MEXEM – Mars Exposed Extremophile Mixture – a space experiment to investigate the capability of anaerobic organisms to survive on Mars

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Assessing the habitability of Mars and detecting life, if it ever existed there, depends on knowledge of whether the combined environmental stresses experienced on Mars are compatible with life as we know it and whether a record of that life could ever be detected. So far, only few investigations were performed to understand the combined effect of different environmental stresses on survival and growth of anaerobic and extremophilic organisms. In the space experiment MEXEM (formerly known as MASE-in-SPACE) the hypothesis will be tested that selected terrestrial organisms, enrichment cultures and original samples from extreme Mars-analogue environments on Earth are able to withstand the Martian environmental stress factors due to their highly effective cellular and molecular adaptation and repair mechanisms. In addition, artificially fossilized and aged isolates from Mars-analogue environments on Earth will be examined and assessed with respect to their suitability for biosignature identification. MEXEM samples will be (i) oxygen-depleted natural sediment samples, (ii) natural sediments spiked with selected, defined strains representative for the respective analogue site, (iii) individual (facultative) anaerobic / micro-aerophilic species including ciliates and viruses, (iv) defined mixtures of these biological entities, (v) isolated strains from samples collected inside the ISS and (vi) artificially fossilized isolates from the natural environments. Most of these samples and isolates were obtained from Mars-analogue environments on Earth in the frame of the EC funded project MASE (Grant Agreement 607297) and from the space experiment EXTREMOPHILES (PI C. Moissl-Eichinger). MEXEM will be flown outside on the ISS in the new exobiology facility ESA is building now. It offers the possibility to simulate of the martian environment, in particular the martian UV cl e, which cannot be done in the lab, but also martian atmosphere and pressure in LEO.