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Life on Mars: returned samples and their storage, the EURO-CARES project

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Introduction: Future missions to Mars, such as the European-Russian ExoMars 2020 and NASA Mars 2020 missions, have the specific objective of searching for traces of life. While it is hoped that the instrumental payload on these rovers (microscopes, various spectrometers for detecting organics) will detect biosignatures, it is likely that definitive identification of traces of life in the martian rocks will necessitate the return of samples to Earth for extensive analysis in terrestrial laboratories. This will be all the more necessary considering the frequent controversy concerning identification of the oldest traces of life on Earth in rocks ~3.5 Ga old. The latter traces represent well established life forms that were already relatively advanced, whereas life on Mars is likely to have never advanced beyond at a very primitive state, given the punctuated habitable conditions on the red planet [1].

The EURO-CARES project: Study and long-term curation of extra-terrestrial samples imply keeping the samples as clean as possible from any potential contaminants, while ensuring they remain contained pending the outcome of the required quarantine, in case of biohazards. The requirements for a combined high containment and ultraclean facility will naturally lead to the development of a highly specialised and unique facility that will require the development of novel scientific and engineering techniques.

In the perspective of curating and storing such sensitive samples, as well as other kinds of extraterrestrial samples, the EURO-CARES project (for EUROpean Curation for Astromaterials Returned from Exploration of Space), funded by the HORIZON 2020 EU Framework Programme for Research and Innovation (agreement n°640190), addresses all aspects of the creation of a curation facility, from planetary protection, architecture, instruments and methods to be used in the facility, portable receiving technologies to the designation of analogue materials to be used in the facility.

We are particularly concerned by the concept of analogues [2, 3]. Analogue samples are complementary to other samples used during instrument development, which are not necessarily relevant to the extraterrestrial body being studied. Most astrobiological investigations have been, are, and will be, focussed on solid materials including rocks, soil, and ices. However, natural materials can be very complex in composition, and the potential traces of life and/or molecules of astrobiological interest that they could contain may be very subtle and challenging to detect; hence, the importance of prior preparation for the missions using analogues. Analogues are terrestrial sites or samples having properties more or less similar than those expected on a given extraterrestrial body. There is a huge variety of analogues on Earth that can be used for many purposes: to test spacecraft landing and rover mobility, to test and calibrate instruments and sample preparation systems for *in situ* missions before launch, to help interpretation of data acquired during missions, and to carry out laboratory experiments. Analogue samples include minerals and rocks, as well as chemical, biological and samples of all materials that come into contact with the returned samples.

References: [1] Westall et al. (2015) Astrobiology, 15, 998 [2]The International Space Analaogue Rockstore, ISAR, www.isar.cnrs-orleans.fr. [3] Bost *et al.*, (2013) *Planetary and Space Science* **82-83**, 113-127