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

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

TRANSENERGY- Transboundary geothermal energy resources in the Pannonian Basin

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supra-regional area (1:500 000)
5 cross-border pilot areas

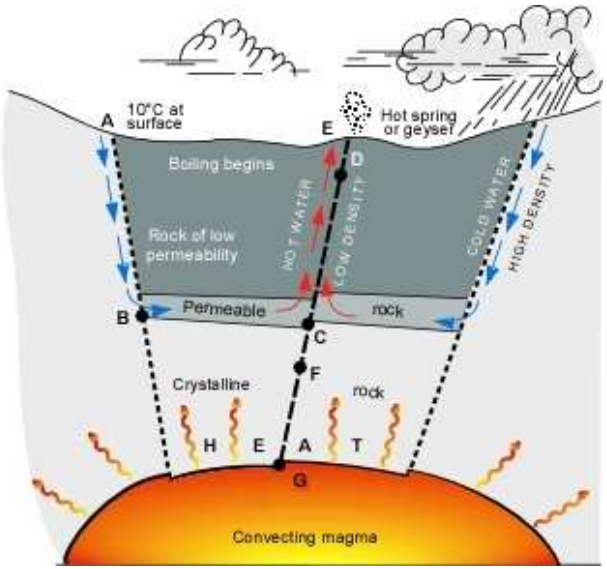
Final goal of Transenergy

A user friendly web-based decision supporting tool (interactive web portal), which transfers expert know-how about the geothermal potential and its sustainble utilization at the W-ern part of the Pannonian basin to decision makers, water- and mining authorities, present and potential investors („transboundary geotis, thermogis")

- thermal karst of Komarno-Sturovo area (HU-SK) 1:200 000
- central depression of the Danube basin (A-SK-HU) 1:200 000
- Lutzmannsburg – Zsira area (A-HU) 1:100 000
- Vienna basin (SK-A) 1:200 000
- Bad Radkersburg – Hodoš area (A-SLO-HU) 1:200 000

Transenergy focus (1)

„Classical" convectional hydrogeothermal systems (HSA play)

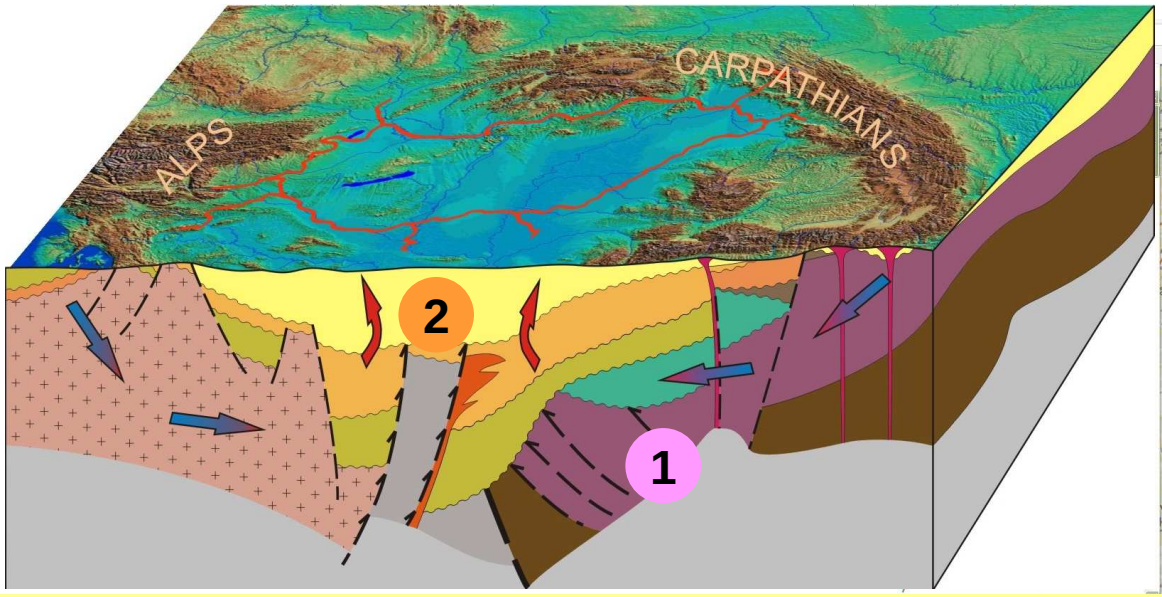


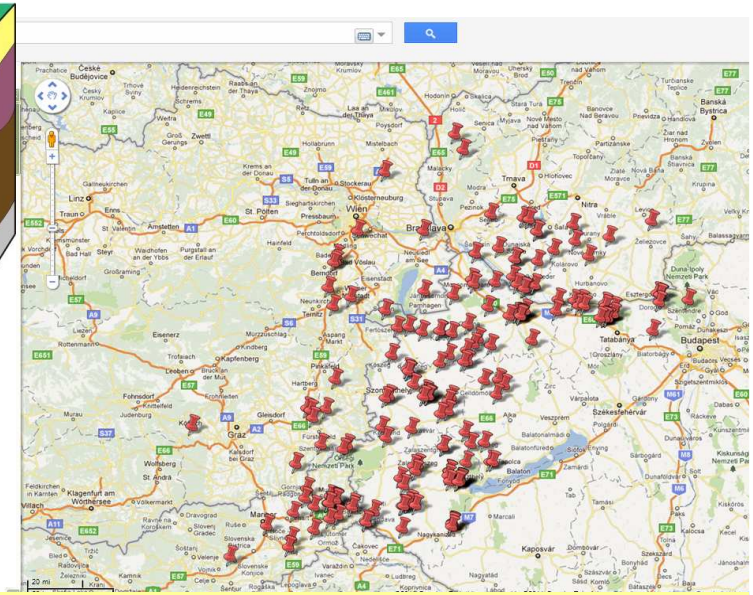
1) To determine the abstractable amount of thermal water which the natural recharge re-supplies → balneology: single well thermal water production – re-injection is not possible du to contmination

2) Promote production – reinjection doublets→ direct heat and power production

Shallow geothermal systems (GSHP) are not part of Transenergy

Transenergy focus (2) - Transboundary approach





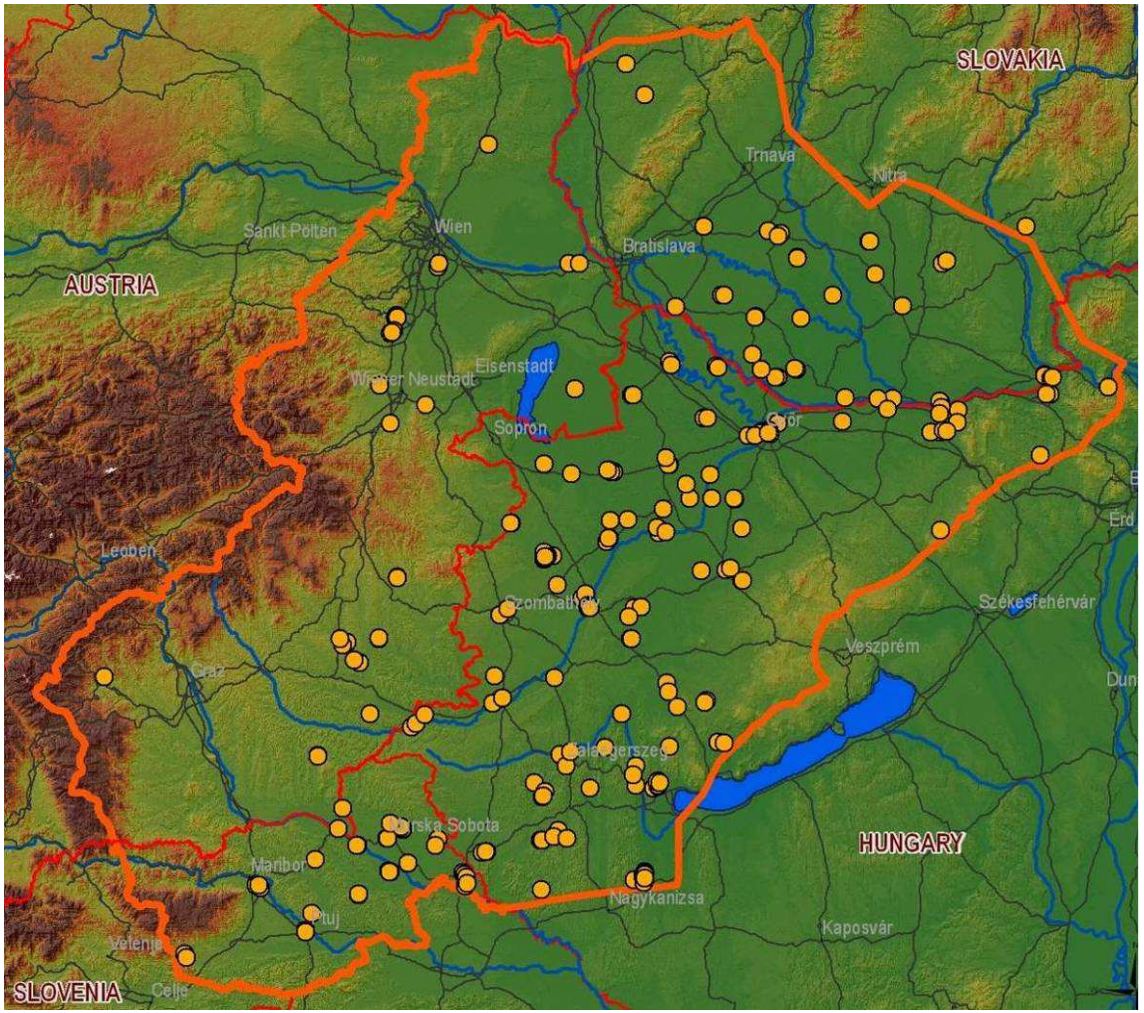
Majority of the users exploit the same reservoirs in the transboundary regions without harmonized management strategies between the neighbouring countries

Main geothermal reservoirs	1. fractured, karstified basement rocks (Palaeozoic-Mesozoic)	2. porous multi-layered sandstones, shales (Upper Miocene-Pliocene basin fill)
thickness (m)	80-100 (upper part)	100-200 (within up to 6000)
depth, temperature	>2500 m, >100-120 ℃	800-2000 m, ~60-80 ℃
porosity	< 5%	20-30%

Utilization aspects

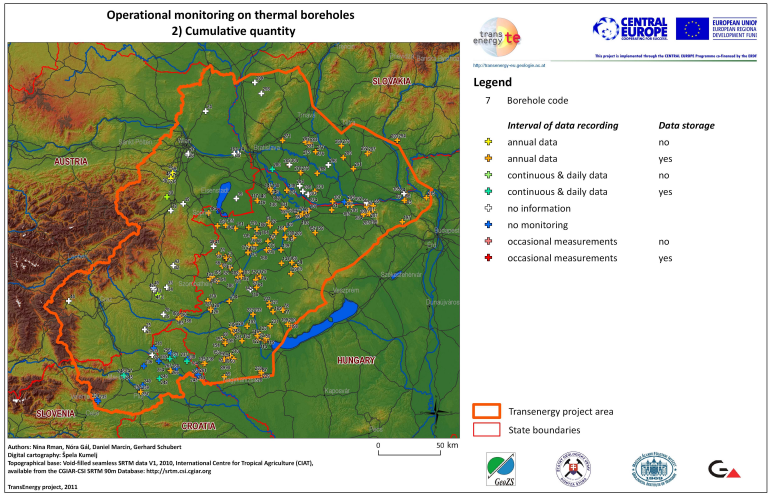
	Organi-zations	Forma-tions	Boreholes
SLO	23	27	35
SK	28	31	39
AT	20	26	50
HU	104	131	184
Total	175	215	308

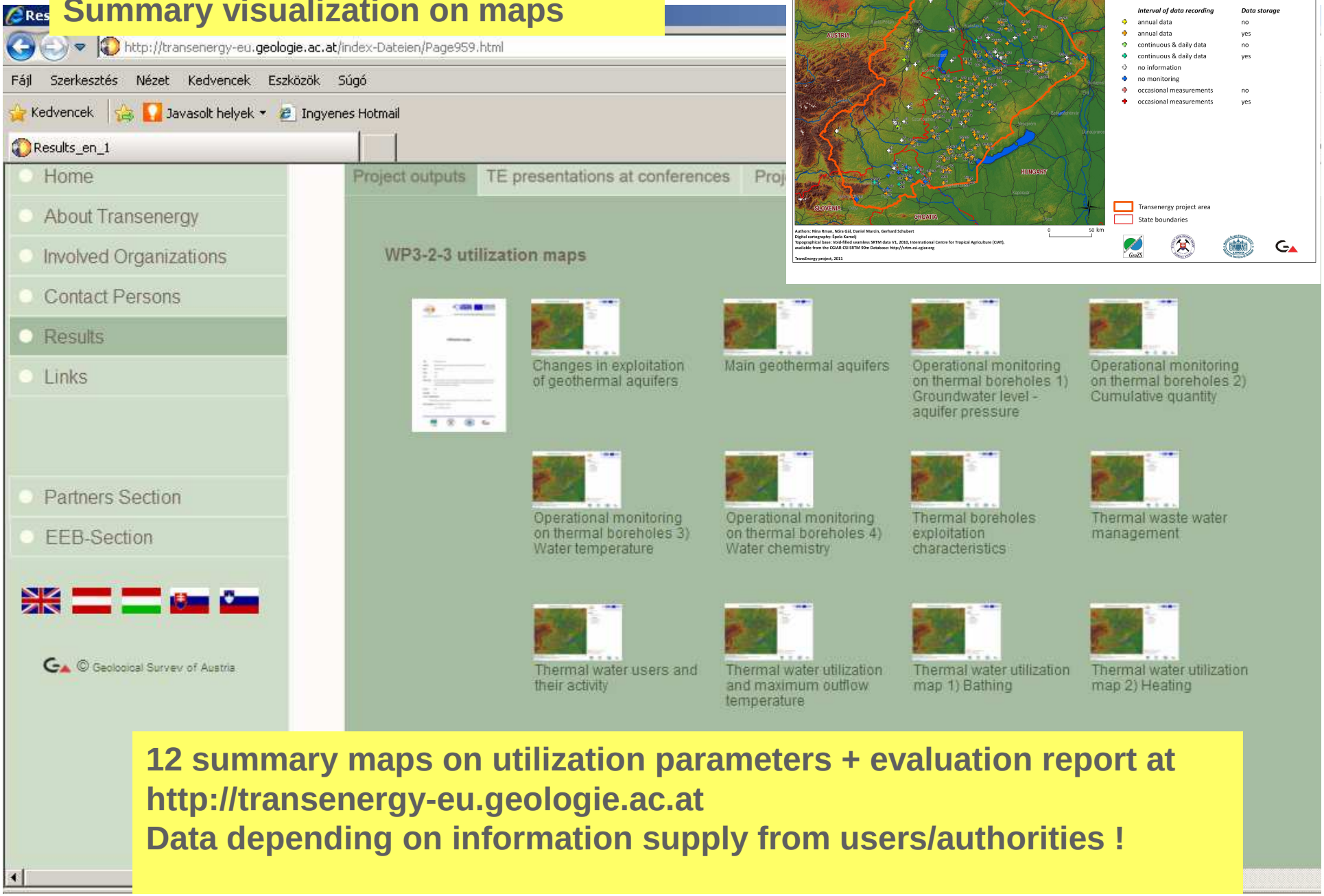
Users' database online



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

Utilization parameters – confidential
Summary visualization on maps

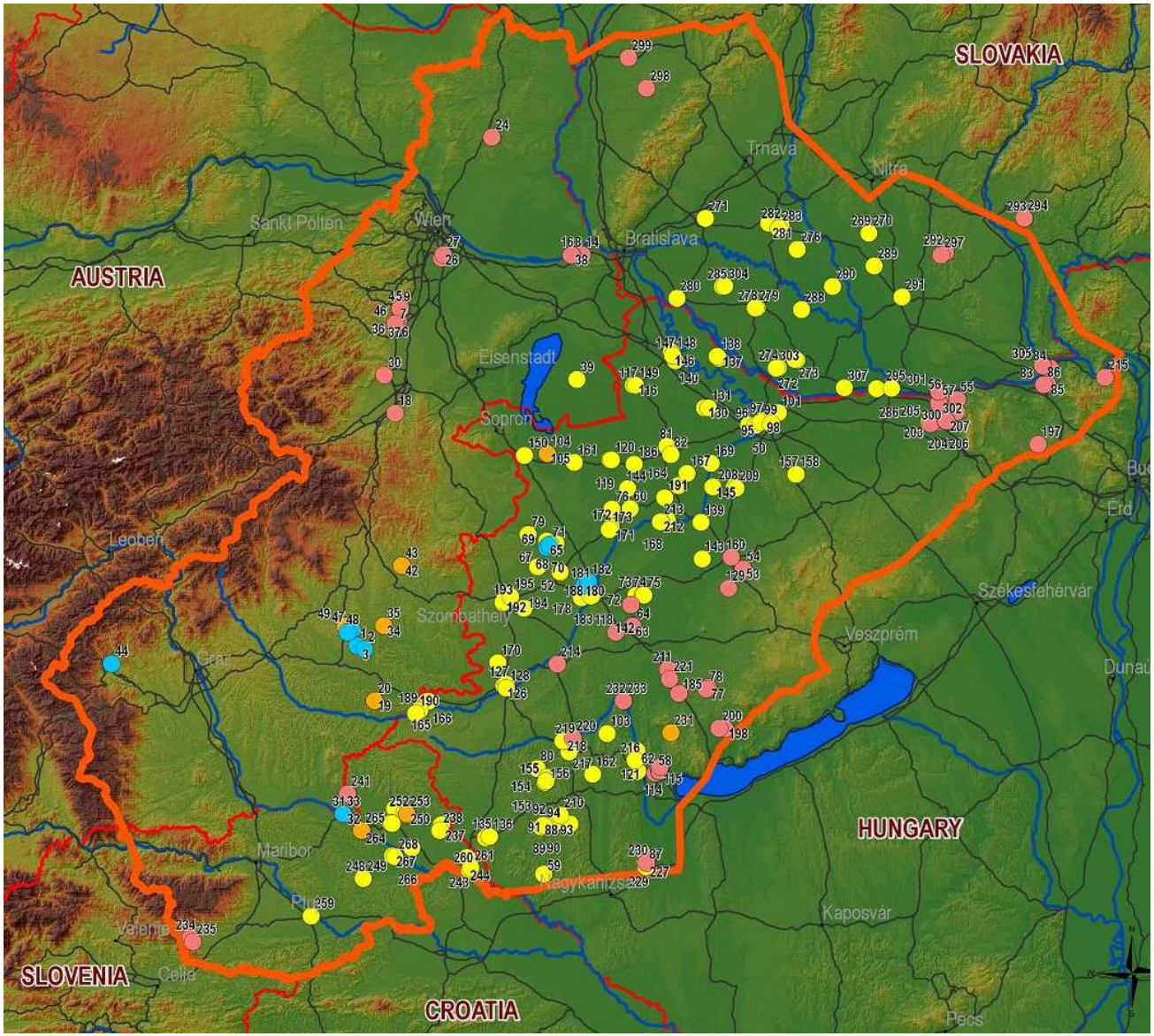




12 summary maps on utilization parameters + evaluation report at http://transenergy-eu.geologie.ac.at

Data depending on information supply from users/authorities !

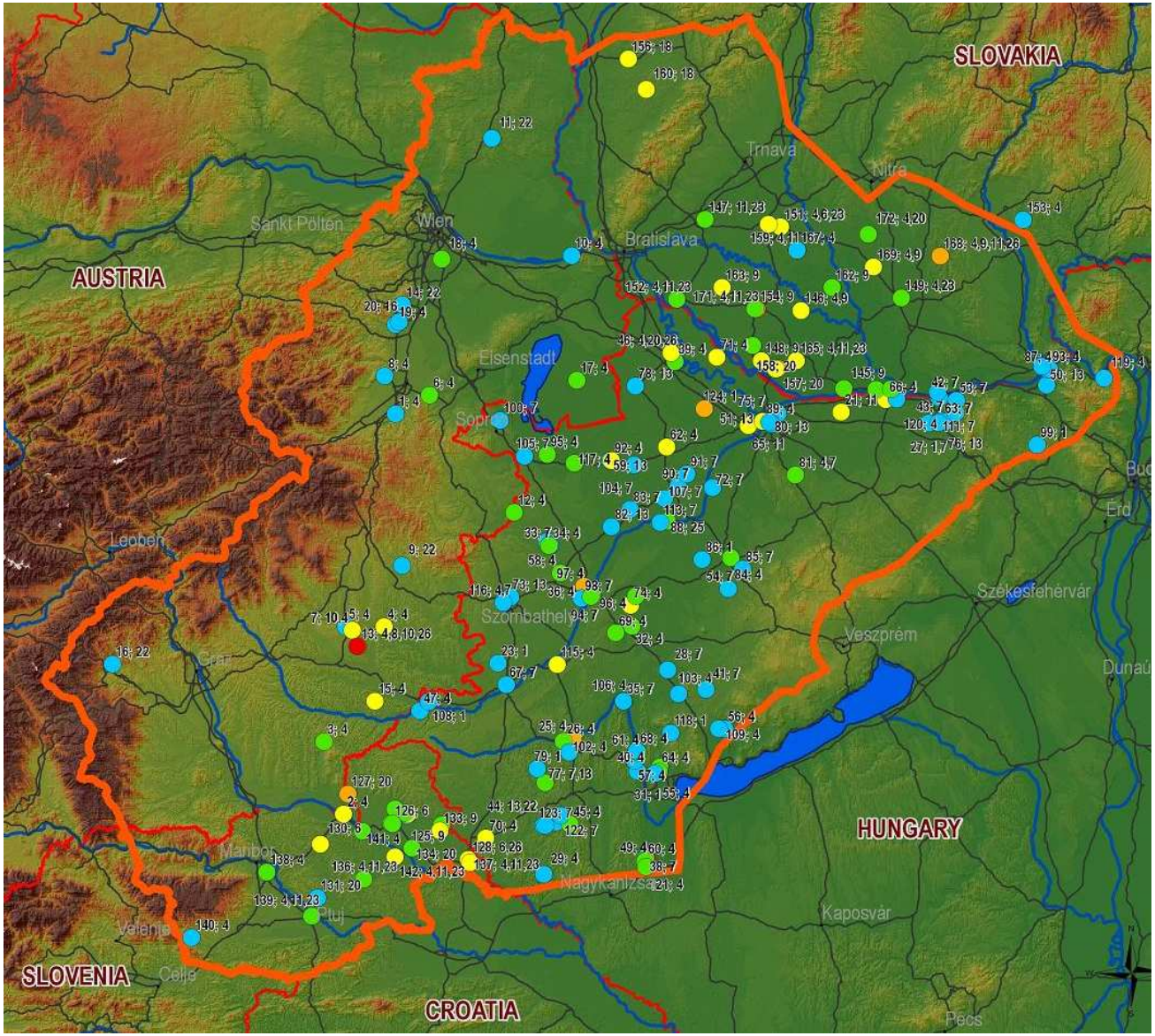
Main geothermal aquifers



Main geothermal aquifer

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

Maximum outflow temperature and utilization

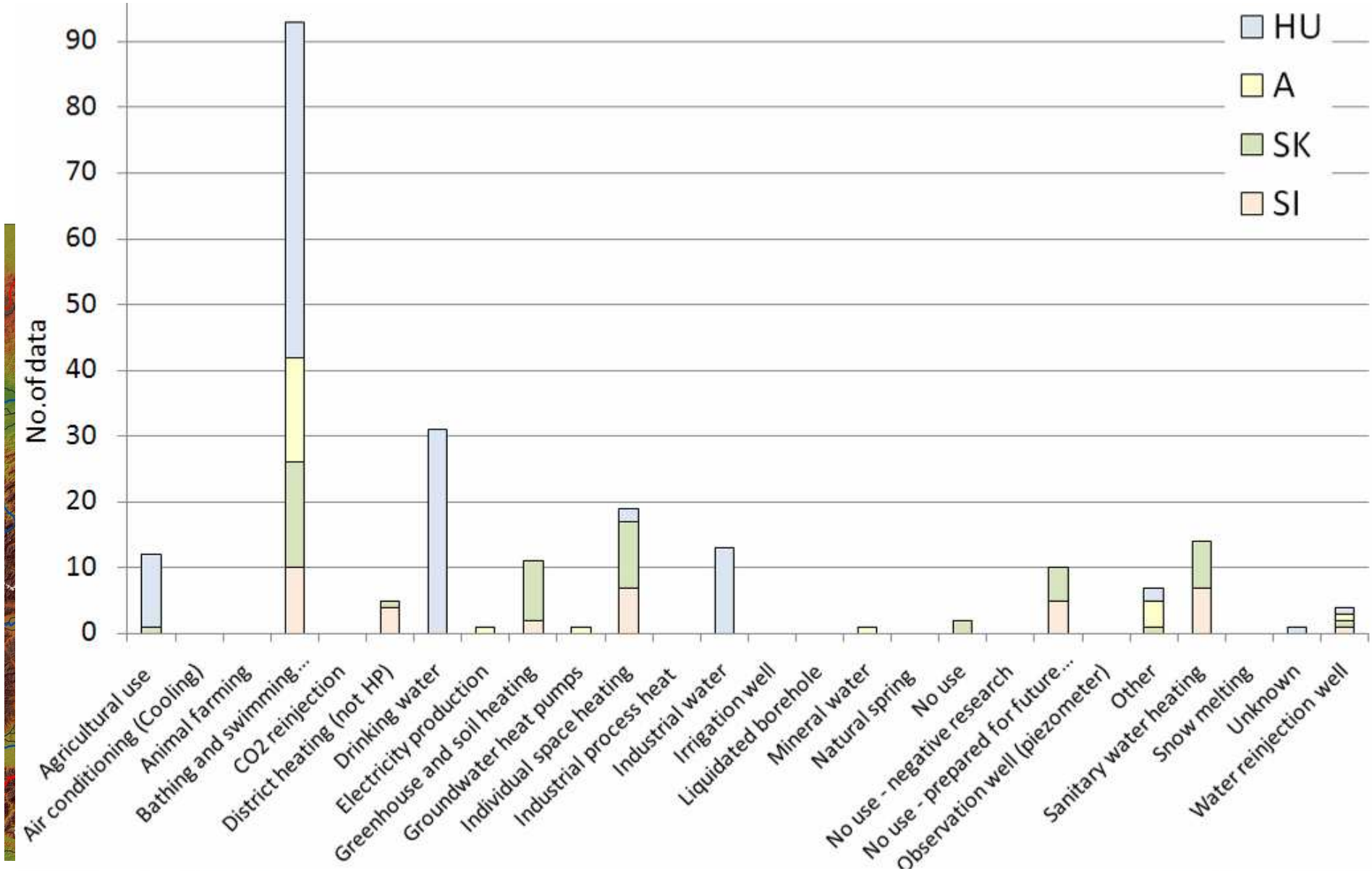


Maximum outflow temperature (°C)

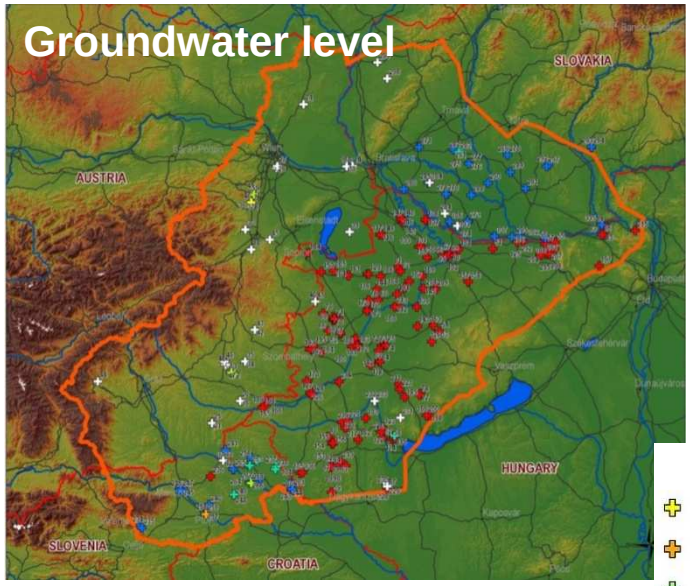
- 20,0 - 39,9
- 40,0 - 59,9
- 60,0 - 79,9
- 80,0 - 99,9
- 100,0 - 110,0

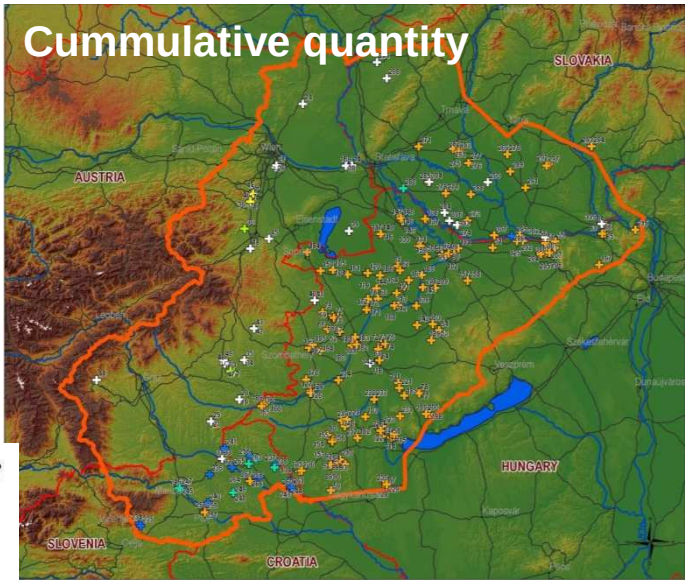
Utilization types

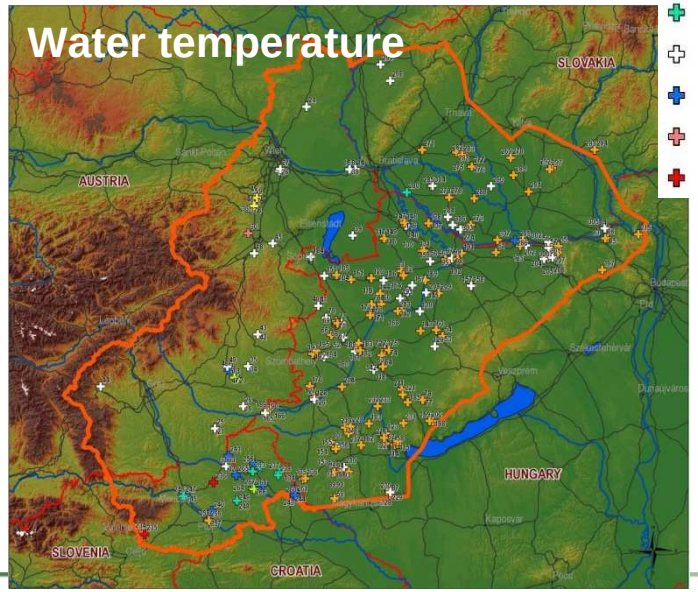
Utilization code	*Utilization types*
1	**Agricultural use**
2	*Air conditioning (Cooling)*
3	*Animal farming*
4	**Bathing and swimming (including balneology)**
5	*CO2 reinjection*
6	**District heating (other than heat pumps)**
7	**Drinking water**
8	**Electricity production**
9	**Greenhouse and soil heating**
10	**Groundwater heat pumps**
11	**Individual space heating (other than heat pumps)**
12	*Industrial process heat*
13	**Industrial water**
14	*Irrigation well*
15	*Liquidated borehole*
16	**Mineral water**
17	**Natural spring**
18	**No use**
19	*No use - negative research*
20	**No use - prepared for future use**
21	*Observation well (piezometer)*
22	**Other**
23	**Sanitary water heating**
24	*Snow melting*
25	**Unknown**
26	**Water reinjection well**

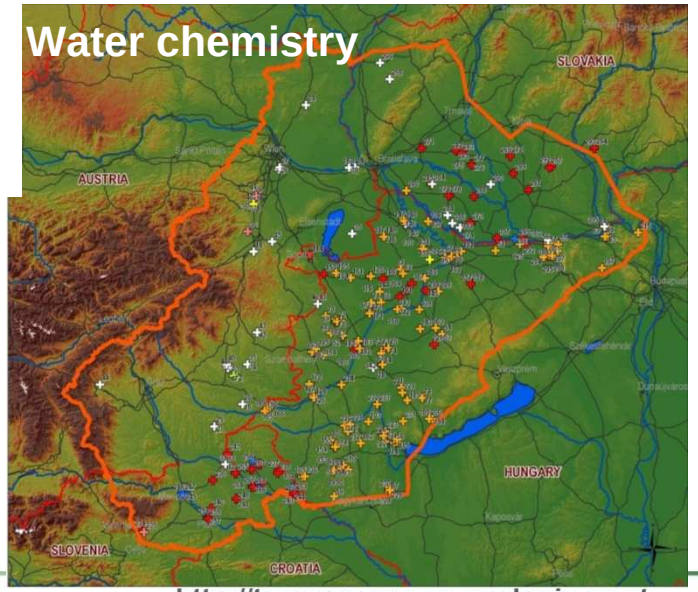

HU
A
SK
SI
No.of data
0
10
20
30
40
50
60
70
80
90
Agricultural use
Air conditioning (Cooling)
Animal farming
Bathing and swimming...
CO2 reinjection
District heating (not HP)
Drinking water
Electricity production
Greenhouse and soil heating
Groundwater heat pumps
Individual space heating
Industrial process heat
Industrial water
Irrigation well
Liquidated borehole
Mineral water
Natural spring
No use
No use - negative research
No use - prepared for future...
Observation well (piezometer)
Other
Sanitary water heating
Snow melting
Unknown
Water reinjection well

Monitoring types and data storage









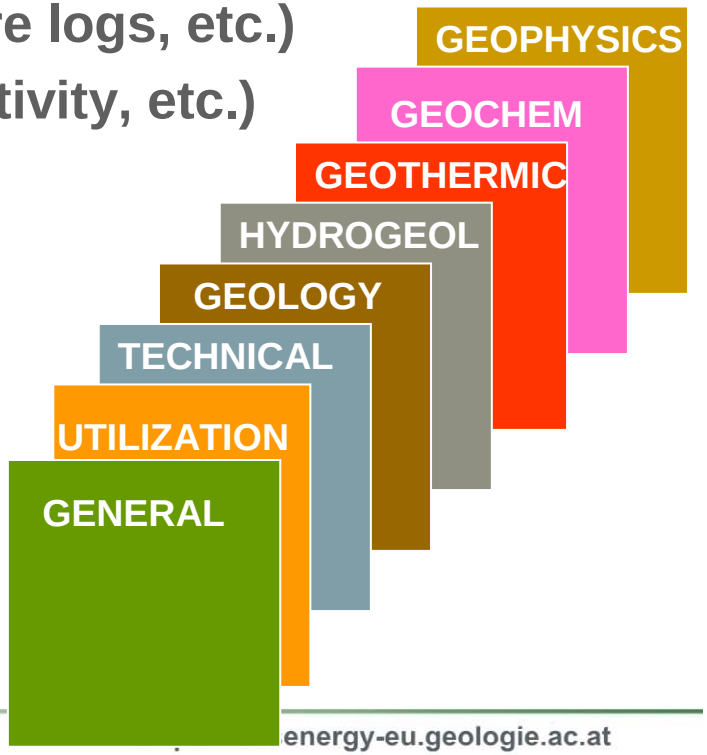
	Interval of data recording	*Data storage*
✚	annual data	no
✚	annual data	yes
✚	continuous & daily data	no
✚	continuous & daily data	yes
✚	no information	
✚	no monitoring	
✚	occasional measurements	no
✚	occasional measurements	yes

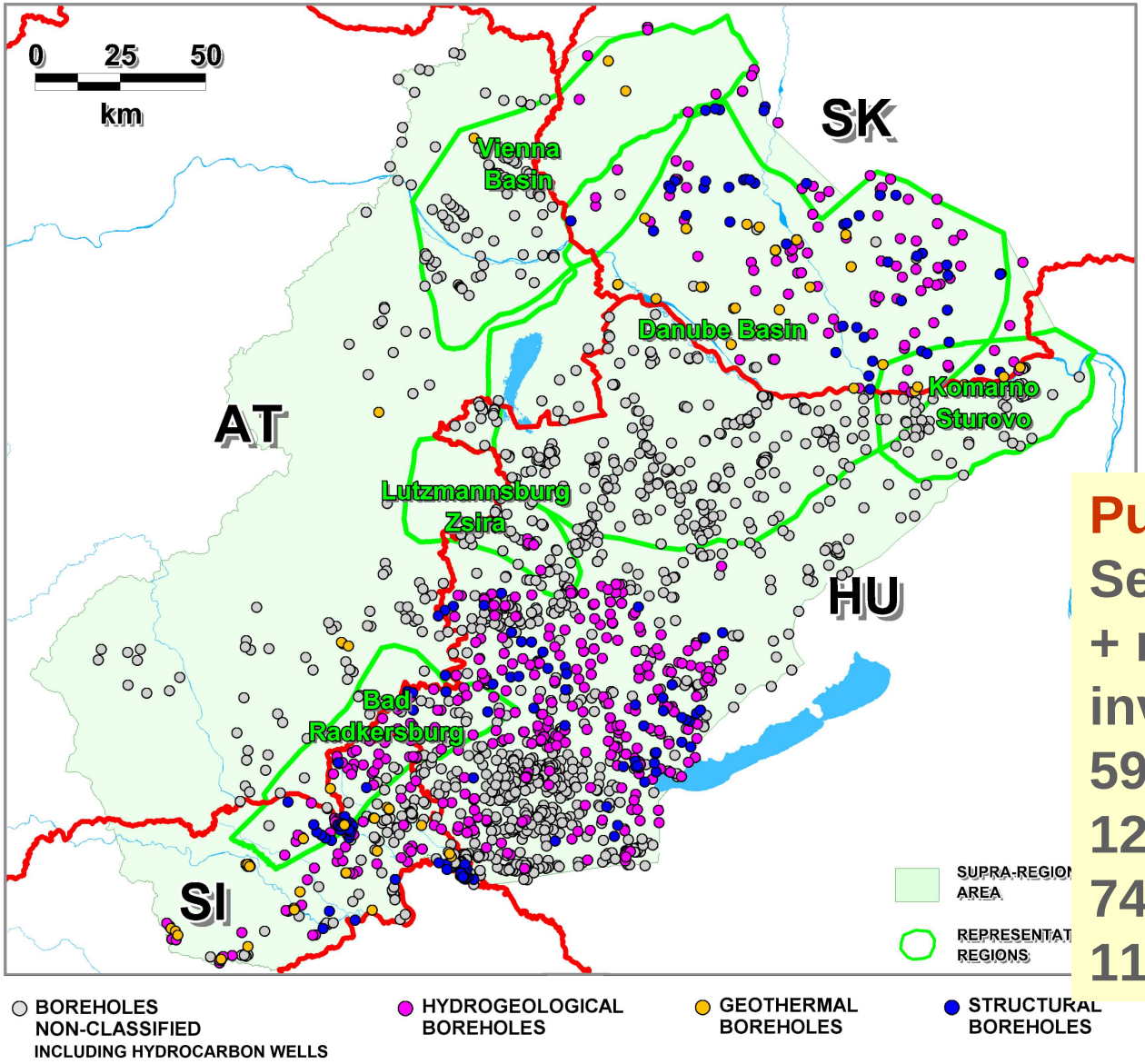
Multi-lingual joint borehole database (MS-Access)

438 parameters, 12 main parameter groups

general (borehole identification, purpose, ownership, etc.)
utilization (heating, balneology, agriculture, reinjection, etc.)
technical (borehole dimensions, screened intervals, etc.)
geology (lithology, stratigraphy, facies, etc.)
hydrogeology (permeability, porosity, pressure logs, etc.)
geothermics (BHT, T-outflow, thermal conductivity, etc.)
geochemistry
- basic chemistry
- isotopes and noble gases
- organic components
- trace elements
- gas analyses

geophysics (borehole logs)

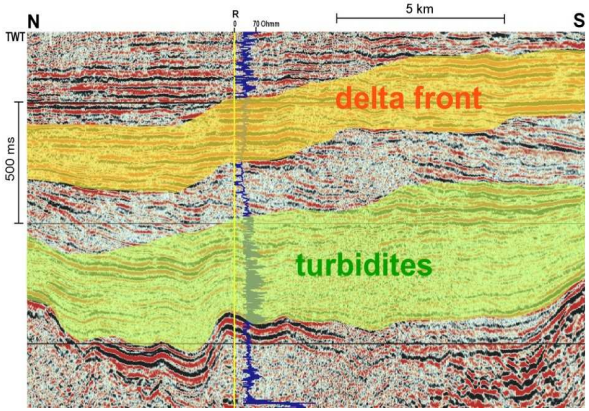




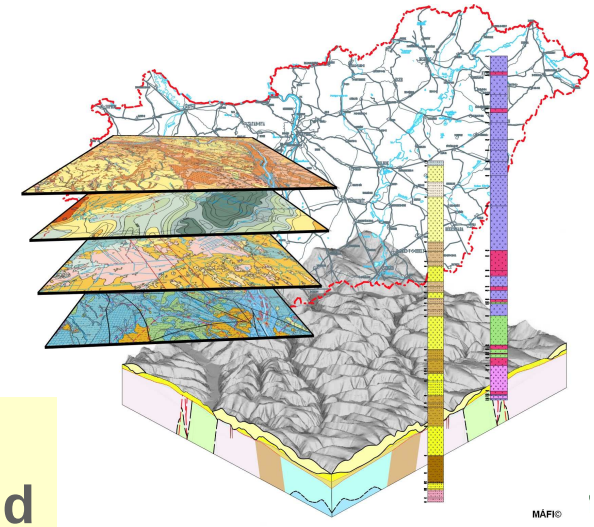
Expert database:
~ 2500 boreholes

Public database:
Selected parameters
+ results of additional investigations
59 SK
129 SLO
742 HU
115 AT

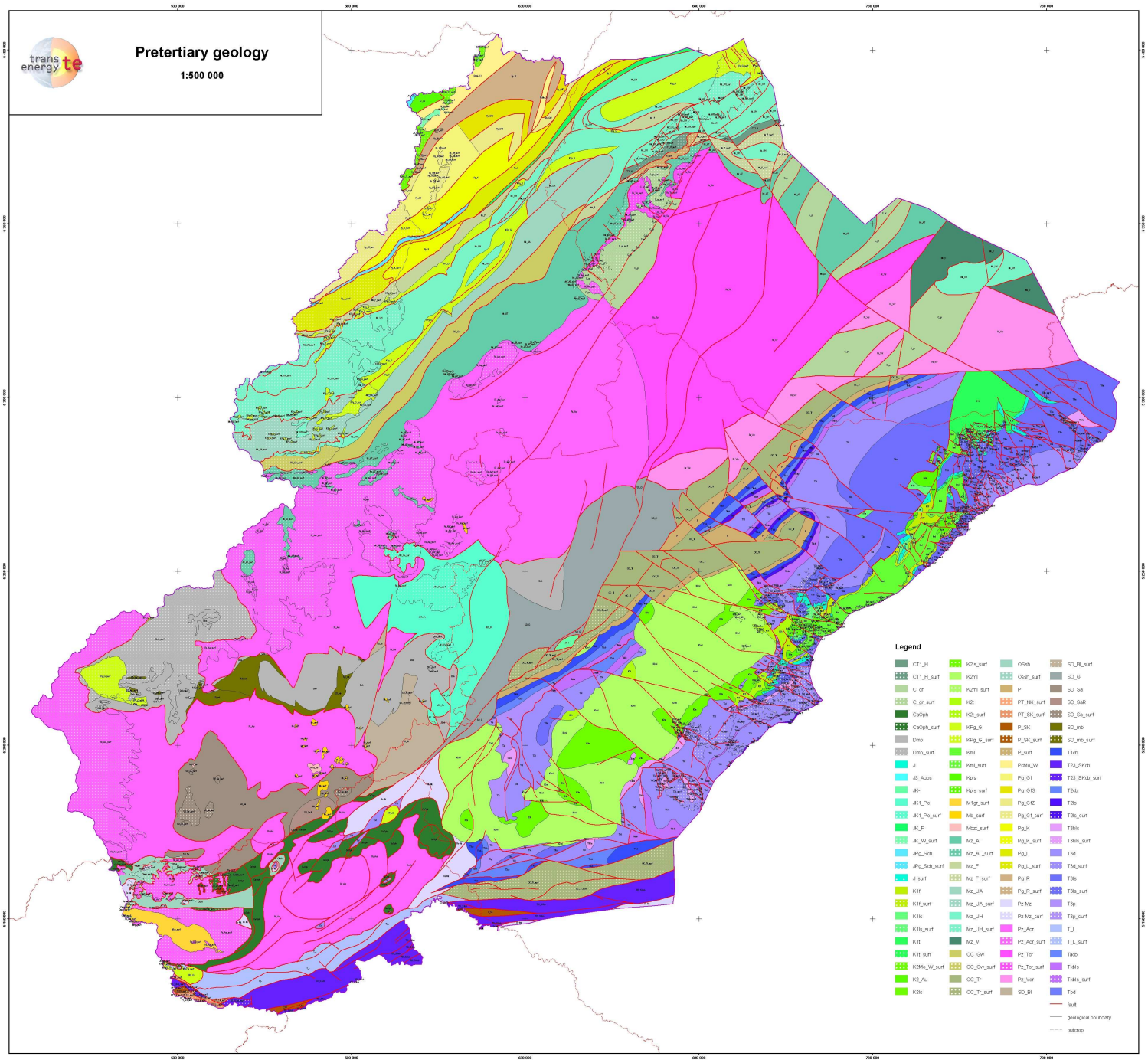
Geological model: bounding surfaces of hydrostratigraphic units

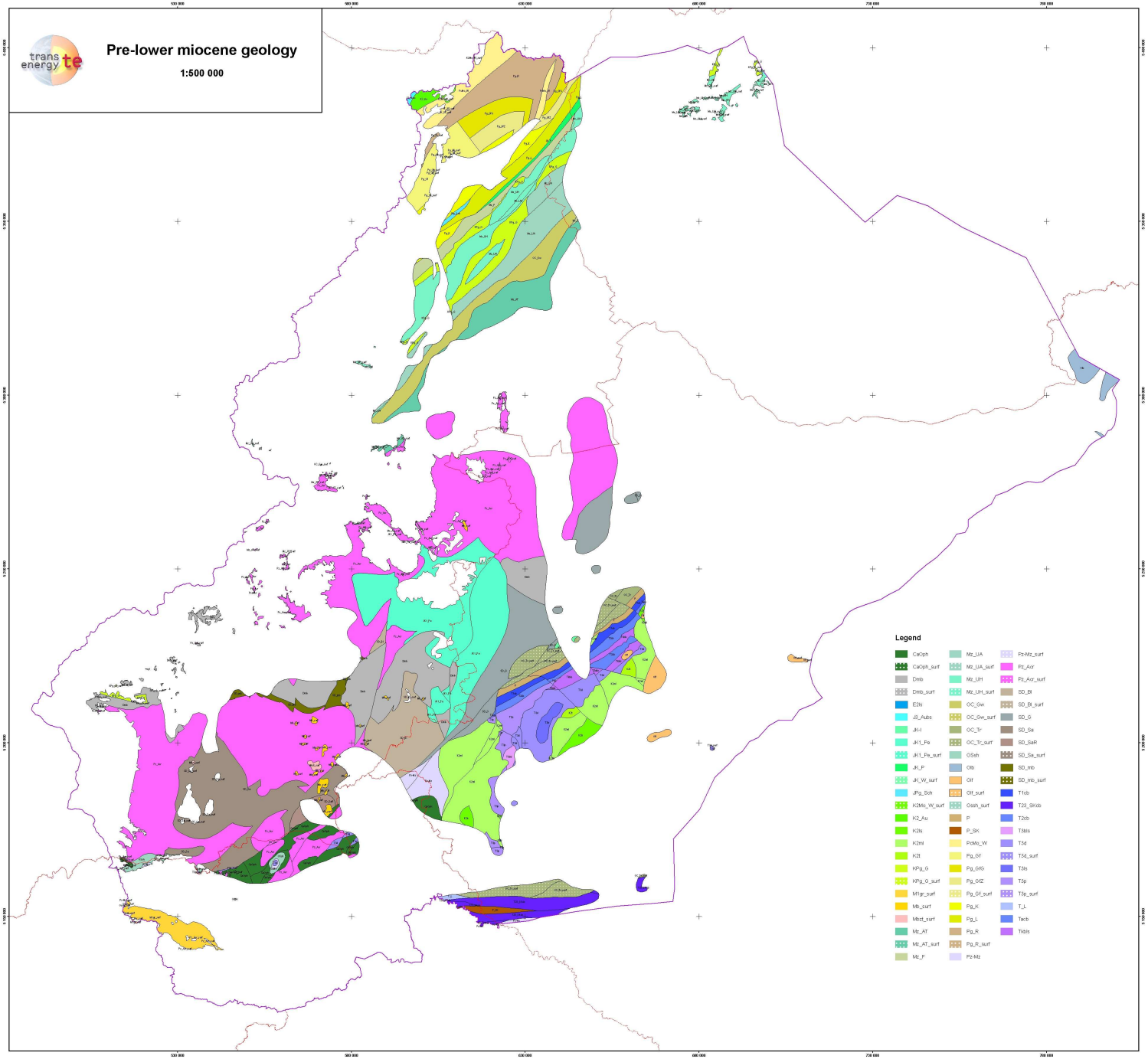


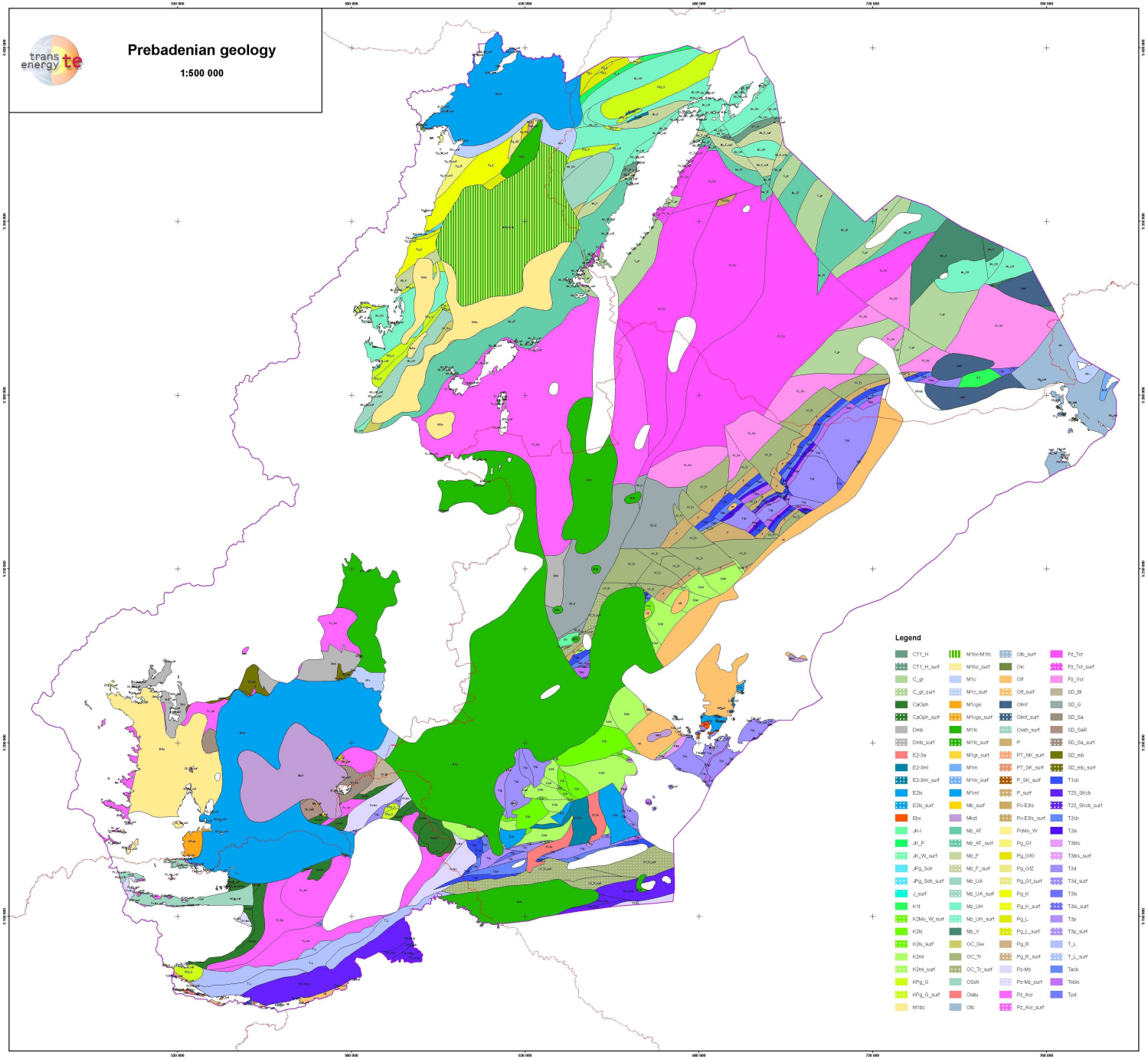
- Quaternary covered (surface) geological map
- Base of the Quaternary formations (Pre-Quaternary)
- Base of the Upper Pannonian formations (base of delta front sands)
- Base of the Lower Pannonian formations (Pre-Pannonian)
- Base of the Sarmatian formations (Pre-Sarmatian)
- Base of the Badenian formations (Pre-Badenian)
- Base of the Neogene formations (Pre-Neogene)
- Base of the Cenozoic formations (Pre-Cenozoic)
- Base of Cretaceous formations (Pre-Creatceous)
- Surface of basement formations

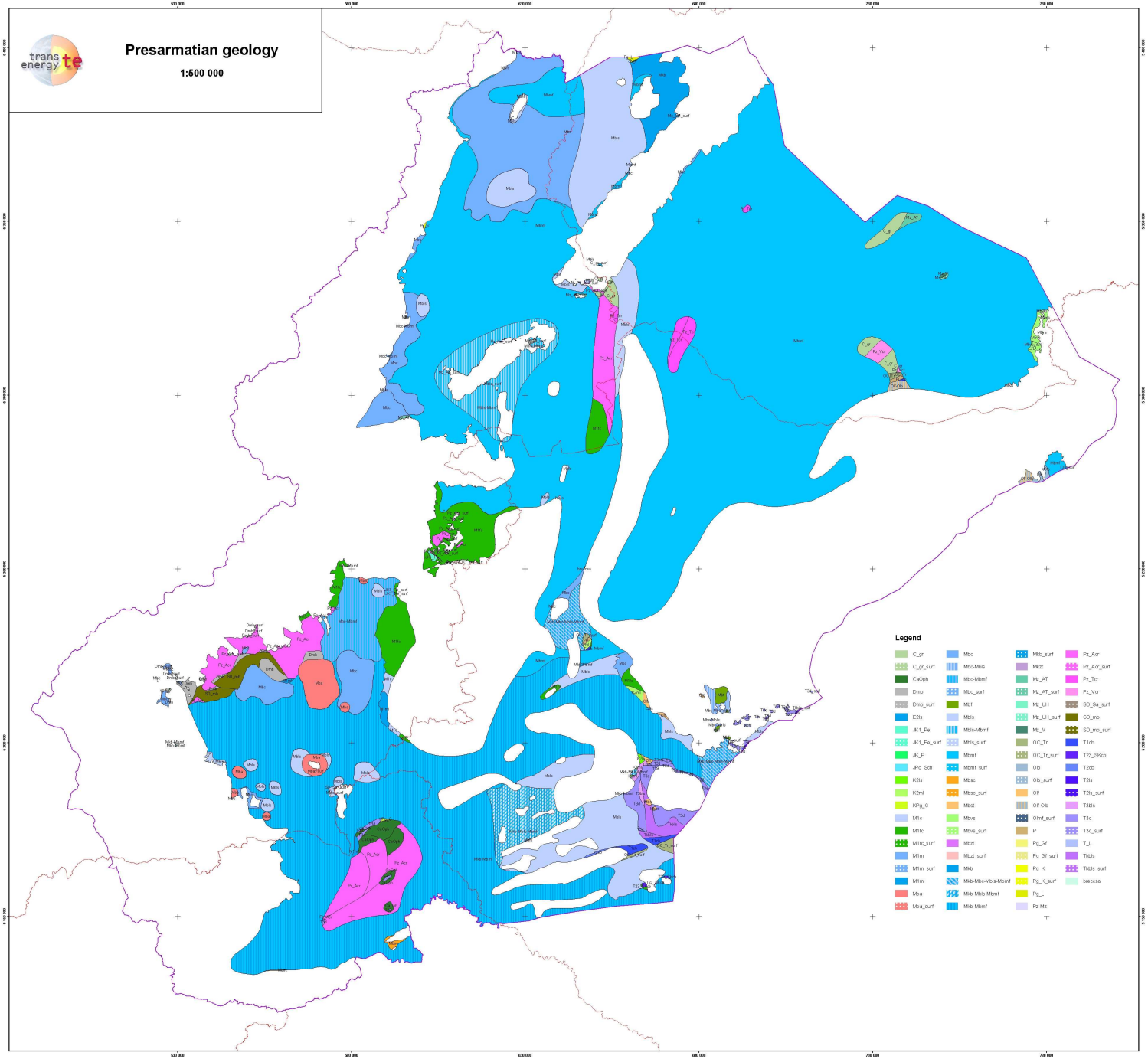


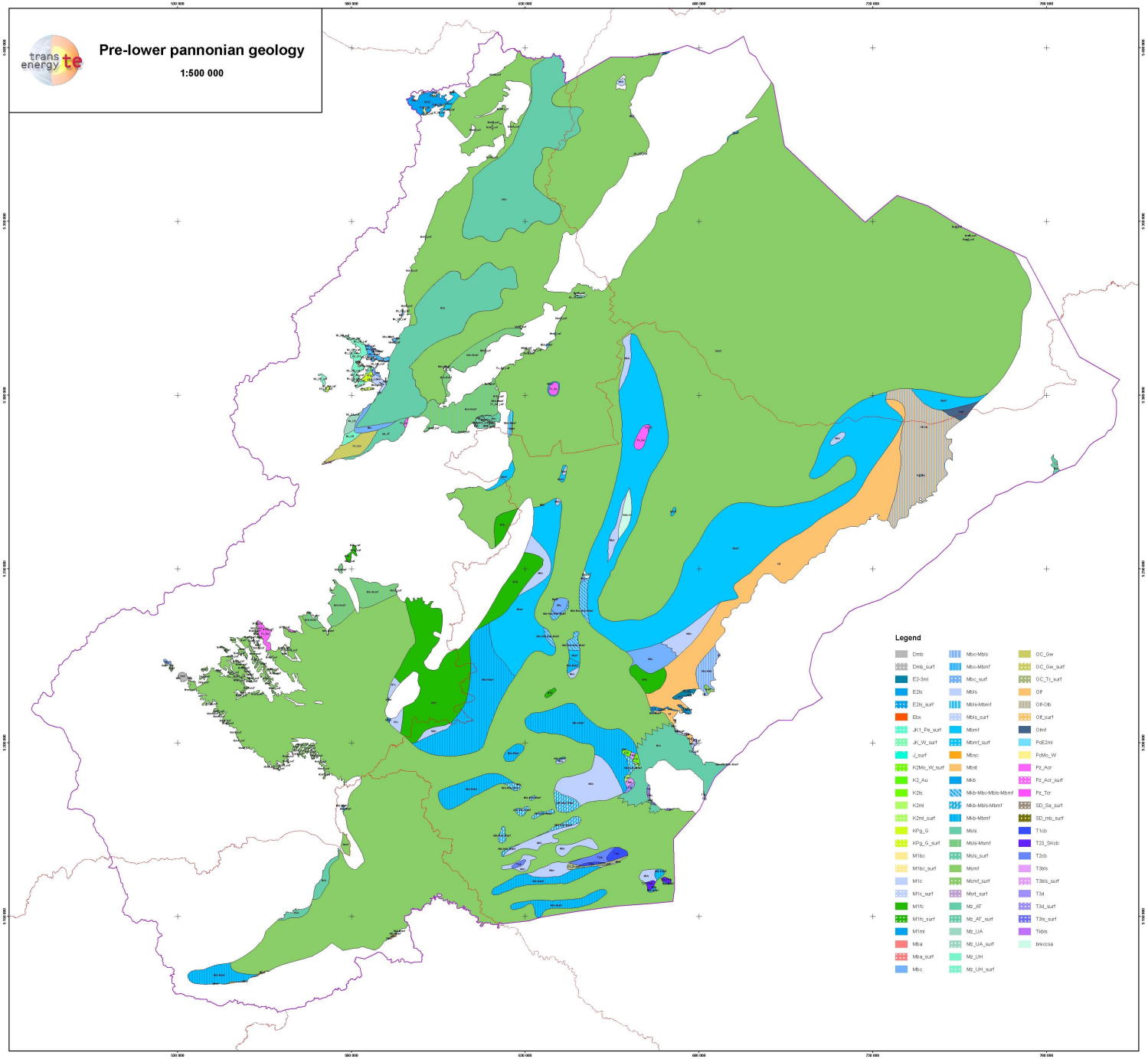
Not compilation of exisiting maps, but edition of surfaces from borehole database - common legend

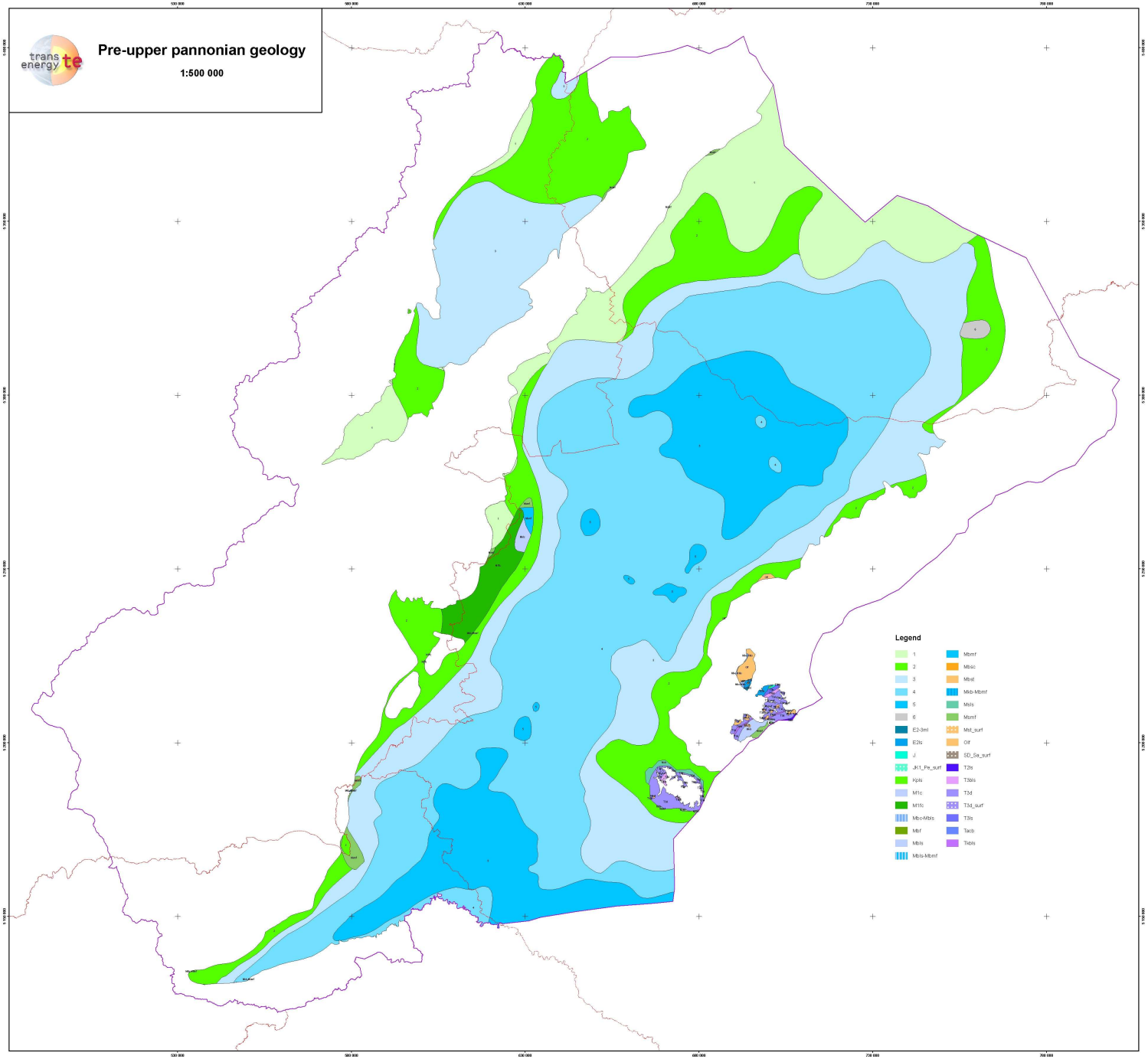

Pretertiary geology
1:500 000
Legend
fault
geological boundary
outcrop

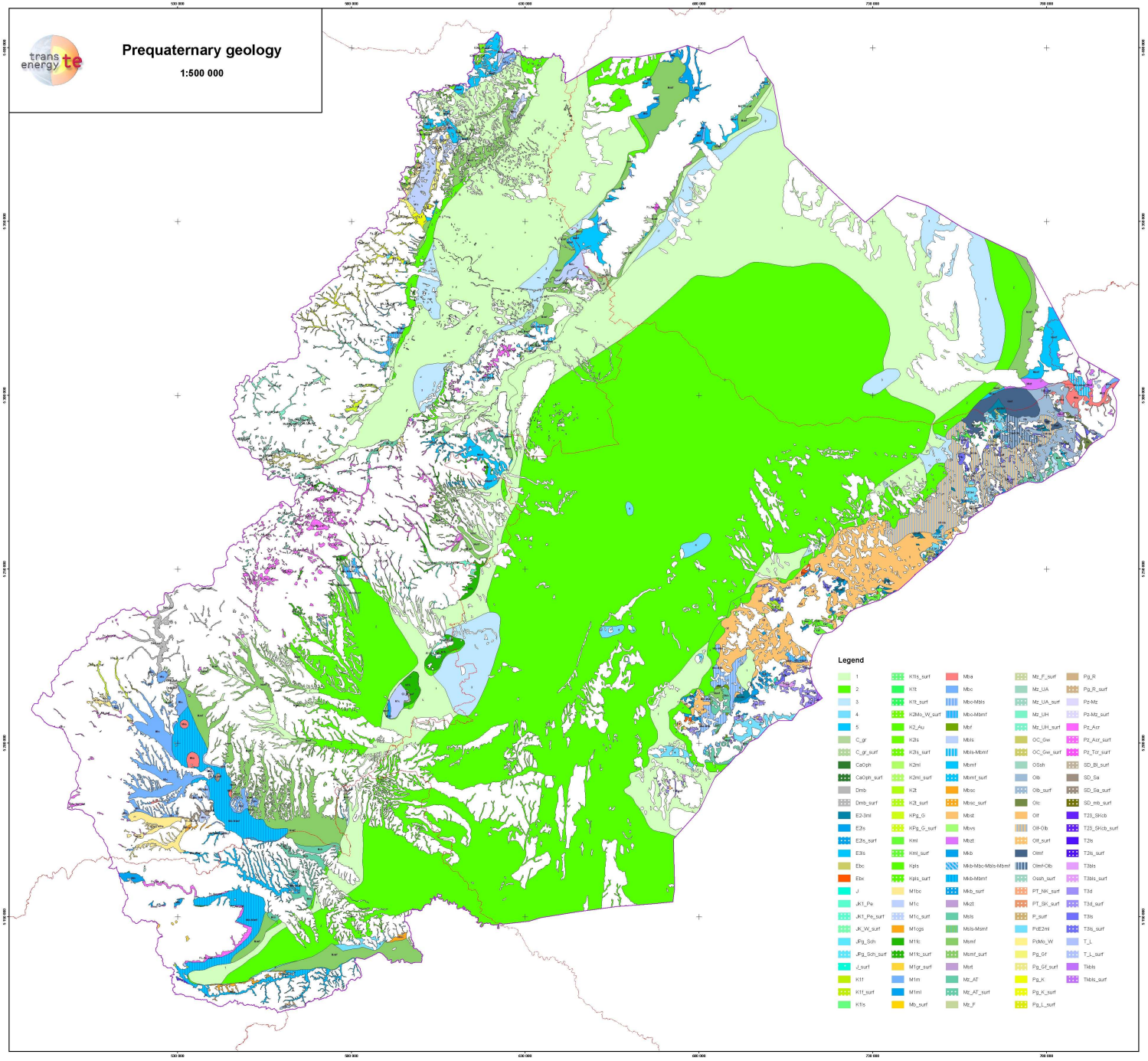

Pre-lower miocene geology
1:500 000
Legend
CaOph
CaOph_surf
Dmb
Dmb_surf
E2ls
J3_Aubs
JK-I
JK1_Pe
JK1_Pe_surf
JK_P
JK_W_surf
JPg_Sch
K2Mo_W_surf
K2_Au
K2ls
K2ml
K2t
KPg_G
KPg_G_surf
M1gr_surf
Mb_surf
Mbzt_surf
Mz_AT
Mz_AT_surf
Mz_F
Mz_UA
Mz_UA_surf
Mz_UH
Mz_UH_surf
OC_Gw
OC_Gw_surf
OC_Tr
OC_Tr_surf
OSsh
Olb
Olf
Olf_surf
Ossh_surf
P
P_SK
PrMo_W
Pg_Gf
Pg_GfG
Pg_GfZ
Pg_Gf_surf
Pg_K
Pg_L
Pg_R
Pg_R_surf
Pz-Mz
Pz-Mz_surf
Pz_Axr
Pz_Axr_surf
SD_Bl
SD_Bl_surf
SD_G
SD_Sa
SD_SaR
SD_Sa_surf
SD_mb
SD_mb_surf
T1cb
T23_SKcb
T2cb
T3Mls
T3d
T3d_surf
T3ls
T3p
T3p_surf
T_L
Tacb
Tibls

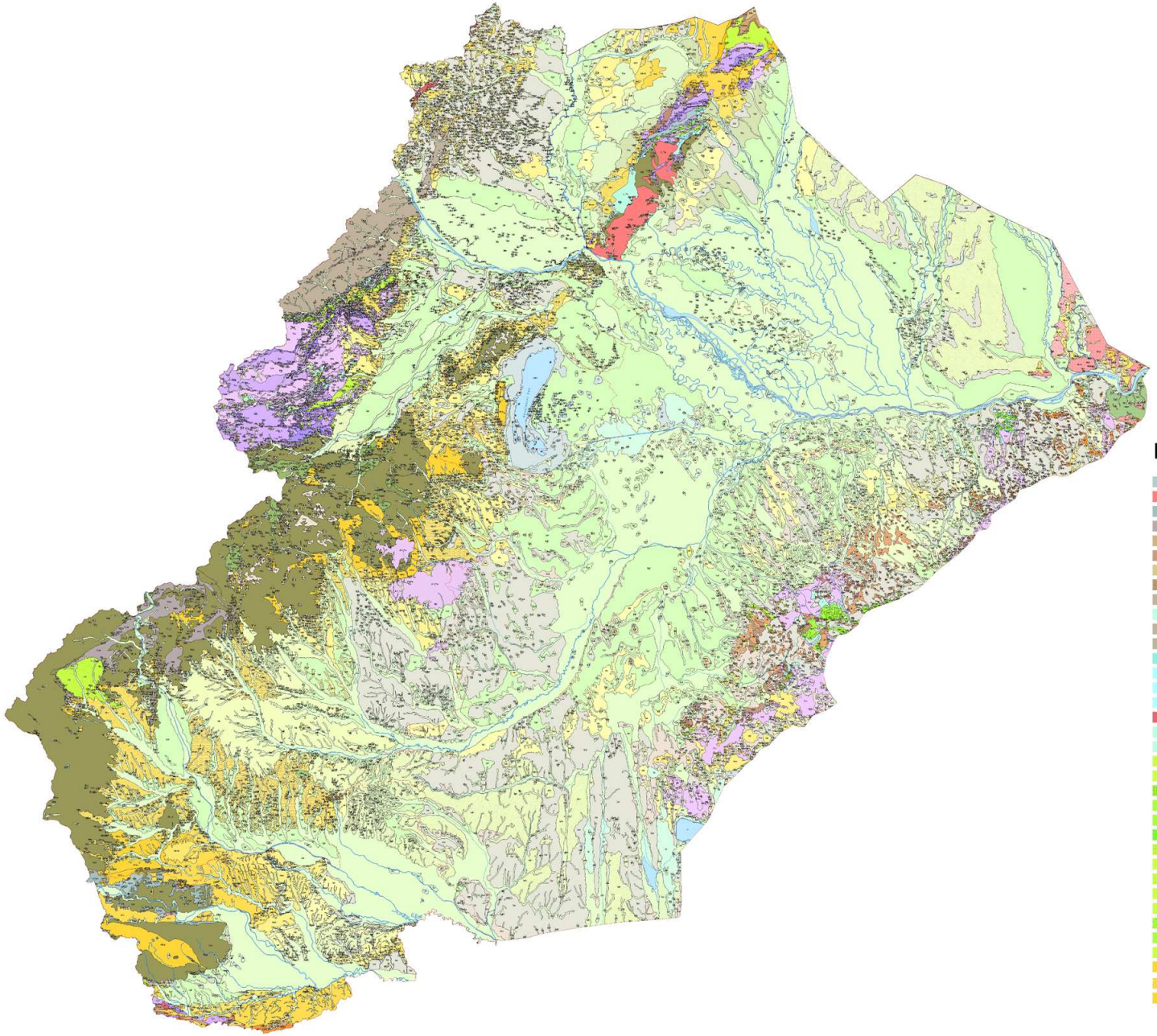

Prebadenian geology
1:500 000
Legend


Presarmatian geology
1:500 000
Legend

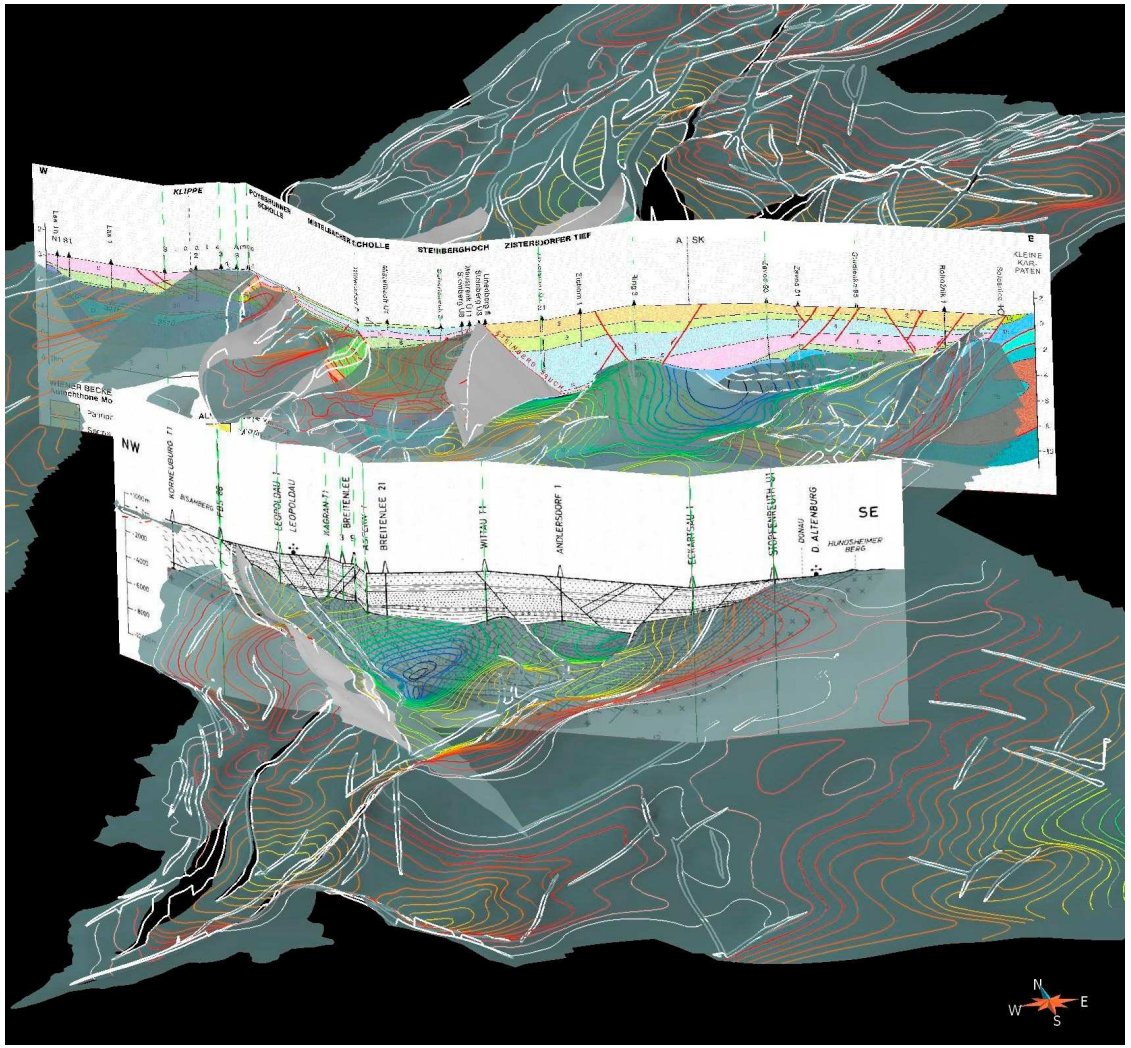

Pre-lower pannonian geology
1:500 000
Legend
Dmb
Dmb_surf
E2-3ml
E2ls
E2ls_surf
Ebx
JK1_Pa_surf
JK_W_surf
J_surf
K2Mo_W_surf
K2_Au
K2ls
K2ml
K2ml_surf
KPg_G
KPg_G_surf
M1bc
M1bc_surf
M1c
M1c_surf
M1fc
M1fc_surf
M1ml
Mba
Mba_surf
Mbc
Mbc-Mbls
Mbc-Mbmf
Mbc_surf
Mbls
Mbls-Mbmf
Mbls_surf
Mbmf
Mbmf_surf
Mbsc
Mbst
Mkb
Mkb-Mbc-Mbls-Mbmf
Mkb-Mbls-Mbmf
Mkb-Mbmf
Mkls
Mkls-Mbmf
Mkls_surf
Mkml
Mkml_surf
Mkrf_surf
Mz_AT
Mz_AT_surf
Mz_UA
Mz_UA_surf
Mz_UH
Mz_UH_surf
OC_Gw
OC_Gw_surf
OC_Tr_surf
Olf
Olf-Olb
Olf_surf
Olmf
PxE2ml
PxMo_W
Pz_Acr
Pz_Acr_surf
Pz_Tcr
SD_Sa_surf
SD_mb_surf
T1cb
T23_SKcb
T2cb
T3bls
T3bls_surf
T3d
T3d_surf
T3ls_surf
T3bls
braccsa


Pre-upper pannonian geology
1:500 000
Legend
1
2
3
4
5
6
E2-3ml
E2ls
J
JK1_Pe_surf
Kpls
M1c
M1fc
Mbc-Mbls
Mbf
Mbls
Mbls-Mbmf
Mbmf
Mbsc
Mbsl
Mkb-Mbmf
Mmls
Msmf
Mst_surf
Olf
SD_Sa_surf
T2ls
T3bls
T3d
T3d_surf
T3ls
Tacb
Tlebls


Prequaternary geology
1:500 000
Legend


Legend
CP_lvs
C_Tgr
CaOph
Dmb
E2-3ml
E2ls
E3ls
Ebc
Ebx
J
JE_H
JE_R
JK
JK_Pls
JK_Tls
JK_Vls
JK_W
J_Hls
J_Tls
K1Tlim
K1Tls
K1f
K1ls
K1ml
K1t
K2ls
K2ml
K2t
KPg_G
K_Tfl
Kml
Kpls
Kss
M1bc
M1c
M1cgs
M1fc
M1gr
M1m
MPl
Mba
Mbc
Mbls
Mbmf
Mbsc
Mbtu
Mbvs
Mbzt
Md
Mdr
Mkb
Mkzt
Mlls
Mp
Mpc
Mpcm
Mpla
Mplf
Mptb
Msls
Msmf
Msrt
Mst
Mzls
Mß
OC_G
OSsh
Olatu
Olb
Olc
Olf
Olmf
P1
Pc-E3ls
PcE1_W
PcE2ml
PcMo_W
PlQfc
Pmcb
Pt
Pz-Mz
PzF
PzS
Pz_s
Qa
Qb
Qel
Qes
Qfe
Qhf
Qhpd
Ql
Qls
Qmo
Qpf
Qpp
Qsl
Qsp
SD_G
T1cb
T2ls
T3bls
T3d
T3ls
Tacb
Tkbls
Tpd

Pilot area models (GoCad, Jewel, Petrell)



Vienna basin

Hydrogeological models (ModFlow and FeFlow): porous and karstic reservoirs

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

Scenario models – pilot areas

- Survey of cross border hydrogeological issues
- Forecast modelling of different technologies / applications
- Forecast modelling of different rates of thermal water use

1:100 000; 1:200 000

Model calibration

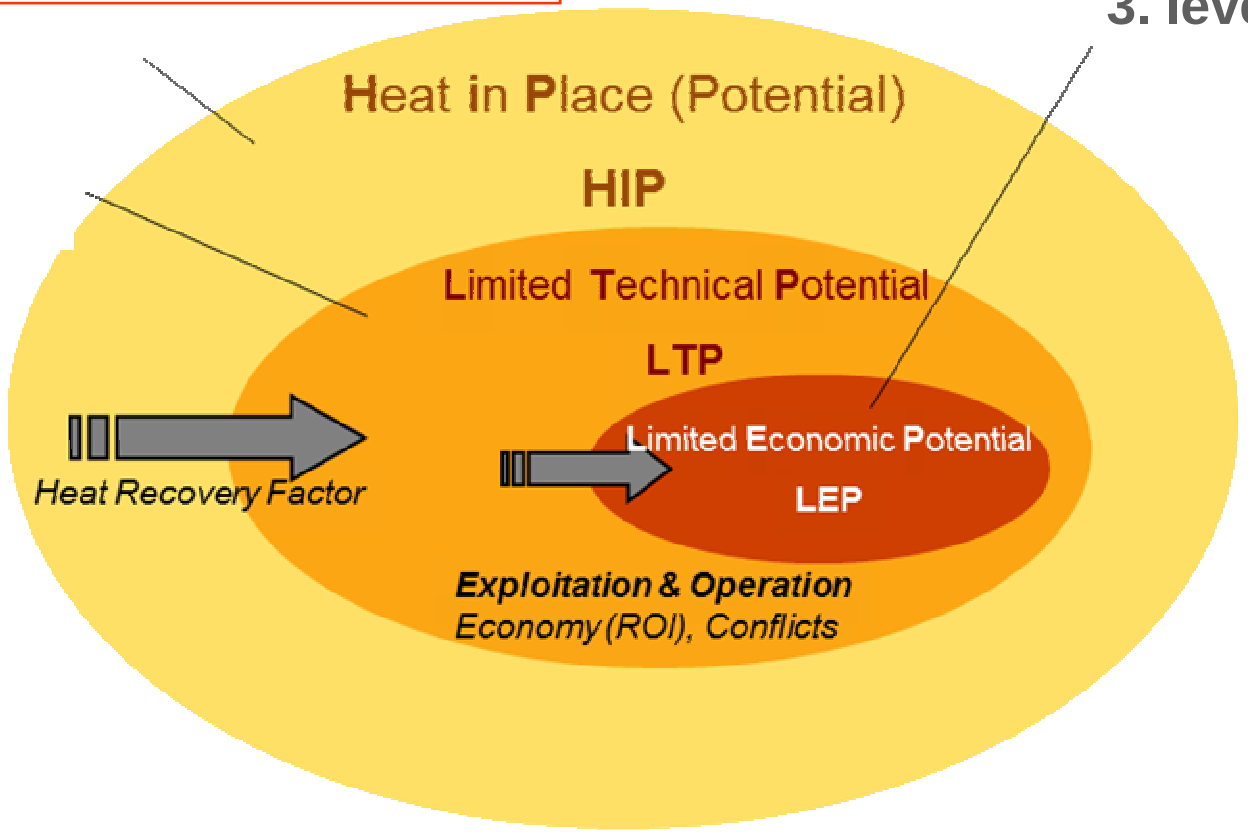
- Chemical and isotope data
- Monitoring data (spatial, temporal changes)
- Production data

Geothermal models

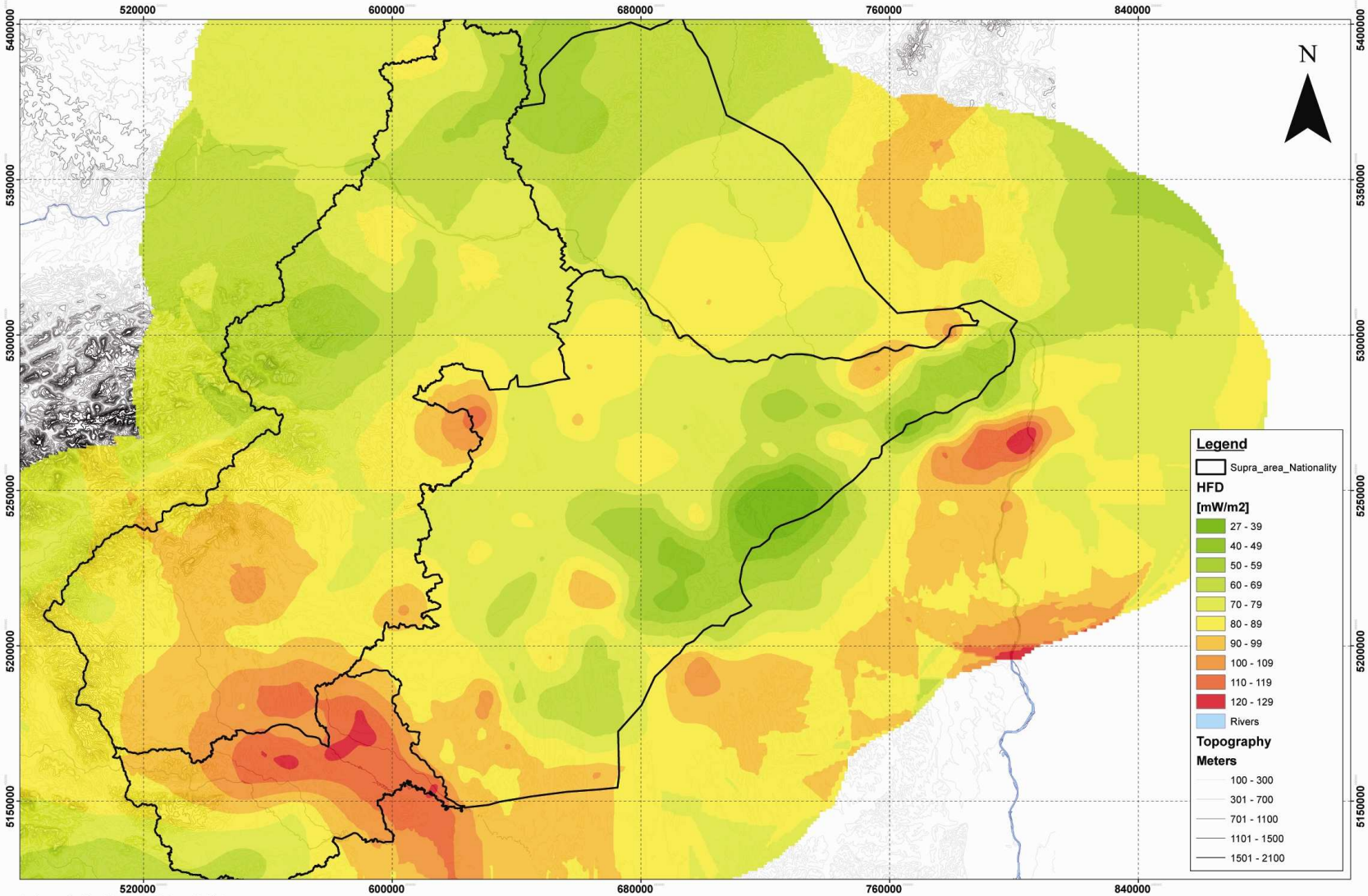
1. level: simple conductive model - HFD and T distributions at supra-regional scale

3. level

2. level

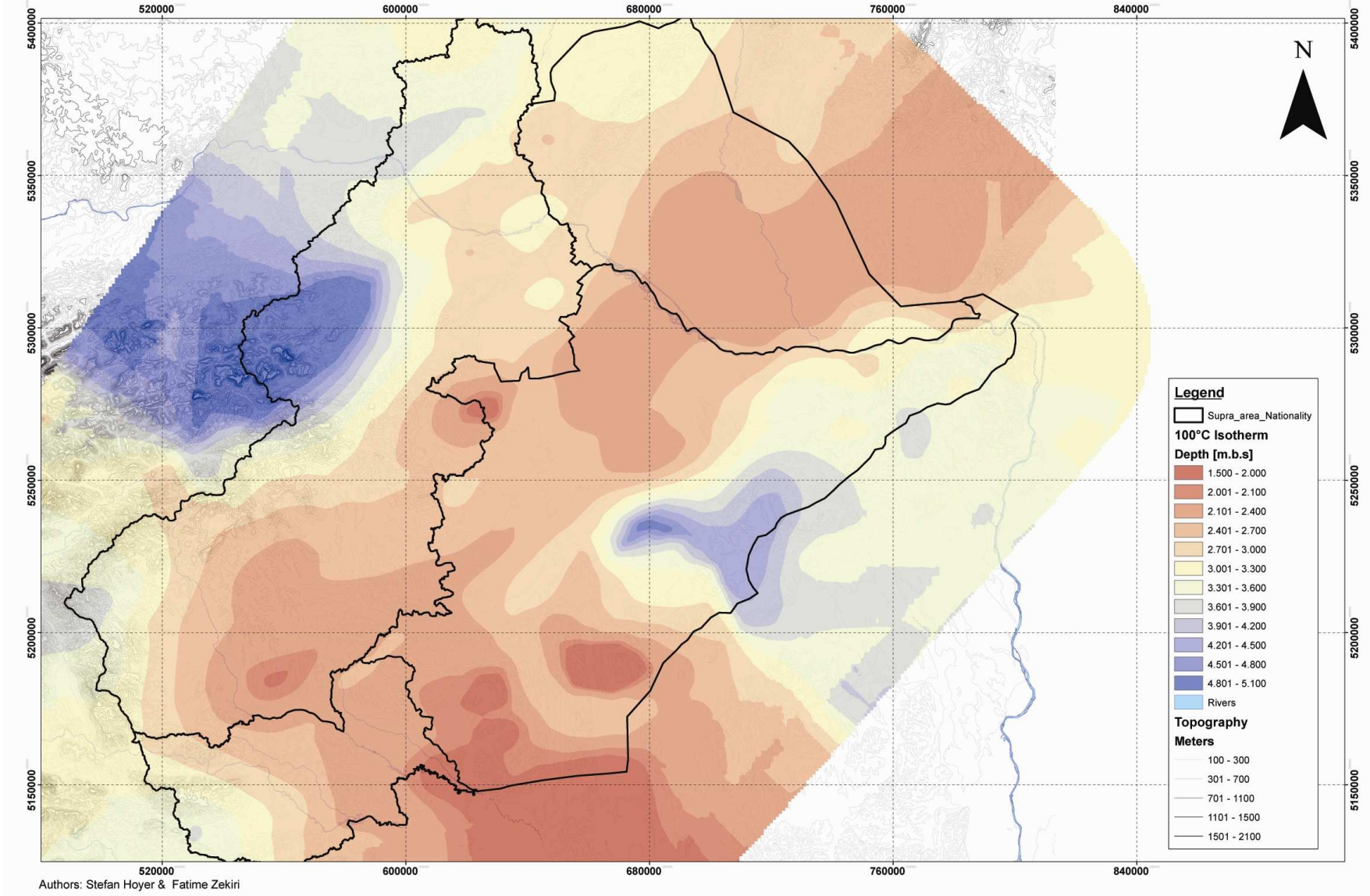


Heat flow density



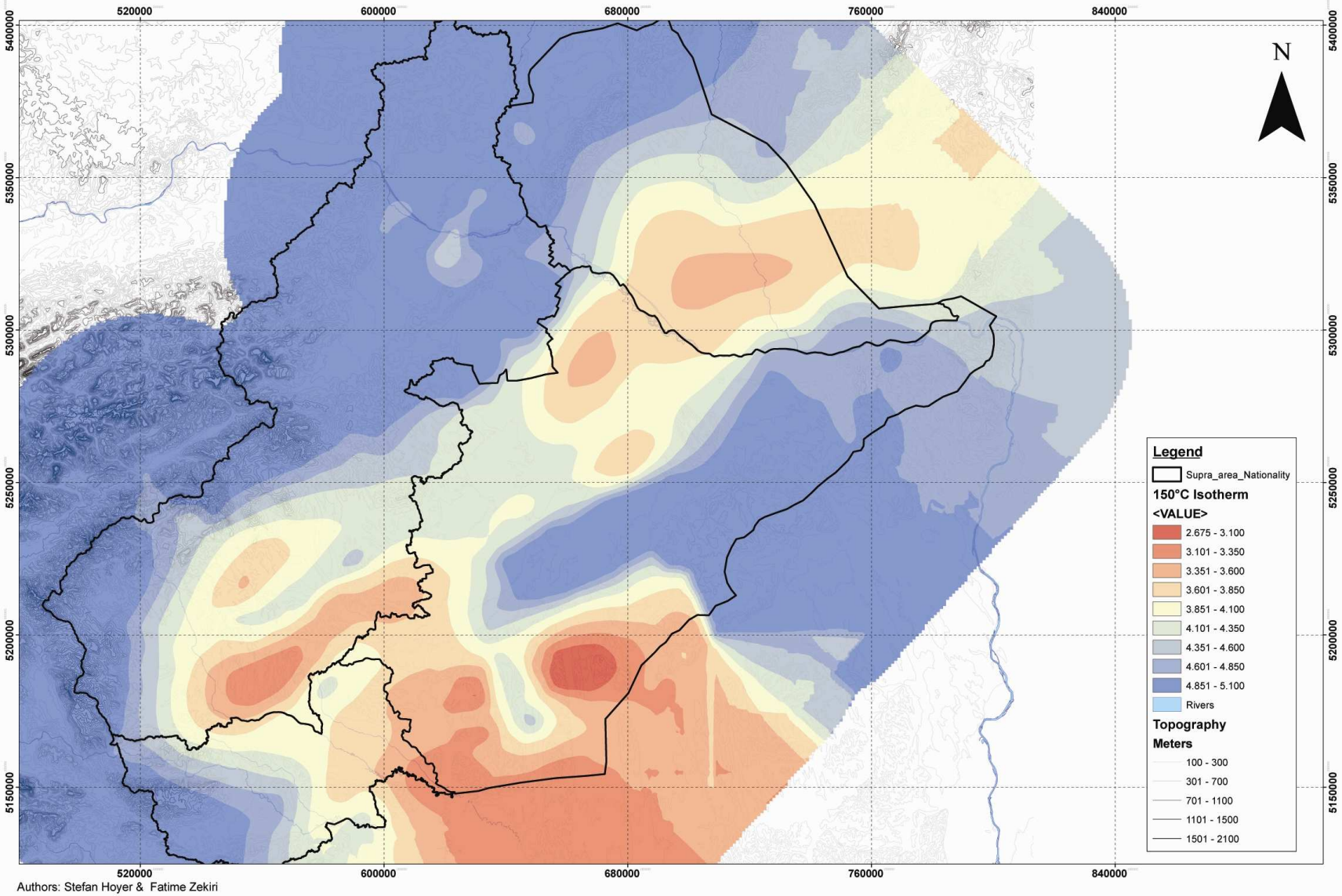
Authors: Stefan Hoyer & Fatime Zekiri

Depth of 100°C Isotherm



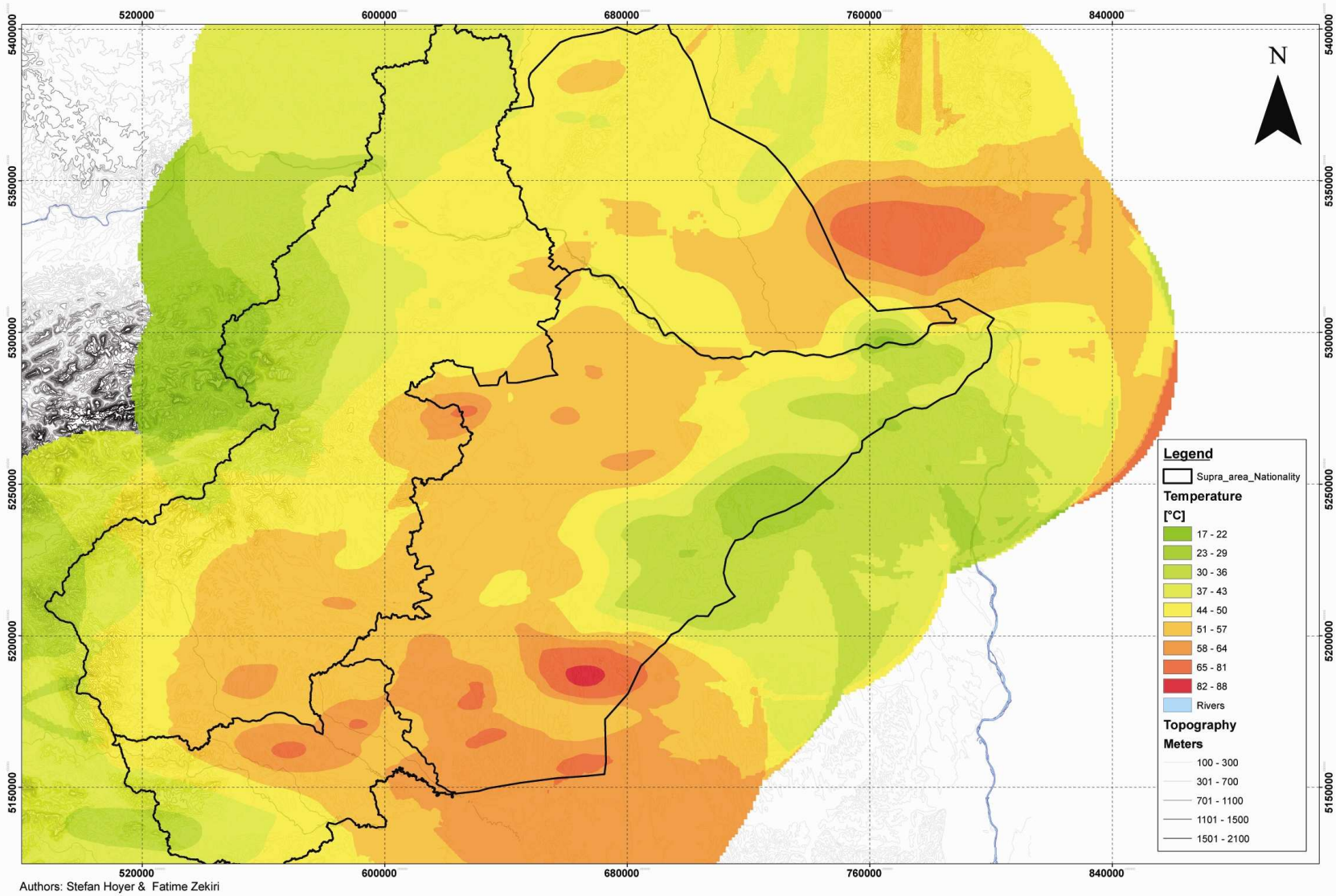
Authors: Stefan Hoyer & Fatime Zekiri

Depth of 150°C Isotherm



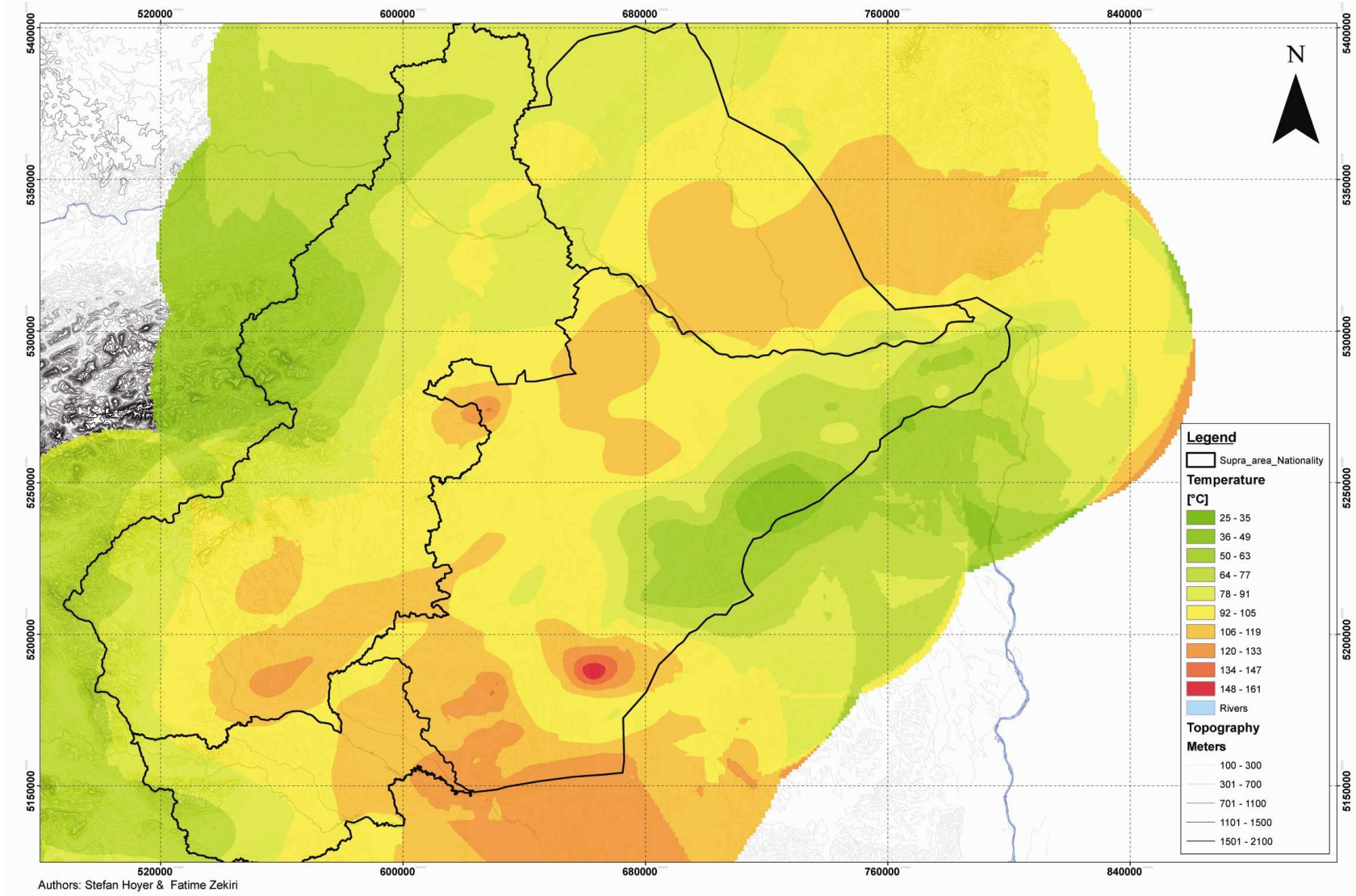
Authors: Stefan Hoyer & Fatime Zekiri

Temperature at a depth of 1000 m



Authors: Stefan Hoyer & Fatime Zekiri

Temperature at a depth of 2500 m



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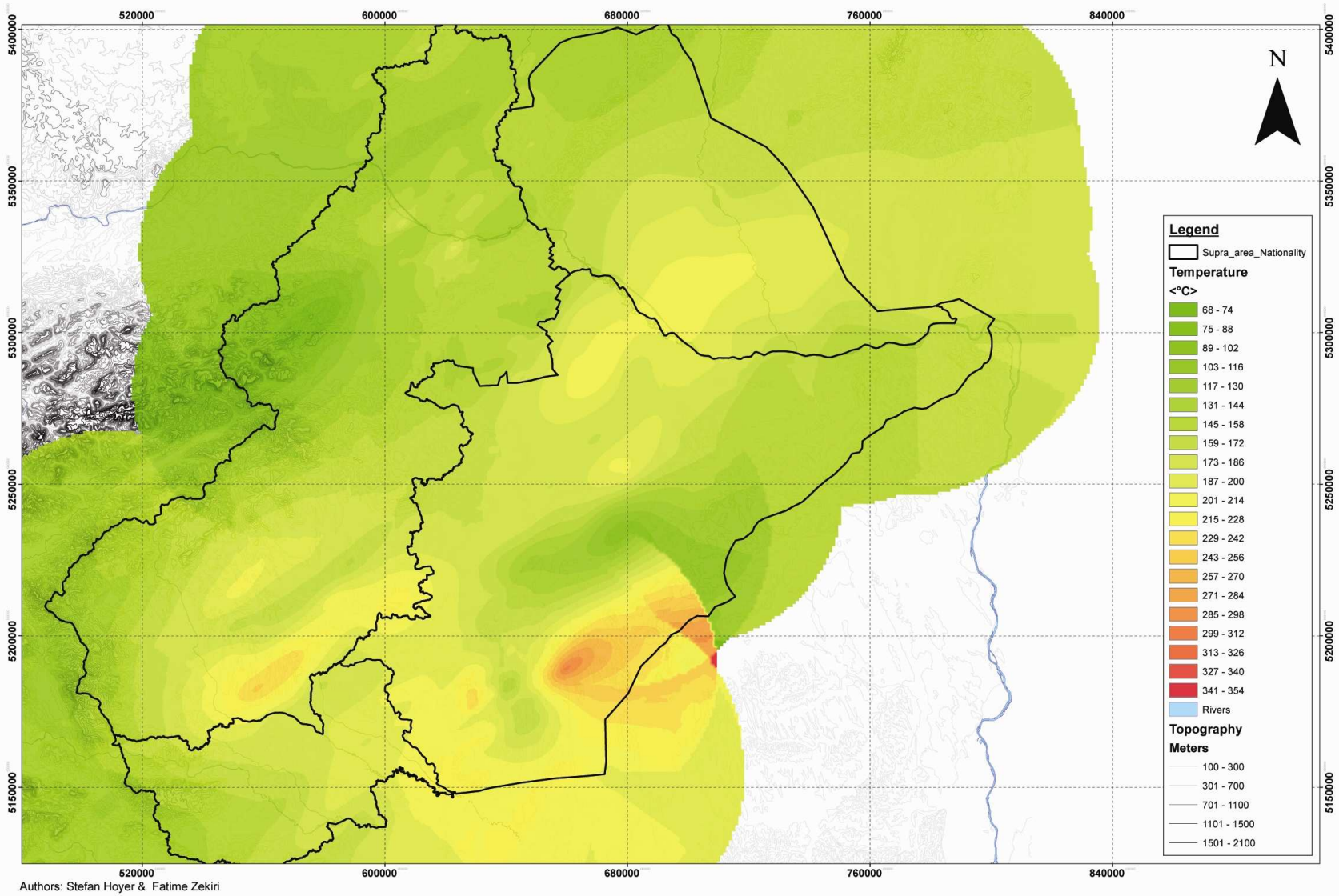
Temperature at a depth of 5000m



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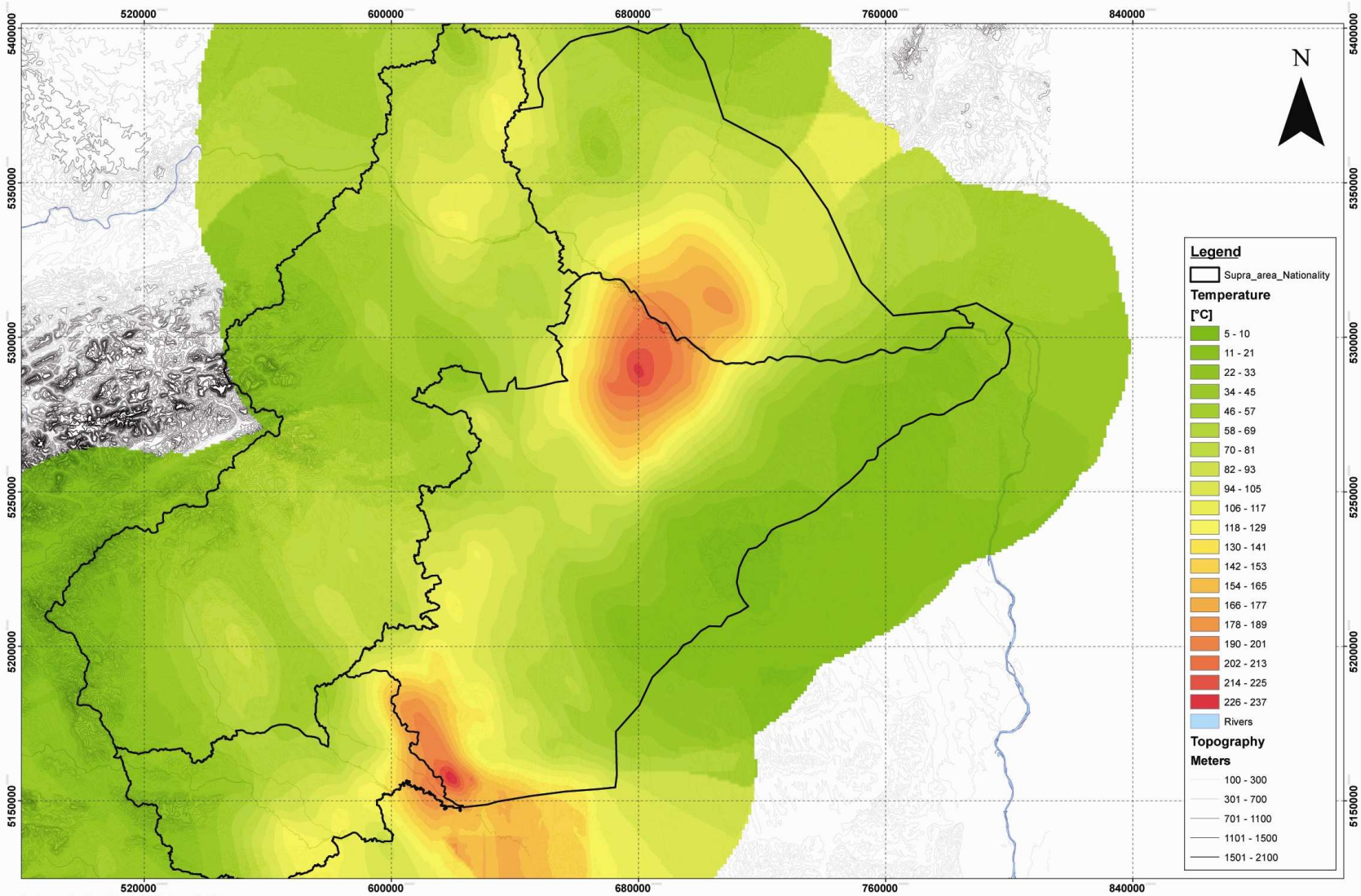
Temperature at top of the basement



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