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## DIG: A New Project to De-risk Ireland's Geothermal Energy Potential

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Potential deep (greater > 400 m) geothermal resources, within low to medium temperature settings remain poorly understood and largely untapped in Europe. DIG (De-risking Ireland's Geothermal Potential) is a new academic project started in 2020, which aims to develop a better understanding of Ireland's (all-island) low-enthalpy geothermal energy potential through the gathering, modelling and interpretation of geophysical, geological, and geochemical data.

The overarching research objectives, are to (i) determine the regional geothermal gradient with uncertainty estimates across Ireland using new and existing geophysical and geochemical-petrophysical data, (ii) investigate the thermochemical crustal structure and secondary fracture porosity in Devonian/Carboniferous siliciclastic and carbonate lithologies using wide-angle seismic, gravity and available geochemical data, and (iii) identify and assess the available low-enthalpy geothermal resources at reservoir scale within the Upper Devonian Munster Basin, i.e. the Mallow warm springs region, using electromagnetic and passive seismic methods, constrained by structural geological mapping results. A new hydrochemistry programme to characterise deep reservoir water composition will add further constraints.

In the island-scale strand of the project, we are using Rayleigh and Love surface waves in order to determine the seismic-velocity and thermal structure of the lithosphere, with crustal geometry. Together with the legacy surface heat flow, gravity, and newly available long-period MT data, this will place bounds on the shape of regional geotherms. Radiogenic heat production and thermal conductivity measurements for Irish rocks will be incorporated into an integrated geophysical-petrological model, within a scheme able to provide critical temperature uncertainties. Regional-scale research will exploit legacy wide-angle seismic data across the Laurentian and Avalonian geological terranes. Geochemical and petrophysical databases will guide in-house Bayesian inversion tools, to estimate probabilities on model outcomes.

Local-scale research will derive subsurface electrical conductivity and velocity images from electromagnetic and passive seismic surveys from the northern margin of the Munster Basin, where the thermal waters tend to have a distinctive chemical fingerprint and a meteoric origin

based on available geochemical and isotopic compositions. This local focus aims to directly image fault conduits and fluid aquifer sources at depth, within a convective/conductive region associated with warm springs. This will determine the scale of the geothermal anomaly and hence will evaluate the potential for local- and industrial-scale space heating in the survey locality.

This presentation will give an overview of this new research project and will deliver preliminary multi-parameter crustal models produced by the thermodynamic inversions that fit the surface-wave and surface elevation data. The project is funded by the Sustainable Energy Authority of Ireland under the SEAI Research, Development & Demonstration Funding Programme 2019 (grant number 19/RDD/522) and by the Geological Survey Ireland.

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