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An analysis error on scalar magnetic anomalies: The case study in the exploration of deep seabed resource project

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A development program of fundamental tools for exploration of deep seabed resources was started in Japan with the financial support of the Ministry of Education, Culture, Sports, Science & Technology (MEXT) in 2008. In this project, we are developing new electrical and magnetic exploration tools for seabed resources using AUV (Autonomous Underwater Vehicle), ROV (Remotely Operated Vehicle), and deep-tow system in order to estimate sea-floor structure precisely.
We are developing the hardware and software for the vector magnetic field survey because a scalar magnetic anomalies do not satisfy the Laplace's equqaion and other physical formula describing the relation between magnetic field and magnetization.
The difference between results obtained from scalar data and from vector data is very significant. The magnetization analyses have been done so far by the methods of analysis proposed by Vaquier 1962, Bhatthacharyya 1964, and Talwani 1965,etc using the scalar anomaly, which was, however, assumed as the vector anomaly parallel to the main geomagnetic field. Such analysis error is evaluated by the difference between the results obtained using vector data and using scalar data.
We surveyed the vector magnetic fields using vehicles such as DT(deep tow), ROV, AUV, DTCM, R/V and a helicopter in 2009 and 2010 at the thermal vent areas where natural resouces are expected.
The analysis error was examined already by Isezaki et al 2009 based on the model analysis. In this report, the model estimation is expanded to the multi-layer case.
We used observed the magnetic anomaly vectors over Aogashima Volcanic Island in 2006 and 2009 conducted as a part of the project. The low magnetization, less than 1A/m, was found in the south-west area of Aogashima. We also analyzed the difference of results obtained from vector data and scalar data.
We emphasize the followings.
1. Analyses of magnetization from TIA(Total Intensity scalar Anomaly) have been done so far under assumption TIA=PTA (Projected Total vector Anomay) on MF (Main Geomagnetic Field)), however, which caused the analysis error due to eT= TIA - PTA .
2. TA(Total vector Anomaly) satisfies the Laplace's equation, and TA can be adjusted to the physically realizable data by solving this equation for TA. For the area where there is no observation TA, we can interpolate them by solving the Dirichlet's problem as the boundary value problem.