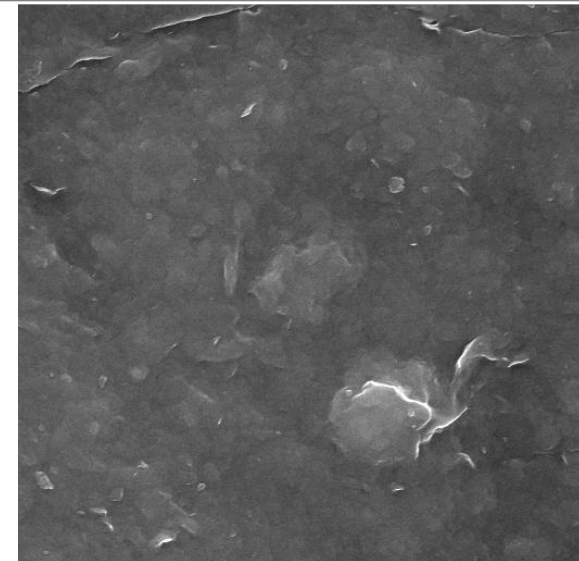
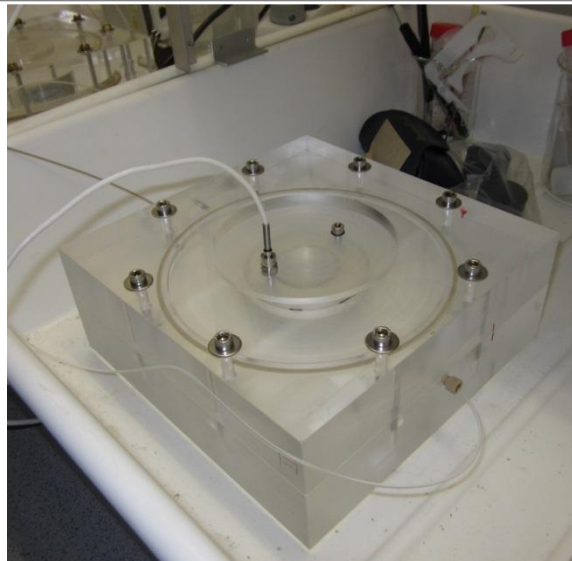


Bentonite erosion in advection controlled systems

Rinderknecht F.*, Heck S., Götz R., Huber F., Friedrich F., Geckeis H., Schäfer T.

*Franz.Rinderknecht@kit.edu

Institute for Nuclear Waste Disposal (INE), Geochemistry

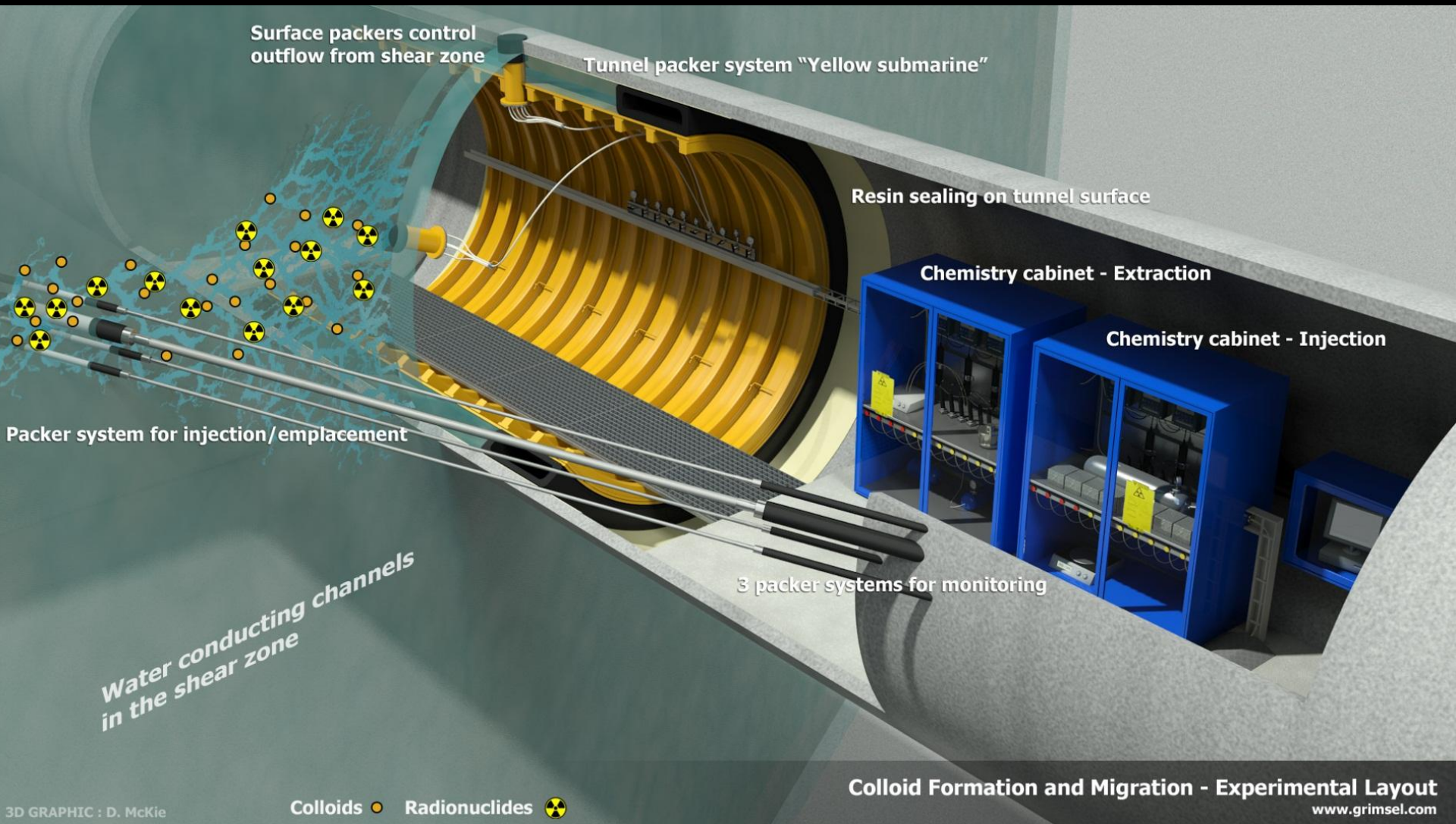


Outline

- Long-term In situ Test (LIT) at Grimsel Test Site
- Colloid erosion
 - Artificial fracture set-up
 - Bentonite sample and preparation
 - Past and present experiments
 - Results
- Update on benchmark test

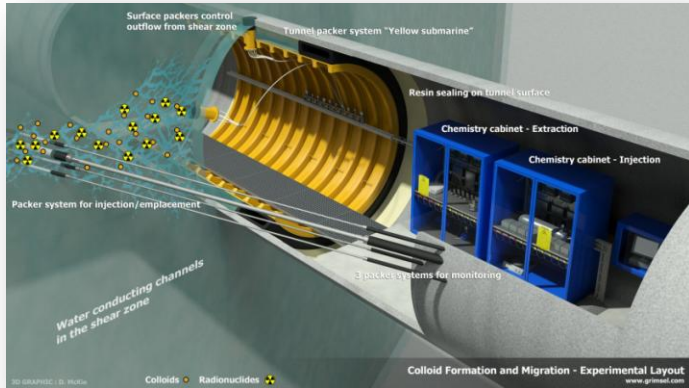
CFM project: **LIT (current status)**

Bentonite erosion/colloid generation directly from compacted bentonite instead of colloid suspension injection under realistic flow conditions.



CFM project: LIT (current status)

■ CFM-LIT started Spring 2014



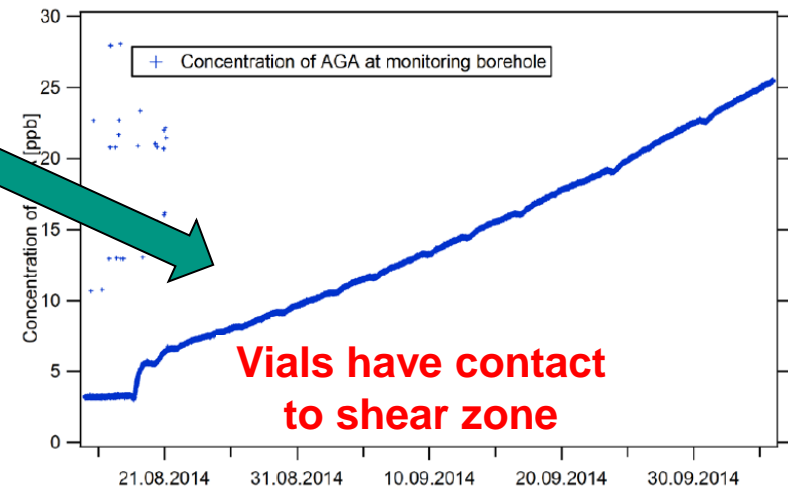
Near-field water chemistry:

pH: 9.6 => 9.0

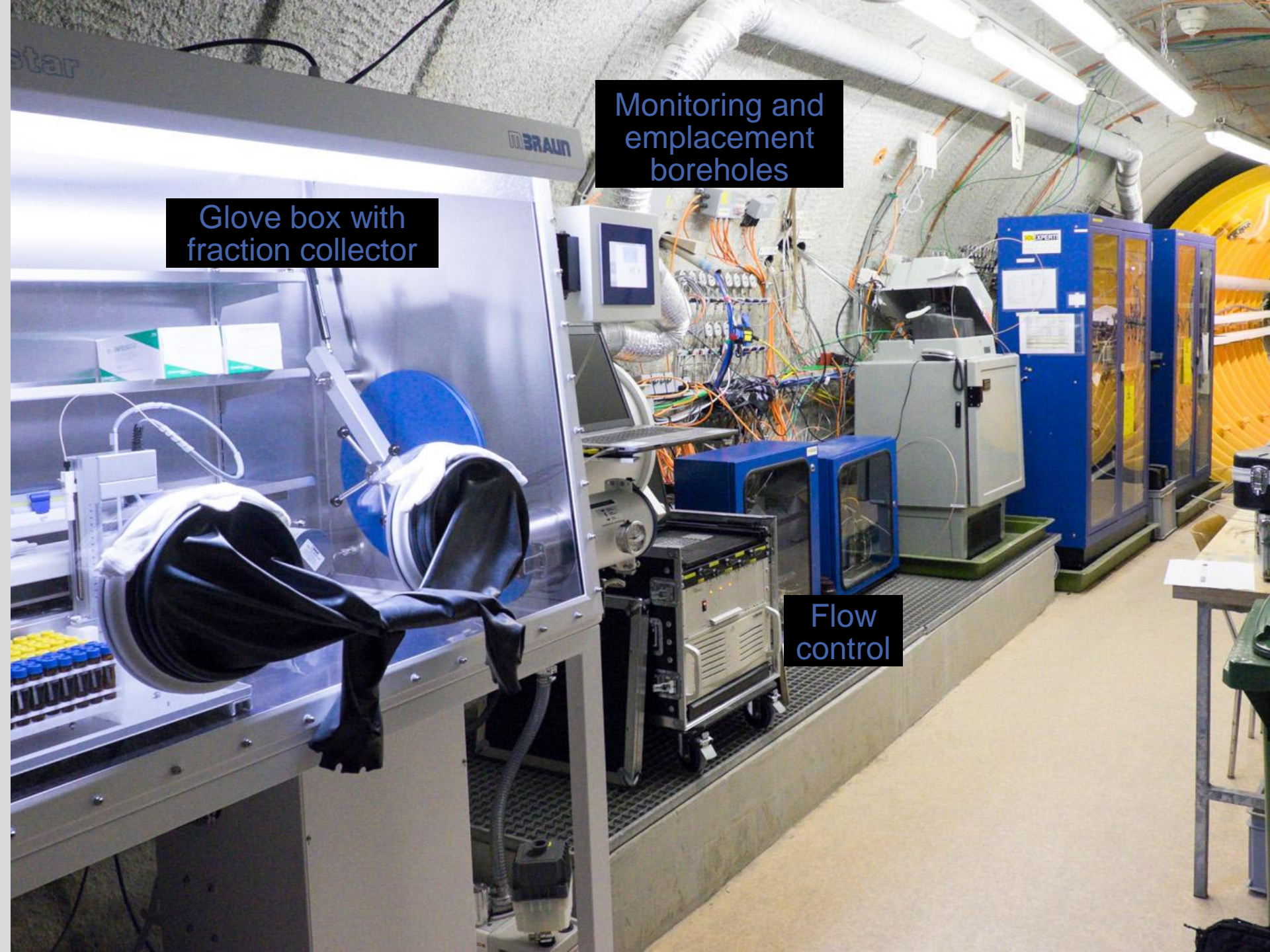
spec. cond.: 60 => 170 $\mu\text{S}/\text{cm}$

$E_{h(\text{SHE})}$: -220mV => +170mV

No increased colloid concentration observed yet (LIBD)!



16 glass vials filled with ^{45}Ca , ^{75}Se , ^{99}Tc , ^{137}Cs , ^{233}U , ^{241}Am , ^{242}Pu , ^{237}Np , Amino-G and **synthetic montmorillonite** slurry emplaced.

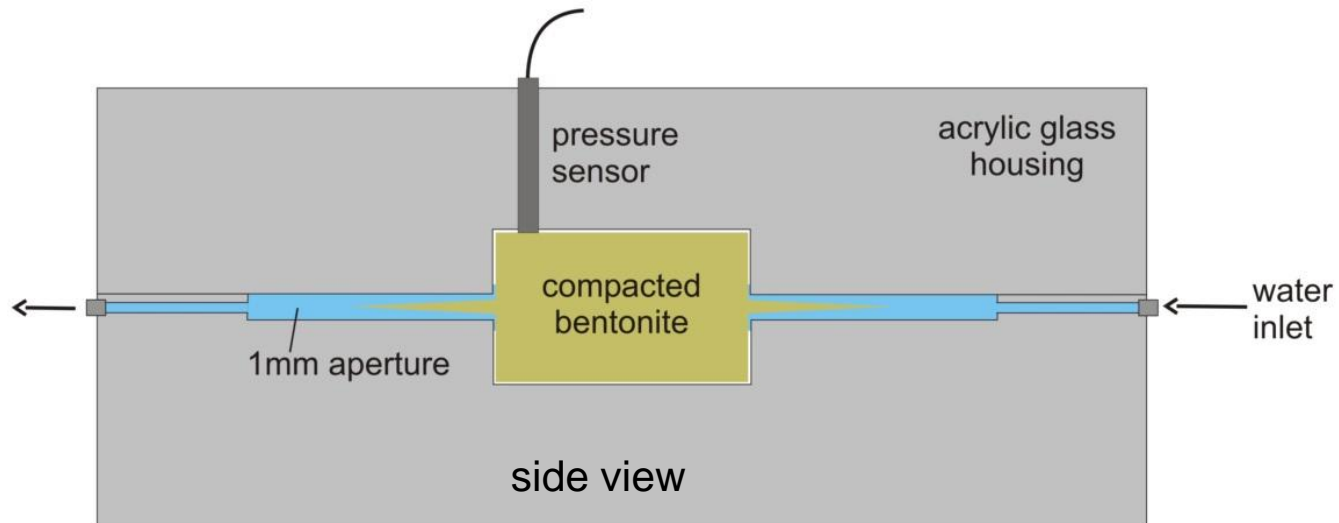
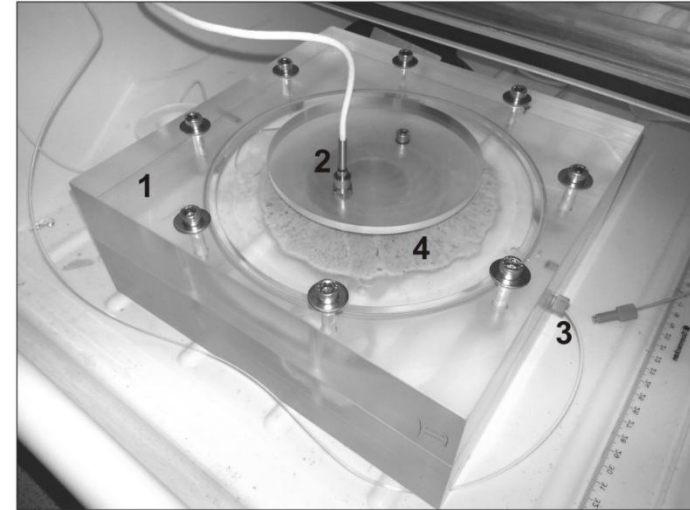
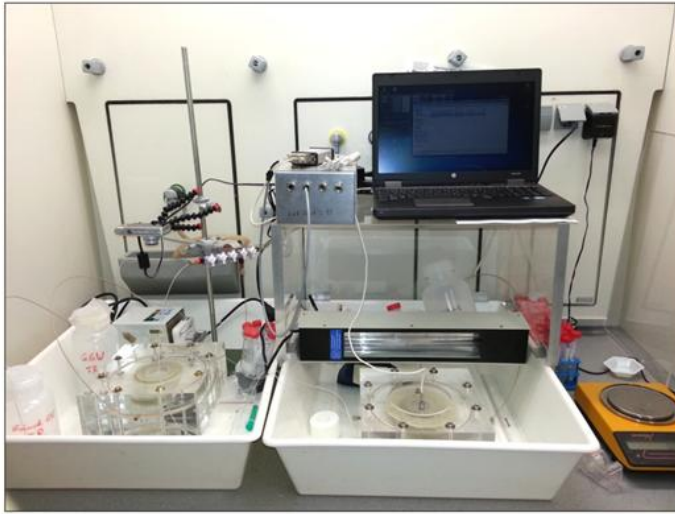


Glove box with
fraction collector

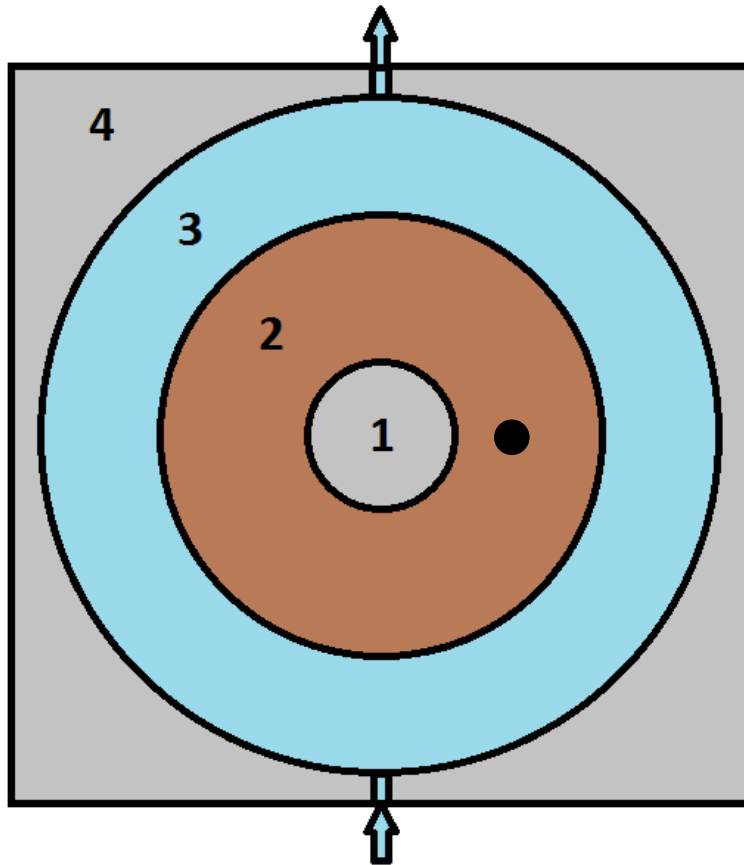
Monitoring and
emplacement
boreholes

Flow
control

Artificial fracture set-up



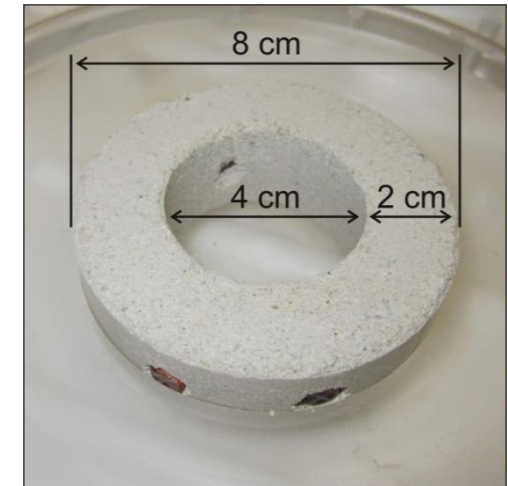
Artificial fracture set-up



- Top view on artificial fracture set-up
 1. Spacer
 2. Compacted Bentonite Ring
 3. Contact zone, $d = 1 \text{ mm}$
 4. Sealed housing
- Geometry like in CFM-LIT (GTS)
- Flow rate $50 \text{ } \mu\text{L/min}$ ($\sim 10^{-5} \text{ m/s}$)
- Ground water used from GTS
- Complete effluent is collected for RN sorption experiments since 5-2014

Bentonite sample

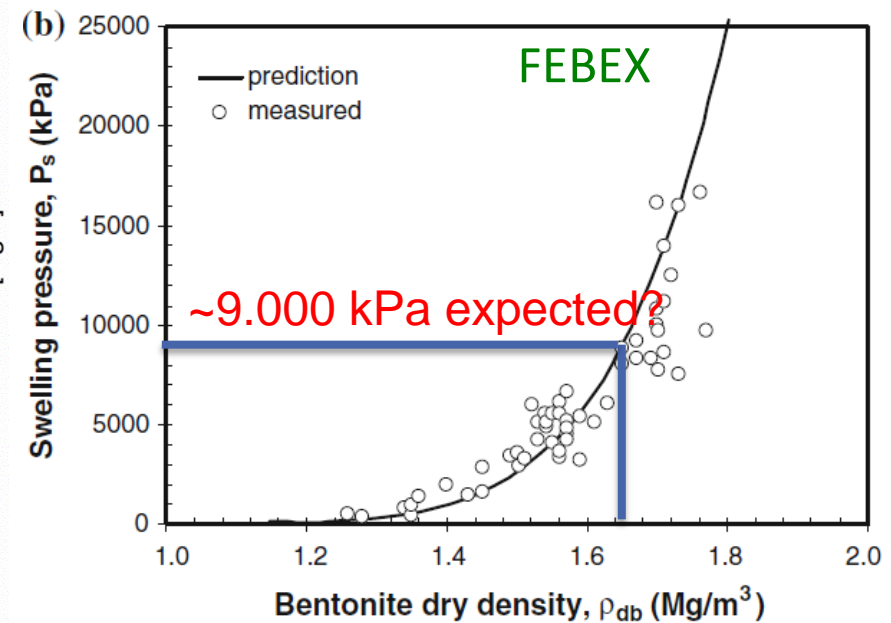
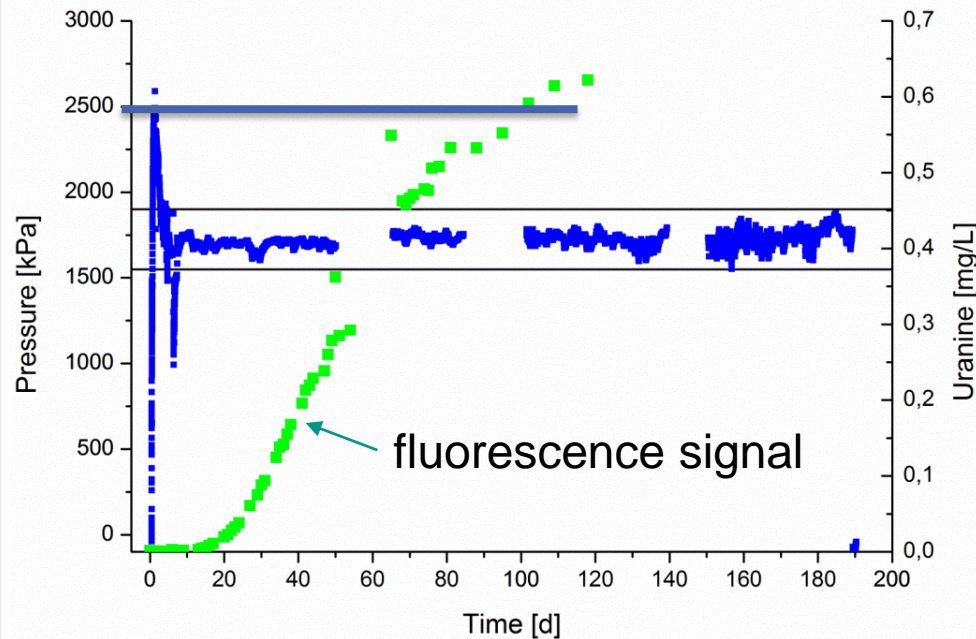
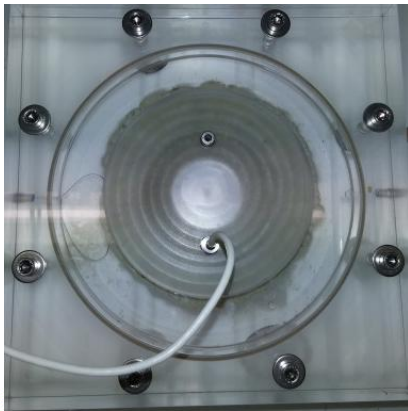
- Ring-shaped samples (LIT)
- Compacted Febex Bentonite ($\rho = 1.65 \text{ Mg/m}^3$)
- 8 Tracer containing glass vials
 - embedded in the bentonite ring
 - Break and release the tracer as pressure rises
- Experiments are performed **without presaturation**



Bentonite Erosion Experiment

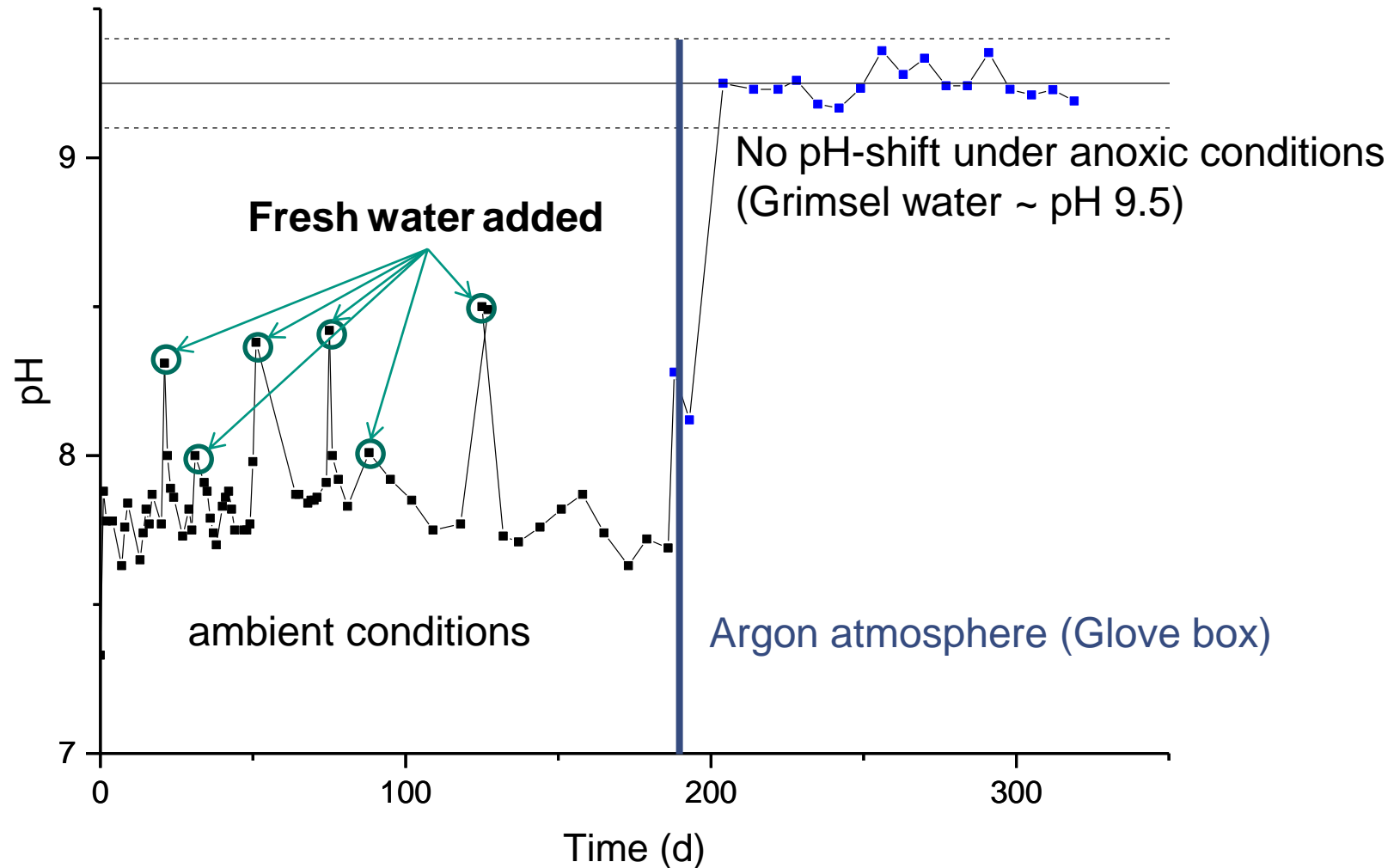
October, 2013

Swelling pressure and fluorescence measurements

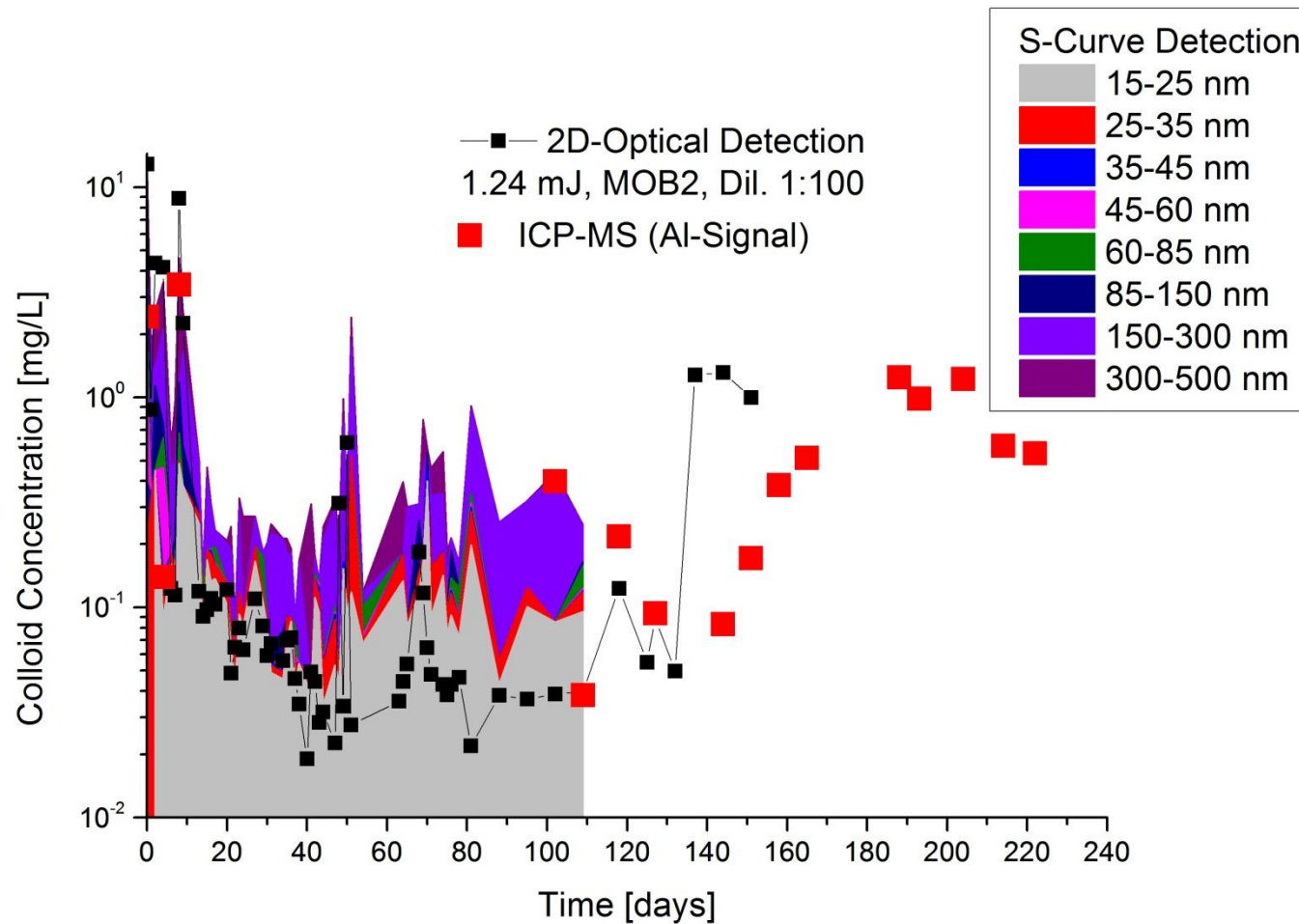


Agus & Schanz (2008) *Acta Geotechnica* 3:125–137

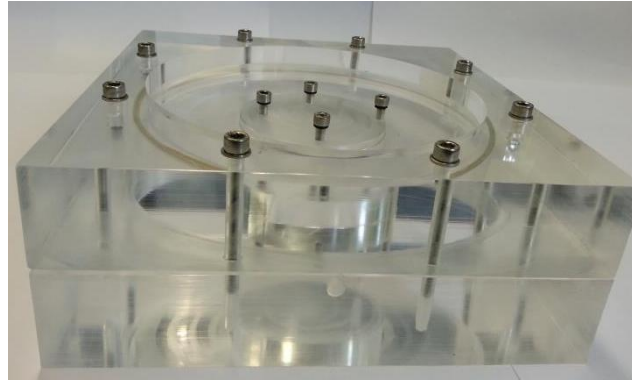
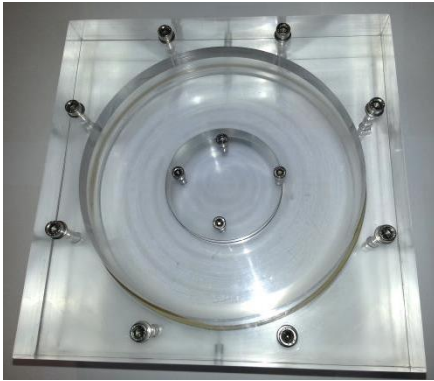
pH-monitoring of the effluent



S-curve LIBD measurements



Update on benchmark test



- Artificial fracture set-up is modified (aperture 1mm \rightarrow 0.1 mm)
- Pressure monitoring is possible at 4 different positions
- Nanocor montmorillonite ring was provided by CIEMAT ☺
- Start of the test ~ mid of November
- Open question: Presaturation of sample????

Thanks for your attention!

