FRACTIONATION DURING SULFIDE OXIDATION. K. J. Rodzinyak[12], R. J. Léveillé[2], B. A. Wing[2], [1]School of Geosciences, University of South Florida, Tampa, Florida krodzinyak@mail.usf.edu [2]Earth and Planetary Sciences, McGill University, Montreal, Canada

Introduction: The process of identifying signs of life in early Earth conditions and extra-terrestrially makes use of biosignatures. Biosignatures are characteristic signatures left behind by biological metabolisms, which in the case of sulfur reducing bacteria can present as fractionation between sulfide and sulfates of up to 70‰ [1-3]. In natural samples or laboratory experiments oxidation has little fractionation [4-6]. This is important for the applications of biosignatures to early Earth and Mars where the sulfides may have been converted to sulfates.

Devon Island: This study analyzes sulfur oxidation using multiple sulfur isotope analysis of sulfide-sulfate pairs from Devon Island in the Canadian arctic. The surficial nodules are pyrite and a variety of sulfates including jarosite, Schwertmannite, and gypsum. The nodules are hosted in Miocene dolomitic silt lake sediments within the Haughton Impact Crater on Devon Island, Nunavut [7-9] .

Figure 1: Field images from Devon Island. On left the weather station is 3m. On right nodules are found within dolomitic silt. Pen for scale is approxmiately 15 cm.

Fractionation in sulfide-sulfate pairs:
Differences between sulfides and sulfates within individual nodules range from -10‰ to 17‰. Associated $\Delta^{33}S$ values are positive ranging from 0.05‰ to 0.19‰ V-CDT. For most samples the sulfur isotope results are unexplained by oxidation or mixing. Most samples have a slightly negative slope with a fractionation of approximately 11 ‰ and cannot be explained by conventional oxidation or mixing.

Figure 2: Nodules from Devon Island. Image on left is primarily pyrite. On right the nodule has been oxidized to a variety of sulfates including jarosite, gypsum, goethite, and schwartmannite [10].

Application to Biosginatures on Mars: Sulfur analyses from Mars show a variety of sulfur species. These have been interpreted by Franz et al. to represent sulfide and sulfate. No fractionation is found between the sulfur species which does not provide any evidence for biological activity[11].

Masking biosignatures: Preliminary work on sulfur isotopes on Mars does not indicate biological processes. However, the results from our work on Devon Island may indicate that oxidation could mask biosignatures since fractionations up to 18 ‰ were measured.

References:

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