A FRACTURED AQUIFER AND ENGINEERED BARRIER - METHODS AND TOOLS OF AN EVALUATION

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OVERVIEW

- Introduction
- Objectives
- Locality
- Tests
  - In the laboratory
  - In the field
- Mathematic modeling
- Conclusion

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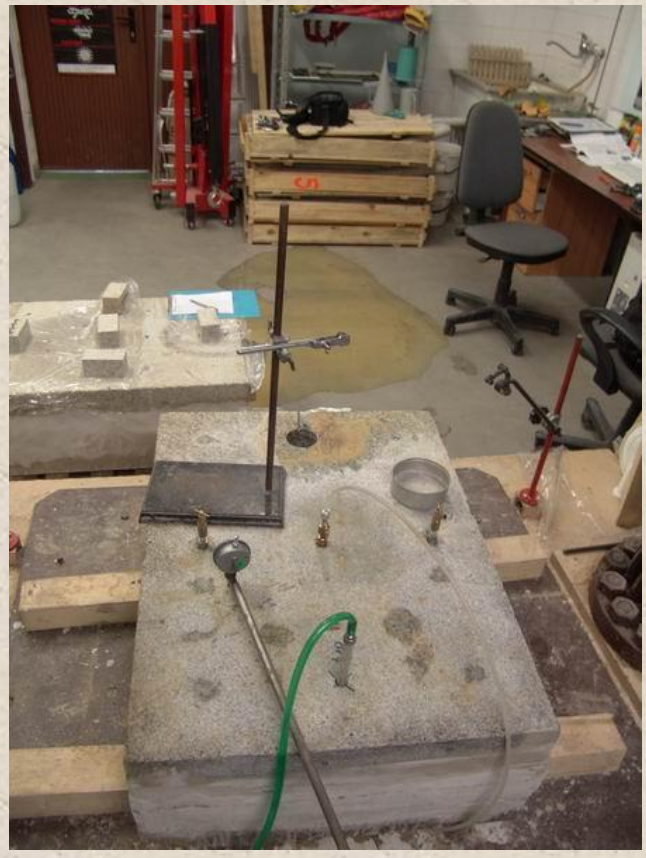
INTRODUCTION

‘Methods and tools for evaluating the effects of engineered barriers on distant interaction in the environment of a deep repository facility‘



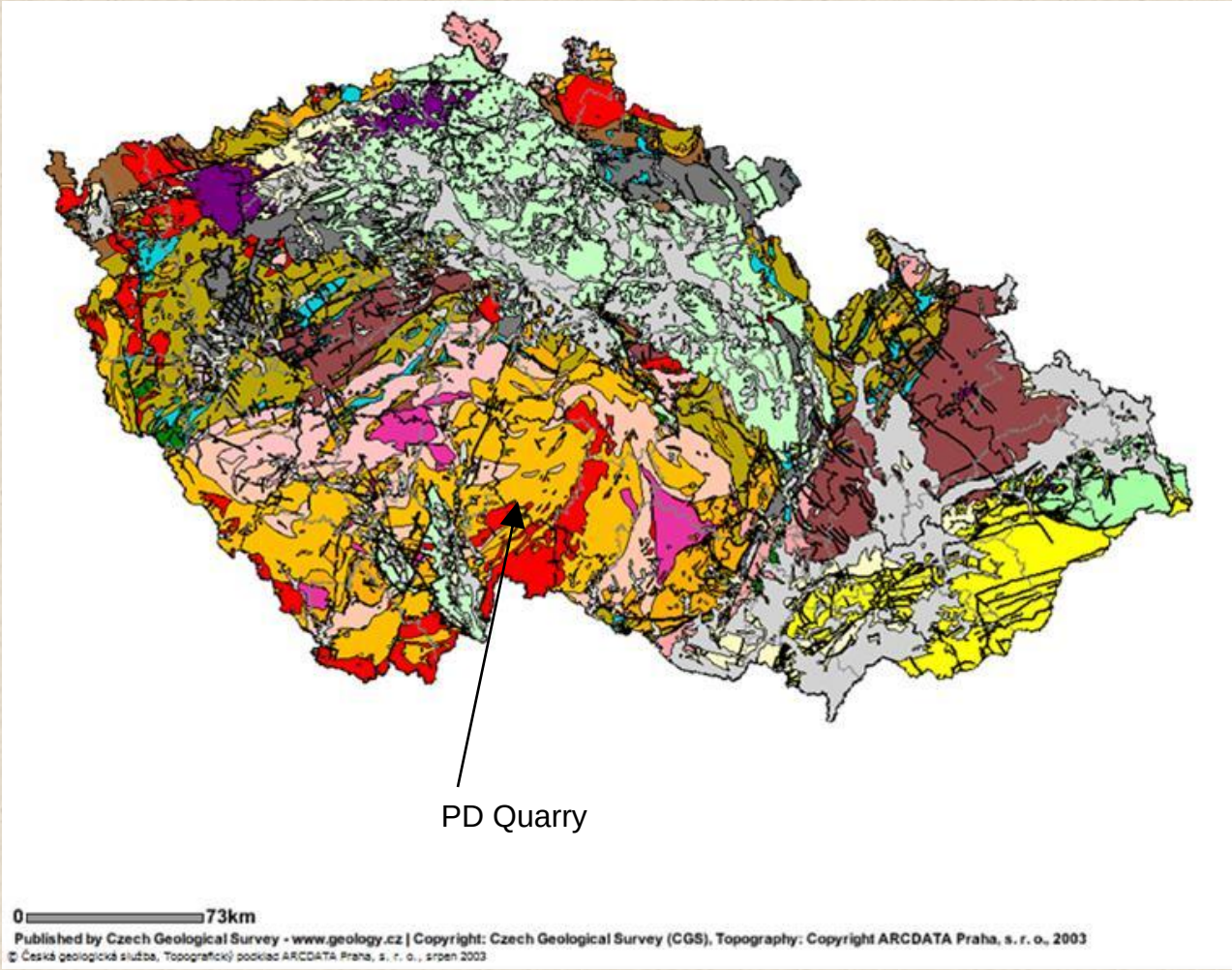
- Need of safe disposal – radionuclides fixing and sealing
- Barriers – natural (mineral), geotextiles

OBJECTIVES

- Main goals:
  - Detail description of a fractured aquifer
  - Methodological procedures
  - Prediction by mathematic modeling

LOCALITY

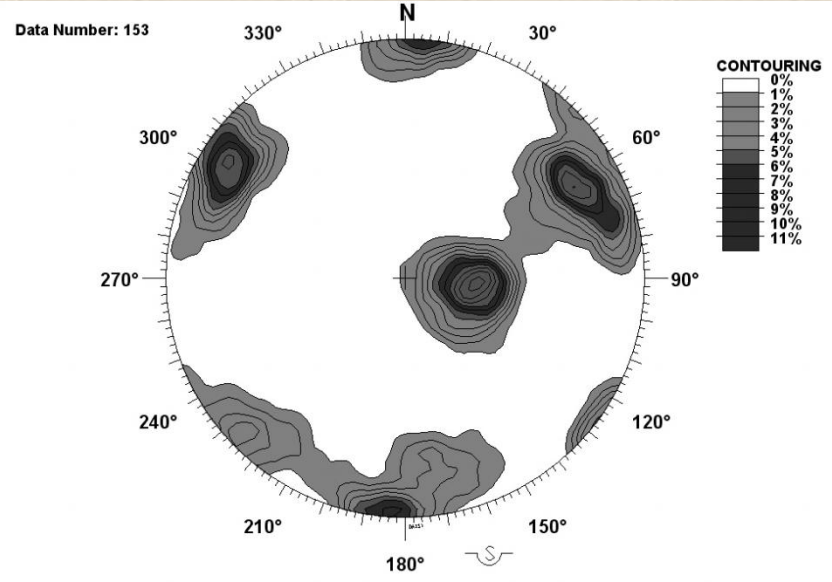
Panské Dubenky

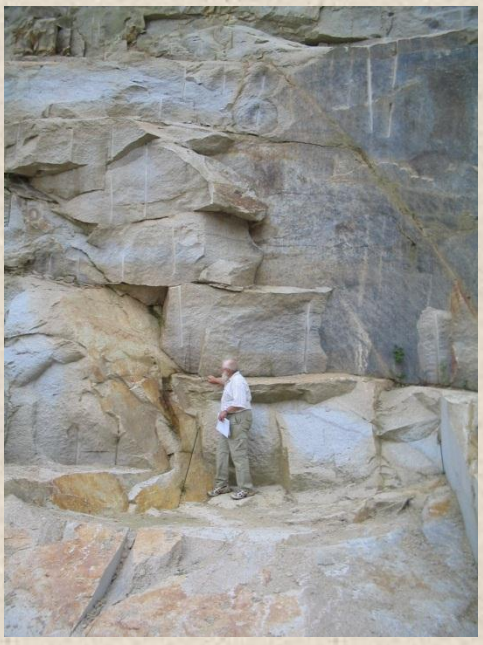


STRUCTURAL GEOLOGICAL MAPPING

Stereogram of the joint-planes poles

lower hemisphere, 153 measurements





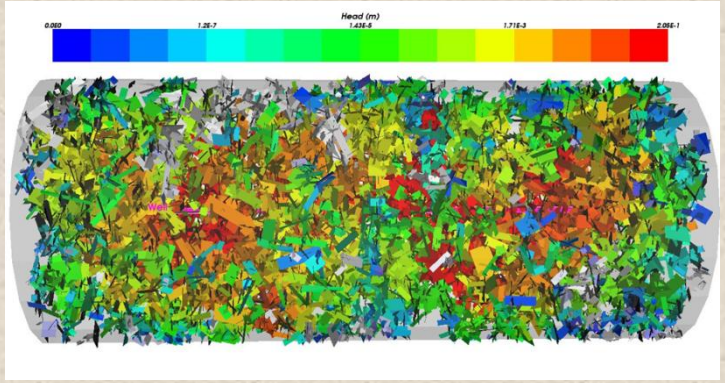
Panské Dubenky quarry face

PERFORMED WORKS

Laboratory works

Field works

Mathematic modeling



LABORATORY WORKS

- Basic characteristics of granite, fracture network and barriers

- Physical properties, description of discontinuities, hydrodynamic and fluid migration tests

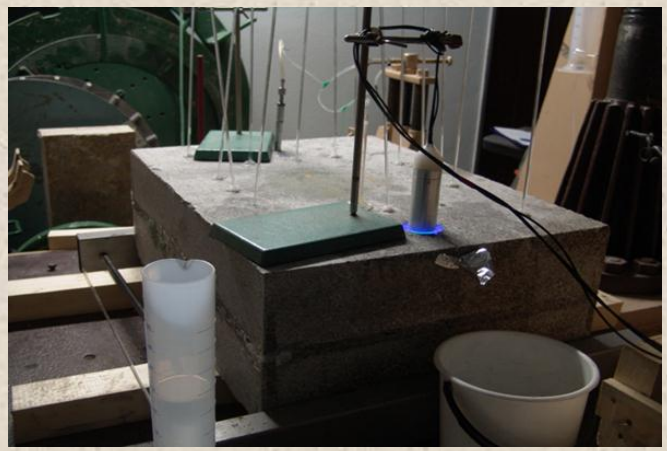
LABORATORY WORKS

- Hydrodynamic and migration tests → volume flow rates, barrier conductivity coefficients, penetration curves for each of the tracers

- Tracers: NaCl-solutions and Na-Fluorescein

- Attained data allowed preliminary mathematic modeling and fieldwork planning

- Natural and artificial barriers

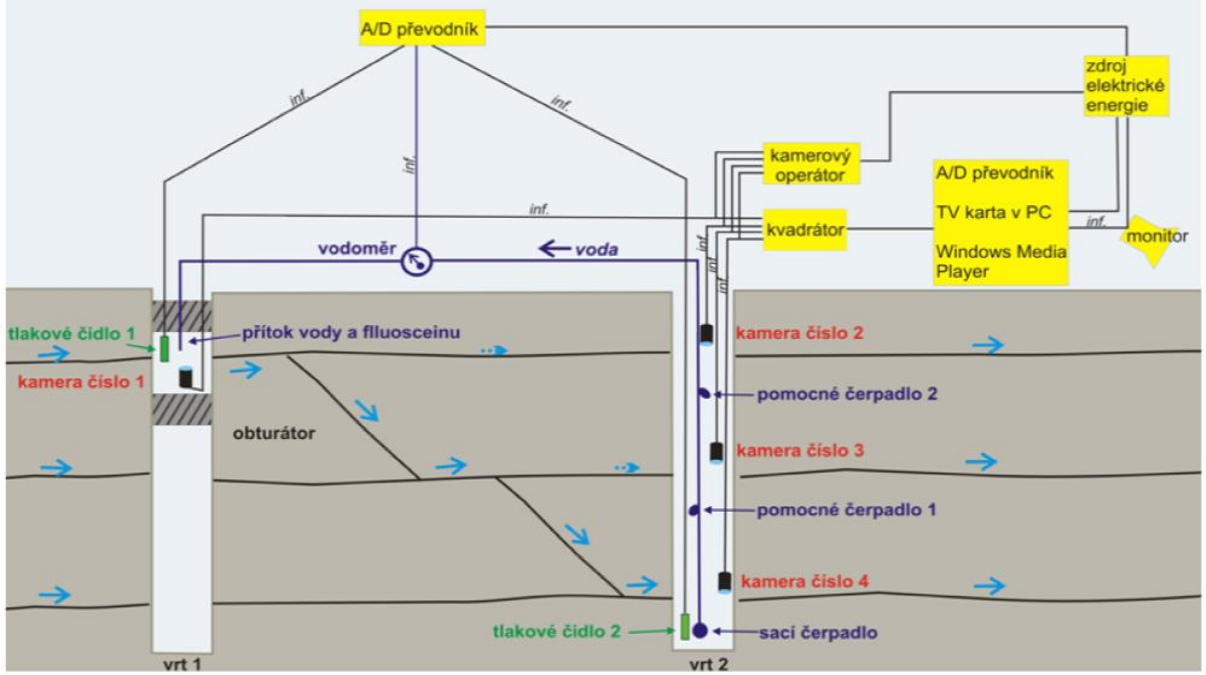


FIELDWORK

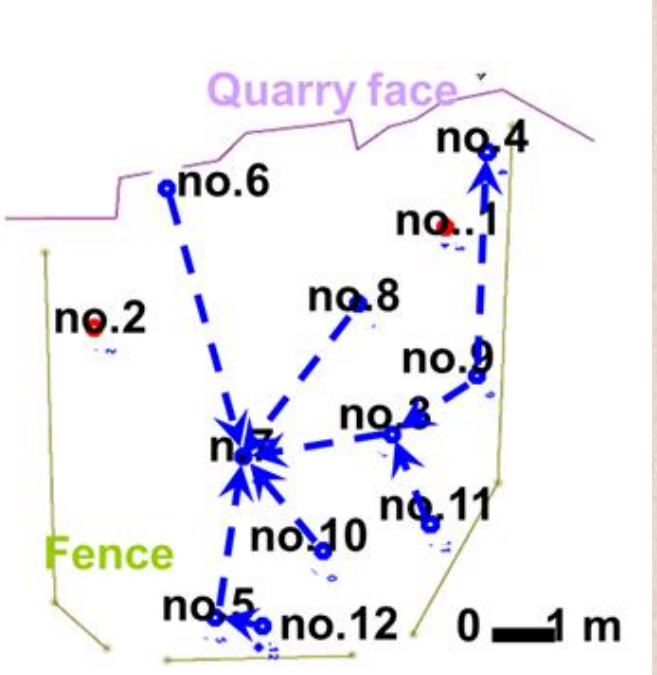
- Polygon app. 400 m^2, 14 shallow boreholes (7 – 10 m)
- Model of fracture network from structural research, borehole inspection, seismic data, multi-electrode resistivity
- Sludge and pumping tests
- Cross-hole tracer tests (for mathematic model calibration)
- 3 boreholes were sealed, bentonite-based barrier used and C-H tests repeated

CONECTIVITY OF THE FRACTURE NETWORK

Scheme of performed tests



Experiment instrumentation

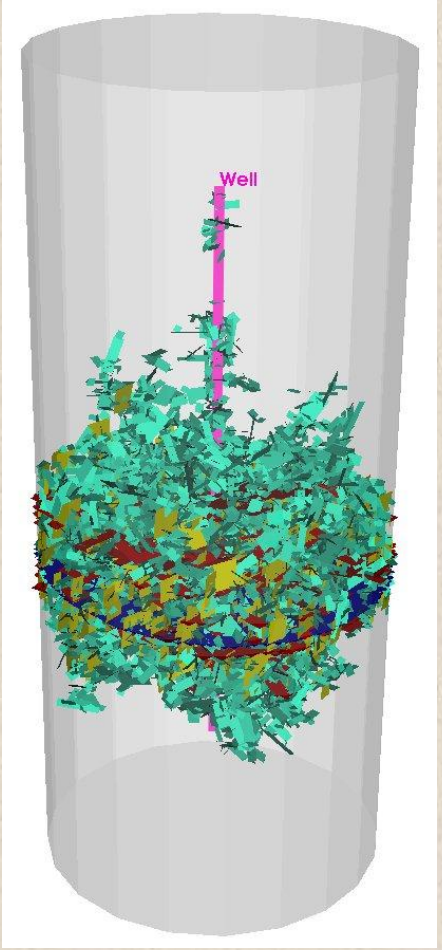


Animation_Sodium_Fluorescein_Detection.wmv

MATHEMATIC MODELING

- Chosen software: NAPSAC and FEFLOW

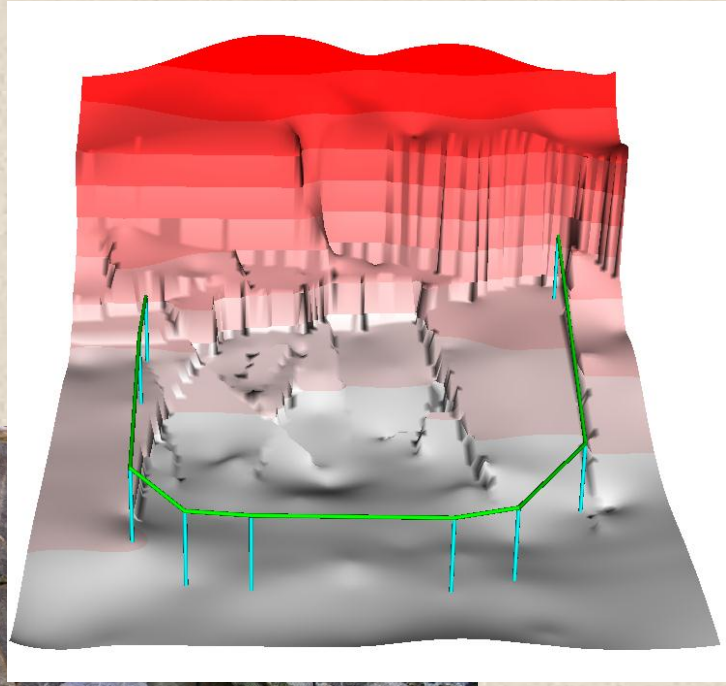
- NAPSAC 9.3 – 9.7.2
  - for geometry, convection and transport of the discrete fracture networks
  - incapable of transient simulation analysis in variably saturated environments
- FEFLOW 5.2 – 5.3(64)
  - allows single joints to be entered in the porous or impermeable environments
  - incapable of geometrically authentic single joint or fracture network simulation
  - simulation at laboratory scale and assessing the influence of the barrier



MATHEMATIC MODELING

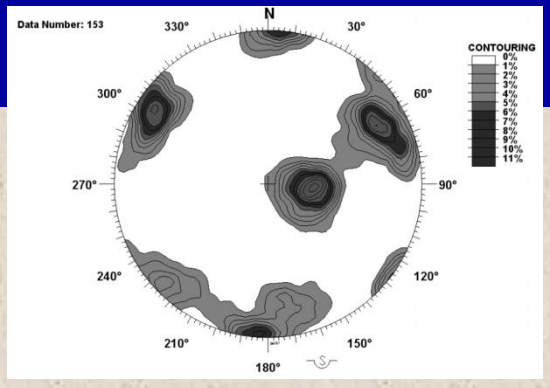
- Data processing for the model of in-situ tests

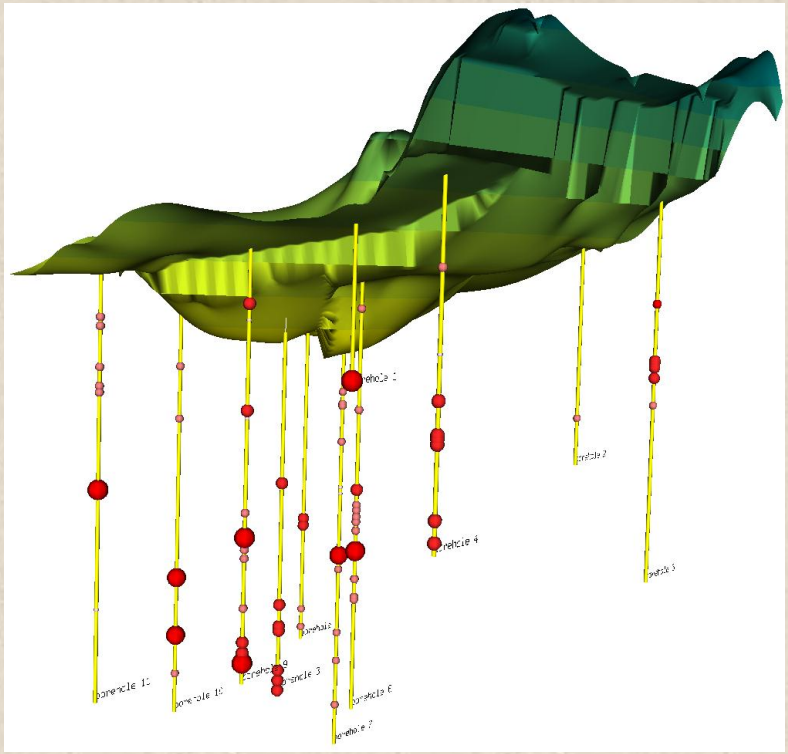
- Terrain digitalization

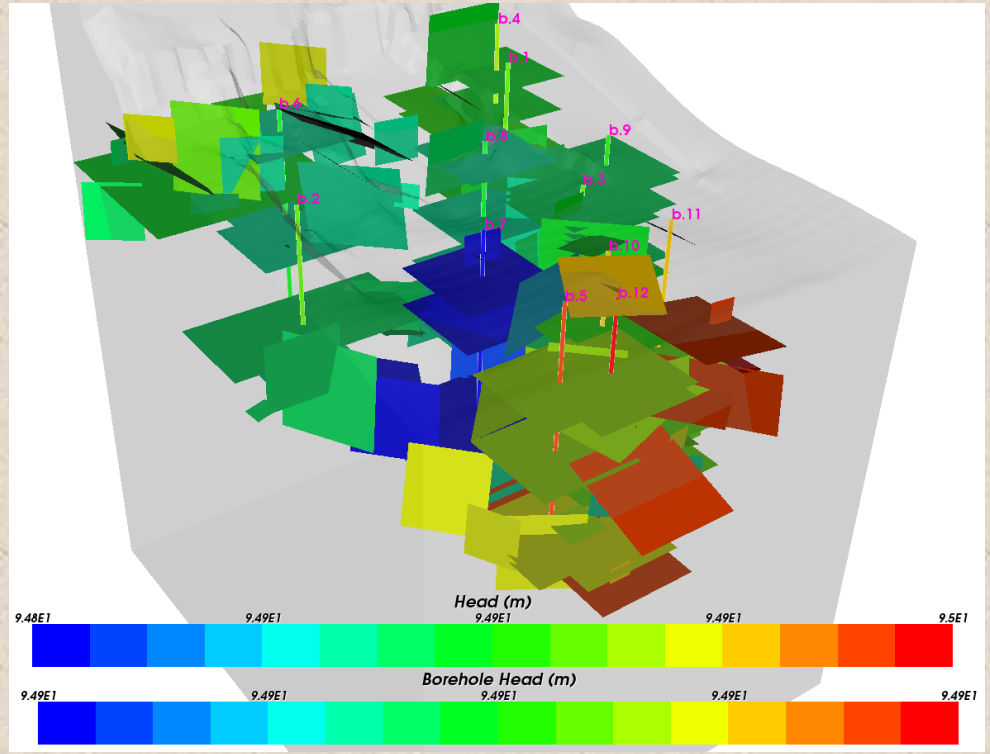


DATA PROCESSING FOR IN-SITU TESTS' MODELING

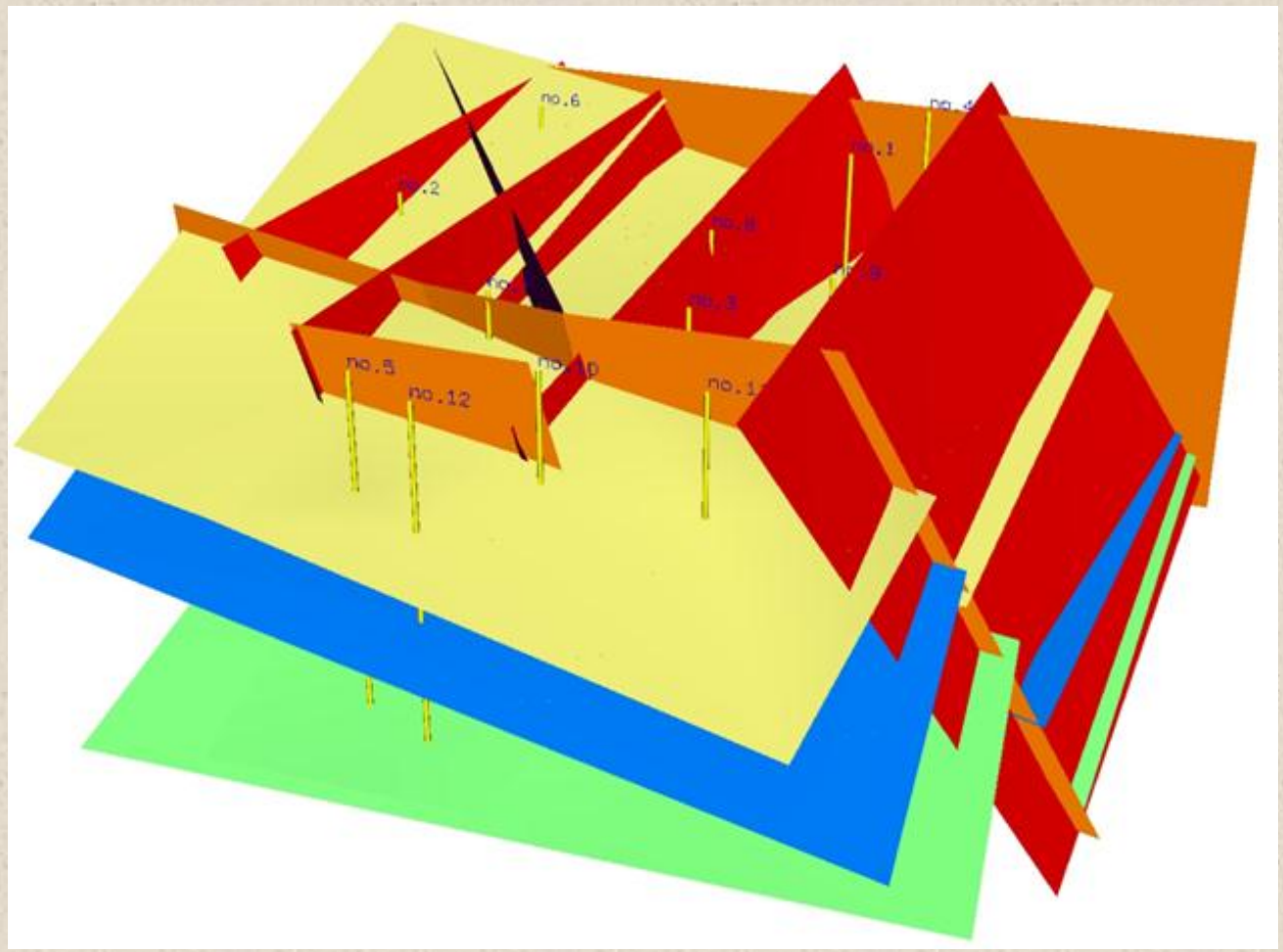
- Borehole documentation
- Geophysical survey



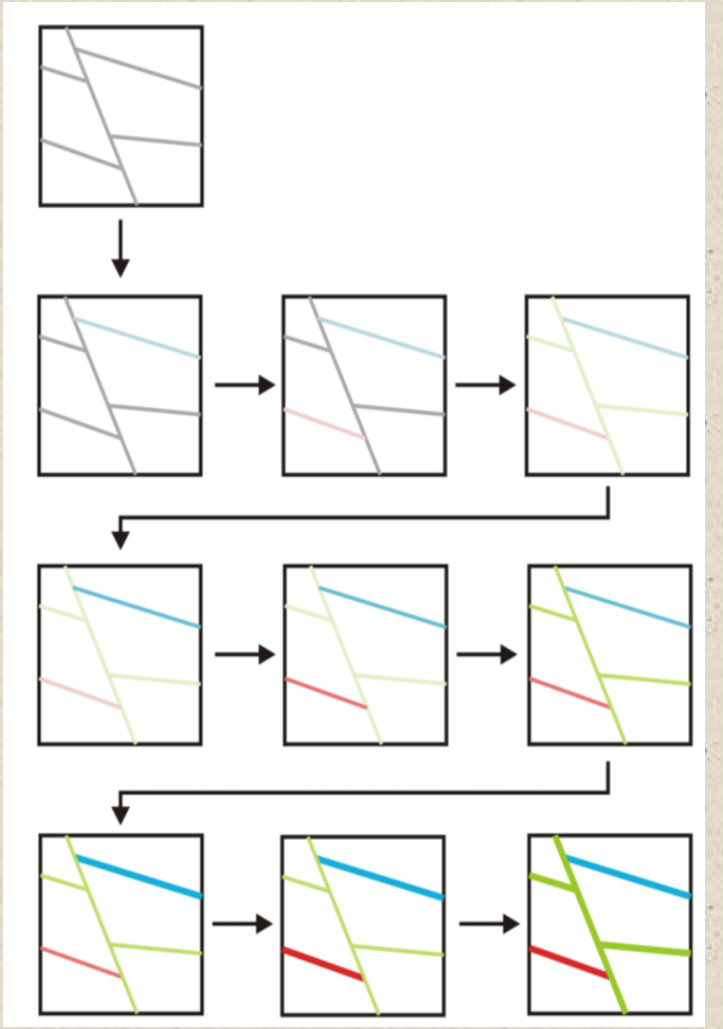




MATHEMATIC MODELING



CALIBRATION OF JOINT OPENING



Calibration step 1

Calibration step 2

Calibration step 3

Calibration of area 1
blue

Calibration of area 2
red

Calibration of area 3
green

ASSESSMENT OF MATHEMATIC MODEL PREDICTION ABILITY

Test name		**1009m1 (with the barrier)**
From the well (joint) - to well (joint)		11 (93.27) 10 (93.72)
Joints involved in test		H.IV2
Water-level difference between the wells during the test [m]		6.66
Waterflow capacity [l/s]	Model	0.013
	Test	0.0062
Time of tracer inflow [s]	Model	139
	Test	135

CONCLUSIONS

- detailed description of surveyed area
- very good prediction ability of mathematic modeling
- applicable also for engineered barrier

THANK YOU FOR YOUR ATTENTION