DATA RETRIEVAL FROM MARTIAN LAVA TUBES AND VALLES MARINERIS

INTRODUCTION

The NASA Swarmathon Mission to Mars sub-competition challenges students to design a simulated Martian environment for an autonomous robot mission. The grander goals of the mission are to promote the advancement of research needed to become a multi-planetary species. The mission plan developed for this sub-competition was focused on exploring Martian lava tubes and the Valles Marineris. Samples shall be collected in these locations and evaluated onsite by a landing capsule serving as a laboratory. The capsule laboratory shall avoid the cost of retrieving samples back to Earth. To establish a research context, the Swarmathon team studied previous Mars NASA missions and incorporated applicable research elements to ensure optimal success. The research was applied to justify the use of Swarmies for future rover missions and the landing locations chosen, as shown in the process section of this mission plan.

BACKGROUND

The rover expeditions evaluated are the missions for Sojourner, Spirit, Opportunity, and Curiosity, and lessons can be learned from them to ensure optimal success for this mission. The mission that sent multiple rovers lasted the longest, they are limited to only operating one task at a time, they do not receive feedback from individuals who maneuver these rovers quickly, and they cost hundreds of millions of dollars. Swarm technology offers a valid progression for previous rover expeditions. Their multiplicity increases mission success rate and allows them to finish tasks quickly, they operate autonomously, and each rover costs substantially less than each of the previous rovers.

LANDING LOCATIONS

To further the objective of becoming a multi-planetary species, the mission focuses on studying the unexplored Valles Marineris and subsurface Martian lava tubes that shall advance research in Martian geochronology and human exploration, respectively. The mission was focused on exploring the Valles Marineris, specifically the Melas Chasma, based on evidence suggesting that Valley Marinesis was eroded by water and on exploring Martian lava tubes because they may potentially offer humans protection from radiation.

PROCESS

A. Samples on Martian Environments

Mechanical April cubes shall be dropped on the Martian Environment before the Swarmies. The cubes operate with a mechanical arm that releases from inside the cube to collect samples from Martian environments. The arm retracts to hold the sample within its structure. The cubes categorize the type of sample collected.

B. Arrival on Martian Environments

Swarmies arrive on the proposed locations inside of a capsule, and land by mimicking Curiosity's landing methods via a jetpack. The capsule protects the Swarmies from hazards as it lands on the Martian terrain. The capsule lands either inside the pit opening of a lava tube or the other directly on the surface of the Melas Chasma. The capsule opens its flower-bud-shaped exterior, revealing the Swarmies inside.

C. Swarmie Release

The Swarmies scatter out of the capsule and spread out to cover the environment. The Swarmies leave the capsule in groups of two so that each Swarmie can easily be assisted by another that is in close proximity.

D. Sample Collection and Environment Measurement

The Swarmies collect geological data from their surrounding environment as they scatter out of the capsule. They operate autonomously. The Swarmies retrieve the April cube to the capsule after collecting them from their surrounding environment.

E. Sample Testing in Capsule Laboratory

The capsule shall function as a laboratory to test samples collected by April cubes. The Swarmies retrieve the April cubes to the capsule. The capsule extracts the samples collected by the April cubes. The samples are tested and measured for their composition. The data collected the test is retrieved to Earth via a satellite. Mission complete.

Conclusion

The process of sample collection and laboratory testing repeats until the Swarmies retrieve all the available April cubes to the laboratory. The data retrieved from the mission will be studied to assess how water played a role on the formation of these environments, the possibility of the environments supporting life, and to make new inferences about Mars. The data will also provide the ground work for human exploration of Mars by assessing the habitability of these environments.

Reference

Castañeda R., Dubon M., Garcia A., Herazo A., Perez P., Rodriguez J., Salinas O.N. (2018). Simulation of Rover Mission in Martian Environments on Swarm Technology. (Unpublished)