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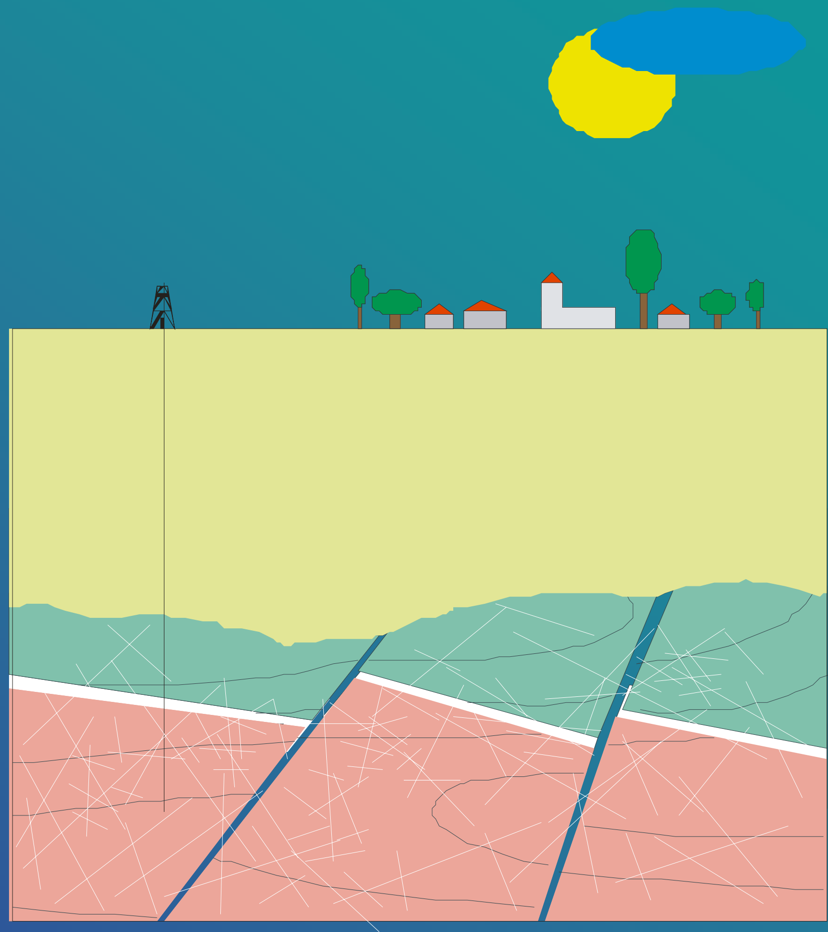
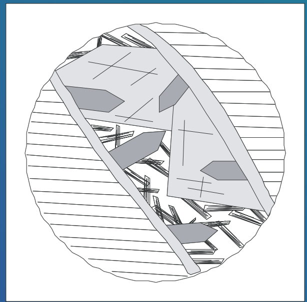
How to integrate borecore information into fractured reservoir models?

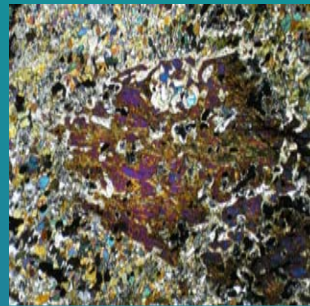
The problem focused

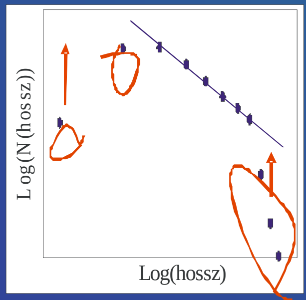
- Fractured reservoirs exhibit different hydraulic behaviour.
- What is the role of lithology?
- What is the role of structural evolution?
- What is the role of fluid-rock interaction processes (dissolution-cementation)?
- How to extend petrologic and structural information to reservoir scale?

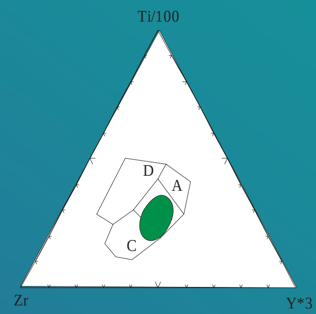


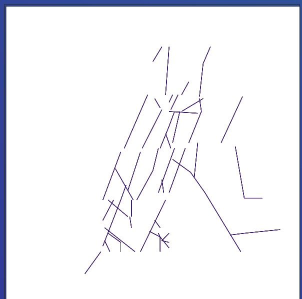
Geologic information stored by borecores

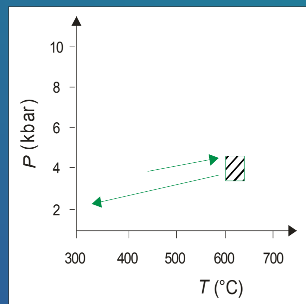




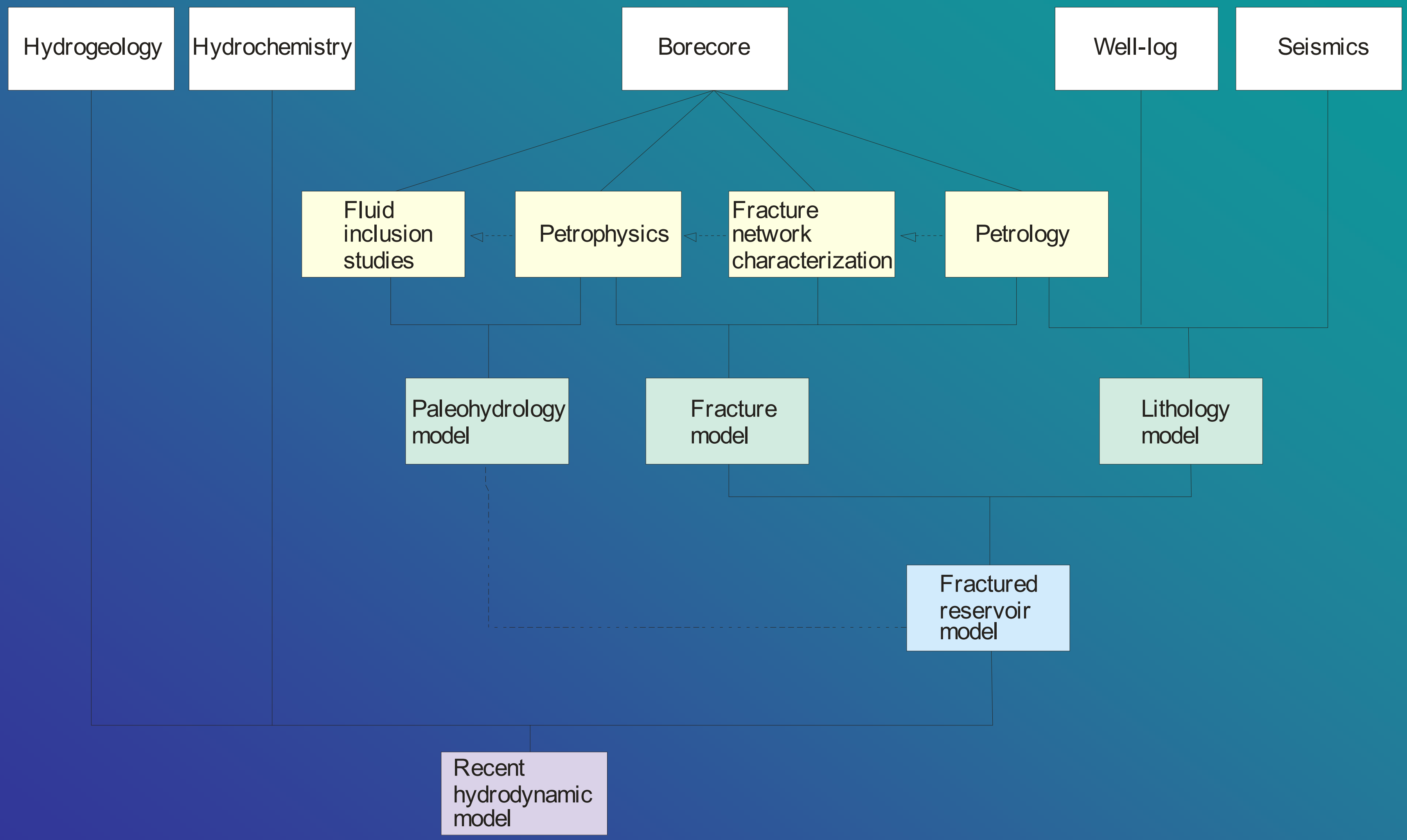






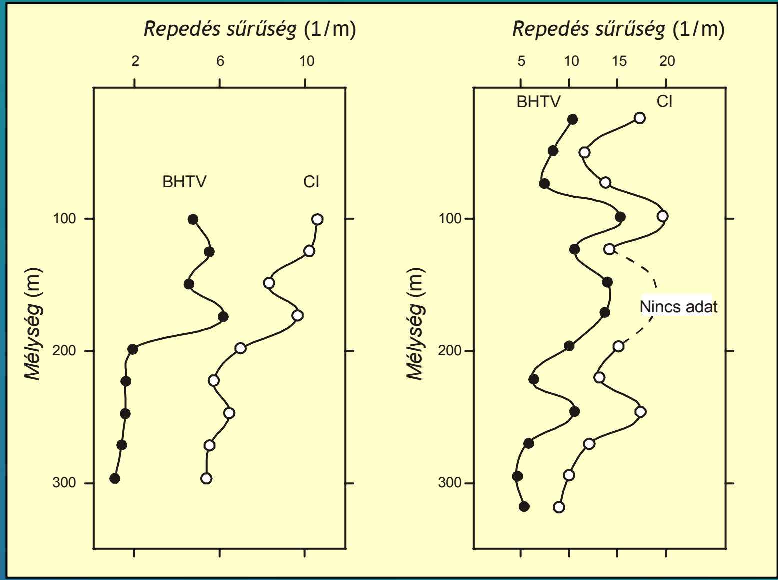


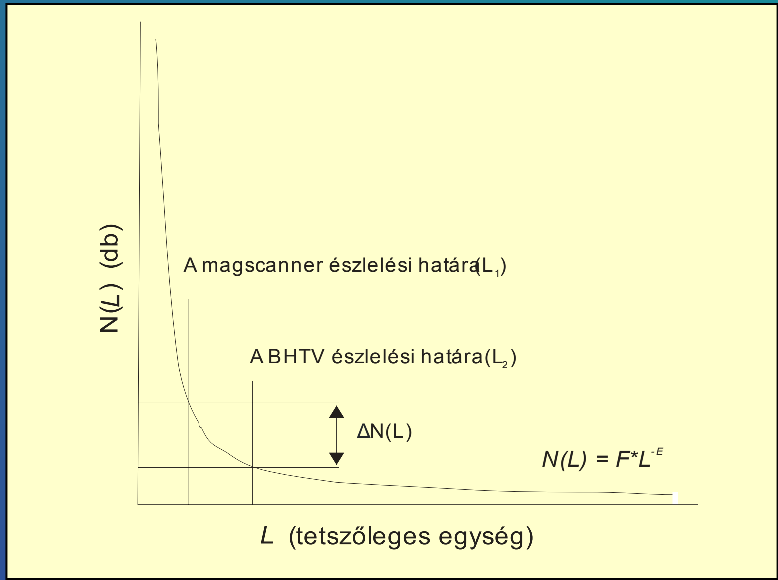
Applied methods and their relationship



Fracture network modelling I.

- Fracture network: mikrostructure and geometry
- Size distribution: N(*L*)=F**L*$^{-E}$
- Spatial density: fractal dimension of fracture centres
- Orientation (dip, dip angle)
- Aperture: *a*=A**L*+B
- Measurement of geometric parameters:
- 2D sections – image analysis
- 1D scanlines
    - new approach (J. Struct. Geol. in press)





Fracture network modelling II.

- New modelling software – RepSim

- Fractal geometry based hybrid DFN (discrete fracture network) model

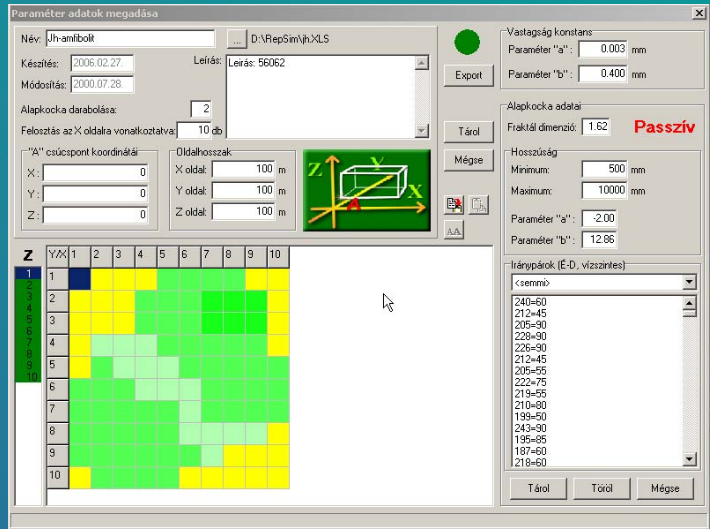
    - simulation of a fracture network in 3D

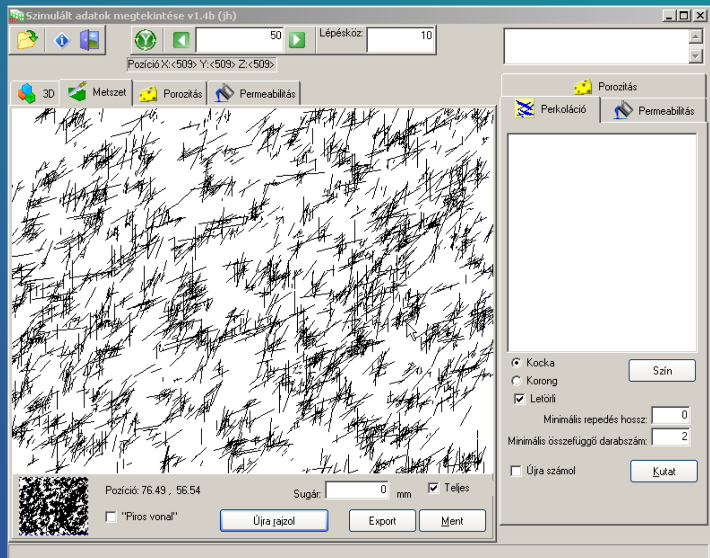
    - RepShow – visualization

    - RepCon – determination of connective subsystems

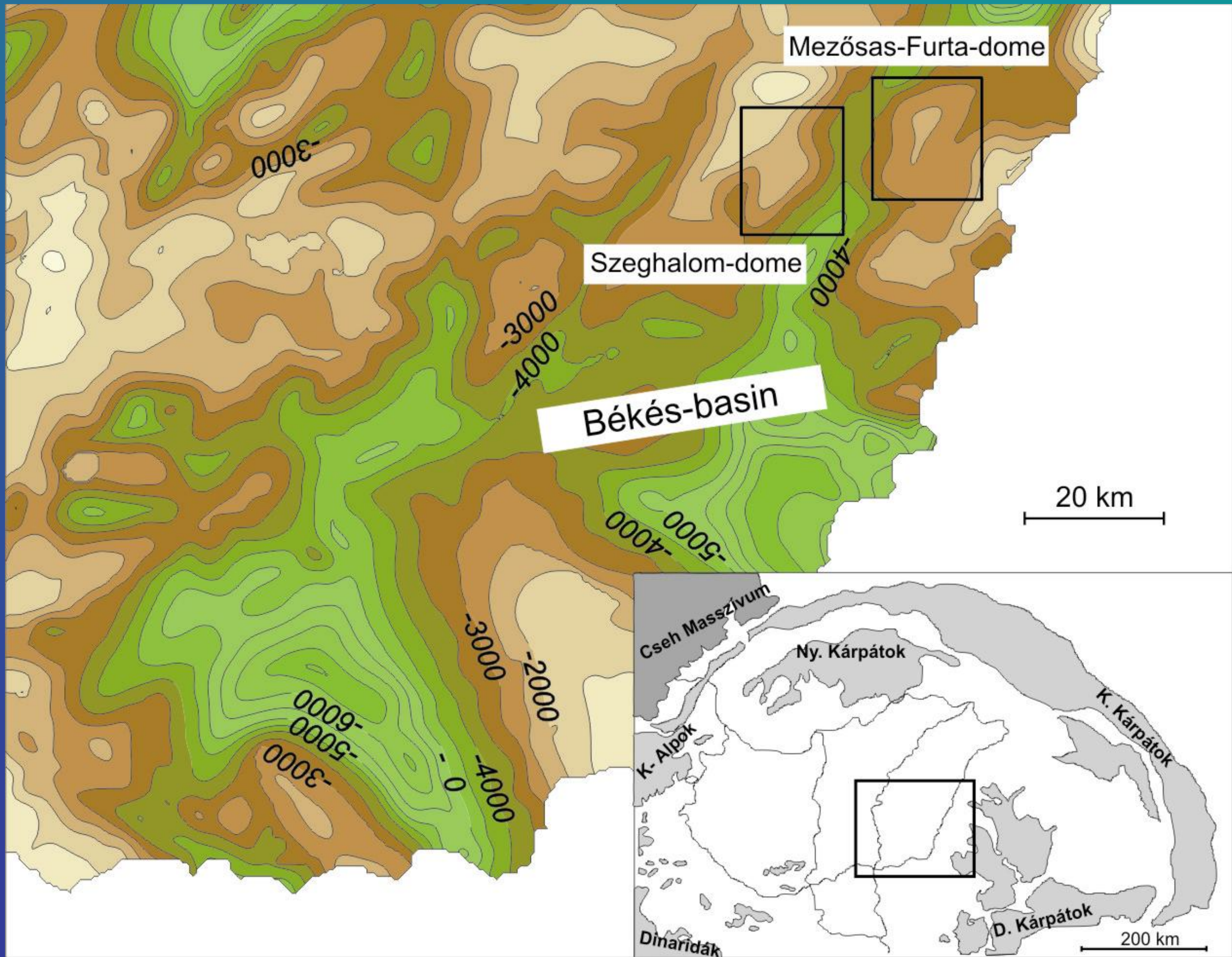
    - RepPor – fractured porosity calculation

    - RepPer – intrinsic permeability tensor calculation





Study area


Mezősas-Furta-dome
Szeghalom-dome
Békés-basin
20 km
-3000
-4000
-5000
-6000
-2000
0
Cseh Masszívum
Ny. Kárpátok
K. Kárpátok
K- Alpok
D. Kárpátok
Dinaridák
200 km

Metamorphic reservoirs – Pannonian Basin

- Szeghalom, Mezősas-Furta metamorphic domes, HC reservoirs

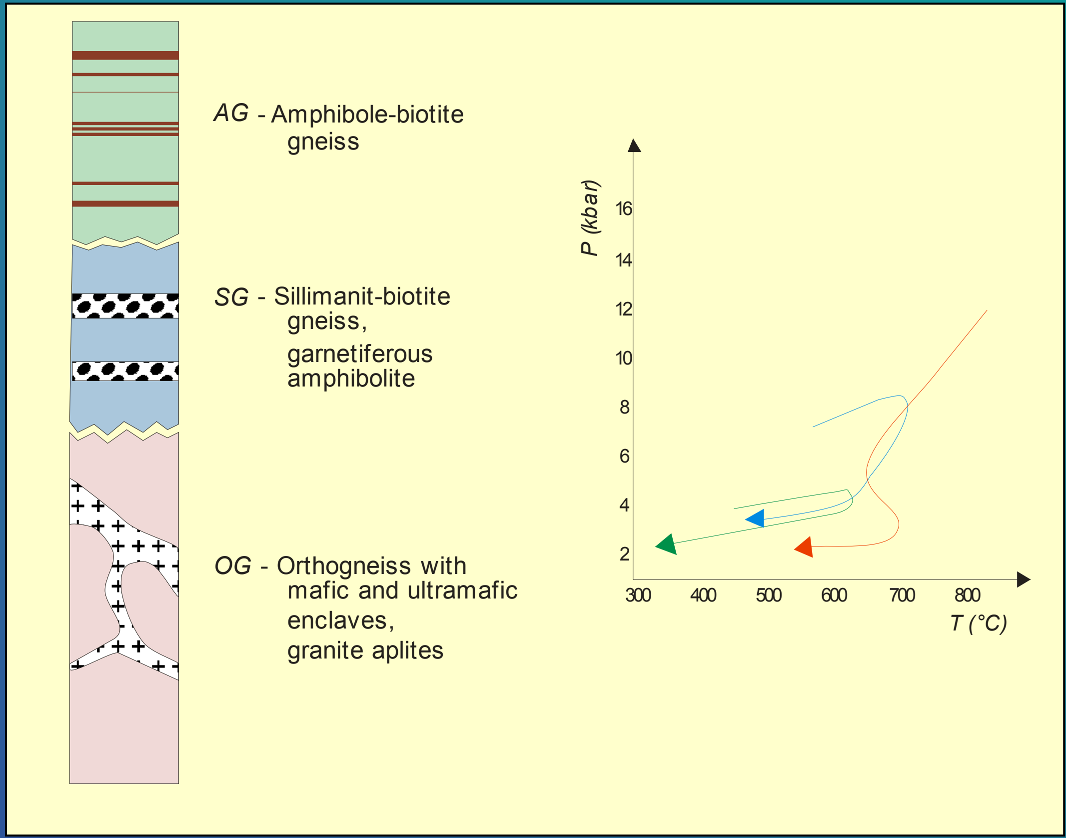
- Identical lithology and structural evolution

- Three blocks of different metamorphic evolution – post-metamorphic tectonic borders

    - orthogneiss with mafic, ultramafic enclaves

    - sillimanite-biotite gneiss, garnetiferous amphibolite

    - amfibole-biotite gneiss



Fracture network

- Geometric parameters of fracture networks are different in different lithologies (rheology differences)

- Amphibolite: *E* ~ 1.8, D_c ~ 1.5

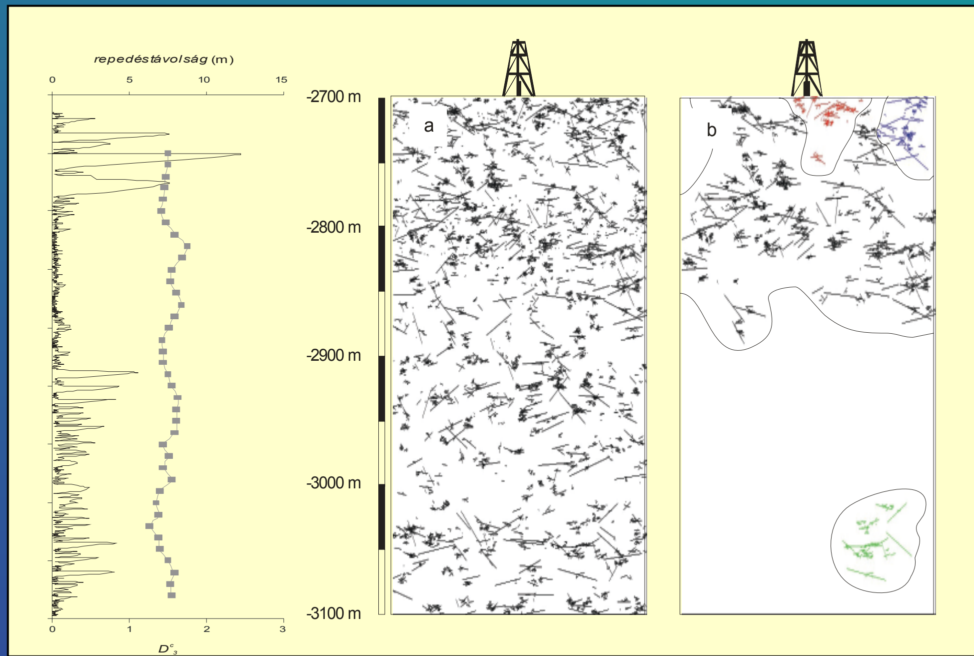
- Gneiss types: *E* ~ 2.5, D_c ~ 1.1

- Amphibolite: communicating fracture system (*Φ* ~ 2 %)

- Gneiss: not communicating fracture system (*Φ* < 0.2 %)

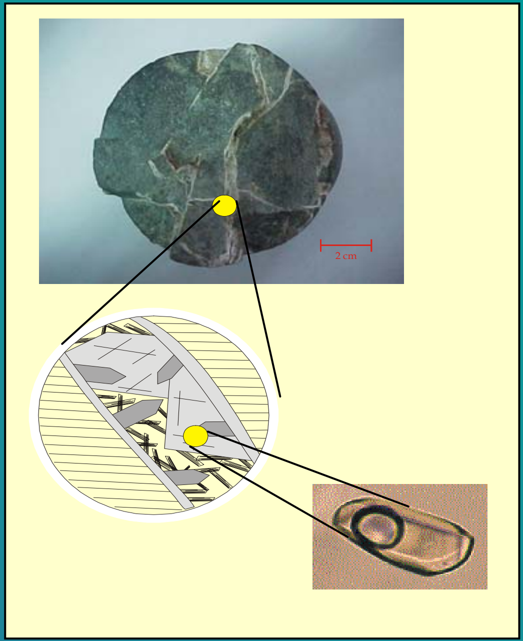
- Sample well: intensively fractured horizon between metamorphic blocks (SG and OG)

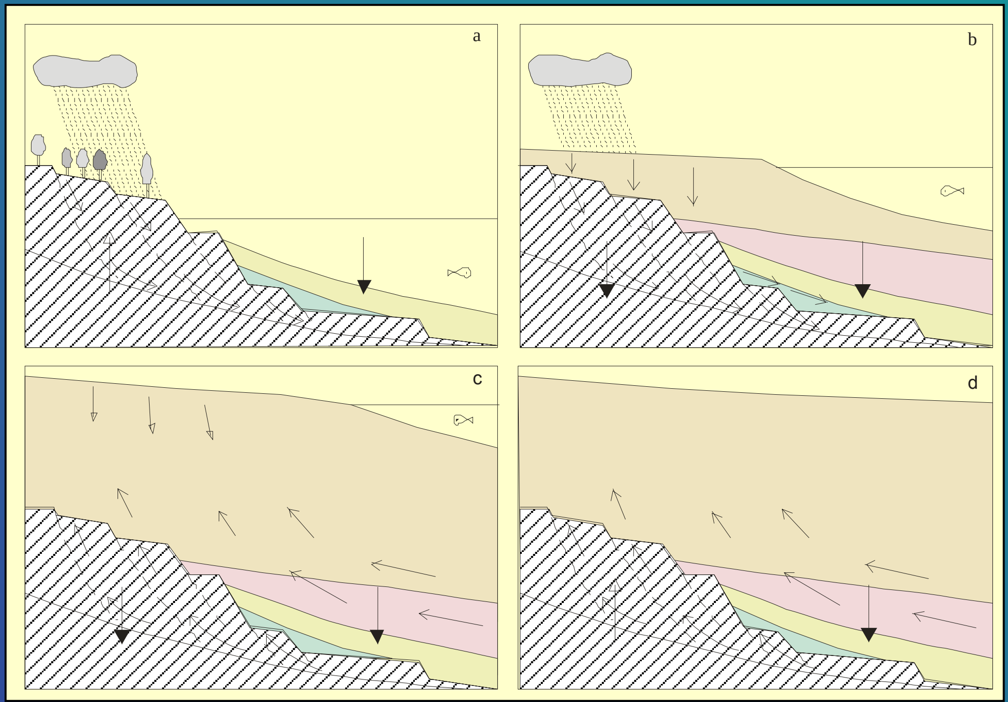
- Communicating system inside the mafic enclaves



Paleohydrology

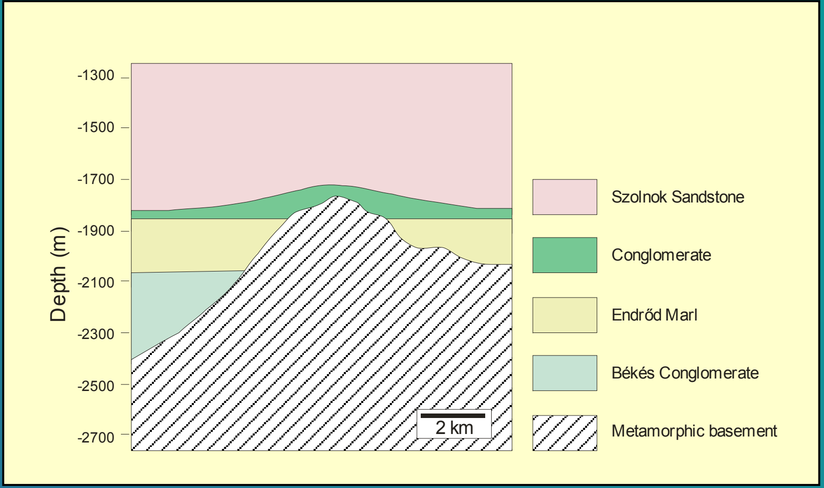
- Fracture cement phases: pyr → chl → cc_1 → qtz → cc_2 → lau
- Chl: $T < 300$ °C,
- Qtz: 150 → 120 °C, HC inclusions
- Cc_2: < 50 °C, meteoric water, terrestic pollens
- Uplift → meteoric recharge area → thermal subsidence → hydraulic inversion → tectonic inversion → recent connection with the surrounding sedimentary basins

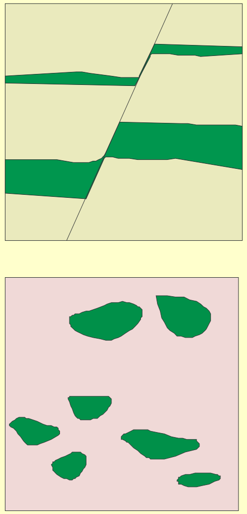


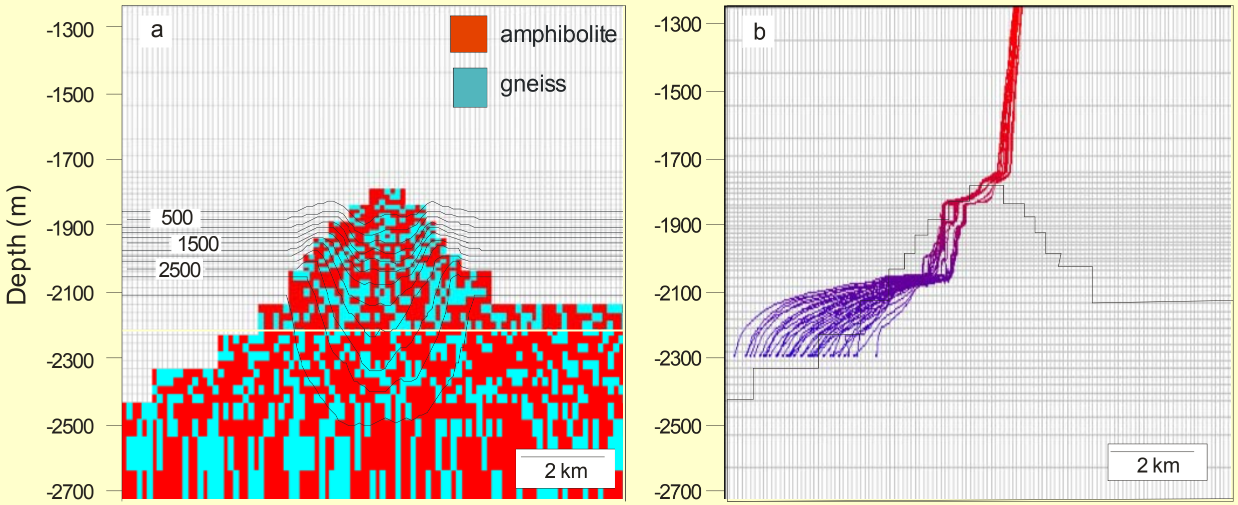


Recent hydrology, HC accumulation

- Overpressure in deep basins
- Discharge through uplifted highs
- Trapment in highly fractured amphibolite blocks and along thrust sheets







Thanks for your attention!