



Transboundary thermal groundwater Transenergy project

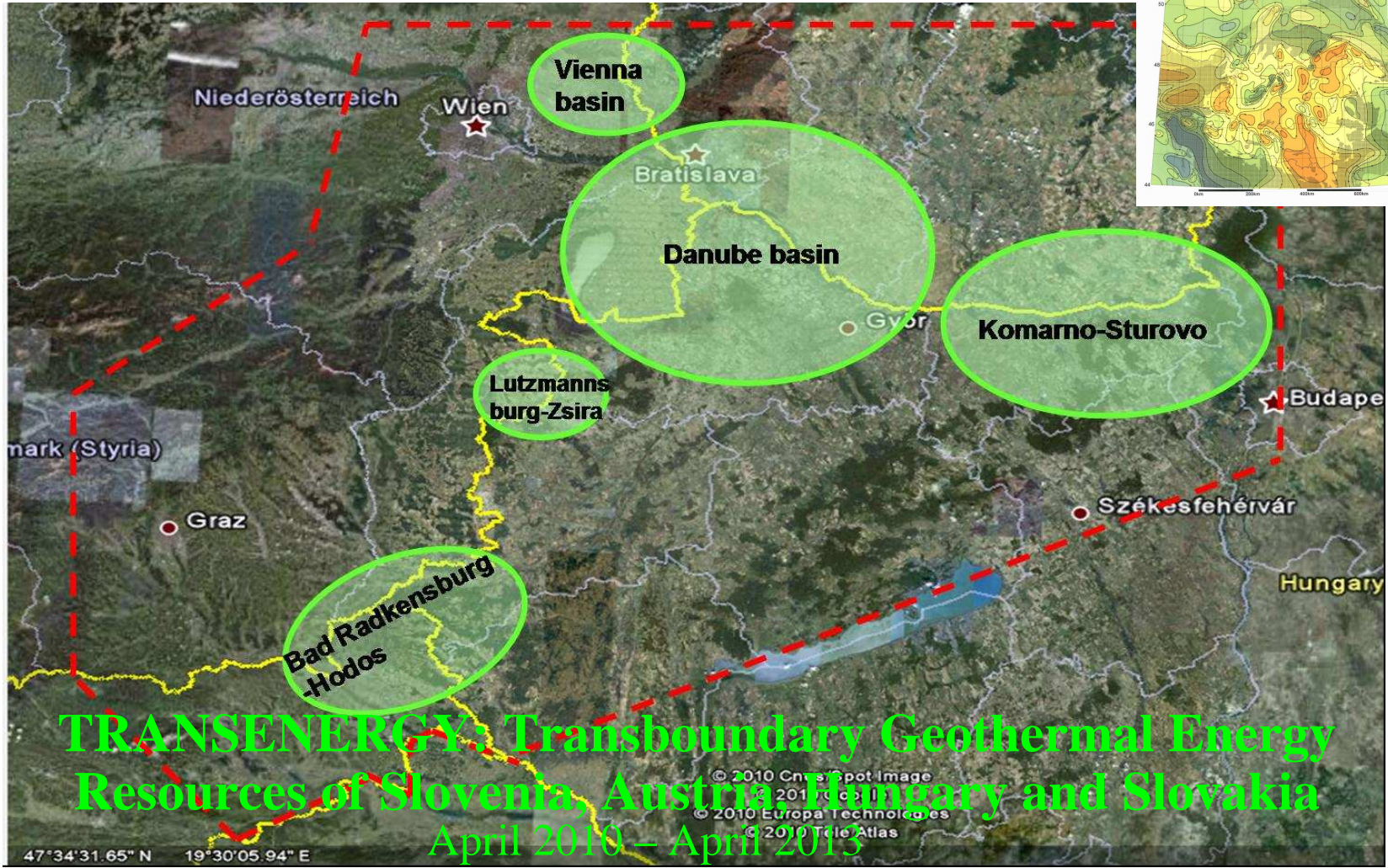
Teodóra Szócs, Annamária Nádor, Ágnes Rotár-Szalkai, György Tóth

Geological Institute of Hungary

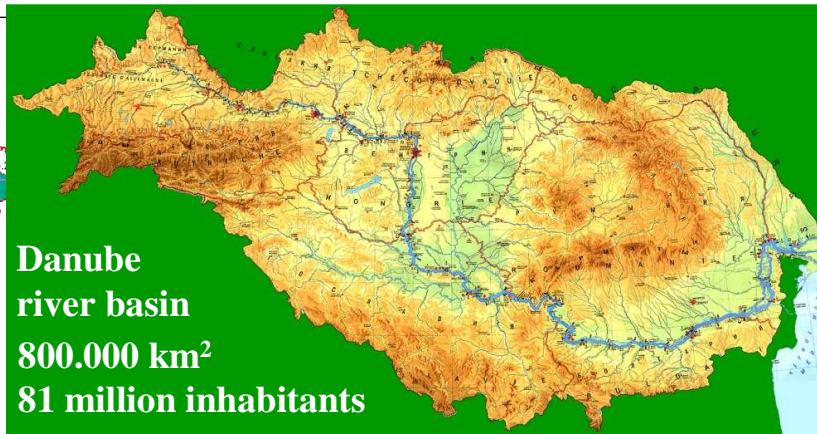
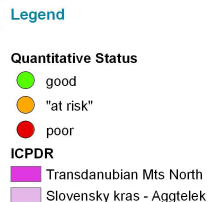
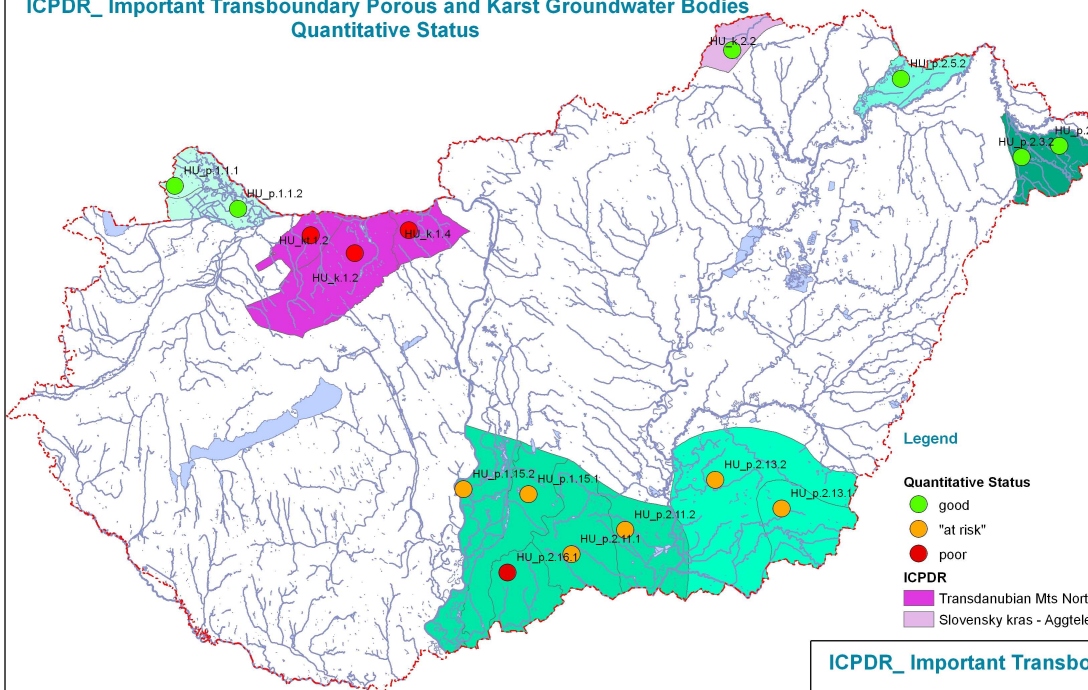
**20th GROUNDWATER WORKING GROUP C PLENARY MEETING,
BUDAPEST, HUNGARY, 27-28 APRIL, 2011**

This project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF.

<http://transenergy-eu.geologie.ac.at>



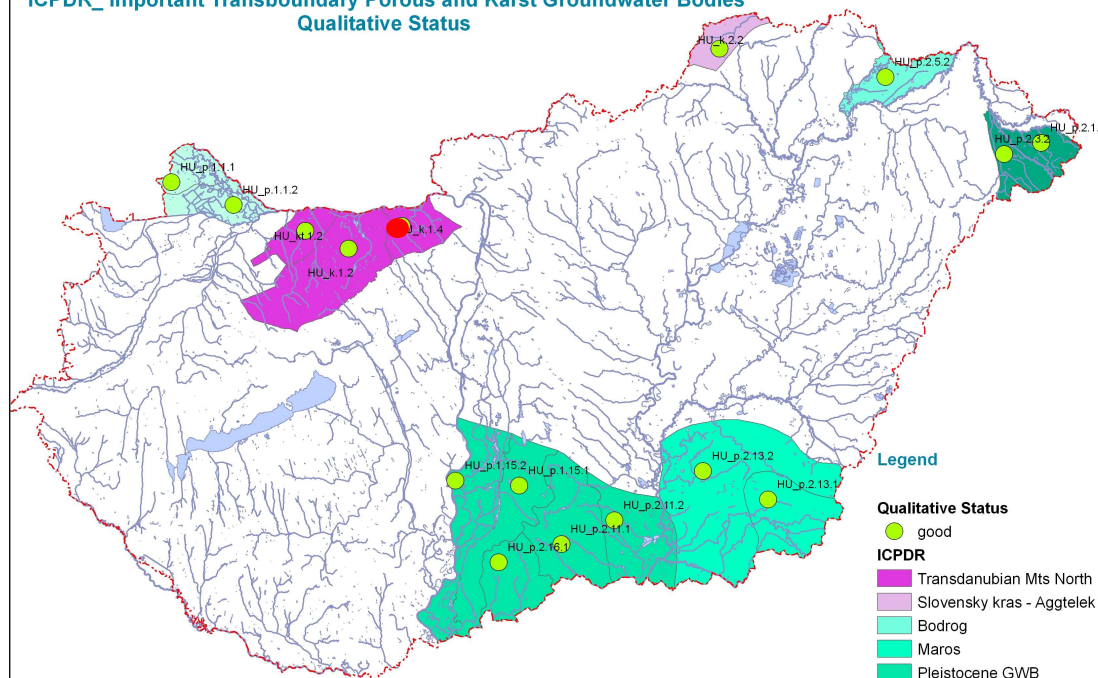
ICPDR_ Important Transboundary Porous and Karst Groundwater Bodies
Quantitative Status

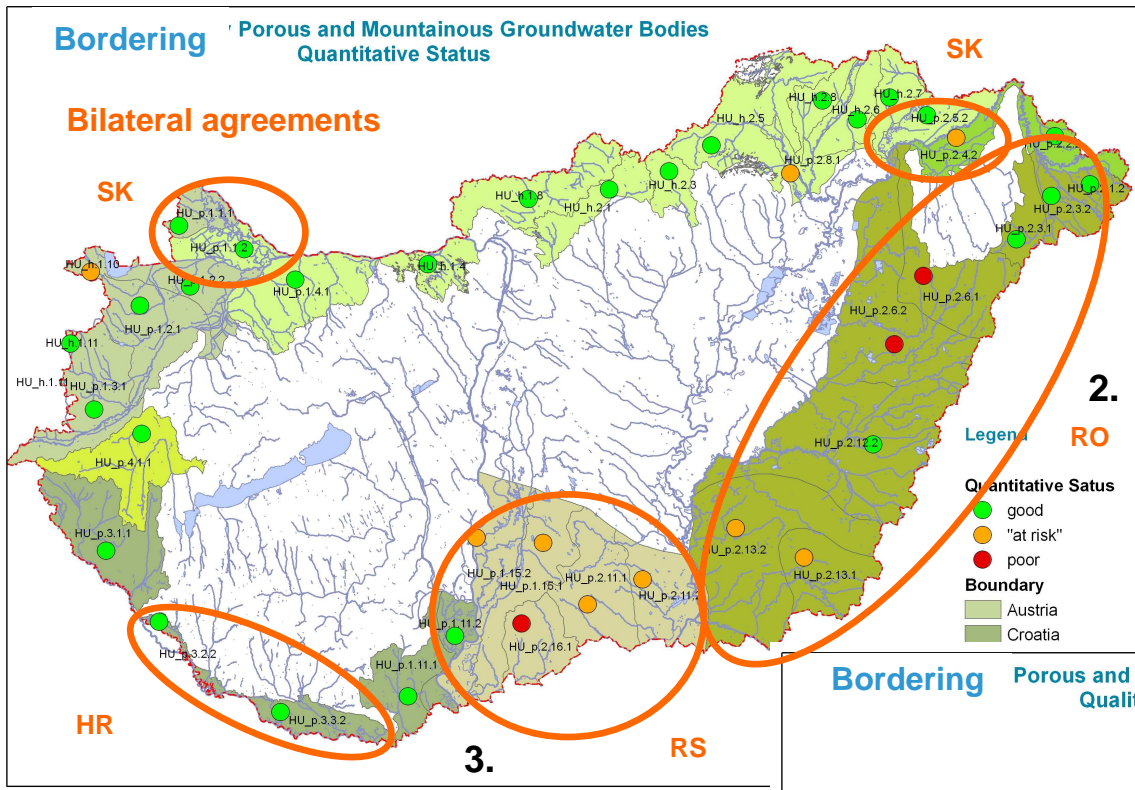


Hungary shares
(transboundary)
aquifers with:

- Austria**
- Slovakia**
- Slovenia**
- Croatia**
- Romania**
- Serbia**
- Ukraine**

ICPDR_ Important Transboundary Porous and Karst Groundwater Bodies
Qualitative Status

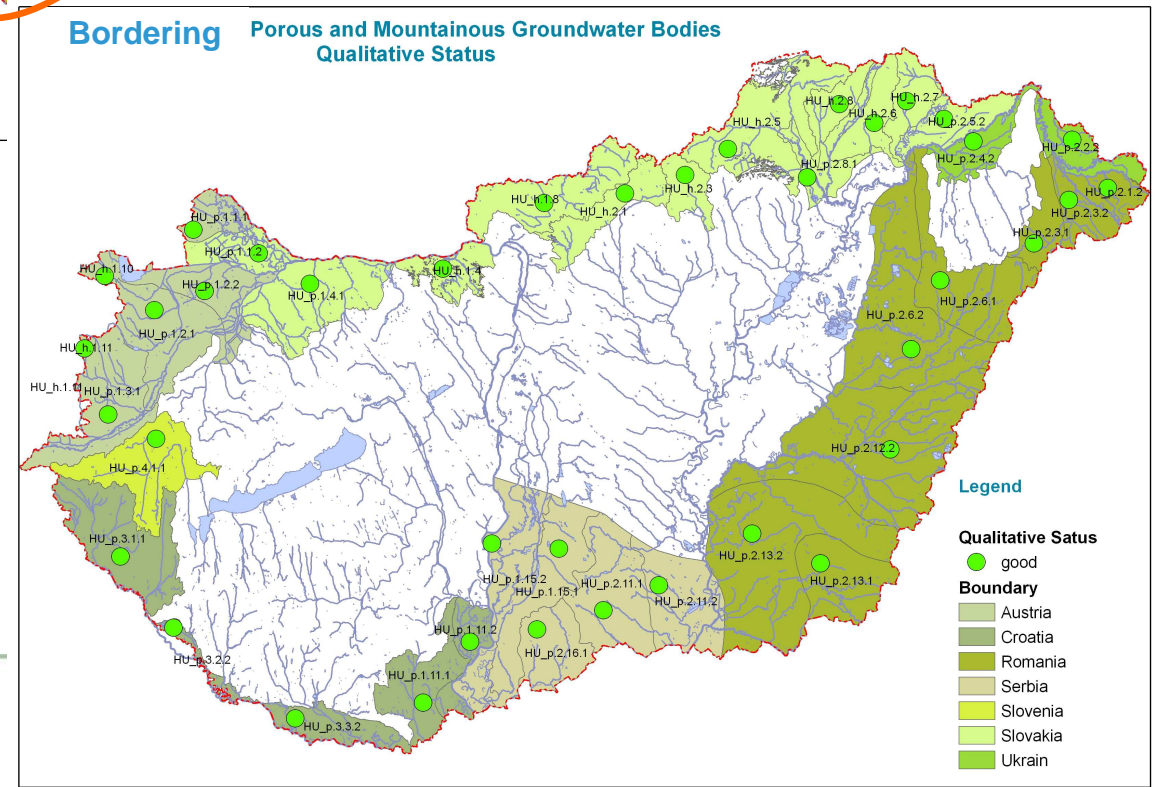




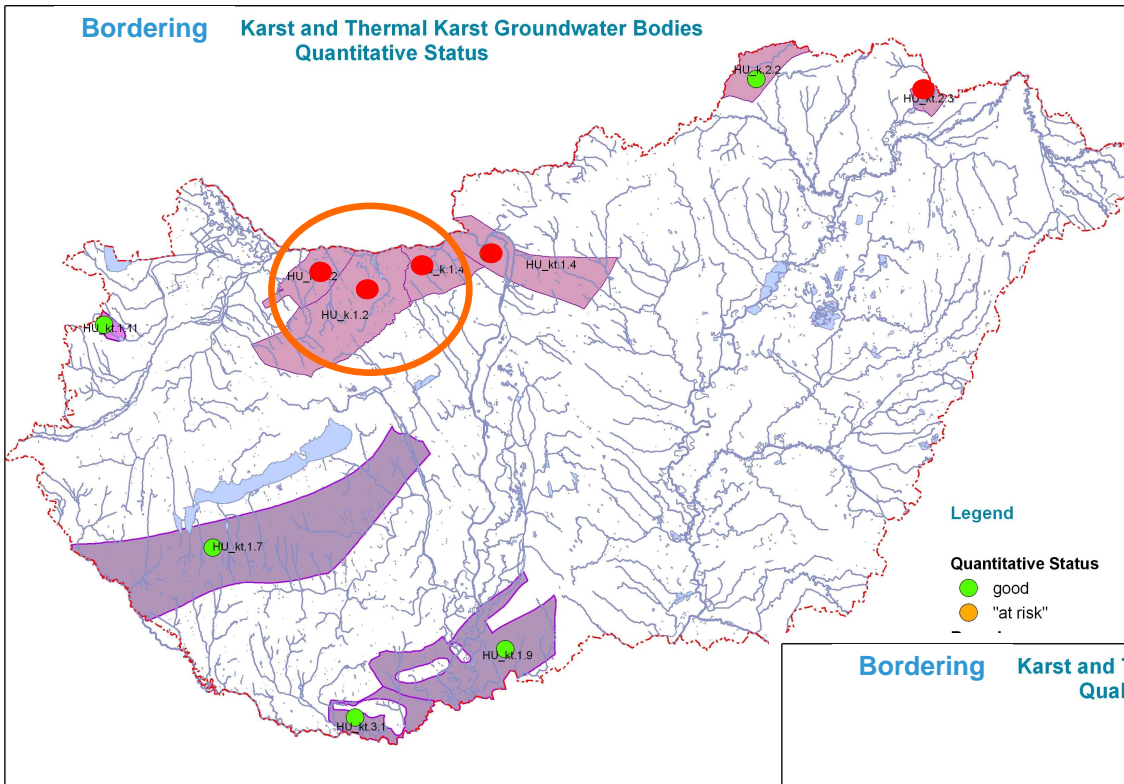
2. Negative water balance

3. Draw down (drinking water extraction, irrigation + gr. water usage in Serbia)

Good chemical status



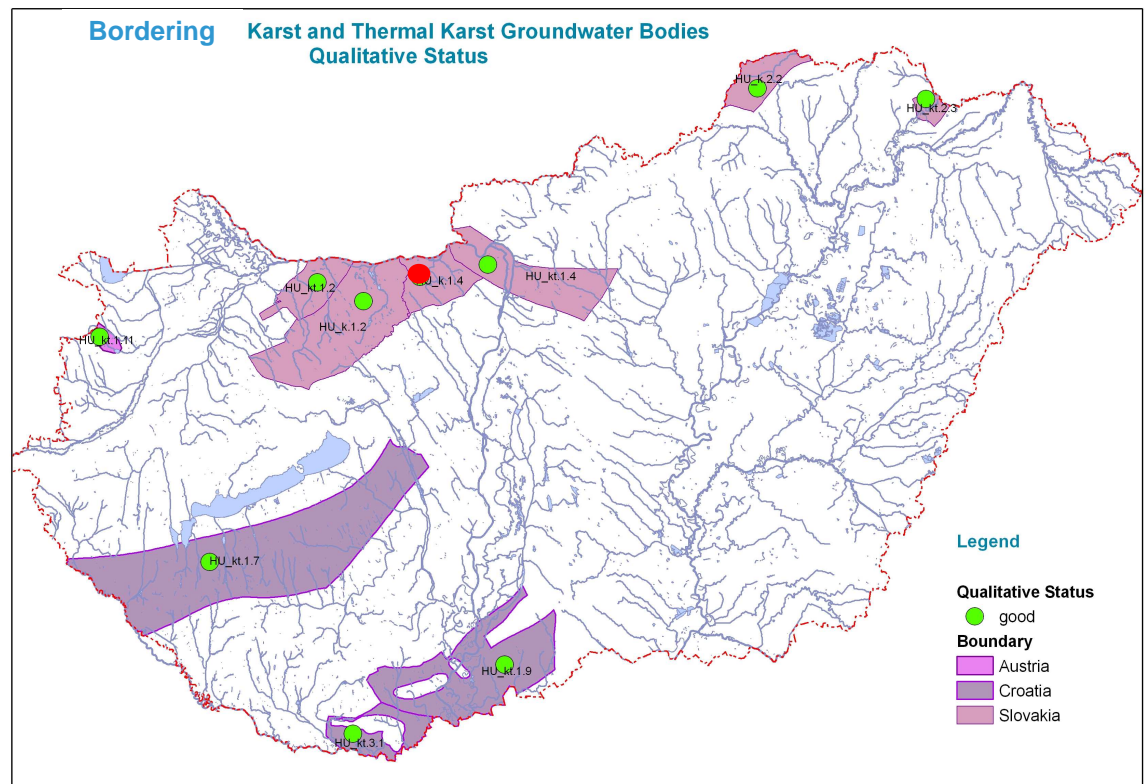
**Bordering Karst and Thermal Karst Groundwater Bodies
Quantitative Status**



**Negative water balance
GWDTE** (previous mining, the actual gr.water extractions delay the recovery)

DWPA (NO3)

**Bordering Karst and Thermal Karst Groundwater Bodies
Qualitative Status**



Main goals of Transenergy

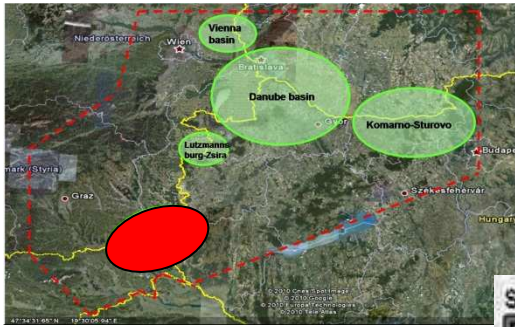
A user friendly **web-based decision supporting tool** (interactive web portal), which transfers expert know-how about hydrogeothermal utilization (single-well - balneology and doublets - geothermal energy) and sustainable reservoir management to stakeholders (**decision makers, water- and mining authorities, present and potential investors, scientific associations and wider public interested**), such as:

- complex assessment of thermal groundwater bodies
- scenario models for different water extractions: predictable quality and quantity changes
- experiences of present (cross-border!) interactions, best practice recommendations
- sustainable utilization

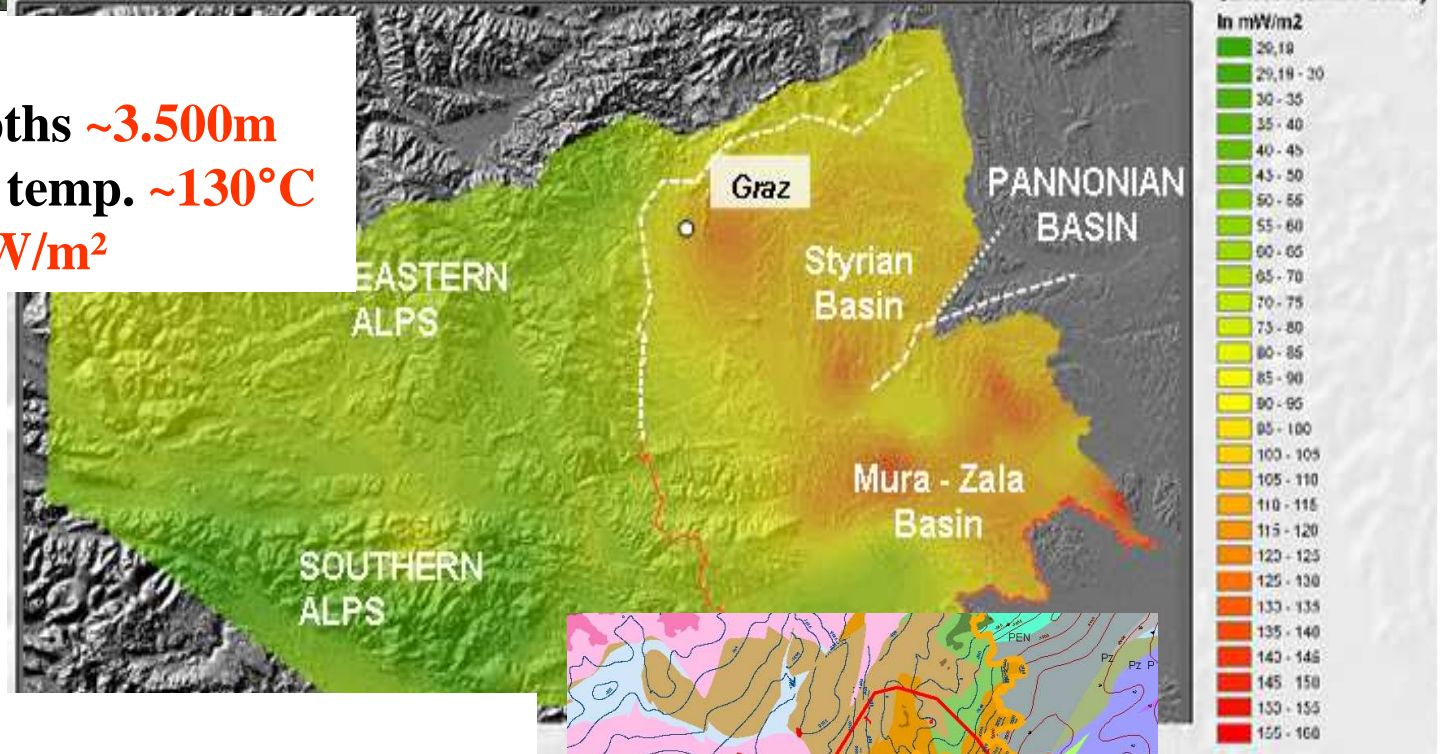
Shallow geothermal potential (Ground-Source Heat Pumps) are not part of assessment

SLO-AT-HU cross border region

Bad-Radkersburg-Hodos pilot area



Surface heat flow density map



Styrian Basin

Maximum basin depths **~3.500m**

Maximum reservoir temp. **~130°C**

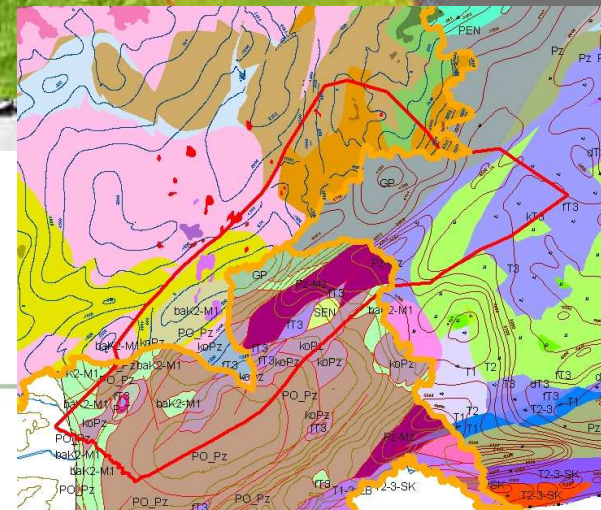
Heat flow **70-130 mW/m²**

Mura-Zala Basin

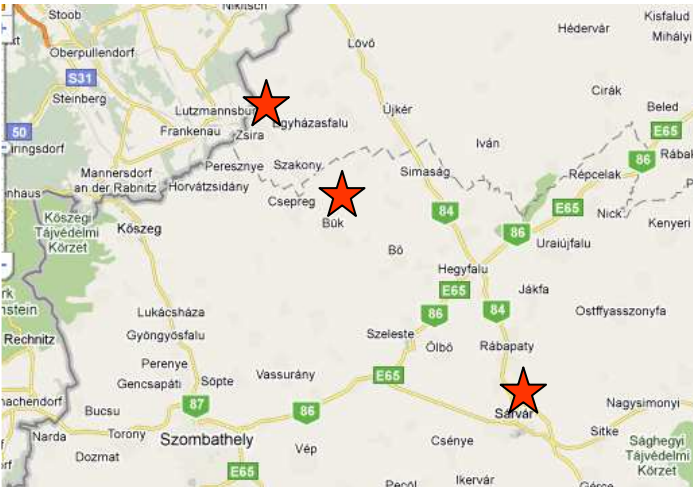
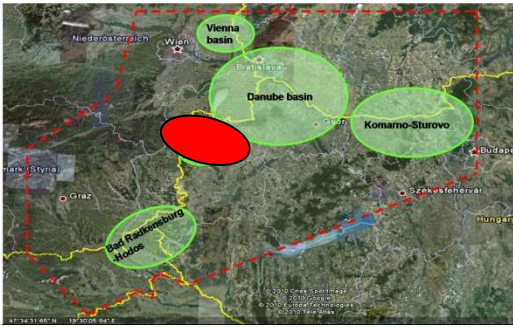
Maximum basin depths **~5.500m**

Maximum reservoir temperatures **~200°C**

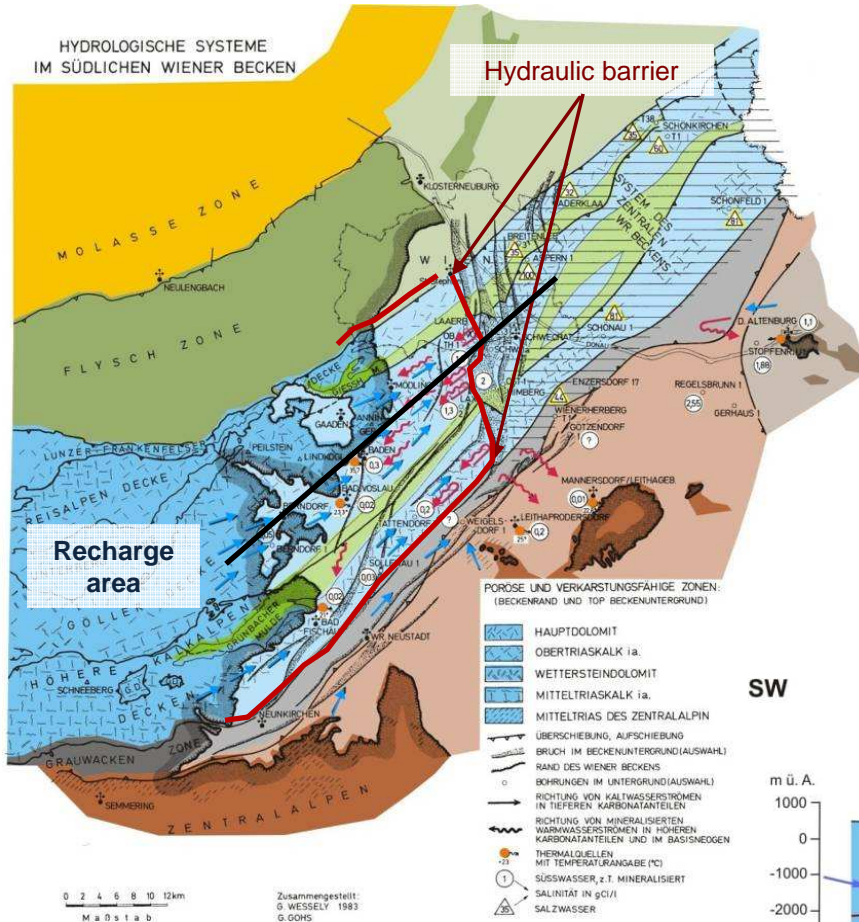
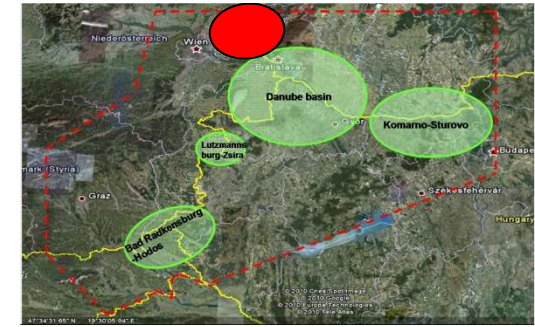
Heat flow **60 -150 mW/m²**



AT-HU cross-border region: Lutzmannsburg - Zsira



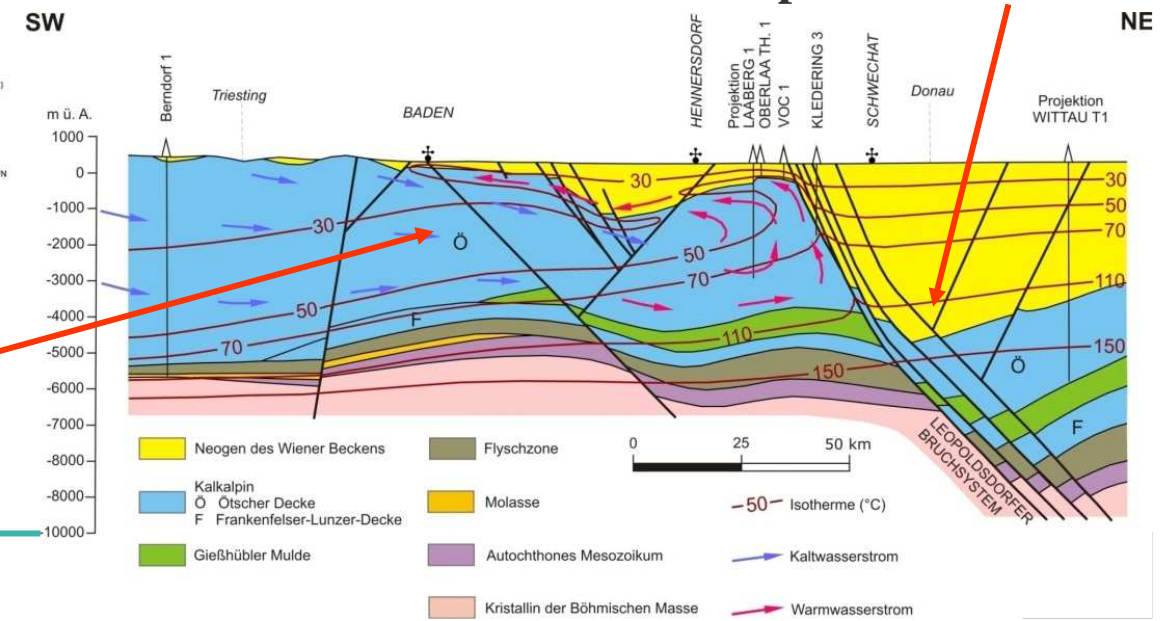
AT-SK cross-border region: Vienna basin

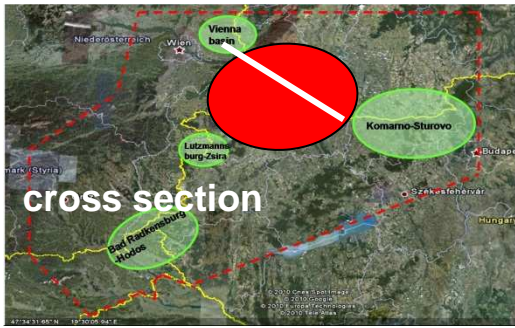


Maximum basin depths **~7.000m**
 Maximum reservoir temp. **~200°C**
 Heat flow **40-90 mW/m²**

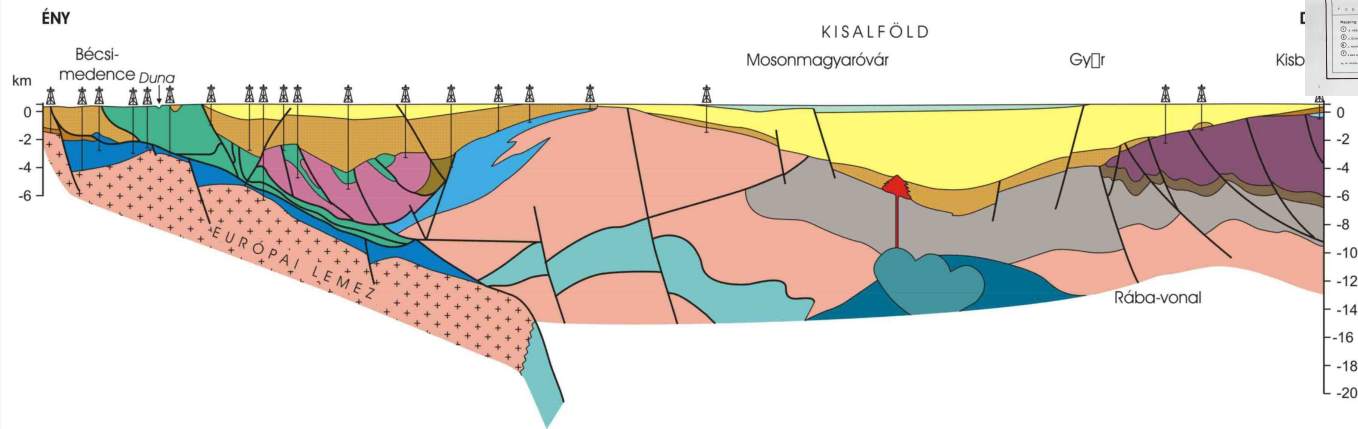
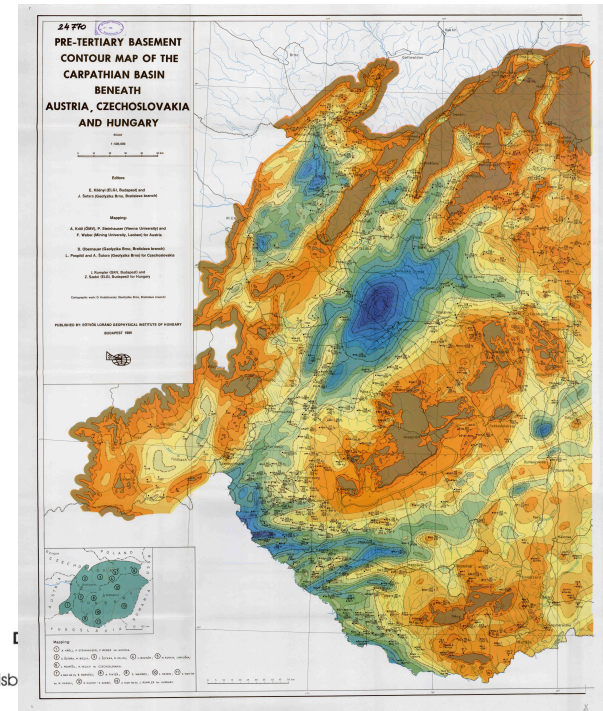
High mineralization
 Connate
 Over pressured

Low mineralization
 Active recharge
 Temperature anomalies





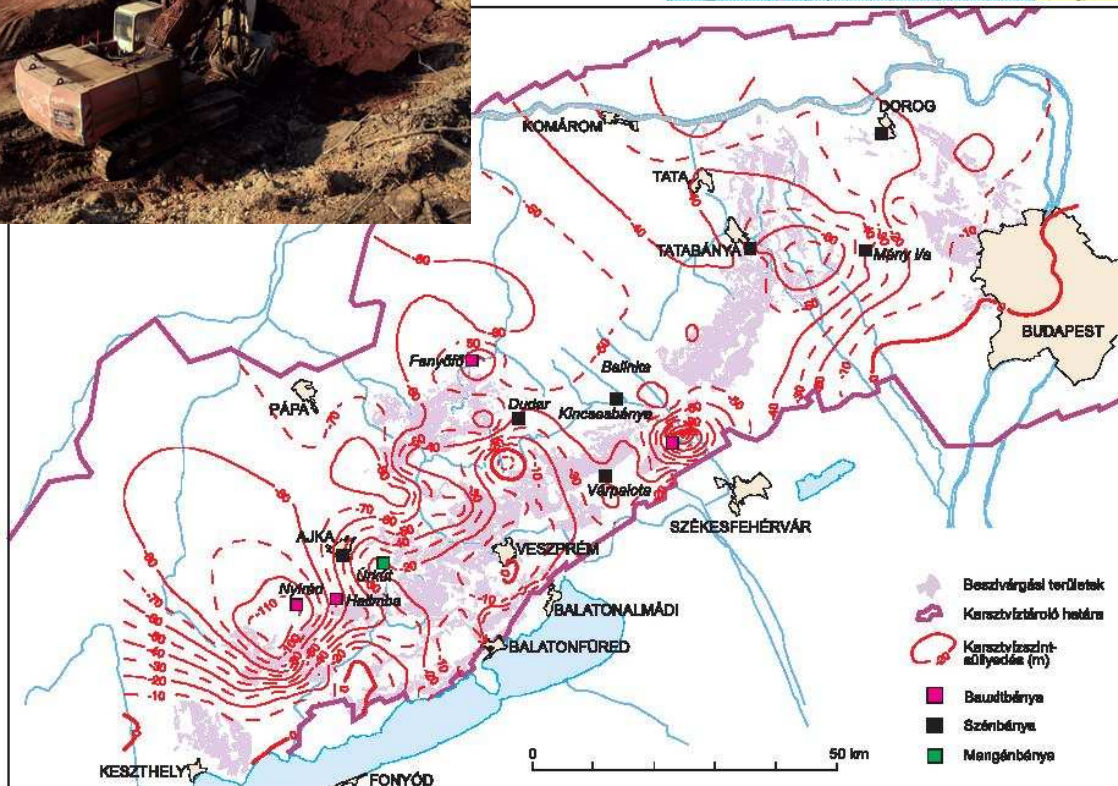
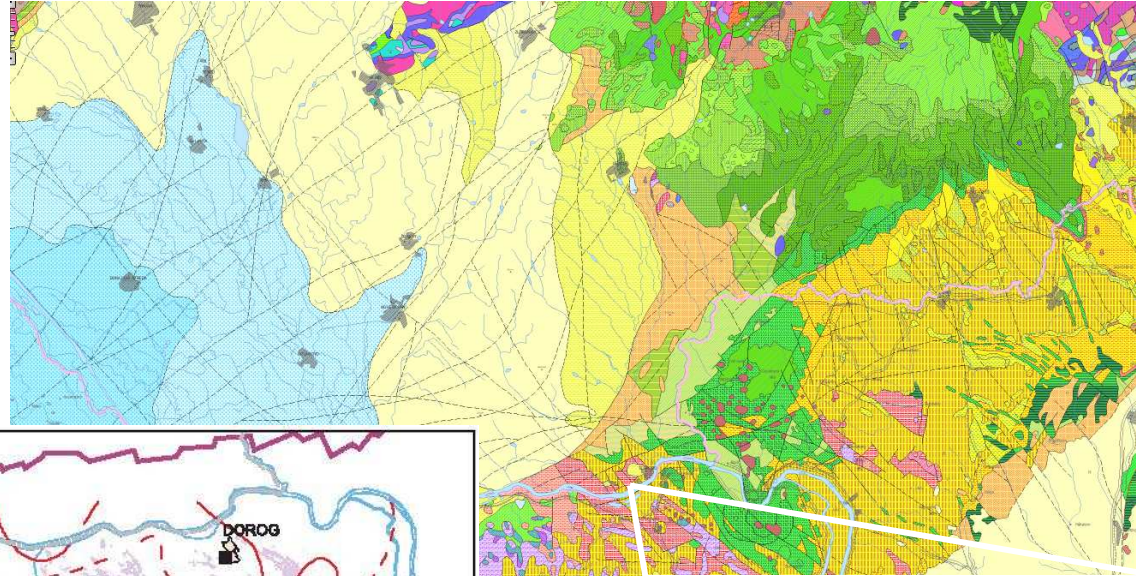
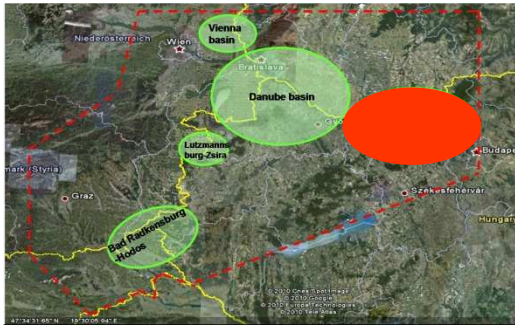
AT-HU-SK cross-border region: Central depression of Danube basin



- | | | |
|-----------------------------------|--|--|
| Kvarter korú folyóvízi üledék | Jura korú homokk[] és mészk[] | Kristályos aljzat |
| Pannóniai korú tavi üledék | Mezozoos k[]zetekb[] álló mészk[] takarók | Cseh masszívum kristályos aljzata |
| Miocén korú tengeri k[]zetek | Metamorfizált mezozoos k[]zetek | Óceáni kéreg bazaltja |
| Miocén korú vulkáni k[]zetek | Triász korú mészk[], dolomit, márga | Nagy mágneses anomáliájú aljzat (benyomult magmás k[]zetek) |
| Paleogén korú tengeri k[]zetek | Perm korú folyóvízi homokk[] | Nagy s[][]ség[] aljzat (benyomult magmás k[]zetek) |
| Kréta-paleogén, tengeri k[]zetek | Felső-paleozoos k[]zetek | Szerkezeti vonal |
| Jura-kréta tengeri mészk[] | Alsó-paleozoos k[]zetek | A kontinentális és az óceáni kéreg határa |



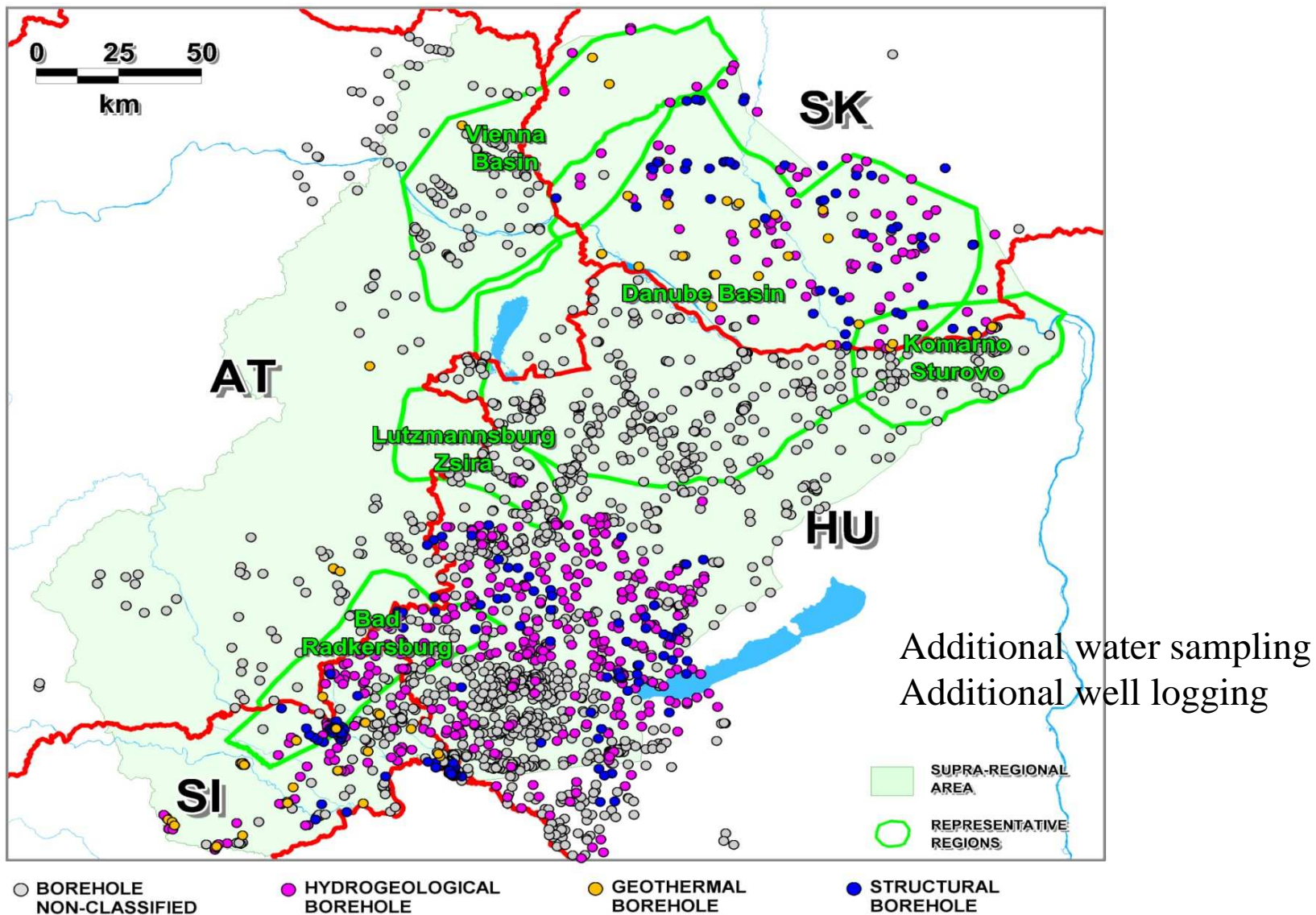
SK-HU cross-border region: thermal karst of Komárom-Sturovo



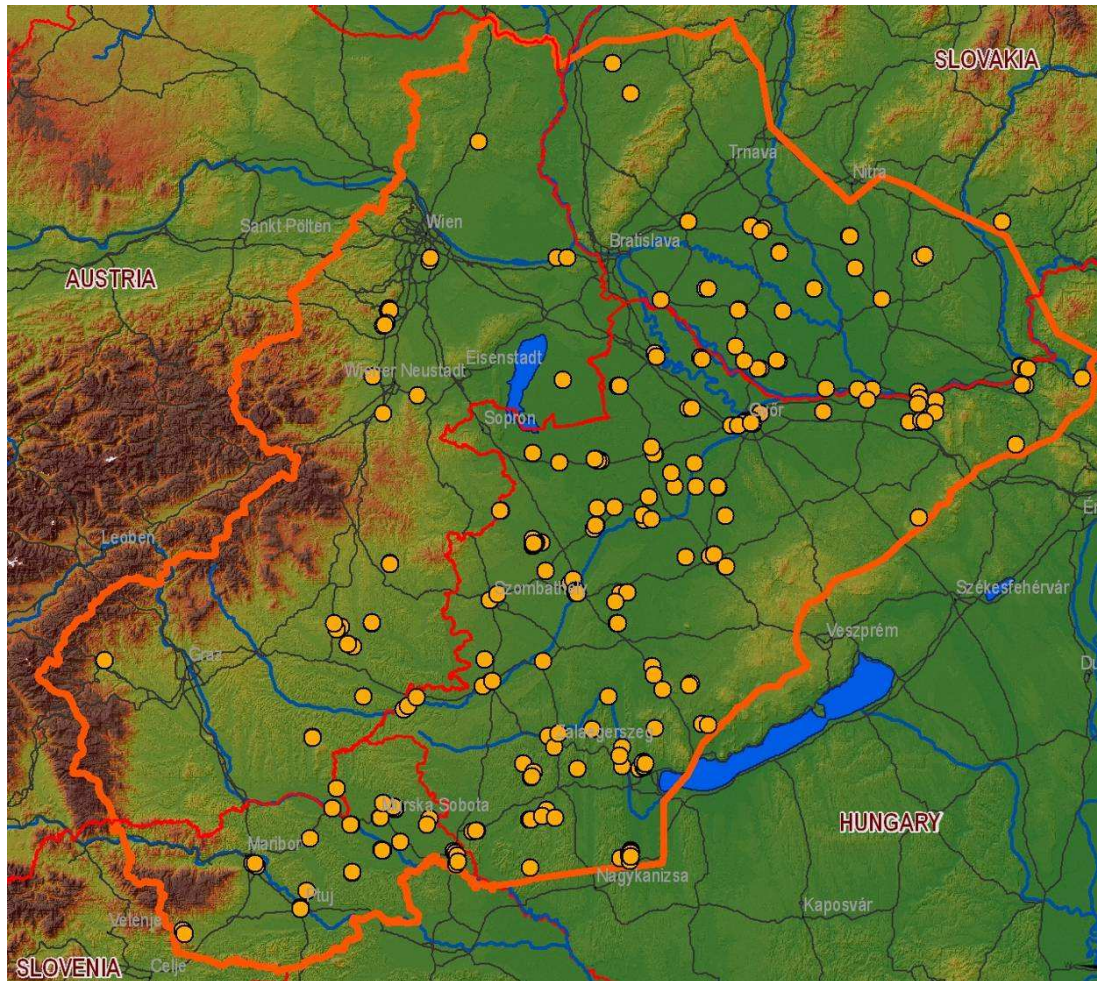
depression in karst water level
1990's

<http://transenergy-eu.geologie.ac.at>

Current status of investigation — Common database



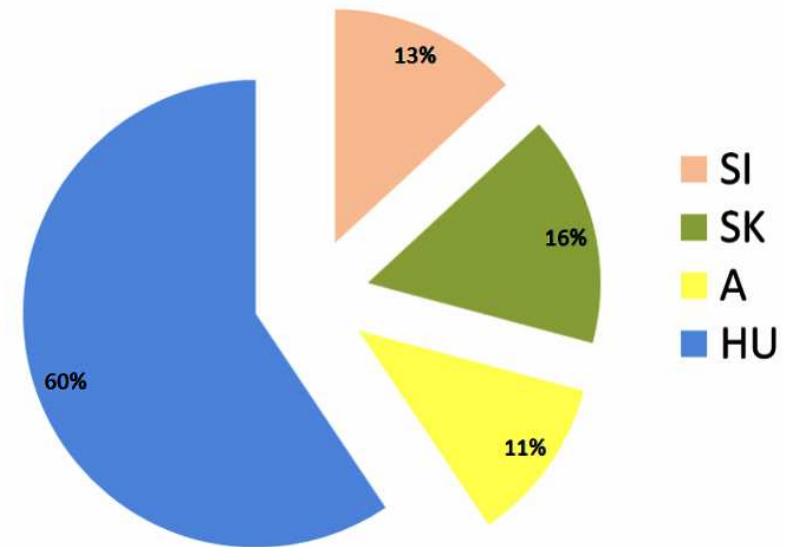
Current status of investigation — Utilization



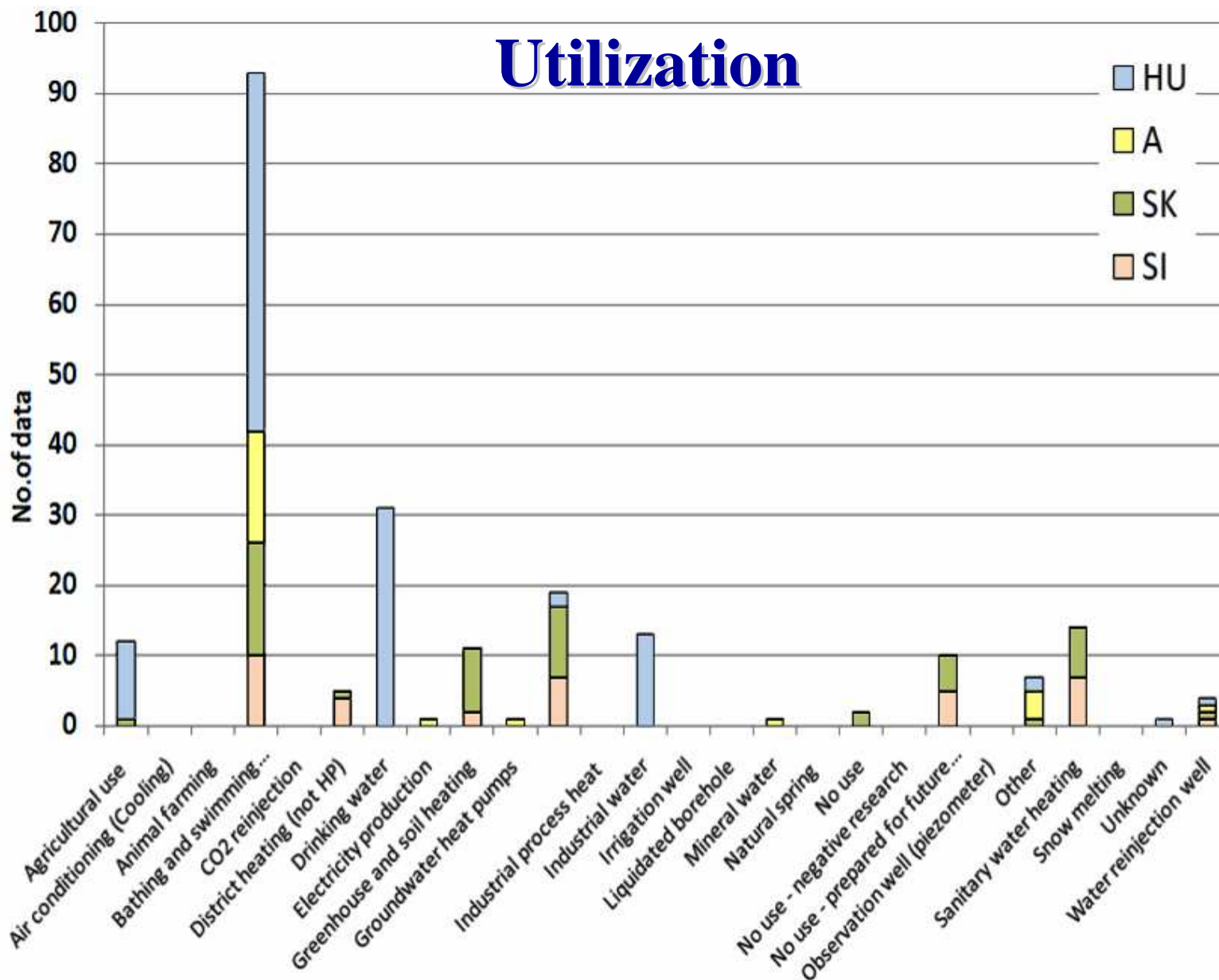
Overview of legislations

Database of thermal water users and authorities who provide the licences for use

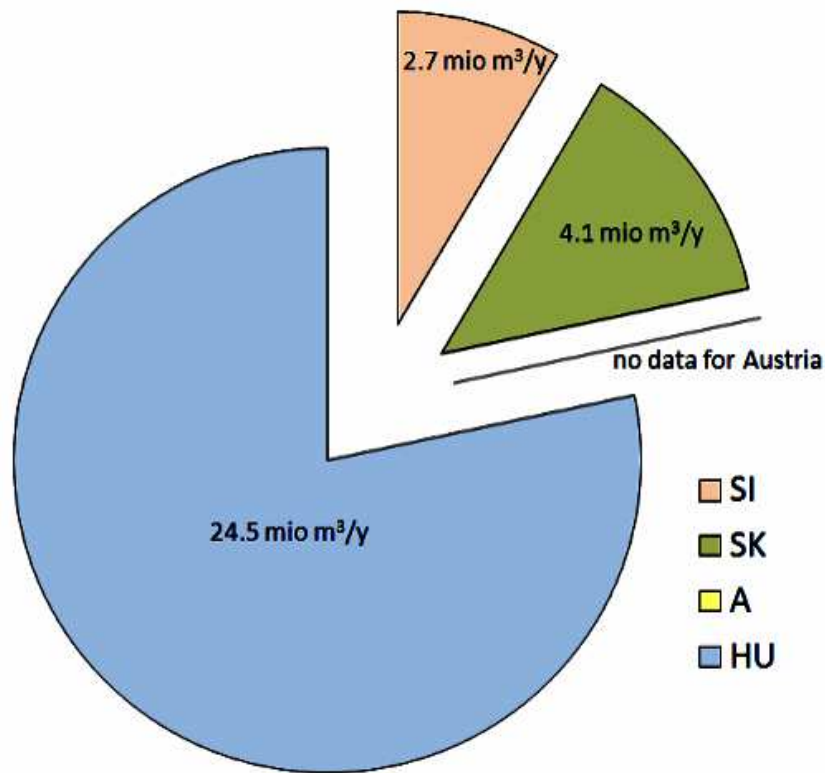
308 operating thermal wells in total



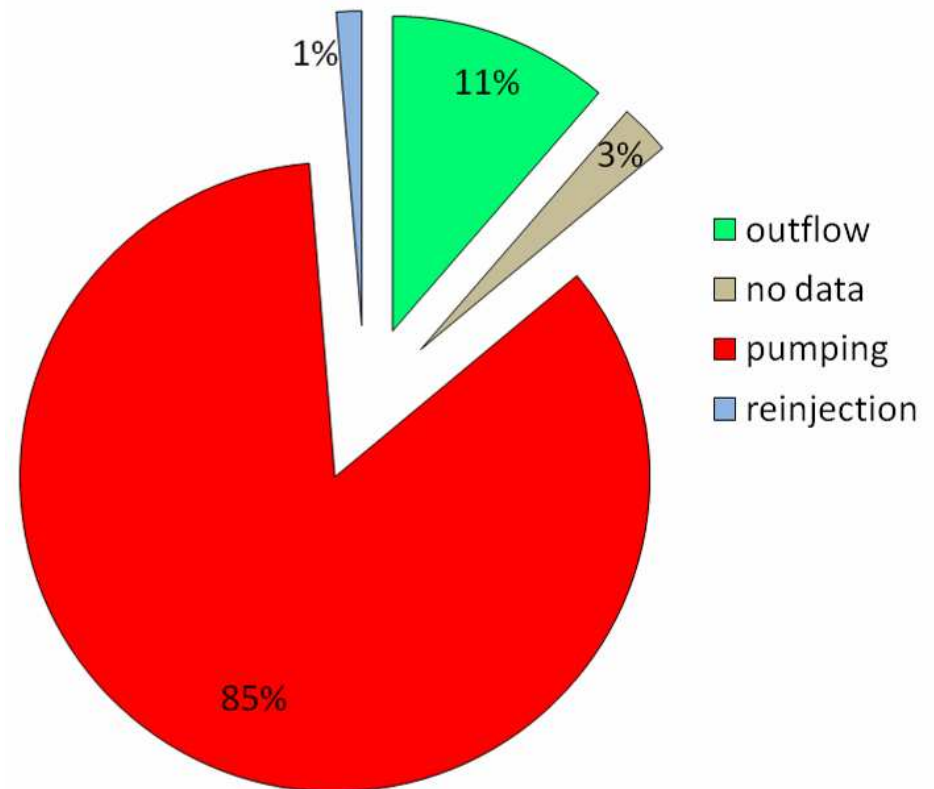
Utilization



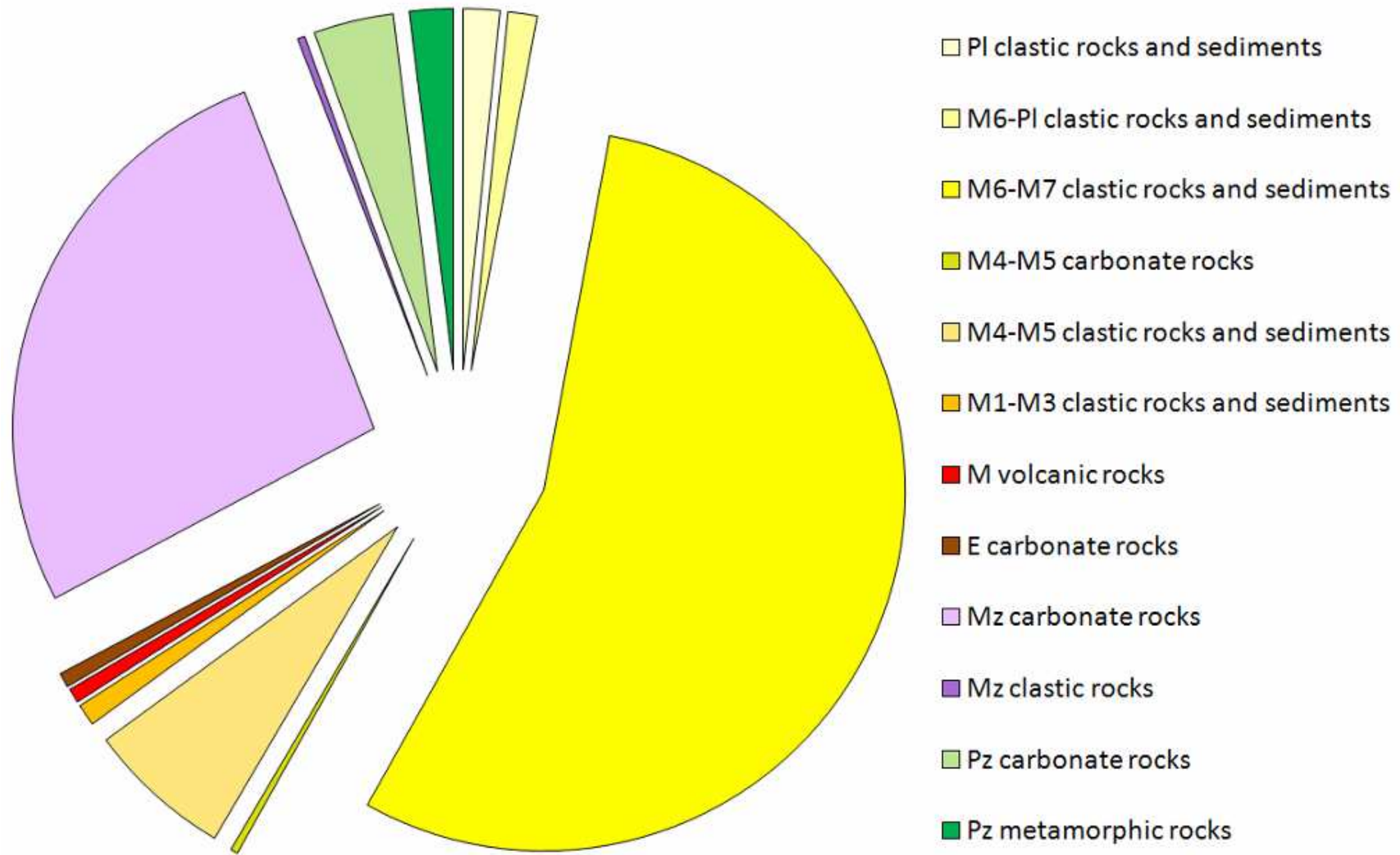
Amount of thermal water usage by countries; 2009



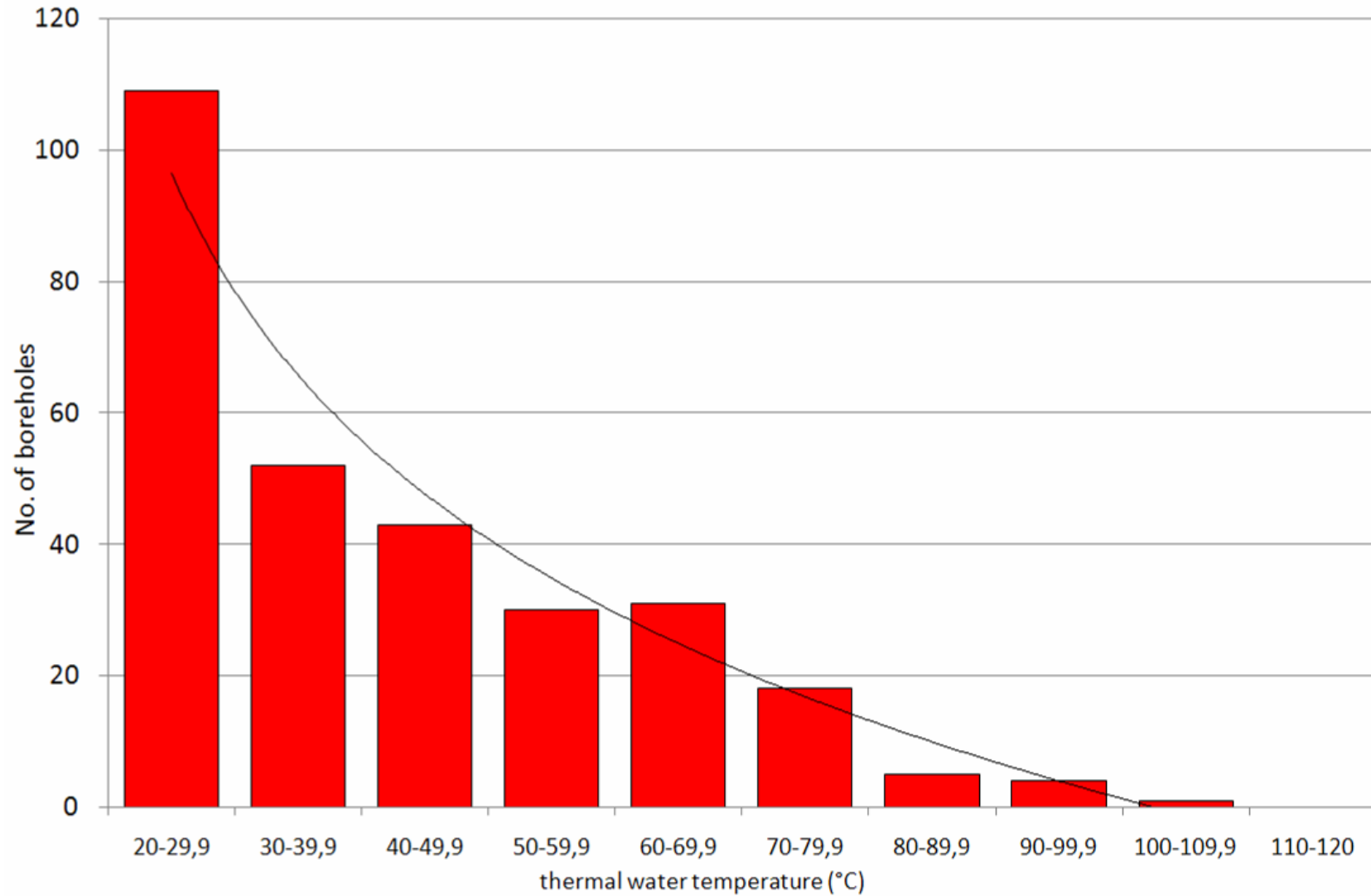
Type of usage



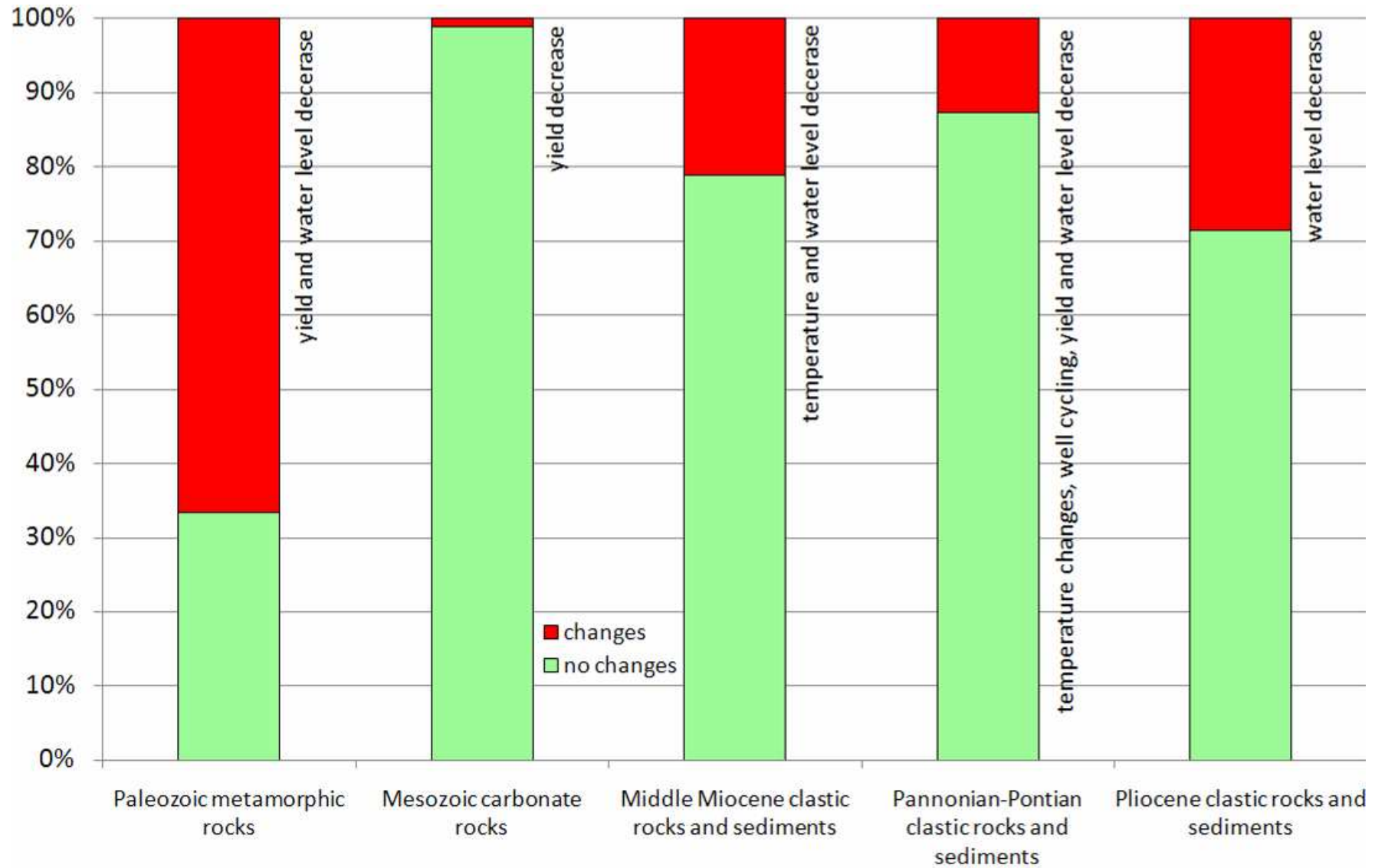
Aquifer proportions



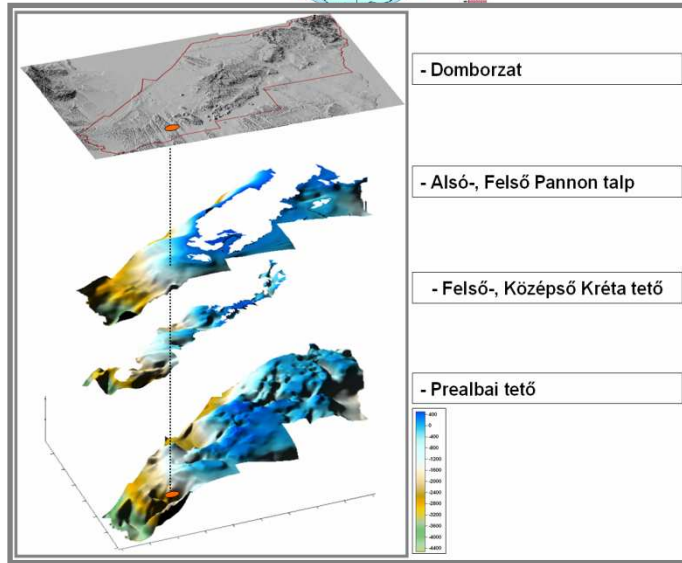
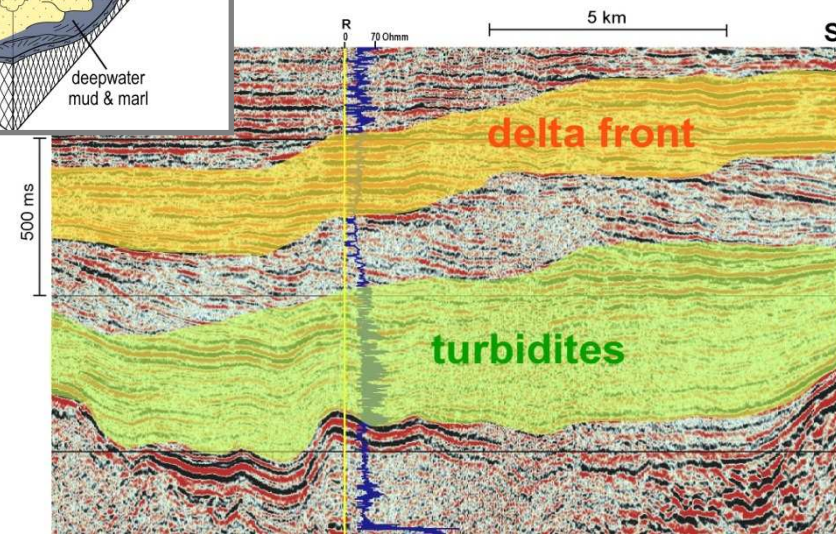
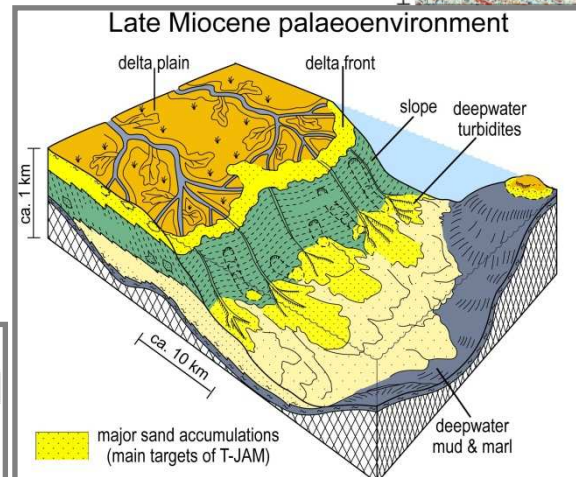
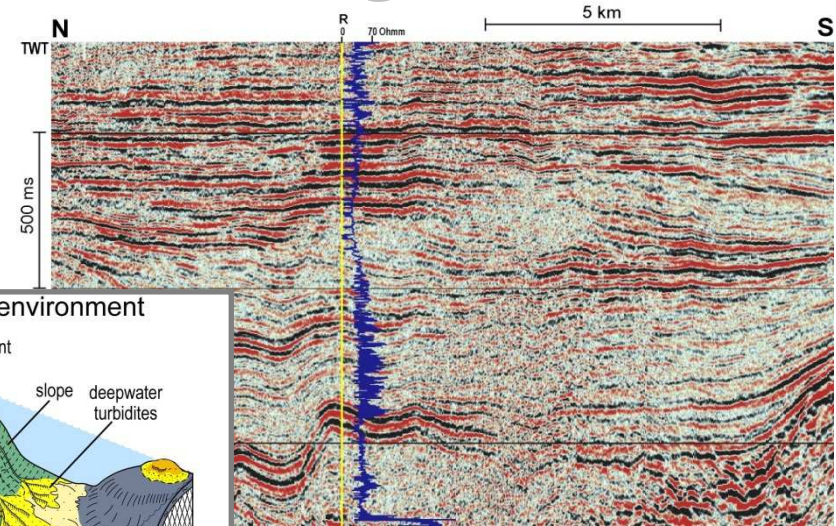
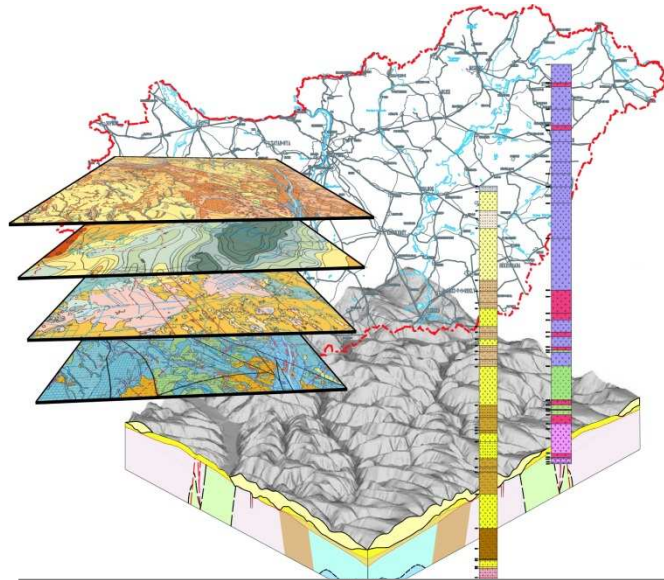
Temperature distribution of extracted thermal water



Changes due to production



Current status of investigation — Geological model



Determination of hydrostatic units

1. Pleistocene sediments
2. Upper Pannonian sediments
3. Lower Pannonian sediments / Post Sarmatian Miocene sediments
4. Sarmatian sediments
5. Badenian sediments
6. Palaeogene formations
7. Post Triassic Mesozoic formations (delineation of Upper Cretaceous limestones)
8. Triassic karstic limestone and dolomite complex
9. Fractured crystalline basement

Hydrogeological models



Supra regional model

- Identification of main flow systems and their connections
- Characterization of regional hydrogeological processes
- Boundary condition determination for the scenario models

1:500 000

Model calibration

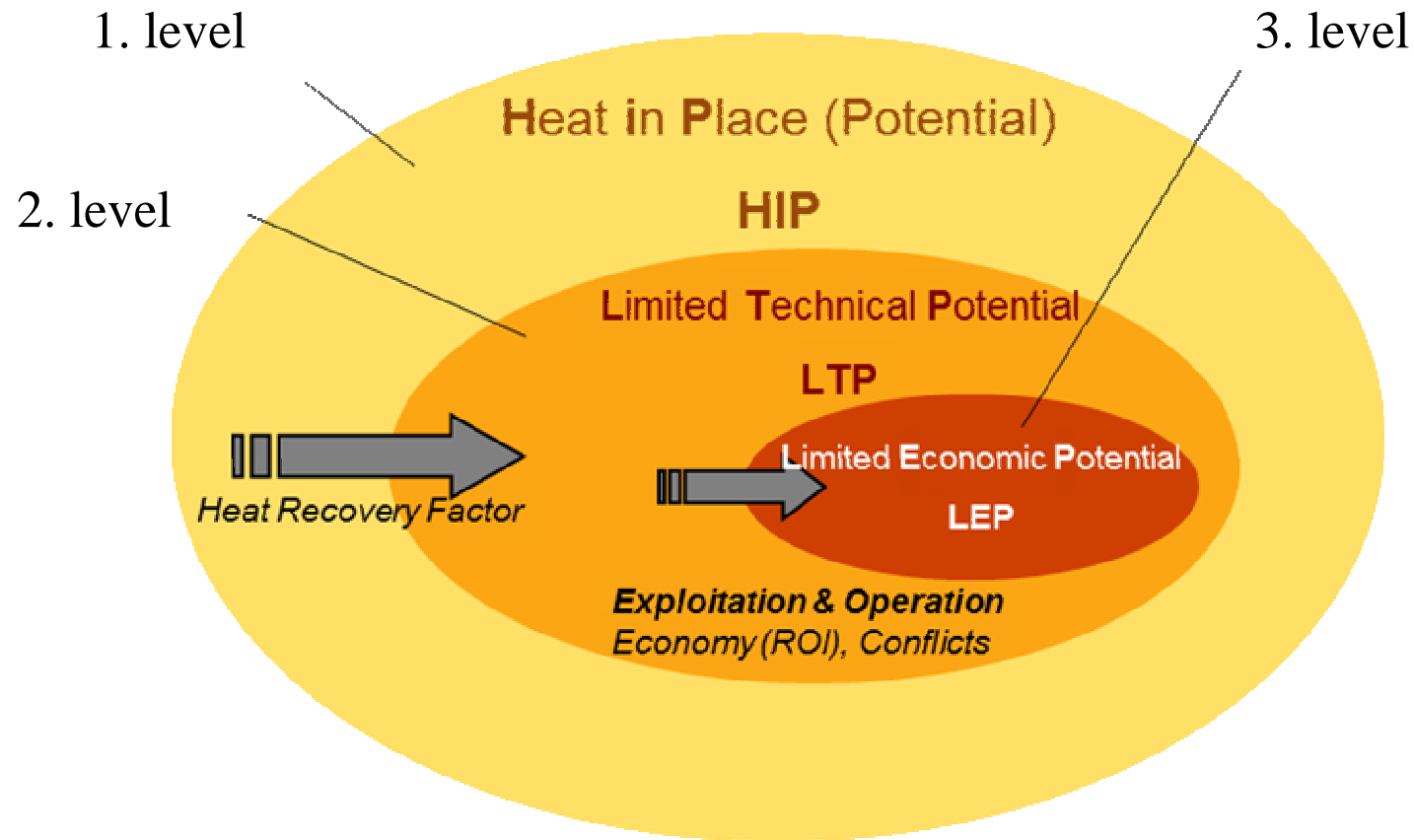
Chemical and isotope data
Monitoring data (spatial, temporal changes)
Production data

Scenario models

- Survey of cross border hydrogeological issues
- Predictive modelling of the applications of different technologies
- Predictive modelling of different levels of thermal water use

1:100 000; 1:200 000

Geothermal models



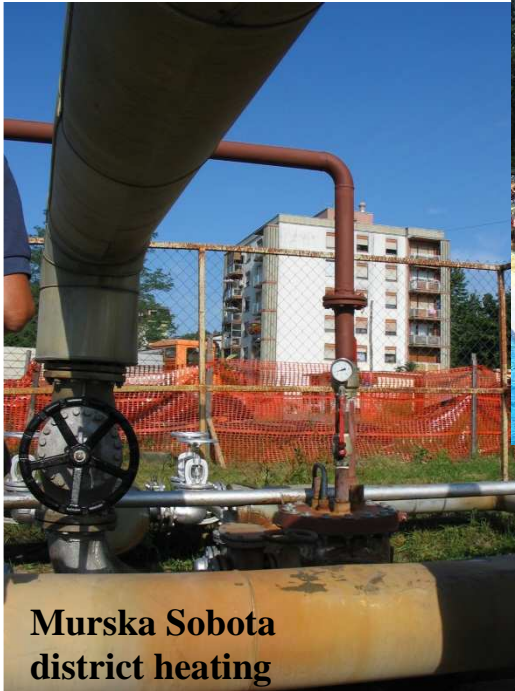
Concluding remarks

- Present utilization of geothermal energy is still far below its potential, synergies with water management should be in focus
- Only harmonized, multi-national management strategies can lead to sustainable utilization of transboundary (groundwater, geothermal) resources; good status maintenance, achievement

Transenergy project

assessment of 5 transboundary pilot areas in the W-ern Pannonian basin (SLO, AT, HU, SK)





**Murska Sobota
district heating**



Bük – spa

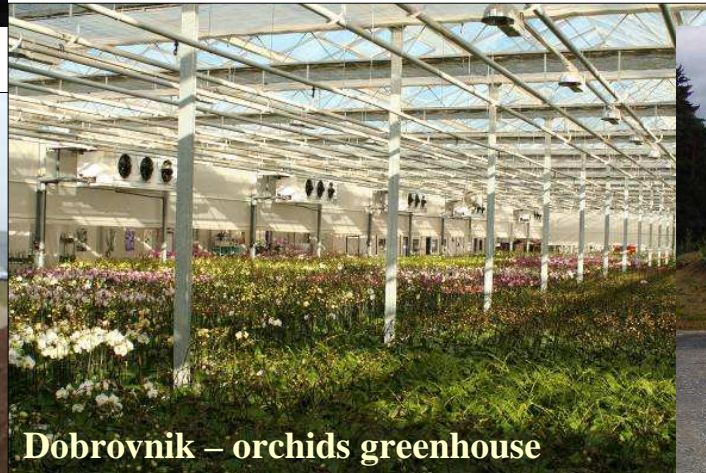


Moravske Toplice – spa

Thank you for your attention!



Lendava – de-icing



Dobrovnik – orchids greenhouse



Blumau – ORC electricity facility



<http://transenergy-eu.geologie.ac.at>

Utilization concepts

single well thermal water extraction – balneology (re-injection is not possible due to contamination)

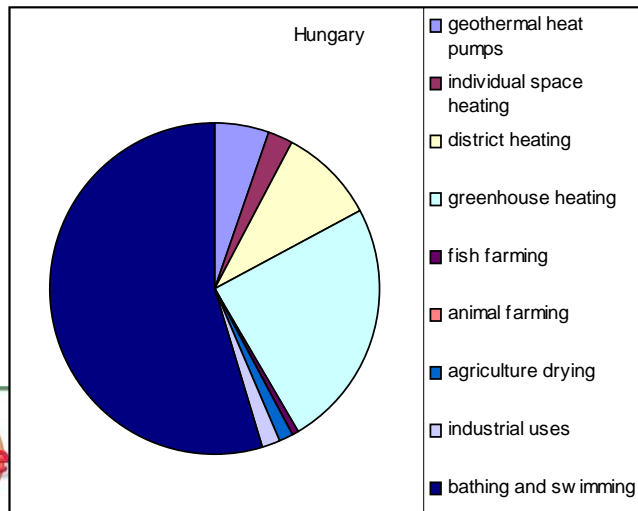
geothermal doublets: production - reinjection wells (energetic purposes)

Benefits

- increased flow rates
- optimum heat recovery
- maintenance of pressure
- land subsidence control
- disposal of the cooled brine

Drawbacks

- „waste water” contamination of the aquifer (e.g. bacteria, gas, chemicals)
- premature cooling (thermal breakthrough) of production wells
- permeability impairment induced by particles



TJ/year	Hungary
geothermal heat pumps	518
individual space heating	232
district heating	930
greenhouse heating	2388
fish farming	44
animal farming	17
agriculture drying	123
industrial uses	159
bathing and swimming	5356
cooling / snow melting	0
total annual use	9767