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First geological mapping of 67P/Churyumov-Gerasimenko nucleus from Rosetta mission

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Abstract

Up to date several cometary nuclei have been observed at different resolutions: 9P/Tempel 1 (up to 10 m/pixel), 19P/Borrelly (up to 47 m/pixel) 103P/Hartley 2 (up to 7m/pixel), 81/Wild2 (up to 14 m/pixel). These observations have revealed that geology and geomorphology of cometary nuclei are extremely variable but with several recurrent features such as spike/pitted and mottled terrains, flat floored craters, smooth and flat surfaces, mesas, ridges and troughs (e.g. [1], [2]). The great inhomogeneity of cometary surfaces is thought to be mostly due to different degree of repeated sublimation which leads to planation, slope retreats, development of lag deposits of variable thickness, focused ablation on pits, smoothening, widening and degradation of impact craters. Jet activity has been instead seen associated to rough areas and mounds on 103P/Hartley 2 comet [3], [4]. Finally layered terrains (recognized on 9P/Tempel 1 [5]), fractures, pits and faults can give important hints on the geological evolution of the body since they might reflect primordial aggregation (potentially defining boundaries of "cometesimals" sensu [6]) as well as later thermal and impacting evolution.

All these geomorphological features are prone to modifications due to cometary activity, while the comet is approaching the Sun. The Rosetta mission, following the comet along its path towards the Sun will give the unique opportunity of realizing detailed geological maps with the aim of defining primary stratigraphic and structural relationships among geological bodies as well as monitoring surface changes. In particular on August 2nd, 2014, the Rosetta far approach trajectory towards 67P/C-G, will end up reaching a distance from the comet surface of about 720 km. At this time, the 67P/C-G nucleus will be imaged through 288 OSIRIS-Narrow Angle Camera (NAC) pixels covering its diameter with a spatial resolution of 13 m.
From August 3rd, up to August 31st, i.e. during the Comet Approach Trajectory (CAT) characterization, the foreseen spacecraft distance will be rapidly reduced down to 52 km, giving the unique opportunity to get full frame images (2048 X 2048 px) and a complete coverage of the nucleus with a scale of 90 cm/px. It is worth pointing out that such images will provide the best ever cometary surface characterization to date; on top of all that, during the close operation phase a more detailed analysis of the surface is even expected, leading to 15 cm resolution images of specific 67P regions. In this phase the OSIRIS-Wide Angle Camera (WAC) will reach its highest spatial resolution of 1 m/px, allowing a comparative analysis with the NAC images acquired during the Comet Approach Trajectory.

We will present the preliminary geological map created from these images (cometary distance from the Sun spanning between 3.6 and 3.4 AU during the month of August 2014), that will be considered as the reference mapping for the following surface modifications/changes due to the incipient cometary activity. Such a detailed geological analysis of the 67P cometary nucleus will be a newcomer in the cometary science frame.

References

[1] Basilevsky, A. T. and Keller, H. U.: Comet nuclei: Morphology and implied processes of surface modification. Planet. Space Sci., vol. 54, pp. 808–829, 2006.

[2] Thomas, N.: The nuclei of Jupiter family comets: A critical review of our present knowledge. Planet. Space Sci. vol. 57, pp. 1106–1117, 2009.

[3]Syal, M.B, Schultz, P.H., Sunshine, J.M., A'Hearn, M.F., Farnham, T.L., Dearborn, D.S. P.: Geologic control of jet formation on Comet 103P/Hartley 2. Icarus, vol. 222, pp. 610-624, 2013.

[4] Thomas, P.C., A'Hearn, M.F., Veverka, J., Belton, M.J.S., Kissel, J., Klaasen, K.P., McFadden, L. a., Melosh, H.J., Schultz, P.H., Besse, S., Carcich, B.T., Farnham, T.L., Groussin, O., Hermalyn, B., Li, J.-Y., Lindler, D.J., Lisse, C.M., Meech, K. and Richardson, J.E.: Shape, density, and geology of the nucleus of Comet 103P/Hartley 2. Icarus, vol. 222, pp. 550–558, 2013.

[5] Thomas, P.C., Veverka, J., Belton, M.J.S., Hidy, A., A'Hearn, M.F., Farnham, T.L., Groussin, O., Li, J.-Y., McFadden, L. a., Sunshine, J., Wellnitz, D., Lisse, C., Schultz, P., Meech, K.J. and Delamere, W.A.: The shape, topography, and geology of Tempel 1 from Deep Impact observations. Icarus 187, 4–15., 2007.

[6] Weidenschilling, S. J.: The Origin of Comets in the Solar Nebula: A Unified Model. Icarus, Volume 127, Issue 2, pp. 290-306, 1997.