

Europlanet TNA Report

PROJECT LEADER

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Date of TNA visit:	05.06.2011 – 10.06.2011
No. of days:	5
Host laboratory:	Mars Wind Tunnel Simulation Facility provided by: Mars Simulation Laboratory, Aarhus University
Reimbursed	Yes

Project Title – Measuring optical and mechanical CO₂ ice properties in support of understanding seasonal processes in Mars' polar regions

Scientific Report Summary.

(plain text, no figures, maximum 250 words, to be included in database)

We used Mars Wind Tunnel Simulation Facility in the frame of Trans-National Access opportunities within the EuroPlanet Research Infrastructure to simulate CO₂ ice condensation in the conditions similar to those expected in the Martian polar areas. Our main goal was to constrain the range of temperatures and pressures that allow CO₂ ice to be formed in its transparent form.

The first round of experiments was conducted in June, 2011 and yielded the following results.

We explored the temperature ranges from 140 K to 170 K at different rates of the CO₂ flux entering the previously evacuated chamber. One restriction of the present set-up was a limited flux of CO₂ gas entering the chamber, while on Mars the reservoir of available CO₂ is virtually unlimited.

A thin slab of CO₂ ice could be produced during several of the runs. This indicates that the conditions for the synthesis of such a material are easy to reproduce in the laboratory. The CO₂ formed in three different crystalline structures depending on temperature. This suggests a variability of the properties of CO₂ ice that are possibly present on Mars.

Full Scientific Report on the outcome of your TNA visit

Approx. 1 page

The idea of a translucent CO₂ layer covering martian polar regions is widely discussed since the first detection in 2000 of a region in the southern cap that remains cold enough that CO₂ ice must be present late in the spring together with the low albedo. It provoked many specialized observational campaigns and modelling work. “Kieffer model” postulates that the CO₂ seasonal cap anneals into translucent slab ice over the course of a Martian winter. It is known that water ice undergoes annealing process during transformation from packed snow to firn and to crystalline ice. However the conditions for such annealing in the case of CO₂ are not constrained neither from observations nor from laboratory experiments. Another possibility for the transparent slab formation, its direct condensation from the atmosphere, is also not explored well enough.

For the main hypothesis of Kieffer’s model the existence of the transparent CO₂ slab is critical. The knowledge about conditions under which CO₂ slab might be formed would greatly benefit our understanding of what kind of ice is dominant in polar areas during the time of biggest changes – local spring.

The main purpose of the present work can be formulated in one question: under what conditions does translucent CO₂ ice form in the present day Martian polar areas?

Simulation of Martian aerosol is performed in a re-circulating wind tunnel enclosed in a low-pressure atmospheric chamber. Such a system allows the atmosphere to be controlled and monitored. A liquid nitrogen cooling system allows the simulation of Mars’ low temperatures.

We used this facility in the frame of Trans-National Access opportunities within the EuroPlanet Research Infrastructure to simulate CO₂ ice condensation in the conditions similar to those expected in the Martian polar areas. Our main goal was to constrain the range of temperatures and pressures that allow CO₂ ice to be formed in its transparent form.

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A thin slab of CO₂ ice could be produced during several of the runs. This indicates that the conditions for the synthesis of such a material are easy to reproduce in the laboratory.

The CO₂ formed in three different crystalline structures depending on temperature (Figure 1). This suggests a variability of the properties of CO₂ ice that are possibly present on

Mars.

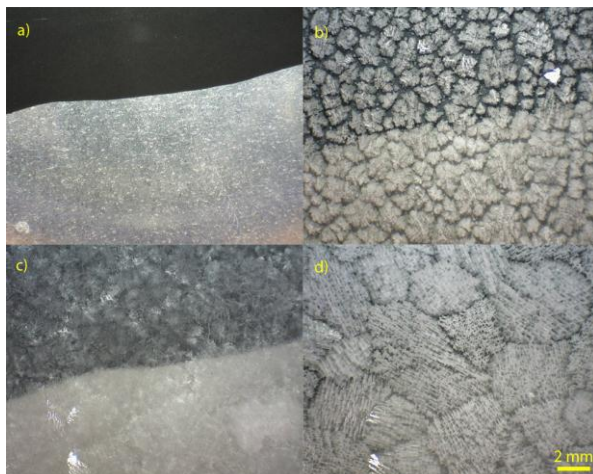


Figure 1 4 frames taken with the microscope during one experiment run. The images show different CO₂ ice structures that were formed during the run. a) bare plate without ice cover with dark-bright marking to enable contrast estimation; b) crystalline CO₂ flakes; c) translucent CO₂ slab, note that the bright-dark border is visible through the layer; d) polygons with organized ice crystals.

Please include:

- Publications arising/planned (include conference abstracts etc)

G. Portyankina, J. Merrison, K.-M. Aye, J. J. Iversen, C. Hansen, A. Pommerol, and N. Thomas, How to create translucent CO₂ ice on Mars: simulations using the wind tunnel of aarhus mars laboratory, 2011, Mars Polar Science and Exploration conference, Fairbanks, Alaska, USA

Planned: a GRL publication: G. Portyankina, J. Merrison, K.-M. Aye, J. J. Iversen, C. Hansen, A. Pommerol, and N. Thomas, Various forms of translucent and non-translucent CO₂ ice under martian polar conditions: simulations using the wind tunnel of Aarhus mars laboratory

- Host approval The host is required to approve the report agreeing it is an accurate account of the research performed.