THE NUCLEUS OF 67P OBSERVED BY VIRTIS/ ROSETTA: DIFFERENT FROM CARBONACOUS CHONDRITES AND SIMILAR TO D-TYPE ASTEROIDS ?

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Introduction: The Visible InfraRed Thermal Imaging Spectrometer, VIRTIS [1] onboard ESA's Rosetta Orbiter has completed two extensive mapping campaigns of the nucleus of comet 67P/Churyumov-Gerasimenko starting in August 2014 [1-2]. Reflectance spectra of the nuclei are being collected within the 0.4-5.1 µm range and provide detailed spatial-temporal observations. Here, we will compare the typical VNIR spectra of cometary crust to laboratory measurements on carbonaceous chondrites and analogues. We will also discuss the relation to disk-averaged spectra of D-type asteroid.

Methods : Reflectance spectra of carbonaceous chondrites (CC) and coals were measured at IPAG under controlled atmosphere. For comparison of absolute photometric levels, a « typical » VIRTIS spectrum of the comet surface was calculated for a standard geometry (θ_i=0°,θ_e=30°) using the photometric parameters of [3].

Photometry and reflectance level : The reflectance of the cometary surface (I/F) is of 0.019 at 0.55 µm and 0.040 at 2.00 µm. These values are lower than those of CC powders (0.057 at 0.55 µm and 0.064 at 2.00 µm for Orgueil). Single Scattering Albedo values derived for the cometary dust [3] are also lower than those derived for meteorite powders [4]. Measurement were also performed on macromolecular carbon compounds analogue to chondritic and IDP insoluble organic matter.

The 3-µm region: The 3-µm region of 67P shows a broad absorption between 2.9 and 3.6 µm [1]. This feature is distinct from the 3-µm band present in CI, CM and CR chondrites indicative of hydrated minerals [5]. There is no evidence for the latter in the cometary dust. Rather, the presence of NH_4^+ ion, together with carboxylic acids can be invoked to at least partially explain the 3-µm feature. Such a mixture has been found as residue of irradiation of ice-mixtures [6] .

Relation to D-type bodies: The 0.5-2.5 µm spectra of D-type asteroids are similar in shape to observations of 67P nuclei [7]. Still, the absorption bands found in the 3-µm region are not strictly identical [8]. Such a difference could be explained by minute-amounts of ice/frost expected to be present on the surface of some D-types [8] and different amounts of the compounds producing the 3-µm feature on 67P (ammonium salts ?).

[1] Capaccioni F. et al., 2015. *Science,* 347, 6620. [2] Filacchione G. et al. (2015) *LPSC XLVI* Abstract. [3] Ciarniello et al., *A&A* submitted. [4] Beck P. et al. 2012. *Icarus* 218, 364-377. [5] Beck et al. 2010. *GCA* 74, 4881-4892. [6] Munoz-Caro G.M. and Schutte, W.A. 2003, *A&A* 412,121-132. [7] DeMeo F.E. et al. 2009. *Icarus* 202 160-180. [8] Takir D. and Emery J.P. 2012. *Icarus*, 641-654.