THE THERMAL CONDUCTIVITY OF THE BURSA CHONDRITE.

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Introduction: Thermophysical properties are important for characterization of extraterrestrial minerals and rocks and their parent bodies: asteroids and planets. The aim of the paper was to predict thermal conductivity (K) of Bursa meteorite at various temperatures: 200 K, and 300 K, in air at 10^5 Pa pressure, and at vacuum. Bursa meteorite fell in 1946, in Turkey, and has been classified as a L6 chondrite.

Methods: The thermal conductivity *(K)* of Bursa L6 chondrite was predicted by various models of rocks, using literature data on modal composition [1], using relationships between thermal conductivity and porosity *K(P)* [2-6], and between thermal conductivity and thermal diffusivity *K(D)*. Porosity *(P)* was calculated applying relation $P = 1 - db/dgr$, where *db* is bulk density, and *dgr* is grain density. Grain density and bulk density were determined by 3D laser scanning and pycnometry. The applied relationships were presented in recent papers devoted to thermal conductivity of meteorites and terrestrial rocks [2-8]. Low pressure conditions for air (10^{-1} Pa, 10^{-4} Pa, 10^{-5} Pa) are designed as vacuum.

Results and discussion: The results confirm that the porosity of the chondrite and air pressure significantly affect thermal conductivity. The thermal conductivity of the skeleton/matrix (*Kmatrix)* predicted by the modal composition of the meteorite and by the geometric mean model is equal to 4.1 W m^{-1} K^{-1}, and by arithmetic and harmonic mean models: 4.3 W m^{-1} K^{-1} at 300 K.

Bulk thermal conductivity of the meteorite predicted by the geometric mean model for porosity of Bursa chondrite $P = 5.8\%$ is equal to 3.0 W m^{-1} K^{-1} for air pressure of 1 atm (10^5 Pa), and 1.8 W m^{-1} K^{-1} for vacuum at 300 K. The Bursa rock is asssumed as a two-component mixture of two components. First component is matrix (skeleton) which consists of grains of minerals, and the second component is fluid filling the pores. It was assumed that Bursa pores are filled with dry air or with air at low pressure (vacuum conditions).

Walsh and Decker equation [2,6,7] for *Kmatrix* = 4.1 W m^{-1} K^{-1}, $P = 0.058$ and aspect ratio of pores $\alpha = 0.022$ leads to value of thermal conductivity of the whole rock of Bursa meteorite 1.8 W m^{-1} K^{-1} for vacuum at room temperature.

The Hashin-Shtrikman model [9] predicts for bulk thermal conductivity the values: 2.4 W m^{-1} K^{-1}, and 1.9 W m^{-1} K^{-1}, and mean of two-layer arithmetic and harmonic models: 2.1 and 1.9 W m^{-1} K^{-1} at 300 K, for air pressure of 1 atm, and for vacuum, respectively.

The relationships between thermal conductivity and porosity based on experimental data for ordinary chondrites indicate a mean value for bulk thermal conductivity of the Bursa meteorite in vacuum: 1.8 ± 0.2 W m^{-1} K^{-1} (range 1.6-1.9 W m^{-1} K^{-1}, and exemplary values for linear and non-linear fits: 1.6, 1.8, and 1.9 W m^{-1} K^{-1}), and relationship between thermal conductivity and thermal diffusivity indicates the value: 1.8 W m^{-1} K^{-1} at 200-300 K.

The mean value for all predictions of bulk thermal conductivity of the Bursa meteorite for air at 1 atm is equal to 2.5 ± 0.5 W m^{-1} K^{-1} (range 2.1-3.0 W m^{-1} K^{-1}) at 300 K, and in vacuum: 1.8 ± 0.1 W m^{-1} K^{-1} (range 1.6-1.9 W m^{-1} K^{-1}) at 200-300 K.

Conclusions: Predicted values of bulk thermal conductivity of the Bursa meteorite, for air and for vacuum, are comparable with values recently predicted for Jezersko H4 chondrite [6], and are in the range of values reported for the ordinary chondrites [2-6]. The thermal conductivity of the Bursa matrix predicted by the geometric mean model for room temperature (4.1 W m^{-1} K^{-1}) is close to the value of thermal conductivity of Jezersko meteorite matrix (4.35 W m^{-1} K^{-1}) predicted by the same theoretical model [6].

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