CORRELATED ANALYSES OF EXPERIMENTALLY SPACE WEATHERED MINERAL SAMPLES. T. D. Glotch[1], S. L. Nicholas[1], C. Legett IV[1], J. M. Young[1], and J. Thieme[2], [1]Department of Geosciences, Stony Brook University, Stony Brook, NY, timothy.glotch@stonybrook.edu, [2]National Synchrotron Light Source II, Brookhaven National Laboratory, Upton, NY

Introduction: Space weathering is a process that affects every airless body in the Solar System. The combined effects of micrometeoroid and high energy particle impacts, solar wind implantation and sputtering, and comminution, lead to chemical and physical changes in airless body regolith surfaces that result in pronounced changes to spectra across multiple wavelength ranges. At visible/near-IR (VNIR) wavelengths, spectra become darker and redder, with weakened crystal field bands. At mid-IR wavelengths, Reststrahlen and transparency features become weaker and the Christiansen feature (CF) emissivity maximum shifts to longer wavelengths.

The relative roles of solar wind and micrometeoroid bombardment in the space weathering process are the subject of much debate. In this work, we subjected single crystals of olivine to micrometeoroid impacts at the Dust Acceleration Laboratory (DAL) at the University of Colorado and conducted a set of correlated analyses of the post-impact samples.

Methods: Polished single crystals of San Carlos olivine were prepared for impact experiments at the DAL. Prior to the impact experiments, we irradiated one crystal with 12 keV protons at the Brookhaven National Laboratory Tandem Van de Graaf generator to simulate solar wind bombardment. At the DAL, both samples were subjected to ~10,000 impacts by ~0.1 µm dust grains coated in conductive polypyrrole and traveling at velocities between 1 and 10 km/s. The recovered samples were analyzed using VNIR reflectance spectroscopy, confocal Raman spectroscopy, micro-FTIR reflectance spectroscopy, and synchrotron X-ray absorption spectroscopy. At the time of this writing, transmission electron microscopy (TEM) and synchrotron micro- and nano-FTIR measurements of the samples are imminent.

Results and Discussion: Raman and IR (Figure 1) maps of the impacted samples reveal the presence of amorphous or disordered material around the impact sites. Micro-FTIR spectra reveal disorder through the weakening of the 920 cm^{-1} Si-O vibrational band in the regions surrounding individual impact craters. Raman spectra in heavily impacted areas of the samples display weaker olivine spectral features and high fluorescence, which is also consistent with the presence of amorphous material.

To investigate the impact craters at finer spatial scales, we have acquired focused ion beam (FIB) sections of portions of the samples for TEM analyses. TEM results, grazing-angle synchrotron X-ray absorption spectra, and synchrotron nano-IR spectra in regions surrounding the impact craters will also be presented.

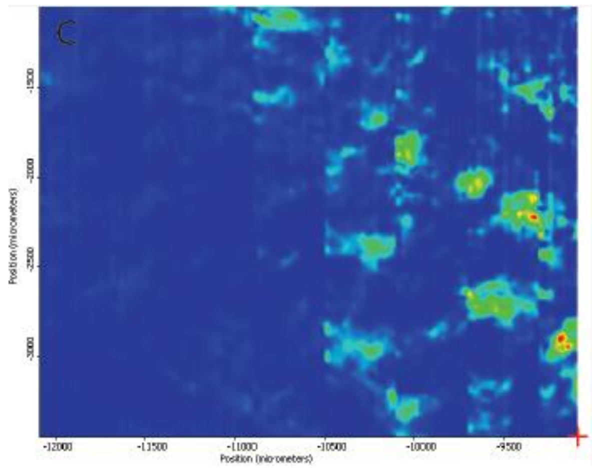

Figure 1. Micro-FTIR map (25 microns/pixel) displaying the strength of the 920 cm^{-1} peak of olivine in a post-impact sample. Dark blue regions have not been affected by impacts, while the green, yellow, and red regions, which correspond to impact craters, display reduced 920 cm^{-1} band strength, indicating structural disorder.