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Space as a Tool for Astrobiological Exploration of the Solar System

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1. Introduction

For the existence of life in the Solar System liquid water is required. Promising targets include Mars and the icy moons, Europa and Enceladus. Finding evidence of life within these potentially habitable environments is dependent on finding unique biosignatures that can be used as irrefutable evidence of life. The main aim of the two ESA space experiments BIOMEX [1] and BioSigN is to support future exploration missions to Mars, Enceladus and Europa using a set of exposure experiments to identify feasible organic biosignatures. There are three specific objectives relevant to this aim: 1) analyse the extent to which selected organisms can survive conditions of space and simulated planetary conditions; 2) analyse the stability and degradation of biosignatures in Low Earth Orbit (LEO) and simulated planetary conditions and 3) to evaluate if some of the resistant microorganisms could be used in future life supporting systems or could be applied for medical treatments to support the human immune system during manned space missions.

2. BIOMEX and BioSigN

The space experiments BIOMEX (BIOlogy and Mars EXperiment) and BioSigN (BioSignatures and habitable Niches) are concepts of investigations to be performed on space exposure platforms on the ISS. Whereas BIOMEX was realized on the space exposure platform EXOPOSE-R2 and results from this experiment are available and will be presented, BioSigN is in the initial phase and is to be performed on a new ESA space exposure device. Both of the projects are using organisms that have previously been isolated from Mars- and sub-surface icy moon analogue sites like Antarctica and the deep sea. The major output of these experiments is on one hand a database of spectra, obtained by mainly Raman spectroscopy of organic biosignatures that are detectable after exposure to LEO and simulated planetary conditions. This database will give insights into the stability of biomolecules under different environmental conditions and the value and pitfalls of using the specified instrumentation for life detection missions. On the other hand both of the experiments are also providing results which are relevant for maintenance of human health and for the use of the tested organisms in life supporting systems. Here the rationale behind BIOMEX as well as BioSigN to support future space exploration missions like ExoMars and Mars 2020 or missions to the icy moons or even manned space missions will be presented.

3. Figures

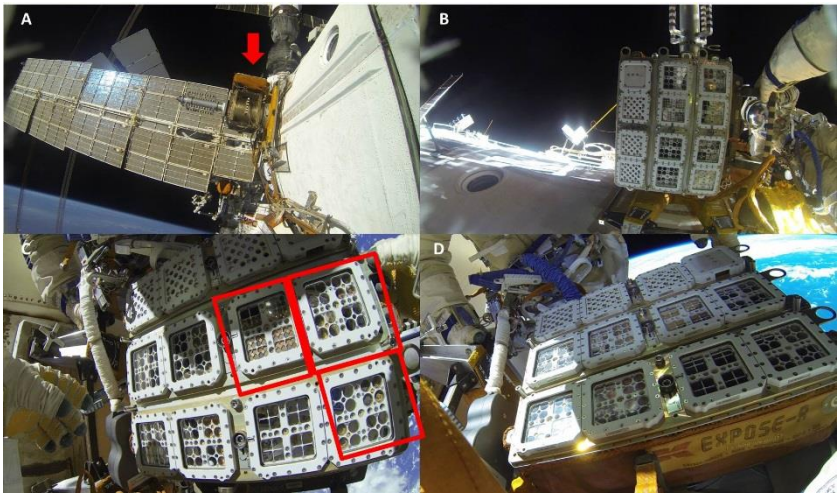

Figure 1: Pictures from the EVA during the EXPOSE-R2 mission in Low Earth Orbit on the ISS. A) Position on the Zvezda module; red arrow: EXPOSE-R2; B) Cosmonauts are approaching the facility. C) The compartments of the BIOMEX experiment are indicated by red squares; C) EXPOSE-R2 - view from the side with in the back our blue planet Earth.

4. References

[1] J.-P. de Vera, U. Boettger, R. de la Torre Noetzel et al.: Supporting Mars exploration: BIOMEX in Low Earth Orbit and further astrobiological studies on the Moon using Raman and PanCam technology, Planetary and Space Science Vol. 74 (1), pp 103-110, 2012.

Short Summary

The two space experiments BIOMEX and BioSigN in Low Earth Orbit on the ISS serve as a tool for future manned and unmanned space exploration missions to Mars and the icy moons in the outer solar system. The main task is to investigate the habitability and the search for life.