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The 67P/Churyumov-Gerasimenko comet: colors, albedo variations and inhomogeneity of the nucleus from the ROSETTA/OSIRIS images

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Abstract

Rosetta is the cornerstone mission of the European Space Agency devoted to the study of the minor bodies. Launched on 2 March 2004, Rosetta has as primary target the comet 67P/Churyumov-Gerasimenko, a short period comet of the Jupiter's family. On its journey to the comet, after three Earth and one Mars gravity assist manoeuvres, Rosetta flew by two selected asteroids, 2867 Steins, in September 2008, and 21 Lutetia in July 2010. In June 2011, Rosetta was placed in hibernation for 31 months to save its power resources, and it was successfully reactivated on January 2014, before the rendez-vous maneuver to the comet at 4 AU from the Sun. The spacecraft will orbit and perform long-term exploration of the cometary nucleus and coma, including its innermost part, for more than 1 year and a half, following the comet up to its perihelion at 1.37 AU and shortly after it.
A large complement of scientific experiments designed to complete the most detailed study of a comet ever attempted are on board Rosetta, including imaging cameras, spectrometers, dust analysers, radio science experiment, and the Philae lander that will land on the nucleus in November 2014.

In this work we will present the results on the 67P nucleus physical-chemical properties derived from the OSIRIS images acquired during the comet approach phase and the first bound orbits in July-August 2014. OSIRIS is constituted of a Wide Angle Camera (WAC) and a Narrow Angle Camera (NAC) [1]. The NAC camera will obtain high resolution images with different filters in the near UV-near IR range. Those filters are optimised for the mineralogical studies of the nucleus. The WAC camera has a wide field of view (12×12 degrees) and narrow band filters devoted to the study of the gaseous species of the coma.
In the July-August 2014 timeframe, OSIRIS will map the entire surface of the comet with several filters in the 250-1000 nm range, at different phase angles (5-50 degrees), and with a resolution up to 1 m/px with the NAC camera.
From the images obtained during the mapping phase a 3D shape model of the comet will be constructed, and the images will then be co-aligned and photometrically corrected. Color cubes of the surface will then be produced by stacking registered and corrected images.
We will present the spectrophotometry reflectivity and albedo maps, and their evolution over time. These data will give preliminary indications on the comet mineralogy, and will allow us to investigate the nucleus heterogeneity at several scales, both in term of albedo and composition, and the locations of different minerals and ice patches. These unique data will cast light on the nucleus-coma interaction, and on the relationships between ice patches/cometary activity with particular geomorphological features or peculiar terrains in term of albedo and surface roughness.

References

[1] Keller et al. 2007, Space Science Reviews. 128, 433