EPSC Abstracts
Vol. 13, EPSC-DPS2019-297-1, 2019
EPSC-DPS Joint Meeting 2019

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

Distributed source of glycine in 67P/ Churyumov Gerasimenko

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Comets play a major role in the study of the physico-chemical processes that took place in our early Solar System. Moreover, they could have brought organic compounds to the primitive Earth that contributed to the chemical evolution that lead to the origin of life on Earth [1]. Thanks to groundbased observations and space missions, it is possible to measure the composition of these small bodies. Although most of the gaseous molecules detected in cometary atmospheres are produced from the sublimation of nucleus ices, other distributed sources have to be taken into account, such as the production of gaseous molecules from the cometary particles present in the cometary coma, which provide further insight about the composition of the nucleus.

Glycine, the simplest amino acid, was observed episodically in the atmosphere of comet 67P/Churyumov-Gerasimenko by the ROSINA (Rosetta Orbiter Spectrometer Ion and Neutral Analysis) mass spectrometer onboard the Rosetta probe. A series of measurements on March 28th 2015 revealed a density profile between 14 km and 26 km from the nucleus [2] which is characteristic of a distributed source. In order to interpret these observations, production of glycine from the cometary particles has to be taken into accounts. A numerical model has been developed to calculate the abundance of glycine in the atmosphere of the comet 67P as a function of the distance from the nucleus, and derive its initial abundance in the nucleus. Three cases have been considered: (i) glycine emitted directly and only from the nucleus, (ii) glycine emitted from the sublimation of solid state glycine on the particles ejected from the nucleus and (iii) glycine embedded in water ice and emitted from the sublimation of this ice from the particles ejected from the nucleus. The last two cases are called distributed source.

Our results show that a unique source from the nucleus does not explain the profile of density measured by ROSINA. We show that a good fit to the observations corresponds to a distributed source of glycine embedded in sublimating water ice from dust particles. The presence of a few hundreds of ppb of glycine embedded in water ice on particles (a nominal value of ~170 ppb in mass of particles is derived from our calculations) is in good agreement with the observed distribution.

1. Orò, J. and C.B. Cosmovici. *Comets and life on the primitive Earth*. in *International Astronomical Union Colloquium*. 1997. Cambridge University Press.
2. Altwegg, K., et al., *Prebiotic chemicals—amino acid and phosphorus—in the coma of comet 67P/Churyumov-Gerasimenko.* Science advances, 2016. **2**(5): p. e1600285.