UK Geoenergy Observatories: Cheshire

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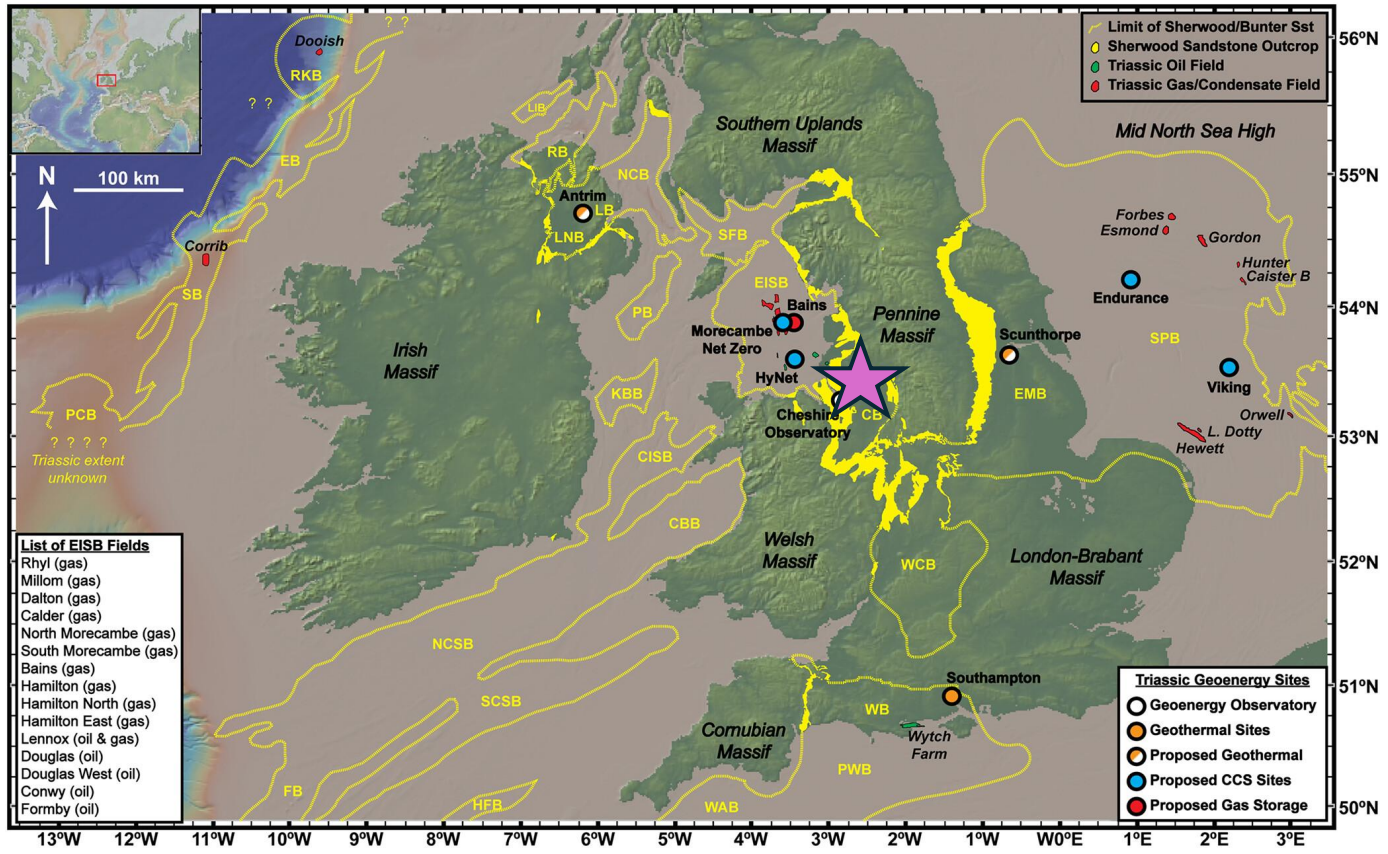


- Thornton Science Park, Cheshire
- On outcrop of Chester Formation (SS aquifer); surrounded by tidal flat deposits
- Bedrock at 0.5 – 2 m beneath made ground and asphalt

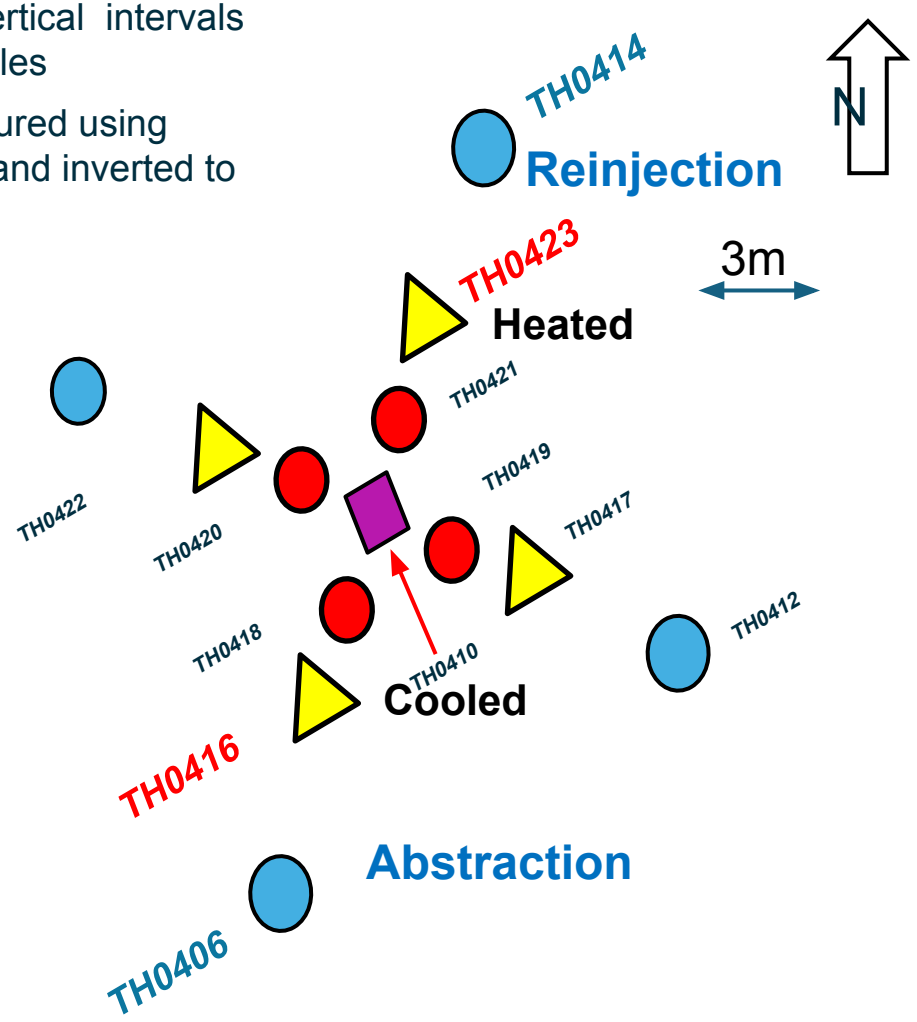
From: Review of Triassic Sherwood Sandstone Group reservoirs of Ireland and Great Britain and their future role in geoenergy applications, English et al., Geoenergy, Vol 2, 2024. Figure made with GeoMapApp (www.geomapapp.org).


TH0415
InSAR reflector
TH0411
Wellhead enclosure for abstraction/ reinjection well
TH0414
TH0424
3m
Data centre
Site office
TH0423
TH0421
Wellhead enclosure for heat exchanger borehole
TH0408
TH0407
TH0422
TH0420
TH0419
TH0417
TH0412
TH0410
TH0418
TH0413
TH0416
Workshop
Storage
Plant room
Plant plinth
TH0406
2 x 20m³ water storage tanks
TH0404
Pipework and cable gantry
TH0409
TH0405
Key
100m borehole with heat exchanger loop installed to 95m bgl in thermal grout
100m borehole with 8 port multilevel sampler installed to 99m bgl for groundwater monitoring
100m piezometer borehole with 1m screen section from 98- 99m bgl for groundwater monitoring
Resistance tomography and fibre optic cables to ca. 84m bgl
100m open bedrock borehole with depth- adjustable packer and pump assembly for groundwater abstraction or reinjection
100m open bedrock borehole for geophysical and hydrogeological investigations. Fitted with 100m removable FLUTe liner to prevent vertical flow
Resistance tomography and fibre optic cables to ca. 15m bgl.
100m open bedrock borehole for geophysical and hydrogeological investigations. Fitted with 100m removable FLUTe liner and 100m fibre optic cable

Experiment: Plume monitoring using electrical resistivity tomography sensors (ERT)

- Over 1100 ERT electrodes are installed at 1m vertical intervals from ca. 12 to 96m bgl in the 100m deep boreholes
- The resistance between electrode pairs is measured using tandem 512 channel BGS PRIME interrogators and inverted to model the resistivity distribution

Screened interval being installed with electrical resistivity sensor



	Key	
△	100m borehole with heat exchanger loop installed to 95m bgl in thermal grout	Resistance tomography and fibre optic cables to ca. 100m bgl
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Experiment measured the changes in electrical resistivity through cooling, heating and the addition of water flow

RESULTS:

- Resistivity is linked to temperature – blue = high resistivity, lower temperature, red = low resistivity, higher temperature
- The resistivity of water saturated rock decreases by approx. 2% per °C increase in temperature
- The resistivity profile along the borehole is related to the lithology, porosity and permeability

15th March
ERT Baseline
Start cooling BHE 416
Zero degrees

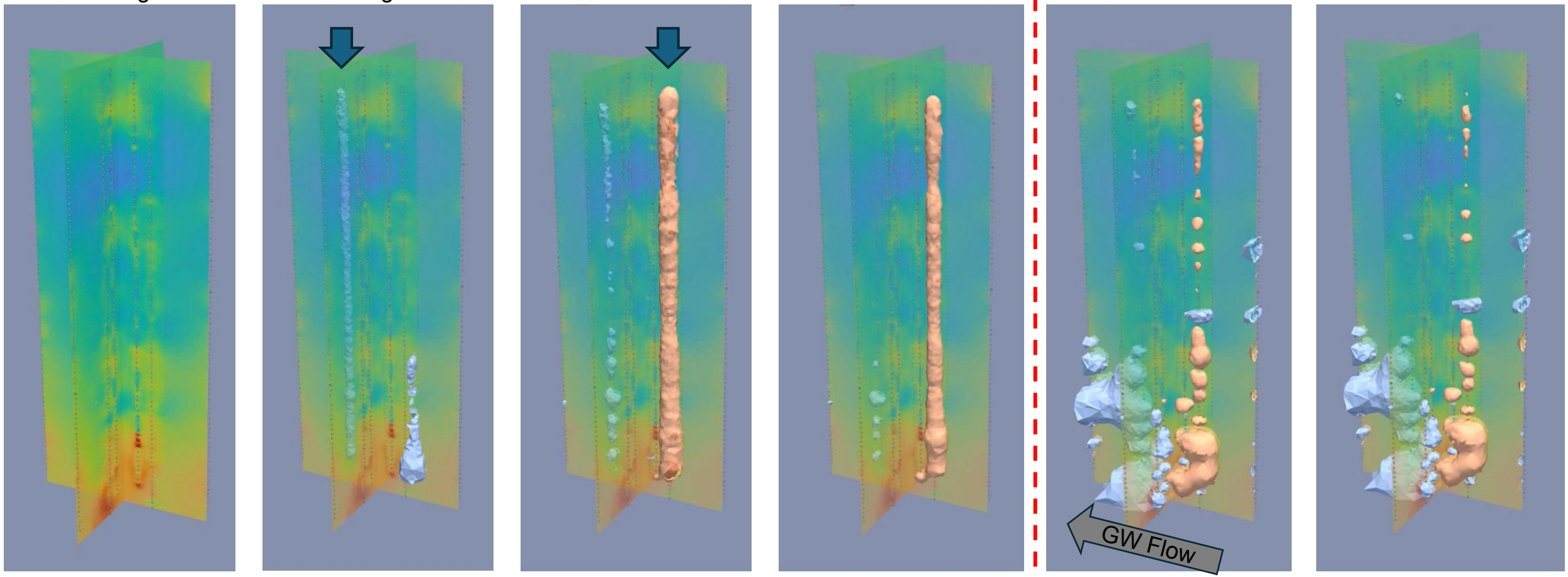
18th March
Stop cooling BHS 416
Start heating BHS 423
25/50 degrees C

22nd March
Stop heating
BHE 423

25th March
Rest period

26th - 28th March
Abstraction/reinjection
48 hours 4L/S

31st March
End Rest period



SUMMARY:

The ERT system can provide information about:

- Borehole thermal energy storage and extraction
  - How long does the heat remain in situ?
  - How wide is the zone around a borehole that is affected by thermal changes?
- How does water flow affect the thermal plume?
- Is there preferential flow through fractures?
- Rock characterisation + flow paths

Research and innovation opportunities: If interested in more details or wish to use the site please contact ukgeosenquiries@bgs.ac.uk

In-situ monitoring of subsurface systems

Sensor development and testing

Optimised monitoring strategies

Advanced 3D flow & transport modelling

Models & digital twins

Big data techniques

4D tracer migration tests

Effects of heating & cooling on aquifers

Chemistry

Microbiology

Aquifer properties

Rock characterisation

Multiscale, adaptive SI approaches