EPN2020-RI

EUROPLANET2020 Research Infrastructure

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Deliverable 1.19
5th call for the TA facilities

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Responsible WP Leader: OU/European Science Foundation, Nicolas Walter

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Dissemination level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Service)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (excluding the Commission Services)	

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Author (s)	Europlanet Coordination Team

Abstract: This deliverable provides the fifth Transnational Access call information as provided to the community on the EPN2020-RI website.

It is complemented by information on the Planetary Field Analogue Sites TA1-The Distributed Planetary Simulation Facility; TA2 and the Distributed Sample Analysis Facility TA3

EUROPLANET TA CALL #5 – CALL TEXT

The fifth Call opens on: **28 September 2018**
Call closes on: **26 October 2018, at 14.00 (2pm) CEST (Brussels, Paris time)**

1. Timeline:

Application to the fifth call should be filled in using the template available on the call page: http://www.esf.org/newsroom/news-and-press-releases/article/europlanet-ta-fifth-call/ and submitted by **Friday, 26 October 2018** at **14:00 (2pm) CEST (Brussels, Paris time).**

2. Background – The Europlanet 2020 RI programme and the TA call

The Europlanet 2020 Research Infrastructure (http://www.europlanet-2020-ri.eu) is a major programme funded under Horizon 2020 to support the research activities of the European planetary science community and particularly to foster collaboration.

A central part of the programme is to allow any European researcher interested in pursuing planetary science research access to a comprehensive set of laboratory facilities and field sites tailored to the needs of planetary research.

Access is provided by a **Transnational Access (TA)** programme which supports travel and local accommodation costs of European researchers (and of researchers from Third Countries under certain conditions), at the facility for an approved period of time to conduct their own research programme. Applications are made to annual calls and are subject to peer review. It should be noted that applicants must apply to use facilities outside the country in which they are employed (i.e. it is a transnational access). Applications can be made for analytical time or access to planetary analogue sites ranging from single days up to several weeks and up to two researchers can be fully financed in each research visit.

Europlanet2020 RI is designed to support planetary science but applications in other research disciplines are also considered based on innovation and potential scientific and technological impact to the planetary sciences field.

Europlanet invites application for Transnational Access through the three themes (detailed list of sites and facilities as well as contact details are provided in Annex 1).

TA1 - Planetary Field Analogues (PFA)
This theme offers access to five well-characterised terrestrial field sites that have been selected so as to provide the most realistic analogues of surfaces of Mars, Europa and Titan, to which planetary missions have either recently been directed or are planned. Access is provided for scientists to perform high quality scientific research and test instrumentation for space missions under realistic planetary conditions and undertake comparative planetology research.

Details on the analogue sites are available on Europlanet-RI website: http://www.europlanet-2020-ri.eu/research-infrastructure/field-and-lab-visits/ta1-planetary-field-analogue-sites-pfa

TA2 - Distributed Planetary Simulation Facility (DPSF)
This theme provides access to a set of laboratory facilities that are able to recreate and simulate the conditions found in the atmospheres and on the surfaces of planetary systems with special attention to Martian, Titan and Europa analogues. The TA also includes the possibility to characterise the

texture and mineral composition of samples in unprecedented detail as well as the ability to detect and characterise life, including Next Generation Sequencing.

Details on the distributed Planetary Simulation Facilities are available on Europlanet-RI website: http://www.europlanet-2020-ri.eu/research-infrastructure/field-and-lab-visits/ta2-distributed-planetary-simulation-facility-dpsf

TA3 - Distributed Sample Analysis Facility (DSAF)

This theme combines the resources of four of the world's leading analytical laboratories to analyse meteoritic and sample returns with un-paralleled precision, offering possibility to apply a wide variety of stable and radiogenic isotopic systems.

Details on the Distributed Sample Analysis Facilities are available on Europlanet-RI website: http://www.europlanet-2020-ri.eu/research-infrastructure/field-and-lab-visits/ta3-distributed-sample-analysis-facility-dsaf

3. Rules for participation

Maximum number of applicants funded per project

The expenses of **up to two** researchers will be covered per access visit. Upon agreement with the host facility, additional researchers will be allowed to visit the facility but will not have their expenses paid.

Additional funding from other sources (COST actions for example) can be used to specifically extend the duration of a TA visit or to arrange a follow up visit for data interpretation and preparation of a publication with the agreement of facility.

Maximum number of grants per applicant

It is recommended that separate applications are made so that sample characterisation and the results from an initial visit are fully evaluated before any follow up work. Sequential applications are encouraged; for example, a field visit followed by analyses elsewhere. However, during the life span of the EuroPlanet project, **applicants will not be supported more than four times**.

Projects duration

Typical unit of access is:

- For TA1 the unit of access is **one week** (five working days) with this being the maximum;
- For TA2 and TA3 the unit of access is **a day** with typical visits lasting up to **five working days maximum**.

Funding principles

Finances to cover TA visits are limited, so applicants are expected to make efficient use of the funds by using economy travel and hotels suggested by the host institution. Living expenses will depend upon the host city.
The eligible expenses covered by the call are:

- Travel (economy class)
- Accommodation (up to 100 Euros/night)
- Contribution to living expenses (up to 50 Euros/day)

Travel tickets and accommodation costs will only be reimbursed on production of receipts and the final visit report. Generally, accommodation will be arranged by the host facility and, in exceptional

circumstances, travel tickets can be booked by the host facility. Expenses will be transferred to the applicant's bank account on production of receipts and the final visit report.

4. Eligibility Criteria

To be eligible and considered

- Application should be submitted by **26 October 2018 at 14.00 (2pm) CEST (Brussels, Paris time**).
- Applications should be written in English, using font Arial, minimum font size 11.
  Application should be filled in using the template available on the call and submission page: http://www.esf.org/newsroom/news-and-press-releases/article/europlanet-ta-fifth-call/
- The core of the application (all parts provided and uploaded as pdf document) should respect the page limit (3 pages maximum all included, i.e. figures, tables, charts, etc.). All page limits indicated in the template are mandatory.
- The Project Leader of the application should work for an organisation based in an EU Member State or an H2O2O affiliated country.[1]
- None of the Project Leader and co-applicant(s) should apply for a facility/site located in the country in which they are employed.[1]
- The core of the application (all parts provided and uploaded as pdf document) are anonymous and therefore should not contain any information (name of the Project Leader and co-applicant, affiliation, etc.) allowing to identify the applicant(s).
- The Project Leader and co-applicant(s) should be researchers actually participating into the visit (i.e. application on behalf of another person is not allowed).
- Maximum one application per applicant per each TA is allowed for each call.

Proposals not respecting any of the points above will be considered ineligible and will not undergo scientific assessment.

5. Technical feasibility

All applications submitted will be addressed to the designated operators of the sites, laboratories and facilities who will check and validate the **technical feasibility** of the investigations proposed.

The technical feasibility validation process is not a scientific assessment, it will not consider the application from a scientific point of view, but rather from an operational and technical implementation perspective.

In the event of an application being considered not to be feasible, it will not be assessed further, and the applicant will be informed of the outcome of the validation process and why his/her application has failed.

Proposals deemed not feasible will not undergo scientific assessment.

6. Evaluation process

All document will be treated confidentially – no information will be circulated outside the assessment process.

[1] http://www.europlanet-2020-ri.eu/research-infrastructure/field-and-lab-visits/frequently-asked-questions

The scientific evaluation process will be anonymous. All applications will be assessed by a disciplinary panel set up by the European Science Foundation. Review panels will be constituted to reflect the scientific profile of all application submitted. Review panel will assess applications submitted to the three TAs falling in their domain.

All applications will be made available to review panel members before review panels convene and each application will be assessed in detail by two review panel members (rapporteurs) before the review panel meeting.

During the review panel meeting (by teleconference), all applications will be presented in detail by the rapporteurs and discussed by the full review panel. Review panel will agree on an overall mark for each application and produce one ranked list per TA. These lists will then be integrated into three ranked lists across all themes (one per TA).

7. Evaluation Criteria

Each proposal will be assessed on four criteria:

- **Criterion 1 - Innovative nature of the proposal** (originality of the research proposed and/or of the methodology to be applied);
- **Criterion 2 - Science and Technology excellence** (Overall scientific or technical merit of the proposal, soundness of concept, and quality of the objectives;
- **Criterion 3 - Implementation** (The quality, effectiveness and feasibility of the methodology and associated work, relevance of the facility/site, strategy for utilisation and publication of the new data);
- **Criterion 4 - Scientific impact** (How the objectives and expected results contribute to advancing the state of the art; relevance of the project to the European and/or international planetary scientific community and/or past or future missions and/or industry and other research disciplines).

Each criterion will be rated on a 0 to 5 scale with an equal weight (total score on 20). The table below provides a guideline illustrating the value and meaning of individual marks.

Numeric score	Corresponding wording	Definition
5	Excellent	The application successfully addresses all relevant aspects of the criterion in question. Any shortcomings are minor.
4	Very good	The application addresses the criterion very well, although certain improvements are still possible.
3	Good	The application addresses the criterion well, although improvements would be necessary.
2	Fair	While the application broadly addresses the criterion, there are significant weaknesses.
1	Poor	The criterion is addressed in an inadequate manner, or

		there are serious inherent weaknesses.
0	-	The application fails to address the criterion under examination or cannot be judged due to missing or incomplete information.

8. Europlanet Policy - Reporting requirements

Successful applicants are required to prepare a short (approx. 2 pages A4) report on their visit and findings. This report should also include plans of how they will disseminate their findings to the planetary science community and to actively engage with the impact and outreach work packages within Europlanet2020-RI to reach the general public. Moreover, the successful applicants are expected to present their results at a future European Planetary Science Congress. Data obtained from facilities operating within Europlanet2020 RI will be stored at the host institution.

These data will be made open access a year after the agreed completion of the research visit, with the exception of commercially sensitive information.

In case of conflicting information found outside the call document, this call document prevails.

ANNEX 1

Transnational Access (TA) programme themes

The programme is arranged in three themes:

TA1. Planetary Field Analogues (PFA) offers access to 5 well-characterized terrestrial field sites that have been selected so as to provide the most realistic analogues of surfaces of Mars, Europa and Titan, to which planetary missions have either recently been directed or are planned. Access is provided for scientists to perform high quality scientific research and test instrumentation for space missions under realistic planetary conditions and undertake comparative planetology research. The PFA are:

1. Rio Tinto Field Site, Spain
   http://www.isa.au.dk/networks/euroPlanet/facilities/tna1/rioTinto.html
2. Ibn Battuta Centre, Morocco http://www.ibnbattutacentre.org/the-centre.html
3. The glacial and volcanically active areas of Iceland, Iceland
4. Danakil Depression, Ethiopia
   https://auditore.cab.inta-csic.es/europlanet/2015/10/16/ta1-earth-analogues/
5. Tírez Lake, Spain
   https://auditore.cab.inta-csic.es/europlanet/2015/10/16/ta1-earth-analogues/

TA2. Distributed Planetary Simulation Facility (DPSF) provides access to a set of laboratory facilities that are able to recreate and simulate the conditions found in the atmospheres and on the surfaces of planetary systems with special attention to Martian, Titan and Europa analogues. The TA also includes the possibility to characterise the texture and mineral composition of samples in unprecedented detail as well as the ability to detect and characterise life, including Next Generation Sequencing. The DPSF are:

1. Planetary Emissivity Laboratory, Germany
2. *Planetary Environment Facilities at Aarhus University, Denmark (**NOT AVAILABLE for 5th call**)*
3. Open University Mars Chamber, UK
4. High-pressure laboratory at VUA, NL
5. Cold Surfaces spectroscopy, Institut de Planétologie et Astrophysique de Grenoble (IPAG), France
6. Center for microbial life detection at Medical University Graz, Austria
7. Petrology-Mineralogy Characterisation Facility (PMCF), Mineral and Planetary Sciences Division, Natural History Museum, London, UK

TA3. Distributed Sample Analysis Facility (DSAF) combines the resources of four of the world's leading analytical laboratories to analyse meteoritic and sample returns with un-paralleled precision, offering possibility to apply a wide variety of stable and radiogenic isotopic systems. The DSAF are:

1. Radiogenic and non-traditional stable isotope facility: Geology and geochemistry, Faculty of Earth and Life Sciences, VU University, Amsterdam, NL
2. Radiogenic, non-traditional stable & rare gas isotopes. Le Centre de Recherches Pétrographiques et Géochimiques (CRPG), Nancy, France
3. Stable Isotope Analytical Facilities - The Open University, UK
4. NanoSIMS 50L Secondary Ion Mass Spectrometer - The Open University, UK
5. Radiogenic & non-traditional stable isotopes: Institute for Planetology (IfP); University of Münster, Münster, Germany

Full details of all the capabilities of the locations and nature of the facilities of each of the TA's can be found using the links to each TA.

TA1: Planetary Field Analogue Sites (PFA)

Planetary Field Analogues (PFA) offer access to 5 well-characterised terrestrial field sites that have been selected so as to provide the most realistic analogues of surfaces of Mars, Europa and Titan, to which planetary missions have either recently been directed or are planned. Access is provided for scientists to perform high quality scientific research and test instrumentation for space missions under realistic planetary conditions and undertake comparative planetology research.

The five PFA sites are:

Rio Tinto Field Site, Spain. Managed by INTA-CAB. Contact Felipe Gómez

Rio Tinto

Ibn Battuta Centre, Morocco. Managed by International Research School of Planetary Sciences; IRSPS. Contact Gian Gabriele Ori Gian Gabriele Ori

Ibn Battuta

The glacial and volcanically active areas of Iceland, Iceland. Managed by Matis. Contact Viggó Þór Marteinsson. Matis has an extensive track record of managing field related research on Iceland, particularly with respect to surveys of life in young and extreme geological environments. They aim to provide the infrastructure to facilitate access to the glacial and sub-glacial environments, and young volcanic areas and active hydrothermal systems. Some examples of the research that the Icelandic PFA site is especially suitable for include:

- Field testing of equipment and methodologies that are supposed to be employed in future Mars Missions, e.g. sampling of putative biological specimens and tracers, remote-controlled vehicles, sensors and analytical instruments, etc.
- Physical, chemical and biological analyses and sampling in extreme, Mars-analog environments to understand the capabilities and limits of microorganisms to exist under these conditions (e.g. extreme heat & cold, inside and on volcanic surfaces or hot springs, etc.)
- Research into geological and geo-chemical interaction between rocks and microorganisms and how this might influence biosignatures/-markers on other planetary bodies."

Drilling to sample the Skaftarkatlalon sub-glacial lake.

Source of the Morilla sub glacial river.

Danakil Depression, Ethiopia (available from early 2017). Stretches from the Dallol Volcano to Lake Assal. The plain is one of the most impressive depressions in the Afar and one of the most inhospitable areas on Earth. A large number of extreme environments form an intricate complex geological and biological setting comprising volcanoes, hydrothermal systems, slat flats and deposits, and extreme microbial communities. Volcanic activity started more than 5 million years ago and continues today in the form of hydrothermal vents and the active Erta Ale volcano. Further research is planned by IRSPS to fully characterize the region (geological and hydrological maps and a reconnaissance study of the biota). The field site will be managed by Professor Ori (IRSPS) who works closely with Professor Mirtus Hagos of the University of Mekele and Barbara Cavalazzi University of Bologna.

Small pond at the margin of a hydrothermal system depositing a variety of sulphates and iron oxides.

Tírez Lake, Spain (*available from early 2017*). It has been proposed to have hydrogeochemistry and geochemical features comparable Europa's ocean, a satellite of the Jupiter system. Tírez waters comprise Mg-Na-SO_4-Cl brines with epsomite, hexahydrite and halite as end mineral members. Frozen Tírez brines are comparable to Galileo spectral data obtained from Europa. Calorimetric measurements have constrained the pathways and phase metastability for magnesium sulfate and sodium chloride crystallization from these waters, which may aid in understanding the processes involved in the formation of Europa's icy crust.
The lake undergoes major seasonal changes, but life is prolific in this hyper-saline environment. Tirez contains two different microbial domains: a photosynthetically sustained community represented by planktonic/benthonic forms and microbial mats, and a subsurficial anaerobic realm in which chemolithotrophy predominates. Further research is planned by INTA-CAB Madrid to fully characterize the region so that it becomes a site available for access in the second part of the research infrastructure. For examples, on-going work is examining how the halophiles tolerate the extreme environmental stress and, in some cases, protect themselves against some damaging radiation using salt minerals. Dr Felipe Gomez is the contact person in relation to this planetary field analogue site.

TA2: The Distributed Planetary Simulation Facility (DPSF)

Distributed Planetary Simulation Facility (DPSF) provides access to a set of laboratory facilities that are able to recreate and simulate the conditions found in the atmospheres and on the surfaces of planetary systems with special attention to Martian, Titan and Europa analogues. TA2 also includes the possibility to characterise the texture and mineral composition of samples in unprecedented detail as well as the ability to detect and characterise life, including Next Generation Sequencing. The seven DPSF are:

Planetary Emissivity Laboratory (DLR, Berlin) is the only spectroscopic infrastructure worldwide that offers the opportunity to measure emissivity of fine-grained powder materials, bulk materials and coatings at temperatures up to 1000°C across the whole infrared wavelength range. PEL is currently supporting a wide range of planetary missions including ESA MarsExpress, VenusExpress and Rosetta, NASA MESSENGER, JAXA Hayabusa II. PEL also is highly utilised by industrial customers working for example on rapid prototyping or spacecraft isolation materials. PEL also can provide transmittance and reflectance measurements for the visible to the far-infrared spectral range. Contact person: Jorn Helbert

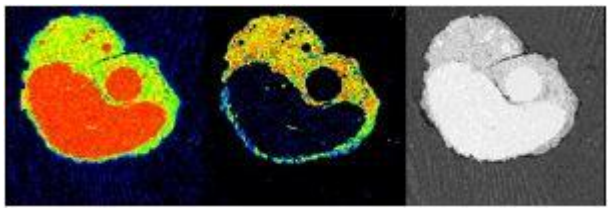
Planetary Environment Facilities at Aarhus University [Not available in Call 5] operates a unique experimental facility capable of re-creating the conditions found on other planets or extreme terrestrial environments. This facility is used for collaborative research by both the scientific and industrial communities, including space agencies (ESA, NASA). Specifically the facility is capable of recreating the key physical parameters such as temperature, pressure (composition), wind flow and importantly the suspension/transport of dust or sand particulates. It supports a broad range of research topics including Planetology, Volcanology, Meteorology and the study of Aerosols. Laser based optoelectronic instrumentation is used to quantify and monitor flow and particle suspension. For more information regarding access contact: Jon Merrison

Green laser being used to monitor particle flow inside the chamber, b with Jon Merrison for scale

Open University Mars Chamber is capable of recreating the Martian surface environment (-70°C to +20°C, 6 mbar CO_2/N_2 atmosphere over a regolith) with illumination. The key characteristic of this chamber is its large size (0.9 m diameter and 1.8 m in length) allowing use for large scale simulation of the Martian surface (aeolian transport etc) or testing large instruments/structures (e.g. rover mechanisms, traction etc). The chamber provides full control of temperature (to -70°C) with associated thermal data logging, as well as control and logging of pressure and high definition video recording. There is an array of data/power feedthroughs, as well as horizontal and vertical mechanical feedthroughs permitting linear manipulation of samples inside the chamber whilst under Martian conditions. Contact person: Manish Patel

High-pressure laboratory at VUA
The high-pressure, high-temperature laboratory at VU University Amsterdam is dedicated to studies of the chemical and physical properties of the minerals, magma, and fluids that rocky planets and moons are made of. The laboratory holds two piston cylinder presses, capable of generating pressures between 0.4 and 3.5 gigapascals and temperatures up to 1873 K, one multi-anvil press, capable of generating pressures between 3 and 20 gigapascals and temperatures exceeding 2000 K, and a 1 atmosphere gas mixing furnace to prepare starting materials at either highly reducing or oxidising conditions as encountered in the interiors of the Earth, Moon, Mercury and Mars. Experiments take between a couple of minutes and one week depending on the specific research topic. The laboratory also has a full set of in-house starting material and run product preparation facilities.
For more information of the facility see http://www.falw.vu/~wvwest/lab.html, or contact Wim van Westrenen with specific questions about experimental techniques and access.

Piston cylinder press



Element distribution maps within an experimental charge

Cold Surfaces spectroscopy, Institut de Planétologie et Astrophysique de Grenoble (IPAG) Grenoble, France:
The facility houses a unique home-made Spectro-Gonio Radiometer (This link will take you to an external web site. We are not responsible for their content.) that allows measurement of the bidirectional reflectance spectra and photometric distribution functions of various types of planetary materials (granular to compact) over almost the whole solar spectrum, from the visible to the near-IR (from 0.4 to 4.8 µm), with a high degree of radiometric accuracy (better than +/-0.5%) under most viewing geometries (illumination and observation up to almost 80°, all azimuths, phase angle > 4-10°). The instrument is fully described in Brissaud et al. 2004, Appl. Optics, 43, 1926-1937. The instrument is located in a dark cold room that can be cooled down to -20°C. It is fully automatized and the data calibration and reduction are made with homemade software.
Different types of measurements can be programmed with different environmental cryogenic cells:

-simple reflectance spectra at one geometry (possibly varying with time, temperature, or physical/chemical process),

-full BRDF,

-limited angle BRDF spectra (SERAC and CarboN-IR cells),

-or all these but only at selected wavelengths.

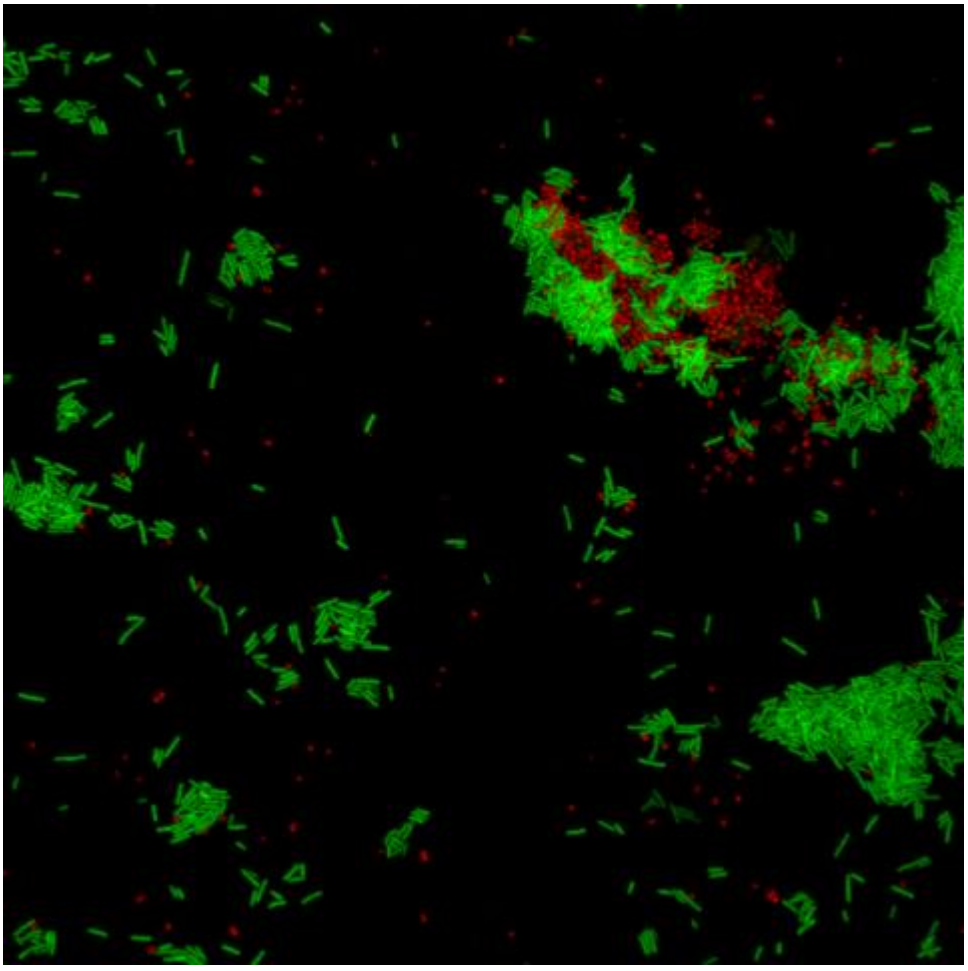
Serac cell and its thermodynamic system

A new spectro-gonio radiometer is under development to include Near-IR channel + calibration and optimized for the measurement, at low temperature, of bidirectional reflectance spectra, over the visible and near-IR (~ 0.3 to 5 µm), of very small dark and/or very fine grained samples (organics, meteorites, minerals) down to about 1 mm3 in volume.
For further information contact: Bernard Schmitt

Spectro-Gonio Radiometer with its stabilized monochromatic source, the goniometer with illumination mirror, an open sample holder with sulfur powder and the detectors and the goniometer and detection electronics.

CarboN-IR environmental cell inside the goniometer

Center for microbial life detection at Medical University Graz, Austria
ZMF - Center for Medical Research
The “center for life detection” will provide expertise in detection of microbial signatures, analysis thereof and microbial cultivation. The involved members have large experience with microbial detection and quantification in samples from extreme environments and the growth of microbial specialists in (pure) cultures (e.g. anaerobes). Specifically we offer:
• Life detection in environmental and appropriate clinical samples (support in DNA extraction, selection of appropriate primers for bacteria, archaea and fungi, polymerase chain reaction (PCR), if desired in combination with propidium monoazide staining (detection of intact cells only), amplicon-sequencing and diversity data analysis, quantification of bacteria, archaea and fungi. If needed, -OMICS technologies can be applied.
• For the life detection workflow e.g. Next Generation Sequencing (Illumina MiSeq) for nucleic acid characterization, Gas Chromatography - Mass Spectrometry (GC-MS) for short fatty acids determination or scanning electron microscope SEM ZEISS DSM 950 for ultrastructure analysis.
• Detection of microbial cells: Domain to genus-specific fluorescence in situ hybridization, probe design and selection, visualization using confocal laser scanning microscopy (CLSM).
• Cultivation of specific microbial specialists, such as anaerobes or oligotrophs for use in laboratory experiments at the host’s institution.
• Support in data analysis includes graphical display of e.g. microbial diversity and interpretation of results with respect to the metabolic capabilities of the microbiome and the possible impact on the habitat.



Visualization of microorganisms

All services will be offered to international users and all ZMF Core Facilities are open to all researchers without

restrictions. The ZMF and IMRG staff will support users with protocol development, hand-on training and analyses.

Moissl-Eichinger team members

For further information contact: Prof. Christine Moissl-Eichinger, Department of Internal Medicine

Petrology-Mineralogy Characterisation Facility (PMCF), Mineral and Planetary Sciences Division, Natural History Museum, London, UK.

Imaging and Analysis Centre

The MPSD will provide access to their world leading sample characterization instrumentation and methodologies. The facility focuses on micro-computed tomography (µ-CT) and X-ray diffractometry (XRD). Micro-CT capabilities produce 3D reproductions of geological materials with a size of between 3–250 mm with a resolution of 3–5 µm (on the smallest samples) and can use X-rays to visualise the internal structure of specimens in the XUM in 2D and 3D (Fig 1). MPSD are specialists in XRD analysis of extraterrestrial samples and have developed a micro-XRD to enable spatially resolved analysis of fine-grained materials. 4 powder diffraction instruments are available: XRD with very large 120º position-sensitive detector, XRD with GeniX high flux X-ray source (µXRD), high-resolution PANalytical X'Pert Pro α1 XRD and Rigaku D/MAX-RAPID II XRD.

The CT and XRD facility is supported by unrivalled imaging capabilities that include Field Emission SEM (two systems available) (Fig 2); Zeiss Ultra+ scanning electron microscope for high resolution secondary and backscatter electron imaging (1nm resolution at 3-5kV in-lens SE); FEI Quanta 650 ESEM FEG high resolution variable pressure SEM equipped with state of the art Bruker flat Quad EDX detector capable of high speed data acquisition including unique ability to analyse highly topographic samples in an uncoated state and at low kV (<10kV). Cameca SX100 Electron Microprobe and Zeiss EVO SEM set up specifically for quantitative electron beam microanalysis with EDX, WDX and CL capabilities in VP and high vacuum.

The NHM also provides state of the art Laser Ablation-ICP-MS, as well as solutions ICP-MS, ICP-AES and Ion Chromatography. These equipment are housed in purpose-built laboratories, with a staff complement of 12 full-time scientists. For further information contact Prof. Sara Russell and her team.

TA3: Distributed Sample Analysis Facility (DSAF)

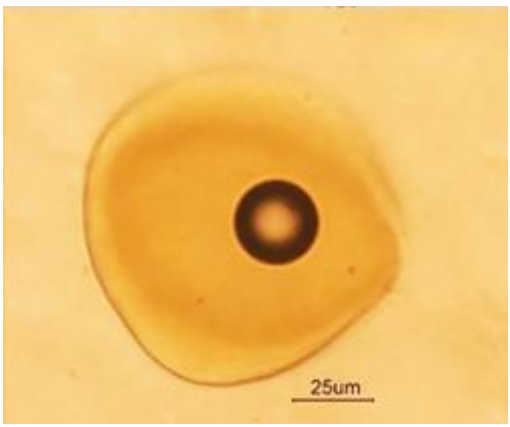
Distributed Sample Analysis Facility (DSAF) combines the resources of four of the world's leading analytical laboratories to analyse meteoritic and sample returns with un-paralleled precision, offering possibility to apply a wide variety of stable and radiogenic isotopic systems. This theme includes the three laboratories that were highly in demand in Europlanet RI; CNRS-CRPG; VU Amsterdam and Open University. A major new addition is the Laboratory for Isotope Geochemistry and Cosmochemistry at the Institute for Planetology, Münster. This is the only German facility solely dedicated to the analysis to extra-terrestrial samples and represents a major expansion in the capabilities in Cosmochemistry to DSAF. The DSAF are:

Radiogenic and non-traditional stable isotope facility: Geology and geochemistry, Faculty of Earth and Life Sciences, VU University, Amsterdam, NL:

The facility is based around three multi-collector (MC) mass spectrometers (MS), FinniganMat 262 RPQ plus, ThermoFinnigan Triton*Plus* & MC-ICPMS (Neptune) plus ancillary geochemical support (sample characterisation, mineral separation, sample preparation, fluid inclusion heating-freezing stages, Raman microscope, scanning electron microscope, electron microprobe and dedicated clean labs for elemental separation etc). The facility is supported by a dedicated chemist and electronic and vacuum engineers. “Routine” analytical approaches include Sr-Nd-Pb-Hf-Si-Fe-Li-B isotope analyses and laser ablation Hf isotope determinations in minor phases such as zircon and high precision isotopic analyses of the extinct system ^{146}Sm-^{142}Nd. 10^{13} Ohm resistors on the Triton has established the potential to analyse as little as 10 pg of Sr-Nd-Pb, opening up totally new research directions [Koornneef et al. 2014]; e.g., individual melt inclusions in olivine and dust from Antarctic ice cores. The Triton has 6 ion counters enabling multi-detector ion counting determination of small beams; e.g., Os, U-Series. Much of the ground breaking research relies on detailed sample characterisation and innovative sampling methodologies; e.g., micro- drilling, polishing for fluid-melt inclusion characterisation and the ability to use *in situ* laser ablation to sample onto a Teflon filter for subsequent conventional Pb-Sr-Nd isotope analysis. Additional capabilities include undertaking HP-HT experimental petrology experiments (TA2) coupled with isotope geochemistry. Additional on-going research focuses on planetary differentiation processes, early Earth environments, magma chamber processes and the application of isotope geochemistry in archaeology-art-forensic-ecology etc.

For further details contact Professor Gareth Davies

Koornneef JM, Bouman C, Schwieters JB, Davies GR (2014). Measurement of small ion beams by thermal ionisation mass spectrometry using new 10^{13} Ohm resistors. Analytica Chimica Acta, 819, 49-55.



Homogenised melt inclusion with CO2-rich bubble

Triton plus at VU including 3 SEMs and 3 CDDs

Radiogenic, non-traditional stable & rare gas isotopes. Le Centre de Recherches Pétrographiques et Géochimiques (CRPG), Nancy, France:

The CRPG is a joint facility of the Centre National de la Recherche Scientifique and University of Lorraine comprising ~100 people (including support staff and students) working in the field of Earth and Planetary Science. It hosts two national analytical facilities, the Service for the Analysis of Rocks and Minerals (Service d'Analyse des Roches et des Minéraux - SARM -) and the ion probe facility. Research undertaken at the CRPG includes the origin of matter in the Solar System, processes and timing of planetary formation, environments of early Earth, biogeochemical cycles: fluxes and compositions of the ocean and atmosphere as well as coupling between tectonic, topography, erosion and climate. CRPG is a NASA host laboratory for lunar samples and has worked on material from all return missions (Apollo, Luna, Genesis, Stardust, Hayabusa) playing a leading role noble gases and volatile element analysis. The CRPG is one of the few laboratories worldwide to analyse nitrogen isotopes in igneous rocks and helium for dating surfaces with cosmic ray-produced 3He.

Ion probe facility (Cameca ims 1270-MC and Cameca ims 1280). - The Cameca 1270 Ion microprobe is a CNRS-INSU national facility, upgraded in 2014 to match the capabilities of the recently installed ims 1280. Routine analyses include U-Pb dating on zircon, monazite or pitchblende, C, O, Si isotope ratios and light and trace elements contents of different matrixes. A notable speciality is the measurement, at high precision, of the isotopic ratios of light elements (H, Li, N, Mg, S) including mass independent fractionation of sulphur isotopes.

Helium and Nitrogen isotope facility. (1 VG 5400, 1 VG 603, 2 Helix SFT, 1 Helix MC and 1 GV Noble). -Helium isotopes determined on meteorites and ET return samples, for surface exposure dating with cosmogenic 3He using the latest He isotope mass spectrometer, the GV Helix SFT, the first instrument of its kind installed in Europe. Analysis of nitrogen at the nanomol level in rocks, minerals and ET return samples is used to fingerprint volatiles and reconstruct magma degassing.

Stables Isotopes: ThermoFinnigan Neptune Plus MC-ICPMS, ThermoFisher MAT253 and GV Isoprime provide the capability for C, O, S, H isotope analyses of rocks, minerals, organic matter and fluids (water, natural gases) by

continuous flow mass spectrometry coupled with elemental analyser or off line extraction and "novel" stable isotopes by sector field ICP-MS (Neptune+). This includes O isotopes on silicates by fluorination and H, C & O on fluids from single inclusions. The determination of high precision Mg, Ca, Fe and Ge isotopes is offered and this is something only available in a handful of labs in the world.

Radiogenic Isotopes determined by TIMS (FinniganMat 262 & ThermoFinnigan Triton) include Os isotopes and the extinct system 146Sm-142Nd (only developed in a handful of labs worldwide) and Sr-Nd-Pb isotopes that are the “traditional” isotopic systems in meteorite, lunar and terrestrial rock studies.

For further details contact Professor Albert Galy

The front end (where solid samples, including polished rock sections are located) of the latest Cameca ims 1280-HR installed at CRPG.

NanoSims and Stable Isotope Analytical Facilities. The Open University, Milton Keynes, United Kingdom:

The Planetary and Space Sciences (PSS) facilities are hosted by CEPSAR (Centre for Earth, Planetary, Space and Astronomical Research). All research laboratories are underpinned by high-quality supporting laboratories and dedicated technical staff.

The main strength of the analytical facilities in PSS is the determination of light element stable isotopic composition using a variety of world-class analytical tools. The isotope labs are supported by a suite of analytical tools (e.g. analytical FIB-SEM, Raman, FTIR, etc) for the characterization of samples and all necessary support labs (chemistry labs, sample prep labs, clean rooms, etc). Additional analytical tools may be available within the Faculty as required (e.g. electron microprobe, ICPMS, FEG-SEM, TEM, etc).

NanoSIMS 50L: is the latest generation of Secondary Ion Mass Spectrometer (Ion Microprobe) instrumentation, allowing high sensitivity compositional analyses of up to 7 species (elements, molecules or isotopes) simultaneously at anominal spatial resolution of down 50 nm, and with high mass resolution. The instrument has two primary ion beam sources (oxygen and cesium), a secondary electron imaging system, 7 adjustable electron multipliers for high sensitivity (ppb level) 3 of which can be swapped for Faraday Cups for high abundance multi-collection measurements.

The instrument is capable of per mil precision stable isotope ratio measurements on few micron spots as well as high resolution isotope ratio and element mapping.

For further information contact Dr Ian Franchi

Stable Isotope Facilities: Two different systems are available, both based around Thermo MAT 253 mass spectrometers. The first system offers high precision oxygen three isotope measurements of silicates and other minerals using a laser fluorination system. This is capable of measuring ^{17}O excesses with a precision of ≈±10ppm on samples of ≈1mg. The second system is a compound specific isotope ratio mass spectrometer system – capable of performing ≈0.1‰ precision measurements of $^{13}C/^{12}C$ and $^{15}N/^{14}N$ on nanomole quantities of individual compounds within a complex mixture (as well as per mil precision measurements for D/H). This instrument is supported by a suite of chemistry labs for sample preparation and a range of GC and GC-MS systems for sample characterization and optimization of analytical conditions.

For further information contact Professor Iain Gilmour

Radiogenic & non-traditional stable isotopes: Institute for Planetology (IfP); University of Münster, Münster, Germany:

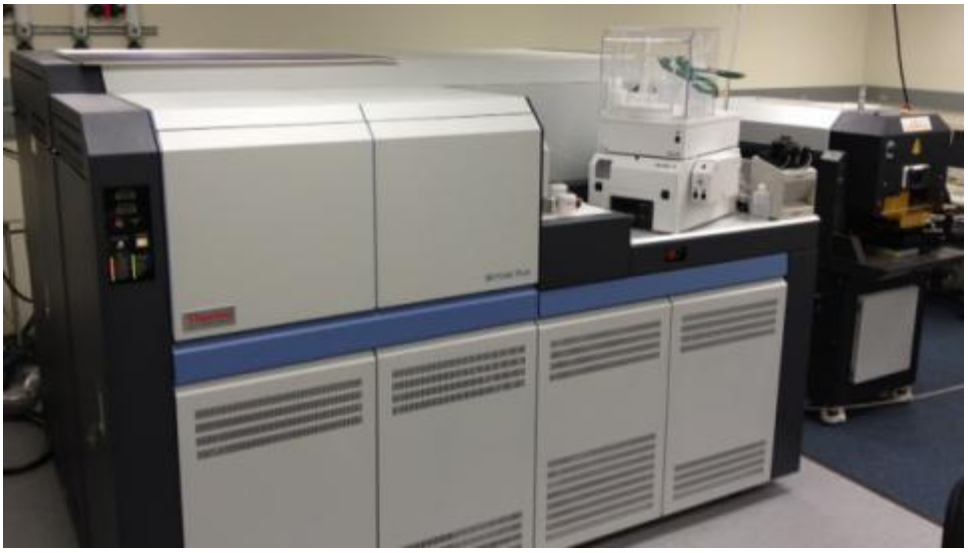
The Analytical Planetology Group of IfP, led by Thorsten Kleine, explores the origin and evolution of planets in the solar system by investigating the petrology, chemical and isotopic composition of meteorites and lunar, Martian and terrestrial samples. We use a wide range of research methods, including fieldwork, chemical microanalyses and isotopic techniques. Furthermore, with more than 3500 different meteorite samples the IfP hosts one of the largest meteorite collections worldwide.

Isotope Geochemistry and Cosmochemistry research utilises small variations in the isotopic compositions to address four main areas of research:

- Chronology of the early Solar System
- Accretion and differentiation of asteroids and terrestrial planets
- Origin and nature of the building blocks of the planets
- Late accretion and the origin of volatiles in the terrestrial planets

The specific facilities comprise ultra-clean laboratory for the preparation of extraterrestrial (ET) samples, a Neptune*Plus* MC-ICPMS, and access to sample preparation laboratories (digestion lab, mineral separation, heavy liquids) and geochemical support (ICP-MS, SEM, EMP). To minimize any risk of terrestrial contamination laminar flow hoods are exclusively used for the preparation of ET materials. The IfP laboratory routinely offers the following techniques: Short-lived isotopes: Hf-W, Pd-Ag, Mn-Cr; long- lived isotopes: Lu-Hf, Sm-Nd, Re-Os; stable isotopes (double spike): Cr, Ge, Mo, Ru, W; mass-independent isotope anomalies: Cr, Ti, Mo, Ru, Pt; highly siderophile element concentrations by isotope dilution.

For further information contact Professor Thorsten Kleine



NeptunePlus