Research Support Office

Radioactive Waste Management

RSO Discipline Update: Underground Engineering

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Introduction

Daniel Garbutt, Senior Engineering Manager RWM

- CEng MICE MIEAust CPEng NER FGS
- Tunnelling and Underground Space SME
- Engineering Digital Lead
- Responsible for Underground Engineering of the GDF at RWM
- Responsible for establishing and enabling the Digital Twin approach for the GDF
- NDA Innovation Council Member for RWM
- Delivery Leadership Board Member for NDA at i3P

Becky Lunn, Professor of Civil Engineering, University of Strathclyde

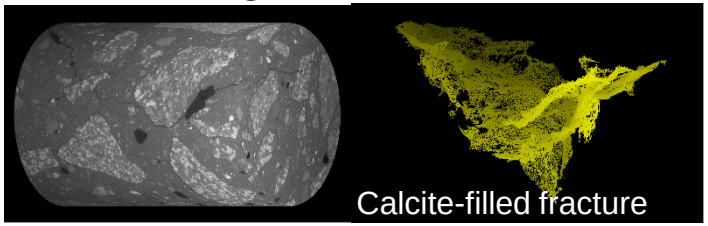
- Member of the RAEng working group on Net Zero Carbon
- Previous 7-year membership of the Committee on Radioactive Waste Disposal

What do I do in nuclear research?

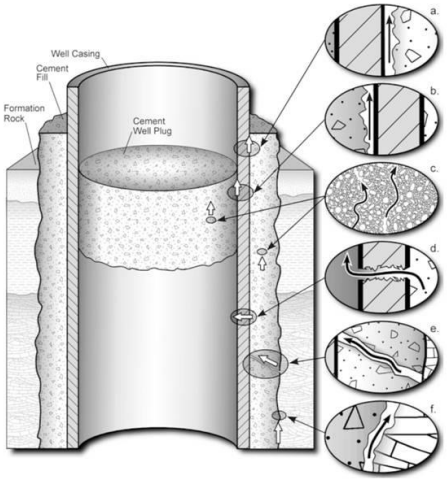
Research Support Office

Subsurface Engineering

Biomineral grout:

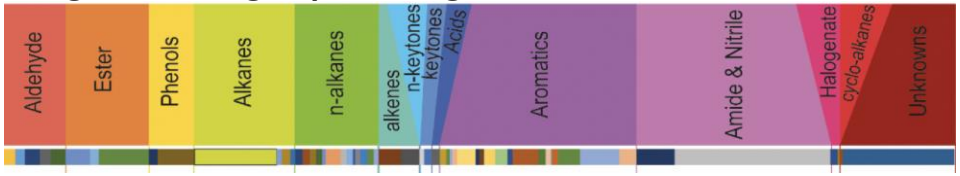


Colloidal silica grout:



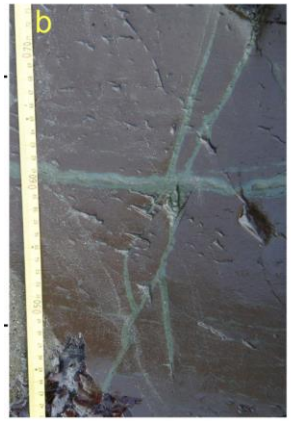
Understanding hydro-mechanical interactions at a 'regional' scale

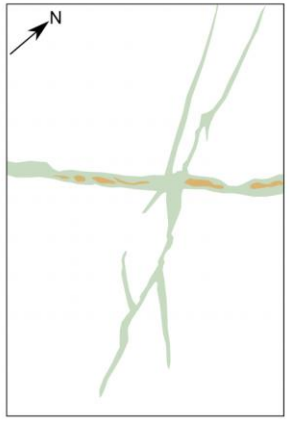
Organic fingerprinting as:



Passive microseismic monitoring as a site investigation tool:

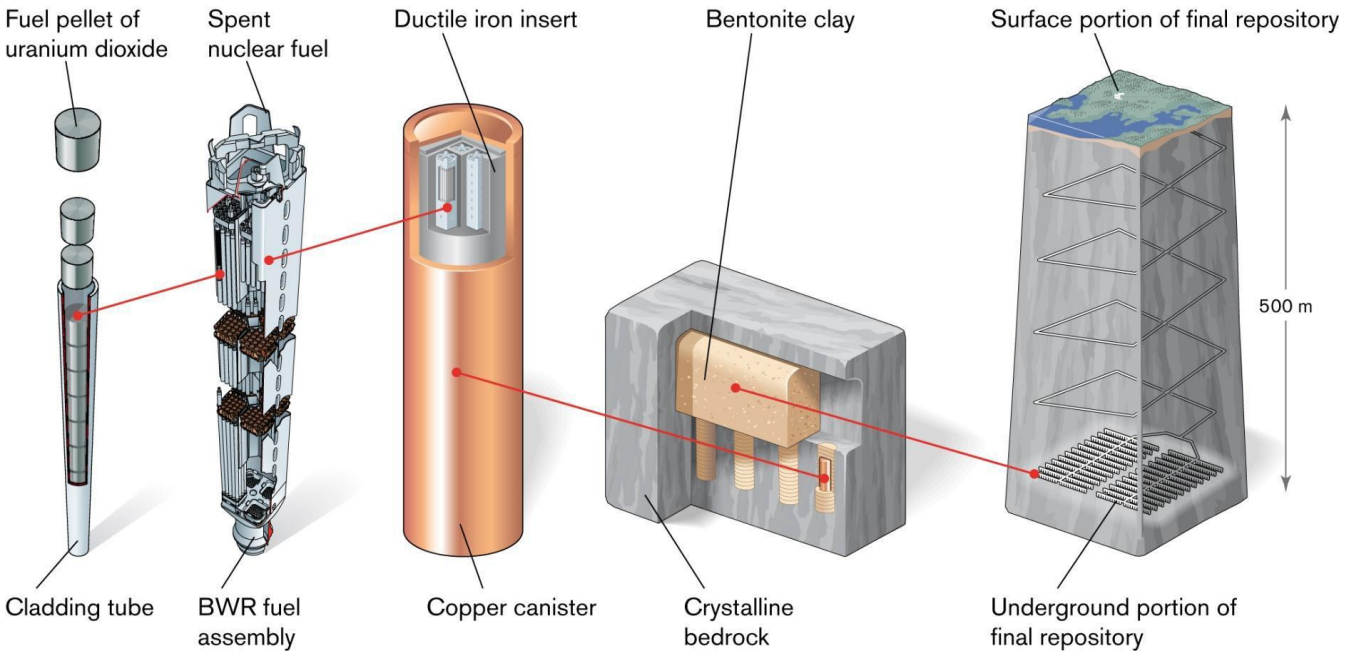
Faults and fluid flow:





The importance of host rock

Hard Rock: Example - Swedish environmental safety concept



- *Safety case is complex relies on engineered barriers remaining in place – radionuclides stay in the repository*
- *Engineering construction and operation simpler in high strength rock*

The importance of host rock

Clay: French/Swiss Environmental Safety Concepts

- Barrier is mainly provided by the clay geology – diffusion-dominated transport, high sorption capacity
- Fractures heal – clay is ‘plastic’
- Construction may require support

(concrete/steel)

Before being emplaced in disposal cells, HL radioactive-waste packages are conditioned in disposal containers.

The importance of host rock

UK Low Strength Sedimentary Rocks are clay 'ROCKS':

- Not plastic – so will contain open fractures for flow
- Not as thick bedded as European sites
- May be inter-bedded with other sediments and salt

Will require a new 'hybrid' generic environmental safety case

- Sorption capacity is high
- Rock is fractured
- Strength for construction is low but not plastic
- *How will engineered barrier materials perform in clay?*

Challenges for subsurface engineering

- Construction and >100 years operation in LSSR
  - Understanding the geotechnical characteristics of a potential LSSR
  - Understanding its hydro-mechanical behaviour
- Generic design concept for the environmental safety case still being developed
  - Construction materials must be cognizant of the environmental safety case
- Monitoring of subsurface infrastructure over long timescales
  - Wireless sensing and smart materials
- **Net-zero construction in a circular economy**

Current Activity

New Discipline formed – 1 month in for me – 1 year in for Dan!

- RWM is developing its geotechnical data baseline and aligning research projects and design to UK specific geologies.
- Developing Digital Twin and Asset Management strategies
- Early stage thinking around sensing required to monitor, operate and maintain the GDF

Upcoming opportunities

PhD Projects Autumn 2021 call for Autumn 2022 Start:

- Two PhD projects on New Materials Assessment for Underground Space in a GDF.

Opportunities in the LSSR Topic Area