IMPACT EXPERIMENTS INTO SERPENTINE – IMPLICATIONS FOR SPACE WEATHERING ON C-TYPE ASTEROIDS. D. L. Domingue[1], I. Hsu[1], S. M. Lederer[2], A. D. Whizin[3], Z. Landsman[4], N. Pearson[1], F. Vilas[1]. [1]Planetary Science Institute, 1700 E. Fort Lowell, Tucson AZ 85719, domingue@psi.edu, [2]NASA Johnson Space Center, Houston, TX, [3]Soutwest Research Institute, San Antonio, TX, [4]The Florida Space Institute, Orlando FL.

Introduction: Micromeorite and ion bombardment, both space weathering processes, affect the spectral reflectance properties of regolith grains on atmosphere-less bodies (e.g., [1]). The spectral effects on lunar and S-type asteroids (including OC chondrites) are well documented and understood (e.g., [1]). In the visible to near-infrared (Vis-NIR) wavelengths they darken (lowers the spectral albedo), reduce spectral contrast (diminishes the strength of absorption features), and redden (increases the slope of the continuum reflectance with increasing wavelength) reflectance spectra (e.g., [1]). In contrast, at ultraviolet to visible (UV-Vis) wavelengths these processes turn spectra bluer (decreases spectral slope with increasing wavelength) [2, 3]. The spectral effects on dark, carbonaceous materials, however, is more complex and has been correlated to initial compositions in laboratory radiation studies of carbonaceous chondrites (e.g., [4]).

Pulsed-laser experiments mimicking the micrometeorite bombardment process have been conducted on Allende (CV) and Murchison (CM) [5 – 7] and on phyllosilicates [8], also showing variations dependent on initial composition, in alignment with what is observed in ion radiation experiments mimicking solar wind ion bombardment (e.g., [4]).

Pulsed-laser experiments produce melting and vaporization, similar to micrometeorite bombardment, but does not produce the quantity of melt [9] nor the shock effects that are produced by micrometeorite bombardment. Here we present the results from impact experiments into powdered samples of serpentine to replicate the melt and shock effects of micrometeorite bombardment.

Impact Experiment: The experiments were performed at the Johnson Space Center's (JSC) Astromaterials Research and Exploration Science (ARES) research laboratory's Experimental Impact Laboratory (EIL) with their vertical gun facility using the procedures developed by [10]. Impact velocities were targeted to ~2.43 km/s into powdered samples of serpentine UB-N.

[11] reported on preliminary examinations of a single sample shot multiple times (Figure 1). Here we report on a series of samples, shot once, and compare with a re-examination of the [11] sample.

Samples were collected from multiple locations within the sample holder post impact for the singly shot samples. Spectra were acquired from each location sampled.

Figure 1. (Taken from [11]). Images of the serpentine sample after the fourth impact (left), along with the crater produced by the impact (right). The crater is 60 - 70 mm deep. The shot velocities for this experiment ranged between 2.41 to 2.44 km/s, a total of 6 shots were made into this sample.

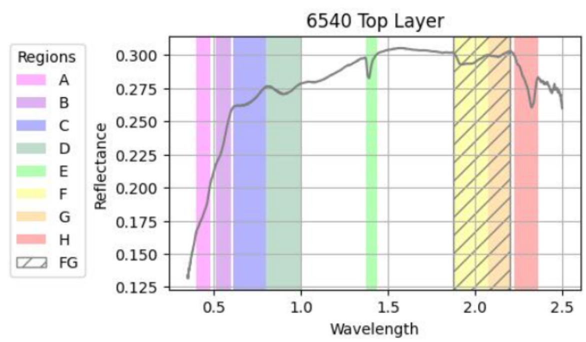

Figure 2. Spectrum of the top layer from sample #6540. The color regions highlight the different absorption bands examined. The absorption F and G were examined separately (yellow and orange, respectively) and in combination (hatched region).

Spectral Analyses: Reflectance measurements of the samples collected, including a control sample, were made in the near-ultraviolet to near-infrared (200 – 2500 nm) using facilities at the Planetary Science Institute.

An example spectrum (Figure 2) shows the identification of absorption features within the serpentine spectra. Each absorption feature was examined using the same process: 1) calculating the continuum across the shoulders on each side, 2) removing the continuum slope by dividing the spectrum by the continuum, 3) calculating the resulting band depth, band minimum position, and band area. Band minimum was measured by finding the lowest reflectance value of the best-fit sixth-degree polynomial of the standardized band. The band depth is the greatest reflectance value subtracted by the lowest reflectance value. Since the greatest reflectance value after standardization is always 1 and the lower boundary is always the band minimum, band depth = 1-band minimum. Band area is the area between the adjusted continuum and the adjusted band. This was found by using the best-fit polynomial and taking the integral between the two shoulders of the band.

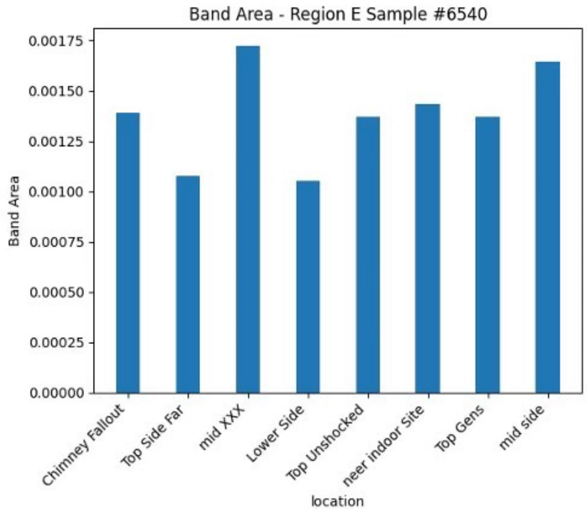

Figure 3. Example of band area variations as a function of sample location from the impact site.

Results: Preliminary results show subtle variations in band area and band depth (example shown in Fig. 3). Changes in spectral slope, both UV-Vis and NIR, predominantly show blueing in both wavelength regions, though some samples display reddening. These responses are different than that seen by [8], who examined cronstedtite and lizardite. The spectral variations show no systematic trends, and are still being analyzed.

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