**EFFECTS OF MICROMETEOROID IMPACT EXPERIMENTS ON THE INFRARED SPECTRA OF OLIVINE.**

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**Introduction:** It is well understood that surface materials on airless planetary bodies are affected by various astrophysical phenomena. These phenomena and the surface processes they cause are collectively referred to as space-weathering [1]. Space-weathering occurs as result of several processes including the exposure to solar wind and high-frequency radiation. Another important cause of the space-weathering of surfaces is micrometeoroid bombardment. Through high-velocity impacts, micrometeoroids are known to contribute to the space-weathering of materials via pulverization of existing mineral grains. Continuous bombardment causes the comminution of larger grains into fine-grained regolith. Due to the high-energy nature of these impacts, surface materials are frequently melted and vaporized as well. The space-weathering processes, including micrometeoroid impacts, cause spectral changes in the visible/near-infrared [2]. Specific effects include (1) *darkening,* (2) *reddening, and* (3) *absorption feature dampening.* While well known, it is unclear and difficult to discern which space-weathering processes or combinations thereof cause a specific spectral effect. In this work, we conducted micrometeoroid impact experiments in order to understand the specific contribution that micrometeoroid impacts have on space-weathering spectral effects.

**Methods:** The materials chosen to be impacted were single crystals of olivine $(Fe,Mg)_2SiO_4$). For this study, two highly polished thick sections of the same single crystal olivine grain were prepared. One olivine section was irradiated with 12 keV protons at the Tandem Van de Graaf generator at Brookhaven National Laboratory and the other section remained unaltered. Spectra were collected before and after proton bombardment and on the unaltered sample as well. Impact experiments were conducted using the accelerator at the Dust Accelerator Lab (DAL) in the Institute for Modeling Plasma, Atmospheres, and Cosmic Dust (IMPACT) at the University of Colorado Boulder. The impactor material used for the experiments was synthetic olivine coated in the organic polymer polypyrrole. A group of impactors with size on the order of 0.1 µm, corresponding to a velocity range between ~1-10 km $s^{-1}$, were used. For each experiment, approximately 10,000 particles impacted the sample. The distribution of impactor mass vs. velocity for one experiment can be seen in Figure 1. Spectra from each target sample were collected before and after the experiment using an ASD FieldSpec3 portable spectrometer.

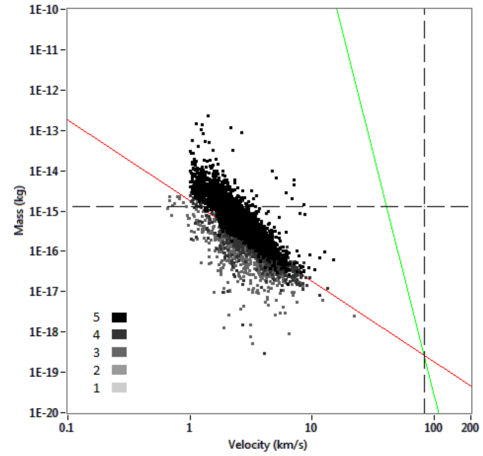


**Figure 1.** Impactor mass vs. velocity distribution.

**Results & Discussion:** Spectra collected from the two olivine sections post impact experiments, show major darkening at all wavelengths, save ~1.0-1.4µm. Sharp and pronounced features are seen in the spectra collected before impacts are observed to be broader and dampened in the post-impact spectra seen in Figure 2. Post-impact surface characterization via Raman spectroscopy shows that highly impacted areas on the olivine include amorphous material and are coated in carbonaceous material which could be a cause of the observed spectral effects. Transmission electron microscopy will be employed in order to ascertain the presence of nano-phase iron ($npFe^0$) in weathered samples.

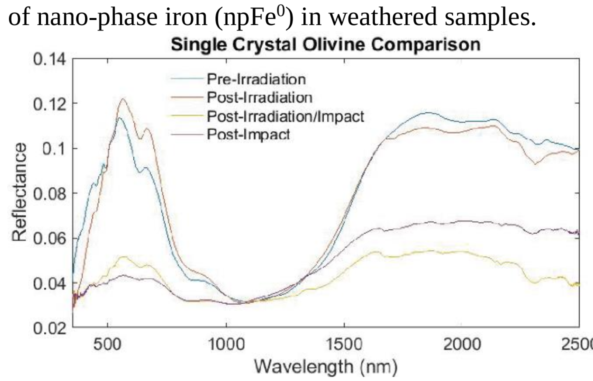


**Figure 2.** Visible/near-infrared spectra collected from pre- and post-impact polished olivine sections

**References:** [1] Hapke (2001) *JGR*, *106*, 10039–10073. [2] Pieters et al. (2000) *MPS*, *35*, 1101-1107