Geophysical Research Abstracts, Vol. 8, 08437, 2006
SRef-ID: 1607-7962/gra/EGU06-A-08437

The Bacterial Role in BIF Diagenesis

K.O. Konhauser (1), D.K. Newman (2) and A. Kappler (3)

(1) Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta, Canada

(2) GPS Division, California Institute of Technology, Pasadena, California, USA

(3) Center for Applied Geoscience, University of Tübingen, Tübingen, Germany

During deposition of late Archean–early Palaeoproterozoic Precambrian banded iron formations (BIFs) the downward flux of ferric hydroxide ($Fe(OH)_3$) and phytoplankton biomass should have facilitated microbial Fe(III) reduction. However, quantifying the significance of such a metabolic pathway in the Precambrian is extremely difficult, considering the post-depositional alteration of the rocks and the lack of ideal modern analogues. Consequently, we have very few constraints on the Fe cycle at that time, namely (i) the concentration of dissolved Fe(II) in the ocean waters; (ii) by what mechanisms Fe(II) was oxidized (chemical, photochemical or biological, the latter using either O_2 or light); (iii) where the ferric hydroxide was precipitated (over the shelf vs. open ocean); (iv) the amount of phytoplankton biomass, which relates to the nutrient status of the surface waters; (v) the relative importance of Fe(III) reduction vs. the other types of metabolic pathways utilized by sea floor microbial communities; and (vi) the proportion of primary vs. diagenetic Fe(II) in BIF. Furthermore, although estimates can be made regarding the quantity of reducing equivalents necessary to account for the diagenetic Fe(II) component in Fe-rich BIF layers, those same estimates do not offer any insights into the magnitude of Fe(III) actually generated within the water column, and hence, the efficiency of Fe and C recycling prior to burial. Accordingly, in this study, we have attempted to model the ancient Fe cycle, based simply on conservative experimental rates of photosynthetic Fe(II) oxidation in the euphotic zone. We estimate here that under ideal growth conditions, as much as 70% of the biologically formed Fe(III) could have been recycled back into the water column via fermentation and organic carbon oxidation coupled to microbial Fe(III) reduction. By comparing the potential amount of biomass generated phototrophically with the re-

ducing equivalents required for Fe(III) reduction and magnetite formation, we also hypothesize that another anaerobic metabolic pathway might have been utilized in the surface sediment to oxidize the fermentation by-products. Based on the premise that the deep ocean waters were anoxic, this role could have been fulfilled by methanogens, and maybe even methanotrophs that employed Fe(III) reduction.