THE MINERALOGIC VARIABILITY OF ICELANDIC PALAGONITES: AN ANALOG STUDY FOR MARS. S. Ackiss[1], B. Horgan[1], J. Gudnason[2], C. Haberle[3], T. Thorsteinsson[4], and T. Thordarson[2], [1]Purdue University, Department of Earth, Atmospheric, and Planetary Sciences, West Lafayette, IN (sackiss@purdue.edu), [2]University of Iceland, Department of Earth Sciences, Reykjavík, Iceland, [3]Arizona State University, School of Earth and Space Exploration, Phoeniz, AZ, [4]Icelandic Meterological Office, Reykjavík, Iceland.

Introduction: Palagonite is commonly misinterpreted as a weathering product produced with low-temperature alteration of volcanic rocks [1-6]; however, it has been conclusively shown that palagonite is a poorly crystalline, hydrated, and oxidized alteration product of glass [7-10] that is produced exclusively at high-temperatures and high water-to-rock ratios. Thus, palagonite only forms in specific environments, including subglacial and submarine volcanic eruptions.

Because palagonite is formed in a chaotic aqueous environment, the composition is often variable. Palagonite composition will also vary based on the composition of the magma it is produced from (e.g. basaltic vs. rhyolitic), meaning the composition can vary even between formation environments.

Volcanism and alteration have been dominant processes on Mars. Because of this, palagonite is often used in laboratory studies as an analog to "classic" Martian rock [11-13]. Palagonite has recently been hypothesized to occur on the surface of Mars [14], although definitively identifying it is tricky due to its mineralogic variability. In this study, we evaluate the composition and variability of palagonite on Earth in order to inform efforts to identify it on Mars.

Methods: Iceland has an abundance of palagonite outcrops due to its long glacial and volcanic history. Subglacial and intraglacial volcanic rocks are found in the Western, Eastern, Northern, Snæfellsnes, and Öræfajökull Volcanic Zone [15]. The rocks within these zones are predominately basaltic, often palagonitized, and formed during the Pliestocene (0.01-0.78 Ma) [15].

Palagonite samples were collected in Iceland at subglacial volcanic sites including around Reyjavik in the Western Volcanic Zone (WVZ; 8 samples), on the Southern Coast in the Eastern Volcanic Zone (EVZ; 1 sample), and from the Herðubreið and Askja volcanoes in the Northern Volcanic Zone (NVZ; 3 samples; Figure 1). While all samples are Pliestocene in age, they vary in degree of surface weathering. The sample from the Southern Coast was the most weathered.

Samples were dried out for 14 days in a fume hood. Visible and near infrared reflectance spectra were acquired of whole rock samples. Samples were not ground or sieved. In addition, the palagonite samples were measured using thermal infrared emission spectroscopy. Whole rock samples were heated to 80°C prior to the measurements.

Results: Below we discuss four samples and their variability.

Visible/Near-infrared Spectroscopy. Visible spectra show a strong red slope from ~350-700nm, with a strong reflectance peak between ~680-780nm (Figure 2). All samples also exhibit a broad absorption band near 1000 nm band, but with variable depth, width, and shoulder absorptions on the long wavelength side of the band. Hydration bands at ~1400 and 1900 nm are observed in all samples, as well as a ~1780nm band consistent with H-O-H/O-H bending and translation/rotation combinations common in some sulfates and zeolites. The samples exhibit highly variable absorptions between 2200-2300nm, consistent with Si-OH or Al-OH stretches near 2200 nm, (Fe,Mg)-OH stretches near 2300nm, and Al,(Fe,Mg)-OH stretches between 2230-2270nm. This suggests the presence of complex clay assemblages and possibly silica within the rock samples.

Thermal-infrared Spectroscopy. Broad absorptions at ~1000 cm^{-1} and ~465 cm^{-1} are consistent with laboratory spectra of glass (Figure 3), with narrower absorptions at ~1050 and 530 cm^{-1} are consistent with phyllosilicates. Modeling the mineral assemblage and the abundances will give possible mixtures for the spectra.

Conclusions and Future Work: Preliminary spectroscopic results show the sampled palagonites vary in mineralogy and possibly contain glass, Fe-oxides, clays, silica, and zeolites. Studying the variability of palagonite can help to differenciate "fresh" palagonite, weathering products, and welded rocks – all of which exhibit similar mineral assemblages but have completely different formation environments. Diffinitively identifying palagonite on the martian surface, while tricky, would be vital in constraining the formation environment and history of the surface.

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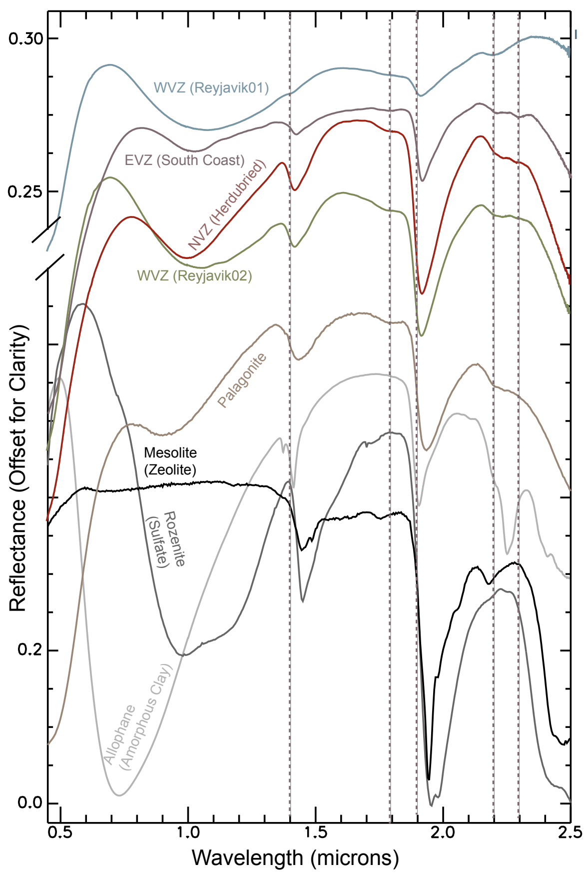

Figure 2. Visible and near-infrared spectra of Iceland palagonite samples (above) and laboratory spectra (below).

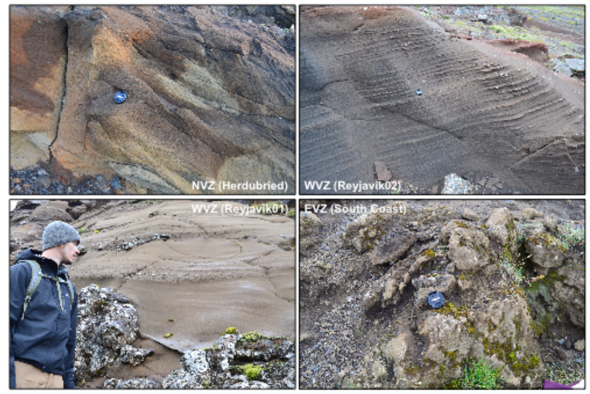

Figure 1. Field context of samples in the NVZ, WVZ, and EVZ.

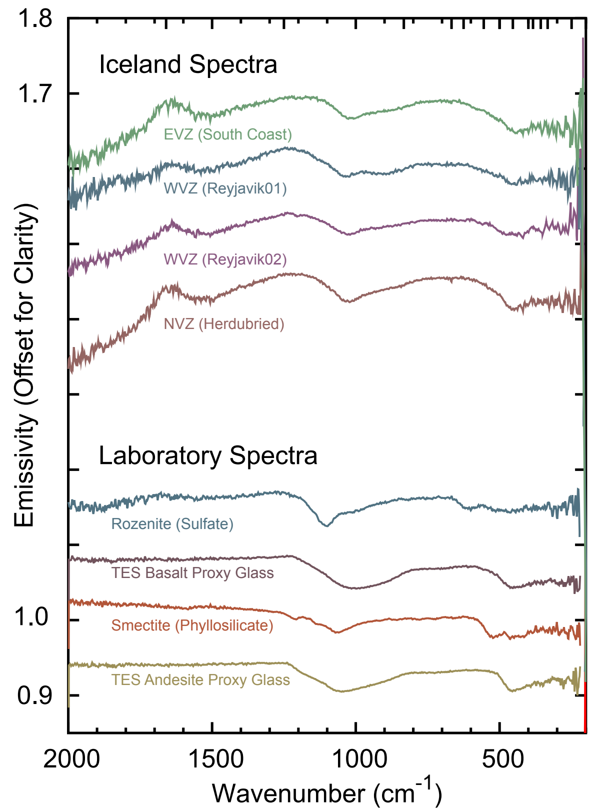

Figure 3. Thermal infrared spectra of Iceland palagonite samples (above) and laboratory spectra (below).