SPECTRAL REFLECTANCE OF LUNAR HIGHLAND ROCKS. Michael P. Charette and John B. Adams, Department of Geological Sciences, University of Washington Seattle, WA 98195.

Absorption features in lunar reflectance spectra permit the classification of lithologic types among crystalline and brecciated rocks. Charette and Adams (1) were able to correlate the spectra of mare basalts with their normative mineralogies. Adams and Charette (2) established a spectral classification for highland rocks and this paper presents further subdivisions to their scheme.

Our approach to the spectra of lunar rocks is along the lines of Adams (3) and Gaffey (4), who recognized the singular features within lunar sample and meteorite spectra which can be used to determine their mineralogy. This approach is preferable to that of curve-matching in its application to the remote sensing of the lunar surface, inasmuch as any given spectral reflectance curve may have a non-unique topology while the individual absorption features that make up the curve are the result of unique mineralogical assemblages (3-4).

The specific mineral phases that have unique and characteristic absorption features in the visible and near-infrared include pyroxene, plagioclase, olivine, ilmenite, and the assortment of colored glasses typically found in lunar soils and breccias. Adams and McCord (5) showed that the wavelength position of the Fe^{2+} charge transition bands at 0.9-1.0μm and 1.8-2.2μm were related to the composition of the pyroxenes. Later refinements of this work established a nomogram that permits one to find the average wollastonite (Wo) content of the lunar pyroxene within a rock or soil to within ±3% (3). The quantitative determination of plagioclase compositions, using the Fe^{2+} charge transition band near 1.2μm may prove to be similarly tractable (6). The absorption band of olivine near 1.1μm partly overlaps with the bands exhibited by calcic pyroxenes (7); however, olivine can be uniquely identified in many mare basalts (1) and the troctolites (this work). Ilmenite displays a broad, shallow absorption band band near 0.6μm and 1.2μm. Absorption bands, in addition to expressing mineral compositions by their wavelength positions, also vary in intensity. Gaffey (4) has utilized this property to derive pyroxene/plagioclase and pyroxene/olivine ratios in meteorites. The glasses present a more complicated picture, with metal→metal charge-transfer transitions due to titanium and iron ions (8) occurring in the ultraviolet (∿0.3μm) and extending into the visible and near-infrared (9).

ANT Suite. The coarse-grained textures of these rocks permit them to be uniquely identified based upon their mineralogy alone (Figure 1). With the exception of anorthosites and troctolites, ANT suite rocks are characterized by: (A) deep pyroxene and plagioclase Fe^{2+} bands; (B) a high left shoulder (near 0.7μm) relative to the right shoulder (near 1.1μm) on either side of the pyroxene band at ∿0.9μm; and (C) the absence of an absorption feature near 0.6μm. The spectra of anorthosite 15415 is dominated by the Fe^{2+} plagioclase band, exhibits a two-pyroxene composite band, and has a feature near 0.6μm perhaps due to very thin plates of ilmenite within the pyroxenes. Troctolite 76535 has similar characteristics, except that a strongly developed

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band near 1.1μm exists due to olivine.

Light-Matrix Breccias. The spectra of the LMB's (Figure 2) are dependent upon the nature and variety of their fine-grained, polymict textures, even though they may have the bulk composition (but not necessarily the mineralogy) of the ANT suite. The LMB's are generally characterized by: (A) pyroxene bands of intermediate depth; (B) left shoulder at 0.8μm which is lower than the right shoulder at 1.1μm; (C) a broad absorption band near 0.6μm; and (D) a positive slope to the overall curve due to the glassy matrices. In the Apollo 14 LMB's, the left shoulder at 0.8μm lowers relative to the right shoulder as a direct function of increased mesostasis glass formed during thermal metamorphism (10).

Dark-Matrix Breccias. The DMB spectra (Figure 3) are distinguished by: (A) weak pyroxene and plagioclase bands; (B) shoulders of nearly equal height on either side of the 0.9μm absorption band; (C) no absorption band near 0.6μm; and (D) a flat continuum slope. The flat slope arises from the low spectral contrast in these dark glassy rocks.

Non-Mare Melt Rocks. These rocks (Figure 4) exhibit spectra with:(A) broad pyroxene bands of intermediate depth and weak plagioclase bands; and (B) the absence of any absorption feature near 0.6μm. Poikilitic rocks have a high left shoulder (near 0.7μm) relative to the right shoulder (near 1.1μm) due to its coarser-grained texture while the KREEP basalts have shoulders of equal height.

Discussion. The discrimination of highland rock spectra on the basis of mineralogy and texture offers the possibility of determining the lithologies within fresh blocky craters using high spatial resolution spectrophotometers aboard a future Lunar Polar Orbiter.

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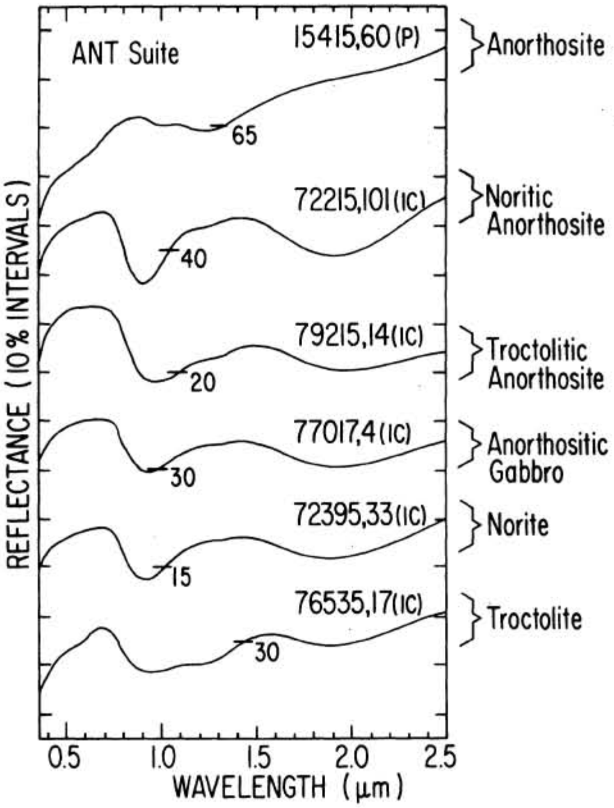

FIGURE 1

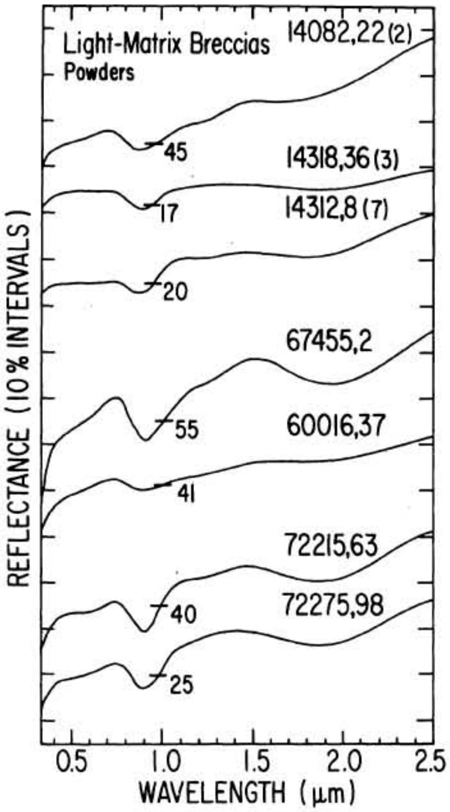

FIGURE 2

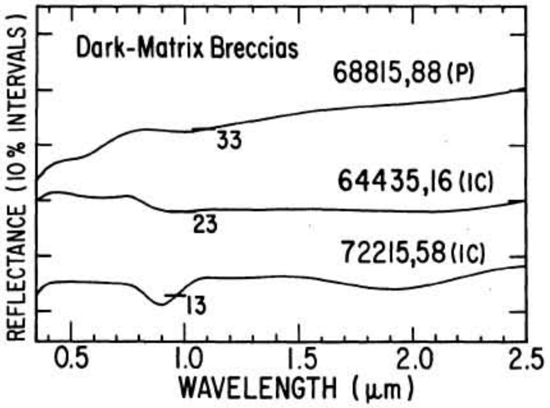

FIGURE 3

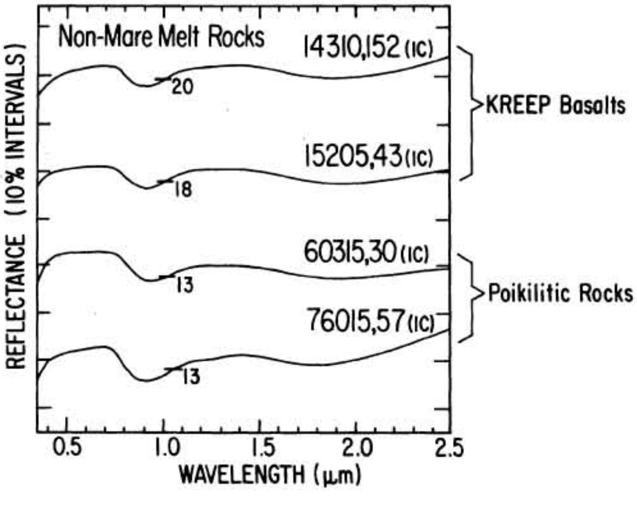

FIGURE 4

P = powder
IC = interior chip