GeoEnergy Test Bed, UK

Ceri J Vincent

British Geological Survey
and GeoEnergy Research Centre (http://www.gerc.ac.uk)

Thanks to Matt Hall, Jonathan Pearce, David Jones, Tim Pharaoh, Jonathan Chambers, Paul Wilkinson, Keith Ambrose

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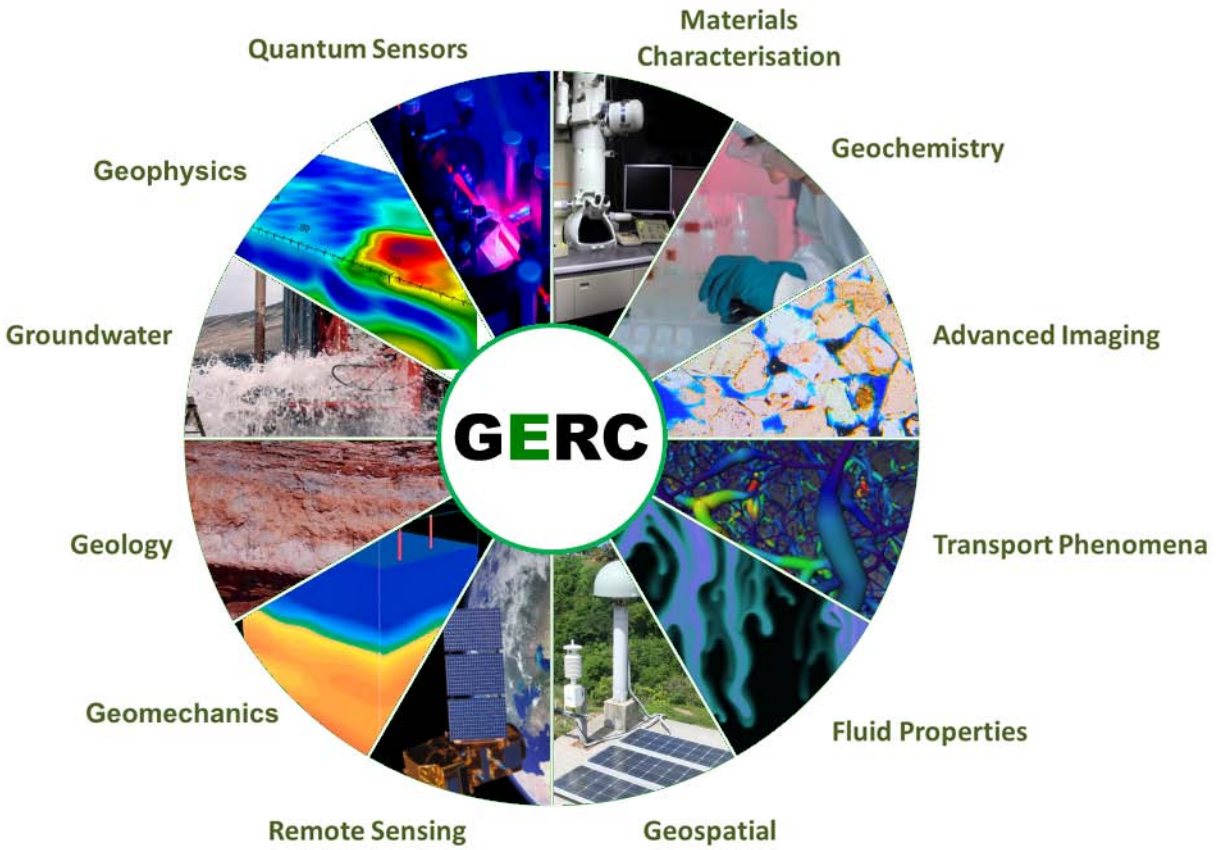
GERC
GeoEnergy Research Centre

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

GeoEnergy Research Centre - GERC

- The GeoEnergy Test Bed (GTB) is an initiative of the GeoEnergy Research Centre (GERC)
- GERC is a research partnership founded by the University of Nottingham and the British Geological Survey



GeoNet

Role of the GTB in research and development

- The GTB will act as a research hub to catalyse scientific collaboration between researchers from academic and industrial backgrounds.
- The aim of the GTB is to advance geoscientific research necessary for a sustainable low-carbon energy future

- The GTB is being managed and developed by GERC and has recently benefited from direct capital investment from the UK Government's Treasury as part of the £180m Energy Research Accelerator (ERA) project

GTB field laboratory

- The GeoEnergy Test Bed (GTB) will…
  - Be used to improve understanding of the impact and processes around fluid storage and migration in the shallow subsurface including advancing understanding of the mechanisms, rates and interactions of fluids in the shallow subsurface
  - Enable development and testing of innovative remote sensing, surface and subsurface monitoring technologies
  - Provide ground truthing for development and validation of advanced fluid flow and reservoir simulation software

Baseline data and work so far

- UoN Estates Department granted site access
- Planning permission for characterisation boreholes and onsite storage/sample preparation facilities obtained (April 2015)
- Open hole, narrow bore borehole drilled by Royal Engineers to prove stratigraphic boundaries (July 2015)
- Geophysical and geochemical baseline data have been collected
  - Electrical Resistive Tomography survey (August 2015)
  - Soil gas survey (October 2015)
  - 3D model using legacy seismic and well data (February 2016)

GTB site development

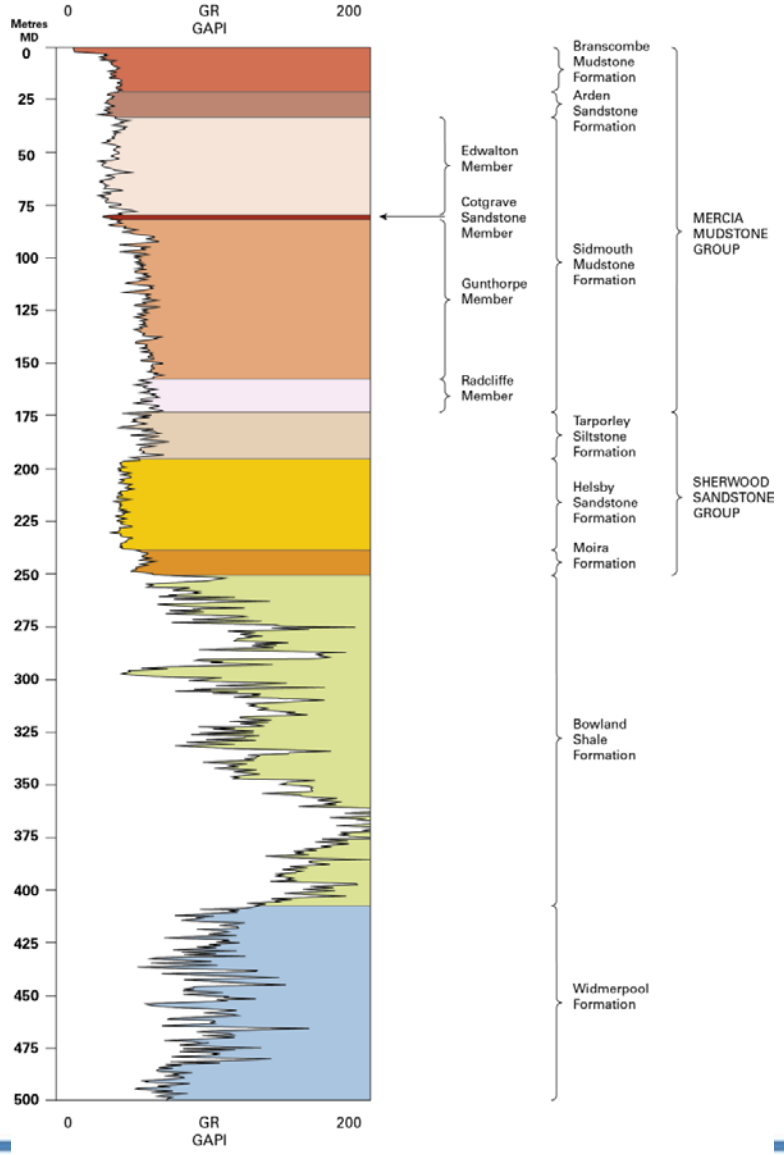
- Currently, activities to characterise the geology of the site are being undertaken. The first borehole was drilled in July 2015 and two new site investigation wells are planned for June and October 2016, with further wells planned for 2017 and 2018.
- When developed, the site will be monitored by an array of down-hole and surface sensors

- A draft science plan has been prepared
- 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 geological formations

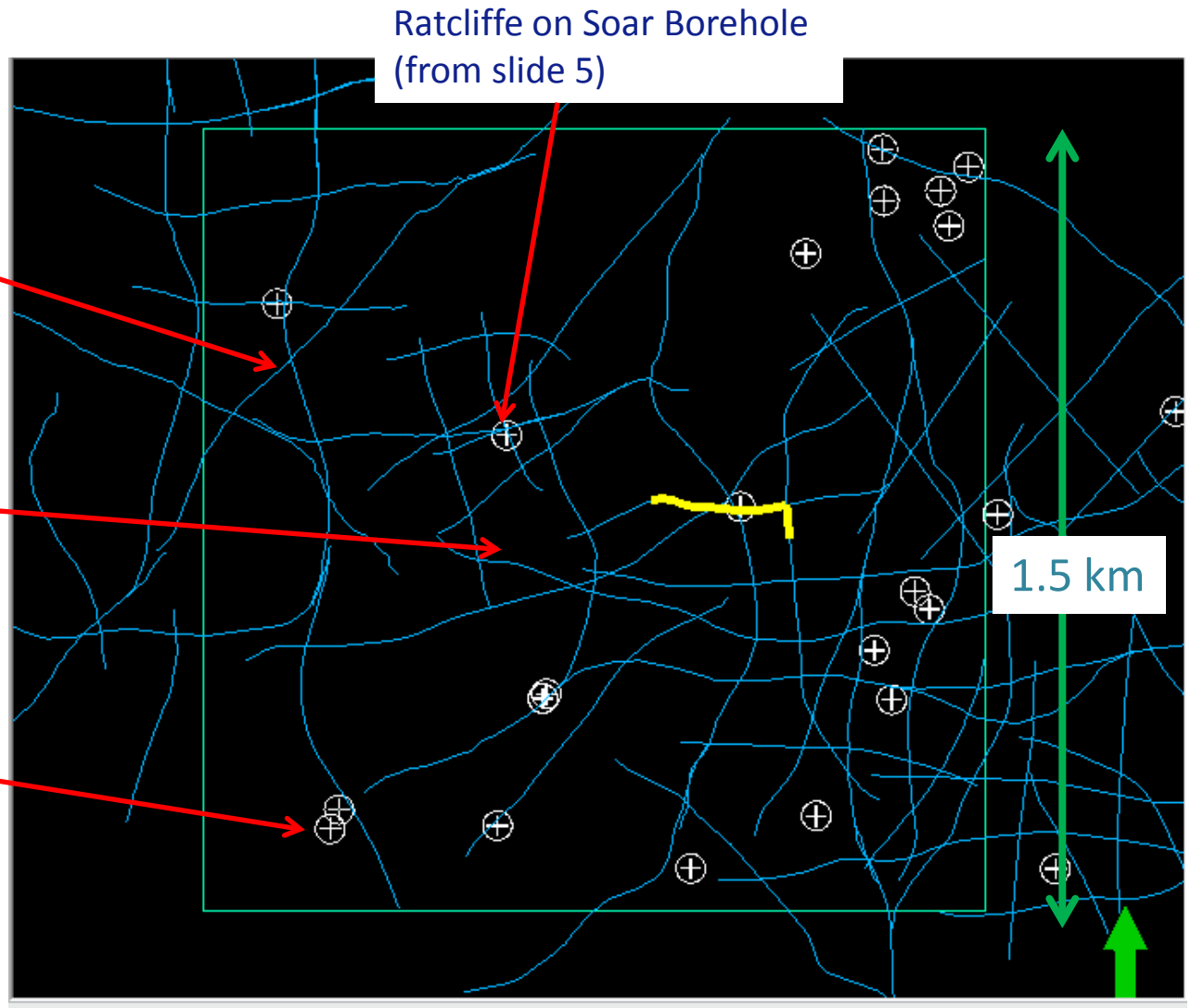
Mercia Mudstone Group – a major caprock in the North Sea for oil and gas fields and potential seal for CO_2 storage sites

Sherwood Sandstone Group – largely equivalent to the offshore Bunter Sandstone Group, a potential CO_2 storage reservoir rock



Ratcliffe-on-Soar 1 – nearby legacy well

Interpretation of legacy seismic and well data (1)



Thanks to Tim Pharaoh

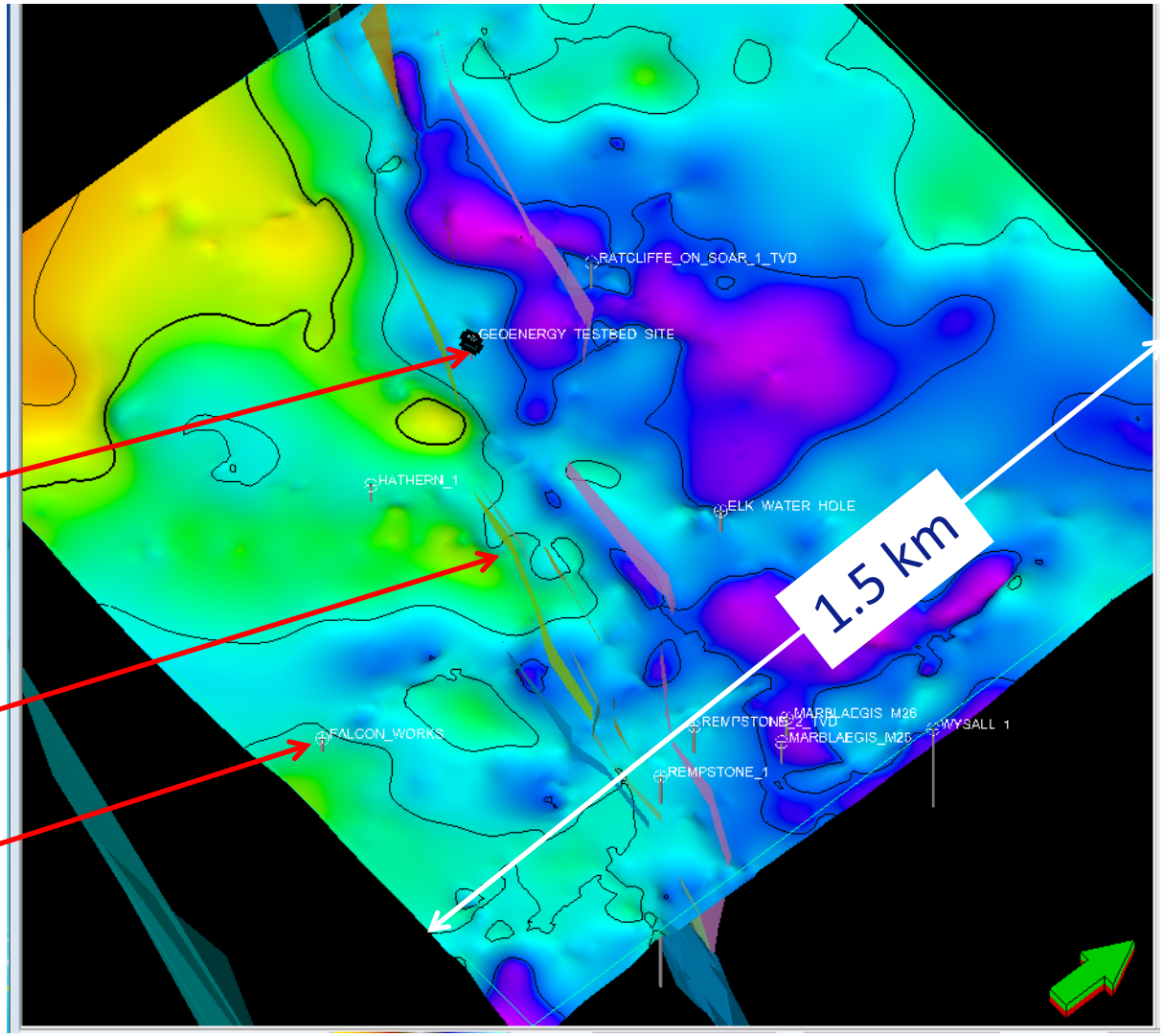
Interpretation of legacy seismic and wells (2)

Top of Sherwood Sandstone Group (time plot from seismic interpretation)

GTB

Major fault planes

Legacy wells shown in grey/white



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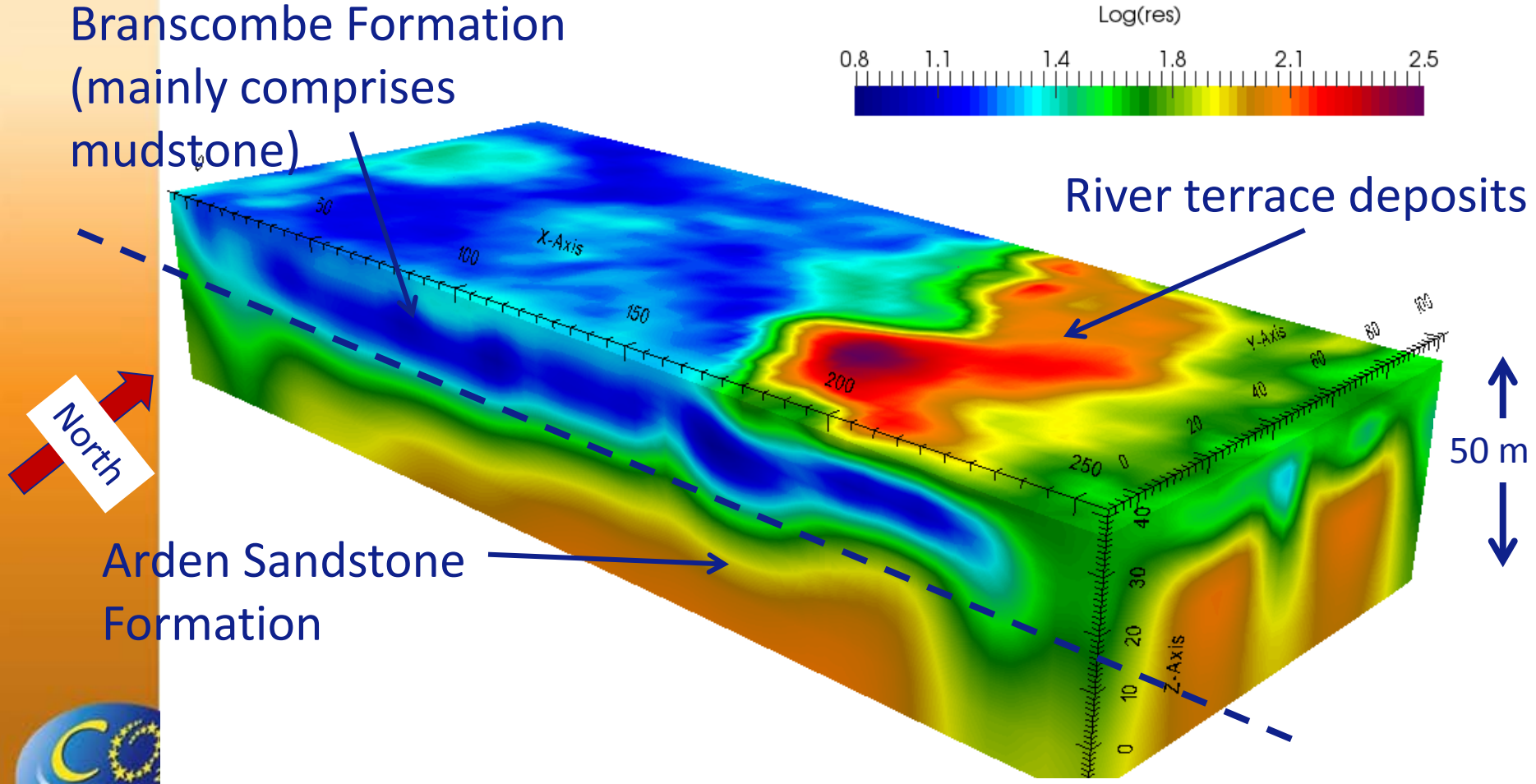
Electrical Resistive Tomography survey

Thanks to Jon Chambers

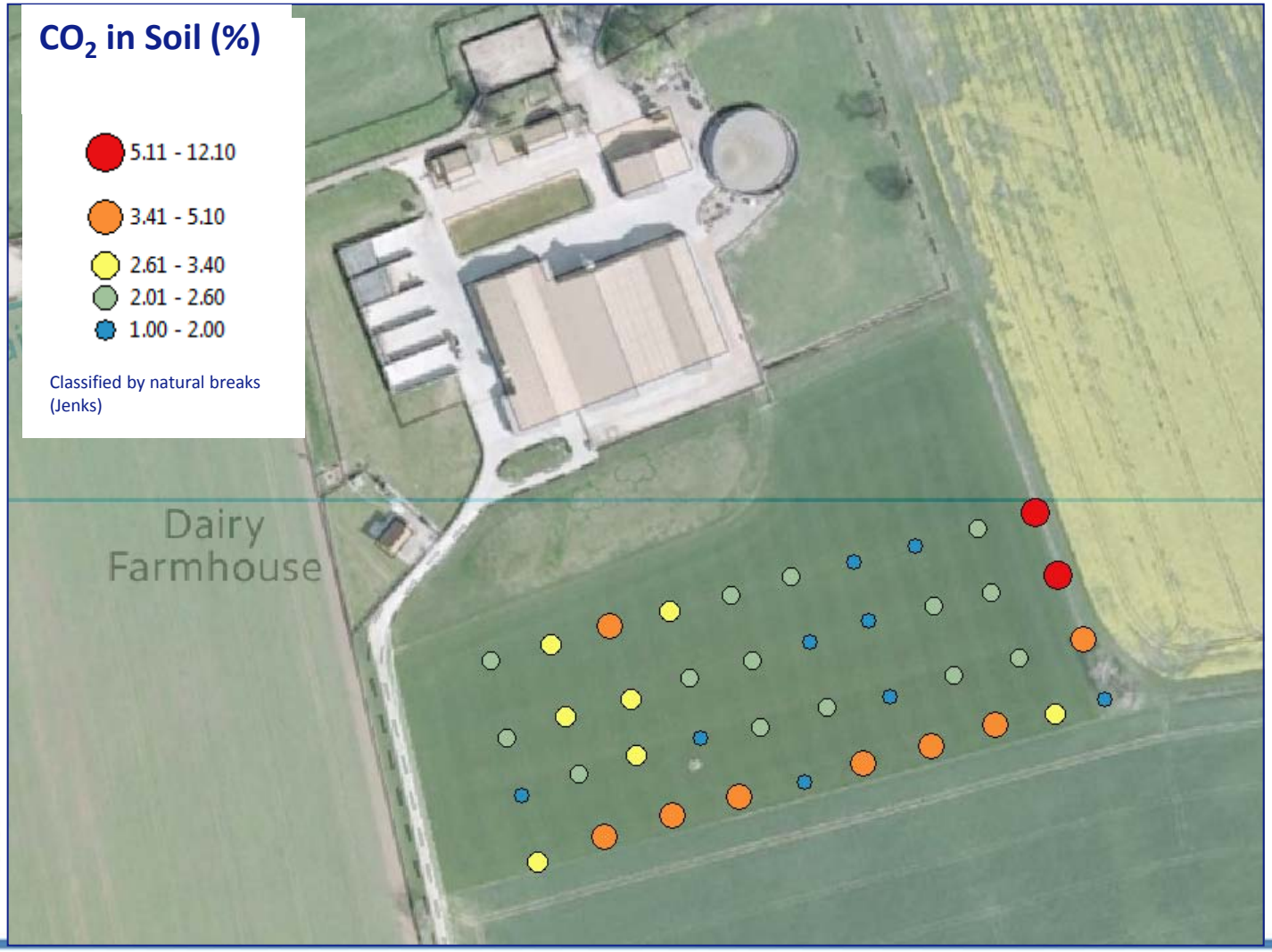
Electro-Resistive Tomography (ERT) model



Gentle regional dip of formations to north-east. However, locally, Arden Sst. may dip to the east – need more data

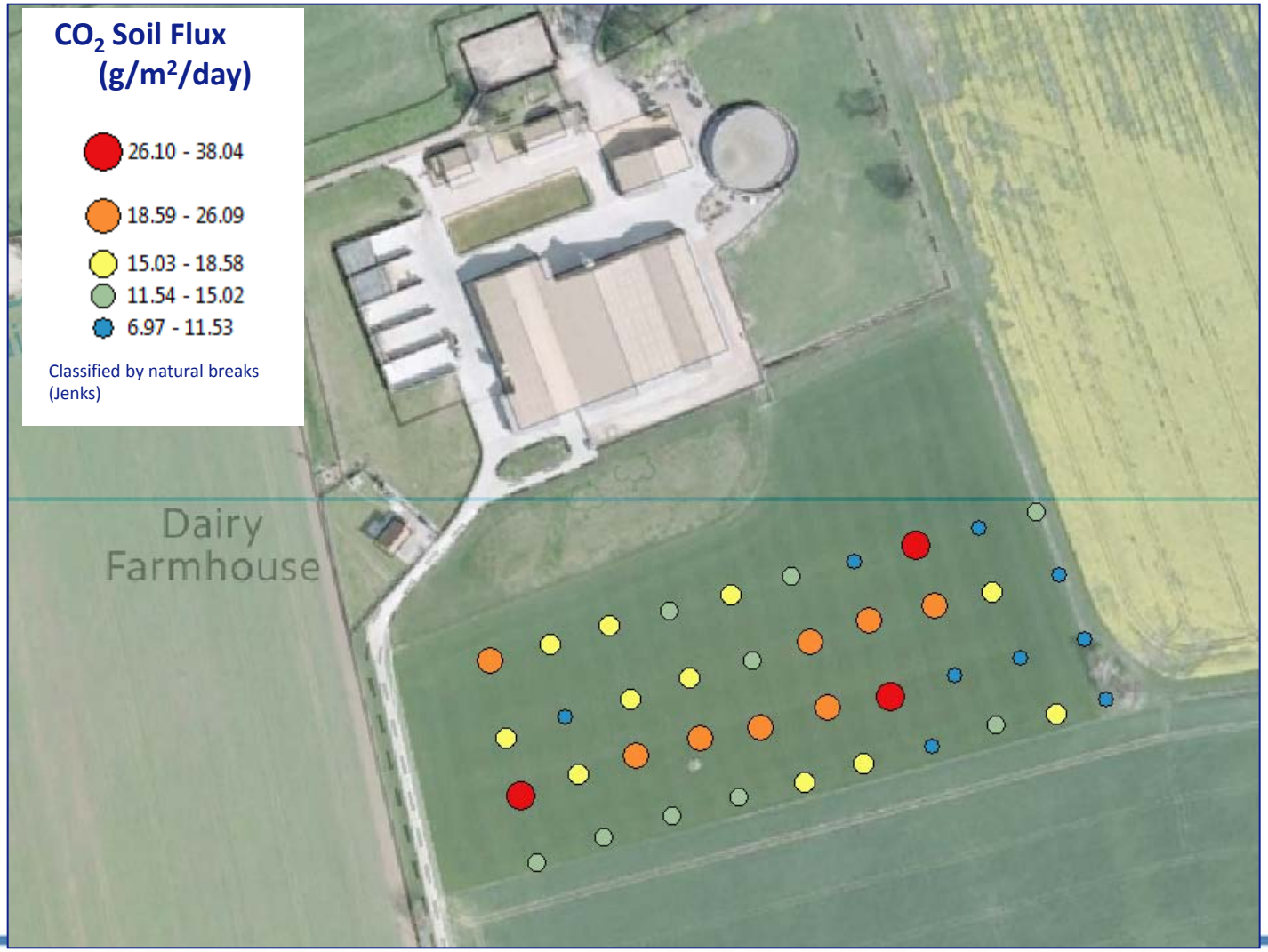
Thanks to Jon Chambers and Paul Wilkinson

Soil gas survey – CO_2 in Soil (%)



Thanks to Dave Jones

Soil gas survey - CO_2 Soil Flux ($g/m^2/day$)



Thanks to Dave Jones

Draft Science Plan (1)

- When site characterisation is complete, will apply for permit to inject small amount of food grade CO_2
- Baseline data are critical (both surface and subsurface)
  - Baseline: gravity, soil gas, electrical resistance, seismic, microseismicity
- Site will be monitored continually (surface and subsurface)
  - Soil gas, pressure, temperature, microseismicity
- Repeat surveys
  - Downhole fluids, ERT
- New (including low TRL) MMV to be tested (including downhole if site integrity can be guaranteed)
- Science plan is draft and subject to change – permits not yet in place and new science ideas to be included

Draft Science Plan (2)

- Experiment 1: Laboratory testing of cores
  - Mineralogy (reservoir and seal)
  - Geochemistry (top and bottom of reservoir, seal)
  - Geomechanical testing (seal)

Draft Science Plan (3)

- Experiment 2: Indicator aquifer
  - Injection of food grade CO_2 (with medical grade tracer) into deeper aquifer
  - Monitor impacts in shallow aquifer; pressure, temperature (time and spatial impacts) subject to permitting
  - What is the minimum amount of CO_2 new MMV can detect in subsurface?
  - How do we upscale and include in reservoir model?

Draft Science Plan (4)

- Experiment 3: Migration in fractured media
  - Injection of CO_2 into shallow aquifer (with medical-grade tracer)
  - Do preferential pathways develop?
  - What is the expression of leakage at the surface (temporal and spatial)
  - What is the minimum amount of CO_2 new MMV can detect in subsurface and at surface?
  - How do we upscale learning to larger fractured media?

Draft Science Plan (5)

- Experiment 4: Migration in deeper aquifer
  - Has the CO_2 injected in experiment 1 migrated significantly? (Formations have minimal dip)
  - Injection of additional CO_2 into deep aquifer (with medical-grade tracer)?
  - How effective is water injection in moving CO_2 away from the well, can we use this as a remediation technique?
  - How do we upscale and include in reservoir model?

Draft Science Plan (6)

- Experiment 5: Longer term reactions
  - What interactions can we observe over the lifetime of the GTB?
    - Cement, reservoir, seal
  - Funding tbc

Science Programme

- Opportunities for collaboration
- Science programme is flexible
- Suggestions for scientific collaboration at the site welcome (cvi@bgs.ac.uk)
- How to maximise scientific value of the site through suggested collaboration opportunities will be considered by Science Panel (led by Ceri Vincent) and GERC Directors

Thank you for your time