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BIOLOGICAL BASED ISRU, RELEASING VALUABLE ELEMENTS, PRODUCING OXYGEN AND ALLOWING FURTHER SOIL EVOLUTION (2760 CHARACTERS)

Abstract

Next to their involvement in bioweathering and the geochemical cycle, microorganisms have already proven their relevance in agricultural and industrial applications such as enhancing soil fertility and biomining. They have also become of interest for space exploration missions as they can generate nutrients from endogenous planetary regolith material, so called "in situ material". We therefore want to show the applicability of this biological based in situ resource utilization (Bio-ISRU) system, leading to release of elements and production of oxygen which thus could be interesting for further use in life support systems, and induce further evolution of soil characteristics. Our aim is to build a demonstrator for Bio-ISRU, to show the advantages and applicability for space and Earth applications. Within these small Bio-ISRU devices, photosynthetic organisms will be used to produce oxygen or hydrogen while releasing organic acids and/or siderophores which will release more elements from the regolith. Thus, not only oxygen but also other valuable elements are produced, and further soil evolution is stimulated. Previous studies indicated that Fischerella sp. can be cultivated in the presence of regolith simulant material while keeping their phototrophic abilities and inducing release of Fe, Al, Mg (Brown et al., 2008). In addition, Nostoc spp release extracellular polysaccharides suppressing regolith crack expansion during desiccation (Aria et al., 2008). Chlamydomonas reinhardtii algae were shown to grow in a low-pressure environment, in the presence of different regolith simulant material, secreting matrix elements which bound and softened the hard-edged simulant material, leading to favorable conditions for growth of Arabidopsis thaliana (Kempf et al., 2009). In addition, the mild conditions of Bio-ISRU processes could permit energy demands to be low, while permitting fluctuations in environmental conditions and ensuring the applicability of these processes on the whole lunar surface. It could also be integrated within other life-support loops and induce further stabilization of soil development, prevent dust particles and increase release of valuable elements. The demonstrator should thus show the applicability of using photosynthetic organisms as a life-support system, by releasing elements from in situ material, not only in space but also for different Earth applications.