INTEGRATED ANALYSIS OF TOPOGRAPHICALLY HIGH MAFIC EXPOSURES AT APOLLO–17 LANDING SITE USING DATA FROM IMAGING SENSORS ON CHANDRAYAAN–1. P. Chauhan[1], N. Srivastava[2], C. M. Pieters[3], Ajai[1], A.S. Kiran Kumar[1], R. R. Navalgund[1], J. W. Head[3], N. Petro[4], C. Runyon[5] and J. N. Goswami[2], [1]Space Applications Centre, (ISRO), Ahemdeabad, India(prakash@sac.isro.gov.in), [2] Physical Research Laboratory, Ahmedabad, India, [3]Dept. of Geological Sciences, Brown University, Providence, RI 02912,USA, [4]NASA/GSFC, Greenbelt, MD, USA, [5] College of Charleston, Charleston, SC 29424, USA

Introduction: Of the six Apollo landings sites on Moon, the one at the southeastern rim of Serenitatis basin, Apollo 17, exhibits complex geology as had been inferred from analyses of collected samples and remote sensing studies [1,2]. Extensive mass-wasting propoably due to Tycho event [3] and FeO enrichment at higher elevations have been reported in this region of the Moon [2].

The imaging sensors onboard India's first Lunar mission Chandrayaan -1 (HySI, TMC and M3) [4,5] for the first time, have provided very high spatial and spectral resolution data in the visible-near infrared region of the electromagnetic spectrum. In this study, the mountains (Sculptured hills, South Massif and North Massif) surrounding Apollo-17 landing site, "Taurus-Littrow valley", have been investigated for their composition using HySI and M3 data. Also, morphologic studies have been carried out for geologically interesting features on these highlands using TMC data of ~5m spatial resolution to understand their mode of formation.

Data Analyses: The high resolution terrain mapping camera (TMC) data for the nadir view, drapped on the DEM derived from TMC stereopairs (Fig 1a) have been used to locate fresh exposures and steep slopes on the above mentioned highlands, surrounding Taurus Littrow (LT) valley. Spectral signatures of the two most prominent mafic exposures i) on the eastern Sculptured hill (marked as 'a' in figure 1a & blown up in 1b) and ii) on the southern flank of sculptured hill (marked as 'd' in figure 1a & and blown up in 1c) were initially generated using HySI data having spectral range of 0.42 to 0.96 µm. HySI spectra for these fresh exposures clearly indicates their mafic characterstics in terms of strong absorption between 0.75 to 0.95 µm spectral region (Figure 2). However, HySI spectral range is not sufficient to conclusively indicate the nature of mafic minerals present in these exposures, therefore, M3 spectral reflectance data in the 0.50 to 2.50 µm range have been used to study the mineralogy of these featuers. Since, the swath of M3 is double (40 km) than that of TMC & HySI (20 km), we could also map some additional fresh exposures using the M3 data. Principal component (PC) analysis of M3 data was done to reduce the data dimensionality. The first two PC images provided information on the albedo and topographic features, respectively (Figure 3). Spectral reflectance curves have been derived for prominent fresh exposures identical from TMC & HySI data, as well for other topographically high exposures seen in M3 data due to increased swath (marked on figure 3b). Further, spectral reflectance curves for fresh exposures on the basaltic valley floor have been included in our analysis to study compositional comparison.

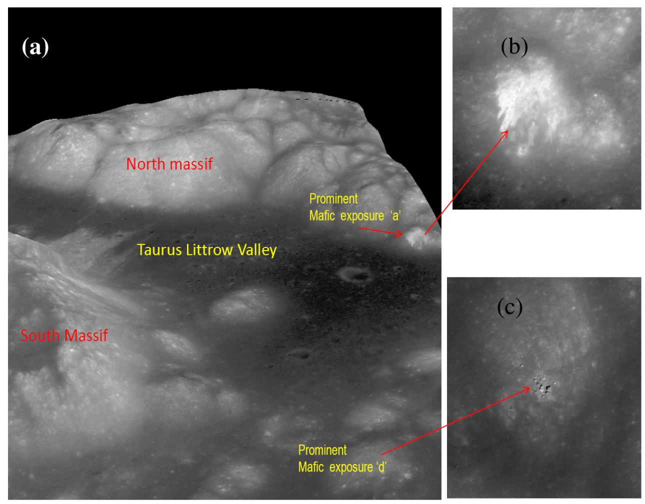

Figure 1:(a) Ch-1 TMC image draped over the DEM from TMC data, (b) Prominent Mafic exposure (MF1) on Sculptured hill, (c) Mafic exposures on southern flank of Sculptured Hill.

Result and Discussions: In general, it was observed that the albedo of the Sculptured hill is lesser compared to north massif. A total of nine mafic exposures have been found at higher altitudes on the hills surrounding the LT valley using HySI and M3 (figure 2 & 3(a)). The corresponding reflectance spectra are shown in figure 2 for HySI and figure 4 for M3 data sets. Out of these nine exposures, six appears to be significantly rich in low Ca-pyroxene. Interestingly, exposure 9 in southeren most portion of the image 3a shows spectral characterstics of crystalline plagioclase. High resolution TMC data for mafic fearure 'a' shows sharp outlines of fresh exposure .

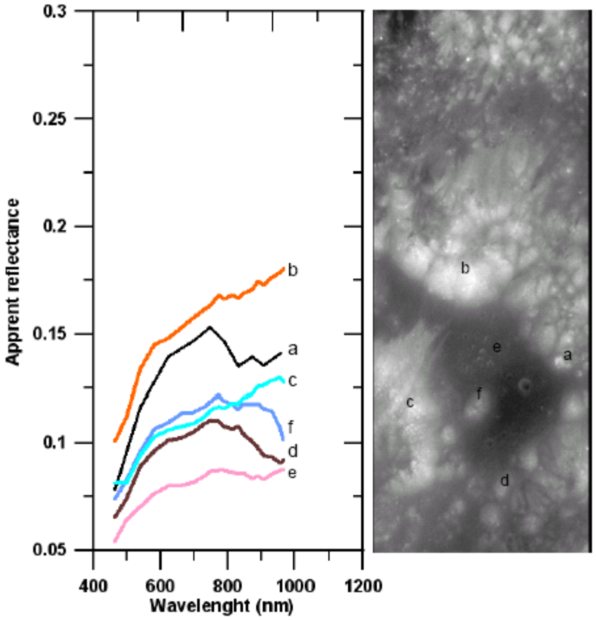

Figure 2: Reflectance spectra for fresh exposures and respective locations marked on HySI 750 nm albedo image.

In earlier studies using Clemetine data, Weitz et al. (1998) have reported ocurrence of fresh noritic patches on the Sculptured Hills, however, Robinson & Jolliff (2002) have used topographically corrected data and have reported mafic exposures as “mafic anomalies” which were inferred to be low Titanium basalt in composition. Integarted analysis of Ch-1 TMC, HySI and M3 data shows that only one exposure located at the southwestern edge of the Sculptured hill depicts signatures of dominance for high Ca Pyroxene (exposure 4 in fig 3a). Rest of the fresh exposures appear to be noritic in nature having low Ca pyroxene. The spectral signature(10 in fig 4) from fresh craters located at bastaic valley floor shows signatures of high Ca-pyroxene.

References: [1] Weitz C. M. et al. (1998) *JGR, 103,* 22725–22755. [2] Robinson M. S. and Jolliff B. L. (2002)*JGR,107,*E11,5110,doi:10.1029/2001JE001614. [3] Lucchitta, B. K., (1977), *Icarus, 30,* 80– 96.[4] Kiran Kumar A.S. et.al. (2009), *Current Science, 96,* 492-499.[5] Pieters C. M. et. al. (2009), *Current Science*, 96, 500-505.

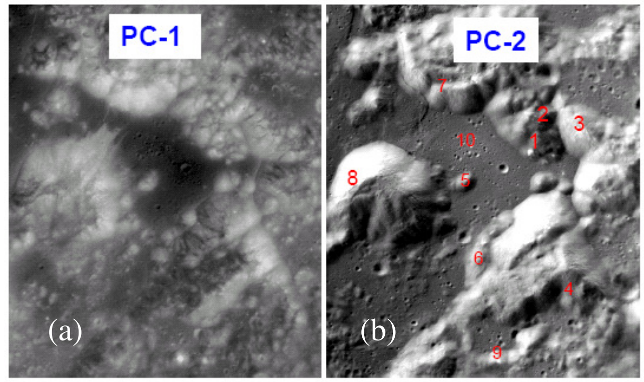

Figure 3: Principal components of M3 data. (a) First PC showing albedo, (b) second PC showing topographic variations with marked locations for the acquired spectra shown in figure 4.

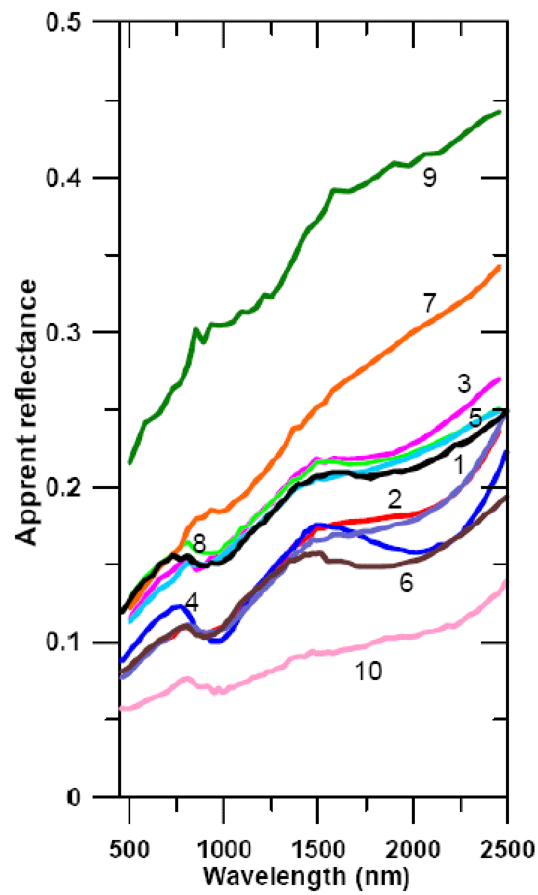

Figure 4: M3 spectra for the fresh exposures, marked on figure 3b.