GEOLOGICAL ANALYSIS OF CLASS-2 LUNAR FLOOR-FRACTURED CRATER BRIGGS.

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Introduction: Of late, the lunar floor-fractured craters (FFCs) have become an important topic of research to understand and unravel the diverse morphological and mineralogical entities that are having implications on the magmatic and thermal evolution of lunar surface throughout the geological history [1-5]. In 1976, Schultz classified these craters based on their various morphological features [6]. Among these, the class 2 craters are characterized by concentric fracture systems, uplifted convex upward floor profile and pronounced moat region adjacent to the crater wall region. Hence, crater Briggs is an ideal example of class 2 type FFCs. This crater (26.45°N, 69.18°W) is placed on the north-western side of the Oceanus Procellarum and north-eastern side of Eddington plain. It is an Upper Imbrian aged, nearly circular shaped crater with a diameter of ~ 37 km. This crater has a prominent central peak area with some concentric fractures in the rugged crater floor.

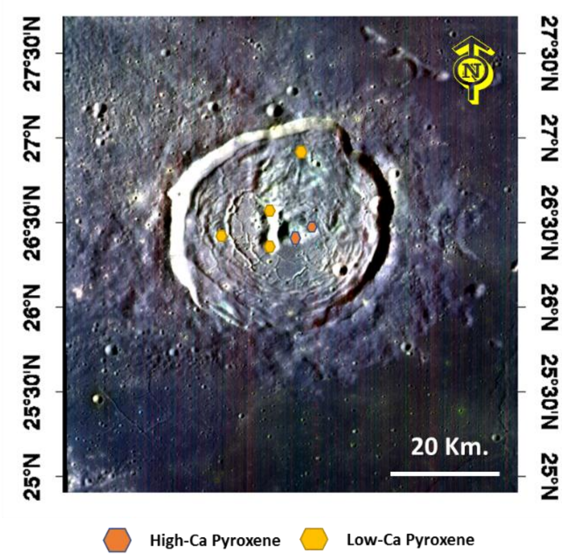

Figure 1: FCC mosaic from M^3 datasets of crater Briggs.

Data used and methods: For mineralogical analysis we used the photometrically and thermally corrected level-2 hyperspectral Moon Mineralogy Mapper (M^3) datasets from Chandrayaan-1 mission with the spectral range from ~ 450-3000-nm [7, 8]. To identify the morphological features, the data from wide angle camera (LROC-WAC) of Lunar Reconnaissance Orbiter (LRO) mission with 100 m spatial resolution, have been used [9, 10]. We also used the lunar orbiter laser altimeter-digital elevation model (LOLA-DEM) datasets with 30 m spatial resolution for topographic analysis of the crater floor. A false colour composite (FCC) mosaic has been generated by assigning the 930 (Red), 1249 (Green) and 2137-nm (Blue) bands of the M^3 orbital strips (Fig. 1). Then the reflectance spectra (Fig. 2) have been derived from this FCC image to identify different mineralogical components.

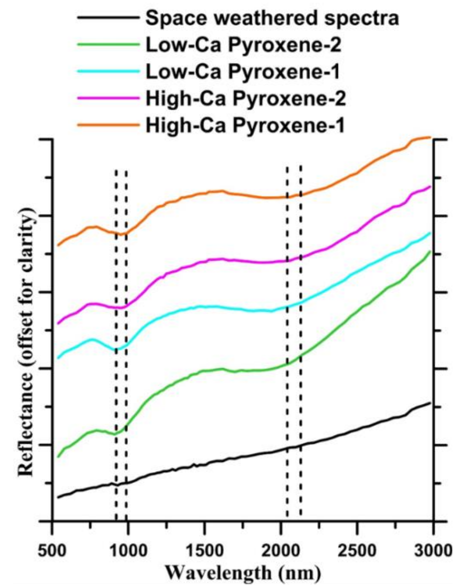

Figure 2: Representative reflectance spectra of various mineralogies derived from M3 data

Results and discussions: The representative reflectance spectra of the study area were analysed for the detection of major mineral phases, based on the diagnostic absorption features of the chief mafic minerals. In the Figure 1, few patches of the mafic exposures in the shades of yellow and green are present along the central peak area and the crater floor. The spectra extraction locations are marked by the polygons. The major mafic mineralogies are represented by Low-Ca pyroxenes (LCPs) and High-Ca pyroxenes (HCPs) and characterised on the basis of their double absorption features near 950-nm with

2059-nm; and 985-nm with 2165-nm respectively (Fig. 2). The central peak area is mainly composed of LCPs (LCP-1, Fig. 2). Most of the spectral signatures of HCPs (HCP-1 & 2, Fig. 2) could be observed in and around the central peak region. The reflectance spectra of these pyroxene mineralogies could also be identified from the fresh crater from various part of the crater floor, which might suggest that they formed at the late stage of evolution and excavated the underlying pyroxene-plagioclase rich mineralogy to the surface. Some mounds composed of LCP bearing mineralogies have been found along both sides of the fracture placed towards the west side of central peak area (LCP-2, Fig. 2). These LCPs might be crystallized from the melt escaped through those fractures. Some featureless spectra were also found which have no absorption in 1000 and 2000 nm, which could be composed of anorthosite affected by space weathering [11]. Hence, the mineralogical analysis results help us to comprehend that the central peak region is enriched in deeper crustal mafic mineral assemblages, which was excavated due to the impact event and the subsequent magmatic event which modified the mineralogy on the floor. In case of morphological analysis, the LROC-WAC image shows the concentric fracture system around the central peak region and also adjacent to the periphery of the crater floor (Fig. 3). Some fractures were generated during the later phase of ductile deformation and cross cut the earlier ones. The topographic relief on the north-eastern side is undulated where the southern and south-western side have relatively planner topography (Figs. 3 & 4). From the spatial profiles (Fig. 4) derived from LOLA-DEM data, we can identify the well-defined moat region adjacent to the crater wall region. The spatial profiles also indicate that the crater floor is uplifted on the central and western side with various type of concentric fractures.

Conclusions: From the present study it is concluded that the crater Briggs is characterised by nearly rounded periphery, uplifted deformed crater floor, concentric fractures and prominent moat regions belong to Class 2 floor-fractured crater [1, 2]. The composition and mineralogy identified through the M^3 datasets indicate the presence of mafic minerals, namely, Low-Ca pyroxenes and High-Ca pyroxenes. Additionally, the morphology of the crater floor and the results of mineralogical analysis did not show any late-stage pyroclastic activity. Further detail studies are envisaged for the deeper crustal significance and understanding the litho-evolutionary mechanisms of the FFC.

References

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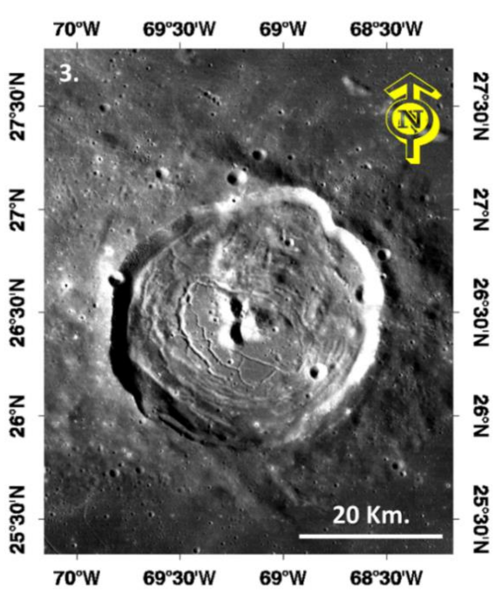

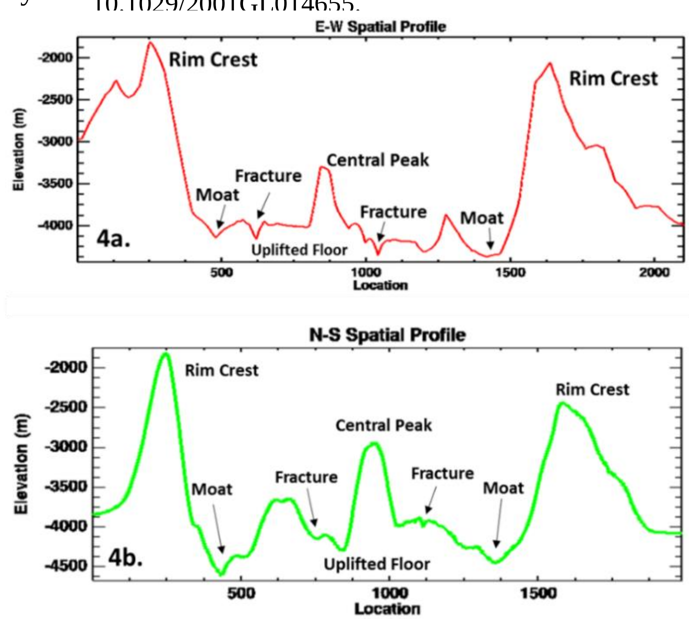

Figures: 3. High-resolution LROC-WAC image of crater Briggs for morphological analysis; 4. Spatial Profiles of crater Briggs (a. East-West, b. North-South) derived from 30m LOLA-DEM data