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TIMODAZ

Thermal Impact on the Damaged Zone Around a Radioactive Waste Disposal in Clay Host Rocks

(Contract Number: FI6W-CT-2006-036449)

Executive Summary of the activities (3rd year)

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PU	Public	PU
RE	restricted to a group specified by the partners of the TIMODAZ project	
CO	confidential, only for partners of the TIMODAZ project	

TIMODAZ

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Executive summary

1 Nature and scope of the project

Spent nuclear fuel and long-lived radioactive-waste management is an important environmental issue today. Disposal in deep clay geological formations is one of the promising options to dispose of these wastes. An important item for the long-term safety of underground disposal is the assessment of the damaged zone extent induced both by the excavation process and the thermal impact.

The TIMODAZ project studies the Thermo-Hydro-Mechanical and Chemical (THMC) processes occurring around a repository. It focuses on the study of the combined effect of the EDZ and the thermal impact on the repository host rock. The influence of the temperature increase on the EDZ evolution as well as the possible additional damage created by the thermal load is investigated. The knowledge gained within the TIMODAZ project will allow to assess the significance of the TDZ (Thermal Damaged Zone) in the safety case for disposal in clay host rock and to provide direct feedback to repository design teams.

Three types of clay are investigated: the Boom Clay, the reference Belgian host formation, the Opalinus Clay, that of Switzerland and, the Callovo-Oxfordian argilitte (COX), the host formation of France.

1.1 Consortium

The research activities covered by TIMODAZ calls for multidisciplinary expertise involving both European radioactive waste management organisations together with the main nuclear research institutes supported by other research institutions, universities, industrial partners and consultancy companies (SME's).

The TIMODAZ consortium is composed of 15 participating organisations representing in total 8 countries: ESV EURIDICE GIE (BE), NAGRA (CH), SCK•CEN (BE), GRS (DE), NRG (NL), CIMNE (ES), EPFL (CH), ULG (BE), UJF (FR), ENPC (FR), CEG-CTU (CZ), ITASCA (FR), ASC (UK), ITC (CH) and SOLEXPERTS (CH).

1.2 Priorities of project

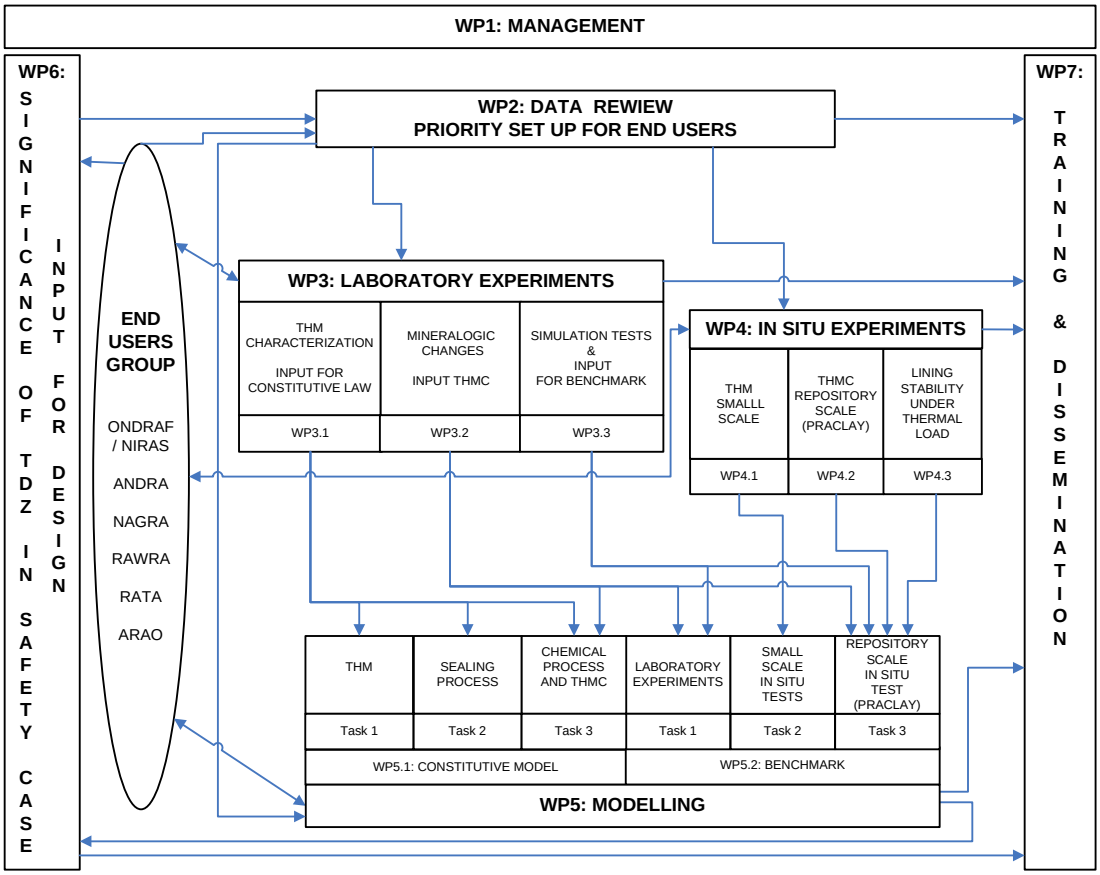
An important item for the long-term safety of underground disposal is the proper evaluation of the Damaged Zone (DZ) in the clay host rock. The DZ is defined here as the zone of the host rock with Thermo-Hydro-Mechanical and Chemical (THMC) modifications induced by the repository, with major changes in the transport properties of radionuclides. These transport properties are the low permeability of clays, a slow diffusive transport combined with the absence of preferential migration pathways for solutes and some sealing capacity.

The DZ is first initiated during the repository construction. Its behaviour is a dynamic problem, dependent on changing conditions that vary from the open-drift period to the initial closure period and the entire heating-cooling cycle of the decaying waste.

The early THMC disturbances created by the excavation, the operational phase and the thermal load might be the most severe transient that the repository will undergo on a large spatial scale and in a relatively short period of time. Consequently the priorities of the TIMODAZ project have been set on the study of the combined effect of the excavation and the thermal impact on the host rocks around a radioactive waste disposal.

1.3 The project structure

The project is broken down in 7 Workpackages as shown below.



Structure of the TIMODAZ project

Starting from WP2-*Data review and priority set-up for end-user*, participants in TIMODAZ will situate their results in the long-term performance contexts, with the constant support of WP6-*Significance of TDZ in safety case*. All experimental works to be performed in TIMODAZ in WP3-*Laboratory experiments* and WP4- *In-Situ experiments* will contribute to a better understanding of the processes occurring within the clay around a disposal system for heat-emitting waste during the thermal transient phase. As this transient should span over several centuries, the development and testing of sound, phenomenology-based models in WP5-Modelling is an essential step in meeting the Safety Case requirement of adequate

understanding of the long-term evolution. Knowledge management and the dissemination of results are also key elements of the TIMODAZ project. Trainings, workshops and international conferences are managed within WP7-*Training and dissemination*.

2 Results achieved at the end of year three

WP1 - Management

This workpackage consists in the technical, administrative and financial management as well as the co-ordination and administration at all levels between the parties and the EC, including communication.

Following meetings were organised during the reporting period to strengthen the communication of the information between the TIMODAZ project and other European projects of interest:

- 5th and 6th coordination meetings
- 3rd Governing Board meeting
- 2nd end-user workshop
- TIMODAZ- THERESA exchange meeting

The web-based TIMODAZ portal stays operational, which constitutes an efficient tool to exchange information and documents between the consortium partners.
The general framework of the project and the specific scientific topics were communicated to the end-user group. According to the recommendation of the end-users formulated after 1st end-user workshop (Deliverable 3), the 2nd **end-users workshop** was organised at 22 Jan. 2009 in Grenoble, during which three joint "pheno-PA" presentations were given. The end-user group agreed with the continuation of the project and didn't suggest a reorientation.
The international conference/workshop on "Impact of Thermo-Hydro-Mechanical-Chemical (THMC) processes on the safety of underground radioactive waste repositories" jointly organised with EC project THERESA was successfully held from 29 Sep. to 1 Oct. 2009 in EC conference centre in Luxembourg. The proceeding is under preparation and will be published at mid 2010!

WP2 - Data review and Priority set up for End-user

This workpackage was completed during first year of the project.

WP3 - Laboratory experiments

Based on the state of the art report, the objectives of the test programme have been reviewed, the protocols of the tests were established and approved by end-user.
Tests under well controlled temperature/stresses/pore pressure conditions with different loading paths are planned to determine the parameters of the Thermo-Hydro-Mechanical constitutive models used for the numerical modelling. More specifically, the thermal effects on the damaged clay and the possible damage induced by the thermal loading itself will be investigated. During the tests, different techniques will be used to evaluate the sealing/healing processes. Some tests consist in simulating the excavation of a gallery in hollow cylinders and the impact of temperature on the excavation damaged zone.
The experimental challenges faced in the TIMODAZ project to tackle coupled THM phenomena in relation with damage evolution in the EDZ are significant. The very low

permeability of the clays investigated also involves quite long testing periods and specific experimental precautions.
The delicate technical problems are well/relatively well controlled by most partners; most of the new equipments are now operational. Some valuable tests results have been obtained.
In order to get valuable test results, all testing equipments developed in the TIMODAZ were carefully tested and calibrated. Figure 1 shows the calibration results of the hollow cylinder triaxial apparatus (HCTA) developed by ENPC. The calibration tests were carried out on a permeable Rothbach sandstone.

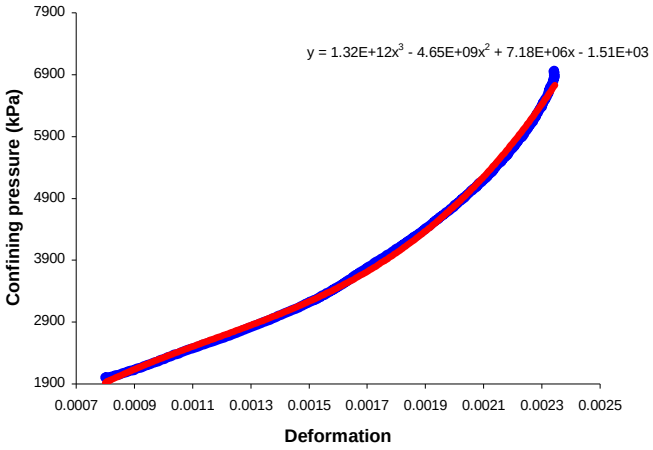
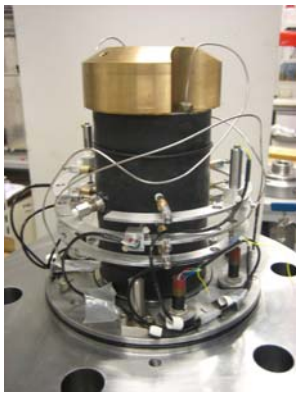
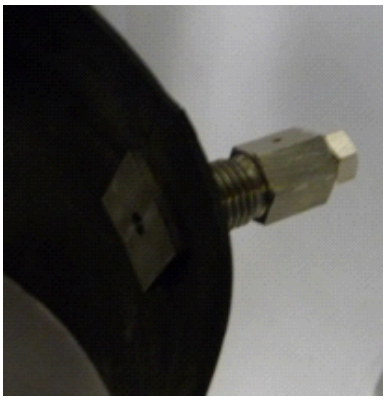


Figure 1 : Isotropic compression test on the Rothbach sandstone for calibration of the hollow cylinder triaxial apparatus (HCTA) developed by ENPC

Moreover, in the course of the experiments, continual efforts were made to improve the testing system in order to better control the test boundary conditions and thus optimise the testing protocol, especially the loading rate including heating/cooling rate controls. Indeed, the loading (including heating) rates affect strongly the test results, good controls of them are very important for the understanding/interpretation of the test results. Figure 2 shows the complex strain measurements device and drainage systems of the hollow cylinder triaxial apparatus (HCTA) developed by ENPC. The inner and outer drainage systems allow to perform the drainage in different positions/directions/conditions and thus to provide information on hydraulic anisotropy effects. Figure 3 illustrates the procedure adopted by ENPC to optimise the loading rate of the test under different drainage and confining conditions. Figure 3 b indicates clearly the effect of the loading rate on the test responses. Figure 3c illustrates clearly the interest of the hollow cylinder drainage configuration at the loading rates of 0.1 and 0.5 kPa/min. The rate of 0.5 kPa/min can be adopted to perform real drained loading tests with the HCTA on Boom clay based on this investigation.

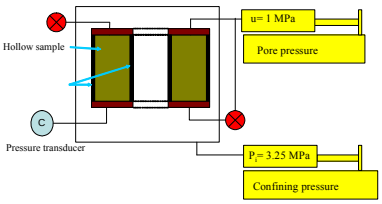


Axial and radial LVDT used for strain measurements

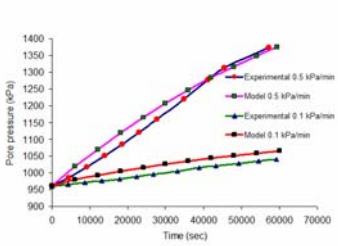


Lateral drainage connections

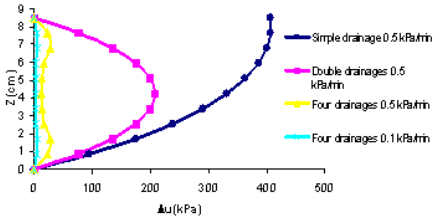
Figure 2 : strain measurements device and drainage systems of the hollow cylinder triaxial apparatus (HCTA) developed by ENPC



a) Drainage/confining system control



b) Different test responses



c) Numerical investigations

Figure 3 : Determination of the loading rate of test

Interesting test results have been obtained by different partners during the third year of the project.

At ENPC, The first tests were carried out with the hollow cylinder apparatus (HCTA) on Opalinus clay and Boom clay. By providing interesting results on the impact of fast thermal loading on the damage through the changes in permeability in both axial and radial drainage, the interest of this new apparatus has been demonstrated. Results show that fast heating at 80°C has an impact on both the radial and axial permeabilities through the opening of cracks due to water thermal dilation, either in the bedding direction or along the shear plane. The good self-sealing properties of both clays are demonstrated both after shearing at 25°C and after applying a temperature cycle (25-80-25°C) on the sheared specimen: the final values of permeability come back quite close to initial value.
Figure 4 gives the stress path for the THM-damage test on Opalinus clay, similar stress path was applied to test on Boom clay. Test results for both clays are given in table 1 and 2 respectively.

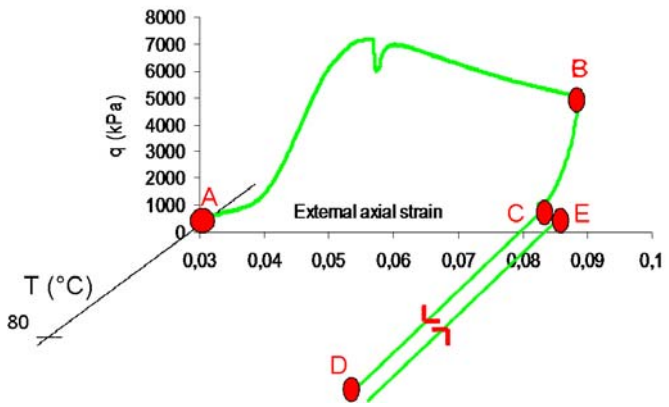


Figure 4. Stress path of the THM-Damage test on Opalinus clay

(Five permeability tests were performed afterwards: (A) before shearing under in-situ conditions, (B) after shearing, (C) after shear stress release, (D) after heating up to 80°C and finally (E) after cooling until 25°C)

Permeability	$k_r\,(m^2)$	$k_z\,(m^2)$	k_z/k_r
Before shearing (A)	3.1×10^{-20}	3.6×10^{-19}	11.6
After shear (B)	1.8×10^{-20}	1.8×10^{-19}	10
Back to zero shear (C)	1.3×10^{-20}	1.8×10^{-19}	13.8
At 80°C (D)	3.9×10^{-20}	7.1×10^{-19}	18.2
Back to 25°C (E)	1.5×10^{-20}	2.0×10^{-19}	13.3

Table 1 : Permeability values obtained along the THM-damage stress path, Opalinus clay

Permeability	$k_r\,(m^2)$	$k_z\,(m^2)$	k_z/k_r
Before shearing (A)	6×10^{-20}	3×10^{-19}	5
After shear (B)			
Back to zero shear (C)	2.8×10^{-20}	1.5×10^{-19}	5.4
At 80°C (D)	5.5×10^{-20}	2×10^{-19}	3.6
Back to 25°C (E)	2.8×10^{-20}	1.5×10^{-19}	5.4

Table 2. Permeability values obtained along the THM-damage stress path, Boom clay

At UJF, a series of triaxial test has been performed to study the effect of a thermal loading (heating/cooling process) on the already damaged clay, i.e., to evaluate the impact of the thermal loading on the process of localisation and/or fracturing. Systematic X-ray CT and the permeability measurement on sample at the different testing phases are performed to assist the investigation (figure 5). In total, 5 tests on Boom clay have been completed, a 6th test is on-going to give redundant results. The systematic use of X-ray CT allowed assessing the presence of pre-existing discontinuities in the specimen and their impact on specimen deformation upon deviatoric loading.

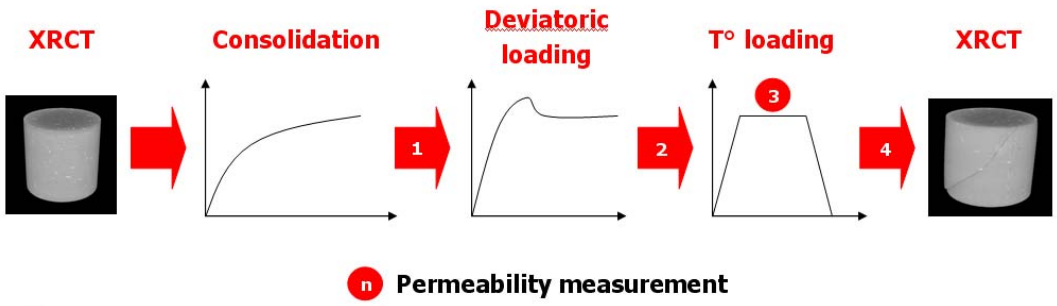
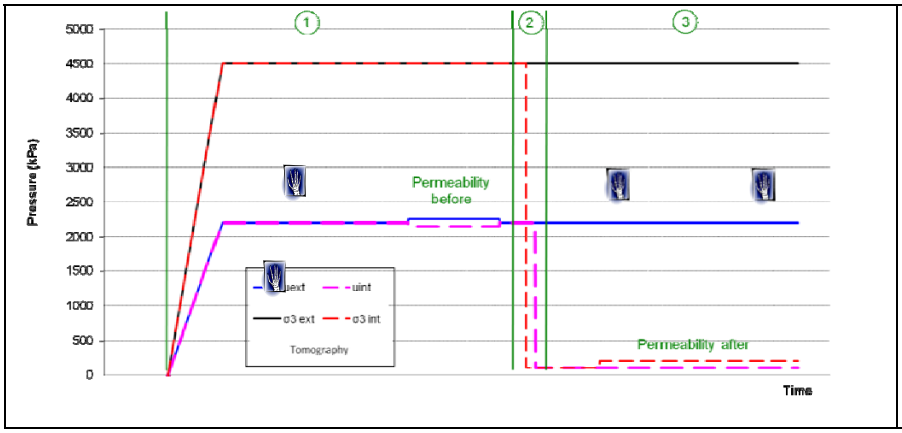


Figure 5 : triaxial HTM test procedure (UJF tests)

At EPFL-LMR, the simulation tests on middle-scale hollow cylinder triaxial cell were well advanced. The test procedure simulates the stress paths encountered around disposal galleries for heat emitting radioactive waste in laboratory in order to study the fracturing and sealing processes that develop in the Excavation Damaged Zone around galleries in clayey formations and the impact of a thermal phase on their evolution (figure 6).
The test results will be served as the numerical benchmark exercise to validate the numerical tools developed in the TIMODAZ project.
To study the development and the evolution of the damaged zone induced around the central hole without removing the sample from the testing cell, permeability measurements and X-Ray Computerized Tomography (XRCT) are carried out at different steps of the experiments. These results are then checked after disassembly of the test by visual inspection of saw-cut sections.



3 steps of the testing procedure:

1: Recovery of in situ stress conditions
2: EDZ Generation
3: Heating and cooling cycle (foreseen in the future)

Figure 6 : Stages of the testing procedure adopted for simulation tests in EPFL-LMR

After about one year of preliminary tests carried out to adapt and check the testing device and procedure, a first test was completed on a sample of Opalinus Clay cored parallel to the bedding planes. Then, 3 experiments were carried out on samples of Boom Clay taken from cores parallel to the bedding planes and 2 others on specimens cored in Praclay blocks in the direction perpendicular to bedding.
Figure 7 illustrates the fractures pattern observed after the laboratory test on Opalinus clay. The similar fracture pattern was observed in a borehole EDZ in Mont terri (WP 4.1) as illustrated in figure 8, which shows the EDZ analysis from the cutting the sections of the overcore of a borehole.

These similar observations from laboratory tests performed by EPFL-LMR and in situ test performed in Mont-Terri have significantly improved the damage process around excavation in Opalinus clay.

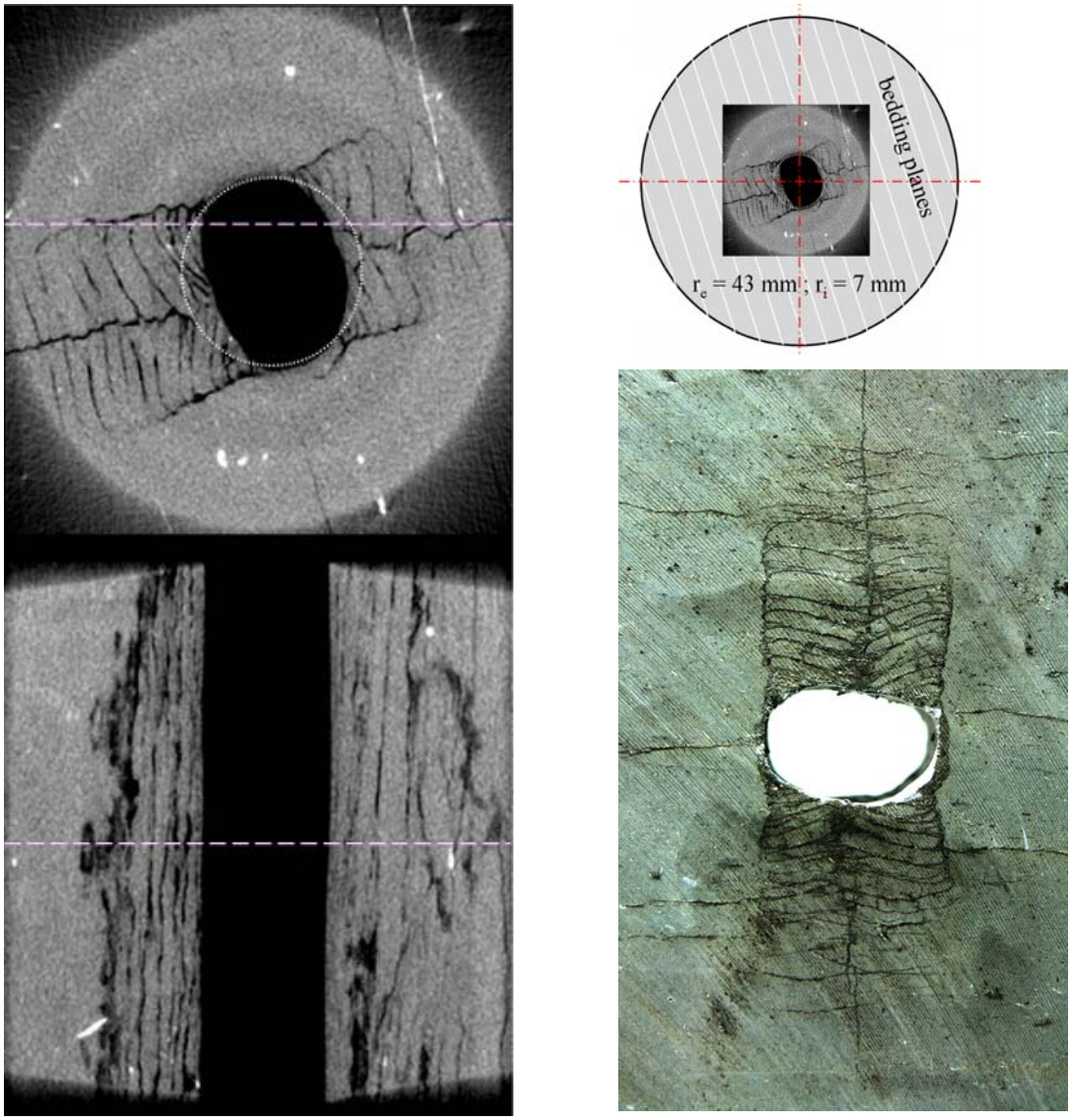


Figure 7 : Fractures pattern observed after the laboratory test (i) by means of a high resolution XRCT (left and upper right pictures; Phoenix scans) and (ii) visually after sawing of the of the sample (lower right). Original diameter of the inner borehole: 14 mm.

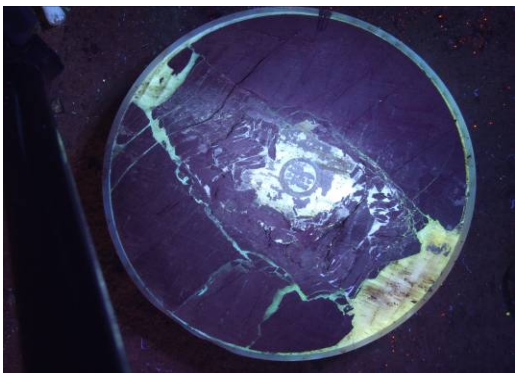


Figure 8: Section of the overcore of a borehole from 8.32 m under UV light. Bedding planes from lower left to upper right. Resin (light blue/green) delineates fracture network around the central borehole. Note the perfect positioning of the old (diameter 101 mm) borehole in the overcore (diam. 330 mm).

For tests on Boom clay, two different image processing methods are considered to investigate the displacement around excavation:

- Digital Image Correlation (DIC) analyses in collaboration with Stephen Hall of L3S-R, which allow to map the displacement field;
- Identification of pyrite inclusions and tracking of their movement, by means of the MATLAB Image Toolbox and ImageJ plugins.

Figure 9 shows first results obtained from the tracking of pyrite inclusions. It points out the anisotropic behaviour of Boom Clay. The difference in convergences in the "elastic" zone in the directions parallel and perpendicular to bedding (respectively about 0.7 and 1.1 mm) seems roughly in agreement with the anisotropic elastic moduli back-analysed from the ATLAS experiment at Mol. On the other hand, the convergence of the clay close to the hole wall is higher in the direction parallel to the bedding planes than in the perpendicular one. This later observation is consistent with the in situ observation in Boom Clay. During the excavation of the Praclay gallery, it was observed that the convergence appeared to be higher in the horizontal direction (so parallel to bedding) than in the vertical direction (so perpendicular to bedding) (81 mm versus to 55 mm, a ratio of about 1.5) (WP4.2).

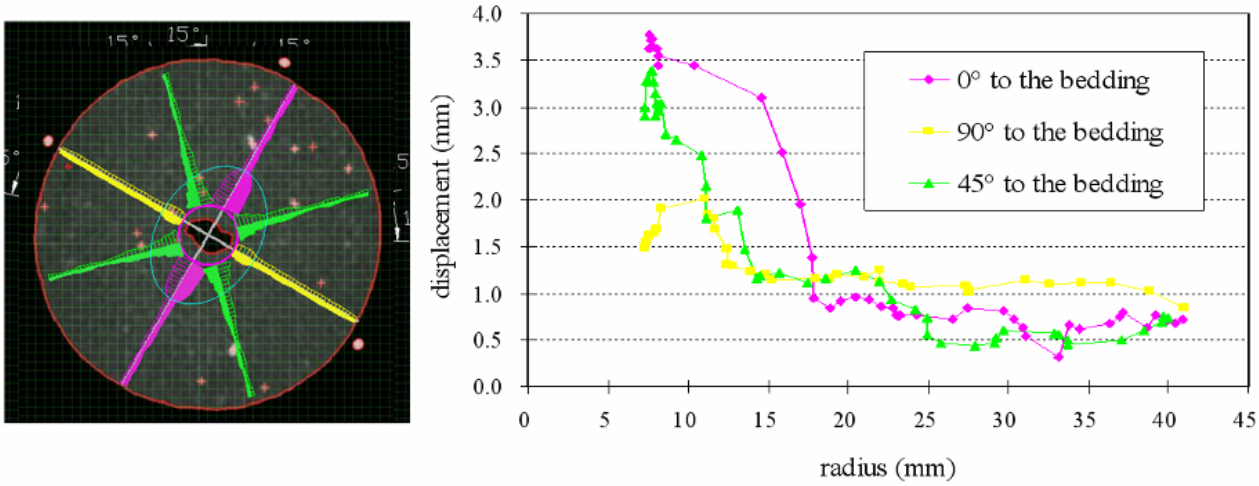


Figure 9 : First results obtained from the tracking of pyrite inclusions in the X-Ray scans. Radial convergence determined along three directions: parallel to bedding (magenta curve), perpendicular to bedding (yellow curve) and at 45° (green curve). Original diameter of the inner borehole: 14 mm.

At EPFL-LMS, three suction and temperature controlled odometer tests on Opalinus clay were performed. The suction and temperature dependent behaviour of Opalinus clay was put in evidence. Meanwhile, the water retention curves for both Boom clay and Opalinus clay at ambient temperatures were determined (figure 10 and 11)

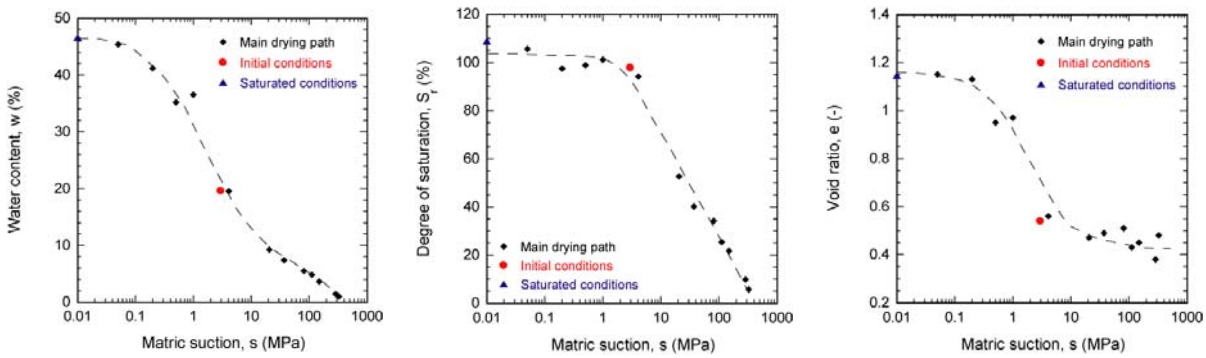


Figure 10: Water retention curve of Boom clay in term water content, degree of saturation and void ratio

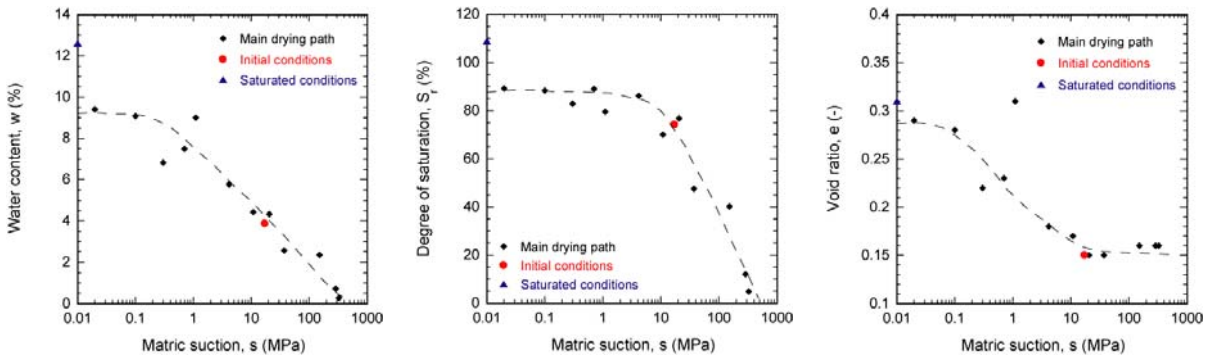
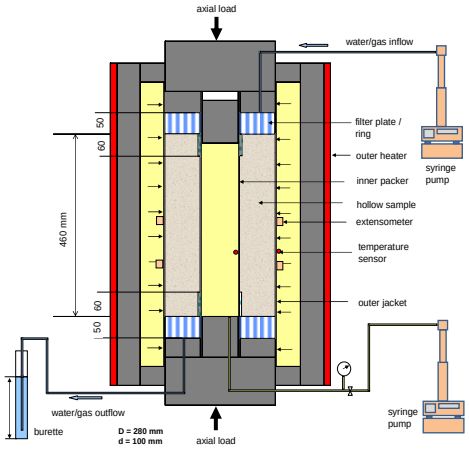


Figure 11: Water retention curve of Opalinus clay in terms of water content, degree of saturation and void ratio

At GRS, a series of swelling tests was performed on COX argillite to investigate thermal impact on the swelling capacity of the argillite. The swelling capacity of the COX heated up to 120°C was investigated in different conditions. Globally, the COX argillite, even though exposed to high temperatures up to 100 - 120°C and highly desaturated, still exhibits a significant swelling potential.

Within WP3.3, GRS has performed four simulation tests on large hollow cylinders of the COX argillite to investigate fracturing and sealing processes of the host rock around HLW disposal boreholes and to provide a data base for validation of constitutive models by benchmark exercise in the framework of WP5.2. Large cores were extracted from the Bure-URL and prepared to hollow cylinders of ~0.5m length and 280mm outer diameter with axially-drilled central boreholes of 100mm diameter. Figure 12 illustrates the test layout and pictures of a large COX hollow cylinder before testing. In the tests, the relevant processes regarding damage development such as borehole excavation, backfilling, heating and cooling were simulated, whereby responses of the COX hollow cylinders were monitored by various instruments for measurements of external confining stress, axial / radial strain,

borehole pressure / convergence, gas / water injection pressure, inflow / outflow, and temperature.



a. Layout of a simulation test

b. large sample before testing

Figure12: Layout of a simulation test on a large hollow cylinder in GRS' big triaxial apparatus

At ULg, several triaxial tests on Boom clay at ambient temperature were performed. Tests are followed by a benchmark protocol defined within the frame of another laboratory THM characterisation program for Boom clay. In addition, drying tests on well saturated boom clay samples were performed to study the effect of the hydraulic transfer properties through the tunnel face and through fractures on the HM behaviour of the studied clays during the open-drift phase.

Finally, SCK•CEN has started the permeability tests on pre-damaged Boom clay and Opalinus clay samples on permeameter and isostatic cells using solutions with different chemical compositions.
Meanwhile, the laboratory mineralogy analysis experiments on the combined effect of temperature and oxidising or alkaline plume conditions on Boom Clay and Opalinus Clay were finished.
The solutions with variable pH and chemistry were mixed with Boom Clay and Opalinus Clay in order to simulate the non-disturbed in-situ as well as geochemically disturbed pore water composition coupled with the heat effects. Laboratory test results indicated no or very limited mineralogical changes in both Boom clay and Opalinus clay for a set of heat and geochemical conditions within the experimental time frame. Altogether, the laboratory study points to a good buffering capacity of both clays and highlights the role of matrix to effectively prevent minerals from reacting with the applied solutions. Also, hydraulic conductivity tests on the clays perturbed with alkaline solutions indicated that the hydraulic conductivity values of reacted clays are comparable to those of the undisturbed material within the error of the measurement.

WP4 - In-situ experiments

Small and large scales in situ tests are performed in different underground laboratories within the TIMODAZ project:

- Small scale In situ ATLAS heater test in Hades, Mol : to study the THM behaviour of Boom clay

- Small scale In situ TIMODAZ/SE-H test (Self sealing with Heating) in Mont Terri: this test includes two phases : Phase A : overcoring of a previously tested borehole (EU Project SELFRAC) to improve the understanding of EDZ geometry and formation in bedding parallel boreholes as a small-scale equivalent to repository tunnels. Phase B: a heated experiment is planned to investigate the effects of temperature on the self-sealing of the EDZ.
- Large scale in situ heater test : Praclay experiment in HADES, Mol: to study the thermal impact on EDZ evolution and large scale THM behaviour of Boom Clay.
- In situ test in UEF Josef (Mokrsko) to study the lining stability under thermal loading

Figure 13 shows the evolution of the pore pressurisation coefficient (dP/dT) at different distance from the heater obtained from ATLAS test in Boom clay.

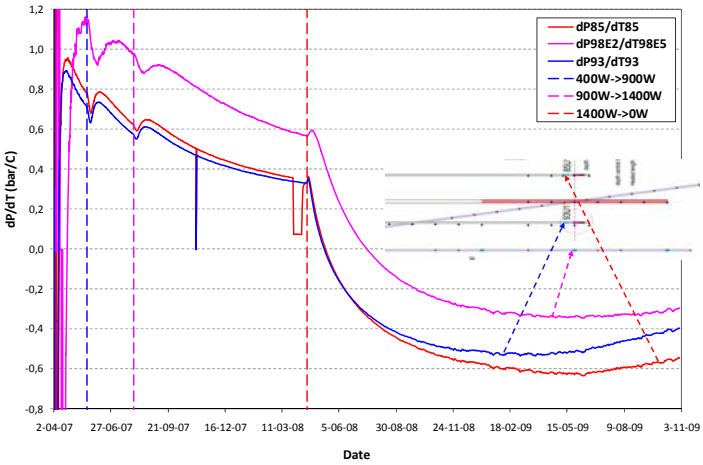


Figure 13 : pressurization coefficients evolution at different borehole

Figure 14 gives the temperature and pore pressure measurements from the SE-H Small scale in situ test at Mont Terri, which indicates that the propagation of the pressure and temperature signals in the rock normal and parallel to bedding differs significantly. Anisotropic behaviour was put in evidence.

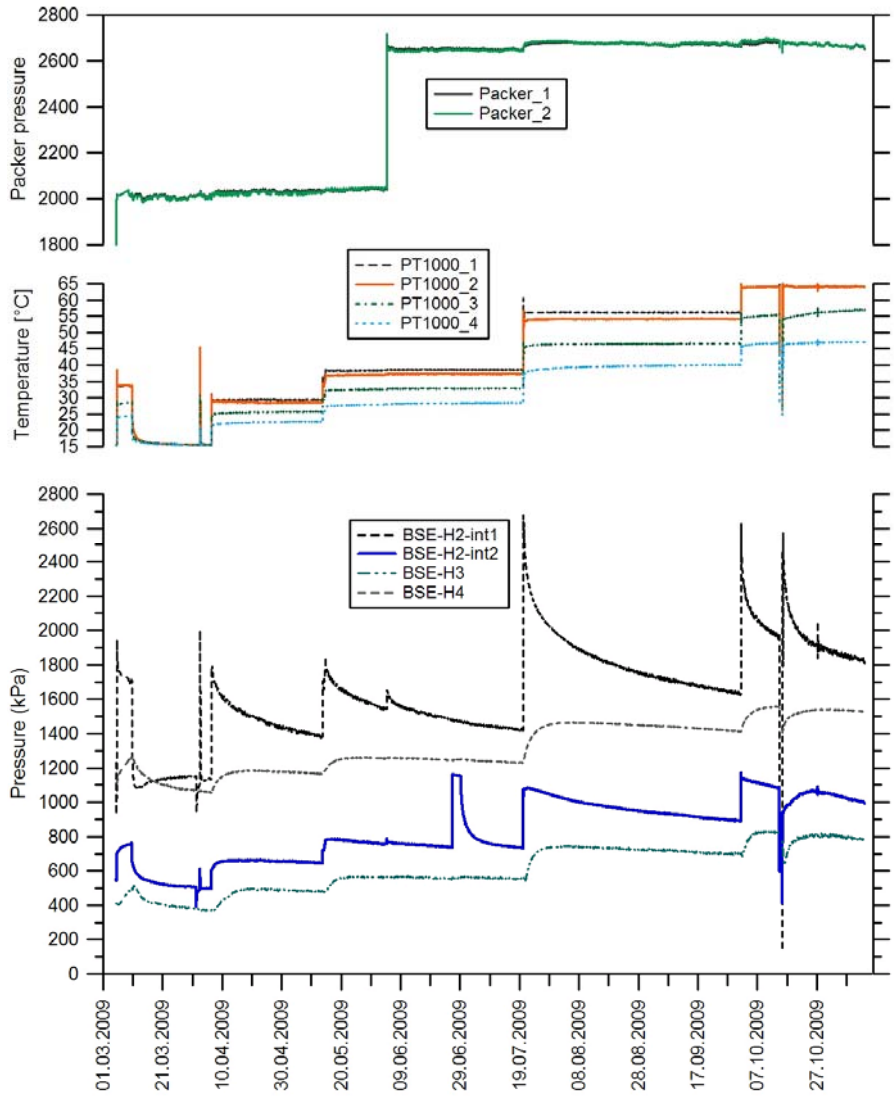


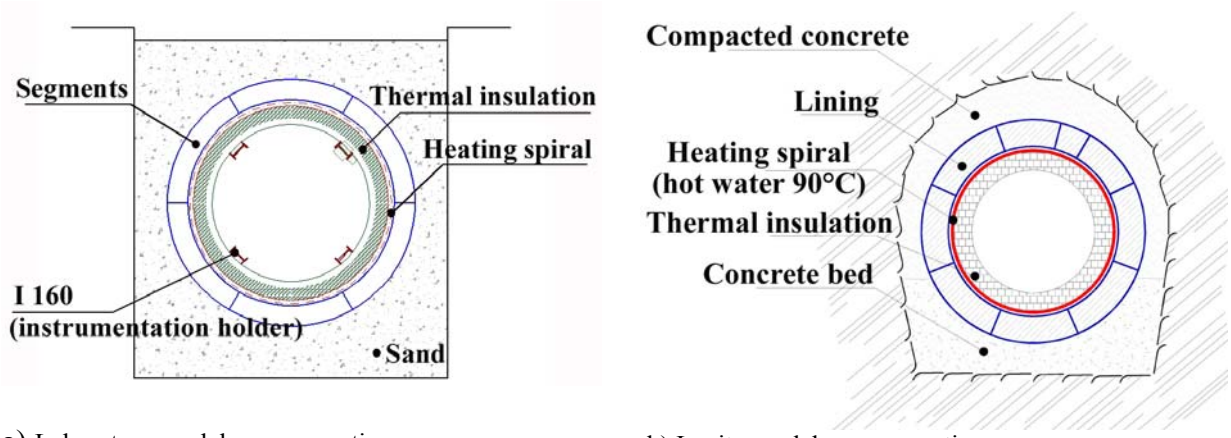
Figure 14: SE-H Small scale in situ test at Mont Terri. Temperature and pressure evolution (BSE-H2: heater borehole, BSE-H3/-H4: pore pressure observations recorded at 70 cm from the heater in the directions normal and parallel to the bedding, respectively.

At ASC, following work were done during the 3rd year of the project:

- Processing of the daily ultrasonic surveys for the period between September 2006 and July 2009.
- Inversion of processed ultrasonic velocities for the modelling of crack evolution for the period between September 2006 and November 2008.

Analysis of the daily ultrasonic surveys around Praclay gallery by ASC gives first insight on evolution of the EDZ and the sealing/healing capacity of Boom clay.

At UJF, Two physical models have been built to study the stability of the tunnel lining under long term thermal load. One is situated in the underground silo of the laboratory of the Centre of Experimental Geotechnics (CEG) in Prague (figure 15a), the other in the underground laboratory of the Josef UEF near Dobříš (figure 15b). Each of the physical models investigates a different extreme case in terms of tunnel lining loading.



a) Laboratory model – cross-section b) In-situ model – cross-section

Figure 15 : physical models to study the stability of the lining under long term thermal load

The laboratory model has been designed to allow lining deformation in the direction towards the surrounding environment (compacted sand) during thermal loading, the principal monitored parameters include temperature and deformation in such case.

The in-situ physical model aimed at, conversely, the study of limit loading. The model has been assembled in a rock continuum (hard tuffitic rocks). The space between the circular lining and the rock is backfilled with concrete, the deformation towards the surrounding environment is in principle constrained. The principal monitored parameters in this case include temperature and stress.

Laboratory model has been run for more than two years, valuable measurements were obtained.

The in situ experiment has been divided into 2 testing phases (phases 01 and 02) and 5 loading phases (of which phase 5 has not yet commenced):

a) Phase 01 – measurement during in-situ model assembly
b) Phase 02 – measurement during testing of the heating system
c) Phase 1 – 1st loading step (10°C – 40°C)
d) Phase 2 – 2nd loading step (40°C – 60°C)
e) Phase 3 – 3rd loading step (60°C – 70°C)
f) Phase 4 – 4th loading step (70°C – 80°C)
g) Phase 5 – 5th loading step (80°C – 90°C)

The heating phase was launched on 30th October 2008, about 1 year of measurements were obtained and analysed.

The final results of the tests will be reported in Deliverable 9.

WP5 - Modelling and benchmark

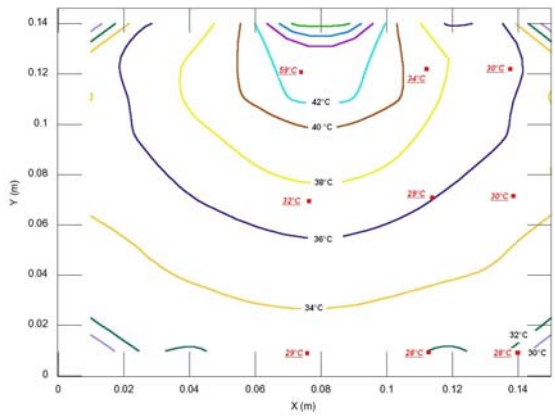
This workpackage aims to develop numerical tools allowing simulation at time and repository scale. The developed numerical tools will be validated through a series of benchmark exercises.

Following progress in development of the modelling tools constitutes a milestone for the project:

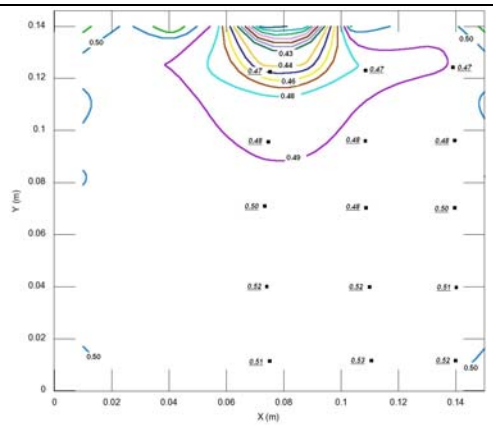
- The "THHMD" model developed by ENPC was implemented in the FE code Theta-stock and well validated through different laboratory and in situ tests on different types of rocks (Figure 16). This model is expected to be a useful tool in the design of nuclear waste repositories.

- The constitutive models for argillaceous rocks considering the effects of bonding, unsaturation, temperature changes and osmotic effect developed by CIMNE.
- The constitutive model AMEG-TS developed by EPFL – LMS describing the soil response under non-isothermal and unsaturated conditions
- The HM second gradient model developed by UJF and ULG with objective to provide objective descriptions of the behaviour in the post-localization regime – in particular the shear band thickness, which governs the interaction with other emerging or existing shear bands and with the water transfer properties (figure 17).
- Calibration of the THM parameters for COX and OPA for specific constitutive laws (GRS and ITASCA)

Moreover, the benchmarks exercises are well progressed and allowed getting a first insight on the THM responses of studied materials at laboratory and repository scales and putting in evidence some important influential factors on them.



distribution of temperature(after 2h heating)



distribution of the saturation degree(after 2h heating)

Figure 16 : simulation of a heating test performed on unsaturated compacted clay [Villar et al. 1993] using the "THHMD" model developed by ENPC
(Dots: experimental results from Villar et al. Isovalue curves: numerical results obtained with the "THHMD" algorithm in the elastic domain)

Figure 17: numerical study on the loss of uniqueness for a given boundary value problem in a biphasic material by means of HM enhanced model performed by UJF and ULg

Moreover, a series of benchmark has been defined and performed partly:
Benchmark 1: The benchmark 1 consists in simulating the large scale laboratory simulation test to be performed within the WP3.3 (Hollow-cylinder test to be performed by EPFL). Different cases considering different constitutive laws were studied.
Benchmark 2.1: The benchmark 2.1 is devoted to the in situ Mont Terri experiment. A first prediction has been done by Ulg.
Benchmark 2.2: The benchmark 2.2 is devoted to the in situ ATLAS experiment (Mol URL).
Benchmark 3: Blind prediction of the Praclay heater tests

The benchmarks exercises are well progressed and allowed getting a first insight on the THM responses of studied materials at laboratory and repository scales and putting in evidence some important influential factors on them.

WP6 - Significance of TDZ in Safety Case and Input for Design

The integration of the results obtained so far in the various work-packages of the TIMODAZ project resulted in the better understanding of the behaviour of clays during excavation and under thermal stress. Based on this understanding, the significance of the TDZ in the safety case has been assessed. This work will be continued in the next year, when new experimental results obtained in the TIMODAZ project become available.
The plastic strain of clay under thermal loading (thermo-plasticity) has been put in evidence. However, the intrinsic permeability of the clay seems not to be influenced much under thermal loading, and also the self-sealing capacity of clays seems not to be affected by the higher temperatures. So far no significant mineralogical modification of clay or modifications

of diffusion and retention (sorption) capacity of clay has been found. Anisotropic characteristics, including hydraulic anisotropy, thermal anisotropy as well as mechanical anisotropic behaviour, have been evidenced in both in-situ tests and laboratory tests. Overall, all the PA assumptions are still valid, and so far there are no indications that the thermal loading that would jeopardize the barrier capacity of host clays.

WP 7: Training and dissemination

This work-package brings together all activities concerning training including knowledge management and transfer. Knowledge management and the exploitation and the dissemination of results are key elements of TIMODAZ.

The following achievements were made in this reporting period

- An exchange meeting with THERESA project was organised, where all WP leaders from TIMODAZ delivered the main program and achievement of the project.
- The organisation of the International conference and workshop "Impact of Thermo-Hydro-Mechanical-Chemical (THMC) processes on the safety of underground radioactive waste repositories" – An international conference and workshop in the framework of the European Commission TIMODAZ and THERESA projects, Luxembourg, 29th September – 1st October 2009 co-organized with THERESA project and EC. There were more than 100 participants. More than 70 papers were submitted.
- The second end-user workshop was held.
- The second TIMODAZ training course was announced ("Impact of THMC processes in Performance Assessment", to be held at UPC in Barcelona, Spain, 13. – 15. January 2010. This required the advertising of the course, first version of the course programme, recruitment of the course tutors, start of registration to the course.
- First folder of TIMODAZ was written and exposed during the TIMODAZ/THERESA conference in Luxembourg.

3 Social impact

Public and political perception with respect to the nuclear waste issue will play a major role in determining the future of nuclear energy. The results of the TIMODAZ project will be situated in the context of the long-term performance of a repository. All of the experimental works to be performed in TIMODAZ will contribute to a better understanding of the processes occurring within the clay around a disposal system for heat-emitting waste during the thermal transient phase. As this transient should span over several centuries, the development and testing of sound, phenomenology-based models is an essential step towards meeting the Safety Case requirement of adequate understanding of the long-term evolution.

The knowledge gained within the TIMODAZ project will allow to assess the significance of the TDZ (Thermal Damaged Zone) in the safety case for disposal in clay host rock and provide direct feedback to repository design teams. To ensure an appropriate and continuous link between the end-user needs and the priorities of the TIMODAZ project, the following end-user group has been constituted: ONDRAF/NIRAS (BE), NAGRA (CH), ANDRA (FR), RAWRA (CZ), ARAO (SI) and RATA (LT). This group will be active throughout the duration of the project.

4 Project logo

5 Project web site:

www.timodaz.eu

6 Contact person

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