SPECTRAL CHARACTERIZATION OF MARE SERENITATIS USING CHANDRAYAAN-1 DATA.

M. Bhatt[1], U. Mall[2], C. Wöhler[3], A. Bhardwaj[1], A. Grumpe[3], D. Rommel[3], [1]Space Physics laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram, 695022, Kerala, India. [2]Max-Planck-Institut für Sonnensystemforschung, Justus-von-Liebig-Weg 3, 37077 Göttingen, Germany. [3]Image Analysis Group, Dortmund University of Technology,Otto-Hahn Str.4,44227 Dortmund, Germany. (mu_bhatt@isro.gov.in).

Introduction

Mare Serenitatis ($26\,^{\circ}N, 18^{\circ}E$) on the eastern nearside of the Moon is covered by basaltic material corresponding to different lava flows [1–7]. A total of 29 units have been identified by [4] based on the analysis of multispectral data using Galilieo Earth/Moon encounter-2 imaging data. These spectral units dated between 2.44 and 3.81 Ga are indicative of prolonged volcanism [4]. The same region have been classified in different number of units in several independent studies using telescopic, multispectral and hyperspectral imaging data-sets based on spectral band parameters, albedo variations and/or iron and titanium abundance estimations [e.g., 1, 4, 6–8]. Using telescopic data [1] mapped 5 units, [5] identified 6 units using Clementine multispectral data, [6] found 14 units based on iron and titanium estimations, and [7] found 13 units using M^3 data. [6] could not find time-dependent changes of FeO and TiO_2 wt.% from the mapped units. Our attempt is to combine spectral parameters and elemental abundance estimations in order to accurately map basalt units and study the basalt composition and their source region chemistry in detail.

We used hyperspectral imaging and point spectrometer data sets collected by the Moon Mineralogy Mapper (M^3) [9] and the Infrared Spectrometer-2 (SIR-2) [10], respectively from Chandrayaan-1 mission [11]. The M^3 data were corrected thermally, topographically and photometrically using the method of [12]. Hence, both the absorption band parameters, 1- and 2-µm (here after named as band I and band II), can be determined confidently using M^3 wavelength range between 0.43 and 3.00 µm. The SIR-2 data were corrected photometrically using the method of [13] and used to determine the band II parameters in wavelength range between 0.9 and 2.5 µm.

A total of 16 SIR-2 tracks from 100 km spacecraft altitude are passing through the selected region (Fig. 1) providing consistent and equidistant sampling of the eastern side of mare Serenitatis. A M^3 reflectance mosaic of 20 pixels/degree resolution has been constructed [12]. The corrected M^3 and SIR-2 reflectance data-sets have been used to define compositional units in the basalts of Mare Serenitatis and in the highlands southwest of the mare.

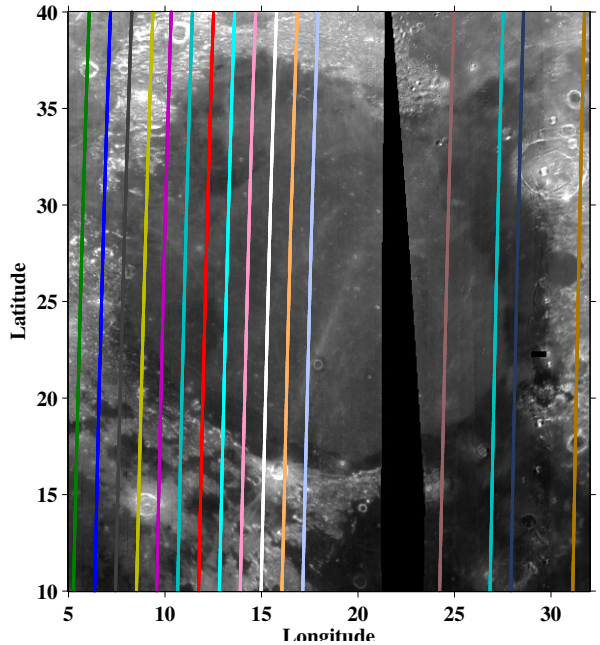

Figure 1: M^3 albedo mosaic (1578 nm) of Mare Serenitatis and a part of Mare Tranquillitatis. The vertical lines are the positions of SIR-2 tracks available from this region. The black strip corresponds to missing data.

Results

Figure 2 shows the iron abundance map derived using the band II based algorithm [14]. The FeO wt.% values of the northern region of mare Tranquillitatis are comparable to the FeO wt.% of the southern part of Mare Serenitatis which extends towards the eastern and western edge of Mare Serenitatis. The central part of the mare exhibits 2-6 wt.% less FeO compared to the southern unit. We identified two major basalt units which can be further

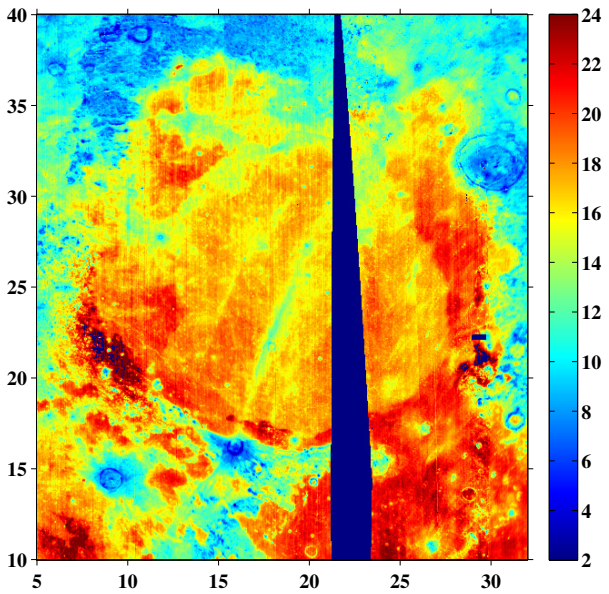

Figure 2: FeO wt.% map of Mare Serenitatis using band II based algorithm [14].

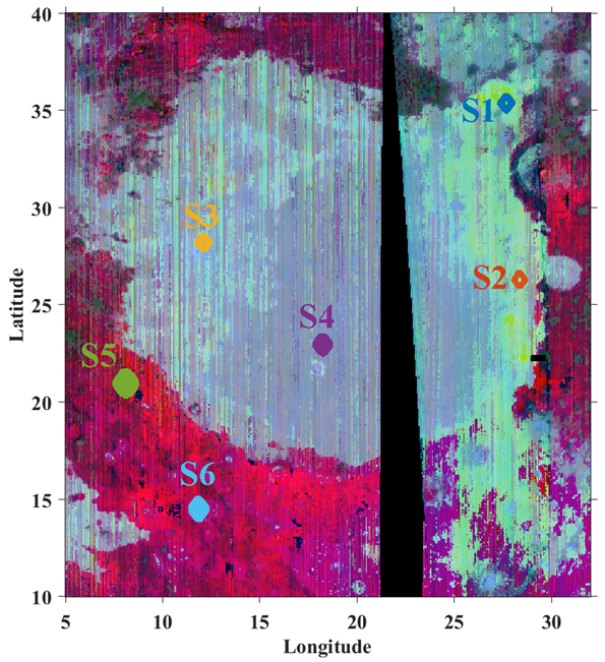

Figure 3: Major compositional units distinguishable in the M^3 band center mosaic. Red colour assigned to band I center, green to band II center and blue to FWHM of band II.

subdivided into six units based on the band I and band II centers and the full width at half maximum (FWHM) value of band II as shown in Fig. 3. The band II center values in Fig. 3 shift towards longer wavelengths in case of units S1, S2, and S3 compared to the unit S4 showing variations in pyroxene compositions. These units probably denote lava flows formed during different eruption events. Especially the boundary between units S3 and S4 shows a lobate, flow-like shape. Unit S5 corresponds to the well-known pyroclastic deposit near Sulpicius Gallus (e.g., [15]) and is dominated by olivine. Some of the units and lava flow boundaries identified by [4, 6, 7] are indistinguishable in Figs. 2 and 3.

Conclusion

In this study we have described several basaltic flow units of different composition in Mare Serenitatis. Based on our preliminary results, we will carry out a systematic study of Mare Serenitatis using spectral information collected from M^3 and SIR-2 instruments in order to integrate spectral parameters analyses and elemental abundances estimations. These studies will be helpful in understanding the relationship between the lava compositions and the Moon's thermal evolution.

References

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