



EUROPEAN
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Community Research



*International Technical Conference on
Practical Aspects of Deep Radioactive Waste Disposal*

Session 3 - Paper N°16:

*Experimental evaluation of the hydraulic resistance
of compacted bentonite/Boom clay interface*

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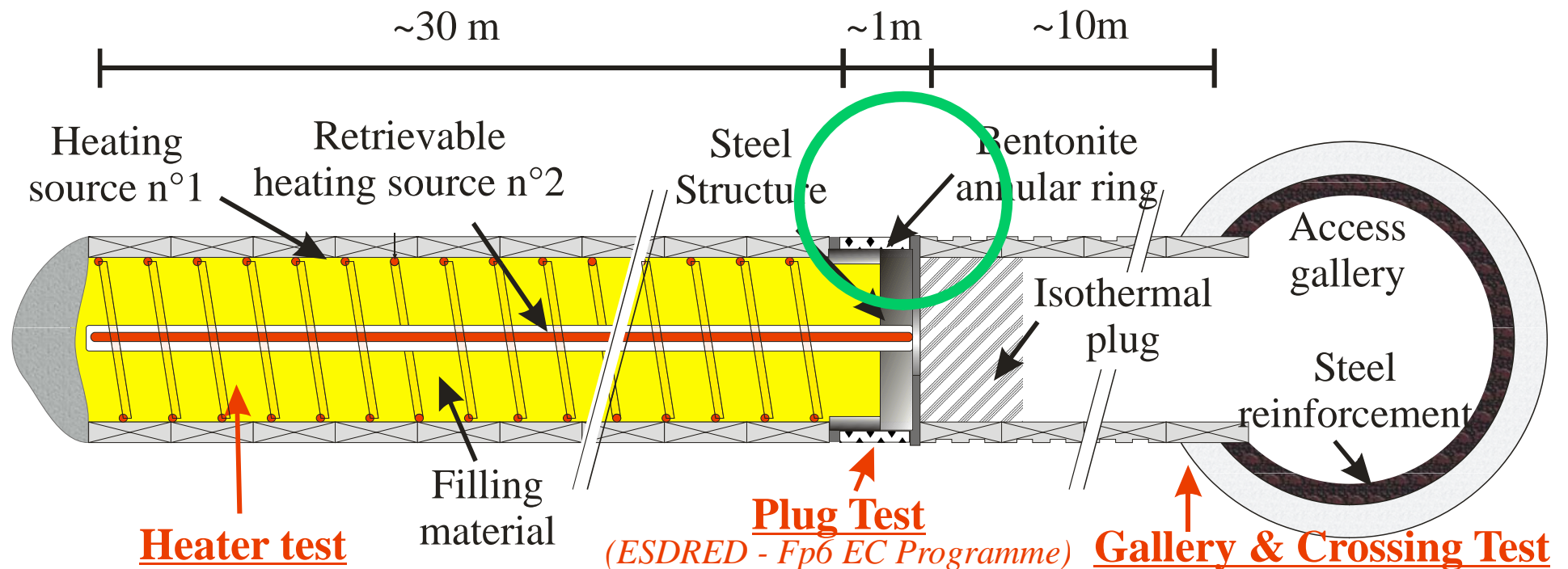
****EURIDICE Group, Belgium*



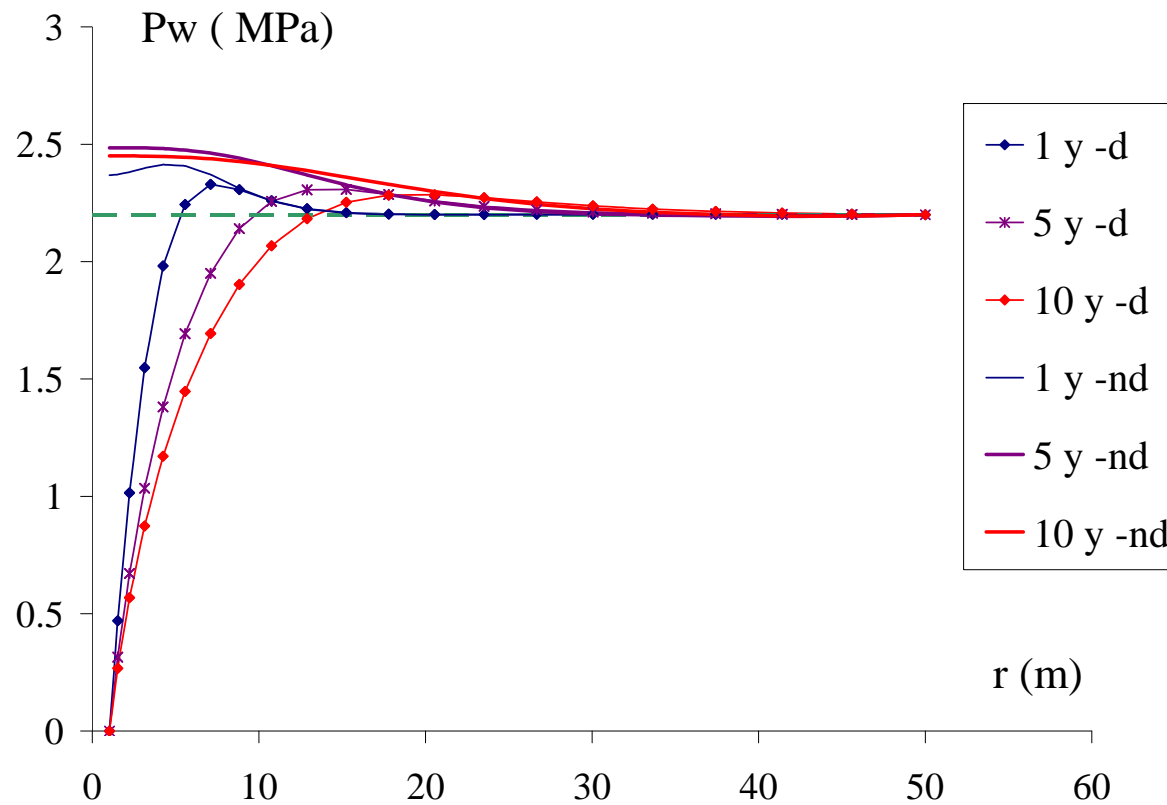
OUTLINE

- Introduction
- Material and laboratory experimental procedures
- Laboratory experimental results
- Conclusion

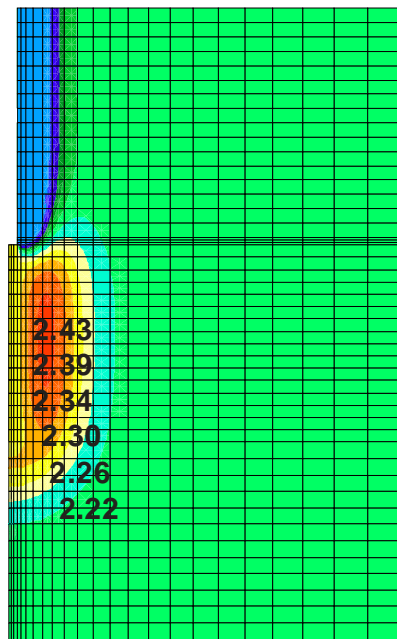
PRACLAY Experiment (HADES URF, BELGIUM)



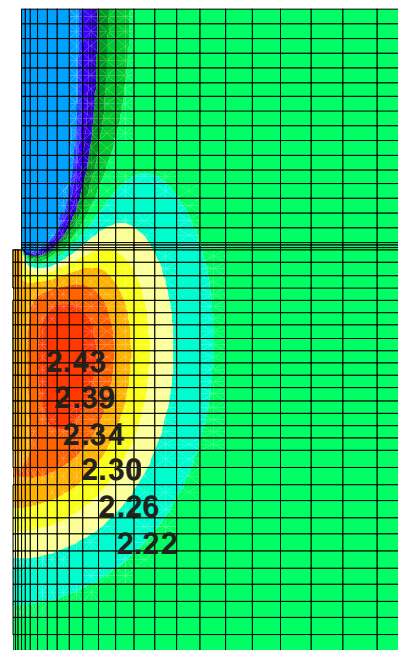
Radial pore pressure profiles at mid plan of the heater for different heating time (d : drained condition, nd : undrained condition)



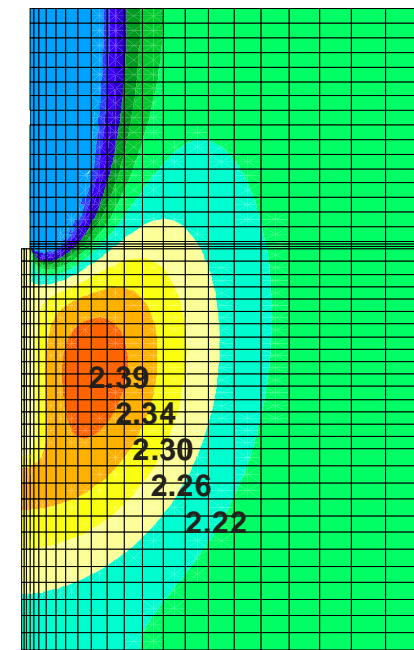
Pore pressure (in MPa) distribution at different heating times



1 year

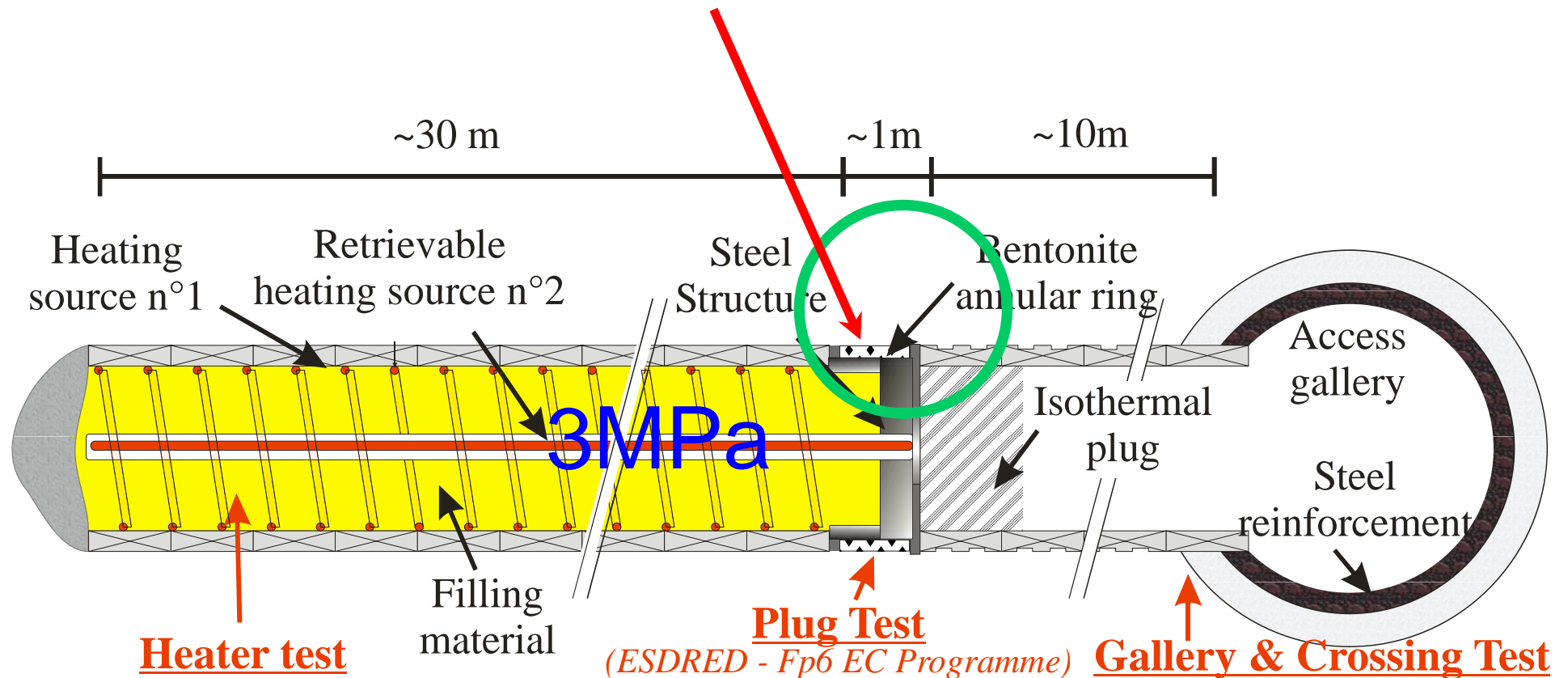


5 year



10 year

Hydraulic resistance of Bentonite-Boom clay interface high enough to avoid any hydraulic shortcut



Main objectives

- To assess the effect of construction in terms of voids bentonite - bentonite and bentonite – Boom clay

- To assess the temperature effect on the hydraulic resistance

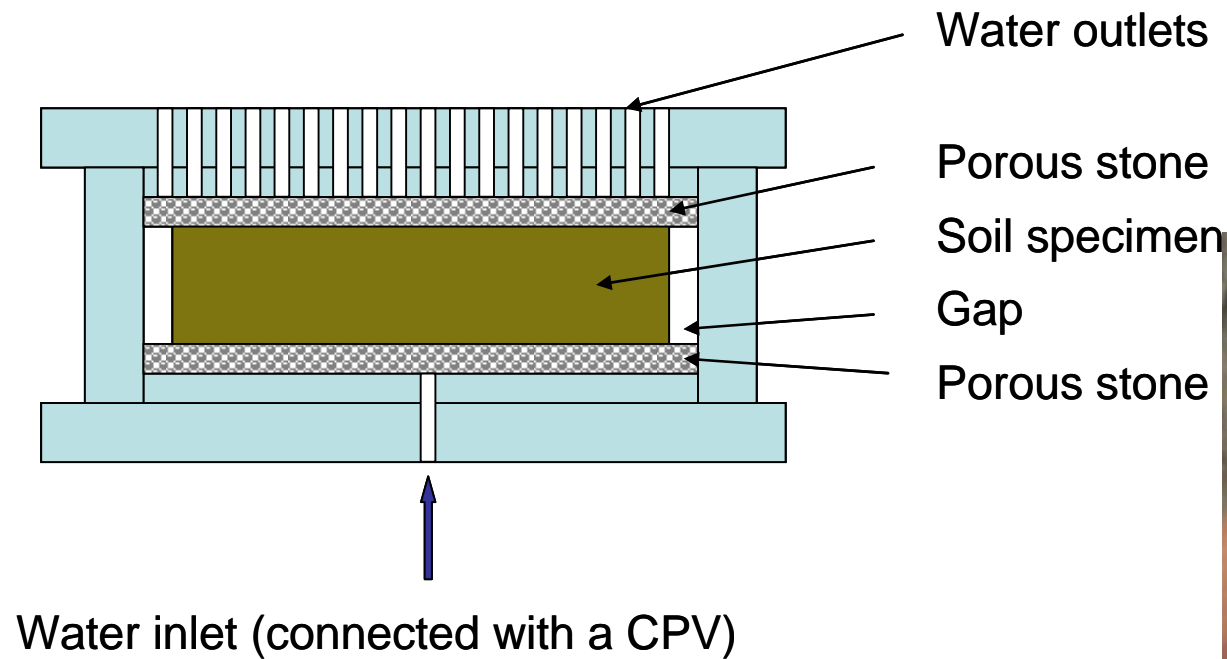
MX80 Bentonite

| Mineral | Madsen (1998) | Montes-H. (2002) |
|--------------------------------|---------------|------------------|
| Montmorillonite | 75.5 | 79.2±3.0 |
| Phlogopite (Mica) | <1 | 3.0±3.0 |
| Pyrite | 0.3 | 0.6 |
| Calcite | 1.4 | 0.8±0.6 |
| Brown spar | | 1.1±0.4 |
| Anatase | | 0.1 |
| Plagioclases | | 9.2±3.0 |
| Feldspar K | 5-8 | 2.0±2.0 |
| Phosphate | | 0.6 |
| Quartz | 15 | 2.8±2.8 |
| Fe ₂ O ₃ | | 0.5±0.4 |
| C organic | 0.4 | 0.1 |
| Total | 100 | 100 |

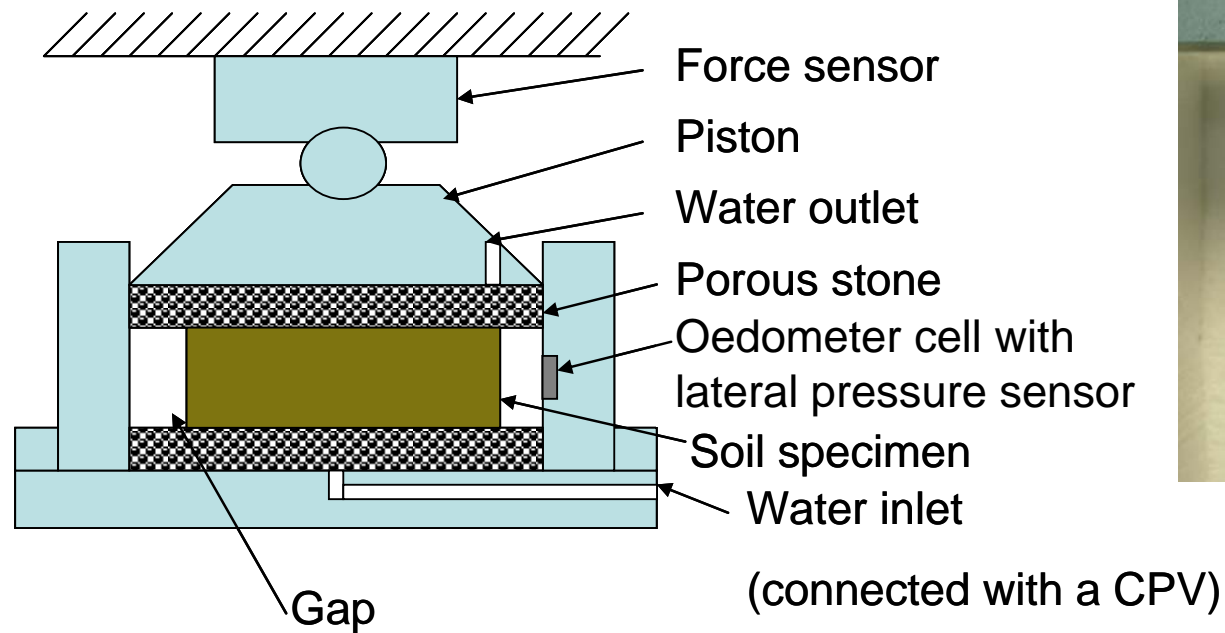
| Parameter | MX80 |
|-------------------------------------|-------|
| Montmorillonite (%) | 82 |
| w _L (%) | 520 |
| w _P (%) | 46 |
| Ip | 474 |
| ρ _s (Mg/m ³) | 2,65* |
| Activity | 5.4 |

* Helium pycnometer

Percolation cell



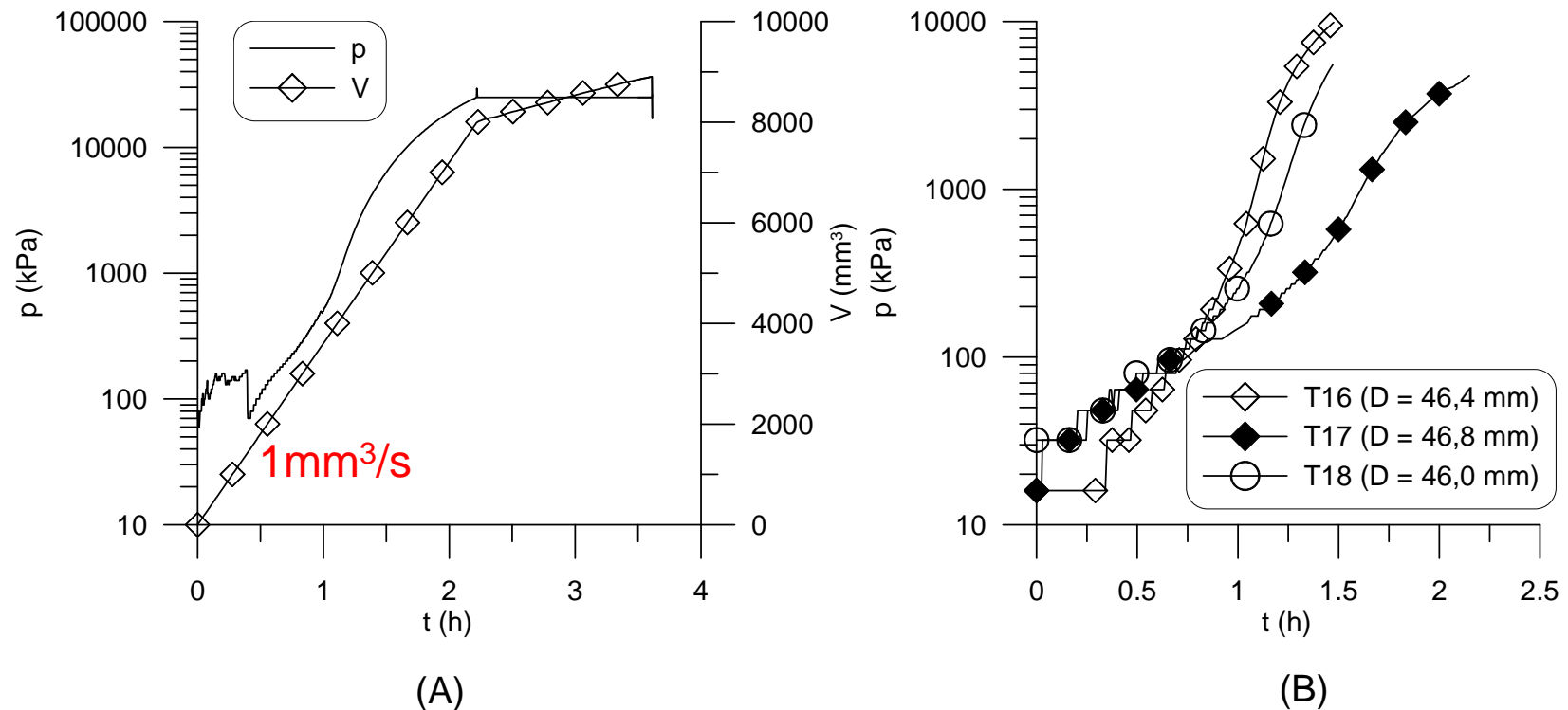
Oedometer cell



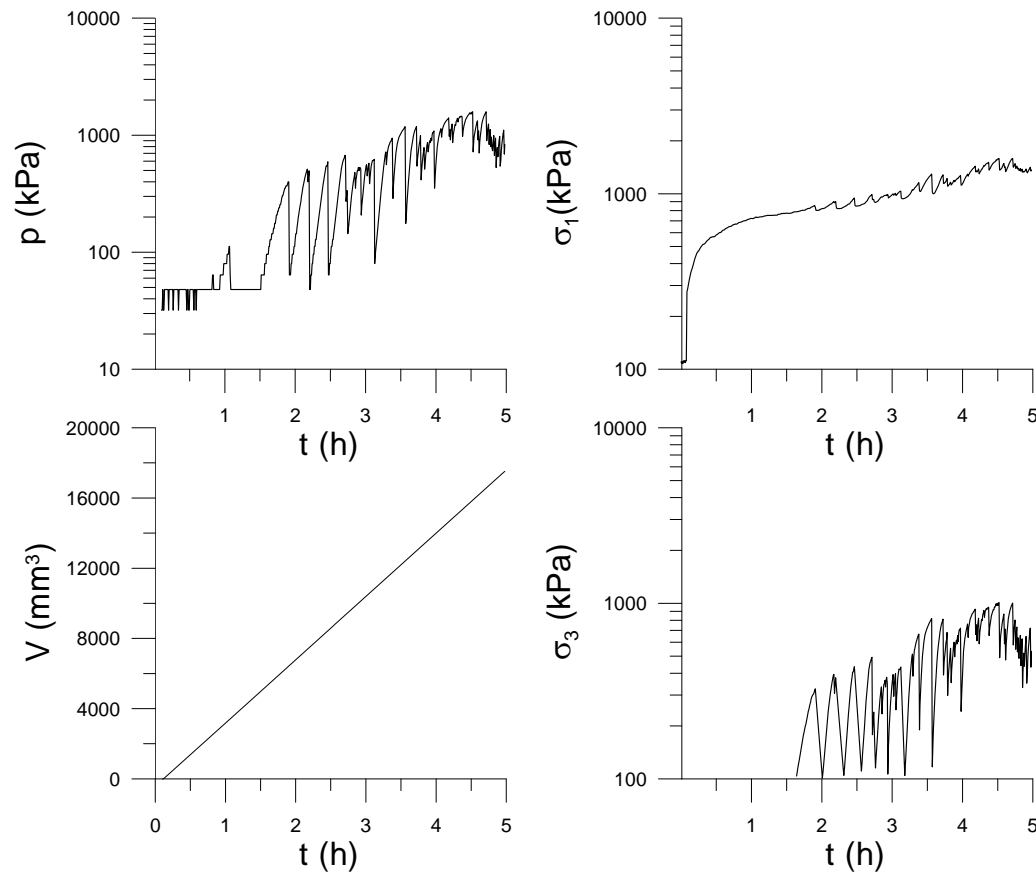
Laboratory test program

| Test | Cell | Gap (mm) | ρ_d (Mg/m ³) | T (°C) |
|------|-------------|----------|----------------------------------|--------|
| T04 | Percolation | 1.8 | 1.75 | 20 |
| T16 | Percolation | 1.8 | 1.75 | 80 |
| T17 | Percolation | 1.6 | 1.75 | 80 |
| T18 | Percolation | 2.0 | 1.75 | 80 |
| T19 | Oedometer | 2.0 | 1.75 | 20 |
| T20 | Oedometer | 1.6 | 1.75 | 20 |
| T21 | Oedometer | 0.0 | 1.25 | 20 |

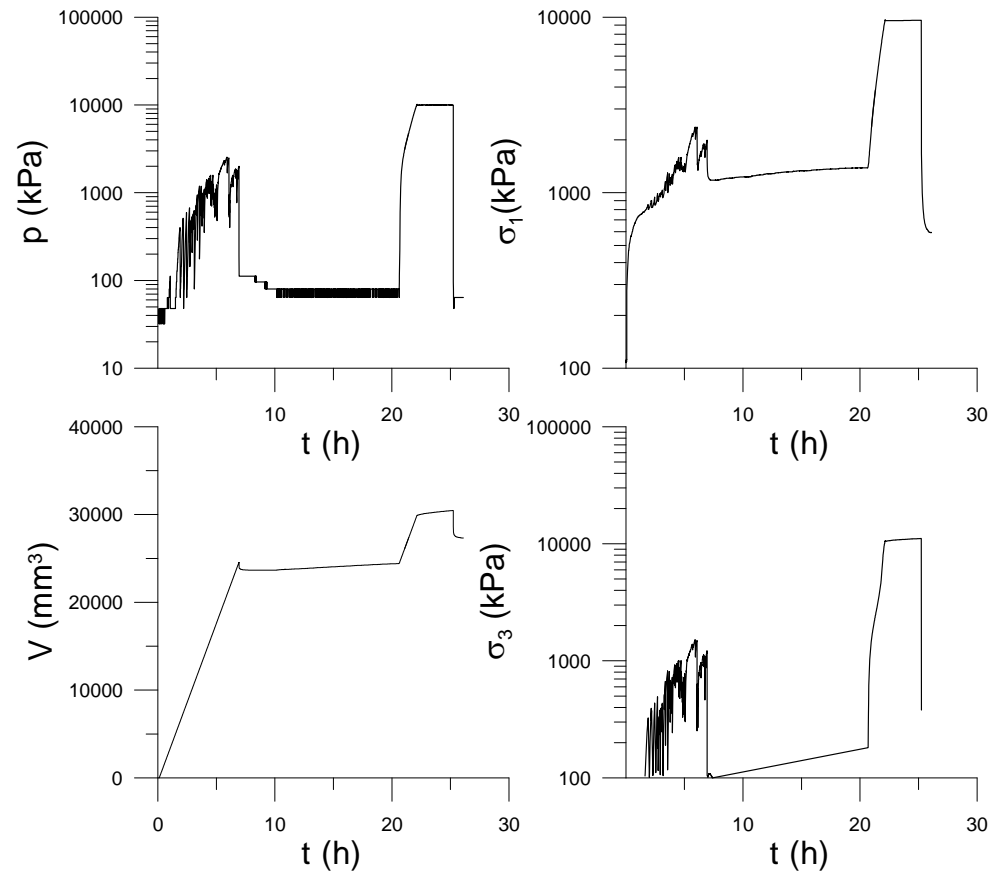
Percolation tests. Changes of pressure and injected volume versus time. Test at 20 ° C (A: T04, D = 46.4 mm) and 80 ° C (B: T16, T17 and T18)



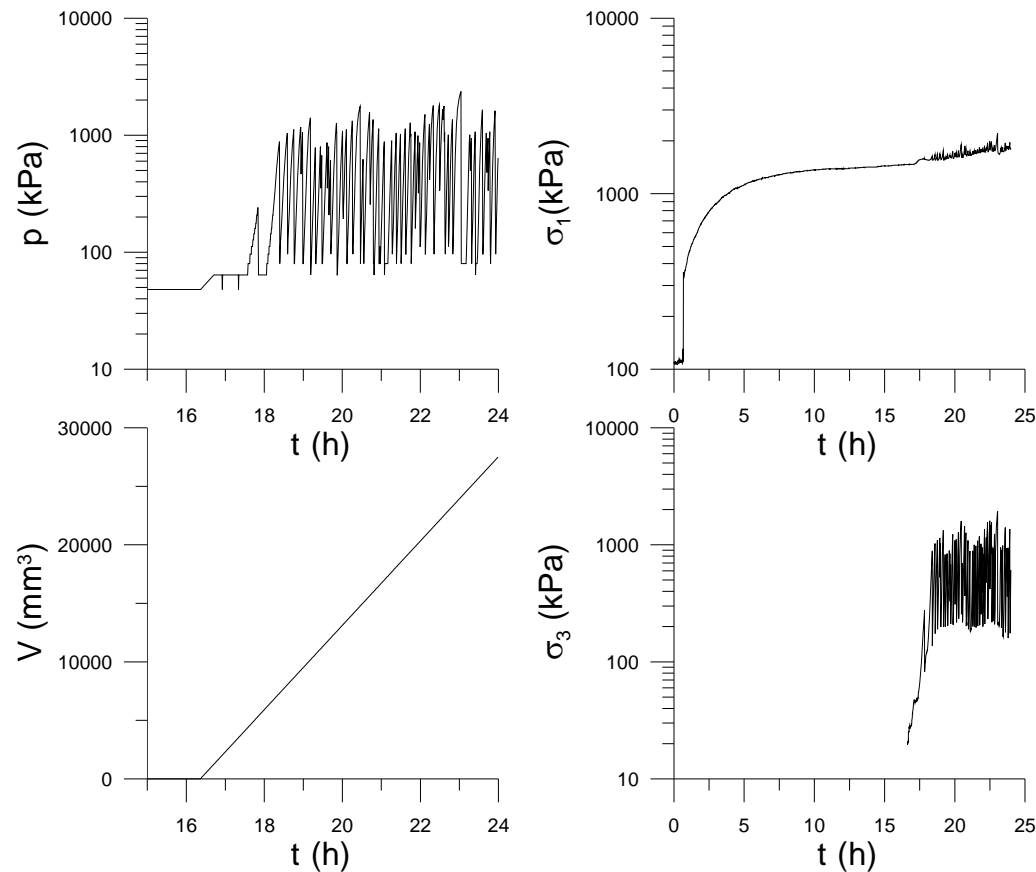
Test T19 (Gap = 2.0 mm). Changes of water pressure, injected volume, vertical and radial stresses versus time (for $t = 0 - 5$ h)



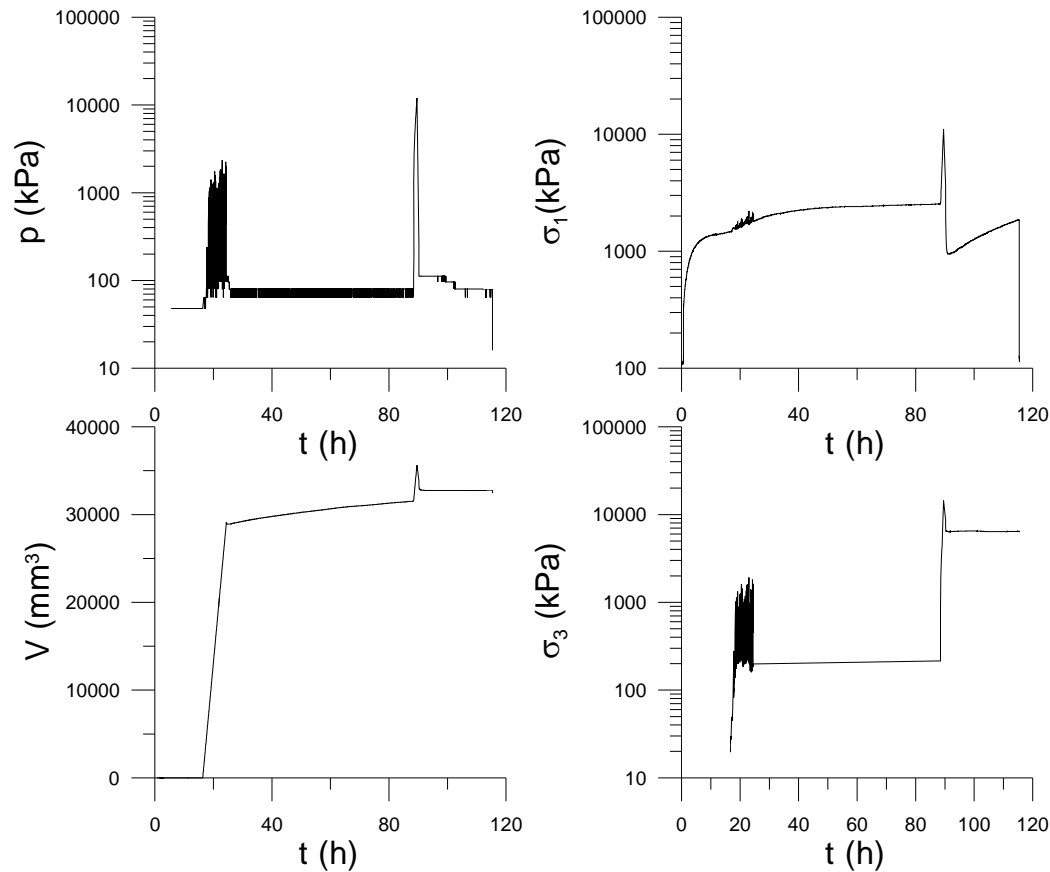
Test T19. Changes of water pressure, injected volume, vertical and radial stresses versus time (for $t = 0 - 30$ h)



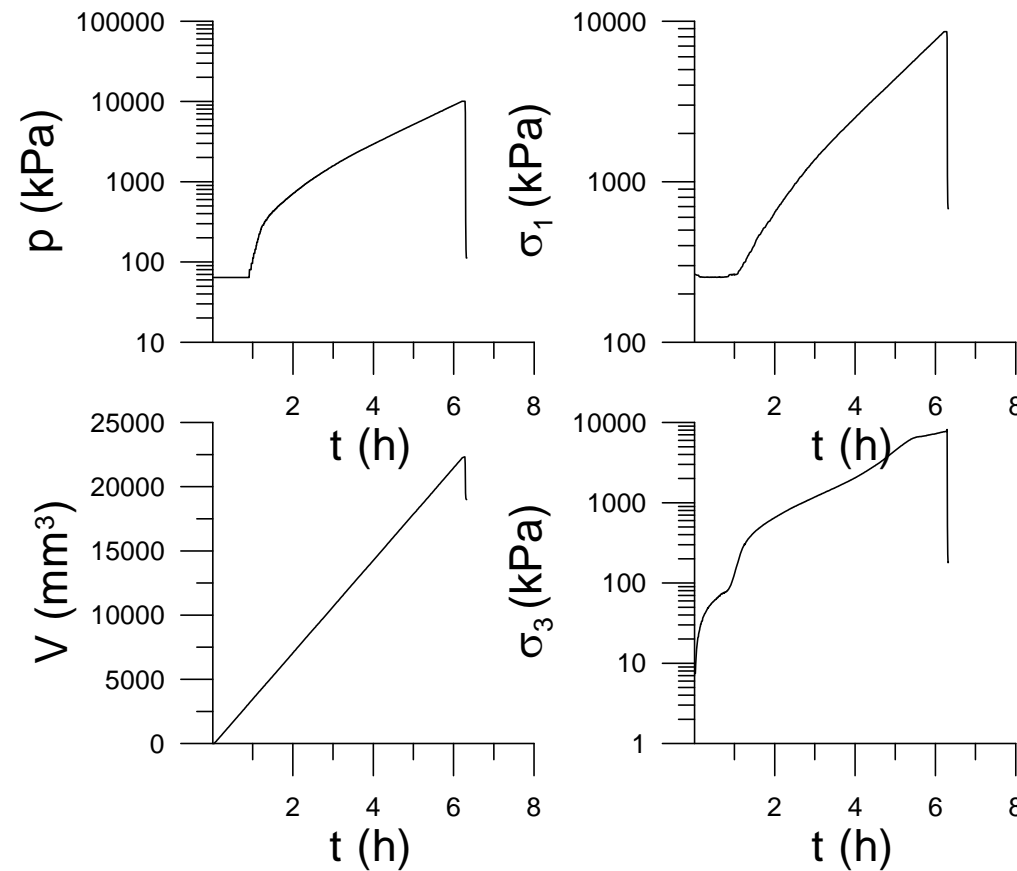
Test T20 (Gap = 1.6 mm). Changes in water pressure, injected volume, vertical and radial stresses versus time ($t = 0 - 24$ h)



Test T20. Changes in water pressure, injected volume, vertical and radial stresses versus time. ($t = 0 - 120$ h)



Test T21 (Gap = 0). Changes in water pressure, injected volume, vertical and radial stresses versus time



CONCLUSION

- Novel simple system to investigate the resistance to hydraulic fracturing of discontinuities.
- Three gap thicknesses (2.0, 1.8, and 1.6 mm) and at two temperatures (20 ° C and 80 ° C).
- Temperature increase enhances the soil swelling thus the hydraulic resistance.
- Hydraulic resistance of the soil/wall interface higher than 5MPa at completion of soil swelling (pore pressure estimated by numerical calculation in the PRACLAY Heater experiment 3 MPa).