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# ELECTRIC SURVEYS APPLICABILITY FOR GEOTHERMAL PROJECT BEIUS (ROMANIA): FORWARD 2D MODELLING, INVERSION AND RECOMMENDATIONS FOR FIELD WORK

Alena Finogenova[1], Juri Muzi[1], Vita Kalashnikova[1], Alexandru Schlett[1], Marian Bordeianu[2]

[1] PSS-GEO, Norway
[2] TRANSGEX SA, Romania

## ABSTRACT

Geophysical methods remain underutilized in geothermal exploration and appraisal campaigns in Romania, where pre-drill subsurface models predominantly rely on regional knowledge and existing well data. Integrating electrical surveys can significantly enhance subsurface understanding and mitigate the risks associated with high-cost well drilling, particularly in low-enthalpy geothermal projects.

This study examines two low-enthalpy geothermal projects in Northwestern Romania, Beiuș and Oradea, with a focus on the feasibility of Transient Electromagnetic (TEM) and Magnetotelluric (MT) electrical surveys.

The Beiuș geothermal field, supplying 75% of the district heating in Beiuș, utilizes a low-enthalpy, open-system geothermal resource with four production wells, averaging a flow rate of 65 l/s and temperatures ranging from 62°C to 81°C. Well data analysis indicates that resistivity logs reveal a medium resistivity contrast, with conductive layers above the Triassic reservoir. Analysis of Beius and neighbor Oradea wells indicated thar there is significant variation of temperature gradients (3-4°C/100m) and flow rates (2-70 l/s), which impact success rate for geothermal drilling.

TEM and MT methods were evaluated for their effectiveness in de-risking the potential future wells and determining main subsurface uncertainties, which are:

- Depth of geothermal reservoir top (Triassic carbonates);
- Position of faults and location of faults with high temperature fluids;
- Location of zones with high porosity and therefore higher water content within target interval.




Three reference models were developed based on resistivity logs and assumed geological structures. Forward modeling and inversion analyses demonstrate that TEM and MT methods effectively delineate reservoir horizons and faults. The results indicate that a combination of shallow TEM and MT surveys is optimal for urban areas, offering improved subsurface understanding while addressing galvanic shift issues. The study confirms that electrical surveys provide valuable insights into reservoir structure and fluid distribution, reducing exploration risks and improving geothermal field development strategies.

This research was conducted under the auspices of the project “Driving Sustainable Urban Futures: A Romanian-Norwegian Innovation Geophysical Alliance for Green Transition and SMART City Development,” which was granted by Innovation Norway, Pre Stack Solutions-Geo, and the University of Bucharest.