PRELIMINARY RESULTS OF IMAGING SPECTROSCOPY OF THE HUMORUM BASIN REGION OF THE MOON, Paul G. Lucey, B.Ray Hawke, Barbara C. Bruno, Planetary Geosciences Division, Hawaii Institute of Geophysics, University of Hawaii at Manoa, Honolulu HI, 96822.

Introduction. The distribution and relative abundances of lunar rock types are crucial parameters in understanding the processes which led to the present state of the lunar crust. Mapping the mineralogy of the lunar surface is a key geologic task as the major lunar rock types are defined on the basis of their mineralogy (1). The transmission properties of the Earth's atmosphere in the visible and infrared portions of the spectrum allow mineralogical remote sensing to be performed using UV, visible and IR spectrometers on groundbased telescopes at fairly high spatial resolution. This abstract describes preliminary results of imaging spectroscopic observations of the Humorum basin region of the lunar surface conducted at the University of Hawaii 2.24-m telescope of Mauna Kea Observatory.

Method The experiment utilized an astronomical CCD spectrograph as an imaging spectrometer. The lunar image was scanned across the input slit of the spectrograph as the CCD imaging detector was read out in order to build a second axis of spatial information. The spectrograph was configured to obtain spectra over the region from .65 to 0.98μm in 129 spectral channels. The angular scale of the data is .5 arcseconds per pixel in column, and 1 arcsecond per pixel in row. The angular resolution, based on observation of stars as point sources, is about 1 arcsecond or 2km at the center of the lunar disk. The data were reduced through the methods of (2).

This study examined an area in the southwestern portion of the lunar nearside centered on the Humorum multi-ringed impact basin. The topographic low within the inner ring in the center of the basin is flooded with mare basalts as is the northeastern portion of the basin which connects the Mare Humorum basalt fill with Oceanus Procellarum. Mare basalts also occur as small ponds and lakes immediately outside the basin. Several large post-Nectarian craters occur within the outermost ring and these have extensively modified Humorum ejecta. The region has been previously studied utilizing multispectral imaging and sparse spot spectroscopy among other remote sensing techniques (3,4). We collected data for the entire basin and surroundings in August, 1988. This imaging spectroscopic data set consists of over 200,000 individual spectra.

The goals of this project are to 1) identify and map the distribution of spectral units which likely represent compositional units; 2) extract representative spectra of these units and interpret them in terms of composition; and 3) to use the results to resolve a number of geologic problems in the region.

Results During reconnaissance inspection of the data set we noticed that areas in the highlands with the highest albedo also seemed to exhibit a turndown in reflectance near 1μm while the mare units in general were either flat or turned up. We constructed a parameter to map this spectral characteristic. In an image constructed of this parameter, high values indicate the presence of the highland spectral downturn, and low values indicate a upturn. In general, areas which exhibit high values in this parameter also have high albedos, consistent with the consistent with the fact that highland areas show higher albedos than mare areas of comparable maturity. Mare Humorum and most of its small craters exhibit a very uniform, slightly negative value. However, two craters in eastern Mare Humorum also exhibit high values of the "highland" parameter. Extraction of spectra from these areas shows a distinctly highland-type spectrum. This implies that the impact events giving rise to these craters

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excavated highland material from beneath the mare basalts. Closer inspection of these craters reveals that only the eastern half of the two craters exhibit highland values. The western halves exhibit more mare-like values. This strongly suggests they struck a change in depth of the highland surface underlying the mare basalt. This places a strong constraint on the depth of the mare fill at this point.

In order to identify units we applied the technique of matching training site spectra to the data set. In this method, an area is selected which is hypothesized to have spectral characteristics typical of a spectral unit with wider spatial distribution. This area is referred to as a "training site". The average spectrum of the training site is compared to each spectrum in the image cube. Those spectra which match the training site spectrum (based on a previously defined criterion) are then flagged. Repeated applications of matching experiments to several apparently homogeneous small areas revealed the presence of two spectrally distinct highland units.

Two distinct highlands units have been identified in the Humorum region. One of the two highland units is exhibits a redder spectral slope than the other highland unit and exhibits a spectral shape that is intermediate between one of the mare types exposed in the region and the other highland unit. There are two interpretations of these spectral characteristics. The first is that the spectrally intermediate highland unit owes its spectral affinity to mare due to the presence of substantial amounts of clinopyroxene as is found at some highland locations such as Tycho and Aristarchus (5,6). Second, this unit may represent normal highland material which is contaminated by a small amount of mare material. The second possibility reflects the following geologic history. First, mare basalts were erupted onto an ancient highland crust. Subsequently, large impacts in the vicinity such as those which formed Mersenius crater and other large craters, or even the Orientale basin event, emplaced a veneer of highland debris atop the mare basalt flows. This was followed by innumerable unresolved small impacts which vertically mixed mare basalt fragments into the surface layer, thus mixing the redder mare signature onto the highland material above.

Conclusion: The technique of imaging spectroscopy, even in the very restricted wavelength region presented here, has revealed its power of mapping the distribution of compositional units on the lunar surface. More importantly, it allows the assignment of specific compositions to those units. This capability has demonstrated its value in allowing two important findings
concerning the composition and distribution of surface units in the Humorum basin region: identification of craters in the mare which have penetrated the basalt filling the basin, and the identification of distinct compositional units in the highlands.

REFERENCES: 1), Stoffler, D., H.D. Knoll, U.B. Marvin, C.H. Simonds, P.H. Warren, 1980. Proc. Conf. Lunar Highlands Crust, 51-70; 2) McCord, T.B., R.N. Clark, B.R. Hawke, L.A. McFadden, P.D. Owensby, C.M. Pieters, J.B. Adams, 1981. JGR 86 (B11), 10883-10892; 3)Johnson, T.V., C. Pieters, and T.B. McCord, 1973. Icarus 19, 224-229; 4) Pieters, C., J.W. Head, T.B. McCord, J.B. Adams, and S. Zisk, 1975. Proc. Lunar Sci. Conf. 6th, 2689-2710; 5) Lucey, P.G. and B.R. Hawke, Proc. 1988. Lunar Planet. Sci. Conf. 18th, 355-364.; 6) Pieters, C.M., 1986. Rev. Geoph. 24, No. 3, 557-578.

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