



VTT

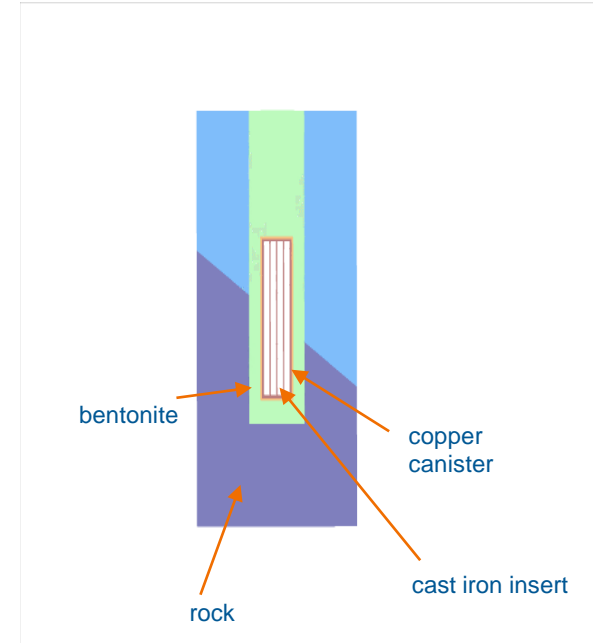
BROCTIO & HITEC: Bentonite Mechanics

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23/05/2022 VTT – beyond the obvious

Objectives

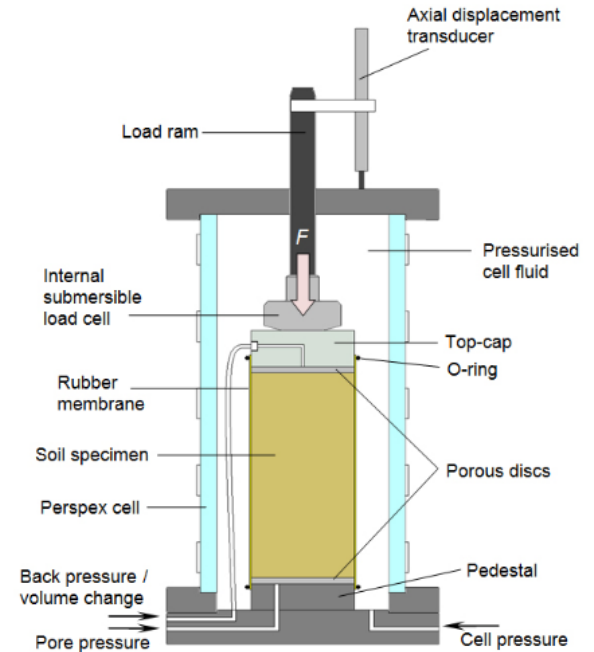
- Fix the shortage in bentonite mechanical models
- Rock movement
 - **Method** to examine bentonite mechanical properties' dependency on deformation rate
 - **Experimental data** on bentonite elastoplastic behaviour in altering deformation rates
 - **Constitutive model** for bentonite elastoplastic dependency on deformation rate
- Geochemistry
 - **Experimental data** on bentonite elastoplastic behaviour in altering chemical conditions
 - **Constitutive model** for bentonite elastoplastic dependency on chemistry



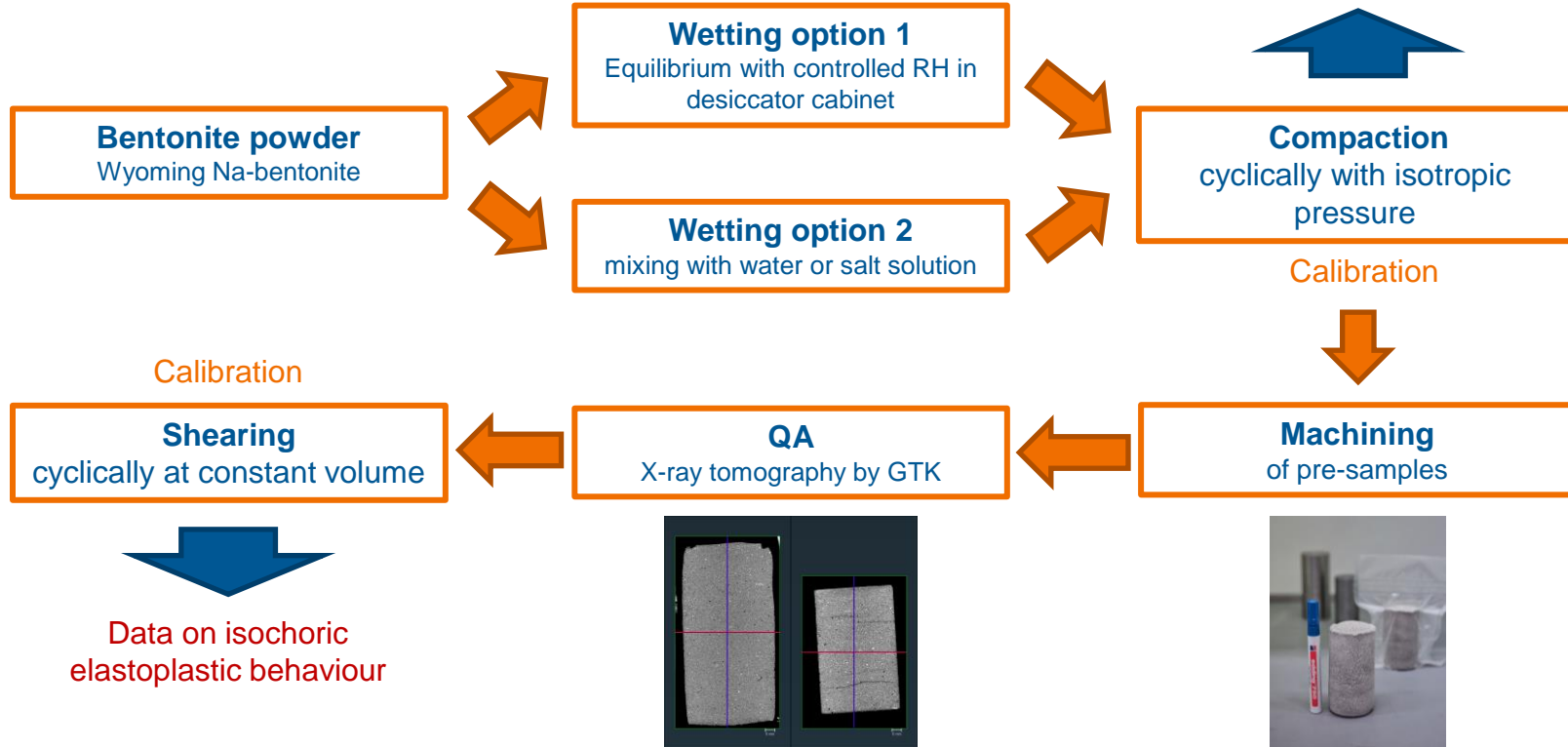
Implementation

- BROCTIO: experiments in various
 - Strain rates
 - Water contents
 - Chemical conditions
 - Results to constitutive models

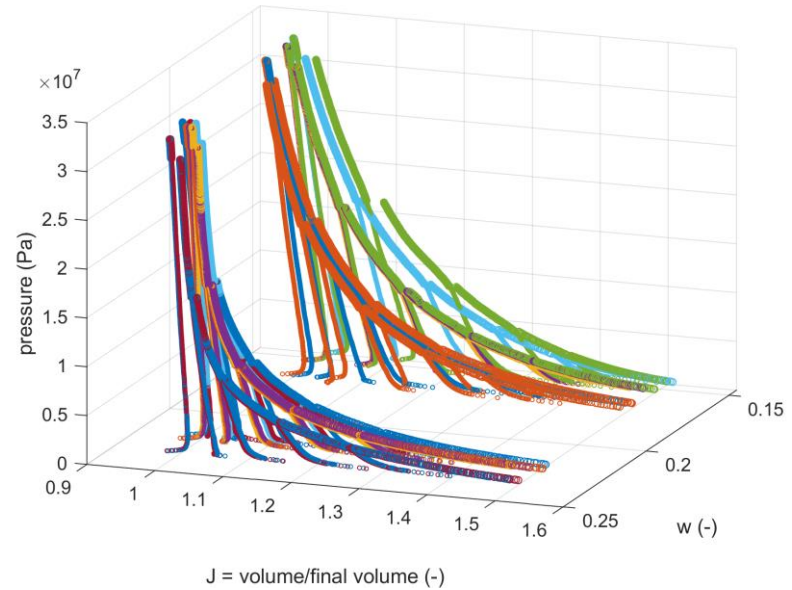
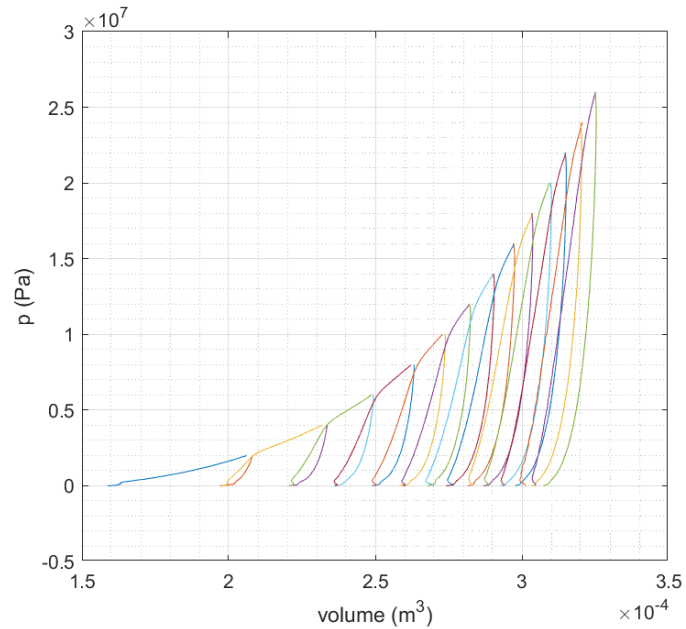
- HITEC: experiments in high temperature
 - Heat treated bentonite
 - Mechanical testing in elevated temperature
 - Results to constitutive models



Experiment process

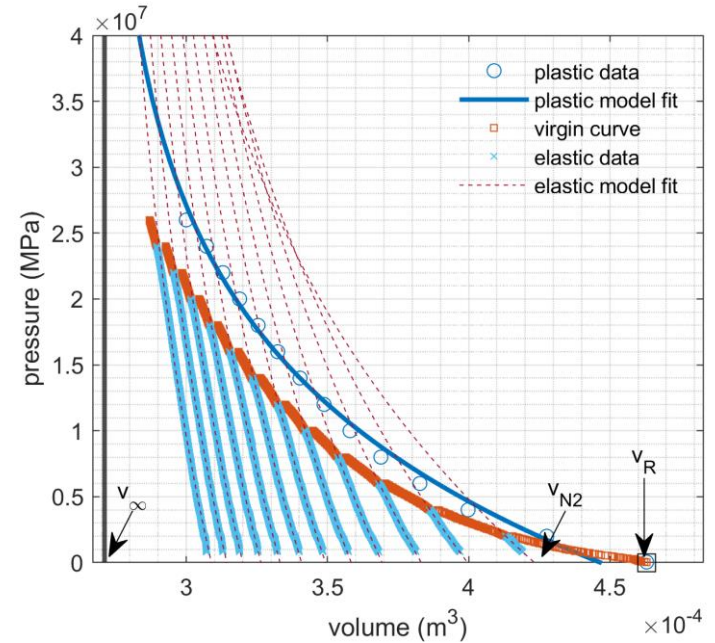


Results



End Users

- Waste management organisations
 - Model development
 - Model calibration
 - Safety and performance assessment
- Regulators
 - Comparing data and models
- Scientific community





VTT

SAFER: Sensitivity Analysis of Disposal Hole Components

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Sensitivity Analysis

Input Parameters

experimentally determined
parameters or functions

water diffusivity

elastic compressibility

chemical composition

hardening law

yield surface

thermal conductivity

etc.

Model for disposal hole
including e.g. bentonite buffer
- wetting
- rock shear displacement

Output Variables

something that we want to
assess

buffer
wetting time

bentonite
density
distribution

copper
canister
deformation

Background

- Long term safety
 - more data on bentonite mechanical behaviour in different conditions is still needed to assess the safety of disposal in varying conditions

- Feasibility
 - ability to use bentonite from different sources (mines) and with different treatment is needed for feasible disposal

- Relative uncertainties of disposal system components (bentonite buffer, canister, bedrock, etc.) have not been assessed

Project steps and objectives

- 1) Screening sensitivity analysis
 - use previous experimental data to estimate which parameters matter for the chosen output variables
 - determine data gaps
- 2) Experiments
 - perform more experiments on the most important parameters found with the screening sensitivity analysis
- 3) Modeling
 - estimate the buffer behaviour such that the uncertainty of the outcome can be quantified
 - estimate the relative uncertainty of disposal hole components

Screening sensitivity analysis

- Model development needed in the beginning
 - Recent experimental findings to VMP model
- Based on parameter fitting to earlier experiments
 - that have been carried out by e.g. VTT, University of Jyväskylä, GTK in previous projects
- Statistical method to set up the sensitivity analysis
 - e.g. Definite Screening Designs
 - three parameter levels: low value, middle value, high value
- Data gap identification

Experiments

- Directed by the screening sensitivity analysis and data gap identification
- Mechanical
 - more data on elastoplastic behaviour in different conditions
 - VTT
- Water transport
 - more data
 - University of Jyväskylä if interested
- Chemical

Modeling

- Model development based on new data
- Sensitivity analysis with continuous input parameter distributions to evaluate the simulation uncertainties with respect to chosen output variables
- Extension of the sensitivity analysis to include other disposal system components, such as disposal canister or bedrock
 - identification of relative uncertainties

Practical matters

- Cooperation with e.g. University of Jyväskylä, GTK, ...
 - to be agreed on
- Estimated annual working months
 - person months: ~16 PM (depends on the budget)
- Estimated duration
 - 3 + 3 years

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the obvious

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