

Canister Retrieval Test, a large scale experiment made at Äpö Hard Rock Laboratory with well-defined hydraulic and mechanical boundaries.

Mechanical Properties of Bentonite Barriers

19 - 20 June 2017

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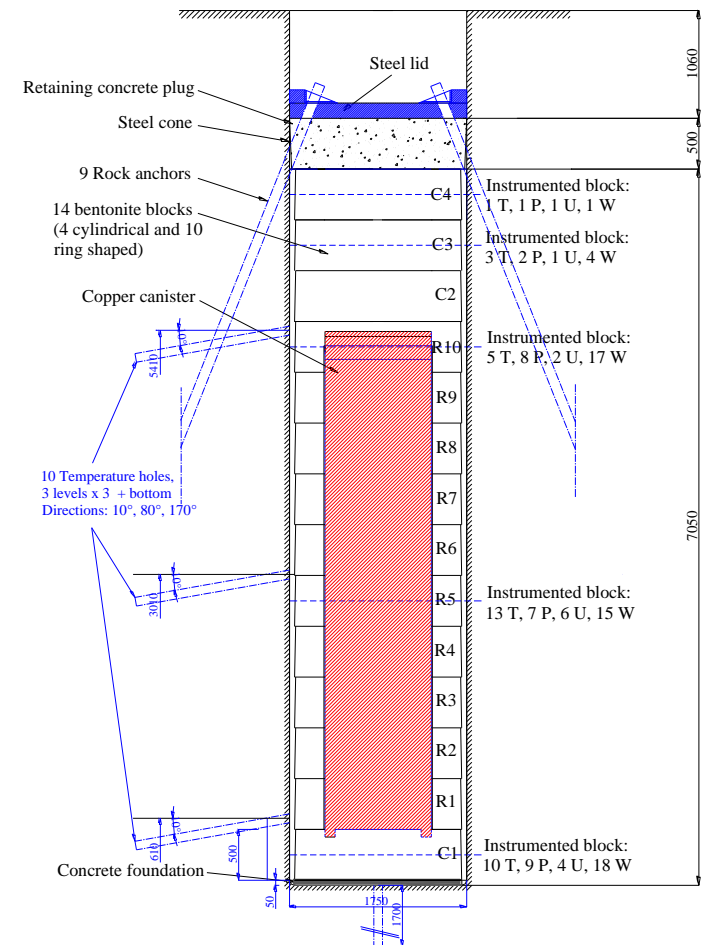


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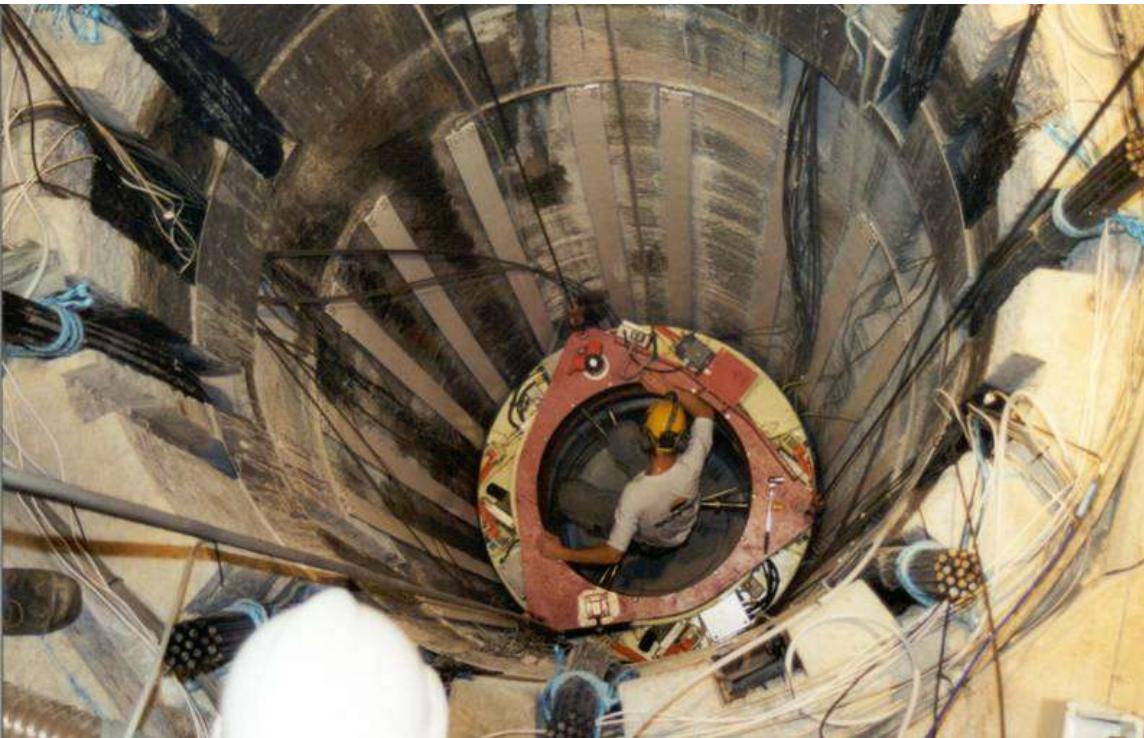
- Background/layout
- Thermal, mechanical and hydraulic boundaries
- Instrumentation and data from the running of the test
- Data from the retrieval of the test
- Modelling of the test
- Summary and conclusions

Background/layout

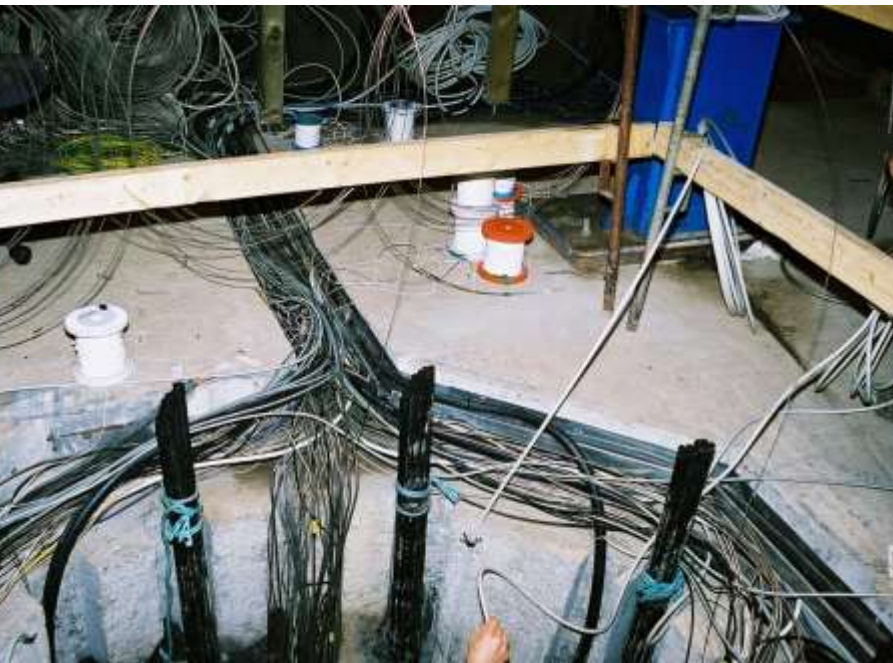
- In accordance with the Swedish KBS3-concept
- Original designed for testing techniques of retrieving canisters
- A full size canister equipped with heaters
- Artificial wetting of the buffer trough filters placed on the wall of the deposition hole
- Instrumentation in five sections of the buffer
- Measurements of the load and the displacement on the plug
- Instrumentation in the surrounding rock



Background/layout

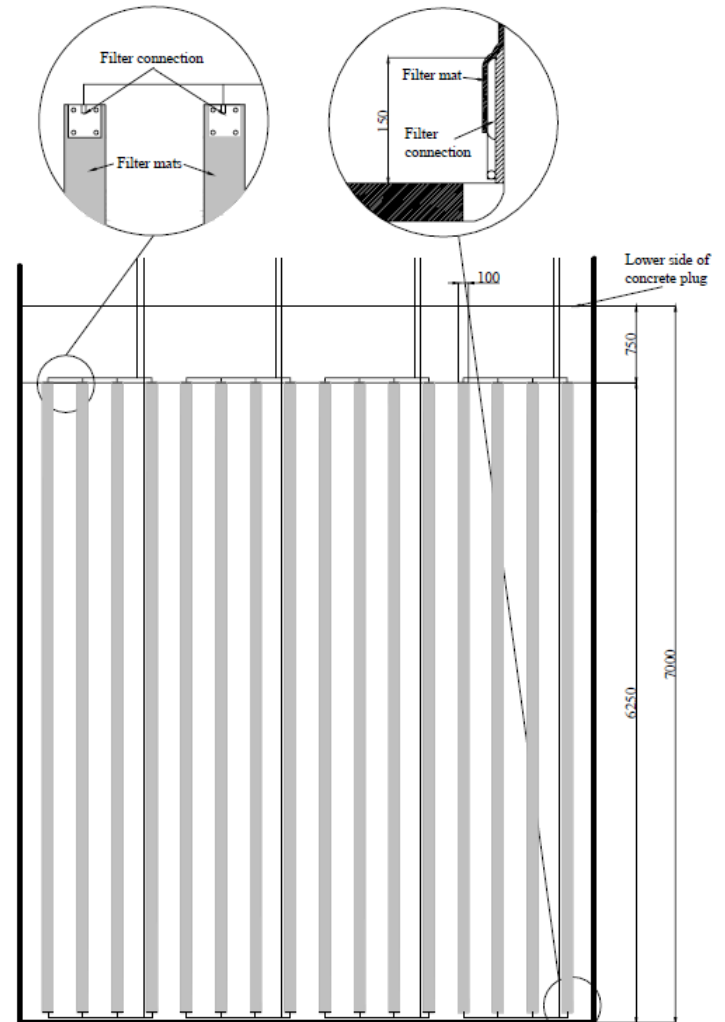


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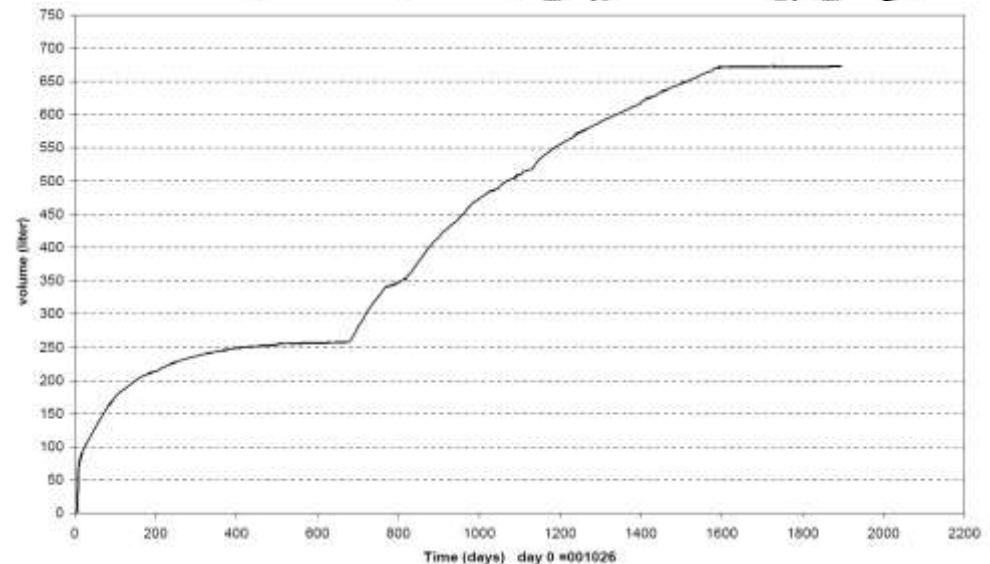


Boundaries

- Hydraulic boundaries
 - ✓ The water pressure in the mats
 - ✓ The total inflow in the mats

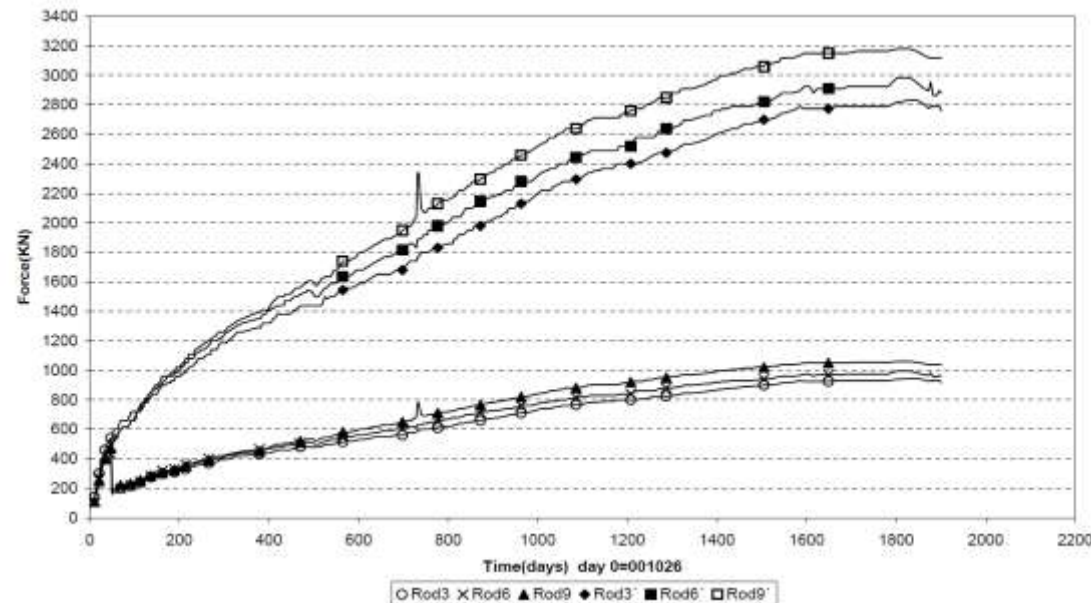


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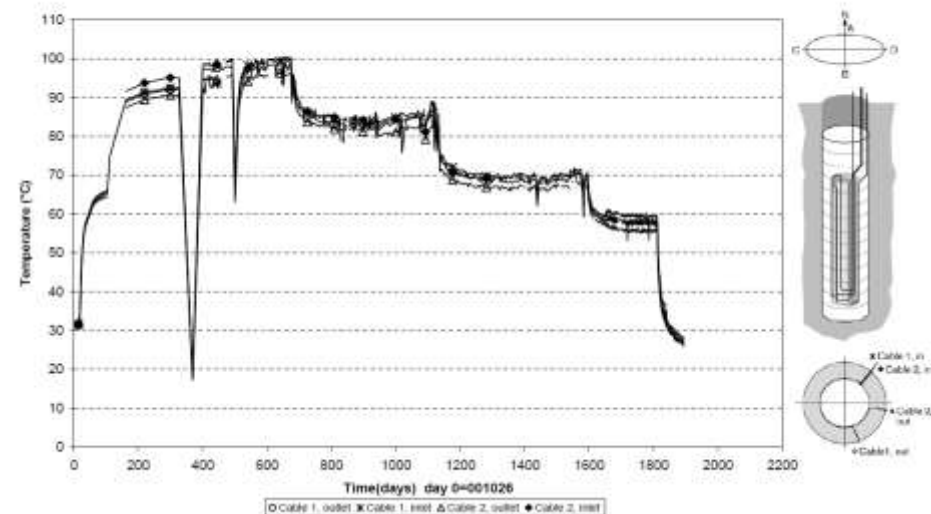
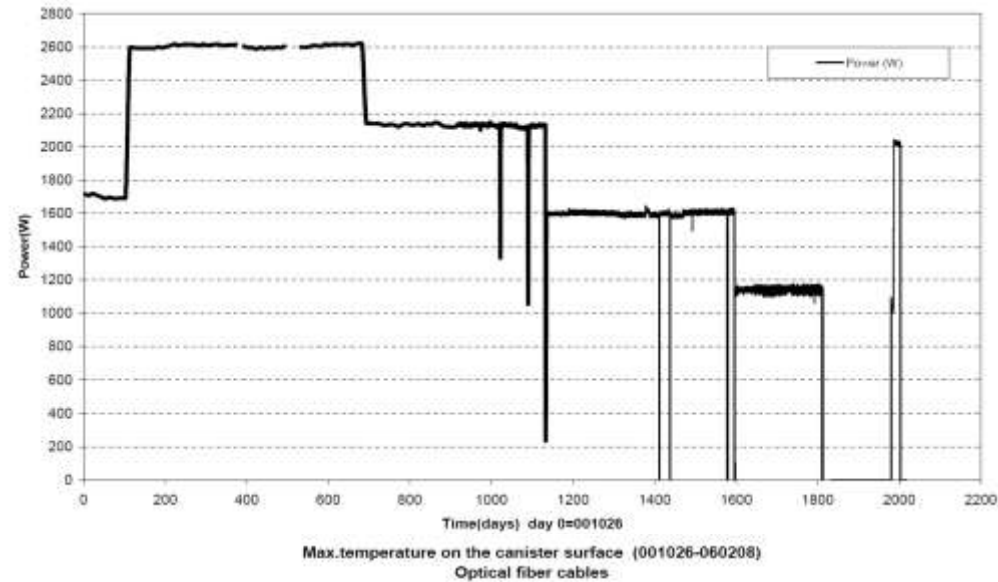
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 - ✓ The displacement of the plug



Boundaries

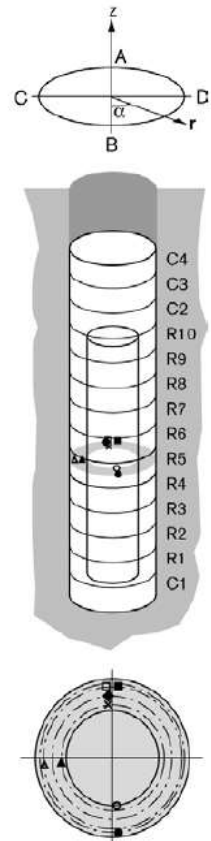
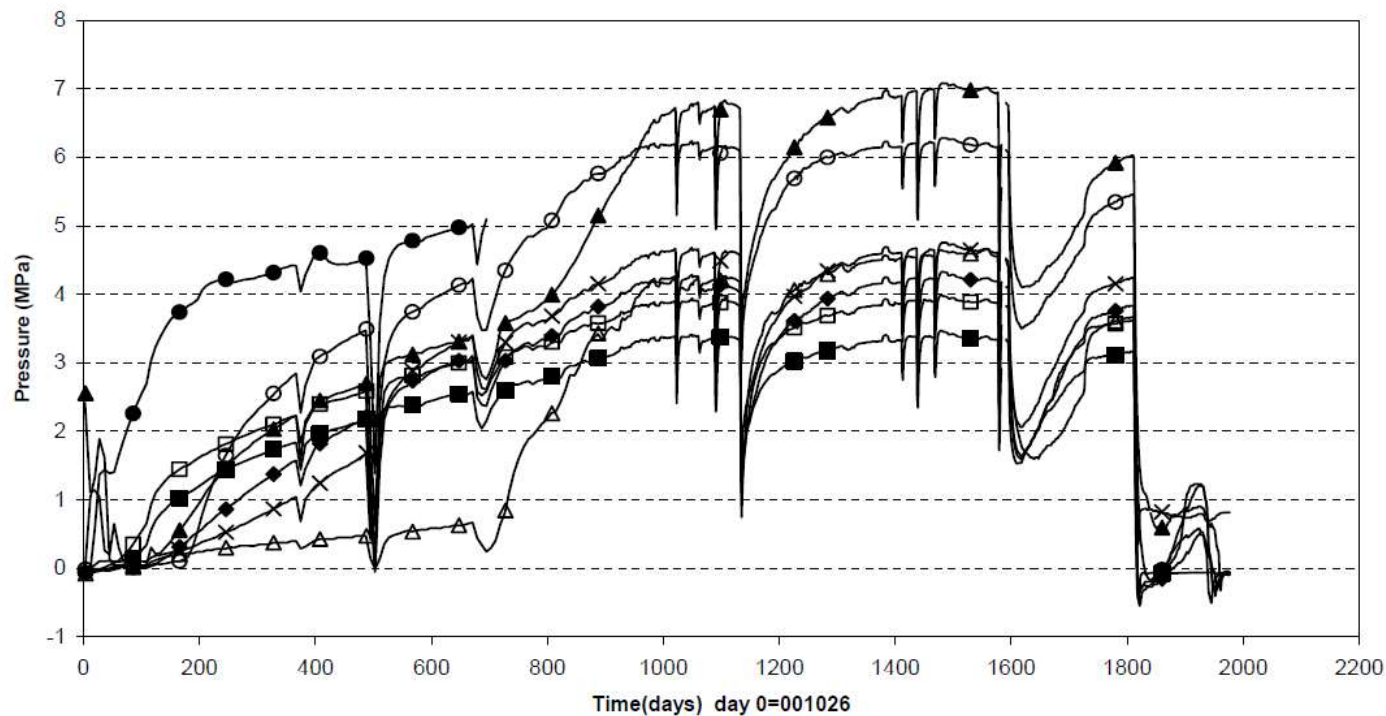
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 - ✓ The water pressure in the mats
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- Mechanical boundaries
 - ✓ The forces in the anchors
 - ✓ The displacement of the plug
- Thermal boundaries
 - ✓ The power applied to the canister
 - ✓ The temperature on the canister surface and in the surrounding rock



- Measurements in the buffer (temperature, total pressure, pore pressure and relative humidity, in total 128 sensors)
- Temperature in the surrounding rock (in total 40 thermocouples)
- Sensors for measuring strains and stresses in the surrounding rock
- Temperature of the canister (optical fiber cables and thermocouples on the insert)

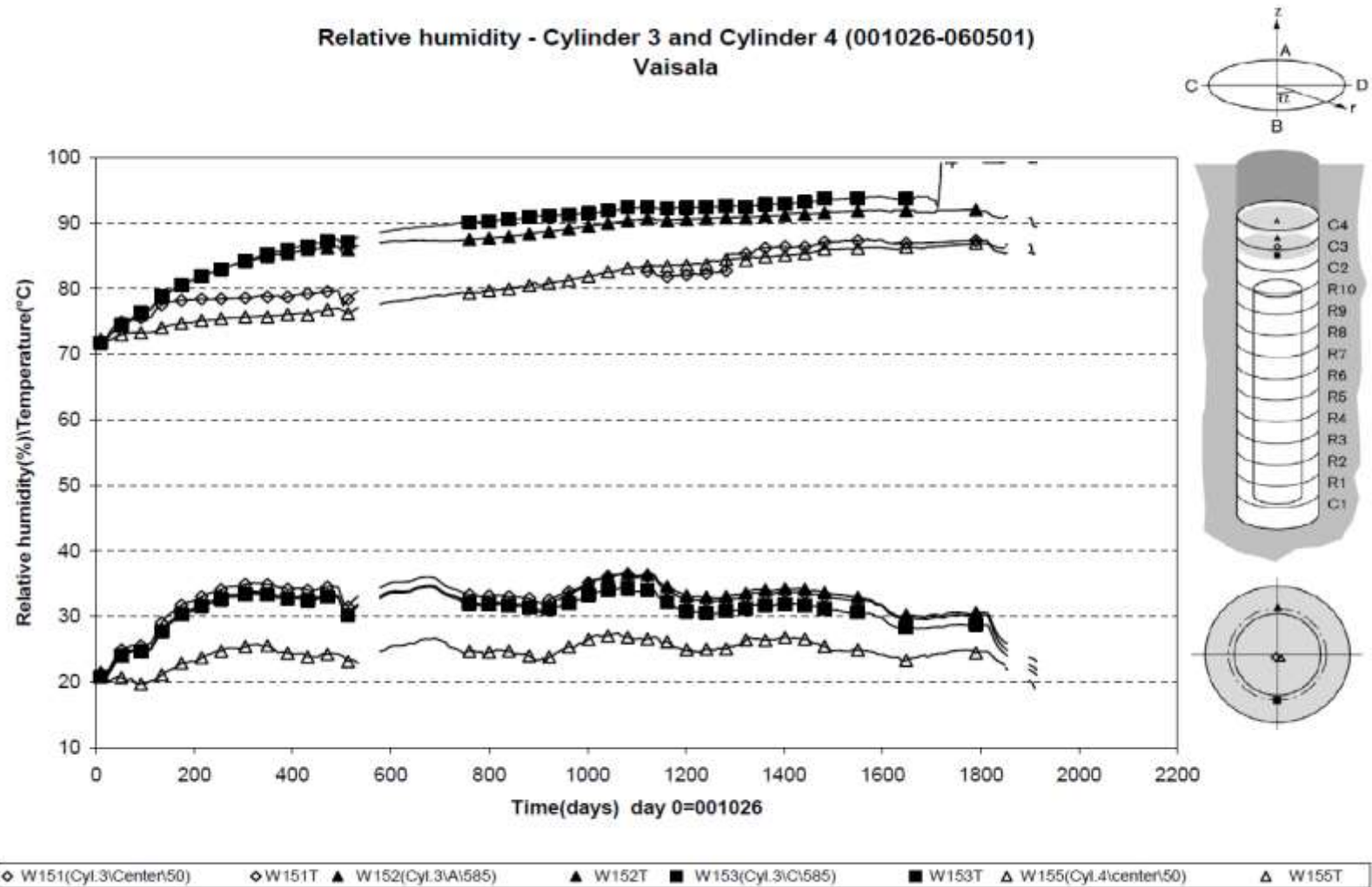
Instrumentation and data

Total pressure - Ring 5 (001026-060501)
Geokon



○ P113(Ring5\B\535)	× P110(Ring5\A\585)	▲ P115(Ring5\C\585)	◆ P111(Ring5\A\685)
■ U106(Ring5\A\785)	□ P112(Ring5\A\785)	△ P116(Ring5\C\785\slot)	● P114(Ring5\B\815\slot)

Instrumentation and data



Retrieval of the test

After 5 years of saturation:

- The anchors were cut and the plug was removed
- Samples were taken of the upper part of the buffer , i.e. down to block R6, by core drilling from the tunnel floor
- The water content and the bulk density of the samples were determined, in total about 1500 determinations were made



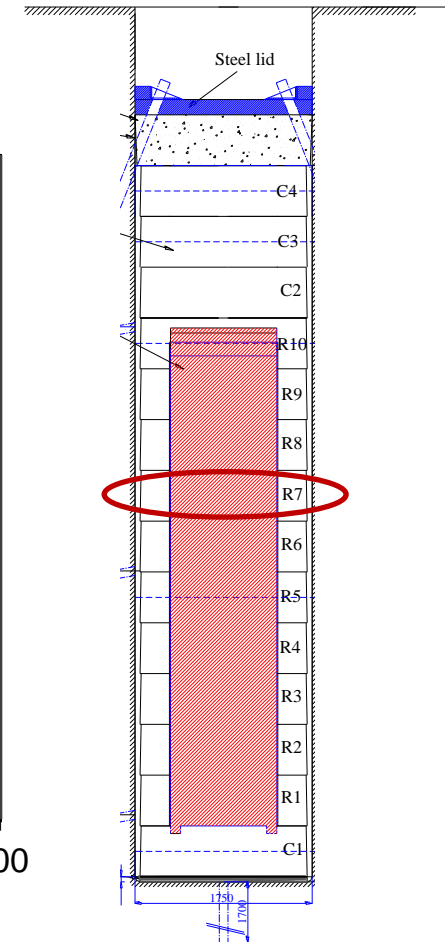
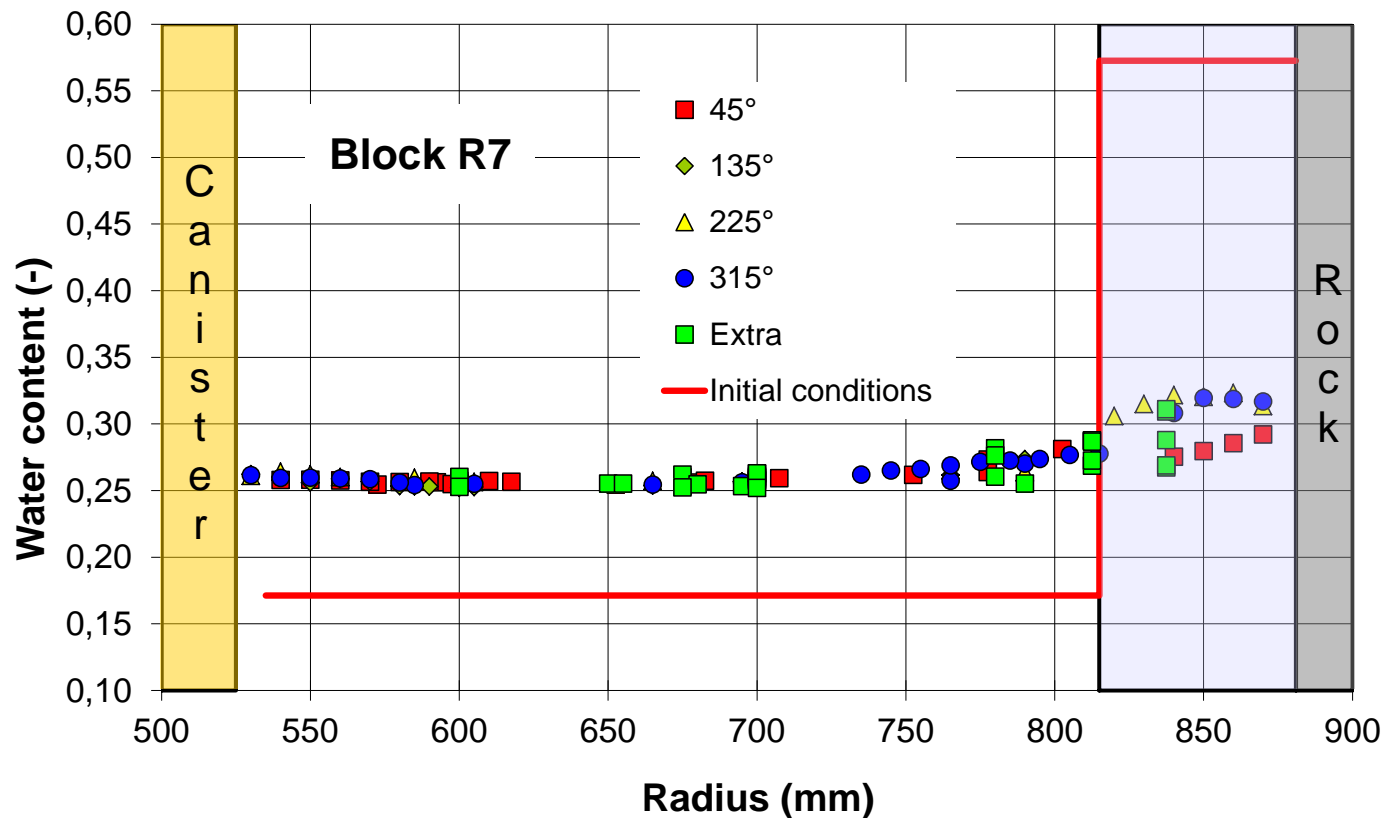
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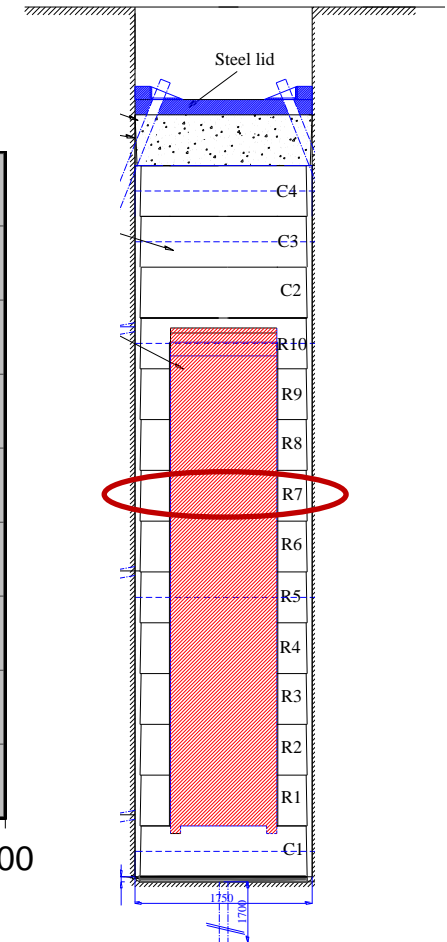
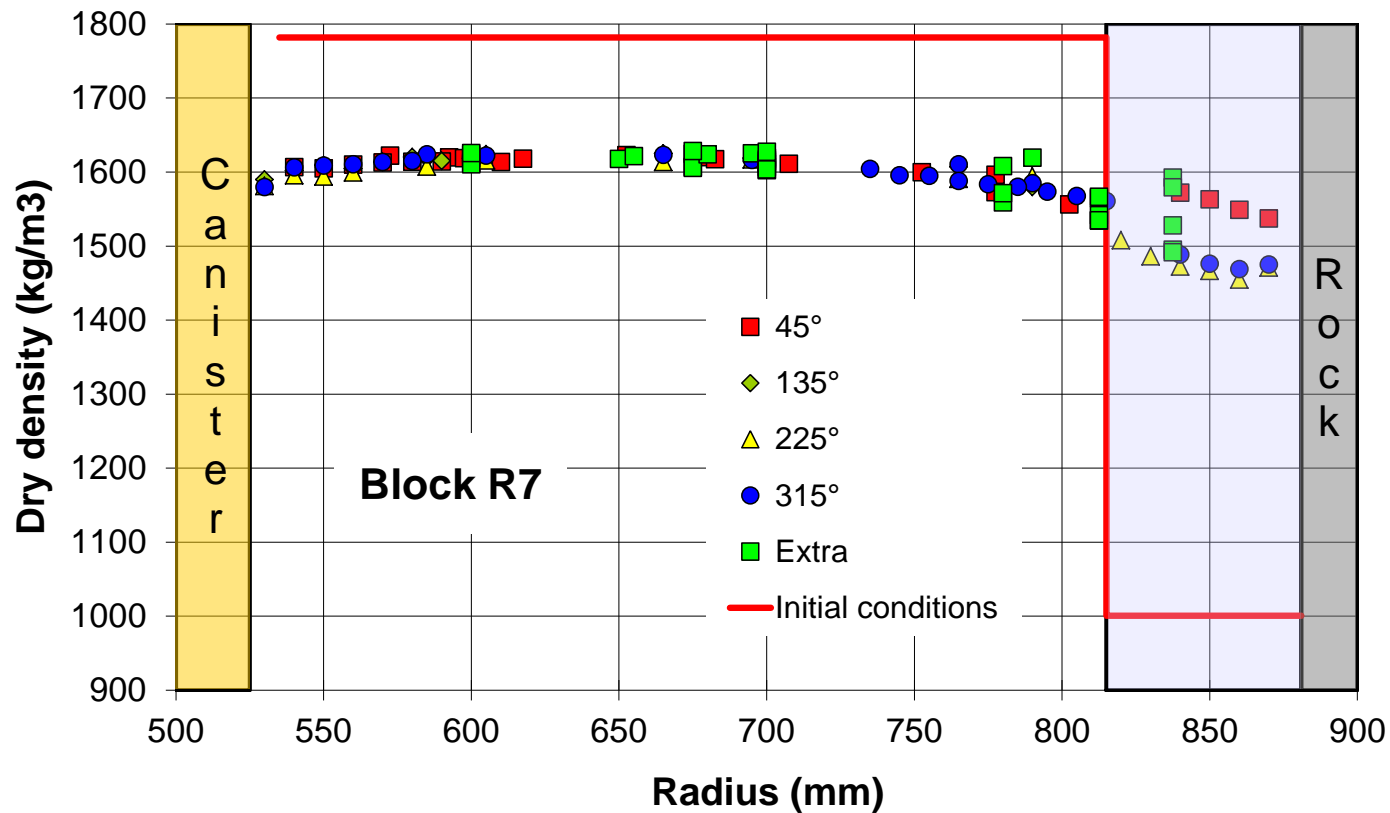
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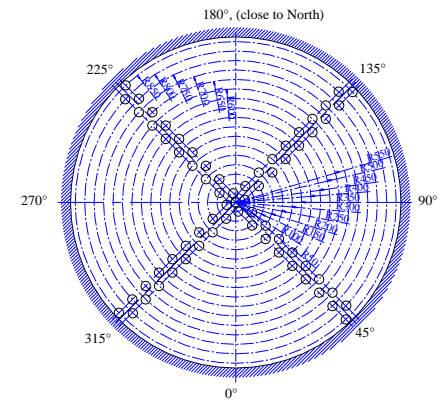
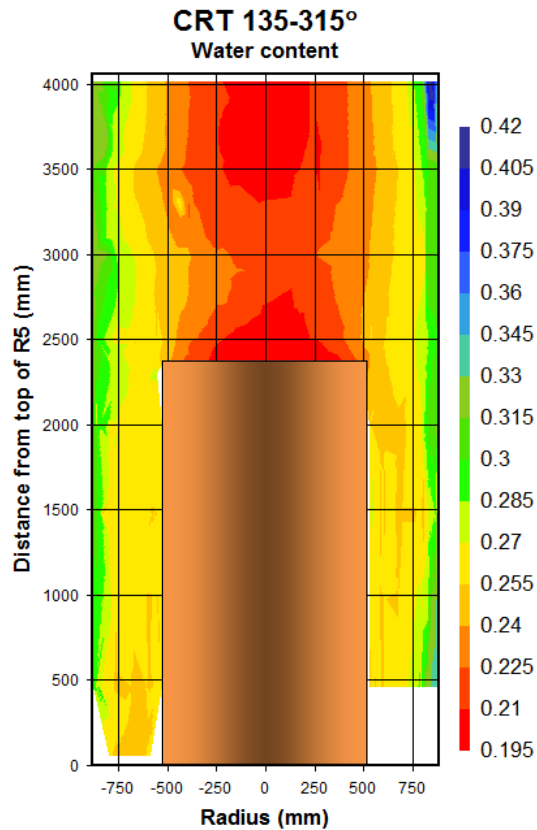
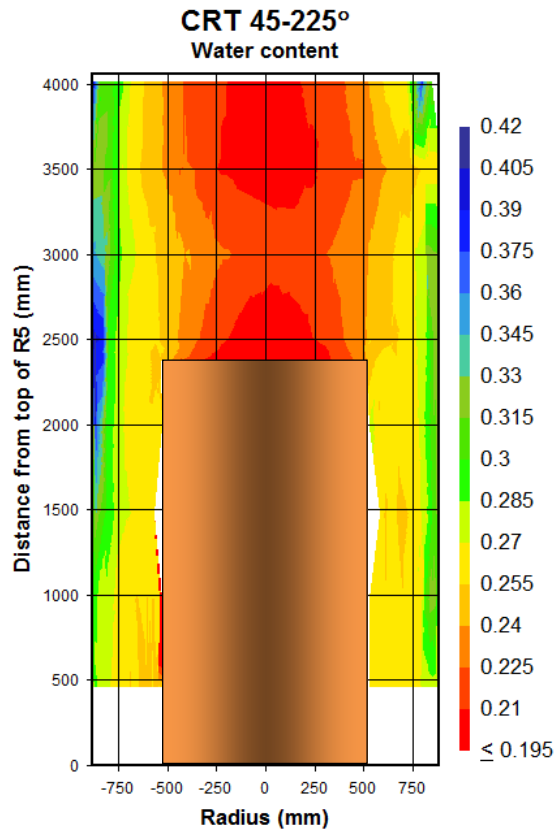
Retrieval of the test



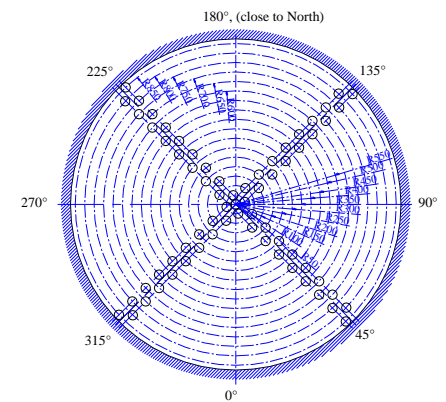
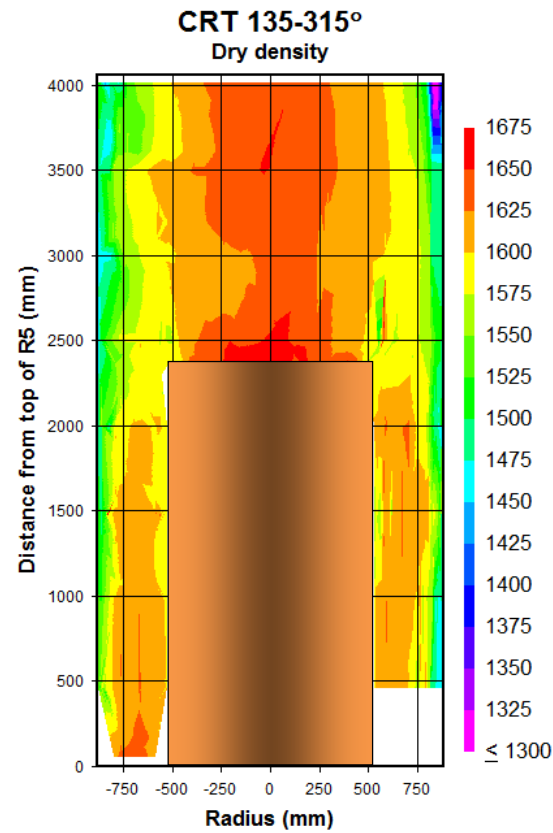
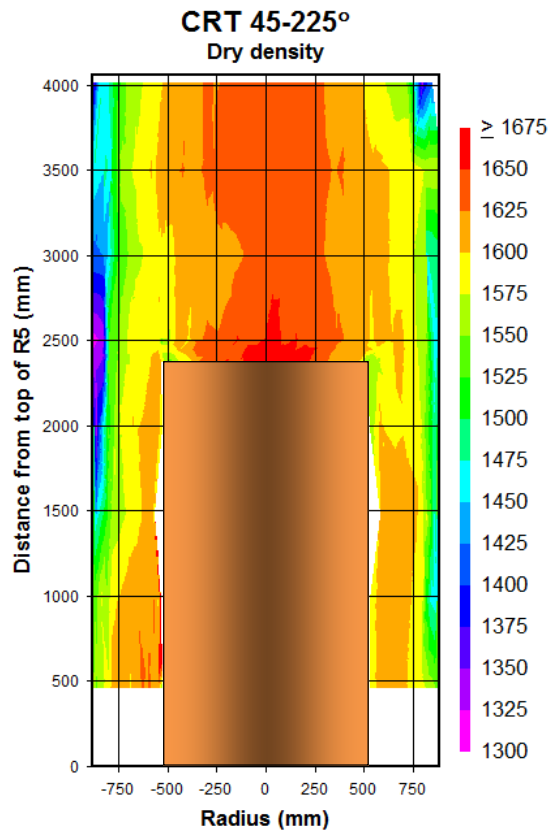
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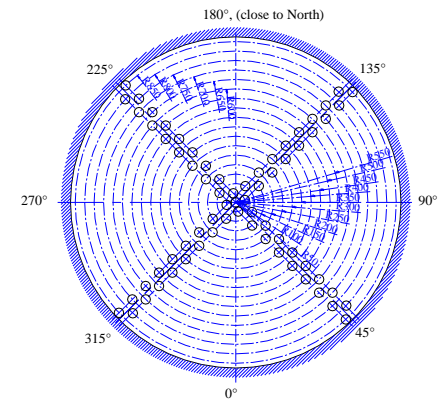
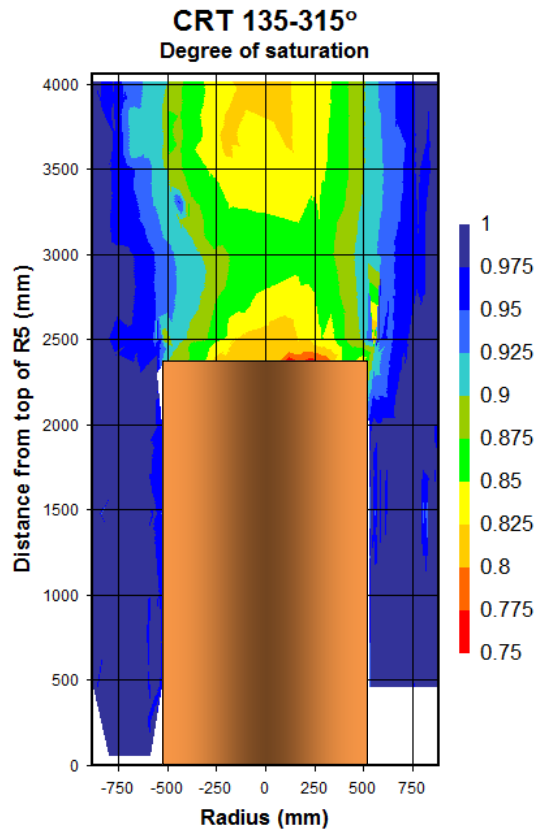
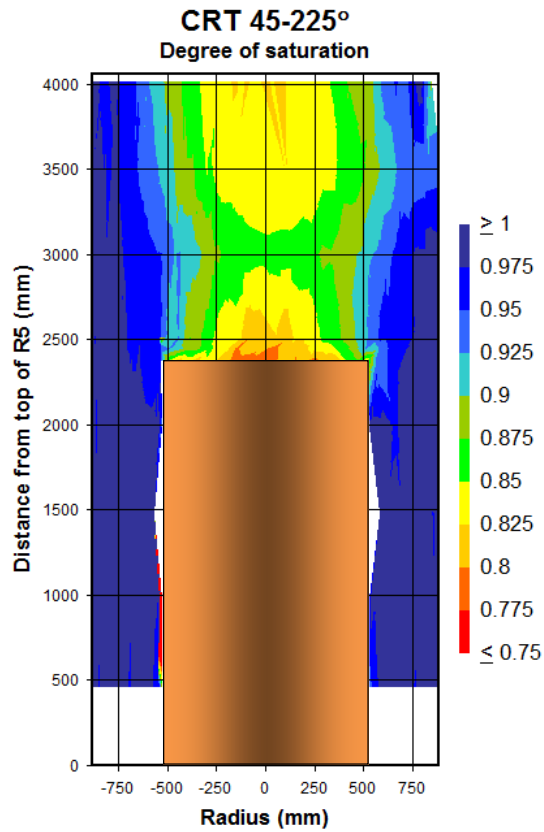
Retrieval of the test



Retrieval of the test



Retrieval of the test



The modelling of the test has been done within the Task Force on Engineered Barrier Systems (EBS-TF) divided into three sub-tasks:

1. Thermal modelling of CRT and TBT with host rock
2. Detailed THM modelling of a disc of engineered buffer at canister mid-height
3. THM modelling of the entire experiment

Kristensson O, Börgesson L, 2015. Canister Retrieval Test. Final Report SKB TR-14-19, Svensk Kärnbränslehantering AB.

Börgesson L, Åkesson M, Kristensson O, Dueck A, Hernelind J, 2015. EBS TF – THM modelling. BM 2 – Large scale field tests. SKB TR-13-07, Svensk Kärnbränslehantering AB.

Summary and conclusions



The analyses of the samples taken from the buffer indicate the following:

- The water content of the pellets filling in the outer slot was decreased compared to the initial water content after artificial water filling
- The water content of the blocks was increased
- There was a compression of the pellets filling resulting in an increase of its dry density
- The buffer blocks had swollen out towards the canister and compressed the pellets filling resulting in a decrease of the dry density of the blocks
- The buffer around the canister was fully saturated while the central part of the solid blocks above the canister was not saturated.
- Although the buffer around the canister was fully saturated, the buffer was not fully homogenized after 5 years of saturation.

Summary and conclusions



The Canister Retrieval Test is a large scale test with:

- Well defined initial conditions
- Well defined boundaries
- Large amount of installed sensors
- Carefully retrieved and sampled buffer