

OR/19/052 Appendix 3d - Array 4 Borehole descriptions

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Kingdon, A, Fellgett, M W, and Spence, M J. 2019. UKGEOS Cheshire Energy Research Field Site - Science infrastructure. *British Geological Survey Internal Report*, OR/19/052. *Contributors*: Midgley, J, Elsome, J W, Dearden, R A, Chapman, C, Burke, S P, Hough, E, Luckett, R R, and Bianchi, M.

Table 13 Array 4 Summary borehole metadata and planned sampling.

Array 4: Multi-scale array	Description
Scientific Objective:	Multi-scale experimental site for quantification of groundwater properties and geological characterisation of the Permo-Trias succession. This will include: identifying the location of the intersection of the Dungeon Bank Fault and the Role of faults as a barriers/pathways to fluid/gas migration
No of Sites	1
Expected Lithostratigraphy at TD	Quaternary/Triassic Sherwood Sandstone Group (SSG) for 50 m boreholes, SSG for 100 m boreholes, Upper Carboniferous (Warwickshire Group or Pennine Upper Coal Measures Group) for 600 m boreholes
Boreholes per site	8 x 50 m, 12 x 100 m, 3 x 600 m
Casing Installed	Steel casing installed in top section of 600 m boreholes
Expected end use	Multi-scale experimental site
Samples available during drilling	Drill cuttings collected sporadically
Cored Boreholes	1 x 600 m 3 x 100 m
Geophysical logs: Run 1	1 x 600 m well: near-oilfield log suite (Density-neutron-spectral-gamma, P&S wave sonic, resistivity, SP), 2 x 600 m well : gamma ray-caliper (borehole diameter)
Borehole Imaging: Run 1	Medium-high resolution resistivity logging in core 600 m well or acoustic imaging in 1 x 600 m boreholes
Geophysical logs: Run 2	1 x 600 m well: near-oilfield log suite (Density-neutron-spectral-gamma, P&S wave sonic, resistivity, SP), 2 x 600 m well : gamma ray-caliper (borehole diameter) + casing inspection tools (Cement bond log + ultrasonic imager)
Borehole Imaging: Run 2	Medium-high resolution resistivity logging in core 600 m well or acoustic imaging in 1 x 600 m boreholes
Drilling parameters	Potentially recording of drilling parameters
Geomicrobiology sampling	Standard geomicrobiology sampling protocol: 1 sample per 10 m of core in cored boreholes
Gas testing during drilling	None Planned
Fluid testing during drilling	None Planned
Fluid Testing Post Drilling	Baseline conditions & after pressure injection experiments
Pump Testing	Multiple cycles planned for experimental array, details to be confirmed
Permanently installed equipment	Cross-borehole and surface-borehole 2D and 3D geoelectrical imaging (electric resistivity tomography) array; Time-lapse imaging of fluid processes in the near surface including natural and induced changes

Components of array 4

The multi-scale array will enable hydrogeological and hydrogeophysical characterisation of the rock

mass from surface to experimental borehole depth. It will allow subsequent investigation of hydraulic, geophysical and geochemical processes at multiple scales (space and time), particularly in response to changes induced by controlled experiments.

Whilst drilling will be completed in Array 4 during the delivery phase of CERFS, this array is intended to continue to operate for an extended period allowing multiple future opportunities for the hydrogeology to be characterised by repeated hydrogeochemical and geophysical sampling.

Data acquisition in array 4

Data, primarily wireline and core data, will be collected through the drilling and construction process. Electrical Resistivity Tomography (ERT) sensor cables as well as DAS/DTS fibre optic cables will be installed down the back of the casing. The metal casing will require electrical isolation from the lithology. The purpose of the fibre optic cables will be to obtain high resolution temperature data to help calibrate ERT electrical imaging data.

The well will be completed to allow future installation of various downhole probes, including but not limited to seismic, pressure and temperature sensors. Screened casing sections may be incorporated to provide hydraulic access to permeable geological units for future hydrogeological and hydrogeophysical experimentation.

Table 14 Array 4 List of borehole codes and site locations (Cored boreholes in Bold).

Location	50 m	100 m	Up to 600 m	Cored
Site A			TH0401	
Site A			TH0402	
Site A			TH0403	Yes
Site A		TH0404		
Site A		TH0405		Yes
Site A		TH0406		
Site A		TH0407		
Site A		TH0408		
Site A		TH0409		
Site A		TH0410		
Site A		TH0411		
Site A		TH0412		Yes
Site A		TH0413		
Site A		TH0414		
Site A		TH0415		Yes
Site A	TH0416			
Site A	TH0417			
Site A	TH0418			
Site A	TH0419			
Site A	TH0420			
Site A	TH0421			
Site A	TH0422			
Site A	TH0423			

Repeated water sampling and pump testing is intended for Array 4 into the future but precise protocols are yet to be defined so sampling opportunities of these materials cannot be provided at this time.

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