Characterization of phases and Fe isotopes of iron sulfide minerals in a microbial gradient culture

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Iron sulfide (FeS_x) biominerals are important reservoirs of information regarding the the paleo-redox state of the ancient Earth [1]. However, the role of biology in mediating the formation, and regulating the geochemistry, of FeS_x minerals is unclear [2]. In the current study, we present a laboratory study of FeS_x mineral precipitation in the presence of microbes at low pH, which we consider to be an analog to late Archean conditions.

An FeS-oxygen gradient culture (Fig. 1) adjusted to pH 2.5 was inoculated with microorganisms sampled from a local acid mine drainage (AMD) stream. After a few months, FeS_x minerals formed along the gradient. The precipitation was microbially catalyzed by fermentation, iron reduction and sulfate reduction. No FeS_x precipitation was observed in the abiotic control; instead, only Fe-oxides formed. Total [Fe] in the abiotic control varied from 7 ppm at the top to approximately 2000 ppm just above the plug.

We characterized the different mineral phases of FeS_x that formed in culture using Mössbauer spectroscopy and Fe isotope analysis. The findings from this study are relevant to elucidating the Fe isotope compositions of sedimentary pyrite during the Archean [1], and for understanding what effect, if any, microbes have on the phase and composition of sulfides formed by their activity.

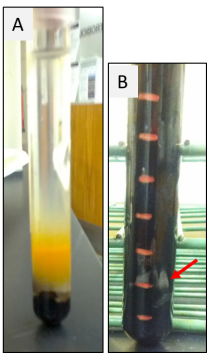

Fig. 1 - (A) Uninoculated gradient culture. Note the black FeS_x plug at the bottom and the mass of Fe-oxides above it. Length of tube is 15cm. (B) Gradient culture inoculated with AMD microorganisms. FeS_x forms in the culture along with putative pyrite (red arrow). Tick marks are 1 cm apart.

[1] Rouxel *et al* (2005) *Science* **307**, 1088-1091 [2] Popa *et al* (2004) *Geomicro. Jour* **21**, 193-206