ASSESSMENT AND CHARACTERIZATION OF SPACE WEATHERING STYLES ON ASTEROID SURFACES. E. M. MacLennan[1], J. P. Emery[1], M. P. Lucas[1], N. Pinilla-Alonso[1,2], [1]Earth & Planetary Sciences Department, University of Tennessee, Knoxville, TN 37996 (emaclenn@utk.edu); [2]Florida Space Institute, University of Central Florida, Orlando, FL 32816.

Introduction: Solar wind exposure and micrometeoroid bombardment are known to cause mineralogical changes in the upper few microns of silicate grains (by forming amorphous rims with embedded nano-phase Fe^0), which affect the light-scattering properties [1]. Changes in the albedo, spectral slope, and absorption band depths observed on silicate surfaces are used as proxies for the amount of alteration due to increased nano-phase Fe^0 [2].

Observations of the Moon have allowed for the characterization of a "lunar-style" of space weathering, characterized by a decrease in albedo, increase in spectral slope, and suppresion of absorption bands [2]. However, images (from spacecraft missions) of (243) Ida and (433) Eros suggest that different space weathering "styles" exist among the silicate-bearing S-complex asteroids (e.g., [3]). While Eros generally shows only an albedo difference [4], Ida's surface only shows changes in spectral slope and band depth [5]. In many space weathering studies, it is often assumed that the lunar style is relevant, and there has been no comprehensive investigation involving all three observable changes relevant to space weathering.

In addition to searching for different space weathering styles, we aim to quantify the factors (solar wind exposure, regolith grain size, mineralogy, and surface age) affecting the degree of space weathering. It has already been shown that asteroids with higher olivine abundance and older surface ages show increased evidence of space weathering [6]. [7] suggests that smaller regolith particles, which have more surface area per volume, should enhance the spectral effects associated with space weathering, but this has not yet been observationally tested for asteroid regoliths.

We present the preliminary results of a new project aimed at searching for and characterizing differing styles of space weathering among S-complex asteroids and quantifying the dependence on solar wind exposure, regolith grain size, mineralogy, and surface age using a large set of near-infrared (NIR) reflectance spectra.

Hypothesis: We hypothesize that increased solar wind exposure, smaller regolith particles, higher olivine abundance, and older asteroid surfaces will exhibit enhanced evidence of space weathering.

Methods: The first task of this project is to derive spectral parameters from Visible-NIR (0.4 to 2.5 μm) spectra for ~500 S-complex asteroids. Most of the data will be taken from existing databases (e.g., MIT-UH-IRTF Joint Campaign for NEO Reconnaissance [8]). In addition, we will target 52 S-complex asteroids using IRTF-SpeX of which we will have grain size estimates (from a separate project). Spectral slopes and absorption band depths will be calculated using the SARA band analysis code developed by [9]. Geometric albedos will be calculated using thermal emission data from the WISE [10] survey.

Search for Space Weathering Styles: We will compile a set of asteroid albedos, band depths, and spectral slopes for approximately 500 asteroids. This will allow us to identify objects that undergo different space weathering "pathways" (e.g., surfaces that experience albedo changes but no spectral reddening).

Space Weathering Factors: The goal of the project is to quantify how solar wind exposure, regolith grain size, mineralogy, and surface age influence the degree of space weathering. At the workshop, we will focus on asteroids in which we will have grain size estimates from thermal infrared data. The approach here is to approximate an un-weathered spectrum for each object, by using a bootstrap method involving a combination of laboratory spectra from the NASA RELAB facility and Hapke's radiative transfer model [7]. Using estimated mineralogy from the set of corrected band parameters [11][12][13] the expected un-weathered albedo, spectral slope, and band depth will be compared to the observed quantities to determine the degree of space weathering and its dependence on regolith grain size.

Preliminary results presented at the workshop include our search for different space weathering styles and newly acquired asteroid spectra from the IRTF, with the corresponding estimated regolith grain size.

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