MICROSTRUCTURE OF HOLOCENE STROMATOLITES FROM LAGOA VERMELHA, A HYPERSALINE COASTAL LAGOON IN BRAZIL – INSIGHTS ON STROMATOLITE GROWTH

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Stromatolites are laminated sedimentary structures thought to be remnants of microbial mats, which are benthic, laminated microbial ecosystems found in the illuminated bottom of some aquatic environments. They were abundant in the Proterozoic Eon, but became scarce towards the Holocene. Presently, growing stromatolites are rare, found in a few environments, including carbonate-rich freshwater lakes and rivers and hypersaline lagoons. In Brazil, growing carbonate stromatolites were described in Lagoa Vermelha, a coastal hypersaline lagoon in Rio de Janeiro State, in the 1980s-1990s. However, since 2013 only the mineral skeletons have been found. Anthropogenic impacts are the probable causes of death of the microbial mat cover. The study of recent stromatolites offer que unique opportunity to observe original minerals and structures, as well as the initial diagenetic processes. Previous work showed that stromatolites from Lagoa Vermelha consist mainly of high magnesium-calcite (HMC), with smaller amounts of aragonite, dolomite and quartz (minor). In this work, we analyzed a stromatolite from Lagoa Vermelha using light and electron microscopy techniques. The stromatolite contained a well-laminated core and some clotted regions at both the base and the apex. Peripheral regions contained abundant animal burrows partially filled by fecal pellets. A thin mineral palisade coated most inner and outer mineral surfaces, including laminae, animal burrows and bioclasts. Bioclasts consisted of mollusk, foraminifera and ostracod shells. Quartz sand was a minor component. Barnacle shells were observed only at the outer surfaces, indicating that they colonized free surfaces after the microbial mat cover was removed. Scanning electron microscopy showed abundant filamentous microorganisms within micro-burrows at the first centimeter from the surface, which were absent in the stromatolite core. These were interpreted as burrowing cyanobacteria, which occurred close to the outer surfaces due to their need of light. Thus, the main modifications of the original structure were bioerosion, growing of a thin mineral layer onto free surfaces, and surface colonization by barnacles. Backscattered electron images of polished laminated samples showed up to four distinct mineral phases. Energy-dispersive X-ray analysis showed that these mineral phases contained distinct Mg/Ca ratios. A low-Mg, Sr-containing phase consisting of elongated particles and clumps of particles was interpreted as aragonite. Other phases were interpreted as HMC with varying amounts of Mg. The arrangement of these minerals within the laminated core suggested a sequence of events leading to mineral precipitation and laminae consolidation. Because aragonite was embedded within HMC, we suggest that it would be the first mineral phase to be precipitated. Aragonite needles could have been precipitated in the water column and then settled onto microbial mat surfaces, or have arisen within the upper layers of the microbial mat. Then these particles would have been cemented together by a HMC phase containing higher Mg, forming irregular peloids. Cementation of these aragonite-HMC peloids by one or two lower Mg HMC phases would have originated consolidated laminae.

KEYWORDS: STROMATOLITE; CARBONATE; LAGOA VERMELHA