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Peer-reviewed Conference Contribution

# Improving data accessibility and application for underground climate research at the British Geological Survey

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The British Geological Survey (BGS) is a world leader in urban 3D geological modelling. This reputation was largely developed through the Glasgow and London cross cutting projects and led to follow-up high profile international 3D modelling-focused projects in Europe (Horizon 2020 COST SubUrban Action), the Middle East (Abu Dhabi) [1] and Asia (Singapore) [2]. BGS has a collection of over a million UK borehole records held in its National Geoscience Data Centre, and thousands of new ground investigation records are added each year. This data provides vital geological, geotechnical and geoenvironmental information that is essential for societal challenges such as climate change and sustainable energy production. BGS allows access to this data via web portals, allowing the public, academia and private-sector industry access to this vast wealth of subsurface information in a spatially-delivered platform.

However, in recent studies BGS estimates that 80% of borehole data is not shared centrally and openly, resulting in an estimated loss of data and knowledge to the UK economy valued in the region of £150-200 million per year. BGS are leading initiatives to help address this problem such as the ‘Dig to Share’ and ‘Big Borehole Dig’ projects which work with the construction and engineering industries to change the culture around data sharing [10]. The BGS has also put in place data sharing agreements with regional and national organisations, like Network Rail, Environment Agency, Highways England and the Welsh Government, committing them and their contractors to provide their ground investigation records to the BGS. In the last two years, the BGS has been working with the UK government to develop standardised clauses around ground investigation data that can be used by all public sector organisations. These clauses are now in the latest version of the UK “Construction Playbook”, which sets out key policies and guidance for how publicly funded projects and programmes are assessed, procured and delivered [11]. The Playbook should be adopted by central government and arm’s length bodies on a ‘Comply or Explain’ basis. All these initiatives and policy augmentations are slowly changing the mindset of how subsurface data is stored, managed and made available for others to use in order to make dramatic savings in cost, time and reduction in risks.

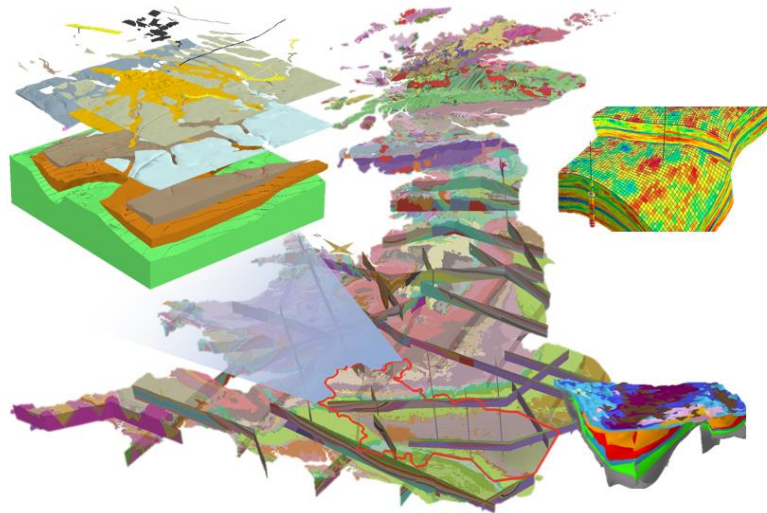
Borehole data is pivotal for understanding geology in urbanised areas, particularly in the shallow subsurface (top 100 m), as anthropogenic deposits often mask and obscure geological outcrop. Borehole data is often interpreted into 3D geological models, and in turn this has led to improved knowledge of subsurface geology and processes in urban areas. 3D geological data and information has been leveraged for use across many types of projects, such as tunnelling and construction, for example the Far-ringdon Tunnel in London 2012 [3], water resource management [4] and geohazards, particularly the shrink-swell clays that cause subsidence[5]. In 2022, the BGS published the London, Cardiff, and Glasgow 3D geological models onto the BGS GeoIn-dex web viewer portal where users can view synthetic boreholes, cross-section and horizontal slices through the 3D geological models to improve subsurface knowledge in these areas. These 3D geological models underpin three studies into the geothermal energy potential under these cities. Two of which belong to the UK Geoenergy Observatory programme in Cardiff and Glasgow, and the other a collaboration between the BGS and the university of Cambridge in the borough of Kensington and Chelsea in London.

The Cardiff Urban Geo-Observatory is a collaboration between British Geological Survey and City of Cardiff Council, and comprises several years of baseline temperature data, an operational shallow open-loop ground source heat pump, and a 3D geo-

logical model of the superficial geology focused on the target unconsolidated sand and gravel aquifer [6]. The observatory is the largest of its kind in the UK, providing open access data through a bespoke web-portal ([www.ukgeos.ac.uk/observatories/cardiff](http://www.ukgeos.ac.uk/observatories/cardiff)). The data from which has been utilised in further research showing how this geothermal energy resource could be optimised in urban environments [7].

The Glasgow observatory is a research facility designed for investigating the shallow, low-temperature mine-water heat energy and potential heat storage resources. 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 Glasgow Observatory is a result of a four-year period of borehole planning, drilling, logging and testing, including 3D geological modelling. A mine water reservoir classification established from the observatory boreholes highlights the resource potential in areas of total extraction, stowage, and stoop and room workings. Since their spatial extent is more extensive across the UK than shafts or roadways, increasing the mine water energy evidence base and reducing exploration risk in these types of legacy workings is important. Mine-water heat abstraction is a technology that is proven but not widely realised. The observatory enables research into the questions that remain about this heat source, from size and sustainability to environmental impacts [8].

The BGS collaborated with the University of Cambridge on the Translucent Cities project from 2018-2019, the objective of which was understand the impact of existing basement structures and potential new structures on the use of the geothermal properties/energy use in closed loop heating and cooling systems. This study demonstrates that the amount of heat from basements rejected to the ground constitutes a significant percentage of the total heat loss from buildings, particularly in the presence of groundwater flow. Understanding the relationship and geometries in 3D of the geological strata, and the thicknesses these, combining this with groundwater flow was fundamental in identifying factors to improve the sustainable utilisation of geothermal energy sources [9].



**Figure 1: BGS have developed a series of multi-scale and multi-purpose models across the UK.**

#### **Contributor statement**

Steve Thorpe – all discussion on 3D modelling and data improvement programs. Ricky Terrington – all discussion on government policy, Farningdon tunnel project.

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