Rare Earth Element Mining on the International Space Station

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Abstract

We tested the hypothesis that Rare Earth Element biomining could be implemented in microgravity (on asteroids) and on Mars using a purposely designed and developed biomining apparatus that we launched to the International Space Station. Our results showed that the microbe *S. desiccabilis* could enhance mean leaching concentrations of REEs under these conditions. This was the first space-based technical demonstration of a bioreactor to harness microbe-mineral interactions to advance the human exploration and settlement of space.

Astronaut Luca Parmitano places our bioreactors into the KUBIK centrifuge on the International Space Station

Project Description

The European Space Agency (ESA) BioRock project was a project led by us at the University of Edinburgh over 10 years, involving the development of a space biomining reactor to test microbial growth and the capacity for biomining on asteroids and on Mars. It culminated in the flight of our experiment to the International Space Station in August 2019 on board Space X commercial resupply mission 18.

During the experiment, we tested various hypotheses about microbial growth in space, including the ability to extract Rare Earth Elements (REE) from basalt, a material found on Mars. Our experiment demonstrated for the first time the economic extraction of REEs under microgravity and simulated Martian gravity.

Key Results and Conclusions

- **We demonstrated for the first time the biological mining of economically important elements in space.**
- **We investigated microbial growth for the first time in simulated Martian gravity in space, testing fundamental science hypotheses.**
- **We tested and validated a prototype reactor for the future use of microbes in space exploration and settlement. This can be used for a diversity of applications including life support and further in the future, economic mining in space.**

Summary of project: **https://www.nasa.gov/mission_pages/station/research/news/biorock-iss-research-microbes-space/**
You tube video by NASA: **https://www.youtube.com/watch?v=DxaP3y5mO6Y**