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Synergistic use of CRISM and THEMIS for identification of Clay-bearing deposits in Capri Chasma region of Valles Marineris on Mars

Nirmala Jain, Ramadayal Singh and Prakash Chauhan
Planetary Sciences & Marine Optics Division, Biological and Planetary Sciences and Applications Group, Space Applications Centre, (ISRO), Ahmedabad - 380 015. (nirmala@sac.isro.gov.in, Fax: +91-079-26915823)

Abstract

Aqueous and mafic silicates minerals such as carbonate, phyllosilicates and pyroxene have been identified in Capri Chasma region of Valles Marineris on Mars with the help of Mars Reconnaissance Orbiter-Compact Reconnaissance Imaging Spectrometer for Mars (MRO-CRISM) hyperspectral data. These results have further been confirmed by Odyssey-THEMIS with its calibrated radiance, emissivity and surface temperature images. The identified mineralogy in association with volcanic and impact crater on plateau area and weathered surfaces suggest that they could have been formed by hydrothermal alteration and erosion processes due to surface and subsurface water activity.

1. Introduction

In present study, we use hyperspectral data like MRO-CRISM and multispectral data like THEMIS in the range of 1 µm to 2.6 µm and 7 µm to 15 µm, respectively for the identification of mineralogy at Capri Chasma. The minerals such as phyllosilicate (saponite), carbonate (ankerite) and mafic silicate (pyroxene) have been confirmed by both datasets. On early Mars phyllosilicates and carbonates are studied as evidence for presence of liquid water [1], [2]. They give the information about existence of the wet environment in past history of Mars [1], [2]. This study will contribute to understand the evolution history of Mars identified minerals in the Capri Chasma.

2. Study area

In the west, Capri Chasma is connected with Coprates Chasma and Ganges Chasma in north and it extends to Aurorae Chaos to the east in Valles Marineris. In Capri Chasma previous studies have been found different geological units such as Interior Layer Interior Layer Deposits (ILD) [3], chaotic terrains AND eroded outcrop of plateaus in the form of ILDs [4], impact craters, and mineralogy such as hydrous sulfates and phyllosilicates. In the present study the imaging spectrometer CRISM has played important role in identification of phyllosilicates and carbonates in a various parts of Capri Chasma. The presence of above mentioned aqueous minerals implies that water played an important role during their formation period.

3. Results

Minerals such as phyllosilicate, carbonate and mafic silicate were observed by CRISM hyperspectral data (figure 1A B). Spectral comparison has been done with standard CRISM spectral library (figure 1C) which confirms the presence of chamosite, ankerite and pyroxene in the study area. The diagnostic absorption bands of hydrated minerals have been observed at 2.31 µm and 2.52 µm which give hint towards the presence of ankerite. 1.88 µm 2.3 µm indicate the presence of pyroxene and chamosite in the study area. The presence of the 1.4 µm and 1.9 µm feature, therefore, indicates the existence OH and H_2O in the identified minerals which are diagnostic features of aqueous minerals. However in multispectral analysis daytime THEMIS calibrated radiance image I26387001 being used. Mineral deposits are distinguished from other surface compositions using THEMIS bands 6, 4, and 2 (centered near 9.66, 7.98, and 6.27 µm) projected as red, green, and blue respectively in DCS calibrated radiance images [5]. Magenta color represents high bulk silica deposit showing low emissivity values at wavelengths corresponding to THEMIS band 4 within the ~8-12 µm Si-O Restrahlen band, (Figure 2A), cyan indicates basaltic composition, and

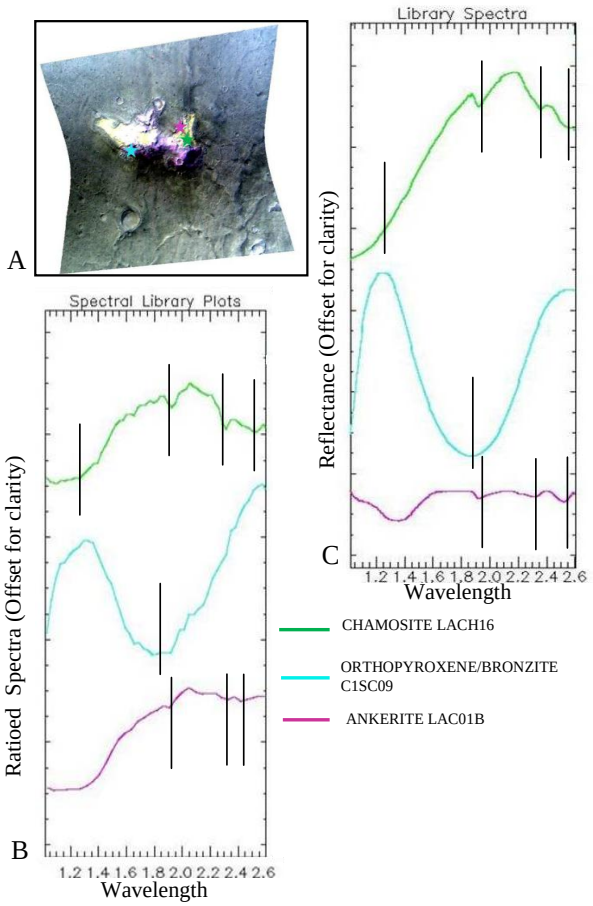
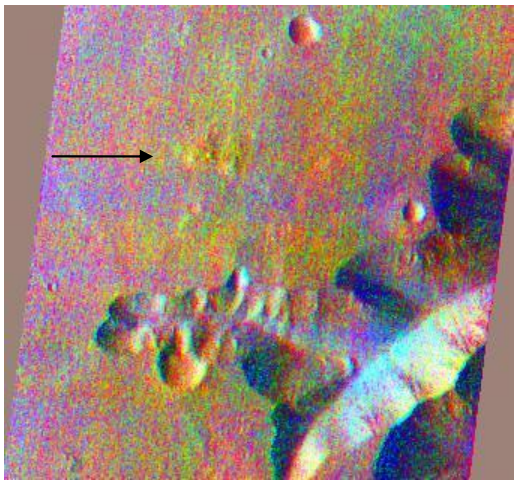
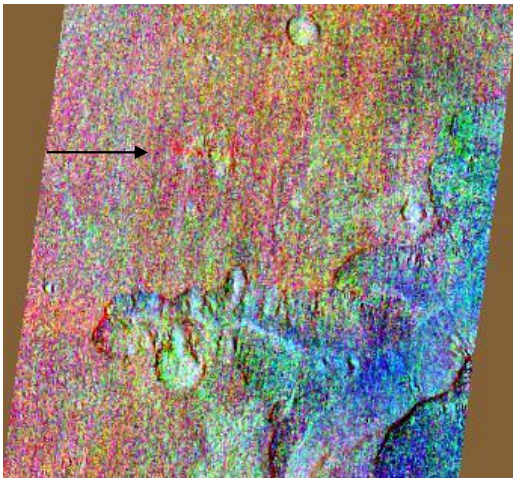


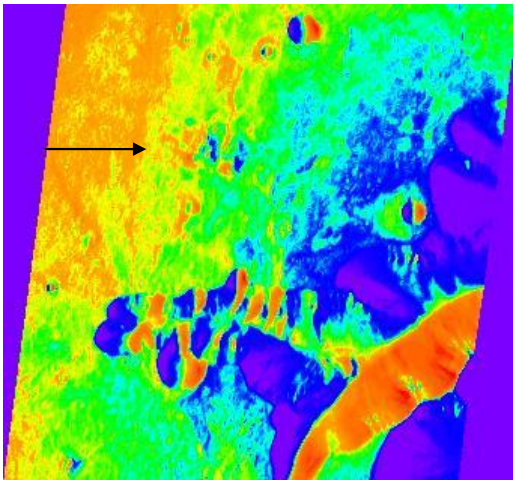
Figure 1: A) Spectral signatures from CRISM data from the study area, Capri Chasma and B) Spectral signatures of minerals from CRISM spectral library.



A



B



C

235 270

Figure 2: A) DCS calibrated radiance, B) DCS Emissivity, C) Surface Temperature

yellow/green color indicates dust cover. Basaltic and dusty surfaces have low emissivity values in THEMIS bands 6 and 2 respectively. On other hand, the calibrated radiance image I26387001 atmospherically corrected for surface emissivity cubes, which have been processed using a decorrelation stretch of bands 5, 7, and 8 projected as Red, Green and Blue respectively. The magenta color in DCS emissivity images represents olivine (Figure 2B). Also there are different surfaces having temperature of 248±2.6 K representing the aqueous material (Figure 2C) [6].

4. Summary and Conclusions

The MRO-CRISM and Odyssey-THEMIS played a significant role in understanding the mineralogy of the surface of planet Mars. THEMIS data has confirmed the presence of mafic and aqueous silicates. With the presence of phyllosilicates and carbonates in the Capri Chasma we conclude that water played an important role during their formation period. Presence of these minerals makes Capri Chasma as promising region for the study of aqueous processes for the future studies.

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