Penetration depth of the GREATEM survey

*QIONG WU[1,2], Sabry Abd Allah[2], Toru Mogi[2]

1. Jilin University, 2. Hokkaido University

The grounded electrical source airborne transient electromagnetic (GREATEM) system uses a grounded electrical transmitter and an aircraft equipped with a receiver. Numerical forward modelling, using a finite-difference staggered-grid method, is performed to generate a three-dimensional (3D) resistivity structure model. A 3D electromagnetic forward-modelling scheme is modified and used to calculate the response of the study model in which a conductor is suited under ground surface at different depths. The sizes of conductor are 100 x 100 x 100 m, 200 x 200 x 200 m, 400 x 400 x 400 m. Depths of conductor are set to 50, 100, 200, 400, 600 m under ground surface. The bedrock has a resistivity of 100 Ω·m, and the resistivity of conductor is 1 Ω·m, 10 Ω·m. The vertical magnetic (Hz) field response decay curves for the different depths are compared. The results showed some differences between the Hz of different depths, so it is possible to detect that conductor in cases of different depths at flight altitude Z = 50 m. We used the relative difference (RD), defined as $|(Hz^{stand}-Hz^{case})/Hz^{stand}|$, of Hz field response for different depths to estimate responses difference quantitatively. When the size of conductor is bigger, it is easier to be detected. For low-resistivity conductor, the detection depth of GREATEM is up to 600m at flight altitude Z= 50 m.
The Ogiri geothermal area is located in southwestern Japan, a southern part of Kyushu Island. The arrangement of the geological structures is Quaternary volcanic rocks and Mesozoic metamorphic formation from the top down. Synthetic numerical models was used to construct 3D resistivity structure model of GREATEM system data in the study area. A 3D model of 3.7×4.2×2.3 km^3 was designed, and discredited into 52×38×41 cells using the grids coordinates that are modelled to the geothermal area. The 3D resistivity model has been based on layered earth resistivity structures. In order to estimate the penetration depth of GREATEM in a geothermal field, we set the resistive basement rock layer at various depth and investigated change of GREATEM responses. There are some differences between the Hz of different depths. The RD of Hz field response is also calculated. The results showed that, the GREATEM can detect structure of a cap rock layer and top of geothermal reservoir, and the penetration depth is up to 1600 m below the ground surface.

Keywords: GREATEM, 3D resistivity structure model, penetration depth, geothermal survey

