Transient responses for three dimensional structure of grounded source airborne EM (GREATEM)

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The grounded electrical source airborne EM (GREATEM) to survey for a deeper part, up to 1000m, has been developed. This method is similar to a ground survey of the long offset time domain EM. Three components magnetic field responses for the subsurface structure are characterized by transient curves depending on a resistivity structure, measuring height as well as transmitter-receiver distance. We have developed three-dimensional numerical modeling scheme for computing electromagnetic response based on the staggered grid finite difference method. Using the numerical modeling, we have been investigating penetration depth, resolving capability for complicated structure of the GREATEM.

We computed several three dimensional models such as buried conductors with or without surface undulation applying a dipole electric source on the ground. The computations have been performed in frequency domain at 30 frequencies in the range between 100000 and 0.1Hz and then converted to the time domain transient response using the Fourier transformation.

The results show that the magnetic field pattern in frequency domain shows relatively simple concentric form in both real and imaginary part of vertical magnetic component (Hz), but horizontal component (Hx, Hy) show complicated pattern even in an uniform earth. The Hz pattern distorted at the front side edge of a conductor to the source. The transient response in the time domain delineates loose curve at the conductor and steep curve at the resistive structure. The effect of the anomalous structure on the response is seen above the structure as well as beyond the backside.

Practically penetration depth is estimated by the time span that observed transient magnetic field exceeds a noise level. Thus penetration depth depends on source moment, source-receiver distance and measuring height. Resistivity of the structure affects decay time of a transient curve. The height is not so much affected to the penetration depth. Based on these results, we interpreted field data obtained at practical complicated structure. And we are now coding a inversion code combining the forward 3D program.