Laboratory investigation of thermal and mechanical properties of icy comet analogs

Mathieu Choukroun, Ahmed Mahjoub, Elizabeth Carey, Scott Moreland, Sona Hosseini, Fang Zhong, Eli Phelps, Sarah Dalessi, Danielle Naiman

Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA, 91109, USA

(mathieu.choukroun@jpl.nasa.gov)

Remove sensing observations of comets by telescopes and space missions (Deep Impact, Rosetta) consistently suggest that comet nuclei are very weak at large scales of meters and more. However, the Philae lander first bounced off the surface of 67P/Churyumov-Gerasimenko at Agilkia, presumably due to a hard layer at depth. At Abydos, the final resting place of Philae, several measurements suggest the presence of a compact and hard layer in the ~ 1 meter surrounding Philae. Such a layer may be due to the recondensation of water ice within the pore space, as suggested by the KOSI experiments. However, the KOSI experiments used a very low dust-to-ice ratio (0.1:1) as compared to what was found by Rosetta at 67P (~ 6:1, although this value is highly debated and still needs refinement), and the insolation timescales were limited.

In order to expand on the KOSI experiments, we are developing a new facility to synthesize porous comet analogs, insolate them using a custom-designed frequency-modulated lamp, and measure the evolution in the thermal and mechanical properties. Samples are prepared by spraying mixtures of dust and atomized water directly into liquid nitrogen. Temperature profiles are measured continuously using a custom-built thermal probe, and 2D time-dependent thermal modeling retrieves the thermal properties and their evolution as function of depth and time. A custom-built cone penetrometer apparatus measures the strength (resistance to penetration) of the comet analogs at various locations of the sample over the course of each experiment. We will report on the status of the experimental development and present preliminary results.

Acknowledgments: This work has been conducted at the Jet Propulsion Laboratory, California Institute of Technology, under contract to NASA. Support from the JPL R&TD program and U.S. Rosetta are gratefully acknowledged.