EPSC Abstracts
Vol. 13, EPSC-DPS2019-64-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

A comparison between the two lobes of comet 67P / Churyumov-Gerasimenko based on D/H ratios in H_2O measured with the Rosetta / ROSINA DFMS

Isaac Schroeder (1), K. Altwegg (1,2), H. Balsiger (1), J. J. Berthelier (3), J. De Keyser (4), B. Fiethe (5), S. A. Fuselier (6,7), S. Gasc (1), T. I. Gombosi (8), M. Rubin (1), T. Sémon (1), C.-Y. Tzou (1), S. F. Wampfler (2), P. Wurz (1,2)

(1) Physikalisches Institut, University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland
(2) Center for Space and Habitability, University of Bern, Gesellschaftsstrasse 6, CH-3012 Bern, Switzerland
(3) LATMOS, 4 Avenue de Neptune, F-94100 Saint-Maur, France
(4) Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Ringlaan 3, B-1180, Brussels, Belgium
(5) Institute of Computer and Network Engineering (IDA), TU Braunschweig, Hans-Sommer-Straße 66, D-38106 Braunschweig, Germany
(6) Space Science Division, Southwest Research Institute, 6220 Culebra Road, San Antonio, TX 78228, USA
(7) University of Texas at San Antonio, San Antonio, TX
(8) Department of Atmospheric, Oceanic and Space Sciences, University of Michigan, 2455 Hayward, Ann Arbor, MI 48109, USA

Abstract

The bi-lobate structure of the nucleus of comet 67P / Churyumov-Gerasimenko was a major surprise when initially observed by the OSIRIS camera array [1] on board the ESA spacecraft Rosetta as it first neared the comet in July 2014. Its interesting shape immediately raised the question of how it came to be – whether it was formed from a single parent or the merger of two [2,3], whether the lobes were homogeneous or heterogeneous and, if the lobes had formed separately, whether they had formed in the same region or in different regions before merger [4].

The deuterium-to-hydrogen (D/H) ratio of water from the nucleus of 67P was previously measured by Altwegg et al. (2015, 2017) [5,6] with the Double Focusing Mass Spectrometer (DFMS) [7] from the ROSINA instrument package on board Rosetta. That measurement, however, was an overall result for the entire nucleus in general. As there was insufficient spatial information available then for lobe-specific measurements [6], the possibility of there being some inhomogeneity between the two lobes could not be completely excluded at the time.

This investigation is a continuation of that earlier research. In this study, we made use of newly available model data which enabled the amount of H_2O contributed by each individual lobe to the gases sampled by Rosetta at any given time to be estimated. The ensuing comparison of the D/H ratios of 67P's larger and smaller lobes revealed that, within the applicable uncertainties at least, there is no discernible difference between the two lobes. This supports the hypothesis that both lobes were formed in the same region before merger and are homogeneous in their D/H ratios.

Acknowledgements

ROSINA would not have produced such outstanding results without the work of the many engineers, technicians and scientists involved in the mission, in the Rosetta spacecraft and in the ROSINA instrument team over the last 20 years, whose contributions are gratefully acknowledged. Rosetta is a European Space Agency (ESA) mission with contributions from its member states and NASA. We acknowledge herewith the work of the whole ESA Rosetta team.

Work at University of Bern was funded by the State of Bern, the Swiss National Science Foundation, and the ESA PRODEX (PROgramme de Développement d'Expériences scientifiques) program. Work at Southwest Research Institute was supported by subcontract #1496541 from the Jet Propulsion Laboratory (JPL). Work at the Royal Belgian Institute for Space Aeronomy (BIRA-IASB) was supported by the Belgian Science Policy Office via PRODEX/ROSINA PRODEX Experiment Arrangement 90020. Work at the University of Michigan was funded by NASA under contract JPL-1266313.

References

[1] Keller, H. U. et al., 2007. OSIRIS – The Scientific Camera System Onboard Rosetta. *Space Sci. Rev.* **128**, 433–506.

[2] Nesvorný, D., et al., 2018. Bi-lobed Shape of Comet 67P from a Collapsed Binary. AJ 155, 246.

[3] Massironi, M., et al., 2015. Two independent and primitive envelopes of the bi-lobate nucleus of comet 67P. Nature 526, 402-405.

[4] Rickman, H., et al., 2015. Comet 67P / Churyumov-Gerasimenko: Constraints on its Origin from OSIRIS Observations. A&A 583, A44.

[5] Altwegg, K., et al., 2015. 67P / Churyumov-Gerasimenko, A Jupiter-Family Comet with a High D/H Ratio. Science 347, 6220.

[6] Altwegg, K., et al., 2017. D_2O and HDS in the Coma of 67P / Churyumov-Gerasimenko. Philosophical Transactions of the Royal Society A, Volume 375, Issue 2097.

[7] Balsiger, H., et al., 2007. ROSINA - Rosetta Orbiter Spectrometer for Ion and Neutral Analysis. Space Science Reviews, 128, 745-801.