Linking surface morphology, composition and activity of the 67P/Churyumov-Gerasimenko's nucleus

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Abstract

The Rosetta mission orbited around the comet 67P/Churyumov-Gerasimenko for more than 2 years, getting an incredible amount of unique data of the comet nucleus and inner coma. This has enabled us to study its activity continuously from 4 AU inbound to 3.6 AU outbound, including the perihelion passage at 1.25 AU.
This work focuses on the identification of the regions sources of faint jets and outbursts, and on the study of their spectrophotometric properties, from observations acquired with the OSIRIS/NAC camera during the July-October 2015 period, i.e. close to perihelion. More than 200 jets of different intensities were identified directly on the nucleus from NAC color sequences acquired in 7-11 filters covering the 250-1000 nm wavelength range, and their spectrophotometric properties studied. Some spectacular outbursts appear spectrally blue, due to the presence of grains having very small size and possibly water ice enriched, while fainter jets often show colors redder than the nucleus and appear dominated by dusty particles. Some jets have an extremely short lifetime, appearing on the cometary surface during the color sequence observations, reaching their peak in flux and then vanishing in less than a couple of minutes. These short lived events were observable thanks to the unprecedented spatial and temporal resolution of the ROSETTA/OSIRIS observations.

We present the results on the location, duration, and colors of active sources on the 67P nucleus from the relatively low resolution (i.e. 6-10 m/pixel) images acquired close to the perihelion passage. The observed jets are mainly localized close to boundaries between different morphological regions. Some of this active areas were observed and investigated in higher resolution (up to few dm per pixel) during the last months of Rosetta mission operations. These observations allow us to investigate the link between morphology, composition, and activity on cometary nuclei.
Jets depart not only from cliffs but also from smooth and dust covered areas, from pits or cavities casting shadows and favorizing the recondensation of volatiles, from fractures, and from consolidated terrain. This study show that faint jets feed continuously the cometary activity close to the perihelion passage, and that the sources of these jets are mostly triggered by the illumination conditions and solar radiation and not associated to a particular kind of terrain.

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