# MICROPHOTOLUMINESCENCE STUDY OF CHELYABINSK LL5 CHONDRITE

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**Introduction:** It was previously found that fragments of the Chelyabinsk meteorite with light and dark lithology have different physicochemical properties [1, 2]. Photo- and thermally stimulated recombination processes occur more intensively in light lithology samples due to the presence of various chain silicates from the olivine and group of multicomponent pyroxenes. Moreover, the kinetic and spectral characteristics of the observed mechanisms depend not only on the phase composition, but also on the radiation history, numerous structural and other transformations in the studied chondrite [3–6]. This work deals with the investigation of photoluminescence properties of the Chelyabinsk chondrite with microscale spatial resolution and comparative analysis of the data obtained with the results of scanning electron microscopy study.

**Samples and Technique:** Fragments of the Chelyabinsk LL5 chondrite with the dominance of light lithology were examined. Optical images of the samples under study (see Fig. 1, *a*) was obtained using an Axio CSM 700 confocal optical microscope (Carl Zeiss, Inc.). Microphotoluminescence (μPL) spectra were studied by means of LUMAM I3 microscope (LOMO, Inc.). The μPL signal was recorded in the 400–700 nm spectral region under excitation by filtered light of a DRSh-250 mercury lamp in the 300–380 nm range. The surface images of the samples in the luminescence mode were obtained using an EOS 650D digital SLR camera (Canon, Inc.) (see Fig. 1, *b*). To achieve high spectral resolution, the images were transferred through an A2873 quartz fiber (Hamamatsu Inc.) to Shamrock SR-303i-B spectrograph (Andor, Inc.). This dispersed signal was measured using Newton$^{EM}$ DU970P-BV-602 CCD matrix (Andor, Inc.) cooled down to 193 K. A quantitative chemical analysis and mapping of elements distribution were carried out via a SIGMA VP electron microscope (Carl Zeiss, Inc.) fitted with an X-Max energy dispersive spectrometer (Oxford Instruments, Inc.).

**Results and Discussion:** Fig. 1 shows that the sample surface luminesces in different spectral ranges. Blue-white and brown emission originating from the areas of about 10 μm dominates. Luminescence in the blue spectral region is also observed in several spatial domains with dimensions of ≤ 1 μm. Additionally, there are some few spots ≤ 1 μm in size of green and yellow colors.

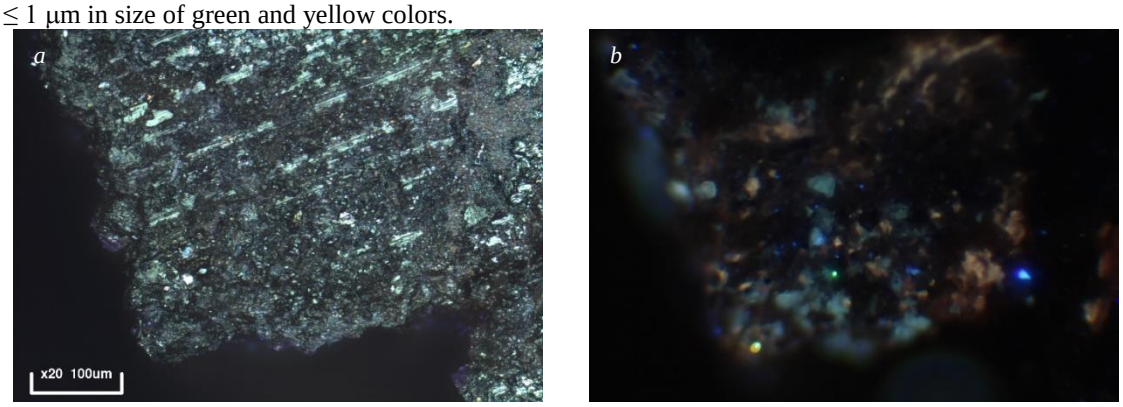


Fig. 1. Photo (*a*) and μPL image (*b*) of the Chelyabinsk LL5 chondrite with the same scale bar.

The study presents μPL spectra measurements of the regions identified by different emission color. Wide structureless bands are observed and positions of spectral maxima are shifted upon the color change of the luminescent region. The obtained results are in reasonable agreement with our preceding PL studies both of individual fragments and powder of the Chelyabinsk meteorite without spatial resolution [1]. The following chemical elements were found at the area demonstrated in Fig. 1: O (61.0 at. %), Si (13.5 at. %), Mg (13.2 at. %), Fe (6.3 at. %), Al (1.8 at. %), Ca (1.4 at. %), Na (1.1 at. %), S (0.9 at. %), Cr (0.4 at. %), P (0.2 at. %) and K (0.2 at. %). Comparison of the μPL image with the elements distribution maps was carried out. It was concluded that olivine and Mg-Fe pyroxenes prevail in the samples of LL5 chondrite along with the presence of lower concentrations of other pyroxenes.

**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. 2014. Meteoritics & Planetary Science 49: A428. [4] Weinstein I.A. et al. 2015. Meteoritics & Planetary Science 50: 5175. [5] Vokhmintsev A.S. and Weinstein I.A. 2017. Meteoritics & Planetary Science 52: A371. [6] Vokhmintsev A.S. and Weinstein I.A. 2018. Meteoritics & Planetary Science 53: 6304.

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