LUNAR SAMPLE 61016 DOCUMENTS A RAPID DEVELOPMENT OF WEATHERING PRODUCTS IN THE LUNAR ENVIRONMENT. C. M. Pieters[1], G. R. Osinski[2], T. Hiroi[1], [1]Brown University, Dept. Earth, Environmental, and Planetary Sciences, Providence, RI, 02912 USA (Carle_Pieters@brown.edu), [2] Institute for Earth and Space Exploration, University of Western Ontario, Canada

Introduction: It is widely recognized that the lunar highlands are dominated by feldspathic breccias believed to result from an extensive impact history of anorthositic crustal products derived largely from a primordial magma ocean. Global remote sensing of the lunar crust confirms that the highlands exhibit a distinctly low abundance of mafic minerals. Returned samples and meteorites nevertheless reveal a complex diversity of feldspathic crustal rock types that include small concentrations of olivine, pyroxene, spinel, accessory minerals and radiogenic and rare-earth elements (KREEP). Although it is recognized that the optical properties of lunar materials alter when exposed to the space environment, the time scale for space weathering products to accumulate in a regolith is poorly constrained. We report coordinated spectroscopic and petrographic measurements from a large well-documented Apollo 16 rock, 61016 'Big Muley', that suggest some weathering process are relatively rapid for material exposed in the lunar environment. Sample 61016 is a 11.7 kg rock described as an impact melt rock with a shocked/melted anorthosite cap. It is believed to have been emplaced by South Ray Crater dated at ~2 Ma and remained exposed to the lunar environment at Apollo 16 since then.

Analyses: We analyzed samples of individual lunar anorthositic lithologies as well as several from 61016. Spectroscopic analyses of particulate samples were measured in RELAB and coordinated grain mounts allowed petrographic analyses at University of Western Ontario. We obtained an additional chip of sample 61016 (,546) that exhibits a patina developed on its exposed anorthositic surface (**Fig. 1**). This chip enabled spectra to be obtained for 2 mm areas across different lithologies. VNIR RELAB bidirectional reflectance (BDR) spectra for all samples are shown in **Fig. 2**, spliced with longer wavelength FTIR spectra at 2.5 μm.

Results: The petrographic and spectroscopic analyses are consistent and support the same results: plagioclase diaplectic glass is pervasive in 61016 samples along with remnant crystalline plagioclase. Most noteworthy is the spectroscopic distinction between the exposed anorthositic cap (,546 A) and similar anorthositic material immediately beneath it (,546 D). Both exhibit the same combination of crystalline plagioclase and diaplectic glass absorption bands (Fig. 2). The exposed surface (A) that accumulated a patina after the rock was emplaced at Apollo 16 exhibits the classic optical properties of $npFe^0$ space-weathering products. Thus, given the additional erosional effects of micrometeorites, this observed space weathering patina must have developed over a period of less than 2 Ma, *i.e*., after South Ray Crater formed and emplaced 'Big Muley' at Apollo 16. Note, however, that diagnostic absorption bands were not substantially diminished in the process.

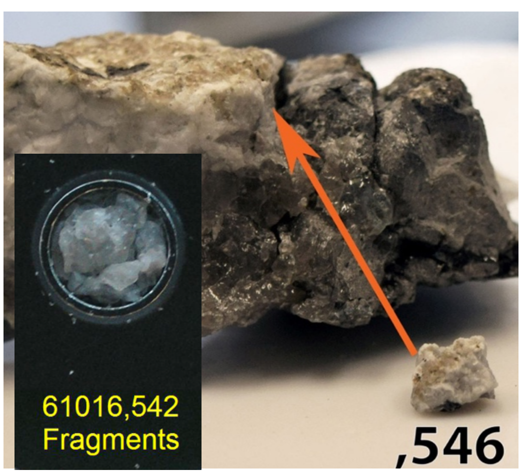

Figure 1. Portion of the anorthositic cap of 'Big Muley' 61016. The location of the ~6 mm 61016,546 chip from the shocked anorthosite is indicated. Particulate sample 61016,542 (shown in RELAB sample dish) was derived from the vitreous zone below the cap and contains abundant plagioclase diaplectic glass.

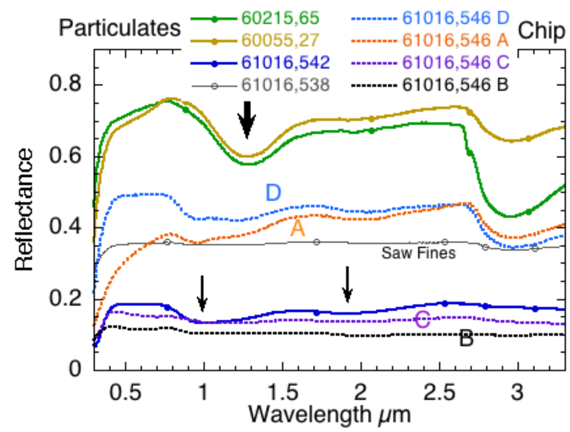

Figure 2. Reflectance spectra of particulate anorthositic lunar samples and areas on the small chip of 61016. [61016,538 saw fines are contaminated.] Large arrow indicates the absorption diagnostic of crystalline plagioclase and small arrows indicate the two glass absorption bands diagnostic of maskelynite (plagioclase diaplectic glass). 61016,546 area **A** contains significant surface patina; area **D** is contiguous unexposed shocked anorthosite.