

CO₂ ICE AND MGS-1 MARS GLOBAL SIMULANT : EXPERIMENTAL WORK TO RECREATE DARK SPOT EVOLUTION ACTIVITY AND SELF-CLEANING PROCESSES OBSERVED BY CaSSIS.

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Introduction: Combined observational data from CaSSIS and experimental work in our IceLab facilities would lead to a better understanding of CO₂ driven processes in Martian polar regions. A previous CaSSIS acquisition was thought to be odd compared to similar observations, showing yellow and green spots, the reflectance profiles over these features display variations in the PAN filter consistent with each other, NIR and RED filters differ in trends with the spots colours [1]. At first, time evolution and light scattering effects were believed to be producing this range of colours, composition was of course another candidate. Lately, several images with yellow and green colouring have been found in CaSSIS database and it is thought to be due to a specific filter combination (PAN-NIR-RED) but the origin of the reflectance variations is yet to be discovered. Our goal is to experimentally identify the processes behind the reflectance variations which may be linked in some ways to the temporal evolution of spots.

Motivations: The self-cleaning process, showed in figure 4a and 4b of [2], is one of the main theory behind spots' evolution. The spots are first deposited after jets have erupted from overpressure at the base of the slab - leaving spiders as remnant on the surface [3], they then sink slowly into the slab, gets covered by fresh CO₂ frost/snow until fully covered (fig.1). A few experiments on dust ejection from CO₂ ice caps have been done [4], we are aiming to experiment on the consequences of such events. Moreover a study of Richardson crater [5] showed the presence of water content in small quantities but still with significant changes in reflectance, this might be also the case in the region we are focusing on and induce those yellow and green colouring (fig.2), although this water content might be difficult to reproduce in the laboratory since it is the order of a few ppm.

Experimental Setup: Using the SCITEAS chamber setup [6], we designed a simple experiment involving CO₂ ice and the newest Martian analogue MGS-1. The analogue is powdered arbitrarily on top of an industrial CO₂ Slab which is then illuminated with a Sun simulator with a power range up to 300W. A CCD Camera records, in the visible range, the sublimating ice and the sinking grains (Fig.3).

For comparison purposes, CaSSIS filters can be added physically on the camera and/or virtually into the acquired images. To obtain more significant results, we use the Optical Coherence Tomography Planetary Ultra-cold Samples (OCTOPUS), which is a system to image sample surfaces in 2D or 3D, to get a quantitative overview of the sinking grains – such as the sinking rate and the depth.

Results and Discussion: Our first test runs have been successful so far, the data acquired is still qualitative. We clearly see the grain sinking into the CO₂ slab while it sublimates. The goal is to quantify this process in a reproducible way and with various setups, including spot shapes, analogue distribution and illumination conditions. Further results will be presented at the conference.

References: [1] Cesar C. et al. (2019) *9th ICM*, Abstract #6253. [2] Kieffer H. et al. (2006) *Nature*, 442, 793-796. [3] Hansen et al. (2010) *Icarus* 205, 283–295. [4] Kauffman E., and Hagermann A. (2017) *Icarus* 282, 118–126. [5] Gardin E. et al. (2010) *JGR* 115-E6. [6] Pommerol A. et al. (2015) *PSS* 109-110, 106-122.

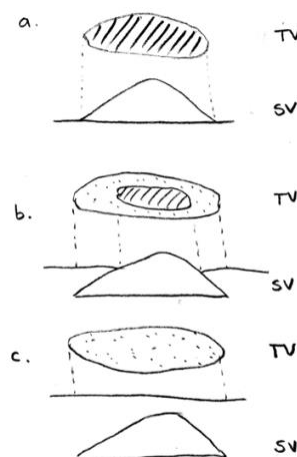


Figure 1 : Sketch of self-cleaning process. (a) Top View and Side View of a full spot on CO₂ ice slab. (b) On the TV of a partially covered spot, the central part appears darker with a “light halo” surrounding it. (c) Remnant halo from a completely covered spot.



Figure 2 : CaSSIS stereo acquisition 2073_266 taken on May 11th 2018 at 18:56:54. (Top) stereo 1 with PAN RED BLU filters showing mostly dark blue spots, a few light blue, and small red ones, and what seem to be a cloudy feature . (Bottom) stereo 2 with PAN RED NIR showing respectively dark, grey and yellow spots, the cloudy feature seem faded and is present only in the PAN filter.



Figure 3 : (Left) Top view of the CO₂ slab during the test run. (Right) Side view of sinking areas after the experiment.