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Geomorphological and Spectrophotometric Study of Philae Landing Site A

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Abstract

On August 6, 2014, the European Space Agency's Rosetta spacecraft started orbiting the Jupiter family comet 67P/Churyumov-Gerasimenko (hereafter 67P). Afterwards, the OSIRIS instrument (Optical, Spectroscopic and Infrared Remote Imaging System [1]), got the highest-resolution-ever images of a cometary nucleus, reaching the unprecedented scale of 50 cm/px. A brief description of OSIRIS early analysis on the nucleus structure and activity of 67P is available in [2]. Despite its small dimensions, ∼4 km diameter, 67P shows a morphological diversity that is still puzzling the cometary community: boulders [3], high-reflectivity particle clusters [4], local fracturing [5], pits [6], as well as dust covered terrains [7], are only few examples that can be found on 67P.

Since the Rosetta arrival, an extremely detailed analysis of 67P surface has been performed to select five different landing sites candidates for the lander Philae. By using the OSIRIS images the comet shape model [8] has been produced to study the slope constraints, as well as the identification and measurements of boulders and production of hazard maps of the landing spots [3]. A final landing site, called Agilkia and located on the smaller lobe of the comet, was announced on October 15, 2014. Here, Philae, on November 12, 2014, made its historic comet touchdown [9].

Despite its unique scientific potential, one of the five finalists, called "site A", was avoided due to higher risks with respect to Agilkia, during both the landing phase and the surface operations. This area is located on the bigger lobe of the comet, on the Seth region [10] facing the Hathor cliff. Site A (Fig. 1) is close to the 'neck' region, i.e. the connecting bridge between the two lobes, where the main dust jet activity has been observed since the Rosetta arrival. This area is the biggest terrace of Seth region, delimited in the upper part by a steep wall showing multiple niches, strata heads and smaller terraces. Moreover, between the 5 finalists, this site has the unique value to provide detailed analysis of the multiple fractures present on its cliff and on the neighboring Hathor.

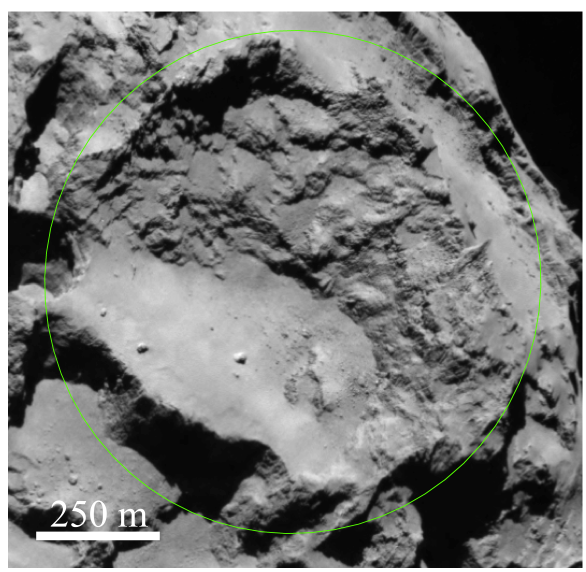

Figure 1: Site A as imaged by the OSIRIS NAC camera on 6 August 2014 at 02:20:12 UT. The distance from the comet center is 117.24 km, the scale is 2.17 m/px.

We here present the geomorphological map coupled with the size-frequency distributions of boulders $\geq$ 2 m located on the different types of terrains here identified, such as outcropping layered terrains, gravitational accumulation deposits, taluses and fine particle deposits. Gravitational slopes, derived through the 67P shape model by assuming uniform density, have been used to characterize and better interpret the various terrains. Moreover, we show the spectrophotometric properties of the area, studied through images taken by OSIRIS NAC with a scale of 50 cm/px. Albedo maps, as well as surface reflectance spectra have been obtained by taking advantage of the shape model and DTM in order to correct for the illumination and observing conditions of the terrain. This multidisciplinary analysis highlights that different types of deposits show different photometric properties.

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