Characterization and settling rate of cyanobacteria-ferrihydrite aggregates formed during oxygenic photosynthetic Fe(II) oxidation

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Banded iron formations (BIF) are iron-rich (~20-40% Fe) and siliceous (~40-50% SiO_2) sedimentary deposits that precipitated throughout much of the late Archean (2.7-2.5 Ga) and Paleoproterozoic (2.5-1.8 Ga). It is generally accepted that planktonic bacteria growing in the ancient ocean's photic zone were responsible for the oxidation of dissolved hydrothermally-derived Fe(II) into Fe(III), followed by the hydrolysis and precipitation of an amorphous ferric oxyhydroxide phase, such as ferrihydrite. The presence or absence of a strong association of cells with minerals or encrustation in minerals influences the rate and extent of sedimentation of the microbial cells, i.e., the biomass. To date, studies directed at understanding plankton cell-ferrihydrite aggregate formation have come exclusively from experimental work with photoferrotrophs. As a consequence, details of cyanobacteria-ferrihydrite aggregate formation remain unclear, specifically what is the size range of individual grains and aggregate sand what fraction of cells become sedimented. Answers to these questions are significant in terms of explaining the presence and absence of minerals observed in BIF; the scarcity of organic carbon in BIF; and ultimately in using BIF as proxies for paleo-environmental conditions. Accordingly, in this work, we experimentally grew cyanobacteria in the presence of both dissolved Fe(II) and silica in anoxic environment to not only observe the size and morphology of the iron minerals produced by cyanobacteria, but as well the association of the cell surface and mineral products to assess the amount of biomass potentially buried when cyanobacteria may have been the dominant player in BIF deposition.

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