Extending CRISM Spectral Coverage in Gale Crater Using THEMIS-VIS and HiRISE

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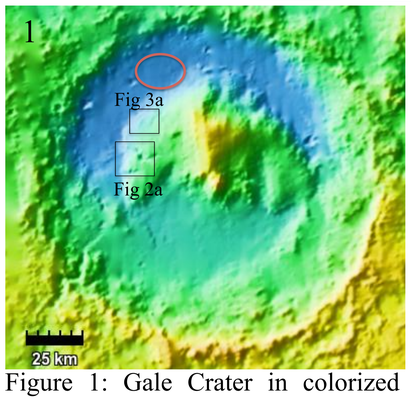


Figure 1: Gale Crater in colorized MOLA elevation data [5]

Introduction

- Gale Crater (landing site for MSL) contains phyllosilicate- and sulfate- bearing materials on and near its central mound [1]
- We investigate whether MRO's High Resolution Imaging Science Experiment color images (HiRISE color) [4] and the Mars Odyssey orbiter's Thermal Emission Imaging System Visible Imaging Sysytem (THEMIS-VIS) [2,3] can be used to identify clay and/or sulfate deposits at finer spatial scales and/or in areas not yet measured by CRISM

Methods

- We converted HiRISE and THEMIS-VIS radiance data to radiance factor (I/F), then to estimated Lambert albedo by dividing I/F by the cosine of the average solar incidence angle
- We investigated parameters such as color ratio and visible spectral curvature to search for potential correlation between visible-wavelength color properties and the presence of phyllosilicates or other mineral phases that have been detected in the near infrared

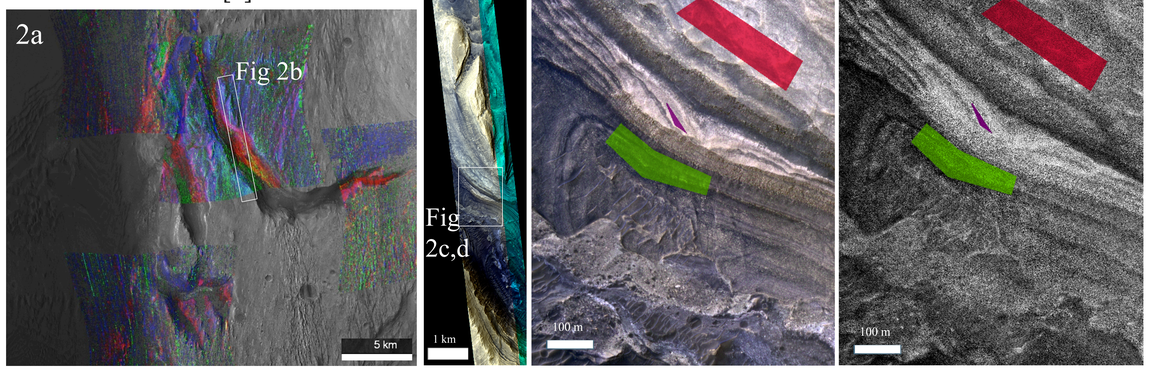
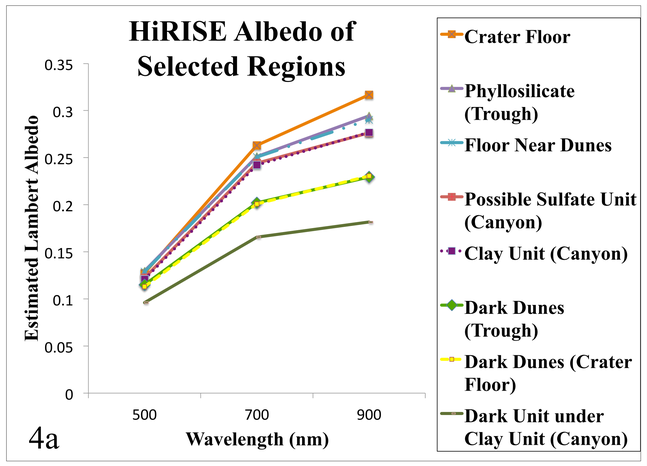


Figure 2: a) From Milliken (2011) [6] CRISM mineralogy of the canyon in Gale's central mound. Red = olivine-bearing dunes, green = nontronite. b) HiRISE image PSP_006855_1750_COLOR crosses the canyon where CRISM detected a clay-bearing unit. c) HiRISE Color Composite (RGB: 900/700/500 nm) [4] of the clay unit in the canyon. Red polygon is a "Possible Sulfate Unit", purple is the "Clay-Bearing Unit", [7] and green is a "Dark Unit under Clay Unit". d) HiRISE 900/700 nm ratio (Black=1.09 White=1.17).



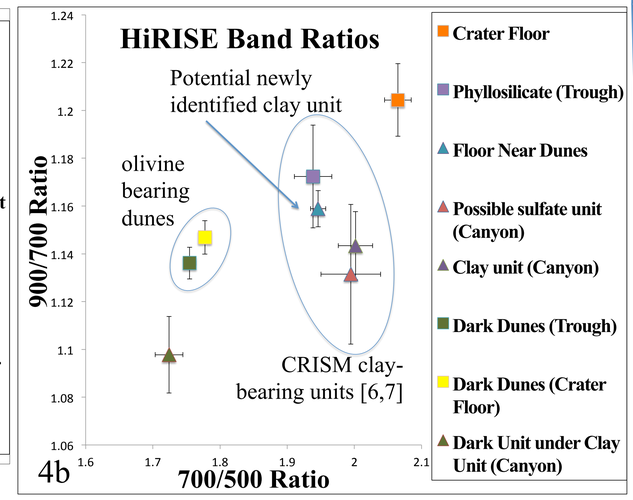


Figure 4: a) Three point spectra of the selected HiRISE regions. b) 900/700 nm ratio vs 700/500 nm ratio for all of the selections. The CRISM identified clay-bearing units are circled, as well as the areas identified as olivine-bearing dunes. c) 900/700 nm ratio vs 700/500 nm band ratio for spectra of various minerals convolved to HiRISE bandpasses. Mineral spectra were found on the online CRISM library [8]. d) An example of a mineral's (Nontronite) library spectrum convolved to HiRISE bandpasses.

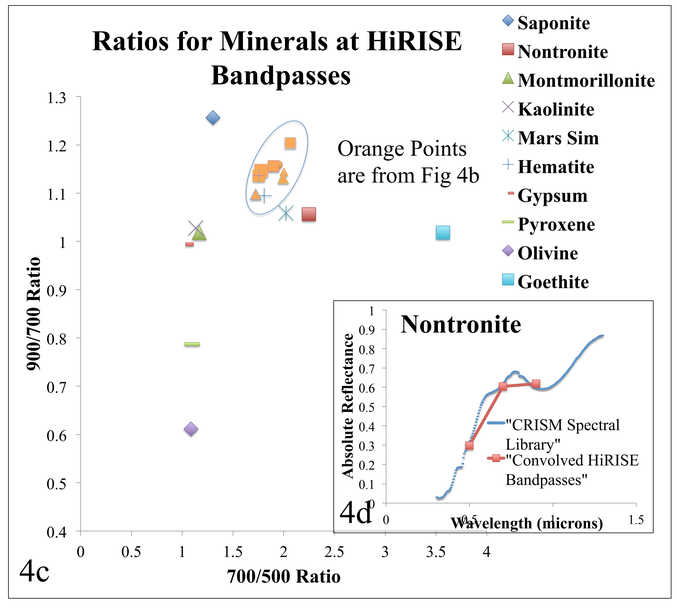
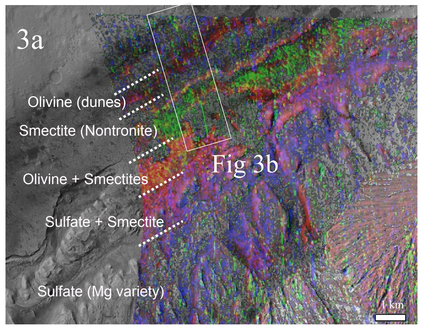
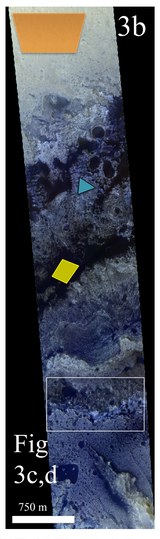


Figure 5: RGB (749, 654, 540 nm) mosaic of THEMIS-VIS 4-band color images available to date within Gale Crater. Most of the MSL landing ellipse and likely traverse region will be covered by THEMIS-VIS color data prior to the August 2012 landing.





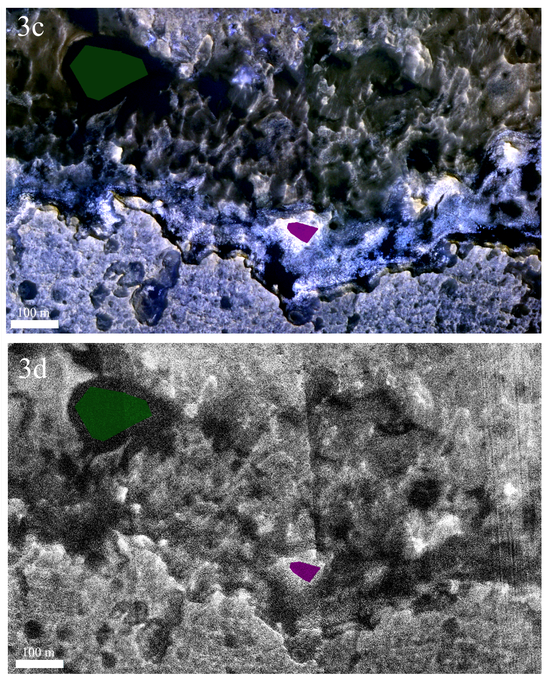
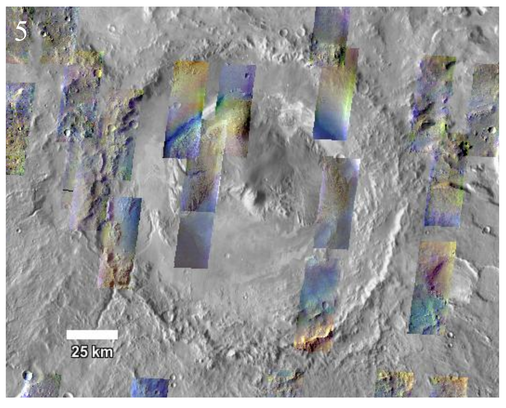


Figure 3: a) From Milliken (2011) [6] CRISM mineralogy near MSL's landing ellipse. b) HiRISE image ESP_021610_1755_COLOR crosses a dune field and a phyllosilicate-bearing trough. Orange polygon is the "Crater Floor". Yellow is "Dark Dunes (crater floor)". Teal triangle is "Floor Near Dunes". c) HiRISE RGB: 900/700/500 close up of the phyllosilicate trough. Purple is the "Phyllosilicate (Trough)" unit. Green ("Dark Dunes (trough)") covers a dune on the floor of the trough. d) HiRISE 900/700 nm ratio. (Black=1.13 White=1.17)



Results

- Olivine bearing dunes and clay-bearing units are separated on a plot of HiRISE 900/700 nm to 700/500 nm color ratio data
- Trends in HiRISE color ratio data follow trends in laboratory convolved mineral spectra
- We identified a potential new clay-bearing unit that is closer to MSL's landing ellipse than the phyllosilicate-bearing trough

Conclusions and Future Work

- Possible HiRISE parameters (900/700 nm band ratio and 900/700 nm vs. 700/500 nm) may provide ability to qualitatively link clay-bearing units identified in CRISM data to color units identified in HiRISE 3-point spectra
- THEMIS-VIS 4-band visible color data are potentially useful, but coverage in MSL field site still somewhat sparse and shorter-wavelengths compared to HiRISE color data may not enable as strong a spectral correlation to near-IR CRISM data
- Future work within Gale and elsewhere will include more extensive analysis of HiRISE color images, a detailed analysis of THEMIS-VIS color data, assessment of potential correlations between CRISM-detected sulfate materials and HiRISE, THEMIS-VIS color

References

[1] Milliken, Grotzinger, and Thomson (2010), Geophys. Res. Lett., 37, L04201; [2] Christiensen, P. *et al.* (2001), Space Science Reviews, 110, 85-130; [3] McConnochie, T. H., *et al.* (2006), *J. Geophys. Res.*,*111*, E06018; [4] Delamere, *et al.* (2010), Icarus, Volume 205, 38-52; [5] Zuber, M. T. *et al.* (1992), *J. Geophys. Res.*,*97*(E5), 7781–7797; [6] Milliken (2011), Mineralogy at Gale Crater, 5th MSL Landing Site Workshop; [7] Milliken, R. E. et al. 2009. LPSC, 1479. [8] CRISM Online Spectral Library, http://ode.rsl.wustl.edu/MROCRISMSpectralLibrary/search.aspx