A Precambrian manganous sea?

C. JONES*, S.A. CROWE AND D.E. CANFIELD

NordCEE, Institute of Biology, Syddansk Universitet (*correspondence: carriayne@biology.sdu.dk)

Differences in the biogeochemical behavior of Fe and Mn can lead to their physical separation and a variation in the Fe:Mn ratio in sedimentary rocks. The mechanisms controlling the Fe:Mn ratios of Precambrian sedimentary rocks remain understudied. Using previously published data from the Mt. McRae shale deposit [1, 2] and the biogeochemical characteristics of Fe and Mn, we evaluate the potential controls on Fe and Mn co-deposition in this succession. We suggest that before the 'whiff' of oxygen, as recorded in the Mt. McRae shale, Fe and Mn were deposited together as carbonate minerals at a ratio reflecting their supply from hydrothermal fluids. During the 'whiff', iron likely precipitated and was sequestered in the sediments as sulfide minerals. This sulfide resulted from a global increase in the flux of sulfate to the oceans due to increased oxidative weathering on the continents [2]. We propose that this led to a global enhancement of Fe removal as Fe sulfides, preferentially enriching seawater in dissolved manganese relative to iron. In the Mt. McRae shale, we find evidence for this in the sediments deposited after the 'whiff', which exhibit a Mn enrichment relative to Fe with respect to both a hydrothermal source and continental weathering. These observations support the hypothesis of a transitional manganous ocean that punctuates intervals of ferruginous and euxinic ocean redox states [3]. We propose that enrichments of Mn relative to Fe in marine sediments deposited under anoxic conditions are a sensitive proxy for increased oxidative weathering.

[1] Anbar *et al*. (2007) *Science* **317**, 1903–1906. [2] Reinhard *et al*. (2009) *Science* **326**, 713–716. [3] Jones *et al*. (2011) *Biogeosci. Disc*. In press.

Ecological niches of Fe-oxidizing acidophiles in a coal mine discharge

D. JONES[1]*, J. BROWN[2], L. LARSON[2], D. MILLS[1], W. BURGOS[2] AND J. MACALADY[1]

[1]Dept. of Geosciences, Penn State Univ., University Park, PA 16802, USA (*correspondence: djones@psu.edu, dbm5029@psu.edu, jlm80@psu.edu)
[2]Dept. Civil Environ. Eng., Penn State Univ., University Park, PA 16802, USA (jfb213@psu.edu, lnl5053@psu.edu, wdb3@psu.edu)

Low pH iron oxidation is a promising strategy for cost effective bioremediation of acidic mine drainage (AMD). To effectively utilize the iron-oxidizing potential of naturally-occurring microbiota in AMD discharges, knowledge of the diversity, iron-oxidizing efficiency, and natural distribution of acidophilic communities is required. Here we used full-cycle rRNA analyses to describe the composition of sediment communities at Red Eyes, an AMD site in Somerset County, PA, USA. Near anoxic emergences, the dominant microbial communities are green benthic *Euglena* biofilms and associated populations of *Gamma-* and *Betaproteobacteria*. As pH and Fe^{2+} concentrations decrease downstream, the dominant iron oxidizers shift first to (i) a close relative of *Gallionella spp*., followed by (ii) *Ferrovum spp*., and finally to (iii) *Acidithiobacillus ferrooxidans*. Archaea and *Leptospirillum spp*. are less than 2% of cells.

In previous research using laboratory reactors [1], we found that normalized iron-oxidation rates were 1.5-2x faster for the *Ferrovum*-dominated communities compared to the *Acidithiobacillus*-dominated communities. We have since extended our sampling and analyses to identify environmental variables that control the distribution of these and other iron-oxidizers at Red Eyes. Overall, turnover among communities is related to changes in pH and Eh. Results so far suggest that the transition between *Ferrovum-* and *Acidithiobacillus*-dominated communities depends on iron concentration rather than pH. Ongoing analyses will further define the ecological niches of these and other important AMD populations.

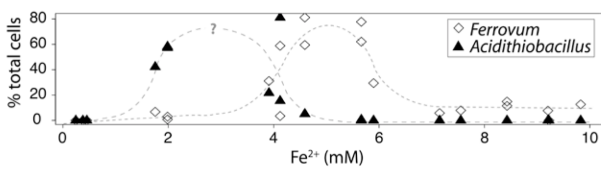

Figure 1. Fluorescence *in situ* hybridization cell counts of *Ferrovum* and *Acidithiobacillus* versus Fe^{2+} concentration.

[1] Brown *et al*. (2010) *Appl Environ Microbiol* **77**, 545–554.