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Detection of weathered basaltic materials on Valles Marineris region on Mars - results of numerical and laboratory modelling

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Introduction

The presented studies on simulated radiance and laboratory measurements of spectral emissivity are continuation of our previous works [1], and are directly connected with spectrometric measurements during Mars Express mission. Laboratory measurements of spectral emissivity of basaltic materials with various particle size ranges and stage of weathering were used in calculations of total radiance in order to account for real variations as a function of wavelength.
The studies are useful in analysis of geological and mineralogical properties of the surface of Mars and composition of dust in the Martian atmosphere, especially in the Valles Marineris region.

Calculations of the radiance from the surface and atmosphere of Mars

The radiance and transmission of the Martian atmosphere (both pure gaseous and with the dust layers) as well as the thermal radiance of the surface of Mars have been computed [1,2].
The samples of basaltic Matrian analogs (especially for the Valles Marineris region) come from the Baikal Rift Zone and Mongolian terranes [3]. The measurements of emissivity of the samples with various stage of weathering have been made in the Planetary Emissivity Laboratory (PEL) at the DLR, Berlin, using a Fourier transform infrared spectrometer Bruker VERTEX 80v in the wavelength range from 3 to 50 μm. For each sample we measured the spectra of four particle size ranges [4].
These new laboratory measurements of emissivity and transmittance of basalts have been used as an input to the radiative transfer code and calculations of the radiance from the surface and atmosphere of Mars.

Results

We have carried out radiative transfer calculations to simulate the joint effect of the atmosphere and the surface and to evaluate the magnitude and the shape of the spectra of Mars in the Valles Marineris region.
Influence of the emittance of various samples on radiance spectra and the transmittance of dust have been observed. The spectral range 2500-3500 cm^{-1} where characteristic variations of emissivities of basalt exists, has been carefully analysed. The modelling shows the influence of spectral emissivity of the surface of Mars and spectral absorption and emission of the atmosphere on the level and shape of calculated spectra. Particular concern has been given to the detection the typical features from the particle size range 25-63 μm. The various geometry of the measurements have been taken into consideration.
The shape of the spectra are determined by the spectral features of the emissivity of the surface and the emission and absorption of the gases and dust in the atmosphere but the different shapes of the spectra depend also on the relation between temperature of the surface and that of the atmosphere.
The numerically simulated spectra were compared with OMEGA and PFS data from Mars Express. Some conclusion about the structure and composition of the surface of Valles Marineris region and dust in the atmosphere were shown.

References

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