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Toward 3-D inversion of seafloor MT data

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We have modifying a three-dimensional inversion code which can invert seafloor data distorted by topography. In recent years, a number of seafloor electromagnetic (EM) experiments have been carried out by using Ocean Bottom Electromagnetometers (OBEMs). The density of marine Magnetotelluric (MT) data has been increasing so that imaging electrical conductivity structures under the seafloor in three dimensions is now feasible. 3-D inversion code which can treat marine MT data, however, has not developed yet. Seafloor data are distorted by topography because of highly conductive seawater. Existence of seawater makes difficult to model EM field on the seafloor. Because seafloor topography is very complex and it requires huge number of grids to incorporate itself into a model. Thus, we induce a new idea as following. EM field affected by background and anomalous bodies is approximated by the fields for simpler three structures separately. The EM fields for background, and background including anomaly are calculated using WSINV3DMT (Siripunvaraporn et al., 2005). The EM field for background including short wavelength topography around observation sites is calculated using FS3D (Baba and Seama, 2002). We have modified forward part of WSINV3DMT to be able to apply complex topography and seafloor data.

Two important techniques are incorporated into our modified code to keep a cost-effective manner; volume-weighted average of the electrical conductivity in a block containing land surface or seafloor, and calculation of the MT responses at an arbitrary point in a block. The volume-weighted average is calculated using conductivities of two media and volumes of these media on the condition of horizontal conductance conservation or vertical conductance conservation. The MT responses at an arbitrary point are calculated using electric and magnetic fields which are computed at the arbitrary point to interpolate or extrapolate.

We chose the best combination between the volume-weighted average and calculation of electric and magnetic fields at an arbitrary point in a block. A two layers model, which is consisted of seawater and land, is used to verification. It is finally concluded that the best way of calculating electric field is to combine the interpolation with the horizontal conductive conservation and that of calculating magnetic field is to combine the extrapolation with the horizontal conductive conservation.

Apparent resistivity and phase obtained from one observation site (T13) are compared with those calculated from our modified code. The conductivity model for the forward calculation consists of 3-D topographic change based on etopo2 over a representative 1-D structure beneath the seafloor obtained by Baba et al.(this meeting). The calculated apparent resistivity and phase are similar with those of the observation data at longer than 10,000 seconds. Differences between the model responses and the observation data suggest that there are anomalous bodies beneath the observation site.

Next step is to modify an inversion part of WSINV3DMT, especially sensitivity matrix. Finally, we will apply the modified code to the OBEM data and reveal three-dimensional conductivity structure of the upper mantle.