Elemental composition of dust particles of the comet 67P/Churyumov-Gerasimenko suggests a pre-accretionary irradiated sub-structure surface composition.

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Comets are small bodies of the Solar System, for which conservation conditions allowed preservation of pristine matter since their formation 4.6 Ga ago. This primitive matter presents high organic content, implying that comets are potential key suppliers of "prebiotic" matter to the primitive Earth. Additionally, mineral phases of comets could also bring crucial information on the nature and structure of primordial matter and on the physicochemical processes at work during the Solar System formation. COSIMA, a TOF-SIMS instrument (Time Of Flight, Secondary Ion Mass Spectrometer) onboard the Rosetta spacecraft, collected and analyzed dust particles ejected from the nucleus of comet 67P/Churyumov-Gerasimenko (hereafter 67P) between 2014 and 2016. The relatively low velocity of the dust particles during collection allowed for good preservation of their material. The dust particles of 67P were analyzed to determine their average elemental composition, and their high abundance of carbon was confirmed. Interestingly, the elemental compositions of the rock-forming elements deviate from the chondritic composition, with a depletion in Mg and Fe, and an enrichment in Si (Bardyn et al., 2017). Further analyses on an extended set of elemental ratios of individual dust particle were performed to explain these results.

The current study focuses on the elemental ratios calculated for H, C, Na, Mg, Si, and Fe elements on 59 dust particles from 67P. A second set of 14 particles was studied, with additional elements such as O, Al, S, K and Ca, which show low signals in spectra, sometimes below the detection limit. Our results are compatible with that of Bardyn et al., 2017, showing high abundances of carbon and silicon, coupled with the depletion of magnesium and iron. We will discuss the large variability of elemental compositions within the new set of particles. This heterogeneity of compositions combined with specific enrichments of Si, and depletion of Mg and Fe, suggest the presence of a thin Mg-depleted irradiated layer on individual grains, the sub-structures of particles. These Mg-depleted rims on grains' surfaces are observed in different objects in Solar System (in IDPs (Bradley, 1994), lunar soils (Keller & McKay, 1997), grains of Itokawa (Keller & Berger, 2014; Noguchi et al., 2014), and in UCAMMs (Engrand et al., 2020)) and could have been formed by solar wind irradiation in the protoplanetary disk before accretion of the minerals in the comet.

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