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BOSS on EXPOSE-R2-Comparative Investigations on Biofilm and Planktonic cells of *Deinococcus geothermalis* as Mission Preparation Tests

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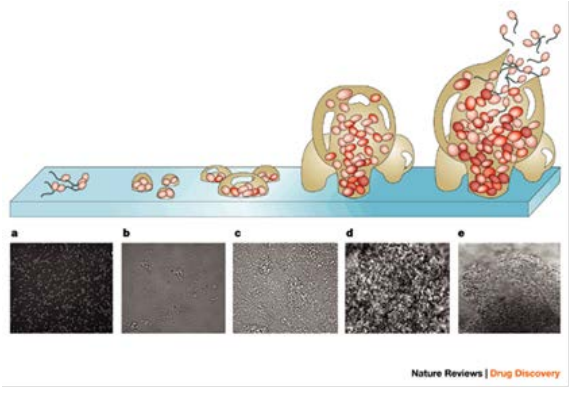
Abstract

Biofilms are of interest for Astrobiological investigations since they are one of the oldest clear signs of life on Earth. In the experiment BOSS the hypothesis will be tested if the biofilm form of life with microorganisms embedded and aggregated in their EPS matrix is suited to support long-term survival of microorganisms under the harsh environmental conditions as they exist in space and on Mars and is superior to the same bacteria in the form of planktonic cultures. An additional protective role may be provided by particles associated in biofilms which may shield the organisms against radiation. The experiment will be flown on EXPOSE-R2 attached outside of the ISS on the Russian module. BOSS has participated the Experiment verification tests and will attend the upcoming Science verification test carried out in the Planetary and Space Simulation Facilities at DLR. The launch is scheduled for April 2014.

1. Introduction

Single-celled organisms generally exhibit two distinct modes of behaviour. The first is the familiar free floating or planktonic form in which single cells float or swim independently in some liquid medium. The second is an attached state in which cells are closely packed and firmly attached to each other and usually form a solid surface. A change in behaviour is triggered by many factors. A biofilm is a structured community of microorganisms adherent to a surface and encapsulated within a self-developed matrix of extracellular polymeric substances EPS. Biofilms are ubiquitous. Nearly every species of microorganism, not only bacteria and Archaea, have mechanisms by which they can adhere to surfaces and to each other. Biofilms are characterized by structural heterogeneity, genetic diversity, and complex community interactions using the EPS matrix for stable, long-term interactions and as an external digestion system. This matrix is strong enough that under certain conditions biofilms can even become fossilized. Usually, abiotic particles are associated with the “sticky” biofilm matrix. One benefit of this environment is increased resistance to different chemical and physical agents as the dense extracellular matrix and the outer layer of cells protect the interior of the community Microbial mats and biofilms are among the oldest clear signs of life on Earth and might also be the first forms of life to be detected on other planets and moons of our solar system. One benefit of this environment is the increased resistance to different chemical and physical agents, as the dense extracellular matrix and the outer layer of cells protect the interior of the community.



2. Materials and Methods

In the space experiment BOSS (Biofilm Organisms Surfing Space) to be accommodated in the ESA facility EXPOSE-R2 on the ISS and in the corresponding lab experiments conducted at the Planetary and Space Simulation Facilities at DLR the hypothesis will be tested if the biofilm form of life is superior to the same bacteria in form of planktonic cultures. The cell condition with microorganisms embedded and aggregated in their EPS matrix is suited to support long-term survival of microorganisms under the harsh environmental conditions as they exist in space and on Mars. Environmental parameters under investigation are desiccation, extraterrestrial UV radiation, simulated environmental conditions as they occur on the surface of Mars, and a Mars-like UV climate. Test organism in the presented investigations is *Deinococcus geothermalis*. Additionally several pretests the suitability of different carrier material was tested.In the ongoing ground-based preparatory studies in the frame of EVTs (experiment verification test) and a SVT (science verification test) the mentioned environmental parameters were tested single and in combination to optimise sample preparation and analysis procedures. Results from the EVTs will be presented.

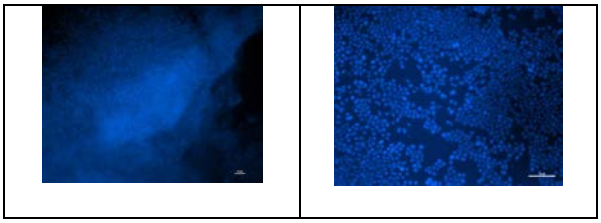


Figure 1: Biofilmsamples on cellophane discs (Optical magnification 400 and 1000) Photo: Jan Frösler

3. Summary and Conclusions

From the ongoing analysis experimental clues are expected to the question, whether biofilms offer more protection against the harsh environment of space for the embedded microorganisms to survive even long-term phases in space. The data will contribute to extent and kind of protection (chemical or physical) against the parameters of space, applied individually or in selected combinations will be identified for selected materials, such as certain soil or rock components. The results of the space experiment will be complemented by data obtained in the laboratory using the space simulation facilities at DLR and will contribute to our understanding of the chances and limits of life in the universe.

4. References

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