

Atomic Dielectric Resonance: A New Geophysical Tool For Geothermal Exploration

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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

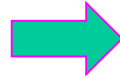
UK's Innovation Agency with the aim of accelerating economic growth. Part-funded by 13 Government organisations.



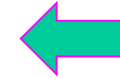
Industry Partner:



Advisor:
Gordon Stove
Managing Director



Knowledge Transfer Partnerships



Academic Partner:



Advisors:
Prof Paul Younger
Dr Robert Westaway



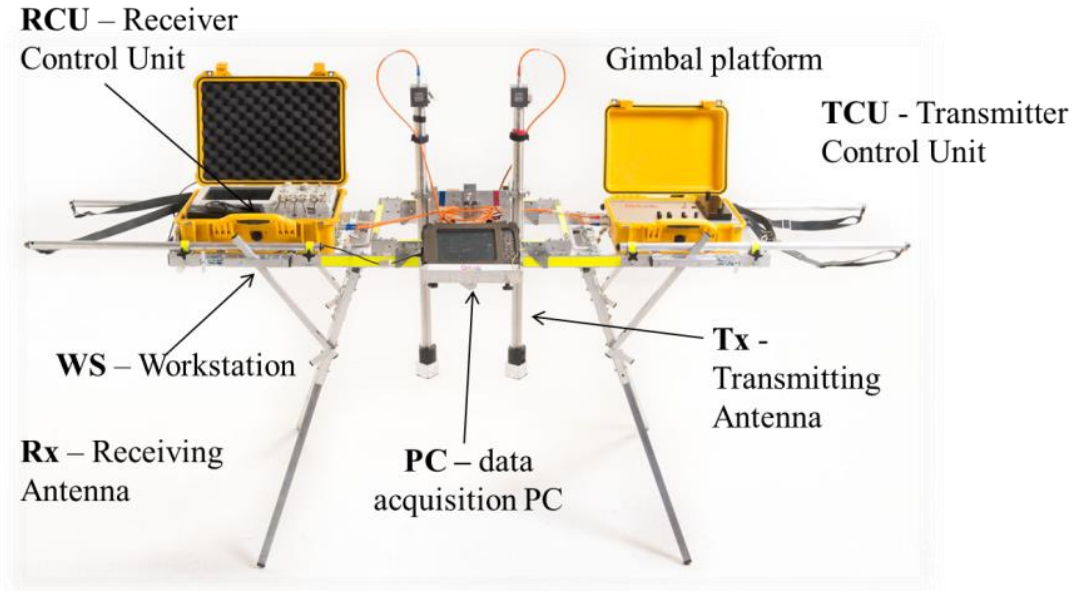
- Established in 1997.
- ADROK uses its proprietary electromagnetic technology to supply geophysical services to clients from all over the world, providing them with measurements of:
 - Rock types
 - Hydrocarbons
 - Minerals
 - Ores
- Achieves far greater penetration than other geophysical tools.
- Conducted over 100 projects all over the world and has testimonials from Caithnes Petroleum, Teck Resources, Dyesol Europe, Barchester Group & Vermeer.

WHO ARE ADROK?



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.



ϵ_r . 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.

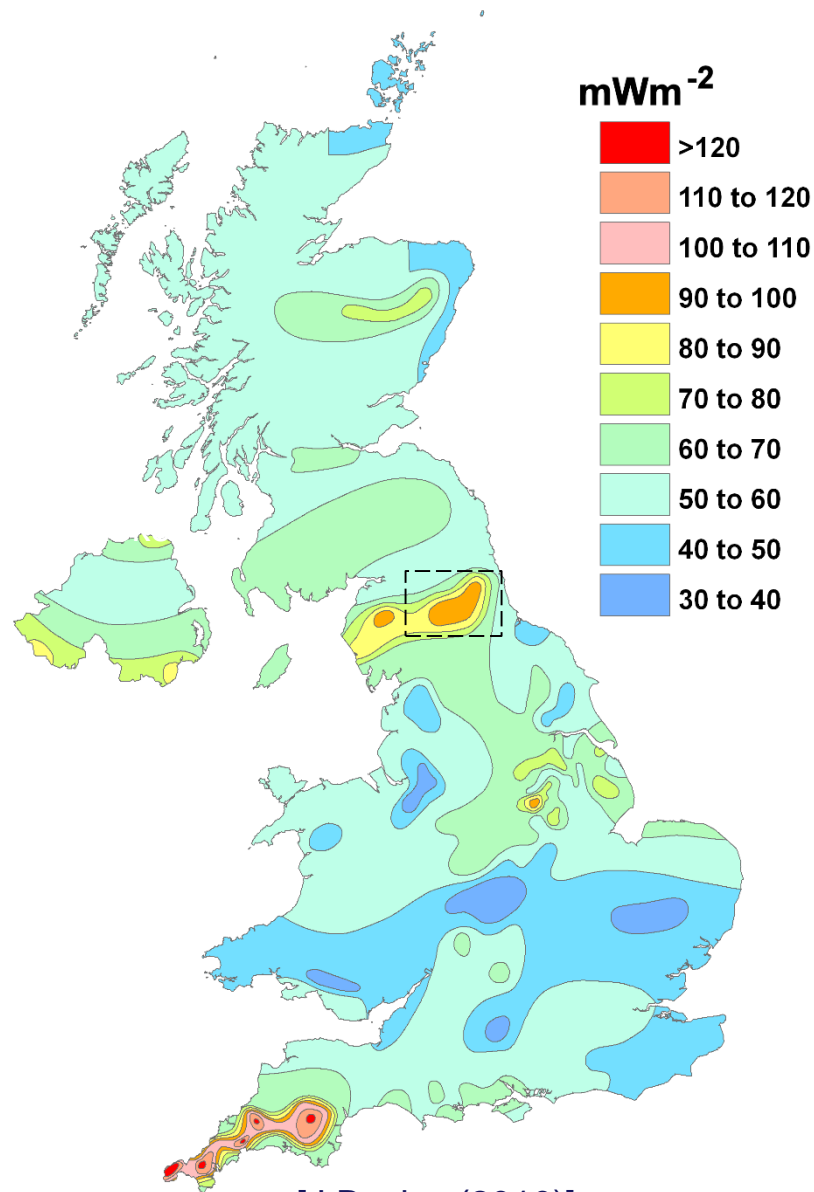


- To review ADROK's ADR scanner technology in the context of deep geothermal drilling market worldwide.
- To test ADROK ADR scanner technology in sites representative of the three main types of deep geothermal system currently targeted for exploration:
 1. Volcano-hydrothermal systems;
 2. Hot sedimentary 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.

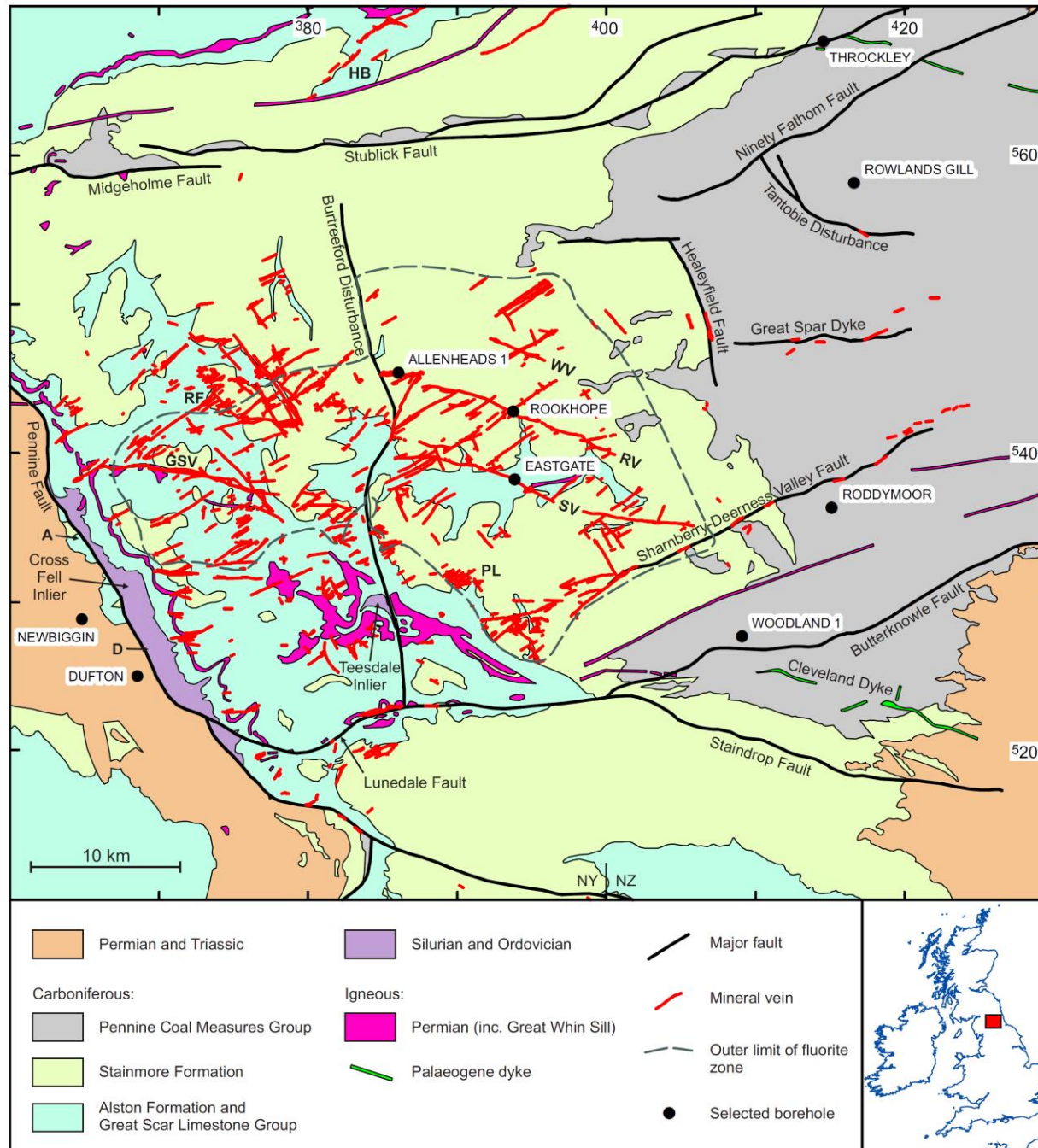


Purpose of Fieldwork:

- 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 ($3.7 \text{ } \mu\text{W/m}^{-3}$) and interest in development into Eastgate Renewable Energy Village, Country Durham.



[J.Busby. (2010)]



[Kimbell et al. (2010)]

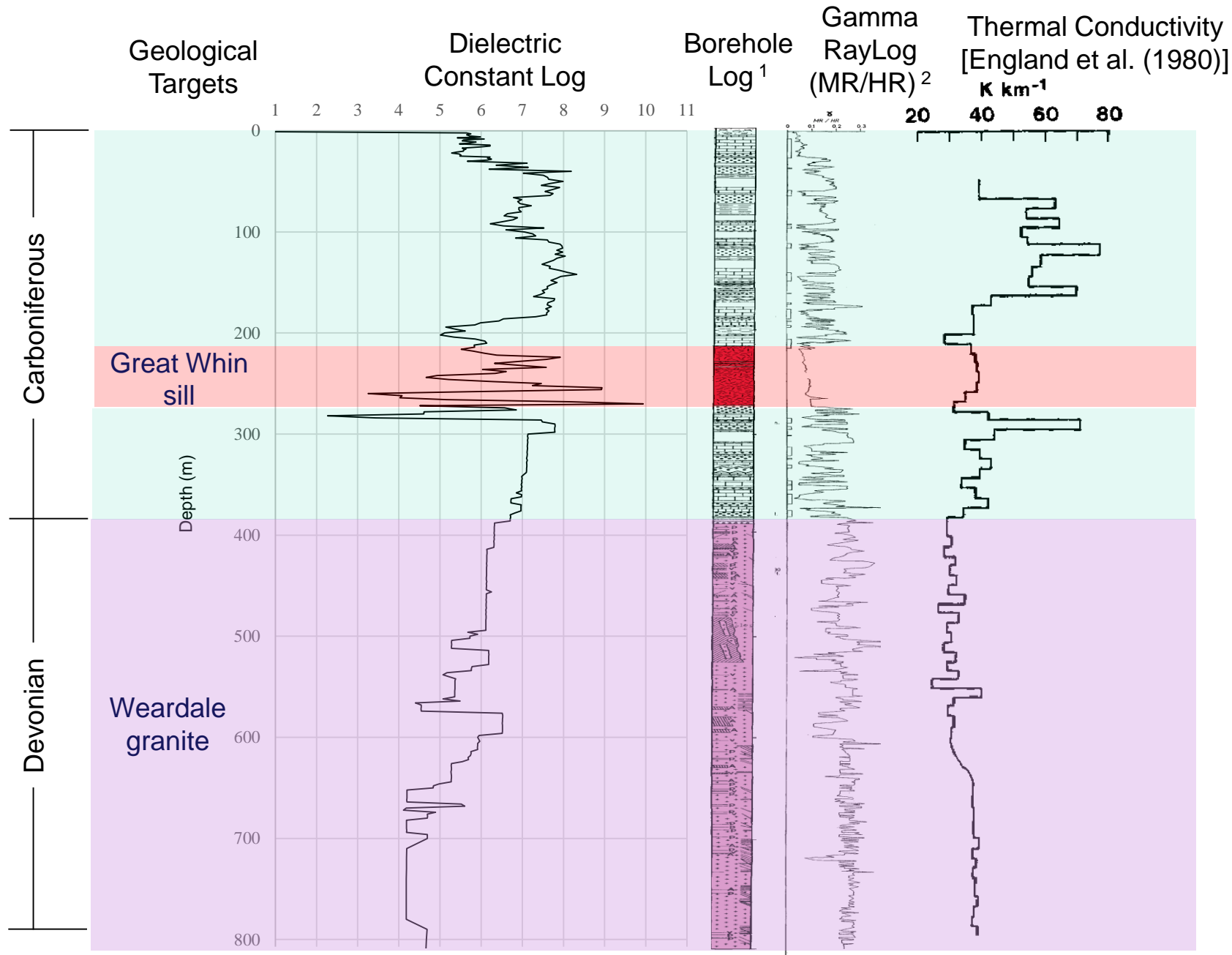
Survey:

- 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).

| RADIO THERMAL GRANITES | HOT SEDIMENTARY AQUIFERS | VOLCANO- HYDROTHERMAL |
|--|---|--|
| Eastgate, Weardale, County 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/
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THANK YOU

Any Questions?

