Geophysical Research Abstracts, Vol. 9, 06070, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06070

Pressure-induced spin crossover in ferropericlase: an alternative concept.

I. Kantor (1), L. Dubrovinsky (1) and C. McCammon (1)

(1) Bayerisches Geoinstitut, Bayreuth University, Germany
(Innokenty.Kantor@Uni-Bayreuth.DE)

Ferropericlase (Mg,Fe)O is the second most abundant mineral in the Earth's lower mantle after (Mg,Fe)SiO_3 perovskite. Its high-pressure and high-temperature properties are crucial for the determination of the Earth's deep interior model. The hypothesis of a pressure-induced spin transition of Fe^{2+} ions in geologically relevant materials was proposed more than 40 years ago [1], but the experimental evidence for such a transition in ferropericlase was obtained only in the last few years. At ambient conditions high-spin and low-spin Fe^{2+} ions have significantly different ionic radii, resulting in significant discontinuous changes of density and often crystal structure of Fe compounds at ambient pressures. Similarly, the same consequences were expected to follow the spin crossover in ferropericlase. A significant discontinuity in density and elastic properties were claimed to occur in ferropericlase due to spin crossover [2,3]. Also, a major change of optical absorption and, therefore, in radiative conductivity, were reported to occur due to spin changes [4]. Our experimental Mössbauer spectroscopic measurements of ferropericlase samples with different iron content and at different pressures and temperatures, combined with literature data, allow an alternative concept of spin crossover in ferropericlase. It is probably not a phase transition, but a continuous (thermal equilibrium) change in high- and low-spin abundance due to low iron content in (Mg,Fe)O solid solution and weak cooperative interactions. The main implication of this concept is the absence of any strong effect of the spin crossover in ferropericlase on elastic properties and density profile of the lower mantle.

[1] Fyfe W.S. Geochem. et Cosmochim. Acta 19 (1960), 141-143. [2] Speziale S. et al. PNAS 102 (2005), 17918-17922. [3] Lin J.F. et al. Nature 436 (2005), 377-380. [4] Goncharov A.F., Struzhkin V.V., and Jacobsen S.D. Science 312 (2005), 1205-1208.