MICROMETEORITE IMPACT EXPERIMENTS INTO SERPENTINE: PRELIMINARY ANALYSIS OF SPECTRAL PROPERTIES. B. C. Lorin[1], Z. A. Landsman[2], A. D. Whizin[3], S. M. Lederer[4], F. Vilas[1], D. L. Domingue[1], N. Pearson[1], [1]Planetary Science Institute, 1700 E. Fort Lowell, Tucson AZ 85719; blorin3@jhu.edu, [2]The Florida Space Institute, Orlando FL, [3]Soutwest Research Institute, San Antonio, TX, [4]NASA Johnson Space Center, Houston, TX,

Introduction: One of the key space weathering processes, along with solar wind irradiation, is the bombardment of planetary surfaces by micrometeorites. [e.g. 1]. Simulations of micrometeorite bombardment via pulsed laser experiments [2 – 9] have provided insights into the regolith alterations, such as vapor deposition and nanoscale Fe production, created by this process. Here, we present results of spectral measurements from actual projectile bombardment micron-scale materials targets in the laboratory.

Studies to date have focused on materials relevant to the lunar surface and S-complex asteroids. With the return of C-complex asteroid samples from 162173 Ryugu by Hayabusa2 and the anticipated return of samples from 101955 Bennu by OSIRIS-REx, we examine the spectral effects on hydrated materials, namely an iron-bearing serpentine, from micrometeorite bombardment.

Laboratory Experimental Setup: The impact experiments were conducted at the NASA Johnson Space Center Vertical Gun Facility. Each sample examined was impacted using the procedures developed by [10]. Impact velocities were targeted to ~2.43 km/s.

Our experiment focuses on the study of a serpentine sample that was impacted several times to examine the possible progression in spectral properties as a function of impact occurrence and the accumulation of shock effects. (Figure 1).

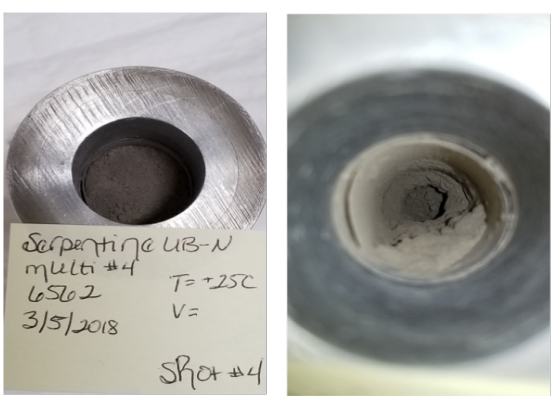

Figure 1. Images of the serpentine sample after the fourth impact (left), along with the crater produced by the impact (right). The crater is 60 -70 mm deep. The shot velocities for this experiment ranged between 2.41 to 2.44 km/s, a total of 6 shots were made into this sample.

Spectral Analysis Methods: The analysis examined the properties of seven mineralogical absorption features (identified in Figure 2), measuring their band position, depth, and area. The band position was determined from the wavelength at which the minimum in reflectance occurred between the band shoulders. To calculate the band depth, we took the difference between the minimum reflectance value of the band and the corresponding reflectance value on the continuum slope across the band at the same wavelength. Band area was calculated from the difference between the integral of the line describing the continuum and the integral of a polynomial estimation to fit the band. An example is shown in Figure 3.

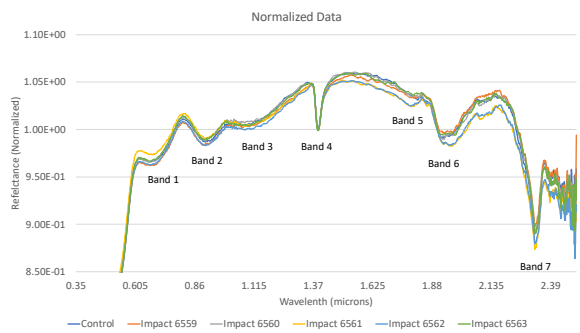

Figure 2: The normalized reflectance spectra for all impacted serpentine samples and control sample, identifying the bands studying in these analyses.

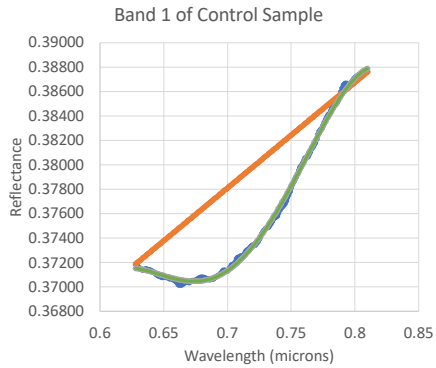

Figure 3: Band 1 from the control sample spectrum. The orange line is the continuum (based on on shoulder potisions at 0.628 and 0.810 microns),, the green line is the polynomial approximation of the band, and the blue points are the measured reflectance values of the band (see Table 1).

Spectral Analysis Results: The measured band properties are summarized in Table 1. The Control sample experienced no impacts. Sample ID 6559 was impacted once, and each subsequently increasing sample ID number experienced an additional impact.

No appreciable shifts in band position are noted. There are subtle variations in band depth and area, but the correlation with number of impacts is still being investigated.

Table 1. Summary of Band Properties

Sample ID	Band Position	Band Depth	Band Area
Band 1			
Control	0.662	0.00464	0.000671861
Impact 6559	0.67	0.00571	0.000760939
Impact 6560	0.673	0.00615	0.000707652
Impact 6561	0.679	0.00585	0.000648143
Impact 6562	0.67	0.00579	0.000739579
Impact 6563	0.67	0.00659	0.000828204
Band 2			
Control	0.907	0.00901	0.000959432
Impact 6559	0.897	0.00937	0.001022991
Impact 6560	0.908	0.00982	0.001002316
Impact 6561	0.904	0.00927	0.00094976
Impact 6562	0.907	0.0095	0.000986384
Impact 6563	0.908	0.00877	0.000852961
Band 3			
Control	1.082	0.00419	0.000902005
Impact 6559	1.066	0.00302	0.000784872
Impact 6560	1.073	0.00355	0.000867772
Impact 6561	1.074	0.00423	0.001177916
Impact 6562	1.073	0.00443	0.001299119
Impact 6563	1.093	0.00434	0.00082776
Band 4			
Control	1.391	0.01887	0.000540833
Impact 6559	1.391	0.01864	0.000548596
Impact 6560	1.391	0.01999	0.000597851
Impact 6561	1.391	0.01891	0.000570751
Impact 6562	1.391	0.01916	0.00057394
Impact 6563	1.391	0.01955	0.000563352
Band 5			
Control	1.92	0.01518	0.001804032
Impact 6559	1.935	0.01602	0.002056053
Impact 6560	1.931	0.01623	0.001959684
Impact 6561	1.962	0.0158	0.001988542
Impact 6562	1.952	0.01638	0.002045169
Impact 6563	1.978	0.0156	0.002152449
Band 6			
Control	2.107	0.0019	7.31745E-05
Impact 6559	2.113	0.00049	9.48054E-06
Impact 6560	2.112	0	2.49965E-06
Impact 6561	2.092	0.00322	0.000176789
Impact 6562	2.104	0.00241	0.000141872
Impact 6563	2.133	0.00202	3.03786E-05
Band 7			
Control	2.323	0.03478	0.068106188
Impact 6559	2.323	0.03445	0.071155495
Impact 6560	2.323	0.03481	0.073272135
Impact 6561	2.323	0.03491	0.074748122
Impact 6562	2.323	0.03391	0.073617032
Impact 6563	2.323	0.03358	0.072833821

Discussion: There are no clear trends seen in spectral slope or band properties with increasing number of impacts. This is in contrast to what is observed in iron-bearing silicates. This suggests that the markers for space weathering in hydrated silicates are different than those in mafic silicates, such as olivine and pyroxene.

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