# THERMAL EFFECT ON THE CHELYABINSK LL5 METEORITE TEXTURE.

E. V. Petrova, A. A. Maksimova, I. A. Danilenko, and V. I. Grokhovsky, Institute of Physics and Technology, Ural Federal University, Ekaterinburg, 620002, Russian Federation, E-Mail: evgeniya.petrova@urfu.ru

**Introduction:** Chelyabinsk meteorite has produced a huge fireball on February, 15 in 2013 in Chelyabinsk region, Russian Federation. A lot of fragments were collected by the Meteoritical Expedition of the Ural Federal University from the snow. The meteorite was classified as LL5 S4 chondrite breccia and it was studied properly [see, for instance, 1–5]. Three main types of Chelyabinsk meteorite matter were distinguished: light lithology, dark lithology and impact melt [4-6]. As far as the origin of the dark lithology part of the breccia was proposed as the result of the heating during the shock event, it might be interesting to obtain the dark lithology from the light one at the laboratory experiment. In the present work light and dark lithology samples of the Chelyabinsk LL5 meteorite were investigated by differential thermal analysis (DTA). The samples texture was explored by optical microscopy and scanning electron microscopy (SEM) with energy dispersion spectroscopy (EDS) before and after heating in the laboratory.

**Samples and Methods:** Two samples of the Chelyabinsk LL5 chondrite (light lithology sample and dark lithology sample) were chosen for the study. Polished sections were analyzed by means of optical microscope Axiovert 40 MAT (Carl Zeiss) and scanning electron microscope ΣIGMA VP (Carl Zeiss) with an X-max energy dispersive spectroscopy device (Oxford Instruments). Then one plane fragment of thickness about 1 mm and of mass about 60 mg was cut from each sample surface for differential thermal analysis. DTA was performed in a noble gas (argon) atmosphere using STA 449 Jupiter device. Each fragment was heated up to the 1000°C under the heating speed and mass control. After the experiment, heated samples were cooled, saved, put into the epoxy, and polished sections were made for the optical and electron microscopy observations.

**Results:** Optical microscopy of the Chelyabinsk LL5 light lithology sample showed the presence of Fe-Ni-Co metal and troilite FeS inclusions within the silicate matrix of olivine $(Fe, Mg)_2SiO_4$ and pyroxene $(Fe, Mg)SiO_3$ mainly. Optical observations of the dark lithology sample revealed that troilite is presented as inclusions and as a thin net of veinlets, which filled cracks. Metal inclusions were found as individual grains and intergrowing with troilite in both light lithology and dark lithology samples.

Differential thermal analysis showed endothermal effect, which was noted at the 150°C for both samples, while there were no changes in the samples masses. This effect could be explained as a polymorphic modification process in troilite [7]. Additional features of the thermal dependences were noted around 850°C.

Optical and electron microscopy study of the light and dark lithology samples after the heating experiments showed changings of the samples texture. The shape of the metal and troilite inclusions, which can be seen under the microscope in the section, was sufficiently transformed. The texture of the light lithology sample after the heating experiment showed similarities with the naturally heated dark lithology material.

The results obtained confirms that as temperature increases, troilite melts, fills cracks and experiences phase transformations. Some texture features of the Chelyabinsk LL5 chondrite dark lithology can be related to the heat treatment effect of the initial light lithology substance.

**Acknowledgements:** This work was supported in part by the Ministry of Education and Science of the Russian Federation (Project no. 3451, 4825), the Act 211 of the Government of the Russian Federation, agreement no. 02.A03.21.0006. Contribution to the study from A.A.M. was funded by the RFBR according to the research project № 16-32-00151 mol_a.

**References:** [1] Popova, O.P. et al. (2013) *Science* 342:1069; [2] Galimov, E.M. et al. (2013) *Geochemistry International* 51:522-539; [3] Oshtrakh M.I. et. al. (2013) *Meteoritics and Planetary Science* 48:1; [4] Kohout, T. et al. (2014) *Icarus* 228:78-85; [5] Badyukov, D.D. et al. (2015) *Petrology* 23:103-115; [6] Petrova E.V. et al. (2016) *Meteoritics and Planetary Science* 51, Abstract #6487; [7] Cruse O. and Ericsson T. (1988) *Physics and chemistry of minerals* 15: 509-513.