

# The Belgian demonstration programme for the disposal of high level and long lived radioactive waste

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TOPSEAL 06

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# ONDRAF/NIRAS

Belgium Research and Development programme to assess the feasibility of a final disposal of HLW

## CEN•SCK

R&D

- THM
- C
- Migration
- Corrosion

## EIG EURIDICE

Large Scale &  
Demonstration Tests

## Other scientific institutes

Specific studies



# The EIG EURIDICE scientific programme

- Scientific management of the HADES URL
- PRACLAY project:  
Faisability study of a final disposal infrastructure
  - Large scale and demonstration experiments
    - construction of the disposal infrastructure (shafts and access galleries, crossings, disposal galleries, ...)
    - THMC behaviour of Boom Clay at large scale
    - construction, handling and performance of the engineered barriers
- Exploitation and valorisation of other projects related to the final disposal: CLIPEX, SELFRAC





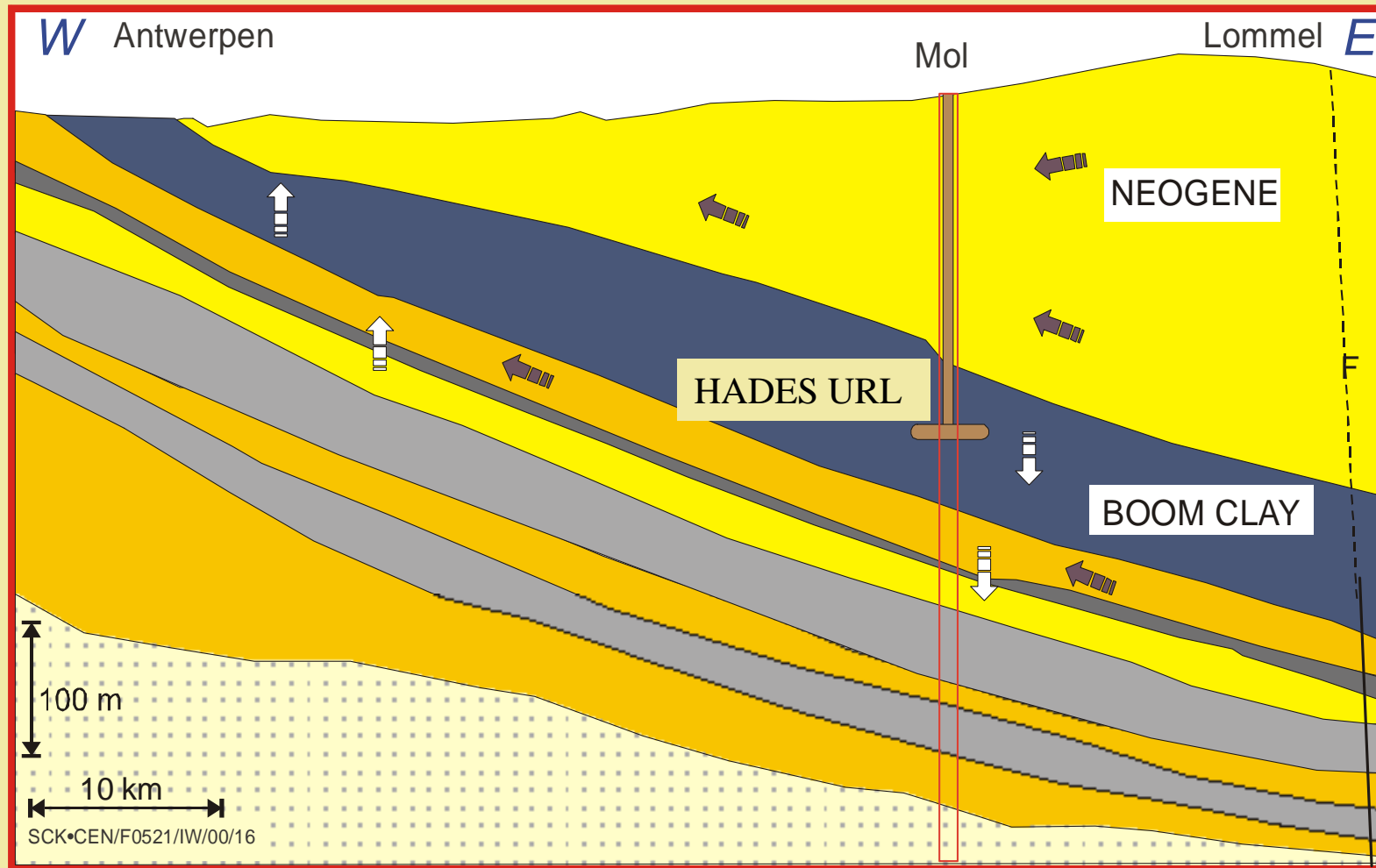
# The research infrastructure

Surface

Underground - HADES URL



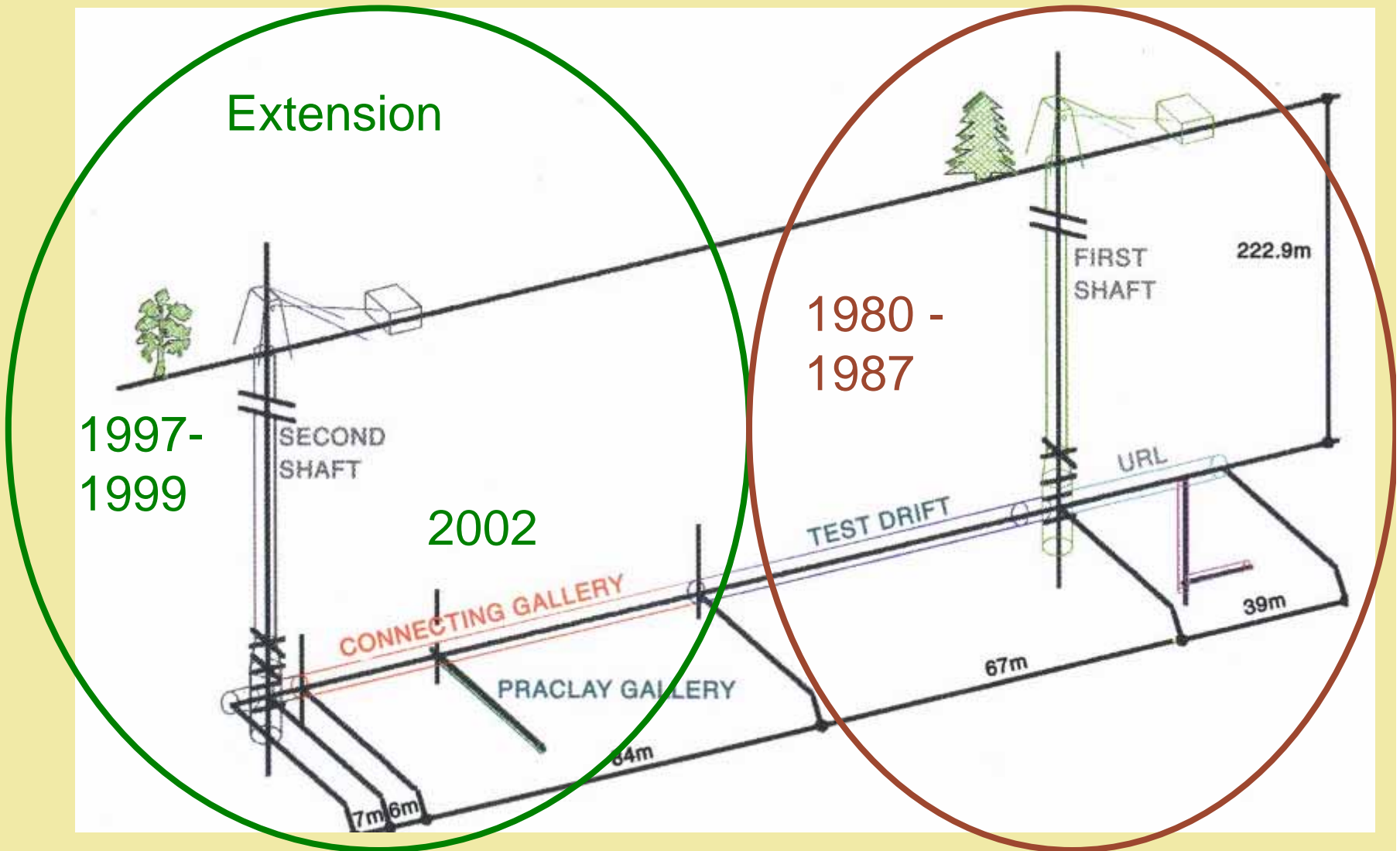
# Boom Clay between 190 and 290 m depth at Mol site



← Water flow direction in the aquifer    ↓ Leakage direction through the aquitard    F: fault area

# The extension of HADES

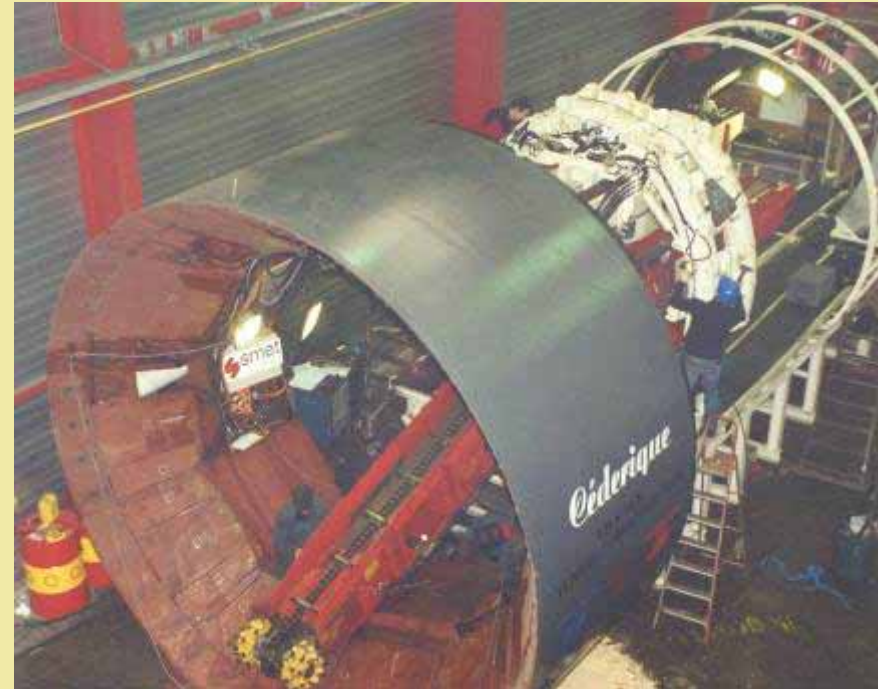
## Second Shaft + Connecting Gallery



# The feasibility to excavate Boom Clay by industrial technique is now demonstrated

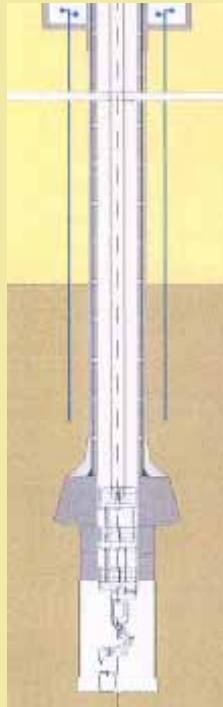


Second shaft

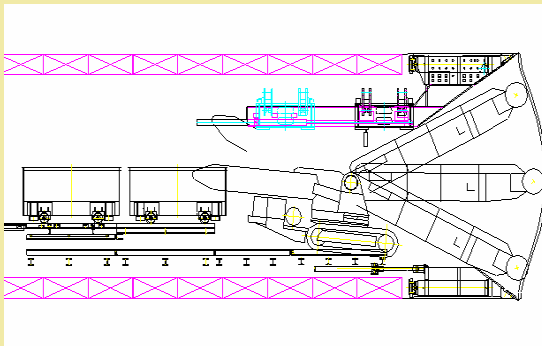


Tunnel machine used for the connecting gallery

# The main achievements are



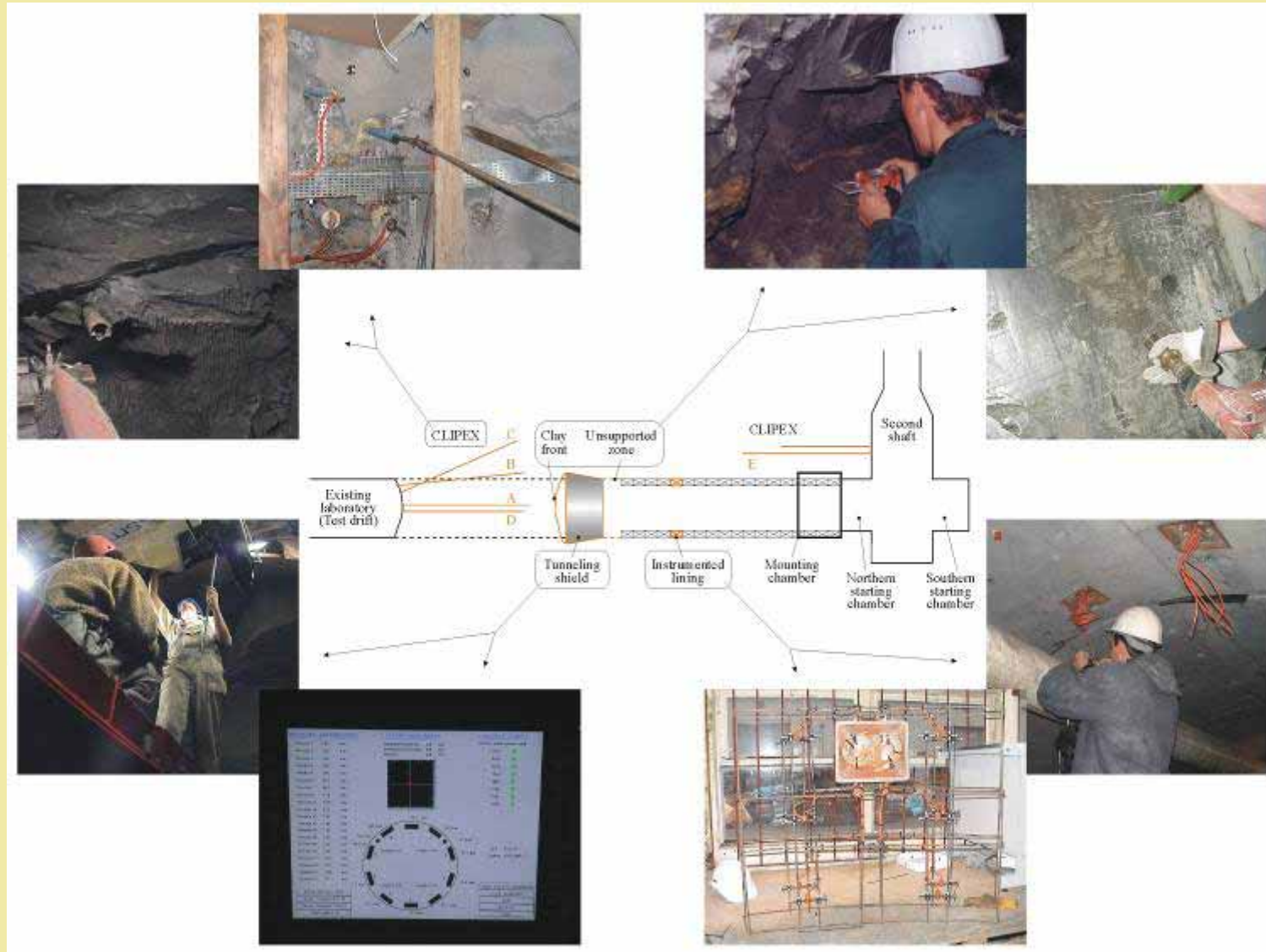
- Homogeneous mechanical behaviour from the top of the clay
- Active support behind the excavation front recommended



- High quality of the excavation
- 10 m/day should be possible
- Knowledge transferable to other cohesive soils



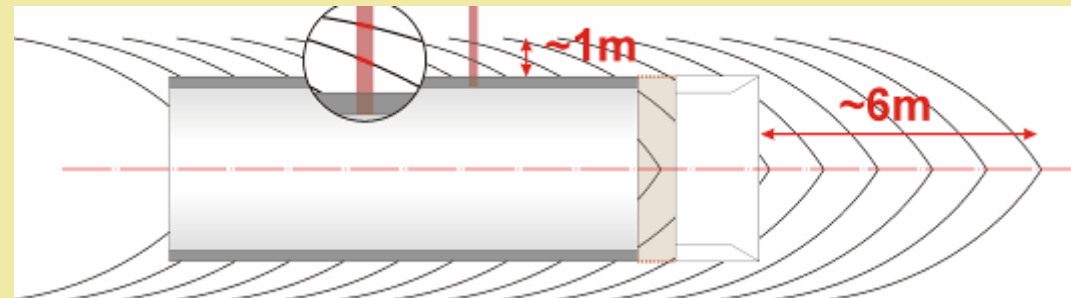
# Observations and monitoring of the connecting gallery



# The EC CLIPEX project has allowed to characterise the HM perturbation

- HM behaviour

- Fracturation scheme around the gallery



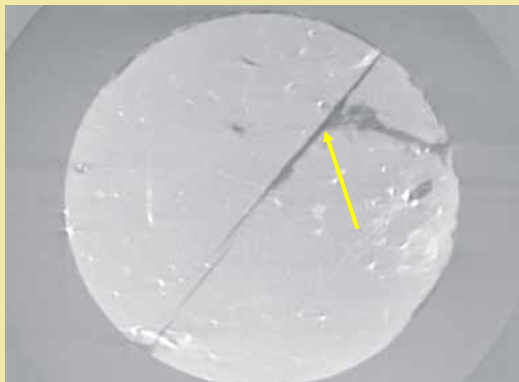
- Hydraulic pressure variation in the far field

- Good prediction of the convergence and of the total pressures

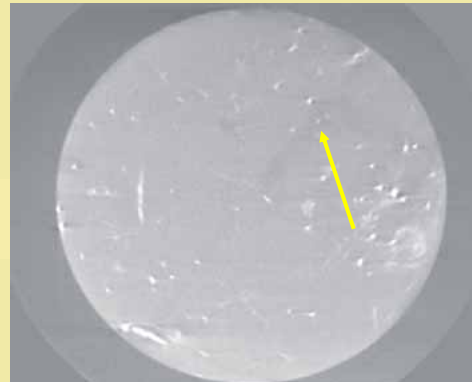
- optimum design of the tunnel machine

The impact of the HM perturbation on the performance of the disposal system has been studied within SELFRAC EC project

- EdZ  $\neq$  EDZ
  - EdZ: disturbed Zone
    - no significant changes in flow and transport properties
  - EDZ: Damaged Zone
    - significant changes in flow and transport properties
- Quick sealing after flooding of the fractures



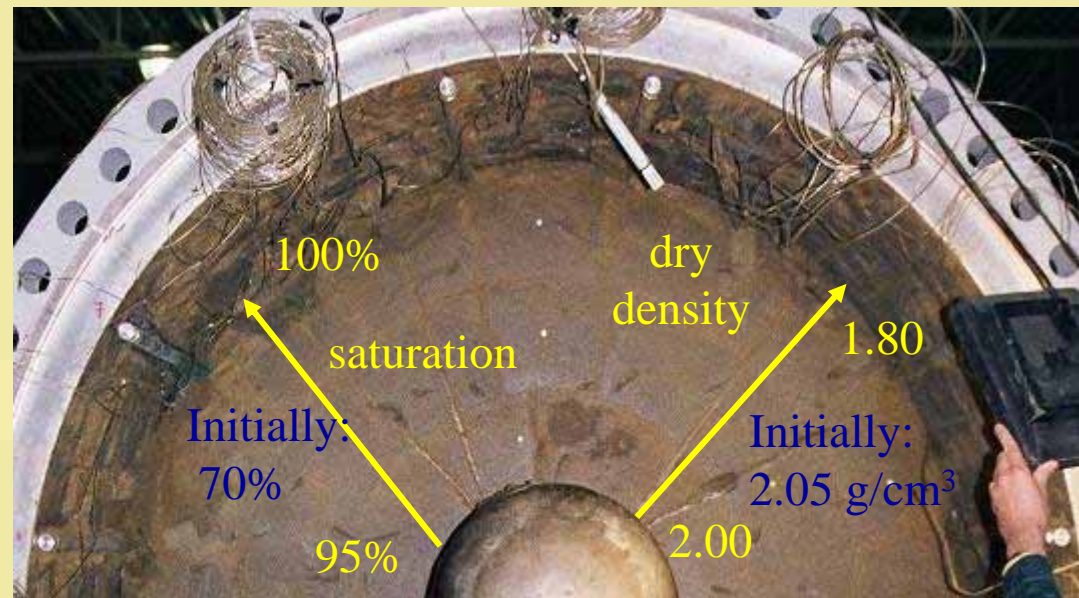
Initial discontinuity



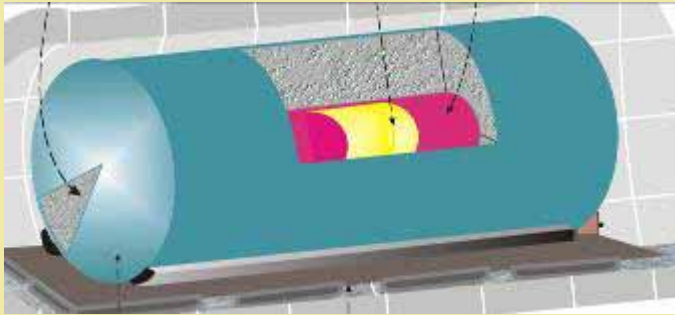
Sealing after flooding

# OPHELIE based on the SAFIR-2 design ('90)

- Handling and fabrication of bentonite blocks
- Sealing of all technological voids
- Slow and unhomogenous hydration
- Concentration of chloride and sulfide species
- No significant mineralogical changes
- Bacteriological developpement
- $T > 100^{\circ}\text{C}$ : Complex phenomena



# ONDRAF/NIRAS is considering now three disposal design alternatives

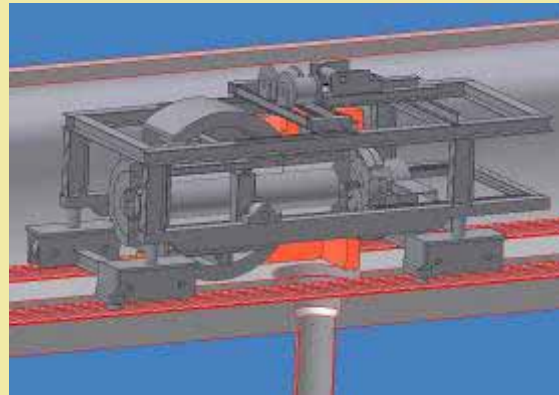


Supercontainer

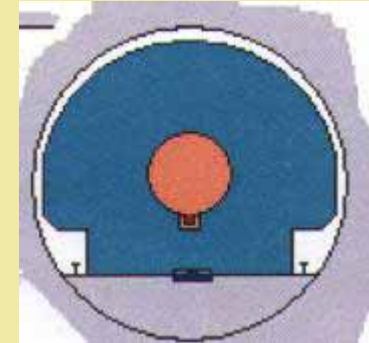
(See Key-Note paper:

Development of the Supercontainer Design

J. Bel and R. Gens)



Borehole

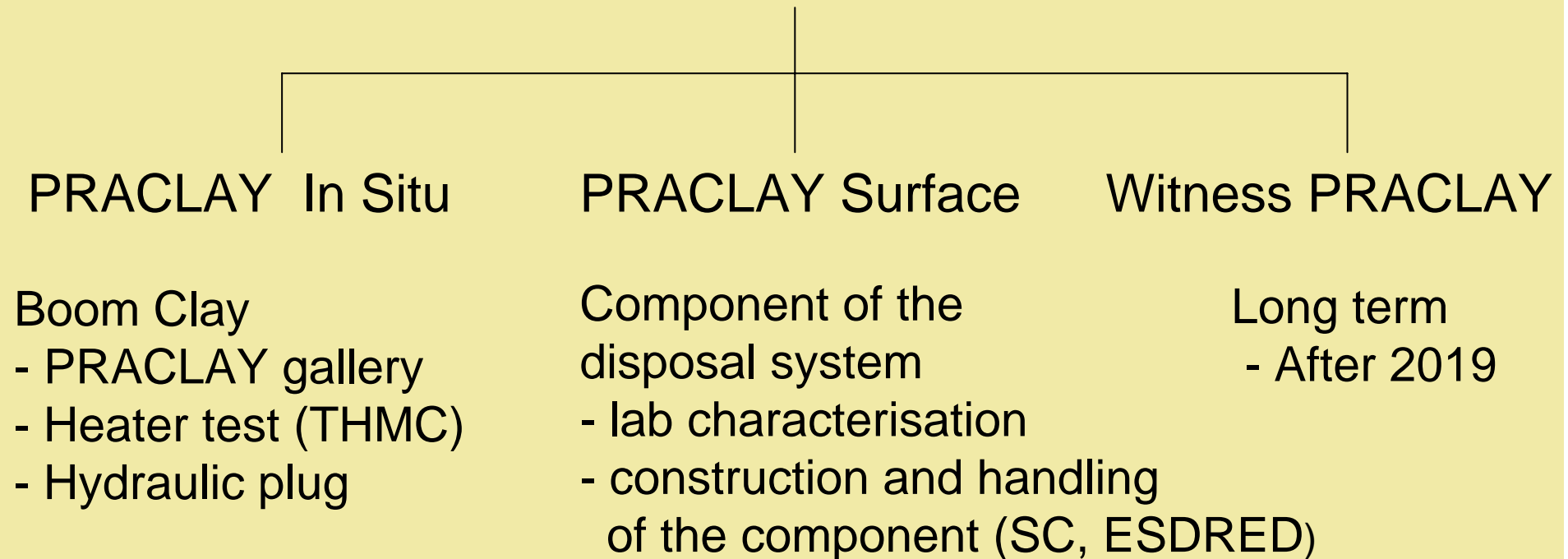


Sleeve

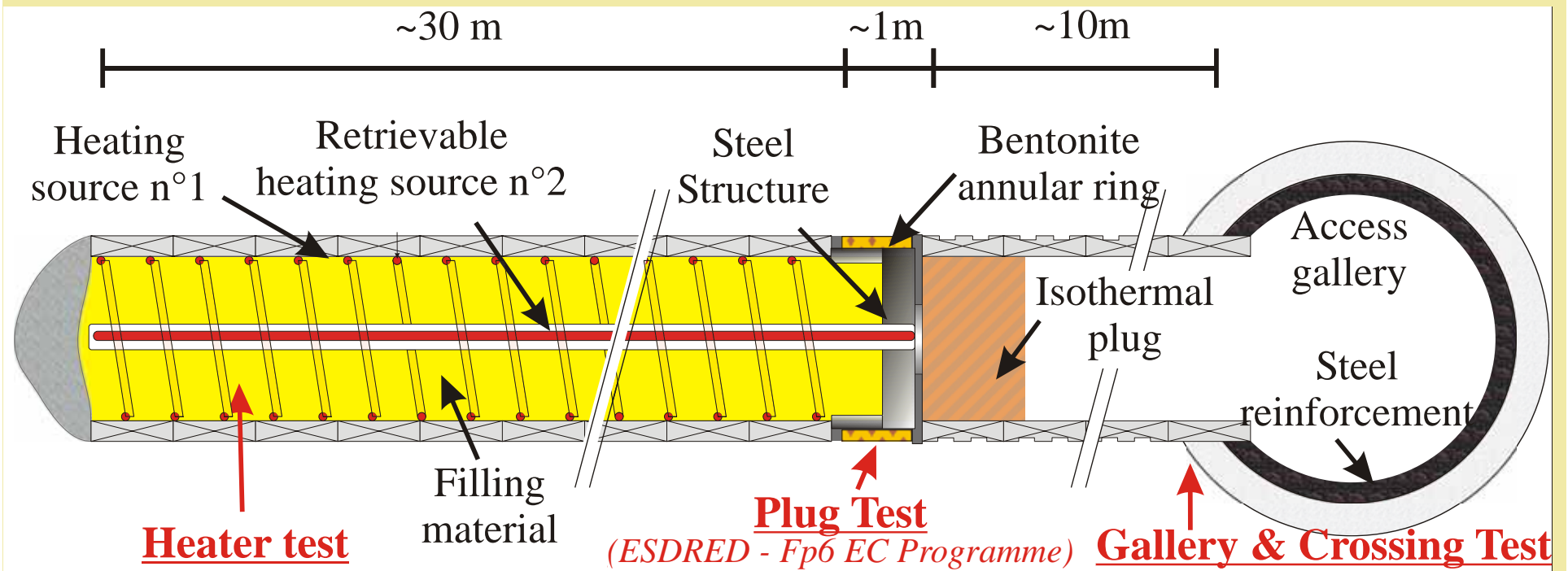
The demonstration programme has to be  
as generic as possible



## The PRACLAY experiments



# The in-situ PRACLAY experiments study the thermal impact at large scale

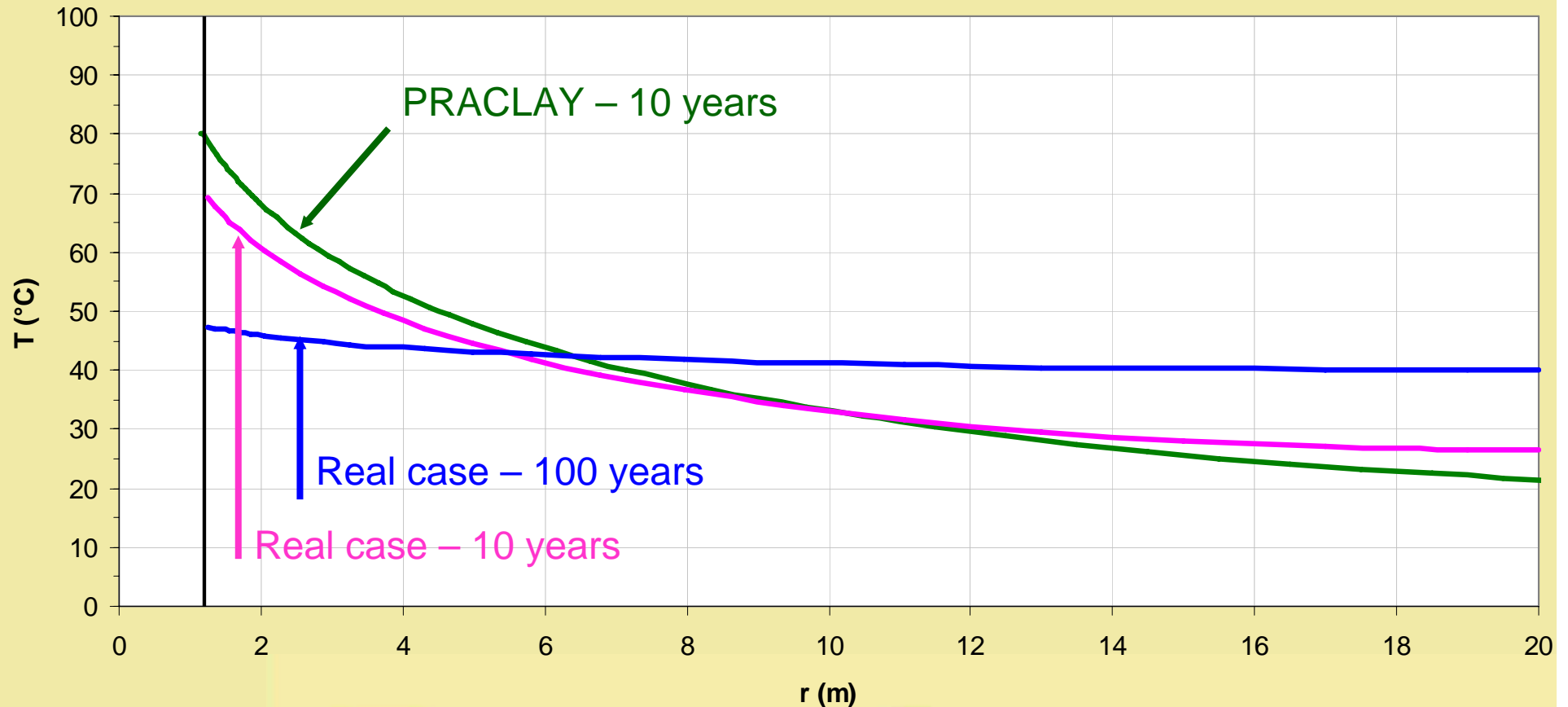


# Main objectives of the heater test

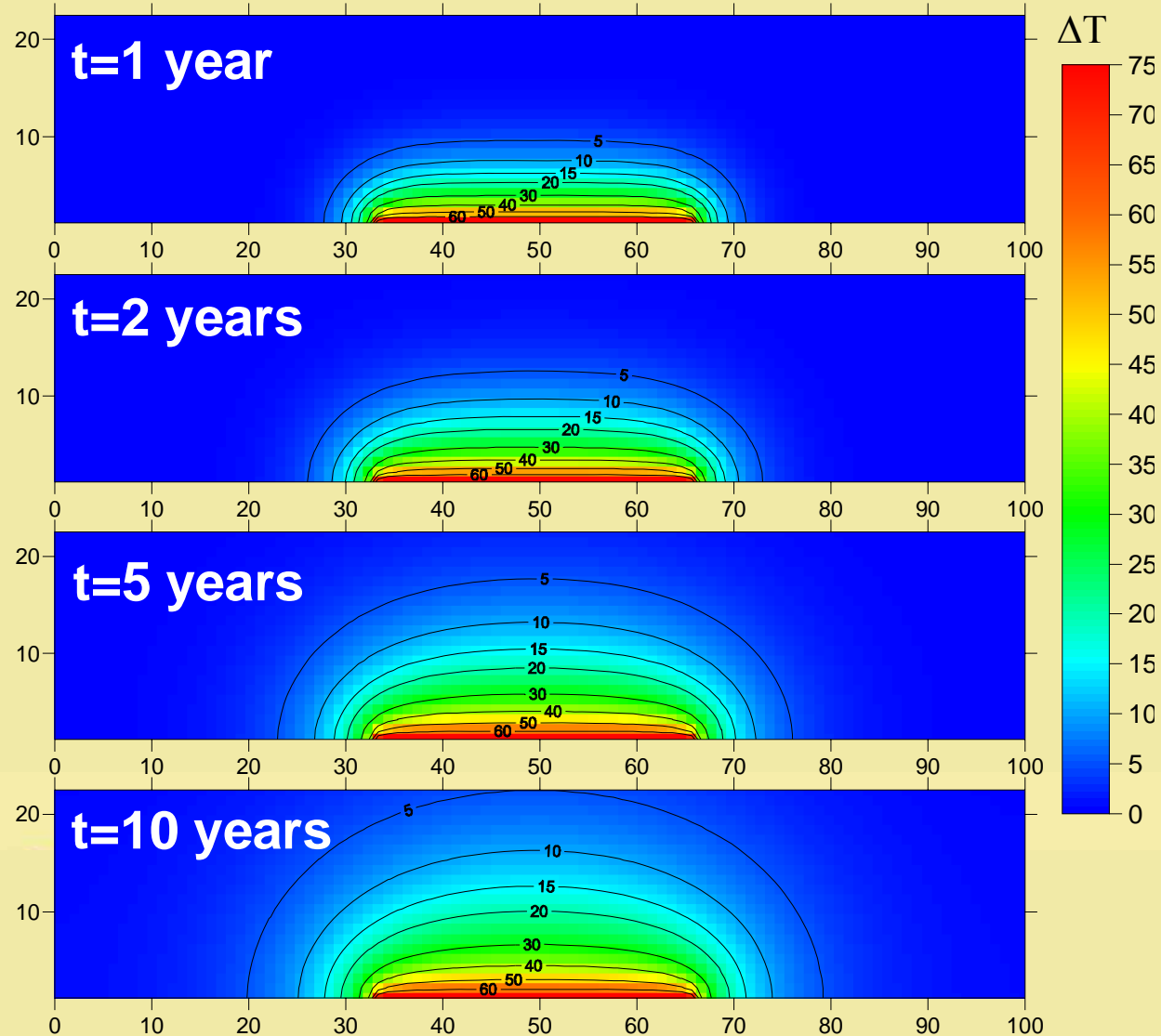
- Configuration similar to a real repository
- Combined effect of the EDZ and the TDZ
- Effect of the thermal load on the stability of the lining (retrievability)
- Verification and confirmation of our knowledge of the THM/C behaviour of Boom Clay
- Demonstration that the thermal load does not affect the performance of the Boom Clay layer
- Duration: ~10 years



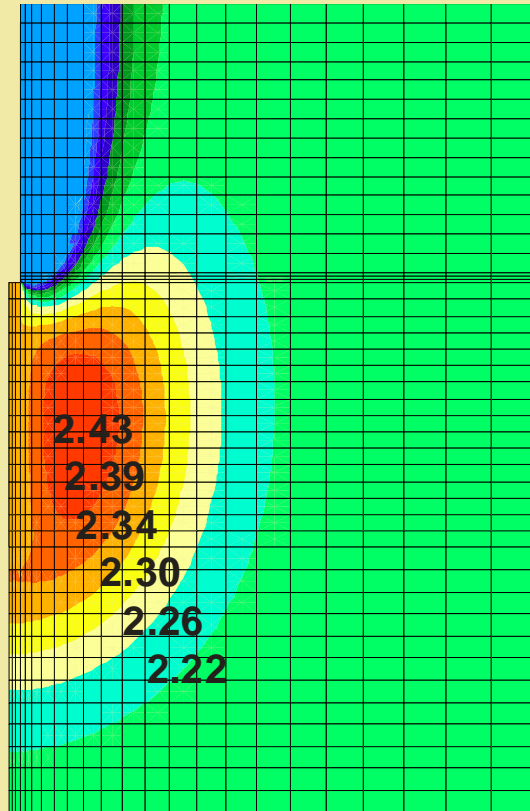
# The most penalising conditions are simulated



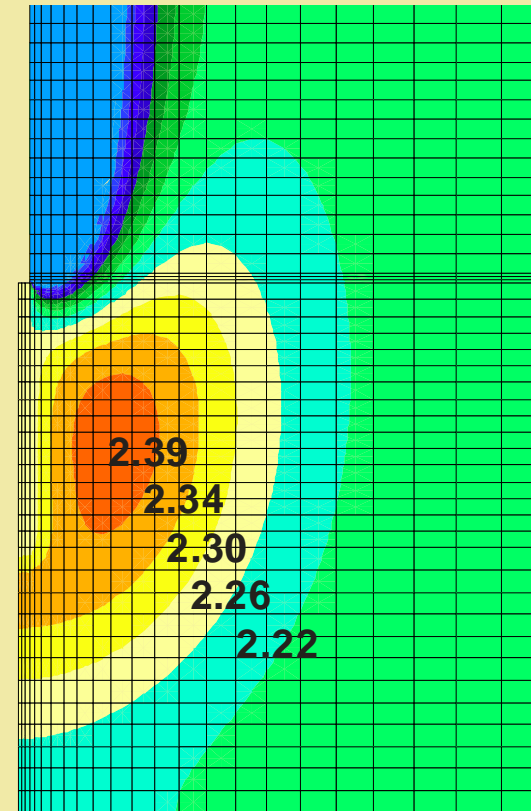
# Isotherm around the PRACLAY gallery



# Pore water pressure around the PRACLAY gallery (MPa)

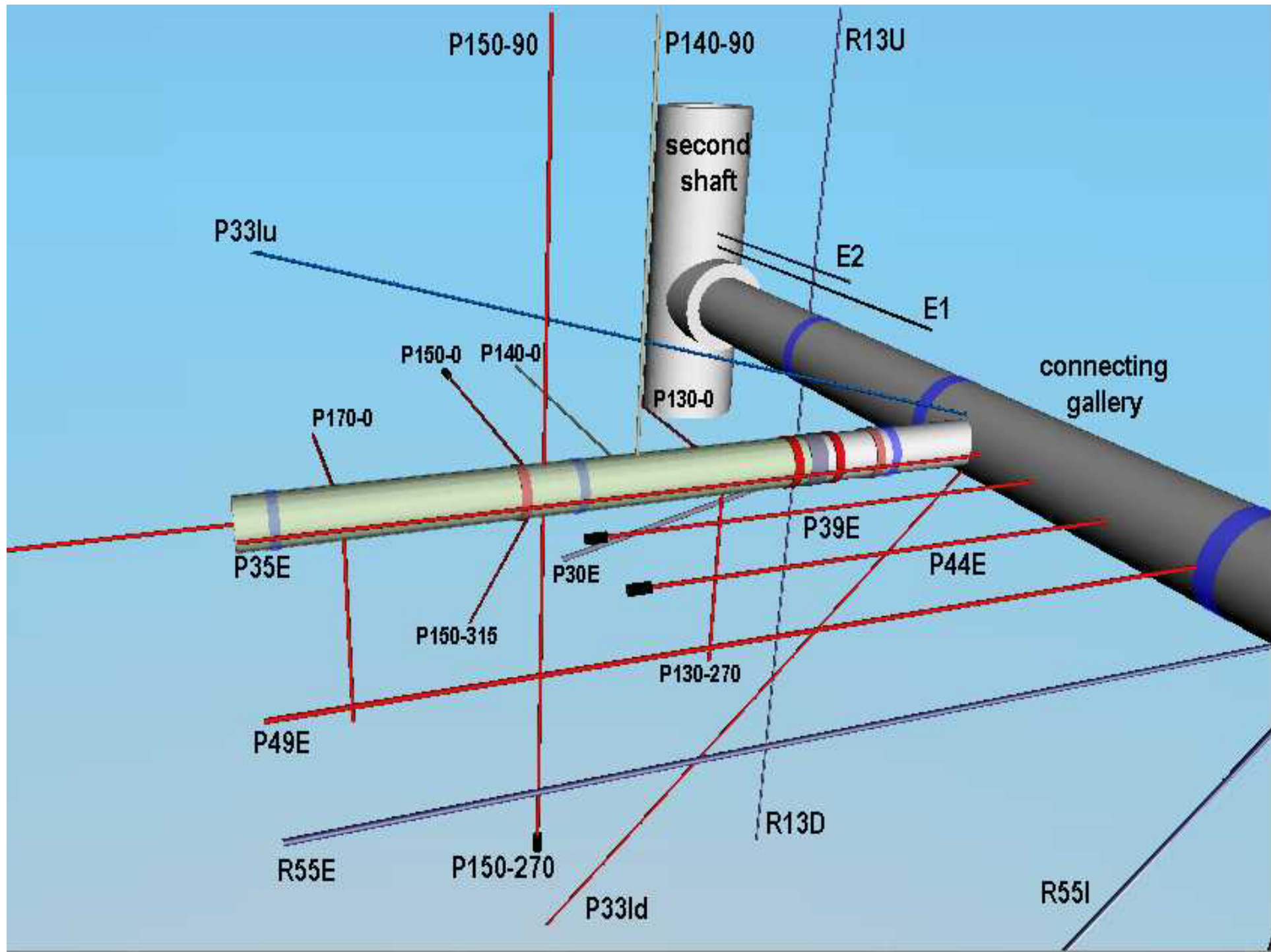


5 years



10 years





# Planning

- PRACLAY gallery specifications Mars 05
- Instrumentation from the HADES 05-06
- Excavation 07
- PRACLAY installation 08
- Start of the thermal phase 09
- Preliminary results after one year SFC1-2013
- Final conclusions SFC2-2020

# Conclusions

- Main futures activities:
  - PRACLAY In-Situ: large scale heater test
  - PRACLAY Surface:
    - SC construction faisability
    - ESDRED: filling of the annular gap
- Integrated modelling and experimental approach
- Support to the development of the disposal architecture

[WWW.EURIDICE.BE](http://WWW.EURIDICE.BE)

