CHROMITE CRYSTALS IN EXPERIMENTALLY HEATED CHELYABINSK LL5 METEORITE.

I.A. Danilenko[1], E. V. Petrova[1], D. A. Zamyatin[1,2], and V. I. Grokhovsky[1]. [1]Ural Federal University (620002 Mira 19/5, Ekaterinburg, Russia, e-mail: Evgeniya.petrova@urfu.ru), [2] Institute of Geology and Geochemistry, Ural Branch of RAS, (620016, Ekaterinburg, A. Vontsovskogo str.,15, Russia).

Introduction: Chelyabinsk LL5 ordinary chondrite fragments are presented by a rock of the light-colored lithology, dark-colored lithology, and impact melt. All these types of rock are thought to be the same material undergone from the different level of shock [1, 2]. With the aim to reproduce the material darkening processes, the thermal experiments were carried out on the samples with the light-colored lithology and with the dark-colored lithology of the Chelyabinsk chondrite. Differential thermal analysis up to the 1000°C of the samples produced dark-colored material. Experimental procedure and thermal effect on the meteorite texture was shown in [3]. Troilite grains melts and experiences phase transformations after the heating, while chromite crystals save their morphology. It might be due to a relatively high melting temperature of chromite, that makes it more resistant to a heating impact in comparison with metal or sulfides. Here we present the results of the study with electron probe microanalysis and Raman spectroscopy of chromite crystals.

Samples and Methods: Differential thermal analysis (DTA) was applied on the two slices of light-colored lithology samples and on the two samples of the dark-colored lithology of Chelyabinsk LL5 using STA 449 Jupiter device. Then, the samples were embedded into epoxy and polished sections were prepared for the further analysis. Optical microscopy observation was performed by the means of Carl Zeiss AxioVert 40 MAT. Scanning electron images were obtained using Carl Zeiss ΣIGMA VP equipped with the X-MAX EDS. The chemical composition of the samples was studied by the electron probe microanalyzer Cameca SX100. Raman spectra were obtained with spectrometer Horiba LabRAM HR800 Evolution (laser line 633 nm, grating 600 gr/mm).

Results and Discussion: Several structural features of the chromite crystals were noted in the samples after the differential thermal analysis. The most of the relatively large chromite crystals are intersected with the troilite veins. It could be due to that empty cracks were filled with melted troilite during the heating experiment.

The chemical composition of the chromite crystals from the heated dark-colored lithology samples reveal zoning in the iron and magnesium content. From higher Mg accompanied with lower Fe in the chromite grain rim, it changes to a lower Mg and higher Fe in the chromite crystals center. Moreover, these peculiarities are correlated with the Raman spectra changes.

Three Raman peaks of chromites revealed a light shift relative to those peaks in the spectra from the centers of the chromite crystals: 497, 597, 676 cm^{-1} in the rim, and 491, 594, 673 cm^{-1} in the center, respectively. It should be noted that the highest Raman peak for the chromites from the heated light-colored lithology typically appears at 672 cm^{-1} and for the heated dark-colored lithology at 676 cm^{-1}. However, authors of [5] noted that this peak is at higher frequencies 680-690 cm^{-1}. Probably it is due to that Raman spectra of chromite crystals in [5] were measured on chromites from the impact melt lithology region of the ‘unheated’ Chelyabinsk LL5 chondrite sample.

Conclusions: The chromite crystals from the Chelyabinsk LL5 samples of light-colored and dark-colored lithology after the differential thermal analysis were investigated using electron microprobe analysis and Raman spectroscopy.

Asknowlegements: This work was supported in part by the Ministry of Education and Science (The projects 5.4825.2017/6.7, 5.3451.2017/4.6), by the Act 211 of the Government of the Russian Federation, agreement no. 02.A03.21.0006, and Russian Science Foundation project N16-17-10283 (agreement of 24.05.2016).

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