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Outer solar system formation: first lessons learnt from Rosetta/ROSINA

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Abstract

Comet 67P/Churyumov-Gerasimenko (67P) is a Jupiter Family comet targeted by the Rosetta mission for in-situ analysis of cometary material and properties. The ROSINA (Rosetta Orbiter Sensor for Ion and Neutral Analysis) instrument on board of the Rosetta spacecraft has been analyzing the composition of gases emitted from 67P since August, 2014 [1]. Here we review the different molecular and isotopic measurements that have been performed by ROSINA over the last few months. We discuss the implications of these measurements for deriving some clues on the formation conditions of the outer solar system. For example, the comparison between the N_2/CO and Ar/CO ratios measured in 67P [2,3] places important constraints on the structural properties of the icy grains from which the comet was agglomerated. Also, the high D/H ratio measured in 67P, about 3 times higher than the standard SMOW value [4], matches chemical models that predict a monotonic radial increase of the deuterium enrichment profile [5,6] and implies that the comet formed at a higher heliocentric distance than JFCs and OCCs with lower D/H ratios, in agreement with recent dynamical models of the outer solar system [7]. If the low N_2/CO ratio measured in 67P [2] is typical of that of planetesimals formed in the outer solar system, this implies that the compositions of Jupiter and Saturn cannot be explained solely via the accretion of these solids during their formation.

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