Visible to Near-IR Spectral Units Along the MSL Gale Crater Traverse: Comparison of In Situ Mastcam and Orbital CRISM Observations

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CRISM: Description & Methodology

- The Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) [1] is a scanning hyperspectral imager aboard the Mars Reconaissance Orbiter (MRO).
- Two separate detectors measure VNIR (362-1053 nm) and IR (1002-3920 nm) at 6.55 nm spectral sampling. We concentrate here on the short wavelength data, which overlaps MSL Mastcam wavelengths.
- The CRISM Analysis Toolkit (CAT) was used to perform photometric correction and map-projection for the selected FRT (full-resolution targeted) observation (see Figure 1) covering the MSL traverse.

Introduction

The Mars Science Laboratory (MSL) Curiosity Rover has been exploring the environment of Gale Crater for over 800 sols. The Mastcam instruments (right column) have collected over 300 multispectral observations, including observations targeted towards the base of Mt. Sharp. This region has also been extensively targeted by the CRISM instrument (left column), whose VNIR detector covers a wavelength range similar to Mastcam.

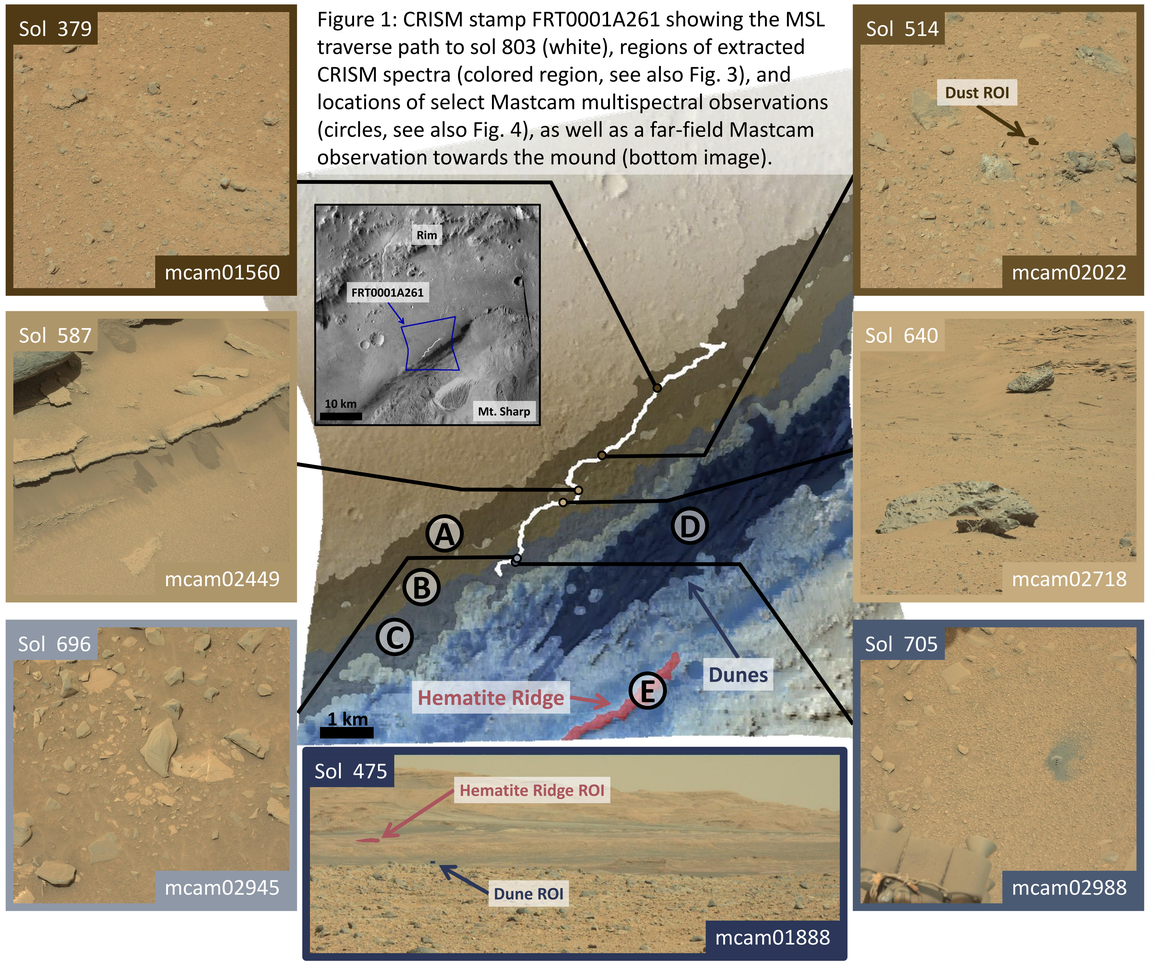

Figure 1: CRISM stamp FRT0001A261 showing the MSL traverse path to sol 803 (white), regions of extracted CRISM spectra (colored region, see also Fig. 3), and locations of select Mastcam multispectral observations (circles, see also Fig. 4), as well as a far-field Mastcam observation towards the mound (bottom image).

Mastcam: Description & Methodology

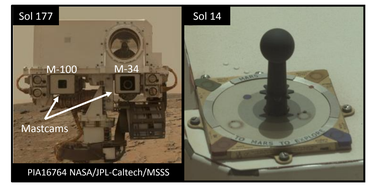

Figure 2: (Left) A Curiosity self-portrait showing the location of the two Mastcam instruments. (Right) The Mastcam calibration target, which contains three grayscale rings and four corner color chips for accurate reflectance calibration.

- The Mastcam instruments [2] are a pair of fixed focal length CCD cameras located atop Curiosity's mast.
- A rotating eight-position filter wheel provides multispectral imaging capabilities in up to 12 unique wavelengths from 445 – 1013 nm [2,3].
- Calibration is accomplished by means of near-in-time imaging of the on-board calibration target [4].
- Multispectral left-eye near-noon observations along the traverse (Figure 1) showing representative surface material were selected for comparison.

CRISM Spectra

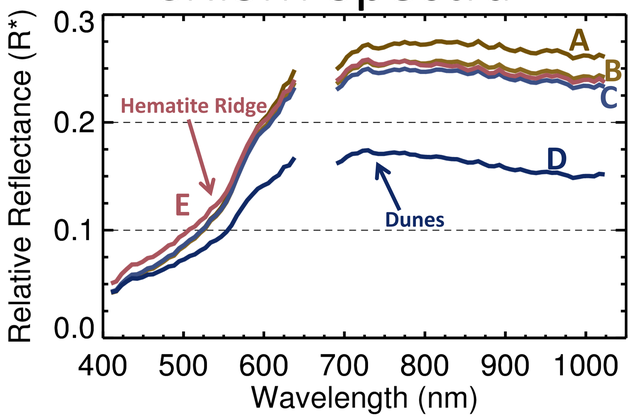

Figure 3: A plot of CRISM VNIR reflectance spectra shows a gradual decrease in reflectance in selected regions (see Fig. 1) approaching the dunes. Also shown is a spectral region (red) previously shown to exhibit a hematite signature [5,6].

Mastcam Spectra

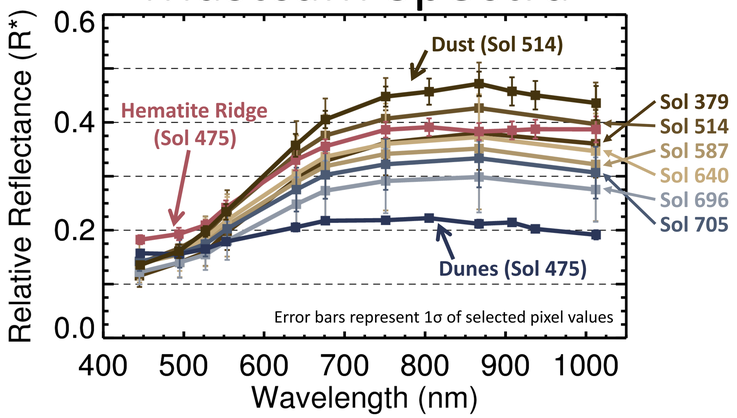

Figure 4: A plot of Mastcam spectra averaged over each image (excluding e.g. hardware) showing a decrease in reflectance from spectra closer to the dunes. Also shown are spectra extracted from an observation targeted toward the central mound containing the dune field and hematite ridge.

Results

- CRISM spectra extracted from spectrally similar regions are shown in Figure 3. These spectra show a gradual decrease in reflectance closer to the dune field. The hematite ridge spectrum has a shallower slope at shorter wavelengths and a weak feature at 850-950 nm.
- Mastcam spectra averaged over whole or large parts of images show a similar decrease in reflectance closer to the dune field (Fig. 4). As in CRISM, the hematite ridge spectrum displays a shallower short-wavelength slope and a weak longer-wavelength absorption in Mastcam data. The dunes exhibit a broad1-µm absorption.

Summary

- Subtle variations seen in CRISM spectra on/near MSL's traverse route are detectable to the MSL Mastcam instrument.
- Changes in reflectance spectra from both instruments are consistent with less dust cover and/or more dark dune material spatially closer to the dune field.
- Mastcam spectra of the "hematite ridge" and dune field are consistent with orbital measurements [5,6,7].

References

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