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PR Mine water heat under the PhD spotlight

Better understanding of a potential new energy resource for coalfield areas is being researched by a PhD student in conjunction with the Coal Authority.

University of Edinburgh student Mylène Receveur is being partly-sponsored by the Coal Authority to expand our understanding of the geothermal warming of mine waters.

“Investigating geothermal heat resources of legacy mine workings, why are some mine waters hotter than others?” is the working title of her thesis, which will explore the key controls that create differences between different mines.

The difference in temperatures between mines has always been known and after mines were abandoned the empty roadways, galleries and fractures have filled with ground water, which is heated by geothermal energy from the earth’s core to temperatures of 11-20 degrees centigrade close to the surface and up to 46 degrees centigrade in deeper coal seams.

A recent Scottish government study on the geothermal potential of Scotland showed that there is a significant variation in the temperature of fluids down to a depth of about 1500 metres.

Temperature gradients ranging from 37°C/km to 45°C/km were recorded in some 61 boreholes but understanding why mine waters reach a certain temperature is critical to being able to estimate the heat resource and storage potential.

The Coal Authority, which recognises that the past can help shape the future, is particularly interested in understanding this thermal energy resource better. Interesting aspects include how quickly mine water heats up and how it could be used on a large scale for heating homes and business for decades to come.

Dr Ian Watson, Technical Lead on water for the Coal Authority and Mylène’s industry partner, said the Coal Authority is particularly interested in better understanding this resource because it is progressing a large number of district heating schemes that will use mines as their source of energy.

He added: “A quarter of UK homes and businesses sit on the former coalfields where the flooded underground workings contain vast amounts of renewable thermal energy.

“We want to work with Mylène to improve understanding of what the main sources of energy are, and how new energy extraction, or energy storage schemes using mine water will be able to make the best use of the vast underground workings left behind after mining stops.

“Several factors are considered to contribute to the temperature profile and the purpose of

Mylène’s PhD is to determine what they are and understand the subsurface “plumbing” and heat distribution of mine workings.”

Jeremy Crooks, Head of Innovation for the Coal Authority, said with a quarter of UK population being on the coalfields, the potential to repurpose the abandoned mines to provide a sustainable energy source for the benefit of future generations, and to help reach challenging climate change targets, is very exciting.

He added: “Mine is a constant source of sustainable energy, protected from the energy price fluctuations, which will help remove people from fuel poverty and provide business with cheap low carbon energy giving them a commercial advantage leading to more employment. To make best use of this asset we do need to know more about the temperatures behaviour and flows within mines. Mylène’s work on this will be invaluable.”

French born Mylène, has a Masters degree in geology from the UniLasalle Beauvais Engineering School in Beauvais, Paris, and also achieved a research Masters in Geology, specialising in Geothermal Sciences from the University of Iceland.

She will be collating data from the Coal Authority and spending time at its Mansfield headquarters. She hopes to develop hydrogeological conceptual models before interpreting the results to ascertain the temperature resources that are available over the long term.

She said: “It is a great challenge to understand what factors control the temperature distribution and the heat recharge rate in systems as hydrogeologically complex as coal mines, but this is essential to assess their geothermal potential.

“I hope being able to develop a numerical approach that faithfully reproduces heat flow processes in mines could be used to support the dimensioning of heat extraction schemes, first in the UK and ideally reproducible abroad. This is the key to ensure a sustainable heat production from low-temperature geothermal resources.”

Christopher McDermott, Mylène’s principle supervisor at the University of Edinburgh, emphasises that it is important to understand the heat resource and distribution, and so to ensure long term sustainability.

He said: “There is always the temptation to extract more heat out of the system than is available by recharge, thereby depleting the resource. Mylène’s work is important in helping us to balance the heat use, and also to investigate ways of enhancing the heat in mines through storage.”

Notes to News Editors:

* this energy can be abstracted using heat pumps - the same technology used in refrigerators. For every 1kw of electrical energy used by heat pumps, between 5 to 20 kw of heat equivalent can be extracted
* where heat pumps can be powered from renewables, such as solar and wind, mine energy will provide a zero carbon footprint without any polluting air emissions
* in mines with lower temperatures close to the surface there is potential to use the deeper seams for heating and the upper seams for cooling, this being the fastest growing sector of energy use in the UK
* heating accounts for 45% of energy use in England and Wales, and 55% in Scotland.
* when mine water has recovered nearer to the surface it becomes cheaper than public supply gas to abstract
* vast amounts of surplus or waste energy from above ground could be stored inter-seasonally in mines - resolving the UK’s dilemma on how to store energy over extended periods. Sources of this surplus energy include energy from waste plants, sewers, industry and renewables
* the Coal Authority operates 75 mine water treatment schemes across the UK, which together, bring 81MW of geothermal energy to surface. These schemes provide a perfect opportunity to access low cost geothermal energy with minimal investment