacies Loc. RK22.

Fig. 4b. Ground view of Holocene beachrock, Loc. RK17, Flamingo Bay, looking east.

Fig. 4c. Ground view of quarry in Pleistocene Tidal Creek Lithofacies, Loc. RK37, looking southeast.

tions, calcrete breccias, and pisolites. The best development of these structures occurs along the west coast of the island at Loc. RK14.

Pleistocene Tidal Creek Lithofacies and Pleistocene Coastal Shallow Subtidal Lithofacies

The surficial rocks assigned to these lithofacies occur above present sea level at elevations up to approximately 3 meters. Similar lithofacies occur on Great Exuma Island (Mitchell, 1984a), Great Inagua and Mayaguana Islands (Mitchell, 1985a and 1985c; Pierson, 1982), New Providence Island (Garrett and Gould, 1984), and San Salvador Island (Teeter, 1985; Thalman and Teeter, 1983; Titus, this volume). The sediment forming these rocks seems to have been deposited during a very high sea level stand 120,000 to 125,000 years ago. The apparent extensive nature of the Pleistocene Tidal Creek Lithofacies suggests that the interior of Rum Cay was inundated, producing a large tidal creek here designated the Lake George Tidal Creek System. The rocks formed by this Pleistocene tidal creek system are excellently exposed in several quarries along Kings Highway between Port Nelson and Port Boyd (Locs. RK37, RK38) (Fig. 4c). Good exposures also occur along Queens Highway 1.5 kms north of Bay Pond (Loc. RK26). An abundant fossil fauna is preserved in the rocks of this lithofacies. The most common species are the gastropod *Bulla striata* Bruguiere and the bivalves *Chione cancellata* (Linnaeus), *Chione paphia* (Linnaeus), *Divaricella quadrisulcata* (Orbigny), *Laevicardium laevigatum* (Linnaeus), *Lucina pensylvanica* (Linnaeus), and *Polymesoda caroliniana* (Bosc). This faunal assemblage is generally typical of hypersaline tidal creeks. However, the species *Chione paphia* and *Polymesoda caroliniana* are now rare in the central Bahamas. Their abundance in the Pleistocene Tidal Creek Lithofacies suggests cooler climatic conditions since these species presently occur further north in the Archipelago. *Chione paphia* has been found to be common in Pleistocene shallow marine assemblages on Great Exuma Island. This, and other associated species, are again suggestive of cooler climatic conditions than at present (Mitchell, 1984a).

The petrology of rocks from this lithofacies indicates a change in sediment type from east to west. Lithologies from the quarries (Locs. RK37, RK38) are oopelsparites. Lithologies from Loc. RK26 are biopelmicrites with a somewhat less diverse fauna. The Lake George Tidal Creek System was apparently formed at a time when a high sea level stand breached Pleistocene eolianites along the southeastern margin of Lake George, inundating the low interior of the island. At this time Rum Cay would have appeared similar (on a much larger scale) to the present Conception Island 25 kms to the northwest.

Contemporaneously, the Coastal Shallow Subtidal Lithofacies was being deposited along the outer flanks of the partially drowned coastline of Rum Cay. At present, elevated evidence for this lithofacies occurs almost continuously along the island's west, north, and south coasts in the form of fossil reefs, reef rubble, and shallow subtidal calcarenites. The abundant coral fauna of these rocks (oopelsparites) consists of typical modern shallow-water species, including *Diploria strigosa* (Dana) and *Montastrea annularis* (Ellis and Solander). The best exposures of fossil reefs occur at RK2, RK19, and RK22 (Fig. 4a); Pleistocene reef rubble is intermittently exposed between Locs. RK28 and RK29. Along the northern coast of Rum Cay, Pleistocene shallow subtidal calcarenites are exposed nearly continuously from Loc. RK19 to Loc. RK31. They are often overlain by the younger Pleistocene Poorly Cemented Eolianite Lithofacies. An additional major exposure of the shallow subtidal calcarenites occurs at Loc. RK-13 (Figs. 2c,3c).

Pleistocene Well-Cemented Eolianite Lithofacies

This lithofacies underlies the rock units formed during the highest sea level stand 120,000 to 125,000 years before present. It is characterized by well cemented, large, individual paleodunes in the form of megadune complexes. Rocks from this lithofacies are oosparites and oopelsparites. Most of the higher elevation central and eastern portions of Rum Cay have significant surface exposures of the well-cemented eolianite lithofacies. Aerial surveys indicate that the steep eastern coast of the island is formed of this lithofacies. The island has

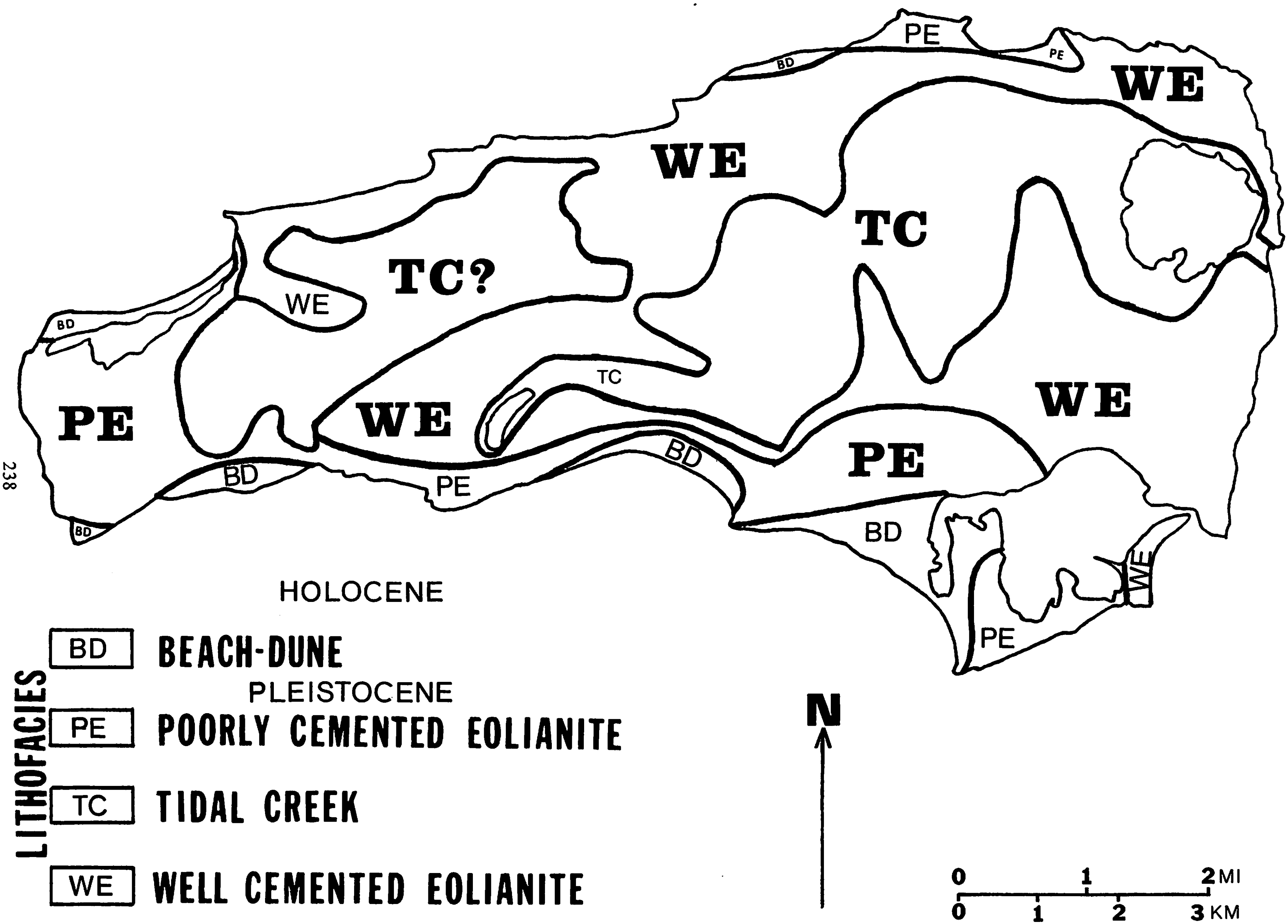

Fig. 5. Preliminary geologic map of Rum Cay showing the inferred distribution of the lithofacies described herein.

has apparently accreted younger lithofacies along the northern, western, and southern coastlines, while the east coast has been continually eroded by currents and waves produced by the prevailing easterly winds. Sampled exposures of this lithofacies include Locs. RK24, RK25, RK35, and RK39.

TIDAL CREEK CLASSIFICATION

The general sedimentology and microfaunas of approximately 20 significant modern tidal creeks in the Bahama Archipelago and Florida Keys have been investigated (Mitchell, 1985b). The dominant grain morphotypes of tidal creek systems can be used in developing a classification of creek systems and associated environmental conditions. At present, five types of tidal creek systems are recognized, based on the dominant lithofacies present.

(1) Skeletal Lithofacies

This lithofacies is dominated by skeletal grains and is the creek type encountered most commonly in the northern Bahamas and Florida Keys. Usually, salinities are not much higher than the open ocean and tidal currents are strong. Long Cay and Bahia Honda Cay Tidal Creeks of the Florida Keys are examples of Skeletal Lithofacies Tidal Creek Systems. Union Creek (Great Inagua Island) is an example of this lithofacies in which the *Peneroplis proteus* Lithofacies (as defined in Pigeon Creek of San Salvador Island) is very widespread due to high salinities (Mitchell, this volume).

(2) Aggregate Lithofacies

Creeks assigned to this group have areas of widespread crustal development. Peloids are a common grain type associated with the aggregates formed when the crusts break up. These creek systems are generally shallow, with low current velocities, and have high salinities. Examples of this creek lithofacies are Abraham Creek (Mayaguana Island), Chalk Sound (Providenciales Island), and Port Nelson Salt Lake (Rum Cay).

(3) Macrophyte Crust Lithofacies

Macrophyte crusts are tubular structures of low magnesium calcite which have been reported from lakes in Europe (Schneider, and others, 1983). Similar tuhular macrophyte crusts are the dominant grain morphotype in Bonefish Pond Tidal Creek of New Providence Island. The creek system has high salinities and strong tidal currents in most areas due to the presence of several very shallow inlets. Cores indicate that Bonefish Pond was previously a Skeletal Lithofacies Tidal Creek with high percentages of silt and clay in its upper reaches. Very recently a dense development of crust-producing macrophytes has occurred in the southeastern part of the creek system. Macrophyte crusts are now the dominant sediment type, producing islands, sand bars, and beaches on top of the pre-existing mud flats. None of these features are present on an 1881 map of the creek system. Water chemistry analyses to determine the environmental changes causing this unique development of marine macrophyte crusts are still underway. Since large amounts of fertilizer have been added to fields adjacent to eastern Bonefish Pond, it seems likely that agricultural pollution is in some way responsible for the major change in the sedimentology of this creek system.

(4)Peloid Lithofacies

Peloids are abundant in tidal creeks with fairly high average salinities (38-42%) and fairly strong tidal currents flowing over shallow tidal flats. Aggregates may be common in this lithofacies. Pigeon Creek and Newton Cay Creek (northern Long Island) are examples of Peloid Lithofacies Tidal Creeks.

(5)Ooid Lithofacies

The principle requisites for ooid production are very strong currents and shallow water. High salinity also appears to be a factor in developing an ooid lithofacies in Bahamian tidal creeks. Thus far, the only modern tidal creek which has been found to be dominated by ooids is Lanternhead Creek of southern Great Inagua Island. The salinity of this creek is very high. Also, there are strong current velocities over a large area of shallow tidal flats. Most Pleistocene tidal creek sediments contain abundant ooids. This suggests that, of the tidal creeks surveyed, Lanternhead Creek would provide the best known modern analog for the environmental reconstruction of most Pleistocene tidal creeks, including the Lake George Tidal Creek System of Rum Cay.

An additional factor important in the classification of Bahamian tidal creeks is the type of inlet system. By definition, tidal creeks are largely landlocked bodies of water subject to oceanic tidal influence through a surficial inlet system. Surficial fresh water additions to the tidal creek are minimal. The number and position of inlets is a major factor in interpreting the formation and distribution of lithofacies. In this study, three inlet configurations are considered significant: (1) single-inlet tidal creeks such as Pigeon Creek (San Salvador Island), Port Nelson Salt Lake (Rum Cay), Ann's Creek (Great Exuma Island), and Abraham Creek (Mayaguana Island); (2) double-inlet tidal creeks such as Union Creek (Great Inagua Island), and Newton Cay Creek (Long Island); and (3) multiple-inlet tidal creeks such as Bonefish Pond (New Providence Island) and Chalk Sound (Providenciales Island). Inlet systems are the major controlling factor in tidal creek salinity distributions, tidal current velocites, biofacies, and lithofacies. Using these lithofacies and inlet categories, Port Nelson Salt Lake would classified as a Single-Inlet Aggregate Lithofacies Tidal Creek and the Pleistocene Lake George Tidal Creek System would be a Single-Inlet Ooid Lithofacies Tidal Creek.

SUMMARY

Five general lithologies are recognized in the surficial rocks of Rum Cay: (1) Holocene Multiple Beach-Dune Lithofacies; (2) Pleistocene Poorly Cemented Eolianite Lithofacies; (3) Pleistocene Tidal Creek Lithofacies; (4) Pleistocene Coastal Shallow Subtidal Lithofacies; and (5) Pleistocene Well-Cemented Eolianite Lithofacies. The lithofacies are distinguished on the basis of cement, fossil faunas, sedimentary structures, sediment grain morphotypes, and stratigraphic position. The rock units reflect a late Quaternary geologic history that is similar to that of other rectangularly shaped islands in the Bahamas: San Salvador, Great Inagua, and New Providence.

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