EPSC Abstracts
Vol. 12, EPSC2018-285-1, 2018
European Planetary Science Congress 2018

The global composition of comet 67P's dust as measured *in situ* by the COSIMA mass spectrometer

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Abstract

We report here the global composition of the dust particles released from the Jupiter family comet 67P/Churyumov-Gerasimenko, as deduced from the COSIMA instrument measurements during the two years of Rosetta mission. We will particularly focus on the high carbon content found [1] and discuss its astrophysical significance and implications.

1. Introduction

COSIMA (COmetary Secondary Ion Mass Analyzer) was a Time-Of-Flight Secondary Ion Mass Spectrometer (TOF-SIMS) on board the Rosetta spacecraft [2, 3]. During two years, the instrument allowed *in situ* analysis of the dust particles released from 67P/Churyumov-Gerasimenko before and after the comet's perihelion. Compared to the previous space missions targeting a comet, COSIMA collected the cometary dust at a lower impact velocity (<10 $m.s^{-1}$ [4]) that largely preserved the dust chemical properties and part of its physical structure such as the particle porosity [5, 6]. More than 35,000 particles were collected during the mission [7] and about 250, ranging from ~50 to ~1000 µm in size (Figure 1), were analyzed by TOF-SIMS.

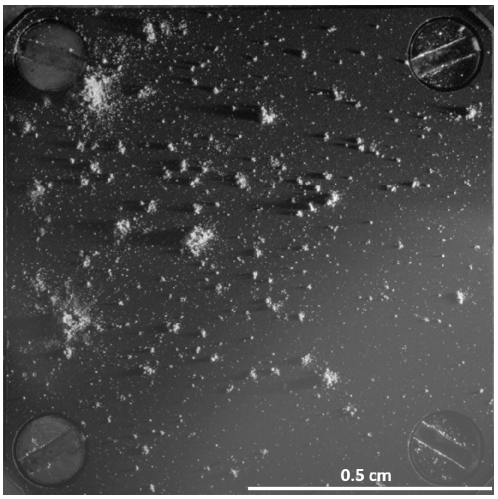

Figure 1: A collecting target (1 cm x 1 cm) of the COSIMA instrument showing cometary dust particles (up to a millimetre in size) that impacted it. Credit: ESA / Rosetta / MPS for COSIMA MPS / CSNSM Team / UNIBW / TUORLA / IWF / IAS / ESA / BUW / MPE / LPC2E / LCM / IMF / UTU / LISA / UOFC / vH & S.

2. Results and discussion

We will present the elemental composition of the cometary dust as deduced from COSIMA

measurements [1, 8, 9]. The average elemental composition measured for 67P's dust will be compared to previous results obtained from the Giotto and Vega missions for comet 1P/Halley and the Stardust mission for comet 81P/Wild 2, to the composition of Chondritic Porous Interplanetary Dust Particles (CP-IDPs), and to the CI chondrite composition.

According to the mass spectra measurements, 67P's dust has a high carbon content (atomic $C/Si = 5.5\ ^{+1.4}_{-1.2}$ on average) [1] close to the solar value and comparable to comet 1P/Halley's value. Based on their elemental composition, the cometary particles collected by COSIMA are estimated to be made of nearly 50% organic matter in mass mixed with minerals that are mostly anhydrous (Figure 2).

The dust collected and analyzed by COSIMA is representative of 67P's non-volatile composition. The average minerals to organics mass ratio deduced from the TOF-SIMS measurements (Figure 2) gives constraints on the comet's surface and nucleus characteristics. The astrochemical implications of COSIMA results will be discussed with a focus on the high carbon content found in the cometary dust [1].

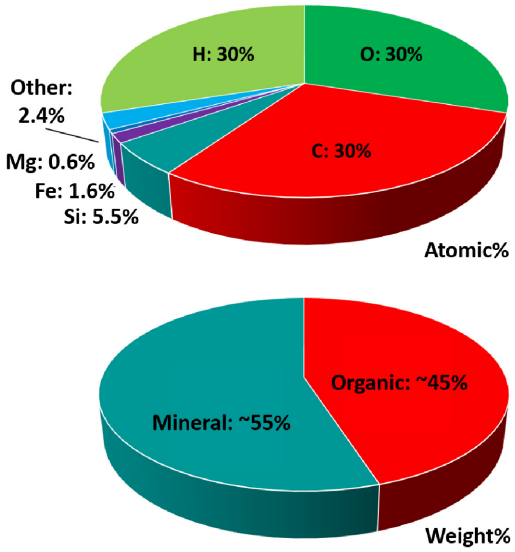

Figure 2: Top panel: the average elemental composition of the dust particles of comet 67P. Lower panel: the average mass distribution of minerals and organic material in these particles [1].

Acknowledgements

COSIMA was built by a consortium led by the Max-Planck-Institut für Extraterrestrische Physik, Garching, Germany in collaboration with Laboratoire de Physique et Chimie de l'Environnement et de l'Espace, Orléans, France, Institut d'Astrophysique Spatiale, CNRS/ Université Paris Sud, Orsay, France, Finnish Meteorological Institute, Helsinki, Finland, Universität Wuppertal, Wuppertal, Germany, von Hoerner und Sulger GmbH, Schwetzingen, Germany, Universität der Bundeswehr, Neubiberg, Germany, Institut für Physik, Forschungszentrum Seibersdorf, Seibersdorf, Austria, Institut für Weltraumforschung, Österreichische Akademie der Wissenschaften, Graz, Austria and is led by the Max-Planck- Institut für Sonnensystemforschung, Göttingen, Germany with the support of the national funding agencies of Germany (DLR, grant 50 QP 1302), France (CNES), Austria (FWF, P26871-N20), and Finland. Rosetta is an ESA mission with contributions from its Member States and NASA.

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Berlin EPSC 2018
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18. 9. 2018

SB17/AB3 Organic Matter in Space (co-organized)

Convener: Vassilissa Vinogradoff
Co-conveners: Gregoire Danger; Laurent Remusat
Lecture Room: Uranus

17:00–17:15: EPSC2018-416
H/C elemental ratios of the refractory organic matter in cometary particles of 67P/Churyumov-Gerasimenko
Isnard Robin, Bardyn Anaïs, Fray Nicolas, Briois Christelle, Cottin Hervé, Paquette John, Stenzel Oliver, Alexander Conel, Baklouti Donia, Engrand Cécile, Orthous-Daunay François-Régis, Siljeström Sandra, Varmuza Kurt, Hilchenbach Martin

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21. 9. 2018

SB8/AB4 Comets after Rosetta - what do we know and what are the new questions (co-organized)

Convener: Matthew Taylor
Co-conveners: Maria Teresa Capria; Bonnie Buratti; Mathieu Choukroun
Lecture Room: Jupiter

09:30–09:45: EPSC2018-285
The global composition of comet 67P's dust as measured in situ by the COSIMA mass spectrometer
Baklouti Donia, Bardyn Anaïs and the COSIMA team