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Colors of active regions on comet 67P

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Abstract

The OSIRIS (Optical, Spectroscopic, and Infrared Remote Imaging System) scientific imager (Keller et al. 2007) is successfully delivering images of comet 67P/Churyumov-Gerasimenko from its both wide angle camera (WAC) and narrow angle camera (NAC) since ESA's spacecraft Rosetta's arrival to the comet. Both cameras are equipped with filters covering the wavelength range of about 200 nm to 1000 nm. The comet nucleus is mapped with different combination of the filters in resolutions up to 15 cm/px. Besides the determination of the surface morphology in great details (Thomas et al. 2015), such high resolution images provided us a mean to unambiguously link some activity in the coma to a series of pits on the nucleus surface (Vincent et al. 2015).

Introduction

Comet 67P's spectrum globally displays a red slope (Sierks et al. 2015) although we see slope variations in smaller scales (Fornasier et al. 2015). The spectrophotometric properties of the comet 67P is investigated in details and three groups of terrains are identified by Fornasier et al. (2015) as low spectral slope, average spectral slope and high spectral slope groups. High spectral slope group describes various parts of the comet surface and the entire Apis region. Defined low spectral slope group hosts the Hapi region, which was showing the most activity at the arrival to the comet and the Seth region, where we see jets rising from the pits. Average spectral slope group includes the Ma'at region, which also hosts active pits. This work focuses on the color variations inside and in the vicinity of those active pits.

Data and Methods

OSIRIS NAC images of the regions Seth and Ma'at with their active pits, and the Hapi are studied. Images taken in various filters are co-registered, Lommel-Seeliger photometric correction is applied and multi-spectral data sets are generated by using USGS ISIS3 (Integrated Software for Imagers and Spectrometers, `http://isis.astrogeology.usgs.gov/index.html`, (Anderson et al. 2004)) software. Photometric angles are extracted from the 8 m resolution 3D shape of the comet (Preusker et al. 2015), using SPICE kernels (`http://naif.jpl.nasa.gov/naif/index.html`) for the orientation of it for the observing conditions. With the help of spectral slopes and the color composites generated by coding images taken in various filters as RGB channels (see Fig. 1 for an example), region of interests (ROIs) are defined for each multi-spectral data set.

Results

By comparing spectral slopes, color ratios of these ROIs, and using spectral parameters described in Oklay et al. (2015), we find that all regions can be classified in 3 main categories:

1. Regions of low spectral slopes correlate with sources of activity.

2. Regions of high spectral slopes correlate with inactive surfaces.

3. Regions of intermediate spectral slopes correspond to either surfaces partially covered by material ejected from active spots or inactive areas peppered with small bright spots, which are currently interpreted as minor ice deposits (Pommerol et al. 2015).

We will present the details of this classification, and how we use it to reliably detect potential active areas on the nucleus.

Figure 1: Stretched RGB image of Seth pits and the Hapi region taken on 22 August 2014 around 01:42 UT. The images taken with filters centered at 989.3 nm, 701.2 nm and 480.7 nm coded to RGB channels respectively.

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