

# UK's top earth scientists join forces to connect the dots in our rocks

The Natural Environment Research Council (NERC) and the British Geological Survey (BGS) are proposing two UK Geoenergy Observatories at Ince Marshes in Cheshire and in Glasgow. The case for new geological evidence was set out in 2015 during a NERC consultation with the UK's leading geologists, geoscientists, geological engineers, regulators and atmospheric scientists. In an ongoing series for *Business Matters*, the scientists involved outline the questions they want to explore and explain why a UK Geoenergy Observatory in Cheshire will break new boundaries in energy, climate change and environmental science.

**Professor David Manning, from Newcastle University's School of Natural and Environmental Sciences, is overseeing the design of the Observatory.**

“Over the last 200 years, the global population has grown from one to nearly eight billion. It is likely to rise another billion by 2050. Coupled with exponentially better living standards since the Second World War, society is now using so many natural resources that we've reached a critical point of needing far more information on the environmental impact of our demands.

We rely on the planet for drinking water, food fertilizer minerals, fossil fuels to power our cars, raw materials to build our homes... as our population grows, so does the demand on these natural resources. But they are limited and extraction has an effect. It's vital that we understand the cumulative impact of our competing demands on the environment. We know enough to manage current uses, and UK environmental regulation leads the world in safety standards. Managing future needs will require much more precise understanding.

This will be particularly important as we move away from fossil fuels. We'll

need to use the rocks to put our carbon back into the ground, to store renewable energy and use geothermal energy at scale. We have to invest in more knowledge to develop a precise understanding of how the underground behaves.

We know that when we extract groundwater there are impacts on the rest of the system from deep underground to the surface. We don't fully understand how the connections rise to the surface, how they might be connected with flooding, what the connection paths look like and where they lead.

Similarly, small seismic movements were detected in Basel, Switzerland, in connection with the use of 'hot dry' geothermal energy, so the operation was stopped. We need to be able to understand how those events arose in order for geothermal heat to have a real future in the energy mix.

We want to understand what changes occur, how, why and from where those changes originate, how they propagate and what effect they have on



Professor David Manning, from the School of Natural and Environmental Sciences at Newcastle University, is overseeing the design of the UK Geoenergy Observatories.

the surface. Only once we know that, we can fully understand how to mitigate those effects and regulate for them.

Accumulating this knowledge requires an observation system that can study the underground environment over an extended length of time in a level of detail never done before. We now have the engineering, technology and computer processing power to provide the best possible account of how underground systems behave and how different

parts of the underground are connected. The UK Geoenergy Observatories will build up a high resolution picture of the underground system, providing a breakthrough in our understanding. This hasn't been done anywhere else in the world. What we learn in Cheshire and Glasgow will lead the way in understanding how to balance our need for resources, with keeping people safe and protecting our environment. The science will have applications across the world. ”

**Professor of geological engineering at the University of Strathclyde Zoe Shipton chairs the Geoenergy Science Advisory Group which authored the science plan.**

“ One of our biggest climate change challenges is how to decarbonise our heat. Generally, we have a pretty good idea about how to decarbonise our electricity and transport. But with more than 80% of our homes reliant on gas heating, it's going to be really tough to get consumers to switch to heating systems that don't rely on fossil fuels. Heat does not transport well. It cools too quickly. We need low-carbon heat sources that are close to the consumer. More than likely, this means that they will come from directly below our towns and cities.

We need to develop low-carbon alternatives that are safe, reliable and affordable. We need to develop them quickly. It's vital that we understand what the potential solutions are, how we can do them safely, in collaboration with people and without impacting on the environment. These technologies require research to ensure efficient, safe and responsible use.

We have really sophisticated modelling techniques and these need to be validated in real geology. We need to understand if by using the rocks in these new ways we're waking up the

bugs that live in the rocks, cooling or clogging the system, causing chemical reactions or moving heat around. If we don't understand the science we won't be able to engineer the system properly, we won't be able to de-risk these emerging low-carbon technologies and operators simply won't be able to attract investment. Delivery depends on learning from research in a location typical of the demands people put on their environment.

We've asked a lot of our landscape over the centuries. We've extracted building materials, water and minerals. We've built into and on top of it. We've put pipes, tunnels and waste in it. We grow our food on it. So, our environment isn't pristine. Detecting change in this 'noisy' environment relies on being able to distinguish between natural, previously induced and new behaviour. In North Cheshire we can see all this activity in one place. Residential, industrial, mining, quarrying, transport, manufacturing, agricultural and resource supply all takes place within a 15-mile radius of the proposed UK Geoenergy Observatory site in Cheshire. That's on top of the natural



**Professor Zoe Shipton, Head of Geological Engineering at the University of Strathclyde, chairs the UK Geoenergy Observatories Science Advisory Group**

environmental fluctuations from the groundwater, the marshlands and the Mersey. Cheshire's particular geology - lots of rock types typical of the rest of the UK in one location and close to the surface - means that we'll be able to build up a really good picture of natural conditions and change in a variety of rock types, and apply this new understanding throughout the UK.

Without these observatories, it will be back to business as usual: where the traditional industries continue to spend millions on geological data of interest to them but is often commercially confidential, so does not assist new technologies

to come forward. The emerging geothermal industry knows it needs this information but it doesn't have the money to invest at this scale. These technologies will happen eventually: but to bring them forward at the pace and scale required to tackle our environmental challenges, we need to change our energy systems profoundly. The whole of the science community has committed to work together to create observatories that will gather the data needed to explain the unknown and understand the risks. If we succeed, this new data will come from a credible source driven by a common goal. ”

#### HOW DO I FIND OUT MORE?

The BGS ran community drop-in events in autumn 2017. Look out for more engagement events throughout 2018. Visit: [www.bgs.ac.uk/ukgeoenergyjobs](http://www.bgs.ac.uk/ukgeoenergyjobs) or email [ukgeosenquiries@bgs.ac.uk](mailto:ukgeosenquiries@bgs.ac.uk) for information.



**British Geological Survey**  
NATURAL ENVIRONMENT RESEARCH COUNCIL

**NERC**  
SCIENCE OF THE ENVIRONMENT

In the next issues, we'll hear from Professor Mike Bickle from the University of Cambridge, Fellow of the Royal Society and Director of the Cambridge Centre for Carbon Capture and Storage, Dr Grant Allen, from the Centre for Atmospheric Science at the University of Manchester; Professor Mike Kendall from the University of Bristol, Dr Alwyn Harf from the Environment Agency, and others.