USE OF MRO/CRISM HYPERSPECTRAL IMAGING DATA FOR MAPPING THE MINERALOGY OF JEZERO CRATER. J. R. Christian[1] and R. E. Arvidson[1], [1]Washington University in St. Louis, Dept. of Earth and Planetary Sciences

Introduction: We have improved portions of our WUSTL processing pipeline [1,2] for hyperspectral image data acquired with the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) hyperspectral instrument on the Mars Reconnaissance Orbiter (MRO) [3]. The improved approach better preserves key diagnostic features between ~2.1 µm and ~2.5 µm of minerals such as sulfates and carbonates as compared to the existing median filtering pipeline component [4].

We have used this processing pipeline along with standard CRISM spectral parameters [5] to map the mineralogy of Jezero Crater and its immediate surroundings as part of a CRISM Team-led comparison of results for multiple scene covering Gale and Jezero Craters and NE Syrtis, i.e., Curiosity's field site, the 2020 rover's field site, and a possible future landing site [6]. In this abstract we focus on HRL000040FF and comparison with co-registered CTX and HiRISE scenes. This allowed us to distinguish minerals present as outcrops, as locally-sourced sands in aeolian ripples, and as sands transported from outside the crater.

Processing Improvements: The preexisting processing pipeline [1,2] for CRISM hyperspectral images consists of two phases: the derivation of single-scattering albedo (SSA) hyperspectral cubes and temperature maps, and refinement of the hyperspectral cubes to retrieve the best estimates of single-scattering albedo (SSA) values in the presence of Poisson noise. The refinement stage first filters noise related to instrument limitations, then inverts the detector's spatial and spectral transfer functions using a maximum log-likelihood model (MLM).

Our improved processing methodology switches from a median filter based on the design of Eliason and McEwen [4] to one which analyzes spectral-domain curvature to detect narrow spikes due to detector-related noise. This approach better preserves subtle spectral features detected by as few as several CRISM channels (~6.55 nm spacing [3]) while still filtering out spikes due to detector noise. Figure 2 shows sample spectra of different mineral assemblages taken from our example CRISM scene (Fig. 1), indicating the improvements made to the calculated SSA spectra by the filtering and MLM steps.

Mineral Mapping: Mineral distribution in Jezero Crater and surrounding areas was accomplished by applying the improved processing pipeline to a number of overlapping CRISM full-resolution targeted (FRT) and half-resolution long (HRL) scenes, processed to a uniform resolution of ~12 meters per pixel. Standard spectral parameters from [5] were used to generate maps, which were compared to co-registered CTX and HiRISE scenes to identify structure (in particular, whether individual detections were from aeolian ripples or in-place outcrops).

Preliminary mineral maps using HRL000040FF (Fig. 1) are largely in agreement with the published literature [7,8]. Spectra taken from a region known to be enriched in Mg-carbonates [8] show characteristic absorption features at 2.3 µm and 2.5 µm (Fig. 2). Spectra taken progressively from the center of the carbonate-bearing region towards the edge show a corresponding decrease in the depths of those absorption features, indicating a gradual transition from a carbonate-dominated composition to one dominated by other hydrated phases.

Implications for Mars 2020: The Mars 2020 rover will be landing in Jezero Crater in February 2021, with the intent of looking for past habitable environments. Results from our continued work and comparisons with other advanced data processing techniques employed by the CRISM Team [6] are meant to be used to help the 2020 rover team direct the rover to in-situ outcrops of geologically-interesting minerals, as opposed to externally-sourced materials of unknown origin, e.g., wind-blown sands of regional origins. Furthermore, this work is meant to elucidate potentially interesting geologic features that merit further exploration and analysis, such as the arc containing both Mg-carbonate and olivine outcrops interior to the crater rim (likely a relic of lacustrine activity within the crater) [7].

Future Work: As part of a comparison between CRISM processing methodologies [6], this processing pipeline will be used to analyze eight CRISM scenes from Gale Crater (where ground truth on mineralogy is available from the Curiosity rover) and Jezero Crater (in preparation for Mars 2020). CRISM scenes planned to be used for this comparison are given in Table 1.

References: [1] Kreisch C. D. et al. (2017) *Icarus, 282*, 136-151. [2] Politte D. V. et al. (2018) *Lunar Planet. Sci. XLIX*, #2063. [3] Murchie S. L. et al. (2007) *JGR*, *112.E05S03*. [4] Eliason E. M. and McEwen A. S. [5] Viviano-Beck et al. (2014) *J. Geophys. Res. Planets, 119*, 1403-1431. [6] Parente M. et al. (2019) these abstracts. (1990) *Photogramm. Eng. & Remote Sens., 56.4*, 453-458. [7] Goudge T. A. et al.

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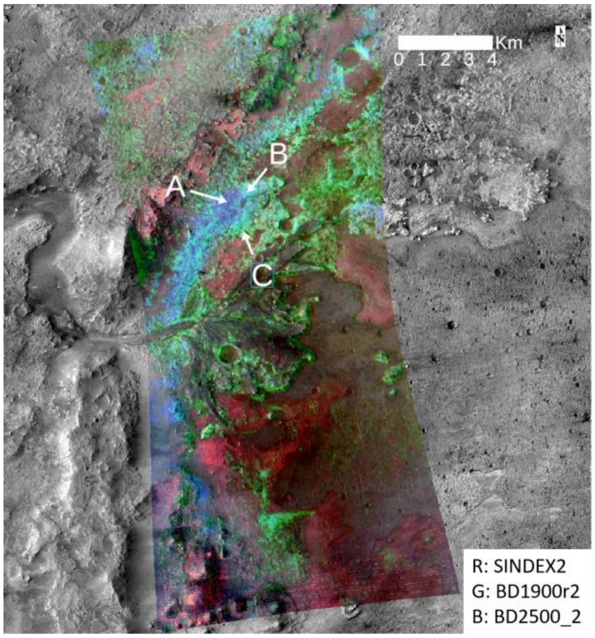

Figure 1 Processed CRISM scene HRL000040FF overlain on a mosaic of CTX images. Arrows indicate the location of spectra in Figure 2. Spectral parameters from [5].

Table 1 Planned scenes for CRISM analysis as part of a comparison between different processing methodologies [6].

Gale Crater	Jezero Crater
HRL000040FF	HRL000040FF
FRT0000B6F1	FRT000161EF
FRT00021C92	FRT00018DCA
ATO0002EC79	FRT00005C5E
FRT0000C518	FRT0001642E
FRT0001FD99	FRS00031442
FRT0001BBA1	FRT000165F7
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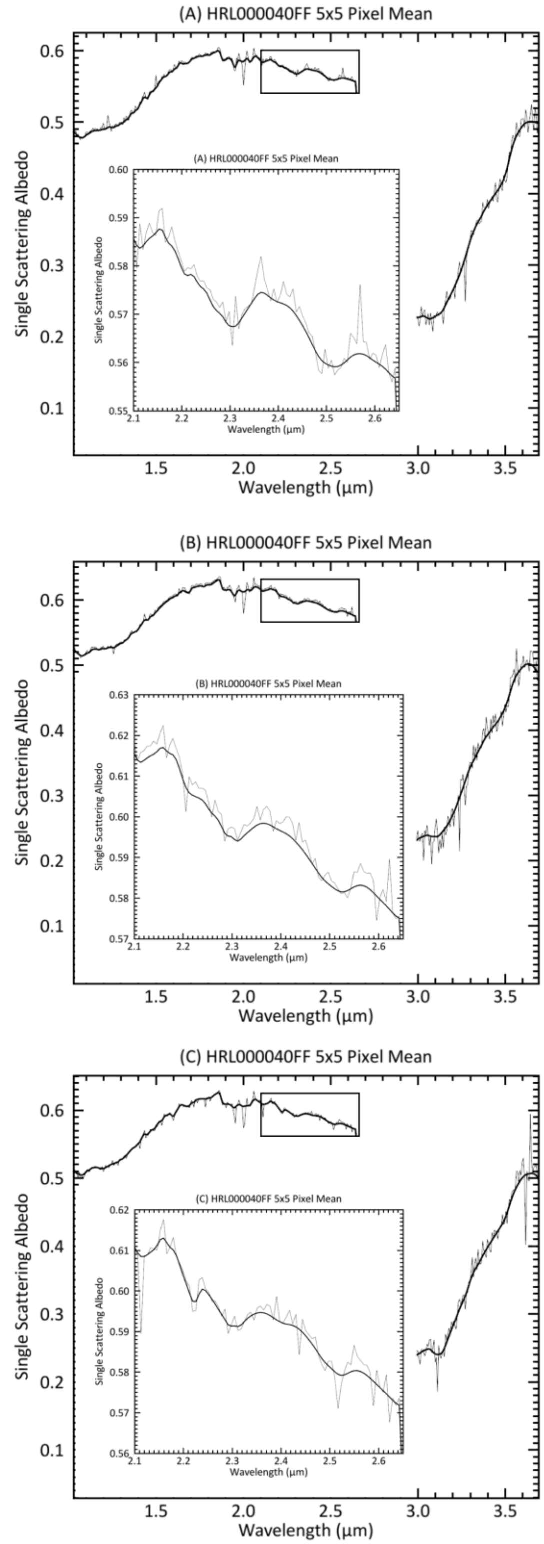

Figure 2 Selected spectra from HRL000040FF, showing retrieved SSA (thin lines) and the MLM-processed SSA (thicker lines). Spectra are interpreted as a mix of Mg-carbohydrates and other hydrated phases, with decreasing Mg-carbohydrate abundance from **(A)** to **(C)**. Spectra locations are given in Figure 1.