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# Morphometric parameters of fresh lunar craters

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**Abstract.** We study the morphometric parameters of 111 lunar craters with a diameter of 10 km or more, the formation of which, according to some researchers, can be attributed to the Copernican period. These craters were selected by analyzing data from the Diviner spectrometer on board the LRO probe. The purpose of this work is to study the morphometric characteristics of such craters in order to identify their characteristic features. According to the results obtained, the morphometric parameters of the fresh lunar craters are significantly similar to the morphometric parameters of lunar craters of the 1st degree of degradation (well-preserved craters) according to the classification of the SAI MSU.

**Keywords:** Moon; craters

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# 1 Introduction

Impact craters have appeared on the lunar surface throughout its history, which is 4.6 billion years. The youngest lunar craters were formed during the Copernican period, which began 1.1 billion years ago and continues to the present time. The shape of an impact crater is determined by the parameters of the collision that formed it and the age of the crater. Quantitative characteristics of the crater shape are its morphometric parameters. The main morphometric parameters of impact craters, following Slodarzh (2021), are their diameters, the inclination angles of the external and inner slopes, the maximum and minimum depths and the height of the crater bottom. Analysis of data obtained by the Diviner infrared spectrometer on the LRO probe showed that 111 lunar craters are clearly visible in the IR range: the ejecta of these craters heated and cooled more slowly than the surrounding surface. The authors of the work Mazrouei et al. (2019) attribute this to the fact that these craters were formed over the last billion years and their ejecta have not yet been fragmented by the fall of other bodies and contain a significant number of large fragments. We compared the morphometric parameters of such craters with the morphometric parameters of well-preserved lunar craters.

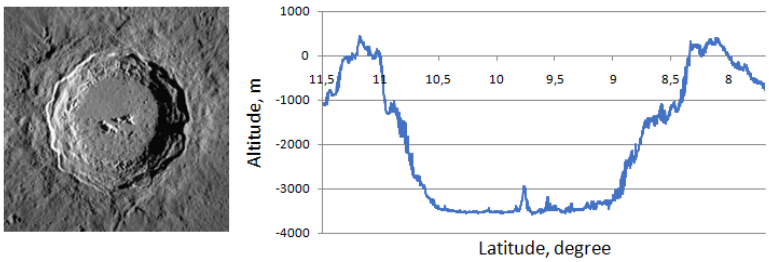


**Fig. 1.** Altitude profile of the Copernicus crater, (the image of the crater was obtained by the WAC camera of the LRO probe (https://www.lroc.asu.edu/about)).

# 2 Comparison of morphometric parameters of craters

According to the classification of craters by the degree of degradation of the SAI MSU, impact craters can be divided into 5 degradation classes: class 1 includes well-preserved craters that have a pronounced clear rim and often a system of rays, crater-ruins belong to the 5th degradation class. Degradation class 1 craters make up 19 % (2850) of the total number of lunar craters with a diameter of 10 km or more.

The degree of degradation of a crater does not always depend on its age: for example, the Sharonov crater (12.4° N, 173.3° E), which belongs to the 1st degradation class, was formed in the Eratosthenes period of lunar history (3.2–1.1 billion years ago). In this paper, we attempted to determine the morphometric features of fresh craters that would allow us to distinguish them from well-preserved craters of different ages. In the Morphological Catalog of Craters of the Moon (Rodionova et al. 1987), craters related to the 1st degradation class were selected. To determine the morphometric parameters of the craters, data from the LOLA altimeter of the LRO probe were used (https://ode.rsl.wustl.edu/moon/). Altitude profiles of 111 fresh craters (Mazrouei et al. 2019) and 150 craters of the 1st degradation class were studied (Fig.1). The distribution of craters by diameter for both crater groups is similar: the diameters of most craters in both groups (92 % of craters Mazrouei et al. (2019) and 96 % of craters of the 1st degradation class according to the classification of the SAI MSU) lie in the range of 10–30 km with a maximum in the range of 10–20 km.

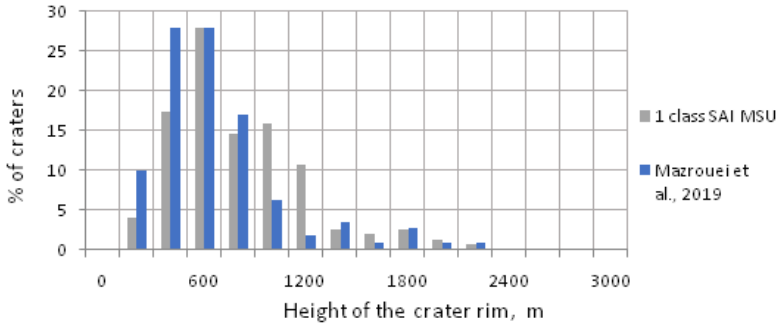


**Fig. 2.** Distribution of craters from Mazrouei et al. (2019) and craters of the 1st degradation class by the height of the rim.

As can be seen from Fig. 2, height of the crater rim for both groups lies in the range of 200–2000 m. About 60 % of the craters of the 1st degradation class and 81 % of fresh craters from Mazrouei et al. (2019) have a rim height of 400–800 m. The values of the inclination angles of the inner slopes of the craters for both groups of craters are approximately the same, ranging from 10 to 40 degrees. For the majority of craters of degradation class 1 according to the SAI MSU (73 %), the inclination angles of the inner walls of the crater lie within the range of 20–25 degrees. Most of the craters from Mazrouei et al. (2019) have steeper inner slopes: the inner slope angles of such craters are in the range of 25–35 degrees. Most craters of degradation class 1 according to the SAI MSU classification (86 %) have inclination angles of

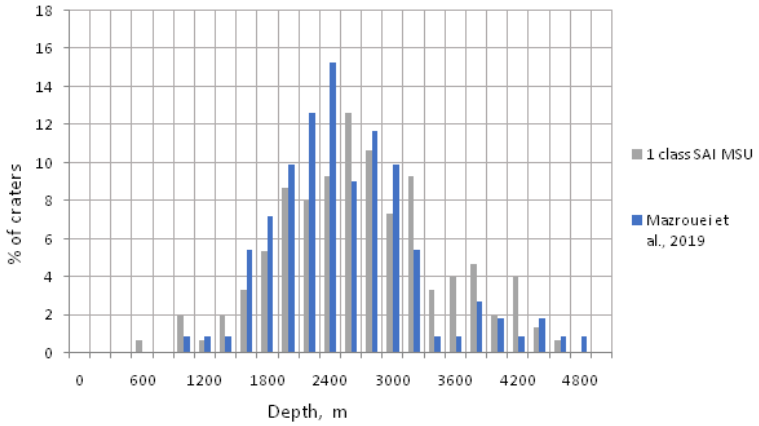


**Fig. 3.** Distribution by depth of fresh craters and craters of the 1st class of degradation.

external walls within the range of 2–8 degrees. The outer rims of the craters from Mazrouei et al. (2019) are on average slightly steeper: the inclination angles of the outer walls of the majority (85 %) of these craters are in the range of 4–12 degrees. The depth distribution of craters of both groups shows similarities. The depths of most of the craters of the 1st class of degradation according to the SAI MSU (71 %) lie within the range of 1800–3200 m (Fig. 3). The depths of the majority (86 %) of fresh craters from Mazrouei et al. (2019) lie approximately within the same range (1600–3200 m).

## 3 Conclusions

The morphometric parameters of lunar craters Mazrouei et al. (2019) are largely similar to the morphometric parameters of lunar craters of the 1st degree of degradation according to the SAI MSU. At the same time, the craters from Mazrouei et al. (2019) have slightly steeper inner and external slopes. Thus, no significant differences were found in the morphometry of craters determined by thermophysical properties as fresh from the morphometry of well-preserved lunar craters according to the SAI MSU data.

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