Composition of cometary volatiles: Results from the ROSINA instrument on board of the ROSETTA spacecraft

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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. ROSINA consists of two mass spectrometers, a double focusing MS (DFMS) and a time of flight MS, both having a Nier-type ion source. The high sensitivity (dynamic range of 1010), high resolution ($m/\Delta m > 3000$) of the DFMS has the ability to resolve adjacent masses (e.g., complete separation of N_2 from CO), and allows bulk analyzis of gases emitted by the comet [1].

The measured D/H ratio is found to be 3 times the oceans' value, precluding that terrestrial water was contributed by this type of material. This high value is also consistent with an increase of the D/H with heliocentric distance [2]. ROSINA measured large fluctuations in composition ($H_2O/CO/CO_2$) during cometary rotation, possibily driven by temperature differences below the comet surface and/or heterogeneous composition of cometary matter [3]. Dinitrogen (N_2) has been detected for the first time in a comet. The N_2/CO ratio is depleted by a factor of 25 compared to the protosola value, suggesting an ice formation temperature below ~ 30 K [4]. Finally, the comet contains significant quantities of argon, that, together with water and the D/H ratio, permits to set constraints on environmental conditions of comet formation and on the contribution of cometary volatiles to Earth [5].

[1] H. Balsiger et al. (2007) *Space Sci. Rev.* **128**, 745–801. [2] K. Altwegg et al. (2015), *Science* **347**, 1261952. [3] Hässig et al. (2015), *Science* **347**, aaa0276. [4] Rubin et al. (2015), *Sciencexpress* 19 March 2015. [5] B. Marty et al., this conf.