

Biogeochemical Characterization of a Sulfur-rich Arctic Ecosystem

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Borup Fiord Pass, in the Canadian High Arctic, is home to sulfur-rich springs which discharge onto glacial ice, releasing H₂S and depositing elemental sulfur and gypsum. Multiple sulfur oxidation states indicate a complex series of redox reactions, and preliminary investigations are consistent with biological mediation. This work aims to identify the biogeochemical processes leading to the deposition of these sulfur-rich materials. Characterization of the site includes geochemical and microbiological DNA analyses of returned samples, and culturing of live field samples. Preliminary DNA analyses reveal potentially novel microbes, however culturing of original live samples is required to identify the more active members of the system. Ongoing experiments are encouraging selective growth of sulfur oxidizing and reducing bacteria and seem to show the production of elemental sulfur, both via oxidation from sulfide and reduction from sulfate. The next steps for these experiments are to continue selecting for active sulfur oxidizing and reducing bacteria, in order to grow samples from which DNA can be analysed and microbiota identified. Investigation of biogeochemical processes operating in this extreme ecosystem will provide an explanation of the interactions between microbial communities present in the system and the local geochemistry. If this connection can be established, the extensive deposits may effectively be viewed as a biosignature; on a large enough scale to allow detection from orbital measurements. The Borup Fiord Pass spring site provides the opportunity to investigate how life can utilize the redox transformations of sulfur to exist in icy and extreme environments such as may exist on icy moons like Europa.