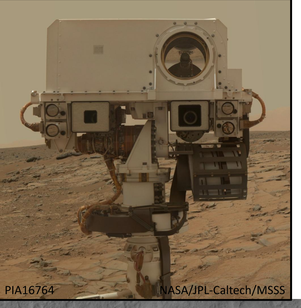


# MSL/Mastcam Multispectral Observations of Lower Mt. Sharp Units: Spectral Evidence of Distinct Alteration Environments

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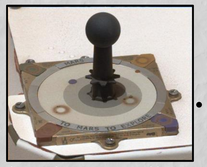
## 1. Instrument & Calibration

- The Mastcam instruments are a pair of 1600x1200-pixel CCD cameras each with a rotating filter wheel for multispectral imaging [1,2,3].
  - The filter set wavelength band centers span from 445 – 1013 nm, and were selected to capture visible/near-infrared absorption features of certain (commonly iron-bearing) minerals [2,4].
  - Frequent images acquired of the calibration target (left) located on the rover deck allow observations to be accurately calibrated to relative reflectance.



*Above: The Mastcam calibration target on sol 66*

## 3. Hematite-Bearing Drill Fines

- Spectral signatures consistent with hematite were observed in bedrock near the Bagnold dunes and again after the rover exited the Naukluft Plateau (See #2173, this session [6]).
- Mastcam can detect a short-wavelength absorption edge and an 860 nm absorption feature that we interpret as evidence of hematite.
- Oudam drill tailings spectra possess the strongest short-wavelength feature (absorption extending to the 527 nm filter) but little evidence of a near-infrared band. The spectrum is very similar to an early hematite-bearing drill target, Confidence Hills (Fig 3.).
- Marimba, Quela, and Sebina drill tailings possess a long-wavelength (860 nm) absorption. This feature is very weak in Quela but stronger in Marimba and especially Sebina.
- These spectral variations may represent difference in hematite grain size, abundance, and/or bulk mineralogy between drill sites.

**Fig. 3:** Reflectance Spectra of Drill Tailings with Hematite-Like Spectral Features (Sols 1363 – 1496, and Confidence Hills)

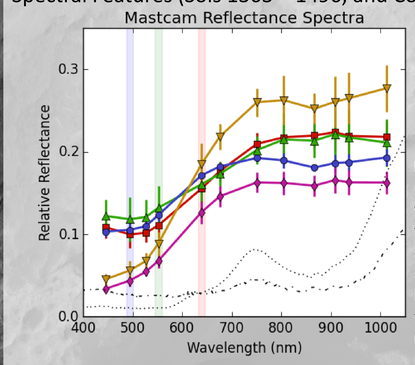



**Fig. 3:** Mastcam reflectance spectra are shown as mean ROI values plotted against Mastcam filter band centers. Vertical color bars indicate the positions of the Bayer channels. The hematite spectra are GDS69 from the USGS spectral library (splib06) [7].

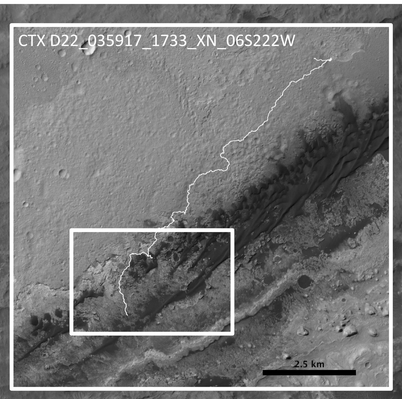



**Fig. 1:** Context map (CTX) showing area used as background (HiRISE image ESP_035917_1755_ RED). MSL rover traverse path is shown in white.




**Fig. 2:** Reflectance Spectra of Drill Tailings of Light-Toned Materials and Adjacent Drill Targets, Sols 1062 – 1333

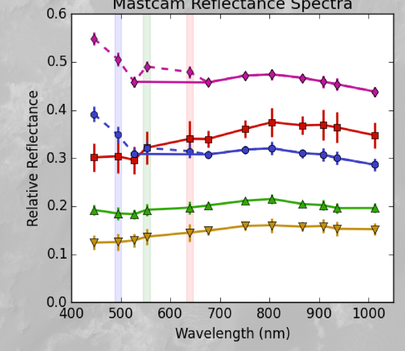



**Fig. 2:** Mastcam reflectance spectra are shown as mean ROI values plotted against filter band centers. Vertical color bars indicate the positions of the Bayer channels. Dashed lines in portions of the Greenhorn and Lubango spectra indicate suspected spectral artifacts.

## 2. High-Si and Nearby Drill Fines

- Curiosity encountered light-toned bedrock enriched in silica [5] near the Murray-Stimson contact at Marias Pass, and further along the traverse within the Stimson unit. In the Stimson, this material occurred as light-toned "haloes" adjacent to fractures in the bedrock.
- Mastcam multispectral observations were acquired on the drill tailings of the Buckskin drill target (Murray Fm.) and Stimson altered/unaltered drill pairs (Fig. 2).
- Light-toned materials have high reflectance values throughout the wavelength range of the camera and lack strong absorption features, consistent with an enrichment of a spectrally neutral species (silica) over darker iron-bearing minerals. A minor downturn beyond 800 nm is attributed to ferrous phases.

**Fig. 4:** Reflectance Spectra of Small-Scale Features, Sol 1445

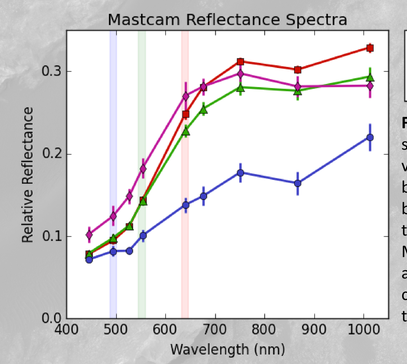



**Fig. 4:** Mastcam reflectance spectra are shown as mean ROI values plotted against filter band centers. Vertical color bars indicate the positions of the Bayer channels. In this plot, M-34 (left camera) values only are shown because most of the corresponding ROIs are outside the M-100 field of view.

## 4. Small-Scale Features

- Small-scale features within the portion of the Murray recently traversed by the rover exhibit strong spectral variations.
- Variations in overall reflectance and in spectral features such as the 867-1012 nm slope have been observed.
- The DRT spot observation of sol 1445 additionally captured unusually strong differences in nearby material, including a dark nodule with one of the strongest NIR upturns observed to date. Other surfaces have a much weaker slope between these filters than the ordinary bedrock (Fig 4.)

## 5. Summary

- Reflectance spectra of silica-enriched drill targets have higher overall reflectance and relatively featureless spectra. The high silica content appears to contribute significantly to the reflectance observed by the cameras. Some of the light-toned halo material (e.g. Lubango) is among the brightest material observed by the rover to date.
- The rover has moved into terrain with spectral features that are consistent with crystalline hematite. These hematite-like spectra themselves vary in the strength of short and long-wavelength features from site to site and over small spatial scales. The variation may be due to a combination of different hematite grain sizes, abundances, and other differences in mineralogy between samples.

## References

[1] Malin et al. (2010) *41st LPSC,* 1123. [2] Bell et al. (2012) *43rd LPSC,* 2541. [3] Bell et al. (2017) *Earth & Space Science*, submitted. [4] Wellington et al. (2017) *Am. Min.*, in press. [5] Wiens et al., P11B-1857 [6] Fraeman et al., P23B-2173 [7] Clark et al. (2007) USGS splib06