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The Role of Sulfate-Reducing Bacteria in Lithification of Microbial Mats

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Microbes, particularly cyanobacteria, have long been implicated in biotic precipitation and lithification. Through metabolic and other processes, microbes can precipitate calcium carbonate by changing ion concentrations, hence the saturation index. Furthermore, microbes produce and consume an exopolysaccharide (EPS) framework, that may bind cations, provide a carbon source for energy and act as a nucleation matrix.

In marine and hypersaline microbial mat systems, cyanobacteria do not appear to be the main actors in precipitation/lithification. Instead, ample evidence suggests that sulfate-reducing bacteria (SRB) play a key role in carbonate precipitation. Two field sites with active lithification were studied to determine the role of SRB in lithification: the open marine stromatolites at Highborne Cay, Bahamas, and the hypersaline microbial mats of Salt Pan on Eleuthera, Bahamas. In both of these sites, the activity of SRB was measured through microelectrode profiles and $^{35}SO_4$-coated silver foil. Both measurements found that SRB are most active in lithified zones (where micrite and/or microspar is formed), further suggesting their involvement in lithification. Distribution of SRB was also measured through 16S rDNA community analysis and fluorescent in situ hybridization (FISH). Furthermore, precipitation of calcium carbonate is enhanced in an enrichtment culture of a sulfate-reducing bacterium isolated from the lithifying layer of stromatolite mats. These observations strongly suggest that

SRB are, in fact, responsible for lithification in these systems. However, the specific role of different types of SRB (i.e., complete vs. incomplete oxidizers) needs further investigation.