Entering the anomaly factory: Conversion of thermomechanical geodynamic models into magnetotelluric models. An example from a pull-apart basin under a strike-slip stress regime.

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SUMMARY

Interpreting the electrical conductivity anomalies of magnetotelluric (MT) models is often a challenging task. The MT researcher is not only constrained by the non-uniqueness inherent to magnetotelluric modelling but also limited by open-ended interpretations due to a limited understanding of the Earth beneath. One can decode conductivity anomalies using experimental electrical conductivity measurements on minerals/rocks and other experimental petrology studies. However, such interpretations also overlook the complex geometries that are inherent in realistic geological environments and how they might be translated into magnetotelluric models. To address this gap in methodology, we developed a new toolkit called 'pide' that can convert thermomechanical models into geophysical observables, including electrical conductivity. In this manner, one can establish a streamlined workflow to decode the anomalies: (1) Production of a thermomechanical model for candidate tectonomagmatic environment, (2) conversion of the model into geophysical observables, (3) generation of synthetic MT data from these models resembling the real-world data arrays, (4) Inversion of this synthetic dataset, and finally (5) comparison with the actual MT models derived from comparable environments. With this iterative procedure, we focused on anomalies of pull-apart basins formed under the strike-slip regime and compared our results to the real-world analogues from the North Anatolian and the San Andreas Fault Zones. By providing an example of such a procedure, we want to showcase a new methodological framework for interpreting geophysical anomalies.

Keywords: magnetotellurics, synethetic data generation, experimental electrical conductivity measurements, thermomechanical modelling

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