Magnetic Transitions in Fe_2O_3 at High Pressures: Magnetism in the Earth's Mantle

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The Earth's crust-mantle boundary (Moho discontinuity) has been traditionally considered as a fundamental boundary between the magnetic crust and the nonmagnetic mantle. Nevertheless, this assumption has been questioned recently by geophysical studies and by the identification of magnetic remanence in mantle xenoliths [1,2], which suggest deep magnetic sources. Owing to their high critical temperatures, iron oxides are the only potential sources of magnetic anomalies at mantle depths [3]. However, the lack of data on their magnetic properties at relevant pressure-temperature conditions hampers any conclusive result about the Curie depth, below which mantle temperature is too high to sustain any kind of long-range magnetic order.

Here I report investigations of the magnetic transitions and critical temperatures in Fe_2O_3 polymorphs [4] to 95 GPa and 1200 K by means of Synchrotron Mössbauer Source spectroscopy [5] in laser-heated diamond anvil cells. The experiments were conducted at ID18 beamline of the ESRF. Our results demonstrate [6] that hematite, α-Fe_2O_3, remains magnetic at the depth of the Earth's transition zones along cold or very cold subduction paths in the West Pacific region. The geophysical implications of these findings will be discussed.

References

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