EGU General Assembly 2020

Isostatic and dynamic controls on neotectonic differential vertical movements and sediment transport reorganization of the Pannonian Basin, Central Europe



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Ádám Kovács[2], Orsolya Sztanó[2], László Fodor[3], András Kovács[2]

Liviu Matenco[4],

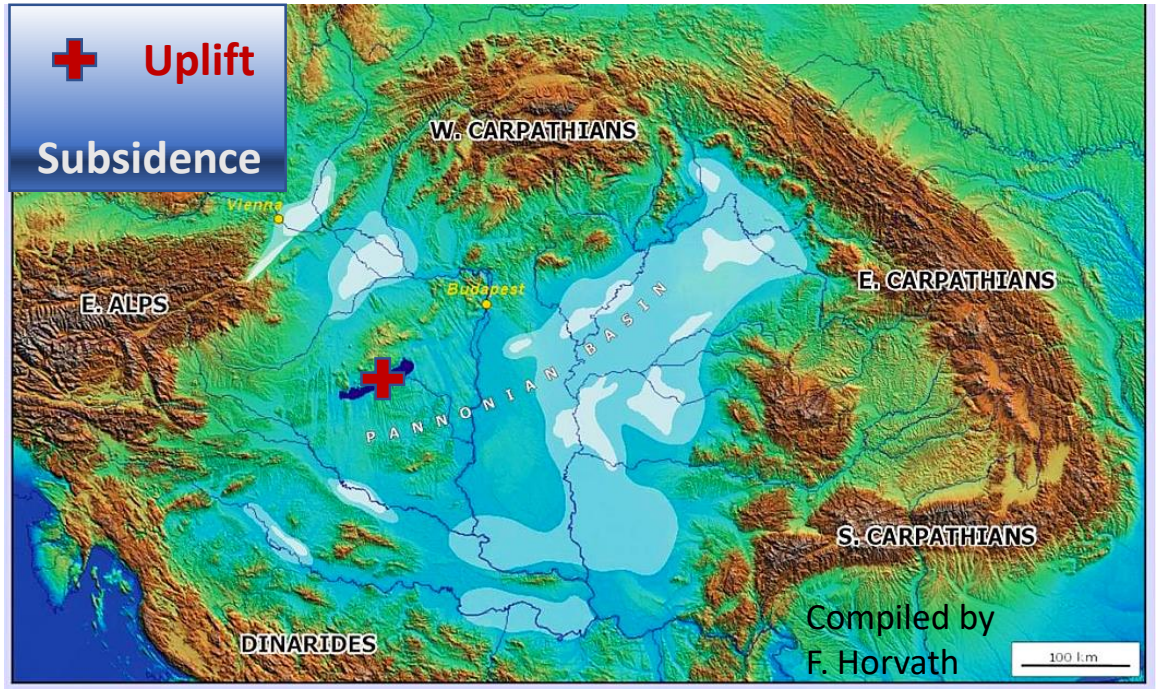
Didier Granjeon[5]

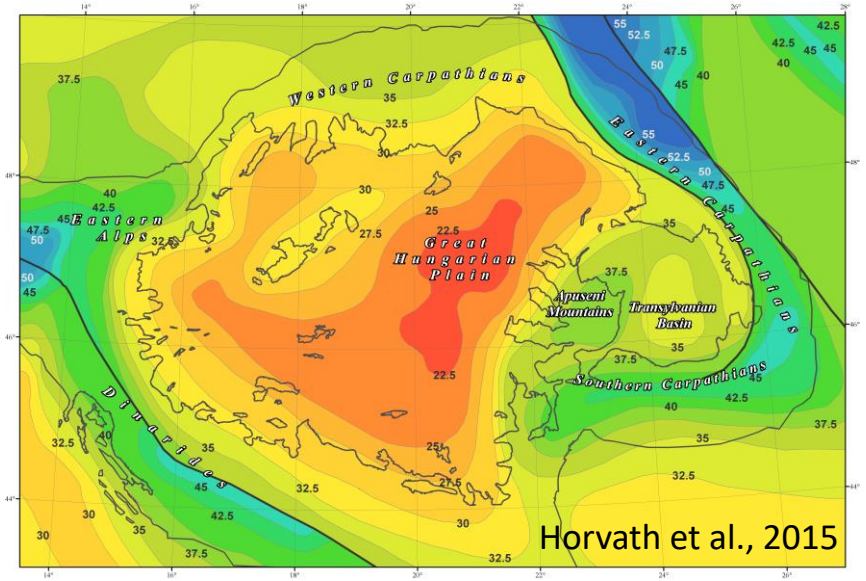
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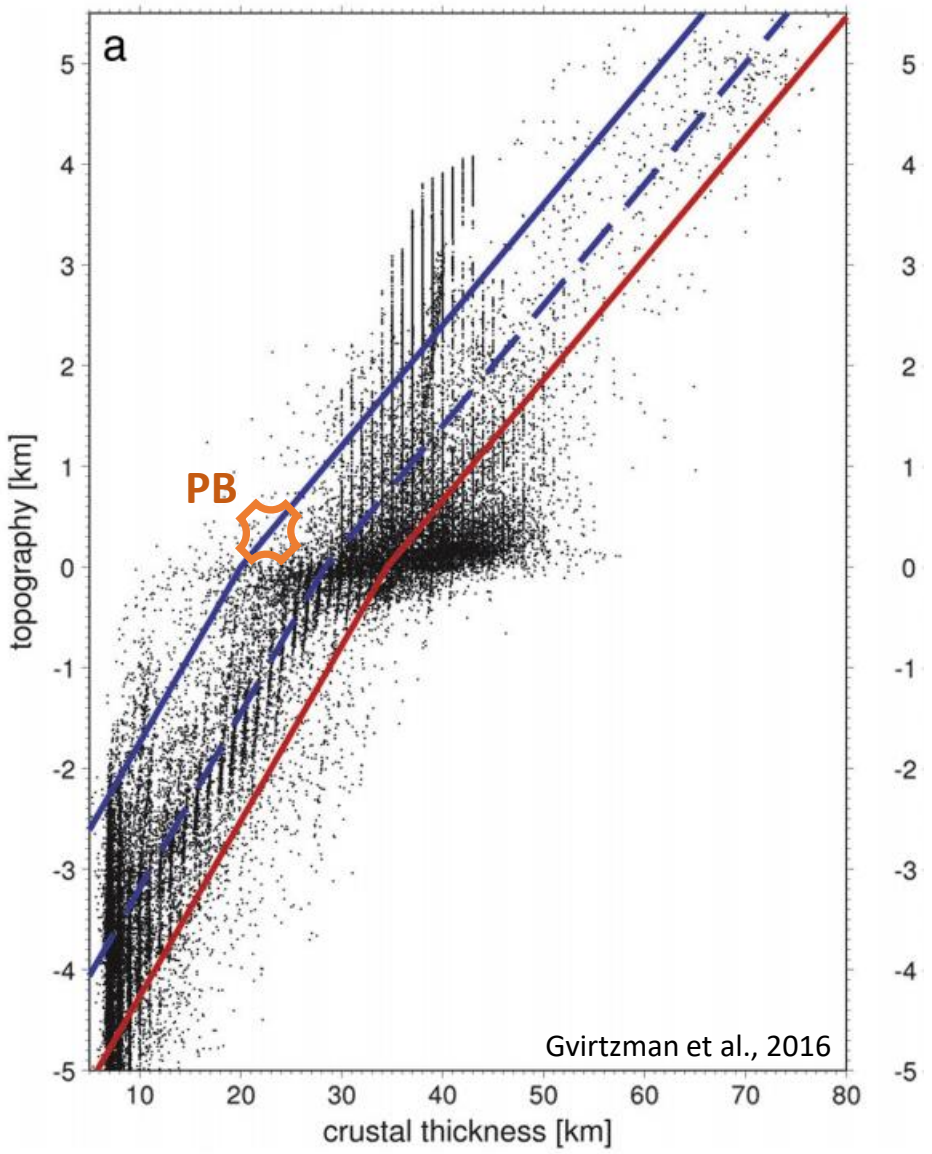
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What are the driving forces for the ongoing differential vertical motions in the Pannonian Basin?





Balazs et al., 2020. EGU

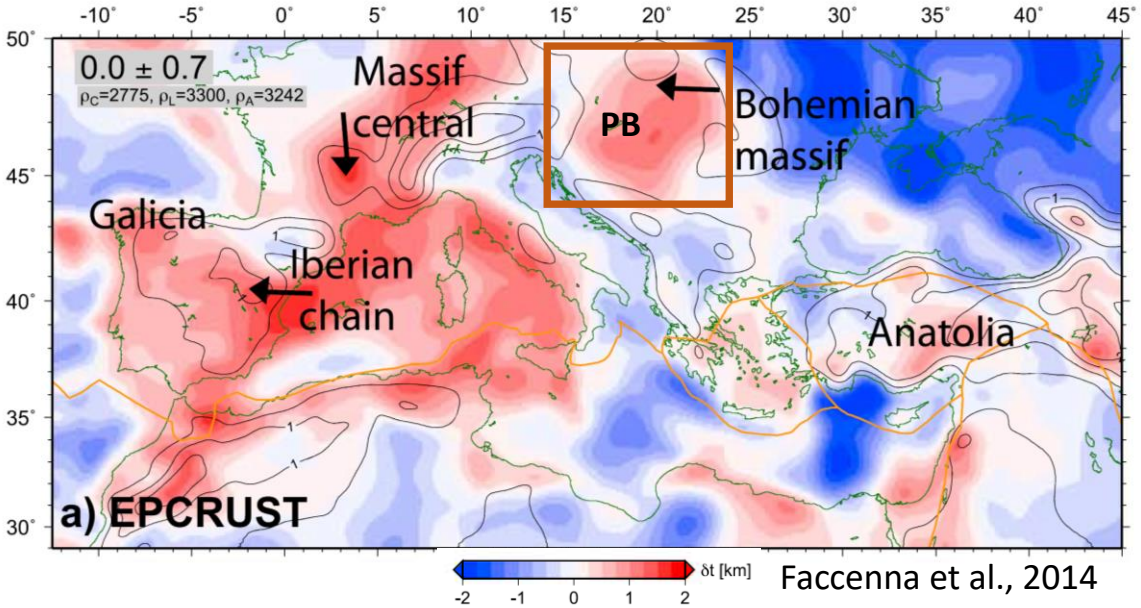


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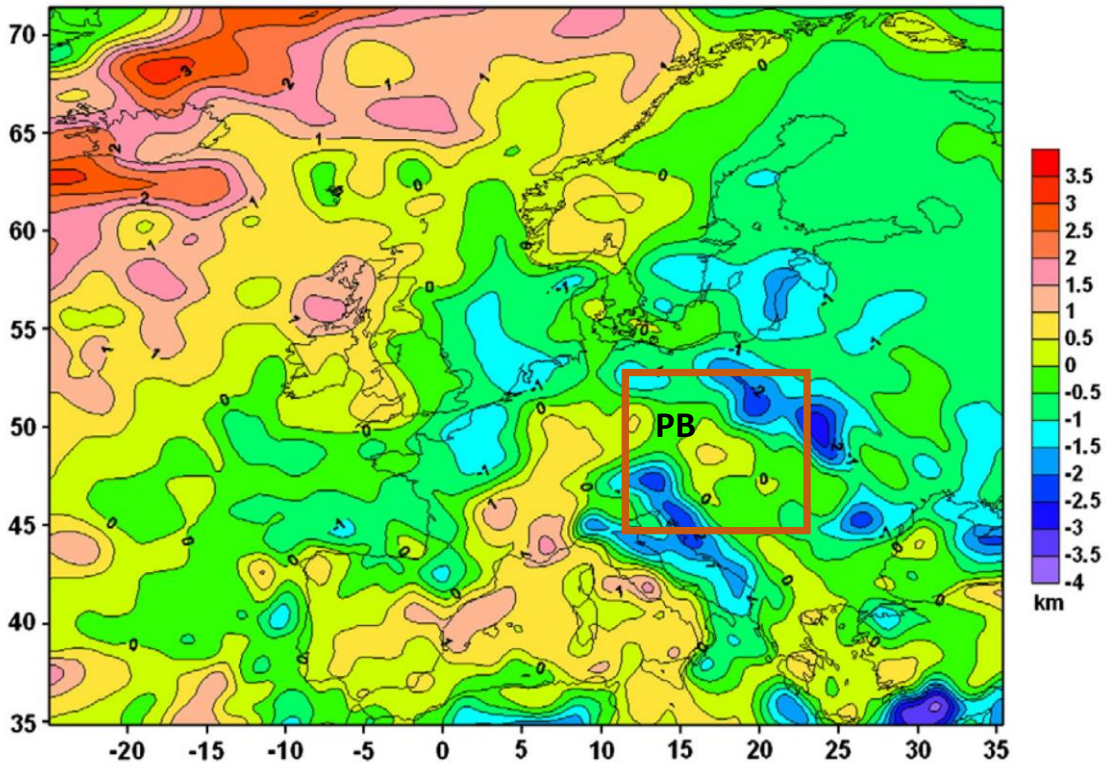
I. Observational data and residual topography calculation in the Pannonian Basin

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Previous residual topography calculations in the region



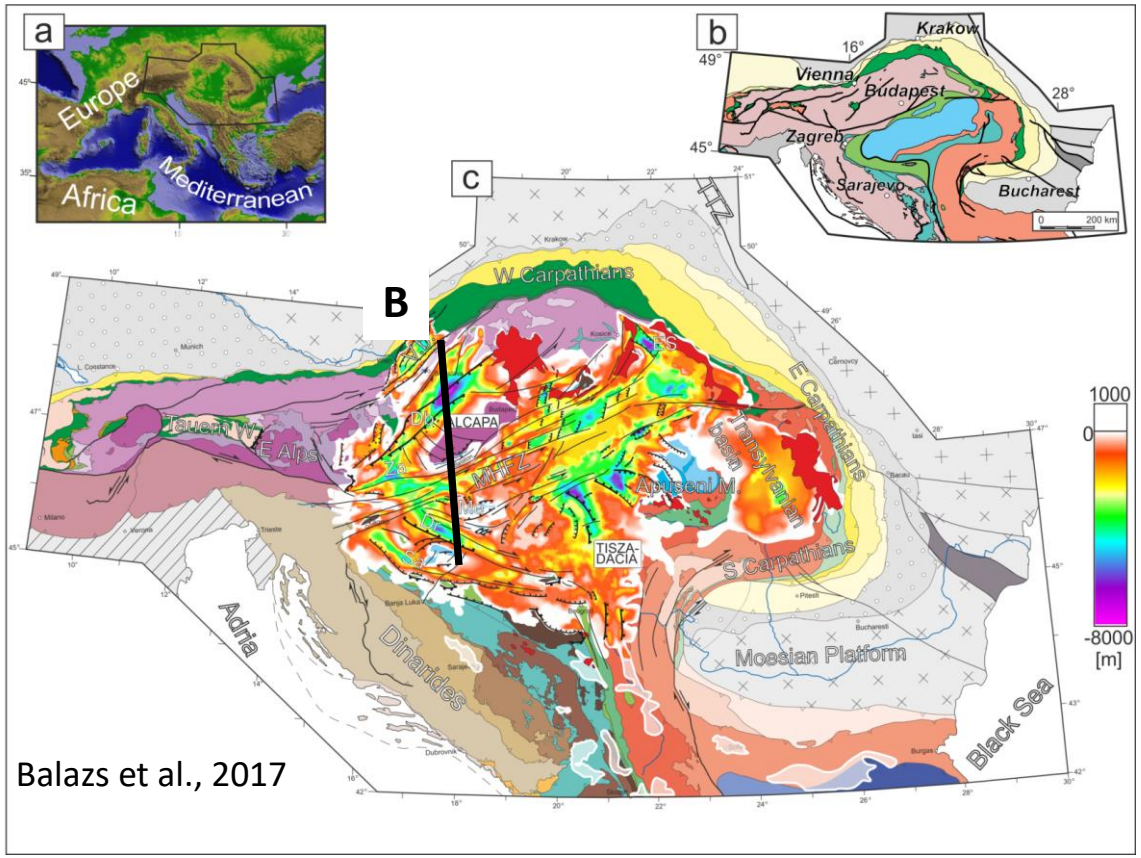
Faccenna et al., 2014



Kaban et al., 2010

Published European models predict 500-1000m positive residual topography, centered in the Great Hungarian Plain part of the basin system

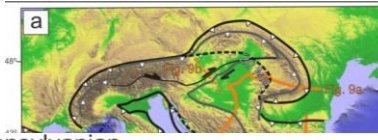
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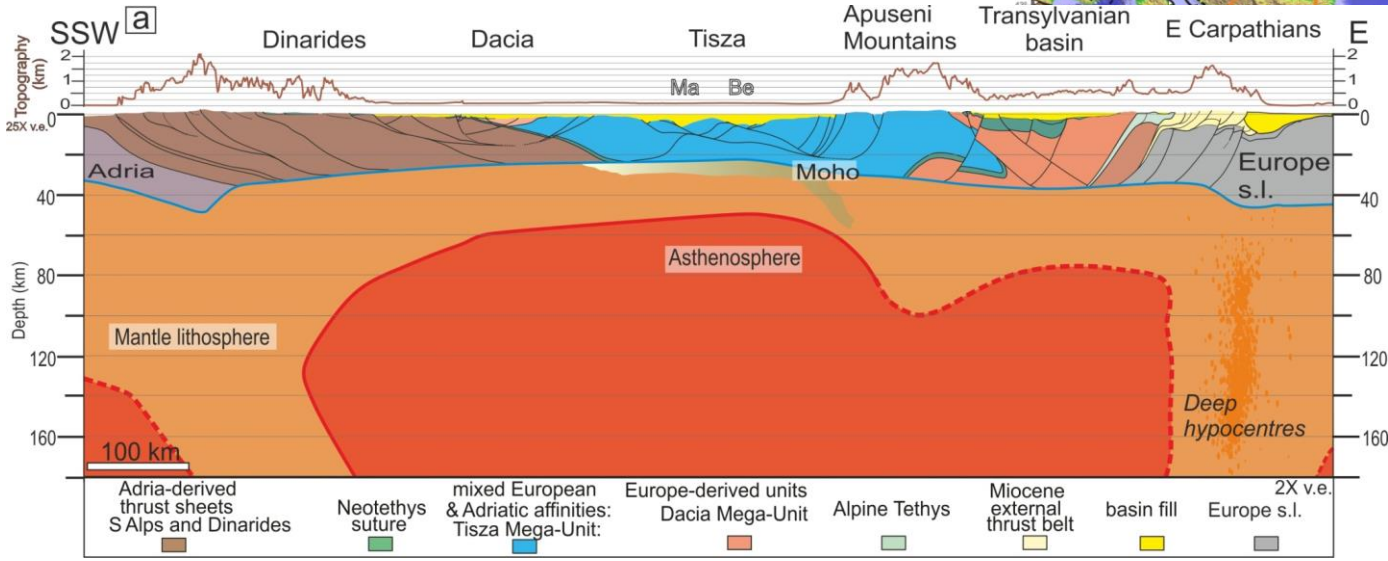


Balazs et al., 2017

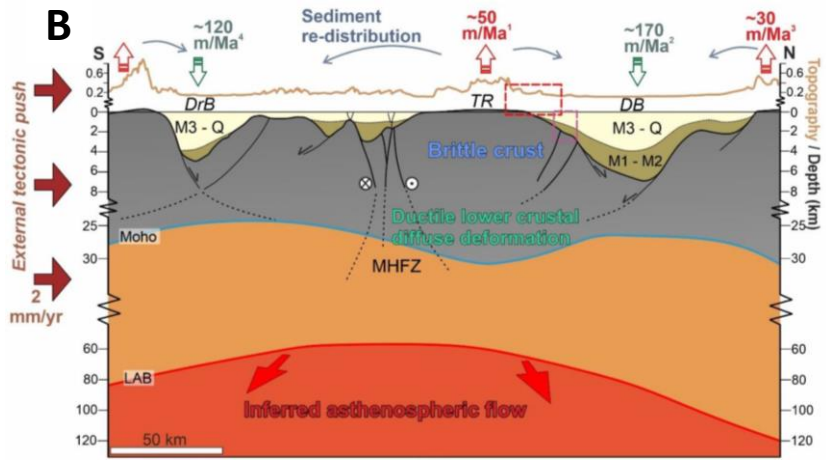
3-8 km Miocene – Quaternary sediment thickness in the Danube Basin and in the Great Hungarian Plain

500-800m Pliocene to Recent uplift of the Transdanubian Range





Balazs et al., 2017 (modified after Matenco and Radivojevic, 2012; Balázs et al., 2016)

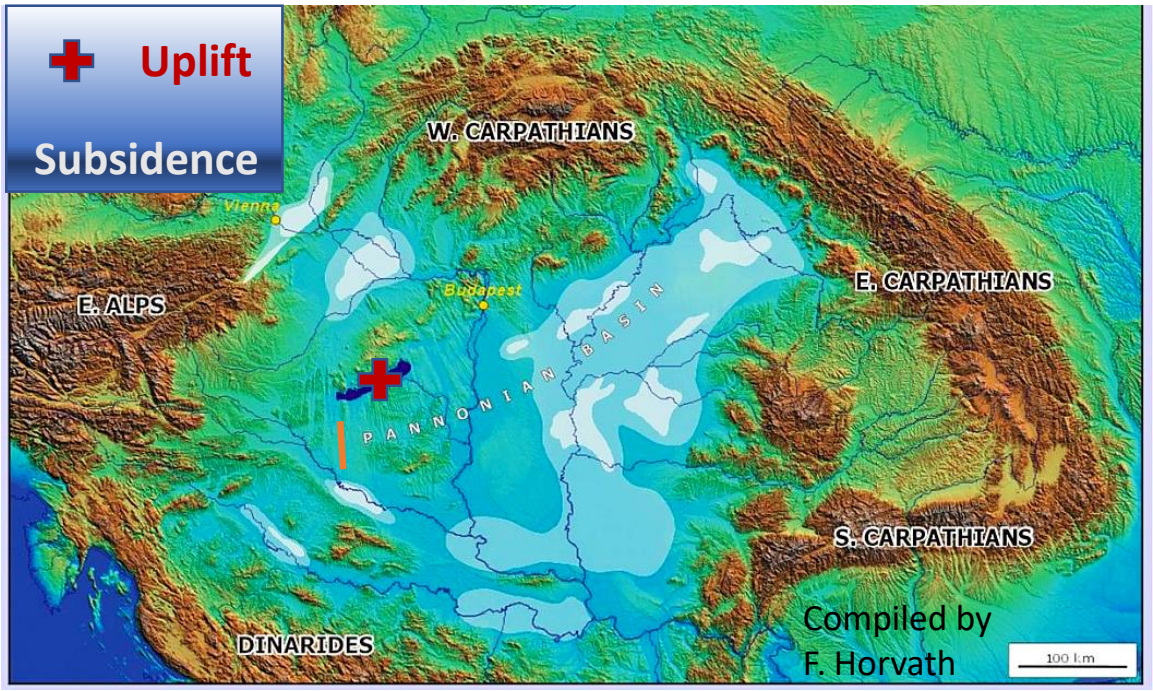


Ruszkiczay-Rudiger et al., 2020

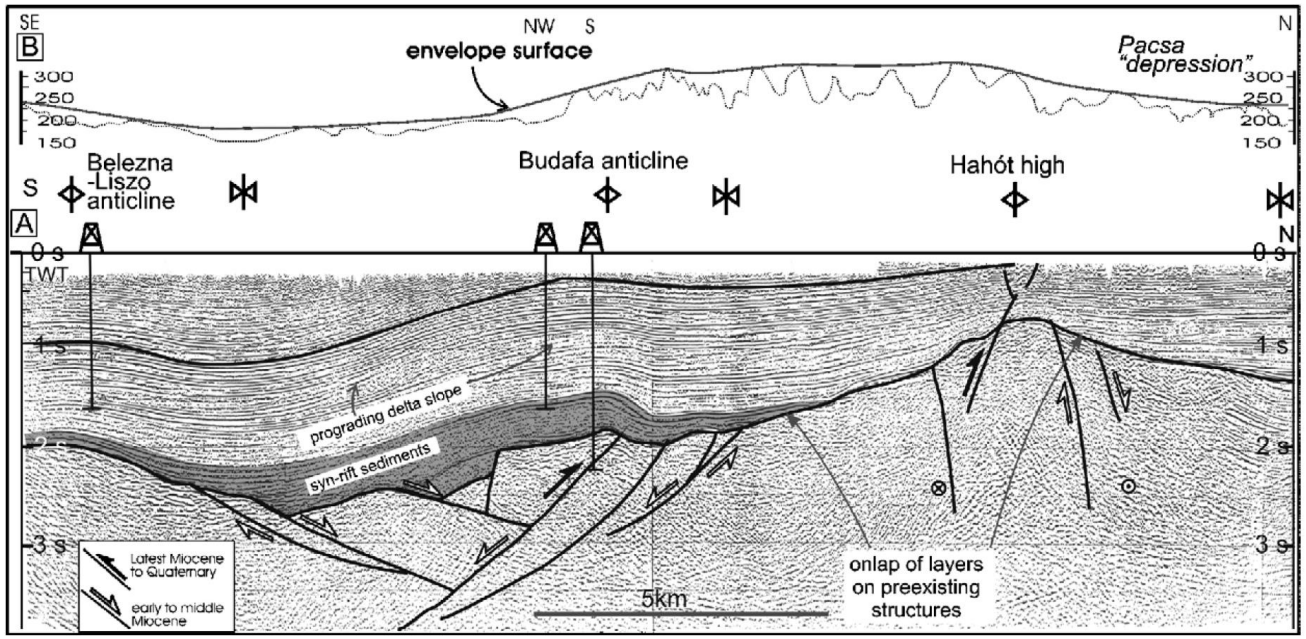
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Balazs et al., 2020. EGU

Structural inversion accentuated in the SW Pannonian Basin from ca. 7-8 Ma



Low-strain shortening inverts the Middle Miocene extensional structures in the SW but cannot account for the 500-800m uplift of the Transdanubian Range where notable contraction does not occur

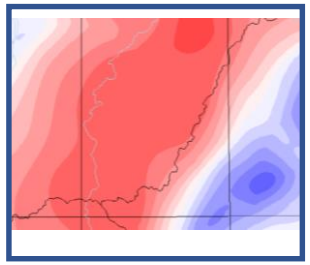


Fodor et al., 2005

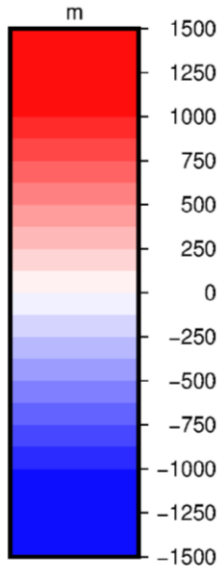
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Balazs et al., 2020. EGU

Our residual topography calculation assuming a 4-layer model

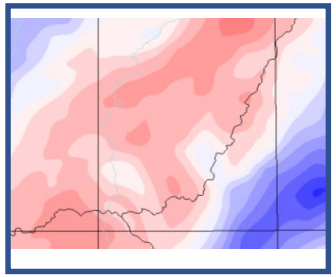


Crust – Lithosphere - Asthenosphere



Kovacs, 2016

Central segment of our new map



Sediments – Crust – Lithosphere - Asthenosphere

Previously inferred 1000m residual topography decreased to 50-300m in the Great Hungarian Plain that records ongoing fast subsidence!

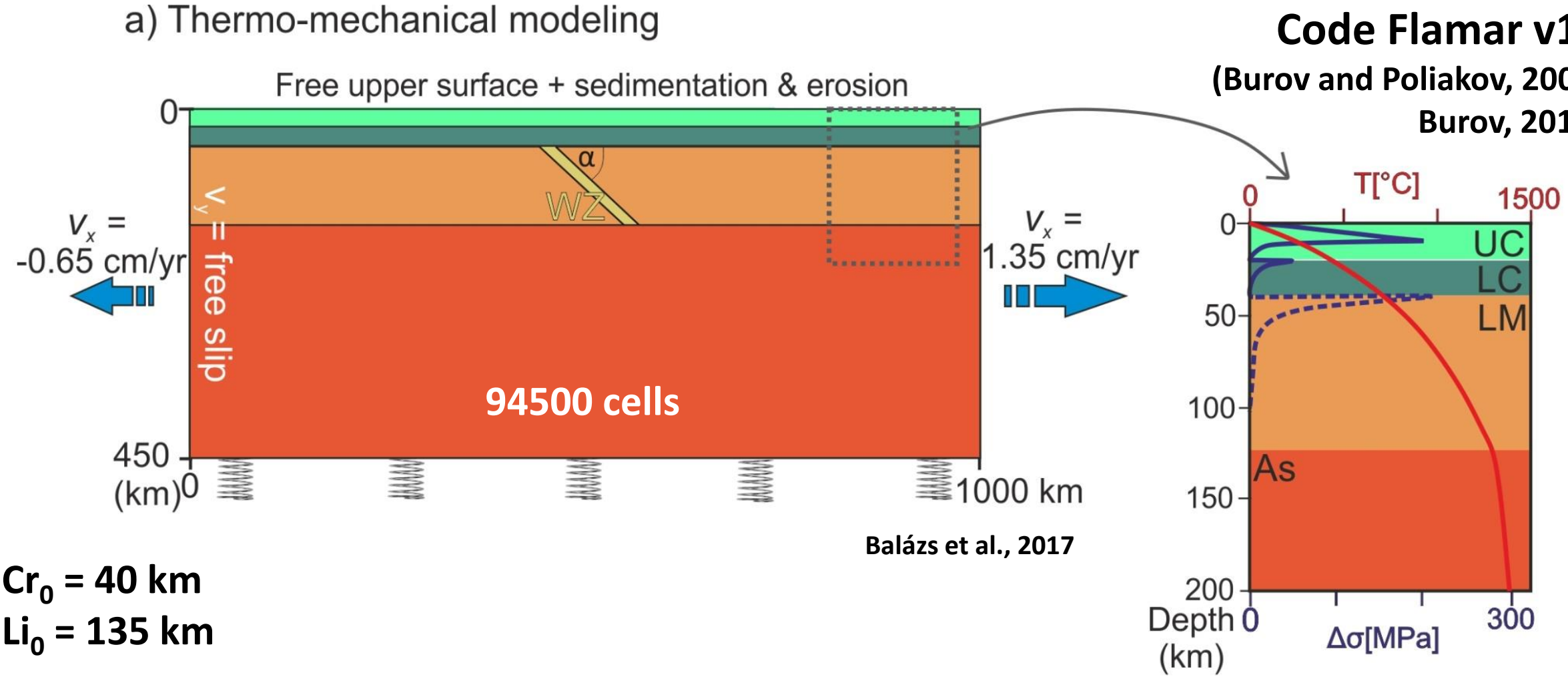
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II. Thermo-mechanical numerical modelling of the Recent differential vertical movements

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Code Flamar v12

(Burov and Poliakov, 2001; Burov, 2014)



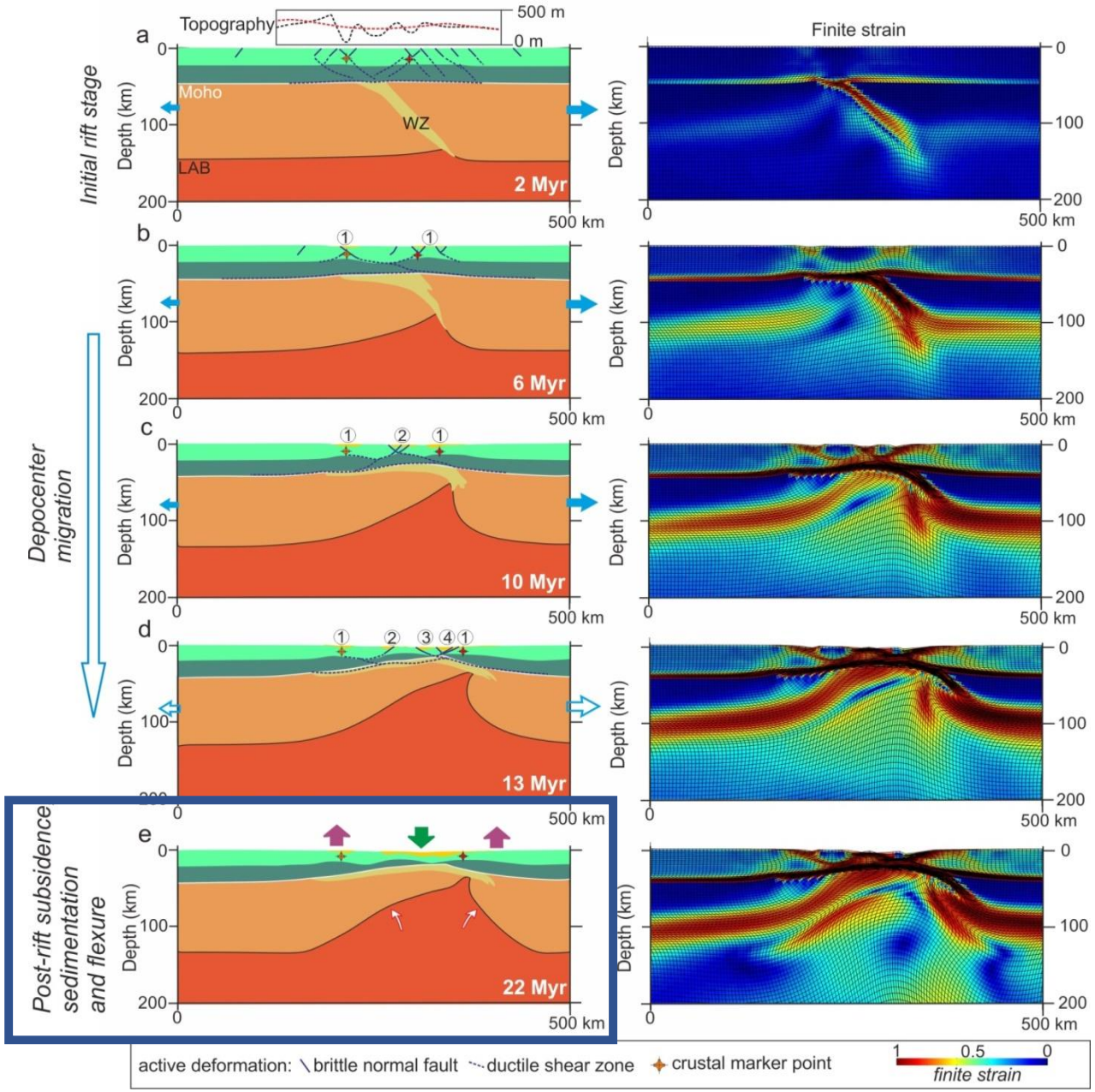
Balázs et al., 2017

Cr_0 = 40 km

Li_0 = 135 km

$$\frac{dh}{dt} = k_e \frac{\partial^2 h}{\partial x^2}$$

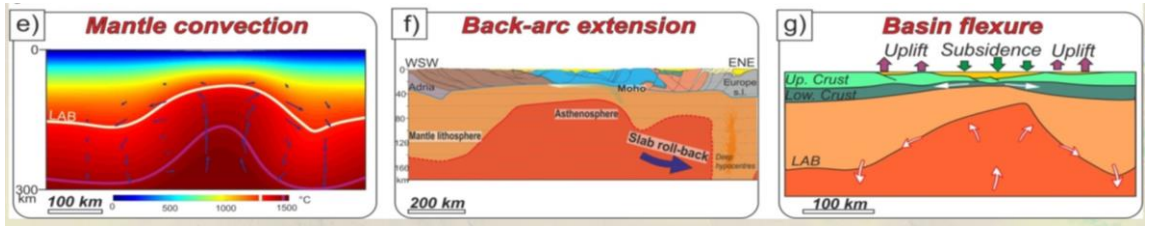
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Balazs et al., 2017

Post-rift (Recent) differential vertical motions Controlled by:

- Small-scale upper mantle convection cell
- Differential unloading and loading by sediment re-distribution from margins to depocenter
- Elastic flexure of the weak lithosphere



Balazs et al., 2017

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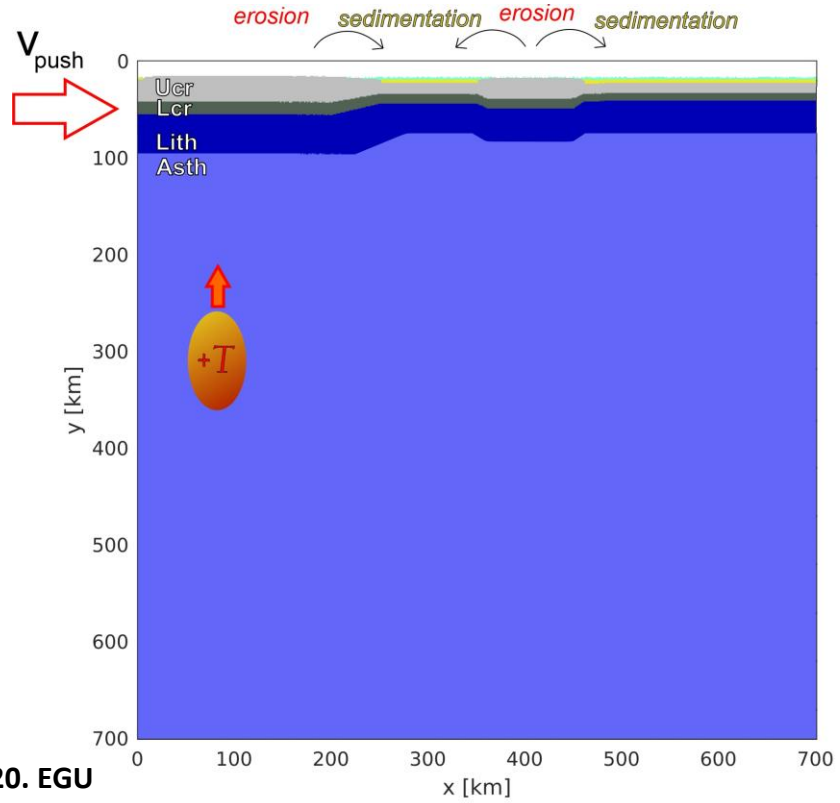
Balazs et al., 2020. EGU

Further analyzing the main forcing factors by high resolution elasto-visco-plastic modelling: 2DELVIS (Gerya and Yuen2007)

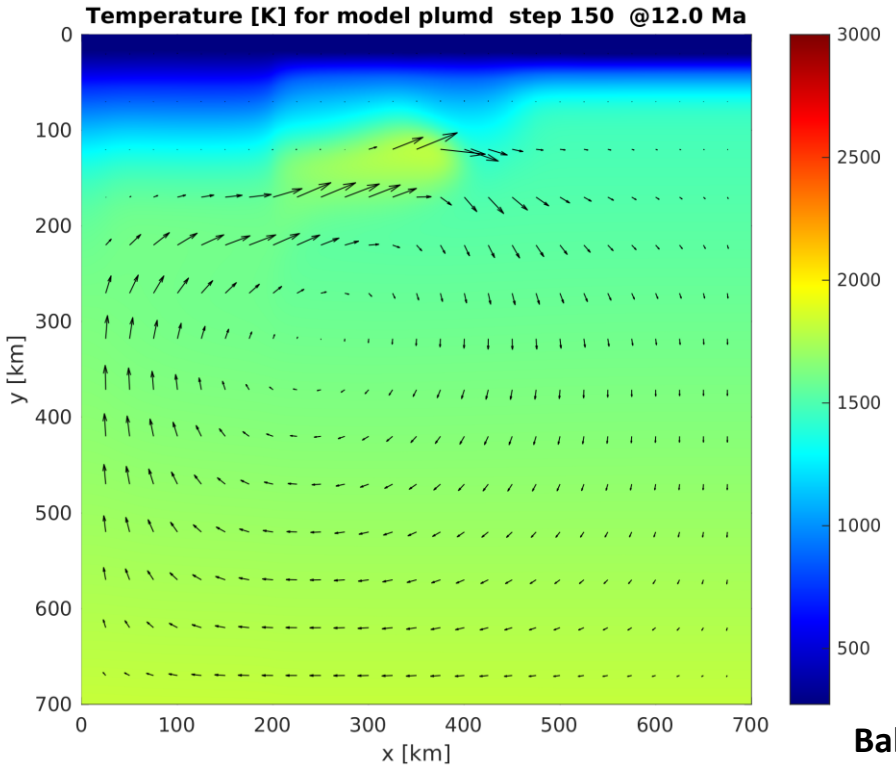
(1) Asthenosphere convection **(2) Elastic flexure** **(3) Sedimentation and erosion** **(4) Contraction**

Uplift **Subsidence** **Uplift** **Subsidence**

Eastern Alps **Danube Basin** **Transanubian Range** **Great Hungarian Plain**

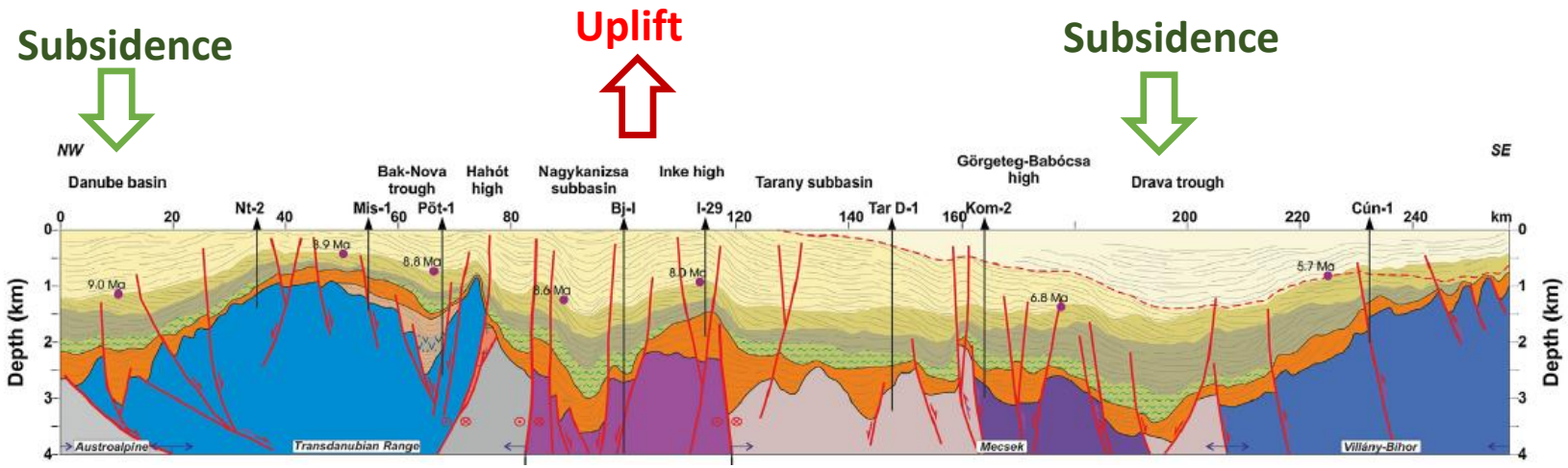


Balazs et al., 2020. EGU



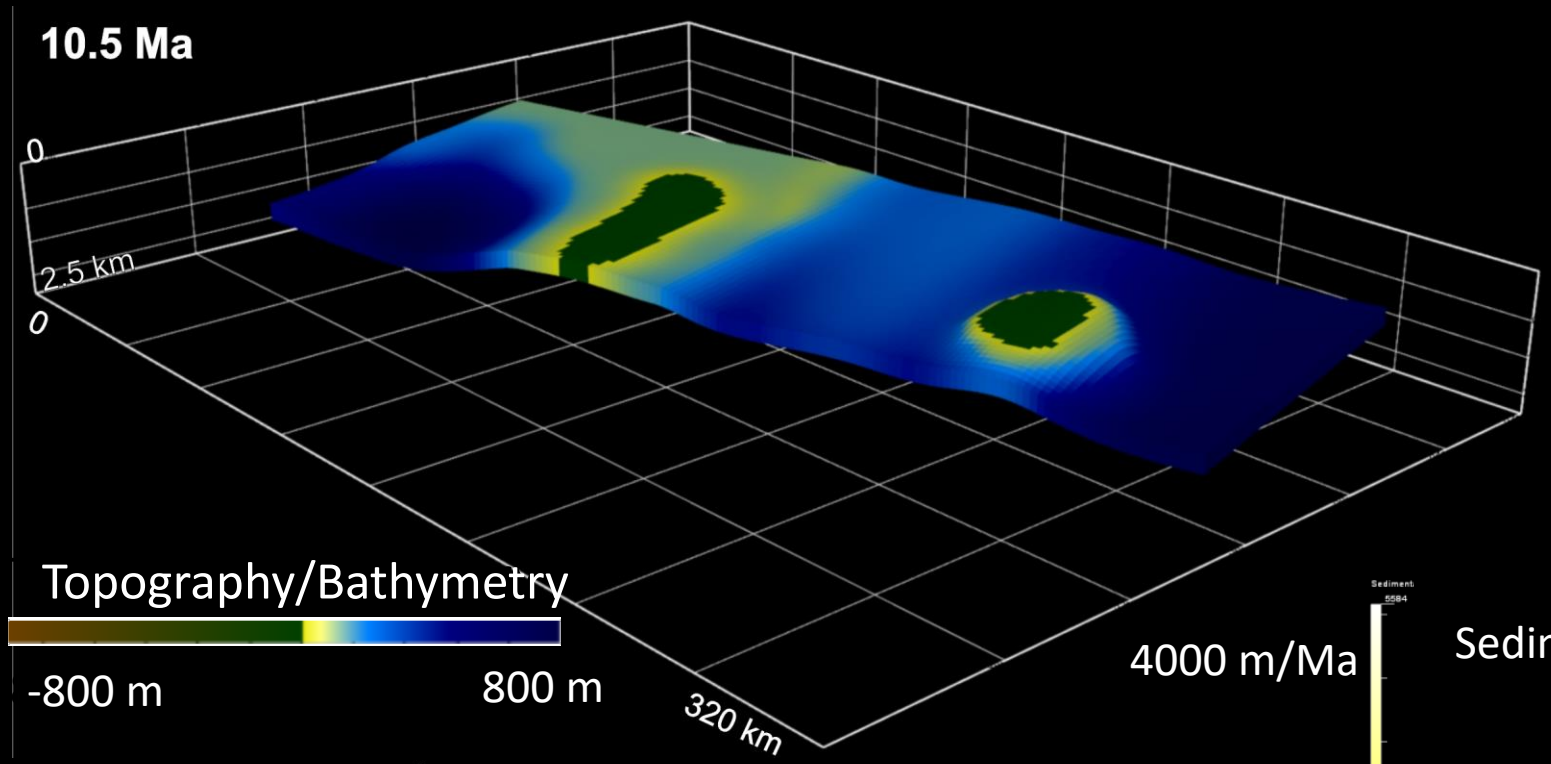
Balazs et al. in prep.

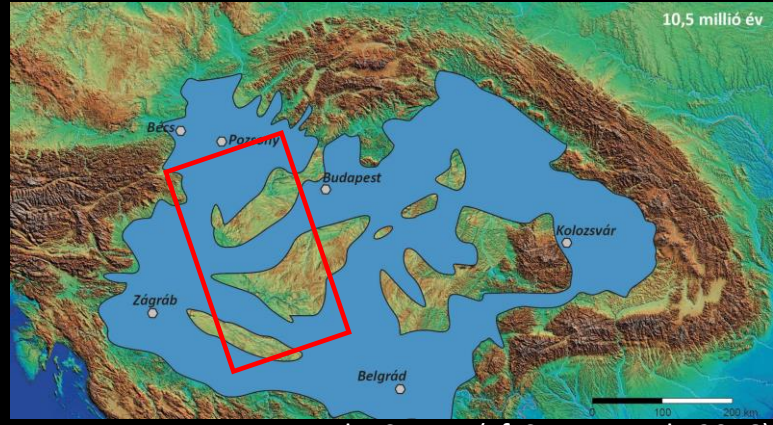
III. Stratigraphic numerical modelling of the Late Miocene to Recent sediment transport reorganization in the Pannonian Basin - DionisosFlow (Granjeon, 2014) (in prep.)



Horvath et al., 2015

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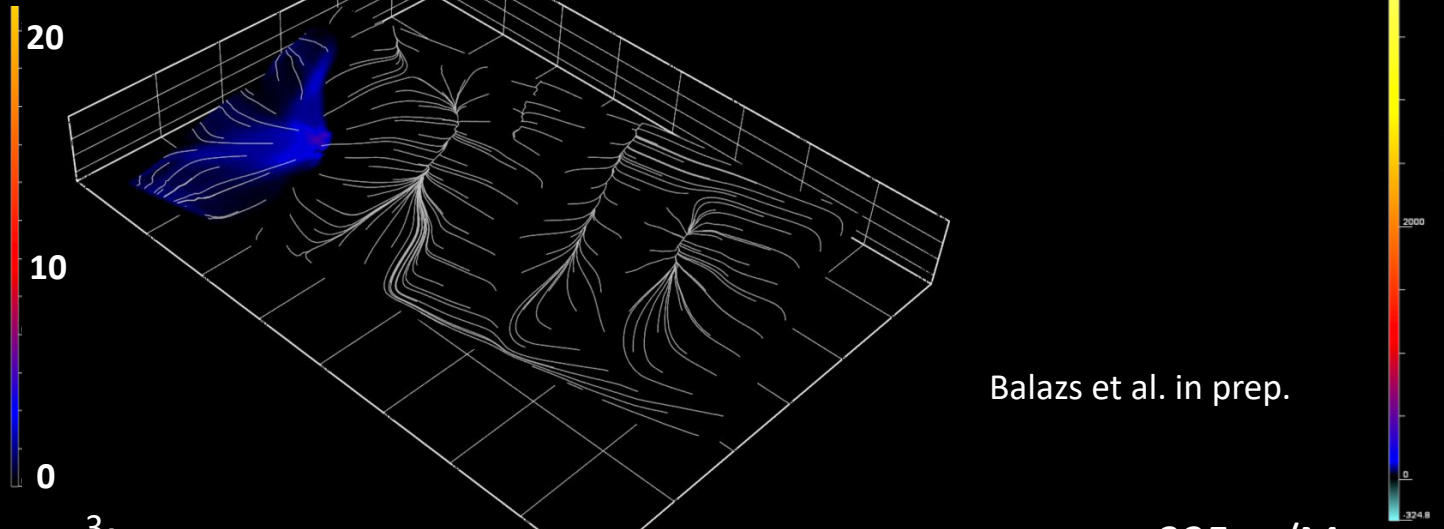
Drawn by Sztano (cf. Sztano et al., 2016)
modified after Magyar et al., 2013

Topography/Bathymetry

-800 m 800 m

4000 m/Ma

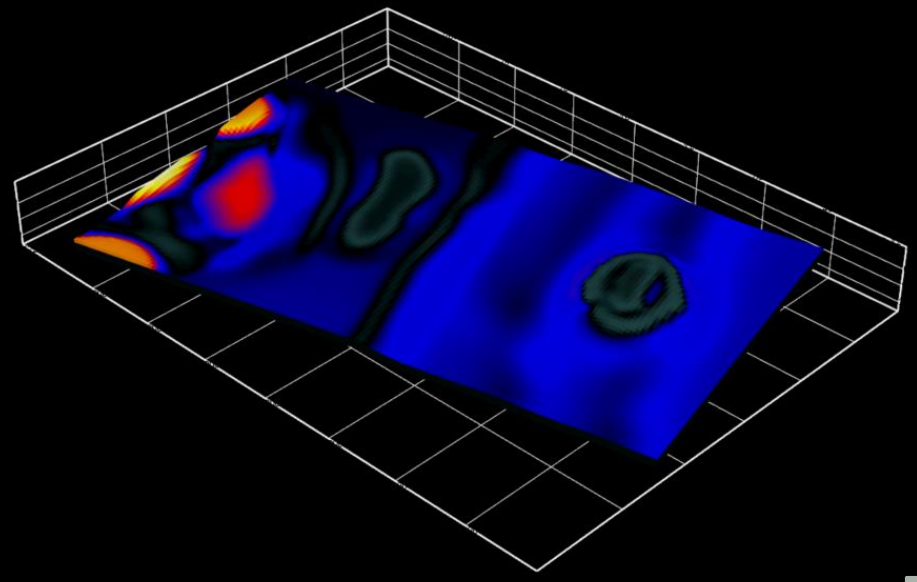
Sedimentation rate



Water Flow and slope lines

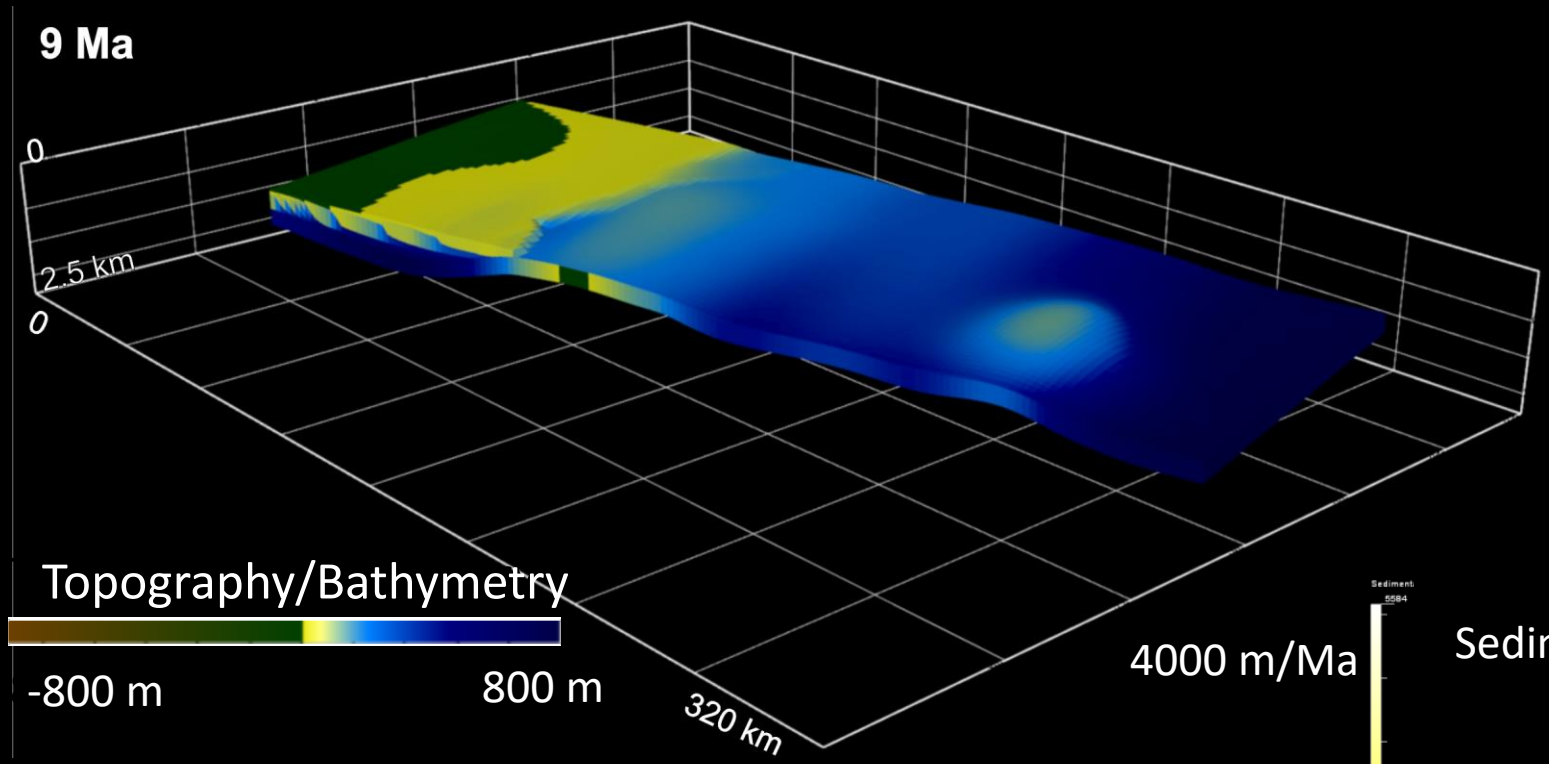
Balazs et al. in prep.

-325 m/Ma



Erosion rate

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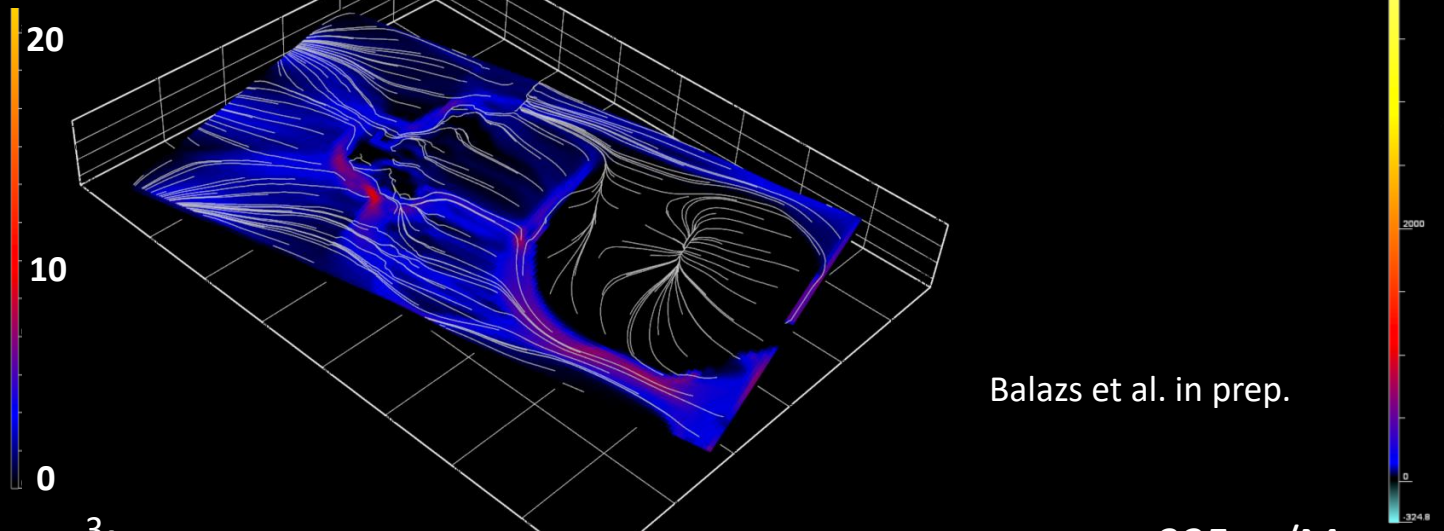
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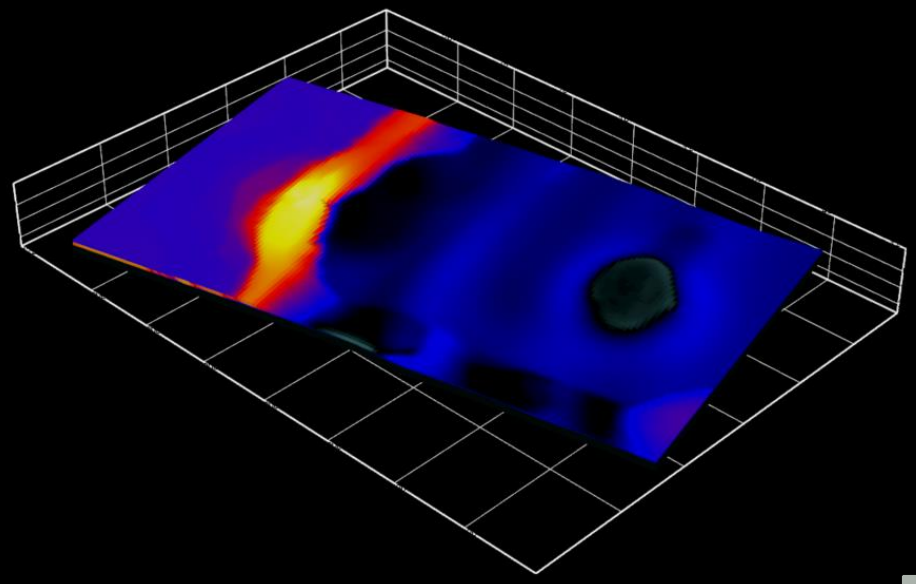
Sedimentation rate



1000 m^3/s Water Flow and slope lines

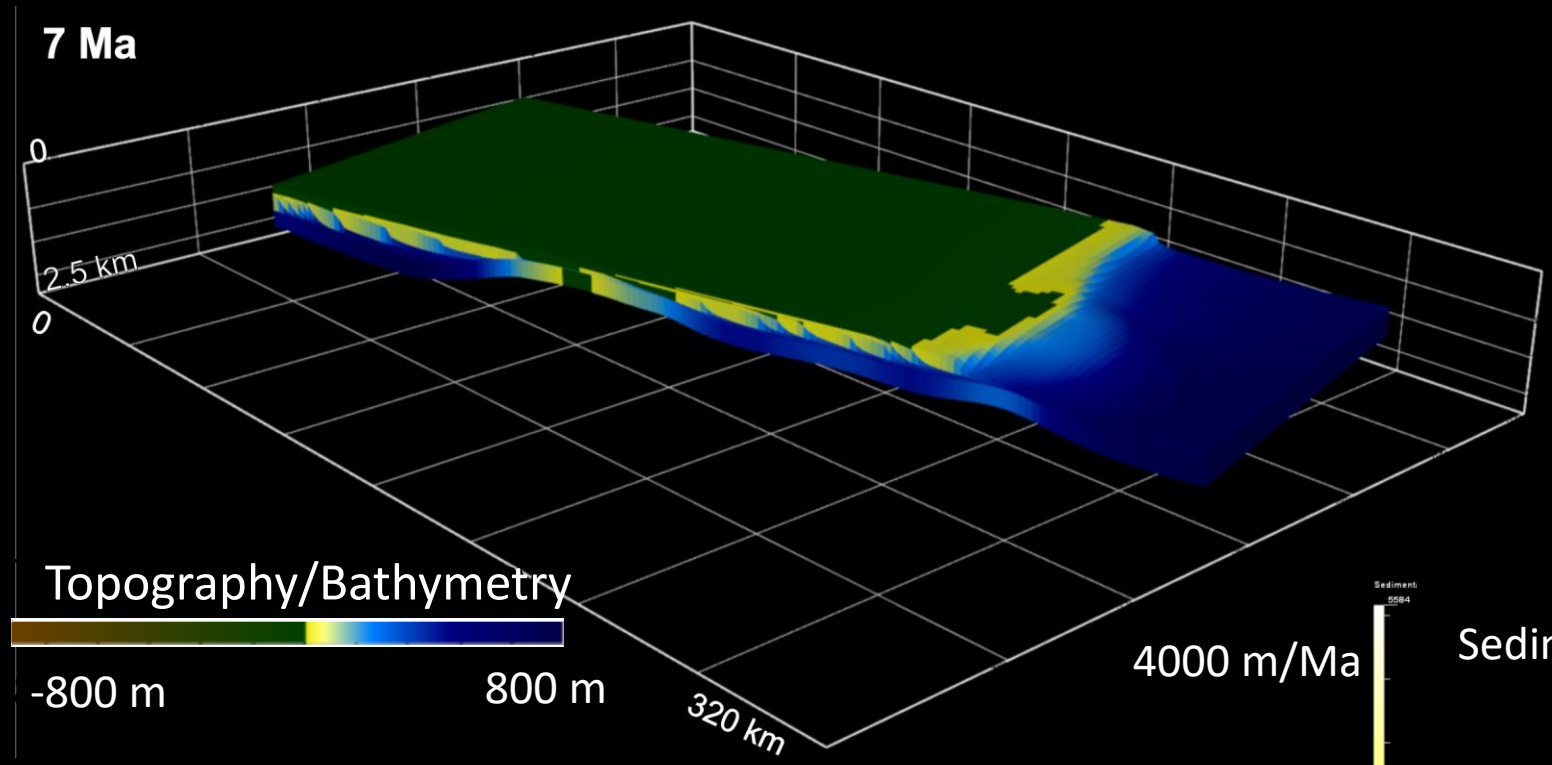
Balazs et al. in prep.

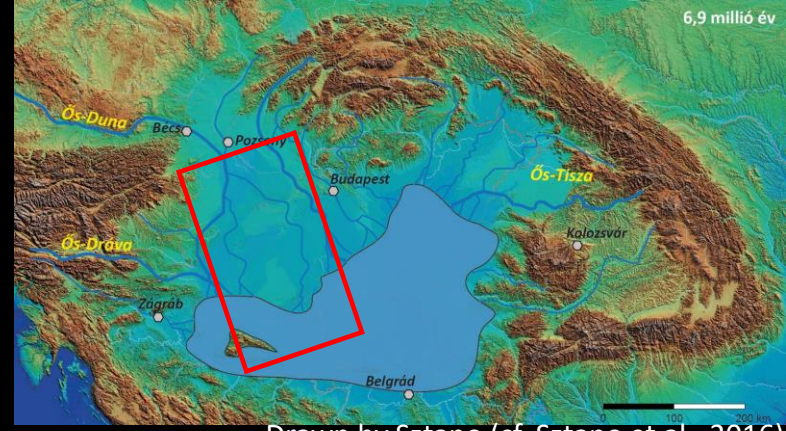
-325 m/Ma



Erosion rate

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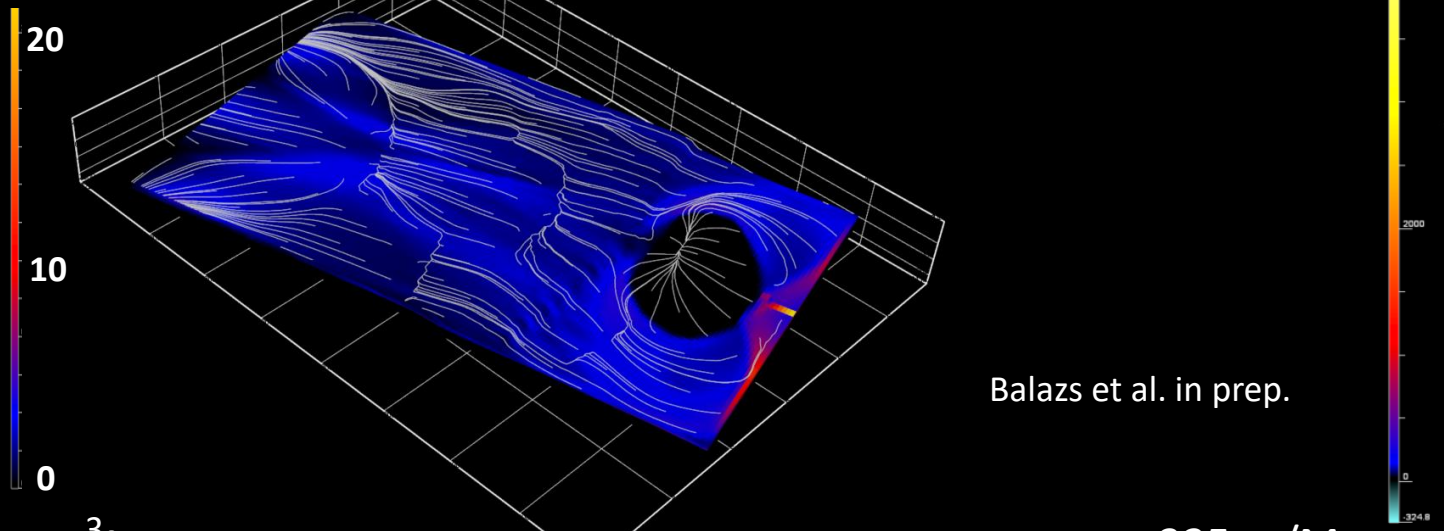
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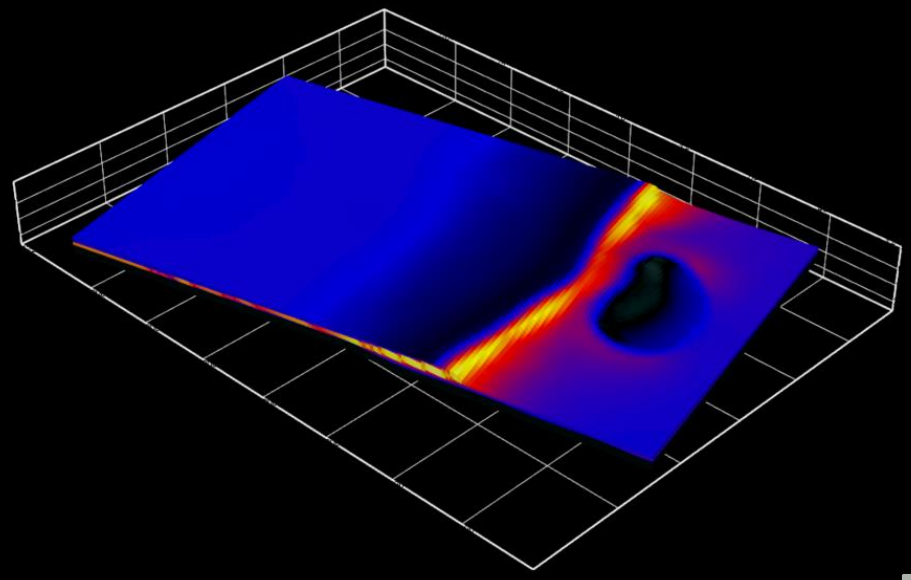
Sedimentation rate



1000 m^3/s Water Flow and slope lines

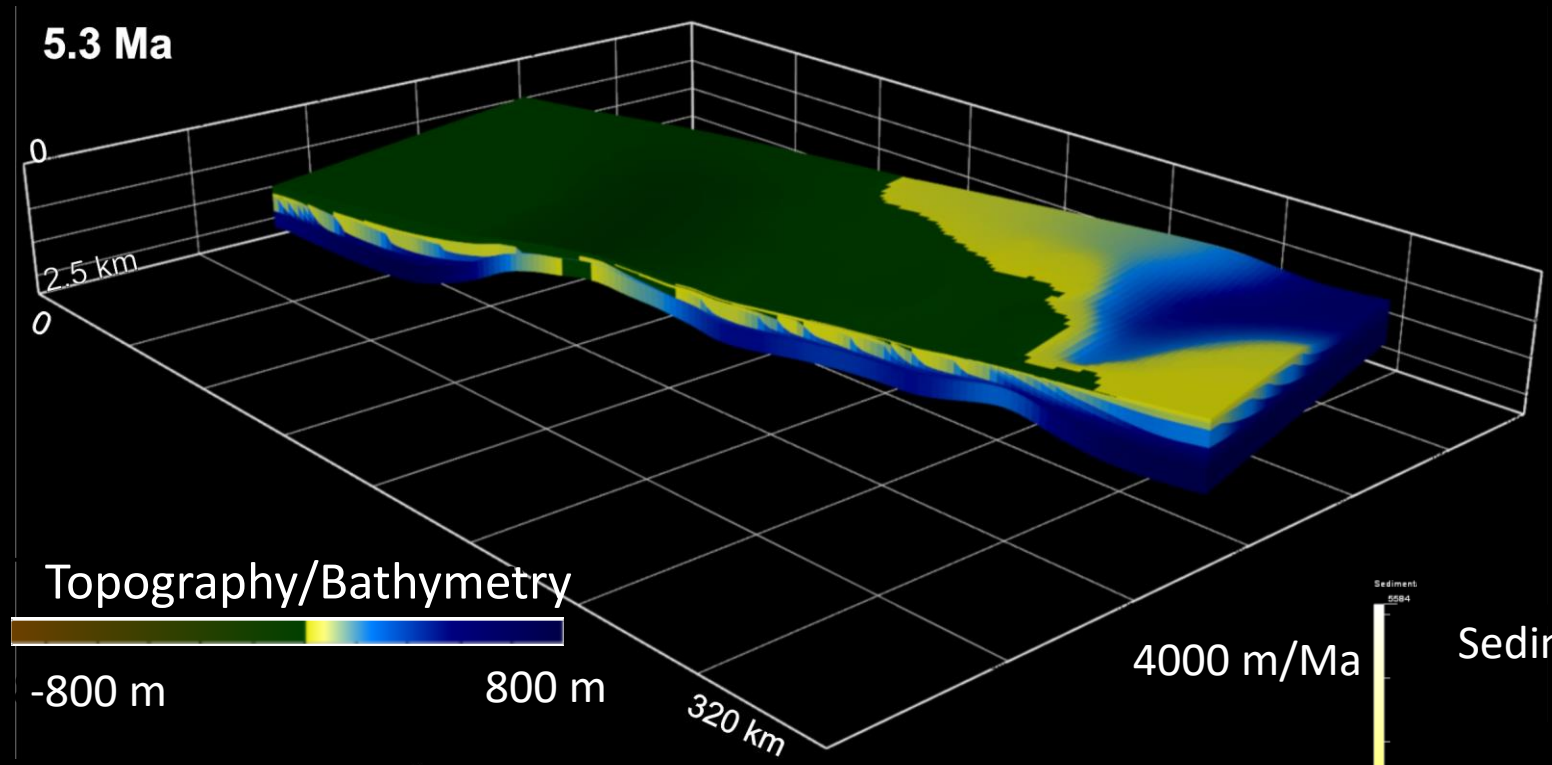
Balazs et al. in prep.

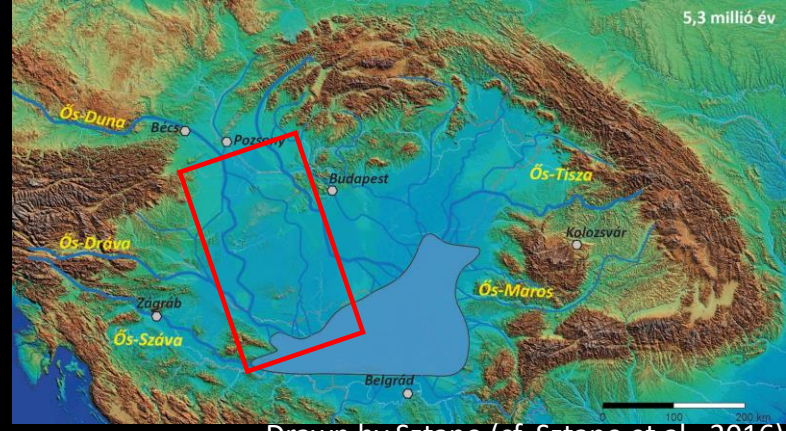
-325 m/Ma



Erosion rate

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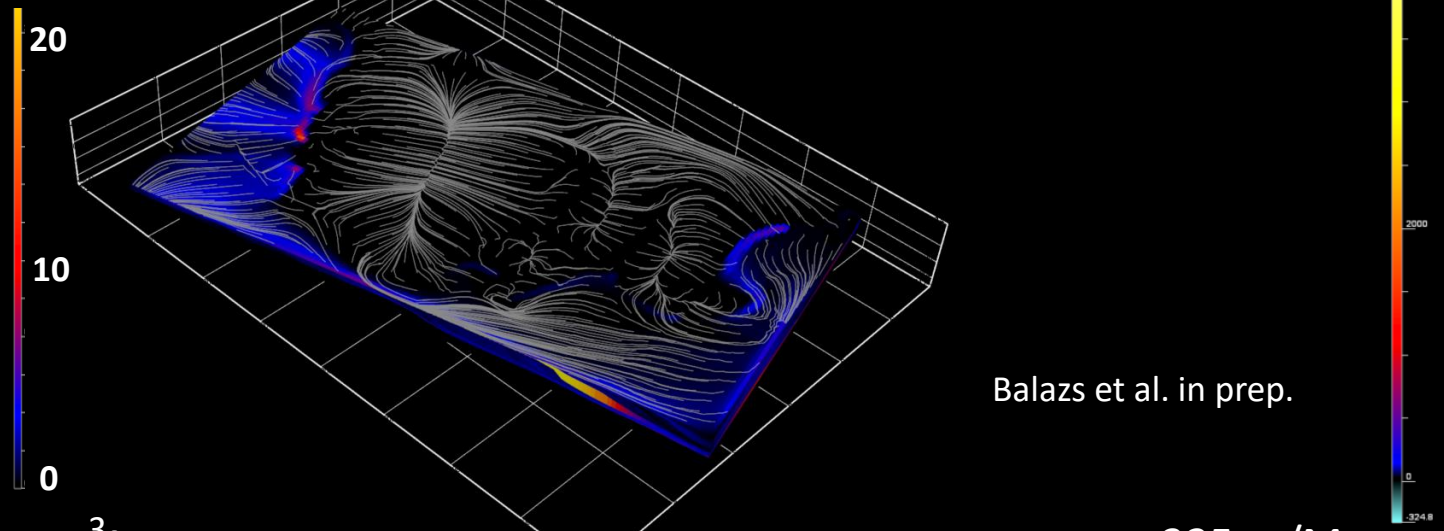
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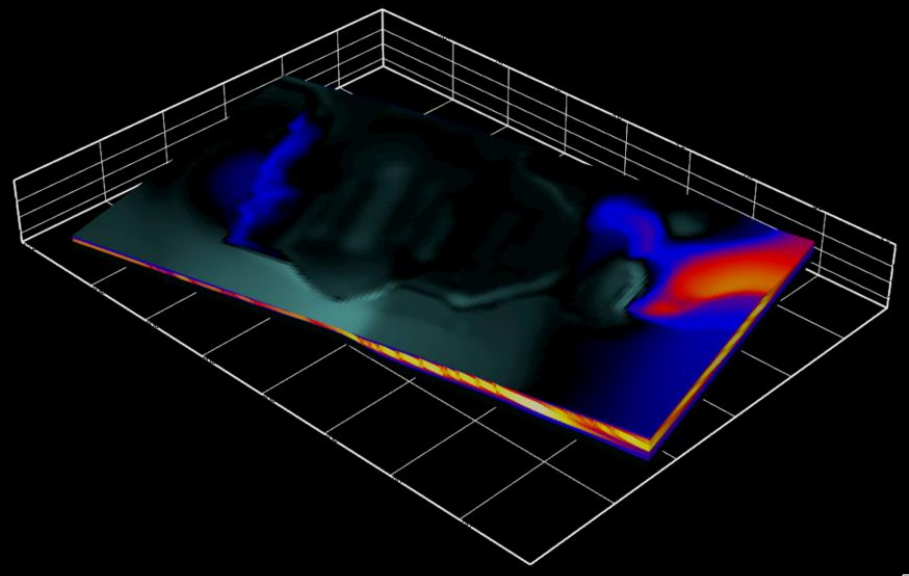
Sedimentation rate



1000 m^3/s Water Flow and slope lines

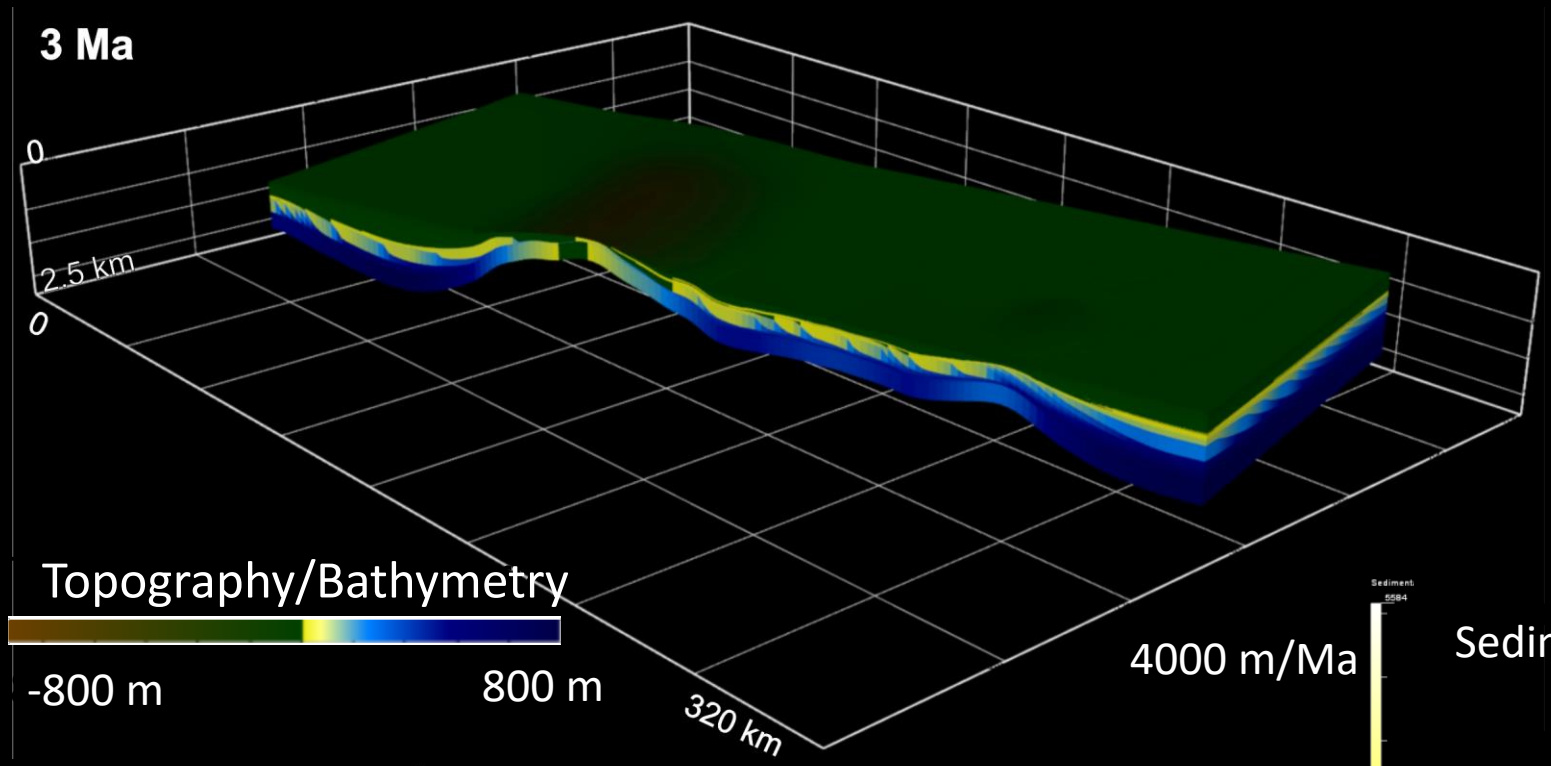
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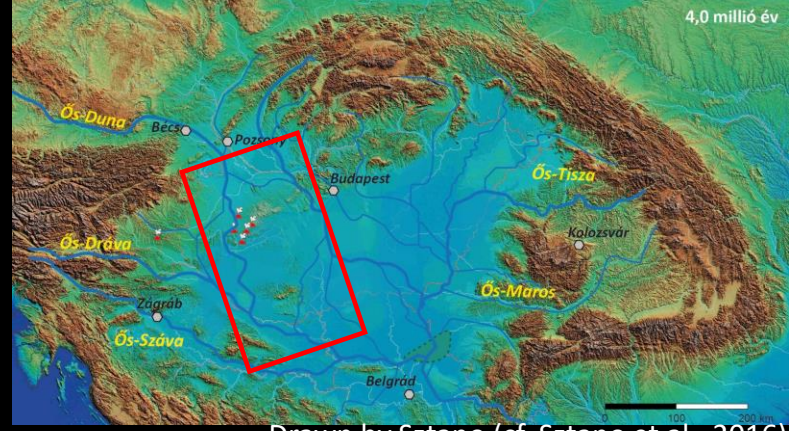
-325 m/Ma



Erosion rate

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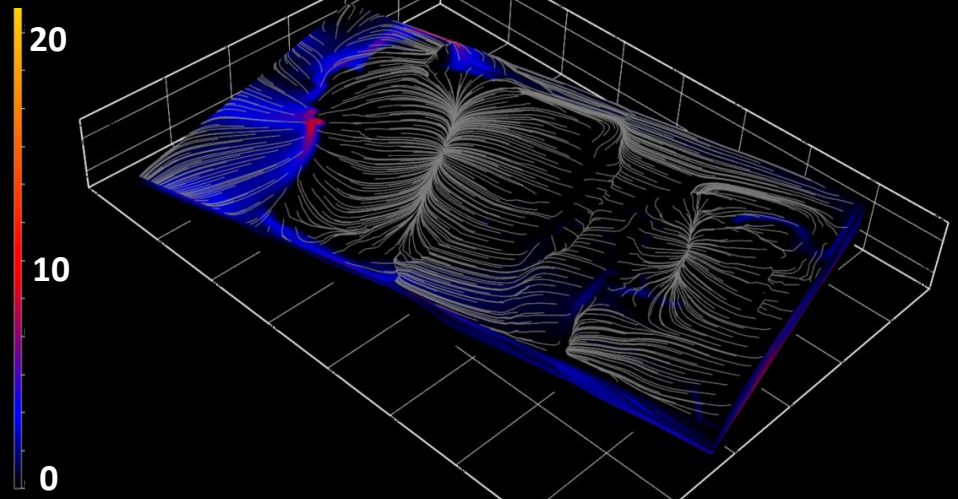
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Topography/Bathymetry

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Sedimentation rate

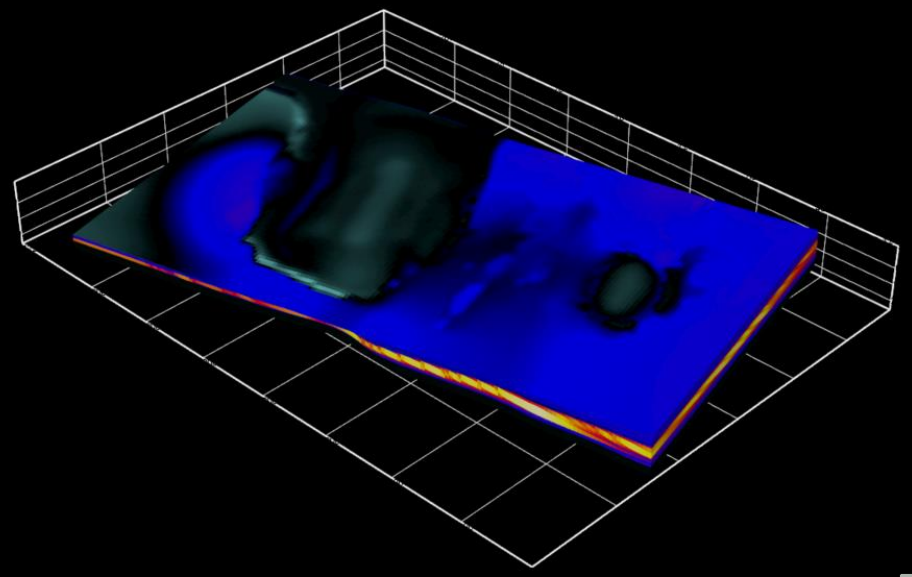


1000 m^3/s Water Flow and slope lines

Balazs et al. in prep.

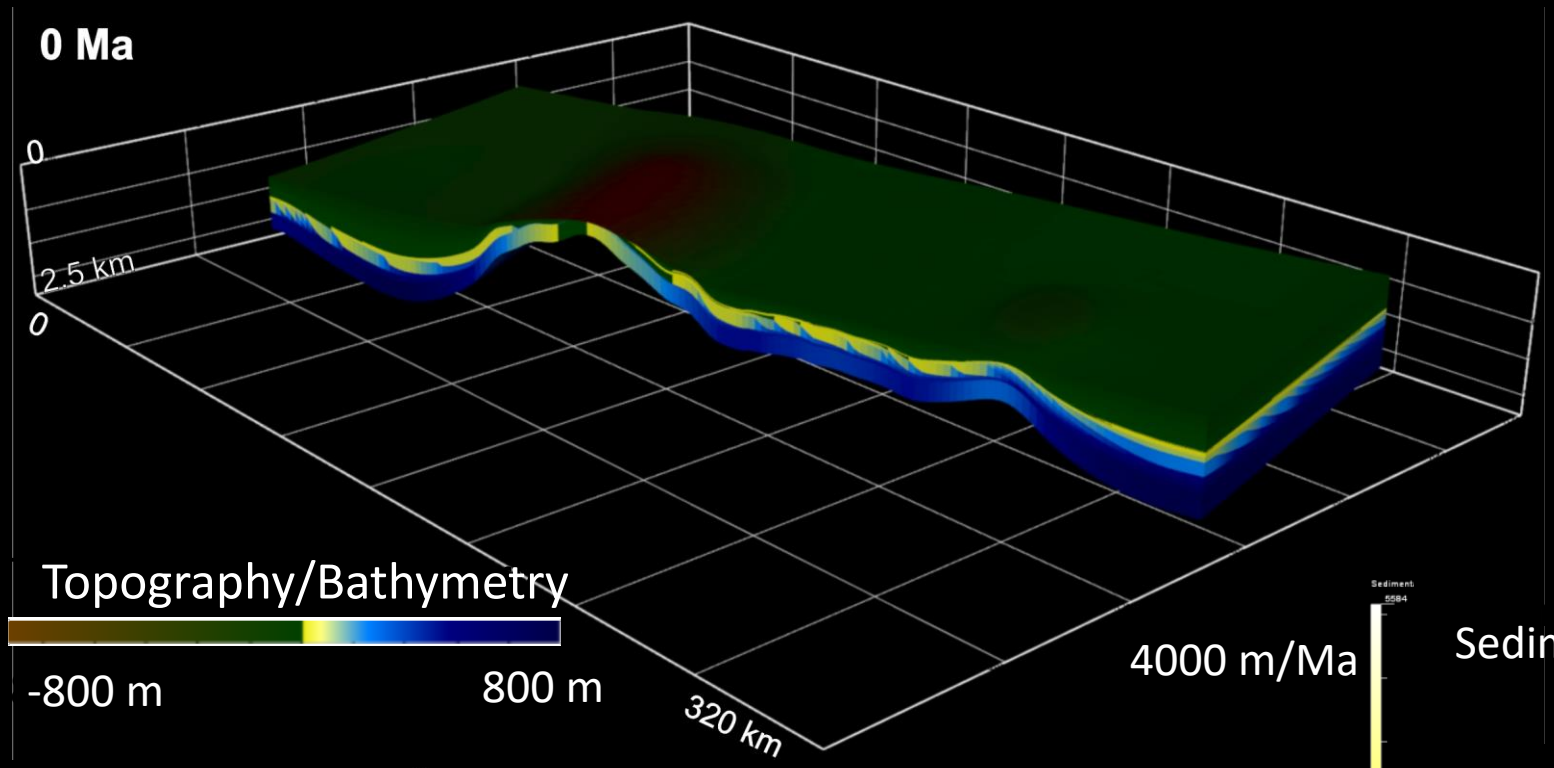


-325 m/Ma



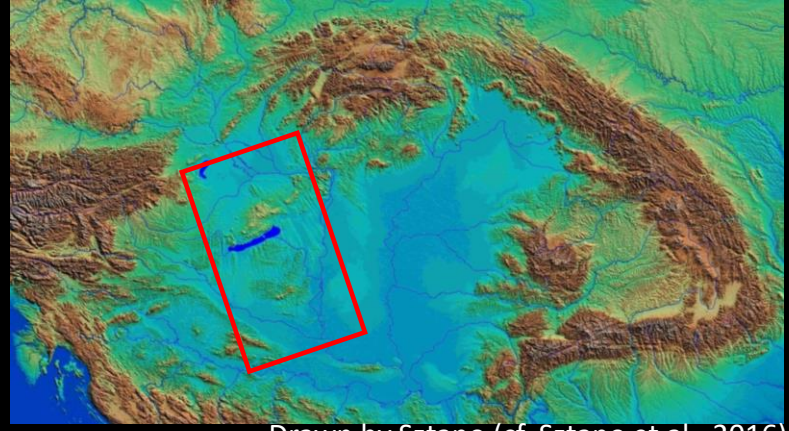
Erosion rate

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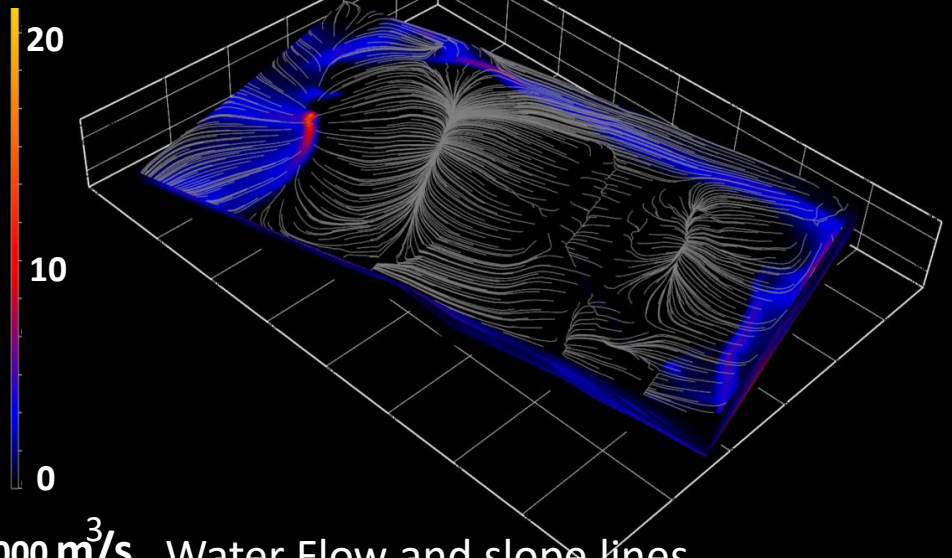


Topography/Bathymetry

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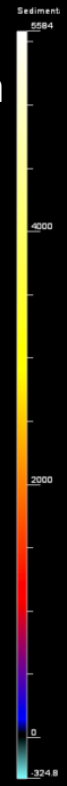


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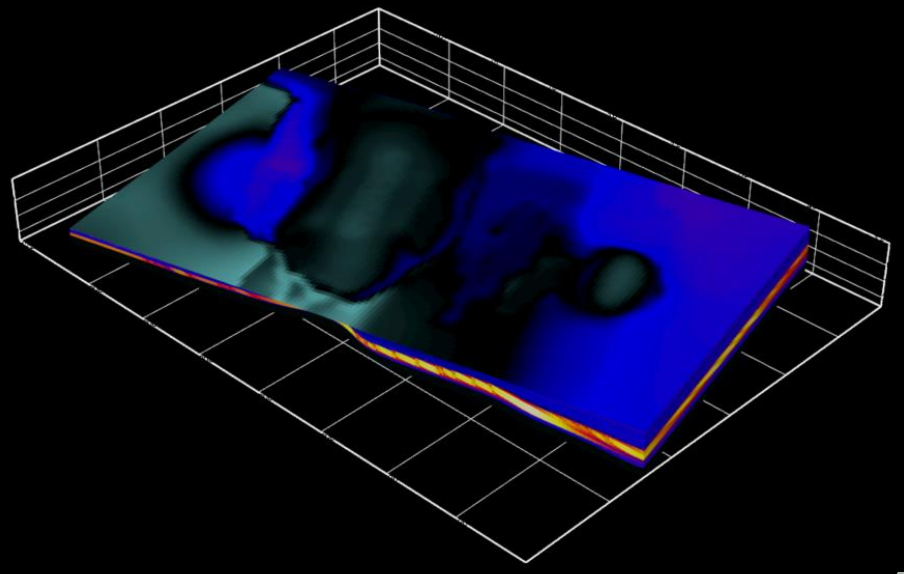
Water Flow and slope lines

Balazs et al. in prep.



4000 m/Ma

Sedimentation rate



-325 m/Ma

Erosion rate

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For questions and comments please contact me:

attila.balazs@erdw.ethz.ch

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