

Regionality of mantle conductivity inferred from geomagnetic daily variation analysis

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SUMMARY

This paper reports on the regionality of the electrical conductivity of the global mantle, inferred from geomagnetic data analysis of daily variation. The mantle has a potential to reserve a huge amount of water, and the electrical conductivity distribution can reveal water contents in the mantle. In this study, geomagnetic data of daily variation at 71 stations were analyzed, and a global distribution of the electrical conductivity in the mantle was detected. It is necessary to take into account the Sq field distribution, because the geomagnetic distribution of daily variation is complex, and it prevents a plane wave assumption. 71 stations, however, are still not enough to draw a Sq field with high resolution. Instead of it, the GAIA (Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy) is used as the inducing field. The GAIA assimilates the meteorological reanalysis data (JRA-55) to the whole atmosphere-ionosphere coupled model and thus it is the well-modelled Sq field. First, we executed spherical harmonic expansion of the magnetic field of the GAIA for three-days time series, which correspond to sequent solar quiet days. Next, three-dimensional forward modeling in the spherical Earth was performed to compare with the observed geomagnetic data. Now, we suppose the one-dimensional structure in the Earth under the ocean-land lateral contrast. We tried several one-dimensional models and searched for the best-fitted model for each station. As the results, beneath Europe, the conductive model, in which the electrical conductivity exceeds 0.1 S/m in the upper mantle, is preferred. Conversely, the resistive model, in which the electrical conductivity is 0.01 S/m or less in the upper mantle, is likely beneath the northwestern Pacific. This difference may be derived from the water contents, which were carried by a subducting slab, because a maximum amount of water depends on the temperature of the slab.

Keywords: mantle conductivity, geomagnetic daily variation, Sq field, GAIA
