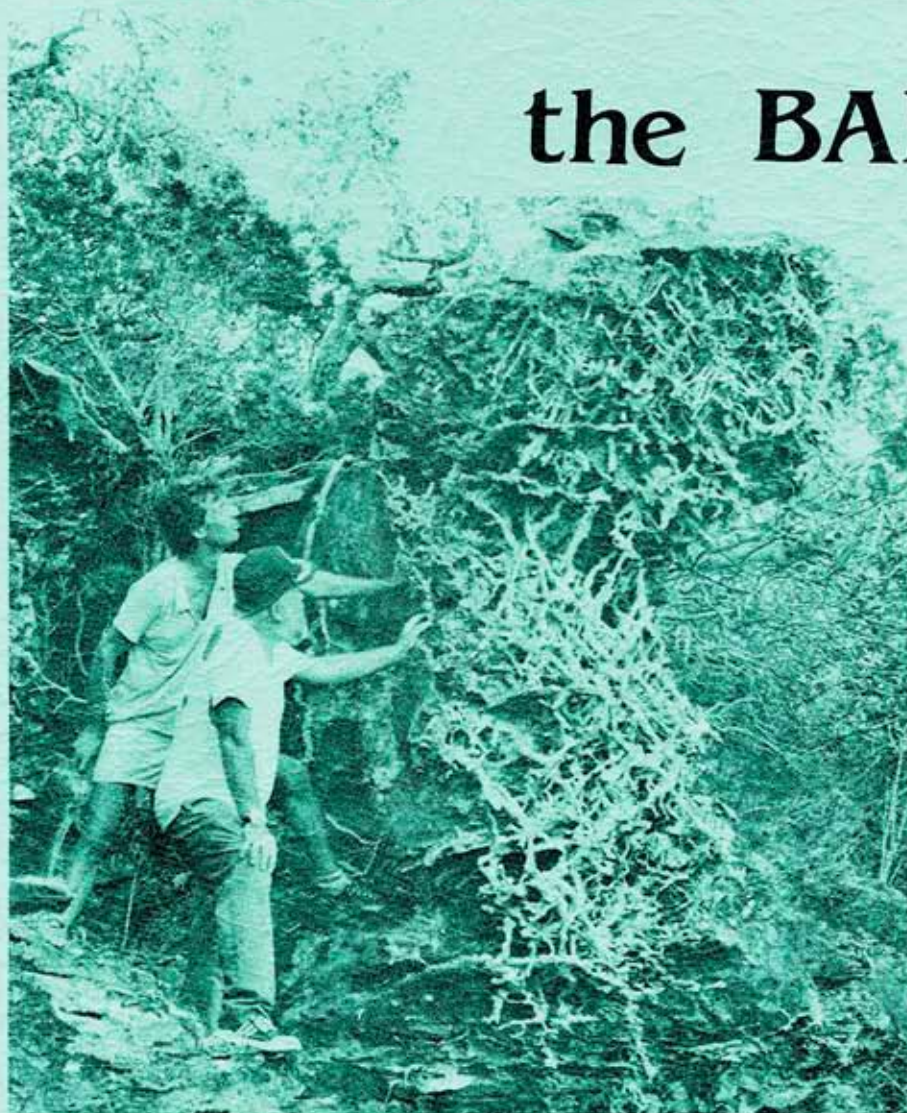


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RECENT MICROBIAL MATS AND STROMATOLITES OF GRANNY LAKE,
SAN SALVADOR, BAHAMAS

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Abstract

Microbial mats and stromatolites are presently forming in Granny Lake and ponds near the lake on San Salvador, Bahamas. Seasonal variation in precipitation and evaporation rates cause changes in water levels and water chemistry. Lake mats and stromatolites extend from a karst surface surrounding the lake to between 100 and 400 meters offshore. Zonation of morphology from the karst surface to offshore includes flat-lying mats, blister and chips, polygonal zone, low relief mat zone, stromatolite zone, and dormant zone. Internal structures of lake stromatolites include thin laminae of high magnesium calcite and organic layers, large pores and fenestrae, and variable fabrics. Pond stromatolites have thick external rinds with pronounced layers but internal fabrics are irregular. Changes in water chemistry, water levels, and dominant organisms in microbial mats are the main controls of stromatolite formation and resultant external and internal morphologies.

Introduction

Stromatolites are organosedimentary structures produced by some combination of sediment trapping, binding and precipitation as a result of the growth and metabolic activity of microorganisms, principally blue-green algae (Walter, 1976). Microbial mats that become stromatolites are usually communities of bacteria, blue-green algae, and green algae.

Microbial mats and stromatolites in Granny Lake contain many types of blue-green algae, bacteria, and a few green algae, and are produced by the above mechanisms. Their occurrence in a hypersaline inland lake and adjacent ponds is one of a relatively few examples of Recent stromatolites. Environments similar to Granny Lake, including hypersaline lakes, lagoons, and marginal

marine settings, and mats and stromatolites that form in these settings, have been studied by Kendall and Skipwith, 1968; Walter, Golubic, and Preiss, 1973; Logan, Hoffman, and Gebelein, 1974; Horodyski and Vonder Haar, 1975; Horodyski, Bloesser, and Vonder Haar, 1977; Von der Borch, Bolton, and Warren, 1977; Bauld, 1981; and Warren, 1982.

Setting

Granny Lake is located in the east central section of the island (see index map of San Salvador). The lake is approximately 3.2 km long, east to west, 0.8 km wide, and is surrounded by low ridges to the north, high ridges to the southwest, and a lowland area to the south and east. A southeast trending abandoned channel extends from the central southern edge of Granny Lake. Bedrock in the lake basin area is entirely carbonates and has been studied by Florentino and Bain (1984). The Granny Lake basin and channel were once part of a Pleistocene lagoonal or estuarine system, and later beach ridge accretion and lowering of sea level isolated the basin (Thalman and Teeter, 1983).

The lake water is hypersaline; salinity measurements for January, 1984, and June, 1984, are 89 ppt and 123 ppt, respectively. Ponds in the eastern basin have salinities ranging from brackish to hypersaline. Lake level fluctuations of 0.5 m from January to June are probably caused by changes in precipitation and evaporation rates. Tidal influences on lake level have not been observed and no blue holes or solution

conduits have been found.

Microbial mats and stromatolites

Microbial mats and stromatolites are located in an area extending from the mud flat on the north, east, and south shores, and from the lake edge on the west shore, for a distance of 100 to 400 meters offshore where the water depth increases abruptly from 1.5 m to 2 m or more. Mats and stromatolites are also located in ponds at the east end of the lake and in ponds in Granny Lake channel.

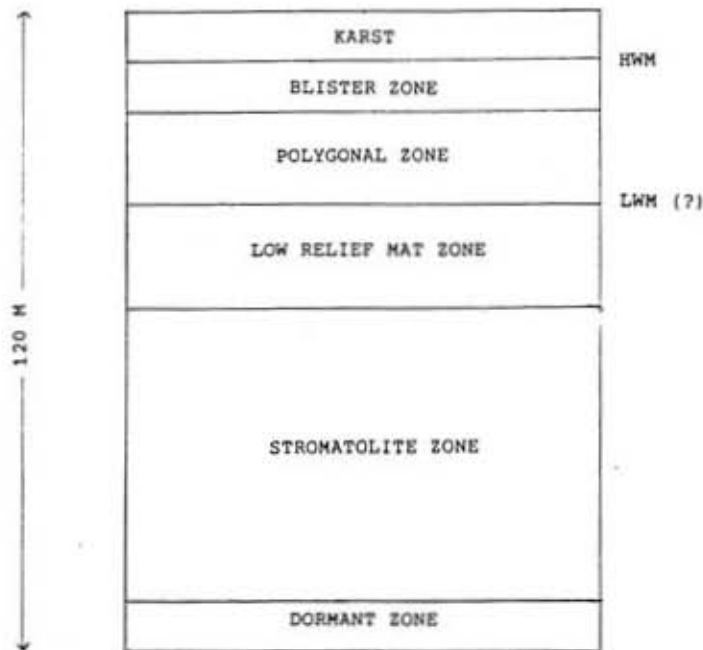


Figure 1: Zonation of microbial mat morphology in Granny Lake. HWM-highest water mark; LWM-lowest water mark.

Microbial mat morphology changes markedly from the shore zone to deeper water (Figure 1). The lake is surrounded by an irregular karst surface. In the mud flat area near the lake edge, the mats are thin and have a soft, rubbery texture. Generation of gas bubbles during photosynthesis or bacterial decomposition forms blisters (Figure 2). Dessication of these mats and precipitation of high magnesium carbonate forms small chips of rock (Figure 3).

The polygonal zone is 25 to 30 meters wide and contains 0.5 to 1 m diameter polygonal mats separated by low ridges (Figure 4). Dessicated mats are composed of high magnesium calcite and aragonite. From the lake edge to 100 meters offshore, water depth increases from 1 to 6 centimeters. Polygons become smaller offshore and grade into low relief mats. Low relief mats and stromatolites are 1 to 3 cm thick and cover most of the bottom in their respective zones. Their distribution becomes patchy as water depth increases, and the substrate between mats is covered by a shell hash of Battilaria and Anomalocardia. Columnar stromatolites and laterally linked hemispheroid stromatolites (after Logan, et al, 1964) form in areas where mats are discontinuous (Figure 5).

Dormant stromatolites occur 120 meters offshore on a submerged bedrock high. Their shape is similar to other stromatolites in the lake, except the dormant forms lack living algae on their outer surfaces.

Vertical sections through lake stromatolites show a color zonation, from bottom to top, of gray, white, red, and dark green

Figure 2: Blister zone. Blisters are hollow and some have collapsed.



Figure 3: Chips of lithified microbial mats in the blister zone.

Figure 4: Polygonal zone. Polygons are outlined by hollow ridges.





Figure 5: Low relief mats (top and right) and small columnar stromatolites ringing barren area and in isolated clumps. (Scale bar is 15 cm long).

Figure 6: Cross section of a lake stromatolite. Light layers are high magnesium calcite, dark layers are remains of microbial mats. Note porous texture.



Figure 7: Aerial photograph of eastern area of Granny Lake and numerous circular ponds. North is to the right.

laminae. Microbial mats from the same area are composed of coccoid and filamentous blue-green algae and diatoms. Internal structures of lake stromatolites include thin laminae of high magnesium calcite and organic layers, large pores and fenestrae, and variable fabrics (Figure 6).

Microbial mats and large stromatolites are located in ponds in the eastern area of Granny Lake basin (Figure 7). The circular ponds have diameters ranging from 0.5 to 4 meters. Some ponds are dry and covered by microbial mats; others are filled with sediment covered by 5 to 10 cm of water. Some of the latter ponds contain microbial mats and stromatolites.

Pond stromatolites have thick external rinds with pronounced layers (Figure 8); however, these outer layers do not relate to any internal features. Cross sections of pond stromatolites show an irregular internal fabric and large pores (Figure 9).

Changes in water chemistry, water levels, and dominant organisms in microbial mats are assumed to be the dominant controls of stromatolite formation and resultant external and internal morphologies. Laboratory and analytical work will be done in fall, 1984, to outline these parameters and determine their relative importance (see notes and acknowledgements).

Notes and acknowledgements

This study is part of a master's thesis research project at the University of Akron that will be completed in May, 1985. We wish to thank Dr. Donald and Kathy Gerace and the College

Figure 8: External morphology of stromatolite from a pond at the east end of Granny Lake.

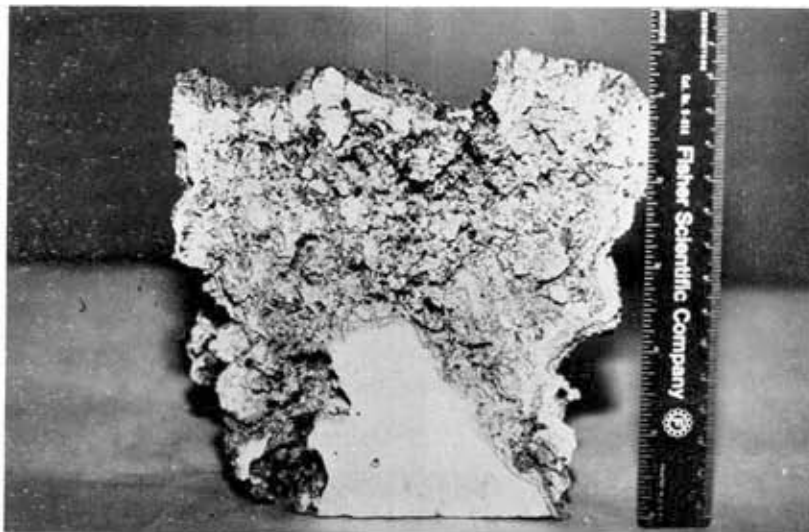
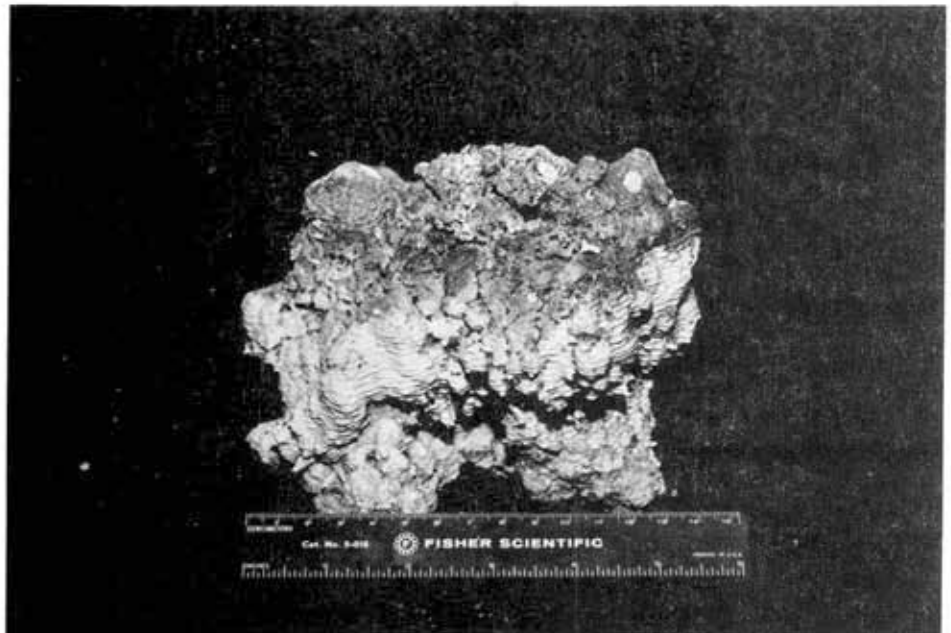


Figure 9: Cross section of stromatolite from a pond at the east end of Granny Lake. Note external rind and irregular internal fabric.

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