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

Shams Rothee[1], Henry Sun[2], and Eakalak Khan[1]

[1]University of Nevada, Las Vegas & [2]Desert Research Institute

Abstract: Robotic and human space missions are extremely costly, and the cost is mainly associated with the launch mass. This cost can be curtailed by reducing launch mass and utilizing in-situ resources. Current in-situ resource utilization processes require hazardous materials and high energy input which severely restrict their use in space. Several desert plants such as Paloverde grow on rocks and solubilize phosphorus and minerals from rocks by excreting biomaterials from their roots. Microbes living in the rhizosphere soil also help the dissolution process by producing soluble microbial products (SMPs) and extracellular polymeric substances (EPS). Our goal is to identify these biomechanisms utilized and biomaterials produced by the plant root and microbes for mineral extraction from rock and mimic them to extract resources from Martian regolith. We planted Paloverde (*Parkinsonia florida*) in crushed granite, sand, and nursery soil to see how they react in different growth media. We will collect the rhizosphere growth media samples attached to the roots and leached irrigated water samples and analyze them using liquid chromatography-mass spectrometry (LC-MS) and inductively coupled plasma-mass spectrometry (ICP-MS) to identify the biomaterials utilized for phosphorus and mineral extraction. We will also analyze the growth media and water samples through plate count and genome sequencing to quantify and characterize the bacterial community and analyze their role in mineral extraction. Analyzing Paloverde roots and branches through LC-MS and ICP-MS will give us insight on the resource extraction efficiency of the plant. This research will help us to identify biomaterials and their sources for resource extraction, which can be used from extracting resources from waste streams to materials in space. It will also give valuable insights into how to grow plants on rocky planets such as Mars and the extraction efficiency result of Paloverde will be useful for the phytoremediation of heavy metals here on Earth.