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Aqueous alteration detection in Tikhonravov crater

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Abstract

The existence of a wet period lasting enough time to allow the development of elementary forms of life on Mars is always been a very interesting issue. In this perspective the research for geological markers of such occurrence has been continually pursued. Once that a favorable site is detected, any effort should be done to get as much information as possible aimed to a precise assessment of the genesis and evolution of the selected marker. In this work, we discuss in detail the recent finding of a possible carbonate deposit in Tikhonravov crater.

1. Introduction

Carbonates have been detected in several craters on Mars: Gusev [1, 2], Leighton [3], Huygens [4] and McLaughlin [5]. For this reason we have undertaken a survey of several impact craters and among them, there is a large impact basin, called Tikhonravov, located in eastern Arabia Terra.
In this crater is visible a layered sedimentary deposit, positioned at the center, classified to be with a probable lacustrine origin [6]. However, CRISM observations (white dashed box in Figure 1a) has shown no evidence for the presence of aqueous alteration minerals [7].
Therefore in this work we have focused our attention on one of the minor craters present within the main crater where are present two CRISM observations (FRT0001175F and HRL00013C1D, Figure 1b). The deepest part of this minor crater is about 1500 m below the Tikhonravov crater floor (as shown in inset of Figure 1). The CTX images of this portion show the presence of dark–toned and light–toned sediments.

2 CRISM observations

Both CRISM images used for this work have been processed converting the spectra to I/F, photometrically corrected for the cosine of the solar incidence angle and then atmospherically corrected following the method developed in [8]. From the reduced data, the spectral parameters connected to the identification of water related materials have been analyzed [9, 10]. The result of the analysis on FRT0001175F is shown in Figure 2. The presence of yellow pixels in CR2 map in Figure 2 is consistent with a carbonate deposit. Similar deposits have been identified also in HRL00013C1D observation.

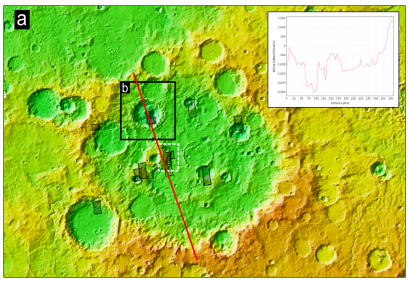

Figure 1: **(a)** MOLA shaded relief map of Tikhonravov crater with superimposed CRISM observations footprints. The white dashed box indicates the exposed layer studied by [7], while, the black square corresponds to the observations discussed in this work. The red line indicates the MOLA profile shown in the inset.

Such identification has been confirmed by the spectral comparison between the average spectrum of the carbonate area and the spectrum of an equivalent area closed to the previous one. The result is shown in Figure 3 where the ratio between the spectra of the two areas is checked against two phyllosilicates and a carbonate RELAB spectra of minerals already detected on Mars (kaolinite, nontronite, and siderite).

3. Conclusions

This new detection of carbonates is important and the implications of such finding will be discussed.

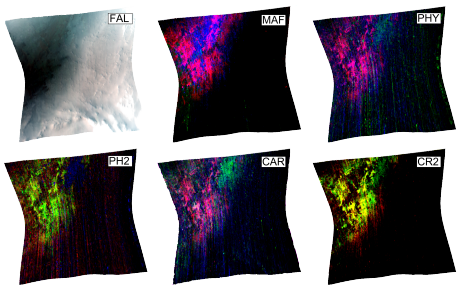

Figure 2: Map–projected RGBs of FRT0001175F showing the distribution of water related minerals in the area under study. FAL: IR enhanced color. MAF: basaltic minerals (for reference). PHY and PH2: phyllosilicates. CAR and CR2: carbonates and phyllosilicates.

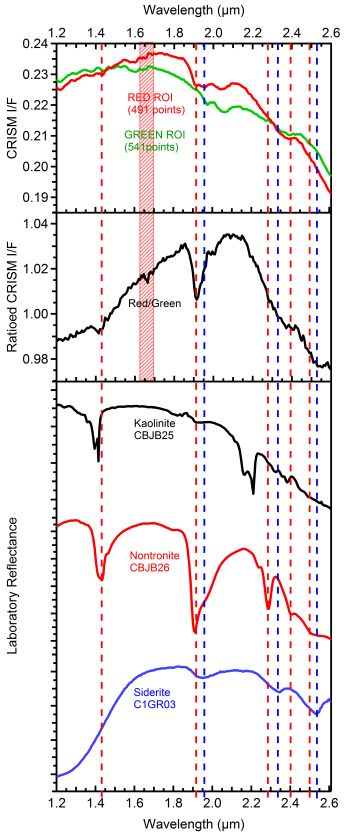

Figure 3: Top panel: average spectra of two selected areas. Middle panel: ratio between the RED (carbonates) and GREEN (reference) spectra. Bottom panel: RELAB spectra for comparison. The shadowed red region indicates bad spectral channels; the red and the blue dashed lines correspond to nontronite and siderite bands, respectively.

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