REMOTE SENSING STUDIES OF THE GRIMALDI REGION OF THE MOON; B.R. Hawke, C.A. Peterson, P.G. Lucey, C.R. Coombs, Hawaii Institute of Geophysics and Planetology, SOEST, University of Hawaii, Honolulu, HI 96822; P.D. Spudis, Lunar and Planetary Institute, Houston, TX 77058

INTRODUCTION: Grimaldi basin is a Pre-Nectarian double-ring impact structure centered at 5°S, 68°W.[1] This multiringed basin was identified and described by Hartmann and Kuiper.[2] Mare basalt covers much of the basin interior to the 230-km-diameter inner ring and is also present in Lacus Aestatis and in the interior of the craters Riccioli and Crüger. A somewhat more irregular outer ring has a diameter of 430 km.[1] We have collected and analyzed seventy near-infrared reflectance spectra (0.6-2.5 μm) for a wide variety of geologic units in the Grimaldi region. The purposes of this study include the following: 1) To determine the composition of geologic units in the region; 2) To investigate the composition of highlands materials exposed by the Grimaldi impact event as well as the stratigraphy of the Grimaldi pre-impact target site; 3) To gain a better understanding of Orientale-related deposits in the region; and 4) To investigate the nature and origin of mare and dark mantling units.

RESULTS AND DISCUSSION:

Orientale Exterior Deposits--Much of the Grimaldi region is covered by the Hevelius Fm., a highlands unit that was emplaced as a result of the Orientale impact event.[3] Numerous spectra were obtained for mature surfaces on the Hevelius Fm. as well as young craters that expose fresh Hevelius material. Analyses of these spectra show the presence of plagioclase feldspar and low-Ca pyroxene. Noritic anorthosites dominate the terrain between the Cordillera ring and Crüger crater, but anorthositic norites are more common elsewhere. These results are in agreement with our previous findings[4] as well as the preliminary results of the Galileo SSI experiment.[5]

Grimaldi-Related Units--Even though Orientale-related deposits cover and obscure primary Grimaldi material in most areas, some spectra were obtained for fresh craters that expose Grimaldi debris. Both Grimaldi DA and GA expose material from the peak ring of Grimaldi basin. An analysis of the spectra obtained for these small craters indicates that either no "1 μm" absorption features exist or that they are extremely shallow bands. Only very minor amounts of low-Ca pyroxene are present in the areas for which the spectra were obtained; an anorthosite lithology is indicated. At least a portion of the Grimaldi inner ring is composed of pure anorthosite.

Anorthosite has also been identified at Damoiseau D (diameter = 17km). This crater is located on the rim of Damoiseau A, a 47-km impact crater, located largely between the inner and outer rings of Grimaldi, which excavated material from deep beneath the floor deposits of Grimaldi basin. In addition, anorthosite appears to have been exposed by Damoiseau D, a 15-km crater located just outside the Grimaldi outer ring.

Grimaldi H is a 9-km impact crater on the western floor of the inner portion of Grimaldi basin. This crater penetrates the Hevelius Fm. and exposes subjacent material. The results of the analysis of the Grimaldi H spectrum, as well as other spectra that were obtained for the original, pre-Orientale floor material of the Grimaldi basin, indicate that this unit is composed of noritic anorthosite or anorthositic norite. The noritic anorthosite composition is most common. The pre-Orientale floor material within the inner ring should be dominated by impact melt and melt-rich deposits formed by the Grimaldi impact event[6] and may represent the average composition of the upper portion of the pre-impact target site.

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It is difficult to determine the compositions of the Grimaldi ejecta deposits because of the proximity of the younger Orientale basin as well as the extensive mare flooding east and northeast of the basin. However, some information can be obtained from the spectra of craters that expose Grimaldi ejecta from beneath the relatively thin and discontinuous facies of the Hevelius Fm. The currently available spectral data clearly indicate that the Grimaldi ejecta deposit is dominated by anorthositic norite and noritic anorthosite.

The results of the spectral studies described above allow us to reconstruct the pre-impact stratigraphy of the Grimaldi target site. Anorthositic norites and noritic anorthosites dominate the primary ejecta deposits of Grimaldi as well as the original, pre-Orientale floor unit. Both of these units were derived from the upper portions of the pre-impact target site. In contrast, spectral data indicate that major portions of the Grimaldi inner ring are composed of pure anorthosite. We propose that the inner Grimaldi ring is a peak ring that was formed by the rebound of deep crustal material from beneath the Grimaldi transient crater cavity during the modification stage of the basin-forming event. The currently available evidence strongly suggests that the Grimaldi pre-impact target site consisted of a layer of pyroxene-bearing highlands material overlying a crustal unit composed of pure anorthosite.

Gabbroic Units--In a previous study,[7] we noted that Crüger G exposed gabbroic anorthosite from beneath the deposits emplaced as a result of the Orientale impact event. We have now identified material with a mafic assemblage dominated by high-Ca pyroxene in two additional areas in the Grimaldi region. One is a small crater southwest of Crüger E, and the other is associated with Olbers B crater. Both of these impact craters expose material from beneath the material emplaced by Orientale.

Pyroclastic and Mare Basalt Deposits --Numerous localized dark-mantle deposits (LDMD) of pyroclastic origin have been identified in the Grimaldi region[7,8] and near-IR spectra were obtained for several deposits. These spectra can be assigned to the three LDMD spectral classes identified and described in previous studies.[7,8,9]

Two spectra were collected for the mare deposits within Crüger crater, and both exhibit "1 μm" absorption bands centered at about 0.98 μm, which indicates that the mafic assemblage is dominated by high-Ca pyroxene.

Two spectra were obtained for the mare deposits within the inner ring of Grimaldi basin. Both spectra exhibit "1 μm" bands centered between 0.98 and 1.0 μm. The spectrum for an area southeast of the center of the mare unit has a band depth of 10.3% and a steep continuum slope (0.78). In contrast, the spectrum collected for the southern portion of the Grimaldi mare unit exhibits a shallow band (8.6%) and continuum slope (0.67).

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