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The nucleus and coma of 67P/Churyumov-Gerasimenko: highlights of the Rosetta-VIRTIS results

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This paper will describe the major results obtained so far during the prelanding and initial escort phases (July 2014 –February 2015) by the VIRTIS (Visible, Infrared and Thermal Imaging Spectrometer) dual channel spectrometer onboard Rosetta.
The scientific goals of the VIRTIS instrument are related to the study of the nucleus surface composition and of its temperature and to the study of the gaseous and dust components of the coma. These are achieved by studying the reflected and emitted radiance of the comet in the spectral range 0.25-5.0 μm with a Mapping Spectrometer (VIRTIS-M) and a High Resolution Spectrometer (VIRTIS-H) (1). The nucleus observations were performed with spatial resolution varying from the initial 500m down to 2.5m and have generated compositional maps of the illuminated areas (2). The nucleus integrated normal albedo has been calculated as 0.060 $\pm$ 0.003 at 0.55 μm (3), and reflectance spectra display distinct gradients in the VIS and IR regions (5-25 and 1.5-5 % kÅ-1 respectively). These results suggest a surface made of an association of carbon bearing species and opaque minerals such as sulfides. In addition a broad absorption feature in the 2.9-3.6μm range has been observed; this band is present across the entire illuminated surface and, its shape and width are compatible with absorptions due to non-volatile organic macromolecular materials, complex mixture of various types of C-H and/or O-H chemical groups (3,4). Ice rich regions of very limited extent, have also been observed (5). The surface temperature has been measured since the first distant observations of the nucleus in thermal emission. The highest surface temperature seen so far is 220K, which is an indication of a surface structure largely covered by a porous crust, mainly devoid of water ice (6,7). Water vapour and carbon dioxide molecules have been observed in the coma and their variability, as a function of altitude and geographic location has been studied. The molecules display an anti-correlated behaviour in their spatial distribution, which could suggest either intrinsic differences in the nucleus composition or insolation induced variability, which most probably will imply seasonal changes (8,9).
References
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