LUMINESCENCE CHARACTERIZATION OF TSAREV L5 CHONDRITE

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Introduction: Tsarev stony meteorite rain (falling date – December 6th, 1922; the first finding – 1968) was classified as the L5 chondrite type. Using results of isotopic analysis it was shown that Tsarev meteorite experienced complex irradiation history [1]. In addition its phase composition features were studied by Mossbauer spectroscopy with high velocity resolution [2]. However, there are practically no data on the characterization of the object with luminescence techniques that are a powerful tool for analyzing the thermal history, the possible impact events, metamorphic processes, the dominant type of silicates etc. This work presents investigation results of spectral and kinetic properties of Tsarev L5 chondrite using photo- (PL) and thermoluminescence (TL) methods.

Samples and Technique: Several fragments of Tsarev meteorite have been studied. The core was separated from the fusion crust and crushed into micropowder, which was treated in hydrochloric acid to remove metal particles. Luminescence measurements of the samples was carried out in phosphorescence regime using LS55 Perkin Elmer spectrometer with original heating accessories [3]. Excitation and emission PL spectra were registered in 200 – 350 nm and 290 – 700 nm ranges with scanning speed 120 nm/min, respectively. The TL spectra were registered in 300 – 700 nm range with scanning speed 800 nm/min and linear heating rate of r = 0.5 K/s. 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 r = 2 K/s. To register laboratory TL response the samples were irradiated at UELR-10-15S linear accelerator with 10 MeV electrons, the radiation dose was 9.1 kGy.

Results and Discussion: It was shown that the investigated PL spectra, excited by 5.9 and 4.6 eV photons, were characterized by a Gaussian shape peaks with E_{max} = 2.85 and 3.18 eV and halfwidths ω = 0.92 and 0.51 eV, respectively. It was demonstrated that TL emission band was observed in the blue spectral region with E_{max}= 2.78 ± 0.05 eV и ω_E = 0.79 ± 0.05 eV.

It was found that the natural TL response exhibits low intensity at maximum temperature of T_{max} = 490 K and with halfwidth of ω_T = 60 K. Obtained dependencies were analyzed in terms of the general order kinetic formalism. It is shown that natural TL curves can be described by a single peak originated from capture level with activation energy E_A = 0.8 ± 0.05 eV. For induced TL approximation it should be used several components which characterize the presence of quasi-continuous system of traps. Besides it was observed that parameters of laboratory TL response depended on the storage time. Estimated fading in this case was 45% within 3 days of storage. Comparison based on the luminescence research of spectral and kinetic characteristics for Tsarev L5 chondrite and Chelyabinsk LL5 chondrite samples with dark-colored lithology [4, 5] was fulfilled.

References: [1] Herzog G.F. et al. 1997. *Meteoritics & Planetary Science* 32(3):413–422. [2] Oshtrakh M.I. et al. 2008. *Meteoritics & Planetary Science* 43(5):941–958. [3] Vokhmintsev A.S. et al. 2015. *Measurement* 66:90–94. [4] Popova O.P. et al. 2013. *Science* 342:1069–1073. [5] Weinstein I.A. et al. 2014. *Meteoritics & Planetary Science* 49:A428.