MT 3

[1]; [2]; [3]
[1] ; [2] IFREE; [3]

Incorporation of topographic effect in a three-dimensional inversion of seafloor MT data

Kiyoshi Baba[1]; Noriko Tada[2]; Hisashi Utada[3]
[1] ERI, Univ. of Tokyo; [2] IFREE, JAMSTEC; [3] ERI, Univ. Tokyo

We have developed a method to incorporate the effect for seafloor topography on magnetotelluric (MT) responses in a three-dimensional inversion analysis focusing on imaging of upper mantle electrical conductivity structure.

Taking the topographic effect into account in the inversion analysis is definitely important in case applying it to seafloor MT data because the data are obtained at the boundary of largely different conductivity media, i.e., sea water and crust, where the electric and magnetic (EM) fields are severely distorted. A three-dimensional (3D) MT inversion program that can incorporate the topographic change as known information into conductivity structure and can apply to seafloor data is now feasible by contribution of Tada et al. (a presentation in this session). However, there is an issue to be solved before applying it to real data. There exists topographic change of various scales in real Earth and it is difficult for numerical modeling to simultaneously resolve the small-scale heterogeneity that produces distortion and yet include the much larger-scale heterogeneous structure of the underlying mantle which is of geophysical interest.

In this study, we model the effect of local small-scale topography around observation sites separately from the response to the regional large-scale topography (including land-ocean distribution) and subsurface heterogeneous structure. According to Baba & Chave (2005), a relationship of $\mathbf{Z}=\mathbf{Z}_t\mathbf{Z}_m$ is assumed, where $\mathbf{Z}_m$, $\mathbf{Z}_t$, and $\mathbf{Z}$ are MT impedance tensor to the structure without the local small-scale topography, the distortion term due to the local small-scale topography, and MT impedance tensor to the total structure, respectively. $\mathbf{Z}_t$ is calculated from the relation once $\mathbf{Z}$ and $\mathbf{Z}_m$ are obtained by forward modeling assuming proper subsurface structure. However, the forward modeling of $\mathbf{Z}$ has difficulty mentioned above. In order to obtain $\mathbf{Z}$, we first simulate the EM fields to the model without the small-scale topography, then, using the output fields as initial and boundary values, we simulate the EM field again to a smaller model space but including small-scale topographic change. In the inversion analysis, we attempt two different approaches. 1) The observed MT responses are first corrected for the effect of the small-scale topography, and the corrected responses are inverted. $\mathbf{Z}_t$ is calculated again using the obtained subsurface structure model. The correction and inversion are iterated to check the mutual coupling between $\mathbf{Z}_t$ and subsurface structure. 2) Likely $\mathbf{Z}_t$ is obtained by trial and error forward modelings with checking the mutual coupling effect. Then, the obtained $\mathbf{Z}_t$ is included in the inversion process in order to minimize the misfit between the observed responses and calculated responses multiplied by $\mathbf{Z}_t$.

The methods proposed above are tested using synthetic data set. We will present the results in the meeting.

(MT) 3 MT

MT

3 MT

,

10km
Baba & Chave (2005) MT
(**Z**) MT (**Z**$_m$)
(**Z**$_t$) **Z, Z**$_m$
Z$_t$ **Z**

2 1) Baba & Chave (2005) MT
3
2)

MT