REMOTE CHARACTERIZATION OF A UNIQUE FE-BEARING SPINEL LITHOLOGY IN GRIMALDI B CRATER. D. P. Moriarty1,2,3, N. Petro1, K. Runyon1, T. C. Prissel4, K. Prissel5,6, T. Powell7, B. Greenhagen7, and D. Buczkowski7, 1NASA GSFC (8800 Greenbelt Rd, Greenbelt MD, Daniel_Moriarty@NASA.gov), 2University of Maryland, College Park, 3Center for Research and Exploration in Space Sciences, 4Planetary Science Institute, 5NASA JSC, 6Jacobs, 7JHUAPL.

Introduction: Grimaldi B (2.94°S, 290°E, 22 km diameter, Eratosthenian age) is the largest impact crater preserved within the 235-km inner ring of Grimaldi Basin, which is partially filled with mare basalts and associated with a subsurface mascon[1,2]. Grimaldi B lies near the heavily degraded northern segment of Grimaldi’s inner ring, just outside of the primary mare sea. Because of its size and location relative to Grimaldi’s volcanic fill, transient cavity, and hypothesized impact melt deposit, Grimaldi B likely excavated material recording the formation and evolution of Grimaldi (e.g., impact melt, pre-existing crust, and post-basin volcanic materials).

Data and Observations: Optical imagery, albedo, and topography for the Grimaldi B walls and interior are presented in Fig. 1. Grimaldi B exhibits a bimodal albedo distribution across several datasets. The southwest wall and areas of the crater floor exhibit low albedo materials, whereas the remaining crater structure appears higher in albedo. This is apparent in both LROC NAC low solar incidence angle imagery (which highlights albedo variations) as well as Hapke-processed LROC WAC 689 nm albedo maps.

What is the nature of this dark material? Spectroscopic data from Moon Mineralogy Mapper (M3)[3] and Kaguya Multiband Imager (MI)[4] provide mineralogical information at ~100 m spatial resolution. These data reveal mineralogical diversity within low-albedo materials in Grimaldi B.

Near-infrared spectra (Fig. 2) of the low-albedo floor unit acquired by M3 exhibit a deep, broad spectral absorption around 2 µm, with a much weaker feature at 1 µm. This spectral signature is indicative of spinel. However, most lunar spinels previously identified in M3 data are Fe-poor MgAl spinels in a low-Fe anorthositic assemblage, and thus do not exhibit a feature at 1 µm[5]. In contrast, the Grimaldi B spinel-bearing unit exhibits 1 µm absorptions consistent with Fe-bearing minerals, either within the spinel itself or a coexisting silicate mineral (i.e., pyroxene, as the unit exhibits very low olivine abundance (Fig. 3))[6]–[10].

The low-albedo unit on the southeast crater wall exhibits a more typical spectrum typical of basalt, with deep spectral absorption bands around 1 µm and 2 µm. This material is spectrally similar to the basalts in the interior of Grimaldi Basin.

These spectral properties and their spatial distributions are reinforced through Kaguya derived mineralogy products (Fig. 3). FeO abundance maps show high FeO anomalies associated with the low albedo materials in Grimaldi B’s wall and floor. The olivine abundance map reveals the heterogeneity within these low-albedo materials. The floor deposit exhibits a local minimum, consistent with the lack of a strong 1 µm absorption. In contrast, the low-albedo material in the southeast wall exhibits an enhancement in olivine abundance, and M3
spectra are consistent with an olivine- and clinopyroxene-bearing basaltic assemblage. Both low albedo units exhibit distinctively low plagioclase.

**Discussion.** What is the nature of this spinel-bearing deposit, and are there similar examples elsewhere on the Moon?

**Morphology:** The spinel deposit is not clearly associated with any topographic or morphologic features such as central peaks or small impact craters. It does not exhibit telltale signs of impact melt emplacement such as surface fracturing or flow features[11]. There are no obvious volcanic vents that could indicate a pyroclastic origin[12]. Small craters across the unit do not appear anomalously bright, suggesting that this material is not simply a surface veneer but it in fact an integral part of the crater floor itself.

**Mineralogy:** Spectrally, the Grimaldi B unit is different from previously-identified pink spinel anorthosites[5] due to the presence of a 1 µm feature indicating the presence of Fe. Although spinel-bearing pyroclastic materials within Sinus Aestuum) [12] and highlands soils with a minor spinel component (<5 wt%)[10] have previously been reported to exhibit a 1 µm absorption feature[12], the lithology in Grimaldi B appears to be a distinct Fe-bearing spinel assemblage (or a MgAl spinel within a pyroxene-bearing assemblage). Lunar pyroclastic glasses (including the spinel-bearing glasses at Sinus Aestuum) commonly exhibit anomalously high values in the Kaguya olivine abundance parameter[13], whereas the Grimaldi B unit exhibits a local minimum in this parameter (Fig. 3). The <5 wt% Fe-spinel-bearing highlands materials previously identified were not associated with notably low albedo[10], whereas the Grimaldi B spinel lithology does exhibit low albedo, indicating a higher spinel abundance. These factors indicate that the Grimaldi B Fe-spinel-bearing lithology is distinct those previously observed at Sinus Aestuum and Crisium. The Grimaldi B spinel-bearing deposit appears to be a lithology not previously identified on the lunar surface.

**Geologic Setting:** The Grimaldi B spinel deposit is located within a continuous low-albedo region in the southwest floor and wall of the crater, and is located near the edge of the low-albedo basaltic unit near the contact with feldspathic crustal material. For this reason, it is reasonable to hypothesize that this spinel could have formed through the interaction of intrusive basaltic magma with feldspathic wall rock, as has been previously invoked to explain both pink spinel anorthosites and the broadly-distributed spinel-bearing pyroclastic materials at Sinus Aestuum. Analysis of the Cr content in these spinels is required to confirm this hypothesis.

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**References:**