MICROBIAL FOSSILIZATION BY THE FORMATION OF CLAY MINERALS. S. A. Newman[1] G. Mariotti[2], T. Bosak[1], [1]Massachusetts Institute of Technology, Earth, Atmospheric and Planetary Sciences, Cambridge, Massachusetts 02139, [2]Louisiana State University School of the Coast and Environment, 1002-Q Energy, Coast & Environment Building, Baton Rouge, LA 70803.

Changes in cyanobacterial fossilization through time may reflect variations in sea water chemistry. However, factors which contribute to microbial fossilization in siliciclastic environments are not well understood.

Here, we investigate the coating and fossilization of filamentous cyanobacteria by clay minerals. Bacterial cultures, composed of a mixed community of filamentous nonheterocystous and heterocystous cyanobacteria are grown in artificial seawater with varying concentrations of silica (0 or 0.4 mM), and varying substrates (inpure silica sand with mica and clay minerals, pure silica sand, glass beads, and plastic beads). Cultures are continuously agitated for 2 months, and media are replaced every 3 to 4 days to maintain a constant pH and replenish ions for cyanobacterial growth. Flow conditions in cultures can suspend clays and organic material, but not silt and sand, mimicking many environments where microbial mats can grow.

Calcium and/or magnesium aluminosilicates coated cyanobacterial filaments greater than 1 micron in size only 6 days after the inoculation in the presence of silica sand. Mineral coating was not observed around thinner (less than 1.5 µm-wide) filaments or beadlike (possibly heterocystous) cyanobacteria, suggesting that these organisms are less likely to be preserved under all examined experimental conditions. The extent of mineral coating increased throughout the first 15 days of cyanobacterial growth, but plateaued after this time point. Although filament coating occurred in both the 0 and 0.4 mM silica conditions, smoother and more extensive coating was present in higher (0.4 mM) conditions, which may indicate mineral precipitation.

To help elucidate the source of mineral coatings (precipitation and/or trapping), we separate clay minerals from the silica sand substrate prior to inoculation. Substrate clays are similar in both shape and size to the minerals coating cyanobacterial filaments. However, slight differences in elemental composition between filament coatings and separated clay minerals are present; K and Na frequently occur in substrate clays, but are rare in minerals coating cyanobacterial filaments. This suggests that the cyanobacteria may be selectively trapping minerals from their substrates or may be coated by newly precipitated minerals.

Additionally, we conduct experiments in which the silica sand substrate is separated from the media and cyanobacteria through the use of dialysis membranes (12-14kD pore size). The dialysis membranes allow ions to flow freely between the substrate and media, but prevent the cyanbacteria from interacting directly with the sand, silt, and clays. We show that little to no mineral coatings occur when cyanobacteria are separated from the substrate, indicating that the majority of mineral coatings may result from the trapping of clay minerals from the sediment.

These experiments improve our understanding of the processes that preserve fossils in various siliciclastics and conditions that may have contributed to the exceptional preservation of microbial mats and soft-bodied organisms in the Ediacaran.