SPRING 2014 SEMINAR SERIES

DEPARTMENT OF OCEAN, EARTH, AND ATMOSPHERIC SCIENCES
3PM – ROOM 200 IN THE OCEANOGRAPHY/PHYSICS BUILDING
THURSDAY FEBRUARY 13th, 2014

"Everything you always wanted to know about microbialites but were afraid to ask."

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ABSTRACT

Microbial mats are organosedimentary biofilms that greatly impacted the geochemical and physicochemical conditions on Earth through geological time. These laminated ecosystems are formed by various geomicrobiological processes, including biomass production, binding and trapping of sediments, and mineral precipitation. Lithified mats, or microbialites date back over 3 billion years in the rock record.
The interpretation of fossil microbial mats in the rock record and, consecutively, assessment of their potential role in the alteration of Earth's geochemical environment through time is hampered by the poor preservation of these organic-rich structures. The preservation potential, however, can be enhanced through microbially-mediated lithification. The three key components of microbially-mediated mineral precipitation are: 1) the "alkalinity" engine (i.e., microbial community metabolism and environmental conditions impacting the calcium (or magnesium) carbonate saturation index); 2) the complex organic matrix comprised of exopolymeric substances (EPS); and 3) the coordination of community physiologies and sensing of environmental conditions (e.g., pH, oxygen concentration) through chemical communication, or quorum sensing. These combined geochemical-microbial activities provide conditions that allow specific microbialites to form, both on a macroscale (i.e., morphology) as well as on a microscale (i.e., shape and composition of minerals).

Even though mineral shape and composition may be a function of the EPS properties and therefore has the potential to reflect a specific signature of the microbial community, it is unresolved how, for example, continuous laminae vs. clotted fabrics form. The cyanobacterial community, situated near the surface according to the ambient light conditions, provides the organic carbon for heterotrophs. All these respiring organisms (including "strict" anaerobes, such as sulfate-reducing bacteria and methanogens) display their maximum metabolic activity along a surface horizon that may lithify. Some ideas emerge how chemical communication may play a role in this, and how microbial signaling compounds may be used to detect specific environmental conditions and may allow synchronizing of intra- and interspecies metabolic activities. These recent observations and ideas are, however, merely a first step in the understanding of microbialite formation, and their potential to weather the diagenetic processes so that some of the biological signatures are preserved.

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