DOPAS TRAINING WORKSHOP 2015

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1.3.1 Case Example of EPSP Experiment

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Outline of the Lecture

- EPSP Project Goals
- Requirements on the EPSP Plug
- Design of the EPSP Experiment
  - Plug design
  - Instrumentation
  - Experiment test planning
- Implementation of the EPSP Experiment
  - Geological conditions – mapping in the niche
  - Tunnel reshaping
  - Improvement of the rock mass
  - Plug construction
  - Data collection and construction of the mathematical models

EPSP Project Goals

- **Construction of an experimental plug**
- **Focus on fundamental understanding of materials and technology**
- **Experimental niche reshaping**
- **Improvement of the rock mass in the experimental niche by polyurethane resin**
- **Instrumentation and performance assessment**
- **Evaluate the use of fibre reinforced sprayed concrete for the concrete plugs and sprayed bentonite pellets composed of Czech bentonite for the bentonite zone**

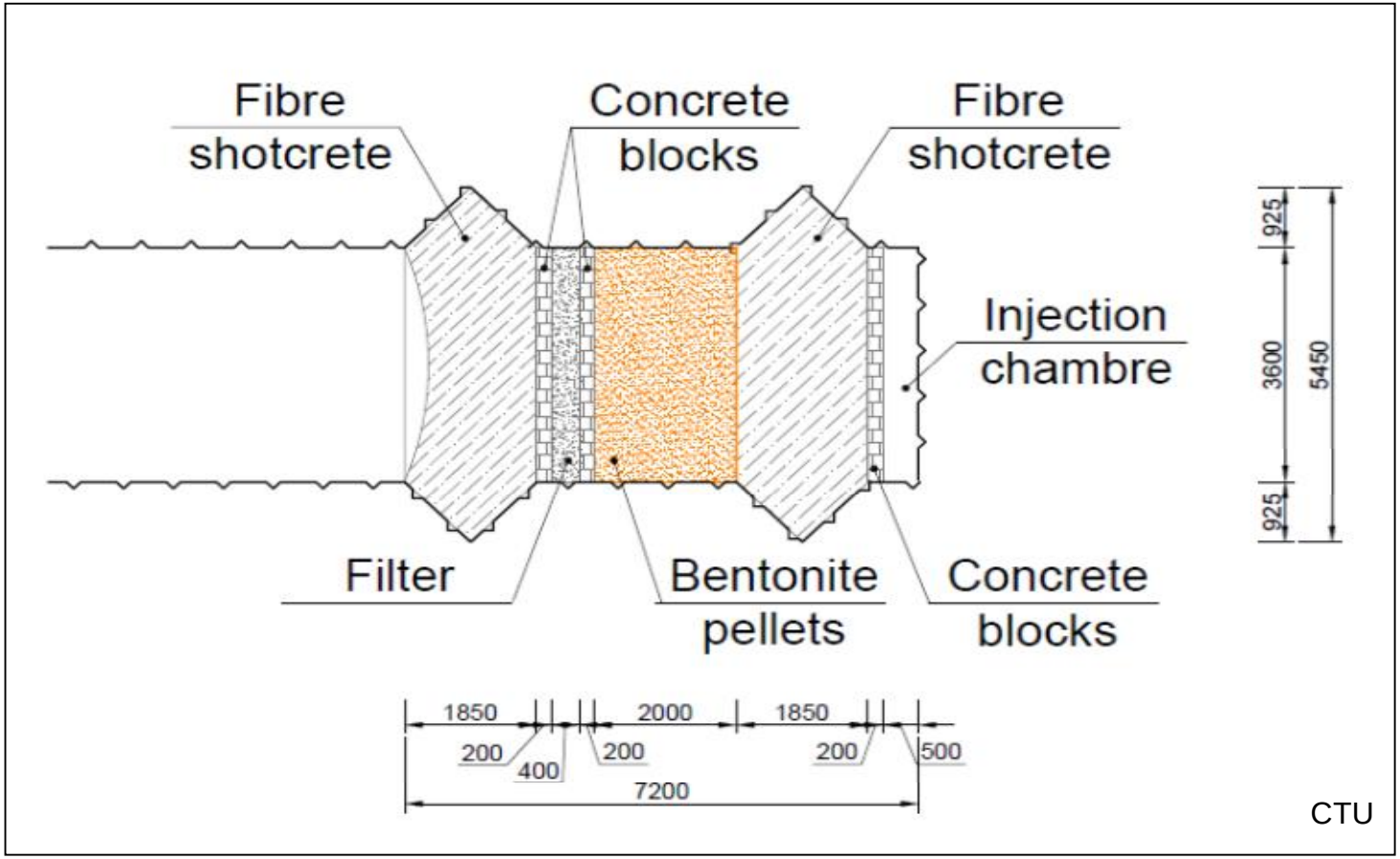
Requirements on the EPSP plug

- **The strength of EPSP shall be consistent with withstanding a pressure of 7 MPa to simulate the maximum pressure expected to be developed by the bentonite buffer in the deposition tunnels**
- **Design working life for the plug components is 150 years**
- **The bentonite zone shall use Czech bentonite (Bentonite B75) as this is the candidate buffer material in the reference concept**
- **A concrete recipe with a relatively low pH shall be used**
- **Fibre shotcrete shall be used for the inner and outer concrete plugs to limit crack formation**
- **The temperature in the concrete plugs during the cement curing shall be controlled in order to limit shrinkage and crack formation**

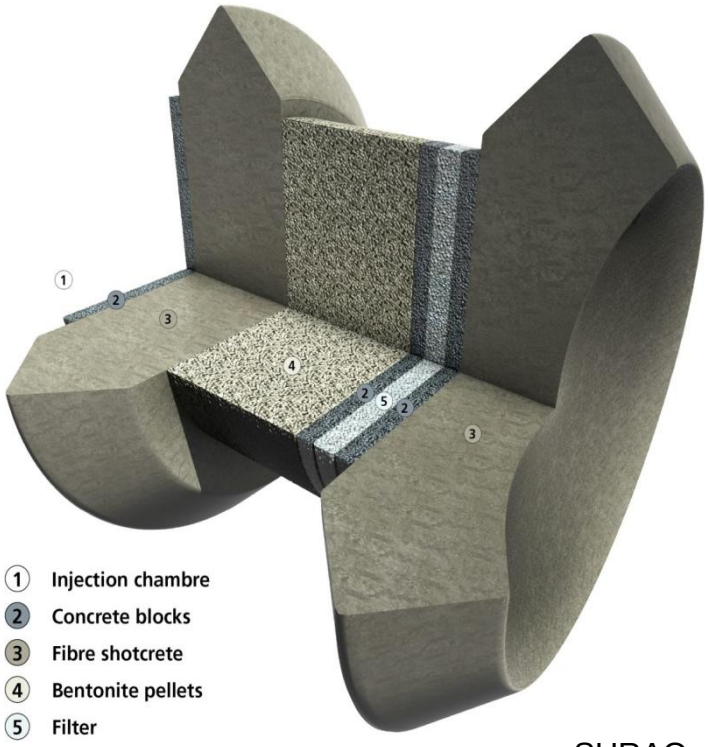
Design of the EPSP experiment

- **The technical design of the plug was the responsibility of the Centre of Experimental Geotechnics of the Czech Technical University (CTU), Prague and was based on a structural proposal contained in Reference Design 2011 (SURAO, 2011)**
- **The EPSP experiment is the first detailed work on plugs and seals**
- **Experience from KBS-3H study (SKB and Posiva)**

Plug design


Fibre shotcrete
Concrete blocks
Fibre shotcrete
Injection chambre
Filter
Bentonite pellets
Concrete blocks
925
3600
5450
925
1850
2000
1850
200
400
200
200
500
7200
CTU

Plug Design



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- **Pressurisation Chamber**

The chamber will serve as primary point for pressurisation media injection

- **Inner and Outer plug**

Concrete plugs are designed to hold the other components of EPSP in place

- **Bentonite Emplacement**

The bentonite pellets are going to be emplaced between the inner plug and filter

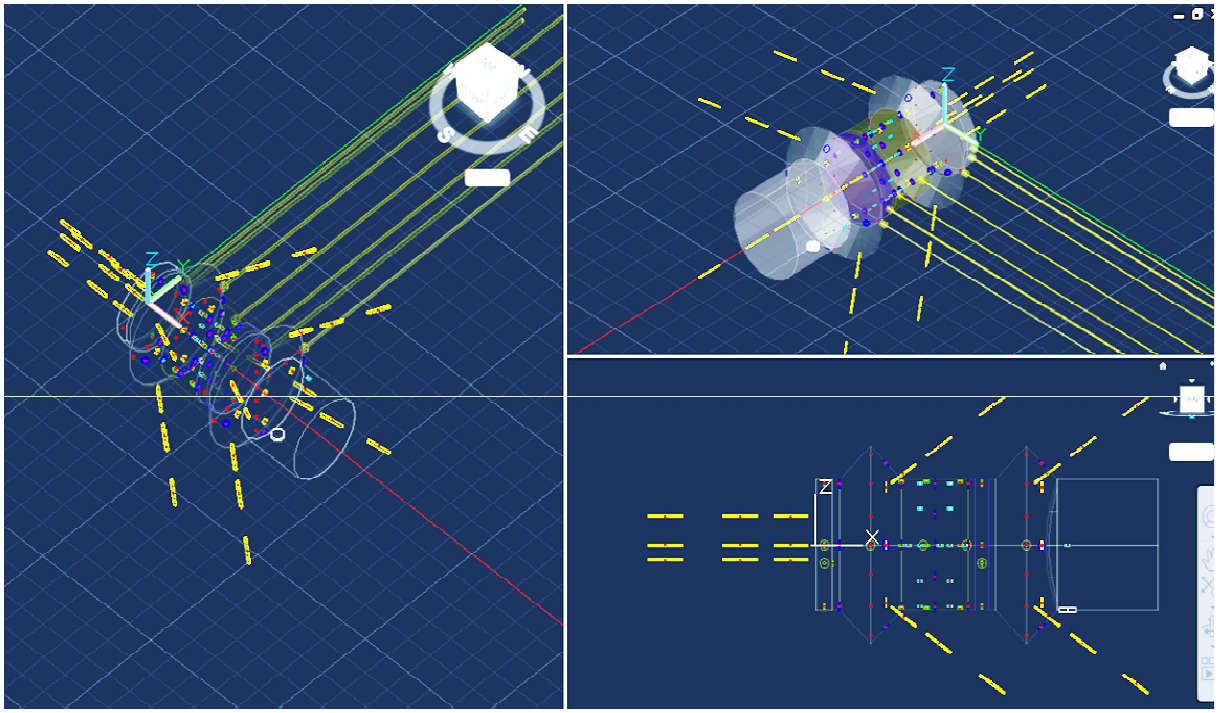
- **Filter**

The filter will serve as collection point of water, which could leak through the EPSP

Instrumentation

- **Monitoring of:**

  temperature, contact stress, deformation, pore pressure, moisture, swelling pressure distribution, ...



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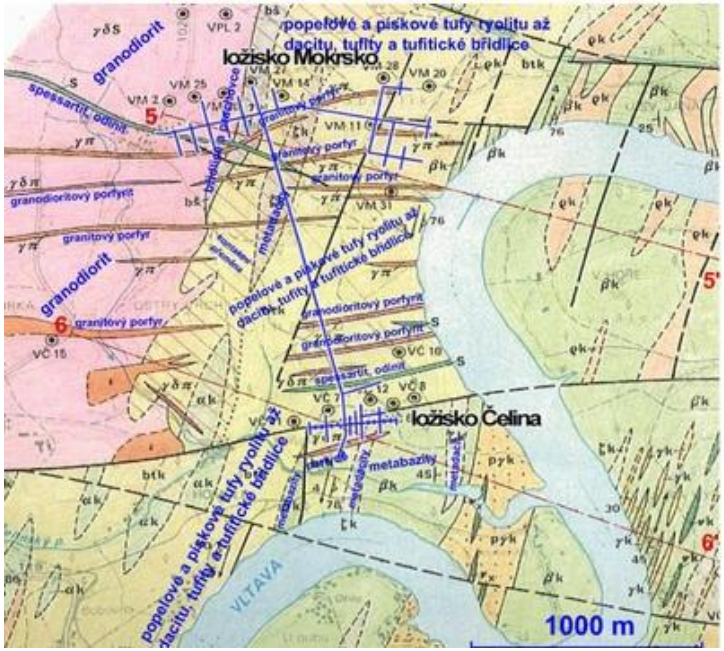
Experiment Test Planning

- **The plug will be tested by means of injecting air/water suspension into a pressurizing chamber, followed by the monitoring of the performance of the plug**
- **Up to 2 MPa**
- **Monitoring of key processes (water, stress, temperature)**
- **Collecting data**
- **Modeling of the whole plug system**
- **Analysis**

Implementation of the EPSP experiment

Geological conditions – mapping in the niche

- **The EPSP experiment is being conducted at the Josef Regional URC which is located near the town of Dobříš in the Čelina-Mokrsko former gold mining area. The host rock comprises Sázava-type granitoids of the Variscan age (Morávek et al., 1992)**



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Tunnel Reshaping

The hydraulic wedge splitting was used in combination with non-detonating (GBT) splitting.

Using those technologies, the profile of the niche has been adjusted and recesses for concrete plugs excavated.

Experimental niche after reshaping works

Improvement of the Rock Mass

- **Once the reshaping has been finished the rock improvement started. The rock properties have been improved by means of grouting. The resin has been used to lower the rock permeability in order to allow higher pressures to be applied on the plug and to limit unnecessary leakages into rock mass.**
- **Grouting of the contact zone between rock and concrete plug**

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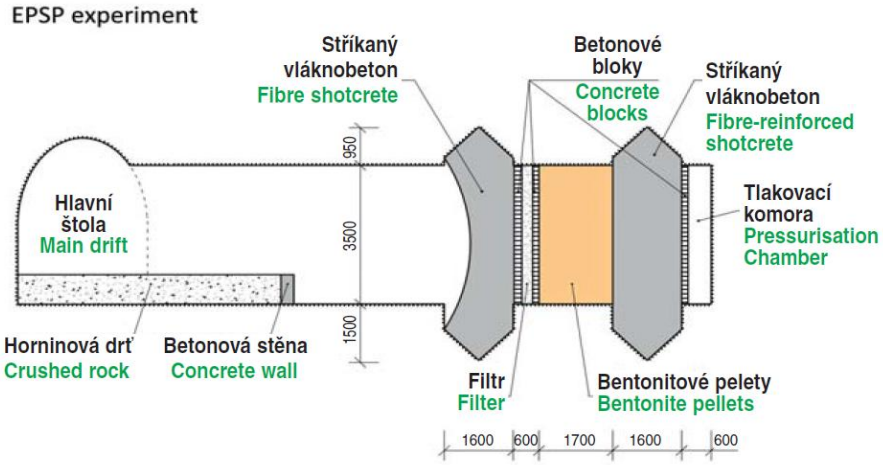
Grouting: 5 m around EPSP
Polyurethane resin (WEBAC)
Hydraulic conductivity < 10^{-8} m/s

Plug Construction

CONCRETE

- Glass fibre shotcrete
- Lower pH



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BENTONITE

- Czech Ca-Mg bentonite
- Dry density around 1.4 Mg/m3
- Hydraulic conductivity < 10^{-12} m/s
- Swelling pressure > 2 MPa

Data Collection and Construction of the Mathematical Models

- **The behaviour of the plug will be comprehensively monitored throughout the duration of the experiment.**
- **The final assessment of the experiment will involve the use of numerical analysis and modelling techniques.**
- **Finally, it is envisaged that the successful completion of the EPSP experiment will contribute towards demonstrating how sealing plug systems behave under real conditions**

References

- **MORÁVEK, P. et al. Zlato v Českém masivu. 1. vyd. Praha : Český geologický ústav, 1992, 243 s. ISBN 80-7075-088-X.**
- **SÚRAO (2011). Update of the Reference Project of a Deep Geological Repository in a Hypothetical Locality. Accompanying Report. Report EGP 5014-F-120055.**
- **WHITE, M. et al. Deliverable D2.1 Design Bases and Criteria, DOPAS project FP7 EURATOM, no. 323273. DOPAS version 1d4 from 26. November 2013, Galson Sciences Limited, 2013, 95 s.**

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