EPSC Abstracts
Vol. 12, EPSC2018-538, 2018
European Planetary Science Congress 2018

Sublimation of cometary ice and mobilization of the dust mantle.

Konrad Kossacki, Katarzyna Misiura University of Warsaw, Faculty of Physics, Warsaw, Poland (kjkossac@igf.fuw.edu.pl)

Abstract

1. Introduction

Most of the surface of comet 67P/Churyumov-Gerasimenko is covered by dust. Patches of exposed ice-rich material were identified, but they lasted only about 10 days [1]. Thus, the dominating way of outgassing is the sub-dust sublimation. The rate of this process depends on the properties of the dust mantle, and of the underlying ice. Thus, it should be calculated taking into account the temperature dependent sublimation coefficient (e.g. [2]).

In this work direct measurements of the recession of the surface of ice covered by sand are presented, when ice covered by a sand of different granulation sublimes into vacuum. The experimental results are compared with the theoretical ones obtained using the Hertz-Knudsen equation with the sublimation coefficient and the Clausing formula for the gas permeability of granular media.

2. Measurements

The experimental is the same as described in [3], but the investigated samples had larger diameters. During experiments the evolving positions $z(t)$ of the surfaces of the samples and the temperature within the samples were recorded. In the experiments three types of sand were used: coarse ($r_g = 0.5 - 1$ mm), medium ($r_g = 0.25 - 0.5$ mm) and fine ($r_g = 0.125 - 0.25$ mm).

The profiles $z(t)$ split into sections. Subsequently, the average recession rate $(\frac{dz}{dt})_{av}$, the average temperature T_{av}, and the average pressure p_{av} were calculated. They were used to compute the values of the sublimation coefficient.

3. Results

The measured rate of erosion is in agreement with the theoretical one, calculated taking into account the temperature dependent sublimation coefficient. The agreement requires using correct value of the characteristic radius r_p of pores. We have found, that for coarse and medium sand $r_p \simeq 0.5(r_{max} + r_{min})$. However, for fine sand $r_p > 0.5(r_{max} + r_{min})$.

Another result is that at high temperature ice covered by fine, or medium sand sublimes faster than it is predicted for a stable layer of sand. This can be due to vibration of grains due to the flow of vapor.

Full description of the results is described in [4].

Acknowledgments

This work was supported by Poland's National Science Centre (Narodowe Centrum Nauki) [decision no. 2014/15/B/ST10/02117].

References

[1] Fornasier, S., et al.: Rosetta's comet 67P/Churyumov-Gerasimenko sheds its dusty mantle to reveal its icy nature. Science 354 Issue 6319, 1566-1569. DOI:10.1126/science.aag2671, 2016.

[2] Gundlach B., Skorov Y.V., and Blum J.: Outgassing of icy bodies in the Solar System - I. The sublimation of hexagonal water ice through dust layers. Icarus, 213, 710-719, 2011.

[3] Kossacki, K.J., Leliwa-Kopystynski, J., Witek P., Jasiak A., and Dubiel A.: Sublimation of cometary ices in the presence of organic volatiles. Icarus, http://dx.doi.org/10.1016/j.icarus.2017.03.006., 2017.

[4] Kossacki, K., and Misiura, K.: Sublimation of buried cometary ice. Submitted, 2018.