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3rd call for the TA3 Facilities

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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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Abstract:

This deliverable provides the additional details on Transnational Access to Distributed Sample Analysis Facility provided by EPN2020-RI through the TA3 call.

It complements D1.7 that provides detailed call information.

TA3: Distributed Sample Analysis Facility (DSAF)

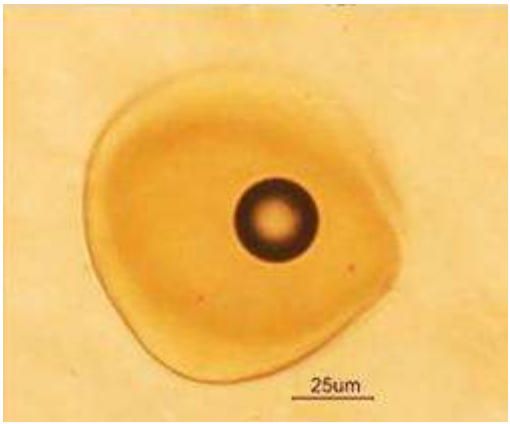
Distributed Sample Analysis Facility (DSAF) combines the resources of four of the world's leading analytical laboratories to analyse meteoritic and sample returns with un-paralleled precision, offering possibility to apply a wide variety of stable and radiogenic isotopic systems. This theme includes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