LUMINESCENCE CHARACTERIZATION OF DIFFERENT LITHOLOGIES IN CHELYABINSK LL5 CHONDRITE

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Introduction: Chelyabinsk LL5 (S4, W0) meteorite fragments, that fell at February 15, 2013, were composed of multiple types of material, in particular, with light-colored and shock-darkened lithologies [1, 2]. Recently the physical properties – bulk and grain density, porosity, diffuse reflectance, magnetic susceptibility – for both types of samples with impact-melt veins were reported [2]. The goal of the present work was the comparative analysis of spectral characteristics for light- and dark-colored lithologies in Chelyabinsk chondrite by means of photo- (PL), thermo- (TL) and cathodoluminescence (CL) techniques.

Samples and Techniques: Several fragments of Chelyabinsk meteorite have been studied. The core was separated from the fusion crust and crushed into micropowder. Two types of samples were purposely isolated and prepared for measurements – with light- and dark-colored lithologies.

PL measurements of the samples were carried out using LS55 Perkin Elmer spectrometer. PL spectra were measured at room temperature (RT) in phosphorescence regime. Excitation spectra were recorded for the 440, 490 and 540 nm bands within the 200 – 360 nm range, while the emission spectra were recorded for the 200 nm excitation within the 300 – 650 nm range. The glow curves of the natural and laboratory TL were registered in the 440 nm band within the range of RT – 873 K with the linear heating rate r = 2 K/s by using an original appliance. The TL spectra were measured within the 300 – 650 nm range. CL study was carried out at room temperature using pulse electron beam accelerator RADAN (150 keV, 2 ns, 150 A/cm^2) and CCD-linear sensor with image intensifier (KLAVI-R) with 20 ms integration time. CL spectra were averaged of 50 pulses.

Results and Discussion: It is shown that the emission and excitation PL spectra for different-colored samples are very similar in the form, but differ substantially in intensity. Emission maxima are at 440 nm. This is consistent with results obtained previously for samples of mixed type [3]. Simultaneously the intensity of the PL for light-colored lithology is higher more than 4 times. It is found that the 440 nm (2.82 eV) emission band is a superposition of two independent Gaussians at 2.45 and 2.80 eV and the second component dominates.

CL spectra are characterized by broad structureless band with 460 nm (2.68 eV) maximum and a 0.79 eV halfwidth. Again the CL intensity of the sample with light-colored lithology is higher more than 3 times. It is demonstrated that the observed features of the luminescence may be associated with defective recombination centers in the structure of forsterite. The presence of olivine minerals in a Chelyabinsk chondrite composition has been shown previously [1, 2]. Besides the 2.35 and 2.75 eV components were characteristic CL emissions for synthetic forsterite crystals grown from the melt under supercooing conditions [4]. Finally, allowing for TL results also, the possible history of parent body of Chelyabinsk meteorite is briefly considered.

References: [1] Popova O.P. et al. 2013. *Science* 342:1069–1073.[2] Kohout T. et al. 2014. *Icarus* 228:78–85. [3] Weinstein I.A. et al. 2013. *Meteoritics & Planetary Science* 48:A368. [4] Gucsik A. et al. 2012. *Journal of Luminescence* 132:1041-1047.