IDENTIFICATION OF SPINEL GROUP OF MINERALS ON CENTRAL PEAK OF CRATER THEOPHILUS: D. Lal[1] , P. Chauhan[2], R. D.Shah[1], S. Bhattacharya[2], Ajai[2] & A.S. Kiran Kumar[2], [1]M.G.Science Institute, Gujarat University, Ahemdabad, India(disha137@gmail.com),[2]Space Applications Centre, (ISRO), Ahemdeabad, India.

Introduction: The Moon is the best preserved and most accessible laboratory for understanding impact cratering processes. Impacts are the most fundamental and important geologic process in the Solar System and on the Moon impact craters are well preserved due the lack of weathering agents on Lunar surface. Complex craters are of particular interest. These have a well defined central peak and often a terraced rim. The central peaks are brought up from greater depths beneath the crater as the ground elastically rebounds after the shock and pressure of the impact[1]. These complex impact structures are well-preserved, and the central peaks - which have brought up materials from great depth - offer us the easiest way to explore the composition of the Moon's lower crust and upper mantle, providing critical insights to figure out how planets in this Solar System (and others, around other stars) are formed.
This paper presents the result of compositional study of one such complex crater Theophilus with prominent central peak using Chandryaan-1 Moon Mineralogy Mapper (M3) & SELENE Multiband Imager (MI) data. Theophilus (26.4° East, 11.4° South) is a very large crater ~ 100kms in diameter having very high walls with terraces, flat floor and imposing Central Mountain[2].

Methodology: Analysis was carried using M3 data having 85 bands with 20-40 nm spectral resolution spanning a spectral range from 0.43 to 3 µm and a spatial scale of 160 m/pixel. Level 1B data was downloaded from the NASA PDS and JAXA data Archive website and apparent reflectance values were generated using spectral band convolved solar flux data. The data was further normalised with respect to the Apollo-16 62231 soil sample and the correction factor were applied to Theophilus crater reflectance data. The Spectral reflectance data derived from M3 were used to study the composition of the Lunar surface and Selene (MI) high resolution data was used to infer the morphological details.

Result & Discussion: The false color composite is generated using red, green and blue channel with reflectance value at 950nm 750nm and 500 nm, respectively (Figure 1). This figure shows the anomalous regions on the central peaks indicating a different surface composition in comparison to the crater walls as well as the crater surface.

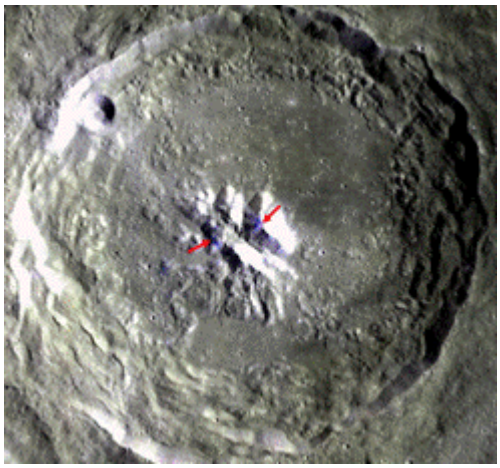

Figure 1: The arrows show the anomalous region at the central peak of the Theophilus crater.

The reflectance spectra for different regions of the crater are shown in figure-2. The walls and the craters on the flat floor of Theophilus (R-1) show the presence of low calcium pyroxene while the spectra of the region 3 (R-3) indicate the presence of olivine within small region of the central peak (absorption center at 1.24 µm). The spectra for the anomalous region (R-2) show a prominent absorption at 2 µm with no 1 µm absorption. The explanation of these spectra can be that the surfaces represent a rock type dominated by Mg-rich Spinel with no detectible other mafic minerals [3].

High spatial resolution (~ 20m/pixel) Selene (MI) data were used to ensure any unusual feature indicating the possibility of any kind of surface disturbance leading to the anomalous spectral signature. The reflectance spectra as obtained from the MI data are shown in figure 3. The spectra for the identified anomalous region (R-2) show no peculiar absorption near 1 micrometer indicative of the absence of mafic composition.

Conclusions: The preliminary compositional investigation indicates the presence of Spinel group minerals at the central peak of the Theophilus crater. This group of minerals is common in lunar samples and was identified using M3 high resolution data in the Dark Mantle Deposits on near side (Rima Bode) and at Mare Moscoviense [4]. Further in this study the origin of

Spinel group of minerals at the central peak of a young crater has to be investigated and may lead us to infer a fresh aspect about the crustal composition of Moon and hence the evolution.

References: [1] Carle M. Pieters, Copernicus Crater Central Peak: Lunar Mountain of Unique Composition, Science, 1982.[2] Stefanie Tomkins and Carle Pieters, Mineralogy of the lunar crust: Results from Clementine, Meteoritics & Planetary Science,1999. [3] J.M.Sunshine, Hidden in Plain Sight: Spinel-Rich Deposits on the Nearside of the Moon as Revealed by Moon Mineralogy Mapper (M3), LPSC XXXXI (2010), Abstract #1508.[4] C.M.Pieters et.al, Identification Of A New Spinel-Rich Lunar Rock Type By The Moon Mineralogy Mapper (M3),LPSC XXXXI (2010), Abstract #1854.

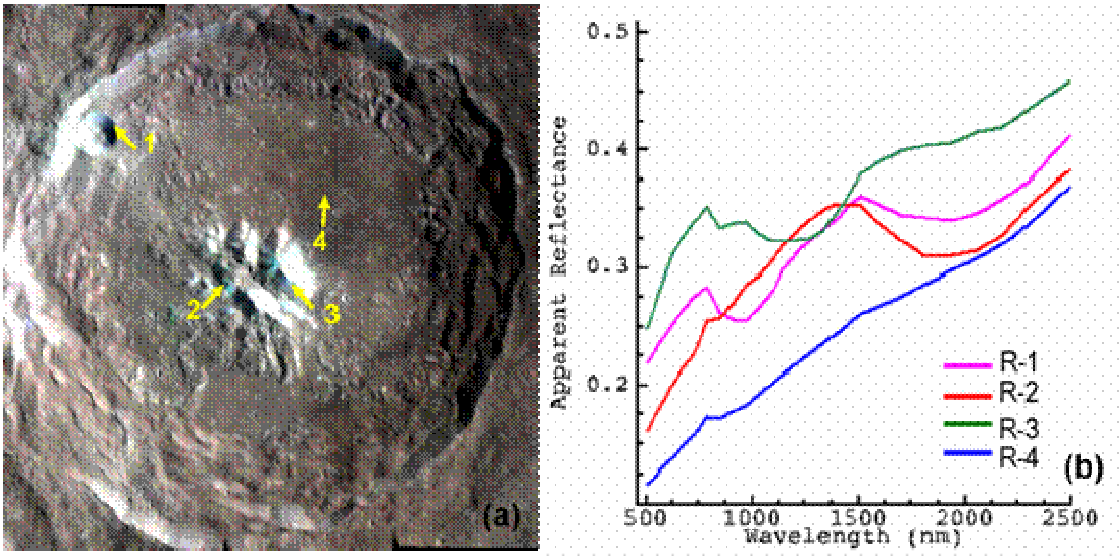

Figure 2: (a) The arrows show different region of the Theophilus crater (M3 image). (b) Reflectance Spectra for respective regions. (R-2 showing Spinel Signature)

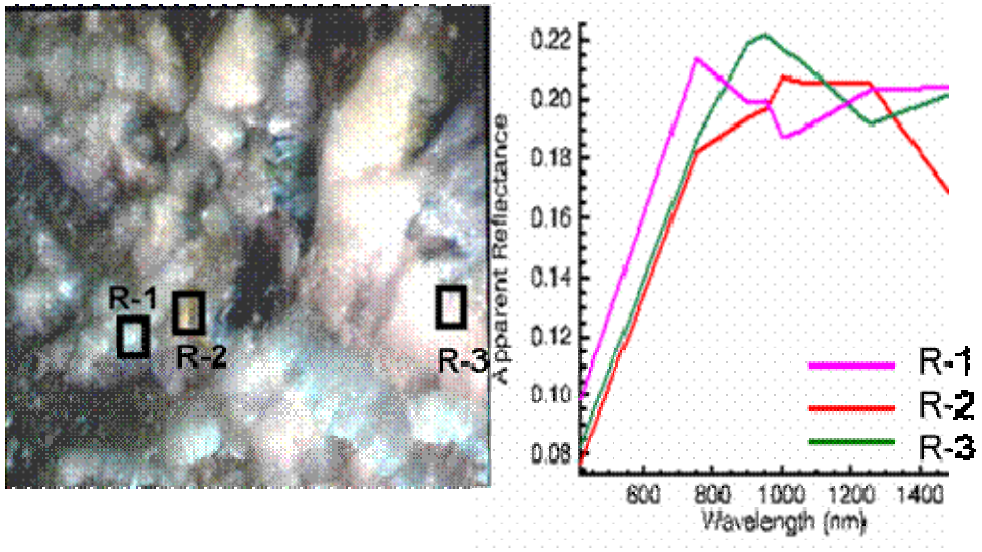

Figure 3: Selene (MI) image showing the anomalous region and their reflectance spectra. (R-2 showing Spinel Signature)