Centre for Doctoral Training (CDT):
Geoscience and its Role in the Low Carbon Energy Transition

PhD Project at Newcastle University
Geostatistical heat flow modelling of the thermal structure of the onshore UK: Implications for deep geothermal energy

Overview
The UK is committed to transition to a low-carbon economy, reducing greenhouse gas emissions to net zero by 2050. In 2018, the main source of emissions from the residential and public sector in the UK was the use of natural gas for heating. Geothermal energy has considerable potential to decarbonise heating, and for electricity generation if the temperatures are high enough. However, the widespread adoption and success, particularly of deep geothermal, is hindered by the high capital costs associated with drilling deep wells. The International Energy Agency has highlighted that reducing the exploration risk is a vital to lowering the entry barrier for investment in geothermal energy.

Geothermal exploration consists of predicting subsurface temperatures, permeability and the lateral extent and thickness of the heat resource, by using geophysical methods and ultimately through drilling exploration wells. A key factor to evaluating geothermal energy’s potential is the distribution of temperature (or heat flow) in the subsurface. At depths >15 m temperature varies as a function of the internal heat production from the Earth and the thermal conductivity of subsurface. Existing maps of subsurface temperature across the UK are of coarse-resolution and may not represent true geological complexity. This project will focus on the sedimentary basins of the UK, working towards an improved understanding of heat flow in these settings.

Methodology
This project will develop this existing temperature and heat flow data, together with temperature data from more recent oil and gas exploration wells to investigate the regional heat flow variations onshore the UK. This project, unlike previous will use geostatistical analysis and 1D modelling to specifically study the spatial correlation and continuity of heat flow, and the primary controls, within the UK’s onshore sedimentary basins. Modelling of subsurface heat flow will be done using a combination of existing software and user-developed models that will specifically address the sensitivities of temperature predictions. The project will, alongside well data, make use of extensive geophysical data, integrating both existing and new interpretations of the basin architecture. Together these interpretations will provide the opportunity to investigate the importance of basin architecture on present day heat flow. A key component of the project will be characterizing the uncertainty of the interpretations and models
The student will be part of the energy geosciences research group at Newcastle working alongside other researchers across a range of geo-energy projects, and have the opportunity to be involved with Newcastle University’s Centre for Energy.

**Training & Skills**

During this project, the candidate will have the opportunity to learn how to use a wide variety of software packages for interpretation and modelling of geological and geophysical data. The student will receive training in the interpretation and analysis of seismic reflection data and well data using industry software. They will receive training in developing numerical models of sedimentary basins. The student will benefit from a multidisciplinary supervisory team, and benefit from the combined academic and industry collaboration. There will be opportunities to engage with the industry partner throughout the project. In addition Newcastle University has a faculty run postgraduate research development programme ([http://www.ncl.ac.uk/sage/learningandteaching/postgraduateresearch/postgraduateresearcherdevelopmentprogramme/#creditrequirement](http://www.ncl.ac.uk/sage/learningandteaching/postgraduateresearch/postgraduateresearcherdevelopmentprogramme/#creditrequirement)) that follows the Vitae Researcher Development Framework ([http://www.vitae.ac.uk/](http://www.vitae.ac.uk/)) focusing on: knowledge and intellectual abilities, personal effectiveness, research governance and organization, and engagement, influence and impact.

**Supervisors**

Dr Mark Ireland (Newcastle University), Prof Jeroen van Hunen (Durham University), Dr Nick Goodwin (BP)
Dr Cees van der Land (Newcastle University)

**Industry partner**

BP

**References:**