ESTIMATION OF FUSION CRUST TEMPERATURE OF SOŁTMANY METEORITE BY TROILITE THERMOMETRY.

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Introduction: Differential scanning calorimetry (DSC) is used to measure enthalpy change and temperature of α/β phase transformation in troilite of L chondrites [1,2], as well as to determine specific heat capacity of extraterrestrial rocks. It has been shown that temperature of laboratory heating [1,2], and the heating period [2] affect the temperature of α/β phase transformation and enthalpy change in troilite. The aim of the paper was to estimate temperature of fusion crust formed during atmospheric heating of Sołtmany (L6) chondrite by DSC data.

Methods: Temperature of α/β phase transformation and enthalpy change in 5-20 mg samples of the Soltmany chondrite containing 4-6 wt. % of troilite were measured by a DSC Q200 (TA Instruments, USA). Samples were heated under nitrogen to various maximum temperatures up to 600 ^{o}C in the DSC instrument, at which they were maintained for 2 min. After each conditioning specimens were cooled down and a heating scan was performed in order to collect thermal characteristics of the sample [2].

Results: Measurements have been conducted on two groups of samples representing various regions of meteorite: i) region of fusion crust, and ii) region of meteorite interior, adjacent to the crust. Samples representing interior of the meteorite revealed that the temperature of α/β transition (offset and T_{peak} temperature), and enthalpy change show gradual decline with the increase in the maximum temperature of preceding heat treatment. The virgin, untreated sample 1 representing interior of the meteorite revealed T_{peak} = 154.35 ^{o}C, and after its subsequent annealing for 2 min the following values of T_{peak} have been obtained in subsequent runs: 153.7 ^{o}C (annealing at 170^{o} C), 153.3 ^{o}C (at 200 ^{o}C), 151.8 ^{o}C (at 300 ^{o}C), 150.3 ^{o}C (at 400 ^{o}C), 150.0 ^{o}C (at 500 ^{o}C), and 149.7 ^{o}C (at 600 ^{o}C). Extrapolating the data to higher temperatures leads to value of T_{peak} = 148.83 ^{o}C for annealing temperature equal to 1000 ^{o}C. Since virgin sample 2, representing fusion crust revealed temperature of α/β phase transformation equal to 148.83 ^{o}C, it means that temperature of measured region of fusion crust during atmospheric passage of Sołtmany meteorite must have been about 1000 ^{o}C.

Conclusions: α/β phase transition data for the troilite present in fusion crust indicate high relict temperature (about 1000 ^{o}C), and our previous [2], and present data confirm that troilite in interior of the meteorite adjacent to the crust indicate relatively low relict temperatures (c.a. 160-170 ^{o}C). Both relict temperatures are the record of local temperatures of various parts of meteorite during its aerodynamic heating due to atmospheric passage. These experimental values of temperatures are reasonable, and they are comparable with the recent simulation data [3].

References: [1] Lauer H.V. Jr. and Gooding J.L. 1996. 27th Lunar & Planetary Science Conference. pp. 731-732. [2] Szurgot M. et al. 2013. Abstract #5004. 76th Annual Meeting of the Meteoritical Society. [3] Parnell J. et al. 2008. *Icarus* 197:282-290.