

D. Dobrev<sup>1</sup>, M.Zuna<sup>1</sup>, V. Havlová<sup>1</sup>\*, J. Steinová<sup>2</sup>, M. Černík<sup>2</sup>, I. Pospíšková<sup>3</sup>

<sup>1</sup>ÚJV Řež, a. s.; <sup>2</sup>Technical University in Liberec; <sup>3</sup>Radioactive Waste Repository Authority

\*vaclava.havlova@ujv.cz



## Introduction

Development of the disposal canister for spent nuclear fuel is fully integrated along with research of potential materials corrosion resistance under presumed conditions of a deep geological repository (DGR). Czech disposal concept for spent nuclear fuel is based on a steel canister, which will be surrounded by compacted bentonite in a granitic host rock. The canister is presumed to consist of carbon steel overpack and stainless steel canister, nowadays with presumed maximum temperature 90 °C at the surface during the disposal.

## Material Corrosion Test (MaCoTe)

The Material Corrosion Test (MaCoTe), lead by Nagra, is therefore focused on corrosion test in natural granitic host rock in Swiss underground laboratory Grimsel Test Site (GTS). The main goals of the experiments are:

- ❑ Provide confirmation of the long-term anaerobic corrosion rate of canister materials in compacted bentonite under repository-relevant environmental conditions
- ❑ Provide experimental evidence of the inhibiting effect of the compacted bentonite on microbial activity

Two types of corrosion tests are performed, non-heated and heated corrosion test. Both types of corrosion tests are long term.

## MaCoTe Heated experiment

- ❑ Based on emplaced of 5 corrosion modules with samples in five individual boreholes in a granitic host rock (GTS).
- ❑ Anaerobic conditions to simulate the DGR granitic host rock environment. T
- ❑ Heated up to 70 °C at samples surface
- ❑ Three types of modules
  - ❑ Czech bentonite and carbon steel samples
  - ❑ MX80 bentonite and carbon steel samples
  - ❑ MX80 bentonite and copper coating sample
- ❑ Construction of the modules
  - ❑ Metal samples
  - ❑ Bentonite rings
  - ❑ Filtration fabric (saturation of bentonite)
  - ❑ Perforated outer casing
- ❑ All five boreholes have been sampled for groundwater for chemical and microbiological analyses within the whole period.
- ❑ Up to now, the metal samples has been already taken from 2 boreholes and transferred to the laboratory for post mortem analyses.
- ❑ Metal samples, corrosion products and bentonite after exposition were analysed
- ❑ Thorough microbiological characterization waas applied both to borehole groundwater and bentonite
- ❑ The latest sampling (after 3 years) took place in November 2018.



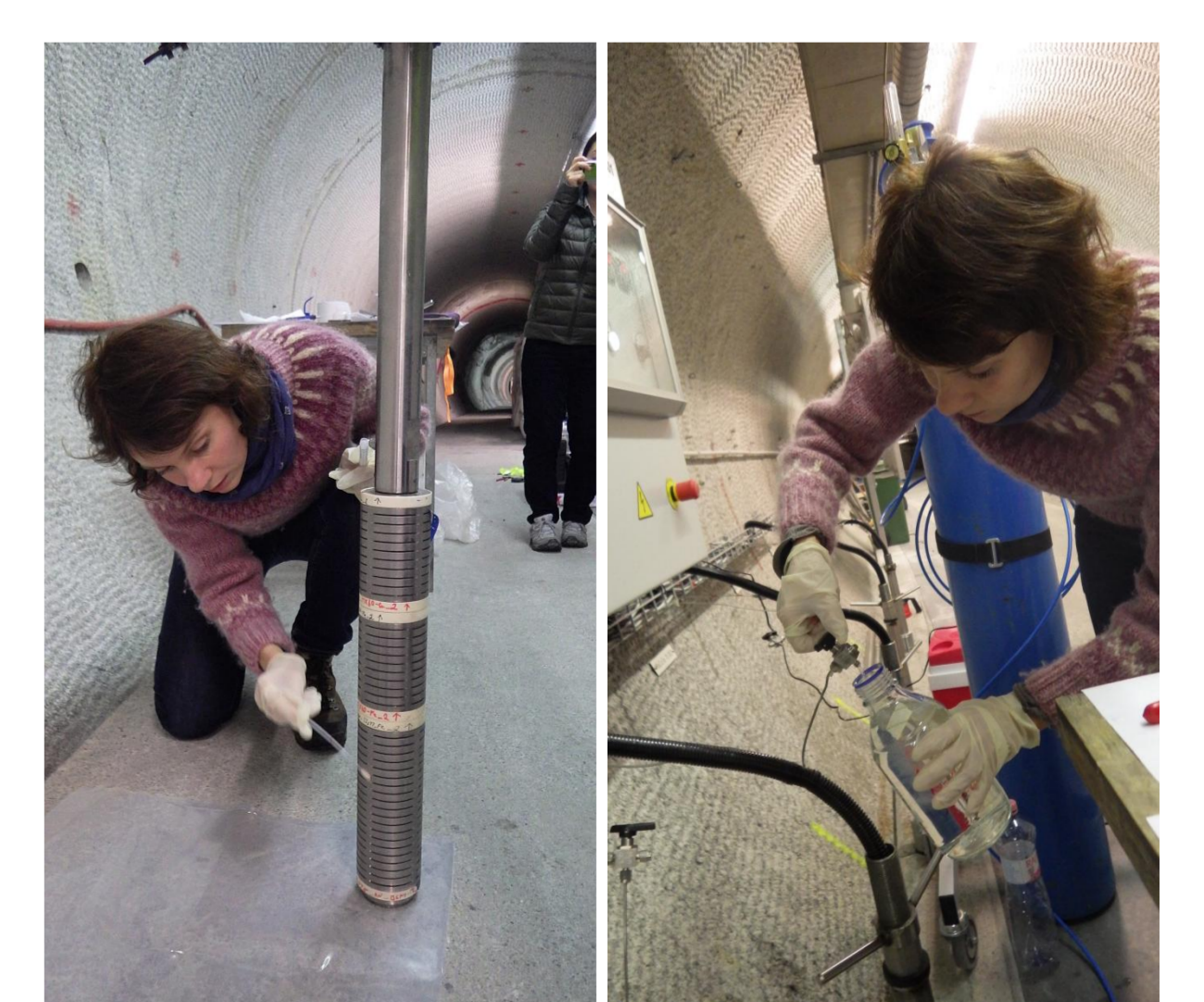
**Fig. 1** Modules used in heated material corrosion test (from the left): Czech bentonite + carbon steel, MX80 + carbon steel, MX80 + Cu coating.



**Fig. 2** Corrosion modules (left) instrumented into the boreholes at the start of the experiment in GTS (right)



**Fig. 3** Dismantled module (up) and the metal sample after 1 year exposure (in anaerobic box)



**Fig. 4** Sampling for microbiology

## Future steps

- The remaining sample modules left in their respective boreholes and are planned for sampling in the campaigns during the following years of the heated experiment.
- **Similar type of experiments would be worth for any alternative canister concepts even those taking into account increased temperatures**

## Acknowledgement

The CZ research is being funded by SÚRAO. The following institutions are involved in MACOTE project: NAGRA, RWM, NWMO, NUMO, SÚRAO (ÚJV/Technical university in Liberec).

