

APOLLO 15 AND 16 DIRECTIONAL SPECTRAL REFLECTANCE, Richard Birkebak\* and James Dawson\*\*, \*University of Kentucky and \*\*Oklahoma Foundation for Research and Development.

Heat balance calculations made on the moon<sup>[1,2,3]</sup> and objects on its surface are greatly influenced by the directional spectral reflectance of the lunar surface material. The values presented here along with the spectral emittance<sup>4</sup> give a complete description of the thermal radiation characteristics of lunar fines.

Results are presented for Apollo 15 sample 15041,38 and Apollo 16 sample 68501,18. Sample 15041 was collected near the ALSEP, station 8, and is from the top of the trench dug at this location. The sample 68501,18 is from station 8 and is a rake soil. The reflectances were obtained from surfaces which can be characterized by a bulk density of approximately 1600 kg/m<sup>3</sup>. This bulk density was used since it falls near the average value of that of the core tube samples<sup>5</sup> and because the reflectance does not change appreciably if the density is increased further. The soils were illuminated at angles from 10 to 60 degrees.

The spectral directional reflectance curves for the Apollo 15 sample is given in Fig. 1 and for Apollo 16 sample in Fig. 2. The results show an increase in reflectance as the angle of illumination increases. The increased reflectance with angle of illumination has a pronounced effect on the lunar surface temperature<sup>3</sup>.

The variation in reflectance between the Apollo samples is associated with its chemical composition and glass content. As the lunar fines become 'lighter in color', we find fewer opaque materials in the fines. Adams and McCord<sup>6</sup> have discussed the lighter appearance of Apollo 14 fines and relate it to the fines having lower overall iron oxide and titanium dioxide content. In general the color of the Apollo 15 and 16 samples follows this general trend<sup>6</sup> with the Apollo 15 sample having a greater percentage of TiO<sub>2</sub> and FeO and a lower percentage of Al<sub>2</sub>O<sub>3</sub> than the Apollo 16 sample.

Near the wavelength of 1μm the Apollo 15 reflectance shows a shallow absorption band and the Apollo 16 reflectance shows an absence of any absorption band. A second absorption band near 1.8μm attributed to pyroxene is indicated in the Apollo 15 reflectance curve. The presence or absence of absorption bands are a function of the dark glass content and the crystal to glass ratio.

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The present results are compared to Apollo 11, 12 and 14 fines for a similar density in Fig. 3. From these results the Apollo 11, 12 and 15 samples can be classified as mare material and the Apollo 14 and 16 as lunar highland material.

## References

- (1) Cremers, C.J., Birkebak, R.C., and White, J.E. (1971) AIAA, 9, 1899.
- (2) Cremers, C.J., Birkebak, R.C., and White, J.E. (1971), The Moon, 3, 246.
- (3) Cremers, C.J., Birkebak, R.C., and White, J.E. (1972), Int. J. Heat and Mass Transfer, 15, 1045.
- (4) Birkebak, R.C. (1972), The Moon, 4, 128.
- (5) "Apollo 15 Preliminary Science Report," (1972), NASA SP-289.
- (6) Adams, J.B. and McCord, T.B. (1972) Lunar Science III (ed. C. Watkins), Lunar Science Institute contribution no. 88, 1.

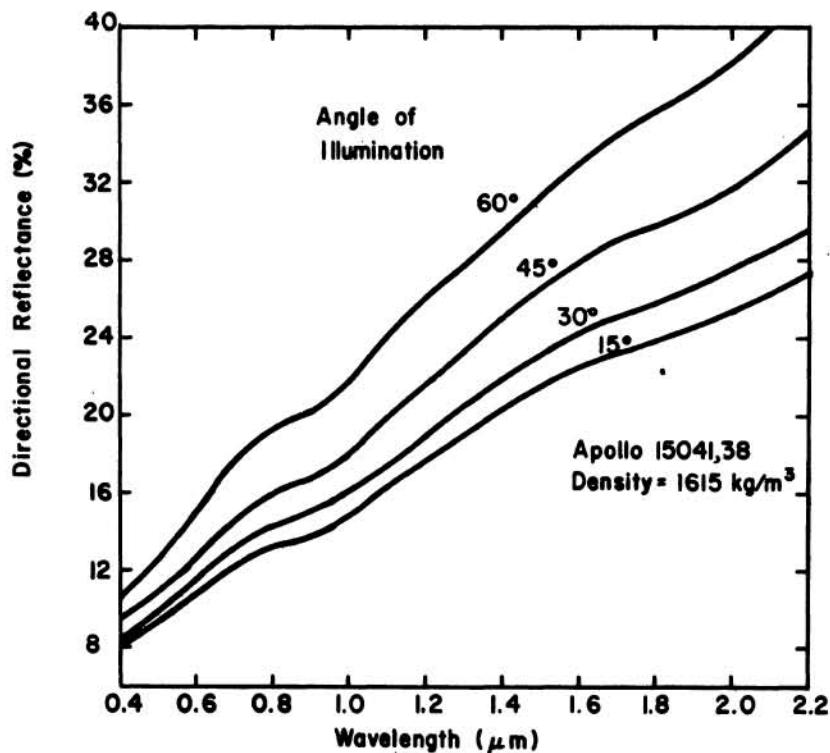


Figure 1 Spectral Directional Reflectance of Apollo 15.

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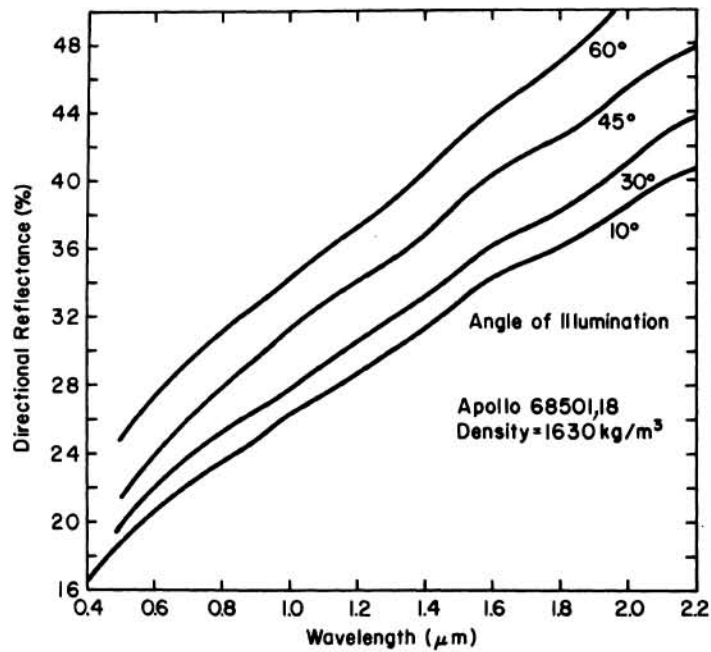


Figure 2 Spectral Directional Reflectance of Apollo 16.

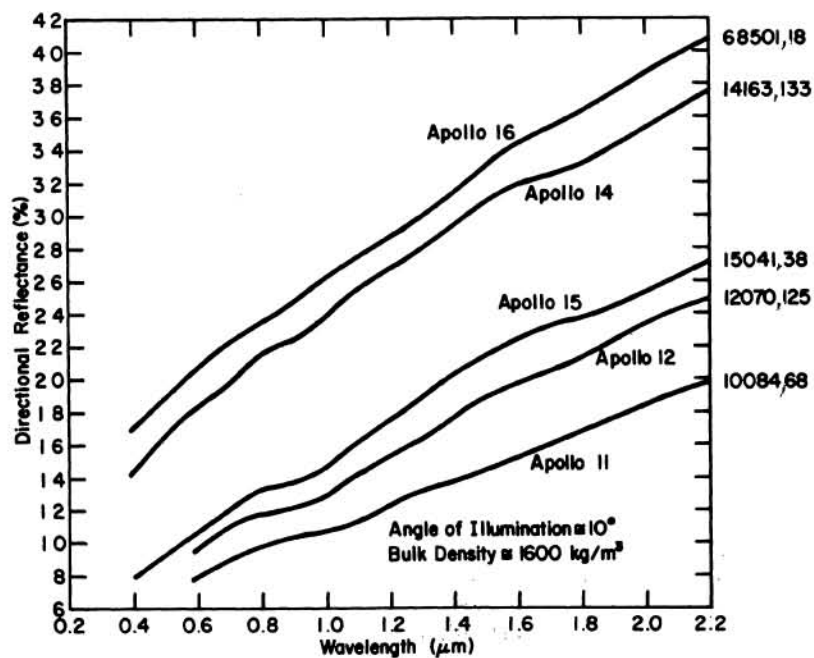


Figure 3 Spectral Reflectance of Apollo Lunar Samples.