

Three-dimensional analysis technique for marine magnetotelluric method

Noriko Tada^{1*}

¹JAMSTEC

Magnetotelluric (MT) sounding is a powerful geophysical method to explore electrical conductivity structure in the Earth's interior. The electrical conductivity of Earth material is known to be strongly dependent on physical conditions such as temperature, water content, and degree of partial melting which control their mechanical properties. Especially in oceanic areas, therefore, a number of efforts have been made to obtain accurate images of the electrical conductivity distribution in the upper mantle since the pioneering work by Filloux's (1973).

However, topographic effect makes difficult to obtain accurate electrical conductivity images. The electric and magnetic (EM) fields observed on the seafloor are generally distorted by rugged seafloor topography. The effect of seafloor topography is more significant than that of land topography (e.g., Nam et al., 2008) because seawater, which has extremely high conductivity, produces strong conductivity contrast at the seafloor (Schwalenberg and Edwards, 2004).

In recent years, several works have attempted to solve the problem of topographic effects on the seafloor MT data. Baba and Seama (2002) proposed a three-dimensional (3-D) forward modeling called FS3D which can incorporate precise 3-D topography over arbitrary subsurface structure. Tada et al. (2012) introduced a practical 3-D inversion scheme called WSINV3DMT with approximate treatment of topography (ATT) which expresses conductivity using volumetric averaging in order to describe seafloor, which treats large-scale topographic effect. Furthermore, Baba et al. (submitted) combined the FS3D method with the WSINV3DMT with ATT in order to treat both small-scale and large-scale topographic effects. These techniques allow us to estimate detailed 3-D electrical conductivity structures beneath the seafloor. Now we can perform 3-D inversion analysis for a data set of seafloor EM survey in the Philippine Sea and in the western edge of the Pacific Ocean in order to reveal upper mantle electrical conductivity distribution.

Keywords: Marine magnetotelluric method, Topographic effect, Three-dimensional, Forward modeling, Inversion analysis