REFLECTANCE SPECTRA OF LOW-TEMPERATURE CHLORIDE AND PERCHLORATE HYDRATES AND THEIR RELEVANCE TO THE MARTIAN SURFACE. J. Hanley, V.F. Chevrier, B.L. Davis, T.S. Altheide, A. Francis, W.M. Keck Laboratory for Space Simulation, Arkansas Center for Space and Planetary Science, MUSE 202, University of Arkansas, Fayetteville, AR 72701, USA, jhanley@uark.edu.

Introduction: Chlorides and perchlorates present on Mars can form aqueous solutions because of low temperature eutectics and related lower evaporation rates [1]. The recent discovery of chlorides and perchlorates on Mars by NASA's Phoenix Lander [2] reinforced the potential for chlorides on Mars.

Chlorides present in databases lack spectral features (absorption bands) in the near-infrared. Most spectral libraries contain only high temperature "Earth-relevant" chlorides, such as NaCl or KCl. However, at typical Martian relevant temperatures, hydrates are more stable [1]. Similarly, not much is really known about perchlorate spectral features.

Experimental: The following salts and their low-temperature hydrates were synthesized and measured: KCl, NaCl, $CaCl_2$, $MgCl_2$, $FeCl_2$, $FeCl_3$, NH_4Cl, $NaClO_4$, $KClO_4$, and $Mg(ClO_4)_2$. We also measured eutectic mixtures of ice and salt. Reflectance spectra were taken using a Nicolet 6700 FTIR Spectrometer to allow analysis in the range 1.0-2.5 µm. For comparison reasons, chlorides and perchlorates stable at ambient temperature were also measured. In the case of eutectic mixtures, we corrected for ice content using KCl + ice as a control sample since it does not form any hydrate.

Results: *Chlorides*. After correcting the spectra for water ice, we see KCl does not exhibit any significant features, nor does anhydrous NaCl (Fig. 1). However, other anhydrous chlorides (e.g. $CaCl_2$), as well as their hydrated forms, clearly show evidence of additional absorption bands. The most significant bands are located at 1.19, 1.44 and 1.97, the latter two due to hydration. Also, notice that the absorption band depth increases with increasing hydration state.

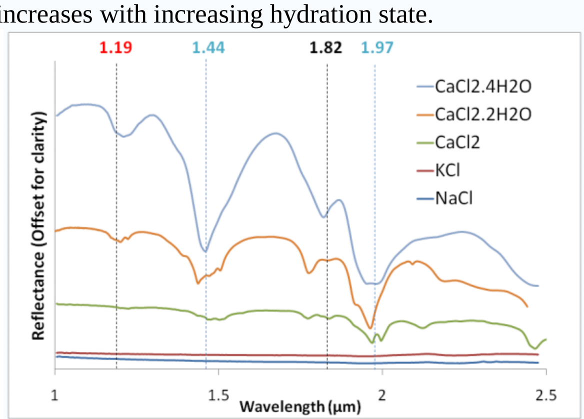

Figure 1. Diffuse reflectance spectra of various Mars-relevant chlorides. Note the presence of spectral features in all hydrated forms, as well as in anhydrous $CaCl_2$.

Perchlorates. Perchlorate spectra show numerous absorption bands (Fig. 2). Even anhydrous perchlorates have significant spectral features, as shown by $KClO_4$, which shows major absorption bands at 1.23, 1.55, 2.01 and 2.13 µm (Fig. 2A). $NaClO_4$•H_2O shows even more absorption bands (Fig. 2B), although at different positions, except for 2.14 µm (possibly due to the Cl-O bond in the perchlorate ion). Other major bands are located at 1.17, 1.42, 1.46 and 1.93 µm, the latter three corresponding to the usual hydration bands observed in all the hydrated phases. We do not observe any significant spectral difference between $NaClO_4$.$2H_2O$ and $NaClO_4$.H_2O except an increase in band depth due to the higher water content.

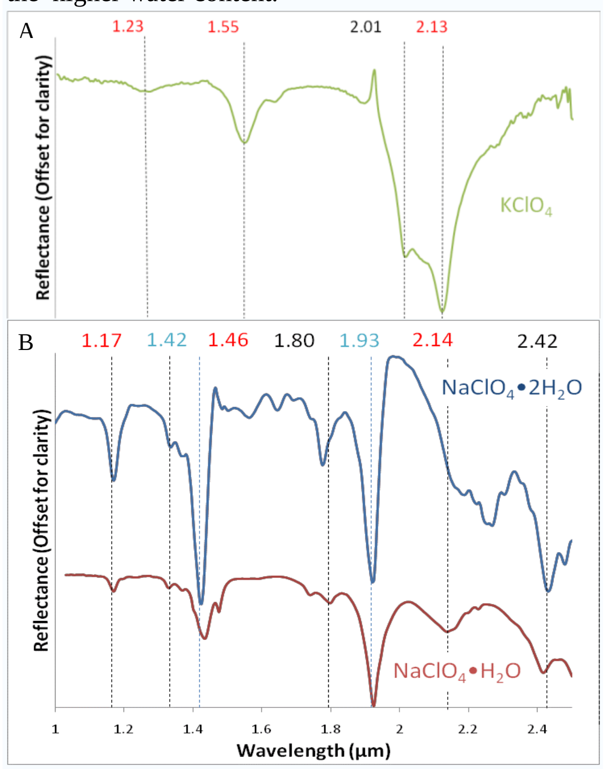

Figure 2. Diffuse reflectance spectra of (A) $KClO_4$ and (B) $NaClO_4$ hydrates.

Conclusions: Chlorides and perchlorates show significant spectral features that should allow for their identification on the surface of Mars: perchlorate bands are present at ~1.2, ~1.5, & 2.11-2.14 µm; hydrates show bands characteristic of hydrated phases (1.4 and 1.9 µm); and hydration band depth increases with increasing hydration state. Therefore, some unidentified hydrates could be chlorides or perchlorates.

References: [1] Chevrier, V. F. et al. (2009) *GRL*, L10202, doi:10.1029/2009GL037497. [2] Hecht, M. H. et al (2009) *LPS XL*, Abstract #2420.