EVOLUTION OF SCARPS ON THE NUCLEUS OF COMET 67P/CHURYUMOV-GERASIMENKO. K. J. Kossacki[1] and A. Jasiak[2], [1]University of Warsaw, Faculty of Physics, ul., Pasteura 5, 02-093 Warsaw, Poland, [2]University of Warsaw, Faculty of Geology, ul. Żwirki i Wigury 93, 02-089 Warsaw, Poland.

Introduction: The nucleus of comet 67P/Churyumov-Gerasimenko has complex topography. Among identified structures are numerous scarps of different inclinations. Breaking of scarps of high inclinations depends on the presence of internal cracks. However, when the inclination of a slope is lower than the repose angle the possible changes of the shape of a slope can be determined by the sub-dust sublimation of ice. This process depends both on the properties of the dust mantle, fraction of ice in the underlying ice-dust material and on the composition of ice itself. Observations of comets indicate, that ice contains volatile organics [1], [2], [3]. Their presence in ice affects the temperature dependent sublimation coefficient [4], [5].

In this work we investigate evolution of scarps of low inclinations. The numerical simulations were performed for a selected scarp in the region Ash.

We use the shape model SHAP4s v1.0 [6].

Model: We use the general numerical model describing thermal and structural evolution of the material composing the nucleus of a comet [7].

The nucleus is covered by a layer of agglomerates of non-volatile particles, so called dust mantle. The thermal conductivity and the specific heat depend on the temperature.

Beneath the dust mantle there is a mixture of dust agglomerates and ice agglomerates. Ice is crystalline H_2O ice with organic volatile admixtures.

Dust component of the nucleus contains carbonitious components.

The transport of heat and vapor in the material are calculated in 1D, while the illumination is calculated in 3D.

The program allows using different equations for the heat and mass transport. In this work the flux of vapor subliming and flowing out through the dust mantle is calculated using the formula proposed by [8] for a medium of high porosity, composed of randomly arranged particles. This formula is additionally corrected for the temperature dependence of the sublimation coefficient [7].

Results: The material parameters of the model nucleus are the same as in [7]. The volume fraction of the dust in the model nucleus is 0.123, and the volume fraction of ice is 0.109. Hence, the volume ratio of the components is 1.13. Dust grains are assumed to be have the density 3500 kg m^{-3}, so the average density of the material is 529.2 kg m^{-3}. This matches the average density of the nucleus of the considered comet (533±65 kg m^{-3} [9]). The dust mantle is characterized by: the porosity 0.877, the non-radiative thermal conductivity 3 – 27 10^{-3} W m^{-1} K^{-1}, the characteristic radius of pores and the thickness. The latter are considered as parameters.

When the dust mantle has thickness 0.5 cm, the thermal conductivity 9 10^{-3} W m^{-1} K^{-1}, and the characteristic radius of pores is very large, 0.4 mm, the rate of erosion is within the range 0 – 7.5 cm per orbital period depending on the location. Thus, the scarp changes its shape, but slowly. If the heliocentric distance at perihelion was close to its present value during 1000 years, that is probable [10], the eroded layer can be in some locations thicker than 10 m, while in other places negligible.

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