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地表磁場成分を用いた電磁マイグレーションによる地下構造可視化の研究
Subsurface imaging with EM migration of magnetic fields

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The underground impedance data is estimated by observing and analyzing both electric and magnetic components in the magnetotelluric (MT) method. Although this method is often used in fault surveys or geothermal prospecting, it has the two problems caused by the observation of electric components. One is that the static shift effect bias the apparent resistivity at the surface, and the other is that it is difficult to secure broad places for the observation of electric fields. Furthermore the analysis of electromagnetic data is also challenging because of its high computational costs, especially in three-dimensional cases. This causes barriers to application to large amounts of field data. So, a new technology which can estimate the subsurface information simpler and faster is needed.

In this study, we suggest the new method to use magnetic components at the surface in order to overcome these problems. The static shift effect can be controlled and the great mobility of magnetometers makes it possible to obtain data at a lot of sites, if magnetic fields are used as analysis data. Magnetic components are applied to not inversion method but migration method, which is generally the visualization method in seismic data processing to save computational cost. We adopted the PSPI (Phase-Shift Plus Interpolation) method (Gazdag and Sguazzero, 1984) and applied this method to the magnetic fields at the surface. In the case of applying the migration technique to the electromagnetic data, it is very important to select the correct frequency band to prevent the multiple reflection and attenuation of the electromagnetic waves.

Through the numerical calculation analyses and the analysis of field data, it was confirmed that applying migration method to magnetic components is the effective. In this migration method, the large value of reflection intensity is estimated around the area if the proper resistivity structure is assigned to the migration. This means that the resistivity structures in the subsurface have an effect on the migration results. In the analysis of the real field data around an active fault, large reflection intensity was estimated beneath the active fault. We discussed the results of the estimated apparent resistivity cross section and the migration results with the geological structure of the area and a previous 2D MT inversion result.

In conclusion, our method can estimate the underground resistivity structure simpler and faster. The combination of this electromagnetic migration method and inversion has possibility to reveal more detailed subsurface resistivity structure.

Keywords: electromagnetic migration, magnetic fields