3D Presentation: ESA's Rosetta Mission – the Search for Organic Molecules on a Comet

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ESA's Rosetta mission is the first spacecraft to investigate the molecular origins of life including the chirality of biomolecules. It made spectators from all over the world dream: In 2014 the Rosetta spacecraft posed the little robot Philae on the nucleus of comet 67P/Churyumov-Gerasimenko and collected information about the composition of the comet nucleus and the origin of the Solar System.[1] The cometary sampling and composition (COSAC) instrument, a device onboard Philae, which we developed in an international partnership lead by the Max Planck Institute for Solar System Research, is a gas chromatograph using eight stationary phases coupled with a mass spectrometer. 25 minutes after Philae's landing and bouncing on the cometary nucleus, COSAC successfully performed chemical analysis of cometary surface material. Organic molecules were identified by using COSAC's MS-only mode.[2,3]

These in situ cometary results are interpreted in relation to laboratory experiments that allowed for the simulation of cometary ices by condensing volatile molecules such as H_2O, NH_3, CO, CO_2, and CH_3OH in an ultra-high vacuum from the gas phase onto a cooled surface of T = 12 K. The cometary ice analogues were shown to contain chiral amino acids,[4] aldehydes and ribose.[5] Circular dichroism has been investigated systematically.[6] The laboratory simulation experiments confirm data on the chemical inventory of comets and the early Solar System obtained by the Rosetta-Philae cometary probe.

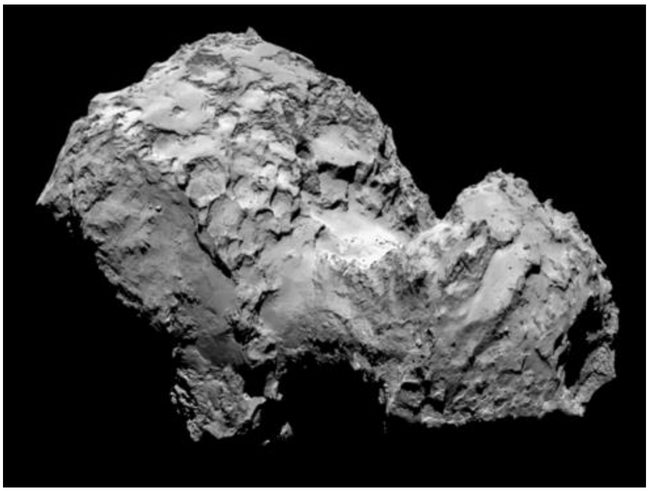

Figure : *Rosetta's target comet 67P/CG. Credit ESA/Rosetta/MPS*

References:

[1] U. Meierhenrich, *Comets and their Origins.* Wiley-VCH **2015**.
[2] F. Goesmann, U. Meierhenrich et al., *Science* **2015**, *349*, 497.
[3] G. Leseigneur, U. Meierhenrich et al., *Angew. Chem. Int. Ed.* **2022**, *61*, e202201925.
[4] G.M. Munoz Caro, U. Meierhenrich et al., *Nature* **2004**, *412*, 403.
[5] C. Meinert, U. Meierhenrich et al., *Science* **2016**, *352*, 208.
[6] C. Meinert, U. Meierhenrich et al., *Nat. Commun.* **2022**, *13*, 502.