VIRTIS/Rosetta observes Comet 67P/CG: Nucleus derived composition and physical properties

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Comets harbour the most pristine material in our solar system in the form of ice, dust, silicates, and refractory organic material with interstellar heritage. The observations of the VIRTIS imaging spectrometer [1] onboard the Rosetta orbiter, have revealed a very complex surface showing varied morphologies related to active processes. The reflectance spectra collected across the surface display a low reflectance factor over the whole spectral range [2], two spectral slopes in the visible and near-infrared ranges and a broad absorption band centred at 3.2 μm. These spectral features describe a largely dehydrated surface, rich in organic compounds and opaque minerals [3]. The low albedo of comet 67P/CG is described by a dark refractory poly-aromatic carbonaceous component mixed with opaque minerals. A semi-volatile component, consisting of a complex mix of low weight molecular species not volatilized at T$\sim$220 K, is likely a major carrier of the 3.2 μm band. COOH in carboxylic acids is the only chemical group that encompasses the broad width of this feature. It appears as a highly plausible candidate along with the NH4+ ion. Photolytic/thermal residues, produced in the laboratory from interstellar ice analogues, are potentially good spectral analogues [4] and are not limited to the species considered above, which could represents only the most reactive species; indeed compounds originated by UV irradiation and/or other irradiation processes can be very chemically and structurally very diverse [6]. Ice rich regions of limited extent have also been observed either as an ephemeral source, resulting from the diurnal re-deposition at the surface of water ice sublimating in the interior (5), or as temporally stable regions [7], resulting from exposure of deeper layers after landslides or debris falls. Spectral modelling of these regions has pointed out the presence of a wide range of sizes of water grains, ranging from few μm to several mm. The implication of this finding in terms of the evolutionary processes that may have affected and shaped the surface of 67P/CG will be discussed.

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