



## **A multi-disciplinary investigation of Irish warm springs and their potential for geothermal energy provision.**

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Irish warm springs are one of a set of several target types that are being evaluated for their geothermal energy potential during the course of the island-wide assessment of the geothermal energy potential of Ireland under the IREThERM project ([www.iretherm.ie](http://www.iretherm.ie)).

Forty-two warm springs and warm shallow groundwater occurrences have been recorded in Ireland; water temperatures in the springs (approx. 12-25 °C) are elevated with respect to average Irish groundwater temperatures (10-11 °C). This study focuses on warm springs in east-central Ireland found in the Carboniferous limestone of the Dublin Basin. A combination of geophysical methods (controlled source electromagnetics (CSEM) and audio-magnetotellurics (AMT)) and hydrochemical analyses (including time-lapse temperature and electrical conductivity measurements) have been utilised at several of the springs to determine the source of the heated waters at depth and the nature of the geological structures that deliver the warm waters to the surface. Using the example of St. Gorman's Well, Co. Meath, we show how the combination of these different methods of investigation and the interpretation of these various data sets enables us to better understand the physical and chemical variability of the spring through time. This will provide the basis for an assessment of the source of these thermal waters as a potential geothermal energy reservoir and will allow for more precise characterisation of the groundwater resource.

We present subsurface models derived from new geophysical data collected at St. Gorman's Well in 2013. This high-resolution AMT survey consisted of a grid of 40 soundings recorded at approximately 200 m intervals centred on the spring. The aim of the survey was to image directly any (electrically conductive) fluid conduit systems that may be associated with the springs and to provide an understanding of the observed association of the Irish warm springs with major structural lineaments, such as the NE-SW Caledonian structural trend which dominates Irish geology.

Seasonal hydrochemical sampling of six warm spring locations commenced in July 2013. Data loggers installed at each location measured temperature and electrical conductivity (15-minute sampling intervals) throughout the sampling period (July 2013 – early 2015). The hydrochemical results and the data from the logger at St. Gorman's Well are examined here in conjunction with regional rainfall and available hydrogeological information in order to establish the nature of the relationship between the hydrological cycle and fluctuations in the hydrochemistry of the spring.