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Martian crust heterogeneities: implications for its thermal and physical properties

N. Michel (1), D. Baratoux (2), L. D'Uston (1), M. Rabinowicz (2), O. Forni (1)

(1) Centre d'étude Spatiale des Rayonnements, Toulouse, France, (2) Laboratoire de dynamique terrestre et planétaire, Observatoire Midi-Pyrénées, Toulouse, France, (nathalie.michel@cesr.fr)

The heterogeinity of the Martian crust in terms of thickness, chemical and mineralogical composition has been documented by Mars Global Surveyor (MOLA), Mars Odyssey (Neutron and Gamma Ray Spectrometers) and Mars Express (OMEGA) missions. The aim of this study is to relate these heterogeneities to the internal dynamic of the planet. For this purpose, we present here (1) a map of the radiogenic heat production in the crust from Mars Odyssey Potassium and Thorium maps, (2) a map of the temperature at the base of the crust and (3) the thickness of the present Martian lithosphere.

As for the estimation of the radiogenic heat in the crust, an Uranium abundance map has been derived from the Mars Odyssey Thorium map and an average Thorium/Uranium ratio estimated from the Martian meteorites (SNC) equal to 3.6 [1] as in the study of *Hahn et al., 2008* [2]. A constant elemental abundance model in the crust thickness given from MGS/MOLA observations [3] were used to derive map of the abundance of radiogenic elements in the crust. Averaging this result over the planet, we found that the present crust heat flux is about $3.3\ mW/m^2$.

Considering the total abundance of radiogenic elements in the planet from elemental abundances in chondrites, the present heat produced in the mantle by radiogenic elements was estimated. Assuming that the secular cooling of the mantle release a quantity of heat equal to about 50 percent of the radiogenic heat, it is found that the average heat flow at the base of the crust is equal to $21.45\ mW/m^2$. From these estimations, it is possible to derive the temperature profile in the crust and in the lithospheric part of the mantle of Mars, solving the heat equation. An average surface temperature of 218 K was assumed, and the conductivity of the crust was set to $3.0\ W/m/K$ and that of mantle to $3.5\ W/m/K$. A map of the temperature at the base of the crust, and a map of the lithosphere thickness were finally derived from the temperature profiles.

We obtain the temperature at the base of the crust that varies between 250 K beneath Hellas and 855 K beneath Tharsis. The lithosphere thickness is, as expected, mainly corelated with the crust thickness and varies between 270 and 310 km. We also conclude that the heterogeneities of the abundances of the radiogenic elements in the crust are not corelated with the variation of the lithospheric thickness. We propose that the present abundances of radiogenic elements in the crust reflect the evolution of the convection of the planet. This hypothesis is presented along with an history of the internal convection of the planet which aims at explaining these abundances in relation with the estimation of the lithosphere thickness beneath main topographics features as a function of the age [4].

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