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Consequences of extremely high magnetization at Curie-depths on magnetotellurics

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As it has been discussed in a recent paper by Kiss et al. (2005), second-order magnetic phase transition may easily occur in the Earth's natural laboratory, and it has two consequences: (1) some of the magnetic anomalies of unknown origin might be explained by assuming small-size bodies (extended in one or both horizontal directions) just at the Curie-depth of the magnetic minerals; (2) in magnetotellurics, the role of magnetic susceptibility (has been so far neglected) should be taken into account. In the presentation we discuss how a highly anomalous magnetization influences the magnetotelluric field in 1D, 2D and 3D situations. In a homogeneous medium, on basis of the complex wave/diffusion number, one would assume a significant decrease in the apparent resistivity. At the same time, in presence of conductivity interface, the apparent anomaly depends on the boundary conditions, in such a way that (a) continuity of the tangential magnetic field leads to an increase in the apparent resistivity, (b) continuity of normal component of the magnetic induction vector leads to a significant apparent resistivity decrease. The resulting multidimensional anomalies are very complicated, and in the terms of traditional apparent resistivity cannot be correctly interpreted. We recommend to compute diffusion velocity of the electromagnetic field, on basis of the Maxwellian stress tensor. Examples from Hungary illustrate that new geophysical images of the Earth are full of surprises. Acknowledgements: Hungarian Research Fund T37694. Reference: Kiss, J., L. Szarka, and E. Prácser (2005), Second-order magnetic phase transition in the Earth, Geophys. Res. Lett., 32, L24310, doi:10.1029/2005GL024199.