THE STRUCTURAL CHANGES IN ORDINARY CHONDRITE TSAREV L5 AFTER SHOCK WAVE LOADING.

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Introduction: Impact events are integral part of the extraterrestrial matter evolution in space. The shock waves loading of the asteroid material affects on a kinetics and a mechanism of phase and structural transformations in its minerals. It is possible to create a wide range of these transformations within a sample, using converging waves loading experiment as it was shown in [1]. Moreover, it is of current interest to create shock features within the meteorite material and compare them to the existed features of the natural origin. Previous works [2-5] was devoted to the study of chondrite Tsarev L5 breccia. In the present work we studied structural changes in the Tsarev L5 meteorite after loading with an impact of converging shock waves.

Samples and Methods: Tsarev meteorite was found on the territory of Russia in the Volgograd region in 1979, while it was considered as the result of the high-power bolide in 1922. Meteorite was classified as ordinary chondrite L5. It mostly consists of olivine, pyroxene, maskelynite, plagioclase, calcium phosphates, kamacite, taenite, troilite, chromite [2,3]. In previous studies [2,3] Tsarev L5 meteorite was described as a chondrite with a clearly expressed texture of shock-breccia. Therefore, for the experimental study we used initial part of the Tsarev L5 meteorite. Sample was prepared as a ball of 50.09 ±0.01mm in diameter, and then reduced by converging shock waves. The experimental procedure was similar to that described earlier in [6]. Then shocked sample was cut, polished and thin section was produced from its diametric cross-section. Microtexture studies were carried out using Carl Zeiss Axiovert 40 MAT and Carl Zeiss Jena Laboval 2 optical microscopy; Carl Zeiss Σigma VP scanning electron microscopy with energy dispersive spectroscopy (EDS) and electron backscattering diffraction (EBSD).

Results and Discussion:

Since the Tsarev L5 meteorite has breccia structure [2, 3], we chose properly an initial dark colored sample of the Tsarev L5 meteorite, which shows homogeneous texture and does not have any brecciation. After the loading with converging shock waves we denote three visually different zones observed in the section. The central part of the shocked sample shows dark-gray porous completely remelted material in the circle, which is about 1cm in diameter. This part is surrounded with the black material ring of 4.5 mm in width. Almost all cracks situated in the bigger ring, of 7 mm in width, including black region. Besides, in the outer part of the section cracks seems notably thinner and material colored as unshocked samples of Tsarev L5 chondrite. Only few visible cracks go through the outer clasts.

Under the polarized microscope melted zone shows newly crystallized large olivine grains, which show sharp extinction and absence of any shock features. At the same zone we noted particles of the metal and troilite intergrowings. According to the dendritic structure of these particles and [7], the rate of cooling in the crystallization range was estimated around 610ºC/s. The black ring area of the shocked sample corresponds to the effect of the chondritic material partial melting (mostly troilite and metal), which took place during the shock wave loading. Texture of this zone contains shock veins of opaque minerals. Olivines and pyroxenes shows sharp and undulatory extinction, because the shock effects were partly removed by the substantial heating. Olivine grains in the outer part of the sample show numerous planar cracks, undulatory extinction, and mosaicism.

Conclusion: Shock features in the Tsarev L5 meteorite material of the different shock level was obtained as the result of the experiment shock. As initial material in the outer part of the sample as completely melted material in the central part can be observed. Futhermore, it is possible to compare experimentally created textural shock features with original material and melted parts of the Tsarev meteorite breccia material. Moreover, it would be of great interest to compare estimations of the shock level determined from the material texture to the experimental conditions and calculated parameters.

Acknowledgement: 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, , and the Russian Foundation for Basic Research, grant #15-35-21 164 mol_a_ved.

References: [1] Muftakhetdinova R.F. et al. (2015) *Letters on materials* 5(1):110-114. [2] Migdisova L. F. et al. (1982) *Meteoritika* 41: 13–30. (In Russian). [3] Migdisova L. F. et al. (1982) *LPS XIII*, Abstract #518-519. [4] Petrova E.A. et al. (2007) *Hyperfine Interact* 177:81–87. [5] Grokhovsky V.I. et al. (1982) *Meteoritika* 41: 37–40. (In Russian). [6] Kozlov E.A. and Zhukov A.V. (1994) *High Pressure Science and Technology* /Eds. S. C. Schmidt, J. W. Shaner, G. A. Samara, M. Ross. New York: American Institute of Physics, P. 977-980. [7] Scott E. R. D. (1982) *Geochimica et Cosmochimica Acta* 46: 813–823.