The UK GeoEnergy Test Bed
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The GeoEnergy Test Bed (GTB)

The GTB is

• A research facility initiated by the British Geological Survey and the University of Nottingham comprising an instrumented borehole array

• The site represents a £6M investment to support new and emergent geo-energy sectors critical for a sustainable energy future (including £2.5 M UK government-funding through the Energy Research Accelerator (ERA) project)

• ERA partners:

  - Aston University
  - University of Birmingham
  - University of Leicester
  - Loughborough University
  - The University of Nottingham
  - Warwick University
  - British Geological Survey

• Research grants will be used to fund scientific research at the GTB
The GeoEnergy Test Bed (GTB)

- The GTB will
  - Provide a **national facility** for future researchers, technology developers and industrial operators
  - **Catalyse collaboration** with UK and overseas institutions
  - Enable development and testing of **innovative monitoring technologies**
  - **Improve understanding** of impacts and processes in the shallow subsurface
  - Provide **ground truthing** for advanced simulation software
GTB project progress

- Concept & design
- Characterisation and baseline data
- Commissioning (drilling and installation of array)
- Monitoring of site during and after injection
- Operation*
- Field data collected
- Closure and abandonment

* Injection subject to obtaining relevant permissions
Geological formations

- **Mercia Mudstone Group (MMG)** – a major caprock in the North Sea for oil and gas fields and potential seal for CO₂ storage sites
- **Sherwood Sandstone Group (SSG)** – largely equivalent to the offshore Bunter Sandstone Group, a potential CO₂ storage reservoir rock

Well terminates in Carboniferous strata (*Carb.*), (mix of mudstone/siltstone/conglomerate expected).

Ratcliffe-on-Soar 1 – nearby legacy well
Current geological model

Arden Sandstone Formation

Cotgrave Sandstone Member

Beds dip shallowly to the south-west

Mercia Mudstone Group

Sherwood Sandstone Group

Helsby Sandstone Formation

Carboniferous strata

River terrace deposits

(Depths are below ground level)
Shallow geophysical surveys (1)

- **Surface Electrical Resistivity Tomography (ERT)** (August 2015)
- **Cone of Penetration survey** (November 2016)
Shallow geophysical surveys (2)

- Shallow refraction survey, (September 2016)
- Tromino passive seismic survey (September 2016)
Geochemical and microbiological surveys

• Soil samples collection for later microbiological assessment (September 2016)
• Soil gas (% and flux) – two surveys (October 2015 and June 2016)
• These surveys will be repeated
GTB well drilling programme

- Main drilling programmes; June 2016 to May 2017
  - One shallow test well and one deep well (funded by BGS, UoN and ERA)
  - Two wells into the shallow aquifer (funded by ERA)
  - Four deep wells, including one cored well, drilled into the Sherwood Sandstone (funded by ERA)
  - Four wells have geophysical log data

Geophysical logging – SB3
When developed, the site will be monitored by an array of down-hole and surface sensors.
Geological data

- Cuttings from several wells (July 2015 and June 2016 – June 2017)
- Core from SB4 (Nov 2016)
- Drilling mud samples (Dec 2016)
Downhole geophysical log data collected

- **SB1** – open hole; natural gamma (July 2016), optical televiewer survey (Oct 2016)
- **SB3** – open hole; spectral gamma, electrical logs, sonic, neutron-density, acoustic televiewer, resistivity imager etc (July 2016)
- **SB3** – through plastic casing; temperature & conductivity (Jan 2017)
- **SB4a** – through steel casing; gamma (Jan 2017)
- **SB5** – open hole; natural gamma, caliper, electric log, neutron-density, resistivity, full waveform sonic etc) (Jan 2017)
Hydrogeological testing

• Pump test to examine permeability of deeper aquifer carried out on SB3 (October 2016)
Current geological model

- Arden Sandstone Formation
- Cotgrave Sandstone Member
  - Beds dip shallowly to the south-west
- Mercia Mudstone Group
- Helsby Sandstone Formation
  - Sherwood Sandstone Group
- Carboniferous strata

River terrace deposits

West to East: 250 m

Depth: below ground level
Future ERA well-based monitoring array at the GTB (1)

Monitoring array will be used to interrogate volume of rock between the deep wells:
- Optic fibre – temperature and acoustic monitoring
- Electrical Resistivity Tomography (ERT) arrays
- Pressure sensors
Future ERA well-based monitoring array at the GTB (2)

- **Microseismic** array to be installed in well SB10
- **Groundwater** monitoring programme planned
Future ERA Surface/near surface surveys and data

- Deep reflection seismic survey planned
- UAV (with CO$_2$ and temperature sensors) survey planned
- Soil gas (% and flux)
- Soil samples for microbiological analysis
- Core still to be tested (poro-perm, reactivity with CO$_2$ etc)
Draft Science Plan

- **Science plan is draft and subject to change** – permits not yet in place and new science ideas to be included
  - Ground truthing of geological model, validation of advanced reservoir simulation software
  - Improve understanding of the impact and processes around fluid storage and migration in the shallow subsurface
  - New (including low TRL) MMV to be tested (potentially including downhole if facility integrity can be guaranteed)

- **As understanding of the site grows and collaboration opportunities emerge, the science plan will be updated and enhanced to maximise the scientific value of the site**
GTB Research collaboration

- Suggestions for ERA scientific collaboration at the site welcome. Please send to Matthew Hall Matthew.Hall@nottingham.ac.uk (GTB Theme Lead for G-era) and Ceri Vincent (GTB Science Lead) cvi@bgs.ac.uk
- Site access and data access/use subject to agreements
Thank you