# Cyanobacterial fossilization through the formation and trapping of clays

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Processes which may have led to the exceptional preservation of microbial mats and soft bodied fossils in siliciclastics during the Ediacaran are not well understood. To address this question, the current study experimentally fossilizes living cyanobacteria.

A mixed community of filamentous cyanobacteria was continuously submerged in artificial seawater with varying concentrations of Si (0 mM and 0.4 mM). Cyanobacteria were grown in the presence of: 1) Si sand with mica, 2) pure $SiO_2$ sand, or 3) glass beads to determine the effect of different substrates on the composition of minerals around microbial filaments. Furthermore, some cultures were physically separated from the sand by dialysis bags to distinguish cyanobacterial trapping of suspended minerals from mineral precipitation. The cultures were agitated to allow for the suspension of finer silt and clay particles (~0.1% of the bulk sand) without disturbing the sand grains or beads.

Fe, Mg, K, Ca and Na-rich aluminosilicate phases as well as calcium carbonate coated cyanobacterial sheaths after 6 days. The extent and uniformity of coating increased over the first 15 days. Most cyanobacterial filaments wider than 1 micron were coated, but the thinner (less than 1 micron-wide) and bead-like (possibly heterocystous) cyanobacteria were not. Smoother and more extensive coating was present in solutions that initially contained 0.4 mM Si. Dialysis experiments revealed that most Al-Si coating was derived from the cyanobacterial trapping of clays. However, when filaments grew in the presence of glass beads, which did not contain Fe, they became coated by phases rich in Fe(III) and $SiO_2$, suggesting the precipitation of Fe-rich amorphous silicates from the solution.

Our experiments show that the precipitation and trapping of silt and clay may co-occur and fossilize cyanobacterial sheaths within weeks. Past environments conducive to this mode of fossilization were likely rich in clay, silt, Fe(III) and dissolved Si.