Spectral Effects from Synthetic Space Weathering. K. A. Shirley[1], T. D. Glotch[1], Y. Yang[2], T. Jiang[2] and H. Zhang[2], [1]Geoscience Department, Stony Brook University (katherine.shirley@stonybrook.edu), [2]Planetary Science Institute, School of Earth Sciences, China University of Geosciences.

Space weathering is an important aspect of regolith development on airless bodies within our solar system that includes micrometeorite bombardment and solar wind irradiation. In the visible and near-infrared (VNIR) reflectance spectra exhibit reduced overall albedo and band strength, and have spectrally red slopes due to space weathering [1-4]; however, there have been few studies on the effects of space weathering on mid-infrared (MIR) spectra. Environmental conditions in which the MIR spectra are measured have been shown to cause spectral shifts from terrestrial spectra [5&6], and the reduction in albedo is likely to produce thermal changes in regolith, which would affect MIR emission spectra. Here, we present our study on the effects of synthetic space weathering on MIR spectra measured within a simulated lunar environment.

We measured VNIR reflectance and MIR emission spectra of laser pulse irradiated olivine samples from [7], and of olivine mixed with nanophase carbon. The olivine from [7] displays all typical space weathering features in the VNIR, but the carbon-darkened olivine only mimics the reduced albedo without the red slope in the VNIR. This distinction was to examine effects of optical and compositional changes versus purely optical changes.

It is important to replicate environmental conditions for the MIR because of the thermal environment in the upper 100s of microns of regolith on airless bodies. For the Moon, the thermal gradient within this region of regolith is extreme [6]; therefore, all samples were measured in the MIR under simulated lunar environment conditions in the Planetary and Asteroid Regolith Spectroscopy Environmental Chamber at Stony Brook University. The Christiansen Feature (CF), an emissivity maximum indicative of silicate polymerization, shifted to longer frequency with increased weathering. Additionally, the band depth of the Reststrahlen Bands, features due to the stretching and bending of the silicon-oxygen bonds, tended to weaken with increased weathering. We compared the CF position to albedo, which was defined as the 750 nm reflectance, and noted a linear correlation between CF frequency and albedo for both the irradiated and carbon-darkened samples.

Because this trend is observed in both sets of olivine samples, we conclude that the shifts in the MIR emission spectra under simulated lunar environment are due solely to the darkening component of space weathering. The generation of nanophase iron from the irradiation experiments does not appear to alter the bulk silicate structure represented in the MIR spectral features. We will continue to study these trends using other rocks and minerals common on the Moon and compare these data to remotely sensed data.

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