LOCAL SCULPTURES AT PHILAE LANDING SITE AS SEEN BY PHILAE/CIVA: CLUES TO PRIMORDIAL ACCRETION PROCESS ?
F. Poulet[1], J.-P. Bibring[1], Y. Langevin[1], C. Pilorget[1], J. Carter[1], P. Eng[1], B. Gondet[1], L. Jorda[2], S. Le Mouélic[3], [1]Institut d'Astrophysique Spatiale, CNRS/Univ. Paris Sud, 91405 Orsay Cedex (francois.poulet@ias.u-psud.fr), [2]Laboratoire d'Astrophysique de Marseille, CNRS/Univ. d'Aix-Marseille, [3]Laboratoire de Planétologie et Géodynamique de Nantes, CNRS/Université Nantes.

Introduction: The Rosetta mission coupled with the Philae observations produced the best views to date of the surface of a cometary nucleus. These missions transformed the comet 67P (Churyumov-Gerasimenko) from an astronomical object into a geological object with a variety of complex structures. It is possible that these structures are giving us important information about the earliest stages of our Solar System's formation. Based on the analysis of CIVA images, we investigate the different physical processes that may have sculpted the various local landforms observed at the Philae landing site.

Local features: Following an epic separation-descent-landing phase, the CIVA cameras operated nominally to obtain the first ever in situ images of any cometary nucleus [1,2]. At the time of the writing of this abstract, the landing site has not been yet identified, but the lander likely sits at a rough terrain apparently in the shadow of a nearby cliff or depression wall. Three CIVA images reveal heterogeneous duricrust and hard-like materials dominated by cm-sized pebble agglomerates with at least two different textures. An example of such granular material is shown on Figure 1. Some of these pebbles (not present on Figure 1) seem to be loosely deposited on the surface. None fine-scaled layer is observed in the CIVA images. By contrast, fractures of various sizes (from mm to several cm's depending on the texture of the materials) are ubiquitous.

Figure 1. Inset of a CIVA image exhibiting pebble pile material.

How is the surface at the landing site shaped?

Following the primordial phases of accretion and collision [3], both exogenic and endogenic processes should modify the surface of 67P at microscopic and macroscopic scales depending on its orbital evolution. Endogenic processes include:

- Erosion (spatially non-uniform) by sublimation (average of ~0.5 m/orbit for a Jupiter family comet such as 67P)
- Redeposition of particles after ejection
- Fluidization and transport of cometary material on the surface [4]
- Recondensation by sintering radiation [5]
- Thermal fatigue that could create cracks and erosion [6]
- Thermal stress that could create macroscopic fractures and surface breakup [7]
- Size segregation (Brazil Nut Effect) due to shaking (thermally-driven) [8]
- Eolian erosion due to local outflow of cometary vapor [9].

On the other hand, exogenic processes that may affect the surface are:

- High energy particles and solar wind bombardment
- Micrometeorite bombardment
- Impact cratering events that would produce re-accretion, shaking and/or sublimation.

We will emphasize that some endogenic processes (thermal fatigue, thermal stress, redeposition) can likely explain several microscopic features revealed by CIVA. Diversity in terms of pebble size and surface texture will be then discussed in relation to sublimation and impact events. Ultimately, we will show that the observed materials could be indicative of the formation process from which the initial cometary nucleus formed.

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