

SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (Part 1) (4A)

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LESSONS LEARNED FROM SD2 OPERATIONS ON COMET 67/P

Abstract

The paper deals with the space systems devoted to drilling and sampling of low-gravity extra-terrestrial soils and, in particular, with the cometary instrument SD2 (Sampler, Drill and Distribution subsystem) onboard the lander Philae of Rosetta mission, which was in charge to drill and sample the comet 67/P Churyumov-Gerasimenko [1]. The behaviour of SD2 is analysed starting from the commissioning and the payload check-outs performed during the ten years' trip. Then, we analyse from the very beginning the in situ activity, by illustrating the consequences of the non-nominal landing of Philae on SD2 operations and the many concerns on the opportunity to use SD2 during Philae's on-comet activities [2]. In fact, due to the non anchored status of the lander Philae, the reaction of the soil on SD2 during drilling could have had dramatic consequences on the stability of the lander on the comet surface. Nevertheless, one sampling procedure was attempted [3]. Following the decision of allowing SD2 to operate, the deployment and retrieval phases went on, as we describe in the paper from the mechanical and energy point of view. Finally, the paper focuses on the lessons learned from SD2 operation during the entire mission and on the suggestions for future similar operations. The main consequences of the lack of a direct measure of the distance of the soil from the lander baseplate are illustrated, together with the advantages that the availability of force and torque sensors could have granted during drilling and sampling operations. Moreover, the paper highlights the importance of providing any future sampling mechanism with a proper level of autonomy to optimize operation planning and to guarantee the adequate management of non-nominal scenarios and the definition of effective contingency plans.

[1] Ercoli Finzi, P.G. Magnani, E. Re, S. Espinasse, A. Olivieri, SD2– How to Sample a Comet, Space Science Reviews, 128 (2007) 281–299

[2] J.-P. Bibring, M.G.G.T. Taylor, C. Alexander, U. Auster, J. Biele, A. Ercoli Finzi, F. Goesmann, G. Klingelhofer, W. Kofman, S. Mottola, K.J. Seidensticker, T. Spohn, I. Wright, Philae's First Days on the Comet, Science, 349 (2015) 493

[3] P. Di Lizia, F. Bernelli-Zazzera, A. Ercoli-Finzi, S. Mottola, C. Fantinati, E. Remeteau, B. Dolives, Planning and implementation of the on-comet operations of the instrument SD2 onboard the lander Philae of Rosetta mission, Acta Astronautica, 125 (2016) 183-195