Anisotropic forward modelling of fluid injection and phase angles exceeding 90° in magnetotellurics

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ABSTRACT

Electrical anisotropy, defined as the directional dependence of electrical conductivity within a medium, causes changes in the electromagnetic signal measured by magnetotellurics (MT) and as such is an important property to consider when interpreting MT data. This study concentrates on replicating the MT response measured at two distinctively different geological settings using a series of 2-dimensional anisotropic forward models. Results presented in this study show that 2-dimensional anisotropic forward modelling is able to account for subtle differences in subsurface anisotropic resistivity structures. Specifically, 2-dimensional anisotropic forward modelling is able to reproduce the measured difference in MT response between pre- and post fluid injection conditions at the Paralana Geothermal System using an anisotropic fluid volume. A second application in constraining the source of the anomalous phase angles exceeding 90° observed in MT measurements of the Capricorn Orogen, shows that 2-dimensional anisotropic MT models are not able to produce phase angles exceeding 90° in the MT data which has its electric field orientated perpendicular to the geoelectric strike. These findings provide a case supporting the use of 2-dimensional anisotropic forward modelling as a means of modelling changes caused by the flow of a fluid through the crust. In addition, they also highlight issues associated with its application to complicated structures perpendicular to the strike of the profile.

KEYWORDS

Magnetotellurics, Anisotropy, Forward Modelling, Phase Angles, Fluid Migration, Paralana, Capricorn Orogen

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