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TEM analysis of microbial mediated sedimentation and lithification in modern marine stromatolites

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ABSTRACT

Three sedimentary processes are involved in the growth of living stromatolites at Highborne Cay, Bahamas: (1) trapping of oolitic sands, (2) formation of surface micritic crusts, and (3) formation of fused-grain laminae. The microbial role in each process was investigated by examining the stromatolites using transmission electron microscopy. Species composition and physiological state of the bacteria were discerned by ultrastructure. A well-dispersed population of *Schizothrix gebeleinii* was observed in rapidly accreting surface layers. Their filaments produce copious quantities of amorphous exopolymer and condensed sheath that surround individual, and pairs of cells. Both fresh and degraded sheaths are, however, devoid of carbonate precipitates. This suggests that the primary roles of *S. gebeleinii* are the trapping and binding of unconsolidated sediment and the production of extracellular polymeric secretions. Surface micritic layers are composed primarily of needle-shaped crystals of aragonite. The uppermost surface of the micritic crust is coated with a biofilm comprised primarily of small Gram negative bacteria (i.e., sulfate reducing bacteria) that range in size from 250 to 500 nm in diameter and up to 1 μm in length. Empty cyanobacterial sheaths and occasional Gram positive spores were also observed. Thin sections through resin-casts of ooid microborings in the fused-grain laminae show cells of the endolithic cyanbacterium *Solentia* sp. and evidence of an organic matrix. The micritic crusts and fused-grain layers became lithified laminae that were preserved at depth, although the organisms that formed them were not. This suggests that morphological remains of these organisms (i.e., microfossils) in ancient stromatolites should not be expected.