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Phobos surface spectra mineralogical modeling

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Abstract

A mineralogical model composed of a mixture of Tagish Lake meteorite (TL) and Pyroxene Glass (PM80) was presented in [1] to explain the surface reflectance of Phobos from 0.25 to 4.0 μm. The positive results we obtained, when comparing the OSIRIS data [2] extended in wavelength to include the [3,4] spectra, forced us to perform a wider comparison between our TL-PM80 model and the CRISM and OMEGA Phobos spectra presented in [5]. Such spectra cover three different regions of interest (ROIs) situated in the Phobos sub-Mars hemisphere: the interior of the Stickney crater, its eastern rim, and its proximity terrain southeast of the Reldresal crater. We decided to vary the percentage mixture of the components of our model (80% TL, 20% PM80), between pure TL and pure PM80, by means of the radiative transfer code based on the [6] formulation of the slab approximation. Once this spectral range was derived, see Fig. 1, we attempted to compare it with the [5] spectra between 0.4 and 2.6 μm, i.e. below the thermal emitted radiation, to see if any spectral match was possible. We observed that CRISM scaled spectra above 1.10 μm fall within pure Tagish Lake composition and the [1] model. The CRISM data below 1.10 μm present more discrepancies with our models, in particular for the Stickney's rim spectrum. Nevertheless the TL and PM80 components seem to be good mineralogical candidates on Phobos. We performed the same analysis with the OMEGA data and, again, we found out that the Stickney's rim spectrum lies out of our model range, while the two remaining spectra still lie between pure TL and 80% TL - 20% PM80, but indicating that a different, more complicated mixture is expected in order to explain properly both the spectral trend and the possible absorption bands located above 2.0 μm.

Within this analysis, we point out that a big fraction of TL material (modeled pure or present with a minimum percentage of 80% mixed together with 20% PM80) seems to explain Phobos spectral behavior, as it was already suggested by [7]: since TL is commonly used as a spectral analog for D-type asteroids [8,9], this result provides additional support for compositional similarities between Phobos and and D-type asteroids tending to favor an asteroidal capture origin instead of an in situ formation.

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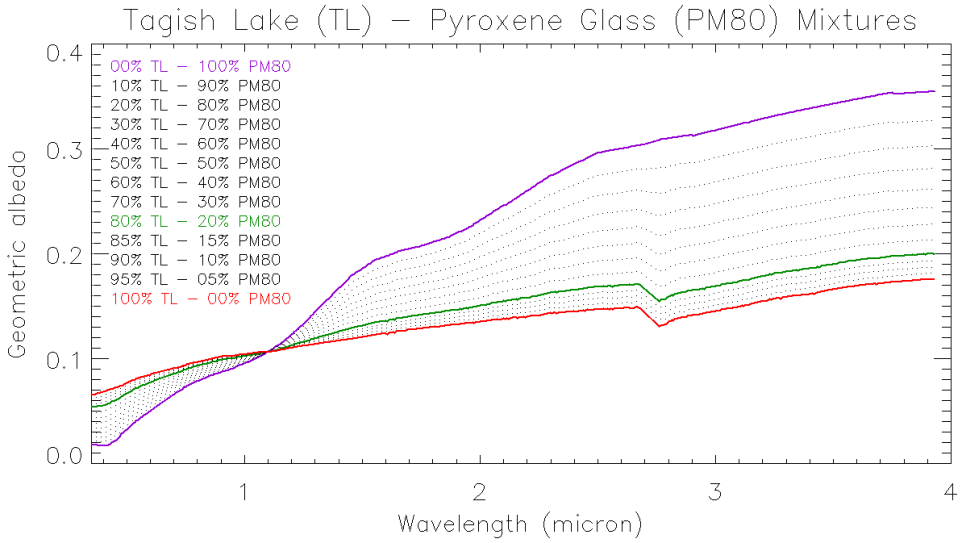

Figure 1: Our mineralogical model presenting the geometric albedo derivable from pure Tagish Lake (in red) to pure Pyroxene Glass (in violet) composition. In green the Pajola et al. (2013) model constituted of 80% TL and 20% PM80 is presented. The grain sizes used in our model are 11 μm for TL and 20 μm for PM80.

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