LPSC Abstract 3061 (Location 409)

Use of MRO/CRISM Hyperspectral Imaging Data for Mapping the Mineralogy of Jezero Crater

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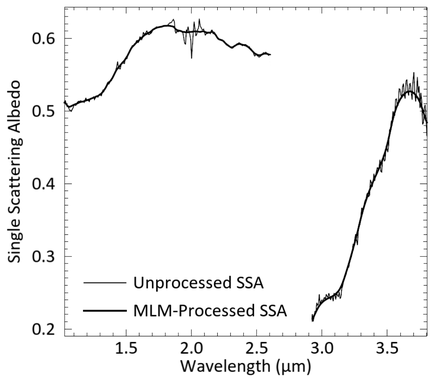
Processing Pipeline [6,8,9]

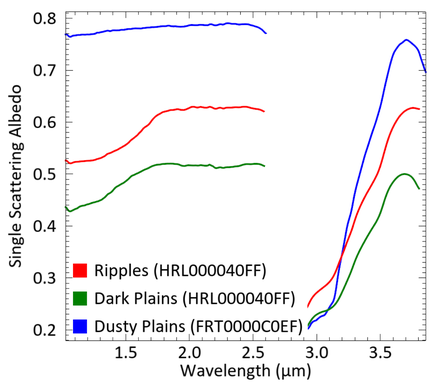
The WUSTL CRISM processing pipeline (see [9] for details) uses radiative transfer modeling (DISORT, [10]), Hapke theory ([4]), and a neural network-based approach ([5]) to generate three types of summary product:

- Single-Scattering Albedo (SSA): the ratio of scattering efficiency to extinction efficiency, which should be independent of viewing conditions
- Spectral parameter maps from [11], built using SSA
- Temperature maps based on an inversion of the Planck function at long wavelengths

A median filter based on [2] and a maximum-likelihood algorithm (termed 'MLM') are used to remove instrument noise and invert the detector's transfer functions.

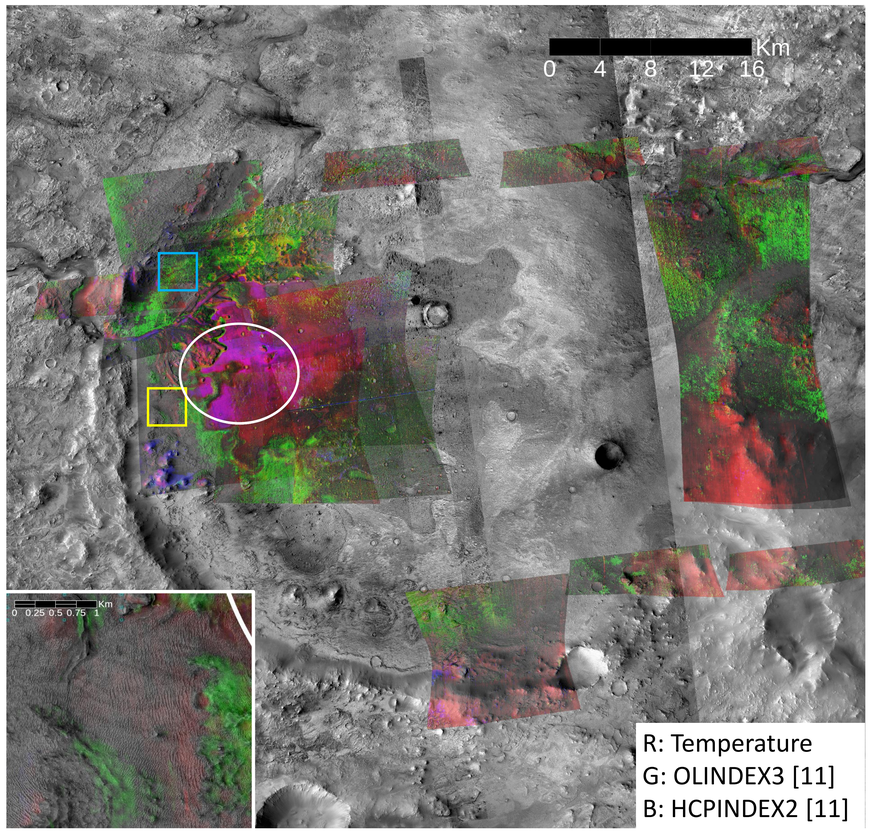


SSA spectra of a carbonate-rich region (1,444 pixel mean) in scene HRL000040FF (blue box, right), both unprocessed (thin line) and MLM-processed (thick line). This work modified the existing median-filter de-noising operation (based on [2]) to better preserve key diagnostic features between 2.1μm and 2.6μm.



Three overlaid SSA spectra, showing the ripple field (central inset, 390 pixel mean) and the nearby dark plains unit (scene HRL000040FF, 476 pixel mean), and the dusty plains unit from Gale crater (scene FRT0000C0EF, 939 pixel mean).

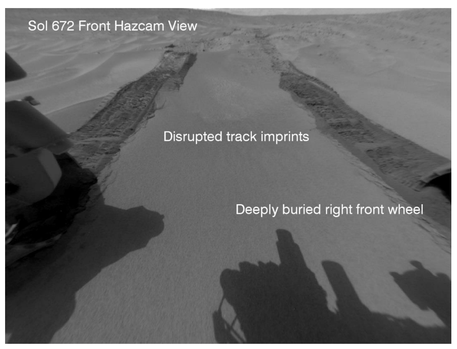
	CRISM Scene Id	Observation Date		CRISM Scene Id	Observation Date
Western Delta	HRL000040FF	2007-01-29	Elsewhere in Jezero Crater	HRL00010963	2009-01-18
	FRT000047A3	2007-02-26		HRL000116C6	2009-03-03
	FRT000066A4	2007-06-27		FRT0001C558	2010-12-09
	FRT0001FB74	2011-08-14		FRS000281D1	2013-01-02
	FRT00021DA6	2011-12-14		FRS0002AF61	2013-08-22
	FRS0002FE75	2014-05-19		FRS0002BA97	2013-10-05
	FRS00031260	2014-07-14		FRS0002C92B	2013-12-05
	FRS00031442	2014-07-19		FRS0002DA94	2014-01-29



Processed CRISM scenes over a CTX mosaic, showing Jezero Crater and the Mars 2020 landing ellipse (in white). The pink region, warm with high HCP, in the landing ellipse has been mapped as a dark plains unit, interpreted by [3] as volcanic in origin. Overlapping parameter maps from separate CRISM observations show very good agreement in the generated parameter maps. **INSET:** CRISM scene HRL000040FF over HiRISE (ESP_042315). Ripple fields, interpreted as basaltic sands, do not appear in these parameter maps.

Comparisons to Gale Crater

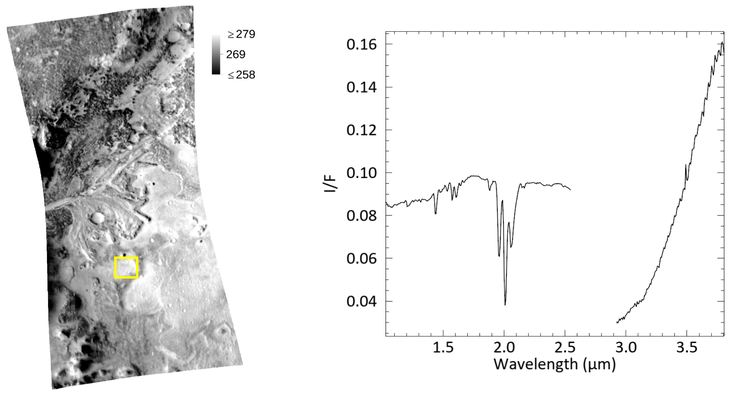
The Bagnold dune field in Gale crater are a major unit of dark-colored, low thermal inertia, actively evolving dunes, with a similar spectrum to their source material. In comparison, the Jezero ripples have a spectral signature between their likely source region (the dark plains unit) and known dusty plains from Gale crater (left), suggesting that they have a dust covering and are likely less active than the Bagnold dunes.



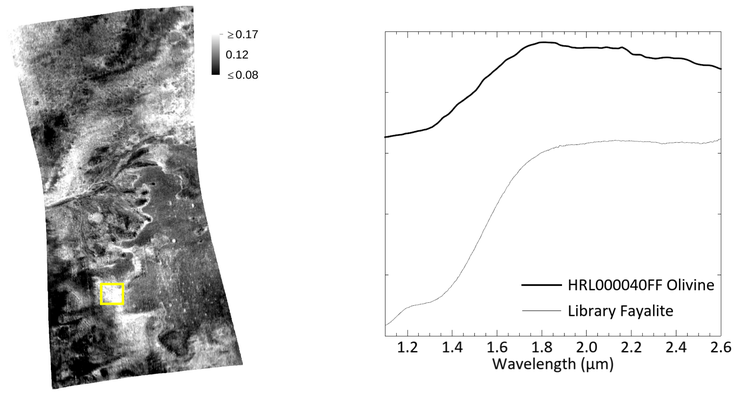
Implications for Mars 2020

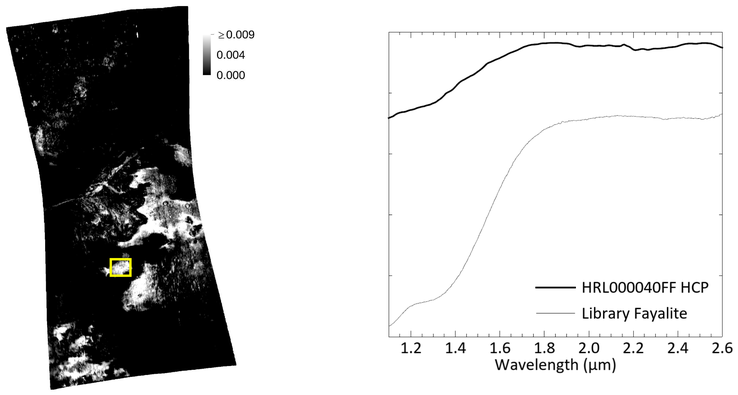
Megaripples can be hazardous for rover navigation, particularly when their wavelengths is similar to the length of the wheelbase of the rover trying to navigate them [1]. This work has already had partial success in locating large ripple fields at high resolution using temperature maps and spectral parameters from [11]. The processing pipeline used can be extended to estimate thermal inertia, which is much lower for loose sediment that would pose a navigation hazard than it is for safer bedrock. Maps showing navigational hazards will be useful for safely directing the Mars 2020 rover to important scientific destinations without risking the rover.

Combination of this processing approach (focused on de-noising CRISM observations and producing easily-comparable spectra) with other processing techniques designed to identify mineral components (e.g. [7]) may help direct the Mars 2020 rover to the most scientifically valuable sites.



HRL000040FF temperature map, with an unprocessed I/F spectra from the dark plains unit (yellow box, 476 pixel mean).





TOP LEFT: HRL000040FF OLINDEX2 [11] map.
TOP RIGHT: SSA spectrum from a high-olivine region (yellow box, 248 pixel mean) with a library fayalite reflectance spectrum. Both spectra show a broadly similar shape, supporting the identification of olivine at that location.

BOTTOM LEFT: HRL000040FF HCPINDEX2 [11] map.
BOTTOM RIGHT: SSA spectrum from a high-HCP region (yellow box, 476 pixel mean) with a library fayalite reflectance spectrum. The observed SSA has much shallower short-wavelength absorption than the library spectrum, indicating that other minerals beyond the omnipresent olivine are present.

Library spectra are from the CRISM spectral library distributed through the CRISM Analysis Tool (CAT) software, available at http://pds-geosciences.wustl.edu/missions/mro/crism.htm

References
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