A geochemical marker for ancient motile communities of filamentous microorganisms

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Filamentous microorganisms are thought to have evolved by at least 1.9 Ga and possibly as early as 3.5 Ga [1]. However, individual microfossils are difficult to obtain and interpret. The identification of communities and their behaviors based on interactions with the sedimentary environment potentially offers far more material for analysis. Monocultures of filamentous cyanobacteria (*Leptolyngbya sp.*) were grown on sand and observed with time-lapse videos. Resultant communities formed mobile ridges and cones. Movement of groups of bacteria generated forces sufficient to roll individual sand grains over the sediment surface. These activities effectively sorted loose sands based on composition (density) and size because larger and lighter grains were generally easier to roll over other grains and were more exposed to moving groups of bacteria. Sorting was most efficient around the flanks of stabilized cones and ridges, resulting in finer and heavier grains concentrated on the bases and coarser and lighter grains near the tops.

High resolution x-ray fluorescence scans were employed to detect sorting patterns of compositionally distinctive heavy minerals on polished slabs of rocks. 3.22 Ga microbial mat deposits [2] (Moodies Group, Barberton Greenstone Belt, South Africa) contain coarser quartz minerals prefentially in and on conical and ridge-shaped features, while smaller zircon and rutile grains are present in topographic lows on both sides. Feldspar grains are distributed similarly to quartz grains, although sorting is less prounced. Less efficient sorting of feldspar grains likely results from their more blocky shapes which would have made them more difficult to roll over other grains. Because patterns of mineral sorting by groups of filamentous organisms moving up slopes are unique relative to sorting patterns produced by other physical processes, they can potentially serve as robust biosignatures. This research thus suggests a novel biosignature based on specific experimentally observed microbial processes.

[1] Schopf (2006) *Phil. Trans. R. Soc. B,* **361,** 689-885. [2] Heubeck (2009) *Geology,* **37,** 931-934.