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VERITAS (Venus Emissivity, Radio Science, InSAR, Topography And Spectroscopy): A Proposed Discovery Mission

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VERITAS is a proposed Discovery mission concept, currently in Step 2 (Phase A), and would launch in 2026. VERITAS addresses one of the most fundamental questions in rocky planetary evolution: why did twin planets follow different evolutionary paths? Venus' hot lithosphere may be a good analog for early Earth, and could be responsible for the apparent lack of plate tectonics. Determining the factors that lead to the initiation of plate tectonics would inform our predictions for rocky Earth-sized exoplanets. VERITAS answers key questions about Venus' geologic evolution and searches for current activity and evidence for past or present water.

Payload: VERITAS carries two instruments and conducts gravity science. The VISAR X-band [Hensley et al., this meeting] measurements include: 1) a global digital elevation model (DEM) with 250 m postings, 5 m height accuracy, 2) Synthetic aperture radar (SAR) imaging at 30 m horizontal resolution globally, 3) SAR imaging at 15 m resolution > 20% of the surface and 4) surface deformation from RPI at 2 mm precision for at least 12 targeted, potentially active areas. VEM [Helbert et al., this meeting] would produce surface coverage of most of the surface in 6 NIR bands located within 5 atmospheric windows and of 8 atmospheric bands for calibration and water vapor measurements. VERITAS would use Ka-band uplink and downlink to create a global gravity field with 3 mgal accuracy / 160 km resolution.

Science: VERITAS looks for the chemical fingerprint of past water in the form of low Fe, high Si rock in the tessera plateaus [Dyar et al. submitted, 2020; Helbert et al., submitted, 2020] and for present day volcanic outgassing of volatiles in the form of near surface water outgassing due to recent or active volcanism.

VERITAS uses a variety of approaches to search for present day activity, including 1) tectonic and volcanic cm-scale surface deformation, 2) chemical weathering, 3) thermal emission from recent or active volcanism, 4) topographic or surface roughness changes, and 5) comparisons to past mission data sets.

VERITAS constrains rocky planet evolution via: 1) examining the origin of tesserae plateaus -possible continent-like features, 2) assessing the history of volcanism, 3) looking for evidence of prior tectonic or impact features buried by volcanism, and 4) determining the origin of tectonic features such as huge arcuate troughs that have been compared to Earth's subduction zones.

VERITAS gravity data (resolution 160 km, 3x better than avg. Magellan resolution), would enable estimation of elastic thickness (a proxy for thermal gradient) and determination of core size [Mazerico et al. Fall AGU 2019].

Conclusions: VERITAS would create a rich data set of high-resolution topography, imaging, spectroscopy, and gravity. These co-registered data would be on par with those acquired for Mercury, Mars and the Moon that have revolutionized our understanding of these bodies. In addition to answering fundamental science questions, VERITAS' data would motivate further Venus missions. Active surface deformation would promote a seismic mission. Accurate topography plus surface rock type would optimize targeting of surface or areal missions.

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