SULFATE MINERALIZATION IN NAKHLA: A CATHODOLUMINESCENCE AND FULL-SPECTRUM X-RAY IMAGING STUDY.
E. Pauli 1,2 and E. P. Vicenzi 1. 1Smithsonian Institution, Department of Mineral Sciences, Washington, DC, 20560-0119. epauli@nmnh.si.edu. 2George Washington University, Department of Earth and Environmental Sciences, 2029 G St., Washington, DC.

Introduction: If the recent discovery of a sulfate-rich mineral assemblage by the MER Opportunity team (1) holds-up to further scrutiny, it will represent the most definitive chemical evidence for ancient aqueous fluids on the surface of Mars. While the in situ spectroscopic identification of sulfates at the planet’s surface represents new information about Martian history, meteorite-based observations regarding evaporitic mineralization beneath the planet were first reported well over a decade ago (2). Subsequent work on the petrographic context and geochemistry of secondary mineral assemblages in Nakhla suggests these minerals precipitated beneath Mars from a low-temperature saline fluid, possibly remobilized from surface evaporate deposits (3), or, precipitated directly from a concentrated brine (4). We present detailed microanalyses and images of a Nakhla alteration assemblage localized along grain boundaries in the mesostasis that contain an assemblage of anhydrite, low-T silicate (clay?), and Cl-apatite.

Methods: Polished thin sections of Nakhla were prepared using a water-free procedure. Specimens were then screened for areas containing salt-bearing secondary minerals using backscattered electron microscopy. Areas of interest were imaged for X-rays of all energies using a ThermoElectron NSS EDS analyzer. Spectral deconvolution and matrix corrections were applied to each pixel yielding fully-corrected elemental images created from >65,500 individual analyses extracted from the data cube. A Ga-tan MonoCl3+ was then used to collect panchromatic, as well as red, green, and blue filtered images. CL-generated UV/VIS/NIR spectra of sulfates were also collected at several spectral resolutions.

Results: Ca sulfate (anhydrite) is a trace component in two thin sections of Nakhla 38LNH examined, and represents ~72 ppm by volume. Anhydrites grains up to ~60 μm in size were found situated along grain junctions of pyroxene and pockets of evolved igneous minerals (principally plagioclase An23). Clusters of smaller Cl-apatite (up to 15 μm long axis) are associated by anhydrite. These two minerals are incompletely surrounded by a thin envelope (3–4 μm) of low-T silicates. The silicate alteration contains ~0.7 wt % Cl and its major element chemistry is not consistent with stoichiometric clay (an indication this material includes an amorphous component). Cl is also a minor element in anhydrite at ~0.3 wt % level. The cathodoluminescence signal in the secondary mineralization is quite intense as anhydrite and Cl-apatite are strong CL emitters. Spectra taken from anhydrite yields major features at 500, 830, and 870 nm which interestingly does not match the well-documented REE activators (5).