Examination of criteria to remove the influence of the Sq-field variations from electromagnetic field spectra for a better estimation of regional electromagnetic responses

*LI RUIBAI[1]、清水 久芳[1]、馬場 聖至[1]、歌田 久司[1]
*RUIBAI LI[1], Hisayoshi Shimizu[1], Kiyoshi Baba[1], Hisashi Utada[1]

1. Earthquake Research Institute, the University of Tokyo
1. Earthquake Research Institute, the University of Tokyo

Electromagnetic (EM) responses such as magnetotelluric (MT) impedance and geomagnetic depth sounding (GDS) response (or tipper) in the period range between several minutes to one day are used to study the electrical conductivity in the upper mantle. Spatially uniform and quasi-random magnetic field variations due to geomagnetic disturbances are considered as the source field in regional EM induction studies using the EM responses. However, the magnetic field variations in the period range from to seconds (mixed excitation band, or ME band) contain those with different spatial structure such as the solar quiet (Sq) daily variations and those induced by the ocean tide. Careful treatment of EM field data is necessary to estimate responses in the ME band that reflect actual conductivity structure. For example, Baba et al. (2010) estimated the EM responses in the period range from to seconds using a method based on Fourier transform after removing line spectra of EM field variations at periods of Sq field variations that include the higher harmonics and constituents of ocean tides. However, it was shown that the estimated responses in the ME band still included the influence of Sq field variations (Shimizu et al., 2011).

In this study we try to estimate EM responses that are less influenced by the Sq field variations. We employed line spectra of EM field obtained by using Sompi method, so called wave element (or namiso) (e.g., Kumazawa et al.,1990, Asakawa eta al.,1988), to estimate the EM responses in order to avoid the influence of the Sq field variations that could be contained in continuous spectra. Also, three conditions are applied to select appropriate wave elements from observed ones for EM response estimations. First is to select wave elements of which eastward component have common phase or that close to each other at two stations. This can avoid wave elements influenced by the Sq field variations since their westward propagation causes systematic phase difference of the magnetic field for supposed longitude difference and apparent period, which is determined by the longitudinal wave number of the variation. Second is to select magnetic field spectra that are linearly polarized in horizontal-vertical plane, because that influenced by the Sq field variations are expected to be more elliptically polarized in the plane than those suitable for regional EM response estimation. Ellipticity of the polarization ellipse is used to apply the condition. Third is to select those which have small ratio of the vertical to the horizontal magnetic field components, because the Sq field variations contain significant vertical magnetic field component that can cause larger amplitude of tipper than those from plane wave. It was confirmed that estimated phase difference, ellipticity, and vertical to horizontal field ratio showed a signature of Sq field variations in the ME band but not at a period shorter than seconds.

In this presentation, we are going to show the characteristics of the observed phase difference, ellipticity, and vertical to horizontal field ratio with respect to the period. Criteria to apply the conditions are assumed based on theoretical estimate of the magnetic field due to Sq principle mode and the induced field in assumed one dimensional Earth. The EM responses obtained by applying each condition are shown and the improvement or influence in the obtained responses, as a result, are discussed

quantitatively.

Asakawa, E., et al. (1988). *J. Geomagn. Geoelec.,*40: 447-463.

Baba, K., et al. (2010).*Phys. Earth planet. Inter.,*183: 44-62.

Kumazawa, M., et al. (1990). *Geophys. J. Int.,*101: 613-630.

Shimizu, H., et al. (2011). *Geophys. J. Int.,*186: 193-206.