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Native Iron in the Earth and Space

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Abstract—Thermomagnetic and microprobe studies of native iron in the terrestrial upper-mantle hyperbasites (xenoliths in basalts), Siberian traps, and oceanic basalts are carried out. The results are compared to the previous data on native iron in sediments and meteorites. It is established that in terms of the composition and grain size and shape, the particles of native iron in the terrestrial rocks are close to each other and to the extraterrestrial iron particles from sediments and meteorites. This suggests that the sources of the origin of these particles were similar; i.e., the formation conditions in the Earth were close to the conditions in the meteorites' parent bodies. This similarity is likely to be due to the homogeneity of the gas and dust cloud at the early stage of the solar system. The predominance of pure native iron in the sediments can probably be accounted for by the fact that interstellar dust is mostly contributed by the upper-mantle material of the planets, whereas the lower-mantle and core material falls on the Earth mainly in the form of meteorites. A model describing the structure of the planets in the solar system from the standpoint of the distribution of native iron and FeNi alloys is proposed.

Keywords: thermomagnetic analysis, microprobe analysis, iron, nickel

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INTRODUCTION

> "It becomes clearer all the time that not a single deep and fundamental question bearing on the structure and development of the Earth can be answered without the use of recently obtained data on the Moon, the planets, meteorites, and asteroids."
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> *V.N. Zharkov*
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> (*Interior Structure of the Earth and Planets*, Chur: Harwood, 1986, p. xvii).

Our long studies (Pechersky et al., 2006; 2008; 2009; 2010; 2011; 2012a; 2012b; 2013a; 2013b; 2013c; 2015; Pechersky and Sharonova, 2012; 2013; Pechersky and Kuzina, 2015) established that particles of native iron are dominated by the Ni-bearing species. One of the probable explanations conjectures that Ni-free iron particles have originated from the widespread terrestrial upper-mantle and core rocks (such as basalts composing the oceanic floor and traps covering vast continental territories) as a result of their effusion, spread of ash, and/or erosion. The possibility of this scenario is explored in this paper where we present the results of the thermomagnetic and microprobe studies of the samples of terrestrial rocks:

(1) Upper-mantle hyperbasites which were transported onto the Earth's surface in the form of xenoliths by basaltic lavas, including hyperbasite xenoliths from the lavas of the Antarctic, Mongolia, Primor'e (Russian Far East), Syria, Svalbard (collections of A. Saltykovskii), and Vitim Plateau (collection of I. Ashchepov) (Table 1);

(2) Traps of the Angara, Maymecha–Kotui, and Norilsk trap provinces (collection of A. Latyshev) (Table 2),

(3) Oceanic basalts forming the floor of the Atlantic, Pacific, and Indian oceans and the Red Sea (collections of V. Matveenkov and S. Silant'ev) (Table 3).

These results are compared to the previous data for sediments and meteorites (Tables 4, 5).

We preliminarily note that, following a number of authors, we refer to such objects as meteorites, asteroids, and interstellar dust as *extraterrestrial* instead of *cosmic* because the notion of a *cosmic* object is not entirely adequate for this case: it also applies to the Earth as a cosmic body.

STUDY METHODS

The experimental procedure included the thermomagnetic analysis (TMA) and microprobe analysis (MPA). TMA was conducted in the Paleomagnetic