INVESTIGATION OF THE NEAR INFRARED SPECTRAL CHARACTER OF PUTATIVE MARTIAN CHLORIDE DEPOSITS. H. B. Jensen$^1$ and T. D. Glotch$^1$, $^1$Department of Geosciences, 255 Earth and Space Sciences Building (ESS), Stony Brook University, Stony Brook, NY 11794-2100. heidijensensb@gmail.com

**Introduction:** Spectrally distinct units in the southern highlands of Mars have been analyzed using Thermal Emission Imaging System (THEMIS) and Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) data and have been proposed to be chloride-bearing based on the lack of spectral features throughout the visible to mid-infrared [1,2,3,4]. While anhydrous chlorides lack spectral features in this wavelength range, other materials such as unoxidized sulfides and homopolar compounds (e.g. graphite) do as well. While sulfides and homopolar compounds may be unlikely based on the geological context of these units, they have not been ruled out spectrally [1]. Chlorides and sulfides on their own do not possess the red slope that is seen in the 1.1-2.7 μm range of the CRISM FRT and HRL near-IR (NIR) data[5,6]. It was previously proposed that this slope could be replicated by the mixing of halite with labradorite [7]. In this work, we test whether this red spectral slope can also be formed by the admixture of anhydrous halite or unoxidized pyrite with other rocks and minerals lacking strong spectral features in the CRISM NIR spectral range.

Here we report on diffuse reflectance spectra of mixtures of halite or pyrite with flood basalt, augite and labradorite. By investigating these mixtures, we hope to find a combination that results in the red spectral slope viewed in the ratioed CRISM spectral data. (Figure 1).

**Methodology:** Natural samples of augite, flood basalt, labradorite and pyrite were obtained from Ward’s Natural Science, and halite was acquired from ACROS Organics (reagent grade 99%+ synthetic sodium chloride). Samples were ground with a mortar and pestle and then dry sieved to several grain size fractions (63-90, 125-180, 250-355 μm). Particulates of less than 10 μm grain size were separated using Stokes’ settling method [8].

Mixtures of basalt, augite, labradorite, and 5, 10, 50 and 75 weight percent halite were made for each size fraction. Samples were gently mixed to obtain sample homogeneity while maintaining grain size. These mixtures were then stored in a vacuum oven at 150ºC for ≥5 days and stored in a desiccator to remove any water adsorbed to the surface.

The 63-90 μm pyrite powder was acid washed with 1.0M deoxygenated HCl solution for 30 min and subsequently rinsed with deoxygenated deionized water and dried in a dry nitrogen glove box. Acid washing was necessary to ensure that oxidation products were not present. Mixtures of 25 and 50 weight percent pyrite were made with flood basalt of size fractions of larger than the 63 μm.

Great care was taken to ensure that the sample mixtures were not oxidized before spectral analysis.

![Figure 1. The CRISM ratio spectra of a putative chloride-rich unit with a phyllosilicate-bearing region for comparison derived from image FRT00009ACE_07. The calibrated I/F CRISM spectra from the region of interest and background are also displayed.](image)

**Results and Discussion:**

**Halite mixtures.** Displayed in Figure 2 is the ratio spectra of the (95 wt. % flood basalt 5 wt. % halite mixture)/ pure flood basalt. Even with only 5 wt. % halite added, the red slope towards longer wavelengths can be seen for all but the finest size fraction. With this quantity of halite, an increase in overall reflectance of the mixture compared to the pure basalt spectra can be seen on the order of a few percent. In order to try to best emulate the CRISM data, it was necessary to raise the overall reflectance of each background spectrum by ~1.5 % to the level of the mixture spectrum.
The 50% flood basalt 50% pyrite mixtures resulted in similar spectral character when ratioed to pure flood basalt.

Results and Discussion Our results show that the red slope seen in CRISM ratioed spectra of putative chloride-bearing units can be replicated in the laboratory by ratioing halite or pyrite mixtures with typical silicate minerals and rocks. The lack of absorptions and sloping character in the 1-2.7 μm region produced by ratioing of the laboratory mixtures supports the hypothesis that either chloride salts or unoxidized sulfides may be present on the Martian surface. While both of these mixtures are spectrally possible, 5% halite mixtures are more geologically feasible than 25-50% unoxidized pyrite persisting at the Martian surface. This idea is supported by the widespread presence of numerous sulfates throughout the surface of Mars indicating weathering of any sulfur-bearing materials on the surface or in the near subsurface. In addition sulfide minerals can be observed in nearly all SNC meteorites as accessory minerals while halite has been observed as a minor component in Shergotty and Nakla [9].

In future work, acid washed pyrite will be mixed with the other two minerals used in this study. If possible, other grain size fractions of acid washed pyrite could be helpful to reduce the discrepancy in grain size of the mixtures. In an attempt to remove the necessity of the alteration of the background spectra, 2% or less halite mixtures may prove useful if the desired slope remains intact. We will also investigate the visible wavelength region to see if spectra of all of the mixtures can also match the CRISM spectral character observed in this wavelength region.

Acknowledgements: This work was partially supported by NASA Mars Data Analysis Program Grant # NNX08AK93G made to T. D. Glotch.