
ELECTROMAGNETIC MODELLING WITH WAVE TILT AND REFLECTION COEFFICIENT: AN APPLICATION TO STRATIFIED EARTH MEDIA USING LOW AND RADIO FREQUENCIES

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Abstract

Many models using electromagnetic sounding techniques have been formulated for use in exploration activities. In deriving the governing equations for the models, Maxwell's equations are used and the earth is taken as a layered medium. Using these boundary conditions, the Sommerfeld integrals are obtained for several models. However, the difficulties and limitations posed by the iterations of the functions, especially the strong oscillations and slow convergence of the Bessel function, call for a search for new methods. This work aims to formulate models, with the advantage of bypassing the problems highlighted above, and to discover new response parameters not considered by the older models due to the limitations of time. Three measurable field parameters, (1) amplitude of the correction factor to the wave tilt, (2) phase of the amplitude of the correction factor to the wave tilt and (3) reflection coefficient, were calculated from this model with various conductivity contrasts over a two-layered earth. Two cases of a top layer overlying a more conductive basement and a more conductive top layer overlying a resistive basement were considered with a radio frequency of 125 kHz and a low frequency of 10 Hz. The model was tested using data from existing models and was then applied to a homogeneous and a layered earth. Results revealed that the phase of the amplitude of the correction to the wave tilt was found to be most diagnostic of the changes in layer parameters. Also, depths of 20 m and 2000 m were achieved with the two respective frequency values. The reflection coefficient was discovered to be an important parameter for detecting layered earth structures, in addition to other parameters. Furthermore, an inverse relationship between the transverse electric and transverse magnetic modes of the reflection coefficient is established.