BOULDERS DISTRIBUTION AT THE PROPOSED SLIM LANDING SITE NEAR SHIOLI CRATER. R. Nagori, A. K. Dagar*, R. P. Rajasekhar, Space Applications Centre, Indian Space Research Organisation (ISRO), Ahmedabad – 380015, India. (*adagar@sac.isro.gov.in).

Introduction: The Smart Lander for Investigating Moon (SLIM) is a landing mission of the Japan Aerospace Exploration Agency (JAXA). SLIM was launched on September 7, 2023 from the Yoshinobu Launch Complex at the JAXA Tanegashima Space Center. It is expected to land on the Moon near Shioli crater (25.2º E, 13.3º S) on January 20, 2024. The main objectives of the SLIM mission are to demonstrate the high precision Moon landing and actualization of lightweight probe system for frequent extraterrestrial exploration [1]. SLIM has three payloads, namely Multi-Band Camera (MBC), Lunar excursion vehicle (LEV) and Laser Retro-reflector Array (LRA). The MBC has 10 spectral bands ranging from 750 to 1650 nm with a resolution of 30 nm [2]. It will help in the characterization and understanding the lithology surrounding the landing site. There are two LEVs proposed on the SLIM lander. These will have wide-angle optical cameras, communications equipment to directly connect with Earth, and other science payloads, such as a thermometer, an inclinometer and a radiation monitor. The LRA is a NASA payload for accurate distance measurement.

In the present study, we have mapped and analysed the distribution of boulders around the Shioli crater using an image from Orbiter High Resolution Camera (OHRC) on-board Chandrayaan-2. OHRC is a very high resolution camera which has been used for mapping meter size boulders [3][4] and boulder trails [5]. The information about the boulder distribution is necessary from the perspective of hazard avoidances in case of landing and roving. Also, boulders make an ideal target for sample collection for further analysis.

Observations and Analysis: Three OHRC images, with a resolution of ~0.25 m, were acquired over the Shioli crater (location: 13.33° S, 25.23° E; diameter = 270 m). Figure 1a shows the contextual map of the region (Lunar Reconnaissance Orbiter (LRO) Wide Angle Camera (WAC) mosaic) with the location of Shioli crater marked in red box. A high resolution mosaic of the region was prepared using two overlapping OHRC images. We identified meter and sub-meter size boulders, from the mosaicked OHRC images, around the Shioli crater and manually mapped their spatial distribution. The spatial distribution of the boulders is shown as yellow dots on the OHRC image in figure 1b. The proposed landing site location of SLIM (~1 km from the crater center) is also shown (red star) on the figure.

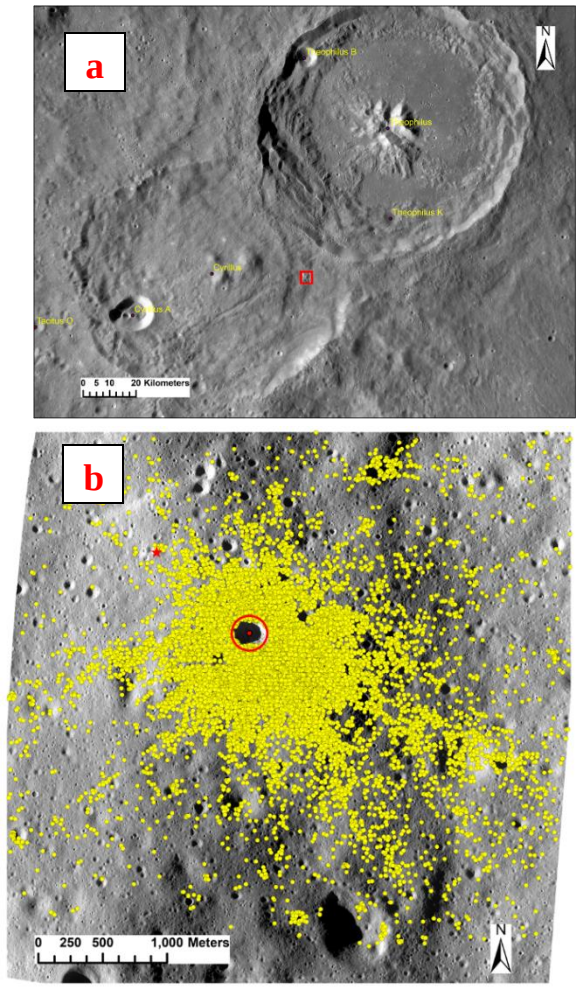
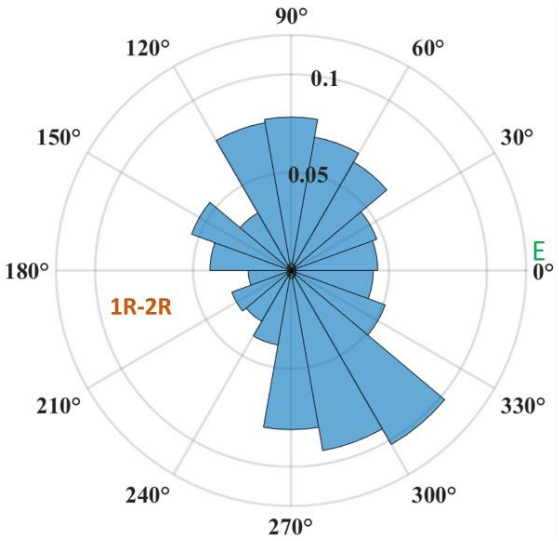


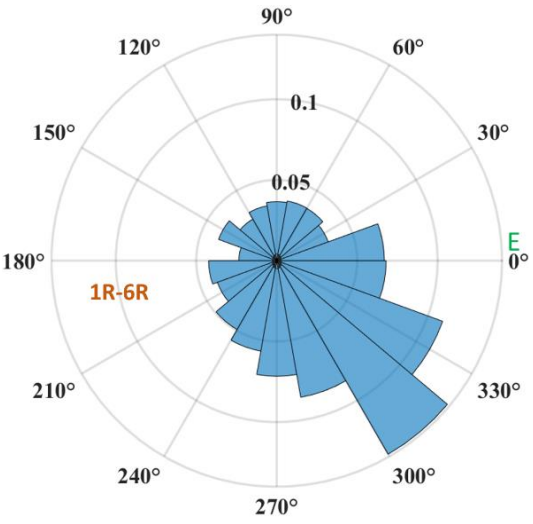
Figure 1. (a) OHRC image subset (bounded by the red box) overlain on the LRO-WAC mosaic covering Cyrillus and Theophilus craters. (b) OHRC image subset over the Shioli crater with the mapped craters (yellow dots) overlain on it. The red star, to the north-west of the Shioli crater, shows the proposed landing site of SLIM.

Results: A total of 15146 boulders were identified and spatially mapped around the Shioli crater (Figure 1b). As we do not have OHRC images for the extended region, the distribution analysis was done for 13 crater radii (R), which is almost equal to the distance to the western boundary of the OHRC mosaic subset. Rose diagram were generated for the boulders distribution to ascertain about the impact directionality. Concentric region around the crater was divided into 18 sectors of

20° each. Figure 2 top to bottom show the rose diagrams for 1R-2R, 1R-5R and 1R-13R distance, respectively. The size of blue color sector is proportional to the fraction of total number of boulders in that distance range. It is evident from the rose diagrams that the boulders have a preferential distribution in SE direction. This may indicate oblique impact origin of the Shioli crater, with up-range direction as NW.

Figure 3 shows the areal density of boulders (/km^2) with distance from the crater center. As expected, the density of boulders is very high (~10000/km^2) in the 1R-2R range which decreases to ~200/km^2 between 12R-13R.





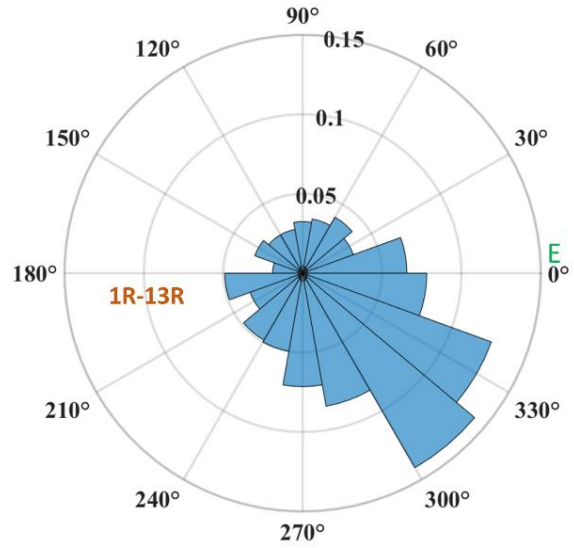


Figure 2. Histogram of the boulder distributions.

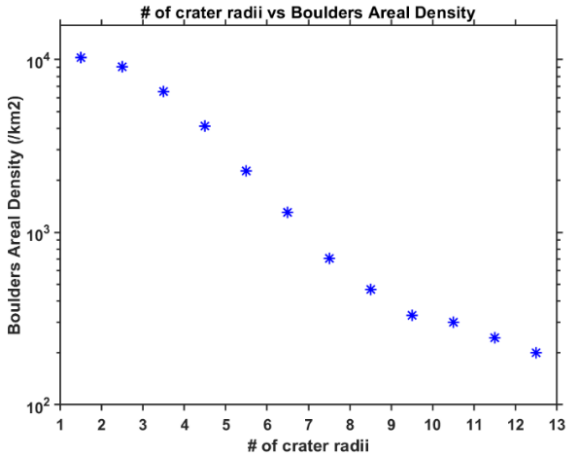


Figure 3. Size frequency distribution of the boulders.

Conclusion: Over 15000 boulders were identified and spatially mapped around the Shioli crater. The directional distribution of the boulders around the crater, as apparent from the rose diagrams, suggests that the Shioli crater might have formed due to a low angle impact. The boulder distribution information can form an integral part for the hazard avoidance during landing and roving phase of the SLIM mission. Boulders are also an excellent target for sampling and other scientific analysis.

References: : [1] SLIM project Press Kit, 24. [2] Nakauchi et al. (2019) *LPSC L*, #1522. [3] Dagar et al. (2022) *Icarus, 386*, 115168. [4] Nagori et al. (2024) *PSS, 240*, 105828. [5] Mohanty et al. (2023) *Icarus, 405*, 115723.