DOPAS

DOPAS
Training Workshop 2015

D2 6.2c EPSP Experiment

Jiri Svoboda, CTU in Prague
September 2015

The research leading to these results has received funding from the European Union's European Atomic Energy Community's (Euratom) Seventh Framework Programme FP7/2007-2013, under Grant Agreement No. 323273 for the DOPAS project.

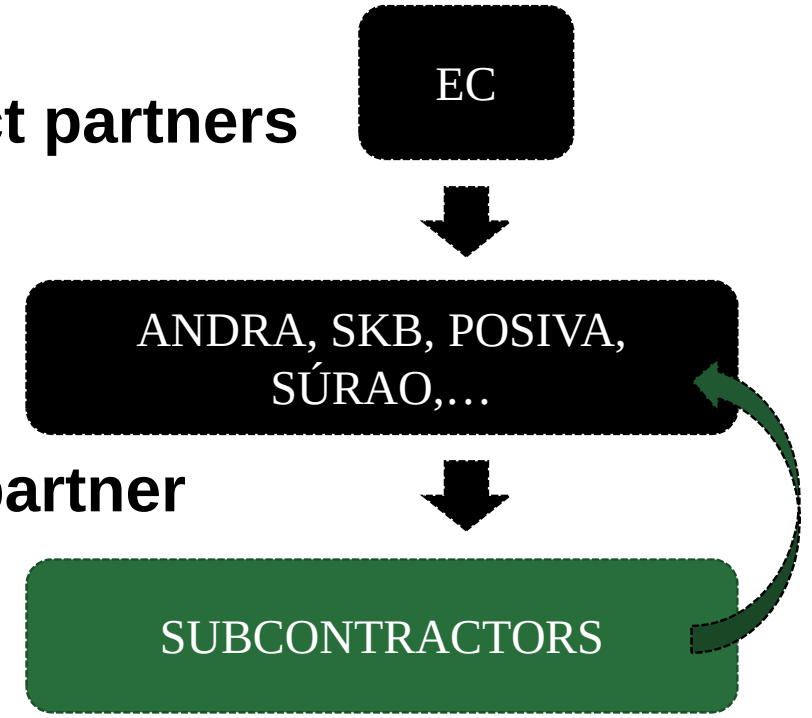
DOPAS Project

- **EURATOM FP7 project**
- **2012-2016**
- **14 partners**
- **8 countries**
- **4 big experiments à EPSP**

- **In CZ: SÚRAO, CTU in Prague, ÚJV Řež, a.s.**

DOPAS Project

- **Originally agencies as project partners**
- **Others as subcontracting**



- **At submission time CTU as partner**
- **Negotiation – EC requests no subcontracting à new partners**

DOPAS Project

Funding of CZ part:

- **CTU in Prague – EC; Ministry of education, youth and sports**
- **SÚRAO – EC + nuclear account**
- **ÚJV Řež, a.s. – EC + SÚRAO**

- **Public money from different sources – lot of rules to follow, public tenders/procurement process**

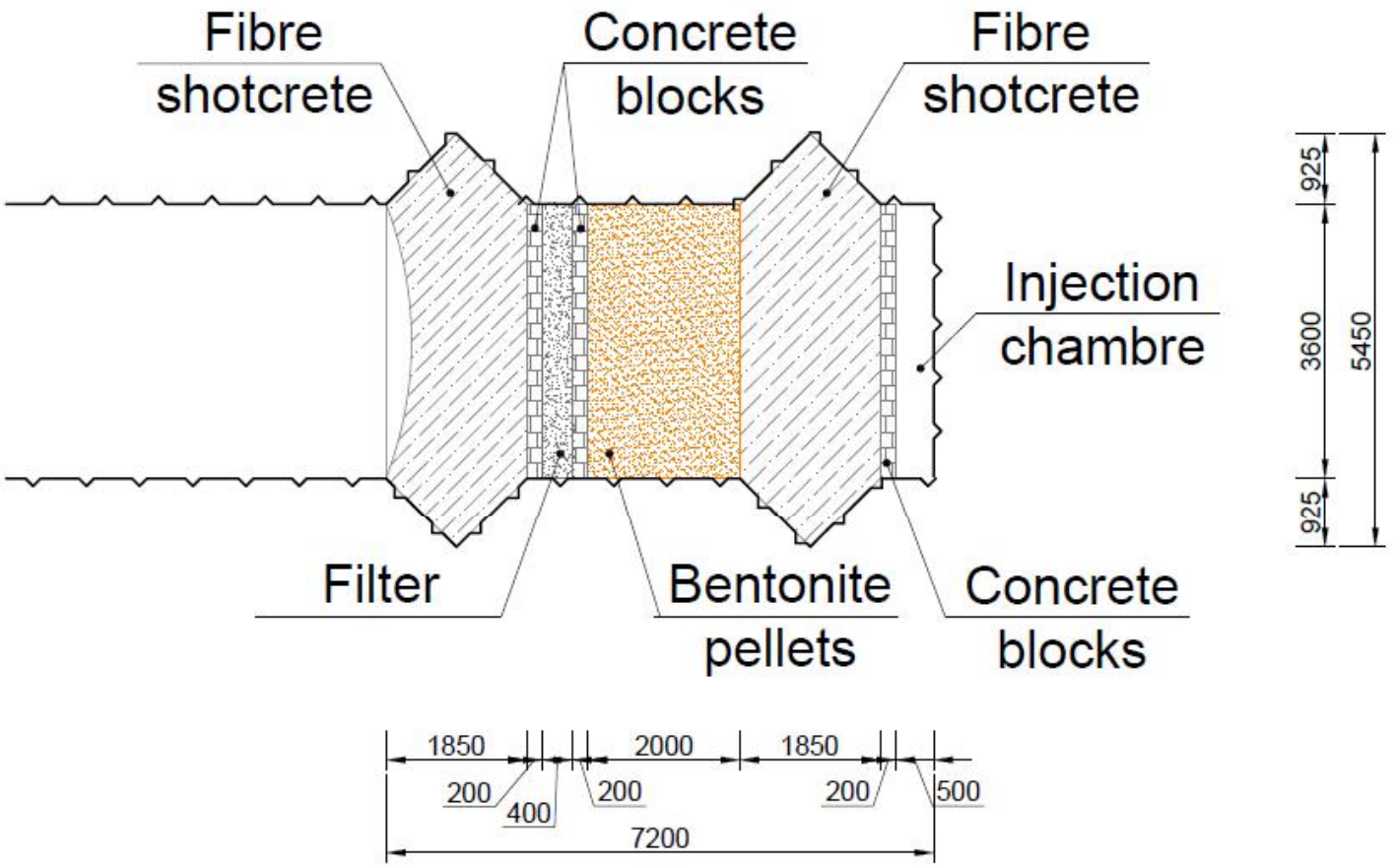
DOPAS EPSP

Main roles and responsibilities of partners within EPSP in-situ experiment:

- **SÚRAO**
  - **Geology mapping, mineralogy**
  - **Rock improvement, boreholes, instrumented rock bolts**
- **CTU**
  - **Design of EPSP**
  - **Construction works & technology**
  - **Monitoring**
  - **Run of the experiment**

Note: Laboratory and other works are not included in this list. Only in-situ works listed.

EPSP


Fibre shotcrete
Concrete blocks
Fibre shotcrete
Injection chambre
Filter
Bentonite pellets
Concrete blocks
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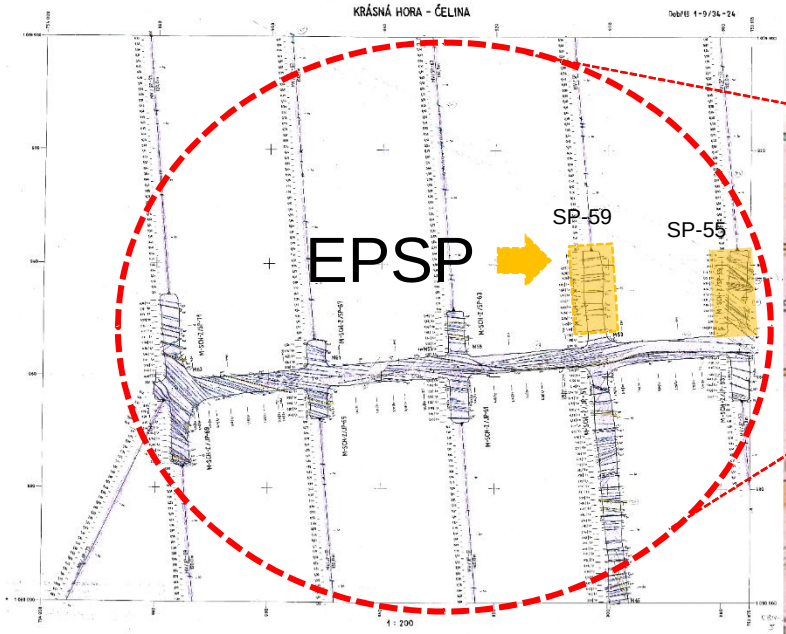
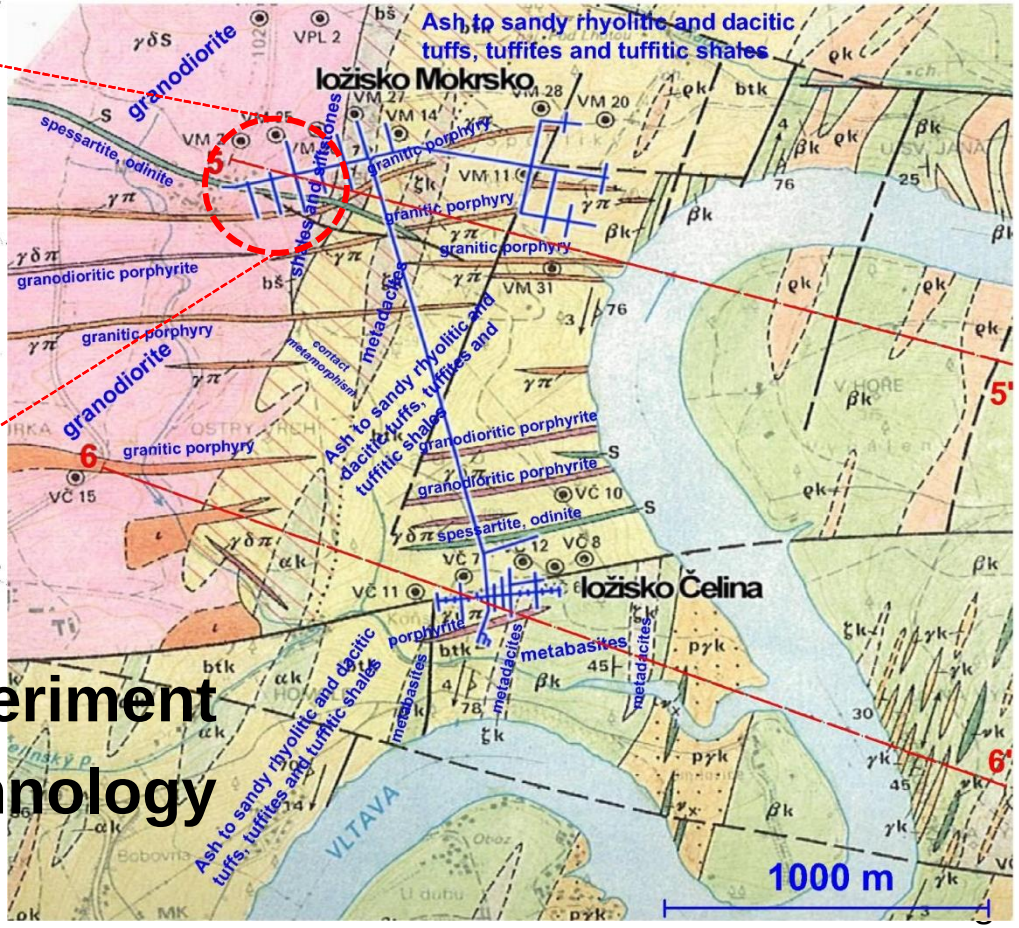
EPSP works

- **Preparation of niche**
- **Construction – phase 1 (subcontracting)**
  - **Rock reshaping & improvement**
  - **Instrumented rock bolts**
  - ***Plug contact grouting***
- **Construction – phase 2 (subcontracting)**
  - **Construction works (shotcrete, support structures, filter,…)**
  - **Technology**
- **Bentonite sealing**
- **Monitoring**

EPSP





- **M-SCH-Z/SP-59 - experiment**
- **M-SCH-Z/SP-55 - technology**

Preparation of niches (CTU)

- **Clean up of the floor (lot of material removed)**
- **General clean-up**

- **Electricity**
- **Water**
- **Network**

- **Concrete floor for technology (2014)**

- ***Expected/delivered: beginning 2013***

Public procurement kicks in…

…lowest price is not always the best thing

Construction works – phase 1 (SÚRAO)

- **SÚRAO**
  - **Part of state**
  - **Internal rules**
  - **Public procurement law**
- **Mapping of geology**
- **Rock improvement & reshaping – public tender**
  - **Tender expected I.Q 2013 à II./III.Q 2013**
  - **Works expected to finish April 2014 (according to agreement with contractor) à September 2014**

à all spare time consumed…

Construction works – phase 2 (CTU)

- **CTU**
  - **Public university**
  - **Internal rules**
  - **Public procurement law – public money**
- **Building works & technology**
  - ***Works could start only once phase 1 is finished***
  - **Works expected to start at the end of 2013 à October 2014**
  - **First public tender (I.Q 2014) had to be cancelled and a new one had to be performed**

Bentonite sealing

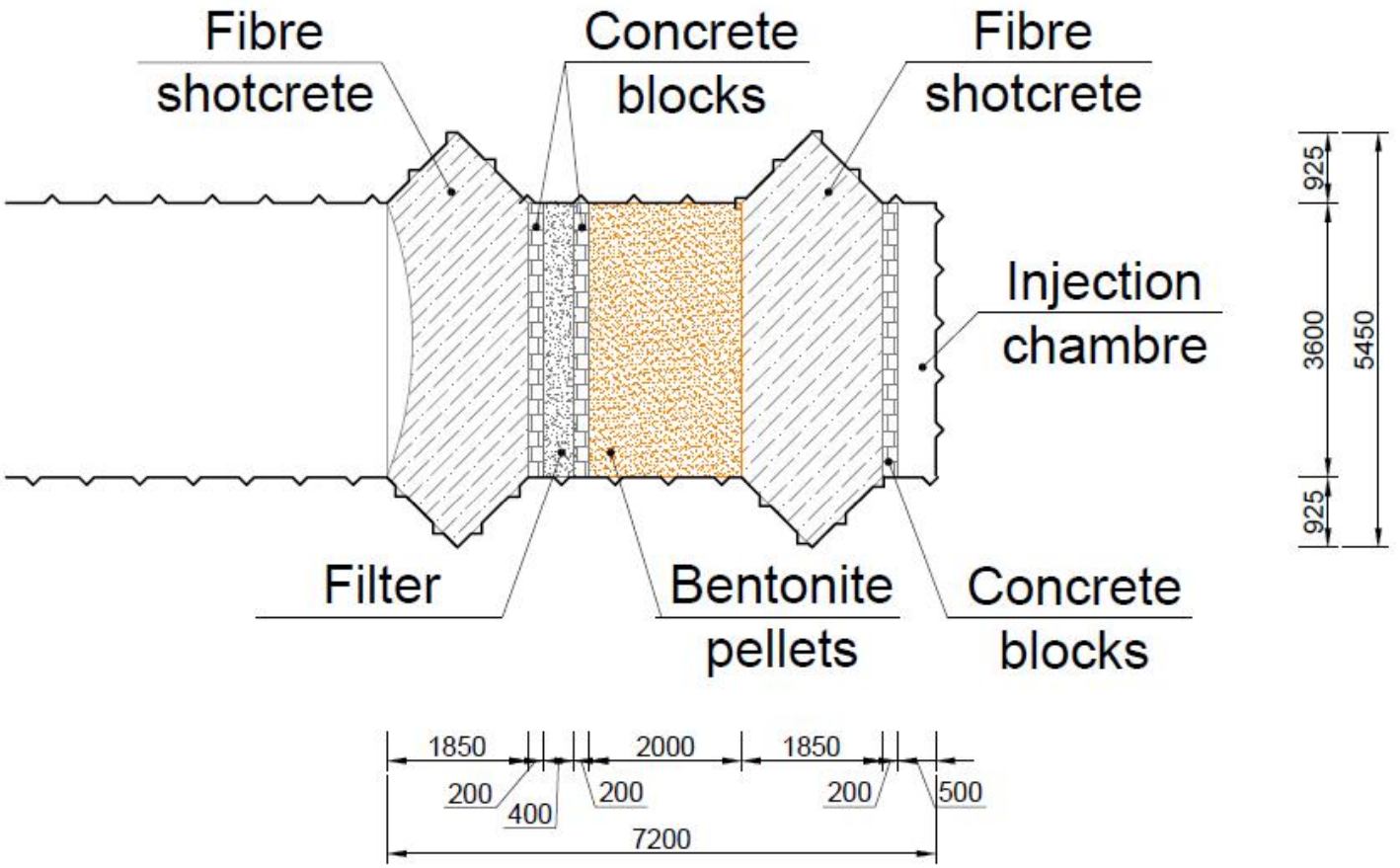
- **Originally planned as part of Phase 2 subcontracting**
- **Work was performed by CTU**
  - **Tighter control on quality**
  - **CTU has already developed technology for that**
  - **More cost effective**
  - **Reduces complexity of tender process**
  - **European Commission (EC) prefers the works to be done by project partners**

Monitoring

- **Originally planned as part of Phase 2 subcontracting**
- **Work was performed by CTU**
  - **Tighter control on quality**
  - **More cost effective**
  - **Saves a lot of time – monitoring has been partially prepared ahead (while Phase 1 has been running)**
  - **Reduces complexity of tender process**
  - **EC prefers the work to be done by partners**

Back to technical…

EPSP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EPSP components

- **Pressurisation chamber**
- **Inner shotcrete plug**
- **Bentonite sealing**
- **Filter**
- **Outer shotcrete plug**
- **Separation walls**

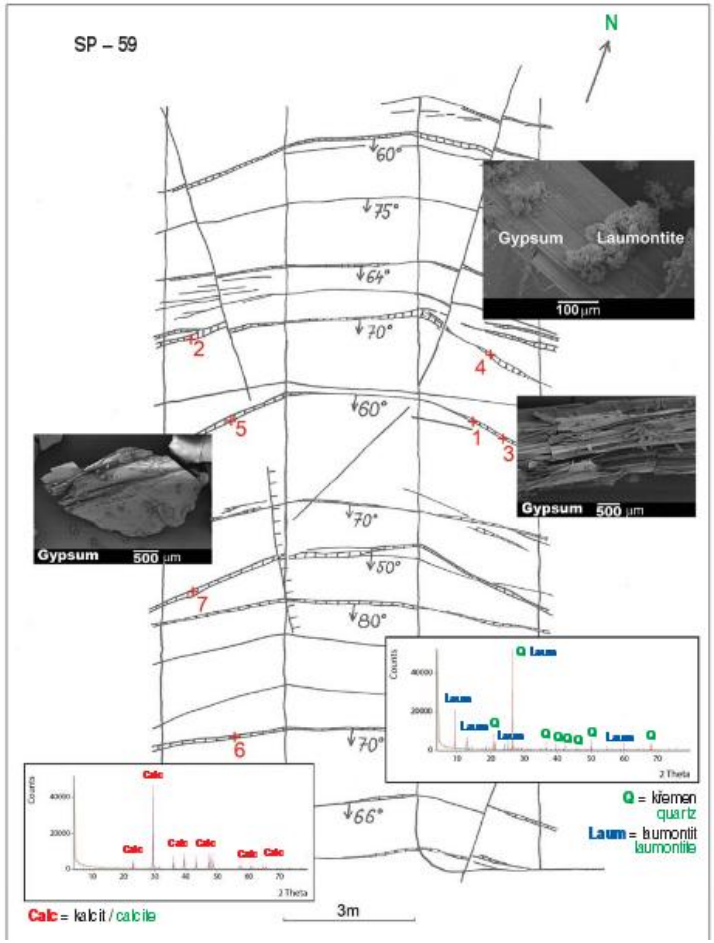
- **Technology**
- **Monitoring**

EPSP works

- **Preparation of niche**
- **Construction – phase 1 (subcontracting)**
  - **Rock reshaping & improvement**
  - **Instrumented rock bolts**
  - ***Plug contact grouting***
- **Construction – phase 2 (subcontracting)**
  - **Construction works (shotcrete, support structures, filter,…)**
  - **Technology**
- **Bentonite sealing**
- **Monitoring**

Geology

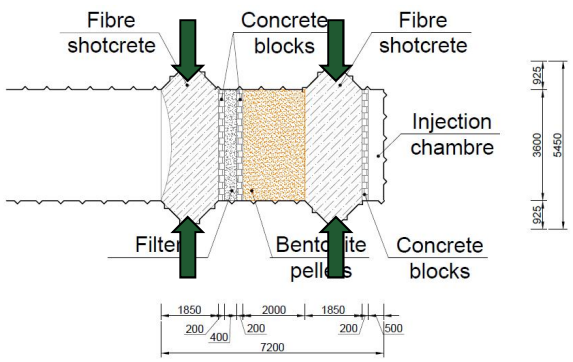
- **Detail mapping of selected niche**



Niche reshaping

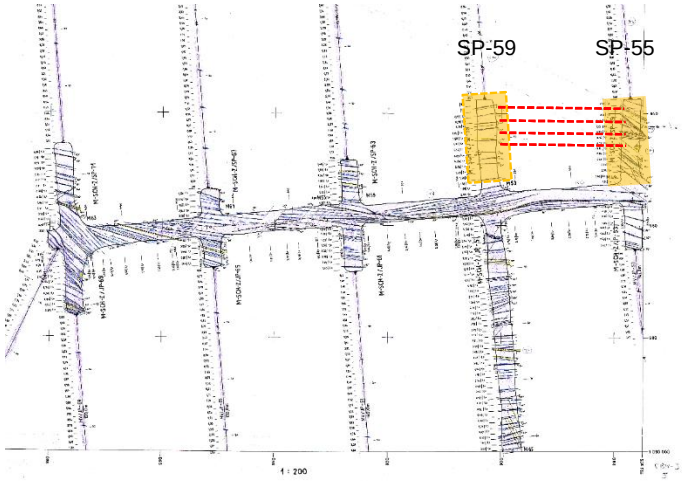
- **No blasting used**

- **Hydraulic wedge splitting**
- **Gas expansion - GBT Non-Detonating Safety Power Cartridge**



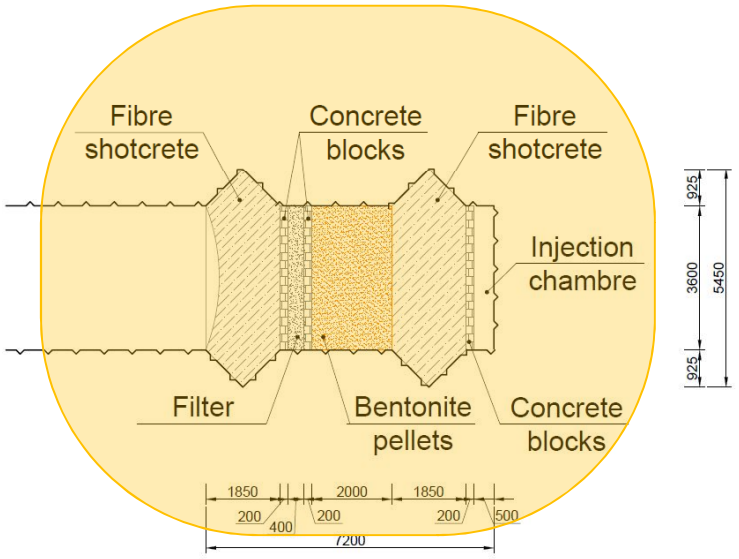
Connecting boreholes

- **Connecting boreholes**
  - **Instrumentation – 5 boreholes**
  - **Pressurisation & extraction**
    - **4 – injection chamber**
    - **4 – filter**



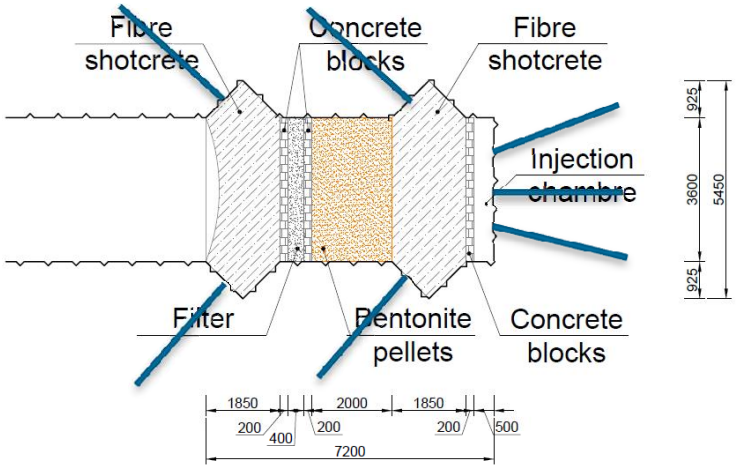
Grouting

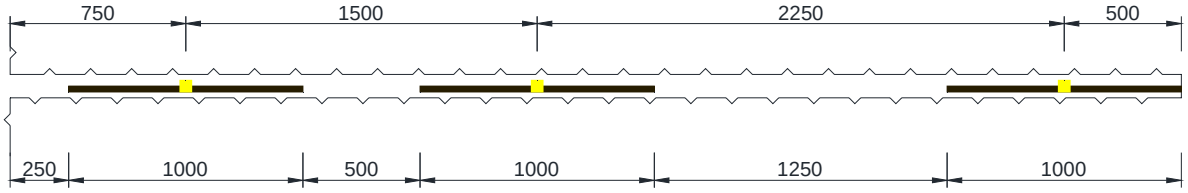
- **Improvement of rock mass**
- **Polyurethane resin (WEBAC)**
- **5m envelope around experiment**



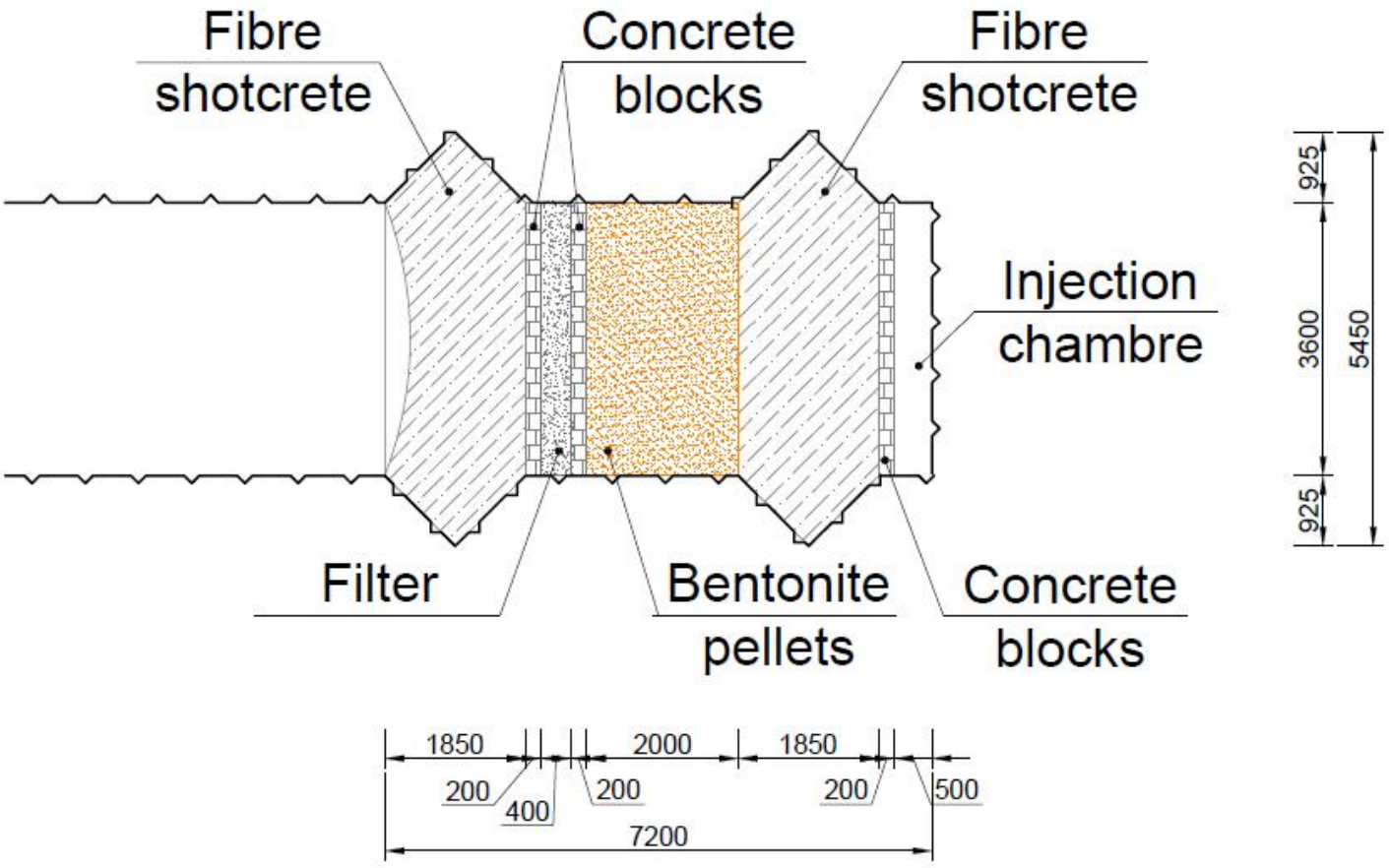
Rock bolts installation

- **Rock response monitoring**
- **GeoKon Rebar**
- **Boreholes origin**
  - **Front face – 4**
  - **First plug – 4**
  - **Second plug – 4**
- **3 sensors in each borehole**
- **“Hard” resin used to glue bars in**





EPSP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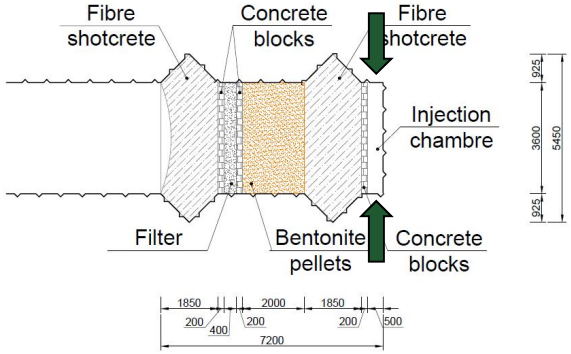
Pressurisation chamber adjustment

- Installation of pressurisation tubes
- Reduction of chamber volume
- Waterproofing
- Installation of sensors
- Erection of separation wall
- Ultimate test of technology and logistics for the plug construction
  - Size constraints on equipment
  - Long distance for concrete transport in the underground
  - Limited power supply



Pressurisation chamber

Pressurisation chamber

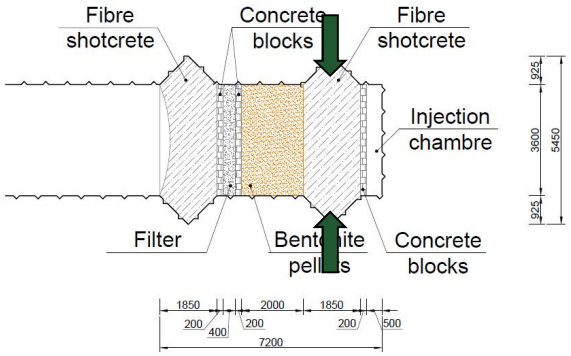
Pressurisation chamber

Separation wall

Inner glass fibre shotcrete plug

- **Erected in nonstop run in 23h (November 12th/13th 2014)**
- **38m^3 of concrete used**

- **Shotcrete (wet mix)**
- **Low pH**
- **Glass fibers**



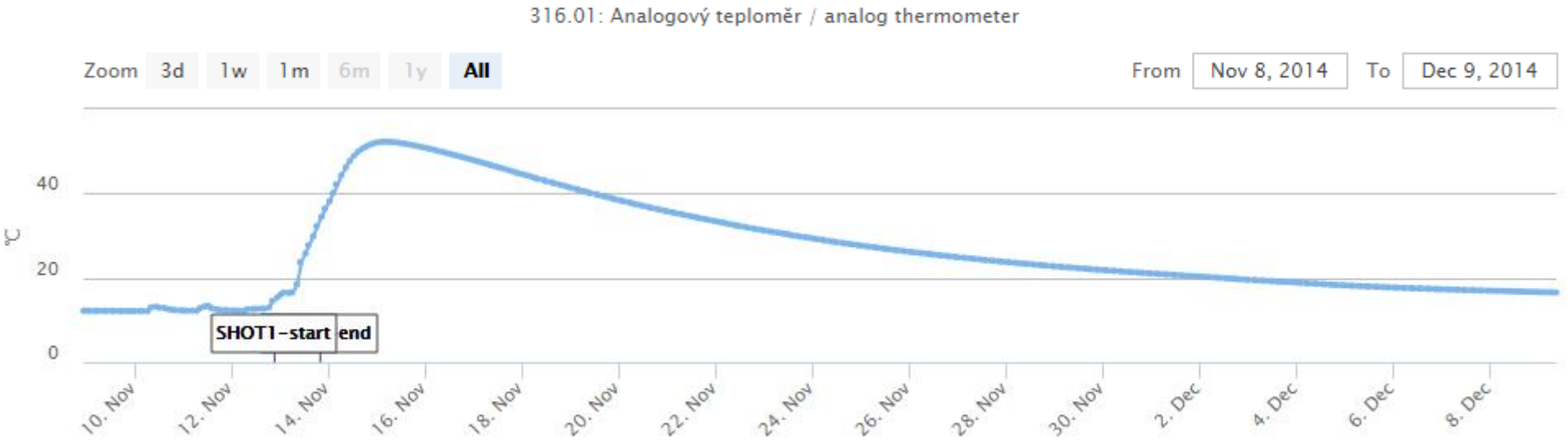
- **Concrete produced in Prague (1 – 1½h transport time)**
- **At portals concrete transferred into small trucks (two small trucks alternating – 2km drive one way, 40 minutes turnaround)**

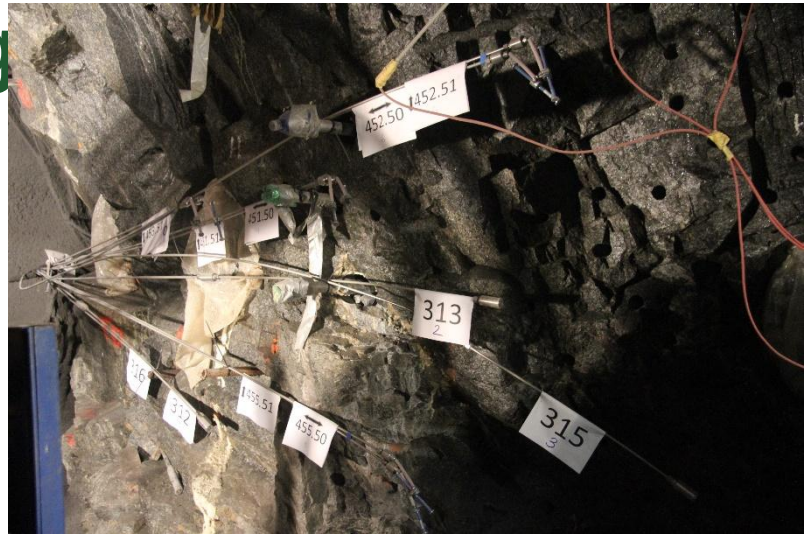
Shotcrete

- **Cement CEM II / B – M (S-LL) 42,5 N**
- **Microsilica SIKA FUME**
- **Sand&gravel 0-4 & 4-8 Dobřín**
- **Plasticiser SIKA 1035CZ**
- **Retardant SIKA VZ1**
- **Accelerator SIKA Sigunit L93 AF**
- **Glass fibres – crack HP (Sklocement Beneš)**

Shotcrete

- **Workability: 12h**
- **Low dust evolution**
- **Maximum temperature inside plug < 55 degr. C**




452.50
1452.51
313
315

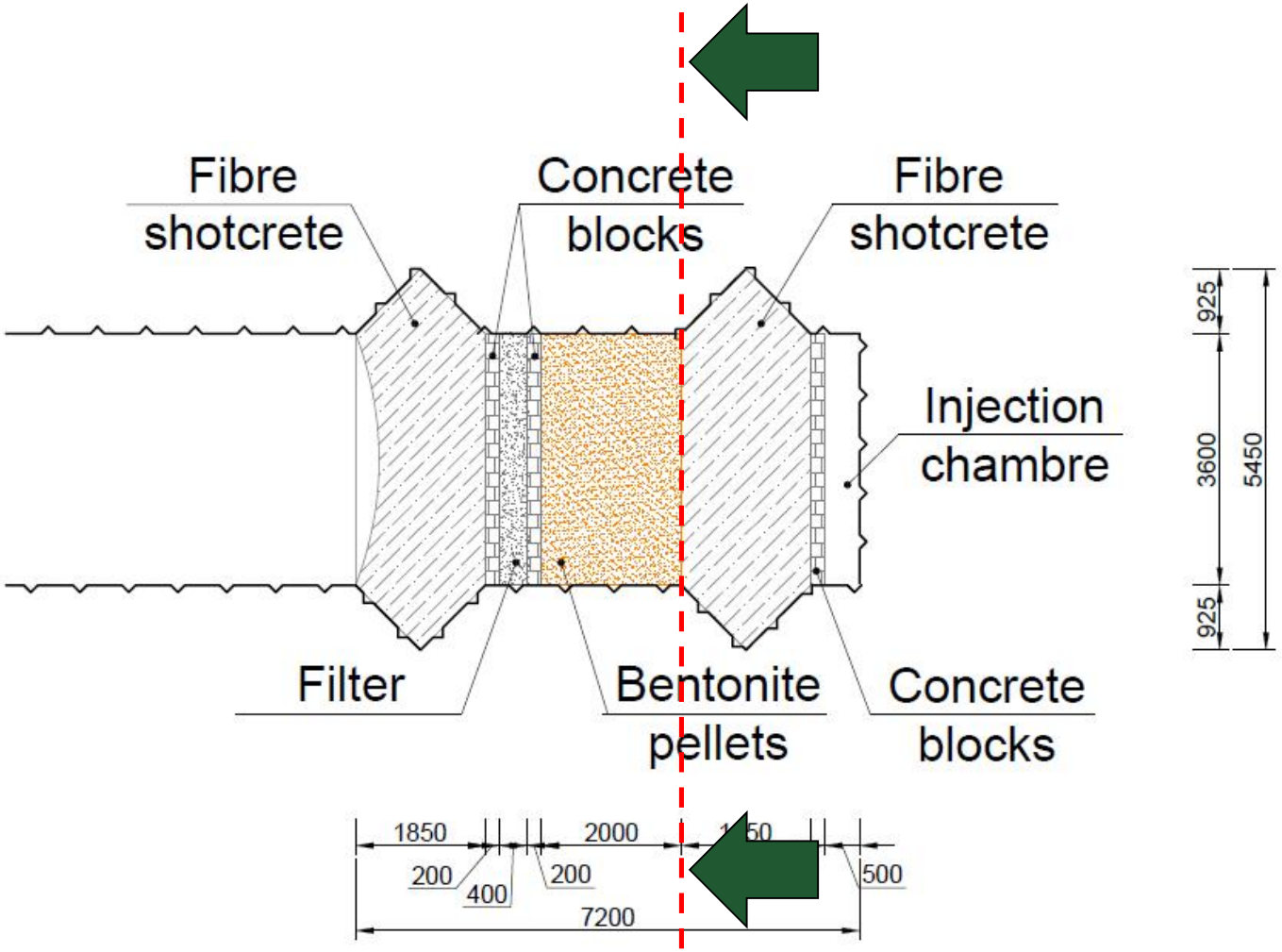
Plug test

- **December 3rd 2014**
- **Water pumped into pressurisation chamber**

- **Excessive leakage on the contact between the plug and rock**

à **Contact grouting**

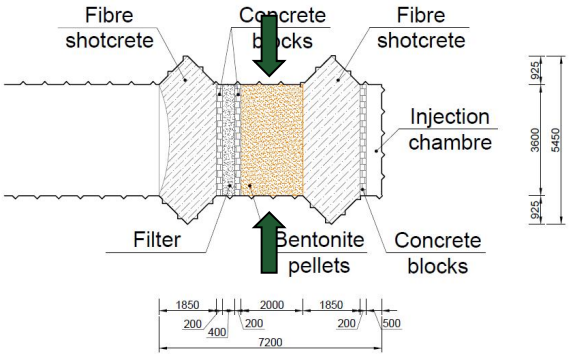
EPSP scheme



36

Bentonite sealing

- **Main sealing element**
- **Pellets (Czech Ca-Mg bentonite)**
- **Emplacement:**
  - **Dynamically compacted (vibration desk)**
  - **Shot clay technology**
- **Target overall dry density over 1400kg/m3**



Pellets

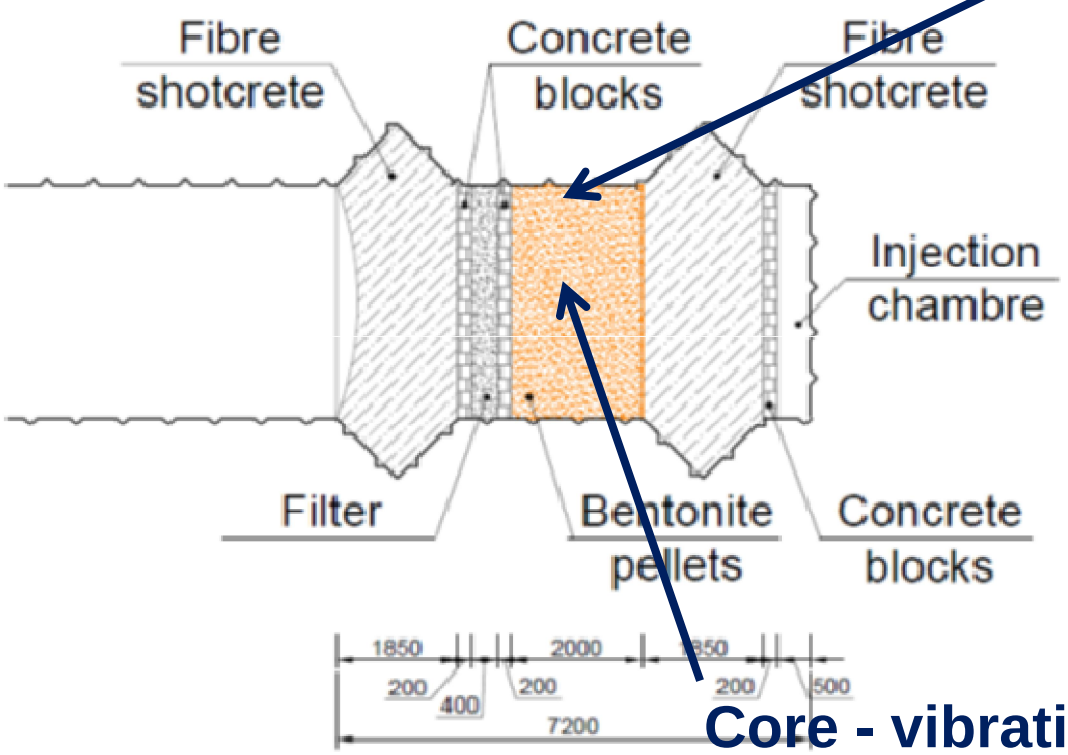
- **Bentonite B 75 in powder form….**
- **Two technological compaction processes were selected from the range of commercial technologies available:**
- **The roller compaction through the disk die.**
- **The compaction by the roll press.**

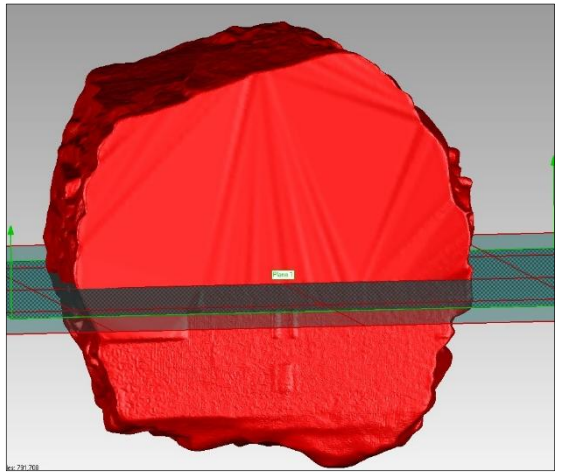
38

Bentonite emplacement

- **Total volume of sealing section 23.7m^3**

Upper vault – shotclay (5%)



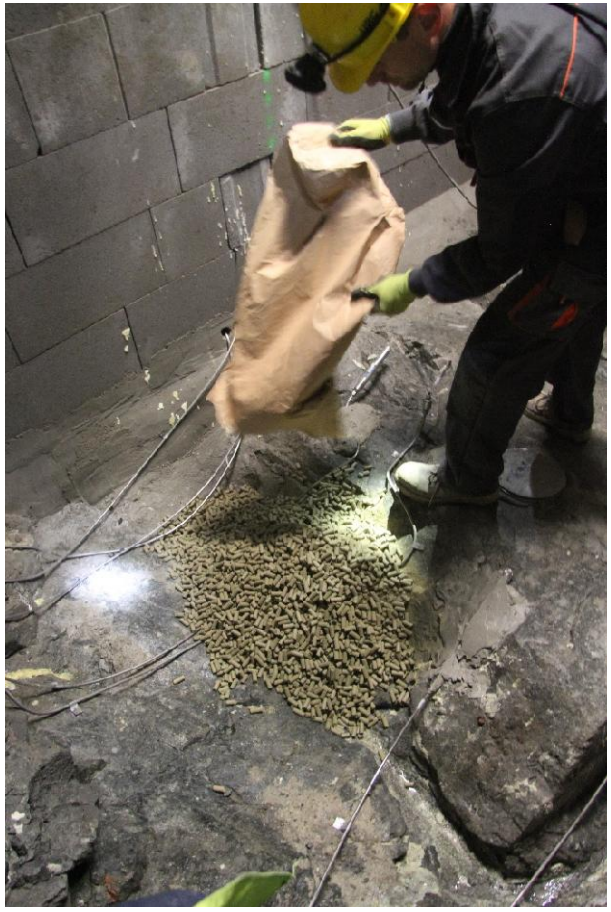


Core - vibration compacted (95%)

Bentonite emplacement

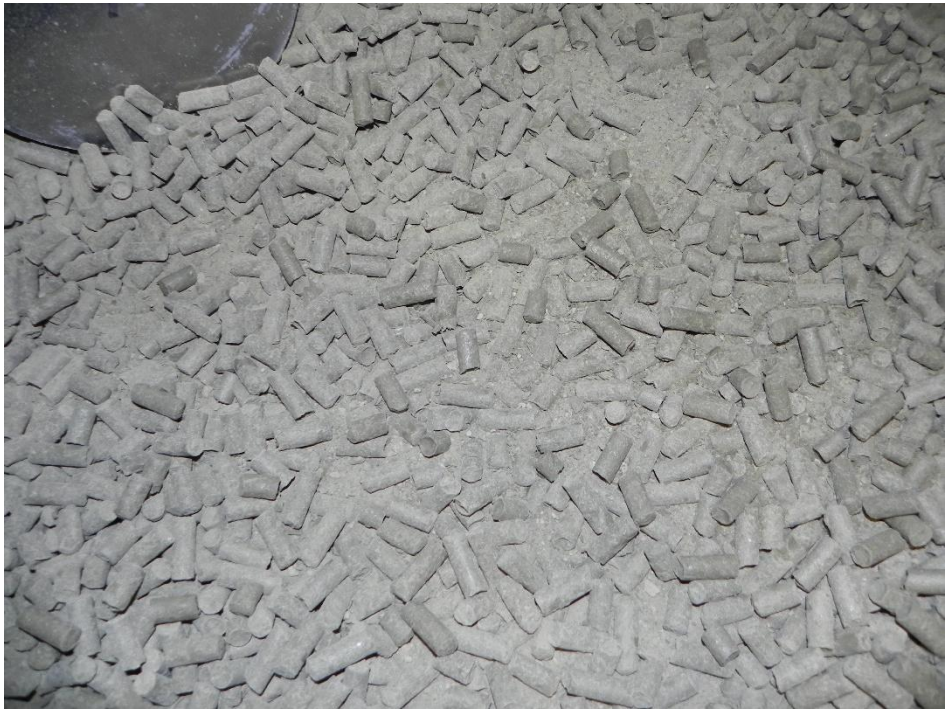
- **Emplacement started on June 5th 2015**

Bentonite emplacement



Bentonite emplacement

- “Fresh” pellets
- Vibration compacted



Bentonite emplacement

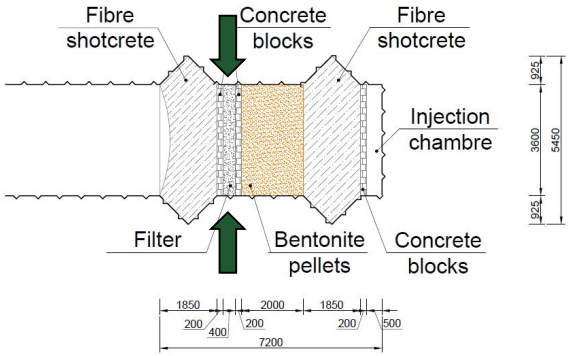
- **Upper parts**

Bentonite emplacement

- **Emplacement done in 9 days between June 5th and 15th 2015**
- **Total amount of material used 39.9 tons**
- **Volume of sealing section 23.7m^3**
- **Average density 1684kg/m^3**
- **Average dry density 1427kg/m^3**

Filter

- **Collection of water**
- **Possible alternative place for pressurisation**



- **Drain at bottom**
- **Connected to the SP-55 via cased boreholes**

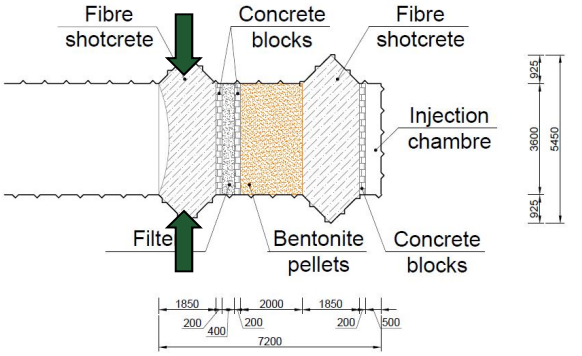
- **Erected step by step to support bentonite emplacement**

Outer plug

- “Copy” of inner plug

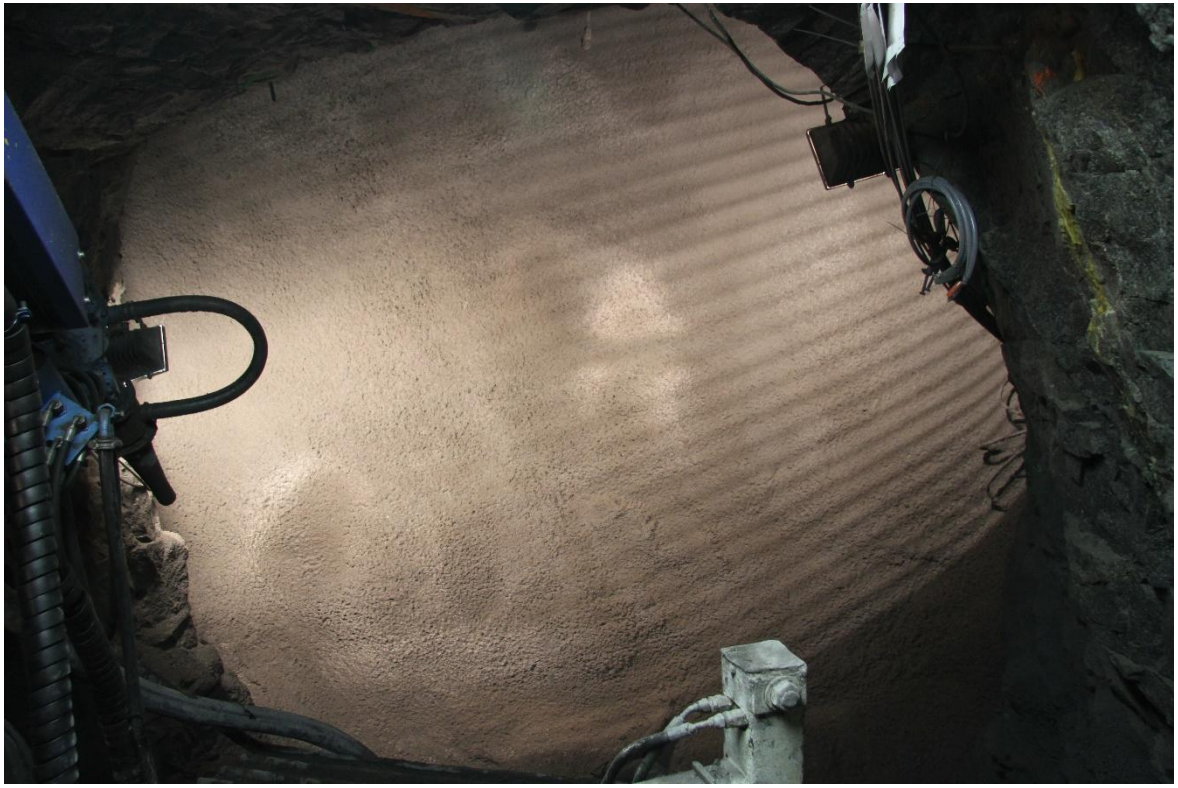
- Structural element
- Same dimensions as inner plug
- Same material as inner plug

- Erected June 19th/20th 2015



Outer plug

Outer plug



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