HYDRATED SILICATES AND CARBONATES MAPPING IN CANDIDATE MARS2020 ROVER LANDING SITES WITH INTEGRATION OF DYNAMIC APERTURE TARGET TRANSFORMATION AND SPARSE UNMIXING (IDATTSU). Xia Zhang[1], Honglei Lin[1], J. F. Mustard[2] and J. D. Tarnas[2]. [1]Institute of Remote Sensing and Digital Earth, CAS, Beijing, 100101 (zhangxia@radi.ac.cn), [2]Dept. of Earth, Environmental, and Planetary Sciences, Brown University, RI, 02912.

Introduction: Mapping of hydrated minerals is helpful for selecting the Mars2020 rover final landing site and can also provide fundamental information for optimizing the rover route. Jezero crater, NorthEast Syrtis Major (NE Syrtis) and Columbia Hills are the final three selected candidate landing sites of the Mars2020 rover. Here, we provide quantitative analysis of hydrated silicates and carbonates in the final three Mars2020 rover candidate landing sites.

Data: CRISM data [1] mapped from 365 to 3937 nm at a spectral resolution of 6.55nm and at high spatial resolution was used in this study. Photometric correction (I/F spectrum divided by cosine of the incidence angle) and atmospheric correction with volcano scan method [2] were performed. The spectral range used in this study is 1.021-2.602μm to focus on diagnostic features of hydrated minerals concentrated in this wavelength range [3].

Method: Two different methods were proposed to qualitatively/quantitatively analyze the presence of hydrated minerals on the surface of Mars in our recent work [4, 5]: Sparse unmixing [6] and Dynamic Aperture Target Transformation [7] (DATT). Sparse unmixing can find targets from a large endmember library to best model the mixed spectra and give the relative abundance of minerals. The DATT method can detect specific mineral signatures in complex mixtures or low abundances and show their distributions. Integrating DATT and Sparse Unmixing (IDATTSU) methods provides more robust results.

Results: The hydrated silicates saponite, talc and serpentine, as well as carbonate (magnesite) were detected in Jezero crater and NE Syrtis, as shown in Figure 1. The magnesite and serpentine detections of IDATTSU are shown in Figure 1A and Figure 1B. The accepted normalized RMSE for saponite and talc detections using DATT must be further analyzed [5]. However, sparse unmixing indicates that both the saponite and talc are needed to model the mixed pixels in the phyllosilicates regions (Figure 1C and Figure 1D). Near the Jezero crater landing site ellipse, a big carbonate plain and a few serpentine outcrops were detected. In the south of NE Syrtis landing site ellipse, a large carbonate outcrop as well as some serpentine outcrops were also detected. Figure 2 show all the serpentine detections around landing site regions. Based on the results of IDATTSU, some serpentine spectra were collected manually and compared with library spectra, as shown in Figure 3.

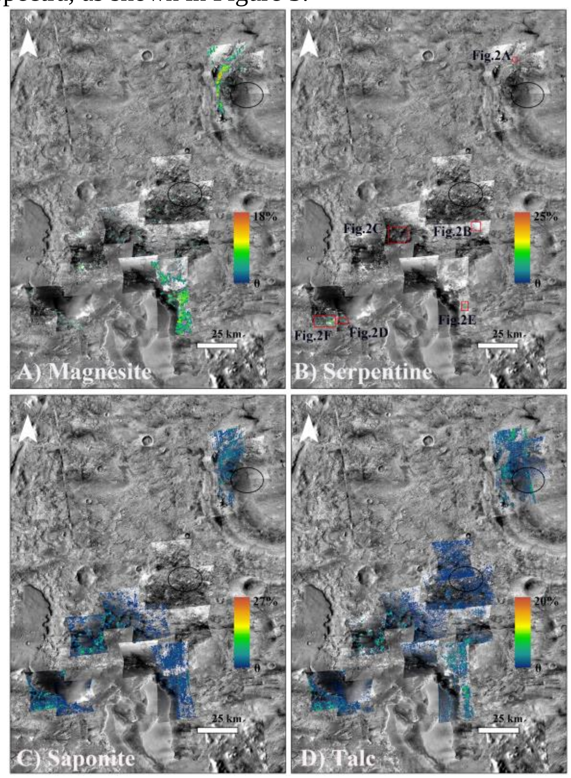

Figure 1 | Hydrated silicates and carbonate detections in Jezero crater and NE Syrtis landing sites. A) Magnesite. B) Serpentine. C) Saponite and D) Talc.

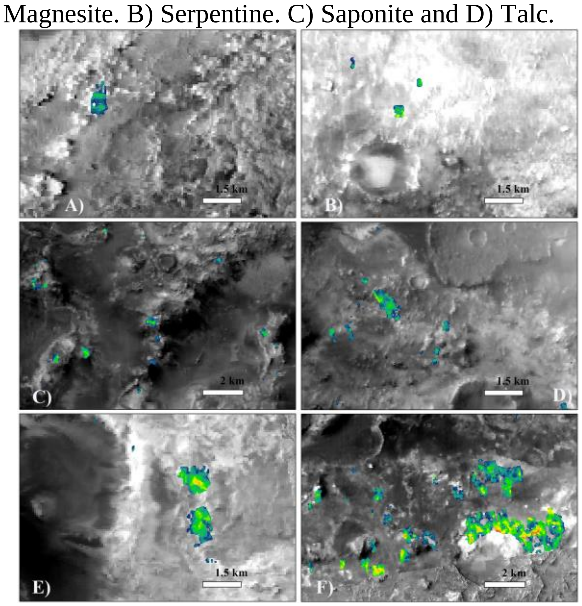

Figure 2 | The serpentine detections in Jezero crater and NE Syrtis landing sites. Zoom in from the red boxes in Figure 1B.

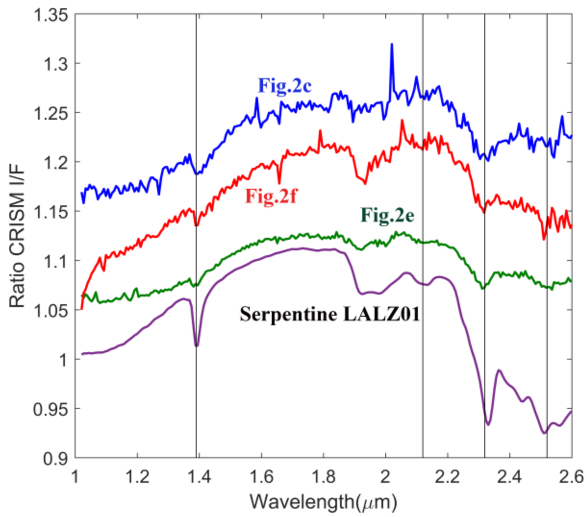

Figure 3 | CRISM ratio spectra form serpentine detections in Figure 2. The vertical lines are 1.39µm, 2.12µm, 2.32µm and 2.52µm.

In Columbia Hills, the pixels in the flat (red dotted region in Figure 4) were selected as the in-scene endmembers. The in-scene endmembers of each column were used for the unmixing of their corresponding column. The pixels of shadow (green dotted region in Figure 4) were also selected as in-scene endmembers and they participated in the spectral unmixing of all columns. Thus, for each column, there are 288 in-scene endmembers in the endmember library. The sparse unmixing results show no hydrated minerals detected (Figure 5). In the previous carbonate and Fe/Mg phyllosilicate identifications, the modeled spectra and mineral abundances are shown in Figure 5H and Figure 5I. In the carbonate outcrops reported by Carter and Poulet [8], 96.02% in-scene endmember, 0.66% olivine, 2.36% plagioclase and 0.94% positive slope endmember best model the spectra. The phyllosilicate identified by Carter and Poulet [8] is fit as 100% in-scene endmember. The DATT analysis also does not find hydrated silicates and carbonate here. Thus, it's difficult to detect hydrated minerals in Columbia Hills at the CRISM spatial and spectral scale.

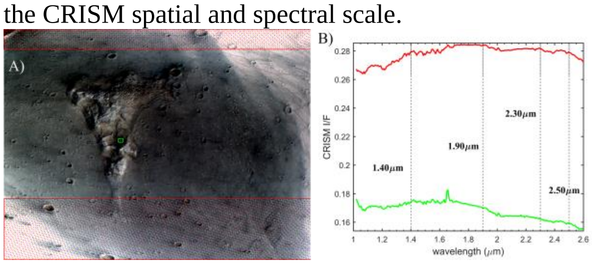

Figure 4 | The in-scene endmembers used in this study. The red and green spectra in B) are the average spectra of the red dotted region and green dotted region in A), respectively.

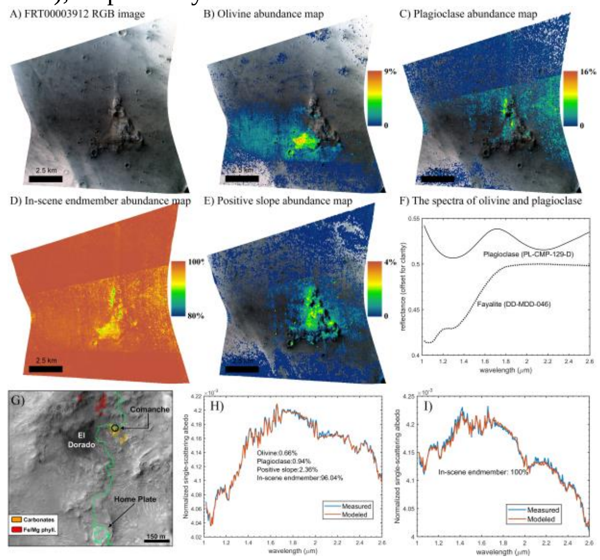

Figure 5 | A) RGB color composite of FRT00003912, R: 2.5295 µm G: 1.5066 µm B: 1.08 µm. B)-E) are the mineral abundance maps. F) The laboratory spectra of olivine (DD-MDD-046) and plagioclase (PL-CMP-129-D) were selected to best model CRISM measurements based on sparse unmixing algorithm. G) The previous carbonate and Fe/Mg phyllosilicates detections [8]. H) Model fit of the carbonate outcrops identified by Carter and Poulet [8] (average 3 × 3pixels centered at x: 446, y: 420). I) Model fit of the phyllosilicates outcrops identified in previous work [8] (average 3 × 3pixels centered at x: 438, y: 415).

Conclusion and discussion: Magnesite, serpentine, talc and saponite were quantitatively mapped in Jezero crater and NE Syrtis landing sites regions. Some new serpentine outcrops were detected using IDATTSU method. The ratio spectra showed positive evidence for the existence of serpentine. More validations are needed for all the mineral detections. IDATTSU analysis of saponite and talc will be completed in the next work. In the Columbia Hills, no hydrated minerals were detected using IDATTSU at the CRISM scale.

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