



British  
Geological  
Survey

UK GEOENERGY OBSERVATORIES

# The Glasgow Observatory

A new open-access mine water energy  
research and innovation facility



UK Research  
and Innovation



Natural  
Environment  
Research Council

The Glasgow Observatory is operated by the British Geological Survey on behalf of the Natural Environment Research Council (NERC), part of UK Research and Innovation (UKRI).

# The Glasgow Observatory

In this brochure you will find information on the site capabilities, technical specification, available data sources and information on how to use the Observatory for your research and to support your innovation.

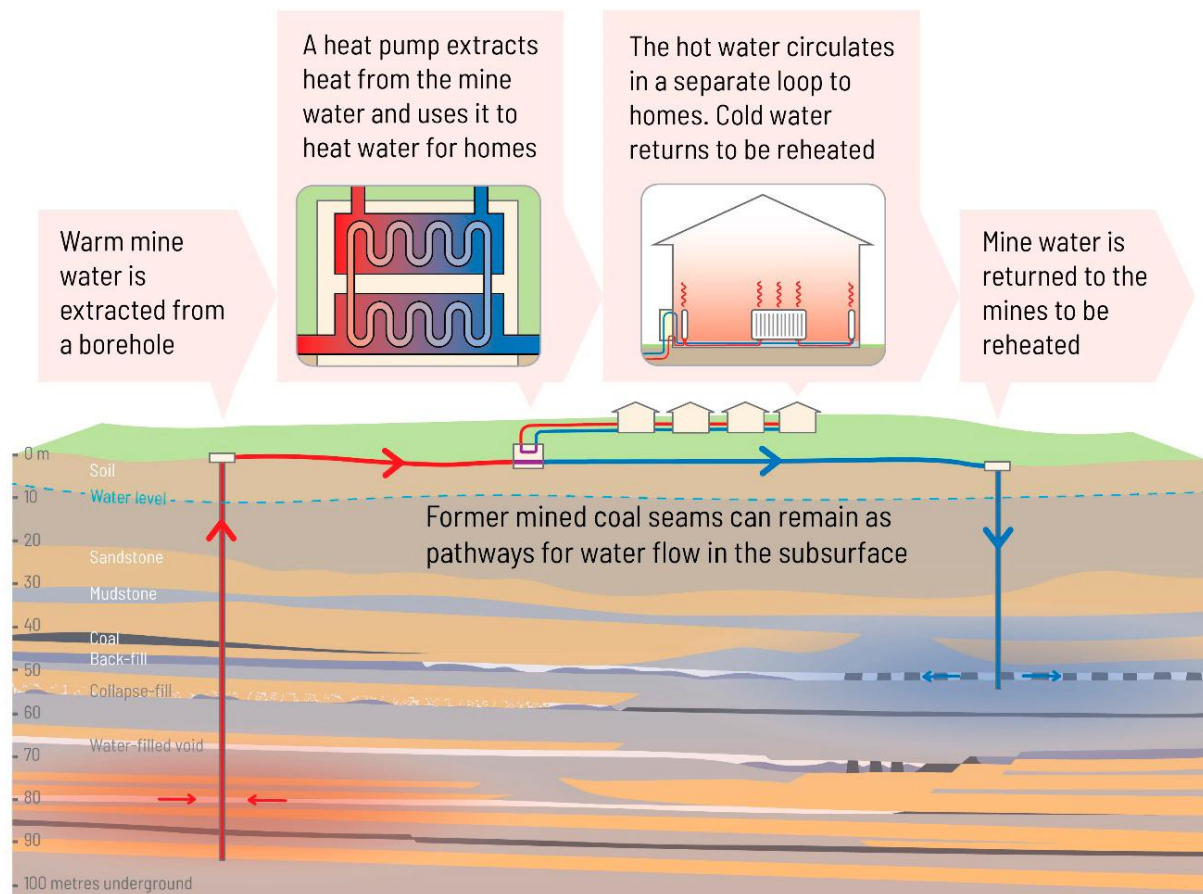
## What is the Glasgow Observatory?

The Glasgow Observatory is a research facility for investigating shallow, low-temperature coal mine water heat energy and potential heat storage resources. Boreholes penetrating abandoned and flooded mine workings at depths of 45–90 m are located in research compounds with extensive surface monitoring capability. Environmental monitoring boreholes targeting both the superficial deposits and the unmined bedrock provide ongoing information about environmental changes in the area.

The Observatory site is typical of towns and cities with a post-industrial urban and coalfield legacy. Towns and cities are where the greatest demand for decarbonising heat lies. The Observatory provides ready-to-use borehole and surface heat network infrastructure in conditions directly applicable to mine water heat abstraction and re-injection. Its unique set up has been designed to be flexible to enable testing, monitoring, model validation, and to create perturbations of flow and heat from the natural baseline.

“The Glasgow Observatory is a new state-of-the-art research facility enabling research on the abstraction and storage of heat in flooded coal mines. Researchers will be able to investigate geothermal heat and fluid transfer, monitor chemical and biological processes, and develop relevant sensors and geothermal process technologies. The road to net-zero requires us to make the most of the sustainable resources under our feet.”

DR KAREN HANGHØJ, DIRECTOR, BRITISH GEOLOGICAL SURVEY



**Figure 1** Schematic showing the process of extracting heat from mine water to heat homes. The Glasgow Observatory is a place to do flexible, at-scale research rather than a heat supply scheme.

## What is mine water heat and heat storage?

Decarbonisation of heat in our homes and businesses is required to meet net-zero carbon targets. Coal mining in the UK has left a legacy of flooded abandoned mines and the water in these mines presents an opportunity for heat abstraction and storage with a technology that is proven, but not widely realised, see Figure 1.

## Glasgow Observatory capabilities

The Observatory enables a wide range of investigative research, in particular:

- subsurface characterisation and monitoring of abandoned mines

- understanding the transfer of heat and flow processes of groundwater
- understanding chemical and biological processes that may be impacted by mine water heat and heat storage activities
- resource characterisation and sustainability
- environmental monitoring, impacts and management
- operational management and geo-engineering
- testing and innovation of tools, sensors, methodologies
- data analytics and digital environment





Image credit: BAM





Boreholes are available for a range of hydrogeological, tracer and sensor tests with each borehole screened at a target interval: either a mine working, bedrock or superficial deposits.

The Observatory provides the opportunity for research into heat abstraction and heat storage in the fractured rock mass, waste-filled workings and open water-filled voids. The spatial and depth scales are representative of mine water schemes, but planned to be small enough to see responses on a timescale suitable for research.

In addition, the Observatory can be used to customise, test and refine equipment related to the commercialisation of mine water energy.

## Research opportunities

The Glasgow Observatory can be used by organisations in the subsurface energy sector to test, calibrate and validate across the lifecycle of mine water heat energy systems; from subsurface resource characterisation and sustainability, to resource appraisal, design and construction, and operations. Examples include:

- Universities and research organisations for research on flow testing and pumping, using temperature responses from sensors, samples for chemistry responses, and to feed data into models to calibrate or history match modelling techniques
- Energy research coupled with social science. Examples include environmental impact studies of water quality, ground motion, seismicity, or ground gas; measuring baseline changes and public acceptance of mine water heat and storage
- Development of training materials for geoenergy, mine water heat and storage skills, and environmental baseline monitoring
- Novel methods for cost reductions for exploration, feasibility, drilling, testing, monitoring using the observatory as a case study. Applications include geochemical markers for groundwater connectivity and sustainability; modelling and water treatment technologies; and development of valves, wellheads and flow monitoring equipment

“There is particular economic and environmental interest at this time in understanding the on-going changes in the subsurface when the original human industrial activity at a site has ceased and the site is repurposed. The Glasgow Observatory has been designed to support investigations in repurposing abandoned coal mines as a renewable energy resource.”

PROFESSOR MIKE STEPHENSON, CHIEF SCIENTIST, BRITISH GEOLOGICAL SURVEY

## Using the Glasgow Observatory

BGS welcomes engagement with research organisations, equipment manufacturers, sensor developers, energy companies, policymakers and others who have a focus on reducing subsurface and surface geoscientific uncertainties and risks.

The Glasgow Observatory is now open although access is limited due to COVID-19 restrictions. Individual requests will be discussed on a case by case basis. The heating/cooling infrastructure is due to be constructed in late summer and the site will be fully available for use in autumn 2021 (COVID-19 restrictions permitting).

Please get in touch to discuss your ideas for research and obtain information regarding access fees.

ukgeosenquiries@bgs.ac.uk

## Overview of the Glasgow Observatory

The Glasgow Observatory comprises:

- 5 wide (248 mm casing ID) diameter mine water characterisation and monitoring boreholes: 3 screened at the Glasgow Upper mine working, and 2 screened at the Glasgow Main mine working
- 1 wide (248 mm casing ID) sensor testing borehole to c.67 m
- 5 environmental monitoring boreholes: 2 screened (146 mm casing ID) in the top of the sandstone bedrock above the Glasgow Upper mine working and 3 screened (103.8 mm casing ID) in superficial sediments above the bedrock
- Seismic monitoring borehole, continuous data openly available

## Borehole equipment

- Removable low-flow pumps.
- Hydrogeological data loggers measuring temperature, conductivity, pressure, salinity and total dissolved solids
- Electrical resistivity tomography (ERT) using sensors installed between the casing and rock down the mine water and sensor boreholes to facilitate cross-borehole time-lapse (4D) imaging of geoelectrical properties

- Fibre-optic cables installed between the casing and rock down the mine water and sensor boreholes monitor acting as distributed temperature sensors (DTS)

## Compound equipment and site data

The Glasgow Observatory offers equipment and open datasets for geoscientific environmental monitoring including:

- Ground gas and near-surface gas monitoring infrastructure\* and open data from ground surveys
- Pre-drill soil chemistry
- Surface water geochemistry data
- Groundwater geochemistry data
- Ground motion InSAR study and reflectors\*

The subsurface and surface infrastructure and open data can be used to characterise ongoing environmental baseline change and evidence any impacts from pumping mine water for heat, and provide opportunities for developing new monitoring technologies and approaches to data analysis.

\*installation and commissioning delayed by COVID-19 restrictions



## Supporting your research

A range of supporting information: 3D geological models, downhole wireline logs, hydrogeological testing data, core scanning data and high-resolution photographs from a 180 m borehole core are available at [ukgeos.ac.uk](http://ukgeos.ac.uk). Core and rock chip samples are stored at the National Geological Repository at the BGS in Keyworth, along with preserved samples for geomicrobiological studies.

The UK Geoenery Observatories includes state-of-the-art core-scanning equipment based at the British Geological Survey in Keyworth. The Core Scanning Facility (CSF) hosts four high-resolution core-scanners for core imaging and non-destructive core analysis.

For detailed information about the Glasgow Observatory see the science capability document and site profiles — available on [ukgeos.ac.uk](http://ukgeos.ac.uk).

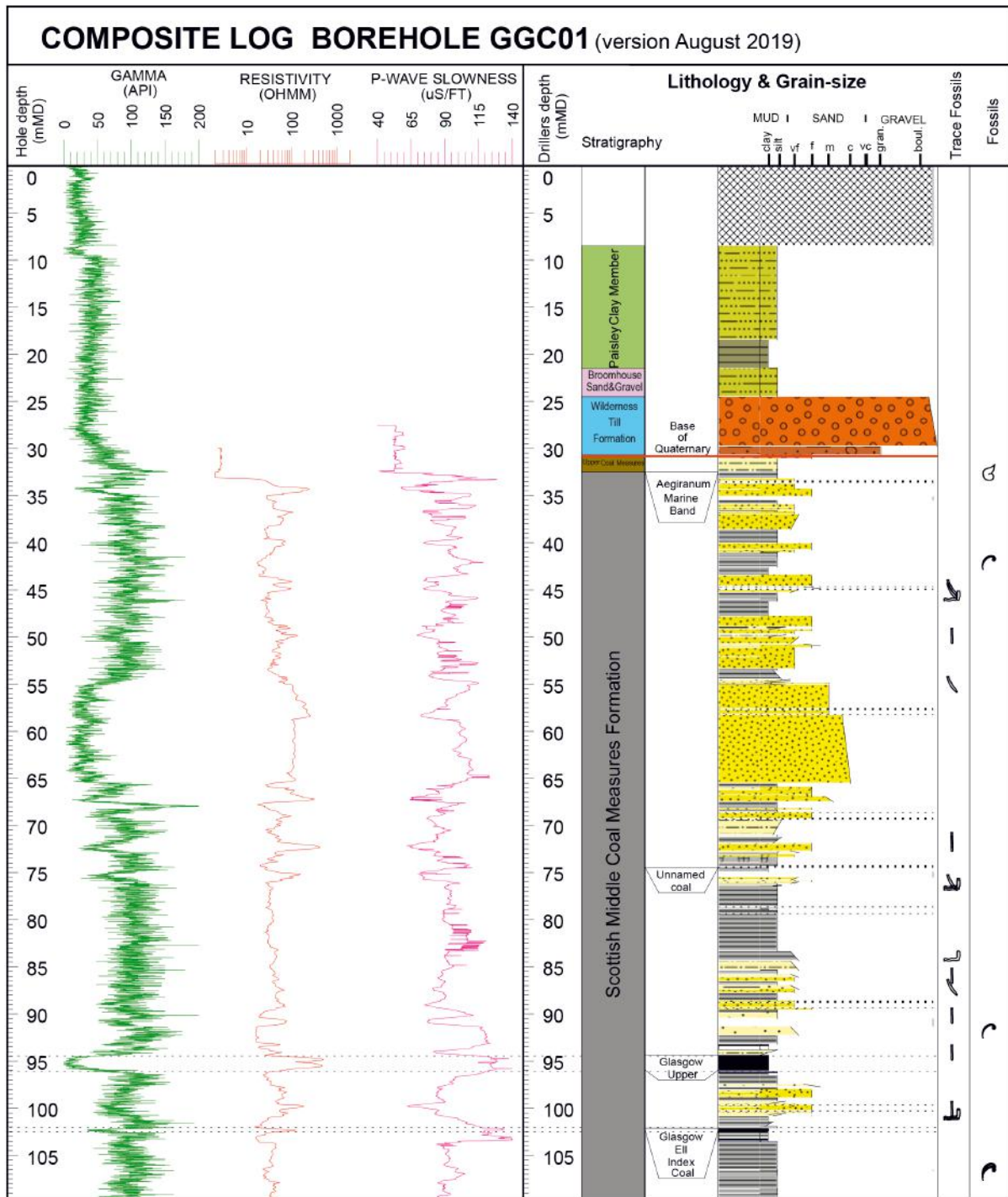
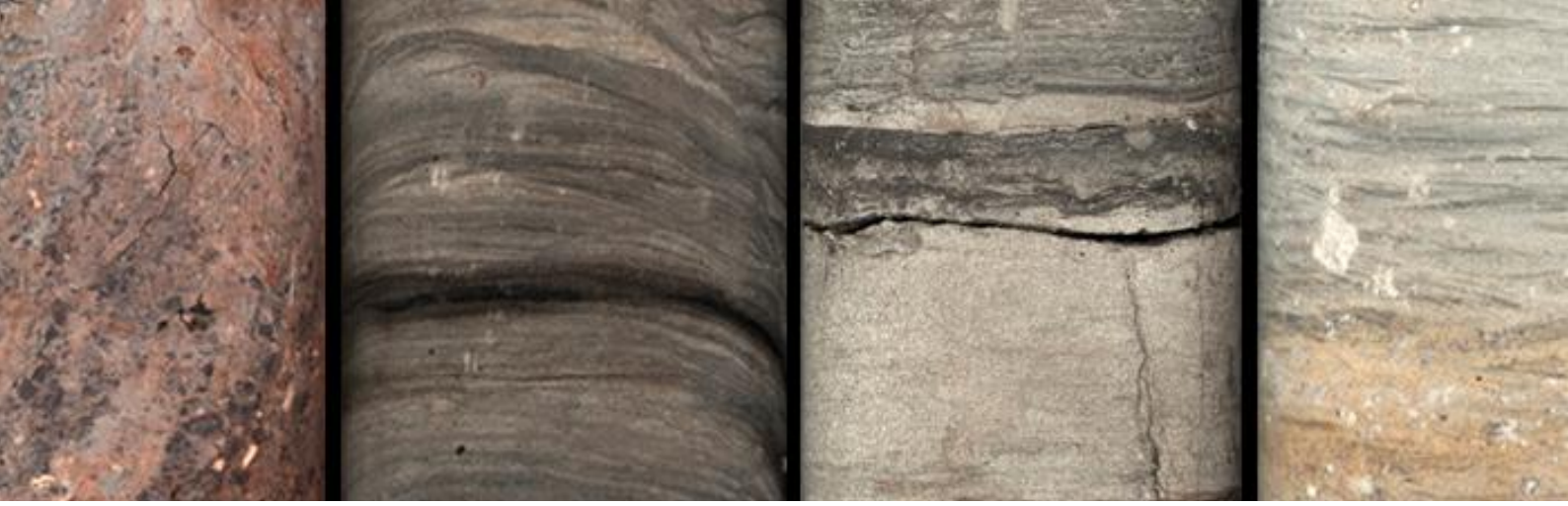


Figure 2 Extract of a borehole log.





# About the UK Geoenergy Observatories

The 2014 UK Government Plan for Growth of Science and Innovation provided £31 million for UK Research and Innovation to create two new, world-class research facilities that will inform the responsible development of new energy technologies. The Observatories are being delivered and run by the British Geological Survey (BGS) for the whole of the UK science community, on behalf of NERC/UKRI. The Observatories in Cheshire and Glasgow will provide essential data about the underground environment to generate new knowledge about the potential of geoenergy to deliver clean energy at the scale required to achieve net-zero by 2050.

## Contact us

### UK Geoenergy Observatories

Nicker Hill,  
Keyworth,  
Nottingham,  
NG12 5GG

[ukgeosenquiries@bgs.ac.uk](mailto:ukgeosenquiries@bgs.ac.uk)  
0115 936 3100  
[ukgeos.ac.uk](http://ukgeos.ac.uk)  
[#ukgeoenergyjobs](https://twitter.com/ukgeoenergyjobs)

