DEVELOPMENT OF A HIGH VOLUME LUNAR HIGHLAND REGOLITH SIMULANT PRODUCTION PROCESS AND LUNAR SIMULATION LABS

Project Background: Currently, lunar technology is being tested in surface simulations like the “Sand Box” in California or a small lab in Florida at the Kennedy Space Center. While facilities like this have benefits, they provide limited data on the performance of lunar equipment because of limits on the amount, quality and type of simulant available to them.

There are two types of lunar regolith that we must simulate, Lowland (basalt based) and Highland (anorthosite based).

Lowland Regolith is found in the dark portions of the moon and is composed mostly of basalt; it is of limited value with its most notable constituents being iron and silicon. Most of the simulated regolith that has been produced is lowland simulant.

Highland Regolith is found in the lighter colored areas of the moon and is composed largely of anorthosite that contains significant amounts of titanium, aluminum, oxygen and other elements important to space exploration. A large quantity of high quality highland simulant does not currently exist, so our knowledge base for working in the lunar highlands is very limited. Our highland simulant, and the lab it is in, will play a critical role in developing this knowledge.

Current technology degrades quickly as soon as it comes into contact with the abrasive lunar environment. At this time there is not enough lunar regolith simulant to conduct effective full scale testing. There is a real need for a large amount of lunar regolith simulant contained in an appropriately controlled facility that will maintain the quality of the simulant.

A quality experimental facility is important, as any attempt to operate equipment on the moon for more than a short period has proven to be prohibitively expensive, and in the case of human activity, unacceptably dangerous. This presentation raises awareness of the need for a high quality lunar testing facility and seeks partnerships for our new highland simulant production methods and lunar testing lab.

Current Lab: We are presently housed in one of the engineering labs located on Saint Martin’s University in Lacey, WA. We are developing production methods to convert over 40 tons of Shawmere anorthosite and other components into enough highland simulant to cover a tennis court with depths up to 1 meter.

Current Progress: We have developed a pre-agglutinate component mixture that very closely approximates the mineral composition of the lunar highlands. We have successfully created agglutinate structures from our anorthosite mixture, some of which are pictured below, and are working to improve our methods and the quality of our simulant.

Figure 1: Phase One Lunar Surface Simulation Lab Concept
**Future Lab Descriptions:** Our current lab set up is dedicated to creating high quality lunar highland regolith simulant.

**Phase One** of our lab will be an environmentally controlled simulation of the lunar highlands (ETA summer 2017). We will move our simulant into a larger lab as it is produced, and begin testing of various proposed lunar technologies. After completion, these labs will be available to other educational and non-profit organizations free of charge, and to government and commercial entities on a contract basis.

**In Phase Two** we want to greatly increase the size of our lunar surface simulation. This will help to provide more variation on topography with possible Lowland and Highland areas. We also want the simulated lunar surface to be housed in a partial to full vacuum with temperature extremes and solar radiation simulations. Additionally, phase two will include shop, lab, mission control and meeting space,

**Phase Three** will add a large Mars Simulation Chamber with surface and atmospheric simulation capabilities.

**New Production Methods:** We are developing new high volume, high quality agglutinate production processes using patent protected methods and high fidelity primary regolith components. We are also employing a system of constant improvement and statistical quality assurance in an ongoing effort to get as close to the real thing as possible.

“Test it like you fly it!”

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