SPECTRAL REFLECTANCE STUDIES OF SELECTED YOUNG BASALTS ON THE MOON USING M^3 DATASETS FROM CHANDRAYAAN-1. V. Indhu[1], N. Srivastava[1] and S.V.S. Murty[1], PLANEX, Physical Research Laboratory, Ahmedabad 380009, India (sneeraj@prl.res.in)

Introduction: The regionally complex lunar volcanism results in minerologically different lunar basalt types with no simple correlation between their composition and absolute ages. The western nearside of the moon is a store house of young high-Ti and Fe rich basalts which were produced during the late stage volcanism. The Lunar basalts have wide range of ages i.e. >3Ga-1.1Ga [1]. From the Clementine UVVIS data, the olivine enrichmet and FeO concentration for the young basalts of Oceanus Procelarum haves been inferred from the 1-μm absorption feature which is much flatter and centered at the longer wavelength than the older basalts [2].

The Study: Statistical geochemical analysis of two young basalt zones (P53) adjacent to Litchenberg crater [denoted as 'L' here] and (P60) asdjacent to Aristarchus crater [denoted as 'A' here] from [3] have been carried out by deriving the spectral parameters namely band center, band strength, band area and band area ratio from M^3 hyperspectral data . To avoid the effects of space weathering and optical maturity in the analysis, spectra are derived from relatively unweathered fresh impact craters only which preserve their diagnostic absorption features. New surface age estimates have also been derived from LROC WAC data.

Datasets Used: For deriving the spectral parameters and the compositional analysis, the photometrically and the thermally corrected Level 2 data of the NASAs M^3 Hyperspectral Sensor aboard Chandrayaan-1 has been used [4, 5]. Only data derived from the images acquired during the optical periods OP1B (phase angle 45° – 62°) and OP2A (phase angle 44° – 68°) have been used in the study. They have 85 spectral bands between a spectral range of 0.5-3.0 μm. The spatial and spectral resolutions are 140m/pixel and 20-40nm respectively.

Methodology: The IBD parameter images have been generated from the mosaic prepared from M^3 datasets (Fig.1) using the formula tabulated in [6]. IBD1000 and IBD2000 images signifies the mafic mineral band strengths of 1-μm and 2-μm absorption features respectively [7]. A total of 11 fresh craters have been chosen for 'L' basaltic zone and 15 craters for the 'A' basaltic zone. 4-6 pixels average spectra have been derived from the individual craters depending upon their diameter. The geodetic and cartographic distances range of crater diameters chosen for the

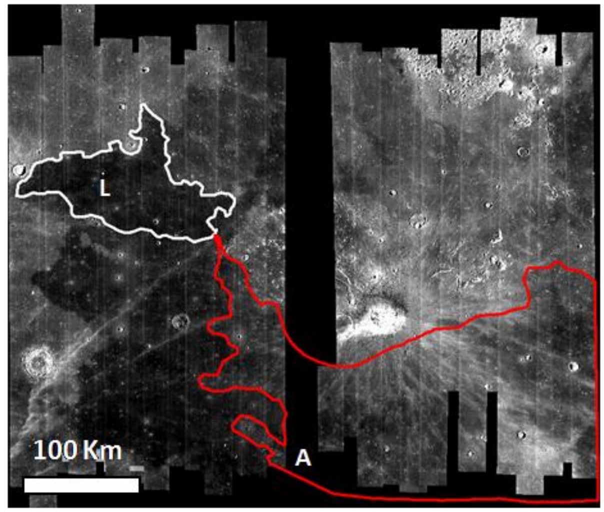

Figure 1. A M^3 mosaic of the study area in the Oceanus Procellurum region. Here areas demarkated with white border (L) and red border (A) shows young basalts adjacent to Litchenberg and Aristarchus craters respectively.

spectral parameter analysis varies from 446 m - 897 m and 516 m - 992 m respectively. These have been measured using the web based LROC quickmap website [8]. The central wavelengths of the 1- and 2-μm pyroxene–olivine absorption features, designated as Bands I and II respectively has been calculated by removing the local continuum by fitting a straight line continuum tangent on both side of the absorptions I and II separately and dividing the spectra by their respective continuum. The convex hull method used by [9] is used for the continuum removal and the local continuum anchor points are chosen according to [6]. The estimation of the band center is done by a 3rd order or a 4th order polynomial curve fitted to the bottom end of the visually determined band minima of the local continuum removed absorption feature. For fitting the polynominal function to the bottom end of the local band minima of the spectra, two data points for Band I and 1 data point for Band II have been taken on either side of the visually determined band minima, since the spectral resolution between the data points is 20 μm and 40 μm respectively. The RMS error of the estimated band centre values varies from 0.002 to 0.003. The ratio of Band II to Band I area known as Band Area Ratio (BAR) [10,11] is calculated by finding the area between the continuum slopes and the data points under the continuum of the 2-µm and 1-µm absorption feature respectively.

Results and Discussion: The average spectral revlectance curves for all the craters studied in areas 'L' and 'A' and their continuum removed counterparts are plotted in fig. 2 a, b.

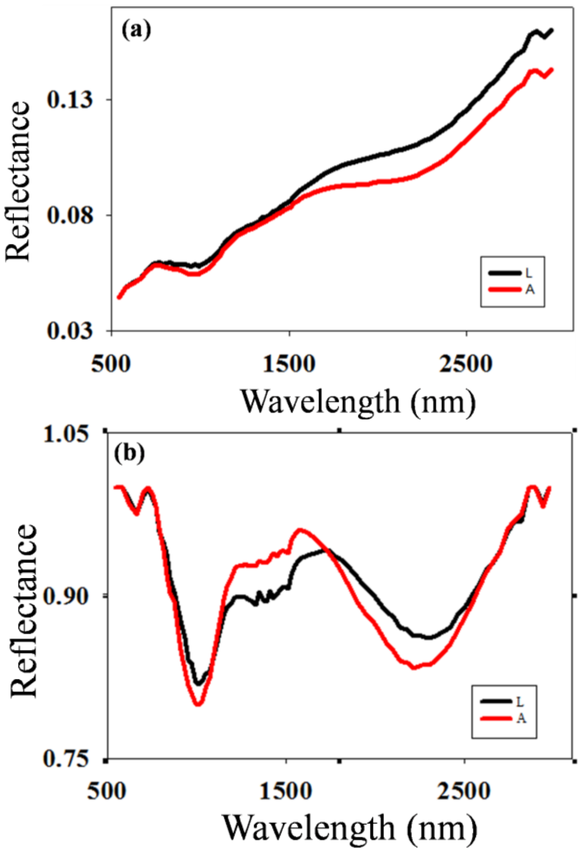

Figure 2: a: Average spectra of young craters derived from Level 2 M^3 data from the study areas L and A. b: Corresponding continuum removed spectra.

It can be seen that both these areas exhibit broad 1 µm absorption feature indicative of presence of abundant olivine in the basalts alongwith hi-Ca pyroxene, as also indicated by [12]. The spectral parameters derived using the methodology discussed above are shown in Table 1. From fig. 3, a plot between BAR nand the Band Centre I, it can be see that almost all the data points for

Table 1. Average spectral parameter values derived from young craters in the study areas L and A.

Study Areas	**L**	**A**
IBD1000	25.07 ± 0.20	25.12 ± 0.18
IBD2000	19.53 ± 0.25	19.74±0.24
Band I centre	1009 ±10	1002 ± 19
Band II centre	2235 ± 43	2202±36
BAR	0.44 ± 0.09	0.73 ± 0.16

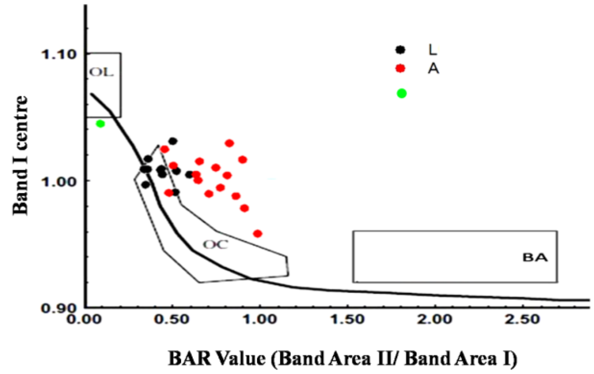

Figure 3: Band I centre Vs Band Area Ratio (BAR) plot as modified by Gaffey et al. (1993). The green dot represents the values derived from a pure Olivine rich area at the edge of Aristarchus crater. Here OL – monomineralic olivine, OC – ordinary chondrites and BA – pyroxene dominated basaltic achondrites.

both these young basalts are ploted towards olivine end thereby also reflecting the olivine enrichment in these young basalts. However, most of the data points from L region are slightly shifted towards left possibly due to slightly higher olivine abundance or higher Ti content for the basalts of L region compared to the A region.

Conclusions: The spectral reflectance study of the young basalts adjacent to Litchenberg crater and the Aristarchus crater in the Oceanus Procellarum using Level 2 calibrated M^3 data, have provided the following results. Both these regions exhibit almost similar spectral characteristics; basalts near Litchenberg crater might be slightly enriched in olivine abundance compared to the ones south of Aristarchus Plataeu. The significance of this disparity in terms of their source composition in the lunar mantle is yet to be deciphered.

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