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Relative spectra and spectral slopes of selected lunar craters from observations by SIR on board SMART-1

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The infrared point spectrometer SIR on board the European Space Agency's SMART-1 mission was designed for the detailed remote spectral investigation of the lunar surface in the wavelength range 0.9 μm – 2.4 μm [1]. The SIR instrument provides high spectral resolution with a footprint size of 330 m to 3 km from typical lunar orbits of 300 km to 3000 kilometers. Comprehensive lunar spectrophotometric studies with SIR will provide a characterization of the overall spectral slope in the near infrared, as well as the effect of absorption bands between 1 μm and 2 μm, which are widely used in lunar remote geochemical studies [2].

There is an ongoing process of archiving the data of SIR and AMIE, the high resolution camera on SMART-1. Data measured by the SIR spectrometer are used to obtain relative spectral slopes for selected lunar sites. All spectra are corrected for bias and for the dark count rate, based on laboratory calibration, as well as for the measurement geometry using Shkuratov's semiempirical function for photometric correction [3]. The spectra are calculated relative to a reference spectrum, which is an averaged spectrum of a selected uniform area from the same orbit as the spectra. In order to also observe low albedo areas reliably, the most sensitive pixels of the instrument are selected for this study, limiting the spectral range between 1.02 μm and 2.13 μm.

A color index C (1.2 μm / 2.0 μm) is calculated and divided by the corresponding color index C_{ref} of the reference spectrum. This can be compared to the color index obtained from Clementine NIR mosaics [4], which have a different calibration and data reduction process. Discrepancies in the compared values of SIR and Clementine could be explained by the very different photometric conditions which existed during the two surveys: There are almost no shadowed crater areas in the Clementine data set (nadir looking and illuminated) while the angle of incidence varied with SIR operating in a nadir pointing mode. Despite the relative nature of our estimates, this fact may cause a difference even after normalization of the data to a standard geometry. Estimates of spectral slopes from SIR data are important for developing and testing models for maturation processes. Several models for the spectral albedo have been developed (i.e. [5]) to describe the influence of increasing the reduced iron (an indicator of regolith maturation) on the spectral slope in the near infrared.

When extended to the visible wavelengths, e.g. by using the UVVIS data from the Clementine mission, together with relative spectra from the SIR instrument, the observational basis for estimating the chemical content is established [6].

We plan to map the spectral slope and relative spectra in the near infrared for a variety of lunar sites, to provide the observational basis for estimating the chemical content and maturity degree of the lunar regolith.

References.

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