

## Project Abstract

### **Biomimicry of the Growth of a Desert Plant as an Approach for Extractions of Phosphorus and Minerals from Martian Regolith**

Several desert plants, such as paloverde, grow on rocks in Nevada with limited water, similar to the conditions on Mars. This means that these plants are able to extract nutrients and minerals from desert rocks such as basalt. These plants survive by extending their roots deep, up to a few meters into basalt fractures. Being legumes, their nitrogen comes from nitrogen gas fixing bacteria living symbiotically in their root nodules. It is hypothesized that these plants have unique mechanisms for the extraction of phosphorus and minerals. For example, they likely release biomaterials from their roots (acidic exudates) for the solubilization of phosphorus and minerals. The goal of this project is to deliver a safe and economical approach to extract phosphorus and minerals from Mars regolith via biomimicry of the growth of paloverde. The main objectives of this proposed research are to: 1. Investigate phosphorus and mineral extraction biomechanisms utilized by paloverde to grow on basalt and Martian regolith simulant; and 2. Characterize biomaterials and their sources and rhizosphere microbial communities and their roles. We expect that the identified biomechanisms can be mimicked for the extractions of phosphorus and minerals from Martian regolith. The vision of the project is not to grow paloverde on Mars but to characterize the biomaterials and biomechanisms which could potentially be adapted through biomimicry for the extraction of resources from Martian regolith and/or adopted through genetic engineering for growing other plants on Mars. Research results will lead to the developments of two main project deliveries: 1. A verified biobased approach (biomechanism) to extract phosphorus and minerals from Martian regolith and 2. Biobased material(s) for the extraction. The proposed project aligns with the goal of the NASA Physical Sciences Program research emphasis “to develop and increase understanding of extraction techniques to generate useful materials from Lunar or Martian regolith.”