COSMIC MICROSPHERES AT BOUNDARY OF THE KUNGURIAN STAGE

R.Kh. Sungatullin[1], G.M. Sungatullina[1], Yu.P. Balabanov[1], M.S. Glukhov[1], L.R. Kosareva[1], A.I. Bakhtin[1], A.V. Gusev[1], D.M. Kuzina[1]
[1]Kazan Federal University, Institute of Geology and Petroleum Technologies, Russia, Kazan, Kremlyevskaya st., 18.
E-mail: Rafael.Sungatullin@kpfu.ru

Introduction: At present, the comparison of different facies sections based on traditional biostratigraphic, lithological, and geochemical methods is very difficult. One of the new additional methods of their correlation is the study of cosmic particles, which in ancient times were deposited on the Earth's surface [1]. Some researchers [2–4] associate with such objects the possibilities of distinguishing event-related stratigraphic levels of a global, regional, and local scale. Our study is devoted to the study of magnetic microspheres from the Mechetlino section, located in the Southern Urals, Russia. This geological section is a candidate GSSP (Global Boundary Stratotype Section and Point) for the lower boundary of the Kungurian Stage (~ 283.5 million years ago) of the International Stratigraphic Time Scale.

Methods: We carried out magnetic separation of 22 samples taken from the sedimentary rocks of the Kungurian-Artinskian boundary of the Mechetlino section (thickness of 20 meters) using a neodymium magnet. Microspheres were studied using a Phoenix V | tome | X S 240 x-ray microtomograph and a Phillips XL-30 electron microscope with an energy dispersive spectrometer. For rocks samples of section, measurements of the volume magnetic susceptibility were carried out using the Bartington MS2 instrument and differential thermomagnetic analysis.

Results: In the Artinskian deposits of the Mechetlino section (16 samples) microspheres were not found, and in Kungurian deposits in the layers 12, 15 and 17 iron oxide (wustite) and intermetallic (Fe-Cr) microspheres were found. The diameter of the particles is 5-300 μm, they have an ideal spherical shape (Fig. 1), a strong metallic luster with a characteristic dendrite and tabular surface. In rare cases, microspheres of native iron were encountered. In addition, a large number of Fe-Cr intermetallic compounds in the form of irregular particles are found in magnetic fraction from Kungurian deposits.

Discussion: According to petromagnetic data, the magnitude of the induced magnetization of rocks varies from 0.13×10^{-3} to 6.08×10^{-3} A/m, and magnetic susceptibility ranges from -0.3×10^{-5} to 8.0×10^{-5} units SI. The content of magnetic minerals is very small, and changes of petromagnetic parameters are not enough for distinguishing different conditions of sedimentation in section. Findings of the microspheres are very useful tool for the dismemberment of this section. The chemical and mineral (wustite, native iron, Fe–Cr intermetallic compounds) composition of the studied objects are close to the microspheres, which appeared during the ablation of meteorites and falling out of cosmic dust [1, 2].

Conclusions: In the future, objects of cosmic origin can significantly increase the accuracy of dismemberment and improve the system of global correlation of geological sections on Earth.

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University also by the subsidy allocated to Kazan Federal University for the state assignment in the sphere of scientific activities #5.3174.2017/46

References: [1] Korchagin O.A. 2010. Doklady Earth Sciences, 431, 6: 783-787. [2] Sungatullin R.Kh. et al. 2017. Meteoritics & Planetary Science, 52, Is.: A336. [3] Sungatullin R.Kh. et al. 2017. Russian Geology and Geophysics, 58: 59-69. [4] Sungatullin R.Kh. et al. 2018. Meteoritics & Planetary Science 53: A6291.

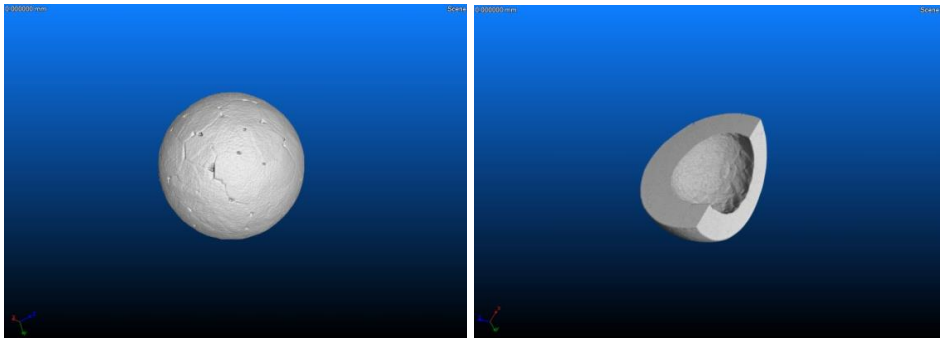

Fig. 1. Tomographic (3D) images of the microsphere. Mechetlino section. Layer 12. Diameter of microsphere 300μm