

Analysis of Mars Express/ PFS data in terms of sulfate detection in the Martian soil: Approach, experimental and methodical limitations, first results

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In situ measurements of Martian bright soils elemental compositions revealed a relatively high amount of sulfur within the soils that is widely suggested to be present in form of sulfate minerals. However, the present sulfate types, their abundances and distributions within bright soils remained unclear so far. More detailed knowledge about them could give us hints to the soil forming processes on Mars and the evolution of Martian environmental conditions.

Laboratory studies show that most particulate sulfates exhibit pronounced absorption bands in the portion of the 4-5 μm wavelength range not affected by the saturated atmospheric CO_2 -absorption band extending from 4.2 to 4.4 μm . These sulfate features are caused by overtones and combinations of the fundamental vibrations of the sulfate ion. The Planetary Fourier Spectrometer (PFS) and the OMEGA instrument on ESA/ Mars Express are the first instruments orbiting MARS that provide Martian remote spectra in this range.

The work presented here focus on the search for the 4-5 μm sulfate features using the PFS data set that covers the spectral range from 1.2 to 45 μm . For first methodical studies we chose parts of Terra Arabia and the Tharsis region exhibiting high albedo (>0.25) and low thermal inertia ($<130 \text{ J m}^{-2} \text{ K}^{-1} \text{ s}^{-1/2}$) that indicates the presence of a fine-grained bright soil surface layer which is a product of regional and global weathering processes. The long wavelength channel (LWC) data of PFS covering the wavelength range from 5 to 45 μm were used to derive the surface temperature of the chosen areas during observation. This is essential to estimate the contribution of emitted thermal surface radiation to the acquired Martian spectra in the 4-5 μm range. Supporting laboratory measurements of sulfate analog materials and mineral mixtures considering relevant surface temperatures have shown that the 4-5 μm features of sulfates become increasingly detectable at surface temperatures below 260 K while they are spectrally hidden between 260 and 290 K resulting from the converse shape of reflectance and emittance spectra. PFS spectra measured at surface temperatures well below 260 K are studied in more detail including careful separation of atmospheric contributions that are mainly caused by CO_2 and, marginally, by CO. Various methods

of atmospheric corrections are discussed. The first results of our analyses are presented including further discussions of sulfate detection strategies and detection limits.