THEMIS VIS COLOR MOSAIC AND MULTISPECTRAL INVESTIGATION OF GALE CRATER K. A. Bennett[1], J. Hill[1], C. Edwards, [2] J. F. Bell III[1], and P. Christensen[1]; [1]School of Earth and Space Exploration, Arizona State University, [2]Division of Geological and Planetary Sciences, California Institute of Technology.
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Introduction: The Mars Science Laboratory (MSL) rover Curiosity landing site is within Gale Crater, a ~150 km impact crater located near 5°S, 222°W. Here we present the first regional color mosaic of Gale Crater using Mars Odyssey Thermal Emission Imaging System, Visible Imaging Subsystem (THEMIS-VIS) images and a multispectral analysis of the area using the THEMIS-VIS four point 425 to 749 nm spectra.

Background: THEMIS is a multispectral imager on the Mars Odyssey spacecraft with a nine-band midinfrared microbolometer array and a five-band visible and NIR (near-infrared) interline transfer CCD imager [1]. The visible/NIR camera (THEMIS-VIS) has a of up to 18 m/pix and four filters with band centers located at 425, 540, 654, and 749 nm. With these spectral bands, multi-spectral THEMIS-VIS observations are useful for the characterization and identification of Fe-bearing minerals [2].

Gale Crater was selected as the MSL landing site in July 2011. At that time, the THEMIS team began targeting Gale and the surrounding area to be covered with full resolution multi-spectral VIS observations. As of July 2011, there were 9 images over Gale Crater. As of March 2014, there are 115, which represents ~70% areal coverage of the target area and ~90% coverage of the crater. In February 2014, the Mars Odyssey spacecraft accelerated its drift towards later local times. This new orbital geometry is optimal for making observations of morning fog as well as sunrise and sunset temperatures. However, as a result, Odyssey now passes over Gale Crater in the late evening, when it is too dark to take visible images. Therefore, the current mosaic likely represents the most comprehensive THEMIS VIS dataset available for compositional analysis at Gale.

Methods: The color mosaic was created using the methods of Edwards *et al.* [3]. Images were first map projected, and then mosaicked together using techniques including blending and normalizing. To analyze the 4 point spectra, we converted PDS-archived THEMIS-VIS radiance data to estimated Lambert albedo using the method in Bennett *et al.* [4].

THEMIS-VIS images have been previously noted to contain artifacts as a result of stray light [5]. In this work we have reduced the effect of these artifacts by manually setting the values of the affected pixels to a null value and by not using severely affected images when multiple images were available over one area.

Preliminary Results: The preliminary color mosaic of Gale crater is shown in Figure 1. Bands 4/2/1 were used as the RGB inputs (749/540/425 nm). We can discern multiple color units within the mosaic, and the 4 point spectra are displayed for several units in Figure 2. Figure 2a shows various spectra from the MSL traverse area, while Figure 2b shows spectra from three different locations on the central mound. The dune fields appear in blue or purple hues in the mosaic and they exhibit anomalously low albedos at longer wavelengths (Fig 2a). The crater floor varies from purple in the south to light pink in the north. Near the MSL traverse route, we sampled two areas of the crater floor: the hummocky unit and the Peace Vallis fan. These two units were spectrally indistinguishable (Fig 2a). The crater rim and walls vary from yellow to brown, but near the MSL traverse the crater wall spectra was not significantly different from the crater floor units (Fig 2a). Gale's central mound is predominantely beige or light pink. Near the MSL traverse area, the Lower mound is not spectrally different than the crater floor and crater wall units, but the yardang unit exhibited higher albedo at longer wavelengths (Fig 2a). Figure 2b shows that the upper mound shows no spectrally signficant diffferences from the lower mound. The crater exterior is generally grey, with some local variations in color.

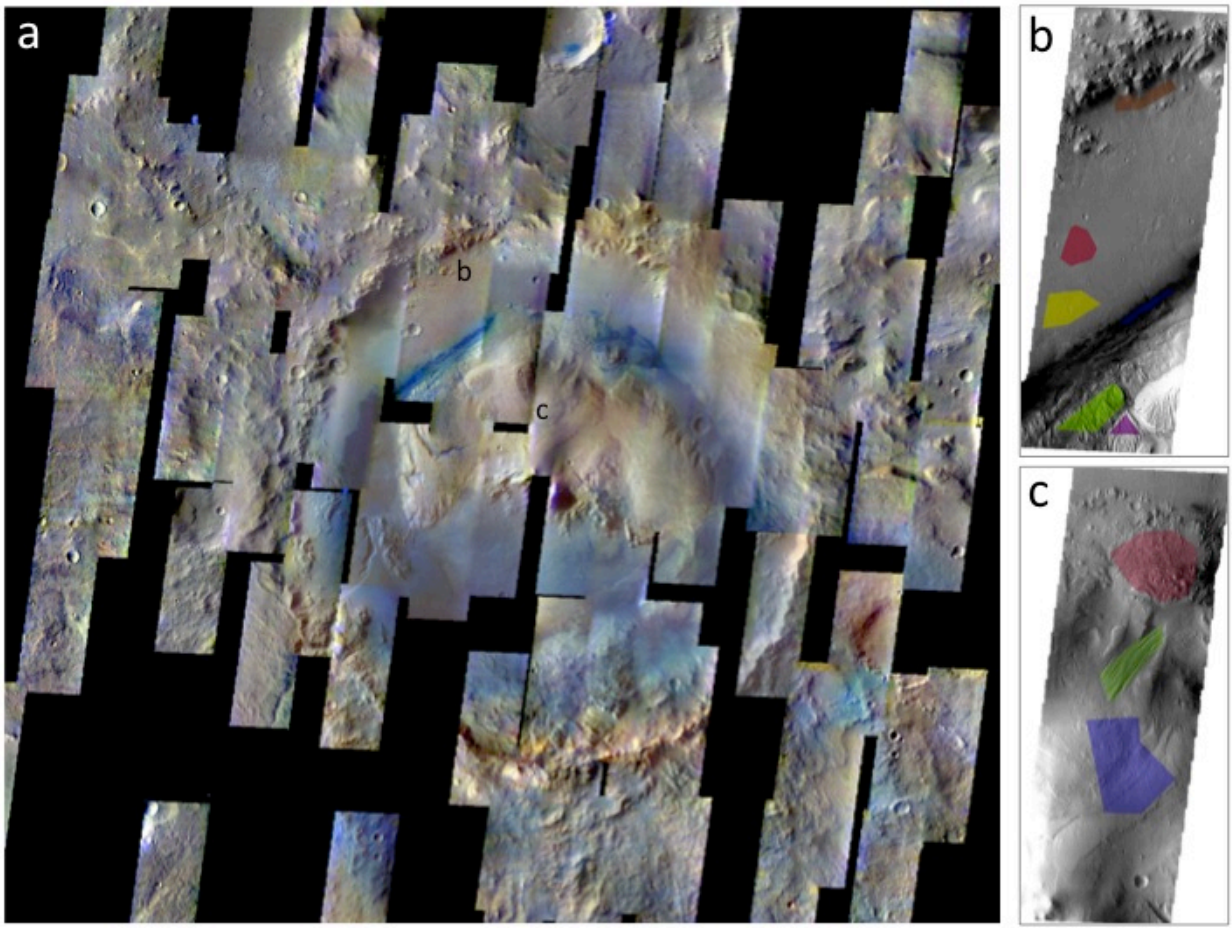
Discussion: The difference between the yardang unit spectra and the other spectra in the MSL traverse area could imply that the yardang unit did not have the same source material as the other units. The dunes also show a unique signature, which we can use to identify its source material if it is near or within Gale. All the mound features exhibit roughly the same spectra, which could imply that the lobate feature and the lineated feature are sourced from the upper mound. It is also possible that the THEMIS-VIS color units are influenced by the occurrence of dust. For example, dunes are relatively dust-free, which could explain their low albedo.

Implications and Future Work: The THEMIS-VIS color mosaic of Gale clearly shows variations in color across the crater. This mosaic should prove to be a useful tool for comparing different units across the region, as well as understanding where the crater floor and mound units were sourced from. Future work will include studies devoted to understanding what type of mineralogy different THEMIS-VIS colors represents. One way to achieve this is to compare THEMIS-VIS

multispectral data to CRISM hyperspectral data. If the color variations seen in THEMIS-VIS correlate to the mineralogy observed in CRISM, we can potentially create more extensive, regional mineralogy maps at Gale crater than already exist with CRISM, whose coverage is primarily limited to the MSL traverse area.

References: [1] Christensen *et al.* (2004) Space Sci Rev 110: 85–130. [2] Bell III, J.F. *et al.* (2008) Cambridge University Press, Ch 8, pp. 169-194. [3] Edwards *et al.* (2011) JGR, 116, E10008. [4] Bennett *et al.* (2012) LPSC, #2761. [5] McConnochie *et al.* (2006) JGR, 111, E06018.

Figure 1: a) THEMIS VIS Color Mosaic of Gale Crater. R= 749 nm, G= 540 nm, B = 425 nm.
b) THEMIS VIS stamp V52390002. The colored regions respresent the areas sampled for the spectra shown in Figure 2a.
c) THEMIS VIS stamp V48007002. The colored regions respresent the areas sampled for the spectra shown in Figure 2b.



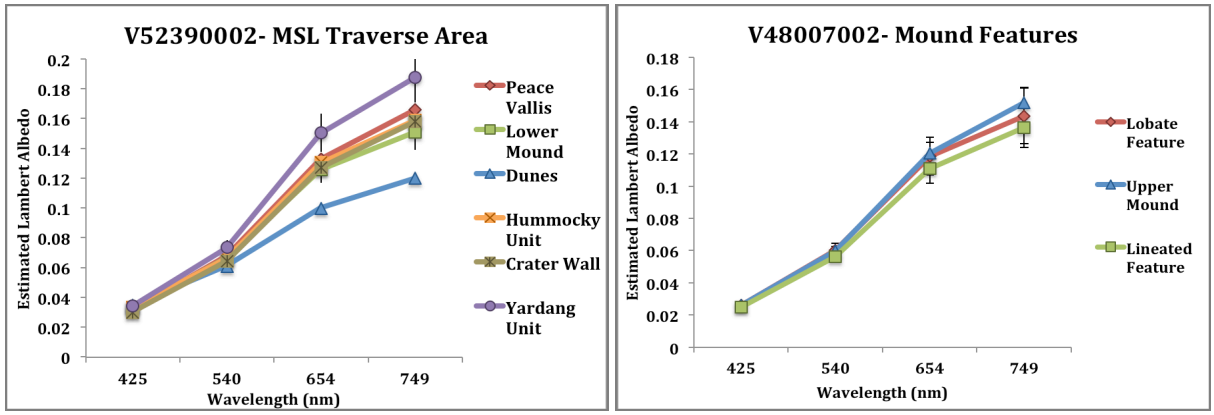


Figure 2: a) (left) THEMIS VIS 4 point spectra from image V52390002 of the MSL traverse area.
b) (right) THEMIS VIS 4 point spectra from image V48007002 of Gale crater's central mound.