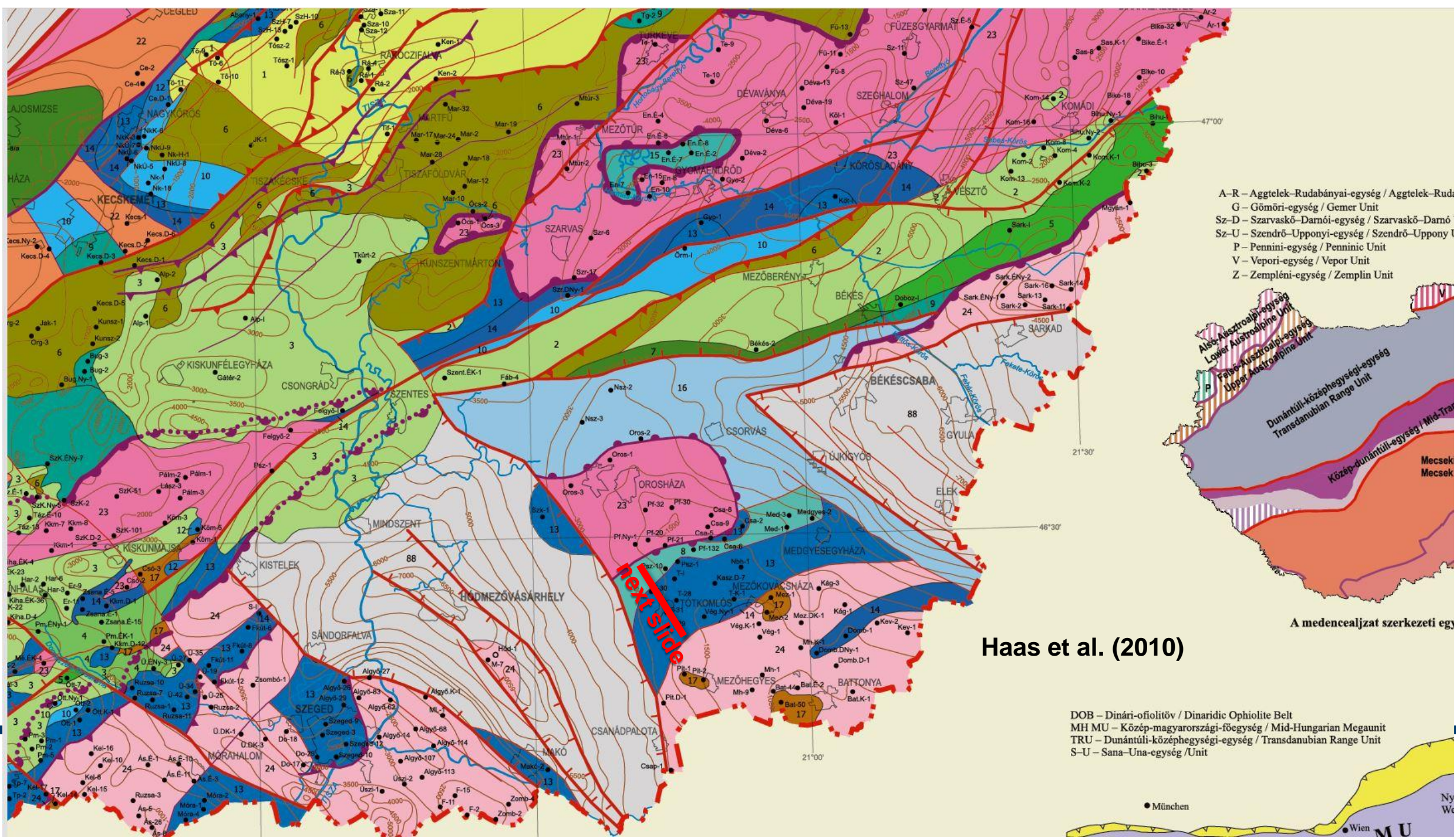


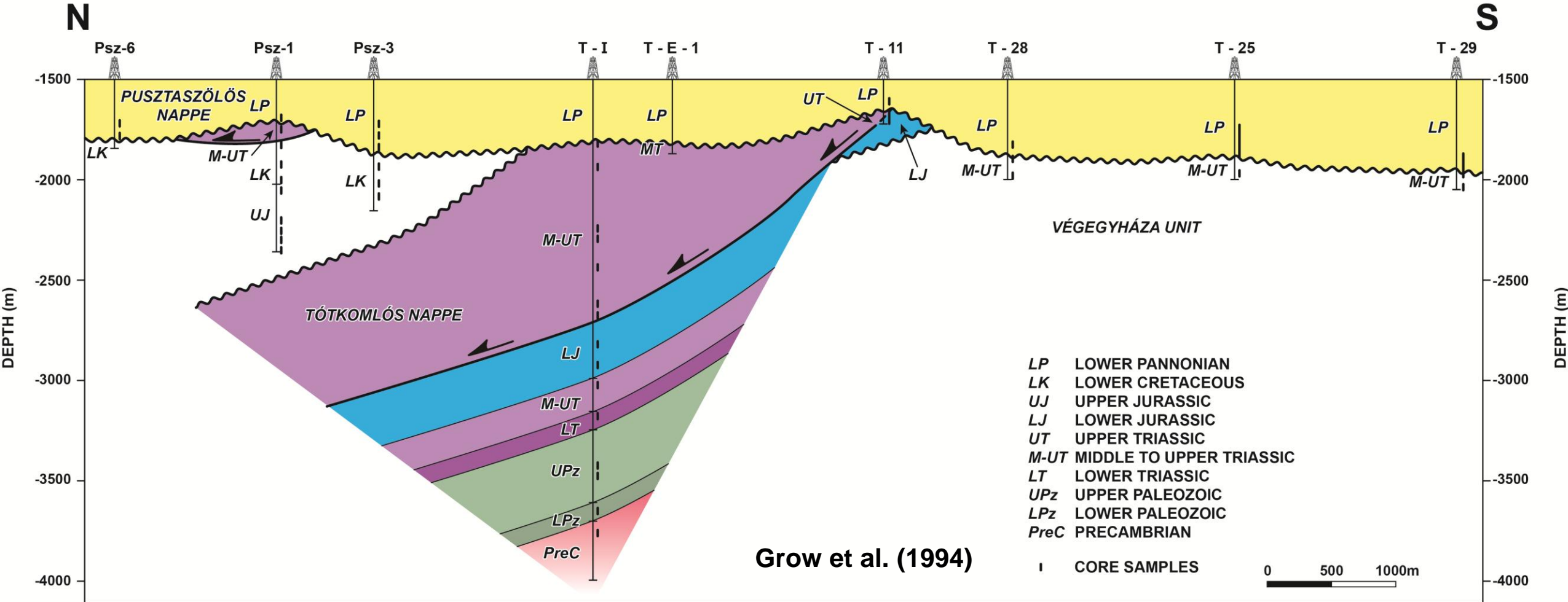
Alpi takarók a Pannon medence alatt: mindent megkutattunk-e már? Tari Gábor

NosztalGEO, Algyő, március 18, 2022

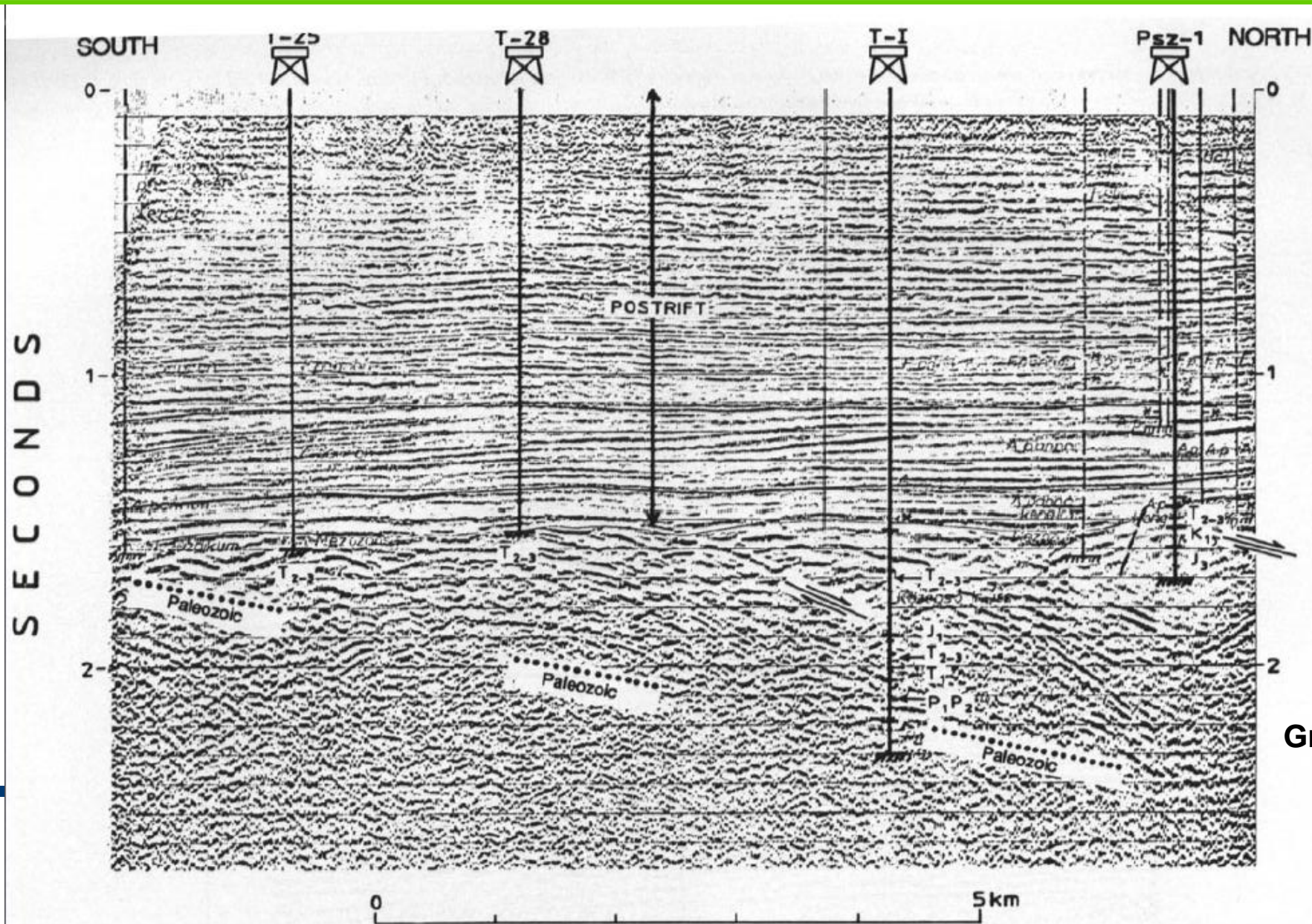
OMV Upstream



Nappes based on well data, Pusztaszőlős-Tótkomlós area

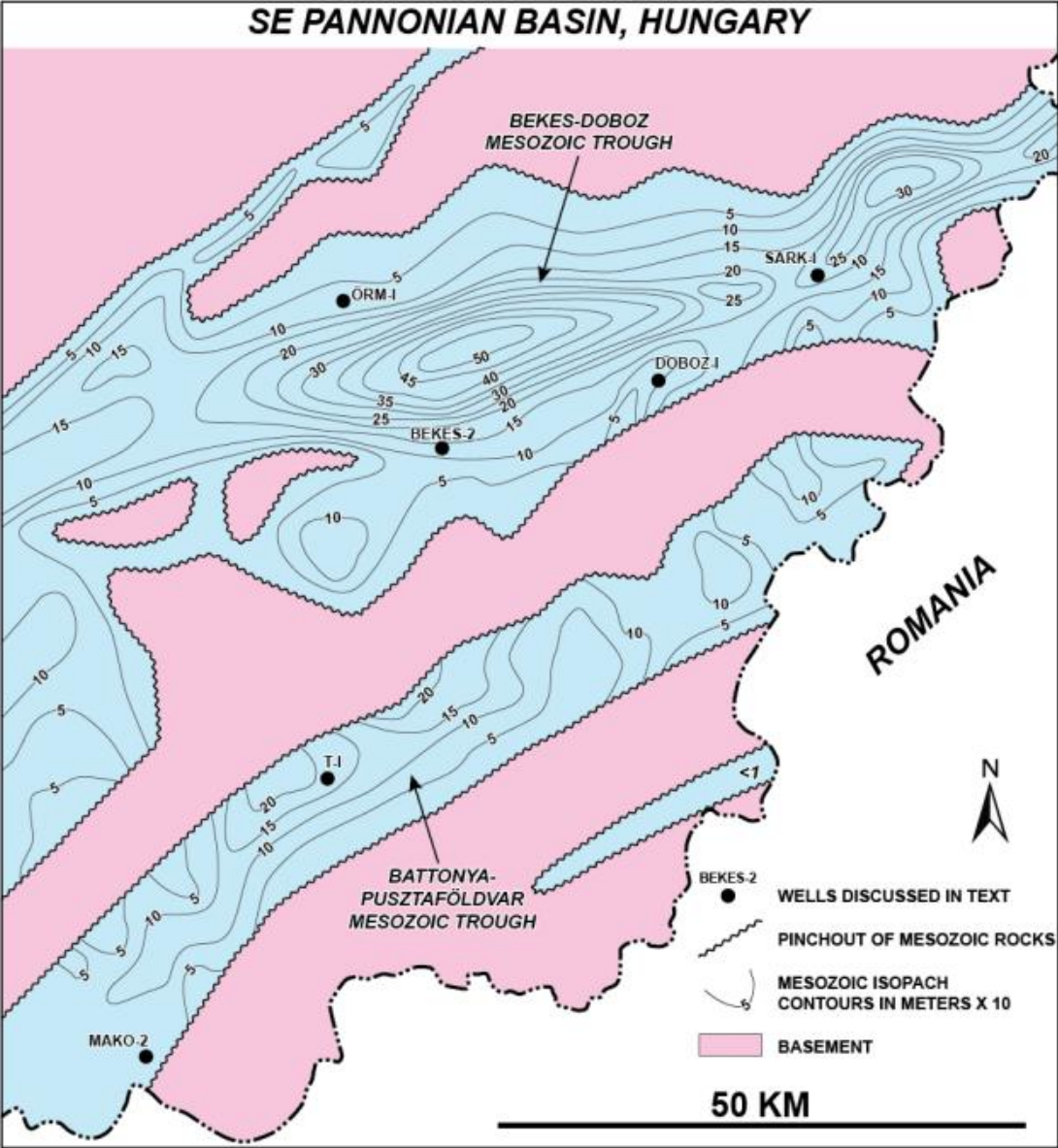


Nappes based on seismic data, Pusztaszőlős-Tótkomlós area

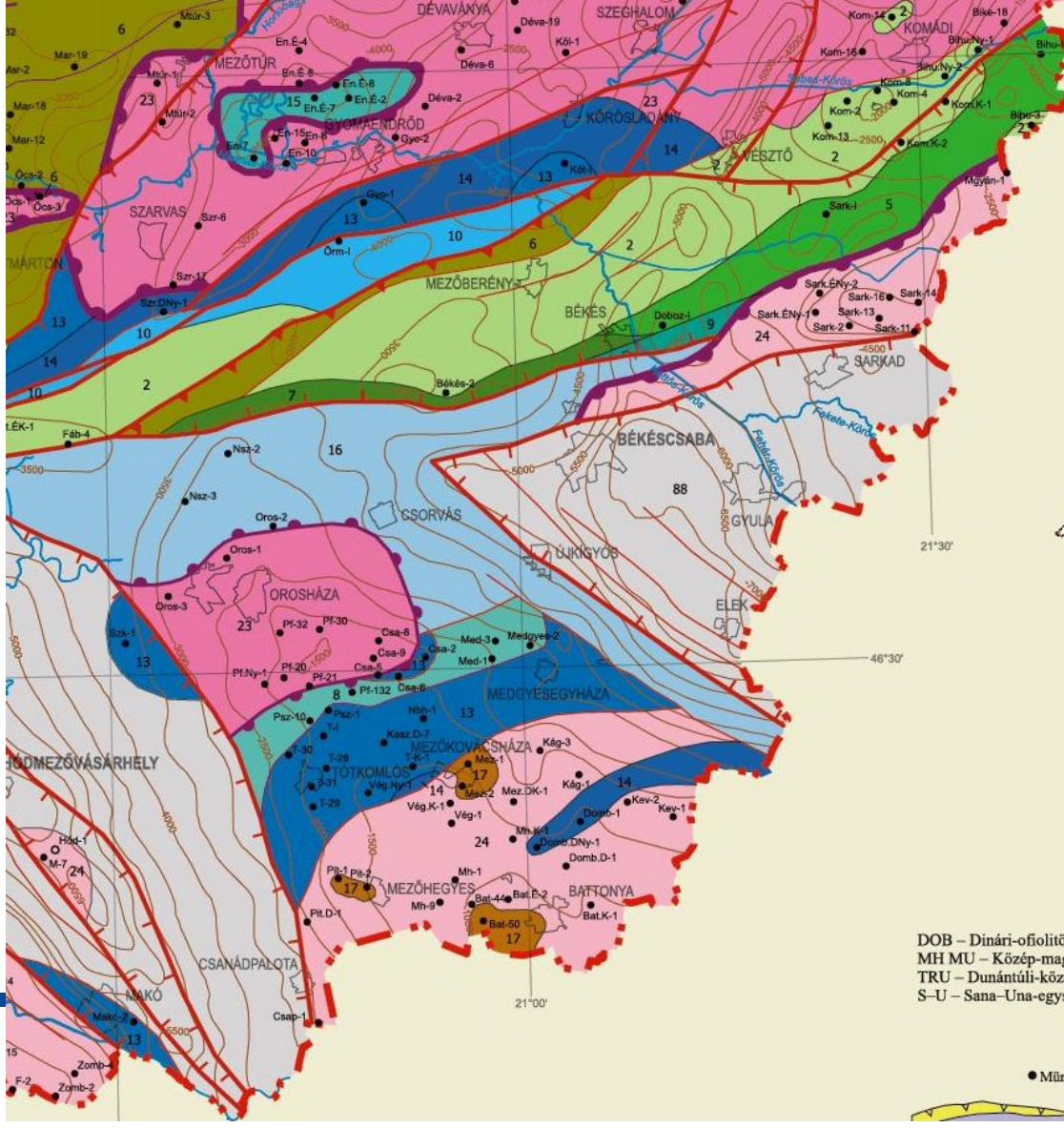


Grow et al. (1994)

Different perspectives on basement units



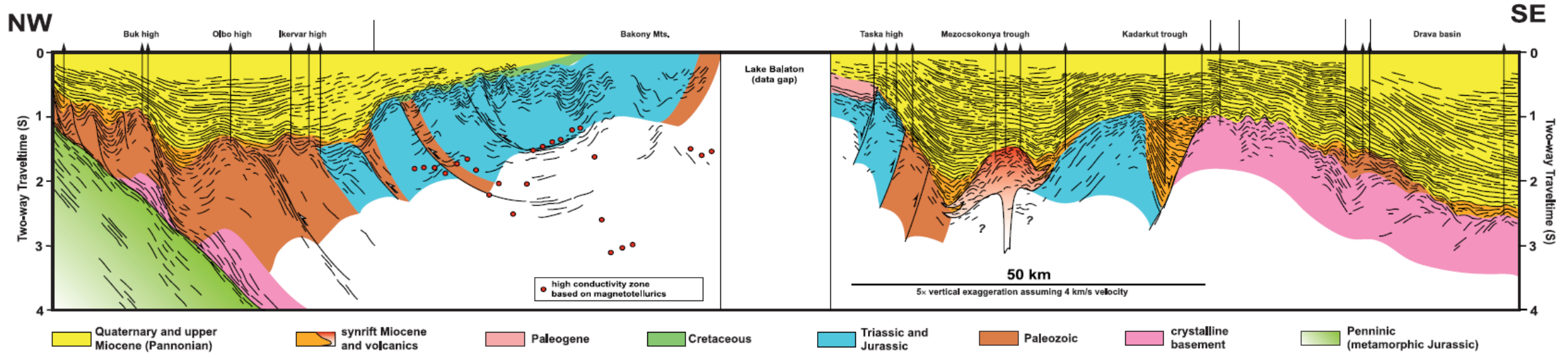
Grow et al. (1994)



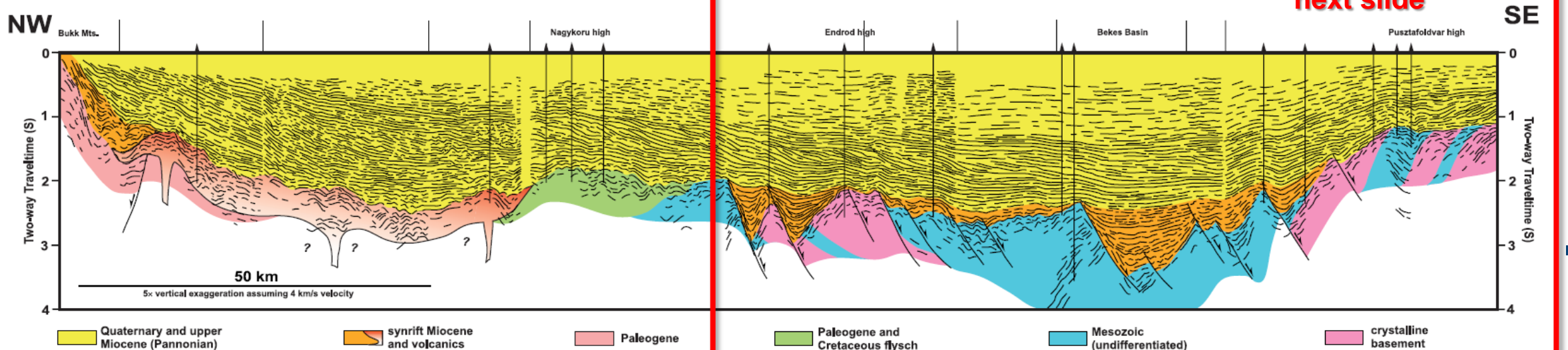
Haas et al. (2010)

Regional transects across the Pannonian Basin

A) Regional Transect, Western Pannonian Basin

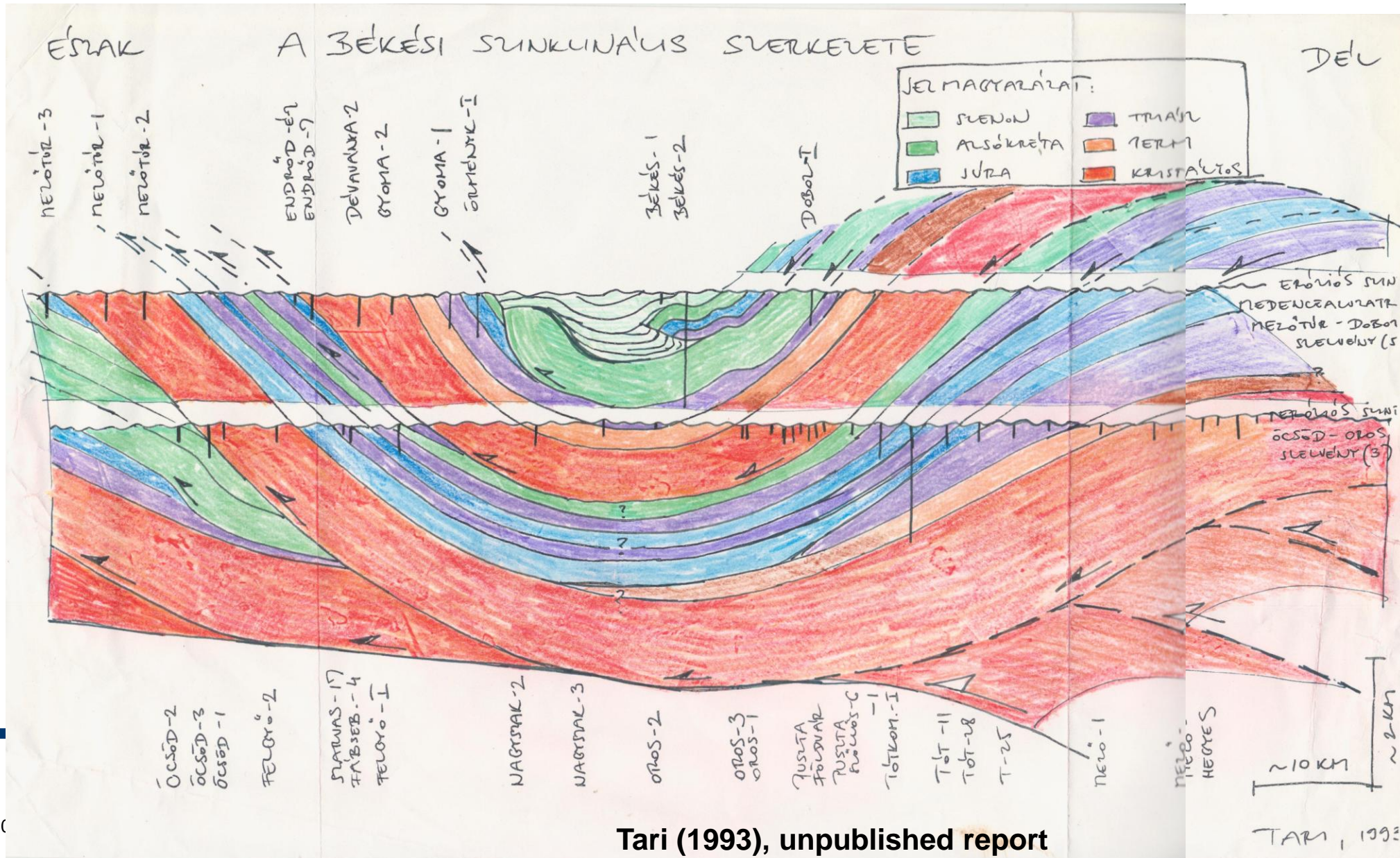


B) Regional Transect, Eastern Pannonian Basin

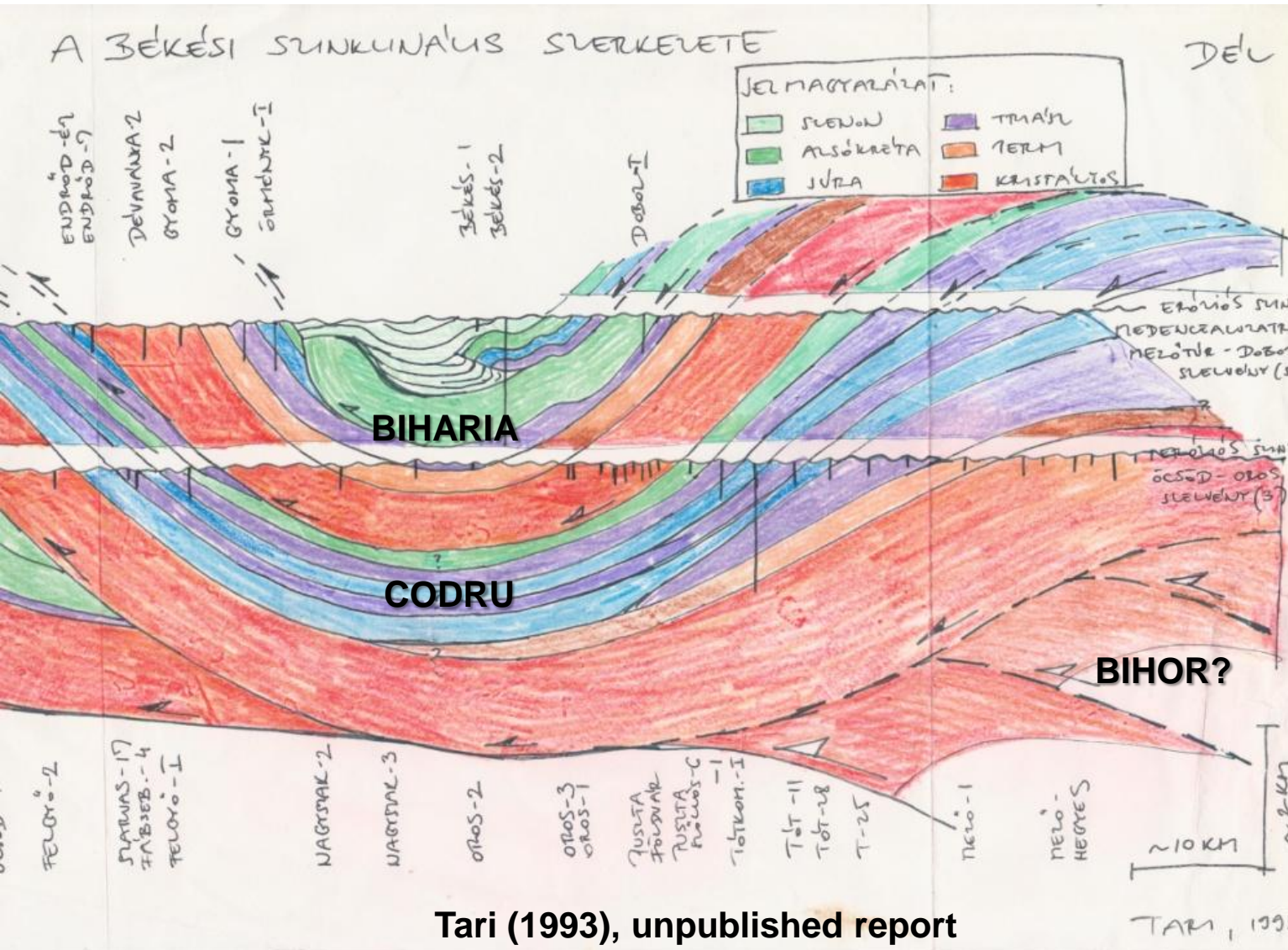


Tari and Horvath (2006)

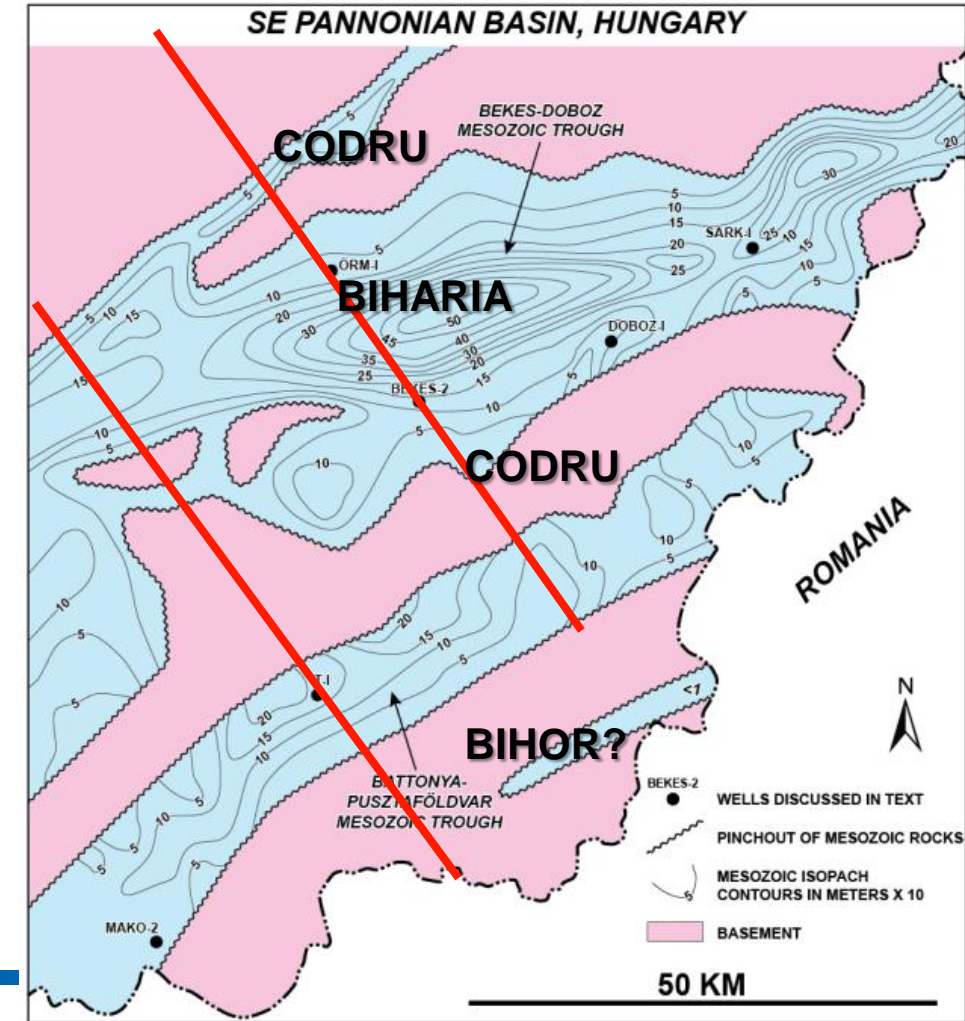
The nappes of the SE Pannonian Basin and the Tisza Antiform



The Békés Synform and the Tisza Antiform

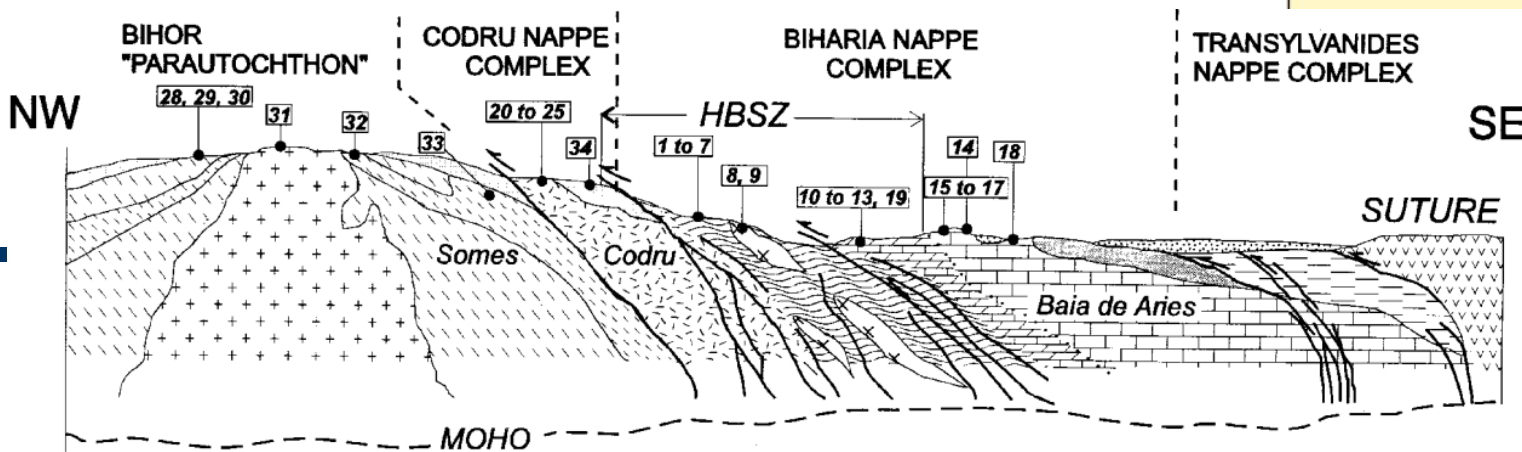
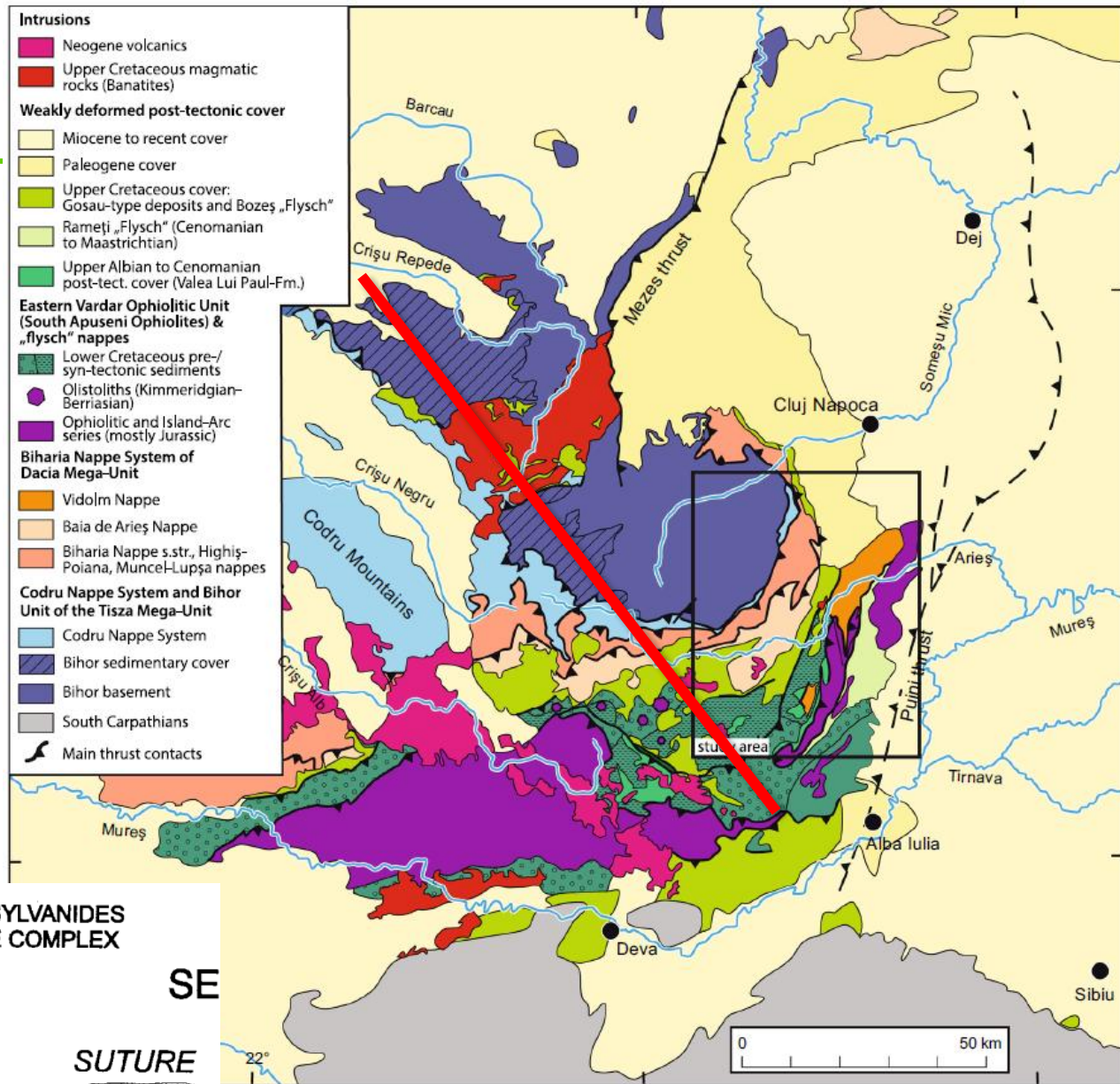


Tari (1993), unpublished report



Grow et al. (1994)

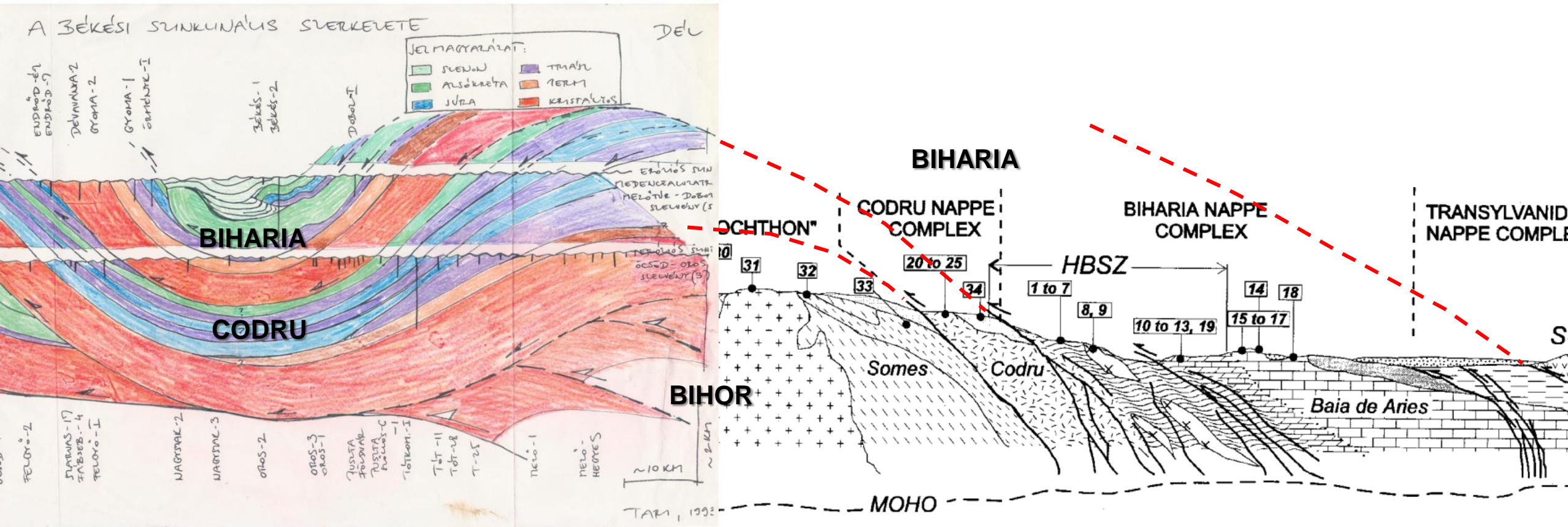
Correlation to the Apuseni Mts.



Reiser et al. (2016)

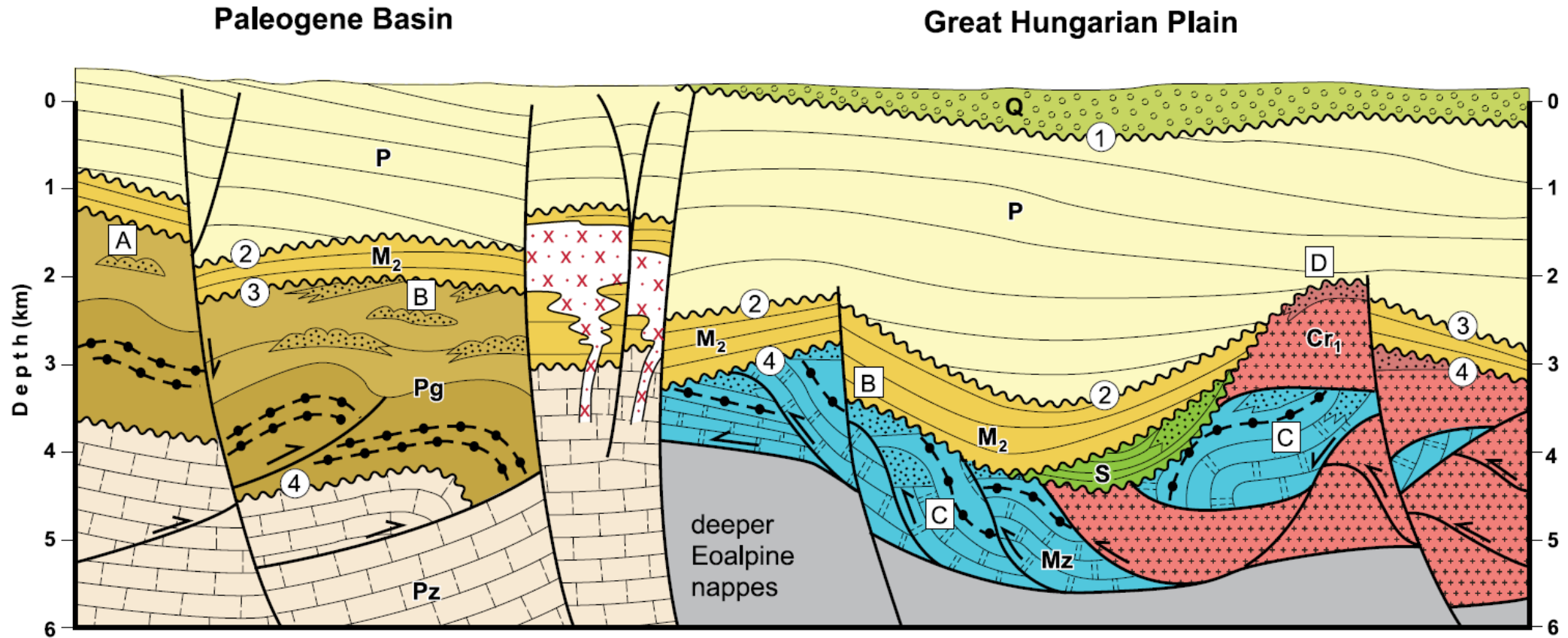
Dallmeyer et al (1999)

Correlation of the Tisza Antiform with the Bihar paraautochthon?



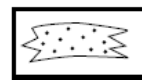
Large offset
(circa 250 km)

Plays within the pre-rift basement? Why is it not working?



Play Types:

- A** turbiditic sandstones in deep basin
- B** subunconformity sandstones and/or carbonates
- C** fault-bend folds and other subthrust traps
- D** basement highs with fractures



reservoir rocks



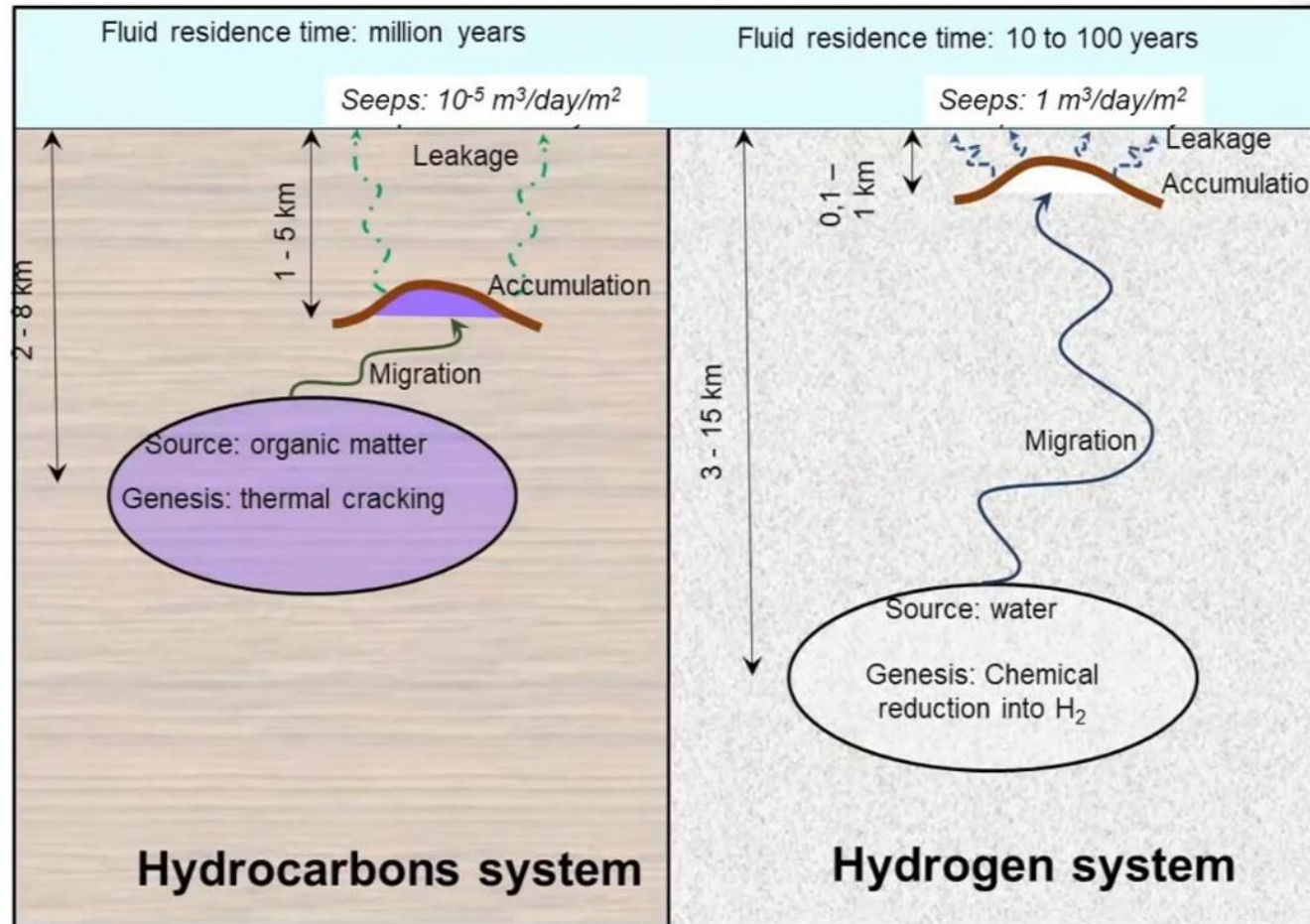
mature source rock (shales and coal beds)

Megasequence boundaries:

- ① top Pliocene (Pannonian)
- ② top of middle Miocene synrift
- ③ top of Paleogene basin
- ④ top of Mesozoic (pre-Senonian) Eoalpine imbricates and nappes

Hydrocarbon versus hydrogen exploration

- ▶ A truly “fossil” and finite energy source, i.e. took millions of years to make an accumulation
- ▶ Source is well defined (organic matter)
- ▶ There are effective seals and traps
- ▶ Largely static system
- ▶ Variable depth for accumulations
- ▶ Seeps, if they exist, are very subtle, i.e. $\sim 0.00001 \text{ m}^3/\text{day}/\text{m}^2$



Prinzhofer (2021)

- ▶ A truly “renewable” and infinite(?) energy source, i.e. dynamic recharge on a human life scale (10-100 years)
- ▶ Source is debated (water, chemical reactions, degassing)
- ▶ No ultimate seal, constantly leaking
- ▶ Dynamic system
- ▶ Shallow accumulations (so far!)
- ▶ Seeps are standard and very robust, i.e. $\sim 1 \text{ m}^3/\text{day}/\text{m}^2$

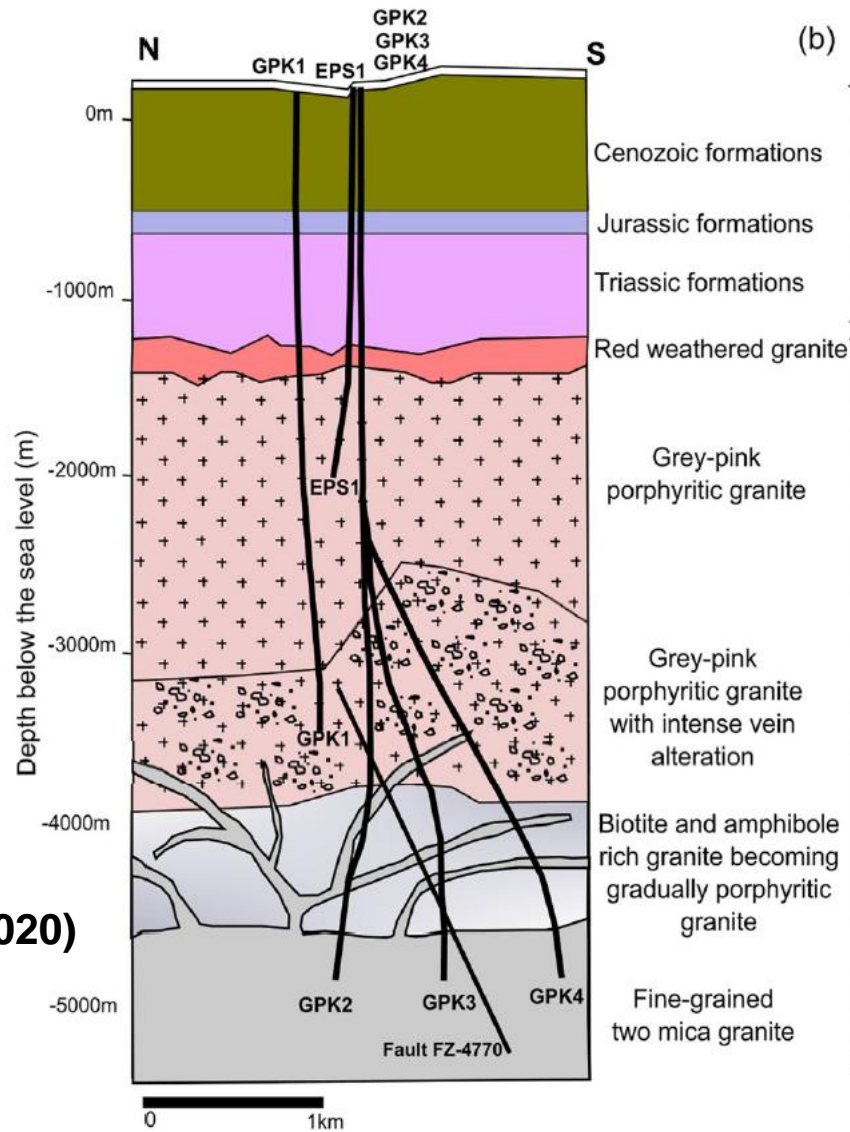
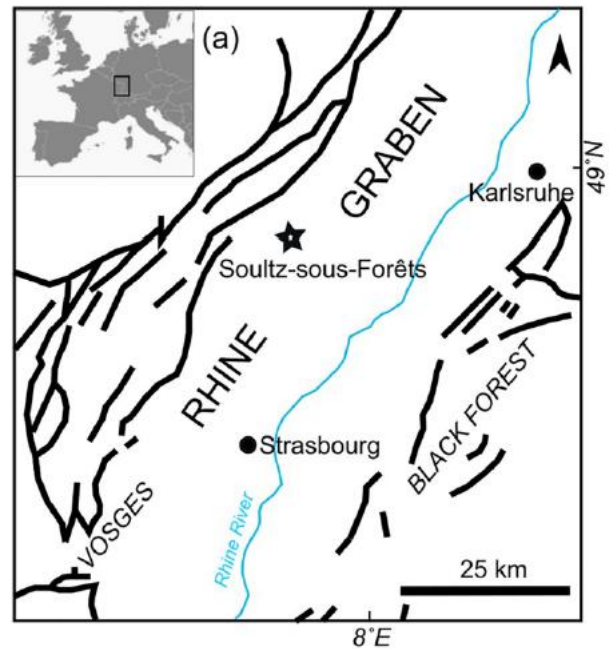
Hydrogen and helium generating granites



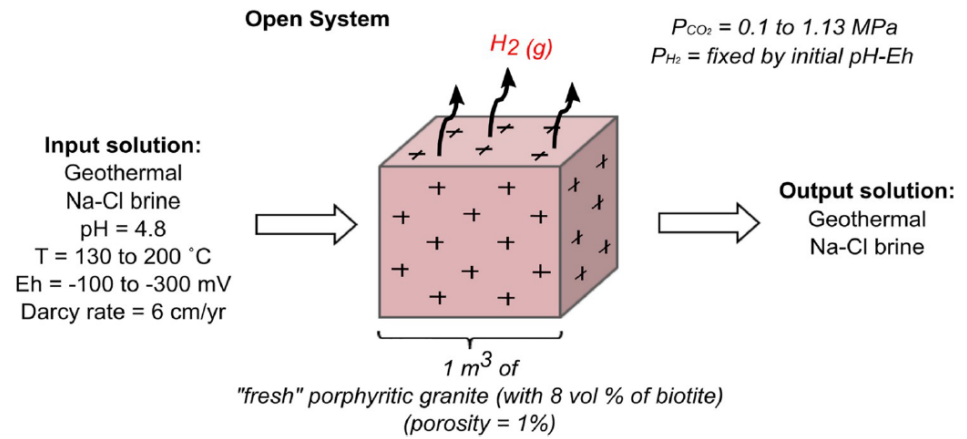
The granites do not need to be necessarily very old (i.e. Proterozoic in this case study) Carboniferous granites can also generate hydrogen and helium, for example, see the case of drilling for thermal water at Székesfehérvár before WWII...



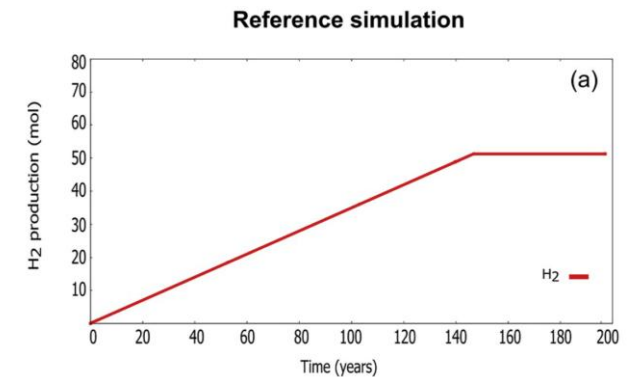
Hydrogen generation from biotite-rich granite



Murray et al. (2020)



Biotite is the most important source of Fe²⁺ that accounts for H₂ generation in the basement of the Soutz-sous-Forêts granitic reservoir, France



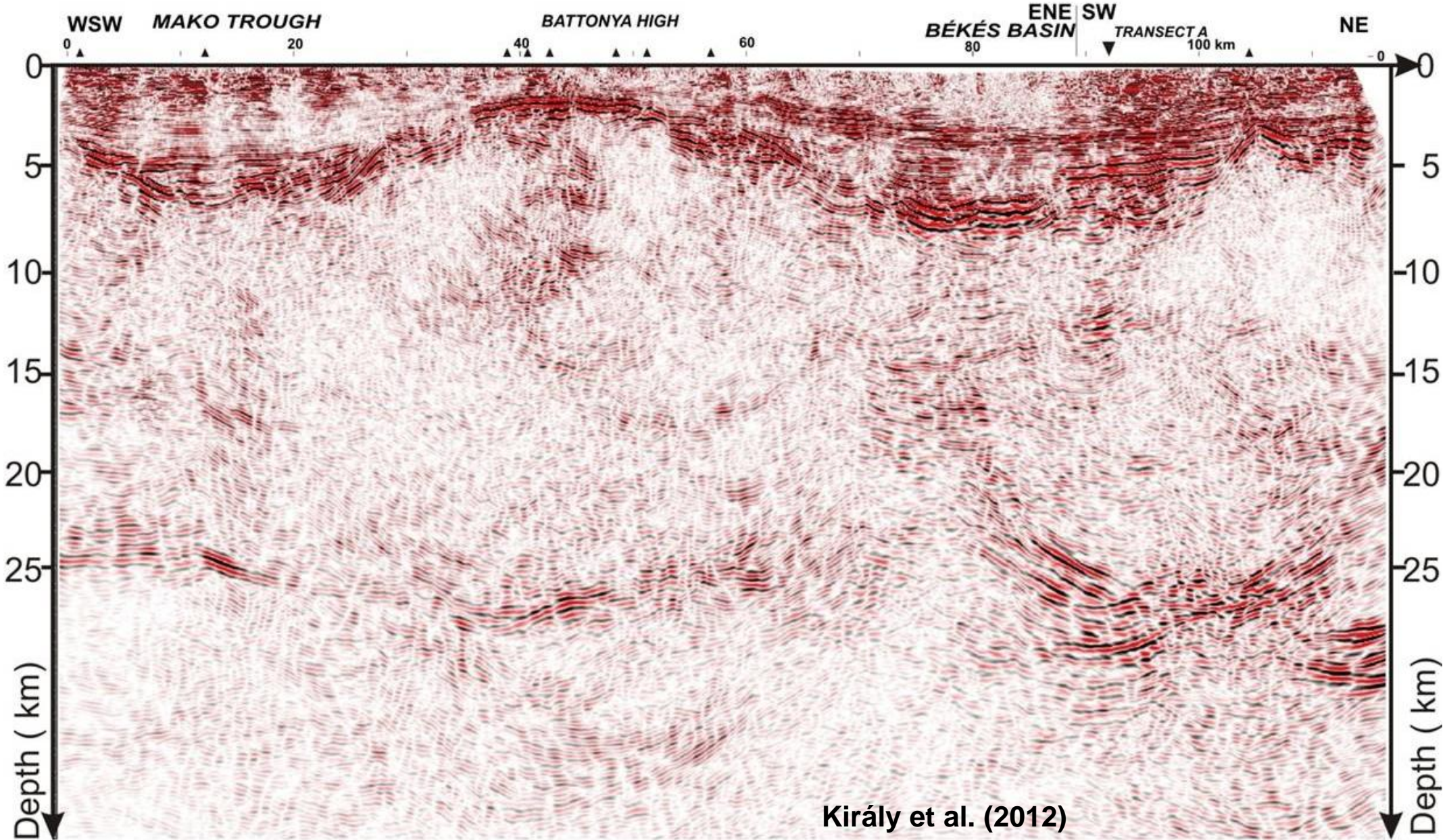
Future research needs to focus on how to reach most of the H₂ potential. Simulations with increasing CO₂ pressures suggest that CO₂ injection can stimulate the H₂ production. This study has implications for possible coupling of heat extraction and future exploitation with H₂ production

Hydrogen generation during serpentinization

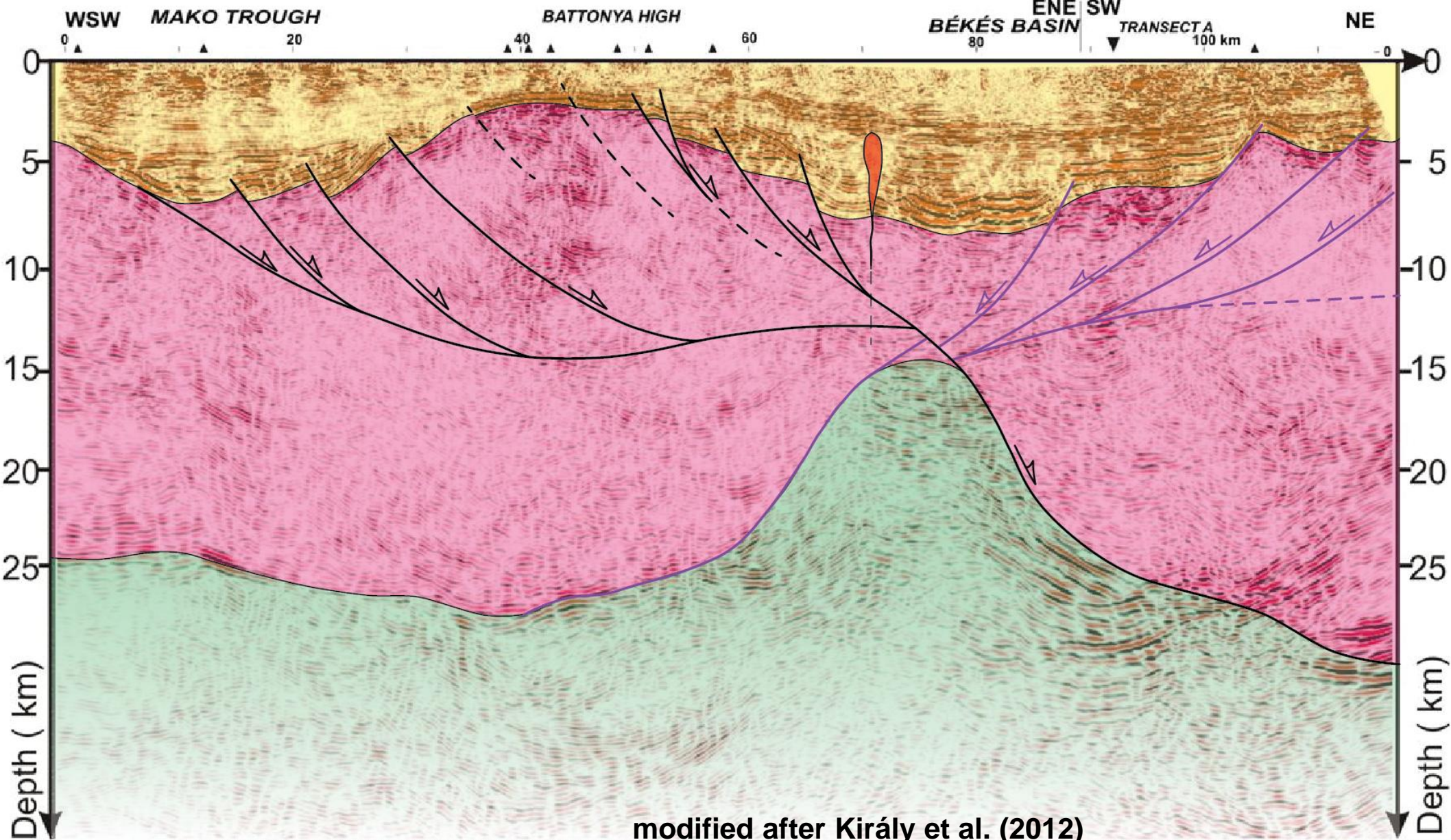


Similarity was noted in the H₂ production processes during hydrothermal alteration of granite and that of mafic rock during serpentinisation

Crustal scale seismic in the SE Pannonian Basin

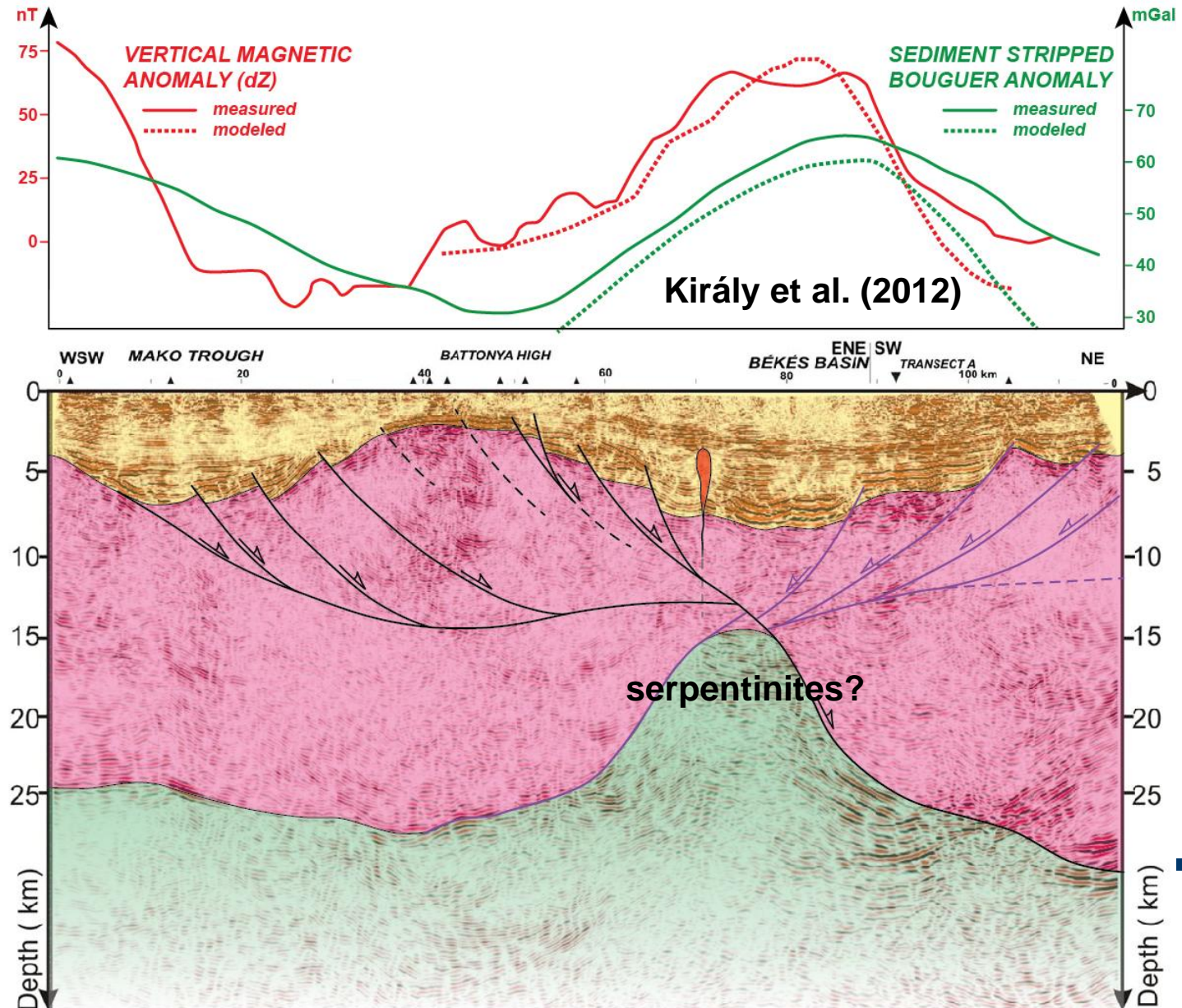
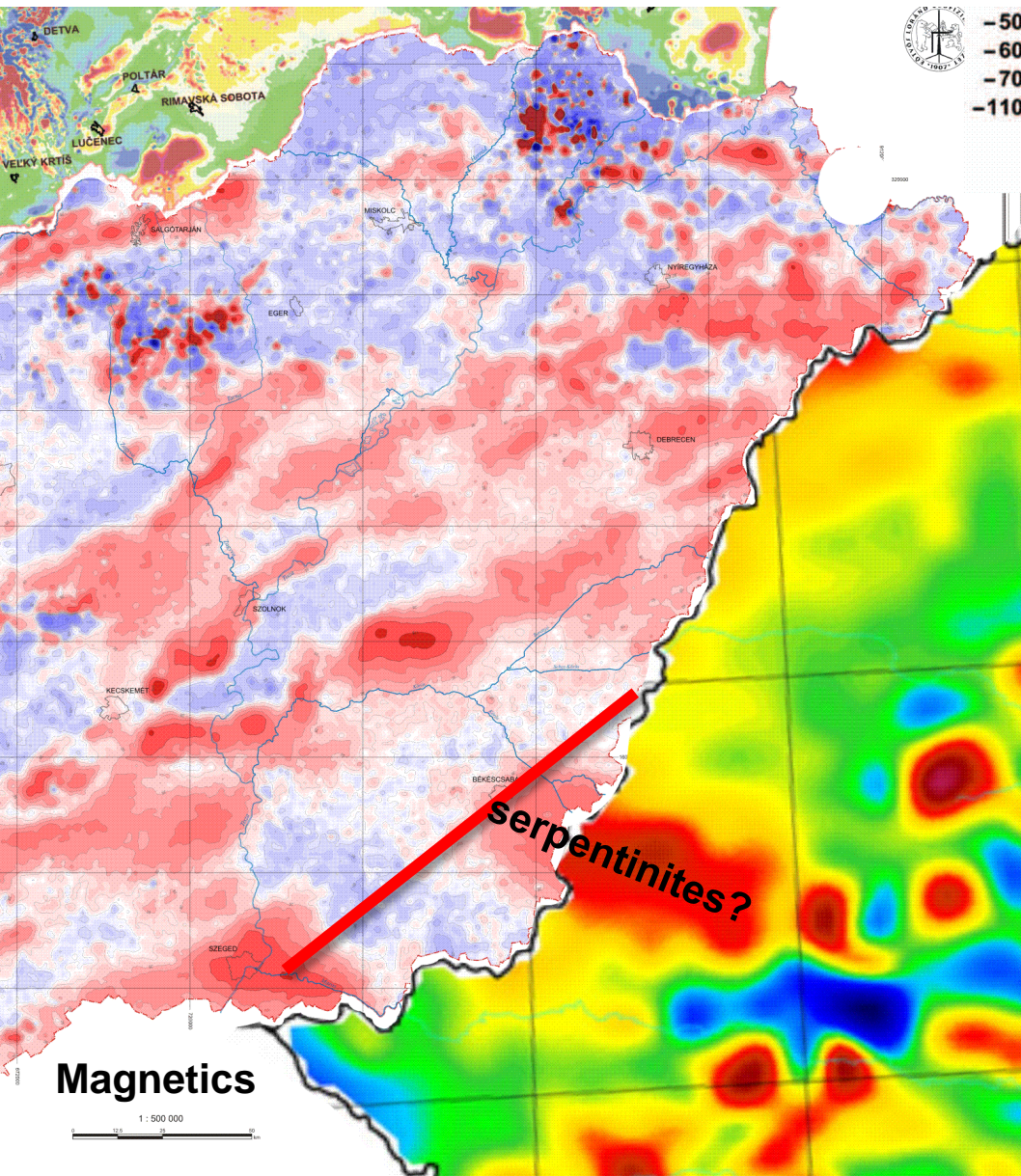


Crustal scale seismic in the SE Pannonian Basin: a new look

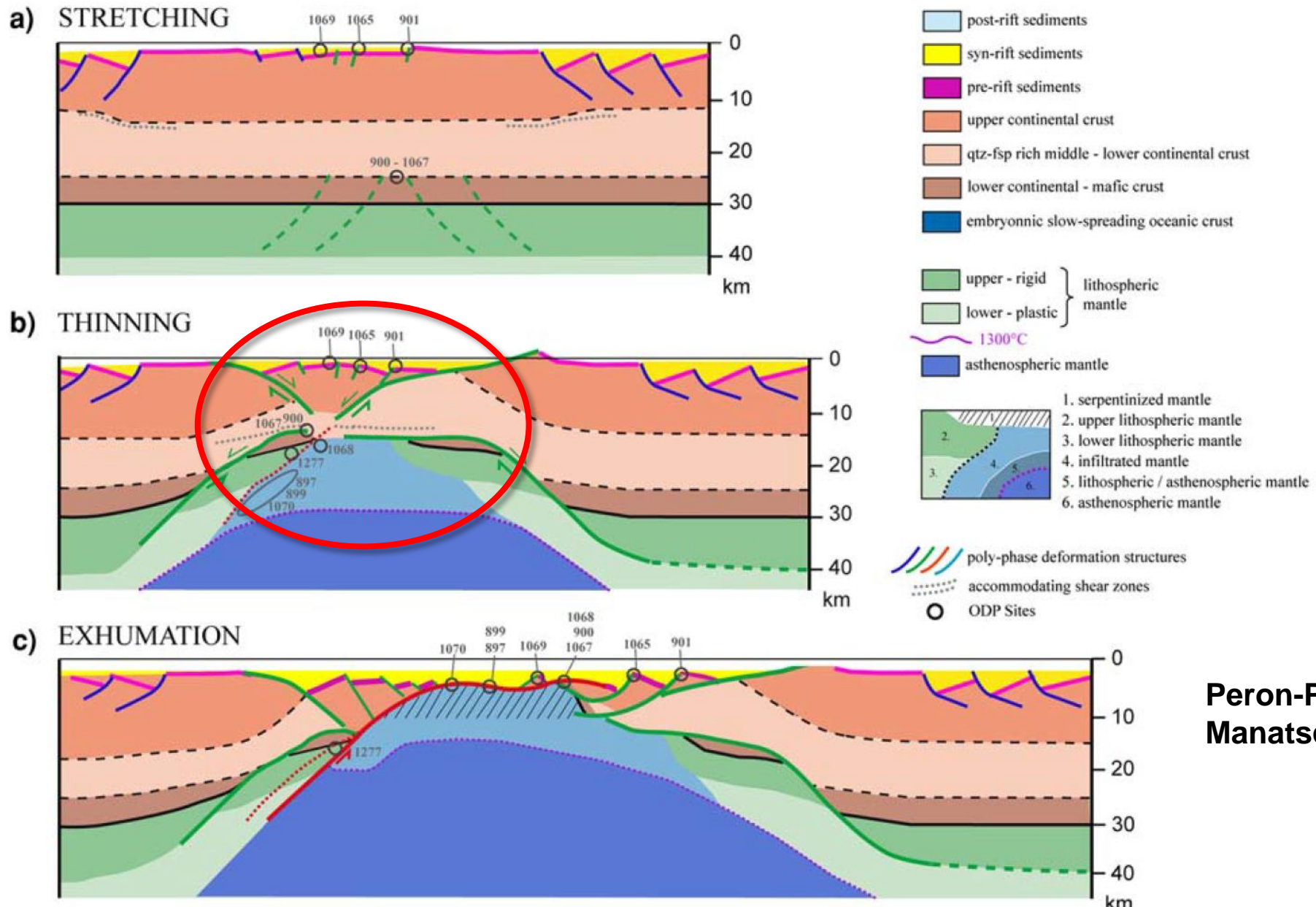


modified after Király et al. (2012)

Potential field modelling supports upwarping mantle geometry



From rifting to seafloor spreading: a generic model

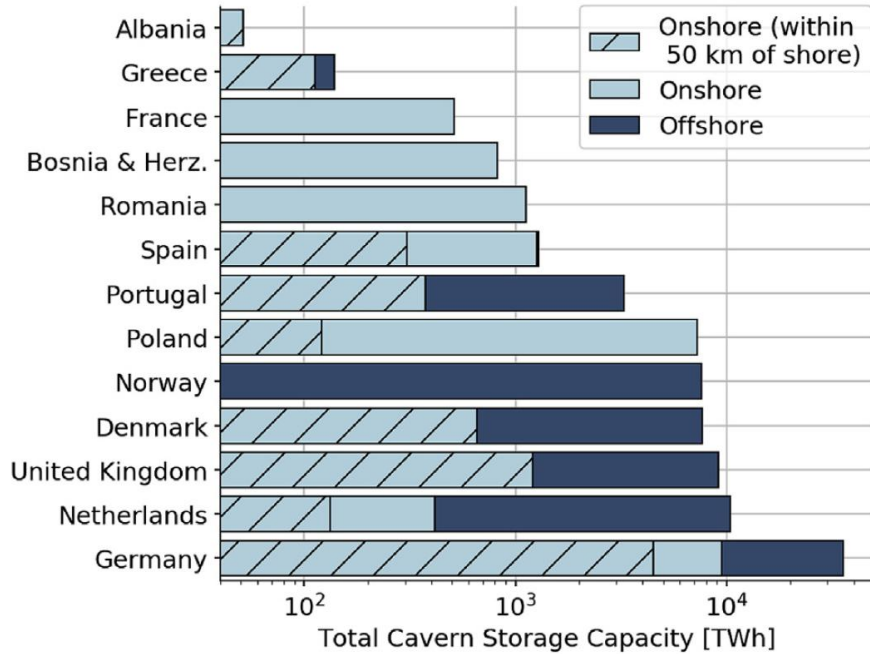


Peron-Pinvidic and Manatschal (2009)

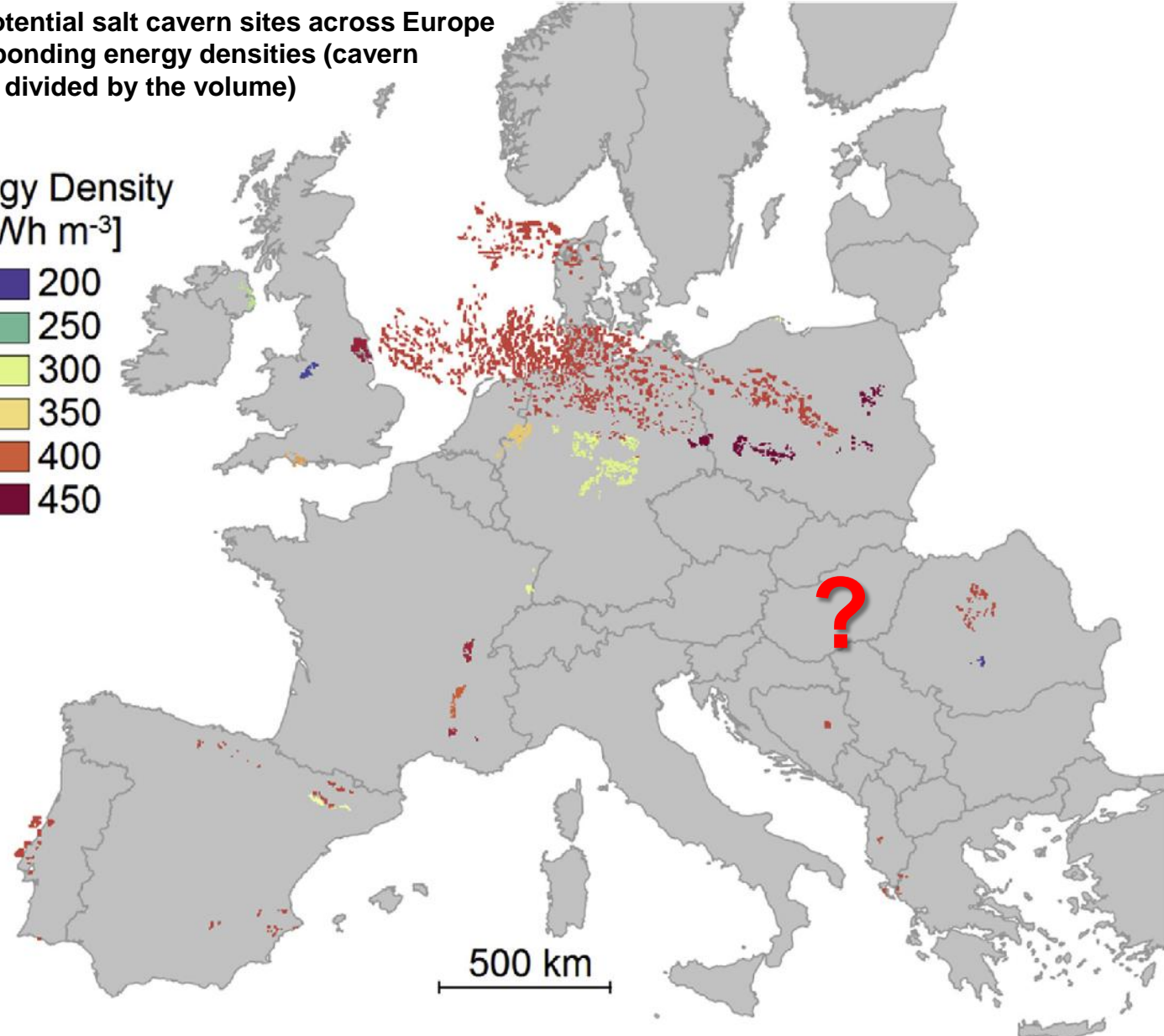
Energy transition in Europe

The hydrogen storage challenge

Distribution of potential salt cavern sites across Europe with their corresponding energy densities (cavern storage potential divided by the volume)

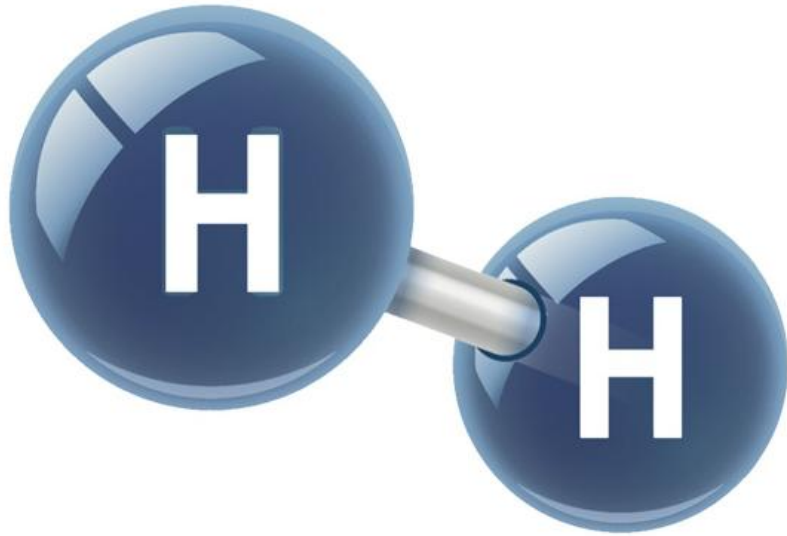


Energy Density [kWh m⁻³]



Total cavern storage potential in European countries classified as onshore, offshore and within 50 km of the shore (Caglayan et al., 2020)

Energy transition in the Pannonian Basin region with no salt Storage challenge for the “Houdini of all gases”



Escapologist
Harry Houdini
(1874-1926)