IF ALHA81005 CAME FROM THE MOON, CAN WE TELL FROM WHERE? C.M. Pieters, Dept. of Geological Sci., Brown University, Providence, RI 02912

Careful documentation of lunar sample locations has been essential for understanding the geologic context of such valuable materials. Samples have been returned from nine locations on the lunar nearside, and each mission has brought new unsuspected surprises. Lunar scientists now seem to have acquired a sample from a 10th location, but without the desired supporting documentation.

Identification of possible source regions on the moon for meteorite ALHA-81005 is difficult, but not impossible if enough clues can be obtained. Presented here are preliminary results of laboratory and telescopic spectral reflectance measurements that are used to identify compositional information to link the mineral assemblages observed in the meteorite with those for unsampled areas on the nearside lunar surface. When combined with other data and the photogeologic evidence, this information could narrow the number of possible source regions considerably. If ALHA81005 is representative of a regional rock type, these first results suggest the source region for the meteorite is not a common surface unit for the lunar nearside and as such has not previously been extensively sampled by U.S. and Soviet missions. However, the general spectral character of ALHA81005 indicates a bulk mineralogy comparable to some specific lunar samples.

Results for Telescopic Reflectance measurements of the lunar nearside. Near-infrared (.7-2.5μm) spectral reflectance measurements have been obtained for about 150 small lunar areas (3-20 km in diameter) using earthbased telescopes. Compositional implications of data for highland craters are presented in Pieters (1) and are only summarized here. Most highland spectra indicate regional rock types with a mineral assemblage of feldspathic material containing orthopyroxene as the dominent mafic component. A few small fresh craters reveal rock types with a greater abundance of more calcium-rich pyroxenes as well. The large, usually older, craters with central peaks have apparently exposed a somewhat different suite of rock types with both more mafic components (olivine and calcium-rich clinopyroxenes) and more complete anorthositic rock types being observed.

Laboratory reflectance measurements of ALHA81005. A potted butt sample ALHA81005,2 was made available for laboratory spectral reflectance measurements prior to preparation of additional thin sections from the sample. Seventeen measurements were obtained using the Reflectance Experiment Laboratory (RELAB) over a period of two days: two visible spectra (.4 to .9μm) 13 near-infrared (.7-.1.8μm), and 2 continued near-infrared (1.7-2.7μm). Data for 12/21/82 were obtained for a smooth flat surface with i=0°, e=30°. The sample was roughened slightly with a coarse grit for the measurements made on 12/22/82. A monochromatic incident beam covered a sample area of about 10mm in length; the detector viewed a sample area of about 2mm in diameter within this beam, the precise location of which was undetermined. The near-infrared data were averaged to obtain a spectrum of the bulk properties of the sample. As is commonly observed for rock or slab spectra the near-infrared continuum was generally flat or negatively sloped. In order to allow direct comparison of absorption features with lunar telescopic data the spectra were divided by an estimated continuum and the residual absorptions examined.

An average for the 13 near-infrared measurements obtained on both days is shown in Figure 1. This spectrum would be comparable to a whole rock spectrum and is the current best estimate of the overall spectral character for this sample of ALHA81005. Since the sample was moved slightly between individual measurements, the location of each measurement and the resulting spectra varied. The top two spectra in Figure 2 are averages for the near-infrared data for all the first (a) and second (b) day's measurements respectively. The bottom two spectra (2c,d) are distinctive single measurements.

Data Interpretation for ALHA81005. Specific mineral components can be identified in the spectra of this meteorite. The band minimum between .9 and 1.0µm in all the average spectra (Figures 1,2a and b) as well as a second absorption observed near 2µm implies a pyroxene component. The broad multiple band with a center near 1.05µm in individual spectrum 2d is characteristic of olivine. The spectrum average for the second day (2b) contains these olivine measurements; its spectral character (broad band widening towards longer wavelenghts) is typical of olivine and pyroxene mixtures (2). The superimposed feature near 1.3µm seen in spectrum 2a is commonly interpreted as Fe-bearing feldspar (3), although a feature this strong usually requires a fairly Fe-rich (>.1%) plagioclase. Further laboratory measurements are required to determine relative contributions to the 1.3µm feature from Fe-bearing feldspar and from olivine in the whole rock spectrum average of Figure 1.

Discussion. Comparisons of the spectral characteristics of ALHA81005 were made with laboratory measurements of lunar highland samples of Adams (4, 5) and telescope measurements of highland areas of Pieters (1). Some returned lunar anorthositic troctolites and gabbros exhibit the same characteristics as ALHA81005: a broad absorption band centered between .95 and 1.0µm with a strong 1.3µm feature or inflection. The average of ALHA81005 data however, is unlike any specific lunar area measured telescopically although it does resemble a minor group of nearside craters that exhibit more majic mineral assemblages than most of the highlands. (The band center for most observed highland areas is at a much shorter wavelength, implying low-Ca orthopyroxenes as the major mafic component.) Of all the nearside lunar large craters with central peaks measured telescopically, only Tycho and Aristarchus would merit further study as possible source regions; both exhibit an absorption between .96 and 1.0µm and a strong 1.3µm feature or inflection.

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References. 1) Pieters C.M. (1983) LPS XIV 2) Singer R.(1982) JGR 86, 7967, 3) Adams, J.B. and Goulland (1978) PLPSC 9th, 2901, 4) Adams and Charette (1975) Moon 14, 483, 5) Charette and Adams (1978) LPS IX, 172.

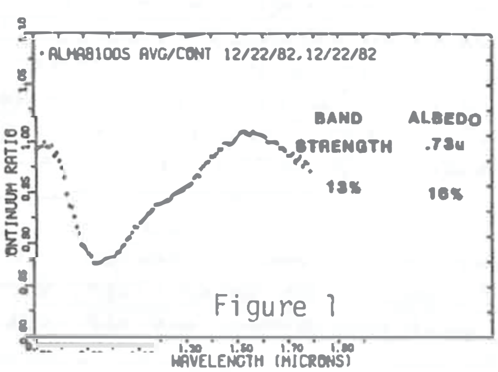

Figure 1

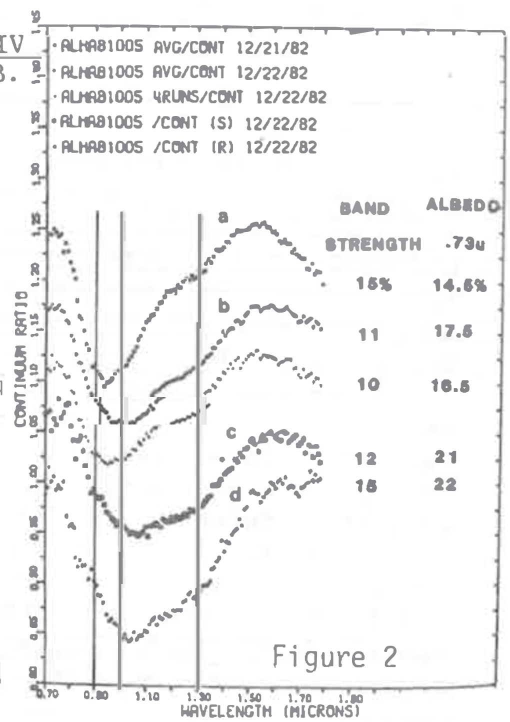

Figure 2