Halophilic archaea as prime candidates for astrobiological research. S. Leuko[1], G. Lamers[1], M. Sebastian[1], S. Sjöström[1],A. Seiler[1], R. Moeller[1], R. Mancinelli[2], and P. Rettberg[1]. [1)]German Aerospace Center (DLR e.V.), Institute of Aerospace Medicine, Radiation Biology Department, Linder Höhe, 51147 Cologne, Germany; 2)

Introduction: The quest of exploring and looking for life in unusual or extreme places has been a human desire since centuries. Nowadays, our endeavors start to focus on the exploration of nearby planets in our solar system and the fascinating possibility to find extant life on one of these planets. Recent studies have increased our confidence that liquid water exists in form of high saline brines on the surface of Mars. Such brines may be similar to high salinity environments here on Earth such as solar salterns or salt lakes in Antarctica. The predominant inhabitants of these environments on Earth are halophilic Archaea. These organisms are not only adapted to high osmotic conditions, but also to high radiation and fluctuations in temperature. Numerous studies have shown that different representatives of this family can cope with a wide variety of stress factors such as changes in osmotic pressure, ionizing radiation, different regimes of UV, exposure to simulated microgravity, exposure to Low Earth Orbit (LEO) and a high resistance to prolonged desiccation. Here we report on the resistance of halophilic archaea against bombardment with HZE-particles, their ability to survive in simulated Martian brines as well as the survival following exposure to outer space for 1.5 years during the EXPOSE-R2 mission.

Results: Cells of exponentially grown *Halobacterium salinarum* NRC-1, *Halococcus hamelinensis* and *Halococcus morrhuae* were exposed to Ar and Fe ions as well as to X-rays and γ-radiation. Doses up to 1 kGy of Ar and Fe ions did not reduce survival significantly. Only cells exposed to 2 kGy of Fe showed a significant reduction of survival when incubated for 7 d (*Hbt. salinarum NRC-1*) or 14 d (*Hcc. hamelinensis and Hcc. morrhuae*), respectively. Increasing incubation time improved to amount of recovered cells but cells were unable to return to values similar to untreated samples. Exposure to γ-radiation up to 112 kGy revealed only survival up to 6 kGy for *Hcc. morrhuae* and *Hcc. hamelinensis* with a growth delay compared to laboratory and transport controls, *Hbt. salinarum* NRC1 showed no growth following exposure to 6 kGy even following incubation for up to 150 days.

To investigate the possibility of halophilic archaea surviving in liquid brines on Mars, several different brines have been prepared (as described in [1]) and the survival of *Hbt. salinarum* NRC-1, *Hrr. chaoviator* and *Hcc morrhuae* have been established. Furthermore, we tested if *Hbt. salinarum* is able to actively grow within these brines and results will be presented on how these organisms survive exposure to a simulated atmosphere and pressure for up to two weeks.

Following 1.5 years outside the International Space Station (ISS) as part of the EXPOSE-R2 mission, *Hcc. morrhuae* is currently revived and first results show survival even for cells exposed to UV radiation. Further experiments such as the detection of potential biomarkers like Bacterioruberin via Raman spectroscopy will allow us to draw a comprehensive picture about the astrobiological potential of this particular strain.

Conclusions:

Overall experimental results indicate that halophilic Archaea are able to withstand the exposure to space related environmental factors for a considerable time. This work in combined with others will lead to a detailed understanding of the response of extraterrestrial conditions to halophilic Archaea for astrobiological considerations.

References:

[1] Fox-Powell, M.G. et al. (2016) Astrobiology 16:427-442.