Archean laboratory models possessing photosynthetic microbial mats

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Introduction

Geochemical signatures of oxygen oases are preserved in late Archean shallow marine environments several hundred million years before the globally recorded great oxygenation event at 2.45 Ga [1]. We have created two possible Archean environments to observe geochemical changes in an oxygen oasis over several months. In both experiments a consortium of cyanobacteria, aerobic heterotrophs, iron reducing bacteria, sulphate reducing bacteria, and methanogens were grown on an olivine substrate. In the first experiment no additions were made to the system; in the second experiment ferrous iron equivalent to 0.01mM, a low estimate for an Archean ocean concentration, was added daily.

Results

Microbial growth in both experiments was dominated by oxygenic photosynthesis until the system became limited by inorganic carbon (Fig.1). $H_{2(g)}$ from low temperature serpentinization may have supported small amounts microbial growth.

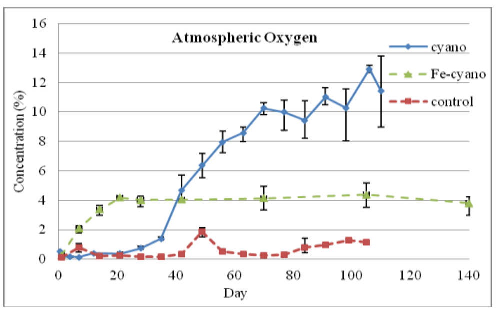

Figure 1: Oxygen accumulation from cyanobacteria mat (cyano), established cyanobacteria mat with iron additions (Fe-cyano) and un-innoculated system with no iron addtions (control).

In the low iron system, scanning electron microscopy showed some sections of mat were mineral free, whereas, other sections had dense accumulations of 0.5-20μm Mg-rich phyllosilicates. Different microbial communities were established on Fe-rich olivine versus Mg-rich olivine. In the high iron system lower oxygen resulted from the oxidation of $Fe^{2+}_{(aq)}$ producing <1μm ferric hydroxides particles. Ferric hydroxides densely covered the cyanobacteria and attached to heterotrophs. Mat growth was not hindered by the addition of iron but greater amounts of exocellular polymeric substances were produced.

Conclusion

This study demonstrates that bacteria in an Archean oxygen oasis had the potential to be fossilized by iron hydroxide minerals. Phyllosilicates, produced in part by biogenic alteration most, likely did not preserve bacteria morphology.

[1] Kendall (2010) *Nature Geoscience* **3**, 647-652.

Anthropogenic alteration of dissolved inorganic carbon fluxes from watersheds

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Section Heading

Introduction. Stream and River dissolved inorganic carbon fluxes represent a key linkage between major reservoirs in the global carbon budget. Over geologic time scales changes in inorganic carbon fluxes from land to sea can cause changes in atmospheric CO2. On shorter time scales alterations in these fluxes can be important to terrestrial carbon budgets, soil chemistry, and the buffering capacity of receiving waters. Here I will discuss what is known about the influence of human's on DIC fluxes from watershed.