

EURO-CARES AS ROADMAP FOR A EUROPEAN SAMPLE CURATION FACILITY.

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Introduction: EURO-CARES (European Curation of Astromaterials Returned from Exploration of Space) was a three year (2015-2017), multinational project, funded under the European Commission's Horizon2020 research programme to develop a roadmap for a European Extra-terrestrial Sample Curation Facility (ESCF). Such an ESCF was designed to receive and curate samples returned from Solar System exploration missions to asteroids, Mars, the Moon, and comets. So far, there are only two facilities dedicated for unrestricted returned samples: the NASA Johnson Space Centre in Houston (USA) and the JAXA Hayabusa curation facility in Sagami-hara (Japan). Previous studies of an ESCF were either country-specific (e.g., [1]) or mission/target specific (e.g., MarcoPolo-R [2]). With the EURO-CARES project we proposed to move onwards from these specific studies, using experience accumulated at NASA, JAXA, and in various laboratories and museums curating meteorites, in combination with expertise from biosafety laboratories, cleanroom manufacturers, electronics and pharmaceutical companies, nuclear industry, etc. Long-term curation of extra-terrestrial samples requires that the samples are kept as clean as possible to minimize the risk of detrimental contaminants, at the same time ensuring that Martian samples remain contained in case of biohazards. The requirements for a combined high containment and ultraclean facility will naturally lead to the development of a highly specialized and unique facility that will require the development of novel scientific and engineering techniques. We report here a summary of the EURO-CARES study. **The project:** EURO-CARES project was organized around five technical Work Packages (WP), led by scientists and engineers from institutions from all over Europe. **Planetary Protection:** Planetary protection requirements and implementation approaches were determined by the best multidisciplinary scientific advice according to international policy [3] and recommendations from the European Science Foundation [4]. Biohazard and Life Detection protocol were assessed. The existing sterilization methods and techniques were reviewed under new discoveries of phenomena associated with terrestrial microbial extremophiles. **Facilities and Infrastructure:** All the aspects, from building design to storage of the samples were covered. The facility should be

composed of a receiving laboratory, a cleaning and opening laboratory, a bio-assessment laboratory, a curation laboratory, and a storage room. The facility will have to be easily adaptable. Long-term curation of samples is a challenging aspect, especially because the pristine nature of the samples should be preserved.

Instruments and Methods: The methodology of characterization of returned samples and the instrument base required at the ESCF was determined. The analyses should provide an appropriate level of characterization while ensuring minimal contamination and minimal alteration of the sample. Instrumentation will also be required to monitor contamination levels within the facility. **Analogue Samples:** Analogue proxies are necessary in a curatorial facility for testing sample handling, preparation techniques, storage conditions, planetary protection measures as well as to validate new analytical methods. For practical reasons, it may be necessary for the curation and analytical facility to have its own collection of analogue samples. The selection of analogues will be constantly evolving to take into account the rapid changes in the understanding of different Solar System bodies that result from current and future space missions, e.g., Curiosity, Hayabusa 2 and OSIRIS-REx. **Portable Receiving Technologies:** The Earth re-entry capsule from a sample return mission is targeted at a specific landing ellipse on Earth, possibly at considerable distance from the ESCF. A portable receiving facility may be used to inspect, document, and package the sample container(s). It will then be transported to the ESCF using a safe and secure method. In addition, methods for the transport of samples from the facility to the outside institutions were studied, to ensure security and non-contamination of the samples.

More information is available on the project website: www.euro-cares.eu

References: [1] Council J. et al. (2002) 34th COSPAR Scientific Assembly, Abstract. [2] Brucato J. R. et al. (2012) 39th COSPAR Scientific Assembly, Abstract. [3] COSPAR (2005) COSPAR Planetary Protection Policy. [4] Ammann W. et al. (2012) Report from the ESF-ESSC Study Group. ISBN 978-2-918428-67-1.

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