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IRON/SULFUR BACTERIA AS MODEL ORGANISMS FOR A PUTATIVE MARTIAN ECOSYSTEM

Abstract

A possible Martian ecosystem would most likely be based on chemolithoautotrophic organisms who are capable of obtaining energy from oxidation of inorganic compounds and of forming biomass by CO2 fixation. In contrast, an ecosystem based on surface photosynthesis seems to be less likely due to the highly oxidizing surface properties of martian regolith and the high solar UV flux encompassing deleterious short UVC wavelengths. Instead, putative Martian organisms should be able to use redox disequilibria, e.g. iron and sulfur at different oxidation states present in the Martian (sub)surface. In our study we are investigating the survival and potentially the growth of Mars-relevant iron and sulfur transforming microorganisms under simulated Martian subsurface conditions with a focus on water stress. We have choosen the chemolithoautotrophic acidophilic iron-sulfur bacteria Acidithiobacillus ferrooxidans and Sulfobacillus thermosulfidooxidans as model organisms to investigate their stress resistance against the environmental parameters as they exist on the surface of Mars and to study the microbe-mineral interactions to understand how minerals can protect microbes from environmental stresses. The choosen bacteria can use many different electron donors and acceptors, some of which are also present on Mars (e-donors: Fe II, S0, S4O6, S2O3, H2 and e-acceptors: O2, Fe III, S0 resulting in Fe III, SO42-, H2O, Fe II, H2S). Their versatile metabolism allows the easy adaptation to oxic as well as to anoxic environments. Growth tests were performed on two different Mars regolith simulants without additional nutrients and under different atmospheric compositions (air, N2/CO2, H2/CO2). Both organisms show growth on both Mars regolith simulants without extra nutrients, by using the Fe(II) dissolved from the minerals (aerobic) or the Fe(III) bound to the minerals by attaching to the particles (anaerobic). More efficient was the observed growth of both microorganisms in an anoxic environment. Both are able to withstand low temperatures (-80C) at least for several weeks without any cryoprotectant. Both species are sensitive to desiccation after growth in liquid cultures either when grown in presence of minerals or only dried in presence of them. However, when grown as biofilms, the organisms are able to survive for somewhat longer desiccation periods. The bacteria exhibit a moderate resistance against UV radiation. In the ongoing studies the radiation resistance against UV and also ionising radiation and the potential adaptation to water stress will be investigated.