

Scenarios for distributed sources of formaldehyde in the atmosphere of comet 67P/Churyumov-Gerasimenko

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Abstract

The polymer of formaldehyde ($(\text{H}_2\text{CO})_n$ - polyoxymethylene – POM) has been tentatively detected in comet 1P/Halley by mass spectrometry with PICCA instrument onboard the Giotto spacecraft [1]. Although its detection has been questioned [2], this polymer could be the origin of distributed formaldehyde observed in the atmosphere of comet Halley and others [3]. We will present modelling results of the photo and thermal degradation of POM on grains in the environment of comet 67P/Churyumov-Gerasimenko, and discuss the extent to which distributed formaldehyde could be detected with Rosetta spacecraft observations in case POM is actually part of the nucleus component.

1. Distributed sources of formaldehyde in comets

Formaldehyde (H_2CO) observations in comets 1P/Halley [4], C/1995 O1 (Hale-Bopp) [5], C/2012 F6 (Lemmon) and C/2012 S1 (ISON) [6] are consistent with a distributed source for this molecule in their atmospheres. This means that H_2CO cannot only be released from the nucleus of the comets, but

rather from a parent compound that could not be identified in the gaseous phase. Thanks to proper modelling based on experimental measurements in the laboratory [7] [8], it has been shown in the case of comets 1P/Halley [9] (see Figure 1) and C/1995 O1 (Hale-Bopp) [10] that the presence of polyoxymethylene in the solid phase at the percent level in grains, and its photo & thermal degradation throughout the atmosphere of the two comets, could account for the observed distribution density of H_2CO .

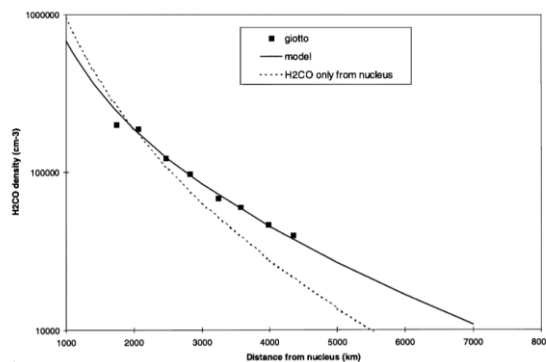


Figure 1: Formaldehyde density profile in comet Halley measured by Giotto (squares) and calculated with (continuous line) or without (dotted line) distributed production of H_2CO from POM. Figure from [11]

2. Scenarios for distributed H₂CO from POM comet 67P/Churyumov-Gerasimenko

Taking into account the grain size distribution as measured by the COSIMA instrument onboard the ROSETTA spacecraft [12], and the actual activity of the comet, we have studied the extent to which formaldehyde could show a significant distributed source of formaldehyde in the atmosphere of comet 67P if polyoxymethylene is part of the grain component. We will discuss trajectories of the spacecraft and observations that could tell whether formaldehyde is distributed or not.

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