Europlanet TA Report

Please see Annex 1 below

Infrastructure short name	Installation ID	Installation short name
DPSF	TA2-4	CSS

PROJECT LEADER – APPLICANT 1

Project number: 18-EPN5-057		
Name: Stefanus Schröder		
Home Institution full address: Deutsches Zentrum für Luft- und Raumfahrt (DLR) Rutherfordstr. 2 12489 Berlin		
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Legal Status* RES		
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Tel: +49 30 67055104	Fax:	E-mail: stefanus.schroeder@dlr.de
Gender: M	Year of birth: 1970	Group Leader: N
New user: Y	Number of visits: 1	Nationality: Netherlands
Affiliation: DLR	Researcher Status: EXP	Activity Domain* (see below) : Physics

CO - APPLICANT – if applicable

Name:		
Home Institution:		
Tel:	Fax:	E-mail:
Gender: M/F	Year of birth:	Group Leader Y/N
New user: Y/N	Number of visits:	Nationality:
Affiliation:	Researcher Status: UND / PGR / PDOC / EXP / TEC	Scientific background* (see below) :

**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?

Colleague			
Other:-			

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	15 April 2019
Finish Date of visit:	26 April 2019
No. of days: Please do not include travel days, this is lab/field access only	10
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 – **An experimental investigation of the nature of Ceres blue material using a Ceres surface analogue**

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

The aim of our experiment is to provide a plausible explanation for why the ejecta of young craters on dwarf planet Ceres appear relatively blue. We performed the sublimation experiment at the *Cold Surfaces Spectroscopy* (CSS) facility at the *Institut de Planétologie et Astrophysique de Grenoble* (IPAG), with two different samples: pure NH_4-bearing nontronite and an analogue material for the surface of Ceres, composed of magnetite, NH_4-bearing nontronite, antigorite and dolomite. We incorporated both materials into 50 µm-sized ice particles and gradually sublimated the ice, while monitoring any spectral changes in the 0.4-4.2 µm wavelength range. We spectrally characterized the samples both before and after sublimation, taking special care to remove any water absorbed by the phyllosilicates. While the spectrum of the bright nontronite sample depended on the thickness of the sample, this played no role for the much darker Ceres analogue. Further characterization was performed by optical and electron microscopic imaging. The nontronite dissolved well in water and ice particles were easily generated. The Ceres analogue material would only partially dissolve in water, and the non-soluble fraction was mixed in with the ice particles made from the liquid phase. Sublimation took place over the course of several days and nights under Ceres conditions (–100° C, high vacuum). After sublimation, both materials had formed a porous surface layer that was blue relative to the original material (negative spectral slope). The high porosity results from the interaction between phyllosilicates and liquid water. The character and strength of the spectral bluing observed for the Ceres analogue material are consistent with our original hypothesis.

Full Scientific Report on the outcome of your TNA visit

Approx. 1 page

The aim of our experiment is to provide a plausible explanation for why the ejecta of young craters on dwarf planet Ceres appear relatively blue. We performed the sublimation experiment at the *Cold Surfaces Spectroscopy* (CSS) facility at the *Institut de Planétologie et Astrophysique de Grenoble* (IPAG), with two different samples of material: pure NH_4-bearing nontronite and an analogue material for the surface of Ceres, composed of magnetite, NH_4-bearing nontronite, antigorite and dolomite. We incorporated both samples into 50 µm-sized ice particles and gradually sublimated the ice under high vacuum at –100° C (Ceres conditions) in the CarbonIR chamber, while monitoring any spectral changes. We spectrally characterized both samples in the 0.4-4.2 µm wavelength range with the SHINE and SHADOWS spectrometers before the sublimation experiment, taking care to remove any water absorbed by the phyllosilicates by heating under high vacuum. We found that the nontronite dissolved well in water and ice particles (intra-mixture) were easily generated. After sublimating the sample for several days and nights, a thick fluffy layer had formed on top of the ice. To speed up the sublimation, we slowly increased the temperature over the weekend, upon which the sample "exploded", creating a thin porous layer in the centre. Due to the high albedo of the sample, the spectrum of the thin layer was different from that of the thick layer (Fig. 1, left). This demonstrated the importance of sample thickness, and we additionally measured the spectrum of a thin sample of the original nontronite, made using the spinning drop technique. After sublimating, the nontronite residue was blue compared to its original state, both for thick and thin layers of the material.

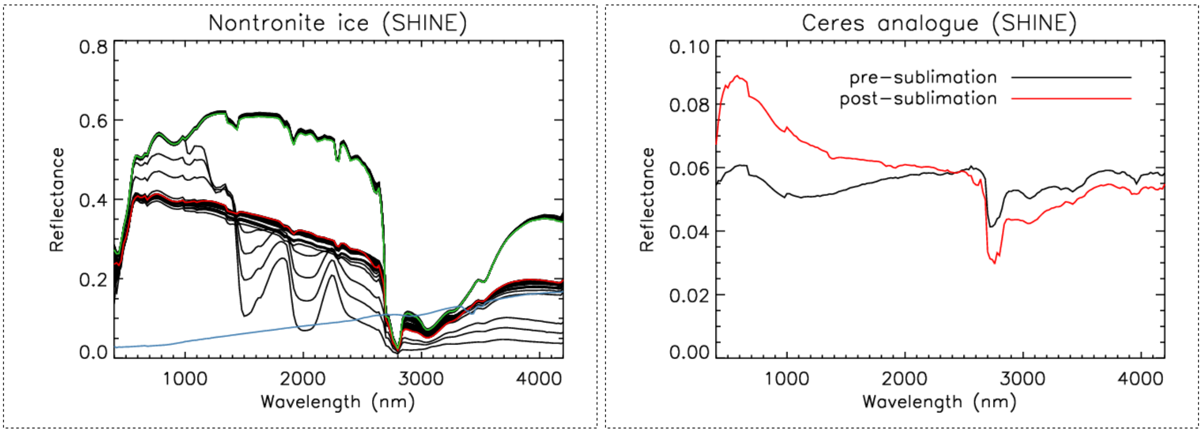

Fig. 1. Experimental results. **Left**: Spectra of the nontronite residue acquired while sublimating. The green spectrum is that of the thick, dry fluffy layer. The red spectrum is that of the thin, dry fluffy layer. The blue spectrum is that of the sample holder. **Right**: Spectral changes induced by sublimation for the Ceres analogue. The post-sublimation residue is blue compared to the original state.

Sample thickness was not an issue for the much darker Ceres analogue. We found that the material would only partially dissolve in water. We therefore created ice particles (intra-mixture) from the liquid phase, and subsequently mixed the non-soluble fraction with the ice particles (inter-mixture). After sublimating the sample for several days and nights, a porous layer had formed on top of the ice, which was blue compared to the original material (Fig. 1, right). Both nontronite and Ceres analogue were characterized by optical and electron microscopic imaging pre- and post-sublimation (ongoing). Our preliminary analysis of the data supports our original hypothesis.

Please include:

- Publications arising/planned (include conference abstracts etc)

We will present these results at the upcoming EPSC-DPS meeting and plan a journal publication later this summer (2019).

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