

# Current and future trends in geothermal energy utilization in the western part of the Pannonian basin

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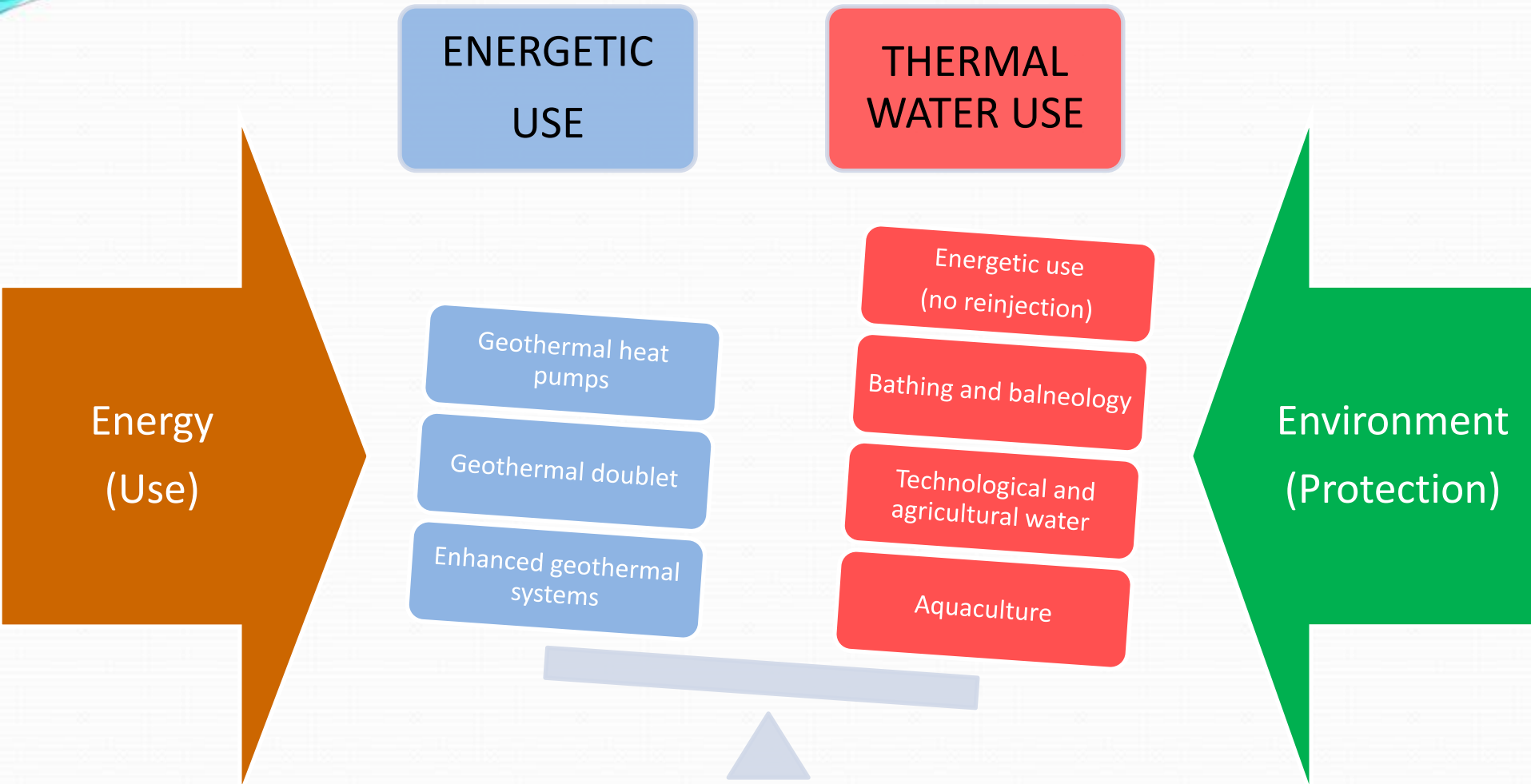
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<sup>4</sup> Geological Survey of Austria

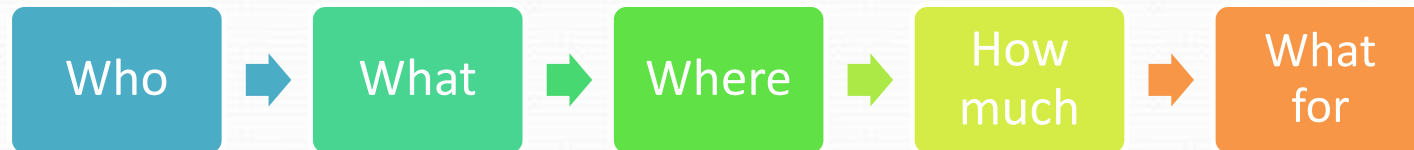


# Geothermal energy use



# Aims of this research

- recognition of the actual state of geothermal energy use (year 2010)
  - practice
  - issues
- identification of geothermal aquifers with indication on overexploitation
  - regional hydrogeological conditions
- enhance a sustainable geothermal energy utilization
  - potential



*Thermal water has the outflow temperature of **20°C or more.***

# Database of users

<http://akvamarin.geo-zs.si/users/>

Country:

Slovenia

Users:

Naravni park Terme 3000, Moravske Toplice

## ORGANIZATION LEVEL

ORGANIZATION

Commercial name

Country

Location

Level

Organization (Original)

Organization (English)

Web address

Address

Postcode

Post name

Telephone

Fax

Organization group

Comment

Google Maps

**TRANSENERGY**  
 Neodaj (eno - 117 ogledov)  
 Ustavljeno dne maj 16 | Ustvi anil - Posodobljeno dne maj 24  
 Oceniti ta zemljevid - Napišite komentar - KML

- Terme Lendava d.d.
- Grede Tešanovci d.o.o.
- Naravni park Terme 3000, Moravske Toplice, d.d.
- Komunala, Javno podjetje, d.o.o.
- Kotrman d.o.o.
- Nafta - Geoterm, d.o.o.
- Občina Benedikt
- Občina Destrnik
- Ocean Orchids, d.o.o.
- Občina Dobrovnik
- Panonska energtika, upravljanje z energijo d.o.o.
- Počitek – užitek, turistično podjetje d.o.o.
- Segrap d.o.o.
- Terme Maribor, d.d.
- Terme Pluj d.o.o.
- Unior Kovaška industrija d.d.
- Zdravilišče Radenci d.o.o.
- Zdravilišče Radenci d.o.o.
- Zdravilišče Rimska Čarda d.o.o.
- Zvezda Diana d.o.o. - v stečaju
- Asia Resort Linsberg Betriebs GmbH
- Bad Radkersburcer Quellen GmbH

[Click to view](#)

Place of water release

Comment

taken by other user

Ledava stream, Greenhouse Tešanovci

# Interactive webmaps

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

Wellbore database

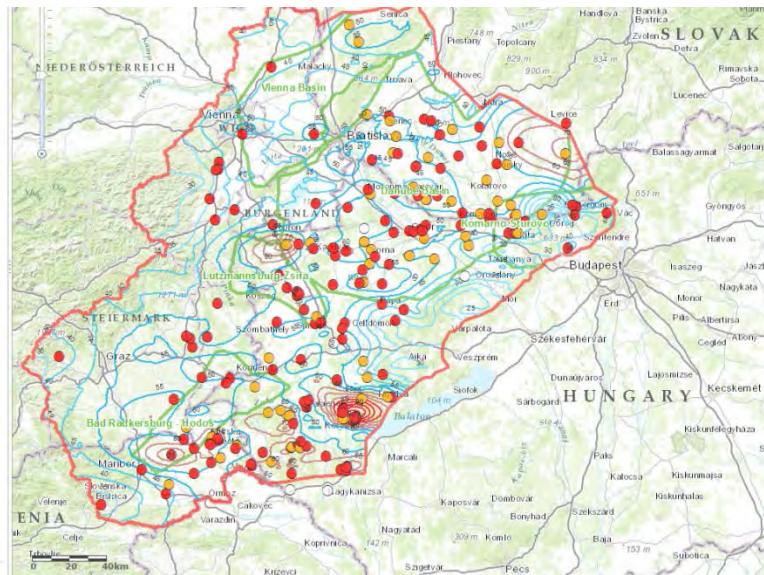
Geological maps

Utilization maps (status in 2011)

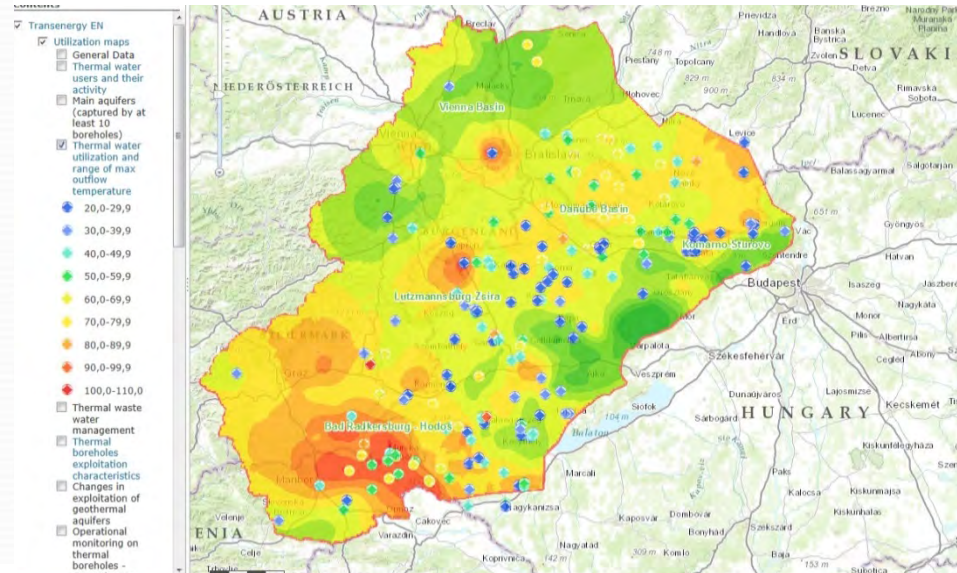
Geothermal maps

**Combination of layers**  
**!!! Scale !!!!**

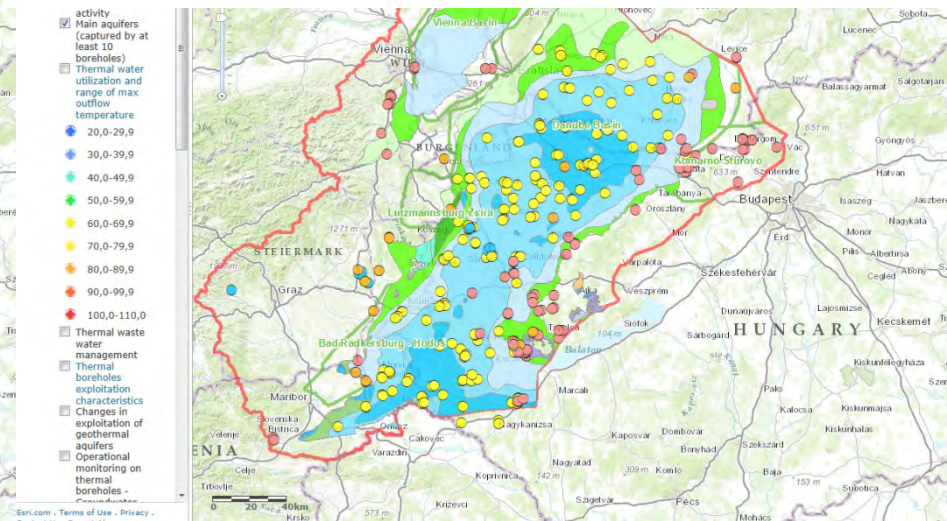
Temperature at 1000 m and thermal water users



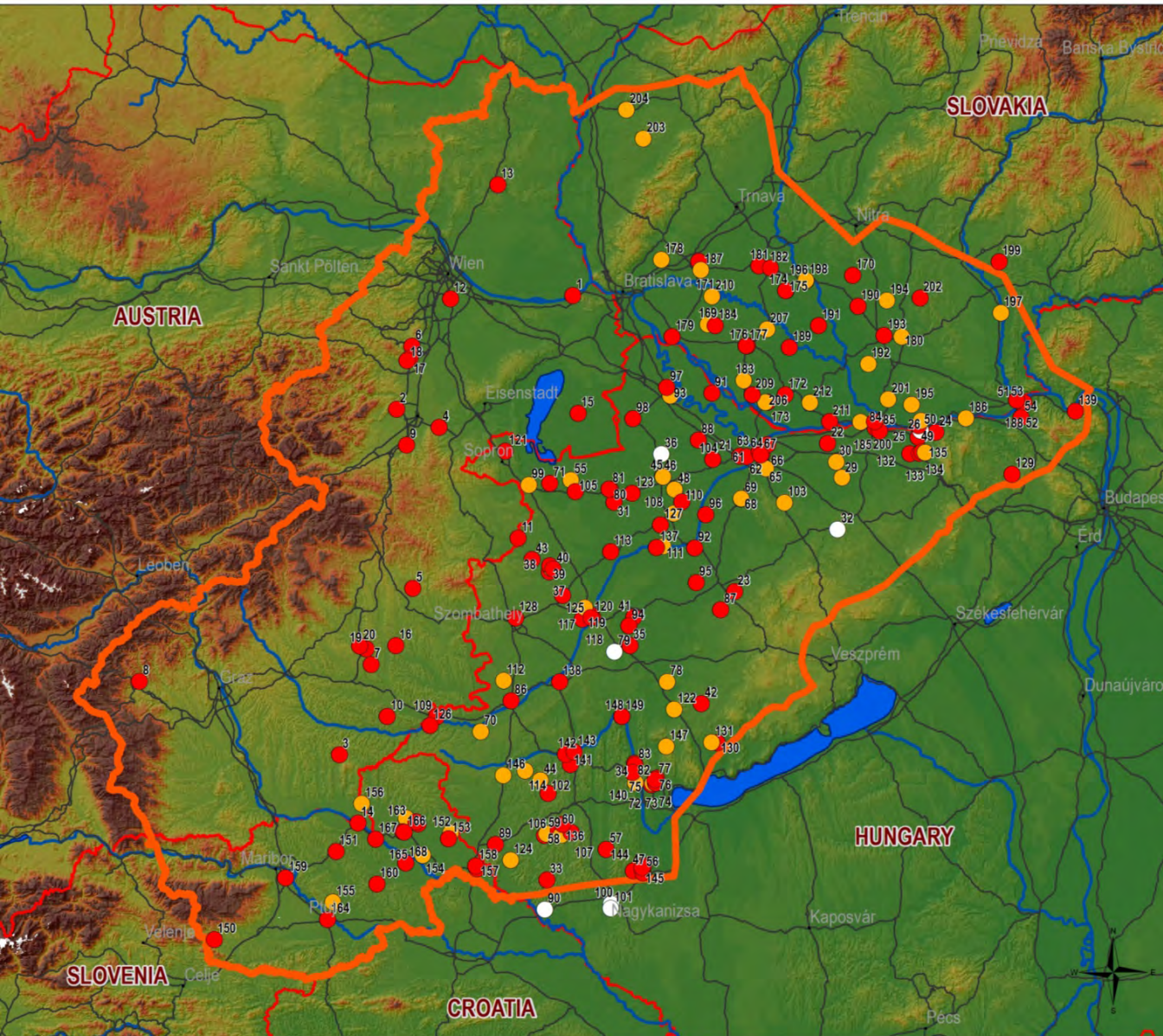
Thermal water temperature and surface heat flow density



Most tapped geothermal aquifers and extent of the Upper Miocene sand



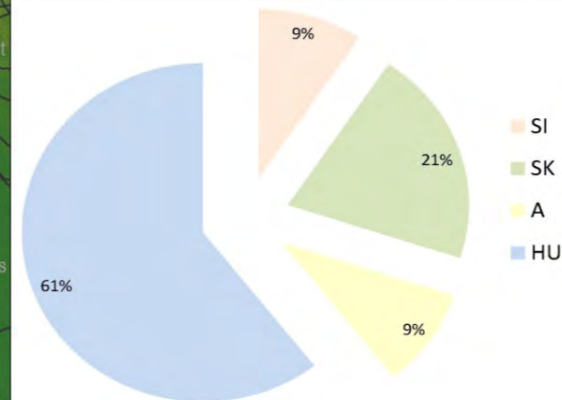
# Thermal water users and their activity



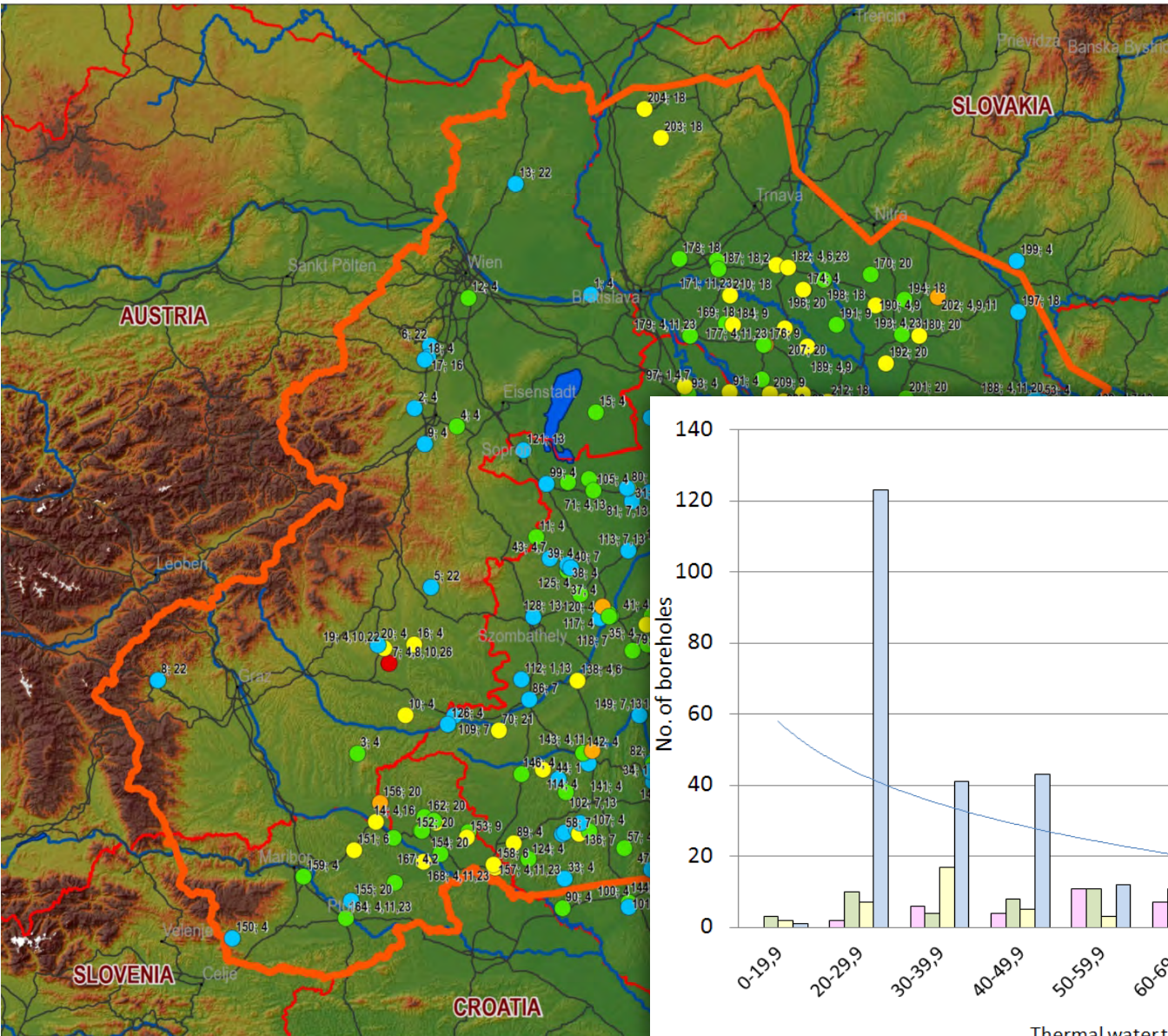
## User status

- active production
- no information
- potential user

|              | Users      | Boreholes  |
|--------------|------------|------------|
| Slovenia     | 20         | 35         |
| Slovakia     | 44         | 59         |
| Austria      | 20         | 48         |
| Hungary      | 129        | 259        |
| <b>Total</b> | <b>213</b> | <b>401</b> |

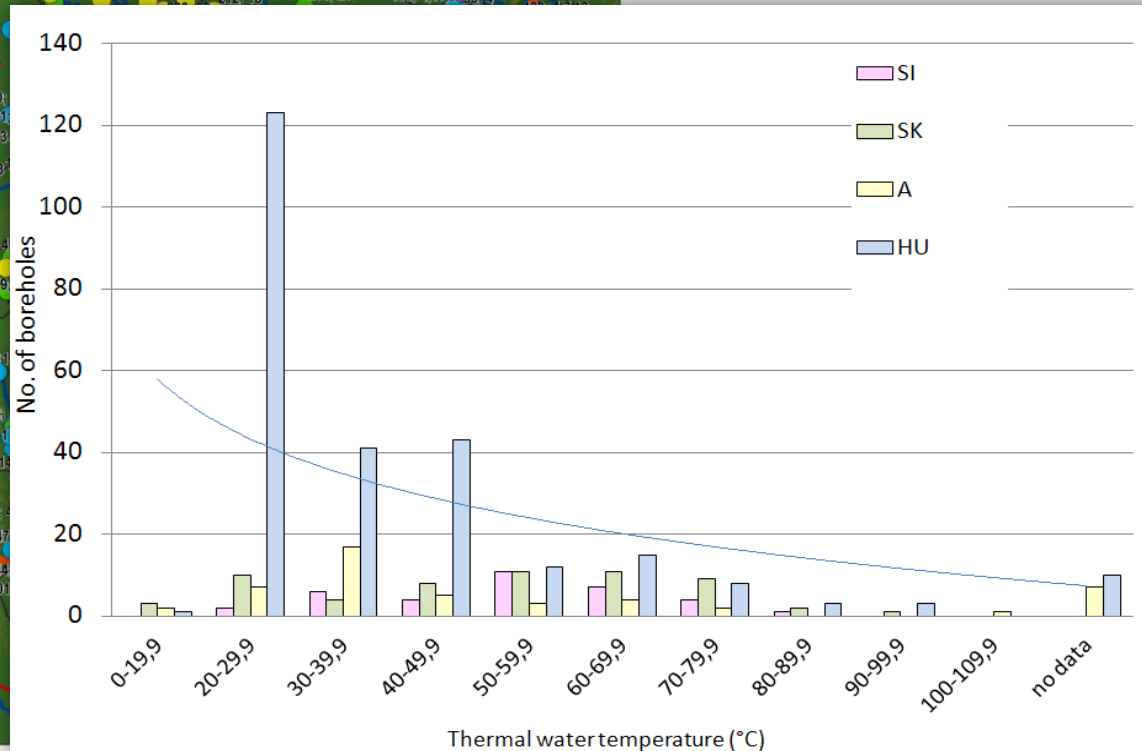


# Maximum outflow temperature and utilization types

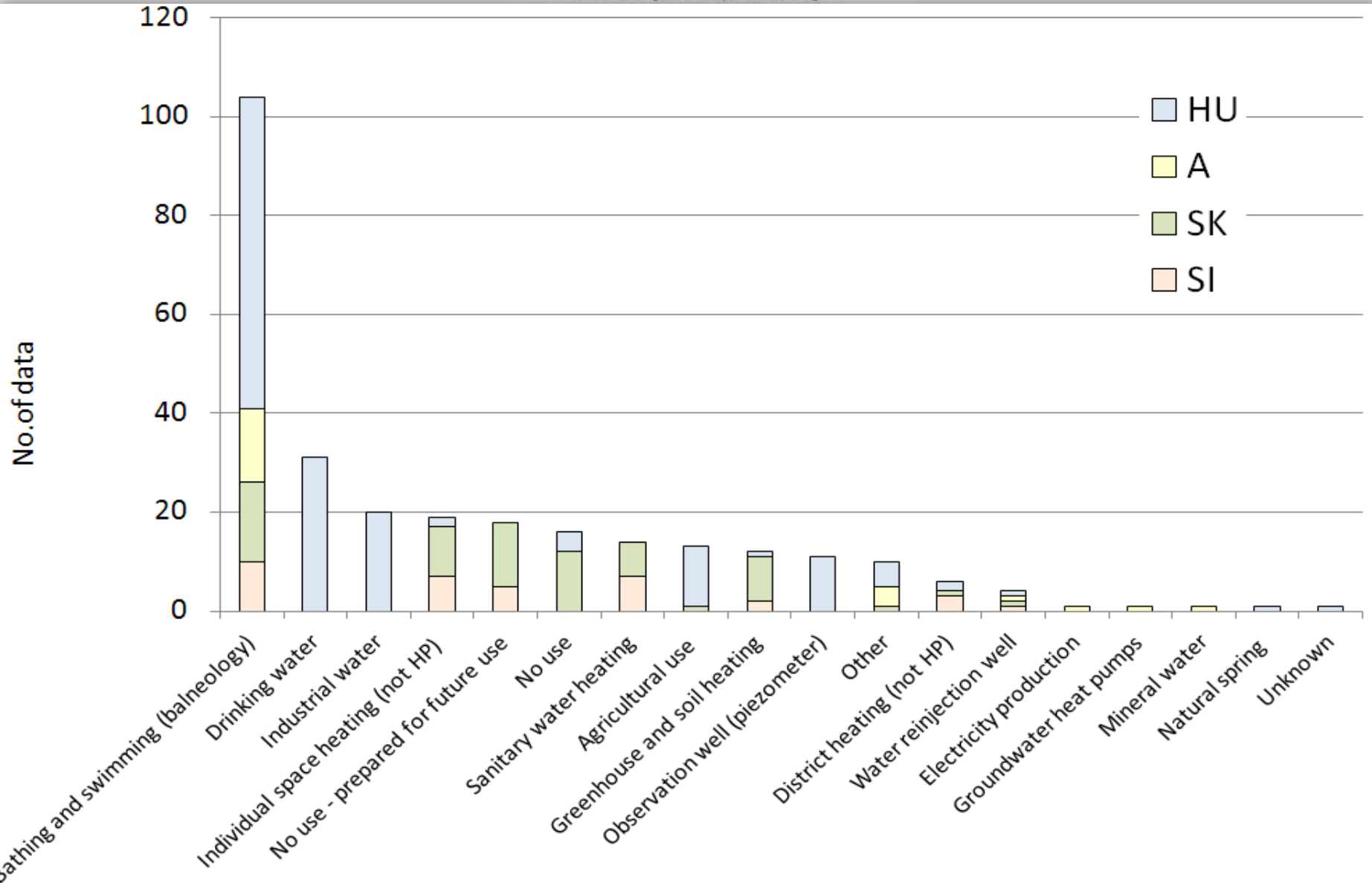


Maximum outflow temperature (°C)

- 20,0 - 39,9
- 40,0 - 59,9
- 60,0 - 79,9
- 80,0 - 99,9
- 100,0 - 110,0

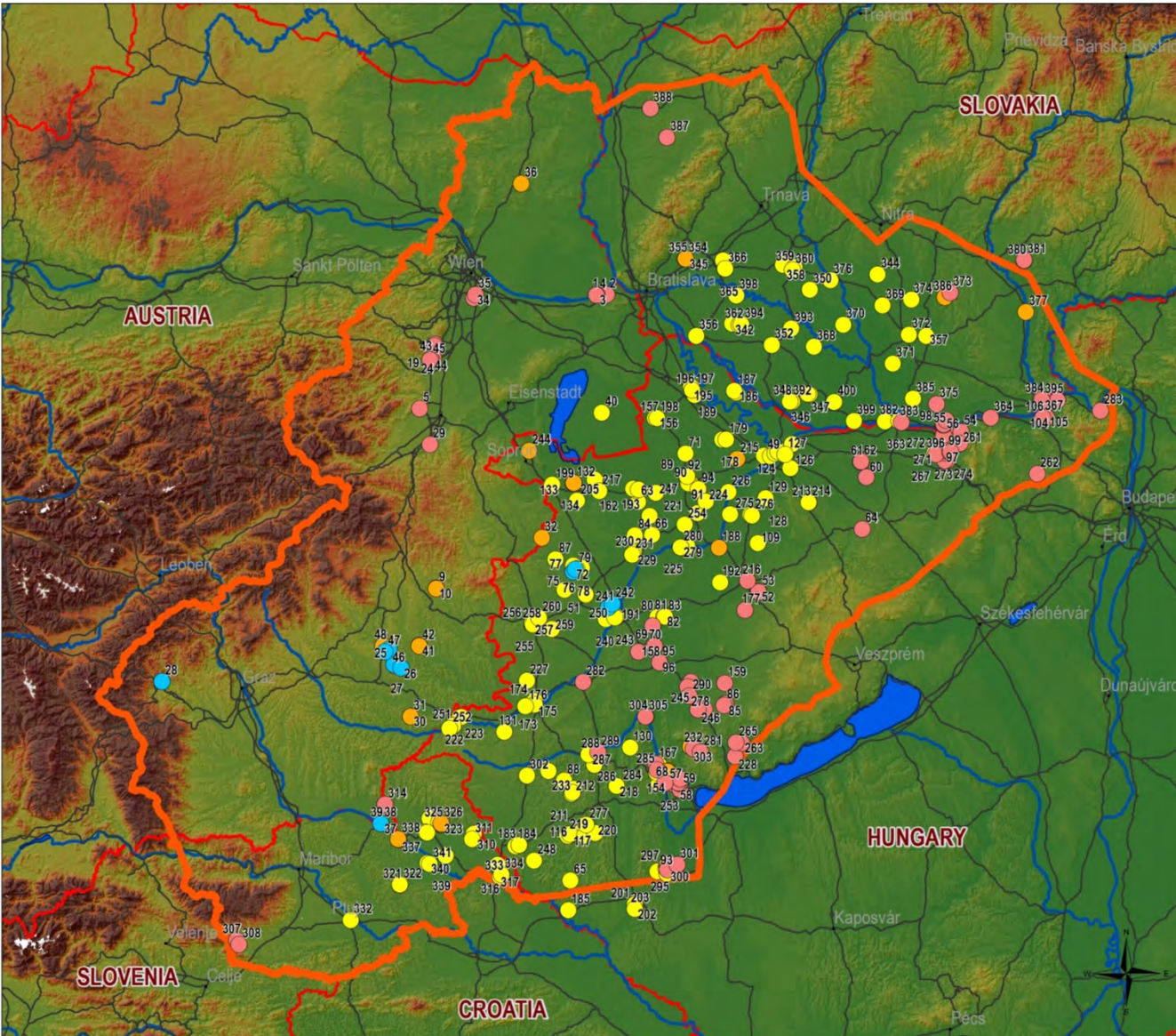


# Thermal water utilization





# Main geothermal aquifers (>10 boreholes)



## Main geothermal aquifer

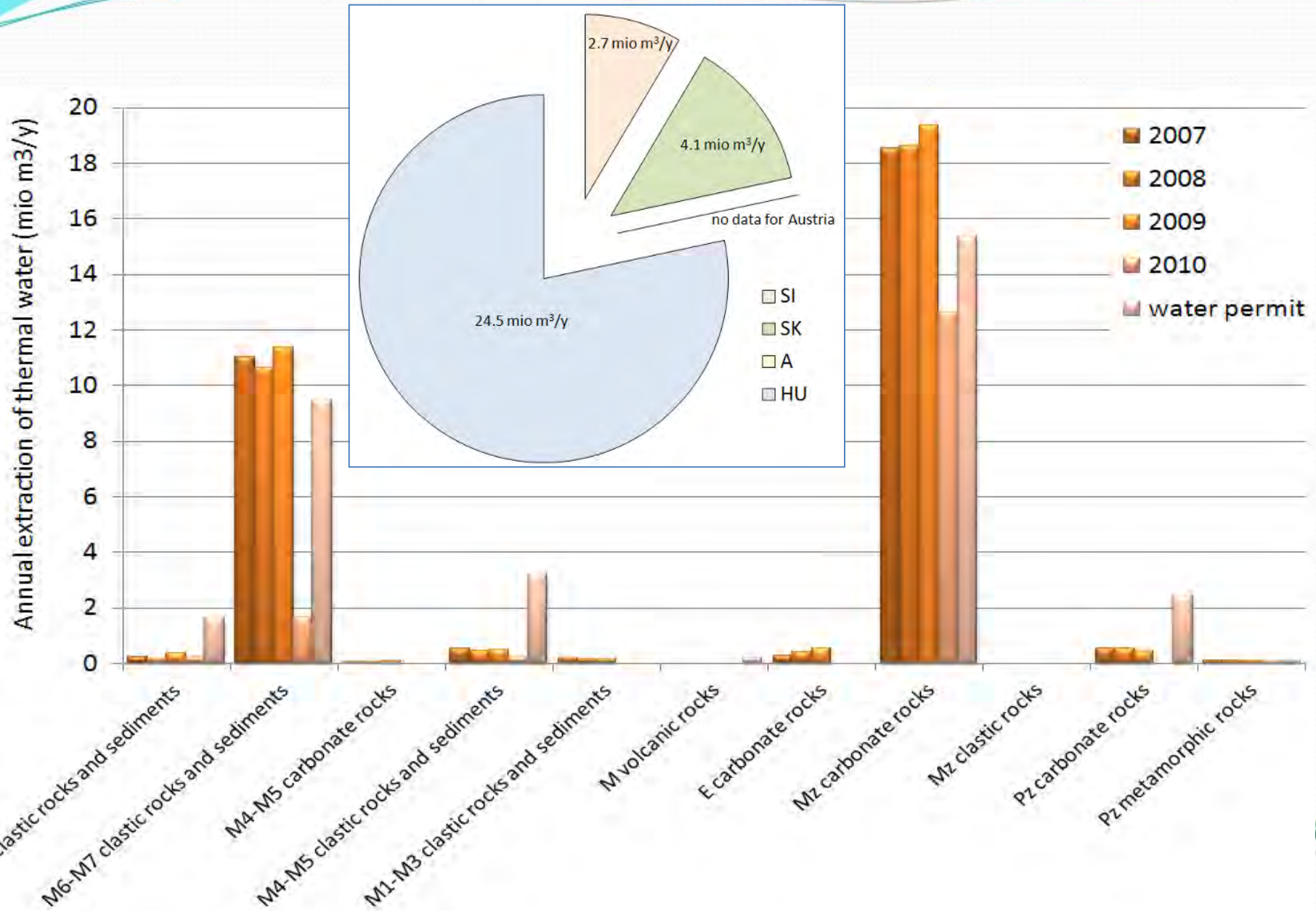
- M6-M7 clastic rocks and sediments
- M4-M5 clastic rocks and sediments
- MZ carbonate rocks
- PZ carbonate rocks

lots of **CO<sub>2</sub> gas**  
**carbonate scaling** →  
inhibitors

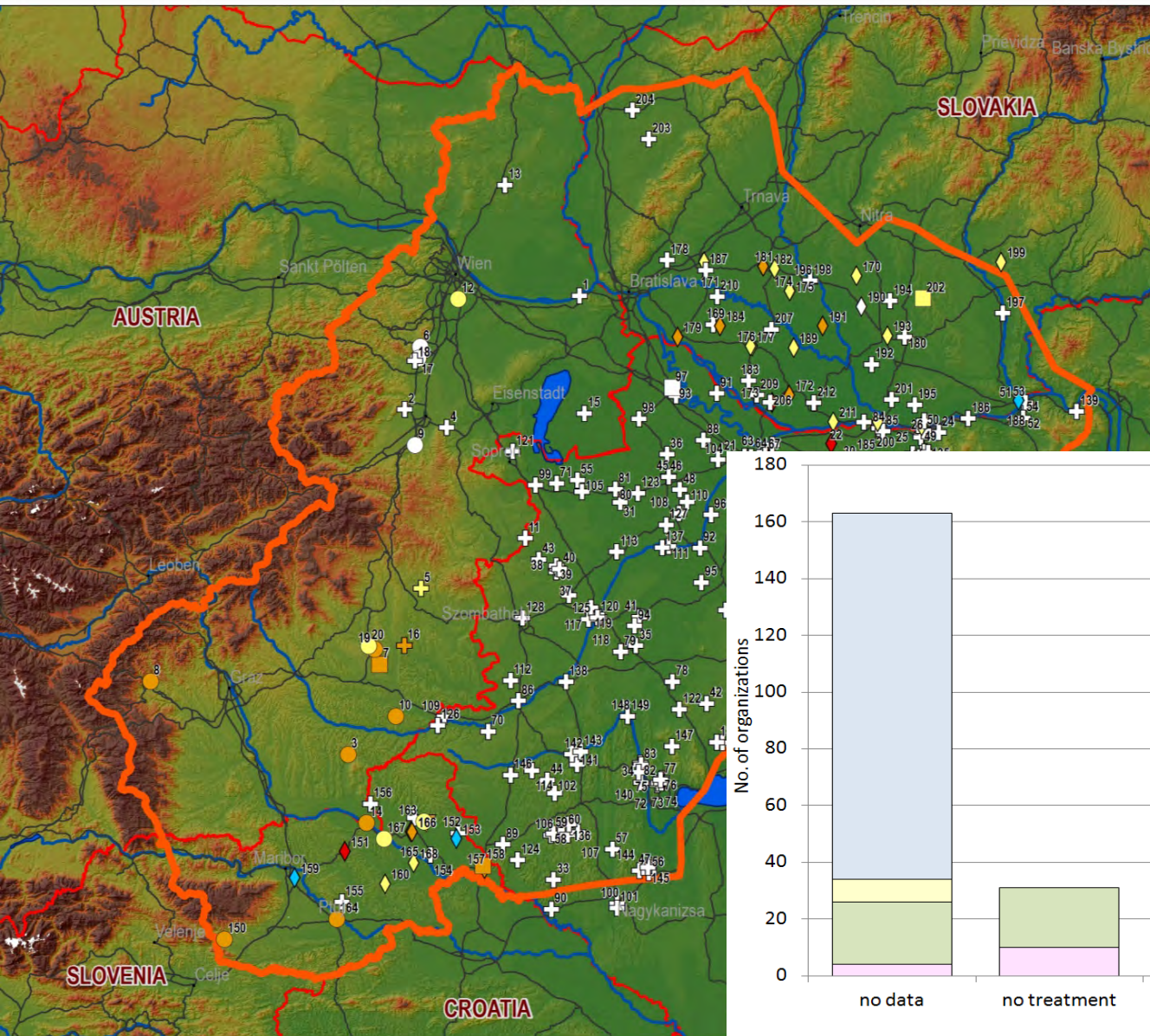
lots of **H<sub>2</sub>S gas** →  
no information on  
mitigation

high extraction rates →  
**pump failures** due to  
sand clogging

# Thermal water production



# Thermal waste water management

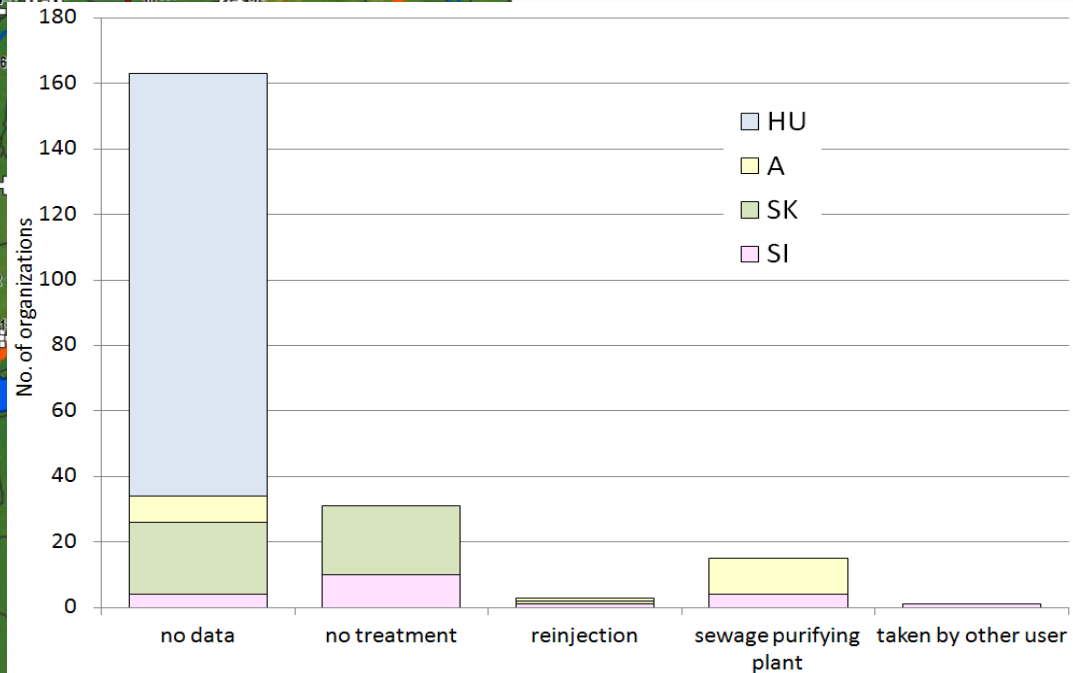


## Thermal waste water temperature (°C)

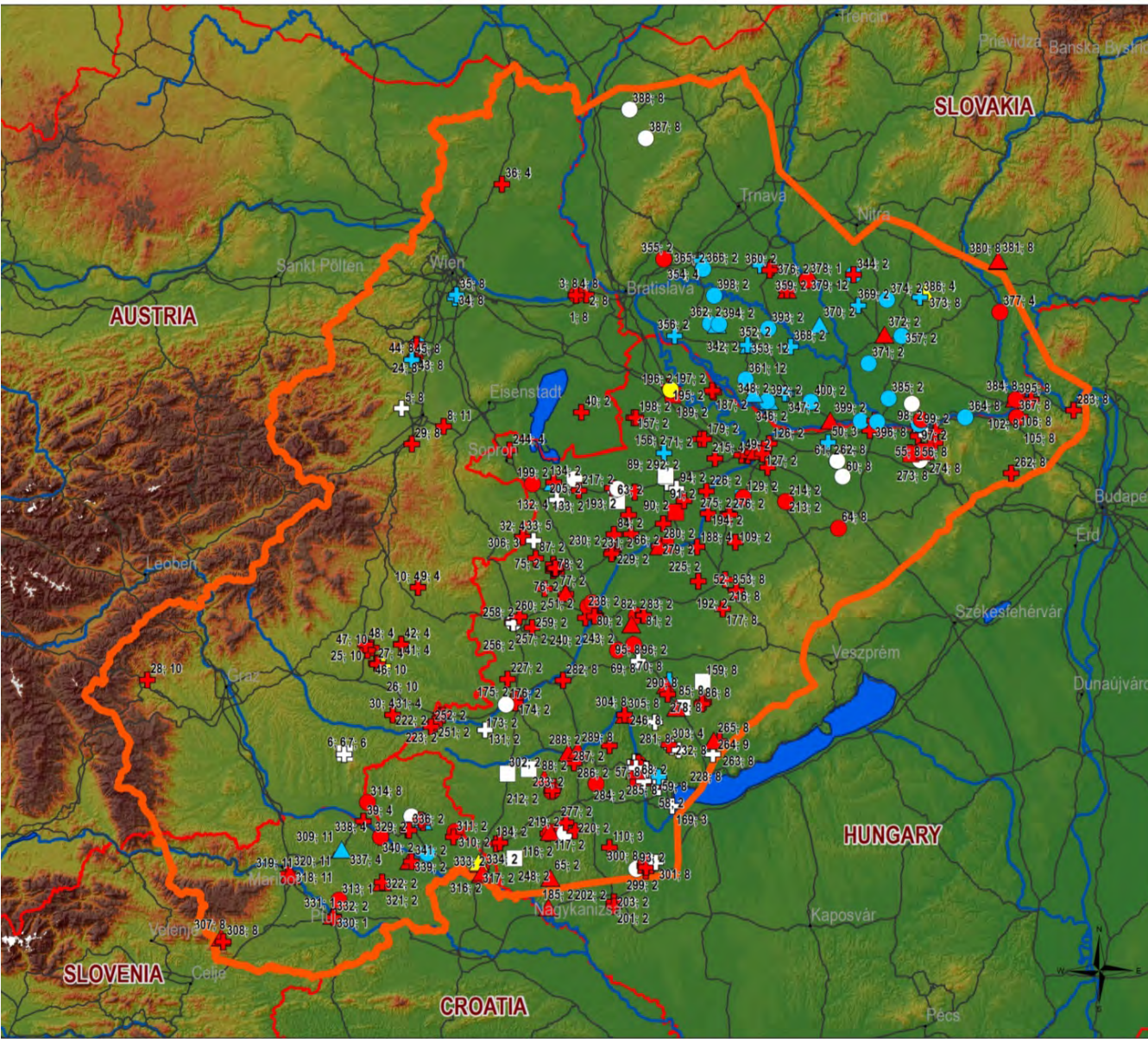
- no information
- 10,0 - 19,9
- 20,0 - 29,9
- 30,0 - 39,9
- 40,0 - 45,0

## Thermal waste water management

- seepage purifying or dechlorination plant
- ⊕ no information
- ◇ no treatment
- no treatment & reinjection
- ▽ no treatment & taken by other user



# Thermal boreholes exploitation characteristics

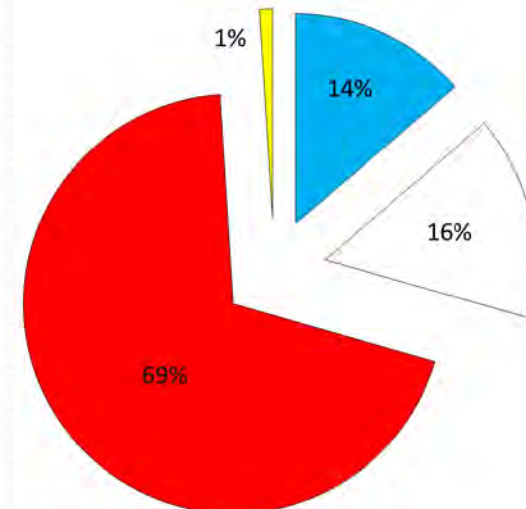


## Water production by

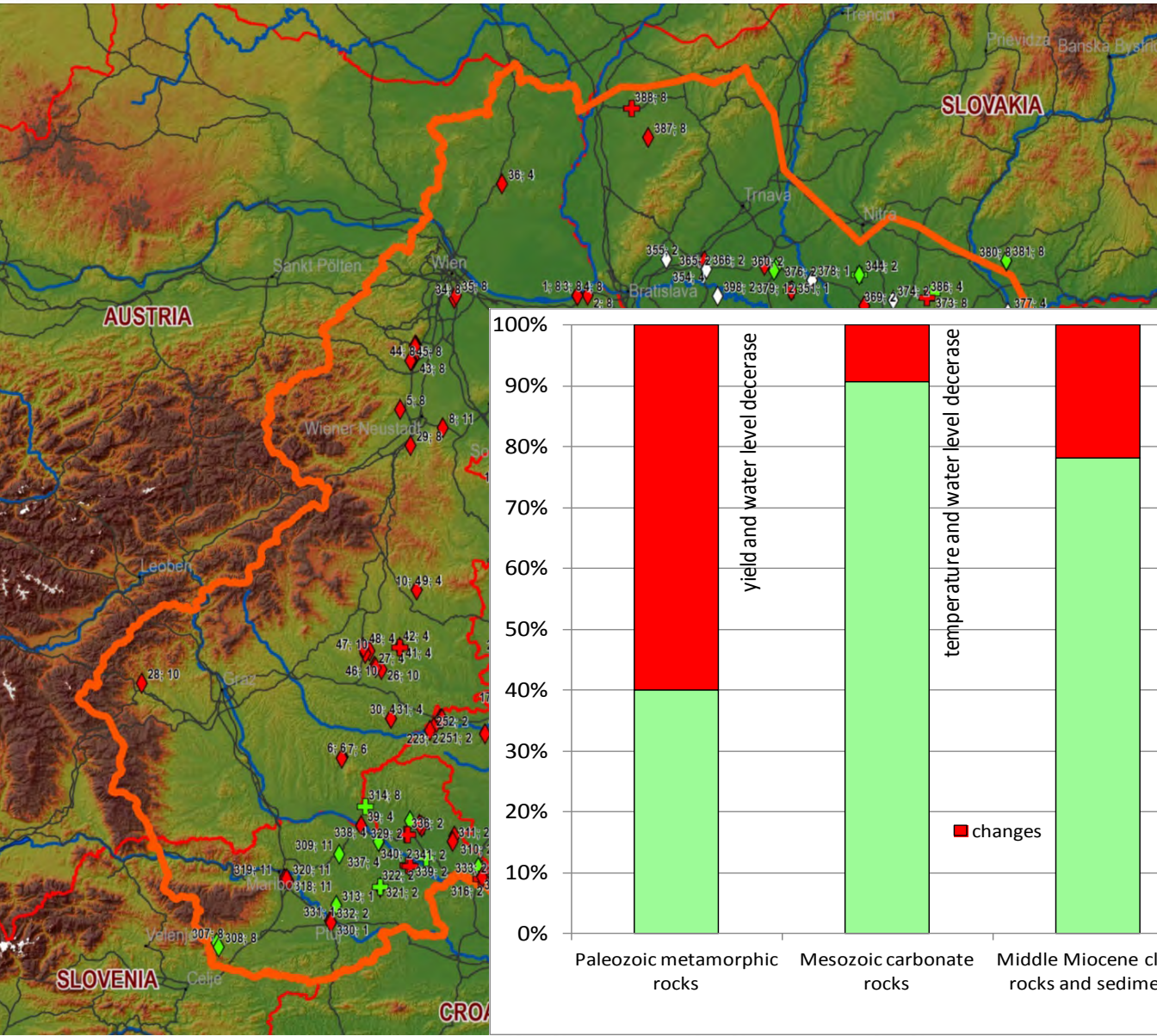
- natural outflow
- no information
- pumping
- reinjection

## Borehole activity

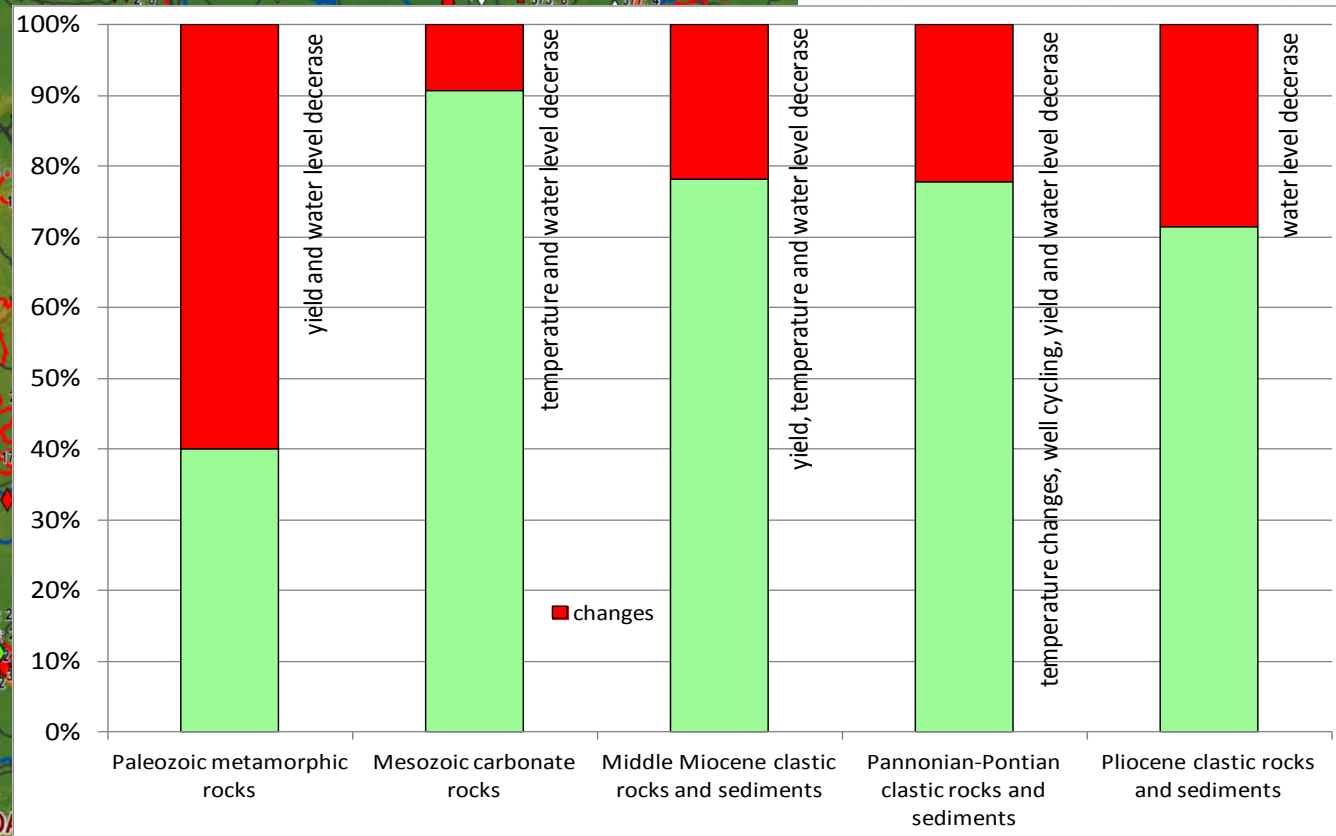
- constant
- inactive
- no information
- occasionally & periodically



# Changes in exploitation of geothermal aquifers



- Screened aquifer**
- ◇ single
  - ⊕ multiple
- Changes in well's operation**
- no
  - no information
  - yes



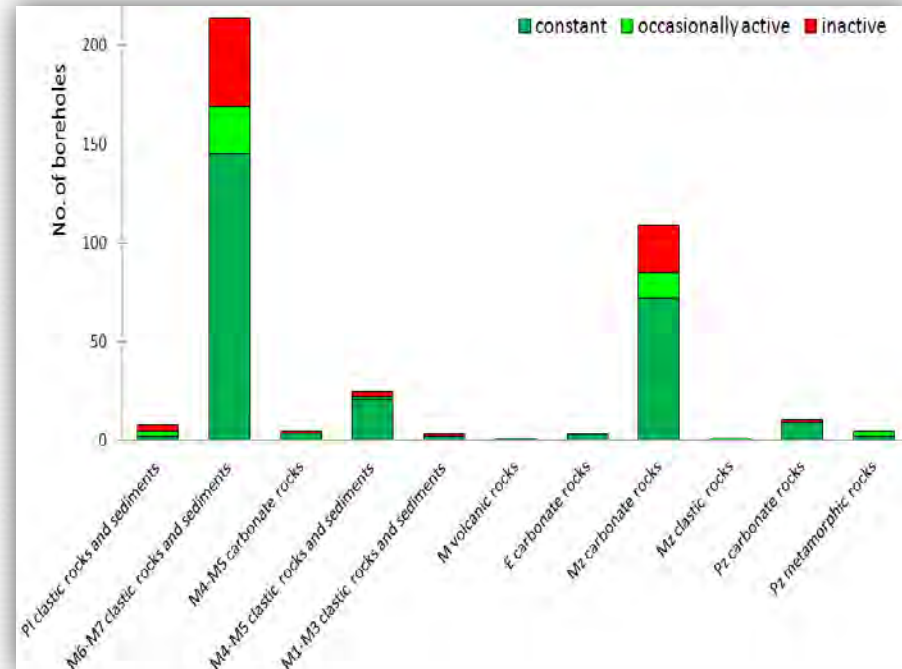
# Potential for future geothermal development

## Technical potential

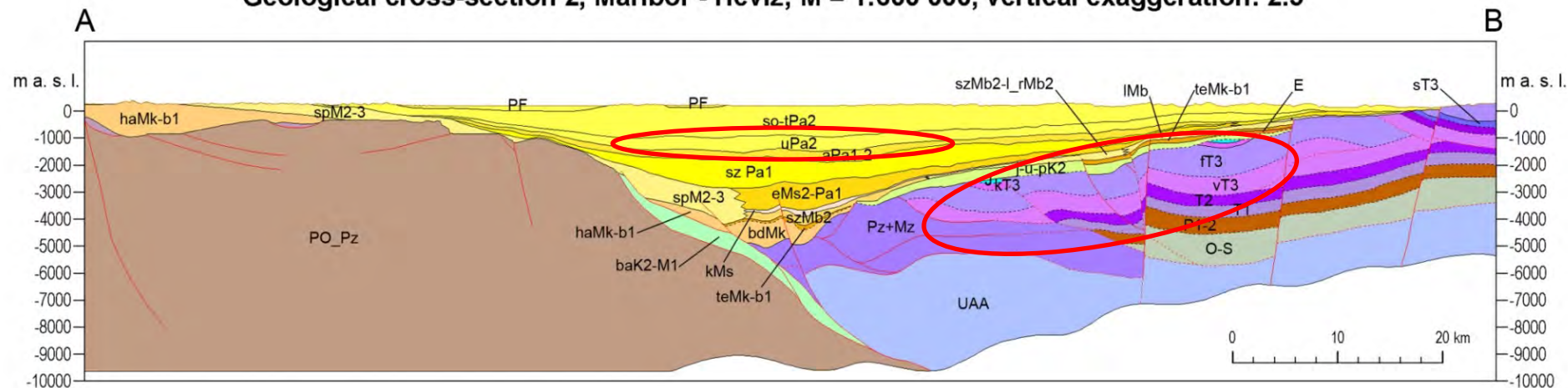
- 65 inactive users and 94 inactive wells  
+7 mio m<sup>3</sup> annually:  
Upper Miocene clastics: +2.8 million m<sup>3</sup> annually  
MZ carbonates: +1.7 million m<sup>3</sup> annually  
Others: app. + 2.8 million m<sup>3</sup> annually

## Hydrogeological potential

- regional and transboundary aquifers → interferences → numerical models

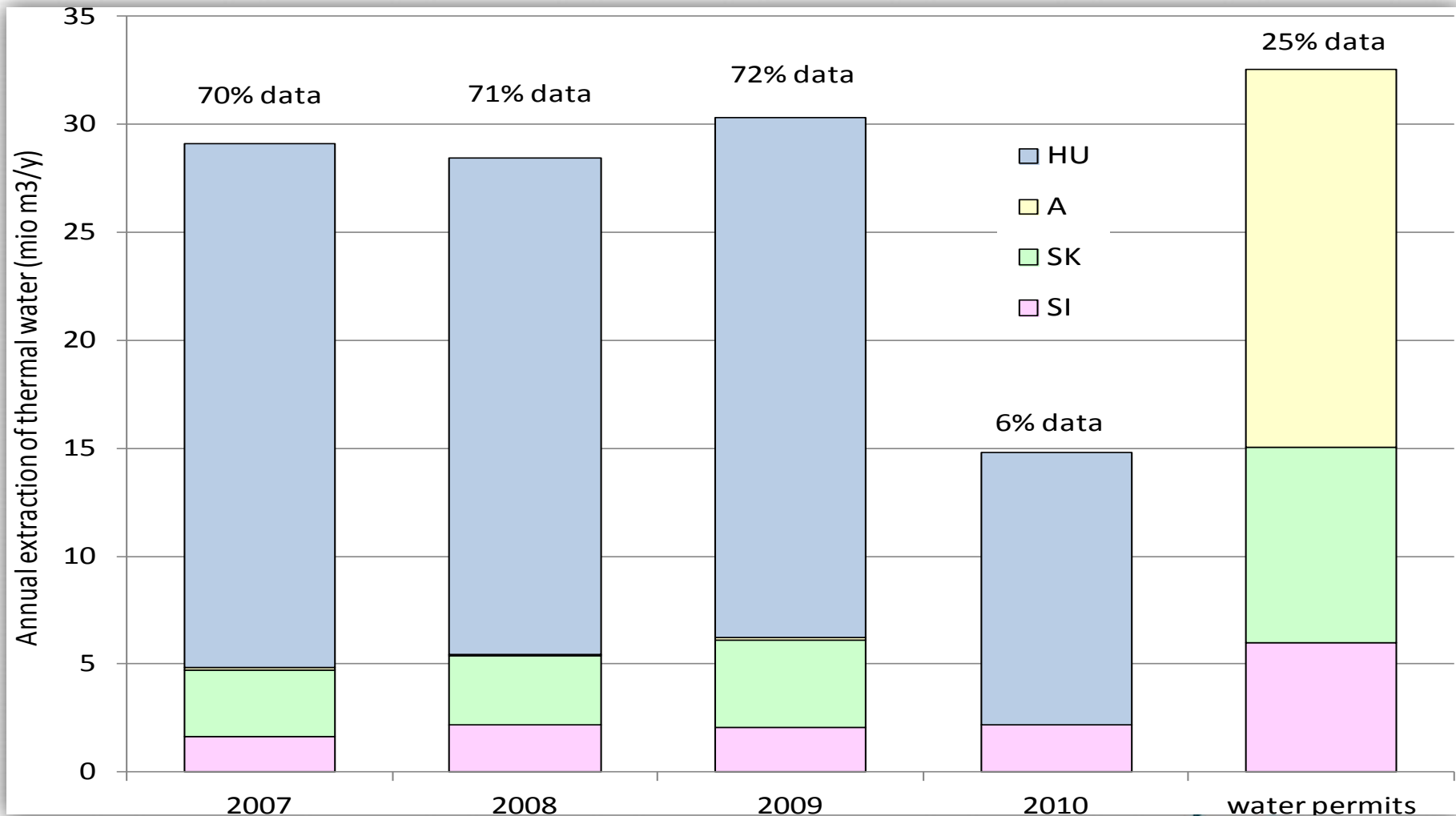


Geological cross-section 2, Maribor - Héviz; M = 1:600 000, vertical exaggeration: 2.5



# Legislative potential

- Granted water concessions (AT, SI, SK):  
**Double current production (excl. Austria):**  
+30 mio m<sup>3</sup> annually



# Conclusions

- **Utilization status in 2010**

- **148 (of 213) active users** with 307 (of 401) active wells in the TRANSENERGY area  
→ **bathing**, drinking water, heating, ....., electricity and reinjection

- extraction of **> 30 mio m<sup>3</sup>** thermal water annually (neglecting Austria)  
→ MZ carbonate aquifers & Upper Miocene clastic aquifers

- **monitoring** practices have been various, not systematic, with different effectiveness  
→ **hydraulic changes** have been observed regionally

- **waste water management** is not sufficient  
→ thermal and chemical pollution of surface waters  
→ only 3 reinjection wells have been operating

- **technical potential** (6 Mm<sup>3</sup>/y), legislative (30 Mm<sup>3</sup>/y), hydrogeological (probably limited)

*Supplementary information:*

**Database:** <http://akvamarin.geo-zs.si/users/>

**Reports and interactive webmaps:** <http://transenergy-eu.geologie.ac.at/>







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