EVIDENCE FOR AQUEOUSLY PRECIPITATED SULFATES IN NORTHEAST MERIDIANI USING THEMIS AND TES DATA.

Melissa D. Lane, Planetary Science Institute, 1700 E. Fort Lowell Road, Suite 106, Tucson, AZ 85719 (lane@psi.edu).

Introduction: Recently aqueously deposited sulfate-rich bedrock was found at the MER-B Meridiani landing site [1]. Additional sulfate was observed from orbit by the Mars Express OMEGA instrument [2]. In this work, I present midinfrared spectral evidence (using THEMIS and TES) for sulfate in and around a channel deposit that lies to the northeast of the hematite-strewn plains of Meridiani at ~2ºN, 1ºW (Fig. 1).

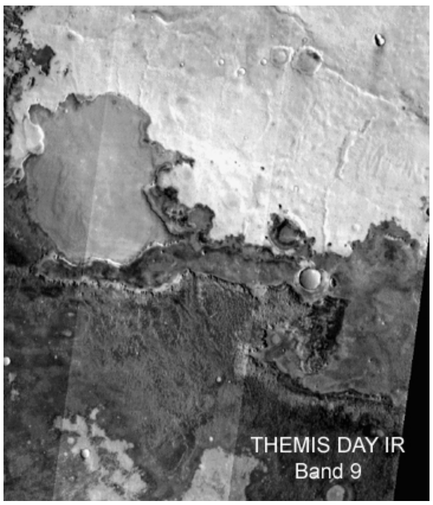

Fig. 1: THEMIS daytime IR band 9 image mosaic showing distinct geologic units.

Approach: A radiance decorrelation stretch (DCS) was performed on THEMIS daytime IR data to magnify the variation in thermophysical and lithologic properties (Fig. 2) as shown by the colors. The data then were radiometrically corrected to produce temperature-independent emissivity. The false-color emissivity images (not shown) still exhibited great color variety, supporting the lithologic diversity.

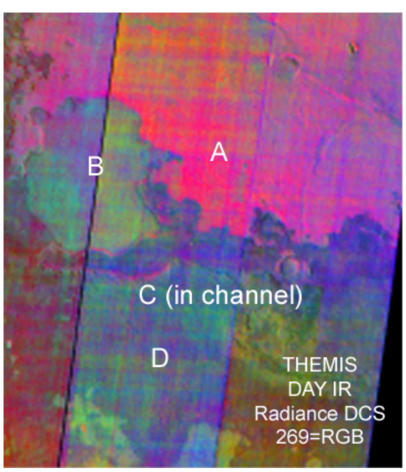

Fig. 2: THEMIS daytime IR radiance DCS image mosaic showing distinct geologic units.

In order to maximize the understanding of the unit compositions, high-spectral-resolution TES data were extracted for each color unit (A-D) defined by the THEMIS data (Fig. 2). These data were then deconvoled using an endmember suite that included the 8 spectral endmembers derived by Bandfield [e.g., 3,4], representing atmospheric as well as broad surface components, in addition to a variety of sulfate minerals.

Results: *Unit A:* Deconvolution of the spectra from the pink area "A" showed a predominance of Syrtis-type [3] basalt (92%) in addition to 8% sulfate. The atmospherically corrected surface spectrum ("Pink unit") is shown in Fig. 3. Comparison of the unit A surface spectrum to a Syrtis-type endmember shows the need for additional components. Although detailed analyses of the spectra have not gone confidently beyond lumping the individual sulfate minerals into a "sulfate" category, the deconvolution results did return glauberite, jarosite, and polyhalite. Comparison of these three sulfate spectra to the modeled surface spectrum shows why these minerals were identified in the deconvolution.

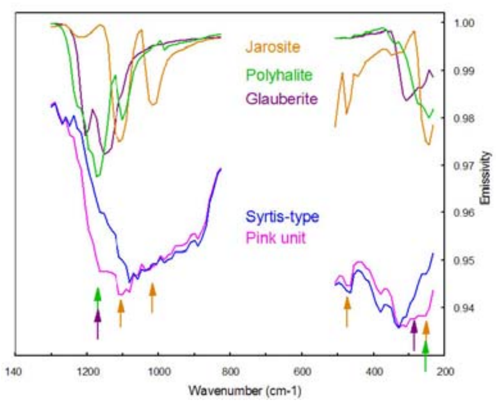

Fig 3. Modeled pink surface (unit "A") spectrum as compared to the derived constituents.

Unit B: The unit "B" was previously identified as bearing coarse, gray hematite [5]. The spectral deconvolutions from this study show the same result of abundant hematite (~24%), in a Syrtis-dominated unit (60%). The component kieserite also was retrieved at ~11%. Minor (~4 and 2%, respectively) jarosite and glauberite were also identified. This list of minerals is intriguing because the MER-B Opportunity rover has found evidence for jarosite [6] as well as Ca- and Mg-bearing sulfates [7] within the hematitic Meridiani plains to the southwest. It is likely that the two hematite units are the same stratigraphic unit [5,9].

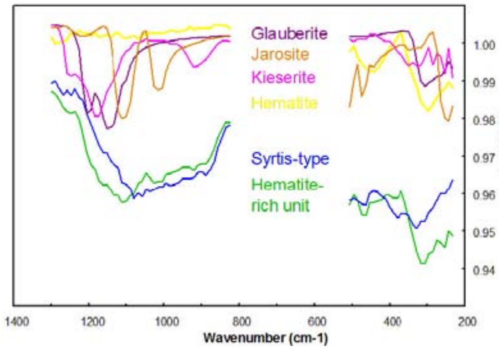

Fig. 4: Modeled hematite-rich surface (unit "B") spectrum as compared to the derived constituents.

Unit C: Data from 5 channel-crossing TES orbits were individually analysed. The deconvolutions all returned sulfates from 10 to 25%. Visual inspection of several 18 m/pixel THEMIS VIS images shows bright "bathtub rings" within the channel and the adjoining crater basins (Fig. 5) that likely originated as

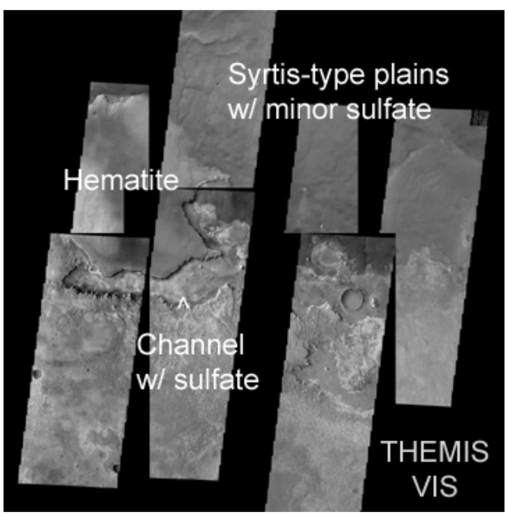

Fig. 5: THEMIS VIS mosaic showing "bathtub" ring deposits in the canyon and adjoining craters

the water dried up and the sulfate-rich salts precipitated. The highest percentage of returned sulfate seems to correlate with the brightest canyon "tub ring" deposits; however that specific deconvolution also had the highest RMS error. An example spectrum of a channel deposit can be seen in Fig. 6. For this particular spectrum 90% of the surface could be modeled as Syrtis-type basalt; however it is clear when comparing it to a Syrtis spectrum that other constituent minerals with fundamental vibrational bands around 1200 cm^{-1} are required to fit the spectrum better. This deconvolution returned 10% sulfate (the lowest of the group).

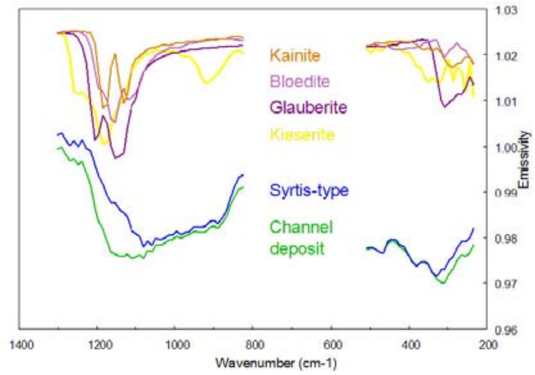

Fig. 6: Modeled channel surface (unit "C") spectrum as compared to the derived constituents.

Unit D: Deconvolution results (not shown) suggest that his unit is dominated by Syrtis-type basalt (~85%); however the unit is also sulfate-rich (~15%).

Conclusions: Spectral deconvolution of high-spectral-resolution TES data show this regional area to be dominated by Syrtis-type basalts and sulfates as well as hematite (for certain units). Although there is work still to be done in deciphering the specific sulfates involved, it appears that they are predominantly Ca-, Mg-, K-, and Na- bearing.

Not only are sulfates found within the channel itself, but also sulfate is required to satisfy the TES spectra of the surrounding plains to varying degrees.

Future work: Additional spectral deconvolution endmembers will be added to include a variety of hydrated silicates. This region and an area just to the east will be investigated further with THEMIS and TES data because preliminary results look promising for more sulfates, and a comparison will be made to the results from OMEGA.

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References: [1] Squyres, S. W. et al. (2004) *Science*, 306, 1698-1703. [2] Bibring J.-P. (2004) COSPAR, abs.#: 04-A-01888. [3] Bandfield, J. L. et al. (2000) *Science, 287,* 1626-1630. [4] Bandfield, J. L. (2002) *JGR, 107,* 5042, 10.1029/2001JE001510. [5] Christensen, P. R. et al. (2001) *JGR, 106,* 23873-23885. [6] Klingelhöfer, G. et al. (2003) *Science, 306,* 1740-1745. [7] Christensen, P. R. et al. (2003) *Science, 306,* 1733-1739. [8] Rieder, R. et al. (2003) *Science, 306,* 1746-1749. [9] Hynek et al. (2002) *JGR, 107,* 5088, doi: 10.1029/2002JE001891.