Magnetotelluric Measurements for Geothermal Energy Prospecting in Radiothermal Granites: Two examples from Britain

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SUMMARY

Geothermal energy is one of the few renewable energy sources that can supply a constant and reliable source of low-carbon heat, and in some cases electricity. In the UK, radiothermal granites offer one of the best potential targets for medium/medium-high enthalpy (100-200°C fluid temperature), geothermal energy resources. These deep reservoirs are still within reach of conventional drilling techniques at depths of 2-5 km.
Scotland hosts the highest heat producing granites in the UK, primarily situated in the Cairngorms. Until now, one of the main reasons why there has been a lack of investment in developing projects within the Scottish granites is that it is not known to what extent permeable (fractured and/or altered) zones exist at depth. Detecting these features in the subsurface is non-trivial, given that they are not easily observable using conventional exploration (e.g. seismic surveying) methods. However, using electromagnetic deep-sounding techniques like the magnetotelluric (MT) method offers the potential to image such features at depth where the electrical resistivity of the host rock (granite) will be much higher than in altered, porous and/or fractured zones, where geothermal fluids are likely to exist. Here, we present MT data collected in spring 2024 in the Cairngorm National Park.
Cornwall is the second site of interest for radiothermal heat production from granites in the UK, with two major deep drill projects already realised. At the Eden geothermal site, a pilot MT survey was conducted to scope the potential to image fluid-bearing fault zones at depth in a semi-urban environment. A low-resolution 3D model of electrical conductivity reveals the extent of the granitic intrusion at depth as well as several linear zones of increased conductivity.
In this study, we compare the initial results from both survey areas and discuss findings and implications for geophysical exploration as a tool to de-risk geothermal drilling.

Keywords: Geothermal heat, fractured rocks, permeability, magnetotellurics