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-EPN4-033		
Name: Mauro Ciarniello		
Home Institution full address: INAF-IAPS Via del Fosso del Cavaliere, 100, 00133, Rome, Italy		
Country: Italy		
Legal Status*: RES		
*__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**		
Tel: 06 49934689	**Fax:**-	**E-mail:** mauro.ciarniello@inaf.it
Gender: M	**Year of birth:** 1983	**Group Leader :** Y
New user: Y	**Number of visits:** 1	**Nationality:** Italian
Affiliation: IAPS-INAF	**Researcher Status:** PDOC	**Activity Domain*** (see below) : Physics

CO - APPLICANT – if applicable

Name: Gianrico Filacchione		
Home Institution: INAF-IAPS Via del Fosso del Cavaliere, 100, 00133, Rome, Italy		
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Gender: M	**Year of birth:** 1972	**Group Leader :** N
New user: Y	**Number of visits:**-	**Nationality:** Italian
Affiliation: IAPS-INAF	**Researcher Status:** EXP	**Scientific background*** (see below) : 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 X	
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 October 2018
Finish Date of visit:	26 October 2018
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**
Lyuba Moroz	Institute of Earth and Environmental Science, Univ. of Postdam; DLR, Institute of Planetary Research, Berlin, Germany.	15-19 October 2018
Vassilissa Vinogradoff	Aix-Marseille University, PIIM UMR-CNRS 7345, F-13397 Marseille, France	23-26 October 2018

Project Title – Spectral Analysis Of Mixtures With Pyrrhotite-Ice-Kerite (SAMPIK) As Analogues For Cometary Surface Composition

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

Our proposal focused on a series of spectral reflectance measurements in the VIS-NIR range (0.4-4.2 µm) of mixtures of water ice and mineral/organic dust, as analogues of cometary surfaces composition.
We took advantage of the *Cold Surfaces Spectroscopy* (CCS) setup at the *Institut de Planétologie et Astrophysique de Grenoble* (IPAG) to perform spectral reflectance measurements on mixtures of water ice-kerite, water ice-pyrrhotite, water ice-pyrrhotite-kerite with controlled grain sizes and different mixing modalities (intimate and intraparticle). This set of measurements will support the interpretation of remote sensing observations of

cometary nuclei and will be used to constrain models of radiative transfer in particulate media, with particular focus on sensitivity to endmembers abundances, mixing properties and grain sizes.

Full Scientific Report on the outcome of your TNA visit

Our visit at IPAG's CSS laboratory took place during two weeks (15-26 October 2018), as requested in the original proposal submitted to the Europlanet 2020 RI TA, Fourth Call. Upon arrival, the visitors for the first week (Mauro Ciarniello and Lyuba Moroz) met Pierre Beck (a staff research scientist and the manager of the CSS facility) and Olivier Poch (a postdoc researcher). They introduced us to the laboratory and showed us the facilities during our stay: the SHINE spectrogoniometer located in the cold room to perform measurements at cryogenic temperature, a chemistry laboratory for powder preparations (with available sieves, grinding tools, a balance, an extractor hood for sample drying and a humidity controlled cabinet for storage) and a room equipped with a fridge and the SPIPA-B setup for the preparation of water ice powders of controlled grain size and water ice-dust mixtures. Olivier Poch extensively assisted the visitors for the whole duration of the visit, thoroughly aiding in the ice-refractory mixtures preparation with the SPIPA-B setup and for spectra acquisition. Along with him, the visitors also benefited from the help of Pierre Beck, Batiste Rousseau (a postdoc at IPAG), Istiqomah Istiqomah (a PhD student) and Robin Sultana (a PhD student).
Refractory materials for the planned experiment (bulk kerite and pyrrhotite, 45-63 μm kerite powder) were shipped to the laboratory prior to our arrival. During the first week and part of the second one, some of the activity was devoted to the preparation of powders of the refractory materials, namely wet-sieved pyrrhotite of 25-50 μm grain size, wet-sieved 25-50 μm kerite, fine-grained pyrrhotite (<25μm, planetary grinding) and kerite (<25μm manually ground). In particular, during the first attempt of preparation of a hyperfine-grained pyrrhotite powder, oxidation of the sample was observed. The second attempt performed by Batiste Rousseau was successful.
During the first week, reflectance spectra (observation geometry: incidence=0°, emission=30°, phase angle=30°) of intimate water ice-kerite and water ice-pyrrhotite mixtures were successfully acquired (see Fig.1A and Fig. 1B). Also, attempts to produce intraparticle water ice-kerite mixtures were performed. The production of such particles was extremely challenging because of kerite's hydrophobic properties, and the resulting samples are likely not representative of an ideal intraparticle mixture. For this reason, we did not further attempt the production of water ice-kerite intraparticle mixtures.
During the second week, upon arrival of Vassilissa Vinogradoff and departure of Mauro Ciarniello and Lyuba Moroz, additional spectral reflectance measurements were performed on intimate mixtures of water ice and kerite (fine-grained), intraparticle mixtures of water-ice and pyrrhotite, and intimate mixtures of pyrrhotite with water ice containing fine-grained pyrrhotite inclusions. In addition, mixtures including only refractory materials (intimate kerite-pyrrhotite) and ternary water ice-kerite-pyrrhotite mixtures have been prepared and spectrally characterized. Finally, spectra of the pure endmembers have been measured. The list of the performed spectral reflectance measurements is reported below.

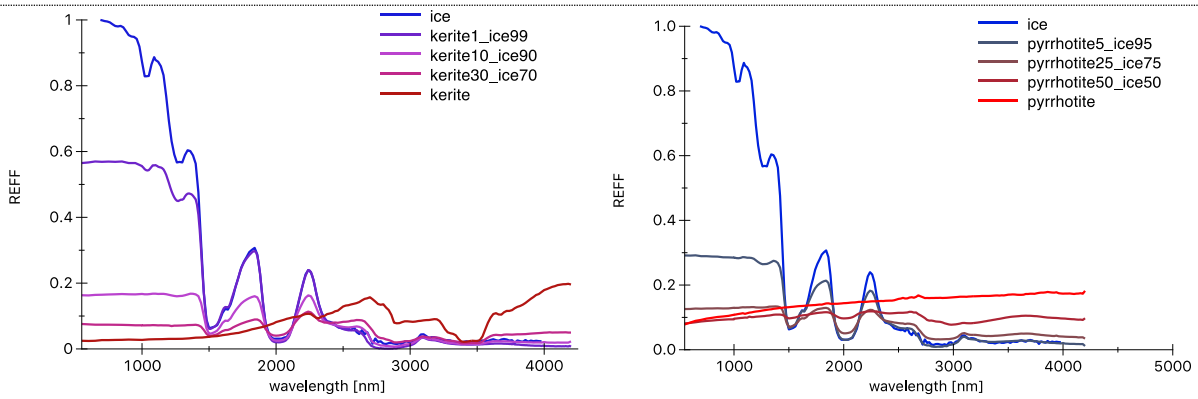

Figure 1. Water ice-kerite (left panel) and water ice-pyrrhotite (right panel) intimate mixtures (endmembers wt% is indicated). Water ice, kerite and pyrrhotite grain sizes are 67+-31µm, 45-63µm and 25-50µm, respectively.

List of measurements (we report the weight fraction of the different endmembers):

- Intimate mixtures of 0.01 kerite (45-63µm) and 0.99 water ice (67±31µm).
- Intimate mixtures of 0.1 kerite (45-63µm) and 0.9 water ice (67±31µm).
- Intimate mixtures of 0.3 kerite (45-63µm) and 0.7 water ice (67±31µm).
- Intimate mixtures of 0.01 kerite (<25µm) and 0.99 water ice (67±31µm).
- Intimate mixtures of 0.09 kerite (<25µm) and 0.91 water ice (67±31µm).
- Intimate mixtures of 0.23 kerite (<25µm) and 0.77 water ice (67±31µm).
- Intimate mixtures of 0.05 pyrrhotite (25-50µm) and 0.95water ice (67±31µm).
- Intimate mixtures of 0.25 pyrrhotite (25-50µm) and 0.75 water ice (67±31µm).
- Intimate mixtures of 0.5 pyrrhotite (25-50µm) and 0.5 water ice (67±31µm).
- Intraparticle mixtures of water ice with embedded 0.01 and 0.02 fine-grained kerite, respectively.
- Intraparticle mixtures of water ice with fine-grained pyrrhotite inclusions: 0.005 and 0.05 embedded pyrrhotite, respectively.
- Intimate mixtures of 0.05 pyrrhotite and 0.95 water ice with 0.01 fine-grained pyrrhotite inclusions.
- Intimate mixtures of 0.2 pyrrhotite and 0.8 water ice with 0.01 fine-grained pyrrhotite inclusions.
- Intimate mixtures of 0.5 pyrrhotite (<25µm) and 0.5 kerite (25-50µm)
- Intimate mixtures of 0.66 pyrrhotite (<25µm) and 0.33 kerite (25-50µm)
- Ternary intimate mixture of: 0.40 pyrrhotite (<25µm) + 0.2 kerite (25-50µm) + 0.4 water ice particles (67±31 µm)
- Ternary intimate mixture of: 0.40 pyrrhotite (<25µm) + 0.4 kerite (25-50µm) + 0.2 water ice particles (67±31 µm)
- Spectra of pure refractory separates: kerite (45-63µm), kerite (<25µm), pyrrhotite (25-50µm), pyrrhotite (<25µm)

Please include:

- Publications arising/planned (include conference abstracts etc): at least 1 paper to be published in Icarus or similar journal in 2019 and 1 conference abstract.

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