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IRETHERM: The geothermal energy potential of Irish radiothermal granites

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The IRETHERM project is developing a strategic understanding of Ireland's deep geothermal energy potential through integrated modelling of new and existing geophysical and geological data. One aspect of IRETHERM's research focuses on Ireland's radiothermal granites, where increased concentrations of radioelements provide elevated heat-production (HP), surface heat-flow (SHF) and subsurface temperatures. An understanding of the contribution of granites to the thermal field of Ireland is important to assessing the geothermal energy potential of this low-enthalpy setting. This study focuses on the Galway granite in western Ireland, and the Leinster and the buried Kentstown granites in eastern Ireland.

Shallow (<250 m) boreholes were drilled into the exposed Caledonian Leinster and Galway granites as part of a 1980's geothermal project. These studies yielded HP = 2-3 μWm-3 and HF = 80 mWm-2 at the Sally Gap borehole in the Northern Units of the Leinster granite, to the SW of Dublin. In the Galway granite batholith, on the west coast of Ireland, the Costelloe-Murvey granite returned HP = 7 μWm-3 and HF = 77 mWm-2, measured at the Rossaveal borehole. The buried Kentstown granite, 35 km NW of Dublin, has an associated negative Bouguer anomaly and was intersected by two mineral exploration boreholes at depths of 660 m and 490 m. Heat production is measured at 2.4 μWm-3 in core samples taken from the weathered top 30 m of the granite.

The core of this study consists of a program of magnetotelluric (MT) and audio-magnetotelluric (AMT) data acquisition across the three granite bodies, over three fieldwork seasons. MT and AMT data were collected at 59 locations along two profiles over the Leinster granite. Preliminary results show that the northern units of the Leinster granite (40 km SW of Dublin) extend to depths of 2-5 km. Preliminary results from the southern profile suggest a greater thickness of granite to a depth of 6-9 km beneath the Tullow pluton, 75 km SW of Dublin. Over the Galway granite, MT and AMT data have been collected at a total of 75 sites (33 consist of only AMT data acquisition, with both MT and AMT recorded at the remaining 42). Preliminary results show a deep resistor extending to depths of 15-20 km beneath the central block, with the resistive upper layer extending to depths of 3.5-7 km west of the Shannawona fault, a major structure that cuts the batholith. MT and AMT data acquired along a profile at 22 locations over the Kentstown granite suggests that this buried granite is at a depth of 400 m beneath the centre of the gravity anomaly.

The MT and AMT data will be integrated with gravity and seismic refraction data (in the case of the Leinster granite) to identify deeply penetrating faults, which may provide conduits for hydrothermal fluids, and to produce a robust estimation of the volumetric extent of the granites, which is crucial in defining their geothermal energy potential. Thermal conductivity and geochemical data will be incorporated to constrain the heat contribution of granites to the Irish crust.