Knowledge Transfer Partnerships

Atomic Dielectric Resonance: A New Geophysical Tool For Geothermal Exploration

22 Apr – 24 Apr 2014

Thomas Harley
13/10/14

DERISKING GEOTHERMAL PROJECTS?

Derisking drilling operations using current Geophysical methods can be:

- Expensive;
- Time consuming;
- Environmentally damaging;

Issues with:

- Depth penetration;
- Resolution;
- Exploratory borehole required;

Innovate UK
Technology Strategy Board

UK's Innovation Agency with the aim of accelerating economic growth. Part-funded by 13 Government organisations

Industry Partner:

Adrok®

Advisor:
Gordon Stove
Managing Director

Knowledge Transfer Partnerships

Academic Partner:

University of Glasgow

Advisors:
Prof Paul Younger
Dr Robert Westaway

WHO ARE ADROK?

- Established in 1997.

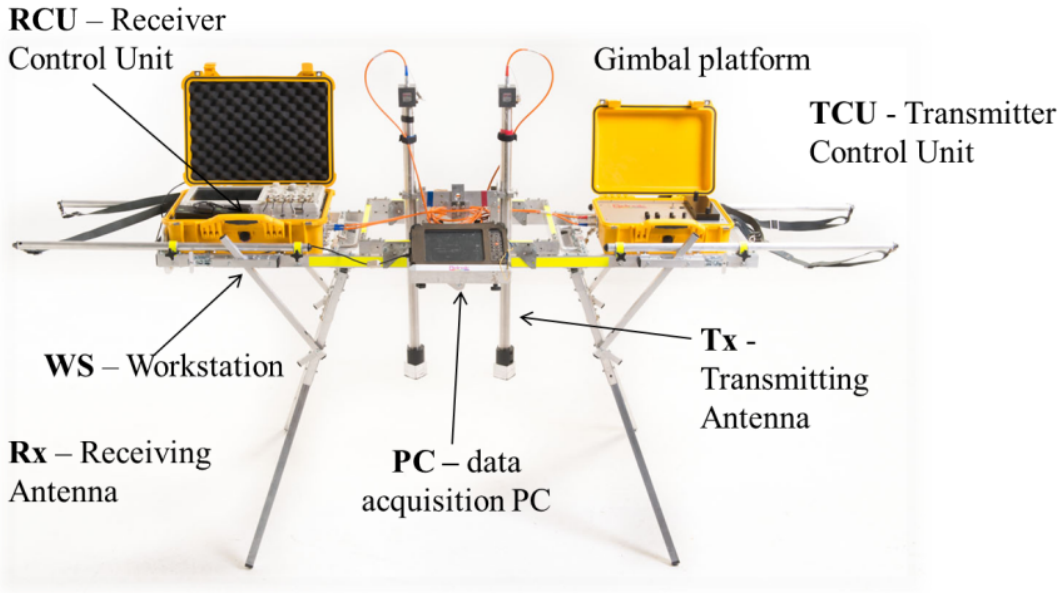
- ADROK uses its proprietary electromagnetic technology to supply geophysical services to clients from all over the world, providing them with measurements of:

    - Rock types
    - Hydrocarbons
    - Minerals
    - Ores

- Achieves far greater penetration than other geophysical tools.
- Conducted over 100 projects all over the world and has testimonials from Caithnes Petroleum, Teck Resources, Dyesol Europe, Barchester Group & Vermeer.

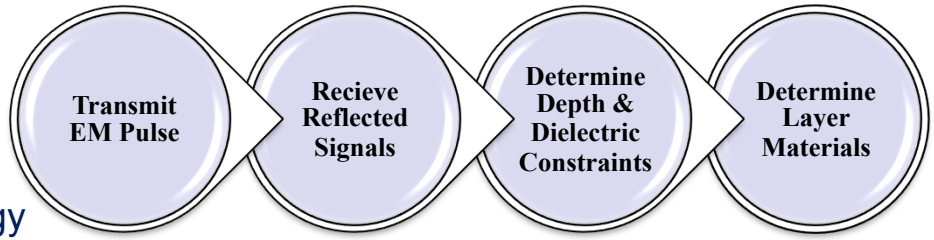
Advantages of ADR Scanner equipment:

- No permitting issues;
- Lightweight;
- Modular;
- Low power;
- Physically safe;
- Environmentally and ecologically safe;
- Works through air, rock, water and ice;
- Cost effective scanning solution that helps to reduce waste.



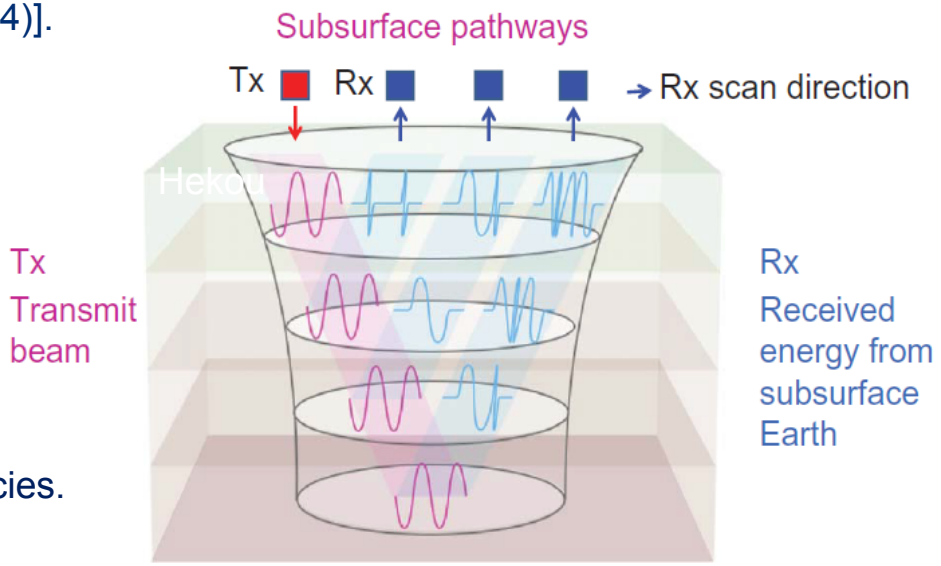
RADAR & MASER beam transmission:

- Microwave Amplification by Stimulated Emission of Radiation;
- Adrok's Scanner illuminates the ground by transmitting and receiving lased EM Energy (radiowaves / microwaves). [G.C. Stove et al. (2014)].



The Beam:

- Pulsed;
- Coherent (Narrow Band);
- Focused for minimal dispersion;
- Cylindrical Shaped;
- Contains resonant radiowave / microwavefrequencies.



εr. Dielectric Constant (Relative Permittivity):

-The rate of transmission of an electromagnetic wave through a medium relative to the transmission rate through air. Air has a DC of 1 and sea water a DC of 81;

-The DC of each geological layer can be calculated from the two way travel time of the beam;

-The DC of each layer can be compared to a database of rock types developed by ADROK;

-Highly suited to geothermal purposes as high DC of water should make identification of reservoirs, aquifers and saturated natural fracture systems accessible.

Other Outputs:

-The returned signal can also be analysed in terms of energy, frequency, amplitude and phase response;

-Statistical and Harmonic analysis can be carried out to further determine and ‘typecast’ rock types.

PROJECT OBJECTIVES

- To review ADROK's ADR scanner technology in the context of deep geothermal drilling market worldwide.

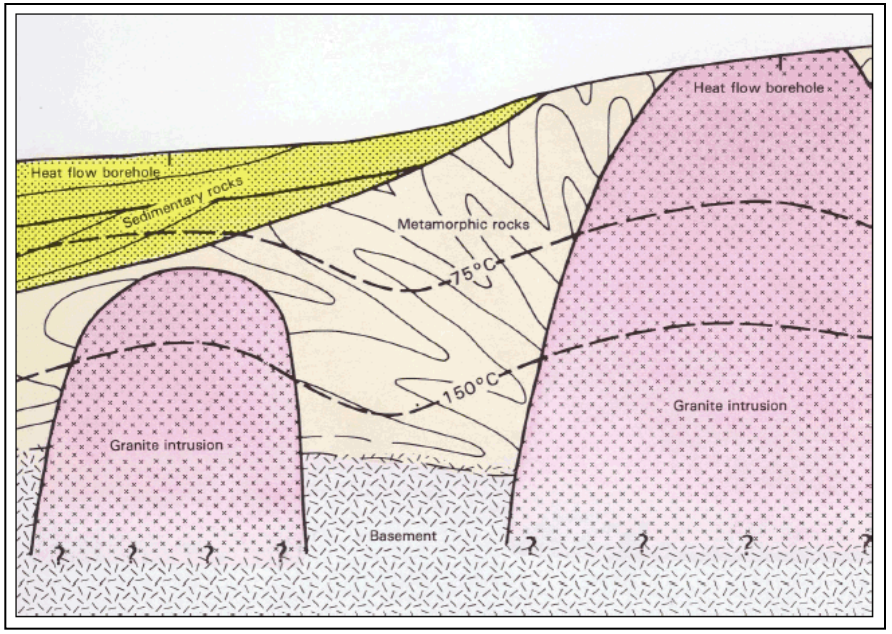
- To test ADROK ADR scanner technology in sites representative of the three main types of deep geothermal system currently targeted for exploration:

  1. Volcano-hydrothermal systems;

  2. Hot sedimentary aquifers;

  3. Radiothermal granites.

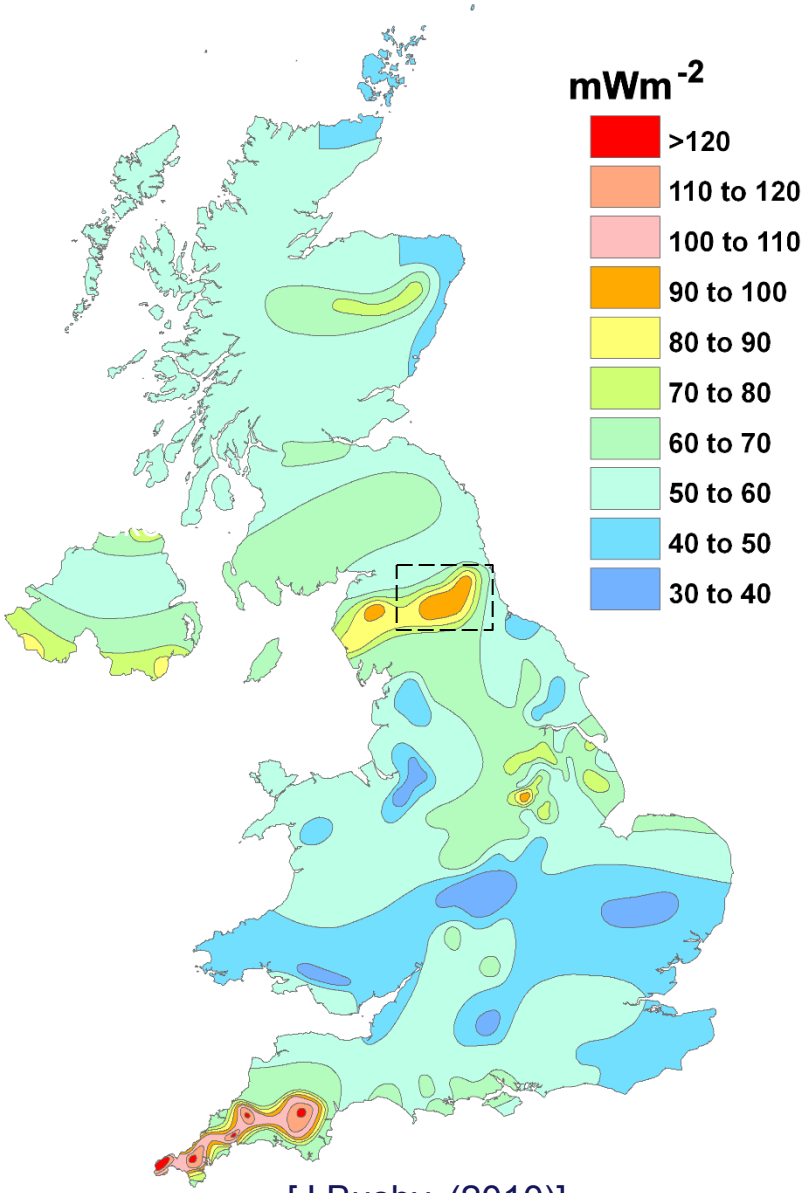
- Demonstrate the ADROK ADR scanner in predictive mode at a site scheduled for subsequent drilling, deriving data-sets and supporting information to allow compelling, worldwide marketing of the service by ADROK.



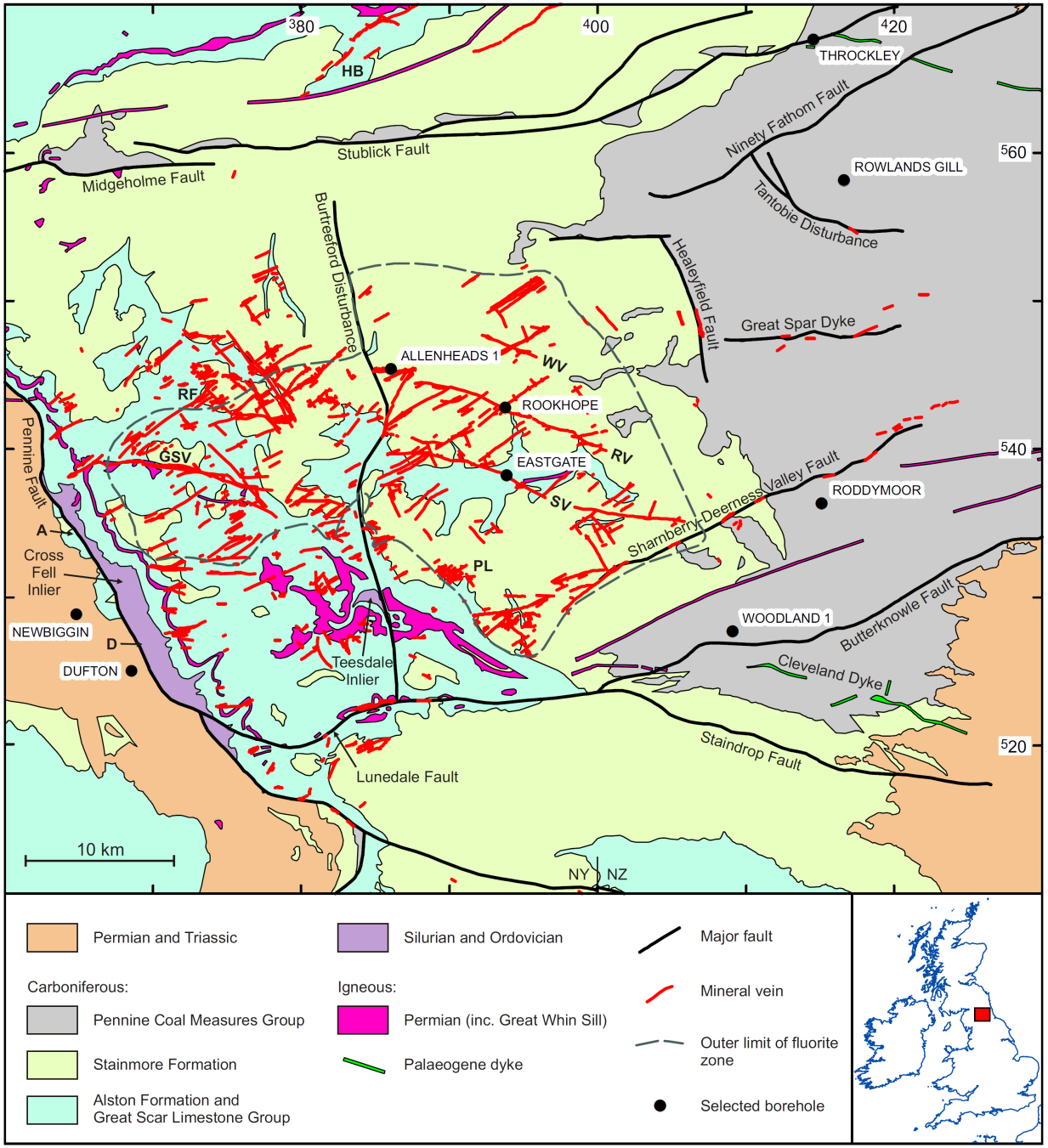
Purpose of Fieldwork:

-To create a virtual borehole at a prospective geothermal site, identify geological features and compare against accurate geological data as a blind test.

-Weardale granite selected due to relatively high HF (95 $mW.m^{-2}$) and HP (3.7 $\mu W/m^{-3}$) and interest in development into Eastgate Renewable Energy Village, Country Durham.



[J.Busby. (2010)]



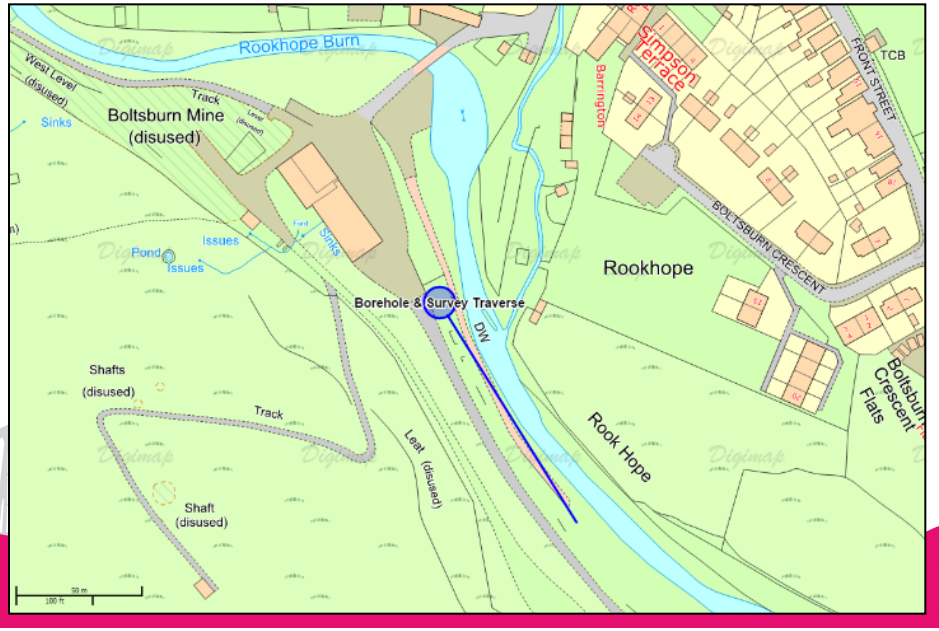
[Kimbell et al. (2010)]

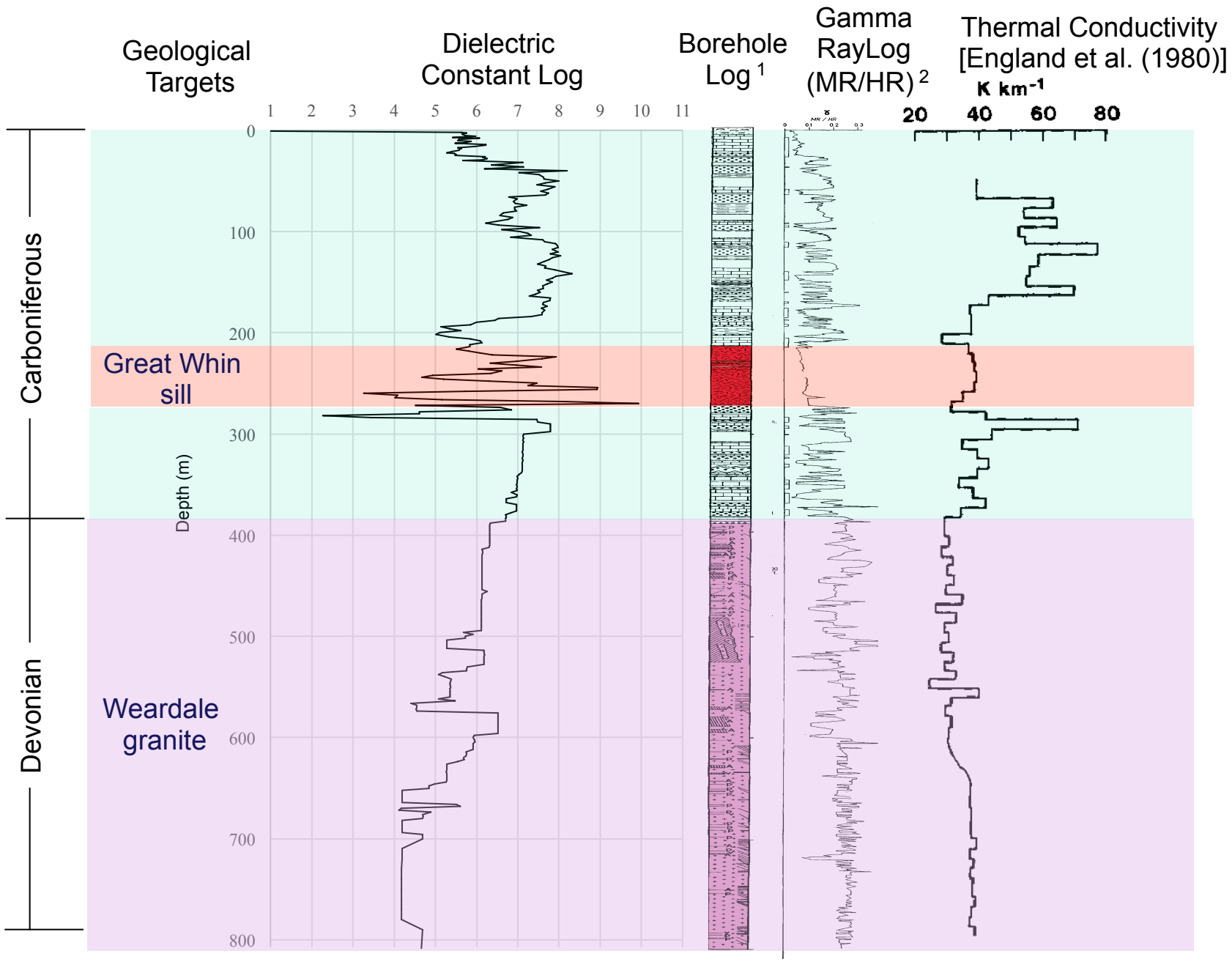
Survey:

- Multiple scans were taken adjacent to the Rookhope borehole so the best quality data could be chosen;
- A 100m traverse was scanned in order to assign depth corrections to the scans taken adjacent to the borehole;
- The ADR scanner was adjusted to scan to a depth of 1000m, the borehole being 807m in depth.

Targets to Identify:

- The Weardale granite as a potential resource for HDR.
- The Great Whin sill as it is an obvious geological target.

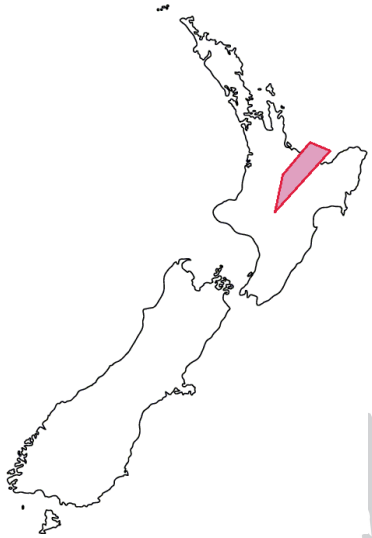




1. 2. Dunham et al (1965). Quart. 07. geol. Soc. Lond. vol. z~z, z96 5 (to face p. 414).

FURTHER FIELDWORK

RADIOTHERMAL GRANITES	HOT SEDIMENTARY AQUIFERS	VOLCANO-HYDROTHERMAL
Eastgate, Weardale, Country Durham, UK (Nov 2014)	Science Central, Newcastle upon Tyne, UK (May 2014)	Taupo Volcanic Zone, New Zealand (April 2015)
United Downs, Redruth, Cornwall, UK (Nov 2014)	Glenrothes, Fife, UK (July 2014)	



Organisation Websites

- www.ktponline.org.uk/
- www.innovateuk.org/
- www.gla.ac.uk/
- www.adrokgroup.com/

My Contact Details

Thomas Harley
KTP Associate
Adrok Ltd.
49-1 West Bowling Green Street
Edinburgh, EH6 5NX
Tel: +44(0)131 555 6662
Email: Tharley@adrokgroup.com

THANK YOU

Any Questions?