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Photophoresis as a source of hot mineral aggregates in comets

O. Mousis (1), J.-M. Petit (1), G. Wurm (2), O. Krauss (2), Y. Alibert (3) and J. Horner (4)

(1) Institut UTINAM, CNRS-UMR 6213, Observatoire de Besançon, BP 1615, 25010 Besançon Cedex, France, (2) Institute for Planetology, University of Muenster, Wilhelm-Klemm-Str. 10, D-48149 Muenster, Germany, (3) Physikalisches Institut, University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland, (4) Astronomy Group, Open University, Walton Hall, Milton Keynes MK76AA, United Kingdom (Contact olivier.mousis@obs-besancon.fr)

A time-dependent model of the solar nebula is used to describe the outward transport of hot mineral aggregates from locations in the warm inner regions of the nebula under the influence of photophoresis. We show that there is a direct dependence between the size of the gap initially assumed to exist in the inner solar nebula and the heliocentric distance to which the aggregates are likely to drift. We demonstrate that, despite a significant contribution to the opacity of the disk resulting from Rayleigh scattering by hydrogen, photophoresis can be considered as a transport mechanism leading to the presence of hot minerals in comets. This mechanism can lead to an influx of hot minerals in the formation regions of the main cometary reservoirs, implying a potential "dust-loading" of bodies from these populations. This scenario is compatible with the detection of crystalline silicates in a growing number of comets and also with the recent identification of CAIs in the samples returned from Comet 81P/Wild 2 by the Stardust mission. Finally, we find that this mechanism is consistent with the compositional diversity observed in small bodies of the outer solar system, in contrast with the other processes invoking an efficient turbulent mixing within the primordial nebula.