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Detectibility of Ca- and Mg-sulfates in the spectra of Martian soils

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Measurements of the elemental composition of Martian soils at Viking 1, Viking 2 and Pathfinder landing sites show a significant amount of the element sulfur in the soils. These measurements have recently been verified by the APXS instruments installed on the two NASA Mars Exploration Rovers. The environmental conditions on Mars lead to the assumption that most of the sulfur is bound in sulfate minerals. However, spectral remote sensing data for the Martian surface did not show clear evidence for significant amount of sulfates in Martian soils. To estimate the general detectibility of sulfates by remote sensing spectra provided by the PFS and OMEGA instruments on Mars Express, we acquired laboratory reflectance spectra of various fine-grained sulfates mixed with a palagonite powder that is a reasonably good spectral analog for Martian soils. Our reflectance spectra cover the spectral range from 1.5 to 17 μm. By varying the amount of the admixed sulfate mineral we were able to estimate detection limits of sulfate absorption features. We found, e.g., that an amount up to 5% anhydrite in Martian soils could be undetectable due to the effect that strong reflectance features of anhydrite near 5 μm are hidden by the emitted radiation of the surface. Results of the Gamma Ray Spectrometer onboard Mars Odyssey spacecraft suggest significant amount of hydrated minerals on the surface. Therefore we studied hydrous sulfates as well as anhydrous sulfates to investigate if they show different detectibility.