COMPARISON OF STRUCTURAL CHANGES IN SIKHOTE-ALIN IIAB IRON METEORITE UNDER VARIOUS ORIGIN SHOCK DEFORMATION

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Introduction: During the evolution of the Solar system small bodies are repeatedly collide with each other, and with planets. Thus, any cosmic substance during its existence has undergone at least one shock event, which is accompanied by the occurrence of high temperatures and high pressures. These shock events are reflected in the structure of meteorites. The classification of the degree of shock metamorphism for chondrites is well known [1]. The structure of iron meteorites after shock loading has been studied in many works, but a clear classification of structural changes is absent. The complexity of this task is explained by the fact that iron meteorites have significant differences in the initial structure and structural changes after shock impacts. In this work we will consider the processes occurring in meteorites under the impact of shock loads on them both in outer space, during falling on the Earth's surface and after experimental loading.

Samples and Methods: The objects of the study are fragments of the Sikhote-Alin IIAB meteorite with different shock prehistory: substance of individual fragment, which was not subjected to shock, matter from the impact crater and samples compressed by converging shock waves. The iron meteorite Sikhote-Alin (IIAB) is belongs to the class of coarse octahedrites. Wide single-crystal bands of α-Fe (Ni, Co) contain a different dispersity of rhabdites. Massive segregations of troilite and shreibersite occur at the kamacite bands boundaries [2]. Microstructure studies were carried out using the Zeiss Axiovert 40 MAT optical microscope and scanning electron microscopy Carl Zeiss Σigma VP with energy dispersive spectroscopy (EDS) and electron backscattering diffraction (EBSD) units.

Results and Discussion: Study of individual fragments of the Sikhote-Alin meteorite revealed the presence of uniformly distributed dislocations, dislocation loops, cellular dislocation substructure, deformation microtwins [3]. In microstructure of these samples traces of the phase transformation $\alpha \rightarrow \varepsilon \rightarrow \alpha$ weren't found.

Fragment from the impact crater Sikhote-Alin demonstrate external signs of plastic deformation, such as pointed ragged edges and the absence of melting crust. In these samples traces of complete or partial remelting of the minerals weren't detected. In the peripheral part of the fragments from the impact crater, a fibrous pattern (fibrous texture) is observed, which was formed due to the flow of metal as a result of cold plastic deformation. Individual fibers in the form of the fine tape-like interlayers contain finely dispersed phosphides. Brittle fracture of rod rhabdites are observed at a distance from the surface of samples. However, in the central part of the sample an unchanged initial microstructure is keep, where boundaries of the kamasite bands decorated with phosphides.

Various traces of shock metamorphism in the Sikhote-Alin meteorite after shock waves loading were observed. Brittle fracture traces in inclusions of rod-like rhabdites $(FeNi)_3P$ are well manifested, as well as in samples from the impact crater. The viscous nature of deformations is well visible during shear passes through thin roaldite $(FeNi)_4N$ plates. Also, an increase in the dislocation density in kamacite, deformation by sliding and twinning, contact melting at the kamacite-rhabdite boundary, regions of complete remelting of phosphides and traces of $\alpha \rightarrow \varepsilon \rightarrow \alpha$ transformations were observed. All this indicates that during the experimental loading, in some zones the pressure was significantly higher than 12 GPa [4,5], and temperature at the interphase boundaries reached 900 ° C.

Conclusion: It was established, that in the individual fragments of the Sikhote-Alin meteorite the pressure amplitude did not exceed 12 GPa, during entering the dense layers of the atmosphere and falling to Earth. Fragments from impact craters underwent inhomogeneous cold plastic deformation, most noticeable in the peripheral part of the fragments. In the simulation experiments, possible structural changes in the coarse octahedrite are demonstrated with significant peak pressure and temperature.

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