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REMOTE SENSING AND GEOLOGIC STUDIES OF THE TERRAIN NORTHWEST OF HUMORUM BASIN

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INTRODUCTION

A portion of the highlands terrain northwest of the Humorum basin, a large multiringed impact structure on the southwestern portion of the lunar nearside, exhibits anomalous characteristics in several remote sensing data sets. The most complete ring of the basin is 440 km in diameter and bounds Mare Humorum.[1] A rimlike scarp almost twice as large (820 km in diameter) and resembling the Cordillera ring of the Orientale basin lies outside of this mare-bounding ring.[1] Gaddis et al.[2] first noted the unusual nature of the highlands terrain northwest of the main ring. They pointed out that an area (45,000 km^2) west of Gassendi crater exhibited relatively low depolarized 3.8-cm radar returns in the radar images presented by Zisk et al.[3] This area, which is centered at 43°W, 15°S, also exhibits unusually low values in 70-cm radar images provided by T. Thompson. Gaddis et al.[2] noted the possibility that this area was mantled with relatively high-albedo pyroclastic debris and suggested that additional evidence bearing on the presence of pyroclastic mantling material in this area might come from near-infrared reflectance studies.

We have been conducting a variety of remote sensing stuidies of the terrain northwest of Humorum basin in order to determine the composition and origin of this anomalous unit as well as the composition of the highland material exposed by the Humorum impact event. The purpose of this paper is to present the preliminary results of this investigation.

METHOD

Near-intrared relectance spectra were obtained utilizing the University of Hawaii 2.24-m telescope at the Mauna Kea Observatory. The Planetary Geoscience Division indium antimonide spectrometer was used. This instrument successively measured intensity in each of 120 wavelengths covering a 0.6-2.5 μm region by rotating a filter with a continuously variable band pass. By using the f/35 oscillating secondary mirror on the 2.24-m telescope in its stationary mode, it was possible to collect spectra for relatively small areas (5-10 km) near the lunar western limb. Differential atmospheric refraction limited such high-resolution observations to periods when the Moon was near zenith.

The lunar standard area at the Apollo 16 landing site was frequently observed during the course of each evening, and these observations were used to monitor atmospheric extinction throughout each night. Extinction corrections were made using the methods described by McCord and Clark.[4] These procedures produce spectra representing the reflectance ratio between the observed area and the Apollo 16 site. These relative spectra were converted to absolute reflectance utilizing the reflectance curve of an Apollo 16 soil sample. Analyses of pyroxene band positions and shapes as well as continuum slopes were made using Gaussian-band fitting and other techniques described by McCord et al.[5]

In addition, the 3.8-cm radar data presented by Zisk et al.[3] was reprocessed and utilized in this investigation.

RESULTS AND DISCUSSION

At least a portion of the mare-bounding ring of Humorum is composed of pure anorthosite. Spectra were collected for Mersenius C (diameter=14 km) and the Gassendi E and K complex. These small impact craters expose fresh material from beneath the surface of massifs in the mare-bounding ring. The "1 μm" absorption features in these spectra are extremely shallow. Only very minor amounts of low-calcium pyroxene are present in the areas for which these spectra were obtained; an anorthosite lithology is indicated. Anorthosite also appears to have been exposed by Liebig A, a 12-km impact crater on the western portion of the mare bounding ring. A preliminary analysis of the spectra obtained for other highlands features in the Humorum region indicates the presence of noritic anorthosite. Anorthosite has now been identified on rings associated with the Orientale[6], Nectaris[7], Grimaldi[8], and Humorum basins.

Lucey et al.[9] have recently presented the results of imaging spectroscopy of the Humorum basin region. They identified a spectral unit in the highlands northwest of Humorum which appeared to represent a mixture of highlands debris with lesser amounts of mare material. This spectral unit generally correlates with the area which exhibits anomalously low 3.8-cm radar returns. We have obtained near-infrared reflectance spectra for Gassendi F and G. Both impact craters are 8 km in diameter and they excavated material from beneath the surface of the anomalous unit. Gassendi G has a partial dark halo. Analysis of our spectral data indicates that both Gassendi G and F excavated mare basalt from beneath a surface enriched in highlands debris. An episode of mare volcanism may have emplaced basaltic units in this region after the formation of the Humorum basin. Subsequently, large impacts in the vicinity, such as those which formed Gassendi, Letronne, and Mersenius craters, emplaced a veneer of highlands debris atop the basalt flows. The mare material could have been mixed with highlands debris either by "local mixing" during ejecta emplacement or by vertical mixing due to small crater-forming impacts in the area. Other interpretations are possible, and additional work will be required to fully confirm the model outlined above.

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