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Geomorphological units of Khepry and Imhotep regions of comet 67P/Churyumov-Gerasimenko

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Abstract

During the two-years mission, ESA's Rosetta spacecraft provided countless images of the cometary nucleus. The two cameras of the Optical, Spectroscopic, and Infrared Remote Imaging System (OSIRIS) were equipped with broad-band filters ranging from ultraviolet to near-infrared wavelengths (250-1000 nm). Thanks to such imagery, the identification of morphological features and units [1,2,3] has been followed by detailed geomorphological maps [4,5] and complemented by studies of the spectrophotometric behaviour of the global surface [6]. Several terrains deviate from the average reflectance of the nucleus (∼6.8% at 649 nm), generally displaying lower values as part of the outcropping consolidated materials and relative deposits, or being notably brighter when associated with water-ice rich material [7].

Images provided by the last Rosetta's flyby, in April 2016, allowed the spectrophotometric comparison of specific features of the nucleus at the boundary between Khepry and Imhotep regions [8], confirming that the brightest patches located on overhangs and alcoves tend to have lower spectral slope than the rest of the terrains. Therefore, those patches are interpreted as water-ice exposures of the nucleus at the time of the flyby. Similarly, bright terraces and proximal deposits that surround those patches (e.g., case A, Fig. 1) and display low spectral slopes are considered rich in water ice.

Consolidated materials of this area are characterised by an additional sort of bright terrains, which conversely show steep red slopes usually attributed to volatile-depleted materials. Those bright terrains appear with a yellow hue in false-colour multispectral images (e.g., case B in Fig. 1) and contrast with low- and medium-spectral slope grey-hue terraces associated with bright patches and high-spectral slope darker outcrops and megaclasts. That yellow hue results from a value drop of the shorter wavelengths, which provides as well the steep spectral slopes.

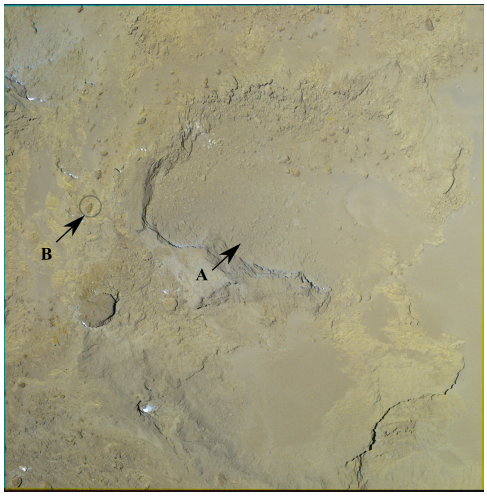

Figure 1: False-color image of the 2016-04-09 flyby sequence (red: F88, green: F82, blue: F84). Letter A labels a bright outcrop associated with water ice, and the relative arrow points to the proximal deposit. Letter B labels a bright yellow outcrop, and the relative arrow points to a dark yellow megaclast.

We therefore propose an analysis of the spectral properties of the discernible geomorphological units of the 2016 flyby area, associating materials of different maturity (i.e. consolidated materials and clasts deposits) depending on those properties and discussing possible explanations of their nature.

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