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# **TRANSBOUNDARY GROUNDWATER RESOURCES EXTENDING OVER SLOVENIAN TERRITORY**

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**Slovenia: 20 273 km<sup>2</sup>**

**Major groundwater basin:**

NE - Panonian basin

W - river Po (including river Soča)

**Area with complex hydrogeological structure:**

NW - Italy, Austria → Alps, Dinarides

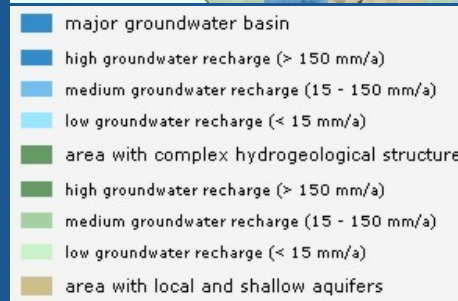
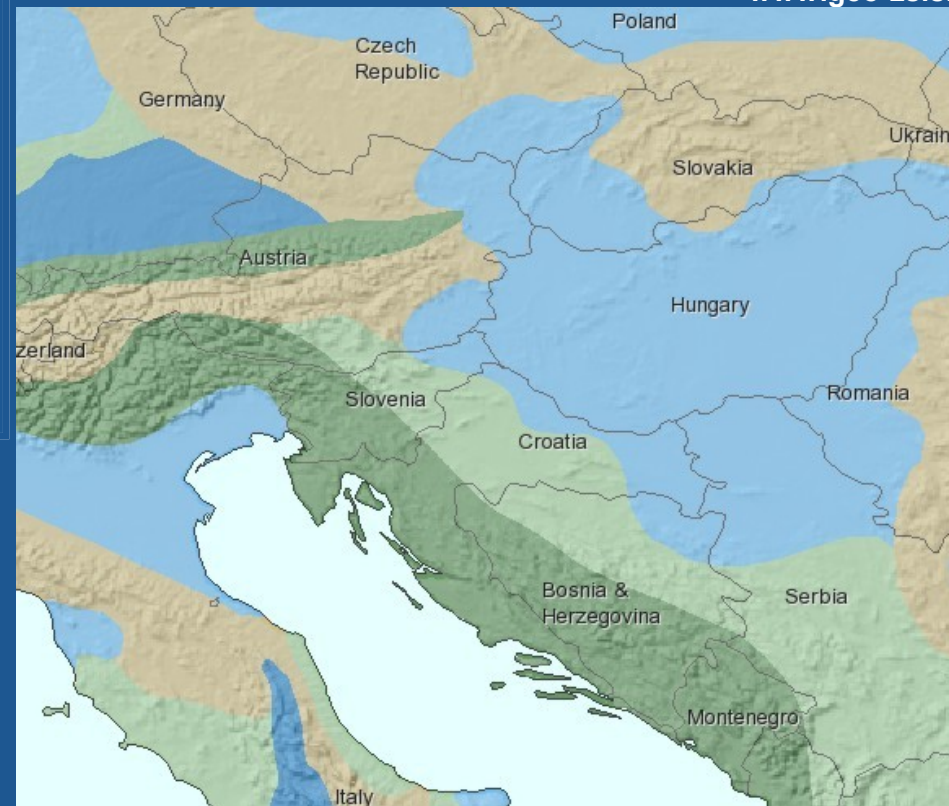
→ SE - Balkan peninsula

**Important groundwater resources are exploited:**

Dinaric karst

Fissured aquifers

Alluvial aquifers



*Reference:*

*World Map of groundwater resources  
M 1:50 000 000;*

*BGR & UNESCO, 2007*

*(<http://www.whymap.org>)*

# Methodology for delineation of Groundwater Bodies (GWB) and Transboundary Groundwater bodies in Slovenia



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Legal base: WFD (Water Framework Directive, 2000)  
Rules on methods for determining water bodies of groundwater (Ur.I.RS, 2003)  
Rules of determining water bodies of groundwater (Ur.I.RS, 2005)

## Type of aquifer systems (adapted after BRGM, 2003):

- (1) Aquifer systems in alluvial sediments
- (2) Aquifer systems in sedimentary rocks and unconsolidated dominantly non-alluvial sediments
- (3) Aquifer systems in hydraulic complex system adapted to intensely folded mountain zones
- (4) Aquifer systems in basement geological strata
- (5) Aquifer systems in low permeable strata and local and limited water resources

# Hydrogeological map of Slovenia (IAH)

M 1: 250 000

## Legend

— State border

### I: AQUIFERS IN WHICH FLOW IS MAINLY INTERGRANULAR (POROUS FORMATIONS GENERALLY NOT CONSOLIDATED)

Extensive and highly productive aquifers

Local or discontinuous productive aquifers, or extensive but only moderately productive aquifers

### II: FISURED AQUIFERS, INCLUDED KARST AQUIFERS (FISSURED AND COMPACTED FORMATIONS)

Extensive and highly productive aquifers

Local or discontinuous productive aquifers, or extensive but only moderately productive aquifers

### III: AQUIFERS IN WHICH FLOW IS MAINLY INTERGRANULAR (POROUS FORMATIONS GENERALLY NOT CONSOLIDATED)

Minor aquifers with local and limited groundwater resources

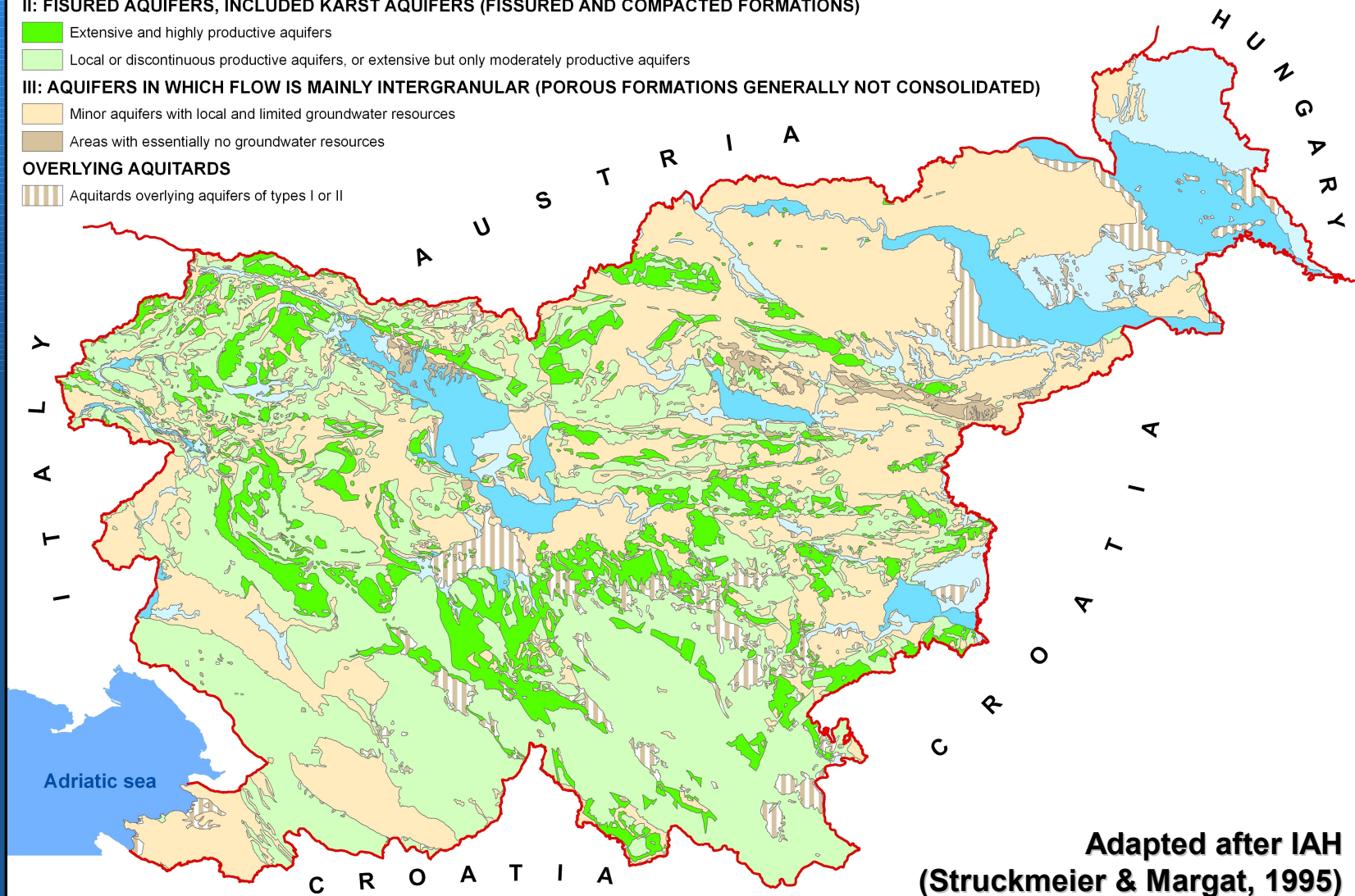
Areas with essentially no groundwater resources

### OVERLYING AQUITARDS

Aquitards overlying aquifers of types I or II



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Adapted after IAH  
(Struckmeier & Margat, 1995)

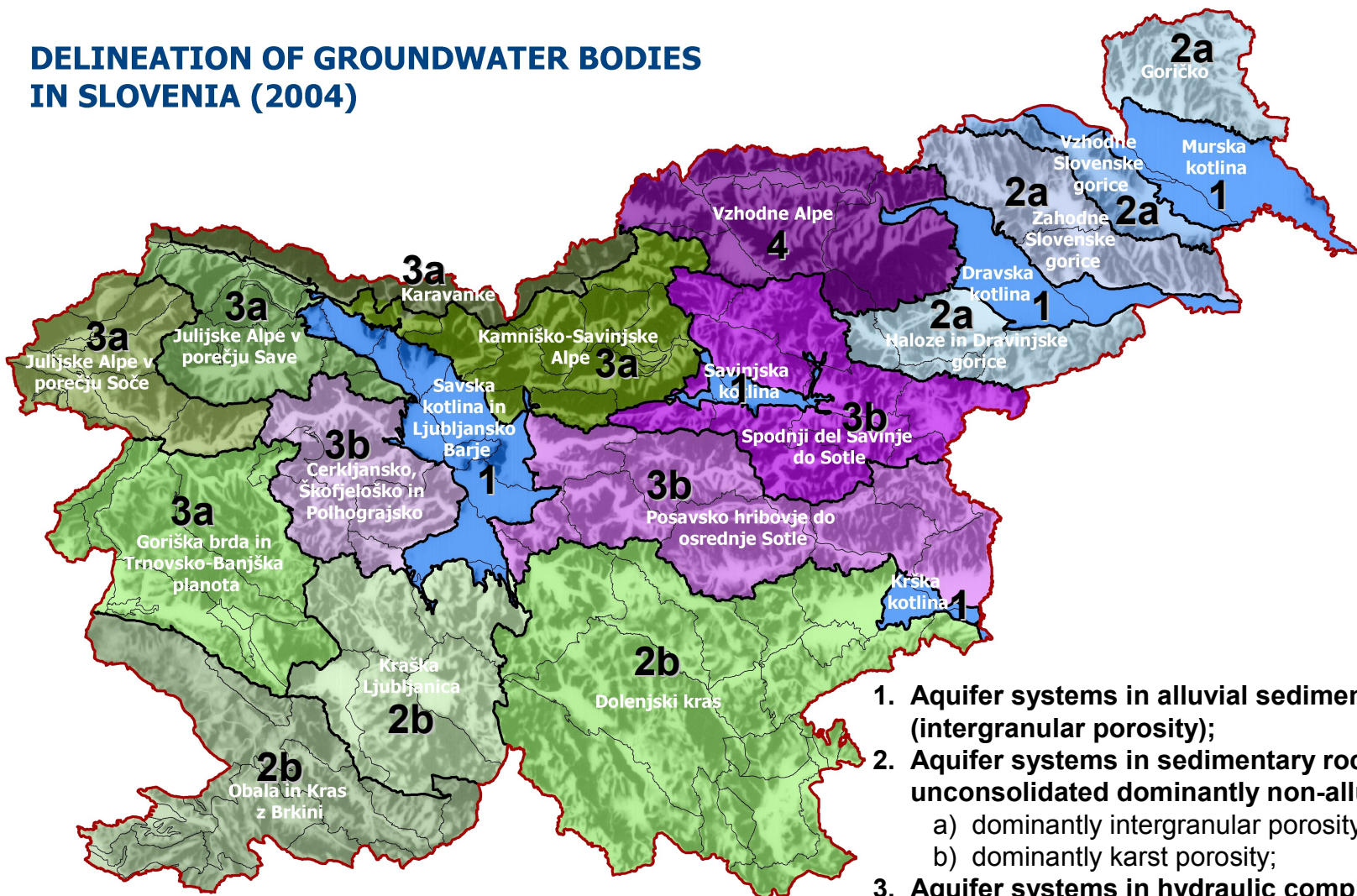
# Delimitation of Groundwater Bodies (GWB) and Transboundary Groundwater bodies



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## DELINEATION OF GROUNDWATER BODIES IN SLOVENIA (2004)

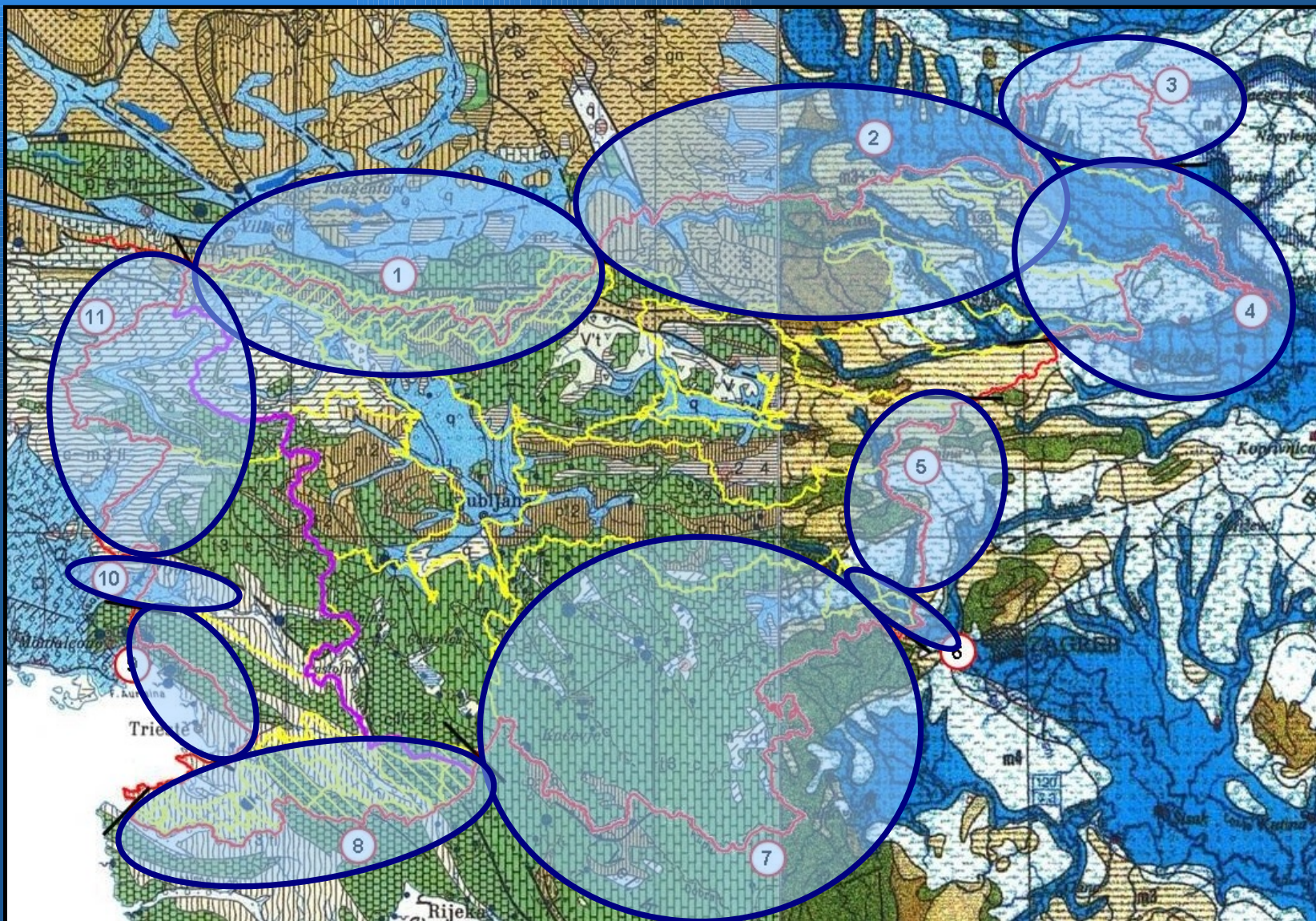


1. Aquifer systems in alluvial sediments (intergranular porosity);
2. Aquifer systems in sedimentary rocks and unconsolidated dominantly non-alluvial sediments;
  - a) dominantly intergranular porosity;
  - b) dominantly karst porosity;
3. Aquifer systems in hydraulic complex system adapted to intensely folded mountain zones;
  - a) dominantly karst porosity;
  - b) dominantly fissured porosity;
4. Aquifer systems in basement geological strata.

# Delineated Transboundary Groundwater bodies between Slovenia and neighbouring countries Croatia, Italy, Austria and Hungary on the Map of Europe M 1:1.500.000



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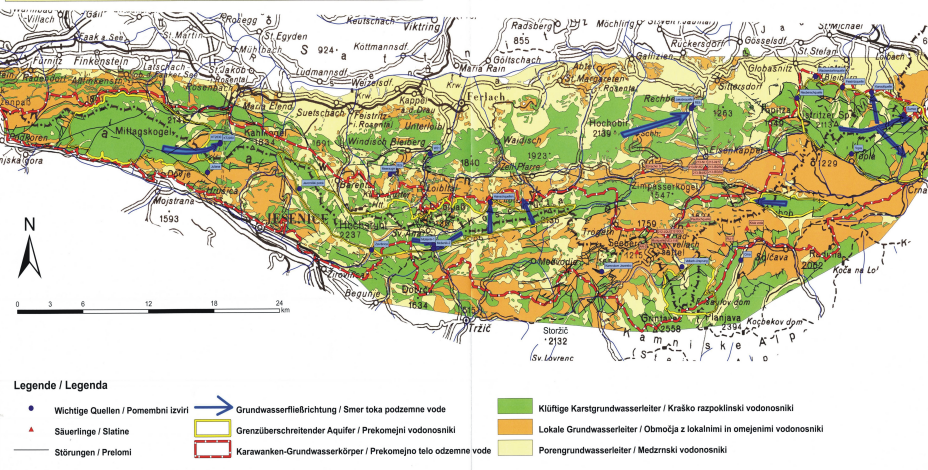
Reference: Karrenberg, H., et al. 1970: Internationale Hydrogeologische Karte von Europa 1: 1.500.000.

# Ttransboundary groundwater bodies

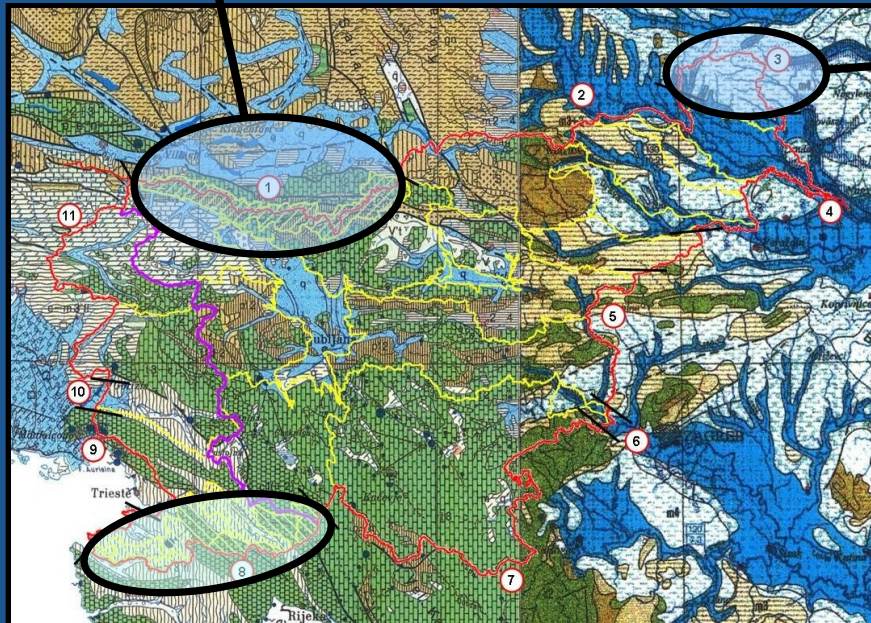
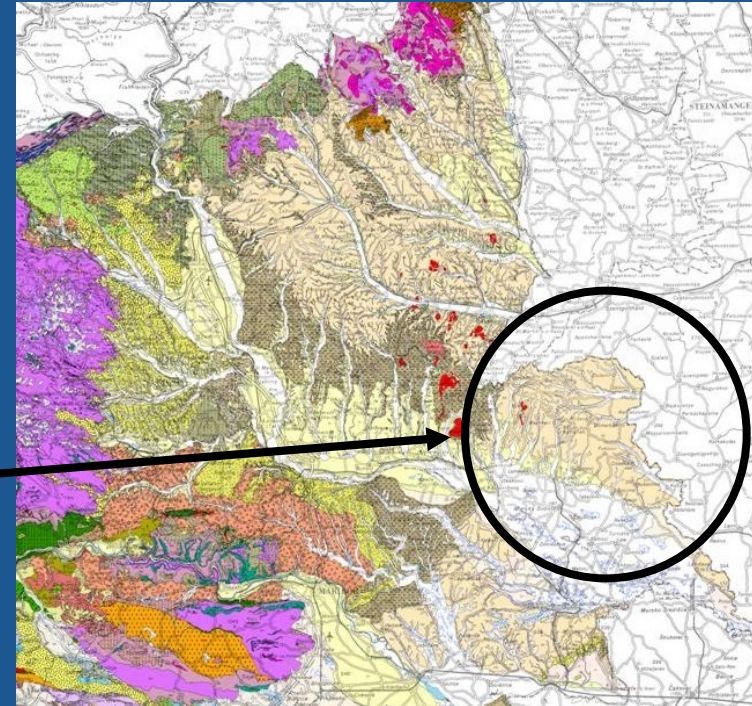
Reference: Brenčić, M., Poltnig, W., 2008: Podzemne vode Karavank – Skrito bogastvo; Grundwasser der Karawanken-Versteckter Schatz,

Ljubljana, Graz

Hydrogeologische Karte / Hidrogeološka karta



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Reference: Lapanje, A. et all, 2007: Geotermalni viri severne in severovzhodne Slovenije (Geothermal resources of northern and north-eastern Slovenia). Ljubljana

# Joined hydrogeological maps Austria-Slovenia (1:250.000) (eWater WEB GIS portal)

[www.ewater.eu](http://www.ewater.eu)



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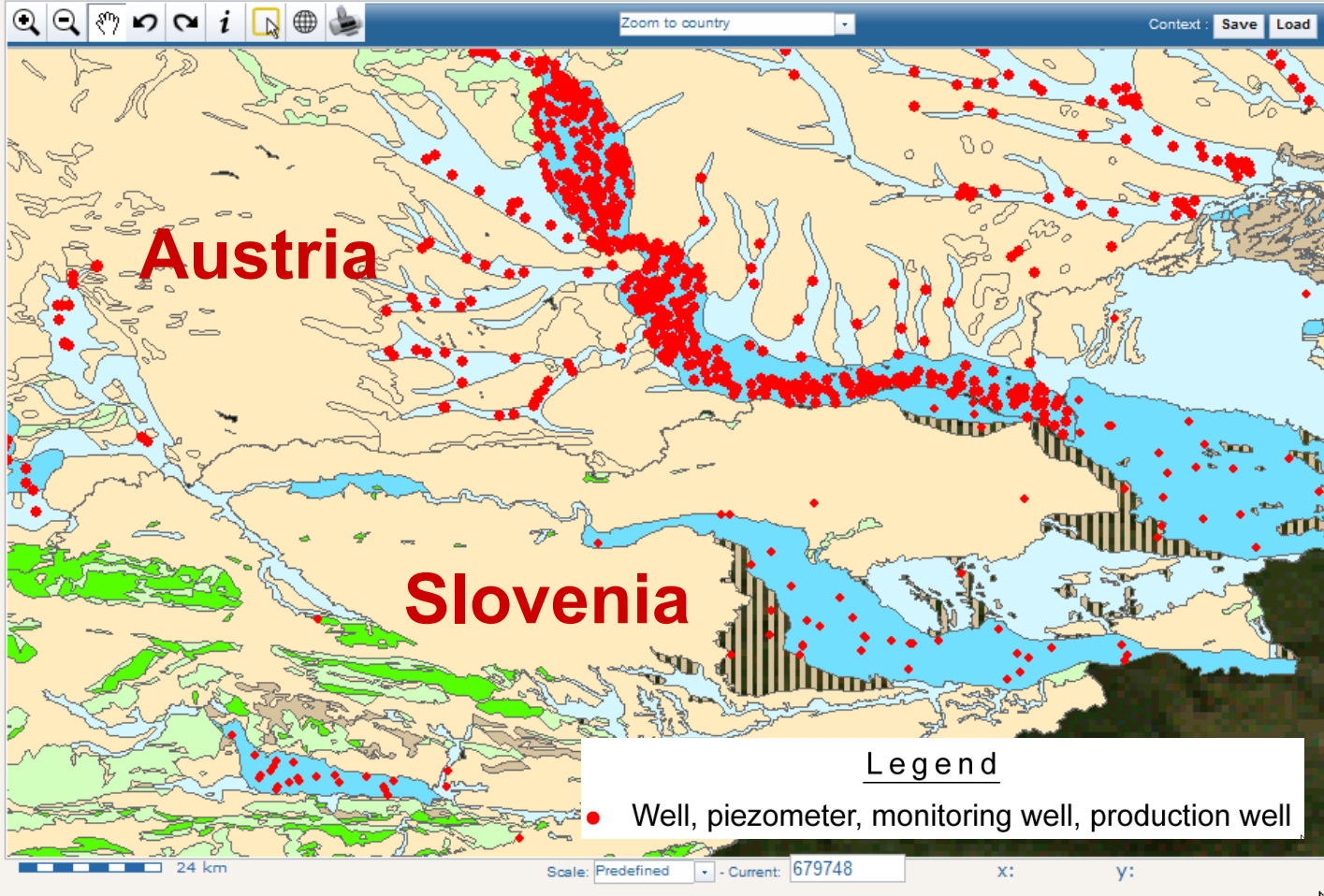
## Navigator



## Add eWater layers

- Map type
- Country
- Data providers

- [ Sweden ] - Groundwaterlevel in
- [ Sweden ] - Hydrogeological we
- [ Spain ] - Hydrogeological point
- [ Slovenia ] - Hydrogeological we
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- [ Italy ] - Hydrogeological well nr
- [ Hungary ] - Hydrogeological pc
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- [ Denmark ] - Hydrogeological w
- [ Austria ] - Hydrogeological poi



## Legend

- Well, piezometer, monitoring well, production well



# Conclusions



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- 1 Transboundary Groundwater body (Karavanke) is bilaterally characterized proposal (Slovenia & Austria) and prepared for process of incorporation in River Basin Management Plan.
- 1 Transboundary Groundwater body (Slovenia & Croatia – Kvarner) – detailed delineation is made, but without bilateral characterization of Transboundary GWB.
- The other Transboundary Groundwater bodies are still on level of characterization. On the highest level are thermal aquifers between Slovenia and Austria. The future trilateral Transboundary Groundwater bodies can be expected.



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**Thank You for Your attention !**