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IRETHERM: Magnetotelluric Assessment of Geothermal Energy Potential of Hydrothermal Aquifer, Radiothermal Granite and Warm Spring Targets in Ireland

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IRETHERM (www.iretherm.ie) is an academic-government-industry, collaborative research project, funded by Science Foundation Ireland, with the overarching objective of developing a holistic understanding of Ireland's low-enthalpy geothermal energy potential through integrated modelling of new and existing geophysical and geological data. With the exception of Permo-Triassic basins in Northern Ireland, hosting geothermal aquifers of promising but currently poorly-defined potential, rocks with high primary porosity have not been identified elsewhere. Whether any major Irish shear zones/faults might host a geothermal aquifer at depth is also unknown, although clusters of warm-springs in the vicinity of two major shear zones are promising.

IRETHERM's objectives over a four-year period are to:
(i) Develop multi-parameter geophysical modelling and interpretation software tools that will enhance our ability to explore for and assess deep aquifers and granitic intrusions.
(ii) Model and understand temperature variations in the upper-crust. Firstly, by building a 3-D model of crustal heat-production based on geochemical analysis of surface, borehole and mid- to lower-crustal xenolith samples. Secondly, by modelling, using a fully self-consistent 3-D approach, observed surface heat-flow variation as a function of variation in the structure and thermal properties of the crust and lithosphere, additionally constrained by surface elevation, geoid, gravity, seismic and magnetotelluric (MT) data.
(iii) Test a strategic set of eight "type" geothermal targets with a systematic program of electromagnetic surveys (MT, CSEM) across ten target areas.

During 2012, IRETHERM collected over 220 MT/AMT sites in the investigation of a range of different geothermal target types. Here we present preliminary electrical resistivity modelling results for each target investigated and discuss the implications of the models for geothermal energy potential:

1. Rathlin Basin
The only sedimentary strata in Ireland known to provide reliable primary porosity, supporting deep hydrothermal aquifers, are found in the Triassic Sherwood Sandstone Group and in the upper-Permian, preserved in several basins in Northern Ireland. Our survey over the Rathlin Basin aims to map the geometry of these strata at depth and assess their porosity and permeability characteristics.

2. Kilbrook warm spring.
Kilbrook warm spring is characterised by the warmest spring waters in Ireland (24.8°C) and highest Total Dissolved Solids concentration. Our high-resolution AMT survey over this occurrence aims to image the subsurface fluid conduit systems that bring these waters to surface.

3. Leinster and Galway granites
Many of Ireland's exposed granites are associated with high radioactive element concentrations, high radiogenic heat production (HP) values and elevated surface heat-flow (SHF). Surveys over two of these granites – the Leinster granite (SHF: 80 mWm-2, HP: 2–3 μWm-3) and the Galway granite (SHF: 65–77 mWm-2, HP: 4–7 μWm-3) – aim to define the geometry, volume and local/regional heating effect of the granites and assess their suitability for energy provision using EGS. The models will also be assessed for indications of naturally occurring hydrothermal aquifers associated with either major faults that cross-cut the granites or the granite-country rock contacts.