Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16476

Impact of silica and iron concentrations on microbial iron cycling in the Archean during the genesis of Banded Iron Formations

CAROLIN L DREHER[1], MANUEL SCHAD[2], MUAMMAR MANSOR[1], KURT O. KONHAUSER[2] AND ANDREAS KAPPLER[3]

[1]University of Tuebingen

[2]University of Alberta

[3]University of Tuebingen, department of Geosciences, Geomicrobiology

Presenting Author: carolin.dreher@uni-tuebingen.de

Banded Iron Formation (BIFs) are 3.8 to 1.85 Ga old marine sediments consisting of iron (Fe)-rich and silica (Si)-rich alternating bands. They represent the largest iron ore deposits, but their deposition pathways are still debated. Before the emergence of free oxygen on Earth during the Great Oxidation Event (GOE), Fe cycling by anoxygenic photoferrotrophic Fe(II)-oxidizing bacteria in combination with dissimilatory Fe(III)-reducing bacteria is the most plausible explanation for Fe(II/III) mineral precipitation and the Fe mineral composition of the early BIFs (Schad *et al.*, 2022). Here we investigate if oxygen produced by cyanobacteria in combination with Fe(III)-reducing bacteria could have also led to iron cycling and the formation of Fe minerals that are present in BIFs today. Hence, we set up batch experiments with the marine cyanobacterium *Synechoccocus* PCC 7002 and the marine Fe(III)-reducer *Shewanella colwelliana* in the presence of different Fe(II) (0 to 5 mM) and silica concentrations (0 to 2.2 mM) in anoxic seawater medium. With alternating light-dark cycles and addition of lactate (to initiate Fe(III) reduction) we conducted three complete Fe cycles. In setups with Archean ocean-relevant Fe(II) concentrations (less than 1 mM) and the presence of silica, poorly crystalline mineral phases were formed, suggesting that the crystalline mineral phases in BIFs are not primary but are formed later through diagenesis and metamorphism. In the presence of higher Fe(II) concentrations (up to 5 mM) crystalline mineral phases like magnetite, siderite, goethite and vivianite were formed. In addition to affecting the mineralogy, the presence of silica also allowed faster and denser growth of cyanobacteria compared to setups without silica probably due to formation of Fe(II)-Si aggregates, thus reducing the formation of reactive oxygen species that are known to be toxic to cyanobacteria.

[1] Schad *et al.* Microbial Fe cycling in a simulated Precambrian ocean environment: Implications for secondary mineral (trans)formation and deposition during BIF genesis. *Geochimica et Cosmochimica Acta* **331**, 165-191 (2022).