DEEP SPACE GATEWAY AS A TESTBED TO STUDY EFFECTS OF REGOLITH-DERIVED RADIATION SHIELDING ON PLANT GROWTH DURING LONG-DURATION EXPOSURE TO SPACE RADIATION. J. G. Mantovani[1], [1]NASA Kennedy Space Center, UB-R1, Kennedy Space Center, FL 32899.

Abstract: In contrast to Earth's environment, planetary destinations like the Moon, Mars and asteroids lack a thick atmosphere and a magnetosphere to naturally protect biological, electrical, and mechanical systems from the damaging effects of incident galactic cosmic radiation (GCR) or solar particle events (SPE). However, these planetary bodies do possess surface resources in the form of hydrated minerals and/or water-ice that can provide a sufficient amount of radiation stopping potential if the shielding thickness and hydrogen content are significant enough to absorb the incident energy of the radiation. High energy protons are present in both GCR and SPE, but their energy level in GCR is much higher (several GeV) than it is in SPE (~10 MeV).

Space radiation will also present one of the highest risk factors to a human crew and their onboard electronics during future interplanetary journeys including to the Deep Space Gateway. These risks could be mitigated effectively and addressed economically by utilizing planetary surface materials to develop regolith-derived radiation shielding rather than launching the radiation shielding from Earth's deep gravity well.

This paper will argue that an external carrier platform at the Deep Space Gateway (DSG) will provide an excellent location and opportunity to study the effects on plant growth due to extended exposure to space radiation, and how hydrated regolith materials can be used as a radiation shielding material to mitigate those effects. Comparable long-duration testing at terrestrial radiation lab facilities under similar radiation and vacuum conditions is not feasible due to costs.

A study of this type at the DSG will also provide data that can be used to better inform the theoretical models of long-duration exposure of space radiation on systems in space. Regolith-derived radiation shielding will be fabricated by consolidating hydrated regolith, and its effectiveness as a radiation shield will be determined as a function of shield thickness and hydrogen content. Software developed by NASA's Human Research Program (HRP) provides an "On-Line Tool for the Assessment of Radiation in Space" (OLTARIS). This software will be used to assess the effects of space radiation on various materials prior to actually testing the materials. The results of the DSG study will inform NASA's STMD and HEOMD on the effectiveness of using planetary and asteroid regolith as in-situ radiation shielding for humans and plants on future missions, and the effect on plant growth of long-duration exposure to space radiation in a vacuum environment.

Resources to be utilized at the DSG include an external carrier platform that is similar to MISSE (Materials International Space Station Experiment), and the ability to retrieve samples (either robotically or by astronauts) after a given amount of time that samples are exposed to space radiation. The total estimated mass is 25 kg and the estimated power requirement is 0.5 kW.