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Stability of iron oxides and their role in the formation of rock magnetism

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Abstract

Thermodynamic conditions (first of all, temperature) are the main dynamic factors in the transformation process of ferrous to ferric iron (TFFI). TFFI usually takes place within a temperature range of 473-843 K (most active at temperatures above 673 K) and does not require presence of the oxidizing agents above 673 K. Analysis of the chemical composition of different rocks and minerals indicates that only for some sedimentary rocks is the relative content of ferrous iron oxide less than its value in magnetite, and this value is minimal for oceanic sediments. The relative content of ferrous iron oxide in oceanic magmatic rocks exceeds this value in continental magmatic rocks and depends on the rate of rock cooling. An investigation of the role of the titanium oxide content of different rocks on stability of ferrous iron oxide against its transformation to ferric iron oxide shows that a significant correlation (r = 0.79) does exist between the relative content of ferrous iron oxide and ratio of TiO_2/Fe_2O_3. Temperature within the solar nebula at location of the Earth was within the temperature range of the TFFI. During the Earth accretion and its early evolution, ferric iron oxide was unstable and most likely did not exist. The first magnetic minerals containing ferric iron could have appeared only after the Earth's surface had cooled below ~843 K. The formation of the first Algoma-type banded iron formations could be used as a marker of the Earth's surface cooling below ~843 K.

Key words: ferric, ferrous, remagnetization, rock magnetism, temperature range.