

# Cheshire Energy Research Facility Site (CERFS): A new experimental observatory location for geoscience energy research.

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### **CERFS** science objectives

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- to reduce subsurface uncertainty to encourage new low-carbon energy technologies including CO<sub>2</sub> storage, shallow geothermal and aquifer storage of heat and compressed air
- investigate the effects of subsurface heterogeneity on fluid flow
- Investigate controls on connectivity of sandstone aquifers at different scales
  - Faults & fractures

**UK GEOENERGY** 

**OBSERVATORIES** 

- pore filling cements,
- changes in depositional facies
- Online realtime monitoring of
- seismicity, ground resistivity, and groundwater





### **Cheshire Energy Research Facility Site**



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#### Structural & stratigraphic model



## **CERFS** Borehole Locations



#### UK GEOENERGY OBSERVATORIES Seismic array : Real-time measurements of ground motions



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- The aim of the array is deliver seismicity baseline data
  - provide a seismic monitoring network to understanding of seismic activity around CERFS
  - □ Baseline data against which future seismic activity will be compared
  - □ One of the highest resolution seismic monitoring arrays in the world.
  - Aims to detect earthquakes of -0.6 to -1.0 magnitude this type of quake is 1000 times smaller than a quake someone is likely to feel.
  - □ Measuring seismicity across all parts of the horst block and graben systems
  - □ Well placed to monitor seismicity on and offshore UK

#### UK GEOENERGY OBSERVATORIES



#### **Description of Seismic monitoring array**

- 10 seismometers installed in boreholes
  - □ 3 at 300 m deep
  - 7 at 200 m deep
- Guralp Radian borehole seismometers
- 3-component (orientation measured by internal magnetometer).
- □ Automatically corrects for even large tilts.
- $\Box$  Broadband (120 seconds to > 200Hz).
- Acceleration output improves performance at high frequencies.
- □ 140 dB dynamic range.
- □ Integral digitiser sampling at 500 Hz

### **New monitoring Technology**

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- Several seismic boreholes will have optical fibre installed behind the casing.
- When connected to a suitable sensor can perform as a string of geophones.
- A laser sends short pulses, which return with a phase shift proportional to the change in strain.
- Technology is currently generating much interest with several important questions unanswered.





# Multi-scale array through the Permo-Triassic succession and into the underlying faulted contact with the Carboniferous





#### **Dungeon Banks Fault Array**

#### **Science Objectives:**

- □ Variation in fault characteristics with depth
- □ Role of faults as a barriers/ pathways to fluid migration
- Potential for movement on fault structures in response to subsurface activities





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#### Design of Dungeon Banks Array (3 x 600m BH across DB fault at 50m or 25m spacing) structures



The 600m boreholes are designed, based on the North Dee 3D seismic interpretation, to intersect the DB fault from 250-550m depth, to support investigation of controls on fluid flow in the vicinity of the fault



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### Thermal/ Tomography Array

Science Objectives:

- Cross-borehole and surface-borehole 2D and 3D geoelectrical im aging
- Advanced hydraulic experimentation with 4D hydrogeophysical monitoring.
- Time-lapse imaging of natural and induced fluid processes in the near surface
- □ Effect of heat addition and removal on subsurface environmenttherm alresponse test well (illustrated)





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# 1 Aim : Static parameterised 3D model

