Infrastructure Factsheet

Description of the infrastructure		
Name(s) of the infrastructure(s)*:	**TA3.1 BGS TRANSPORT PROPERTIES RESEARCH LABORATORY (TPRL)**	
Location (town, country):	Keyworth, Nottingham, UK	
Website:	www.bgs.ac.uk	
Legal name of organisation operating the infrastructure:		Natural Environment Research Council (NERC) as represented by the British Geological Survey
Location of organisation (town, country):	Keyworth, Nottingham, UK	
Infrastructure Contact (name, email)	Caroline Graham caro5@bgs.ac.uk	
RICC Contact (name, email)	Keith Bateman kba@bgs.ac.uk	

**Infrastructure (s): means a facility, a resource (or a coherent set of them) together with the related services that are used by the scientific community to conduct research.*
***Installation: means a part of an infrastructure that could be used independently from the rest.*

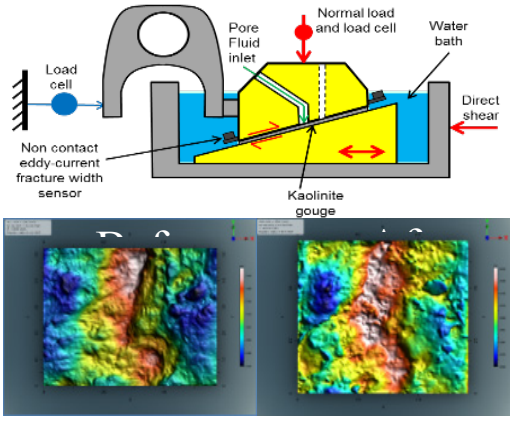
Description of the facilities

Brief general description of the infrastructure to which access is offered highlighting its state-of-the-art equipment and services offered to users that make it rare or unique in Europe. Outline the areas of research normally supported by the infrastructure, as well as any possible new areas opening to users. If the infrastructure is composed of several installations**, are these described here including their specific features. If parts of the infrastructure are still under construction, the description includes the starting date of construction and indicative date when access can realistically be made available.

TA3.1 BGS TRANSPORT PROPERTIES RESEARCH LABORATORY (TPRL)

Purpose and brief technical description, including figures as appropriate

Focus is on multi-phase flow in natural and engineered, low and ultra-low permeability geomaterials (e.g. caprocks, well bore cements, halite and engineered clays), and their associated deformation behaviour. Measurements include: saturation and consolidation properties; intrinsic permeability (or transmissivity); anisotropy; specific storage; coupled flow parameters (e.g. osmotic permeability); capillary entry, breakthrough and threshold pressures; gas permeability function; drained and undrained compressibilities; and rheological (creep) properties. Laboratory experiments are performed under simulated in situ conditions (stress, pore pressure, temperature and chemical environment). Three key areas explored are: (i) baseline characterisation of hydromechanical properties, (ii) influence of stress path and stress history on transport properties and (iii) transmissivity of fractures, faults and discontinuities (e.g., wellbore interfaces). Tests are designed to provide quantitative data for mathematical modelling of ultra-low permeability materials, together with process understanding of key transport mechanisms. Key equipment includes: high pressure isotropic permeameters (70 MPa); constant volume permeameters (70 MPa); high pressure triaxial permeameter (70 MPa); heavy-duty, high-precision shear-rigs; high temperature, high pressure geochemical flow reactor (130 MPa at 140°C); and novel tracer systems (nano particle injection or radiological tagging of gas) to characterise and identify potential migration pathways.



State of the Art, uniqueness (if applicable), and any specific advantages (e.g. technical, economic etc.)

The TPRL is one of the leading centres in Europe for the study of fluid movement in ultra-low permeability media. The facility is well known within the radioactive waste disposal and carbon capture and storage sectors for high quality experimental work and process-based interpretation. Unique BGS-manufactured equipment and experimental systems provide high-resolution and high accuracy data. Physical properties are routinely examined in ultra-low permeability materials (~$1x10^{-22}$ m^2 and lower). Capability in deformation and fluid flow relevant to CCS consists of a blend of standard and bespoke equipment with more than 15 experimental rigs. These allow stress states and temperature to be simulated across expected *in situ* reservoir conditions. Tests can be conducted with pure water, brine, helium, carbon dioxide (gaseous, liquid, super critical and saturated solution) and nitrogen. Data is collected using a state-of-the-art National Instrument logging system and tests can be monitored and operated by remote control online.

Scientific environment (related and potentially available scientific and technical services at RI's location e.g. analysis, material preparation etc.)

The TPRL has a long track-record of involvement in many national (NERC, EPSRC, government) and international collaborative projects, working with academics and operators across Europe, Canada and Asia (including RWML, SKB, Nagra, Andra, JAEA, NWMO, COVRA; Shell, Statoil, KPN, BP etc.). The laboratory operators have a wide-reaching scientific impact, coordinating large-scale projects and publishing widely as a result. Complimentary services available to the laboratory include sample preparation, geotechnical characterisation, thin section preparation and petrological/microstructural analysis.

CCS PROJECTS:

EU-funded CCS projects:

ULTimateCO2, CO2GeoNet, NF-Pro, CASTOR

Other CCS projects:

BigCCS, CO2Store, Green River Drilling Project, EPSRC CONTAIN

Main/major non-CCS projects:

FORGE (Fate of Repository Gas Emissions), MEGAS, PROGRESS, OPERA, EPSRC IMAGES, EPSRC SAFE BARRIERS, CEBAMA, M4-Shale Gas, BGS Onshore Carboniferous Consortia, Gaz du Transfer

Patents:

Selected publications:

- Cuss, R.J., Milodowski, A. & Harrington, J.F., 2011. Fracture transmissivity as a function of normal and shear stress: First results in Opalinus Clay, Physics and Chemistry of the Earth, 36, 1960-1971.
- Cuss, R.J., Harrington, J.F., Graham, C.C., and Noy, D.J. (2014) Observations of Pore Pressure in Clay-rich Materials; Implications for the Concept of Effective Stress Applied to Unconventional Hydrocarbons. European Geosciences Union General Assembly 2014, EGU Division Energy, Resources & the Environment (ERE). Energy Procedia, 59, pp.59-66; doi:10.1016/j.egypro.2014.10.349
- Cuss, R.J., Harrington, J.F., Noy, D.J., Graham, C.C., and Sellin, P. (In review) Evidence of localised gas propagation pathways in a field-scale bentonite engineered barrier system; results from three gas injection tests in the Large scale gas injection test (Lasgit). Applied Clay Science, 102, pp.81-92, doi:10.1016/j.clay.2014.10.014
- Cuss, R.J., Harrington, J.F., Sathar, S., and Norris, S. (2015) An experimental study of the flow of gas along faults of varying orientation to the stress-field; Implications for performance assessment of radioactive waste disposal. Journal of Geophysical Research – Solid Earth. 120, pp.3932-3945, doi:10.1002/2014JB011333
- Graham, C.C., Harrington, J.F., Cuss, R.J., and Sellin, P. (2014). Pore-pressure cycling experiments on

Mx80 bentonite. In: Norris, S., Bruno, J., Cathelineau, M., Delage, P., Fairhurst, C., Gaucher, E. C., Höhn, E. H., Kalinichev, A., Lalieux, P. & Sellin, P. (eds) Clays in Natural and Engineered Barriers for Radioactive Waste Confinement. Geological Society, London, Special Publications, 400, doi: 10.1144/SP400.32.

- Harrington, J.F. & Horseman, S.T., 1999. Gas transport properties of clays and mudrocks. In: Muds And Mudstones: Physical And Fluid Flow Properties (eds A.C.Aplin, A.J. Fleet, and J.H.S. Macquaker), Geological Society of London, Special Publication No. 158, 107–124.
- Harrington, J.F., Noy, D.J., Horseman, S.T., Birchall, J.D. and Chadwick, R.A. (2009). Laboratory study of gas and water flow in the Nordland Shale, Sleipner, North Sea. in M. Grobe, J. C. Pashin, and R. L. Dodge, eds., Carbon dioxide sequestration in geological media—State of the science: AAPG Studies in Geology 59, p. 521– 543.

FACILITY AVAILABILITY:

Unit of access:

Month

Availability per year:

Min 1 month

Expected duration of single experiment:

1 month minimum

OPERATIONAL OR OTHER CONSTRAINTS:

Specific risks:

All risks associated with operating laboratory equipment are covered in the TPRL working protocols and associated risk assessments which are provided to laboratory users.

Legal issues: