

VNIR REFLECTANCE AND MIR EMISSIVITY SPECTRAL CHARACTER OF CHLORIDE-BEARING MINERAL MIXTURES. C. Ye¹ and T. D. Glotch¹, ¹Department of Geosciences, Stony Brook University, Stony Brook, NY, 11794-2100 (cheng.ye.1@stonybrook.edu).

Introduction: The presence of chloride salt-bearing deposits in the southern highlands of Mars was originally observed in Mars Odyssey Thermal Emission Imaging System (THEMIS) daytime mid-infrared images. These features display a blue slope in the 8-13 μm region compared to the surrounding terrain [1, 2]. Chlorides have also been detected at VNIR wavelengths with the Mars Reconnaissance Orbiter Compact Reconnaissance Imaging Spectrometer for Mars (CRISM). At VNIR wavelengths, chloride salt-bearing deposit spectra have featureless red slopes in ratio spectra relative to the surrounding terrain over the ~ 1 -2.6 μm range and a weak or absent 3 μm feature, indicating lower overall hydration than the surrounding terrain [3, 4]. Laboratory data show that the characteristic CRISM spectra for these regions can be matched by mixtures of anhydrous chloride salt and silicates [5].

Chlorides often form as solute-rich waters or brines evaporate. Evaporative environments on Mars are most likely to resemble hydrologically closed continental brine systems on Earth. On Earth, these systems display a variety of mineral assemblages, which include chlorides, carbonates, and sulfates. No additional evaporite minerals have been identified in relation to chloride salt-bearing deposits on Mars.

In this work, we try to constrain the composition of chloride salt-bearing deposits on Mars and determine the additional evaporite minerals that may be present in halite/silicate mixtures. Here we present some preliminary results of simple mixtures of halite, gypsum, calcite, and laboradorite ($< 32 \mu\text{m}$ in size fraction).

Methodology: We obtained natural samples of halite, laboradorite, calcite, gypsum from Ward's Natural Science. Samples were ground with a mortar and pestle and then dry sieved to several grain size fractions ($< 32 \mu\text{m}$, 63-90 μm , 180-250 μm). Particles of less than 10 μm grain size were separated from the $< 32 \mu\text{m}$ fraction using Stokes' settling method. We made the halite/laboradorite mixtures with 5, 10 and 20 wt% halite. The third component, calcite and gypsum, was added to the mixtures with 20 wt%. Samples were gently mixed to obtain sample homogeneity. We collected VNIR reflectance spectra of our samples using an ASD FieldSpec3 Max spectroradiometer and MIR emissivity spectra on a Nicolet 6700 FTIR spectrometer at Stony Brook University's Vibrational Spectroscopy Laboratory.

Results: Mixtures of halite and laboradorite. Figure 1a shows spectra of halite/laboradorite mixtures. At visible to near-infrared wavelengths, the spectra show absorptions at 1.4 μm , 1.9 μm , 2.2 μm and 2.3 μm . In general, increasing halite corresponds to higher reflectance. At mid-infrared wavelengths (Figure 1b), the overall emissivity decreases with increasing abundance of halite. The emissivity spectra have an inverted silicate absorption between 1300 and 800 cm^{-1} .

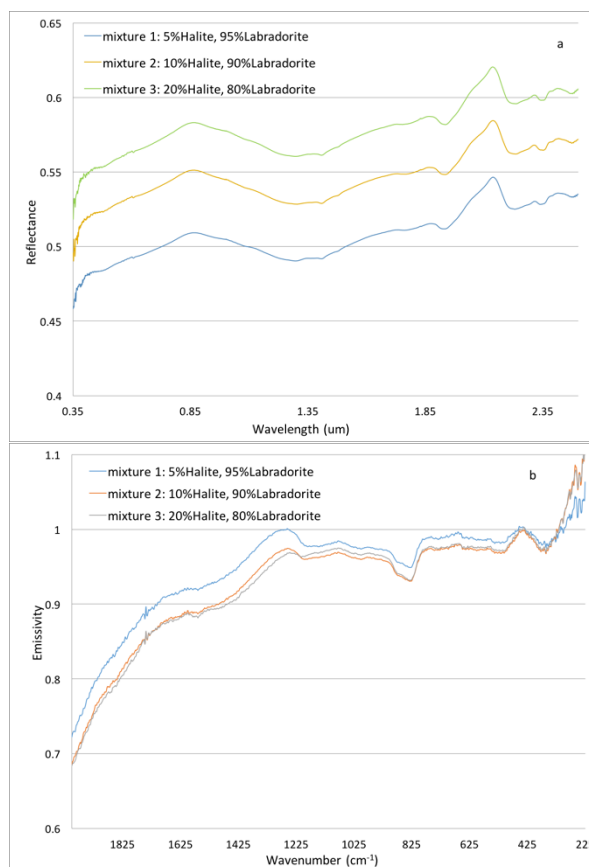


Figure 1. VNIR reflectance (a) and MIR emissivity (b) spectra of 5, 10, 20% mixtures of halite and laboradorite.

Mixtures of calcite and halite/laboradorite.

Figure 2a shows the spectra of calcite and halite/laboradorite mixtures. The overall spectral shape is similar to the two-component mixtures spectra. However, the mixture with 10% halite now has the lowest overall reflectance. The absorptions at 2.3 μm are deeper than those of halite/laboradorite mixtures, and are attributed to calcite. In the MIR emissivity spectra

(Figure 2b), the $\sim 1300\text{ cm}^{-1}$ is inverted compared with the emissivity of halite/labradorite mixtures.

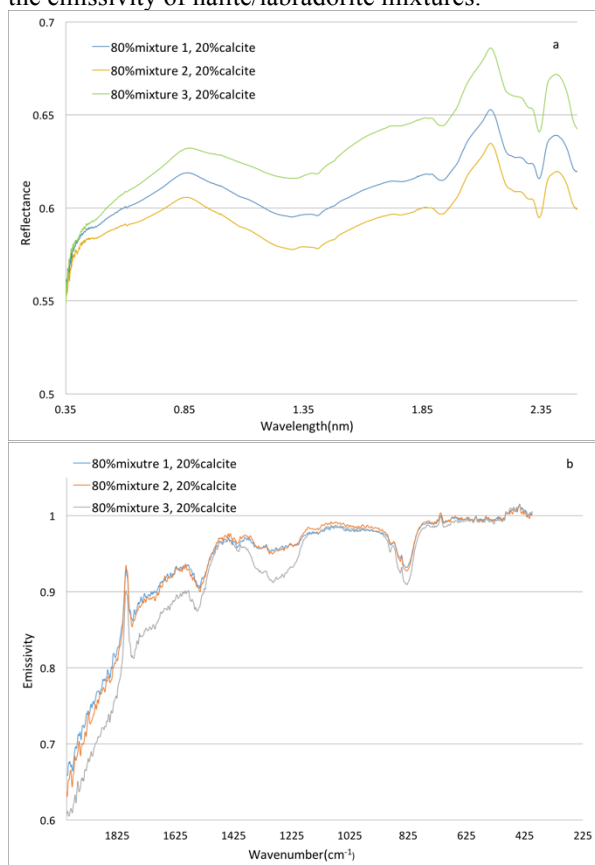


Figure 2. VNIR reflectance (a) and MIR emissivity (b) spectra of 20% mixtures of calcite and halite/labradorite.

Mixtures of gypsum and halite/labradorite.

The main features of the VNIR and MIR spectra (Figure 3a, 3b) are similar with the spectra of halite/labradorite, but the absorptions caused by gypsum are obvious in both VNIR and MIR spectra. Figure 3a shows the deeper absorptions at 1.4 and 1.9 μm and a new absorption at 2.5 μm due to gypsum. In MIR emissivity spectra (Figure 3b) an absorption band at $\sim 1530\text{ cm}^{-1}$ is much deeper and broader than the feature in halite/labradorite emissivity spectra.

Discussion: Our laboratory results of mixtures of halite and labradorite are consistent with previous work [5, 6]. At 20% abundances, calcite and gypsum contribute substantially to the spectra and are easily detectable.

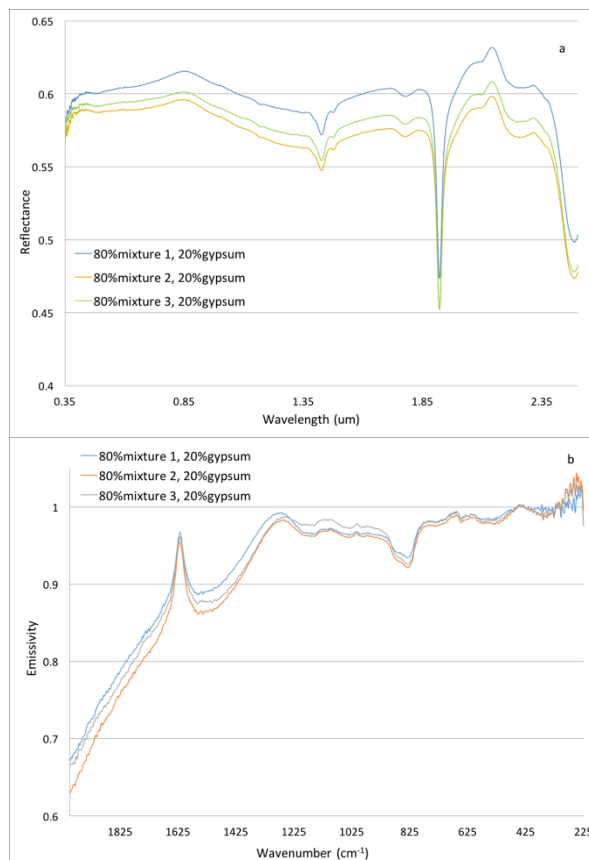


Figure 3. VNIR reflectance (a) and MIR emissivity (b) spectra of 20% mixtures of gypsum and halite/labradorite.

Work in progress includes the addition of other grain size fractions of all the samples and other evaporite minerals and/or chemical weathering products with different abundances to examine the influence of grain size and abundance on the spectra. We will also use several quantitative scattering models to predict spectra and then compare with laboratory data.

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References: [1] Osterloo, M. M. et al. (2008) *Science*, 319, 1651-1654. [2] Osterloo, M. M. et al. (2010) *JGR*, 115, E10012. [3] Murchie, S. L. et al. (2009), *J. Geophys. Res.*, 114, E00D06. [4] Glotch, T. D. et al. (2010), *Geophys. Res. Lett.*, 37, L16202. [5] Jensen, H. B., and T. D. Glotch (2011), *J. Geophys. Res.*, 116, E00J03. [6] Glotch, T. D. (2013) 44th LPSC, Abstract #1549.