THE DISTRIBUTION OF LITHOLOGIC UNITS IN THE WESTERN HIGHLANDS OF THE MOON; C.A. Peterson, B.R. Hawke, P.G. Lucey, G.J. Taylor, Planetary Geosciences, Univ. of Hawaii, 2525 Correa Rd., Honolulu, HI 96822; P.D. Spudis, Lunar and Planetary Institute, Houston, TX 77058

A number of distinct lithologic units have been identified on the western portion of the lunar nearside. These include deposits of pure anorthosite, gabbroic units, and cryptomare deposits. The Inner Rook ring of the Orientale Basin and at least a portion of the inner ring of Grimaldi Basin and the mare-bounding ring of Humorum Basin are composed of pure anorthosiste. Gabbroic anorthosite which had been buried by ejecta from the Orientale impact event has been exposed by the craters Byrgius A and Prosper Henry. Two craters to the north, near Crüger, may also have excavated gabbroic material from beneath Orientale ejecta. Some unusual properties of the cryptomare and other terrain northwest of Humorum Basin suggest a complicated history for this region. The craters Gassendi G and F expose mare basalt from beneath a highlands-rich surface unit emplaced as ejecta from nearby impact events. Mixing analyses of spectra obtained for the cryptomare unit and the Letronne ejecta deposit indicate that significant amounts of mare basalt are present. The presence of a major mare basalt component could help to explain anomalously low radar returns observed for the terrain northwest of Humorum.

INTRODUCTION: In recent years, we have been conducting remote sensing studies of lunar basin and crater deposits in order to determine the composition and origin of surface units as well as to investigate the stratigraphy of the lunar crust. [1,2,3,4] We have combined both visible and near-IR spectral observations with Earth-based multispectral imagery in order to determine the lithology of relatively small (2-10 km) portions of the lunar surface. Our attention has been focused on the western portion of the lunar nearside in response to the first Galileo spacecraft encounter with the Earth-Moon system. Numerous deposits of pure anorthosite, gabbroic rock, and cryptomare have been identified, and interesting patterns can now be discerned.

RESULTS and DISCUSSION:

A. **Anorthosite Deposits**.

Orientale Basin region. With the exception of the Inner Rook massifs, all the highland units associated with the Orientale Basin appear to be composed of either noritic anorthosite or anorthositic norite. Our spectral data indicate that the Inner Rook ring of the Orientale Basin is a mountain range composed of pure anorthosite. [1,2]

Grimaldi Basin Region. Spectra obtained for the inner ring of Grimaldi indicate that this feature is composed, at least in part, of pure anorthosite. [3] Another anorthosite deposit has been identified just inside the outer Grimaldi ring. This material was excavated from beneath the basin floor material by subsequent impacts.

Humorum Basin region. At least a portion of the mare-bounding ring of Humorum is composed of anorthosite. [2,3] However, the entire ring is not composed of anorthosite, and no anorthosites have yet been identified on the outer Humorum rings.

Other occurrences. Pure anorthosites have also been identified in other portions of the nearside. These include the four innermost rings of Nectaris Basin, the central peaks of Alphonsus and Petavius, and two areas in the northern lunar highlands (within Goldschmidt and west of Thales). [4,5,6,7] To date, anorthosites have only been identified in a relatively narrow belt in the southern highlands, extending from Petavius in the east to the Inner Rook Mountains on the western limb, and at two locations in the far north. Extensive spectral studies of many nearside regions (e.g., north-central highlands, Imbrium) have failed to reveal additional depostis of pure anorthosite. Lunar anorthosite deposits are almost always found on or very near basin rings. This association is significant only for the inner rings of basins such as Grimaldi and Orientale. These rings were derived from beneath more mafic-rich layers in the pre-impact target sites. In contrast, the anorthosites associated with the outer rings of Nectaris and other basins are generally found in the central peaks and walls of large impact craters. It appears that these anorthosites were derived from layers many kilometers beneath the crater target sites and that the surfaces of these outer rings are not composed of anorthosite.

B. **Gabbroic Units**. A gabbroic province has been identified in the western highlands. The Byrgius A and Prosper Henry impact structures have exposed material that is dominated by gabbroic anorthosite. The spectra obtained for these features have relatively wide "1 µm" absorption bands centered longward of 0.95 µm. [5] It appears that these craters excavated gabbroic material from beneath the Orientale ejecta blanket which is dominated by noritic anorthosite with lesser amounts of anorthositic norites. This gabbroic province may extend to the north of Byrgius A. Two craters near Crüger appear to have exposed gabbroic material from beneath the deposits emplaced as a result of the Orientale impact event.

C. **Cryptomare Deposits**. Both Galileo and Earth-based remote sensing data are being utilized to better understand ancient, pre-Orientale mare basalt deposits that were covered by highlands-rich material emplaced as a result of the Orientale and other impact events. [e.g., 2,3,8,9] Cryptomaria are located in the Schiller-Schickard region, the Mendel-Rydberg region, within the South Pole-Aitken Basin, and northwest of Mare Humorum. Out attention has recently been focused on the cryptomare NW of Humorum because of its possible association with terrain that exhibits anomalously low returns in the 3.8-cm, 70-cm, and 7.5-m radar data sets. [3] The results of our previous spectral studies demonstrated that both Gassendi G and F craters expose mare material from beneath a highlands-rich surface unit that was emplaced as a result of Letronne, Gassendi, and other impact events. Some ancient mare material could have been mixed with this highlands debris either by local mixing by secondary craters during ejecta emplacement or by vertical mixing due to small crater-forming impacts in the area. The presence of a mare basalt component in the surface layer could be responsible for the radar anomaly in the region since a significant amount of mare basalt could alter the bulk dielectric constant of the regolith. However, the spatial extent of the radar anomaly argues against this interpretation because the anomalous radar unit commonly extends to near the rim crests of the craters that apparently covered the ancient basalts with highlands debris. [3] It is unlikely that such a thick layer of ejecta could incorporate enough of the subjacent mare basalt, either through local or vertical mixing, to produce the observed anomaly.

In order to further investigate this question, we have analyzed three near-IR spectra obtained for the terrain NW of Humorum. Two spectra were collected for the surface of the cryptomare unit. The relatively strong "1 µm" absorption bands exhibited by these spectra suggest that significant amounts of mare basalt are present in the areas for which the spectra were obtained. Linear mixing analyses were conducted on the spectra. A mature mare spectrum (MH0) and a typical mature highlands soil (Apollo 16) were used as endmembers. The results indicate that mare material contributed 23% and 40% of the flux measured in these two areas. Hence, significant amounts of mare basalt are present in the surface of the cryptomare unit.

A spectrum was also obtained for a portion of the Letronne ejecta deposit. The area for which this spectrum was collected is just south of the Letronne rim crest; the ejecta should be relatively thick in this area. A mixing analysis indicated that mare basalt contributed approximatedly 42% of the flux. The most straightforward interpretation of this result is that mare basalt was present in the Letronne pre-impact target site and was incorporated into the crater's ejecta deposit. The Letronne impact event may have contributed some mare material to the terrain NW of Humorum, and this basaltic component may be, at least in part, responsible for the low radar returns.

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