INTERACTIONS BETWEEN MICROBIAL PHYSIOLOGY AND CARBONATE MINERALIZATION

[1]ROBBINS, L. L. and [1]YATES, K. K., [1]USGS, Center for Coastal Geology, 600 4th St. South, St. Petersburg, FL 33701 U.S.A.

Large deposits of non-fossiliferous lime-mud comprise significant portions of the rock record. Recent research suggests that microbes played a role in the production of these deposits, which represent a significant portion of the carbonate sediment budget and have inevitably influenced atmospheric pCO_2 through time. Importantly, an understanding of microbial cellular physiology and its potential effects on calcification chemistry is critical for environmental interpretation. Microbial physiologic factors that influence or enhance mineral precipitation include charged external membranes (eg., s-layer proteins), the generation of internal- external cellular pH gradients, and transport of cations into and out of the cell. Each of these factors has been the subject of laboratory experiments and field studies using aerobic microbes. Calcium carbonate chemistry can be defined by reactions involving the chemical species CO_2, HCO_3^-, CO_3^{2-}, H_2CO_3, Ca^{2+}, and H^+ (pH). Microbial physiological processes have the potential to rapidly affect this chemistry by manipulating vital chemical components. Based on experimental evidence, models for cyanobacterial and unicellular green algal calcification provide a basis for determining pathways of inorganic carbon and metals during calcification. The ultimate fate of CO_2 sequestered by both photosynthesis and calcium carbonate production depends on the preservation potential of mineral and organic material. SEM, TEM, and antibody analyses of ancient and modern carbonate sediments, which are products of microbial calcification, reveal cyanobacterial cells and organic matter encased in massive deposits of calcium carbonate crystals. Data demonstrate that both organic and inorganic forms of carbon are potentially sequestered on widely divergent time scales.