HIGH-DOSE INDUCED THERMOLUMINESCENCE OF LIGHT-COLORED LITHOLOGY IN CHELYABINSK METEORITE

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Introduction: Thermoluminescence (TL) analysis takes an important place in the thermal history consideration of meteorites and characterization of occurring metamorphic processes. It is known the validity of quantitative conclusions about impact and irradiation events is influenced by many factors. On the one hand, the factors are associated with the parameters of an extraterrestrial body, its phase composition, Earth weathering, dose fading degree etc. On the other hand, the estimates precision due to volatility of the technique itself, varying conditions of TL measurements, the type of used laboratory irradiation, different statistical errors etc. Chelyabinsk meteorite that fell two years ago, immediately attracted the interest of researchers and has been subjected to TL studies [1 – 3]. The feature of mentioned LL5 chondrite is the presence of several types of lithologies, which can be an additional factor of influence on the observed TL response. In this regard purpose of the work was to study effects of high-dose irradiation on the laboratory TL parameters in Chelyabinsk meteorite samples with light-colored lithology.

Samples and Technique: Several fragments of Chelyabinsk meteorite with selected light lithology were investigated. The core was separated from the fusion crust and crushed into ≈100 μm powder with metal particle removing. TL study of the samples was carried out in phosphorescence regime using LS55 Perkin Elmer spectrometer with original heating accessories [4]. The glow curves of the natural and laboratory TL were registered in the 440 ± 20 nm band within the range of RT – 873 K with the linear heating rate r = 2 K/s. Laboratory dose was varied in the 9.1 - 36.4 kGy range using UELR-10-15S linear accelerator of 10 MeV electrons. Shape parameters of measured TL curves were averaged over five independent measurements for each dose.

Results and Discussion: It was shown that glow curves of the natural TL have a well marked peak with $T_{max} = 460 \pm 10$ K, halfwidth $\omega = 72 \pm 5$ K and a high temperature shoulder within the 550 – 700 K range. These parameters are in satisfactory agreement with previous results [1, 3]. With dose increasing the high temperature shift of laboratory TL curves was registered in the range of $T_{max} = (390 – 430) \pm 10$ K, while the halfwidth $\omega = 70 \pm 10$ K remains practically unchanged.

Obtained dependencies were analyzed in terms of the general order kinetic formalism. It is shown that all induced TL curves for different doses can be described by two peaks which characterize the system of trapping centers with activation energies distribution in the $E_A = 0.7 – 1.2$ eV values. Natural TL response can be approximated by a peak within single trap model with $E_A = 1.1 \pm 0.05$ eV. The maximum position of natural TL is shifted to the high temperatures by gradual process of emptying traps from low-energy tail of the distribution. It is necessary the studying laboratory TL response under varying storage times of irradiated meteorite fragments to analyze the fading observed.

References: [1] Popova O.P. et al. 2013. *Science* 342:1069–1073. [2] Biswas R.H. et al. 2013. *Meteoritics & Planetary Science* 48(SI):A62. [3] Weinstein I.A. et al. 2013. *Meteoritics & Planetary Science* 48(SI):A368. [4] Vokhmintsev A.S. et al. 2015. *Measurement* 66:90–94.