METALLIC MICROSPHERES OF COSMIC AND TECHNOGENIC ORIGIN

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Introduction: The origin of metal microspheres in sedimentary rocks causes discussions among researchers. There are hypotheses of natural terrestrial (volcanogenic), cosmic (ablation, impact), technogenic and biological origin [1, 2, 3, 4]. The present work is devoted to the search for additional criteria for the separation of space and technogenic microspheres.

Methods: The morphology of metallic microspheres selected by a neodymium magnet is described. The technogenic microspheres are treated with oxalic acid (HOOC-COOH) in an ultrasonic bath. The chemical composition was studied using a Phillips XL-30 electron microscope with an ESEM energy dispersive spectrometer.

Results: 6 microspheres were examined from the dust of drilling equipment (1) and welding process (2). The average diameter of technogenic microspheres (1) is 60 μm, the range is 36-80 μm; the surface of the microspheres is smooth, matte (Fig. 1a). The main elements are C, O, and Fe. After HOOC-COOH treatment, some balls acquire a texture surface (Fig.1b), which is look like the microrelief of natural microspheres (Fig. 1d). Welding balls (2) are characterized by large dimensions (diameter 300-1500 μm), mostly smooth surface (Fig.1c), and large set (about 10) of chemical elements. Among the main elements are C, O, Fe and Ti up to 10-16%. In general, for technogenic balls, a 2-fold excess of oxygen content is noted, compared with natural (cosmic) microobjects [4, 5].

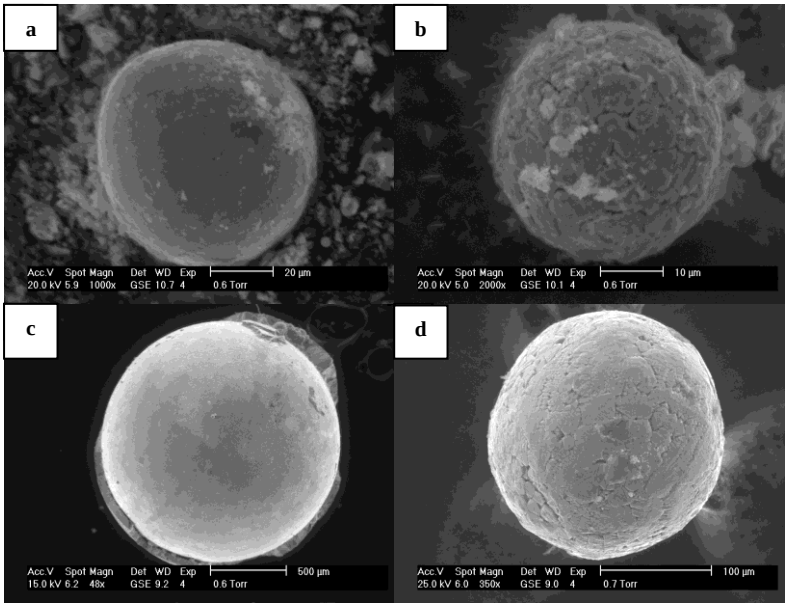

Fig. 1. Metal microspheres: a, b - from the dust of drilling equipment (a - without treatment, b - treated with HOOC-COOH); c - welding ball; d - magnetite microsphere from Carboniferous deposits (~ 310-313 million years ago).

Discussion: A comparative analysis of the chemical composition of technogenic and cosmic microspheres from the core of the wells of the sedimentary rocks of the Paleozoic age (Fig. 1d) showed that the first is characterized by a wide range of chemical elements, the presence of carbon, sometimes titanium. In space objects, the main elements are Fe and O (more than 95%). Technogenic samples have basically a smooth surface; natural balls have a microrelief surface, which is considered one of the defining criteria of cosmogenic origin [2]. The recalculation of chemical analyzes for minals showed that hematite predominates in man-made spheres, and magnetite in cosmic balls. The increased oxygen content in artificial objects indicates the oxidative conditions of their formation near the Earth's surface.

Conclusions: The differences between technogenic and cosmic microspheres in chemical (presence / absence of carbon, wide / primitive composition of elements, absolute content of O) and mineral composition are revealed. In the future, the internal structure of microspheres in polished sections and using X-ray microtomography will be studied, which will complement the criteria for the separation of balls according to genesis. Hence, the results obtained will allow the use of metal microsphere finds in rocks (cosmic dust) as an additional tool in the correlation of polyfacial sections and the search for stratified minerals [5].

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