SPECTRAL STUDIES OF THE LUNAR FLAMSTEED REGION: COMPOSITIONAL IMPLICATIONS

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The Flamsteed region of Oceanus Procellarum is known to be composed of spectrally distinct basalts (1). Comprehensive studies including spectral measurements, Apollo γ-ray data, and crater age determinations show that the stratigraphic sequence of these unsampled basalts differs greatly from the general stratigraphic sequence of sampled basalts exposed in the eastern maria as Tranquillitatis or Serenitatis (1). Spectrally, the Flamsteed basalts are similar to the Apollo 11 basalts. However, considerable spectral differences occur near the 1 μm absorption indicating differences in mineralogy and chemistry between the Flamsteed and eastern maria basalts.

In order to get a deeper understanding of these differences we need spatially resolved spectral data. In 1989 we observed the Flamsteed region at the Hawaii Mauna Kea Observatory in the spectral range 0.38μm to 1.0μm by using a CCD camera of high sensitivity. The spatial resolution of the CCD data is 2 km/pixel. The spectral resolution was realized by 12 narrow-banded filters in the visible to near-infrared spectral range. The data were decalibrated and corrected for extinction. Images in different spectral channels were registered and photometrically corrected. The photometric correction is based on the Hapke photometric model (2) using photometric parameters of the lunar surface as derived from photometric studies by Helfenstein and Veverka in 1987 (3). The photometric studies of Helfenstein and Veverka discriminate between distinct lunar brightness regions, i.e. bright highland, intermediate highland and dark mare areas. Thus, a differential photometric correction can be performed (4).

For a first overview of the composition of the Flamsteed basalts image color ratios were calculated (Fig. 1). The ratio of violet to green is sensitive for the TiO_2 content of basalts (5) whereas the ratio of IR to 0.75μm describes the strength of the 1 μm absorption which is indicative for Fe-bearing minerals. In accordance with previous studies (1) we found high violet/green ratios and low IR/0.75μm ratios indicating that the basalts of the Flamsteed region are relatively Ti-rich and also enriched in Fe-bearing materials. However, the basalts appear to be subdivided in different spectral types.

In order to obtain quantitative chemical information on different basalt types we compared the remotely sensed spectral data with spectroscopic lunar sample studies. Based on the correlation between the spectral characteristic and the chemical composition of lunar samples, a spectral-chemical model which makes use of principal component analysis and multiple regression analysis was developed (4). Previous studies (6, 7) show that this model allows us to derive quantitative chemical information from multispectral reflectance measurements of the lunar nearside. We applied the spectral-chemical analysis to the Flamsteed spectral data and found that the concentration of four main mineral-forming elements (Fe, Ti, Al, Ca) can be estimated with confidence. Thus, color-coded chemical concentration maps of these elements can be calculated. These results will be shown in the poster session.

In a first-order approximation, lunar basalts can be discriminated on the basis of their iron and titanium concentration. More detailed lithological information can be derived by combining the iron and titanium concentrations with either the concentrations of aluminum or calcium using ternary systems. The final data evaluation will result in a spectral-chemical classification of Flamsteed basalts and other unsampled basalt types of the western lunar maria.

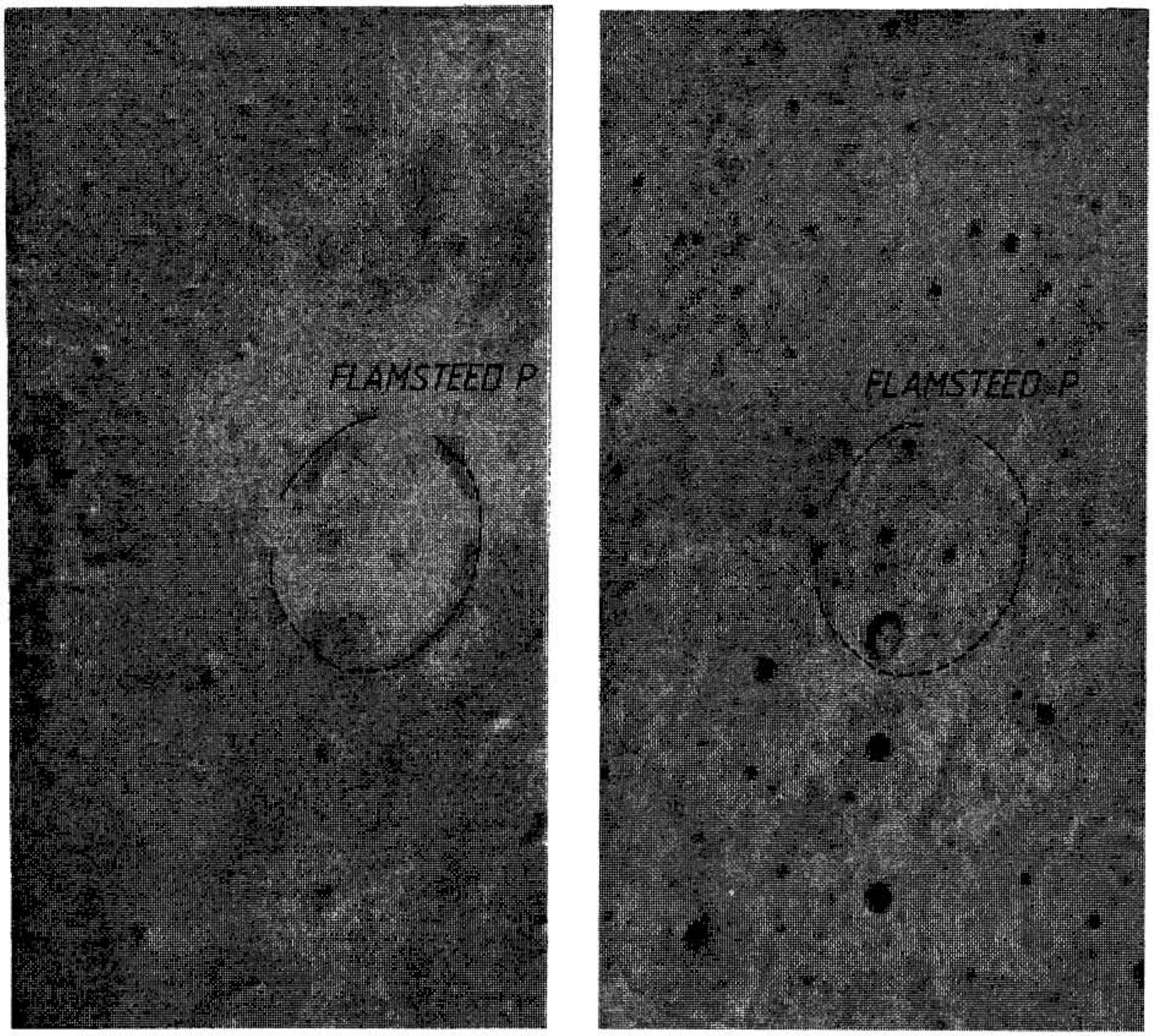

Figure 1. Image Color ratios of the Flamsteed region. Violet/green ratio (left), IR/0.75μm ratio (right). High ratio values appear bright, low ratio values appear dark.

References:
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(2) B. Hapke, (1986), Icarus **67**, p. 264-280.
(3) P. Helfenstein and J. Veverka, (1987), Icarus **72**, p. 342-357.
(4) R. Jaumann, (1989), DLR-FB **89-40.**
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