Coherence base reservoir modelling in Barcs-W – Stari Gradac Field

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Considered content

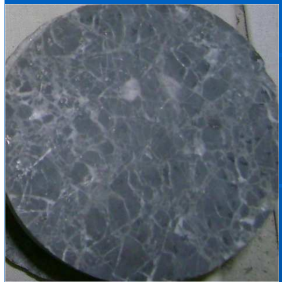
- Geological Classification of Fractures
- Dimensional Questions
- Heterogenity of Fractured Reservoir Properties
- Main Res. Parameters and Structure of the Studied Area
- Production History
- Applied Method
- 3-D Reservoir Model
- Summary

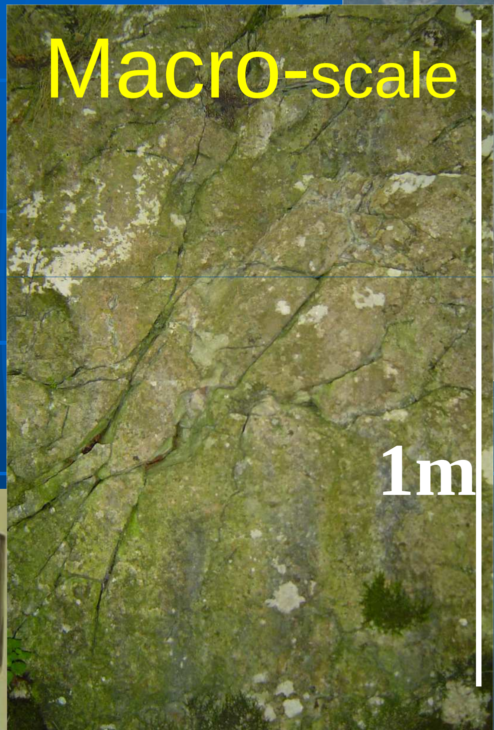
Geological Classification of Fractures

A genetic classification scheme for natural fracture systems permits separation of complicated fracture systems into superimposed components of different origins and include:

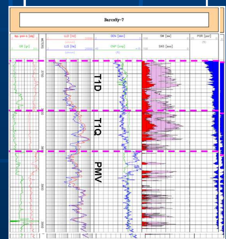
- Fault-Related Fractures
- Fold-Related Fractures
- Regional Fractures (Joints)
- Stylolite-Associated Fractures
- Diagenetic Fractures (Contractional)
- Surface-Related Fractures

Dimensional Questions

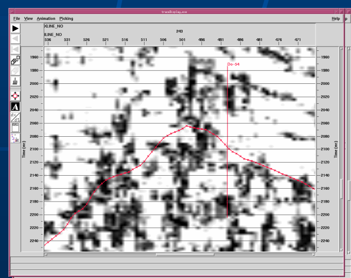




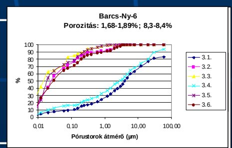
Log



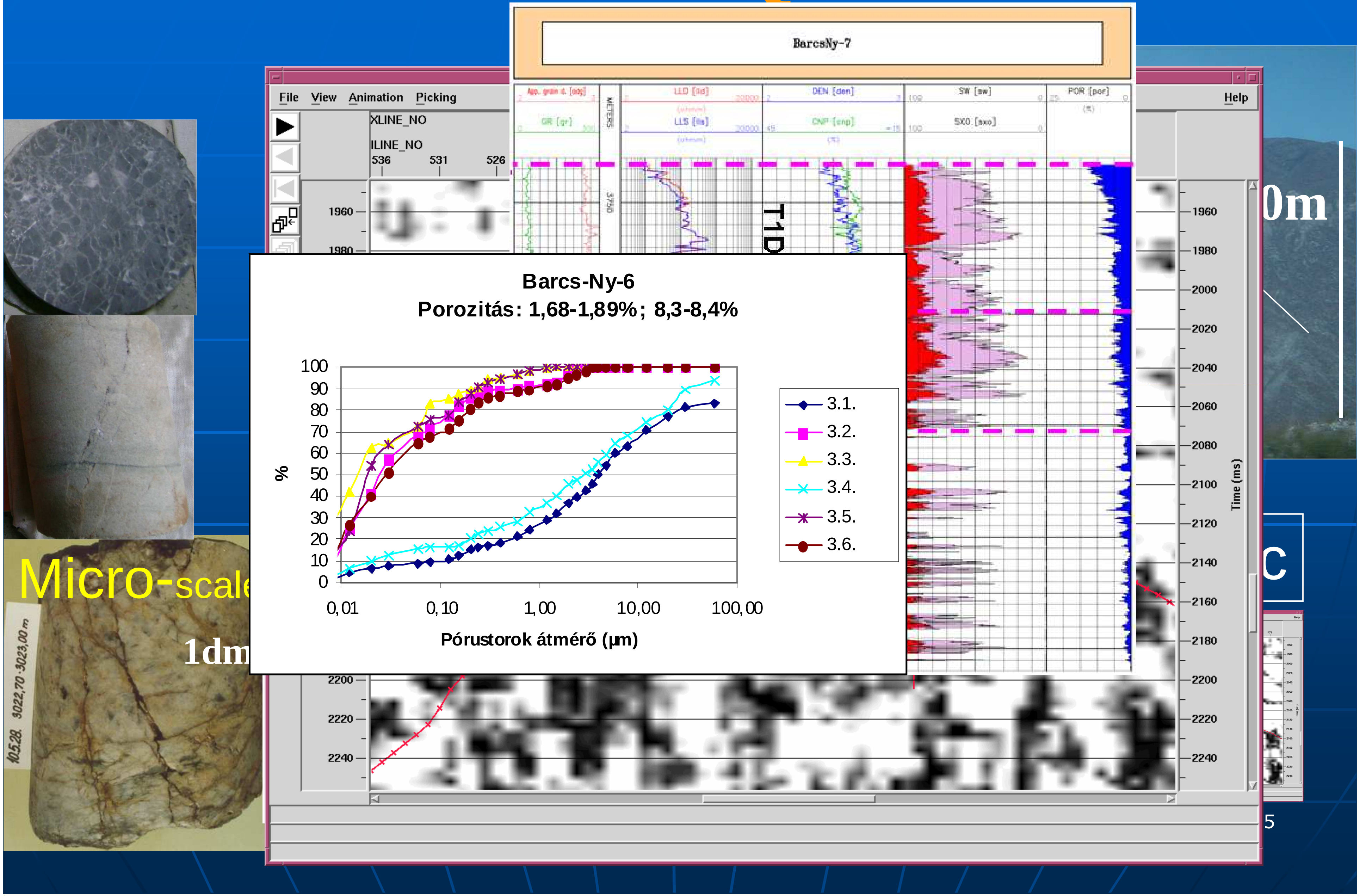
Seismic



Core

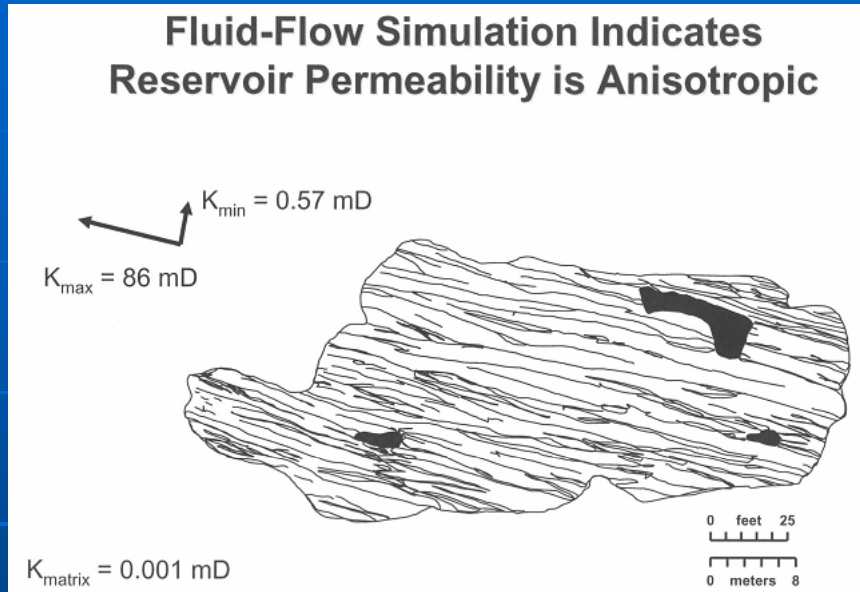


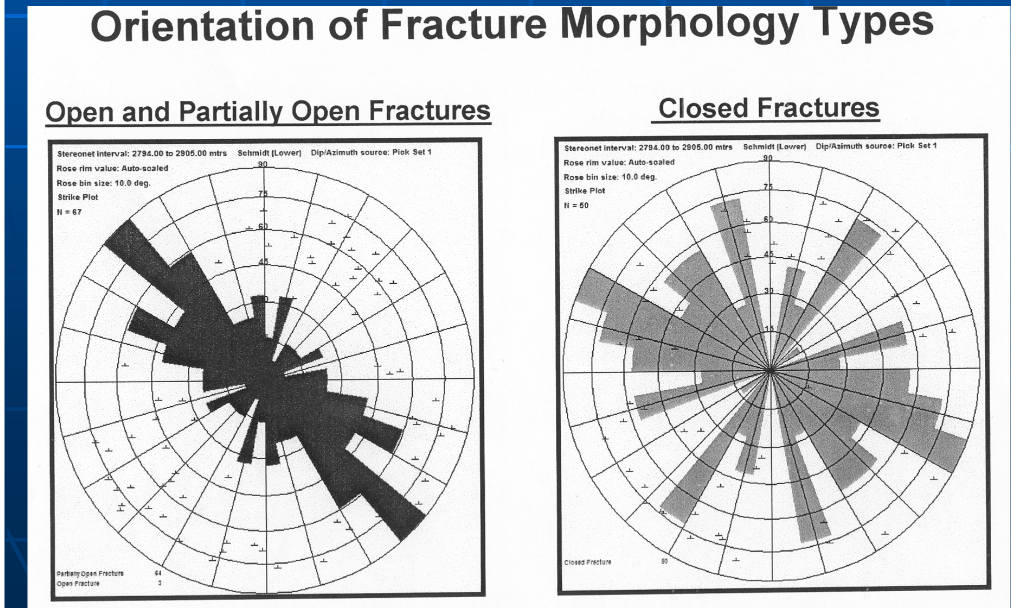
Dimensional Questions



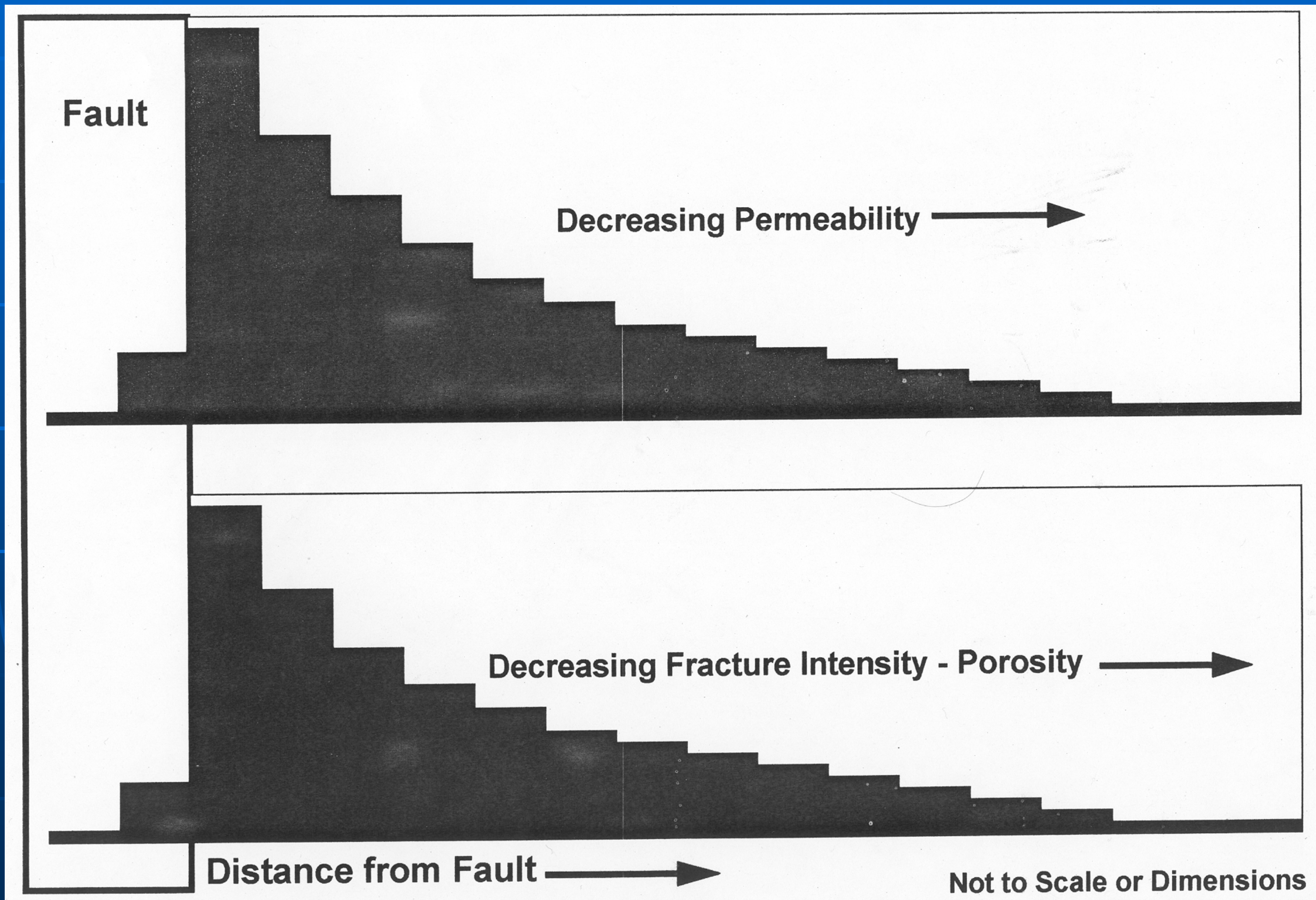
Orientation dependence

- Heterogenity of fracture system influence
  - Accumulation of the reservoir
  - Distribution of the HC





Idealized Model of a Fault Zone



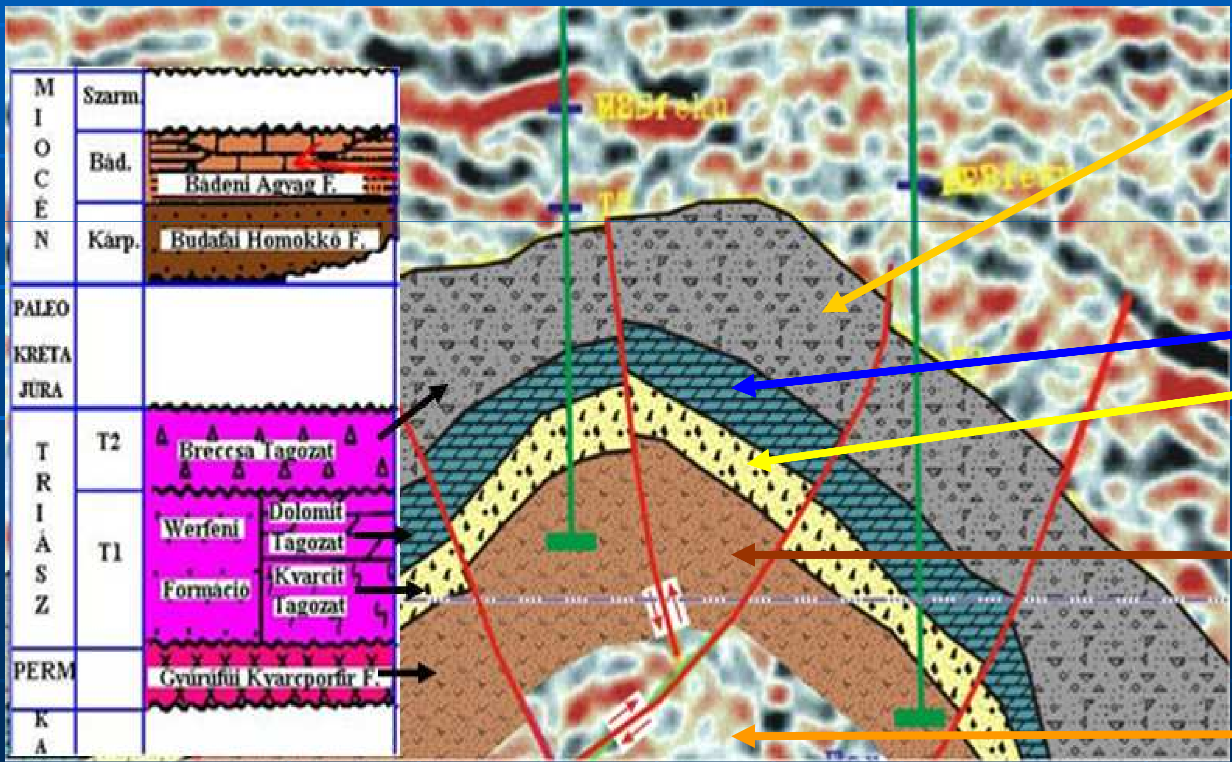
Target reservoir

- Discovery in 1979 (Barcs-W-1 well)
- Overpressured Gas Condensate Reservoir with relevant inert content (H_2S!)
- Fractured litological complex system (4 units)- tectonically intensive unit
- Hydrodinamically connecting compartments
- 9 (Hu.)+7 (Cr.) wells were drilled
- Only 4 have been producing from 9 originally in Hungarian side (2 of them nowdays- rapid watering)
- Several well interventions (fracturing job, side track, workover jobs)- moderate succes

Main Reservoir Parameters

OGIP	5061 Mm^3
Porosity	2.3- 3.2 %
Permeability	0.22-05 mD (1-10 mD)
Bg_i	0.00395 m^3/m^3
Composition	CO_2 ~10 mol%, H_2S 100-4000 mg /m^3, ~1100 cm^3/m^3
GWC_i	3860 (ssm)
P_i	505 bar (30% over)
T_i	191 C^o

Lithology of the Presented Area



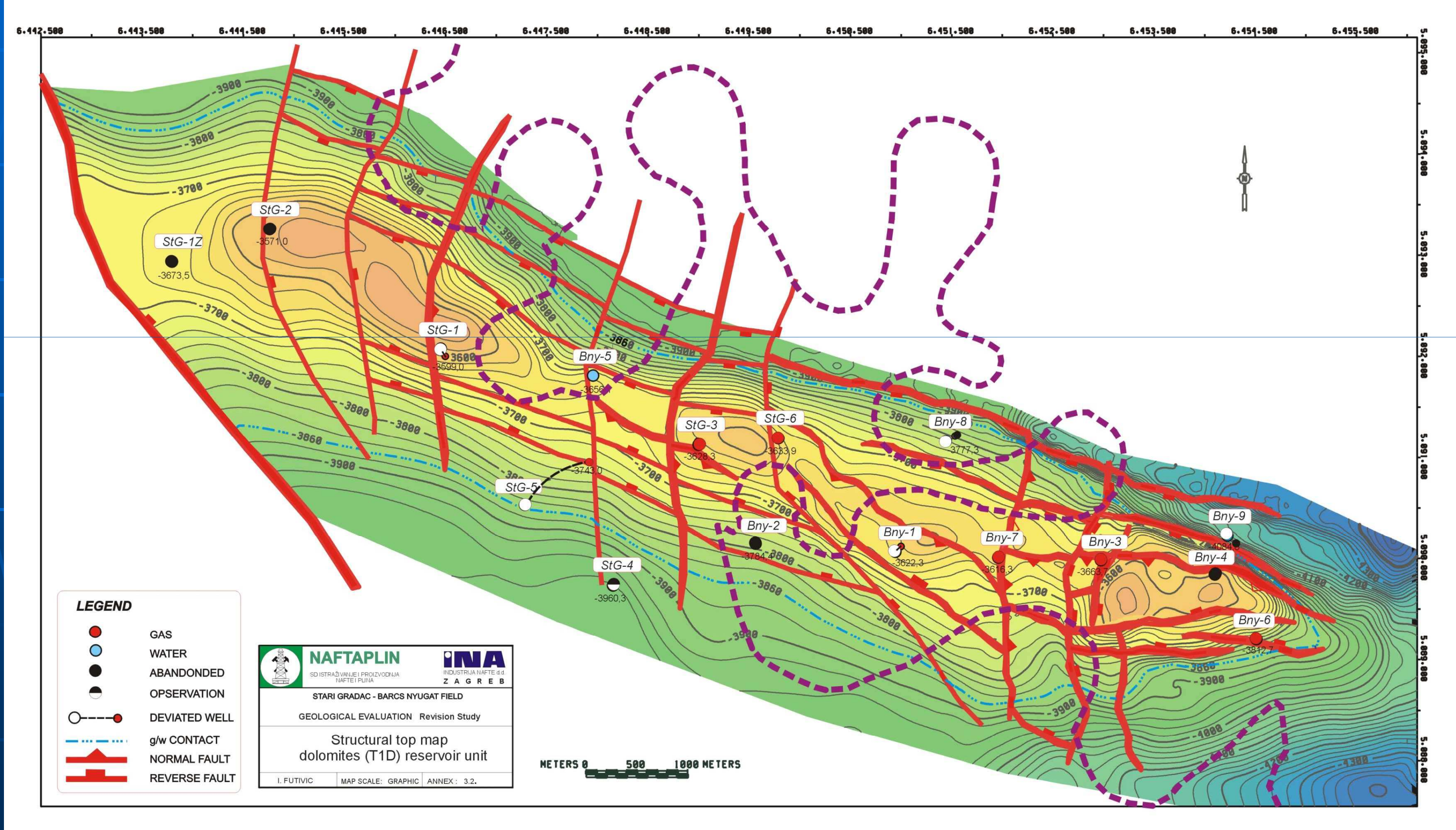
Triassic / Miocene
Coarse sediments
breccia, conglomerate.

Lower Triassic:
Dolomite and
Quartzite.

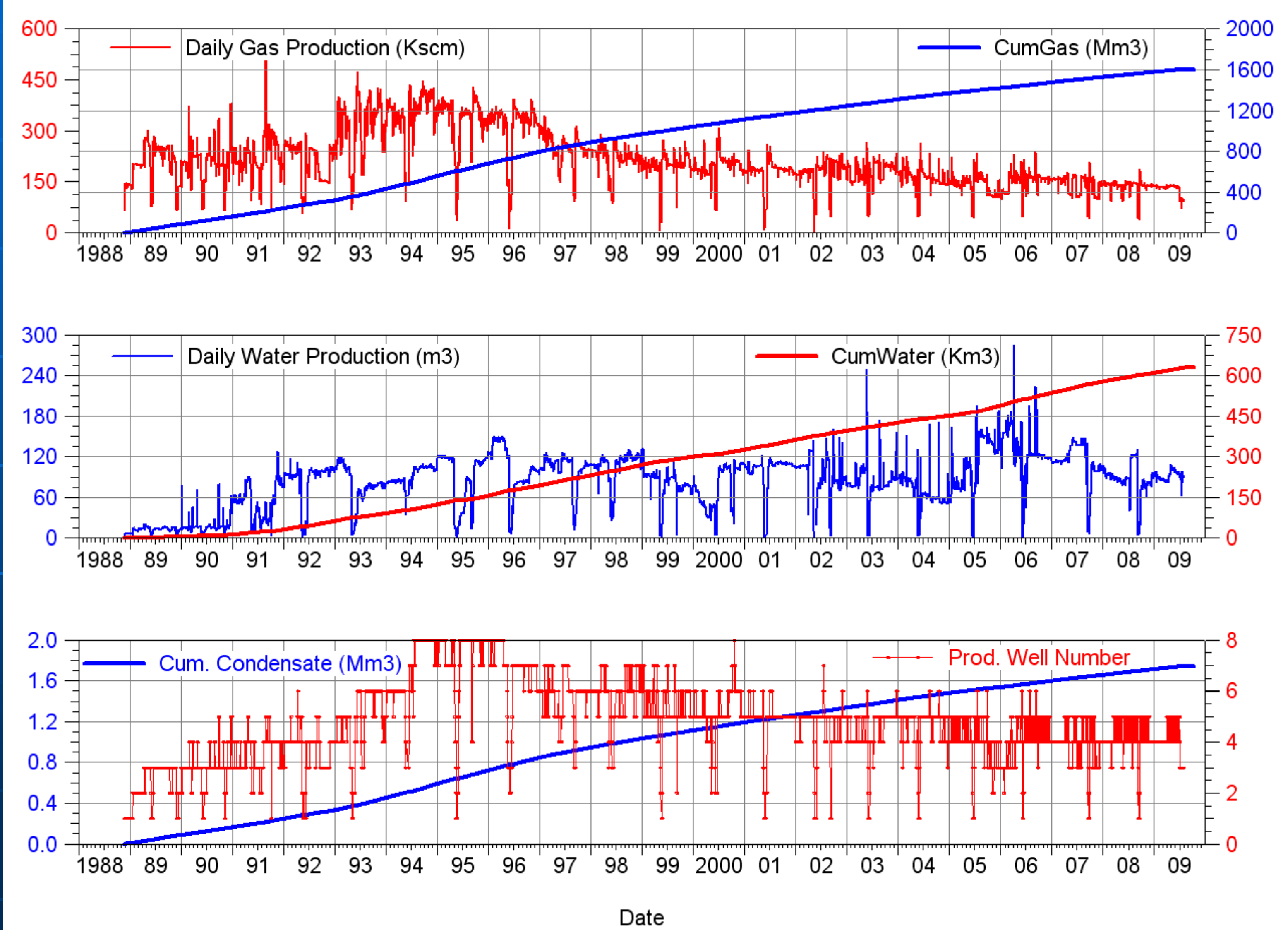
Permian metavulcanite:
rhyolite, rhyolite tuff,
intermediate vulcanite.

Crystalline basement:
Mica-schist, gneiss.

Structural Map of the Triassic Dolomite



Production History (Field)



1603 Mm^3

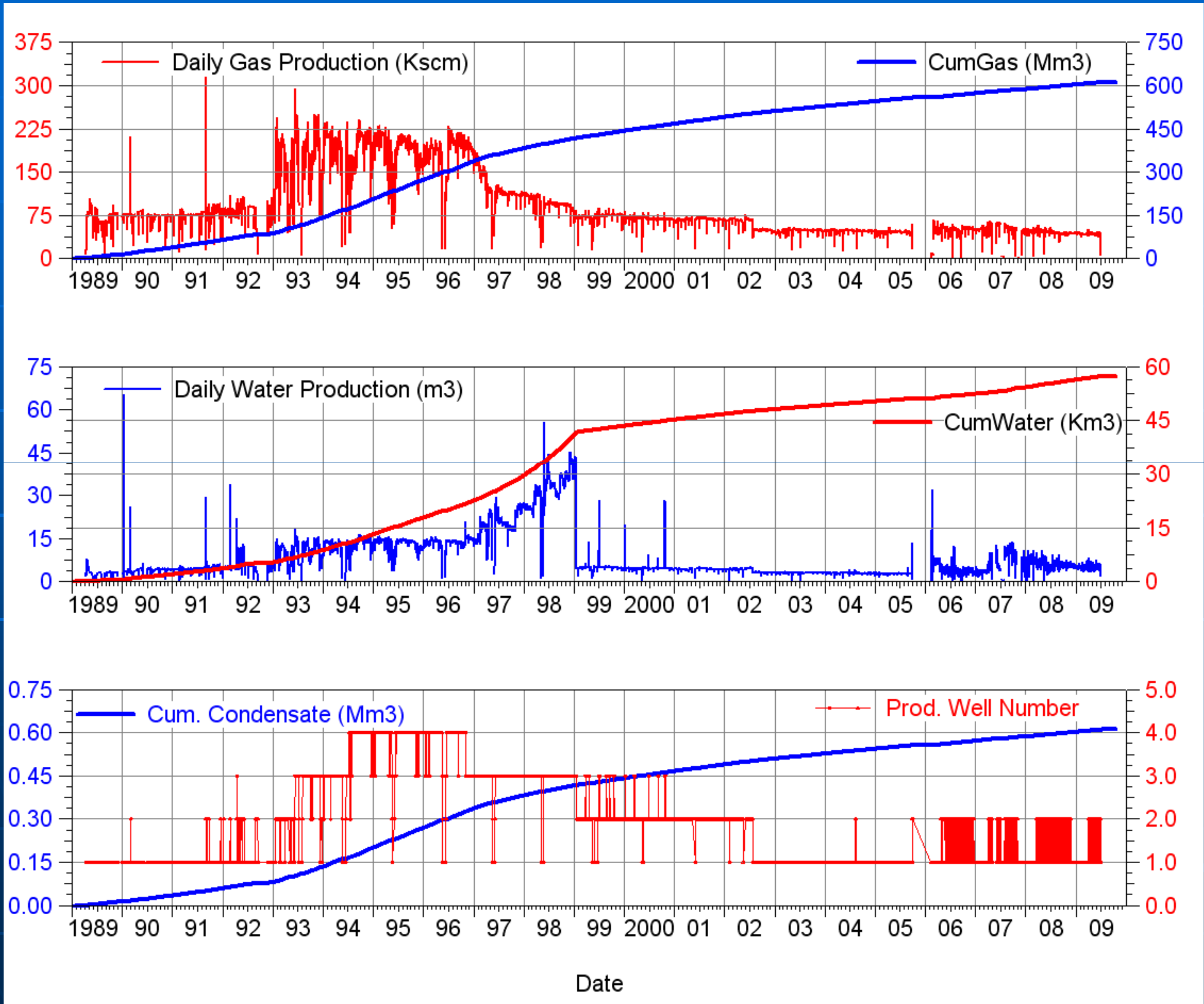
31% Ref

628 Km^3

1.743 Mm^3

5 wells

Barcs-W production history

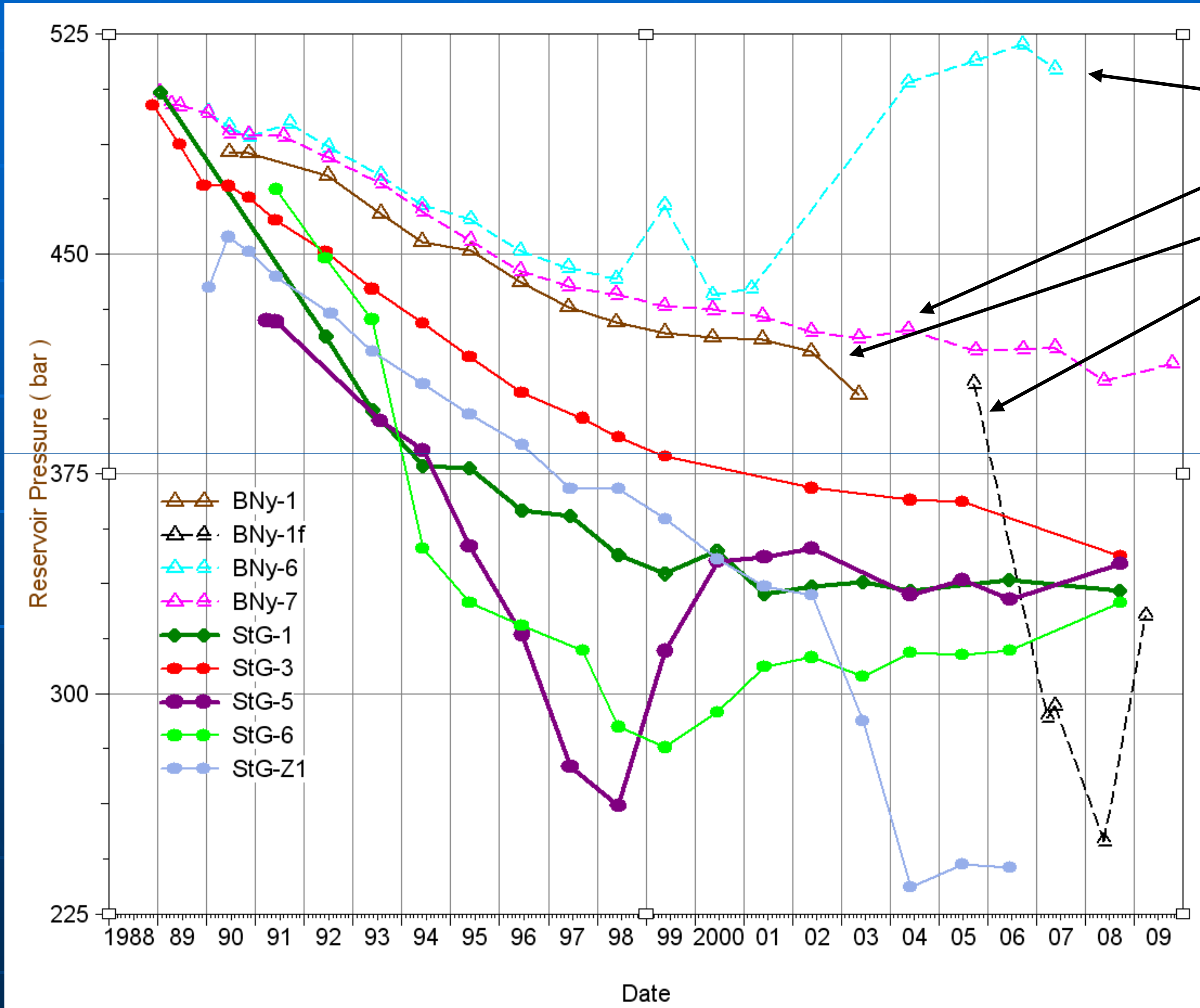


611 Mm^3 (38%)

57 Km^3 (9%)

2 wells

Res. pressure history

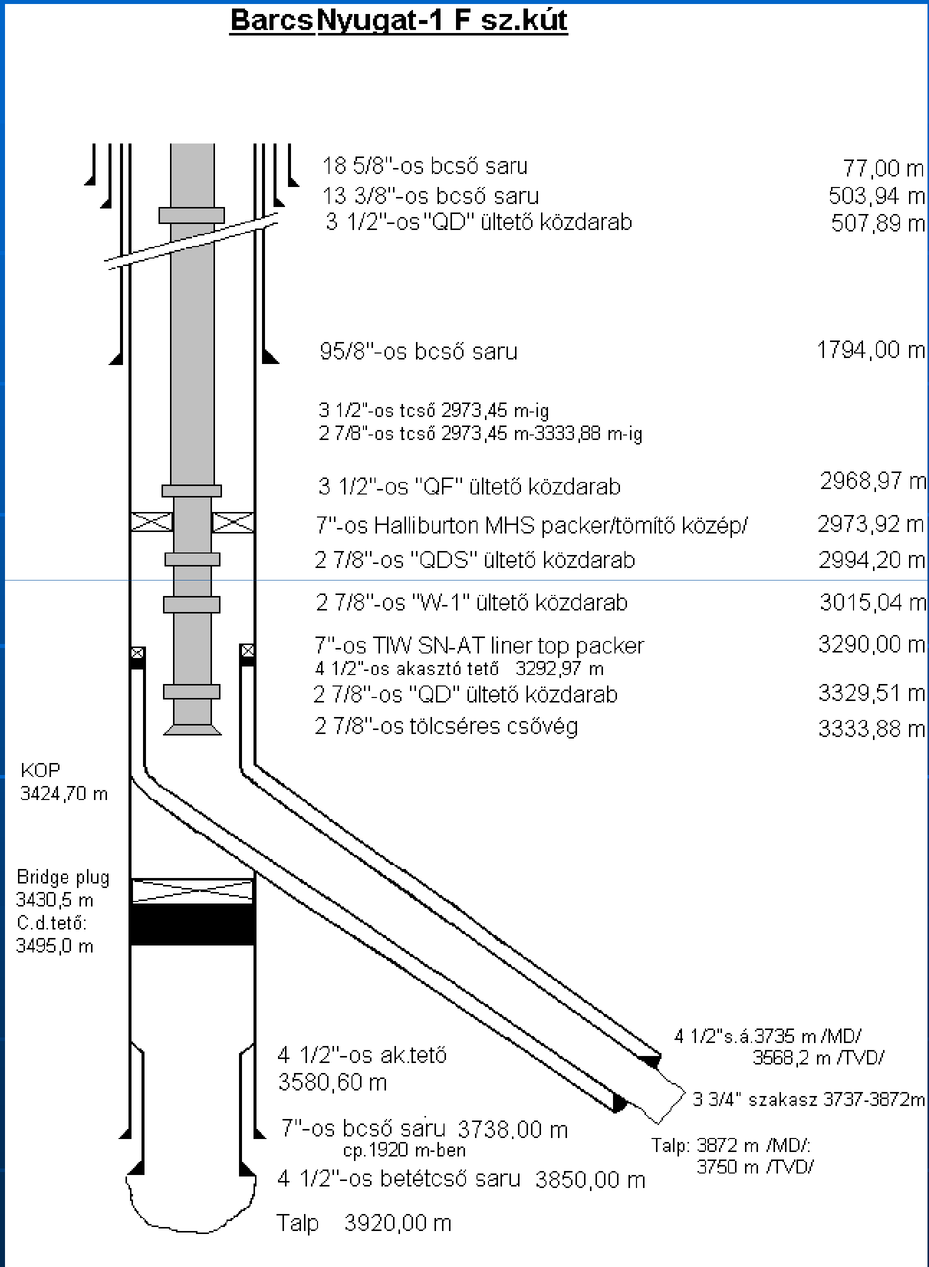


Barcs-W

Lower Rec. factor

Gas transmiss. on STG-3 area

Key Factor- selection of frac. zone



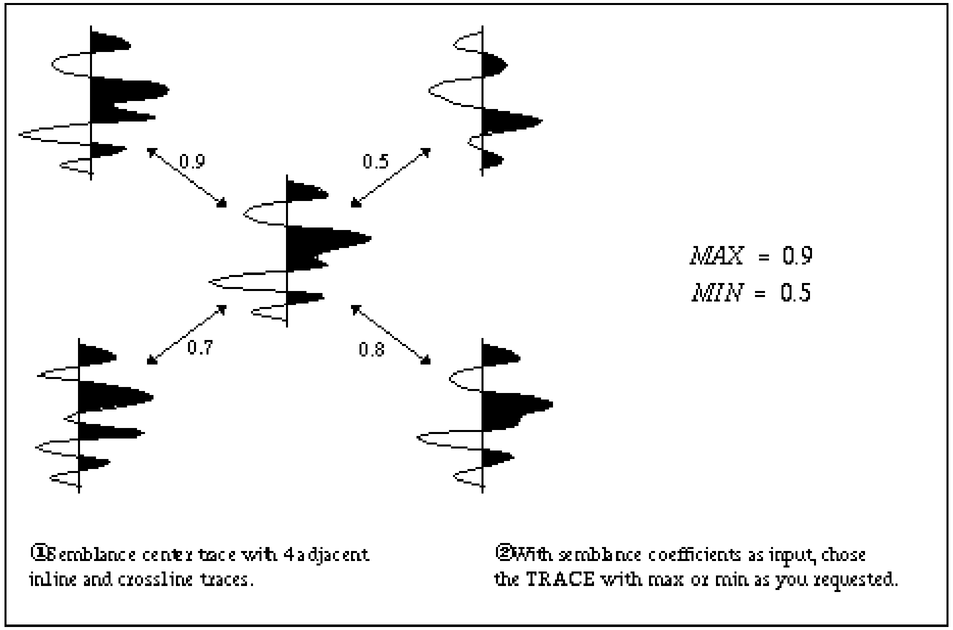
Side track in 2004

Technically succesfull

Tight miocen formation
(low productivity)

<u>Gas bearing zone</u>

The Applied Method

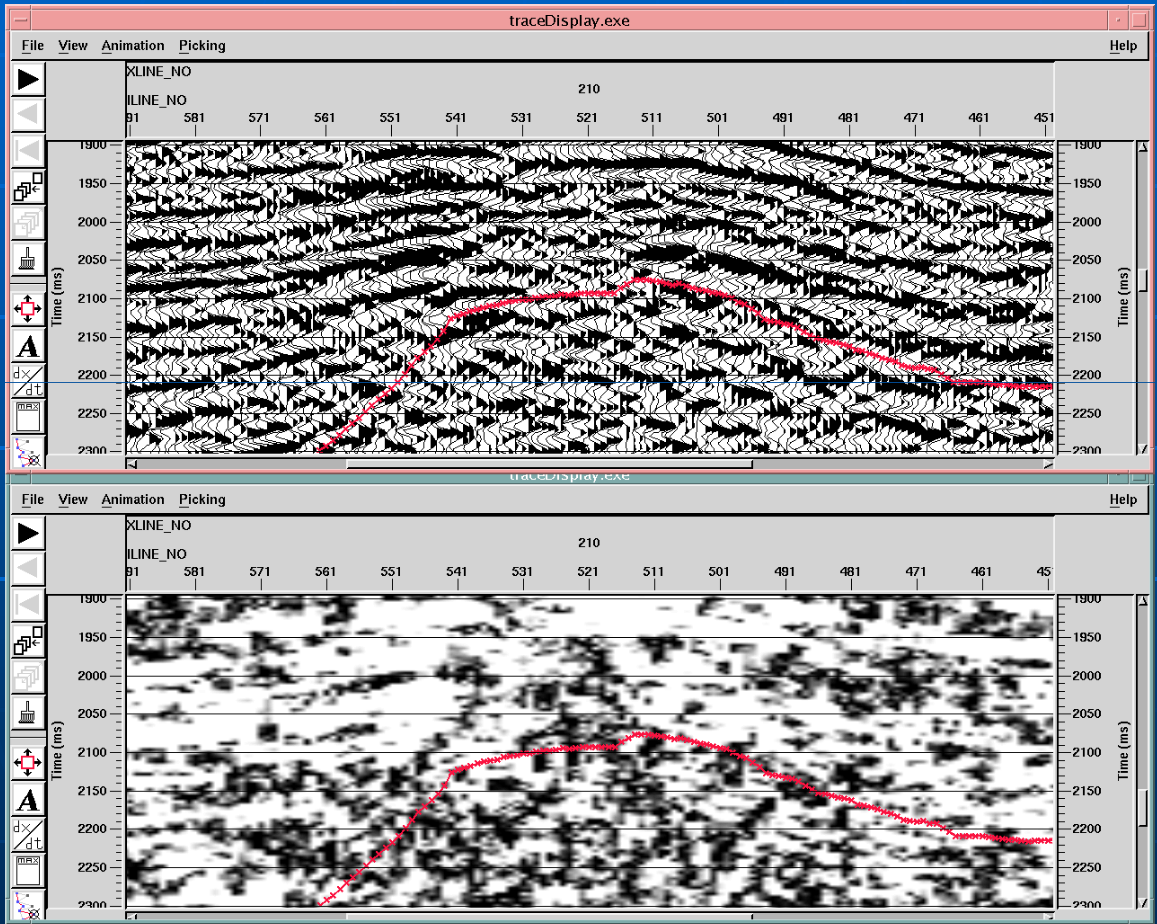


How PostStack Calculates the Target trace: An Example Using a 4-Trace Analysis Pattern retaining the min and max of all the Manhattan distance comparisons.

Coherence

- **is a seismic attribute wich use**
  - **-Semblance coefficient (around a given channel);**
  - **-Manhattan distance (between target channels).**
- **depends on**
  - **-number of the neighbour channels (for semblanse);**
  - **-range of time window.**

Application



Coherence express

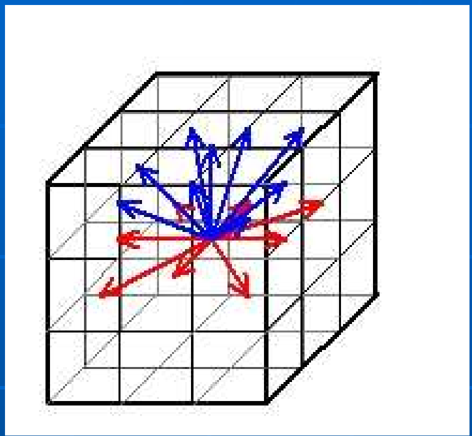
similarity (or dissimilarity) between seismic channels.

Practical

to identify faults in sedimentary basin,

and brecciated zones in metamorphic rocks.

Orientation of inhomogenity



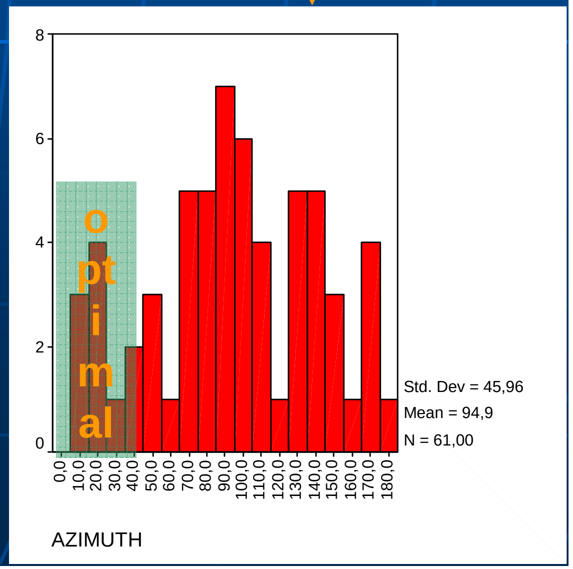
Direction Vector into the Neighbor Cells (Weighted own Coherence Value)

+

Azimuth of the Sum Vector

Direction of the Inhomogenity

Well test

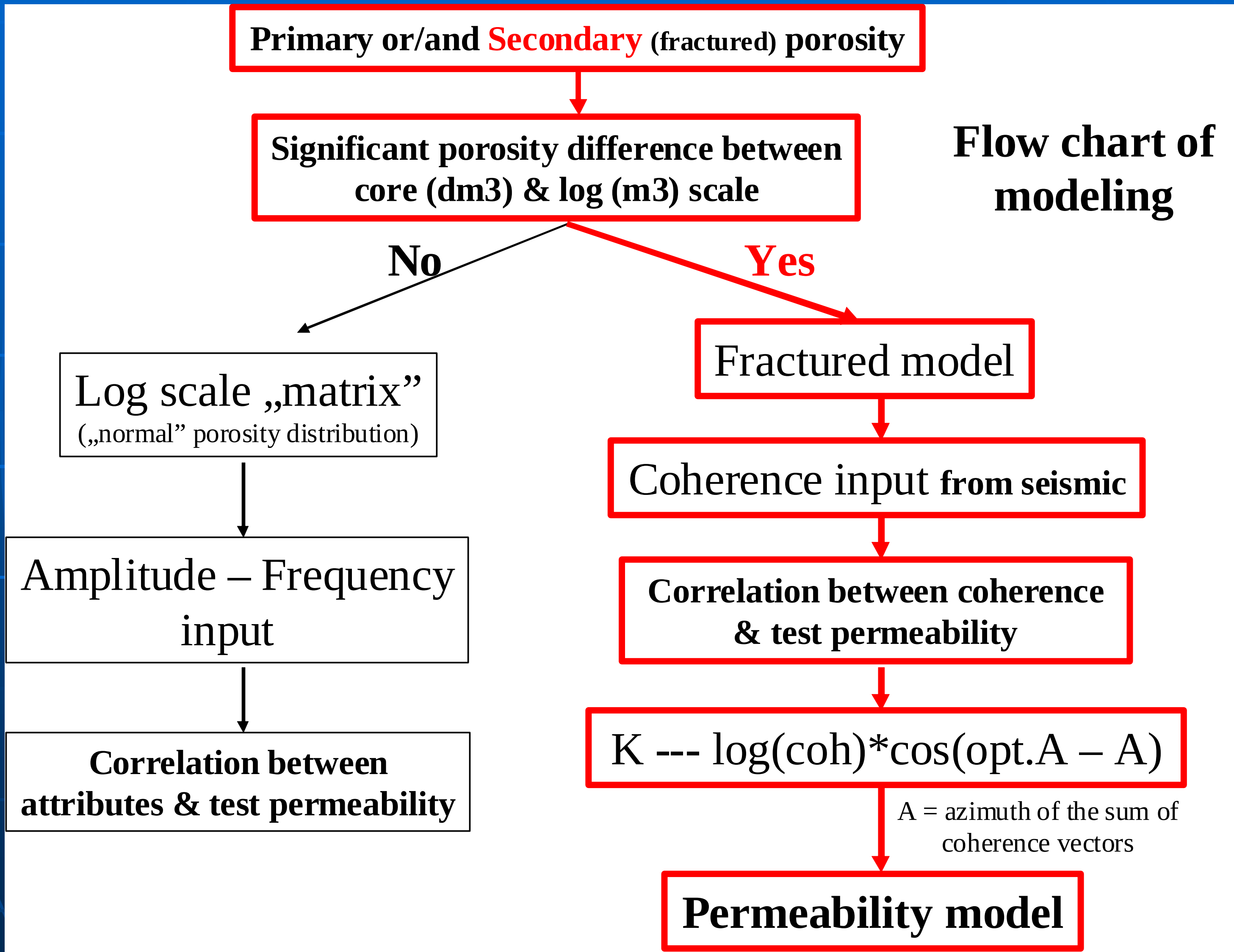


<u>Permeability</u>

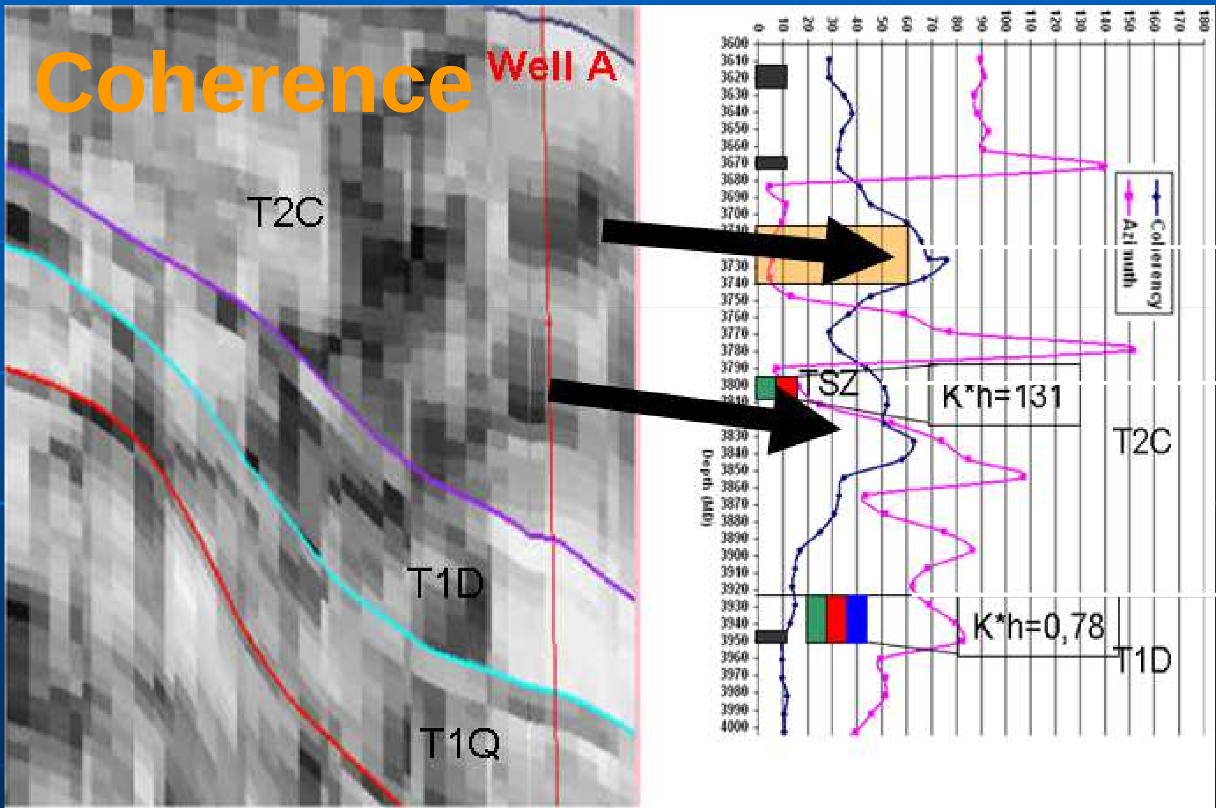
K ~ Coherence & diff.(actual A; optimális A)

cosinus

Workflow


Primary or/and Secondary (fractured) porosity
Significant porosity difference between core (dm3) & log (m3) scale
Flow chart of modeling
No
Yes
Log scale „matrix”
(„normal” porosity distribution)
Amplitude – Frequency input
Correlation between attributes & test permeability
Fractured model
Coherence input from seismic
Correlation between coherence & test permeability
K --- log(coh)*cos(opt.A – A)
A = azimuth of the sum of coherence vectors
Permeability model

Coherence and azimuth in well „A”

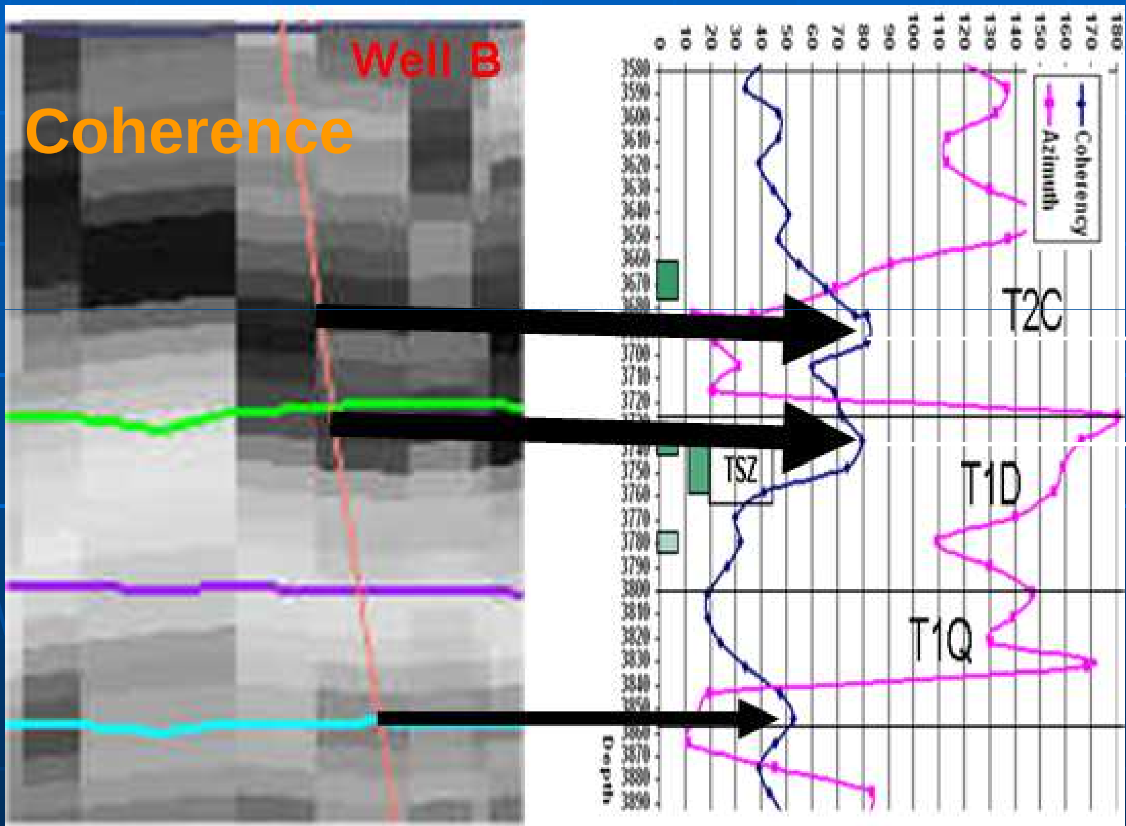


Mud Loss

6 mm
85300m3/day gas
79,2 m3/day cond.
0,08 m3/day water

20 mm
11700m3/day gas
7,56 m3/day cond.
7,88 m3/day water

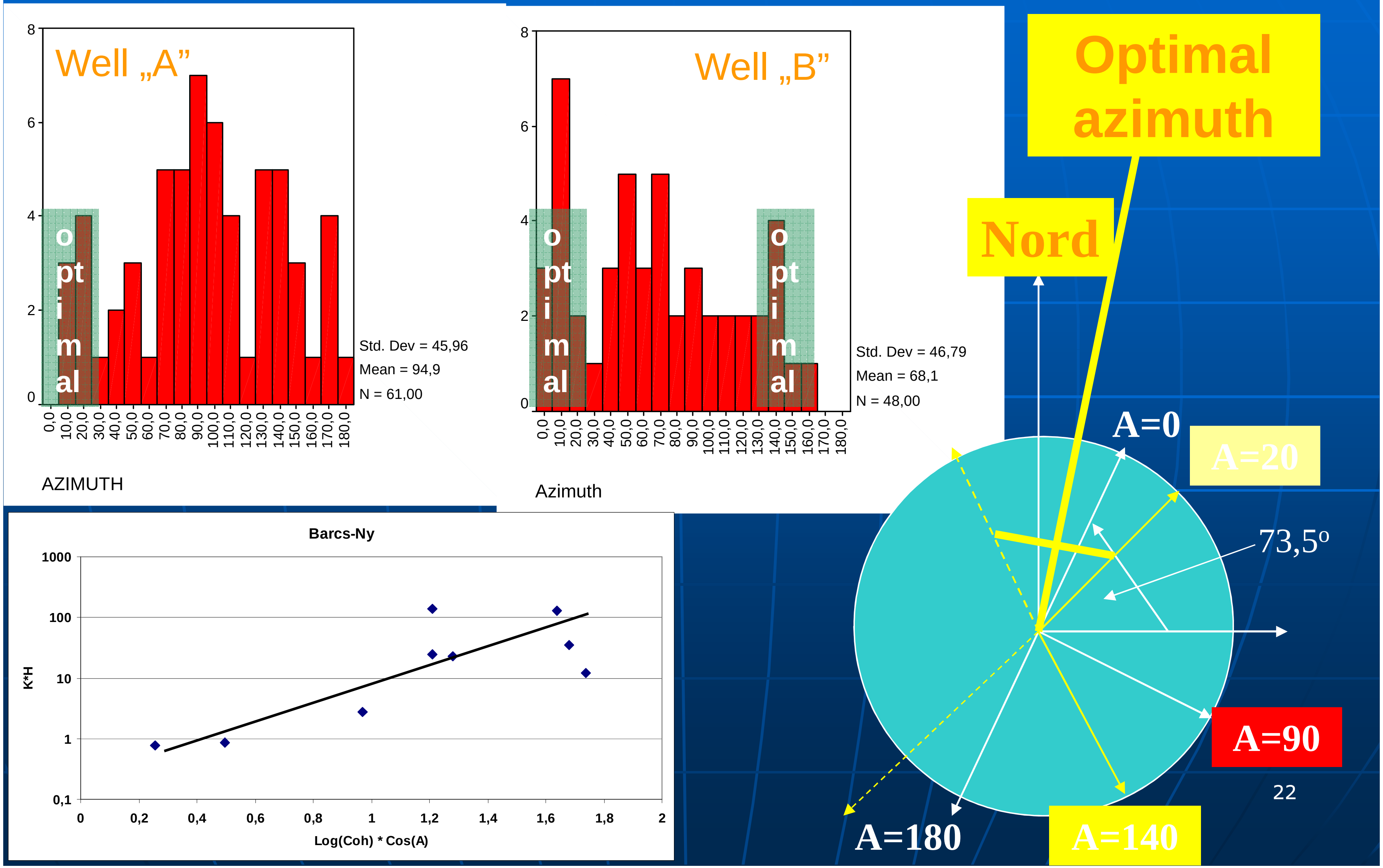
Coherence and azimuth in well „B”



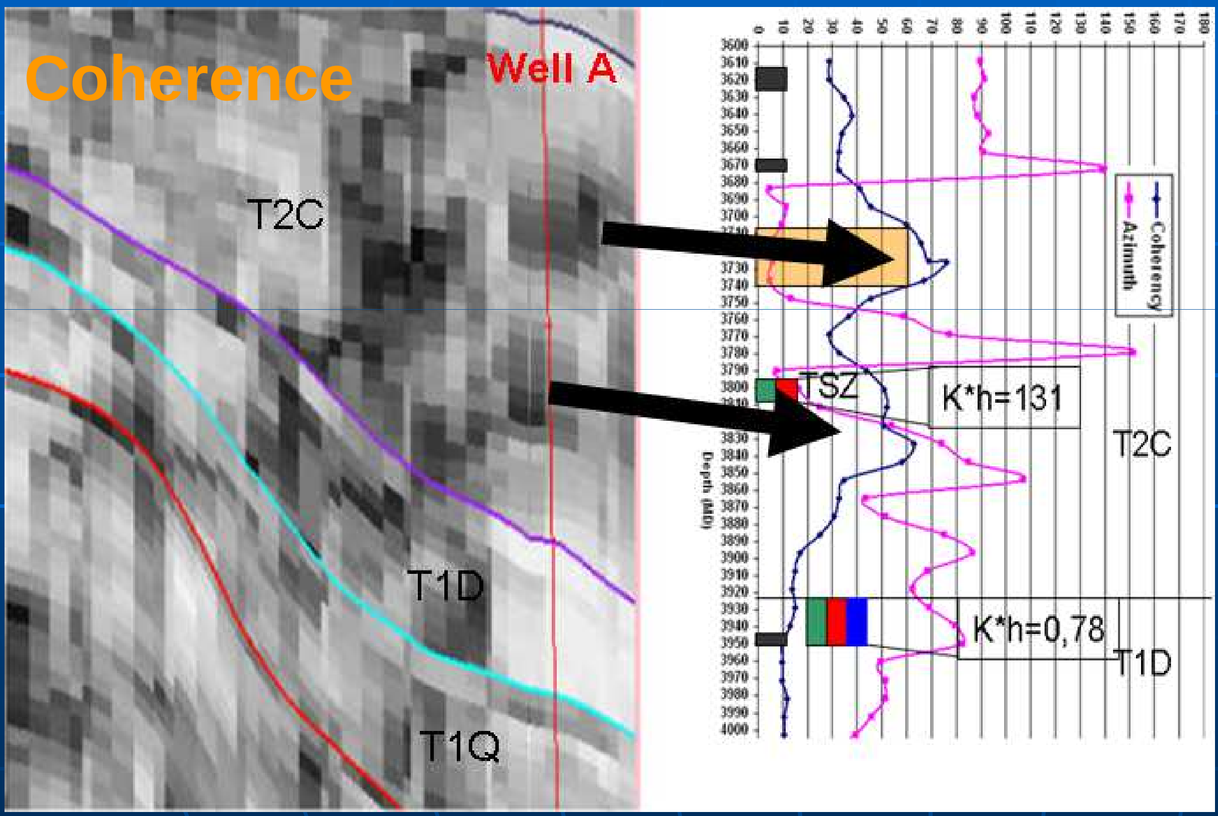
Totally Mud Loss in 3691 m

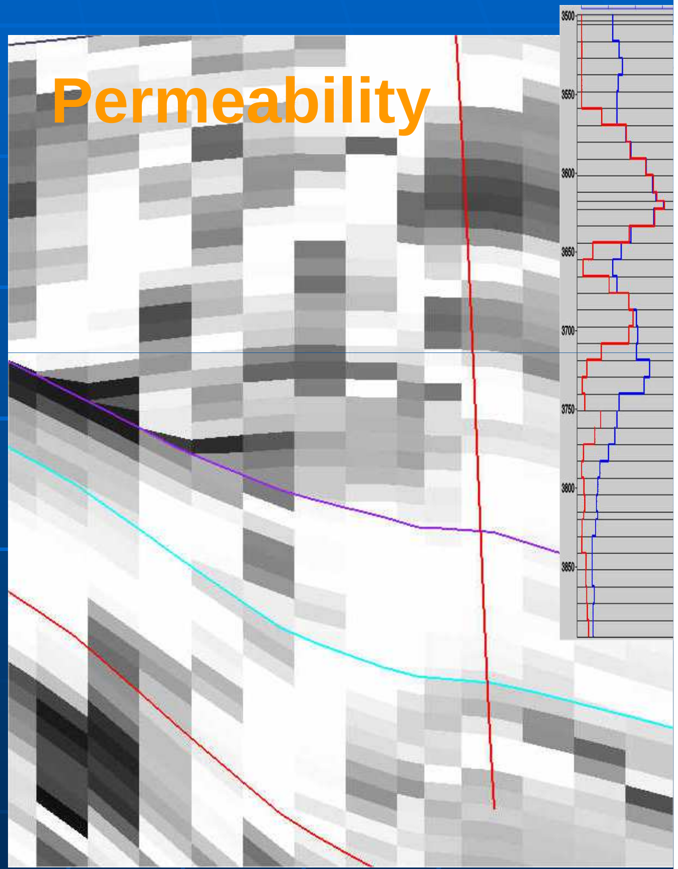
5 mm
40400m3/day gas
45,6 m3/day cond.
0,01 m3/day water

Optimal Azimuth of the Field

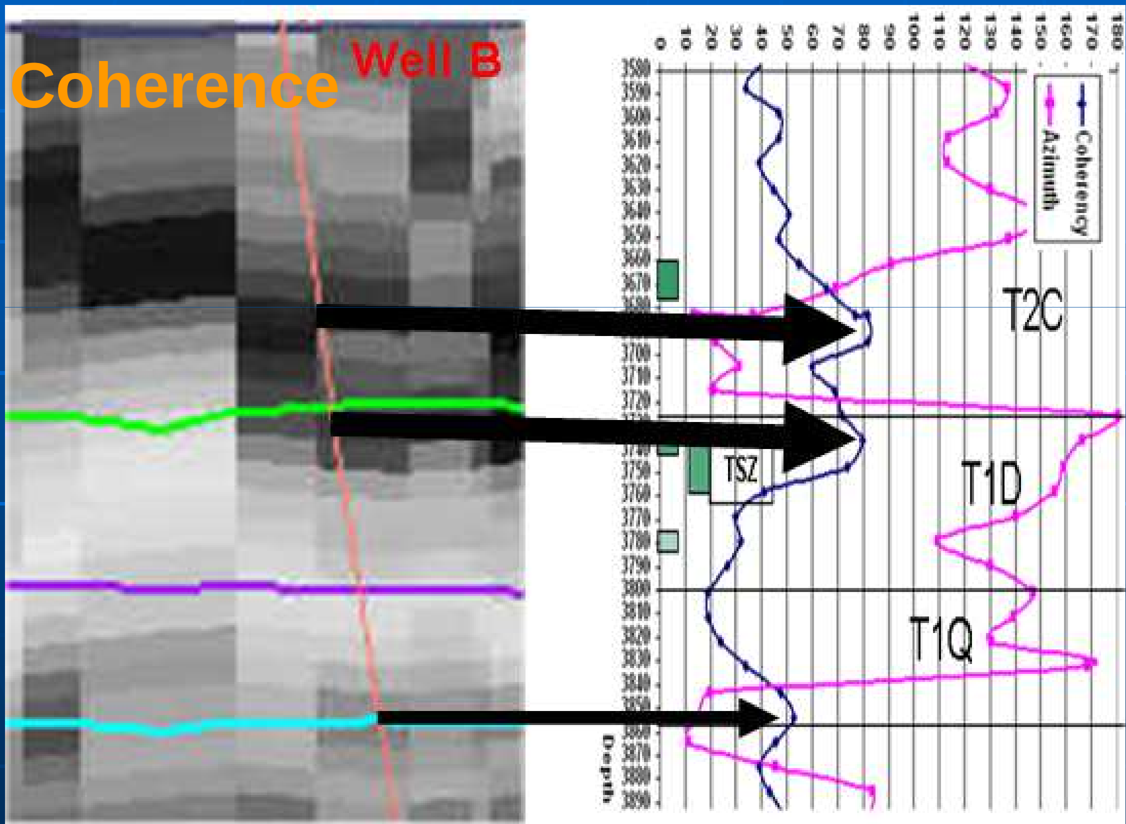


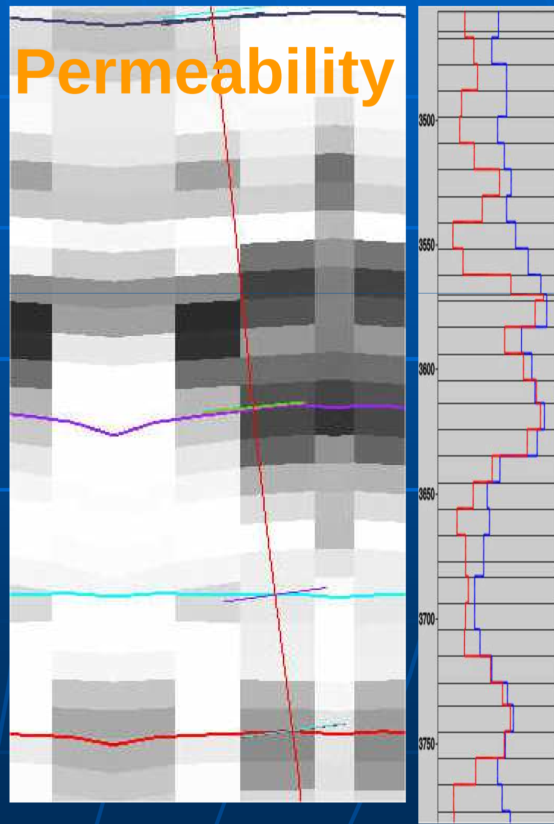
Permeability model around well „A”



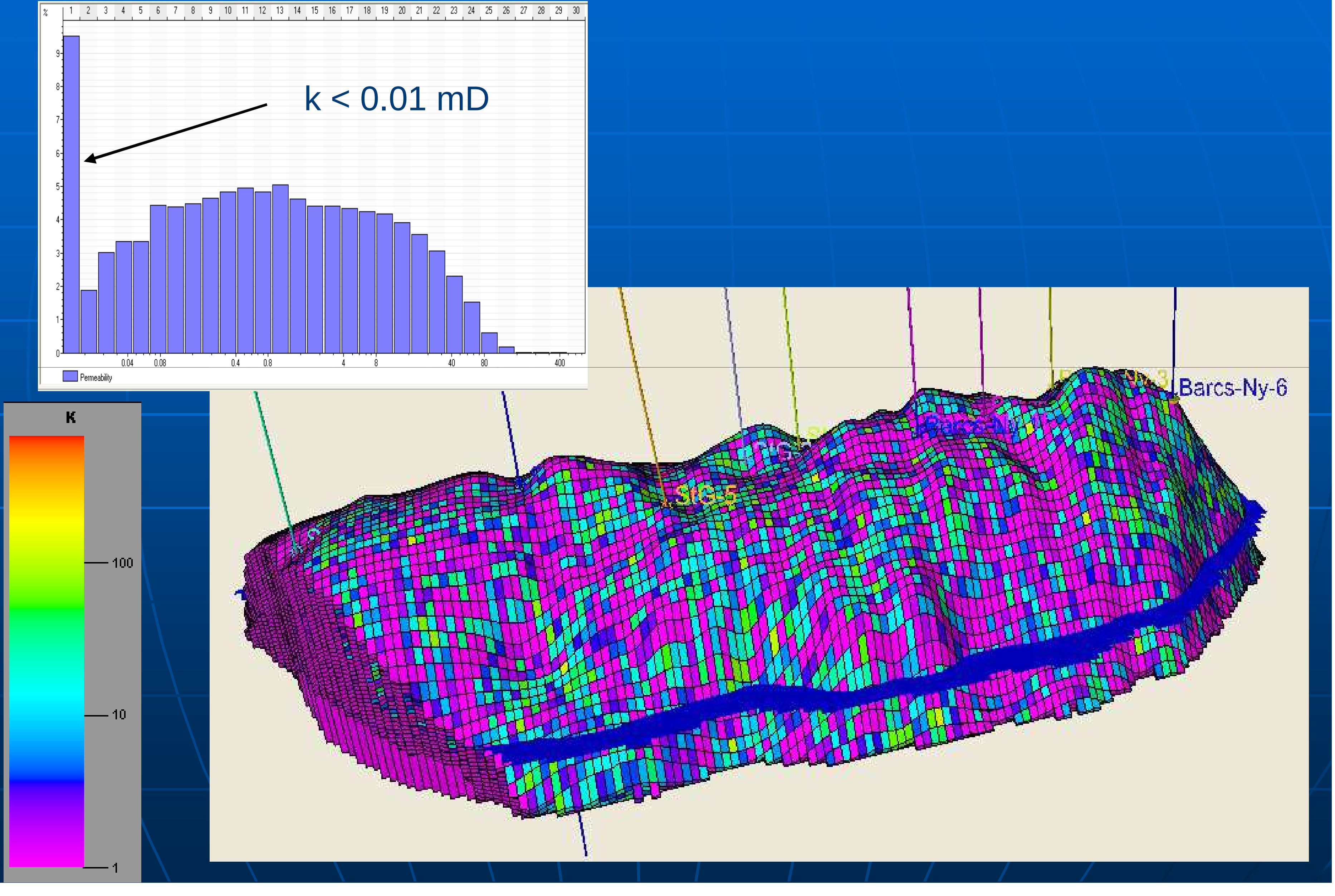


Permeability model around well „B”

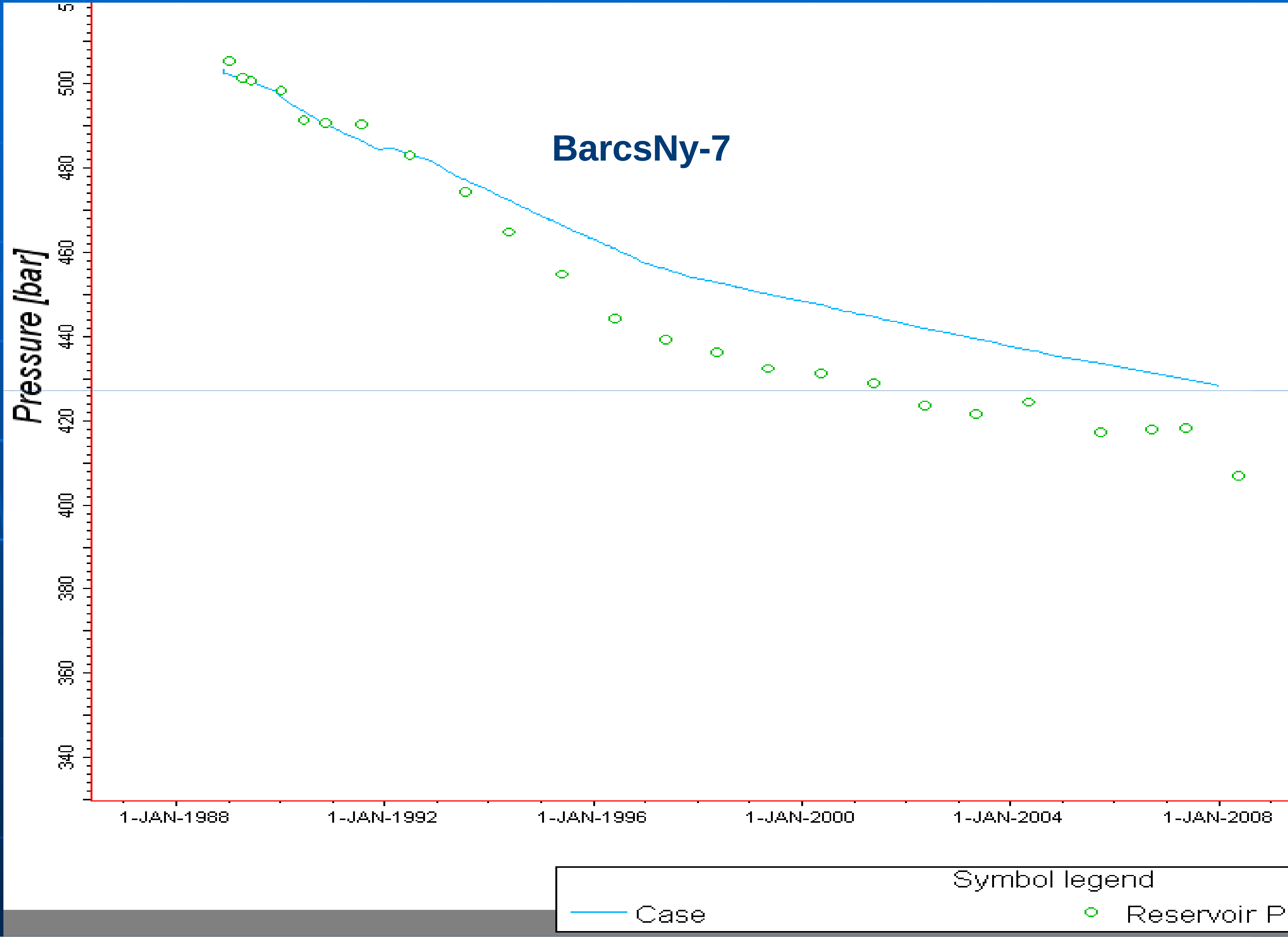




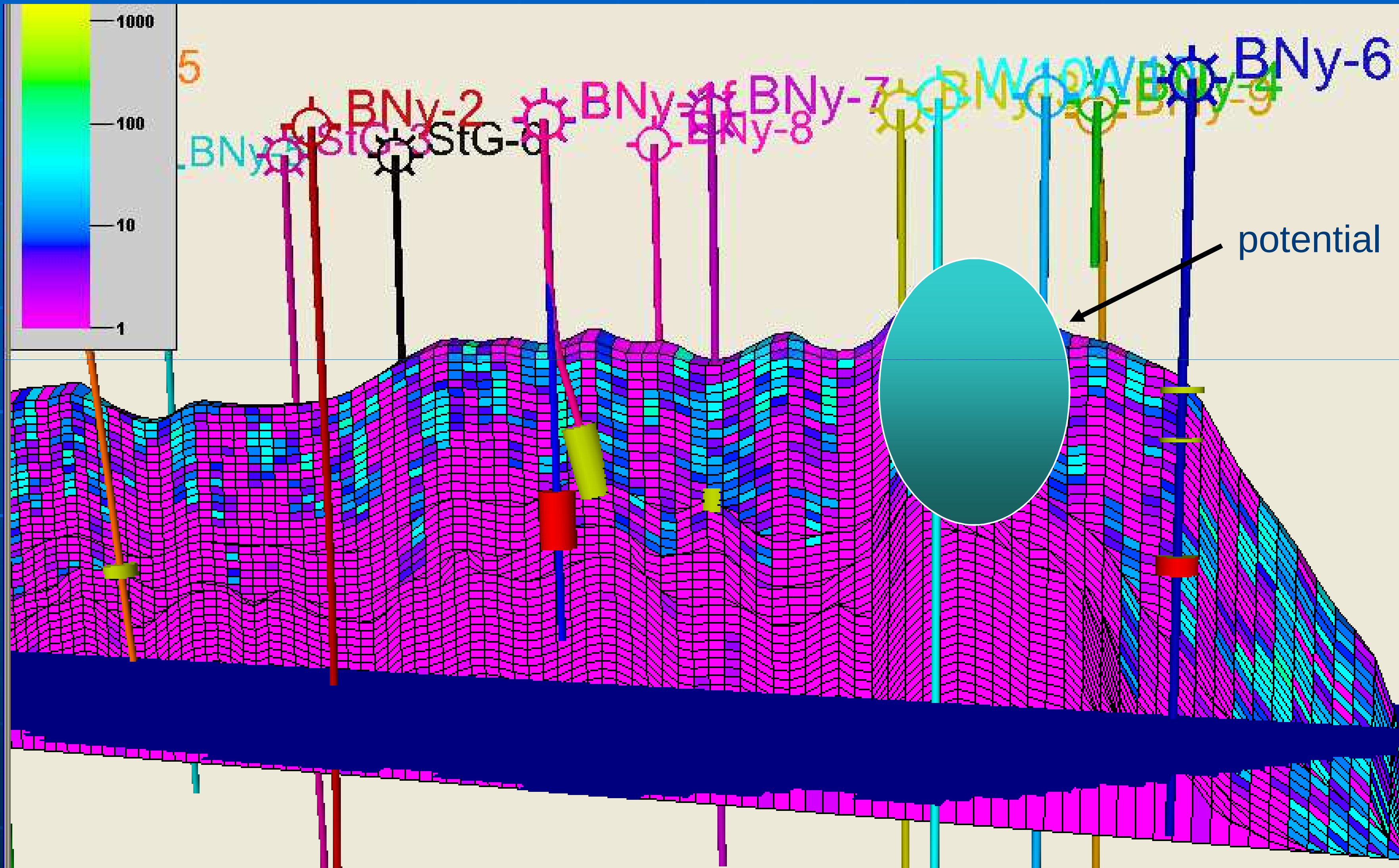
Permeability distribution in modell



Pressure matching



Potential



Summary

- Despite of the moderate OGIP, relatively low rec. factor and several well interventions the production rate have been decreased continually in the last decade;

- The key factor for succesfull well completion and well pattern improvement is the characterization of fractured zones;

- Coherence anomalies generally correlate fairly with the fractured zones, consequently also with the best production intervalls;

- The model proved transmissibility connections between different lithological units;

- The model could be suitable modelling fractured and double porosity reservoirs, especially permeability;

- The model is a good base for the further numerical simulation;

- The methodology gives any chance to model younger, double porosity reservoirs also.

Thank you for your attention!

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