VENUS INTREPID TESSERA EXPLORER (VITaL): A MISSION CONCEPT STUDY FOR THE NATIONAL RESEARCH COUNCIL PLANETARY DECACAL SURVEY

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ABSTRACT

NASA Headquarters commissioned the Goddard Space Flight Center (GSFC) with the Venus Intrepid Tessera Lander (VITaL) study to support the National Research Council's 2010 Planetary Decadal Survey Inner Planets Panel. The study focused on a Venus landing in the rough tessera of Ovda Regio. The tessera regions of Venus provide fundamental clues to Venus's past, but the terrain has been viewed as largely inaccessible for landed science due to the known roughness. Ovda Regio was selected because its location near the equator ensures that a mission scenario could be found with excellent lighting conditions. Several possible landing ellipses were found that had average slopes on the km scale of less than 40 degrees and do not contain significant intra-tessera plains. This site selection led to the development of a robust Ring Lander design concept with a low center of gravity, one that could land upright even on steep slopes. A flyby carrier is a communication relay for the up to 1 Gbit of data generated by the probe instruments.

Extensive instrumentation is included in the design concept to provide high fidelity context images along with extensive mineralogy and elemental measurements via a Raman/LIBS system. The Raman/LIBS laser and optics sizing was explored and a mechanism enables a 0.86 m linear survey at a distance of 2.5 m. The system is smaller than some laboratory versions due to volume and power constraints. There are three sets of camera to help provide context for the lander: 1) a descent imager, 2) a 240° panoramic camera with a filter wheel, and 3) a Raman/LIBS context imager that can resolve the 300 micron Laser spot.

The Ring Lander has been designed to withstand landing on a block 0.86 m high that is sitting on a 40 deg slope without tipping over. This configuration was traded with alternate designs that had the ability to tumble. The complexity of those landers drive design, analysis, and testing costs out of reach of the New Frontiers budget goal. Mechanically surviving landing on steep slopes is not the only characteristic to consider when landing in the tessera. Data uplink to the carrier spacecraft also becomes an important driver for non-flat landings. For local slopes above 40 degrees, part of the 2 hours of carrier spacecraft commuications can be blocked by the surrounding terrain. Tolerating some blockage (at the beginning or end of the two hours) allows more data return than altering the carrier spacecraft trajectory to a higher altitude and lowering the uplink rate. Collected science data will be prioritized on the lander to ensure the highest priority data reaches the carrier spacecraft. A highly capable Ring Lander mission is viable for landing in the tessera at a cost near the New Frontiers cap.