**A benchmark of the large-scale in-situ PRACLAY heater test**

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**Abstract**: Deep geological disposal is widely considered as one of the most sustainable solutions for isolating radioactive waste from the biosphere and ensuring its long-term management. Understanding the thermo-hydro-mechanical (THM) behavior of the host rock is important for the design of geological disposal. In Belgium, a poorly indurated clay named Boom Clay is studied as a potential host rock thanks to its low intrinsic permeability, its excellent self-sealing property and its capability of adsorption of radionuclides. Laboratory tests [1] and former in-situ small and intermediate scale heater tests [2] carried out in the HADES underground research facility (URF) in Mol (Belgium) already showed the strong hydro-mechanical coupled behavior of the host rock. However, the relatively limited size of these tests suffers from the inevitable mechanical disturbance induced by the installation of the heater and a lower accuracy in reproducing the thermal pressurization in the excavation damaged zone (EDZ).

A large-scale in-situ heater test PRACLAY [3] (Fig. 1) is thus now conducted in HADES URF to reproduce the thermal impacts in the EDZ and in the near field and to verify at large scale the far field performance. A 2D benchmark, carried out in the framework of the European Joint programme EURAD HITEC [4], is proposed to model the PRACLAY heater test with fully coupled THM finite elements and to investigate the in-situ behavior of the host rock. The geometry of this model is a cross-section of a supported heating gallery and host rock perpendicular to the gallery axis. Only a quarter of the full gallery is modelled thanks to the symmetry of the problem and the boundary conditions. The numerical modelling comprises four primary phases: excavation, waiting, artificial injection, and heating phases, conducted by adjusting boundary conditions of gallery wall and the linner. An extensive monitoring system established around the PRACLAY gallery enables the observation of temperature and pore water pressure changes within the Boom Clay. The comparison between the numerical prediction and in-situ measurement are carried out. The computation is performed with the finite element code LAGAMINE, developed at the University of Liege.

The thermal pressurization due to the discrepancy of thermal dilation between solid and fluid phases is well predicted in the EDZ. To well reproduce the evolution of pore water pressure, the dependency of the permeability on the deformation is introduced in the implemented modelling [5]. The small strain stiffness theory based on the HSsmall model is also taken into account [6]. Finally, a good agreement is obtained between the in-situ measurement and the numerical results (Fig. 2). The benchmark provides valuable insights into the THM impact on the host rock and reliable indications of the model capacity.

**Keywords**: PRACLAY heater test, large scale, THM modelling, Boom Clay, in-situ behavior

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Fig. 1 Overview of the PRACLAY in situ experiment including the components of the heater test (©EIG EURIDICE)

Fig. 2 Comparison of pore water pressure between the in-situ measurement (dash nodes) and numerical predictions (solid lines) in the horizontal and vertical directions