Metabolic Activity of microorganisms during and after simulated Mars-like conditions – what do we learn about the habitability of the Red Planet?

Jean-Pierre de Vera[1], Janosch Schirmack[2], Paloma Serrano[3], Joachim Meeßen[4], Sieglinde Ott[4], Rosa de la Torre Noetzel[5], Francisco Javier Sánchez Iñigo[5], Andreas Lorek[1], Dirk Schulze-Makuch[6], Dirk Wagner[3], Tilman Spohn[1]

[1]German Aerospace Centre, Institute of Planetary Research, Rutherfordstr.2, D-12489 Berlin, Germany
[2]Alfred Wegener Institute for Polar and Marine Research, Research Unit Potsdam, Telegrafenberg A45, 14473 Potsdam, Germany
[3]Helmholtz Centre Potsdam, German Centre for Geosciences (GFZ), Section 4.5 Geomicrobiology, Telegrafenberg, 14473 Potsdam, Germany
[4]Institute of Botany, Heinrich-Heine-University, Universitätsstrasse 1, 40225 Düsseldorf, Germany
[5]Instituto Nacional de Técnica Aeroespacial (INTA), Ctra.de Ajalvir km. 4, 28850 Torrejón de Ardoz, Madrid, Spain
[6]School of Earth and Environmental Sciences, Washington State University, Webster Hall 1148, Pullman, WA 99164, USA

An overview on different experiments with methane producing archaea and photosynthetic organisms such as lichens and cyanobacteria shows different degrees of adaptation to very harsh conditions. The most resistant organisms can be found in polar and alpine habitats. The reason for their resistance can be explained by their occurrence in intensely irradiated, very dry and/or cold environments, which are close to Martian surface conditions. A systematically approach comparing measurements on methane production and photosynthetic activity for a variety of organisms, in relation to measured environmental parameters obtained in Mars analog field sites, with data collected from space exposed samples or during Mars simulation experiments, is urgently needed. Some of these tested organisms were exposed during experiments either directly to space conditions or on space exposure platforms like BIOPAN and EXPOSE-E on the International Space Station, or to Mars environmental conditions in Mars simulation chambers. Some of these species were also exposed to both of extreme environmental conditions. Results of these performed investigations and more recent experiments will be presented to elucidate on the habitability conditions of present Mars. We emphasize that more work is needed to answer these questions. For example: *in situ* monitoring of environmental parameters during exposure to space conditions on the space exposure facilities is a prerequisite. These kinds of experiments are currently done in some of the Mars simulation facility laboratories. *In situ* measurements on the ground and in space are a significant progress to get more precise estimations about the influence of each of the tested Mars-like parameters on metabolic activity and the adaptation capacity of microorganisms to Mars-like conditions. The outcome of this work might be relevant for the classification of Mars as a habitable planet using a new experimental and biological approach, and this work has also implication to the possible terra forming of Mars.