D1.7.

Top Level Requirements for an Extraterrestrial Sample Curation Facility

General Requirements

The Extraterrestrial sample curation facility (ESCF) shall be designed to preserve and protect the samples for generations to come.

The ESCF shall be designed to optimise maintenance during active operation and in the long term.

The ESCF shall require ongoing political support and funding.

The ESCF shall have the capacity to curate several hundred kilograms of samples.

The ECSF shall have the capacity to curate samples from Mars and its moons, the Moon and asteroids.

The construction of the facility shall be achieved at least a year before delivery of the first samples, to allow a proper training of the personnel, to test (using analogues) and practice manipulation and all other curation steps, and to write and refine the many necessary procedures.

The facility should be protected against a large diversity of threats both human and natural, such as theft, climatic change, leaks, fire, hurricanes.

Planetary Protection

The probability that a single unsterilized particle [from Mars] of ≥ 0,2 µm in diameter is released into the terrestrial biosphere shall be ≤ 1x10-6.

Samples returned from Mars must be handled under biosafety level 4 containment (BSL4; the highest level of containment) until deemed to be free of any biohazard.

The ESCF shall have the capability to handle Mars samples as per the state-of-the-art planetary protection protocols.

Infrastructure

The ESCF shall serve the needs of the scientific community in making suitable samples available for study on an appropriate timeframe.

A significant effort should be made to avoid power failure that could affect the sample integrity. This would require the use of uninterruptible power supply and generators to ensure a continuous electrical distribution.

The facility shall have appropriate methods to minimise and characterise contamination from gases, liquids and solids (dust).

The facility shall be designed with appropriate failsafe modes to ensure sample integrity is retained.

New approaches of samples curation and storage will have to be developed to allow curation of volatile species such as ices.

Instrumentation and Methods

The ESCF should have the appropriate instruments available to monitor potential sources of contamination within the facility.

The ESCF should have instruments capable of undertaking preliminary examination prior to release to the scientific community for detailed measurement.

We identify a need of a significant technological advance over the methods currently used for the handling and preparation of the samples.

Analogues

The ESCF requires appropriate analogues for testing sample processing equipment (e.g. saw, splitter) and handling systems during facility development.

The ESCF requires analogues for staff training purposes.

The ESCF requires analogues for scientific instrument testing and calibration.

The ESCF requires appropriate analogue samples which can be used as 'witness samples' for test determine levels of contamination during curatorial processing. .

The analogue samples shall be stored and utilised in such a way to minimise risk of contamination of extraterrestrial returned samples.

Sample Transport

Sample transport shall comply with state-of-the-art planetary protection protocols to ensure no release of potentially hazardous materials to Earth's biosphere.

For Mars moon, Moon and asteroid sample return missions (i.e. bodies without planetary protection requirements) strategic plans and protocols should be developed to prevent terrestrial contamination of samples in a non-nominal landing event.

Impact

The ESCF shall have mechanisms in place to maximise potential for education and public engagement with the facility, associated space missions and scientific investigation of returned samples.