

## THE SAMPLE ANALYSIS LABORATORY (SAL) AT DLR: MINERALOGICAL AND GEOCHEMICAL ANALYSES OF PLANETARY MATERIALS

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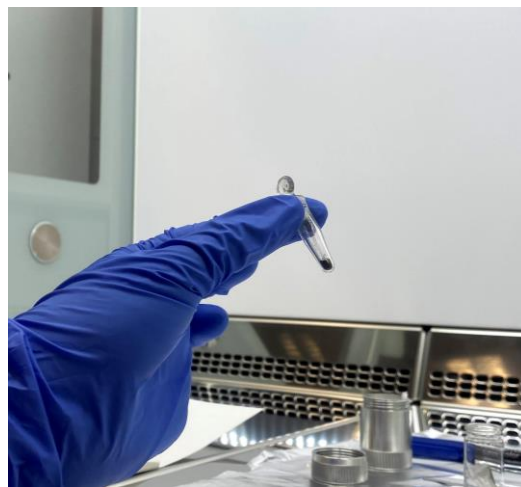
**Introduction:** Laboratory measurements of extra-terrestrial materials like meteorites and ultimately materials from sample return missions can significantly enhance the scientific return of the global remote sensing data.

This motivates the ongoing addition of a dedicated Sample Analysis Laboratory (SAL) to complement the work of well-established facilities like the Planetary Spectroscopy Laboratory (PSL) and the Astrobiology Laboratories within the Department of Planetary Laboratories at DLR, Berlin. SAL is being developed in preparation to receive samples from sample return missions such as JAXA Hayabusa 2 and MMX missions, the Chinese Chang-E 5 and 6 missions as well as the NASA Osiris-REX mission. SAL will be focusing on spectroscopic, geochemical, mineralogical analyses at microscopic level with the ultimate aim to derive information on the formation and evolution of planetary bodies and surfaces, search for traces of organic materials or even traces of extinct or extant life and presence of water.

**Sample Analysis Laboratory:** The near-term goal is to set up the facilities on time to receive samples from the Hayabusa 2 mission. The operations have already started in 2018 with the acquisition of a vis-IR-microscope, a Bruker HYPERION 2000 Advanced variant, capable of collecting data in transmission and reflection modes between 0.4 and 20  $\mu\text{m}$  and with a spot size of 50  $\mu\text{m}$ . The microscope is equipped with a X,Y,Z motorized stage which allows the collection of large area maps and different magnifications. Before the end of 2021, an Empyrean Series 3 X-ray diffraction (XRD) system from Malvern Panalytical has been purchased. The system has a Bragg-Brentano geometry which can be switched to parallel beam geometry, equipped with a Cu K $\alpha$  source, 1Der detector and iCore PreFIX automated incident beam optics. The system also allows to collect microdiffraction ( $\mu\text{XRD}$ ) maps using a selection of different monocrapillaries down to 140  $\mu\text{m}$  in spot size. Currently ongoing are the acquisitions of a Field Emission Gun - scanning electron microscope (FEG-SEM) and of a Field Emission Gun – electron microprobe analyzer (FEG-EMPA), as well as a polarised light microscope for high resolution imaging and mapping.

The facilities will be hosted in a clean room (ISO 5) equipped with glove boxes and micromanipulators to handle and prepare samples. All samples will be stored under nitrogen gas ( $\text{N}_2$ ) and can be transported between

the instruments with dedicated shuttles in order to avoid them to enter in contact with the external environment. Based on current planning the first parts of SAL will be operational and ready for certification by end of 2022.



**Figure 1.** Glass vial containing Lunar regolith collected during the Soviet Luna 24 mission (Credits: Helbert, DLR).

**Outlook:** The construction work for SAL has started and the first instruments will be arriving by late summer 2022. SAL will be operative by the end of 2022, on time to welcome samples collected by the Hayabusa2 mission.

In collaboration with the Natural History Museum in Berlin SAL will also have the expertise and facilities for carrying out curation of sample return material which will be made available for the whole European scientific community. DLR is already curating a 0.45 mg of Lunar regolith (Figure 1) collected from the Luna 24 Soviet mission and the first analyses of the material are being planned.

SAL follows the approach of a distributed European sample analysis and curation facility as discussed in the preliminary recommendation of EuroCares. Like other laboratory facilities at the DLR Institute of Planetary Research (such PSL and RMBL) which are part of the Europlanet RI, the new SAL will be from the start open to the scientific community.

Our goal is to establish an excellence centre for sample analysis in Berlin within the next 5-10 years building on our collaborations with the Natural History Museum in Berlin and the Helmholtz Center Berlin as well as the universities in Berlin.