Geophysical Research Abstracts
Vol. 16, EGU2014-6416, 2014
EGU General Assembly 2014

Characterization of deep geothermal energy resources using Electro-Magnetic methods, Belgium

Sian Loveless, Virginie Harcout-Menou, Fjo De Ridder, Bert Claessens, and Ben Laenen
Flemish Institute of Technology (VITO), Mol, Belgium (sian.loveless@vito.be)

Sedimentary basins in Northwest Europe have significant potential for low to medium enthalpy, deep geothermal energy resources. These resources are currently assessed using standard exploration techniques (seismic investigations followed by drilling of a borehole). This has enabled identification of geothermal resources but such techniques are extremely costly. The high cost of exploration remains one of the main barriers to geothermal project development due to the lack of capital in the geothermal industry. We will test the possibility of using the Electro-Magnetic (EM) methods to aid identification of geothermal resources in conjunction with more traditional exploration methods. An EM campaign could cost a third of a seismic campaign and is also often a passive technology, resulting in smaller environmental impacts than seismic surveys or drilling.

EM methods image changes in the resistivity of the earth's sub-surface using natural or induced frequency dependant variations of electric and magnetic fields. Changes in resistivity can be interpreted as representing different subsurface properties including changes in rock type, chemistry, temperature and/or hydraulic transmissivity. While EM techniques have proven to be useful in geothermal exploration in high enthalpy areas in the last 2-3 years only a handful of studies assess their applicability in low enthalpy sedimentary basins. Challenges include identifying which sub-surface features cause changes in electrical resistivity as low enthalpy reservoirs are unlikely to exhibit the hydrothermally altered clay layer above the geothermal aquifer that is typical for high enthalpy reservoirs. Yet a principal challenge is likely to be the high levels of industrialisation in the areas of interest. Infrastructure such as train tracks and power cables can create a high level of background noise that can obfuscate the relevant signal.

We present our plans for an EM campaign in the Flemish region of Belgium. Field techniques will be developed to increase the signal-noise ratio and identify background noise. Firstly, surface noise will be filtered off by non-parametric approaches such as proper orthogonal decomposition. Secondly, the EM signal and newly acquired seismic data will be combined to obtain a multi-dimensional earth model via an inversion process. Typically, these identification procedures are non-unique, resulting in multiple possible scenarios that cannot be distinguished based on the information at hand. To this end standard approaches) use a regularisation term including an apriori model. Here, Bayesian approaches will also be used, in which expert knowledge is used to guide the outcome to reasonable solutions.

We will assess the reduction in uncertainty and therefore risks that EM methods can provide when used in combination with seismic surveys for geothermal exploration prior to drilling. It may also be possible to use this technique for monitoring the evolution of geothermal systems. Such techniques may prove to be extremely valuable for the future development of geothermal energy resources.