THERMAL CAPACITY OF MARS, MARTIAN CRUST, MANTLE AND CORE.

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Introduction: Thermal capacity of solid terrestrial materials (heat capacity per unit volume, *Cvolumetric*) is almost constant at room temperature and equal to *Cvolumetric* = $Cp \cdot d \approx 3 \cdot 10^6$ J/(m^3·K) [1]. To calculate thermal capacity, specific heat capacity *Cp*, and bulk density *d* are needed. Recent data on thermal capacity of meteoritic matter show that the mean value of *Cvolumetric* is close to the terrestrial value ($2.9 \cdot 10^6$ J/(m^3·K)), but the mean thermal capacity of stony and stony-irons ($2.5 \cdot 10^6$J/(m^3·K)) is lower than of irons ($3.6 \cdot 10^6$ J/(m^3·K)) [2]. Thermal capacity of terrestrial minerals shows a similar trend [3]. The aim of the paper was to estimate thermal capacity of Martian crust, mantle, and core, as well as of the global Mars.

Results: Relationship between specific heat capacity and bulk density [2] was used to estimate *Cp* and heat capacities *(C=Cp·M*) of asteroids, satellites, and terrestrial planets at room temperature [4,5]. *Cp*, and *C* values for Mars, Martian crust, mantle and core have been also estimated [5,6]. Our data show that: *Cpcrust* = 741 J/(kg·K), *Cpmantle* = 675 J/(kg·K), *Cpcore* = 489 J/(kg·K), *CpMars* = 635 J/(kg·K) at room temperature (RT) [5]; and *Cpcrust* = 741 J/(kg·K), *Cpmantle* = 1080 J/(kg·K), *Cpcore* = 831 J/(kg·K), and *CpMars* = 1016 J/(kg·K) at high temperatures (HT) [6]. Temperature correction was used to determine *Cp(HT)* values [6], for the hot interior of Mars [7]. To determine thermal capacity, literature data on mean densities of crust, mantle, core and Mars were used: *dcrust* = 2.99 g/cm^3, *dmantle* = 3.52 g/cm^3, *dcore* = 7.04 g/cm^3, and *dMars* = 3.94 g/cm^3 [8]. Calculation of thermal capacity values for room temperature gave: $2.22 \cdot 10^6$ J/(m^3·K) for crust, $2.38 \cdot 10^6$ J/(m^3·K) for mantle, $3.44 \cdot 10^6$ J/(m^3·K) for core, and $2.50 \cdot 10^6$ J/(m^3·K) for the global Mars. Using high temperature values of *Cp(HT)* and the same values of density gives: $2.22 \cdot 10^6$ J/(m^3·K) for crust, $3.8 \cdot 10^6$ J/(m^3·K) for mantle, $5.85 \cdot 10^6$ J/(m^3·K) for core, and $4.0 \cdot 10^6$ J/(m^3·K) for the global Mars. Our data show that *Cvolumetric* depends on *d,* and linear and quadratic fit *Cvolumetric(d)* can be used: $Cvolumetric(J/(cm^3 \cdot K) = 0.301 \cdot d\ (g/cm^3)+1.32$, at RT,
$Cvolumetric(J/(cm^3 \cdot K) = -0.354 \cdot d^2 + 4.42 \cdot d\ (g/cm^3) - 7.69$, at HT. Since *Cvolumetric* = K/α, where *K* is thermal conductivity, and α is thermal diffusivity, Mars' matter shows the sequence of ratios:

$$(K/\alpha)crust : (K/\alpha)mantle : (K/\alpha)core = 1 : 1.7 : 2.6.$$

Conclusions: Mean thermal capacity of Mars, Martian crust, mantle and core have been determined. Relationships between thermal capacity and density of Martian materials were established. Mean Mars' thermal capacity ($4.0 \cdot 10^6$ J/(m^3·K) is dominated by the material of its mantle ($3.8 \cdot 10^6$ J/(m^3·K).

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