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Implications of marine phytoplankton trace element variability for the interpretation of the Banded Iron Formation trace element budget

MANUEL SCHAD[1], MICHELLE M GEHRINGER[2], DANIELA GUTIERREZ RUEDA[1], YUHAO LI[1], SOEREN DRABESCH[3], CAROLIN L DREHER[3], LESLIE J ROBBINS[4], DANIEL S. ALESSI[1], ANDREAS KAPPLER[5,6] AND KURT O. KONHAUSER[1]

[1]University of Alberta
[2]University of Kaiserslautern-Landau
[3]University of Tuebingen
[4]University of Regina
[5]University of Tuebingen, department of Geosciences, Geomicrobiology
[6]Cluster of Excellence: EXC 2124: Controlling Microbes to Fight Infection

Presenting Author: schad@ualberta.ca

Precambrian iron formations (BIFs) are iron (Fe)- and silica (Si)-rich biochemical marine sedimentary deposits that formed between 3.8 and 1.85 Ga and are frequently used to reconstruct the geochemistry of early oceans. Their utility for paleo-environmental reconstructions, however, is limited by uncertainties regarding the nature of the primary mineral phases. Additionally, the use of empirical adsorption coefficient relationships between seawater and primary minerals for the interpretation of Precambrian ocean trace element (TE) concentrations is not straightforward. These relationships are heavily influenced by confounding factors such as co-precipitated organic matter, Si, and divalent cations such as magnesium and calcium. Consequently, tight constraints on Precambrian ocean TE concentrations remain elusive.

A recent avenue of research [1] has suggested that phytoplankton biomass, such as that of anoxygenic photoautotrophic Fe(II)-oxidizing bacteria (photoferrotrophs), which lived in the upper water column, could have represented the primary vector for TE transport to the seafloor in place of primary mineral phases. The TE profiles contained in this phytoplankton necromass would then have been preserved in the BIF record. However, this proposition is currently based on the analysis of one marine photoferrotroph model strain, *Rhodovulum iodosum*. Therefore, several open questions remain: (1) Do various photoferrotrophs display different TE compositions? (2) Does the photoferrotroph TE composition differ from other early primary producers such as cyanobacteria? (3) Can we trace these differences in the BIF rock record? (4) How does this potential TE variability influence the interpretation of the BIF TE budget, and can it be explained by necromass-sourced TE? To answer these questions, we grew 4 different photoferrotrophs and 6 different cyanobacteria and analyzed them for their TE composition. Preliminary results show that although there is some variability in the photoferrotroph TE composition they display similarities with BIF TE profiles. Since TE deposition via photoferrotroph necromass alone cannot account for all TE contained in BIFs, additional TE sources such as minerals or additional microbial necromass need to be considered.

[1] Konhauser et al. (2018), *Geol. Soc. Am. Bull.* 130, 941-951.