

Crater mapping and analysis using Cartosat 1 DEM. Vijayan. S¹., Vani. K²., and Sanjeevi. S¹
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Introduction:

Impact craters have a raised rim, a central depression and sometimes a wall terrace. Three dimensional analysis of the crater helps to understand better the rim, central depression, slope, depth, etc. which are the main morphological parameters of an impact crater. Thus, deriving and analysing these parameters will be helpful in distinguishing craters and understanding the effect of the impact on litho type. In this paper the above mentioned factors were performed for the Lonar crater, India. The slope, circularity index of the crater and extraction of the flow patterns were also obtained. The inference from this study is that the impact angle of the projectile plays a major role in descending the morphological characterisation of the crater .

Study area:

On the Earth there are several impact craters on different target rocks. One amongst them is the Lonar crater, India. It is a unique impact crater on the Basaltic terrain. Lonar crater has a diameter of ~1800 meters and whose depth is ~230m-245m from rim crest to crater floor [1]. The interesting fact about the Lonar crater is that it is formed on a single target rock i.e. basalt, which is also prominent litho unit of the lunar mare surface. Hence, studying this crater is significant to compare and analyze the lunar mare crater.

Crater analysis:

The parameters considered for the present study are, circularity index, DEM, slope and flow structures.

(i) Digital Elevation Model (DEM):

The Cartosat-1 stereo pair images are used for the DEM extraction for the Lonar crater. The crater elevation model is shown in fig.1a. The saline lake at the centre was masked to avoid error during the computation process. For this study all the image analysis were made using the DEM of the Lonar crater.

(ii) Circularity index (CI):

The CI value for the Lonar crater is ~0.902 (extracted from the DEM image). The CI value indicates that the crater is near circular shaped (0-ellipse shape, 1 –perfect circle).

(iii) Slope:

The slope of the Lonar crater is shown in fig 1.b. From the figure it is observed that Northern side of the crater is steep, while the southern side of the crater has a gentle slope. The slope was also extracted for the region outside the crater rim. The inner slope (inside the crater) varies from 20-40 degree. This is in agreement with the reports of GSI [2], which indicated a slope of ~26 degrees. The outer slope varies from 1-10 degrees.

(iv) Lava flow structure:

From the DEM image the basalt flow structures were also extracted (fig.1c). On careful analysis of the flow structures, on the S, SW and SE directions of the crater such features were seen. On the northern part of the crater does not possess any flow structure. The reason may be the projectile may have impacted from the north direction and compressed the flow structure (still further study needed).

The inner flow is covered by an area of nearly ~60m with four layers visible in the southern part of the crater. Whereas few such patterns (lava flows) are seen on the SE and SW of the crater and those are discontinuous.

The flow structures were also extracted for the outer periphery of the crater (fig 1c). As mentioned by Senthil Kumar, 2005[3] the rocks are upturned outside and on the top most rim of the crater. The flows are compressed near the rim. These are the impact effects on the rock surface.

(v) 3-Demisional model:

A 3-D visualization model is shown in figure 1(d).

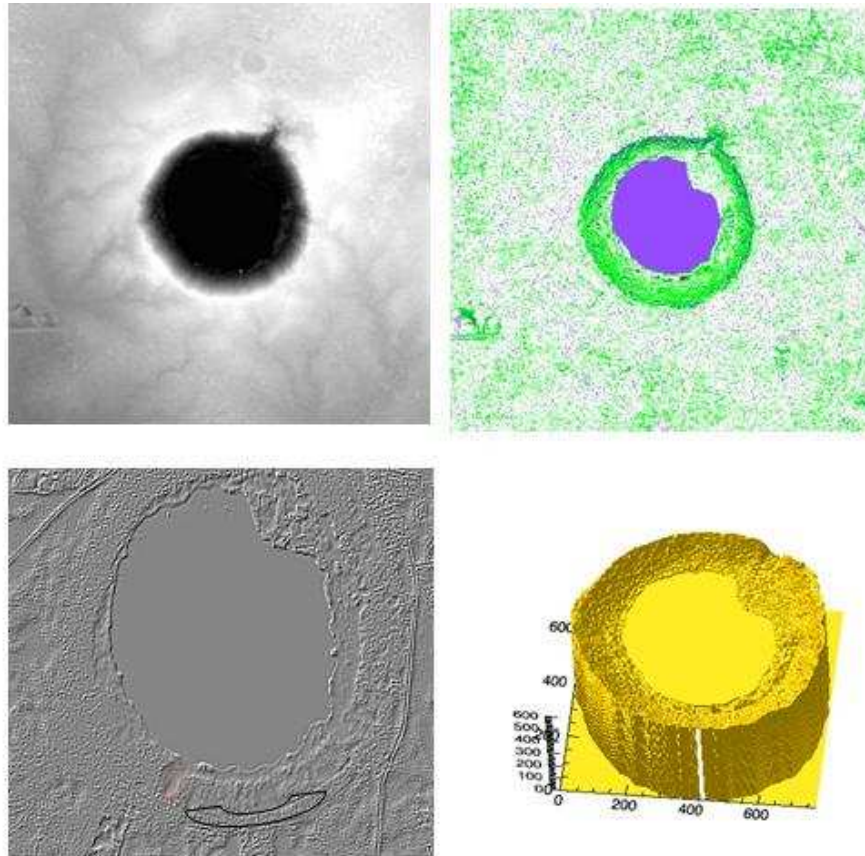


Fig. 1(a) Digital elevation model (b) Slope map (c) Lava flow structure (extracted) (d) Three dimensional image

Conclusions:

For the impact angle identification, the compression of the flow structure can be taken as a parameter. The north part of the crater is observed to be more vertical than the other sides (gently sloping) indicating that the crater was more compressed towards north. Moreover the lava flow was not seen on the northern part but occurs in the southern part of the crater. This indicates that the crater may have had more effects towards north. Further studies are being carried for the structural analysis of the Lonar crater.

This study would help in studying the character of the impact crater on the lunar mare surface.

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