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VERITAS – a Discovery-class Venus surface geology and geophysics mission

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A deep understanding of solar system evolution is limited by a great unanswered question: How Earthlike is Venus? We know that these “twin” planets formed with similar bulk composition and size. Yet Venus followed a divergent evolutionary path, losing its surface water and becoming hotter than Mercury. How did this happen? The answer has profound implications for how terrestrial planets become habitable and the potential for life in the universe.

Prior Venus missions discovered that its surface (like Earth’s) is covered with diverse geologic features formed mostly in the last billion years. It probably remains geologically active today. Water, though not stable on the surface, is likely still shaping interior dynamics, driving volcanic outgassing, and influencing surface and atmospheric chemistries. However, without moving tectonic plates, how similar is Venus to Earth? Does it represent a transitional state between the tectonically inactive terrestrial planets and Earth? Is Venus still geologically active today? Does it retain the chemical signature of past water near the surface? VERITAS (Venus Emissivity, Radio Science, InSAR, Topography, and Spectroscopy) will answer these questions. The mission goals, which flow directly from the Planetary Science Decadal Survey, SMD Science Plan, and VEXAG goals, are: 1) understand Venus’ geologic evolution, 2) determine what geologic processes are currently operating, and 3) find evidence for past or present water. The mission design also enables a unique opportunity to send a nanosat probe into the atmosphere, carrying a mass spectrometer to sample the noble gases and their isotopes just below the homopause – high payoff additional science for only incremental cost.

The primary mission goals, accomplished by seven objectives, require just two instruments and a gravity science investigation over a 2-year orbital mission. VEM (Venus Emissivity Mapper) maps surface emissivity using six spectral bands in five atmospheric windows that see through the clouds. VISAR (Venus Interferometric Synthetic Aperture Radar) generates a long-awaited DEM (digital elevation model) at 250 m horizontal postings by 5 m height accuracy, maps.

To achieve low cost on a planetary mission, the scope has to fit within the available funding. VERITAS achieves this by using a heritage spacecraft adapted for the environment at Venus, and by following the old adage – keep it simple. The mission has only two instruments, and VISAR for example has only one mode of operation. The VEM instrument is a simple pushbroom imager with no moving parts. Gravity science is carried out using the spacecraft’s telecom system. No new technologies are used. Onboard processing of the radar data using a COTS space-qualified processor reduces data volume to levels commensurate with downlink rates for other NASA planetary orbiters, so no heroics are required to get the data back. Mission operations are simple and repeatable. Finally the VERITAS team is very experienced and well-qualified for their assigned responsibilities, and have worked with JPL on many previous, successful planetary missions.

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