

GeoNetZero CDT

The Centre for Doctoral Training (CDT) in Geoscience and the Low Carbon Energy Transition

Integrated reservoir characterisation and monitoring of low-enthalpy geothermal resources in flooded mines using hydrogeophysical methods (UKGEOS observatory, Glasgow)



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UNIVERSITY OF
ABERDEEN



British
Geological
Survey

Supervision

Drs Jean-Christophe Comte, Andres Quiros, Jan Vinogradov and David Healy | **University of Aberdeen**

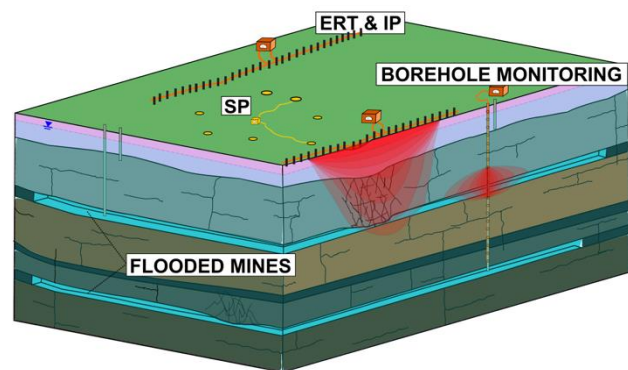
Dr Romain Chassagne | **Heriot-Watt University**

Drs Jonathan Chambers, Paul Wilkinson and Oliver Kuras | **British Geological Survey**

Project description

With thousands of flooded abandoned coal mines, many located near major population centres, these low-enthalpy geothermal resources can be harvested to provide a major contribution to decarbonising energy supply in the UK, with district and industrial applications. In mine water geothermal systems, heat transport and storage are controlled by the hydro- and thermodynamic interactions between a complex network of conduits (mine galleries) and a heterogeneous rock matrix characterised by intergranular and/or fracture porosity. Long-term sustainable use of mine water geothermal resources requires a good understanding of the hydrodynamic and thermal properties of the conduit-matrix system, which can be attained with a robust characterisation and monitoring routine. Surface and borehole electrical geophysical methods are potentially well suited to outscale 1D borehole physico-chemical profiles in order to map geological properties and monitor subsurface water flow and temperature at high spatiotemporal resolutions.

The PhD project will **develop the capability of the joint use of time-lapse borehole and surface-to-hole geoelectrical data to characterise and monitor geothermal resources in flooded coal mines towards optimal and sustainable exploitation and management of the resource.** This study will use the new Glasgow UK GeoEnergy Observatory (UKGEOS), run by the British Geophysical Survey.



Conceptual model of the Glasgow UKGEOS mine water system with existing and planned geophysical instrumentation

Project objectives

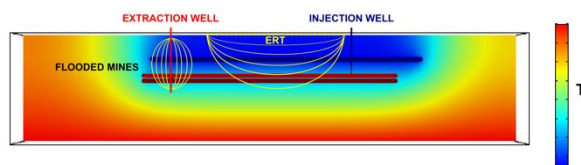
[O1] to map the reservoir seasonal and interannual variations of the system's hydro- and thermodynamic conditions based on collection and analysis of existing hydrological and geophysical data, and acquisition of new time-lapse electrical data (surface resistivity, chargeability, and self-potential data);

[O2] to quantify the heterogeneity of hydro- and thermo-dynamic properties and assess the role of conduits vs. rock matrix in terms of heat storage and release, based on a data assimilation workflow (hydrothermal, electrodynamic and geophysical) into a coupled multiphysics model;

[O3] to better estimate the site geothermal potential and design the monitoring tool needed for sustainable exploitation.



Surface and borehole geophysical surveys



Geophysically-aided hydrogeothermal modelling of abstraction-injection scenarios

Project deliverables

[D1] a conceptual model of hydrothermal conduit-matrix interactions in flooded mines;

[D2] a first 4D (space-time) hydro-thermo-electro-dynamic model of the UKGEOS reservoir;

[D3] a robust methodology for monitoring;

[D4] a data assimilation framework for low-enthalpy geothermal resources management.

Project location

The PhD will be based in Aberdeen under primary supervision by Jean-Christophe Comte (hydrogeology/hydrogeophysics) with additional expertise provided by Andres Quiros (multiphysics modelling), Jan Vinogradov (reservoir engineering) and David Healy (structural geology), and will involve placements with co-supervisors at Heriot-Watt, Edinburgh (Romain Chassagne, data assimilation) and at the British Geological Survey, Nottingham (Jonathan Chambers, Paul Wilkinson, Oliver Kuras, geophysical tomography).

Data access

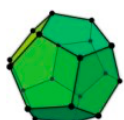
The project will benefit from existing datasets, including monitoring data, at the site: geological and mine 3D models; 11 new boreholes hydraulically tested, monitored for water level, chemistry, temperature and equipped with telemetric fibre optic for temperature profiles and cross-hole, time-lapse electrical resistivity tomography.

Training and career routes

The student will gain training in multiple field geophysical methods, interdisciplinary computer modelling, understanding of geothermal and hydrogeological processes from the project team. They will also have access to the broad range of geosciences training offered by the GeoNetZero CDT, and generic skills training offered by the University of Aberdeen. This will make them highly employable across the energy and environmental industry, government agencies, academia.

Further information

For inquiries about the project, please contact Jean-Christophe Comte (jc.comte@abdn.ac.uk). For information about eligibility and application procedure, please follow this [link](#).



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