Detection of of biological impacts on serpentinite weathering on Earth and potentially other planetary systems

A.A. OLSEN[1], A.R. TAYLOR[1], E.M. HAUSRATH[2], K.A. NEGRICH[1] AND E. YARDLEY[1]

[1]5790 School of Earth and Climate Sciences, University of Maine, Orono, ME 04469; amanda.a.olsen@maine.edu

[3] Department of Geoscience, UNLV, Las Vegas, NV 89154; elisabeth.hausrath@unlv.edu

Serpentine, an ultramafic mineral that can form both as a direct nebular condensate and from hydrothermal aqueous alteration of Fe and Mg-bearing parent, has been observed in multiple locations in the solar system, including Earth, Mars, and Europa. Serpentine minerals are of particular interest in planetary exploration because they are habitable environments for microorganisms on Earth. Serpentinites are also rich in multiple trace elements, including Ni, Cr, Ti, Co, and Cu. When rocks or soils interact with aqueous solutions, changes in chemistry and mineralogy can occur. Such changes can preserve characteristics of the interactions with liquid water, including factors such as pH, duration, and chemical composition of the water, and can therefore act as signatures of those altering conditions.

We have completed a series of experiments examing the effects of organic acids and bacteria on both serpentine mineral (lizardite) and whole serpentine rock (serpentine + augite) dissolution. Oxalic acid accelerated the rate of lizardite dissolution by less than an order of magnitude in batch reactors over the pH range of 3 to 6. The presence of *Acidithiobacillus ferrooxidans*, a species common in acid mine drainage increased dissolution rates of lizardite in the first 8 hours of experiments in batch reactors at initial pH values ranging from 1.5 to 4.0.

Additionally, we completed whole rock serpentinite dissolution experiements to test the hypothesis that aqueous alteration with and without organic compounds will result in chemical signatures of alteration distinct from unaltered serpentine. Dissolution experiments were completed using solutions containing a) inorganic acids; b) organic compounds commonly resulting from abiotic processes (“abiotic organic compounds”); and c) organic compounds commonly resulting from biological processes (“biotic organic compounds”). Results from these experiments will allow interpretation of potential chemical and mineralogical signatures of aqueous alteration, which are useful because they may persist in the intense radiation at the surface of some planets including Mars.