The demise of Paratethysin the time of the Messinian Salinity Crisis:

impact on Eurasian paleogeography and Mediterranean environment

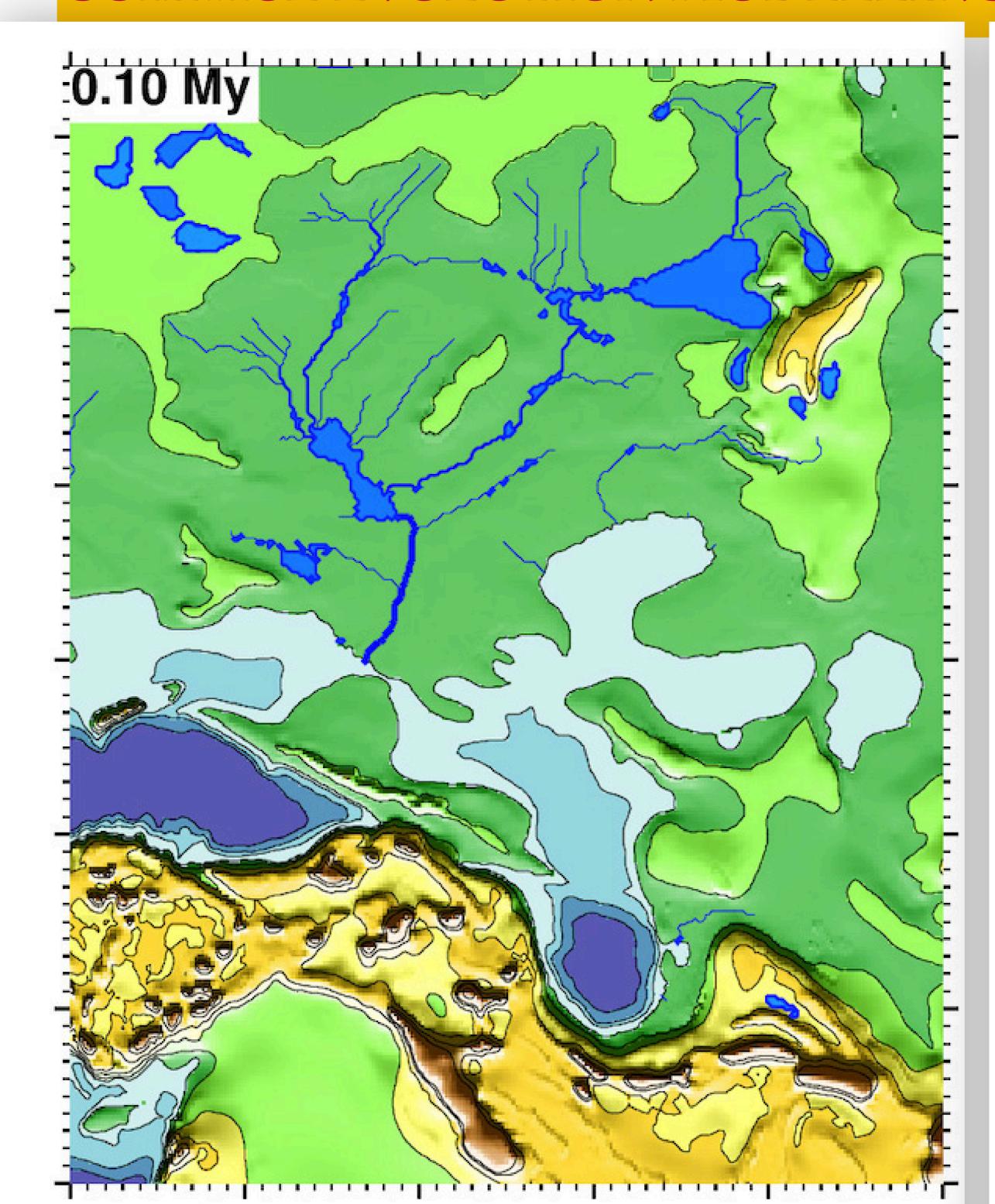
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During the Messinian Salinity Crisis (MSC), the Mediterranean Sea experienced a severe partial desiccation followed by the refill with low-saline waters exhibiting Paratethys signatures, although it is estimated that the Paratethys discharge was insufficient to fill the Mediterranean basins.

Here we show that Paratethys disintegrated during the MSC: the Black Sea Basin, capturing most of the rivers significantly increased its discharge in the Mediterranean, and the Caspian Basin experienced a long desiccation.

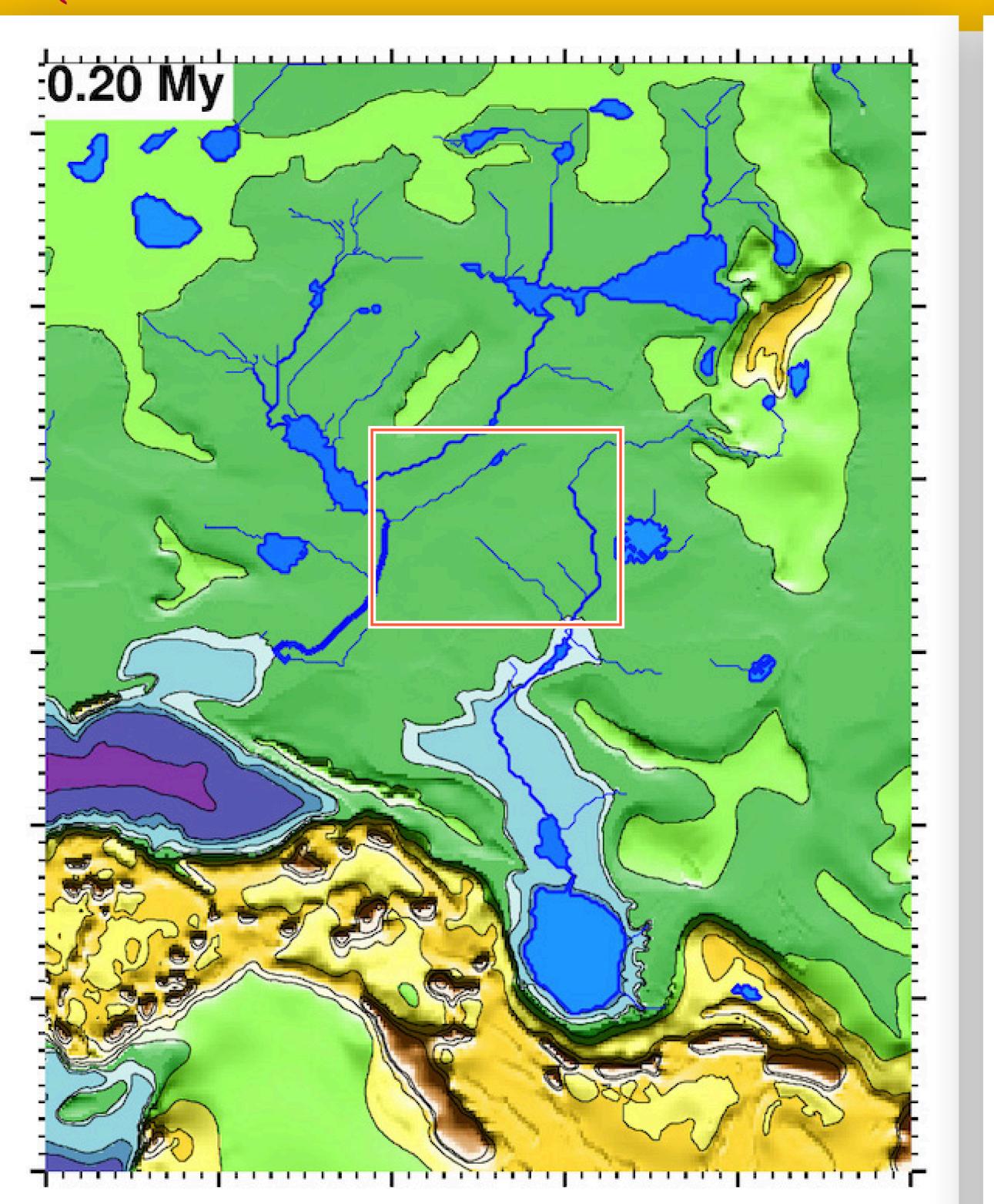
SURFACE EVOLUTION MODELLING (TIME SINCE THE MSC DESICCATION)



Paratethys before the MSC:

a large brackish/freshwater realm

A large trapped sea-lake formed from several interconnected basins, in the heart of Eurasia, characterized by positive water-budget due to large river networks draining the areas west of the Ural Mountains (e.g., Paleo-Don).



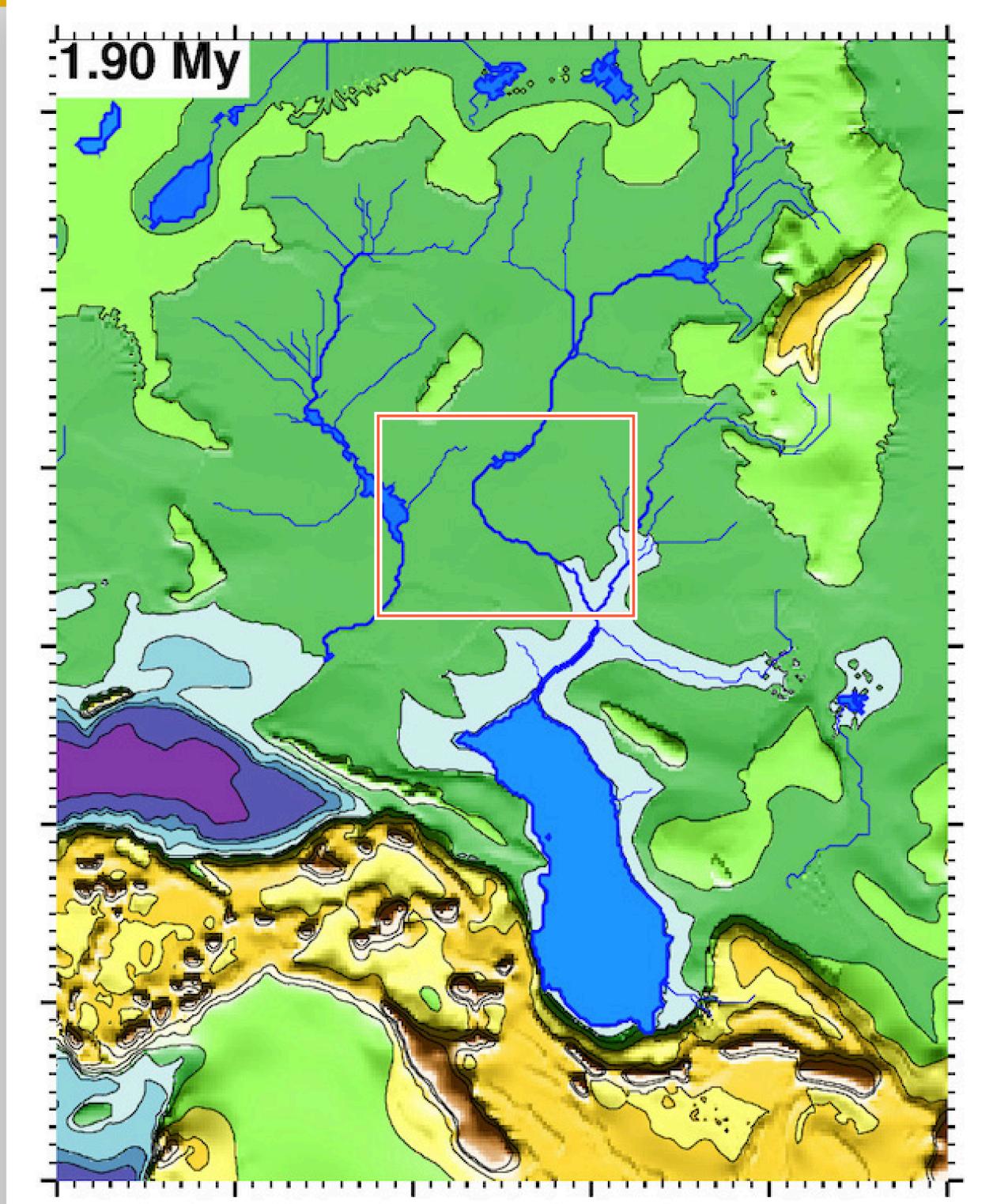
After Paratethys:

competing seas and lakes

Black Sea captures most of the river networks.

The Caspian basin desiccates and the PaleoVolga river is born, eroding northwards.

Large excess of freshwater discharged in the Mediterranean Basin.



The rise of the Volga:

drainage reconfiguration due to erosion

Black Sea loses a large part of its freshwater supply.

The Volga river captures the east of the PaleoDon drainage and floods the Caspian (including the PaleoVolga that remains preserved as a erosional scar).

TISC MODELLING

Parameters surface evolution modelling TISC:

Resolution: 10x10 km (251x321

nodes)

Hybrid detachment+transport limited model, based on the basal shear stress law (formulation and values in Garcia-Castellanos & Jimenez-Munt, PlosONE, 2015)

Rainfall (runoff): From modern precipitation distribution, factored by x0.4 to match discharge modern Volga to accumulated runoff in Volga

Timestep for calculating erosion:

10 Kyr

Elastic thickness for calculating flexure:

25 km

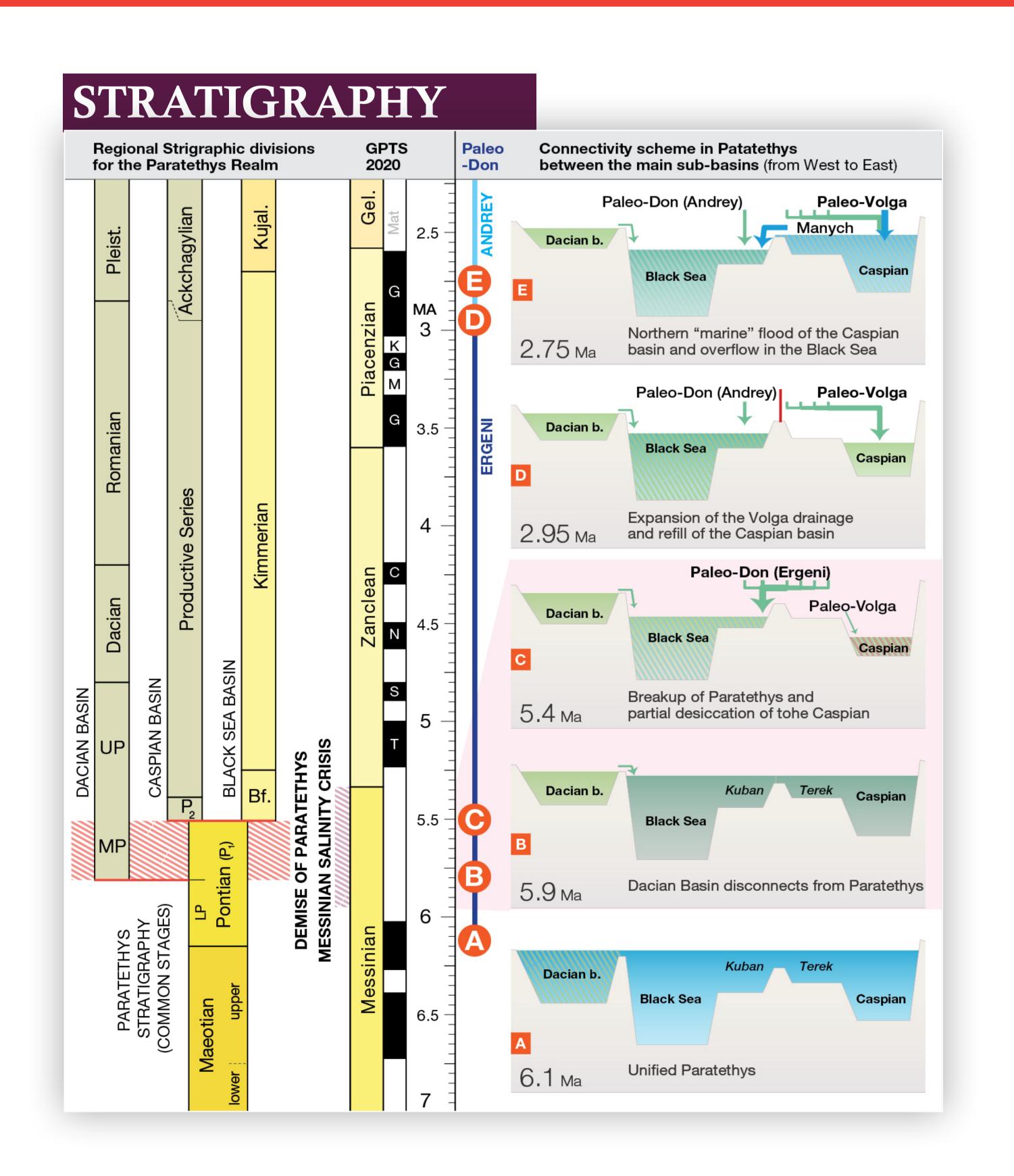
Evaporation over lake surface: 1500 mm/yr

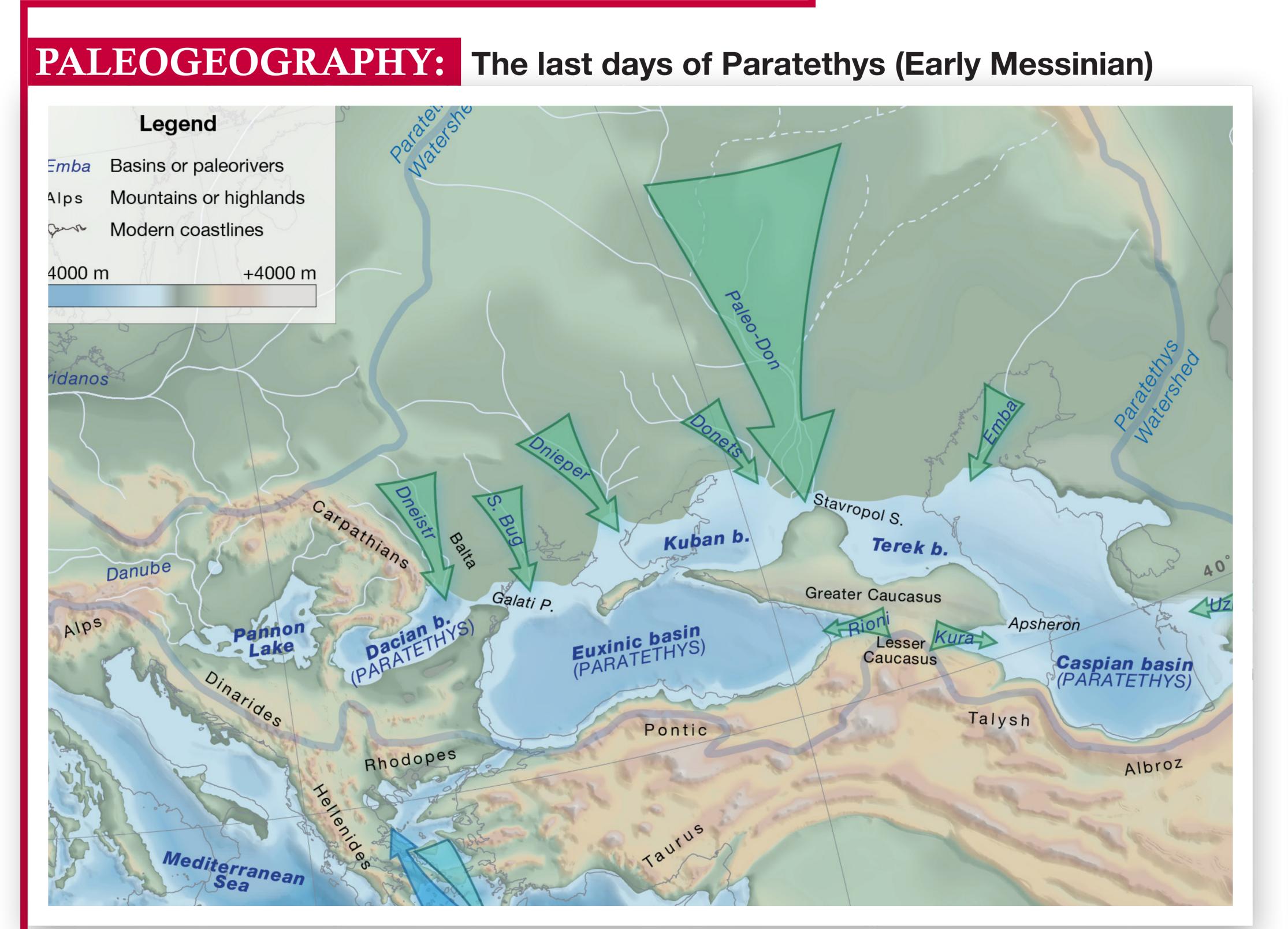
Erodibility platform: 5e-5 m*(yr^-1)*(Pa^-1.5)

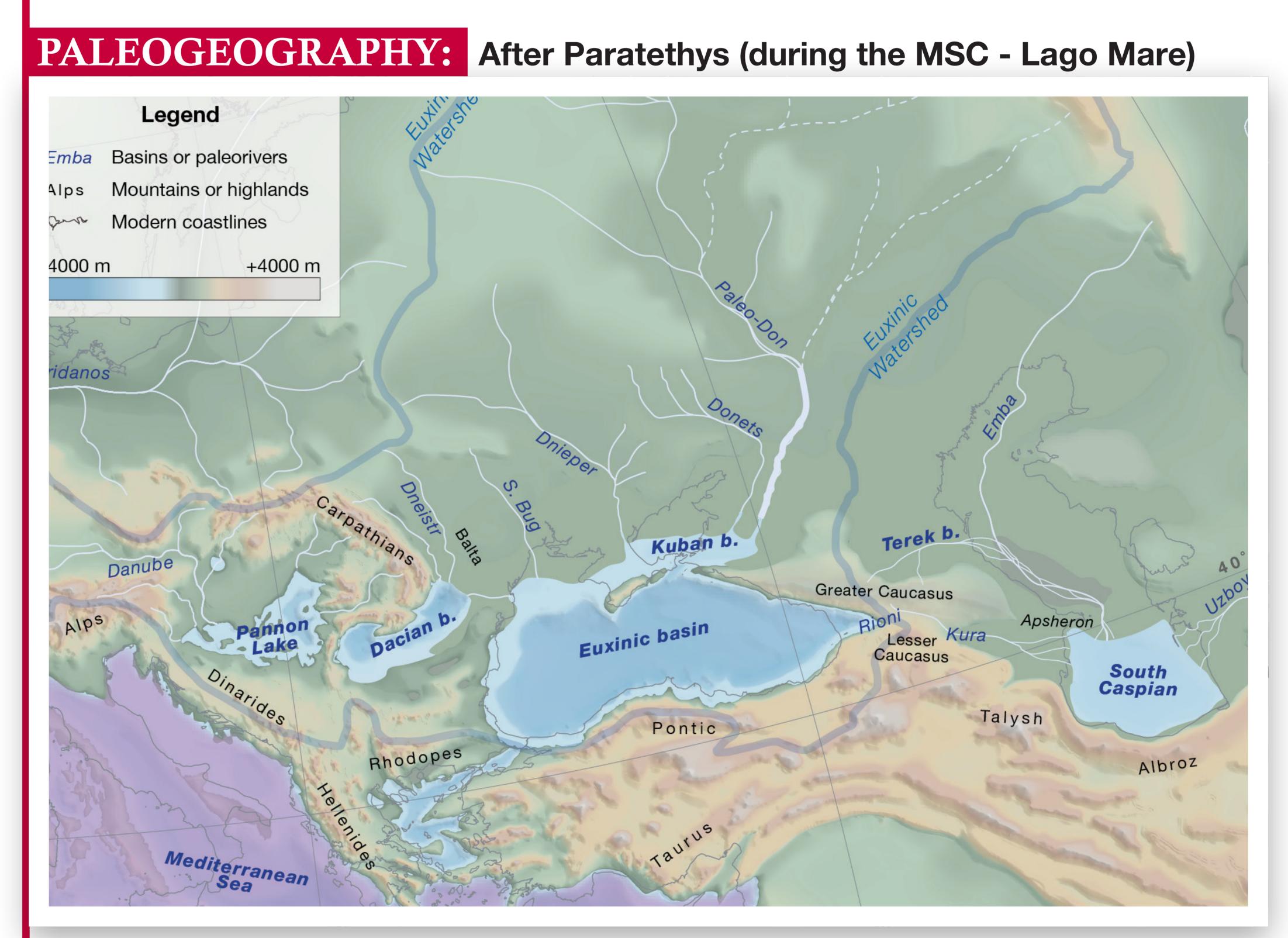
Erodibility mountains: 1e-7 *(yr^-1)*(Pa^-1.5)

River capacity for transporting sediments: 500 kg/m³

THE DEMISE OF PARATETHYS, THE CASPIAN BASIN DESICCATION & THE LAGO MARE, - CONNECTED EVENTS?







CONCLUSIONS

A possible MSC scenario:

The Mediterranean desiccation triggered the river erosion of the seaway(s) with Paratethys and a delayed base-level drop in Paratethys.

The base-level drop (~30m) triggers the fragmentation of Paratethys - the Black Sea captures most main rivers and increases its discharge in the Mediterranean, partially refilling it.

The Zanclean flooding cancels the influence of the Black Sea discharge.

Upstream erosion in the Caspian captures part of the Paleo-Don drainage that refills the Caspian Basin.