Astrobiological Relevance of Weathering Serpentinites of Southwestern Puerto Rico.
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Introduction: Understanding biosignatures in systems analogous to those exposed on other planetary surfaces anchors astrobiology. The generation of serpentine minerals from parent rocks in Earth has been proposed as a chemosynthetic cradle of life on Early Earth [1,2,3]. Scrutiny of the serpentinization process (for which water is a prerequisite and which evolves hydrogen, a potential chemosynthetic fuel) will also inform Mars 2020 objectives at Jezero Crater, thought to be a clay-rich lake-delta system, with serpentine detected at crater rim outcrops [4].

In southwestern Puerto Rico, Cretaceous massive serpentinite (KJs, generally sheared, green, altered harzburgite) and carbonate-capped, conglomerate-hosted serpentinites from the Miocene/Oligocene (Tjd) and Maestrichtian to Santonian (Kp), age under tropical climate conditions [5], in terrains described as dry/moist or wet/lower montane wet [6]. These weathering units offer distinct petrographic and alteration histories in terms of unit ages and petrogeneses (c.f., [7]). We investigate selected samples from these locales to determine (a) how serpentinites weather in active through-flow settings, such as in shallow sub-surface settings, and (b) what kinds of mineralogical and geochemical signals are produced that relate to water percolation in crater rim settings, as proposed for the serpentine detections at Jezero Crater on Mars [4].

Methods: Serpentinite clasts in weathered planetary surface materials were analyzed by x-ray diffraction (mineral content), Fourier Transform infrared spectroscopy (bonding information), microscopy (petrography). Preliminary geochemistry data were also obtained. At the University of Rhode Island, bulk powders of samples were analyzed with an Olympus Terra XRD system and a Thermo Nicolet iS50 FTIR bench spectrometer coupled with a Continuum IR microscope, equipped with 250 µm and 50 µm MCT-A detectors. Geochemistry data were obtained by low resolution XRF (Niton system) and high resolution laser-ablation ICP-MS for selected specimens.

Results: Preliminary findings show weathering patterns within and between clasts. Bulk data on serpentine-dominated materials contextualizes fine differences in mineralogy and geochemistry.

Mineralogy. Differences in XRD data emerge when comparing bulk to clay splits and also with degree of weathering. FTIR data are generally complementary.

Petrography. Complex serpentinization and post-serpentinization alteration histories are shown by cross-cutting relationships and mineral replacement processes.

Geochemistry. Against a backdrop of relevant geochemical modeling results, fine scale geochemical data for weathering serpentinites follow predicted alteration paths with few excursions. We consider the integrated impacts of element loss and gain to the solid system over time, and relate this to weathering in extraterrestrial settings.

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