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Exploring a Hostile World: Understanding Surface Weathering on Venus through Laboratory Analyses

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ESA and NASA are currently planning the EnVision and VERITAS missions to Venus, respectively. The Venus Emissivity Mapper (VEM) on VERITAS and Venus Spectrometer – Infrared Mapper (VenSpec-M) on EnVision will measure the thermal emission of the planet in several bands between 1.0 and 1.18 μm [1]. Thermal emission in these bands is expected to be affected by surface weathering processes, modulating and potentially obscuring the identification of the primary surface mineralogy on Venus [2].

To explore how surface weathering affects Venus materials, we are analyzing synthetic and natural samples of volcanic glass that were exposed to Venus-like surface conditions for 60 days in the NASA Glenn Extreme Environments Rig [3,4]. We are using scanning electron microscopy (SEM) with energy dispersive X-ray spectroscopy to characterize the bulk textural and compositional characteristics of weathering products, and transmission electron microscopy (TEM) to identify their mineralogy and depth of alteration down to the atomic scale.

For a mid-ocean ridge basaltic glass, we have observed sulfate and minor sulfide weathering products in both the SEM and TEM, consistent with past studies [e.g., 5]. On the sample surface we identify a 60 nm thick alteration layer of anhydrite across the sample surface. Immediately below this weathering deposit is a layer depleted in calcium, magnesium, and sodium compared to the bulk glass composition. We have also characterized the surface deposits in a rhyolitic glass as being sodium- and sulfur-rich. We expect that our results will help inform future efforts to interpret measurements by VERITAS and EnVision of Venus's surface emissivity.

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