$^{16}O/^{18}O$ & $^{16}O/^{17}O$ in Water in the Coma of Comet 67P/Churyumov-Gerasimenko measured with the Rosetta/ROSINA Double Focusing Mass Spectrometer

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Abstract

In an earlier study, the ^{16}O **/** ^{18}O ratio of H_2O in the coma of the comet 67P **/** Churyumov-Gerasimenko was found to be 445 ± 35 (Schroeder et al. 2018) [1]. The result was based upon in-situ measurements of $H_2{}^{16}O$ **/** $H_2{}^{18}O$ and ^{16}OH **/** ^{18}OH performed with the ROSINA Double Focusing Mass Spectrometer (DFMS) on board the ESA spacecraft Rosetta and represented an 11% enrichment of ^{18}O as compared to the terrestrial value of 498.7 ± 0.1 measured by Baertschi (1976) [4]. This was consistent with leading self-shielding models, which had predicted primordial water in comets to be between 5 ~ 20 % more enriched in ^{18}O than terrestrial water [6]. The ^{16}O **/** ^{17}O ratio, however, could not be easily determined at the time due to the low signal from the $H_2{}^{17}O$ peak and its overlap with the much larger HDO peak.

In contrast, CO_2 in the coma of 67P has a ^{16}O **/** ^{18}O ratio of 494 ± 8, as previously determined by Hässig et al. (2016) [2] using the same instrument, which is consistent within 1σ uncertainty with the terrestrial value. The solar wind measured by McKeegan et al. (2011) [5], on the other hand, exhibited ^{18}O-depletion with a ^{16}O **/** ^{18}O ratio of 530 ± 2.

In this follow-up study, we separate the $H_2{}^{17}O$ peak from that of HDO by manually fitting them with equal-width Gaussians and thus obtain an estimate for the ^{16}O **/** ^{17}O ratio of H_2O in 67P's coma from several DFMS mass spectra that were acquired during 67P's outbound equinox in March 2016 and which were chosen for their strong signal.

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