Characterizing the biological and geochemical architecture of hydrothermally derived sedimentary deposits: coupling micro Raman spectroscopy with noble gas spectrometry. D.M. Bower[1], P.G. Conrad[1], A. Steele[2] and M.D. Fries[3], [1]Planetary Environments Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD 20771, dina.m.bower@nasa.gov, [2]Geophysical Laboratory, Carnegie Institution of Washington, 5251 Broad Branch Rd, NW, Washington, D.C., 20015, [3]Astromaterials Research and Exploration Science (ARES), NASA Johnson Space Center, Houston, TX 77058.

Introduction: The chemical components of sedimentary strata on the surface of Mars contain clues to its planetary evolution and possibly signatures indicative of life. The most efficient way to interrogate these clues is to use non-destructive in situ analytical techniques, but often it is necessary to use methods that are destructive to collected samples. A good strategy to combat the loss of potential biosignatures and paleoenvironmental indicators is to utilize non-destructive techniques prior to destructive ones.

A wide variety of microbes flourish in modern hydrothermal environments on Earth, and their ancient ancestors are preserved in siliceous deposits that formed in hydrothermal settings [1]. Hydrothermally derived silicate materials are also of particular relevance to Mars analog studies, and these studies may be very informative in determining possible landing sites for upcoming missions [2]. With these ideas in mind, chemical species in cherts and glass fragments representative of hydrothermally derived sedimentary samples were analyzed using micro Raman spectroscopy. We tested a novel Raman spectroscopic mapping technique that utilizes quartz Raman peak ratios to investigate features of interest in the context of silicate fabrics [3]. In particular, we established the provenance of quartz in cherts that contain multiple quartz generations and determined that much of the macromolecular carbon in our chert samples is not syngenetic.

To expand upon our understanding of the origins of the sedimentary deposits that contain possible biosignatures, we will also analyze the same sample fragments for heavy noble gas isotopes. The chemical inertness of noble gases (Ne, Ar, Kr, Xe) results in the retention of their isotopic signatures, and some of these signatures are useful in indicating the origins of hydrothermal deposits [4]. The noble gas xenon is especially useful as a geochemical tracer and can be trapped in amorphous siliceous materials as part of the silicate structure or as components of fluid inclusions [5]. Our goal is to combine micro Raman spectroscopy and noble gas spectrometry to robustly characterize the biological and geochemical architecture of ancient hydrothermal sedimentary deposits.

References:

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