Biogeochemistry of Microbial Mats and Biofilms from a Hypersaline Pond and Coral Reef, The Bahamas

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Microbial mat and biofilm communities host complex biogeochemical processes and play a role in the formation of many carbonate rocks. Redox reactions occurring within microbialites have been shown to influence carbonate precipitation and/or carbonate dissolution. Understanding the biotic constituents, chemical microgradients and precipitates within modern environments can aid in understanding biologically-induced carbonate precipitation and diagenetic processes that occurred in ancient analogs. Microbial mats were collected from a hypersaline pond (~60-100 practical salinity units) in San Salvador, Bahamas and biofilm samples were collected at varying water depths (~4- 20 meters) from a coral reef in Abaco, Bahamas. Biogeochemical analysis and scanning electron microscopy were used to find possible variations in community composition and whether chemical microgradients exist between samples and layers. Biogeochemical analyses included oxygen and sulfide microelectrode profiling, carbon substrate utilization profiling, fatty acid methyl ester and total organic carbon analysis. Scanning electron microscopy shows that organic matter greatly exceeds sediment or precipitate amounts. Microelectrode profiles show that mat samples had an oxic upper portion above a sulfide-rich, anoxic lower portion where sulfate reduction appears to be the dominant heterotrophic microbial respiration pathway. Oxic layer thickness varied from 1500 microns to 23000 microns. Total organic carbon values averaged 8.7 % by weight. Statistical analysis of carbon substrate utilization profiling results show significant (<0.05) differences in the microbial communities. The influence of organics and microbes appear to be vitally important in microbial carbonate formation and cannot be ignored in future research.