MAPPING VENUS MINERALOGY AND CHEMISTRY *IN SITU* FROM ORBIT WITH SIX-WINDOW VNIR SPECTROSCOPY. M. D. Dyar[1], J. Helbert[2], T. Boucher[3], D. Wendler[2], I. Walter[4], T. Widemann[5], E. Marcq[6], A. Maturilli[2], S. Ferrari[7],1, M. D'Amore[2], N. Müller[8], and S. Smrekar[8], [1]Planet. Sci. Inst., 1700 East Fort Lowell, Tucson, AZ 85719 USA (mdyar@mtholyoke.edu); [2]Inst. Planet. Res., DLR, Rutherfordstrasse 2, 12489 Berlin, Germany; [3]Col. of Inform. and Computer Sci., Univ. of Massachusetts Amherst, Amherst, MA, 01003, USA; [4]Inst. Optical Sensorsystems, DLR, Rutherfordstrasse 2, 12489 Berlin, Germany, [5]LESIA; [6]LATMOS; [7]Center of Studies and Activities for Space G. Colombo, University of Padova, Via Venezia 15, 35131 Padova, Italy ; [8]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena CA, 91109.

Introduction: How can Venus' surface mineralogy and geochemistry best be studied? Technological advances in surface techniques since prior Venus landed missions such as LIBS, Raman [1], and XRF [2] make in-situ instrumentation attractive. However they are limited to short analysis times, autonomous sample collection, and provide local versus global information.

Although not designed to image the Venusian surface, both the Galileo spacecraft and VIRTIS on Venus Express were able to image the surface through transparent windows in the CO_2 spectrum near 1 μm [3-7]. To leverage this capability, the Venus Emissivity Mapper (VEM) was developed specifically to study the surface of Venus through six different windows at 0.86, 0.91, 0.99, 1.02, 1.11, and 1.18 μm. This project explores what can be learned about Venus surface geochemistry and mineralogy using those six windows from an orbiter *in situ* at Venus, with two focuses:

1) the ability of VEM-window data to distinguish among key rock types on Venus, and

2) their capability to evaluate redox state and transition metal contents of Venus surface rocks.

Data: VNIR data were collected at Venus temperatures in the Planetary Spectroscopy Laboratory at DLR [8-10]. Fe^{3+}/Fe^{2+} ratios were measured using Mössbauer spectroscopy [11] and standard methods. Samples studied were reported in [12].
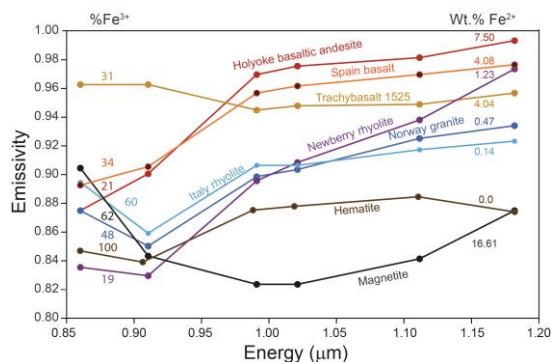

Figure 1. Laboratory emissivity data with %Fe^{3+} (left) and wt.% Fe^{2+} (right, indicated as determined by combining Mössbauer, x-ray fluorescence, and EMPA.

Rock Type Distinctions: As seen in **Figure 1**, samples containing Fe oxides (rhyolite, granites, and the oxides themselves) have negative slopes between the two lowest wavelength bands. The wavelength region ~0.99 and 1.02 mm allows felsic rocks to be distinguished from mafic ones. In this region, Fe (and other transition metals) in silicate minerals causes elevated emissivity, causing felsic rocks to group separately, and oxides to have low emissivities. Binary classifiers [1] demonstrate that at current best estimate errors, basalt spectra can be confidently discriminated from basaltic andesites, andesites, and rhyolite/granite.
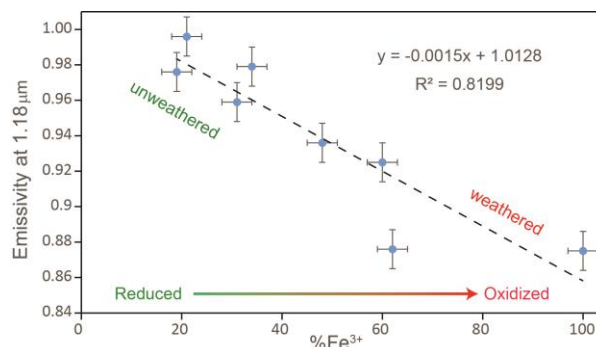

Figure 2. Assessment of weathering based on emissivity at1.18 μm; other bands can also be used to support this trend.

Redox state: Surface weathering based on oxidation state can be inferred from the 1.18 μm and other bands (**Figure 2**). This distinction can also be made using the 0.99 and 1.02 μm bands, where hematite is easily distinguished from magnetite.

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