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Compositional mapping of Dionysius Crater using Moon Mineralogy Mapper data

Henal Bhatt[1], P. Chauhan[2], Satadru Bhattacharya[3], Mamta Chauhan[4], Paras Solanki[1], [1]M. G. Science Institute, Ahmedabad 380009, India, [2]Indian Institute of Remote Sensing, (ISRO), Dehradun, Uttarakhand, India; [3]Space Application Center, ISRO, Ahmedabad, India; [4]Banasthali Vidyapith, Banasthali 304022, India. (henalbhatt@yahoo.in)

Abstract

This study presents compositional and morphological characteristic of the simple and Copernican aged Dionysius crater using high resolution data from the recent lunar missions.

1. Introduction

Dionysius Crater is centered at (2.8°N, 17.3°E), on the south-western limb of Mare Tranquillitatis, on the eastern near side of the Moon. Its diameter is 18.4 km [1]. It is a Copernican aged crater with the brightest crater albedo and the characteristic long-darker ray system. Dionysius is situated on mare-highland boundary, its dark ray system spreads over highland and mare region. A feasible dark ray system of the Copernican-aged crater Dionysius is dominated by mare basalts [2]. This crater has been studied using hyperspectral data for the first time, in this work.

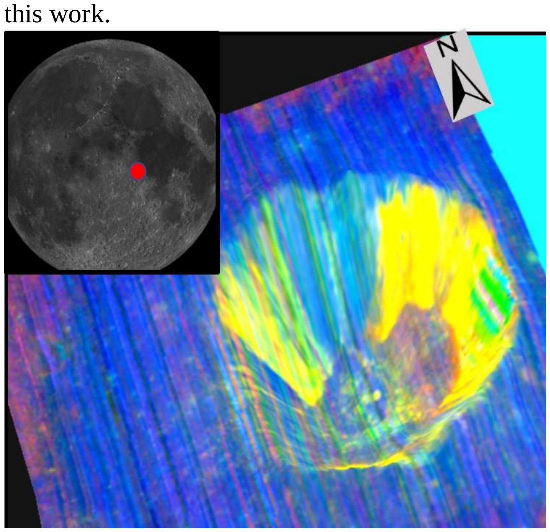

Figure 1. Location Map of Dionysius crater and M^3 mosaic analyzed using band ratio technique.

2. Data set and Calibration:

The hyperspectral data from Moon Mineralogy Mapper (M^3) camera onboard Chandrayaan-1 is utilized. M^3 operating in VNIR spectral region, ranging from 540 nm to 3000 nm with 85 contiguous band and 140 m/pix spatial resolution [3]. M^3 level-2 data which is pixel located, thermally corrected, photometrically corrected, reflectance data with optical period-OP1A and OP1B from the 100 km orbital altitude is acquired from PDS Geoscience Node (https://ode.rsl.wustl.edu/moon/index.aspx) which was georeferenced and mosaiced.

3. Methodology

Band ratio technique is used for identification of pyroxene, spinel and plagioclase which is assigned corresponding Red, Green, Blue channel to generate False Color Composite (FCC) image (Fig. 2) as per [4]. FCC map was draped over LOLA-DEM for generating 3D model of compositional map (Fig. 1, 2). Average reflectance spectra were calculated to study the mineralogy of the area (Fig. 5). Triangular Irregular Network (TIN) model has been generated to study the topographic variation of the area (Fig.3).

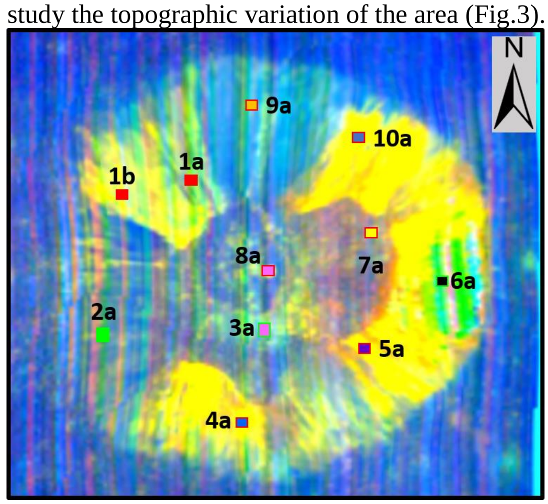

Figure 2: M^3 FCC generated using band ratio technique. Marked area shows location of the reflectance spectra collected in the present work.

4. Results and Discussions:

Green colour in the FCC image shows presence of Fe-spinel bearing material. Blue colour presents plagioclase bearing highland material. Yellow colour shows presence of high calcium pyroxene (HCP) bearing material. Western Half part of the crater is exposing mostly the highland material such as spinel and anorthosite. While eastern half part of the crater exposes HCP rich mare material. Area near to marked 7a is slumped material. Western rim part (near to marked 2a in Fig. 2) shows slumping of the ejecta material from the rim which have been deposited after the impact event. North most, south most and eastern most rim displays comparatively less slumping of ejecta material (Fig. 3-Gray shaded region).

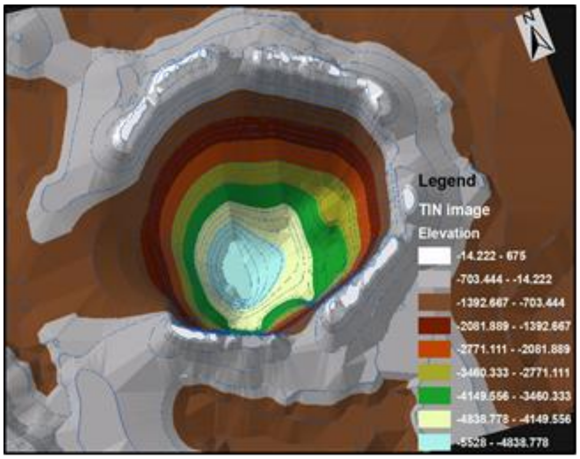

Figure 3: Triangular Irregular Network (TIN) image generated from contour map to study the topography. Legend is showing elevation in meters.

Spectra 6a and 9a represents mafic glass mixture at northern wall and eastern wall of crater. North-East and south-east wall show presence of HCP rich material. Floor of the crater shows presence of Fe-spinel bearing material marked with 3a and 8a. North West wall (marked 1a and 1b) shows prominent debris flow in the LRO Narrow Angle Camera (NAC) image which is Fe-Spinel bearing material (Fig. 4b). Floor of the crater shows presence of boulders and cooling cracks (Fig. 4a). Normal and Continuum removed reflectance spectra for all the marked location in Fig. 2 is presented in Fig. 5.

Conclusion:

Dionysius crater exposes highland material in the western half part which shows presence of Fe-spinel bearing material, which may have exposed from highland Mg-suit of rock type. Eastern part exposes HCP rich mare basaltic material from the Mare Tranquillitatis.

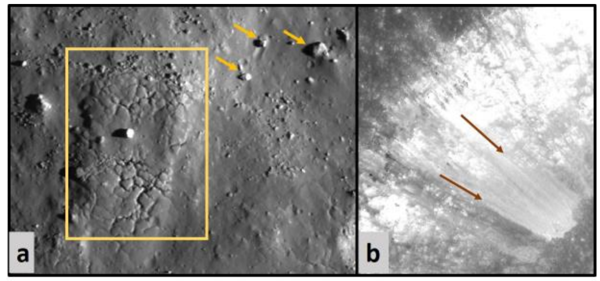

Figure 4. a. NAC image shows cooling cracks at southern floor of crater along with boulders, b. debris flow at SW wall of crater.

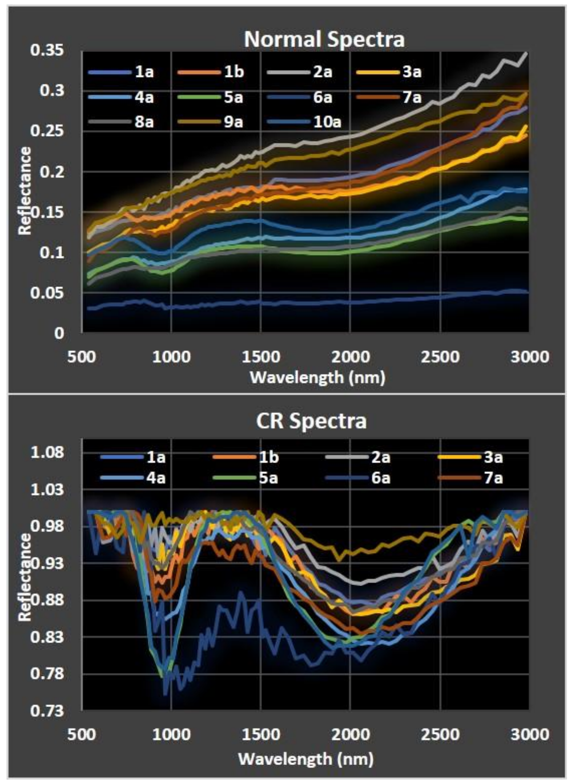

Figure 5. M^3 normal and CR reflectance spectra**.**

References: [1] Sharpton, V. L. (2014), JGR, 119, 154-168. [2] Giguere T. A., et al., (2006). Journal of Geophysical Research: Planets, 111(E6). [3] Pieters C. M., et al., (2009). The Moon Mineralogical Mapper (M3) on Chandrayaan-1. Current Science 96:500–505 [4] Pieters C. M. et al., (2014), American Mineralogist, 99, 1893-1910.