TOPOGRAPHIC ANALYSIS BASED IDENTIFICATION OF FLAT SEDIMENTS IN A CRATER NEAR RABE ON MARS. A. Vitai[1], [1]Affiliation (Eötvös Lóránd University (bokos@student.elte.hu)).

Introduction: The water ice hosting sediments filled craters are important targets on Mars as they help in the reconstruction of ancient environments. One such was analyzed here has a diameter of 75 km at 70 km north of the Rabe Crater, which is referred here as *Crater North of Rabe Crater*. The interior of the crater can be divided into two parts: a flat ad and eroded (south-western part) area. Ii is assumed that sediment was deposited probably similar to those can be observed in Rabe. The erosion dominated 1/4 of the crater was probably also covered with similar sediment. The main question of this research is could the sediment filled terrain identified by automatized topography analysis?

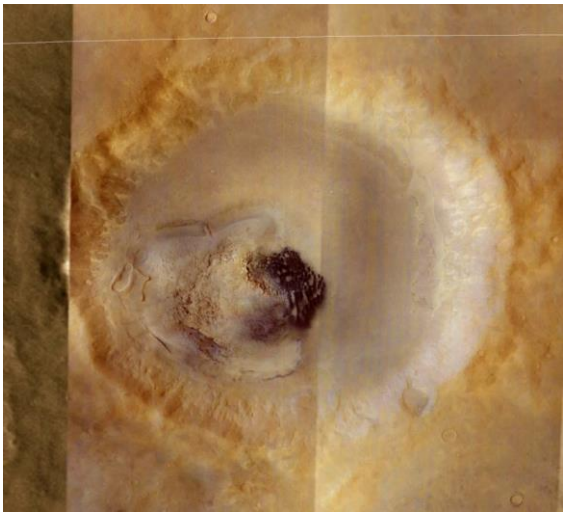

Figure 1: Crater North of Rabe Crater.

Methods: During the investigation HiRISE (PSP_010788_1390, ESP_019570_1390, ESP_030607_1390), CTX, MOC and MGS MOLA - MEX HRSC Blended DEM Global 200m v2 data were used. Color segmentation, flatness analysis and relief clustering were applied. Beside the inner areas of the crater, the examination area was extended outside of the crater, to find a difference in the segmentation of the topography.

Based on the HiRISE images the erosion area is occupied by sand-like, fine-grained sediment, perfectly represented by dunes, barcans and wind-shaped formations. Comparing to other CTX images of nearby areas, it cannot be clearly established that there is sediment, but at the inner rim several features of fine-grained sediment surfaces similar to this on Earth can be found. First, I wrote my own program code to process the data, which examined the flatness of the area at different resolutions and filled the non-data areas (1-2 pixels) with whole numbers calculated from the values of the surrounding pixels. After that, I examined the topography with a general discrete color scale, and finally created a special color scale, which is sensitive to the height data. Then, I used another python code to perform a special segmentation, where I ran an n*n sliding window that calculates the relief inhomogeneity of the areas. Here the resolution depends on the window size (n) and the smoothing threshold (t), above or below which the inhomogeneity is reduced to zero.

This code helps to highlight the regional inhomogenities and the more extensive relative homogenous (flat) areas, thus the changes in the topography of the study area can be well tracked. To see the differences between the inner and crater surrounding plains, I covered the crater with an ellipse and the same sized ellipses outside the crater. The histogram for the height data within clearly shows that the areas with a depth between -100 and -150 m are mostly typical of the areas inside the crater. In addition, smaller craters with a diameter of several tens of meters can be observed in the mentioned flattened area (MOC record), in which we can also observe dunes. Based on this information, it is very likely that the crater is indeed filled with sediment.

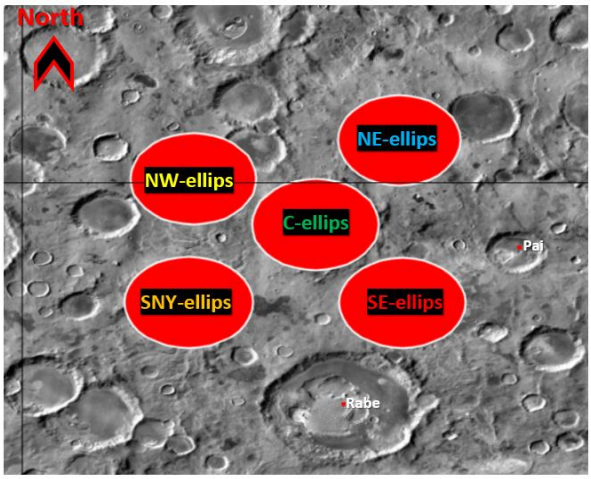

Figure 5: Research area ellipses, the C-ellips represents the target crater.

Results: The color segmentated images (Figures 2-3.) clearly show that the area around the crater has more variable relief compared the inside of the crater, e.g., the inside of crater is flatter. The default color-segmented image (Figure 2.) also shows that the inner areas of the crater contain more similar elevation data, and outside the crater the topography is more variable.

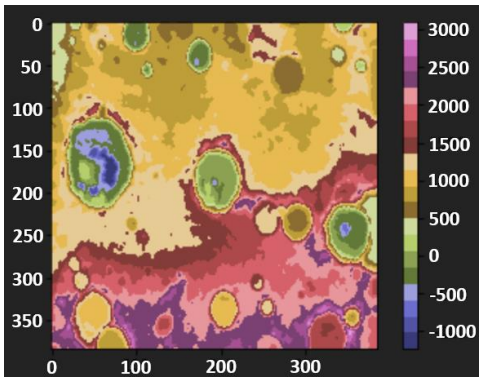

Figure 2: Default color-segmented image.

In addition, the higher resolution special color-segmented image (Figure 3.) reproduces better this difference. The inside of the target crater is blue-green, while the outside is more varied. This implies that the elevation data inside the target crater are very similar and different from the data outside the crater.

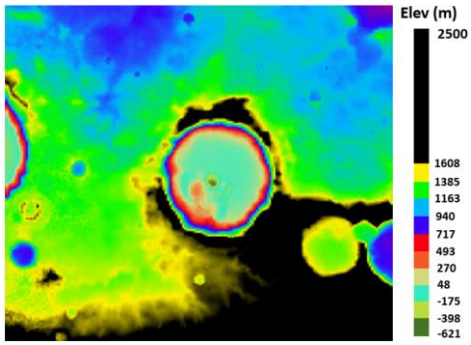

Figure 3: Special color segmentated image.

After that examining the homogeneity map (Figure 4.) that shows the changes of relief is larger in the inside of crater than outside. The homogeneity values (this value shows how much the elevation or slope of a pixel differs from its surroundings) are 25-40 for the flattened areas inside the crater and 200-500 outside the crater, demonstrating that within the crater the change in altitude is minimal compared to other areas.

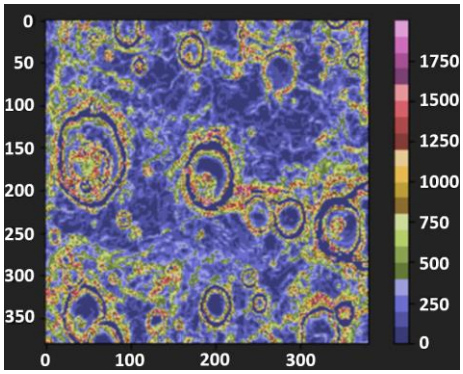

Figure 4: Special segmentated image based on relief homogeneity.

This can also be seen in the histograms of the ellipses (Figures 5-6.), where green indicates the target crater elevation values.

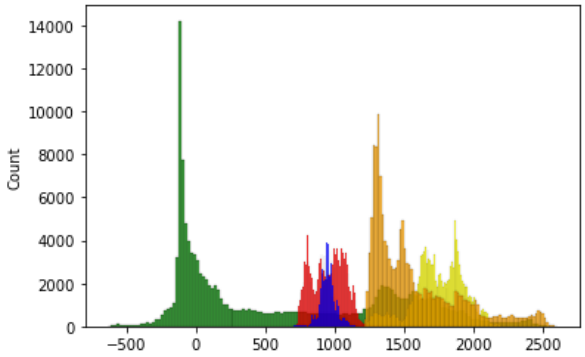

Figure 6: Topographic histograms of ellipses. Green: C-ellips, yellow: NW-ellips, orange: SNY-ellips, red: SE-ellips, blue: NE-ellips.

In the histogram of the target crater, there is one intensely prominent value (between -100 and -150), while the other values follow a steady trend. For the other ellipses, this is not visible at all, and they histograms is very jagged. It is also validated by the previous map results. It follows that the inner areas of the crater are indeed flatter than the outer areas of the crater. From these it is clear that the slope angle within the crater is smaller and the flatness of the area is better than the surroundings, cofirming the crater is filled with sediment.

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References:

[1] Changela H. et al. (2021) *Int. J. Astrobio. 20*, 394426.
[2] Séjourné A. et al. (2018) *JGR 124*, 483-503.
[3] Orgel Cs. et al. (2018) *JGR 124*, 454-482.
[4] Ramsdale J.D. et al. (2018) *JGR 124*, 504-527.
[5] Ramsdale, J. D. et al. (2017) *Planet. Space Sci. 140*, 49-61.