

# Advancing the Magnetometric Resistivity (MMR) Method: 3D Forward Modeling with the Relaxation Technique

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## Abstract

Please check the details in Tada et al. (2024, EPS)!

We have developed a 3D forward modeling method for the marine MMR method. The MMR method is one of the techniques used in controlled source electromagnetic method (CSEM) surveys, whose theory was first introduced by Edwards et al. (1978). The marine MMR method consists of two parts: a bipole source and seafloor receivers (Fig. 1). The bipole source is composed of two electrodes connected by electric wires to make an artificial bipole electric current that runs between one electrode on the sea surface and another on the seafloor. The receivers (e.g., OBM) measure three components of magnetic field variations including the magnetic field induced by the bipole source.

There is only 1D analytical solution, thus numerical methods are needed for revealing 3D electrical resistivity distributions beneath the seafloor. The key point of our 3D forward calculation is to divide the calculation into three separate models in order to accurately compute the magnetic field variations induced by the bipole source (Fig. 2).

By determining the sign of the magnetic field anomaly, which is induced by anomalies, we can infer whether the electrical resistivity of the anomalous body is more conductive or more resistive compared to the surrounding oceanic crust. Furthermore, we demonstrate that increasing the number of bipole sources is more effective in exploring anomalous bodies than increasing the number of receivers.

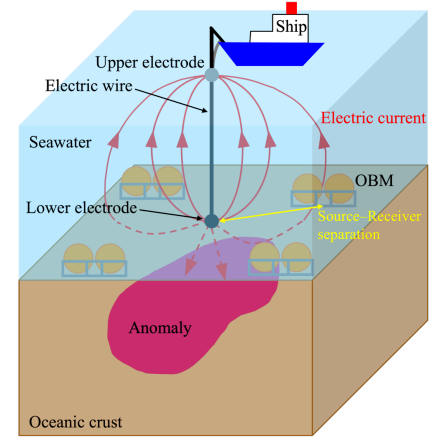


Fig.1 Concept of the MMR method

## 3D forward calculation

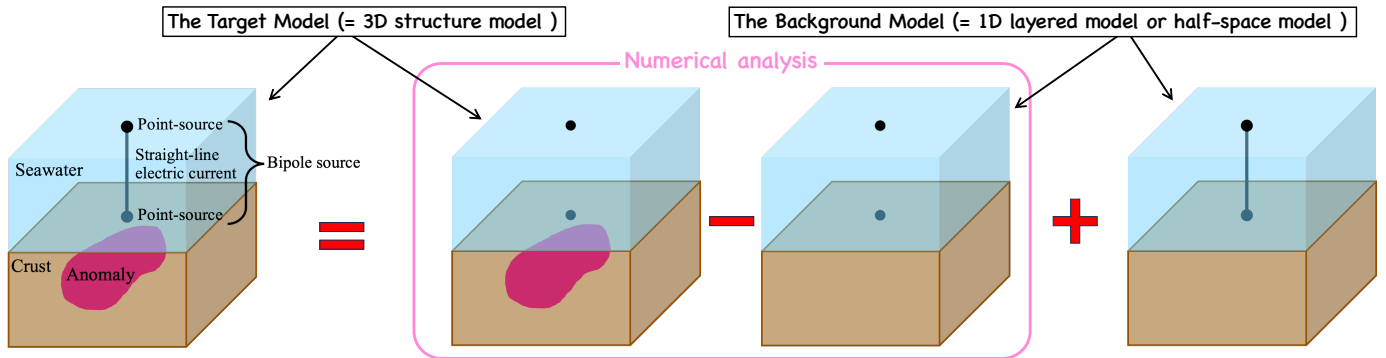


Fig.2 Structures and sources used in the 3D forward code

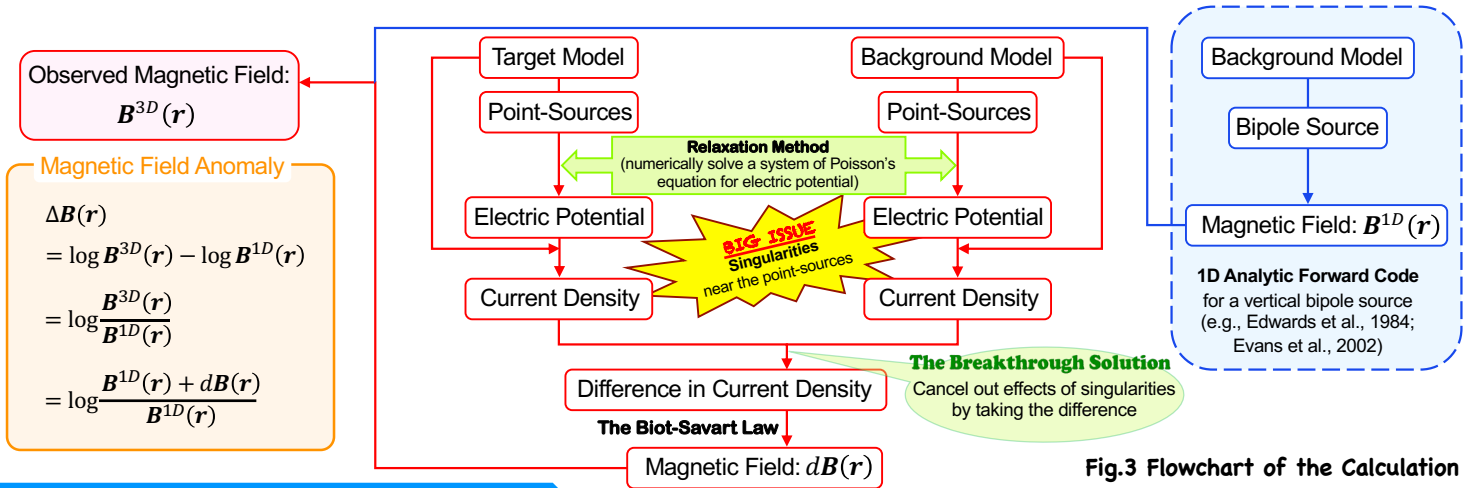


Fig.3 Flowchart of the Calculation

## Examples of Magnetic Field Anomaly

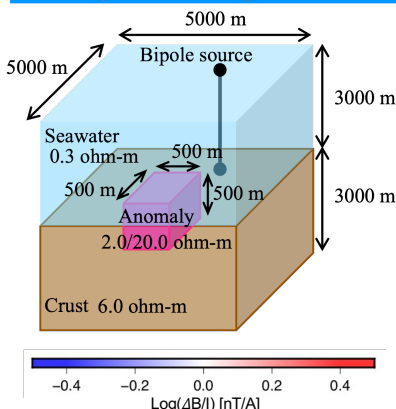


Fig.4 3D Resistivity Structure used in the synthetic test and Magnetic Field Anomalies

