S34A-01 - Geothermal Exploration of the Baia Mare Region (Romania) with Magnetotellurics

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Wednesday, 14 December 2022

20:45 - 20:53

Online Only

Abstract

Geothermal energy plays a key role in our society's transition to sustainable energy. Geothermal energy represents an economic and adaptive source of renewable energy and is genetically related with the formation of ore deposits necessary for our society's energy transition. The Baia Mare region is located within the Neogene Inner Carpathian volcanic arc. The region is characterised by an anomalously high heat flow in Romania (>100 mW/m2) and features surface hot springs and salt/metal mining, all of which point to a hydrothermal system that could be exploited.

In September '21, a Magnetotelluric (MT) survey was conducted to further attest and estimate the potential of the Baia Mare hydrothermal system. Broadband transfer functions (period of 0.003 – 1000 s) have been obtained at 24 sites using instruments from Luleå University of Technology, Sweden. Continuous telluric broadband recordings at the Surlari National Geomagnetic Observatory, Romania, and magnetic fields recorded at other INTERMAGNET observatories serve as remote. Non-stationary, robust processing allowed to improve poorly constrained estimates in the MT dead band. Transfer functions have been interpreted using ModEM. The obtained 3D electrical resistivity model, the estimated confidence and model sensitivity are presented. Model confidence has been assessed by complementary approaches: 1) starting model bias, 2) jackknife test for the leverage of single sites, 3) model uncertainty based on convergence, and 4) sensitivity analysis.

The 3D model is interpreted along several geological and seismic transects and with consideration of magnetic and gravity anomaly maps. The sediment deposition centres are characterised by low resistivity (tens Ωm), whereas the basalt-andesite subvolcanic intrusions generally suggest high resistivity in the model (hundreds Ωm). The inverse model indicates a large conductive anomaly 2 to 3 km below the urban centre of Baia Mare. Results suggest that heterogeneous hydraulic properties in the upper crust control the regional thermal situation. The strong lithological contrast, regional decollement horizons and strike-slip fault

systems add to the complexity and call for integrated interpretation of various geological and geophysical data for a robust assessment of geothermal potential.