Using the Abitibi Greenstone Belt to understand Martian hydrothermal systems and the potential for biosignature preservation in high temperature aqueous environments

J. Hurowitz[1], J. Abelson[2], A. Allwood[1], R. Anderson[3], B. Atkinson[4], D. Beaty[1], T. Bristow[5], B. Ehlmann[2], J. Eigenbrode[6], J. Grotzinger[7], K. Hand[1], I. Halevy[7], A. Knoll[8], D. McCleese[1], R. Milliken[9], M. Russell[1], D. Stolper[7], E. Stolper[7], N. Tosca[10]

[1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, [2]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, [3]Department of Astronomy, Cornell University, Ithaca, NY, [4]Ontario Geological Survey, Timmins, ON [5]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, [6]Planetary Environments Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, [7]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, [8]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, [9]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, [10]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA.

Impact and magmatic driven hydrothermal systems have long been postulated to exist on Mars. Recent observations of high-temperature mineral associations, e.g., smectite-chlorite-carbonate-serpentine, provide supporting evidence for hydrothermal environments in the ancient Martian rock record. In light of these discoveries, it is instructive to examine fossil hydrothermal systems on Earth to better understand the conditions under which martian hydrothermal mineral assemblages may have formed. Such investigations may prove to be important in the era of Mars Sample Return, as we possess little scientific understanding of the biosignature preservation potential of ancient terrestrial hydrothermal systems.

Motivated by these issues, the Agouron Institute organized a Geobiology Field School in July, 2011 to study the 2.7 Ga Abitibi greenstone belt in Ontario, CA. The Abitibi hosts world-renowned economic volcanogenic massive sulfide mineral deposits, and is characterized by a rich suite of lithologies emplaced predominantly in sub-oceanic settings, including komatiites, basalts, and rhyolitic volcanic rocks and banded iron formation, most of which have been hydrothermally altered, remineralized, and tectonically deformed under greenschist facies conditions. During a 10-day excursion to the Abitibi, guided by the Ontario Geological Survey, our team examined these assemblages, performed in-situ analyses using field portable active mid-IR and reflectance VIS-NIR spectrometers, an X-ray diffractometer, and an X-ray fluorescence spectrometer to inform an extensive sampling campaign. These samples have been returned to our laboratories for in-depth analysis. We will report on the outcome of our field campaign and discuss the unique opportunity provided by examination of the Abitibi to compare and contrast the effects of hydrothermal alteration and mineralization on an ocean planet with an active biosphere to a planet where the presence of large, long-lived water bodies and biology remain open questions.