Europlanet TA Report

Please see Annex 1 below

Infrastructure short name	Installation ID	Installation short name
Distributed Planetary Simulation Facility (DPSF)	TA2-4	CSS

PROJECT LEADER – APPLICANT 1

Project number: 18-EPN5-040		
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*__UNI__ (University and other higher education organisations) **RES** (Public research organisation (including international research organisation as well as private research organisation controlled by a public authority) **SME** , **PRV** (Other Industrial and/or profit Private organisation) or **OTH**		
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Gender: M	**Year of birth:** 1974	**Group Leader:** Y
New user: N	**Number of visits:** 3	**Nationality:** Italian
Affiliation: INAF-IAPS	**Researcher Status:** EXP	**Activity Domain***: Physics

CO - APPLICANT – if applicable

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New user: N	**Number of visits:** 3	**Nationality:** Italian
Affiliation: INAF-IAPS	**Researcher Status:** PDOC	**Scientific background***: Physics

**Please select the most appropriate description from the list below:*

Physics	Chemistry	Life Sciences & Biotech	Earth Sciences & Environment

Mathematics	Energy	Material Sciences	Engineering & Technology
Social Sciences	Humanities	Information & Communication Technology	

How did you hear about us?

Website	Advertising email	Colleague	
Other: Already applied and selected previously (in 2016 and 2017).			

HOST (TA Facility) **–** Please be accurate. This information is required for reporting.

Name:	**Host laboratory:**
Cold Surfaces Spectroscopy (CSS)	Institut de Planétologie et d'Astrophysique de Grenoble (IPAG) Bât. OSUG A 414, Rue de la Piscine - Domaine Universitaire 38400 St. Martin d'Hères France
Start Date of visit	5 May 2019
Finish Date of visit:	10 May 2019
No. of days: Please do not include travel days, this is lab/field access only	5
Applicant/Co-applicant reimbursed? Please indicate Yes or No	Yes

VISITORS TO LAB (If different from above applicant and co-applicant) **–**

Name:	**Affiliation:**	**Date**

Project Title – ***Characterization of Hydrated Na-Sulfates at Cold Planetary Conditions***

Scientific Report Summary.

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

Our proposal is focused on a series of laboratory measurements aimed to acquire VIS-NIR spectra of magnesium chlorides with different levels of hydration, in three different grain sizes and in a broad range of cryogenic temperatures, representative of real planetary surfaces.

To achieve this goal, we used the SHINE Spectro-Gonio-Radiometer, which is part of the

Cold Surfaces Spectroscopy (CSS) facility at the *Institut de Planétologie et Astrophysique de Grenoble* (IPAG), to measure magnesium chlorides in three different grain sizes and in the overall temperature range 80-295 K.

These measurements are key to correctly interpret spectroscopic data acquired by instruments carried onboard planetary space missions that in the near future will deeply investigate Jupiter's icy Galilean satellites (*JUICE*, *Europa Clipper*) and Mars (*ExoMars 2020*, *Mars 2020*).

Full Scientific Report on the outcome of your TNA visit

Our visit to IPAG's CSS installation, supported through Europlanet 2020 RI TA, Fifth Call, took place from 5 to 10 May 2019 and covered the measurements of one out of the two compounds that had been the subject of our original proposal, namely magnesium chloride hexahydrate. Because it was impossible to measure both chemical compounds covered by our proposal, given the limited allowed time (5 working days), the second compound, i.e. anhydrous magnesium chloride, was measured the following week by a third person supported by external fundings. The CSS team offered us, outside the Europlanet TNA program, this additional time and support on the SHINE setup. The chemical compounds to be measured were sent a few days in advance. In particular, the sieved samples of anhydrous magnesium chloride, given their extreme hygroscopicity, were been placed in a vacuum cabinet on the same day of their delivery to IPAG, on 30 April 2019. Upon our arrival on 5 May, we met Pierre Beck (staff research scientist and co-manager of the CSS facility) and Olivier Brissaud (staff technician), who immediately put us at ease making us available, among other things, a vacuum oven to preserve the anhydrous samples at hot temperatures (100°C) for several days before the measurement that would have been carried out the week following our visit.

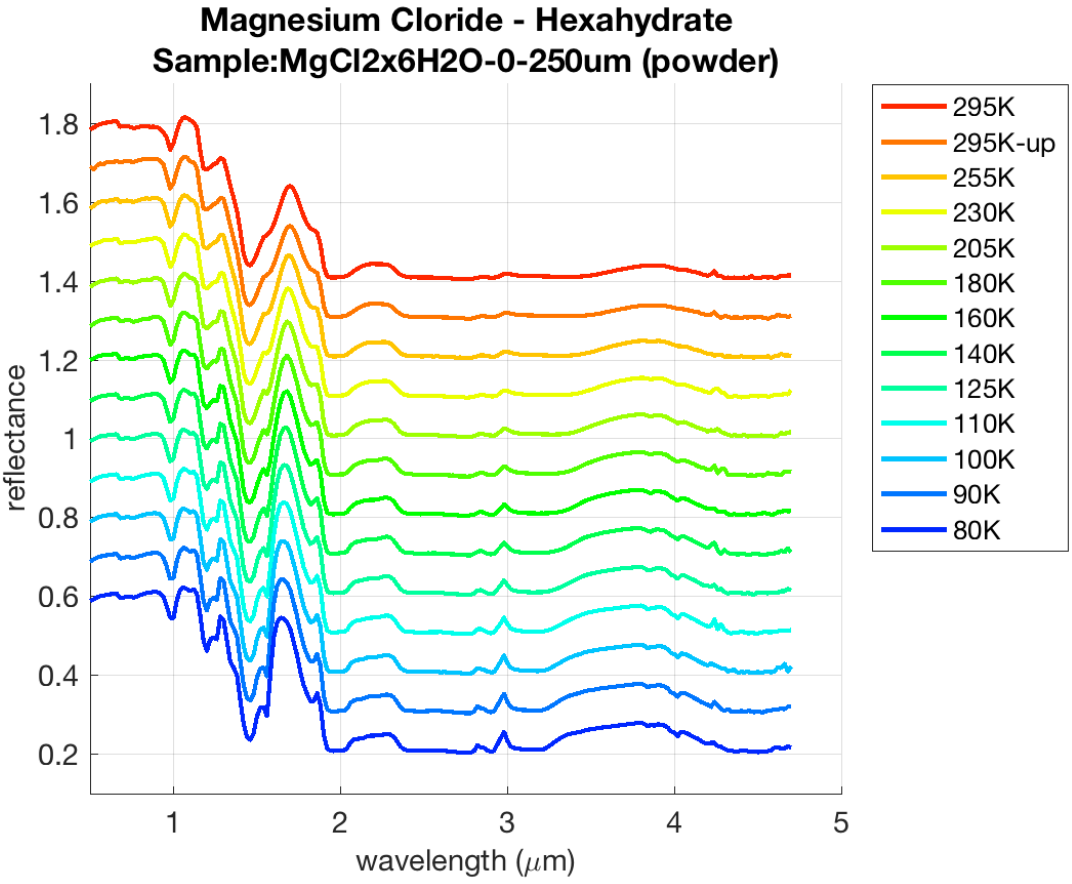
We learned that unlike some years ago, the cooling system of the room where the SHINE facility is physically located at IPAG has been turned off in 2018, and it is turned on only in special cases for the preparation of icy samples or samples that require cold and dry conditions. To be sure, the cell that contained the sample was anyway maintained at the desired temperature values. However, it should be noted that the room temperature requires careful attention, as it may facilitate condensation of water vapor on the optical window of the cell if a given sample is extracted and replaced with another sample too quickly.

Our original proposal planned to prepare three different sieved grain size ranges for both anhydrous magnesium chloride and magnesium chloride hexahydrate: 36-50 µm, 75-100 µm, and 125-150 µm. These grain sizes were chosen to: (1) be indicative of typical regoliths known or expected to exist on the surface of the icy satellites, and (2) avoid overlapping between ranges, therefore minimizing particles contamination among the dimensional classes. However, while sieving magnesium chloride hexahydrate, we found that the grains tended to stick together and form agglomerates, ultimately making it impossible to obtain fine grains. Therefore, and different from our original proposal, we had to adapt and measure magnesium chloride hexahydrate at overall larger grain sizes: 150-250 µm, 250-500 µm, and 500-800 µm. On the other hand, the original grain sizes could be retained for anhydrous magnesium chloride, given the intrinsic fineness of the material to be processed. Each grain size was measured with the SHINE Spectro-Gonio-Radiometer facility in the 0.5-4.7 µm spectral range (longer wavelengths, being very noisy, were discarded), with

constant spectral sampling of 20 nm and spectral resolution decreasing with increasing wavelength. For each sample, the overall 80-295 K temperature range was acquired in 12 steps varying from 10 K to 25 K, imposed by time constraints. In particular, at the uppermost (room) temperature 295 K, we acquired the spectra both at the beginning (before cooling) and at the end of the ramp, to check for any macroscopic physical-chemical changes in the sample.

The automation system implemented for the CSS-SHINE facility by the IPAG staff enables the automatic acquisition of a sequence of spectra in given temperature ramp. This in fact allows the applicants to take advantage of the entire available time, including night hours and closing days, to complete the set of measurements, which in our specific case would otherwise require from 1.5 to 2 days for each sample (i.e., each grain size).

In the following plot, we show an example of spectral profiles measured for one sample of magnesium chloride hexahydrate (grain size <250 µm), which nicely confirms the capability of the CSS-SHINE facility in acquiring reflectance spectra in a sufficiently broad spectral range and cryogenic temperature range, indicative of real planetary surfaces. Our experience is overall positive and CSS, after several years, is still the best facility in Europe where such spectroscopy measurements can be performed.



Please include:

- Publications arising/planned (include conference abstracts etc):

1 conference abstract (European Planetary Science Congress 2019), and 1 peer-reviewed scientific paper to be prepared and submitted to the Icarus journal by the end of 2020.

Please add the Europlanet official Acknowledgement to each publication and dissemination activity

"Europlanet 2020 RI has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654208"

- Host approval

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

The two managers of the facility, Bernard Schmitt (CNRS/IPAG, Grenoble), and Pierre Beck (UJF/IPAG, Grenoble), approve the report and agree that it is an accurate account of the research performed during the visit of the Cold Surface Spectroscopy facility (DPSF/CSS/TA2-4).

Annex 1

Access provider short name	*Short name of infrastructure*	*Installation*		*Installation Country code*
		ID	*Short name*	
INTA	PFA	TA1-1	Rio Tinto	ES
IRSPS	PFA	TA1-2	Ibn Battuta	IT
Matis	PFA	TA1-3	Iceland	IS
INTA	PFA	TA1-4	Tirez Lake	ES
IRSPS	PFA	TA1-5	Danakil	IT
DLR	DPSF	TA2-1	PEL	DE
MUG	DPSF	TA2-2	IMRF	AT
AU	DPSF	TA2-3	PEF	DK
CNRS	DPSF	TA2-4	CSS	FR
UJF	DPSF	TA2-4(8)	CSS – 3rd party	FR
VUA	DPSF	TA2-5	HPHT	NL
OU	DPSF	TA2-6	LMC	GB
NHM	DPSF	TA2-7	PMCF	GB
VUA	DAFS	TA3-1	GGIF	NL
CNRS	DAFS	TA3-2	HNIF	FR
CNRS	DAFS	TA3-3	SRIF	FR

OU	DAFS	TA3-4	HS50L	GB
OU	DAFS	TA3-5	LFS	GB
OU	DAFS	TA3-6	CSSIA	GB
WWM	DAFS	TA3-7	RNTSI	DE
CNRS	DAFS	TA3-8	IPF	FR