MINERALOGICAL ANALYSIS OF THE FRACTURED FLOOR REGION WITHIN CARDANUS CRATER

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Introduction: The mineralogical study of lunar basalt helps in understanding the geological evolution of the differentiated Moon. The western region of Oceanus Procellarum near the equatorial transition region is dark, rich in mare basalts and is a low lying area. Cardanus crater is a lunar impact crater located in the western region of Oceanus Procellarum centred at 13.2°N 72.4°W. The crater is 50km in diameter with deep floors, complex central peak and extensive wall terraces. The outer rim of the crater is sharp-edged with the hummocky outer rampart and terraces along parts of inner wall. Several small craterlets can also be seen on the surface of the crater floor.

The unique feature of the Cardanus crater is its fractured floor characterised by radial, concentric and polygonal fractures and features like ridges, crescent shaped mare deposits and dark haloed pits [1]. The fractures may have formed due to the initial crater impact on the surface of the moon.

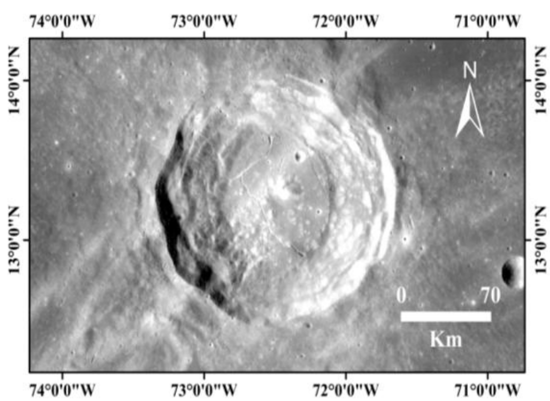

Fig.1. *LROC WAC image of the study area.*

Data set and methodology: For mineralogical analysis, photometrically and thermally corrected Level-2 data products of CHANDRAYAAN-1 Moon mineralogical mapper have been used [2]. It has a spectral range from 460-3000nm with spatial resolution of 140m/pixel from 100 km orbit and 280m/pixel from 200 km raised orbit [3]. For morphological analysis, LROC Wide angle camera has been used that has a spatial resolution of 100m/pixel in visible region and 400m/pixel in ultraviolet region. LOLA data from lunar Reconnaissance orbiter has been used to study the elevation of crater. The lunar minerals are identified in the visible to near-infrared reflectance spectra based on the photon interaction with the crystal field in different absorption bands [4]. Minerals like olivine and plagioclase has strong absorption band near 1000nm and 1250 nm respectively. ENVI image processing software is used for the mineralogical mapping of the study area. Band shape algorithm has been done to delineate the abundance of minerals in the study area. The algorithm includes band strength (bs), band curvature (bc), band tilt (bt) and band ratio (br) [5]. These are calculated at a specific wavelength to distinguish specific minerals in false colour composite map.

bs= 1009/750nm

bc= (750/910 + 1009/910) nm

bt= 910/1009 nm

br= 2018/1009 nm

Results and discussion: According to Schultz [1976], Cardanus crater has been morphologically classified as class 1 crater based on the fractured floor. The crater floor is considered to have radial fractures. Mineralogical mapping results are correlated with the morphological units to understand the basis of fractured floor formation.

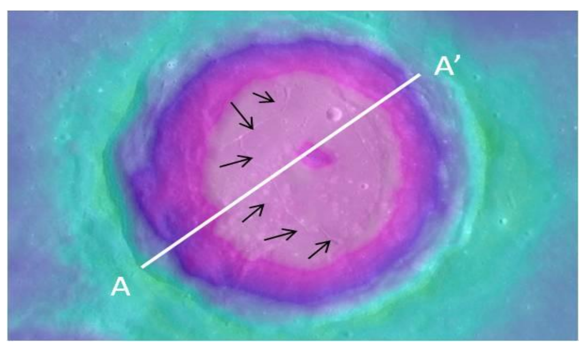

Fig.2*. LOLA image of Cardanus crater showing fractures on the floor.*

The fractured floor crater has olivine rich area which was delineated through the ratio of 2018/1008 nm. RGB composite shows high band tilt values which appears in green colour indicating the presence of olivine rich lithology. It has a strong absorption band near 1000 nm and there is no significant absorption near 2000 nm [6]. Around the fractured floors, band curvature values are high which probably indicates the presence of low calcium pyroxene that has high Fe/Mg components. Fe-Mg components show strong absorption near 2000nm and weak absorption near to 1000nm.

In some areas of the fractured floor, FCC shows some patches of olivine bearing lithologies associated with the hydration features. These olivine and OH features have been identified based on its absorption feature at 1070 nm and 2816nm respectively [7]. The fractured floor crater that is to the south of crater has high calcium pyroxenes with their band 1 absorption features near 940 and 985 nm and band 2 absorption features near 2045 nm and 2135 nm respectively.

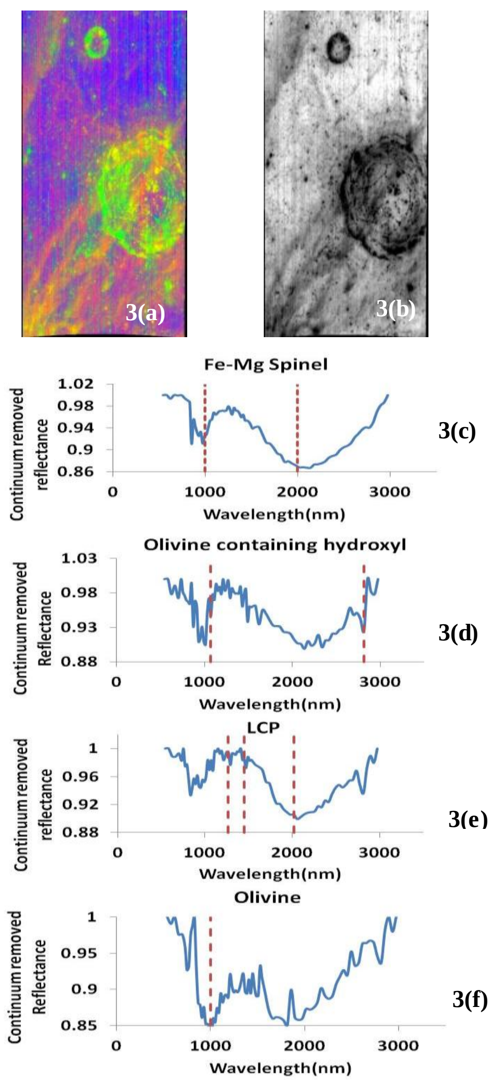

Fig.3 (a) RGB Composite of bs,bc and bt in the study area. Fig 3(b) Gray scale image of the study area based on 2018 nm/ 1008 nm. Fig.3 (c)-(f) showing the continuum removed reflectance spectra of various minerals within the floor fractured crater. 3 (c) showing strong absorption near 2000nm. 3 (d) shows absorption bands between 1000nm and 2000nm. 3 (e) shows olivine mineral with strong absorption feature at 1000nm. 3 (f) mark the olivine containing hydroxyl mineral with strong absorption feature at 1070 nm and 2816 nm.

Conclusion: The present study describes the mineralogical variation in the fractured floor feature of the crater Cardanus. Its mineralogy indicates the exposure of mafic body from deep crustal zone upon impact on the surface. Presence of olivine and its hydroxyl association in some parts of FFC suggest that the crater could have magmatic origin. Detailed mineralogical study around FFCs shows diversity in terms of surface mineral composition.

References: [1] Jozwiak, L. M. et al. (2012) *Journal of Geophysical Research: Planets*, *117*(E11). [2] Clark R.N.et al. (2009) JGR, 116, E00G16 [3] Boardman J.et al. (2011) JGR, 116, E00G14. [4] Varatharajan, I. et al. (2014) *Icarus*, *236*, 56-71. [5] Sivakumar, V. et al. (2017) *Geoscience Frontiers*, *8*(3), 457-465. [6] Chauhan, M. et al. (2015, March) *Lunar and Planetary Science Conference* (Vol. 46, p. 1407). [7] Pathak, S. et al. (2017, March) *Lunar and Planetary Science Conference* (Vol. 48).