

Modern2020

Non-Intrusive Geo-Electrical ERT Monitoring of High-Level Radioactive Waste Experiments in Tournemire URL

Bruna de Carvalho Faria Lima Lopes

Pierre Dick, Johan Bertrand, José Luis García-Siñeriz & Alessandro Tarantino

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This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement n° 662177

Background

- Aim
 - ✓ Monitor the changes of saturation (and temperature) induced to the buffer along the time using ERT with electrodes installed in boreholes surrounding the buffer

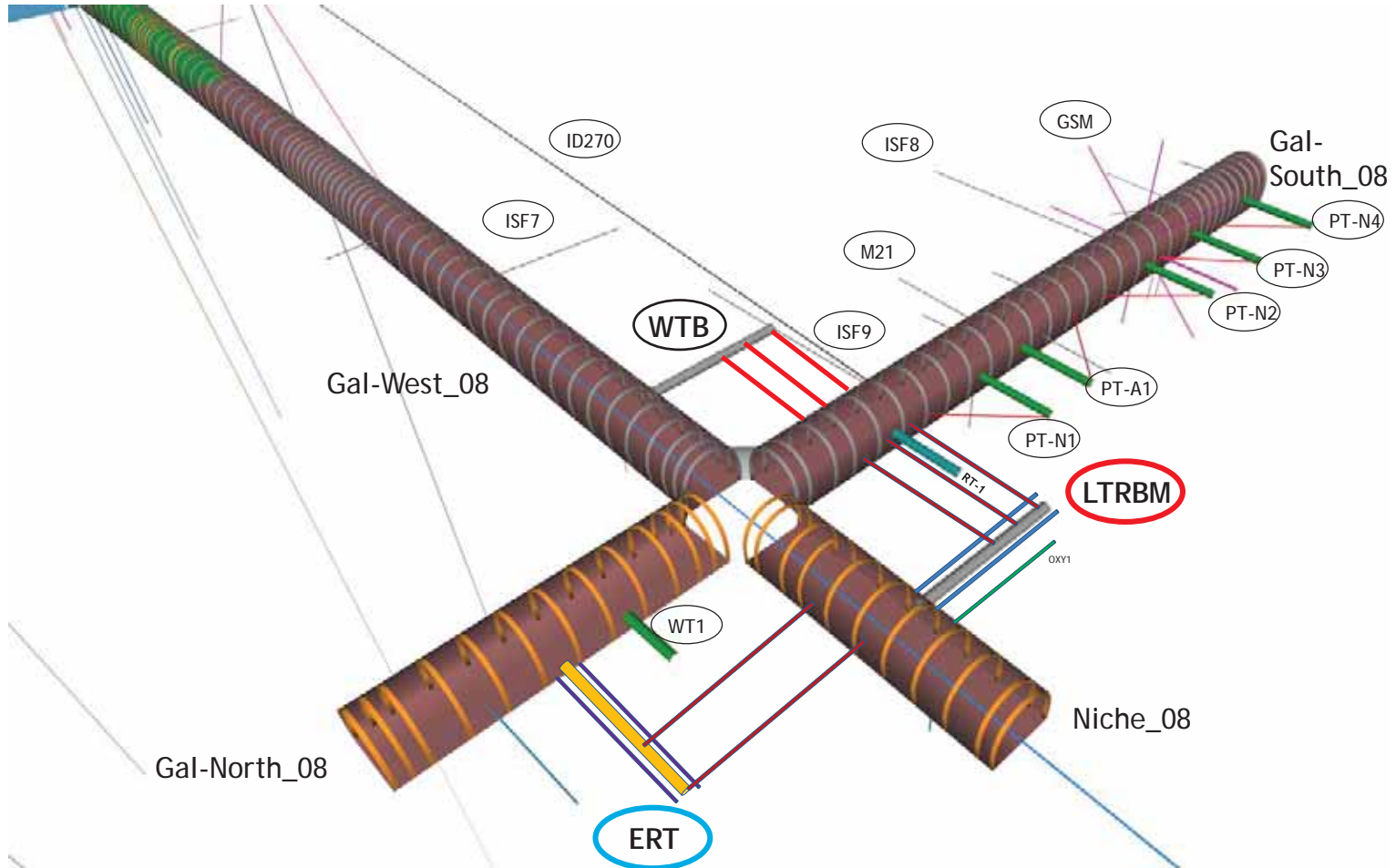
Borehole electrodes design

Copper
Electrode
(1.5x3cm)



Inflatable system

Location of experiments in Tournemire URL



TASKS

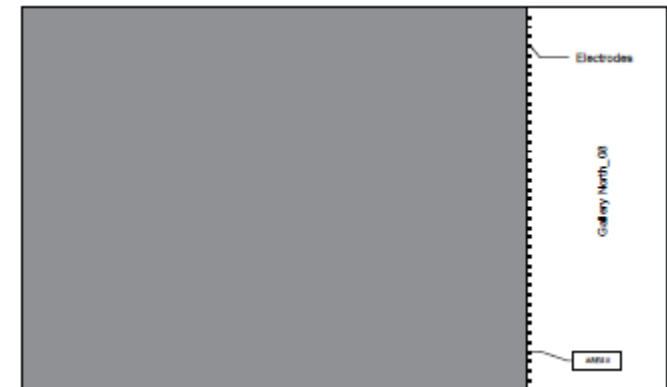
- Task 1: January 2017 – Blank ERT surveys: background information
- Task 2: November 2017 – Blank ERT survey of rock matrix and MB
- Task 3: June to September 2018 – Installation
- Task 4: September 2018 onward – ERT surveys: monitoring stage



Jan 2017: Blank test #1

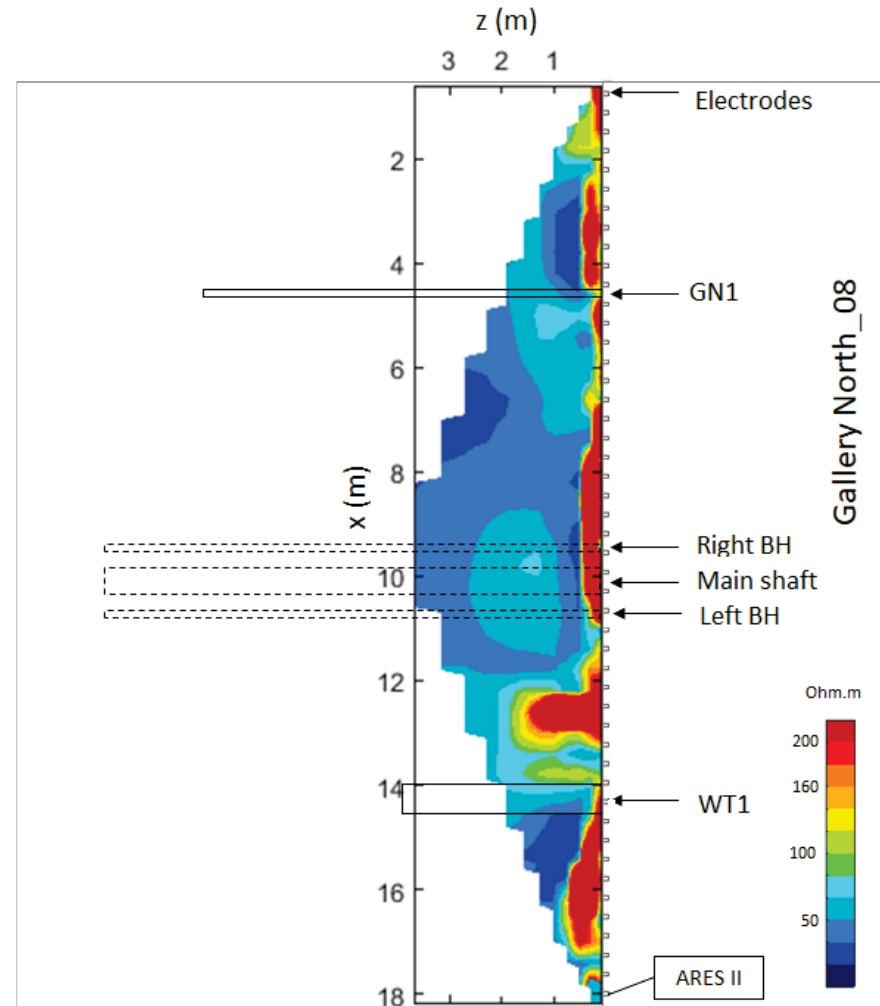


Electrodes spacing	0.4m
Total number of electrodes	48
Total length	18.8m
Position of electrodes in z-axis	1.4m from the gallery floor
First electrode (EI 0) in x-axis	On the right: standing on Gallery North_08 and facing the ERT demonstrator location
Measurement type	2D surface
Unit used	ARES II
Array used	Schlumberger
Electrodes used	Conventional metal sticks (surface)

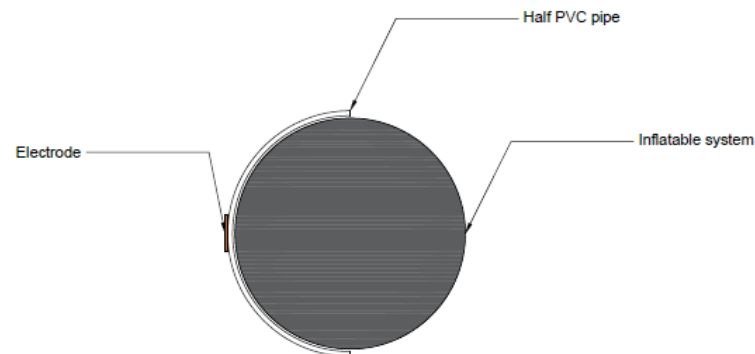
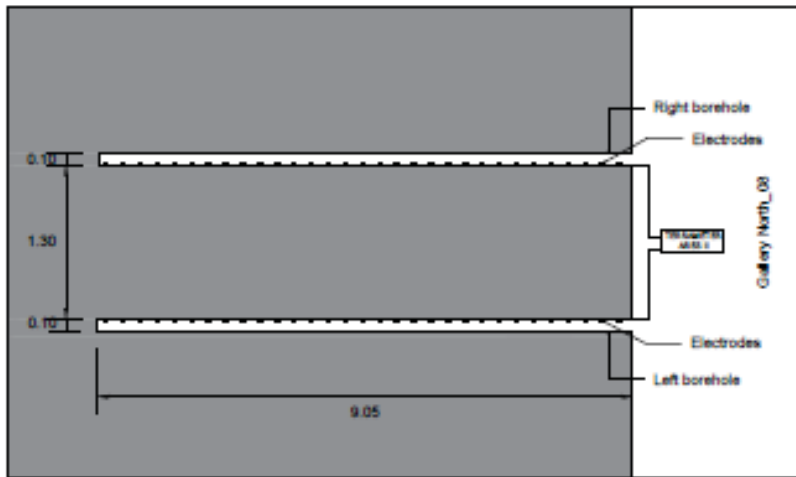


Jan 2017: Blank test #1

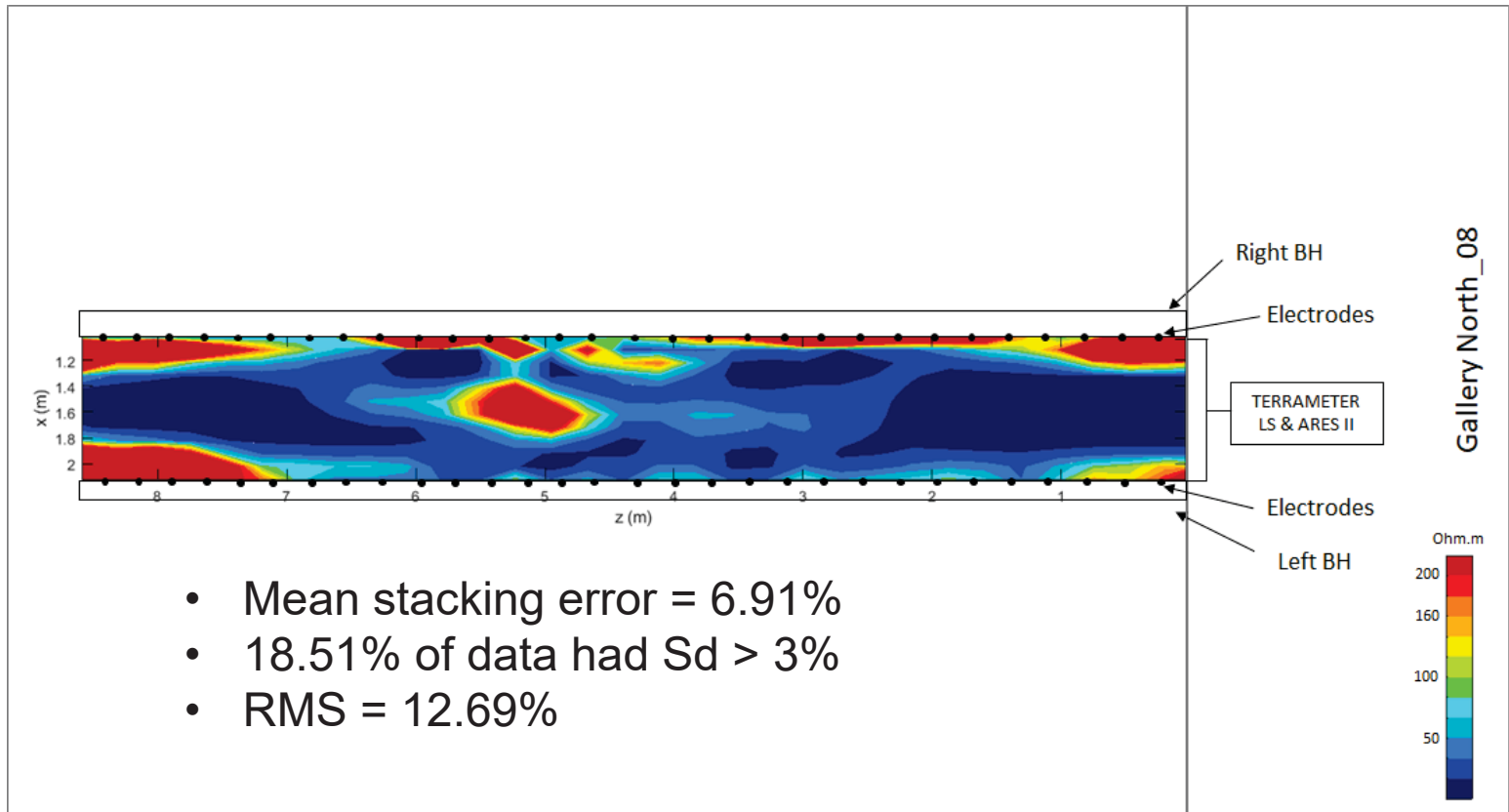
- Largest contact resistance = 3.5 k Ω
- Mean stacking error = 0.16%
- RMS = 9.2%



Jan 2017: Blank test #2



Jan 2017: Blank test #2



Jun - Sep 2018: Installation

Concrete layer

Heater

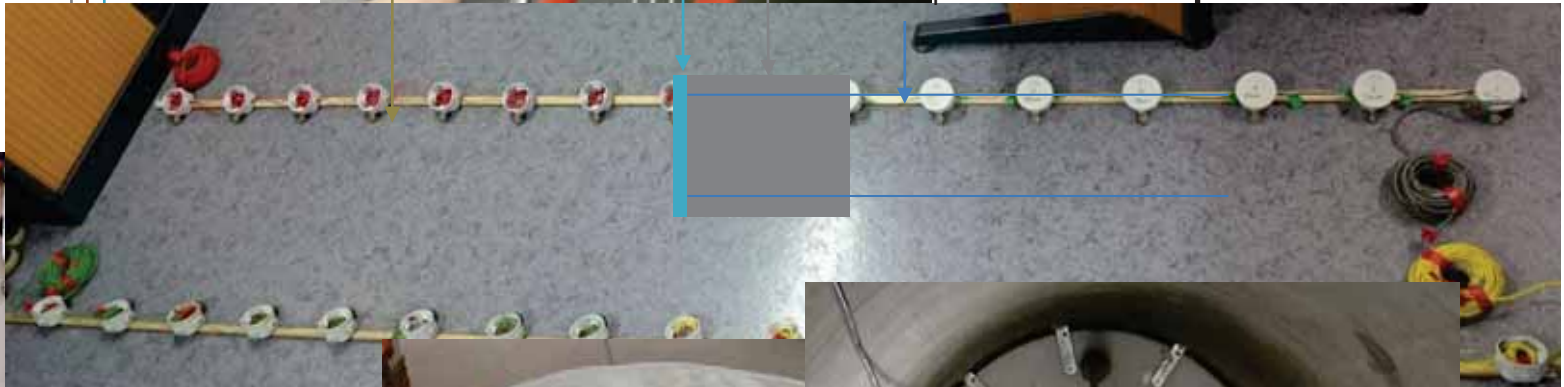
Hydration mat 1

Bentonite buffer

Hydration mat 2

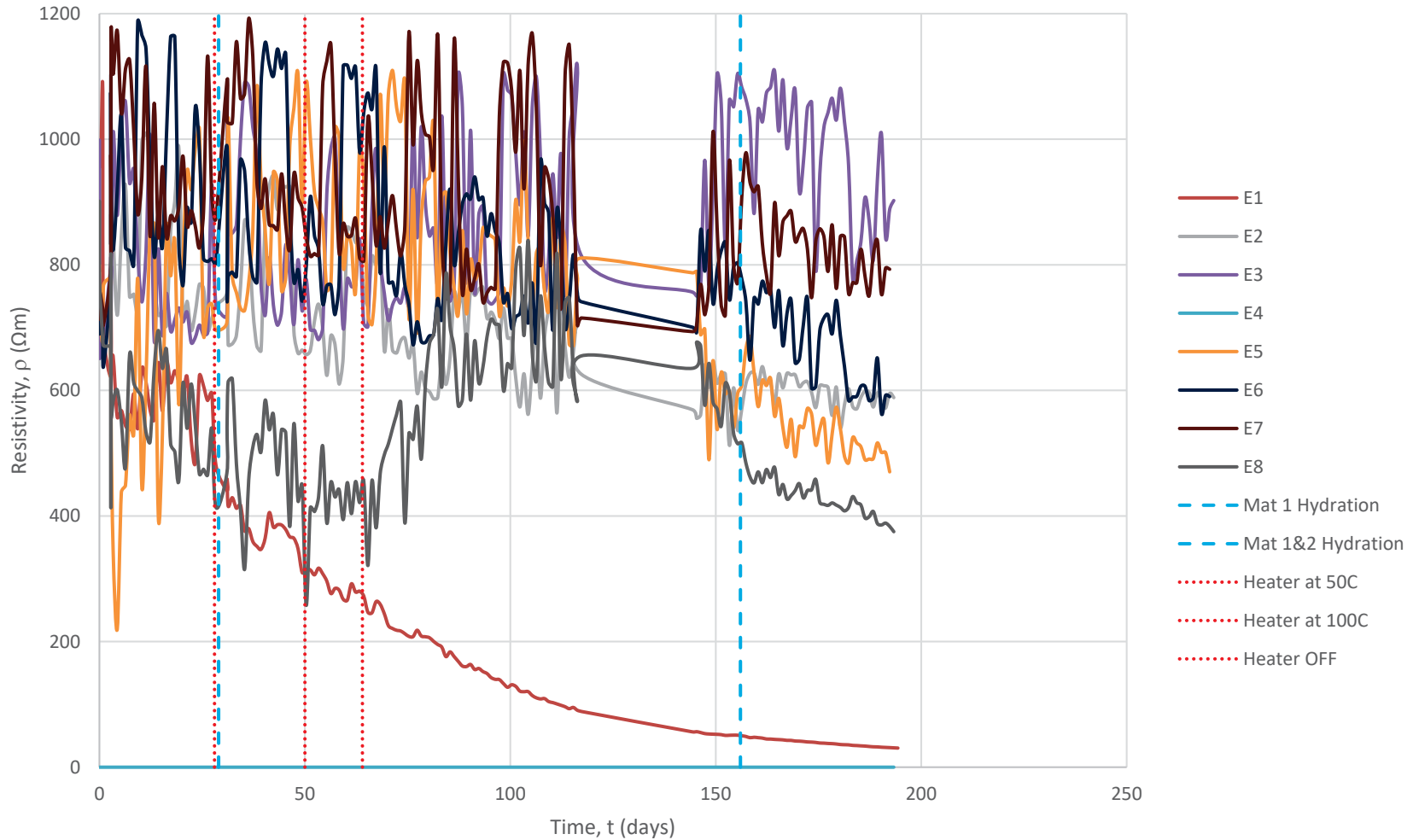
Cement plug

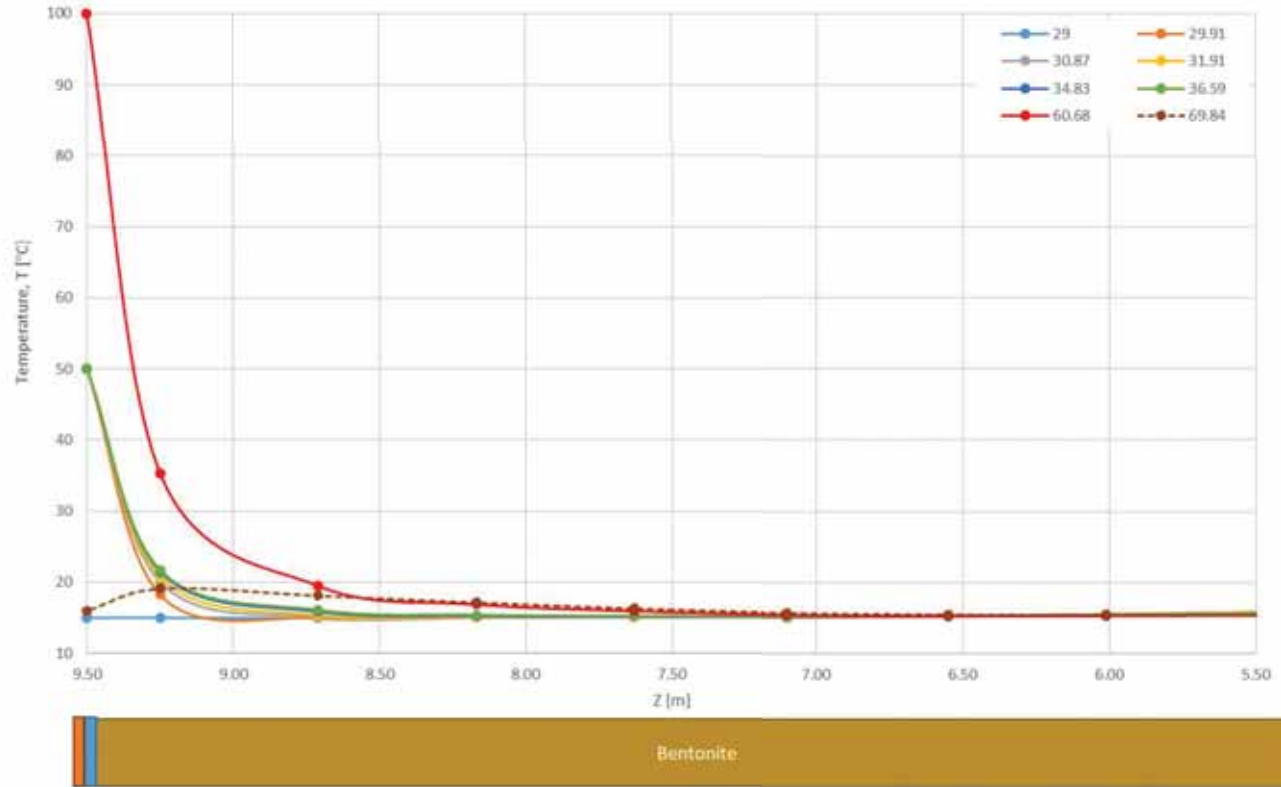
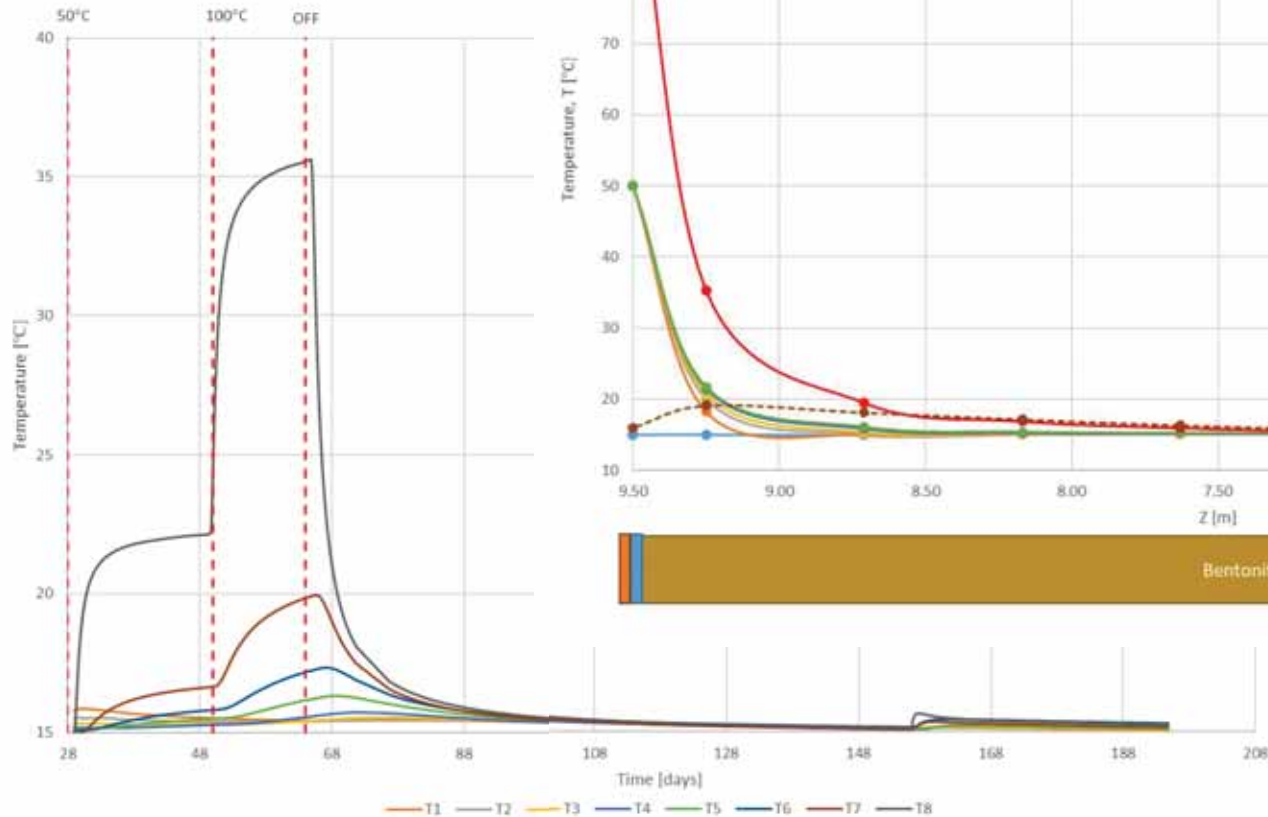
Fibre optics



Jun - Sep 2018: Installation



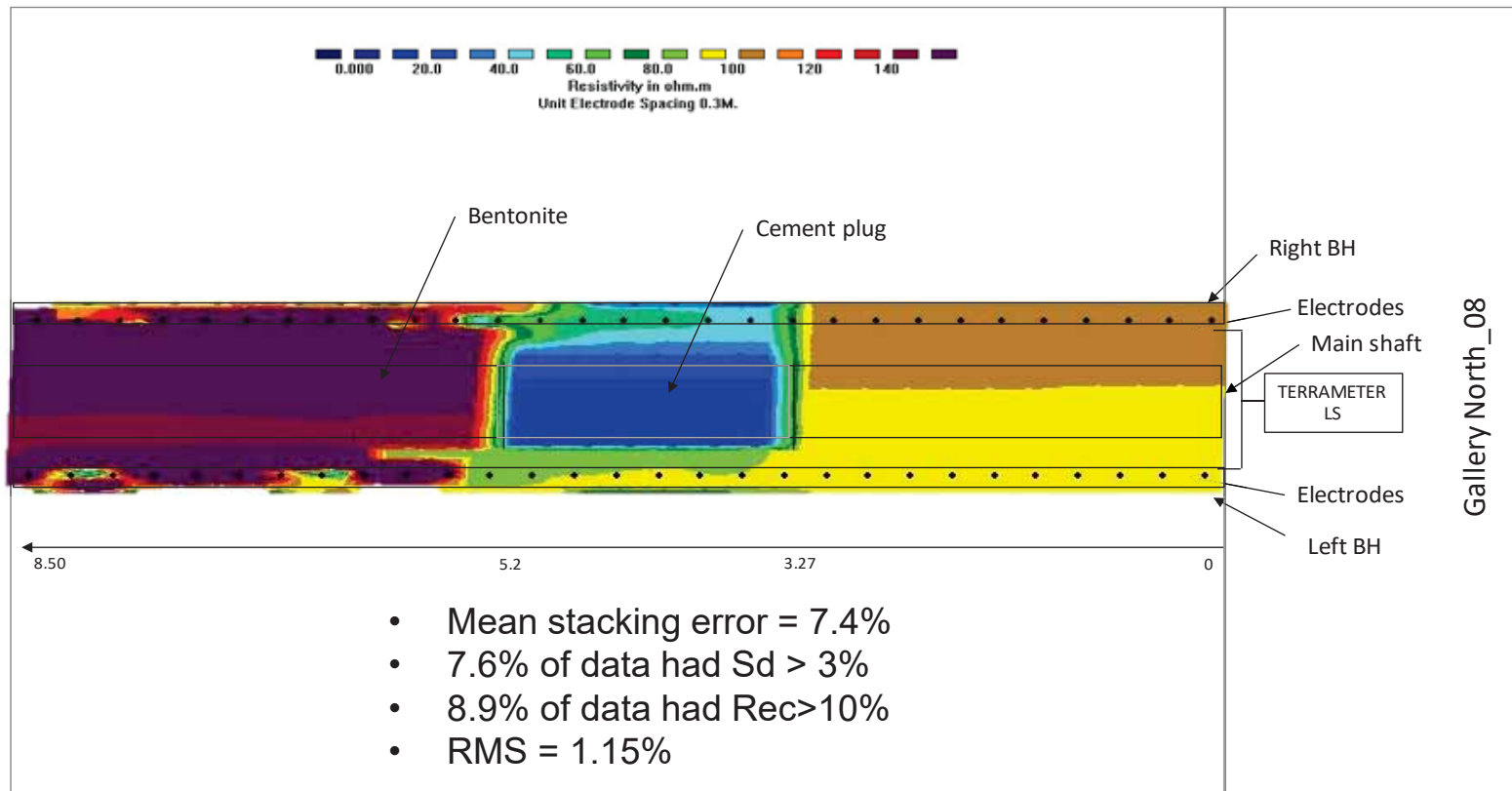




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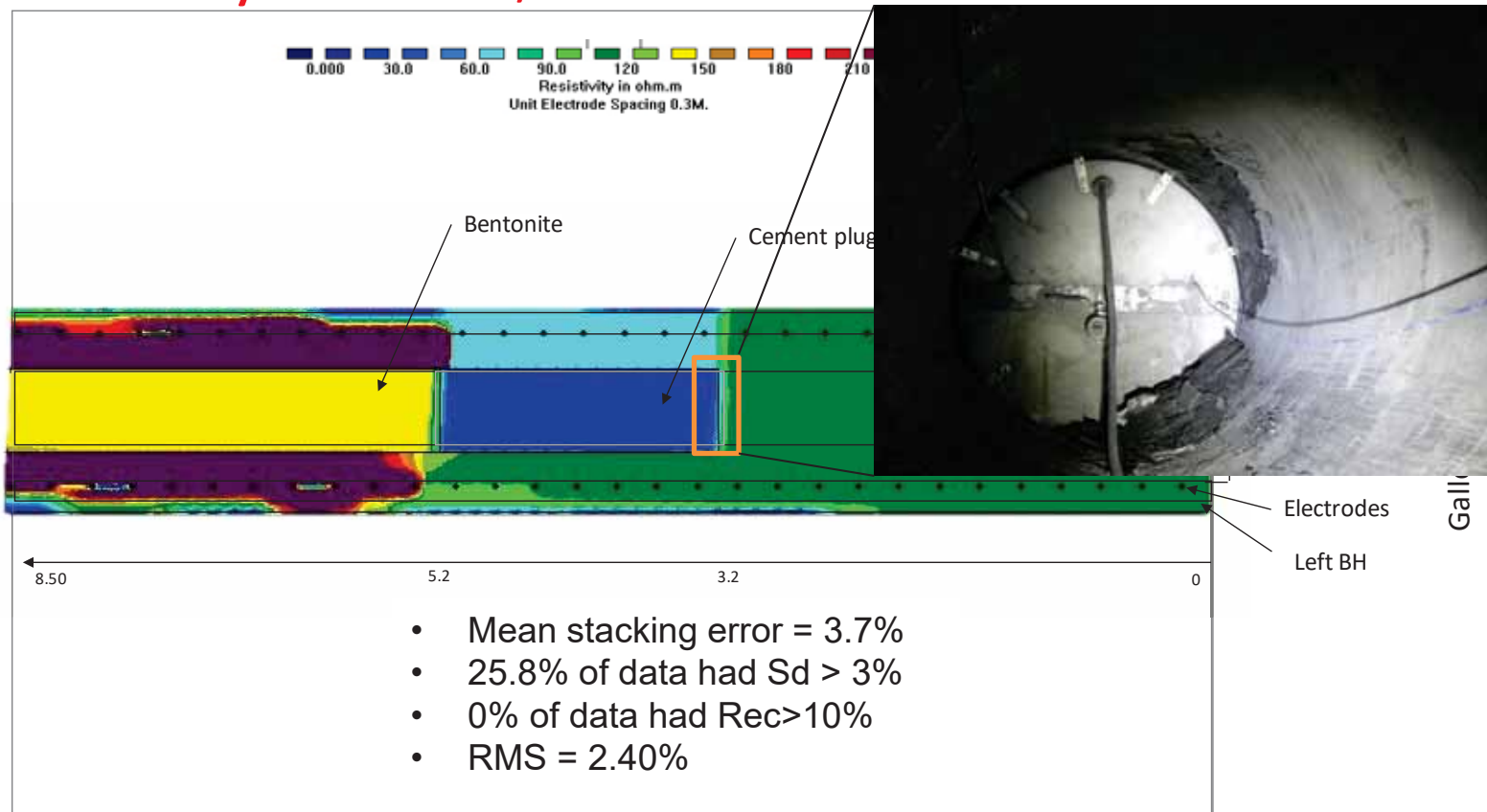
ERT surveys to monitor hydration and heating

October 2018: Day 36



ERT surveys to monitor hydration and heating

February 2019: Day 154

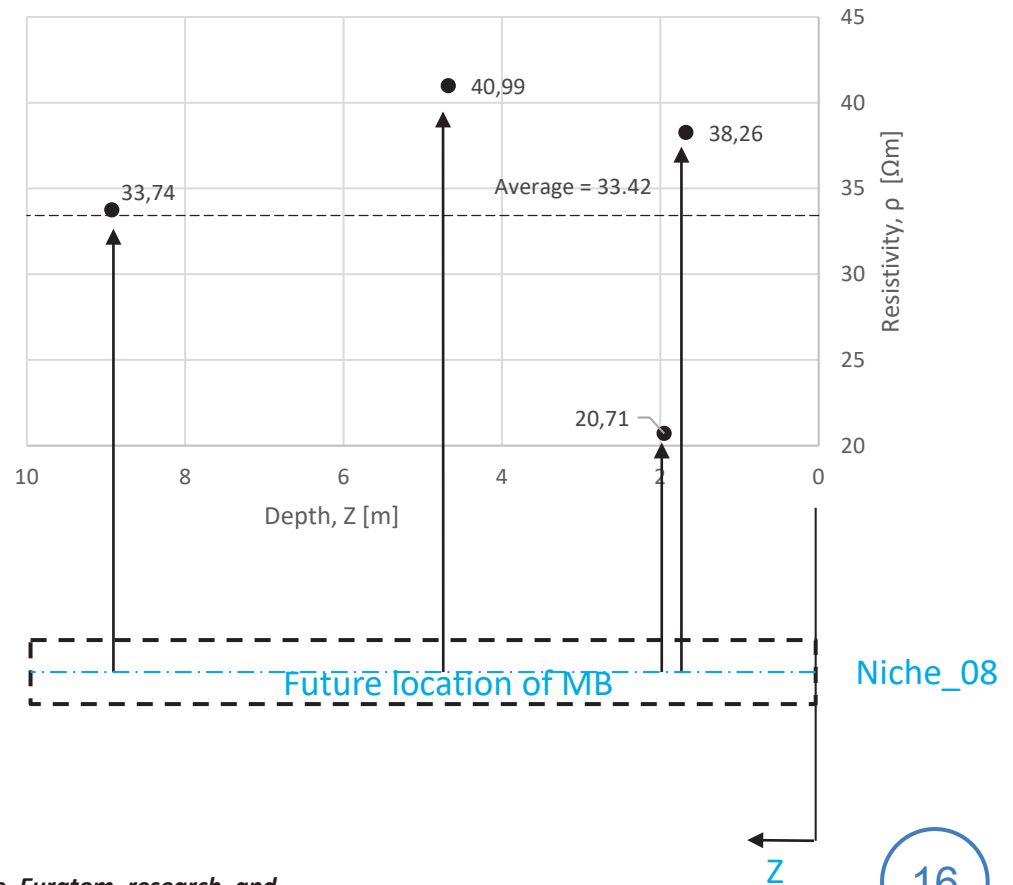
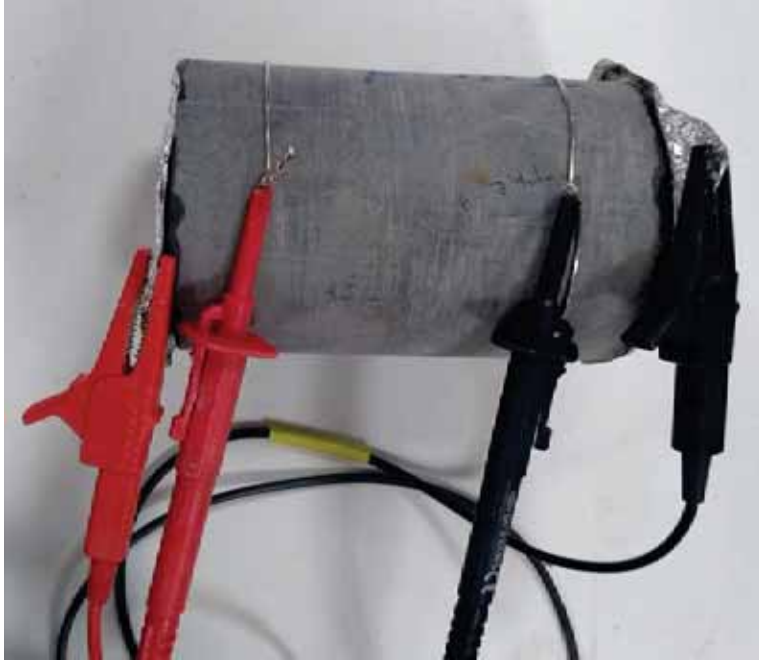


TASKS

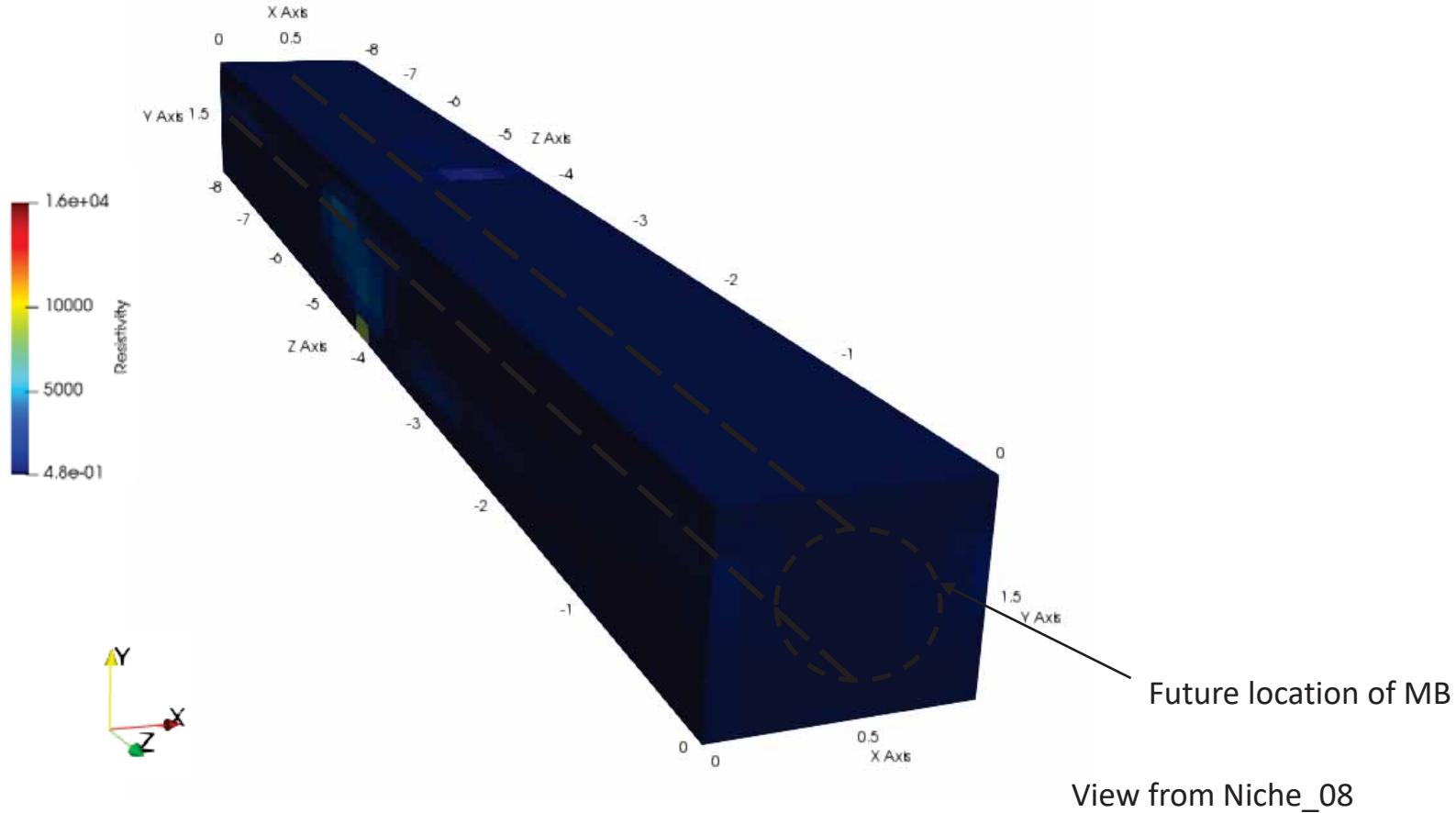
- Task 1: February 2018 – Blank ERT survey: background information
- Task 2: June to July 2018 – Installation of support instrumentation
- Task 3: September 2018 onward – ERT surveys: monitoring stage



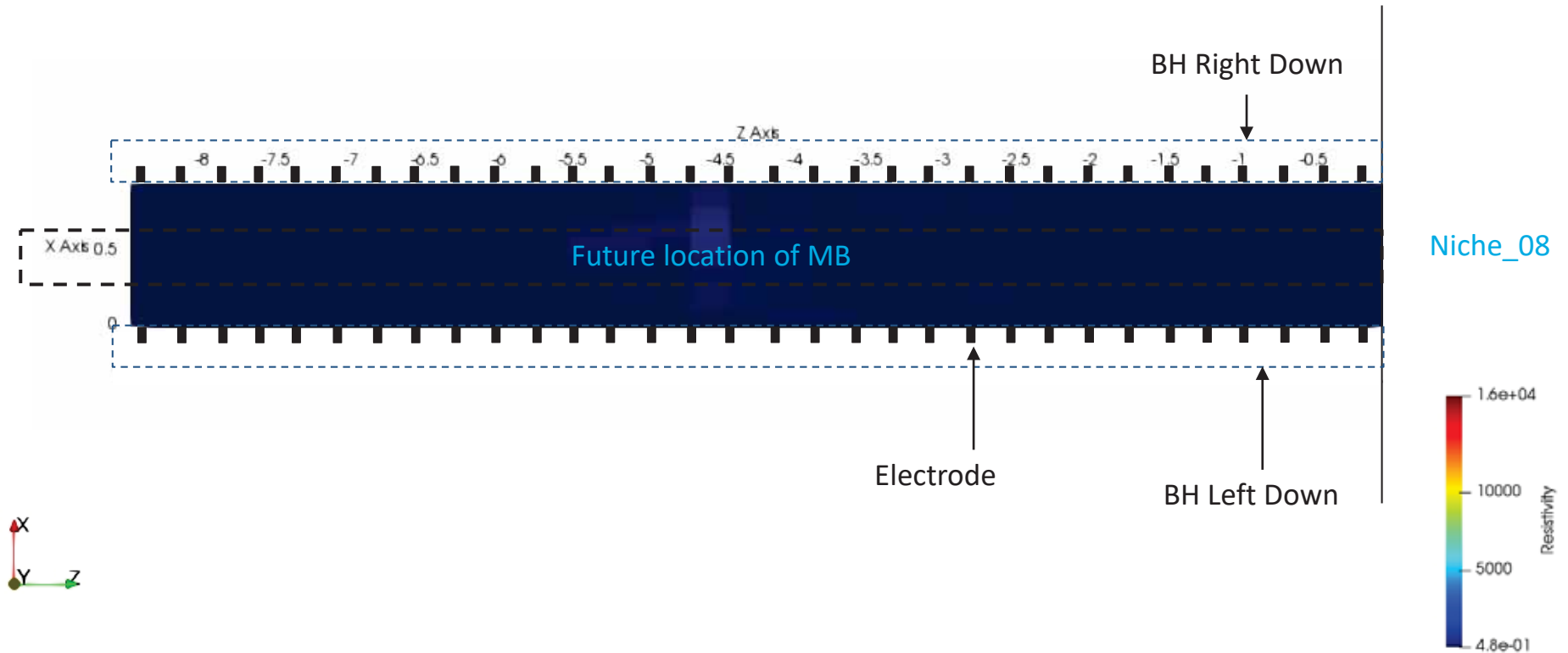
TASK 1 - Feb 2018: Blank test



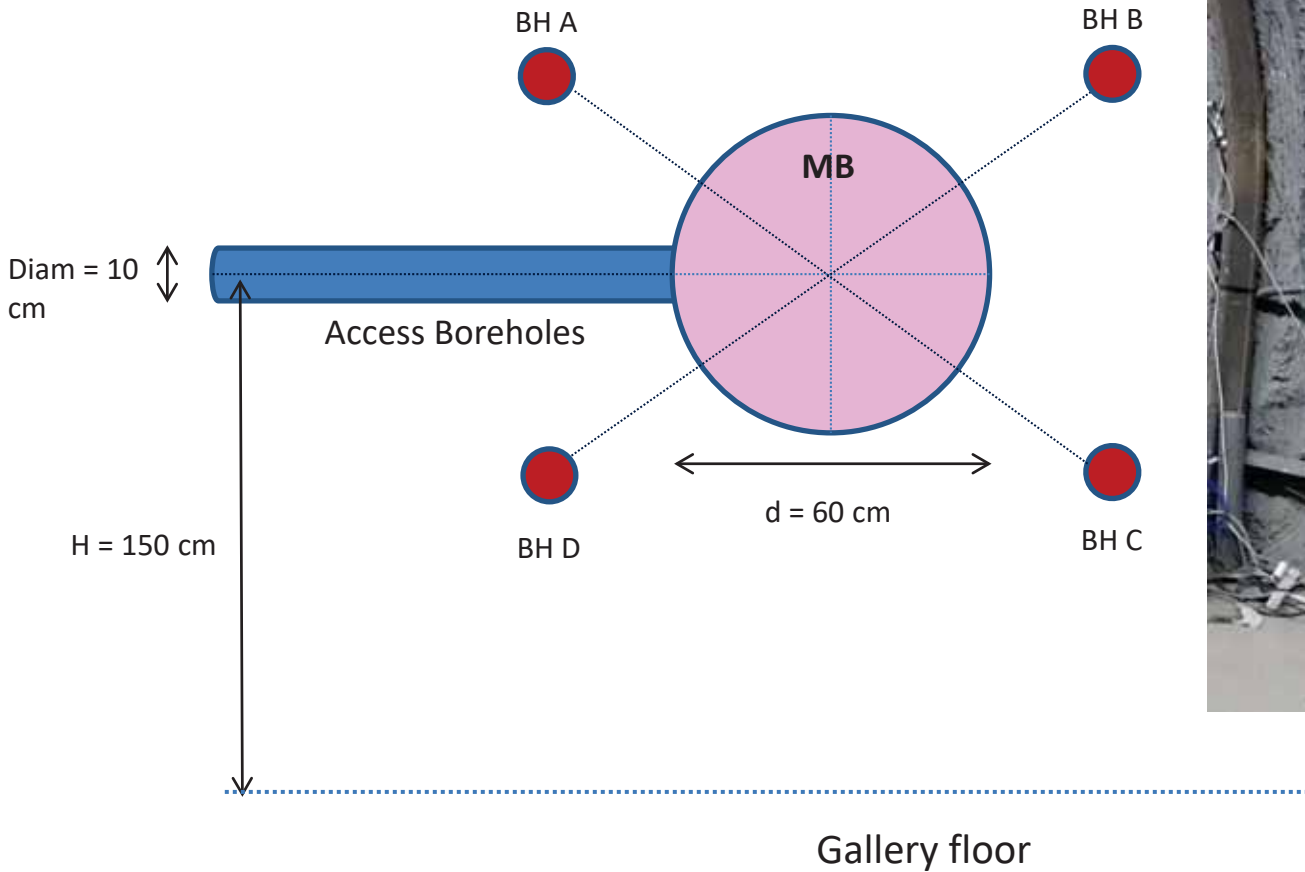
TASK 1 - Feb 2018: Blank test



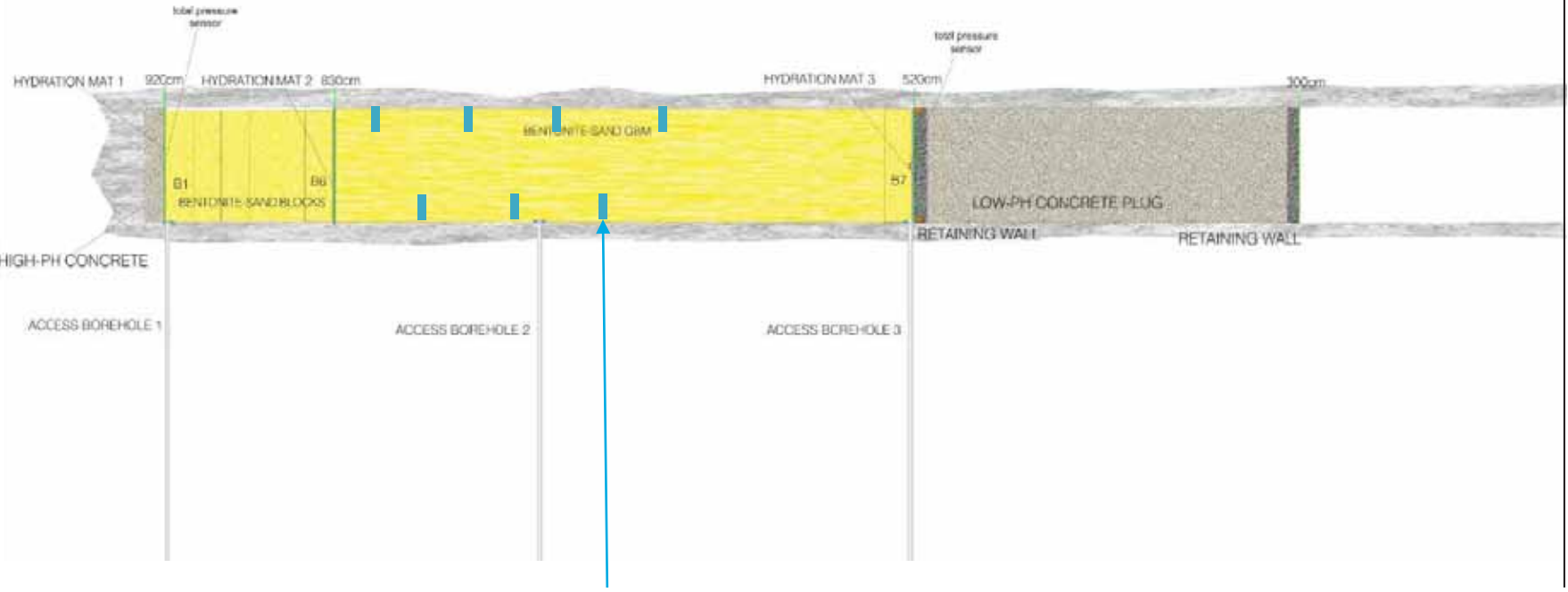
TASK 1 - Feb 2018: Blank test



LTRBM



TASK 2 – Jun-Jul 2018: Installation

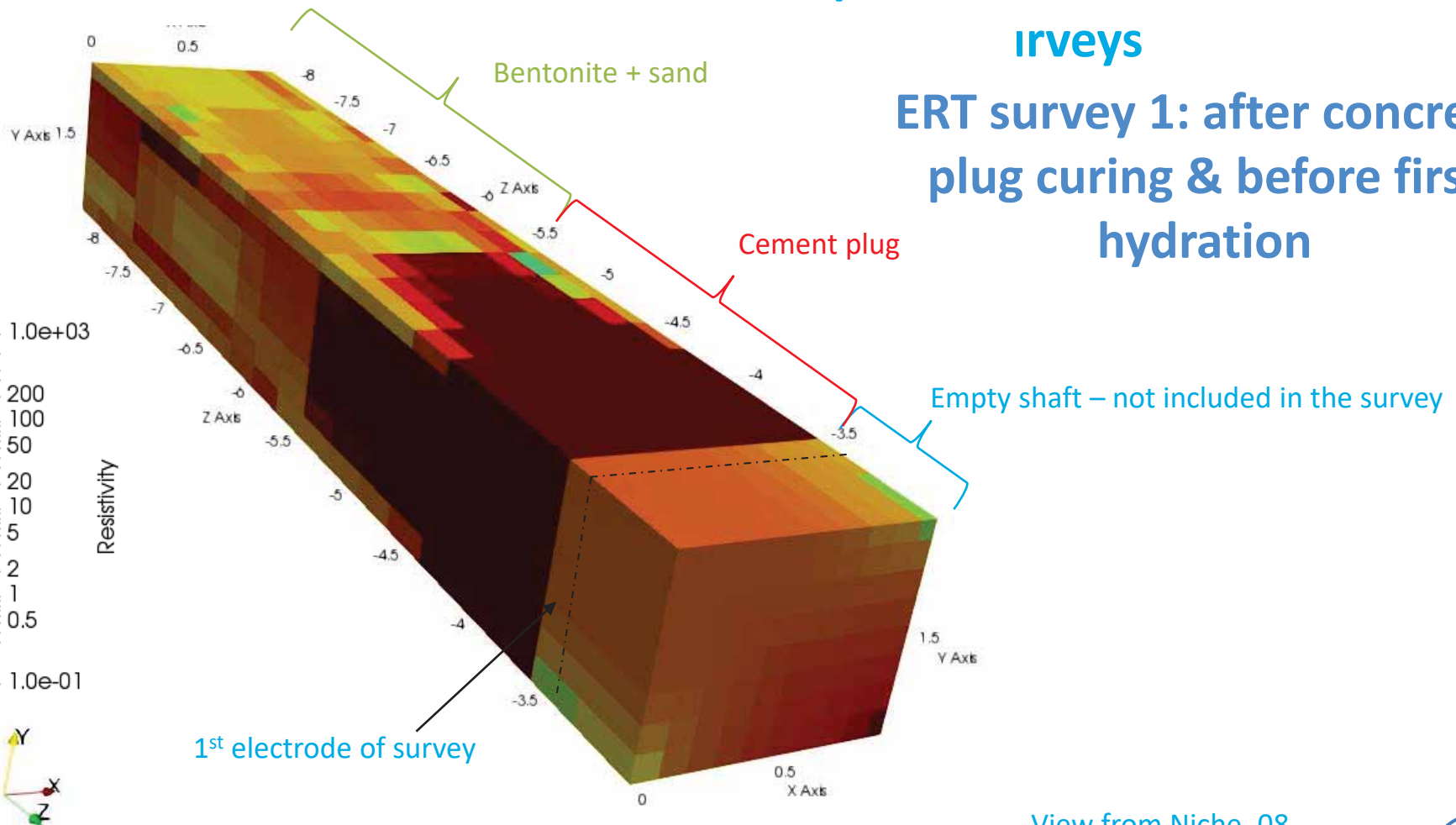


TDR probes

Niche_08

TASK 3 – Sep 2018-onward: ERT monitoring surveys

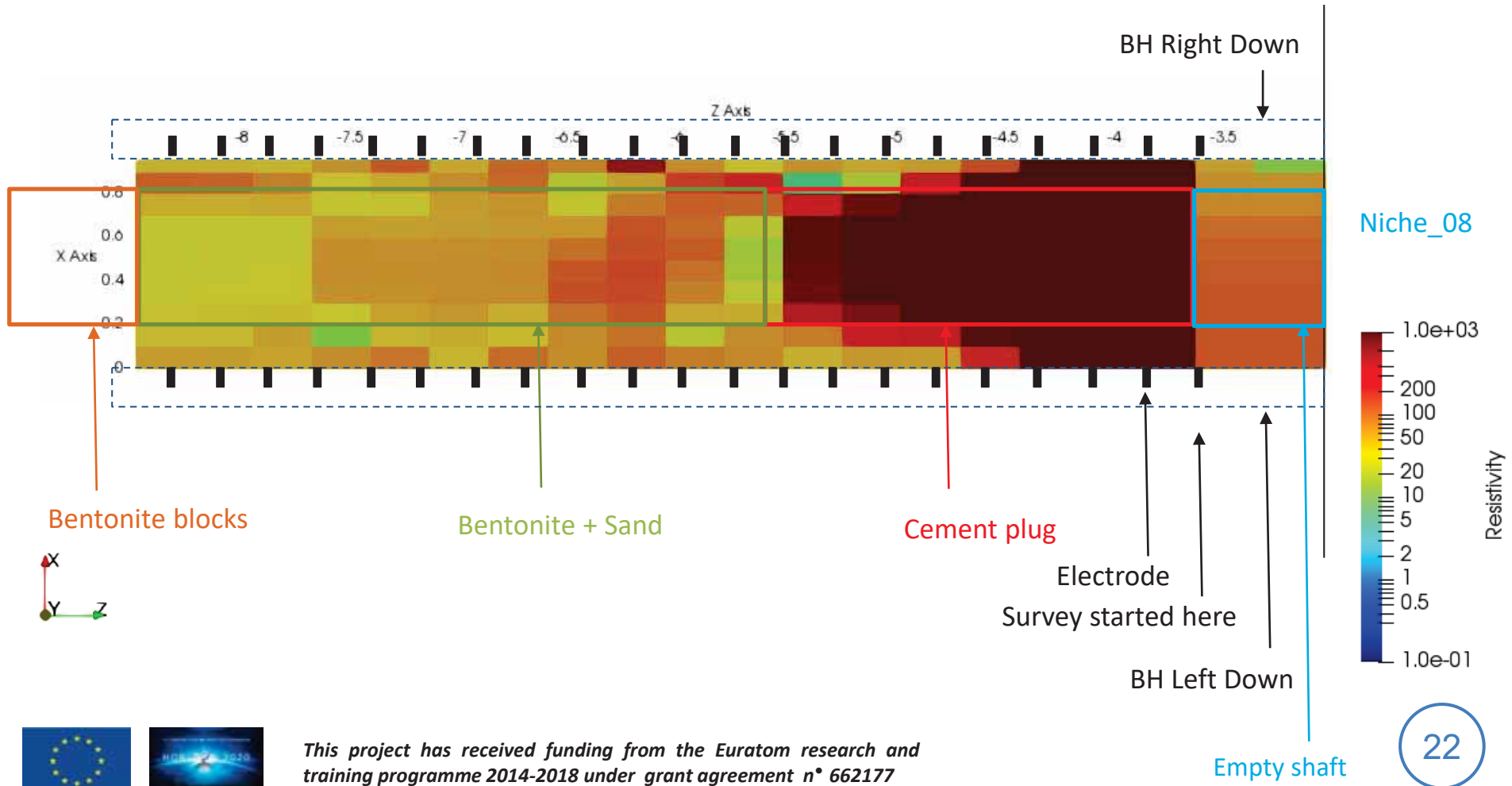
**ERT survey 1: after concrete
plug curing & before first
hydration**



View from Niche_08

TASK 3 – Sep 2018-onward: ERT monitoring surveys

ERT survey 1: after concrete plug curing & before first hydration



- Host rock resistivity around both experiments area is quite homogenous and $< 100\Omega\text{m}$;
- Preliminary results of the monitoring period for both experiments are also promising, different materials within the installation are identifiable and changes in resistivity due to water injection are also expected to be noticeable.
- The methodology developed for the electrode installation in boreholes and based on the use of PVC half tubes pushed against the borehole wall by inflatable pipes has proved to be successful. However, electrode contact resistance remains a challenge that needs to be addressed.



- Interpretation of resistivity results could benefit from time-lapse inversions.
- The possibility of using IPT associated with ERT are under consideration. This step would potentially allow indirect quantitative assessment of water content changes.

