MORPHODYNAMIC STUDY OF OBLIQUE IMPACT CRATER ON LUNAR SURFACE USING TERRAIN MAPPING CAMERA ONBOARD CHANDRAYAAN-2. Shubham Gupta[1, 2, *], A. S. Arya[1], P. M. Solanki[2], Amitabh[1], K. Suresh[1], Ajay Kumar Prashar[1], Ankush Kumar[1], Vishnukumar D. Patel[1], Arup Roy Chowdhury[1]. [1]Space Applications Centre, Indian Space Research Organization (ISRO), Ahmedabad-380015, India. [2]M. G. Science Institute, Gujarat University, Navrangpura, Ahmedabad-380009, India. [*]eps.shubham@sac.isro.gov.in

Introduction: Impact cratering is a primary geological process for planetary evolution and shaping of the planetary bodies. The impact craters are the dominant geological structures on the lunar surface in which most of the craters are in circular shape, however, some of them are very distinct shape e.g. sub-rounded to elliptical depending on their ellipticity. Such type of craters give the opportunity to study about cratering mechanism of oblique shape impact craters. The angle of impactor for oblique crater formation has long been known most likely 45° [1]. However, the angle of impactor could be less depending on the shape of crater. The final shape of impact craters does not only depend on the impactor angle but it also depend on the target characteristics such as pre-impact topography and the velocity of impactor as well as the surrounding environments i.e. gravity and atmospheric conditions of planetary body where the craters form. The aim of this study is to analyse the impactor angle and its direction of impact for oblique crater formation using morphological characteristics of crater and the publish results of impact experiment which is performed by various authors [2], [3], [4].

Data and methodology: Terrain mapping camera (TMC-2) onboard Chandrayaan-2 acquired the image of the crater (Figure 1) at the altitude of 100 km in polar orbit on 27 November 2019, which is seleno-referenced and ortho-rectified, has been used in this study. The crater (diameter is 0.51×0.46 km) is situated at NW quadrant (crater's center 15.158° N, 152.289° W) of the moon and the ellipticity is calculated as 1.1. The morphological units of the crater such as ejecta distribution (proximal and distal), impact melt etc. are mapped in ArcGIS 10.5 platform, which is shown in Figure 2a. The cratering mechanism of the crater has been studied with the correlation of the morphological datasets and published results of impact experiments.

Results and discussion: Crater ejecta shows asymmetric distribution and rays pattern around the crater and most of them are confine at the north side of the crater. It is the characteristics of oblique impact.

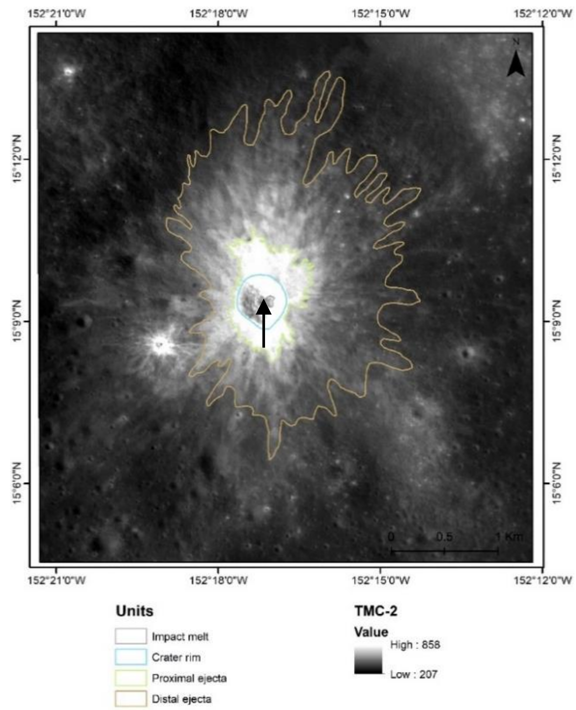

Figure 1. Morphological units of crater are overlay on TMC-2 ortho image.

The ejecta is divided into two categorize i.e., 1) Proximal ejecta (forms within < 5 times of crater radius) and 2) Distal ejecta (forms within > 5 times of crater radius) [5]. They have been shown in Figure 2a. The crater rim is also not circular. The ejecta distribution pattern is correlated with the experimentally derived crater (Figure 2b, c & d) and it is suggested that the impact angle and its trajectory could be possible in between 30° to 40° and south direction respectively.

Conclusion: The asymmetrical distribution of ejecta and elongated rim suggest an oblique impact for crater formation. The crater is correlated with experimentally derived crater and it is suggested that the impact angle could be possible in between 30° to 40° and direction of impact south direction. Here, the oblique impact does not produces a typical oblique shape crater. It could be explained that the crater shape does not only depend the impact angle but it also depends on the pre-impact target topography [6].

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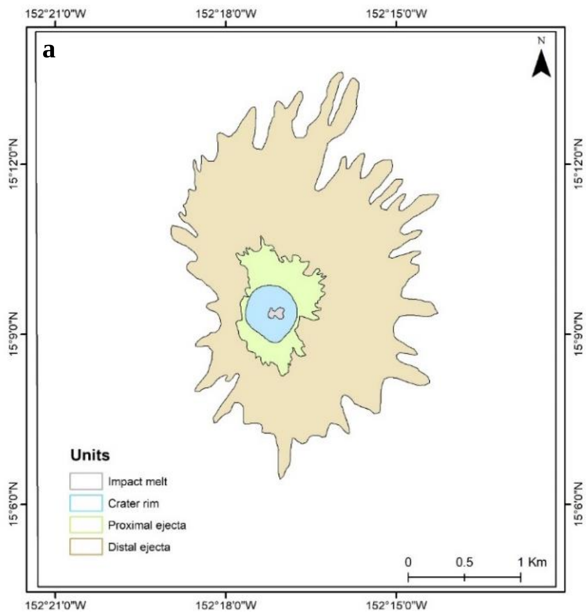

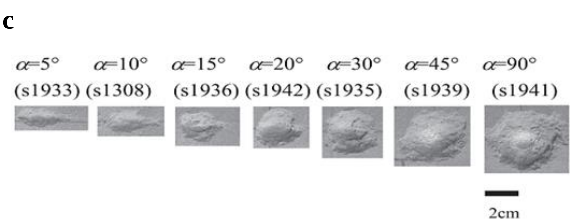

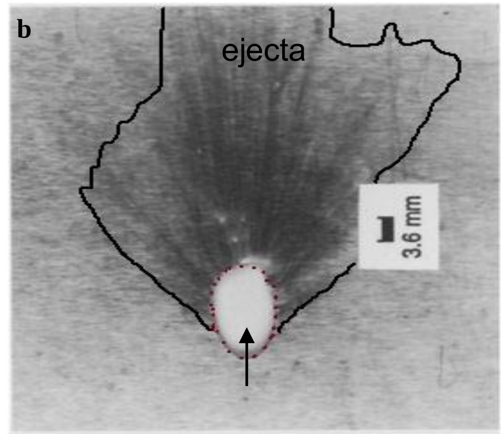

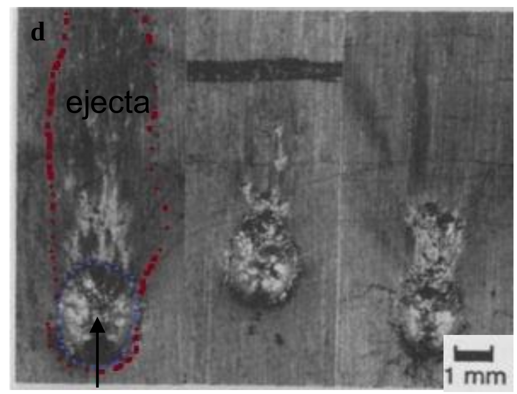

Figure 2. (a) Distribution and orientation of crater's morphological units (basemap: TMC-2 ortho image). (b) 3.6 mm aluminum sphere projectile at 6 km/sec at 65° into aluminum plate [3]. (c) Elliptical craters from impact of 7.14 mm diameter spherical nylon projectile on mortar targets at various impact angles with the speed of 2.3 km/sec [4]. (d) 1 mm aluminum sphere impacting at 7.0 km/sec at 70° on aluminum [3].