EPSC Abstracts
Vol. 6, EPSC-DPS2011-1292, 2011
EPSC-DPS Joint Meeting 2011

YOUNG MARTIAN CRATER GRATTERI AND IT SECONDARY FIELD

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Abstract

We re-assess the issue of the putative pollution of secondary craters on the crater retention age assessment. We study the secondary flied of Gratteri crater, a young 7 km crater. We assess the crater density of small impact craters inside and outside Gratteri rays at different distance from the primary impact. Our results reveal that the crater density is homogeneous outside the rays from 0 to 500 km to Gratteri and that the crater density experienced a peak at 150 km from Gratteri inside the rays. Inside the rays, the secondary craters are easily identifiable as they are clustered and aligned. Our study suggests that away from secondary clusters, and rays the crater density is not obviously affected by the secondaries.

1. Introduction

Recent studies have vigorously questioned the reliability of the age determination from crater counts of small impact craters (less than one kilometer) [1,2]. Especially for Mars, it is a crucial debate because the surface processes on Mars seem to have been active until very recent period of time. A part of the surface of Mars is young, exposing surfaces depleted in craters or only with few impact craters. Determining an age from these few impacts craters is a crucial challenge to understand the recent Martian activity. A part of the debate is to understand the role of secondary impact craters (craters produced by fallback of ejecta blocks from a primary impact) in terms of the density of the small impact craters and the consequence on the reliability of the ages determined from this range of diameters. Results from Europa [2] and Mars [1] suggest that secondaries dominate the population of small craters and may falsify the age assignment from density of impact crater smaller than 1 km. We re-assess this question by studying the secondary field of Gratteri crater.

2. Methology

We construct a Geographic Information System (GIS) to store and exploit imagery data. MOC images as well as HiRISE images featuring the secondary field of Gratteri crater have been geo-processed and integrated in our GIS. The GIS also includes data with a global coverage such as a MOLA elevation map, THEMIS infrared mosaics or geological maps. We map the small craters to assess the crater densities under GIS environment.

3. Gratteri crater

Gratteri crater is a 7 km diameter crater located in Memnonia Fossae region at 17.7°S and 160.1°W . The crater is notable for its strong pattern of rays, revealed in THEMIS thermal infrared imagery, and suggesting it should be one of the youngest craters in its size bin [3, 4]. The crater retention age of Gratteri has been estimated by [4] in a range of about 1 My to 20 My. The crater counts made on the surrounding plain are consistent with a Noachian surface from the crater density of the impact larger than 1 km.

4. Secondary field

We indentify Gratteri secondaries from 3 main characteristics: First, one notes clusters of small (D < 125 m), sharp rimmed craters spaced along the infrared rays. Second, these reveal the morphology typical of the Gratteri secondaries in this region, namely small, sharp-rimmed craters. Third, one then notes that even in the areas between rays, the population of these craters is distinct from the background, because the background craters are mostly strongly degraded whereas the apparent secondaries stand out as sharp-rimmed smaller craters. We also observe an unusual type of secondaries with rampart-like ejecta blankets primarily on the side away from Gratteri and at angles as ranging up to 90^{o} from the anti-Gratteri direction. These secondaries may be related to special target properties.

We then did crater counts of the total crater density of small impact craters on MOC and HiRISE picture at distinct distances from Gratteri from 0 to 500 km and we performed count inside Gratteri rays and outside the rays. The results are partly presented in figure 1. First of all, our results emphasis that there are almost no variations in the crater density according to the distance to Gratteri outside the rays. Secondly, the density of small impact craters inside the rays increases with distance from 0 to 150 km where the density shows a maximum. Then the crater density decrease rapidly to be in the same order in magnitude as the one outside the ray from 300 km to Gratteri.

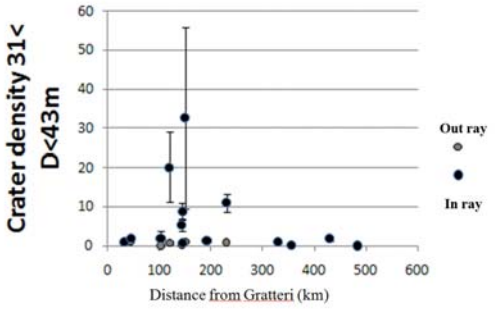

Figure 1: Crater density (in size bin 31-43 m) vs distance from Gratteri, inside and outside of the rays.

5. Preliminary conclusion

Our results seem to indicate that the secondary field contribute to the overall crater density inside the ray at a certain distance from the primary impact where secondaries are easily identified because they are clustered and aligned radially to the primary impact. In the case of Gratteri, we suspect that distant secondaries would not have much effect on crater retention ages measured between rays at large distances from the crater (Figure 1).

Acknowledgements

This work is supported by the International Space Science Institute (Switzerland).

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