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Water and carbon dioxide production in 67P/Churyumov-Gerasimenko: comparison with VIRTIS-M observations

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Abstract

The VIRTIS spectrometer (1) on the Rosetta mission performed infrared observations of the coma of the comet 67P/Churyumov-Gerasimenko, detecting water and carbon dioxide emission (2). Using a thermopysical model, we compare the results of the observations with the theoretical gas production. Preliminary results show that the interior composition is probably quite homogeneous and that illumination conditions and topography can explain observations.

1. Introduction

The VIRTIS-M imaging channel detected and mapped water vapour and carbon dioxide emissions in the comet's coma from 8 to 14 April 2015 when 67P was at a heliocentric distance of 1.9 AU.
The maximum H2O emission was mainly concentrated above two active regions, Aten-Babi and Seth-Hapi, while the CO2 distribution appeared more uniform with significant emissions coming from both the "head" and southern latitude regions.
Through the use of a thermophysical model, we are willing to see if the different behaviour of water and carbon dioxide outgassing above the surface, seen in the VIRTIS-M data, might be indicative of a different thermal history of the northern and southern hemispheres of 67P or reflects instead a primordial compositional difference.

2. The method

We are using the Rome model for the thermal evolution and differentiation of nuclei in order to analyze the gas emission from the comet during the period of the VIRTIS observations in April 2015. Different hypotheses on the internal composition (abundance, homogeneity and status of the ices, layering) are considered. The code is solving the coupled heat transport and gas diffusion equations in a porous body, composed by ices and a refractory component. The illumination history of the comet and the surface topography of the nucleus are taken into account. Studying a number of different cases, we try to reproduce the observations and we derive which set of initial assumptions is giving the best match with the observations.

3. Summary and Conclusions

Preliminary analysis, restricted to this set of data, suggest that internal composition is probably quite be interpreted and reproduced by considering the thermal and illumination history of the comet along its orbit. A key element that we derive is the depth at which the active layers are to be found.

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References

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