A Microchemical Study of Iron Oxidizing Bacterial Mats from Differing Surface Environments

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Oxidation of Fe in groundwater solutions by lithotrophic organisms is an obvious illustration of the importance of the interplay between the biological and geological systems. This notion coupled with the astrogeological observation of the significance of Fe-rich material (identified first by spacecraft orbiting Mars and later confirmed by *in situ* analysis obtained from MER Opportunity) makes the characterization of oxidized terrestrial Fe-rich chemical sediments that much more worthy of scientific scrutiny.

While the microbiological aspects of Fe-rich seeps have been studied in some detail, information regarding spatially-resolved elemental and molecular species is lacking. We are pursuing the nature of the composition of Fe-rich mineralization that appears biologically organized along the walls of bacterial filaments (including longitudinal zonation in filaments) as well as obtaining a characterization of the matrix Fe oxides. Samples in this study were collected from in a variety of surface environments in addition to laboratory analogs, including: neutral and acidic creek water (Contrary Creek, Virginia), neutral Fe seep (Marselisborg, Denmark), abiotically-formed Fe-oxides, pure cultures of Fe(II) oxidizing bacteria (CC), and a high temperature-adapted Fe(II) oxidizing isolate (Soufriere, St. Lucia). In this study, we have employed a suite of hyperspectral imaging methods to obtain the maximum amount of microchemical information from each examined region-of-interest within a given sample: 1.) Full-spectrum X-ray imaging using energy dispersive spectroscopy (EDS), 2) scanning confocal Raman spectroscopy, and finally, 3) Full-spectrum mass resolved imaging *via* Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS).