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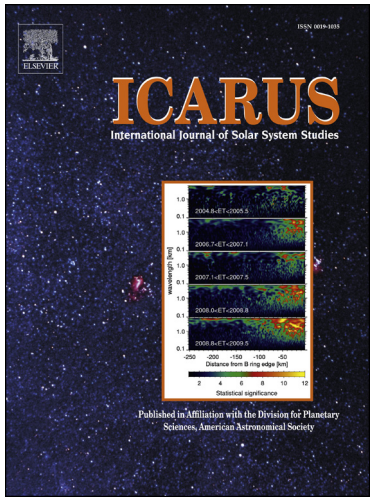

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Visible-Near Infrared Spectra of Hydrous Carbonates, with Implications for the Detection of Carbonates in Hyperspectral data of Mars

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Abstract

We present visible-near infrared (VNIR, 0.35 to 5 μm) spectra for a suite of hydrous carbonates that may be relevant to the surface of Mars. This includes VNIR spectra for ikaite, nesquehonite, synthetic monohydrocalcite and lansfordite over the 0.35 – 2.5 μm range that are new to the literature. The spectral features of the hydrous carbonates are dominated by absorptions at ~1.0, 1.2, 1.4–1.5, 1.9 and 2.8μm that are due to overtones and combinations of fundamental water and hydroxyl vibrations. Absorptions due to $(CO_3)^{2-}$, Mg-OH, Fe-OH, and/or water are seen at ~ 2.3-2.5, 3.4, and 3.9 μm in hydrous Mg and Mg-Fe^{3+} carbonates containing hydroxyl groups, but are weaker than in the common anhydrous carbonates. When present in the hydrous carbonates, the positions of the centers of the 2.3 μm and/or 2.5 μm absorptions are often shifted relative to the anhydrous carbonates, which may be diagnostic. Some or all of the $(CO_3)^{2-}$ absorptions typical of anhydrous carbonates are weak to absent in the hydrous carbonates, and thus this group may be difficult to distinguish from other hydrous minerals like sulfates, phyllosilicates or chlorides in Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) data using standard spectral search parameters for anhydrous carbonates. We present strategies for recognizing hydrous carbonates in CRISM data using combinations of spectral parameters that measure the intensity and shape of the water-related absorptions in these minerals.

Keywords: Mars, surface; Spectroscopy; Mineralogy