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Cosmic microspheres in the Carboniferous deposits of the Usolka section (*Urals foredeep*)

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Abstract

Magnetite microspheres from the Carboniferous deposits of the Usolka reference section were studied by probe microanalysis, with comparison of the distributions of chemical elements and microspheres. The presence of microspheres in sedimentary strata is considered to be an additional factor for stratigraphic correlation between sedimentary sections. The microspheres are shown to be of cosmic nature. The Late Paleozoic paleoclimatic changes (extreme cooling) and biotic crises were caused by the periodical Solar System motion in the Galaxy, cosmic-dust fallout, and meteorite bombardments of the Earth.

Keywords: Carboniferous; cosmic bombardment; magnetite microspheres; chemical composition; paleoclimate; Urals foredeep

Introduction

In recent years, wide introduction of electron scanning microscopy (SEM) in geology has raised the interest of Russian researchers to metallic microparticles (≤1 mm) of different shapes (spheres, drops, plates, spirals, and wires) that seldom occur in sedimentary deposits (Akulov et al., 2014; Astakhova et al., 2014; Goleva et al., 2014; Grachev et al., 2008; Karpov and Mokhov, 2010; Korchagin, 2010; Korchagin et al., 2010; Medvedev et al., 2006; Murdmaa et al., 2015; Osovetskii and Men'shikova, 2006; Pechersky et al., 2013a,b; Sungatullin et al., 2014, 2015a, 2016). Magnetite microspheres in sedimentary rocks were first described by Murray and Renard (1891) during the voyage of HMS Challenger as early as the 1870s. They were found in deep-water red clays, assigned to cosmic dust, and called cosmic balls. The geologists focused their attention on such particles in the course of the study of cosmic substance and the Earth's genesis (Badyukov et al., 2011; Cordier et al., 2011; Finkelman, 1970), the influence of the Earth's and cosmic processes on the climatic and biotic events in the geologic history (Barash, 2012; Ellwood et al., 2003; Ermakov et al., 2009; Gillman and Erenler, 2008; Glukhovskii and Kuz'min, 2013; Lozovskii, 2013), and the perspective of global, regional, and local correlations for rock units of different facies (Grachev et al., 2008; Korchagin et al., 2007; Murdmaa et al., 2015; Nigmatzyanov, 2015; Raukas, 2000; Sungatullin et al., 2015a,b, 2016). The origin of such metallic microparticles, however, has been the subject of controversy. There are three main hypotheses of their formation: natural terrestrial, cosmic, and technogenic (Grachev, 2010).

The object and methods of study

This paper deals with morphological description and analysis of the chemical composition of microspheres from the Carboniferous deposits of the Usolka section (Fig. 1). This section is located in the axial part of the Sterlitamak zone of the Urals foredeep. It is formed by Middle Carboniferous–Lower Permian condensed flysch carbonate–clay–siliceous deposits with interbeds of volcanic tuffs and is characterized by continuous sedimentation and high denudation. The biostratigraphy and lithology of the section were studied in detail (Chuvashov et al., 1990; Mizens, 1997; Nelson and Ritter, 1999; Sungatullina et al., 2014b; Zeng et al., 2012), and absolute zircon dating (Schmitz and Davydov, 2012) and

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