3-D resistivity structure of hydrothermal circulation system using the 3-D forward program of MMR method

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We estimate three-dimensional (3-D) resistivity structure of the upper most oceanic crust to understand the 3-D temperature distribution of hydrothermal circulation system in the oceanic crust. Magnetometric Resistivity (MMR) method is one of the controlled source methods and is more efficient method for the upper oceanic crust resistivity structure than the methods which use natural source. MMR method consists of two components, i.e., source and receiver. The source is artificial vertical electric bipole source. The receiver is Ocean Bottom Magnetometer (OBM) which measures orthogonal three components of magnetic field. We have developed 3-D forward program of magnetic field related with MMR method to estimate 3-D resistivity structure.

3-D forward program uses relaxation method. The dimensions of block are 100 by 100 by 100. The resistivities and the calculated current values are given at the center of the block, while potentials and magnetic field values are at the corner of the block. The boundary condition of sea surface is treated as insulator, and the other boundaries are defined as if the medium extended to infinity. The bipole source is put on the center of the horizontal plane, and the seafloor is center of depth. In this study, the seafloor is assumed to be flat.

Anomalous magnetic fields made by anomalous resistivity region are most important values of this 3-D forward program: the values of magnetic field calculated between the two layered model and the two layered model with anomalous resistivity region in the oceanic crust. The two layered model means the ocean and the half-space oceanic crust, and seafloor is flat.

We have applied the 3-D forward analysis to the observational magnetic anomalous data. The target is the hydrothermal vent called Alice Springs Field (18-12.9'N, 144-42.5'E, and 3600 m deep) in the central Mariana Trough, which was surveyed during R/V Kairei KR02-14 cruise (Seama et al., 2003). The vertical bipole source transmitted a rectangular wave-form with a period of 16 s and with a peak current of approximately 19 A for about 30 minutes at each transmission site. The transmission sites were 34 points. Four OBMs settled around Alice Springs Field were measured orthogonal three components of magnetic field. The magnetic field data of each transmission site were separated, and picked up only 16 seconds period wave using fast Fourier transform. The amplitude of the signal at each transmission site was computed for each OBM. The averaged curst resistivity was calculated from all amplitude data, and the value is 4.6 ohm-m. The differences between the amplitude calculated from the half-space crust of 4.6 ohm-m and the amplitude measured by OBM are adopted as an anomalous magnetic field data for each transmission site and each OBM.

Now, we are estimating 3-D resistivity structure of Alice Springs Field using 3-D forward program referring the anomalous magnetic field map of 4 OBMs. We will present this result in this meeting.