MECHANICAL PROPERTIES OF VARIOUS LITHOLOGIES OF THE CHELYABINSK METEORITE

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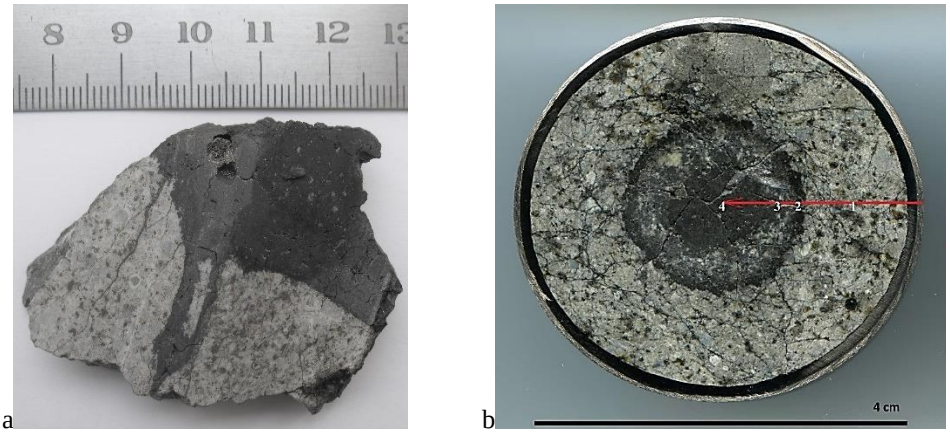
Introduction: As is known, three lithologies are observed in the Chelyabinsk meteorite: light (original), dark (containing a proportion of remelted sulfides), and impact melt (completely molten and crystallized matter) [1]. There are both individual samples with monolithology and breccias containing all types of lithologies (fig. 1a).

Experimental: We studied the mechanical properties of the Chelyabinsk chondrite with the structure of impact metamorphism in space and after impact, loading them in the laboratory. For explosive loading from a fragment with light lithology of the investigated meteorite [2] a spherical sample in size 39.99±0,01 mm was made. After which it was subjected to spherical explosive compression with using explosives [3]. Explosive experiments with the preservation of compressed specimens were carried out in RFNC-VNIITF (Snezhinsk). The surface of the samples after sawing was prepared according to the standard metallographic technique (fig. 1 b). The determination of Vickers hardness for various structural zones was carried out on a Zwick/Roell Z 2.5 machine at a load of 50 N.

Results and Discussion: The material of different lithologies has different mechanical characteristics. Based on the data obtained from measuring hardness, we can conclude that material with a light lithology has the lowest hardness values (~1200 H/mm^2): the black component is almost three times harder (~3300 H/mm^2). An analysis of hardness values in different zones of the shocked sample reveal the correlation with values obtained from individual fragments and breccia. We assume that the gray and black lithologies were strengthened as a result of filling fractures, including the smallest ones, with impact melt, which plays the role of binding "cement". The hardness values of the black lithology are higher than those of the impact melt (~2500 H/mm^2).In our opinion, this is the result of the weakening of the gray lithology due to the influence of phenomena like shrinkage voids and cracks. The mixed lithology, which outwardly resembles rounded areas of light lithology (chondrules, fragments of light lithology, relics of olivine grains, and unaltered chromite grains), is surrounded by a melt of darker silicates and troilite veins. The mixed lithology in individual samples shows overly low hardness values (~500 H/mm^2), possibly due to the material's strong heterogeneity.



a b

Figure 1. a) A brecciated sample of the Chelyabinsk meteorite, b) a section of a ball from the Chelyabinsk meteorite after shock-wave impact.

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