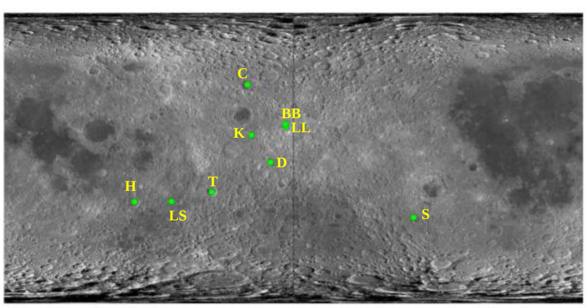
SPECTRAL REFLECTANCE STUDIES OF THE MARE BASALTS ON THE FELDSPATHIC HIGHLAND TERRANE OF LUNAR FARSIDE USING M^3 DATASETS OF CHANDRAYAAN-1. I. Varatharajan[1,2], I. A. Crawford[1,3] and H. Downes[1,3], [1]UCL/Birkbeck Center for Planetary Sciences, [2]Department of Physics and Astronomy, University College London, UK indhu.varatharajan.15@ucl.ac.uk; [3]Department of Earth and Planetary Sciences, Birkbeck University of London, UK i.crawford@ucl.ac.uk, h.downes@ucl.ac.uk.

Introduction: Understanding the mineralogic construct of the volcanic exposures of the lunar nearside and farside will provide insights into the thermal evolution of the Moon. Unlike the vast volcanic regions on the nearside of the Moon, which lasted from ~4.2 Ga to ~1.2 Ga [1,2], the farside of the Moon displays more localized and discrete volcanic extrusions, with episodic eruptions between ~3.8-1.5 Ga as well as suspected cryptomare regions [3,4,5]. Some of the small scale volcanic deposits are also correlated with high-Th content [6]. Our study focuses on the mineralogy of the mare volcanic deposits on the lunar farside and their spatial and spectral heterogeneity.

Datasets Used: The Chandrayaan-1 Moon Mineralogy Mapper (M^3) Level-2 hyperspectral datasets are used to study the reflectance spectra characteristics [7,8] and to derive spectral parameters such as band center at the absorption centers and the integrated band depth ratio. These datasets are corrected for their optical and thermal effects; however residual thermal effects could be expected in the longer wavelength end of the spectra (say, beyond 2.5 µm) [9]. The crater sizes chosen for the spectral studies are measured using the LROC Actreact Quickmap webportal.

Study Regions: The study regions for spectral assessment in understanding the compositional and mineral diversity of the farside lunar volcanic deposits include mare deposits in the Campbell crater, Buys Ballot crater, Dewar crater, Humboldt crater, Kohlschutter crater, Tsiolkovsky crater, and also the lacus bodies namely Lacus Luxuriae and Lacus Solitudinous and they are mapped in Fig. 1.



C – Campbell ; BB – Buys Ballot ; D – Dewar ; H – Humboldt ; K – Kohlschutter ; LL – Lacus Luxuriae ; LS – Lacus Solitudinous ; T – Tsiolkovsky

Figure 1. LROC WAC Global image showing the studied mare regions on the lunar farside.

Derivation of spectral parameters: All the spectral parameters are calculated from the continuum-removed spectra with offsets at 699 nm and 1578 nm for 1 µm absorption and near 1578 nm and 2538 nm for 2 µm absorption feature. The band center near the absorption band centers at 1 µm (BC1) and 2 µm (BC2) is derived by fitting a 2nd order polynomial at the end of the curve and the minima of the curve corresponds to the band center of the absorption feature. The integrated band depth ratio (IBDR) is defined by the ratio of the integrated band depth at 2 µm (IBD2000) to the corresponding 1 µm (IBD1000) where IBD1000 and IBD2000 are defined in [10, 11].

Methodology: As we focus on mare volcanic deposits in the study, the major mafic minerals that could be identified in the M^3 spectra are olivine and pyroxene. The unique absorption feature near ~1000 nm for olivine and the two spectral absorptions at ~1000 nm and ~2000 nm for the pyroxenes can be studied by deriving spectral parameters such as band center of their absorption feature and the integrated band depth which shows the strength of absorption feature. The spectral parameters are compared using the graphical plots between the BC1-IBDR to identify the proportion of olivine-pyroxene mixture in the spectra [11, 12]; and the BC1-BC2 are compared for studying the nature of pyroxene [13, 14]. These plots not only show the characteristics of the olivine and pyroxene but also show other effects such as mixture of Fe-glasses, the dominant cations in the mineral, and also spinel inclusions if present [15]. The spectral parameters such as band center and integrated band depth are derived from the reflectance spectra of small fresh craters in the respective mare field. The fresh craters expose the bed rock mineralogy, and additionally the freshness of the crater wall and ejecta of these small craters minimizes the optical maturity effects induced in the spectral properties. Thus the spectral plots along with the characteristic reflectance spectra of the mare volcanic deposits in the study regions are used for the comparative mineralogy assessment which will therefore help in understanding the style and nature of lunar farside volcanism.

Results: The average reflectance curves for all the fresh craters studied in each respective study regions and their continuum removed reflectance curves are mapped in Fig. 2 a, b. The M^3 derived spectral parameters are then plotted against each other, namely BC1-

IBDR and BC-BC, are shown in the Fig. 3 a,b. In Fig. 3 shows the spectral diversity in the mare patches studied in the lunar farside. A small triangle in Fig. 3a is attributed to the olivine-rich mare basalt excavated by a ~2.5 km size crater on the floor of Lacus Luxuriae.

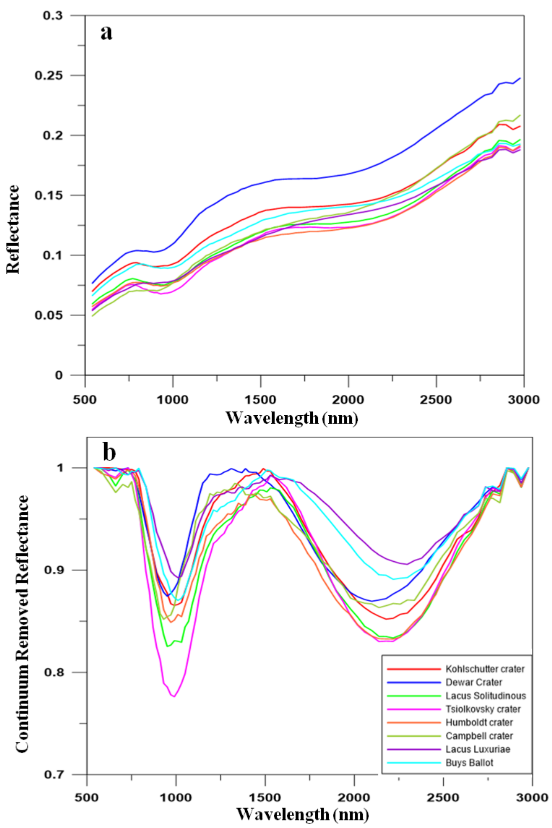


Figure 2. The average reflectance curves representing the spectral nature of the basalts on the lunar farside.

Discussions: The study shows that farside volcanism exhibits diversity in the spectral nature of the erupted basalts. This would imply differences in the source regions of the magma, and their compositional heterogeneity.

Further work: Further study will focus on the compositional nature of the mare basalt in a particular unit. The careful study on the size of the crater and their spectral characteristics of these mare patches will be used to study the stratigraphy of the mare and therefore possible changes in the composition of the mare flows in time. The study will also test for possible compositional heterogeneity in the magma source regions and/or the magma evolution during its ascent to the surface.

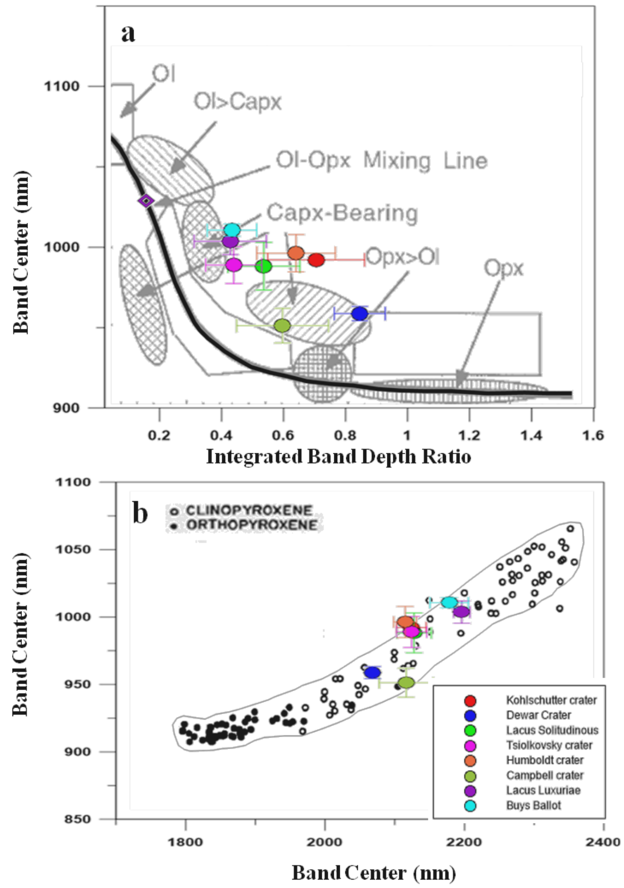


Figure 3. a) The BC1-IBDR plot b) BC-BC plot, the datapoints are the averaged spectral parameters for all the fresh crater spectra sampled from each respective study region.

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