THE STRUCTURAL CHANGES IN THE KAMACITE–RHABDITE BOUNDARY REGIONS OF SHOCK LOADED SIKHOTE-ALIN IRON METEORITE.

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Introduction: The role of the impact processes is very important for analysis of the history of various bodies in the solar system. It is well known that these processes may be reflected by the structure of extraterrestrial metallic minerals and its variations. The method of shock-isentropic loading is a useful tool for the shock effects modelling using a wide range of pressures and temperatures for the analysis of the structure, phase transformation and properties of meteorites [1, 2]. Sikhote-Alin iron meteorite demonstrates the presence of rhabdite microcrystals in kamacite matrix [3]. In this work we discuss the results of the study of the structural changes in the kamacite–rhabdite boundary regions in Sikhote-Alin iron meteorite resulting from the effect of converging shock waves.

Experimental: Two balls with different diameters from Sikhote-Alin IIB fragments prepared and affected by explosive loading with converging shock waves (see [1]) were used in this study. The slices of these samples were investigated by means of optical microscopy with image analysis and scanning electron microscopy with energy dispersive spectroscopy (EDS) and electron backscattering diffraction (EBSD).

Results and Discussion: The effect of the Sikhote-Alin balls shock loading led to the formation of non-spherical cavity in the ball center with brittle cracks. The shock-induced thermal effects were supposed to be on the basis of structural changes observed in the kamacite–rhabdite boundary regions. The changes in the initial kamacite matrix structure surrounded some rhabdite microcrystalls were observed in the form of new kamacite grains. These grains had curved boundaries with kamacite matrix. Concentration of Ni was not changed in comparison with the initial kamacite matrix. EBSD analysis demonstrated misorientation of new grains. The reason of this structural change may be a diffusionless $\alpha \rightarrow \gamma \rightarrow \alpha_m$ transformation at temperatures above 700 °C. The regions of contact melting at the kamacite–rhabdite boundary were found around some rhabdites. The eutectic liquid in these regions was formed during a local heating. EDS analysis of these regions revealed a decrease of phosphorus content in comparison with that in rhabdite. The phase and orientation maps demonstrated polycrystalline α-Fe(Ni). The area of contact melting after heating (above the melting point of 950°C) and rapid cooling transformed to the supersaturated solid solution of P in the kamacite (α-Fe(Ni)+P). The complete re-melting of rhabdites followed by crystallization was observed in the regions affected by higher shock-produced temperatures. Thus, we demonstrated that these regions were formed by the mixture of α-Fe(Ni)+P microcrystals and dispersed phosphide-kamacite eutectic.

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References:

[1] Kozlov E. A. et al. 2001. #1057. *32th Lunar & Planetary Science Conference*. [2] Grokhovsky V. I. et al. 2000. *Meteoritics & Planetary Science*. 35:A66. [3] Oshtrakh M. I. et al. 2001. *Materials Chemistry and Physics.* 130:373–380.