VENUS MOBILE EXPLORER (VME): 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 Mobile Explorer (VME) study to support the National Research Council's 2010 Planetary Decadal Survey Inner Planets Panel. The VME mission concept affords unique science opportunities and vantage points not previously attainable at Venus. The ability to characterize the surface composition and mineralogy in two locations within the Venus highlands (or volcanic regions) will provide essential new constraints on the origin of crustal material, the history of water in Venus' past, and the variability of the surface composition within the unexplored Venusian highlands. As the VME floats (~3 km above the surface) between the two surface locations, it offers new, high spatial resolution, views of the surface at near infrared wavelengths. These data provide insights into the processes that have contributed to the evolution of the Venus surface. The science objectives are achieved by a nominal payload that conducts *in situ* measurements of noble and trace gases in the atmosphere, conducts elemental chemistry and mineralogy at two surface locations separated by ~8–16 km, images the surface on descent and along the airborne traverse connecting the two surface locations, measures physical attributes of the atmosphere, and detects potential signatures of a crustal dipole magnetic field.

The study team developed an elegant, volume efficient cylindrical gondola to accommodate the science payload in a thermally controlled environment. An innovative, highly compact design surrounds the gondola with a toroidal pressure tank capped with metallic bellows, enabling the entire lander system to fit in an aeroshell with heritage geometry. The thermal design enables the gondola electronics and instruments to survive 5 hours near the Venus surface, thus providing sufficient time for surface chemistry and an aerial traverse >8 km in the current-like winds.

After release from the carrier, the VME probe enters the atmosphere, descends on a parachute briefly, and then free-falls to the surface. Science is conducted on descent and at the surface. While collecting data at the first site, the metallic bellows are filled with helium and when buoyant, rise with the gondola, leaving the helium pressure tank on the surface. Driven by the ambient winds, the gondola floats with the bellows for ~220 minutes, conducting additional science. At the completion of the 8–16 km aerial traverse, the bellows are jettisoned and the gondola free falls back to the surface, where final surface science measurements are performed. The total mission time in the Venus atmosphere is 6 hours, which includes 5 hours in the near surface environment. The VME probe transmits data to the flyby carrier spacecraft continuously throughout the 6-hour science mission. After losing contact with the VME probe, the carrier spacecraft then relays all data back to Earth. A companion paper discusses metallic bellows details.