



# **Mature Based for New Solutions Conference**

**Visegrád, 21 November 2013**

**Society of Petroleum Engineers**

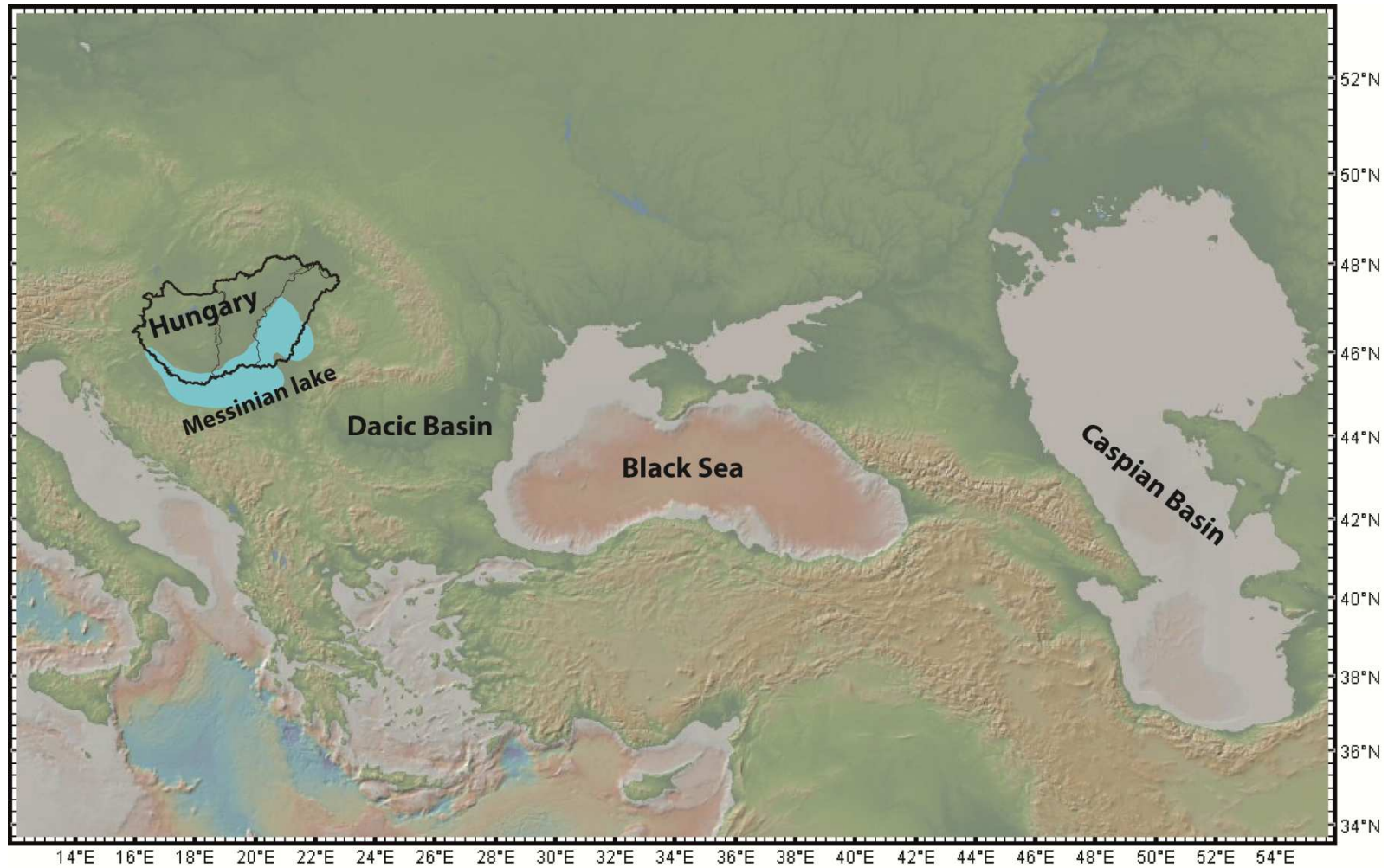


# **Sequence Stratigraphy: A concept to find stratigraphic traps in the Pannonian Basin, Hungary**

**István Csató, Sándor Tóth**

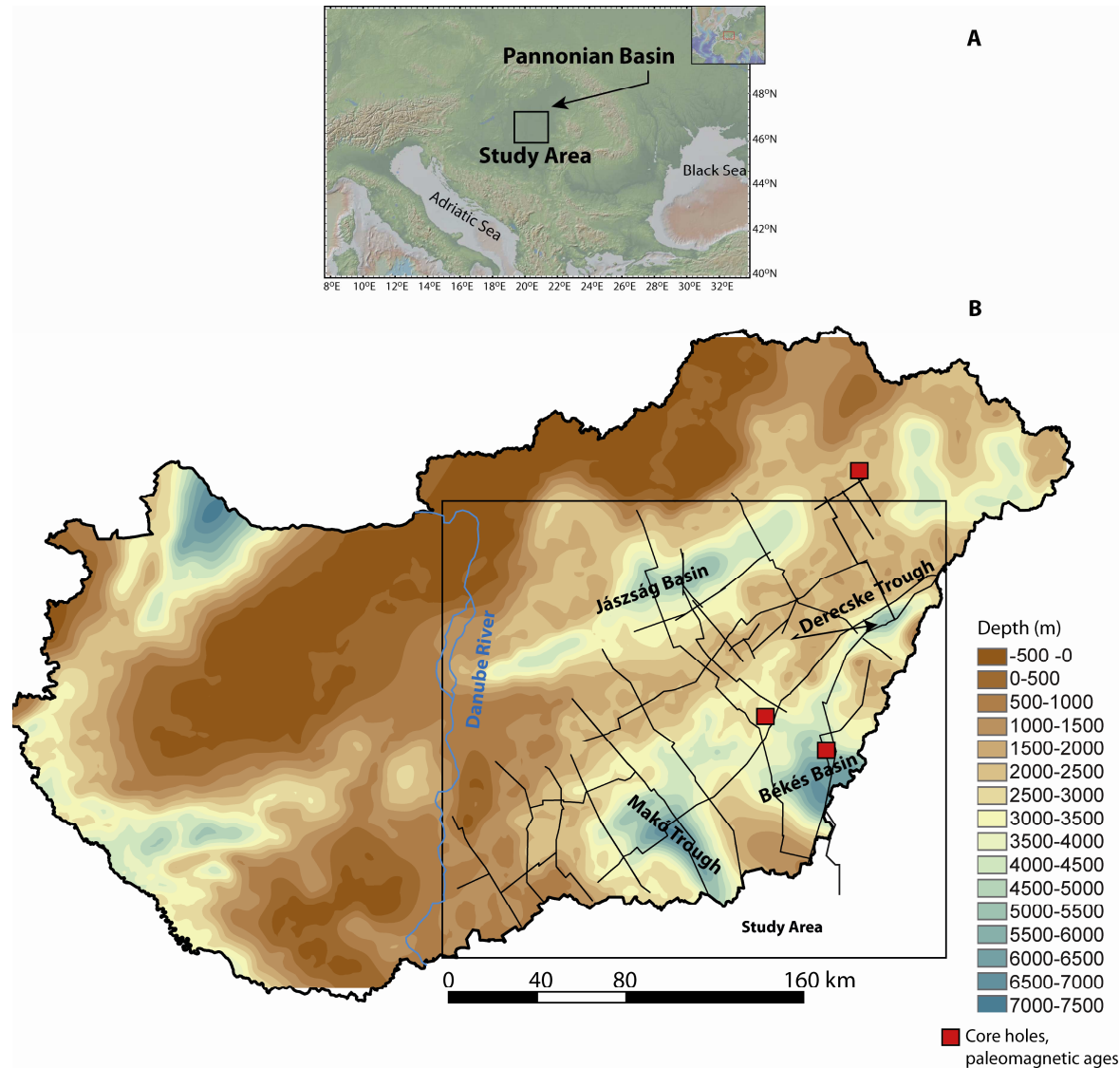
**E&P MOL Group, Budapest**

# The Pannonian Basin



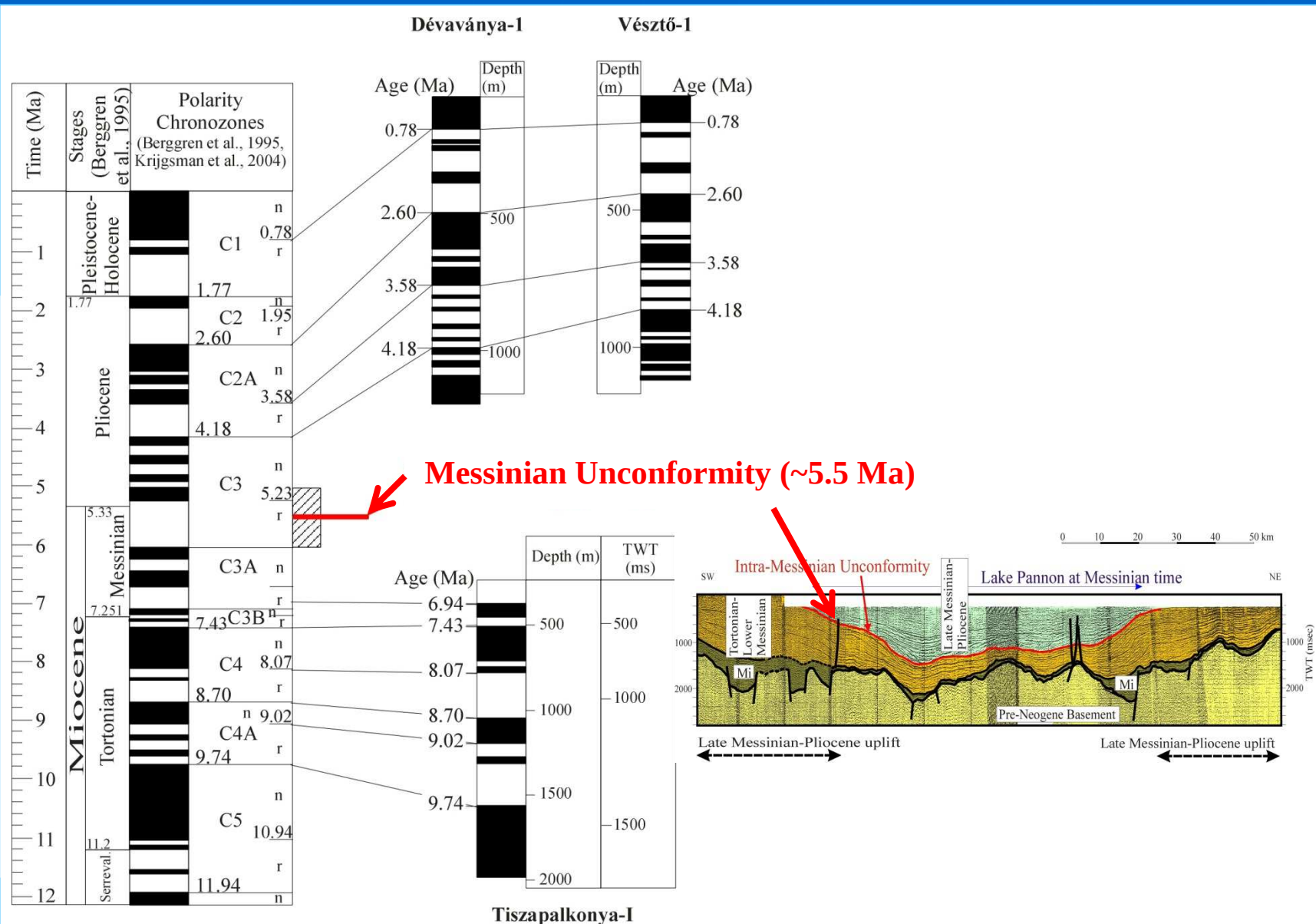
- **Data; Basin Fill Model**
- **Regional Seismic Sections**
- **Stratigraphic Simulations**
- **Messinian Petroleum System**

# Location, Data Set

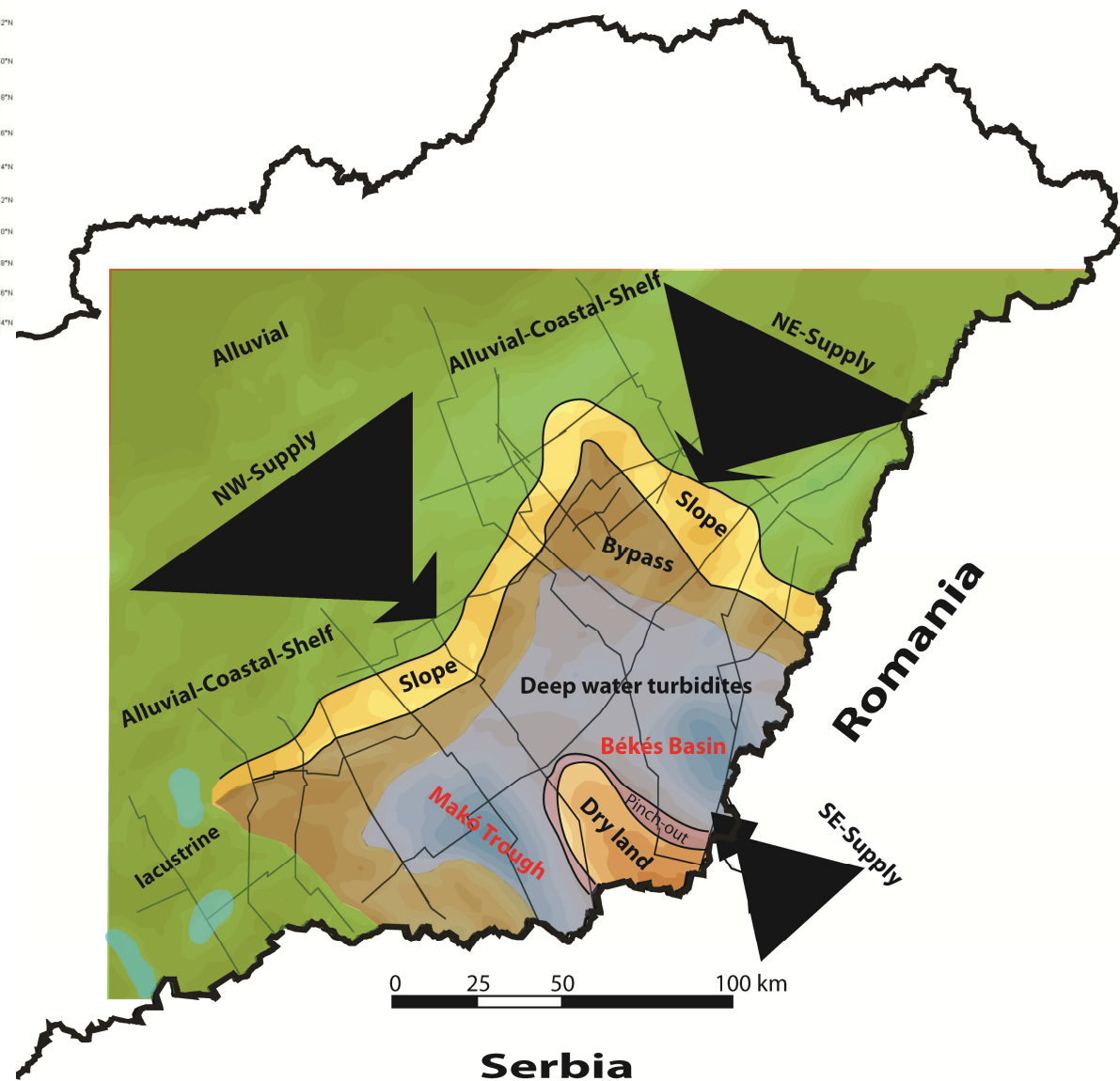
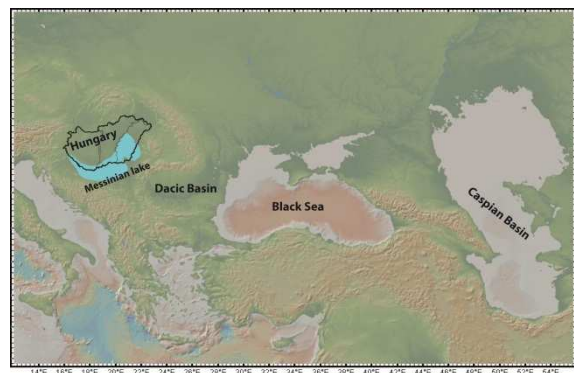


# Data: Paleomagnetic Chronozones

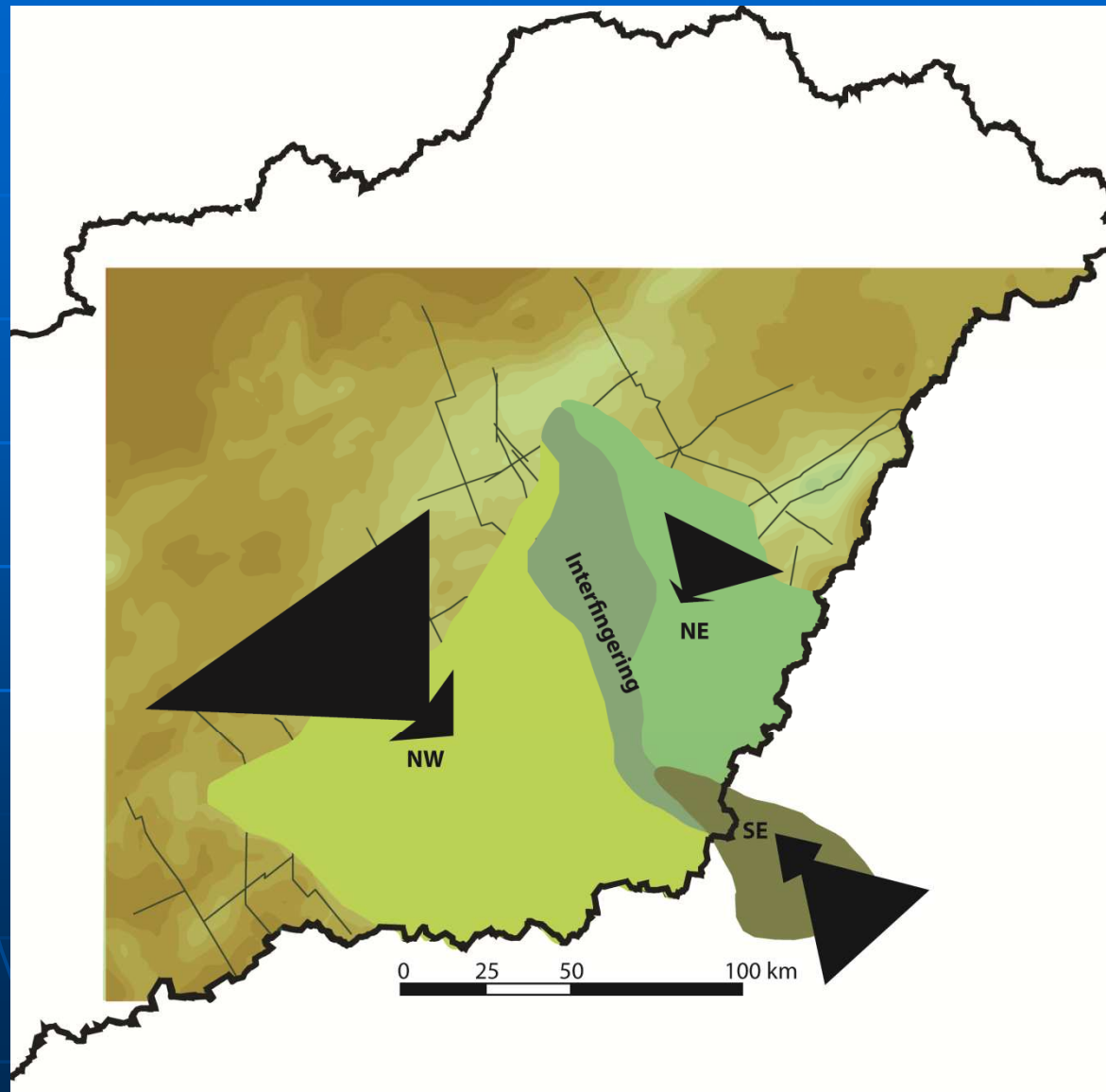
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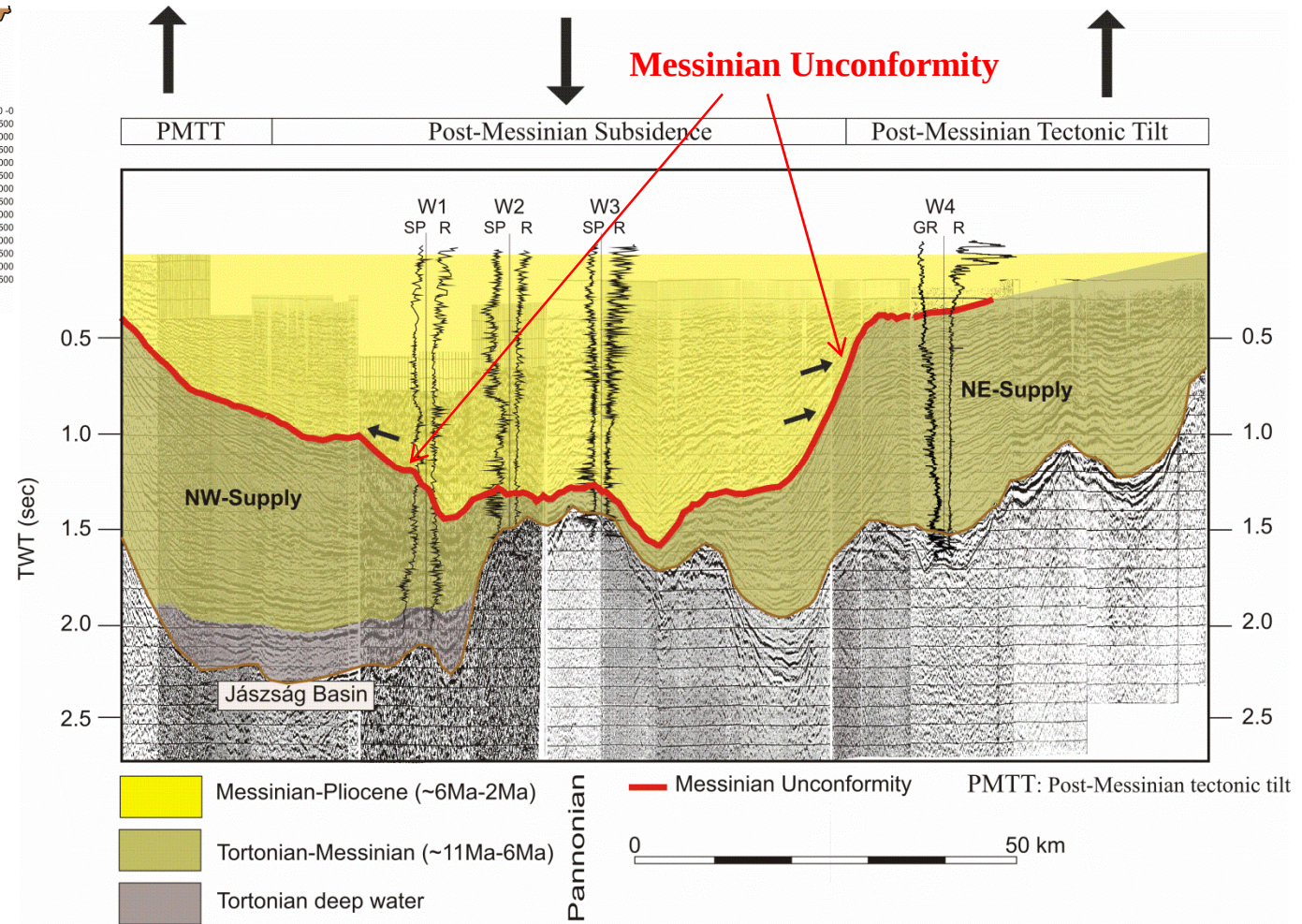
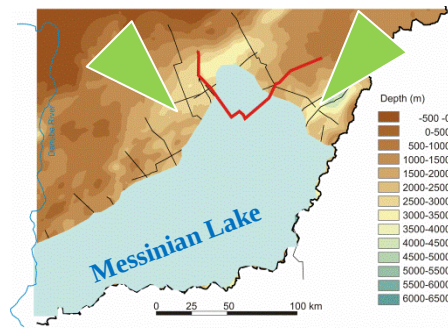
# Basin Fill Model: Messinian



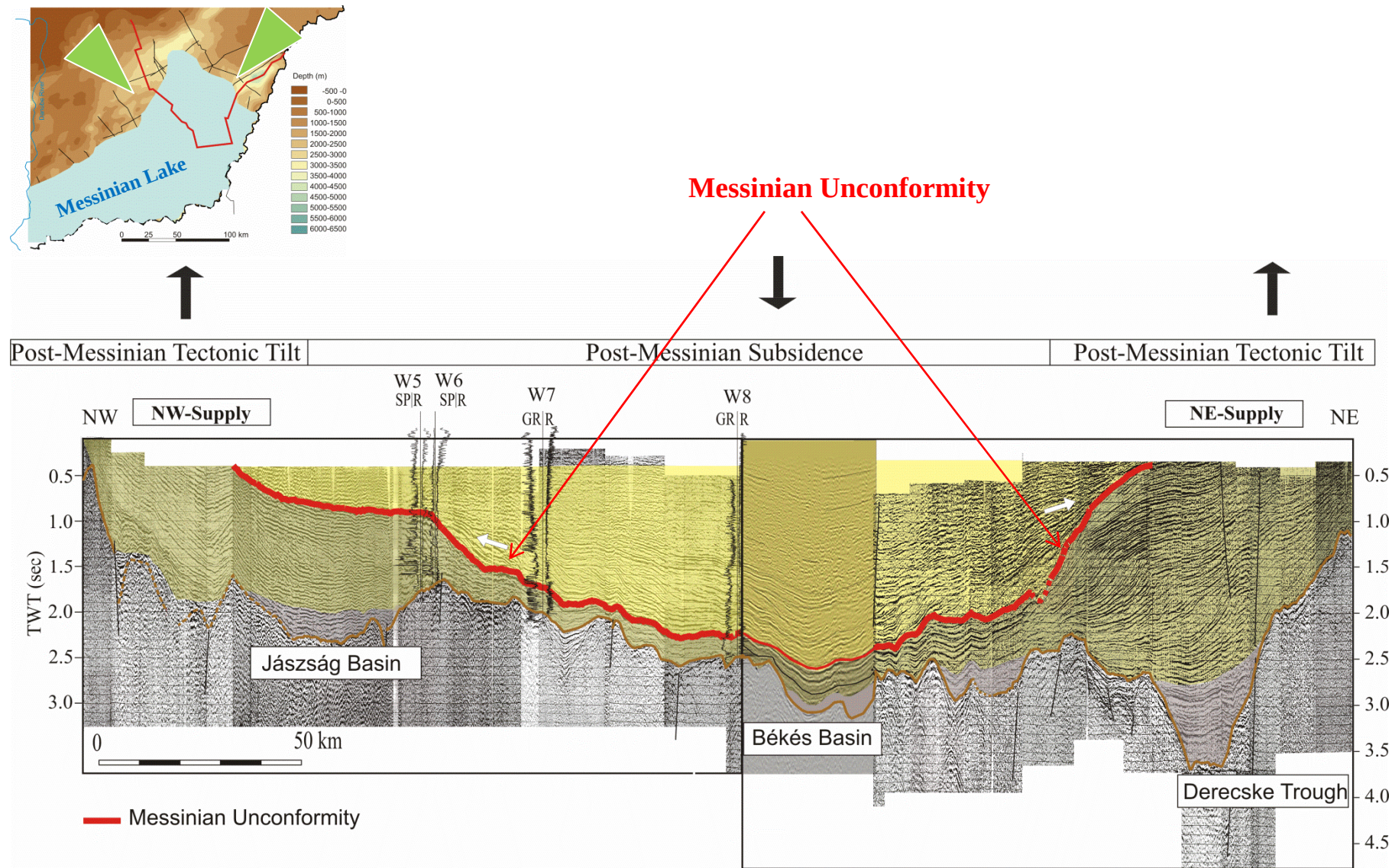
## Basin Fill Model: $\sim 3$ Ma



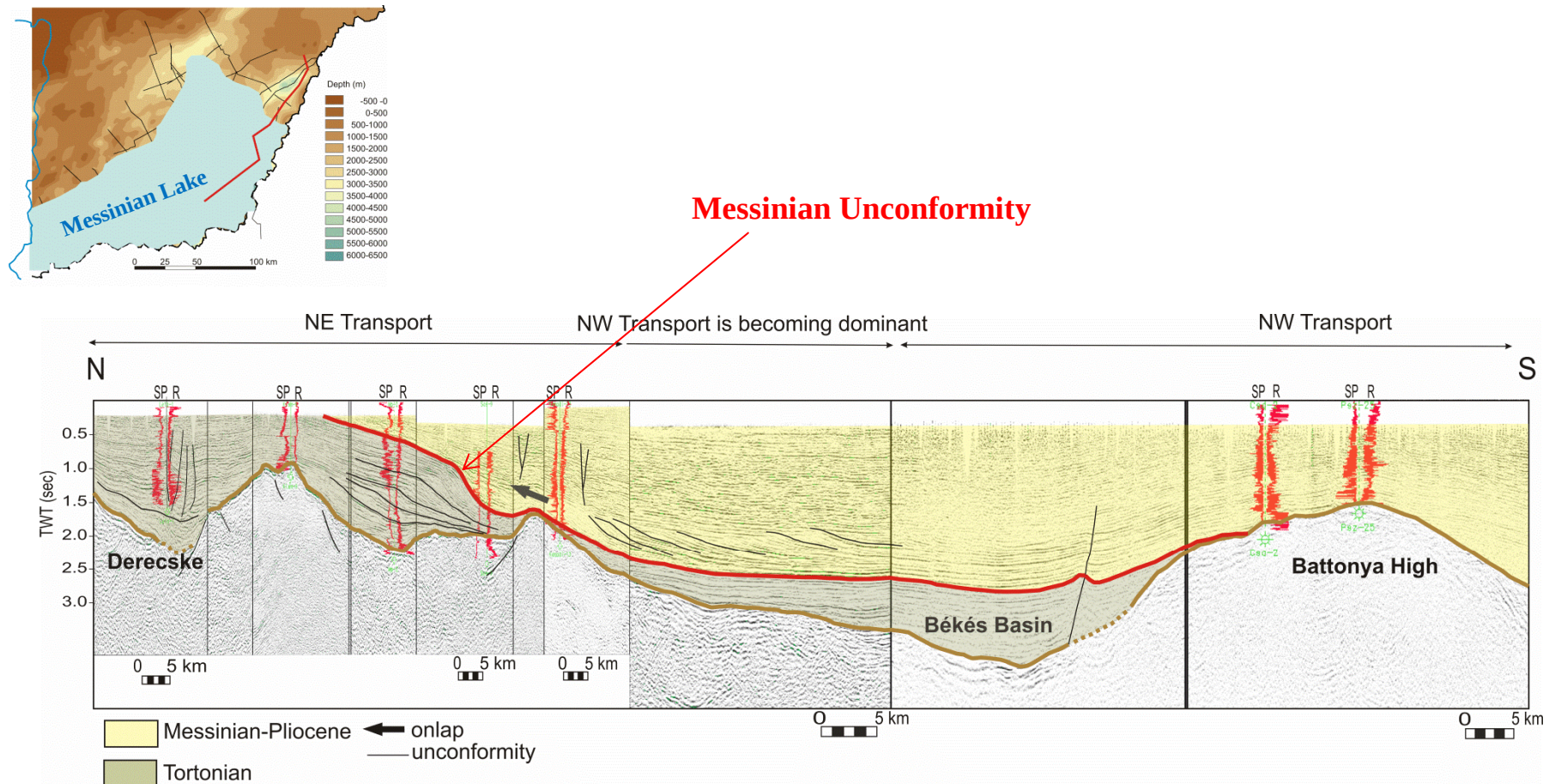
# Regional Seismic Sections



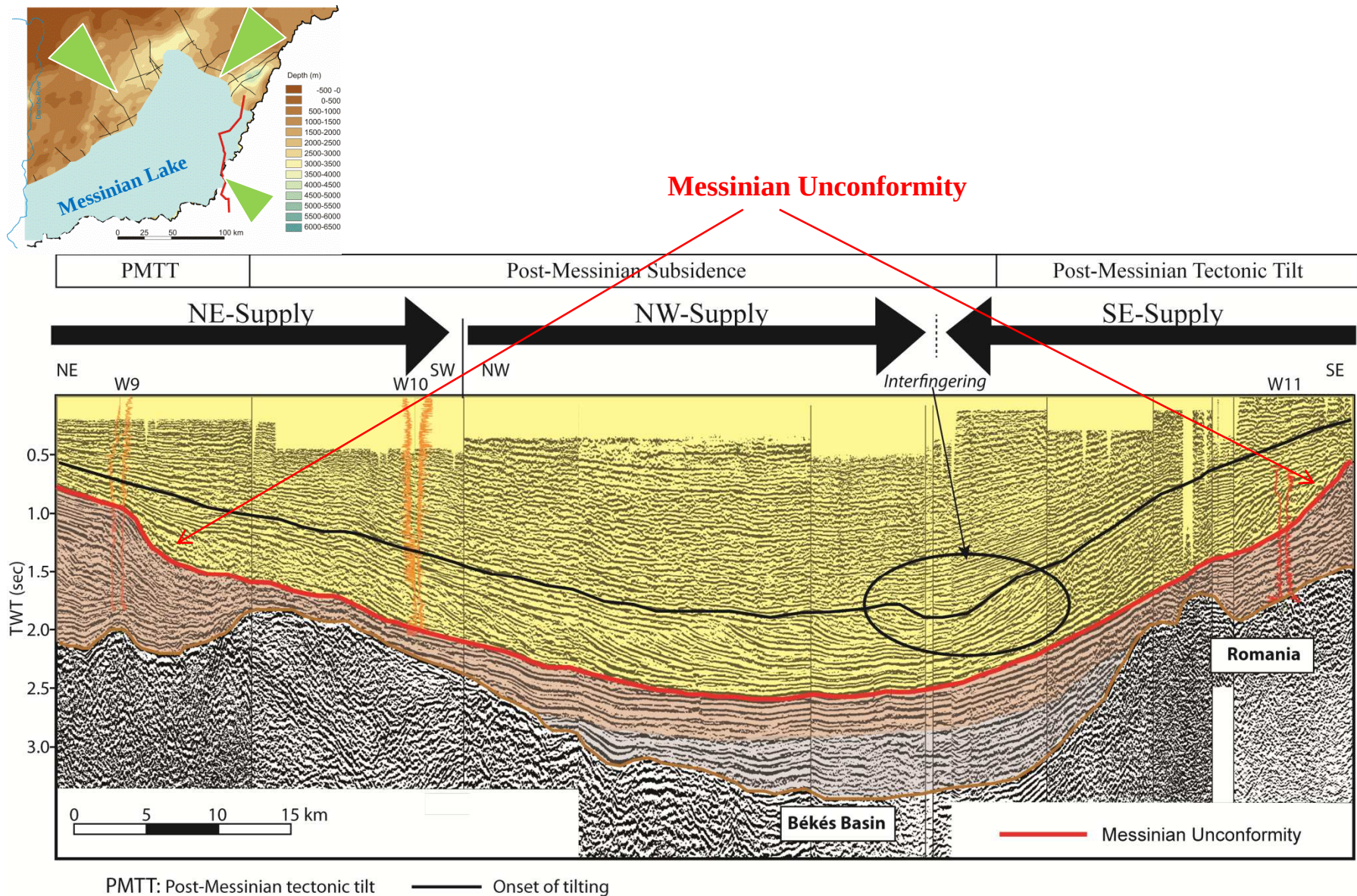
# Regional Seismic Sections



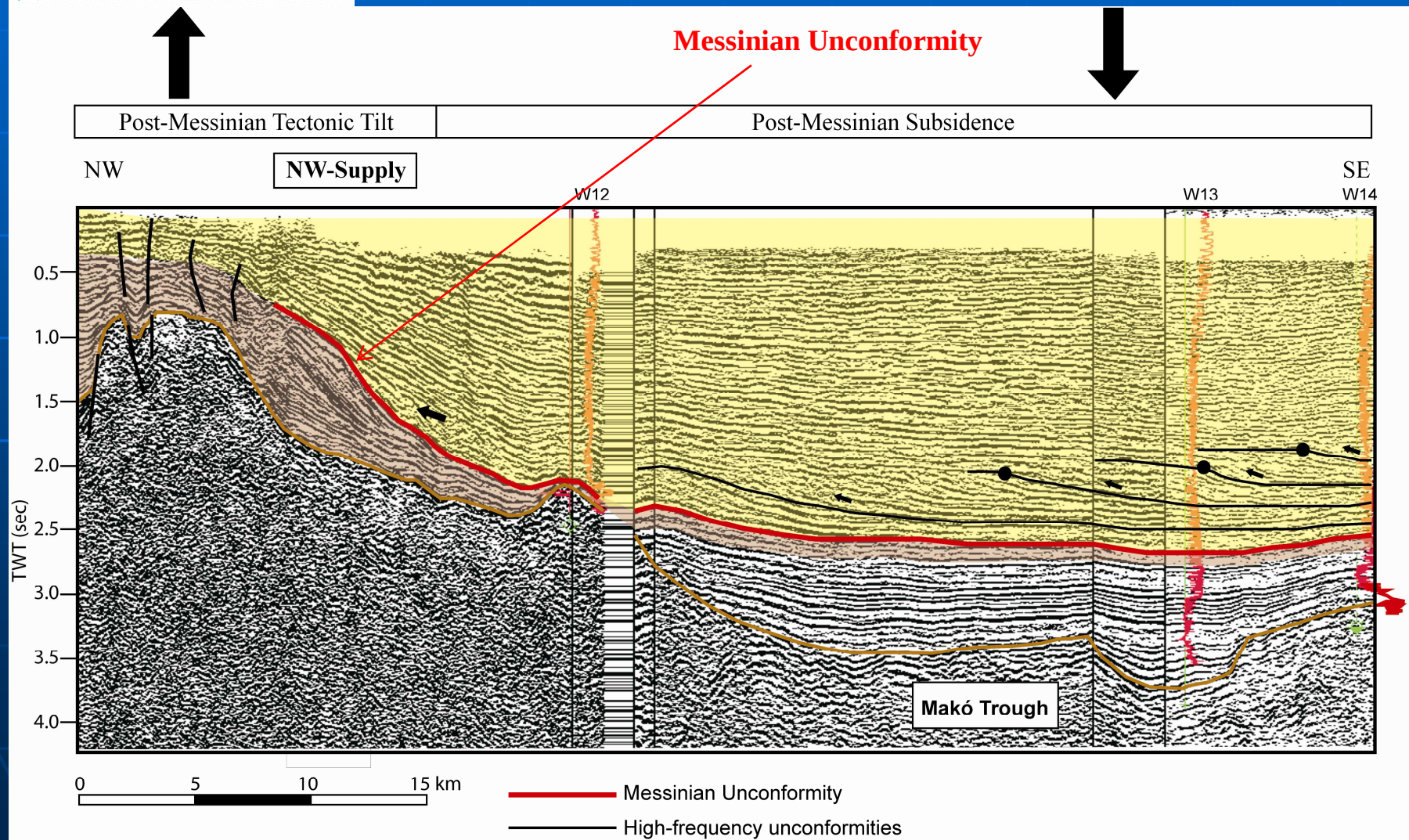
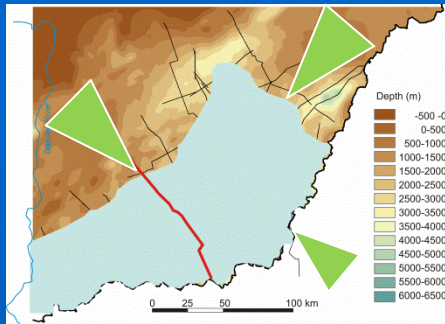
# Regional Seismic Sections



# Regional Seismic Sections



# Regional Seismic Sections



# Stratigraphic Simulations

## Mathematical Model: Sediment Diffusion

$$Q_S = -(K_S + K_W Q_W^n S^{m-1}) \vec{\nabla} h$$

$$Q_s = K \hat{Q}_s^n \hat{S}^m \text{ with } \hat{Q}_s = \frac{Q_s}{Q_{sw}} \text{ and } \hat{S} = \frac{S}{S_g}$$

$$Q_{s,ij} = \left( \frac{S_{ij}}{\sum_k S_{ik}} \right) Q_{si}$$

$$\vec{Q}_{si} = -c_i Q_{si}^n S_{ij}^{m-1} \vec{\nabla} h \text{ with } S_{ij} = \left\| \vec{\nabla} h \right\|$$

### Diffusion Coefficients

A

| Ages                                                                          | 10–6.5 Ma | 6 Ma | 4–0 Ma |
|-------------------------------------------------------------------------------|-----------|------|--------|
| Total water discharge<br>(from all sources) (m <sup>3</sup> s <sup>-1</sup> ) | 16230     | 4817 | 7441   |

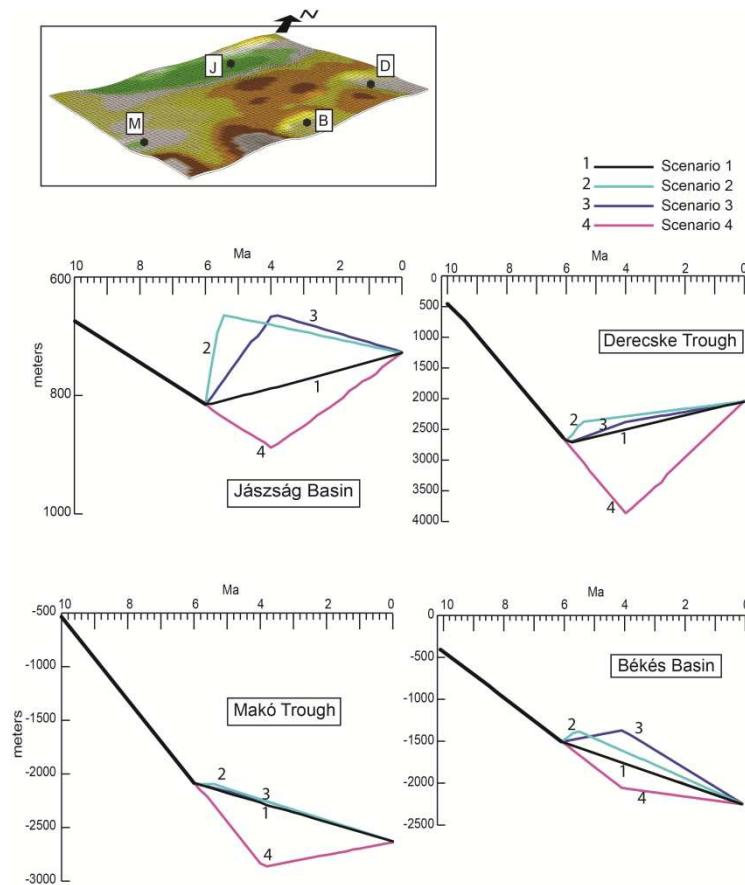
B

|                                                                        | Sand                | Silt                | Shale               |
|------------------------------------------------------------------------|---------------------|---------------------|---------------------|
| Continental diffusion<br>coefficient (m <sup>2</sup> a <sup>-1</sup> ) | 2 × 10 <sup>6</sup> | 3 × 10 <sup>6</sup> | 4 × 10 <sup>6</sup> |
| Marine diffusion<br>coefficient (m <sup>2</sup> a <sup>-1</sup> )      | 4 × 10 <sup>2</sup> | 4 × 10 <sup>3</sup> | 10 <sup>4</sup>     |

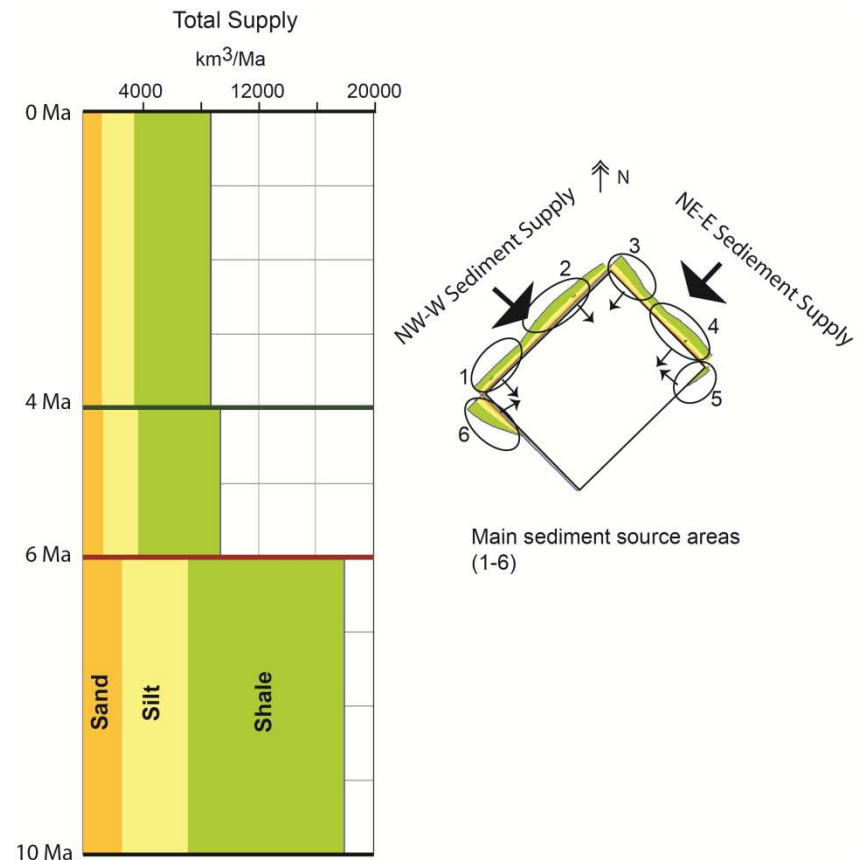
Software Dionisos by D. Granjeon

# Stratigraphic Simulations

## Subsidence History



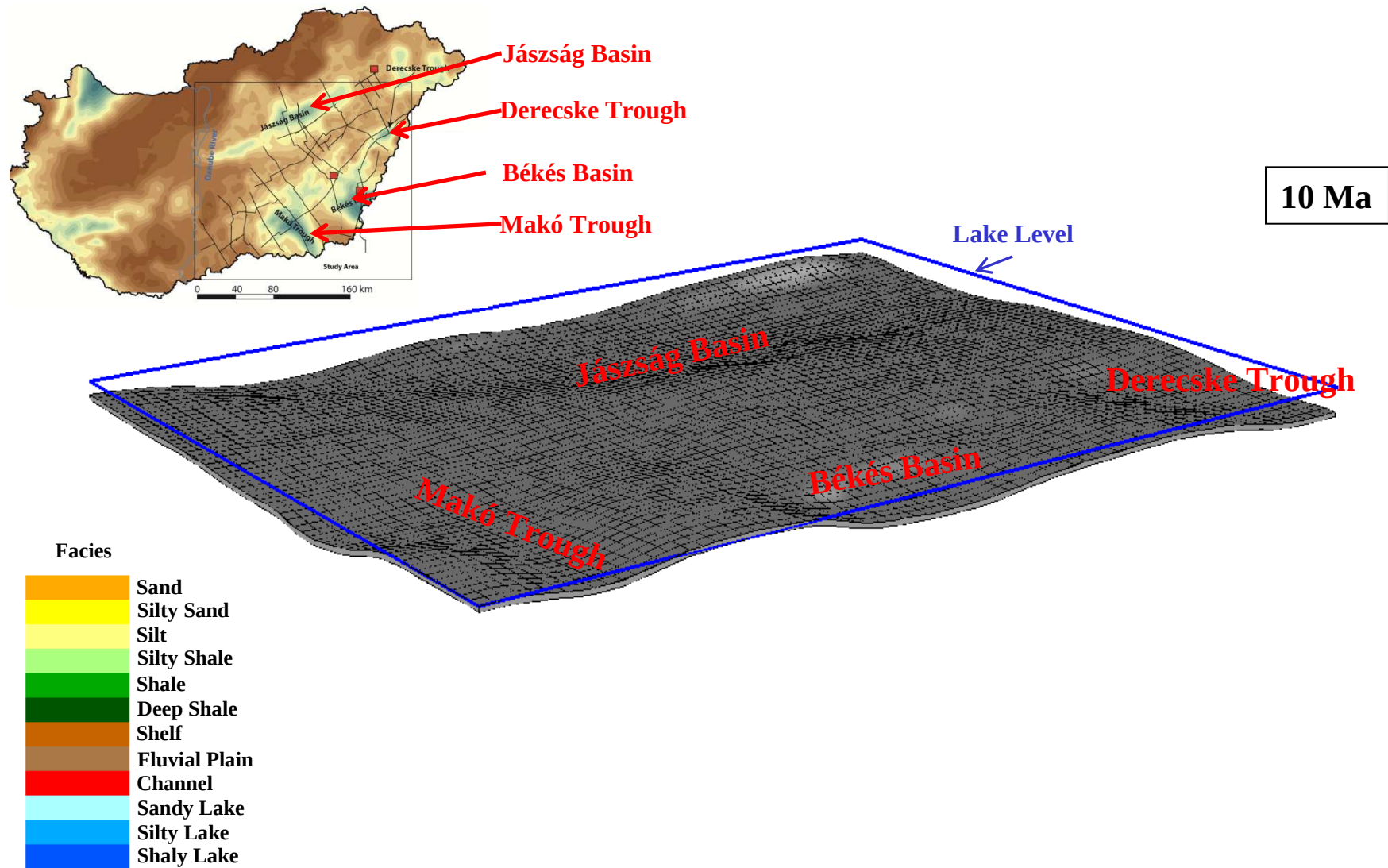
## Sediment Supply



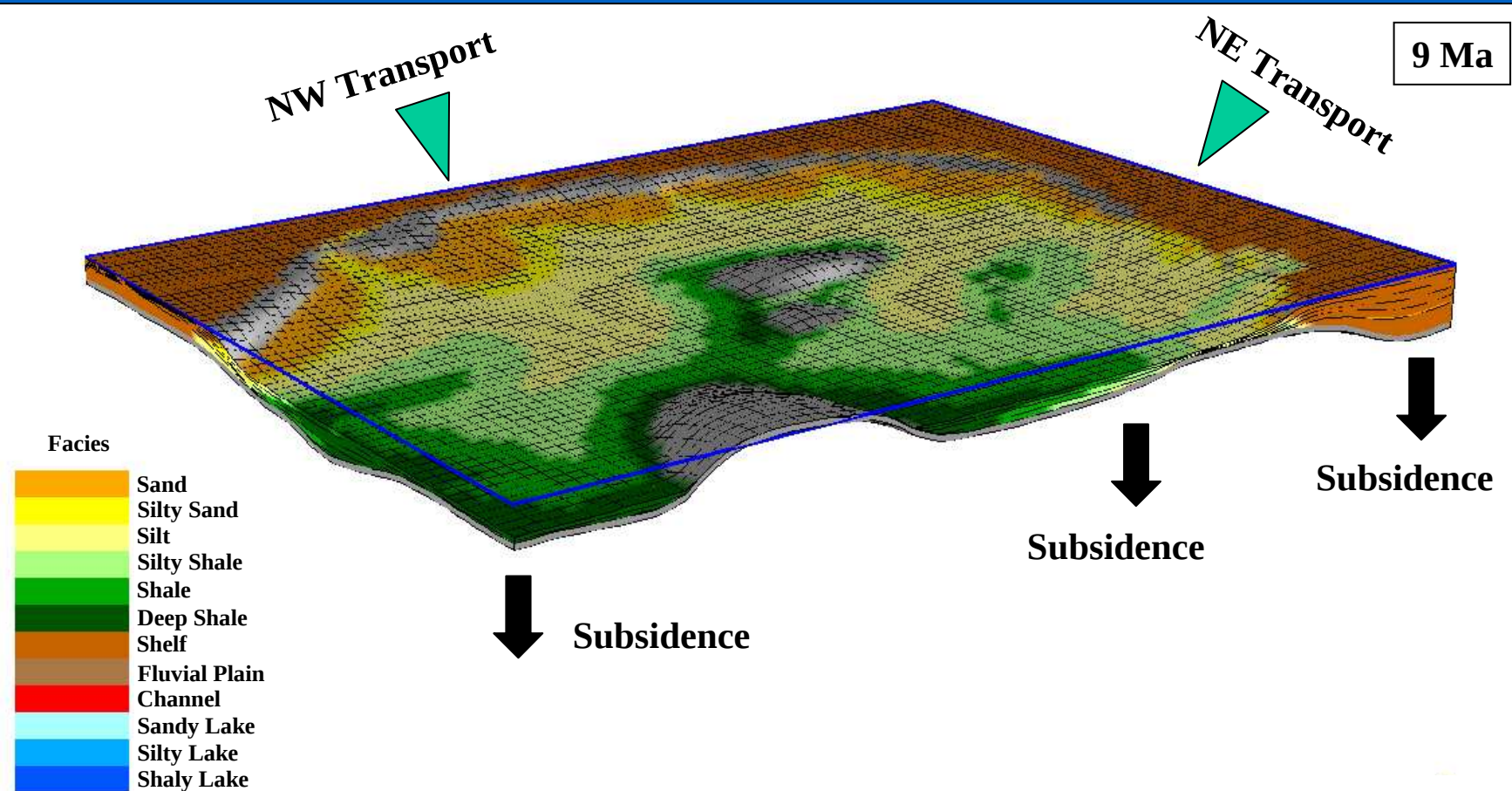
## Compaction

|                                     | Sand | Silt | Shale |
|-------------------------------------|------|------|-------|
| Initial porosity, ( $\Phi_0$ ) [%]  | 40   | 50   | 60    |
| Residual porosity, ( $\Phi_r$ ) [%] | 0    | 5    | 10    |
| Decay, (D) [m]                      | 2000 | 1000 | 500   |

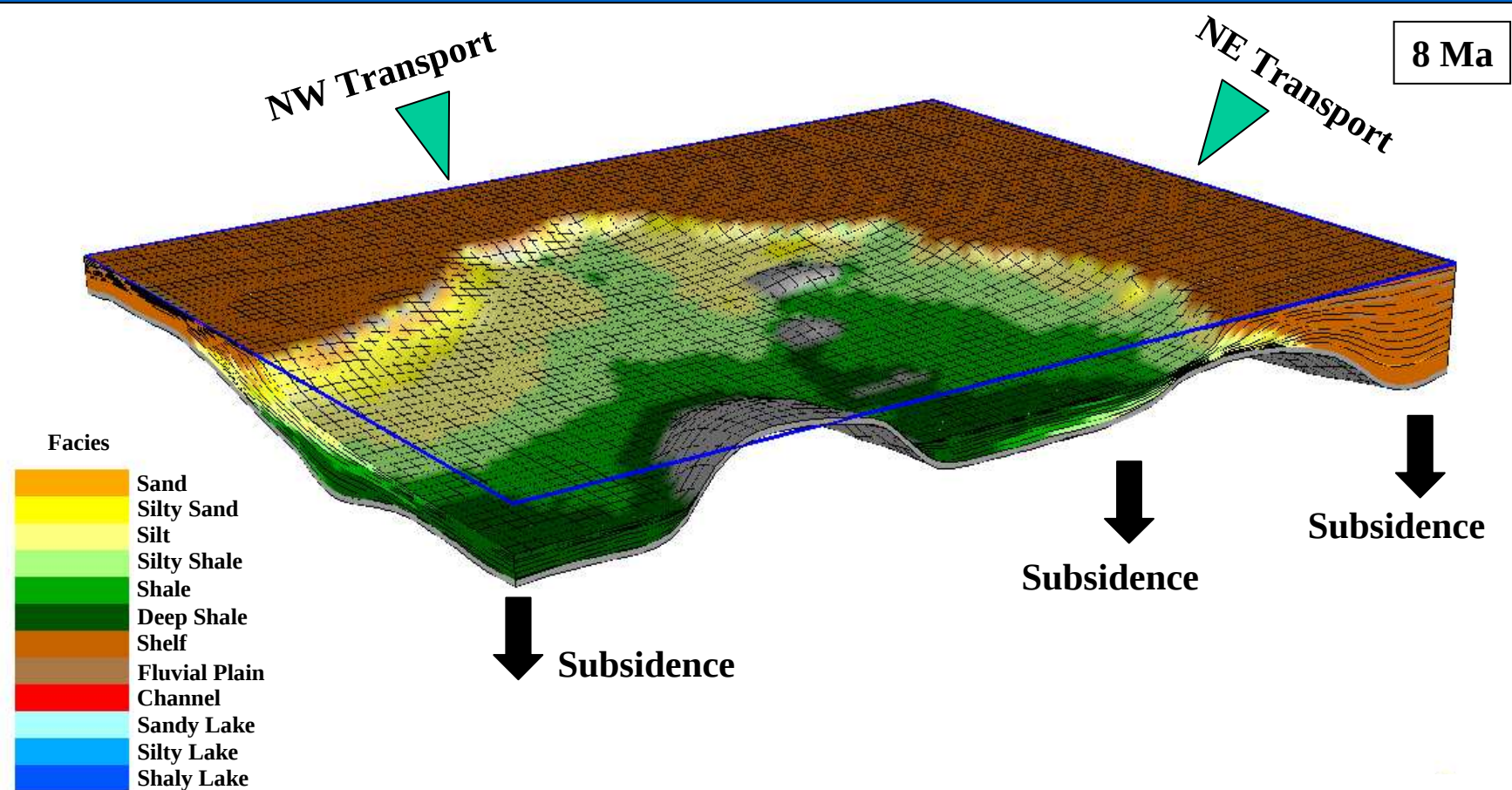
# Stratigraphic Simulations



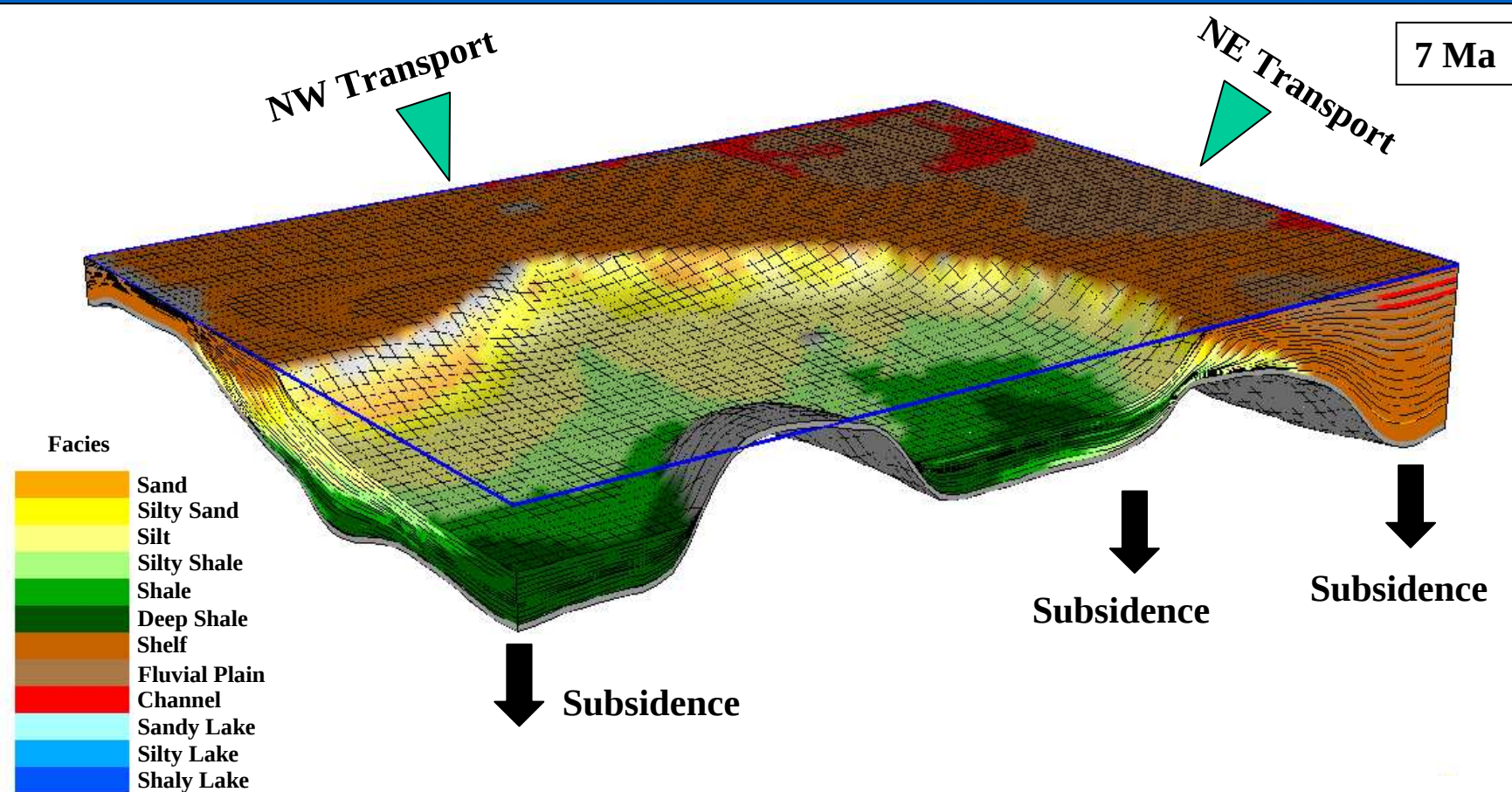
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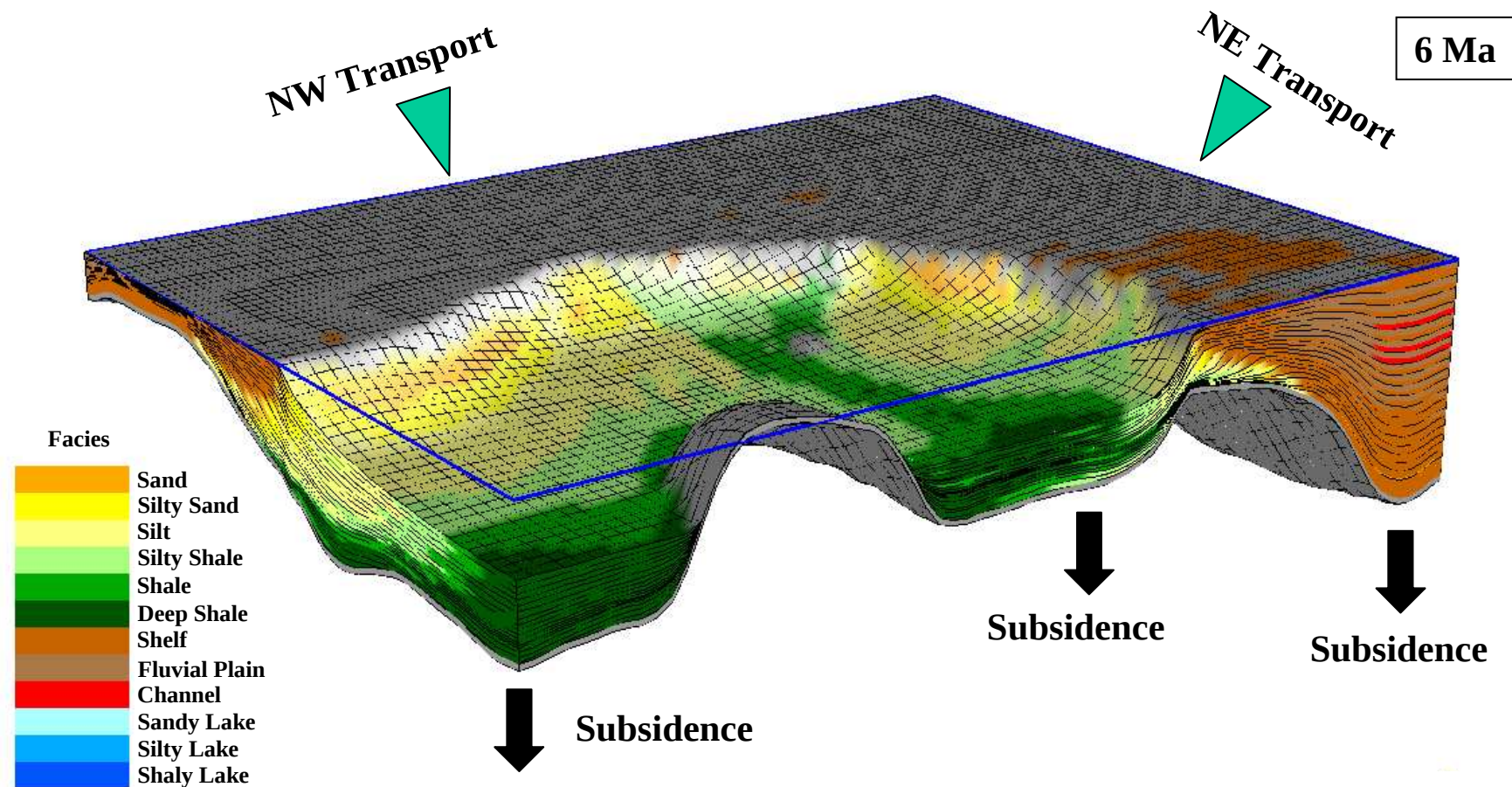
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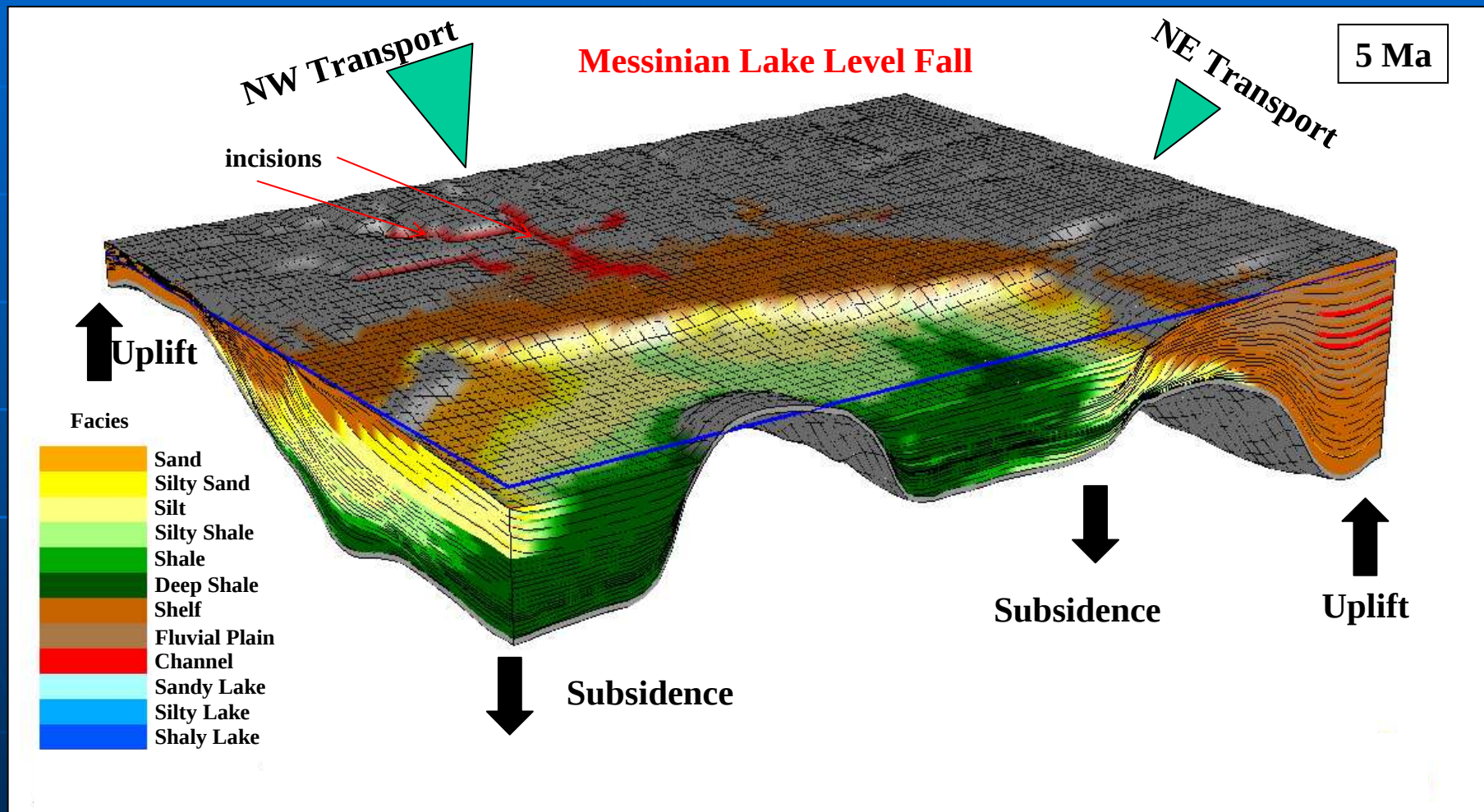
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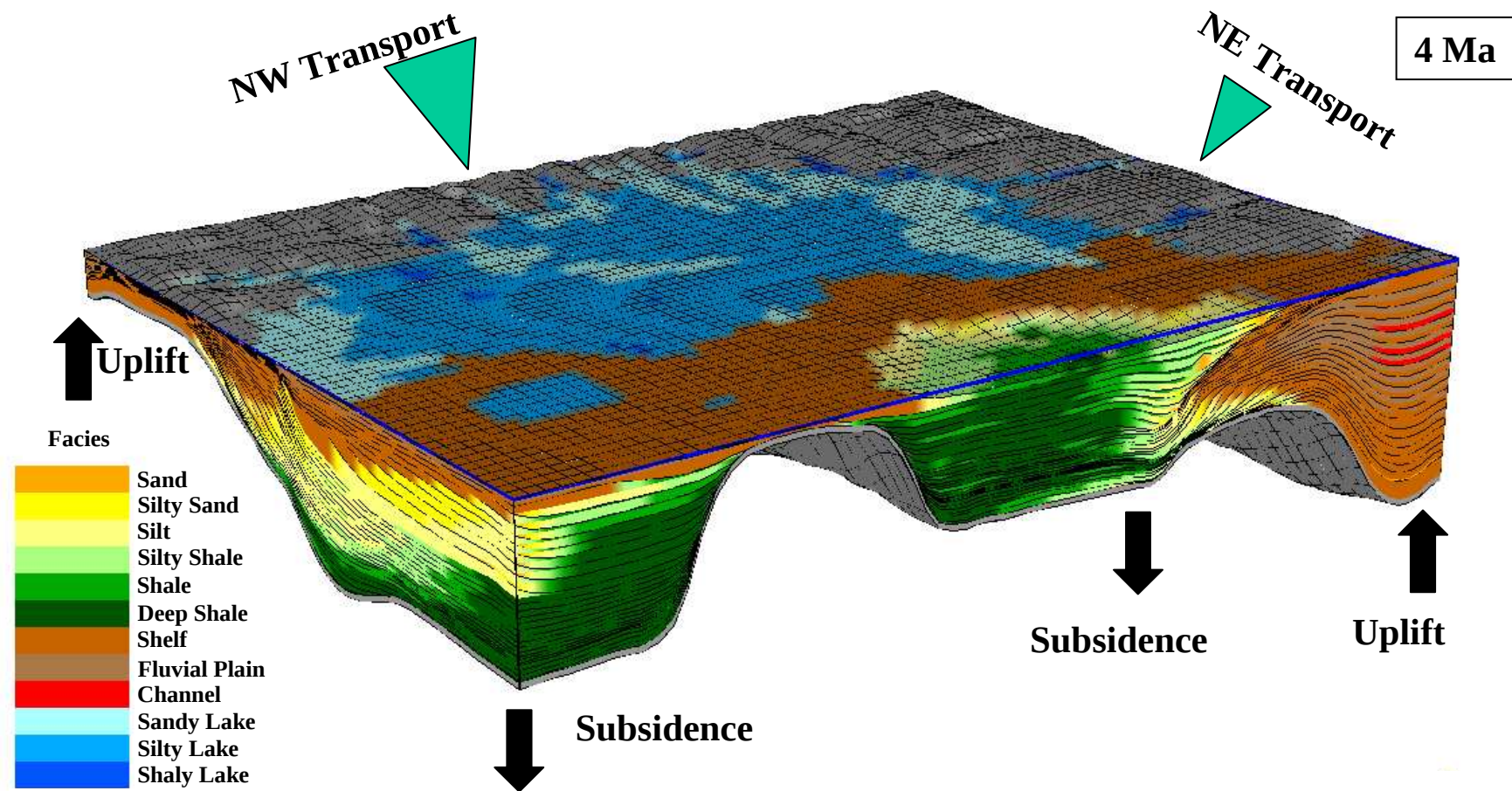
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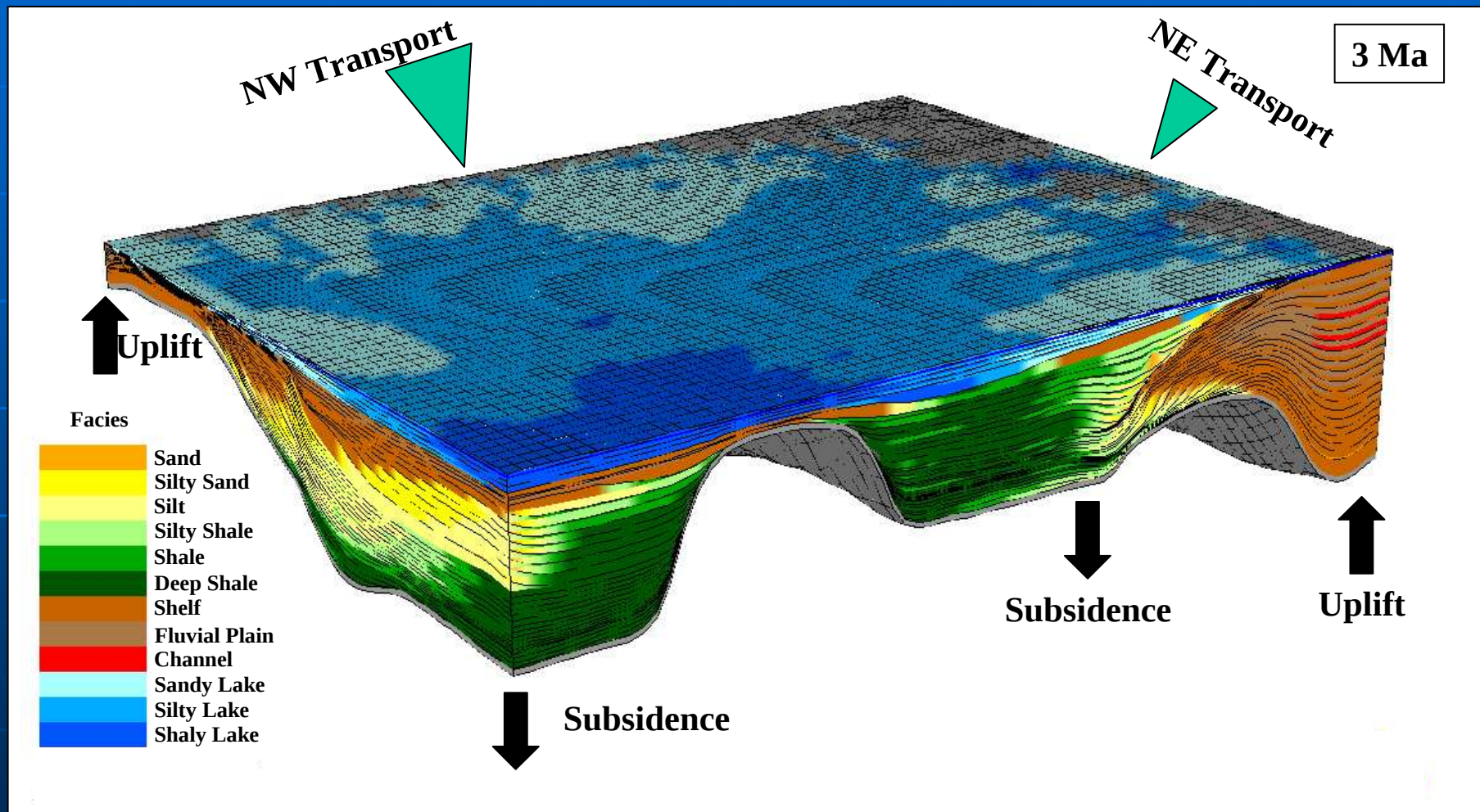
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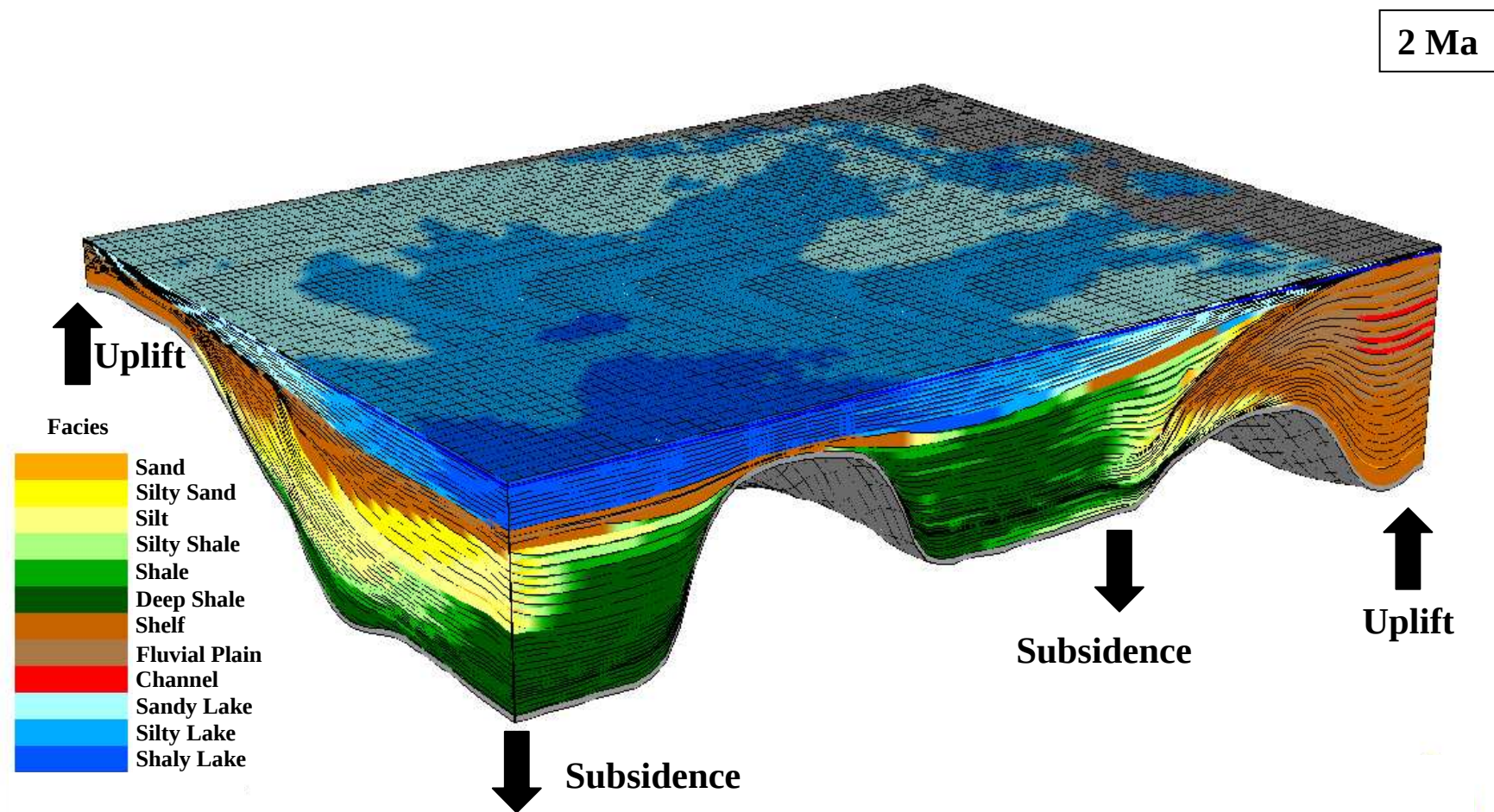
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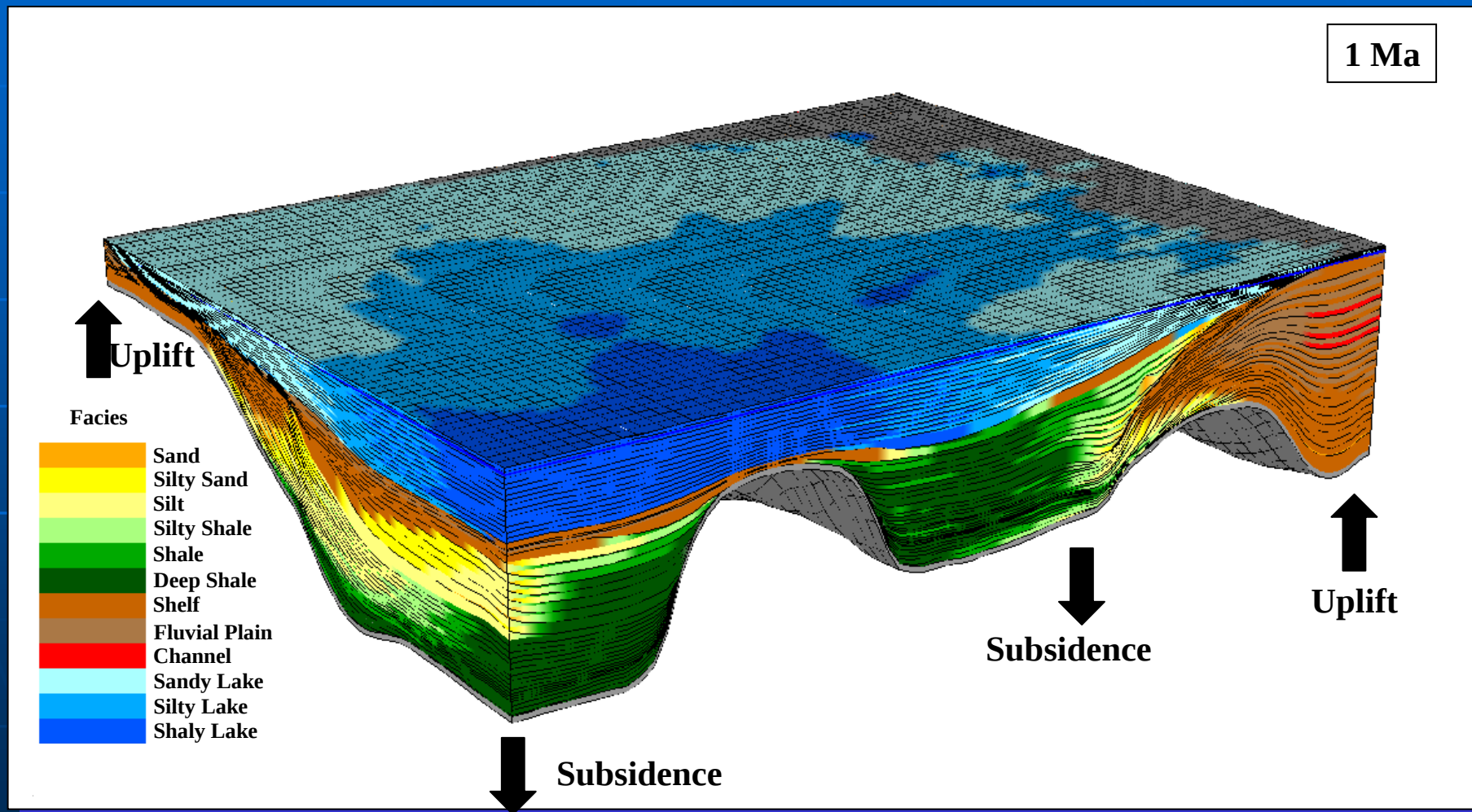
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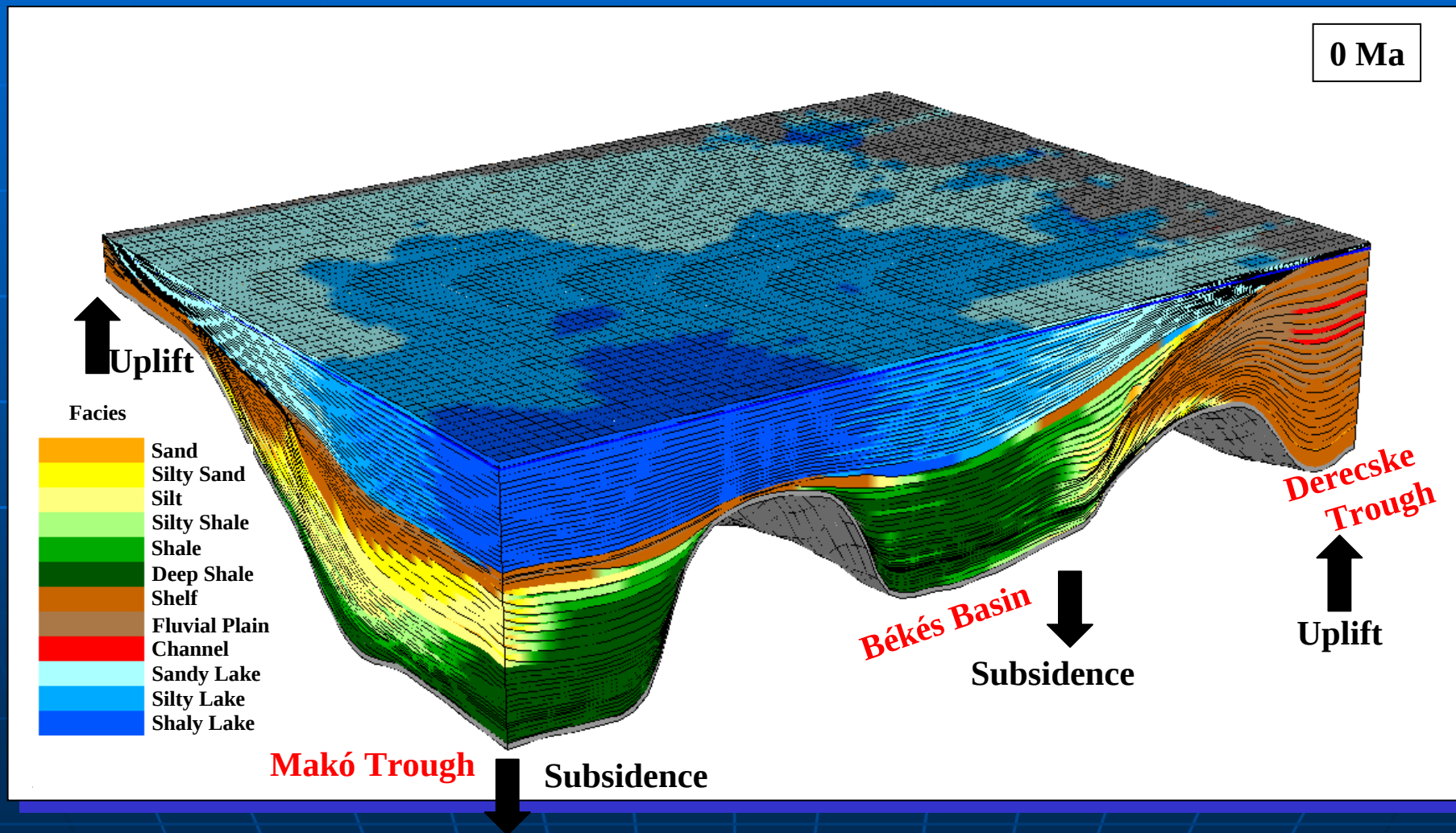
# Stratigraphic Simulations



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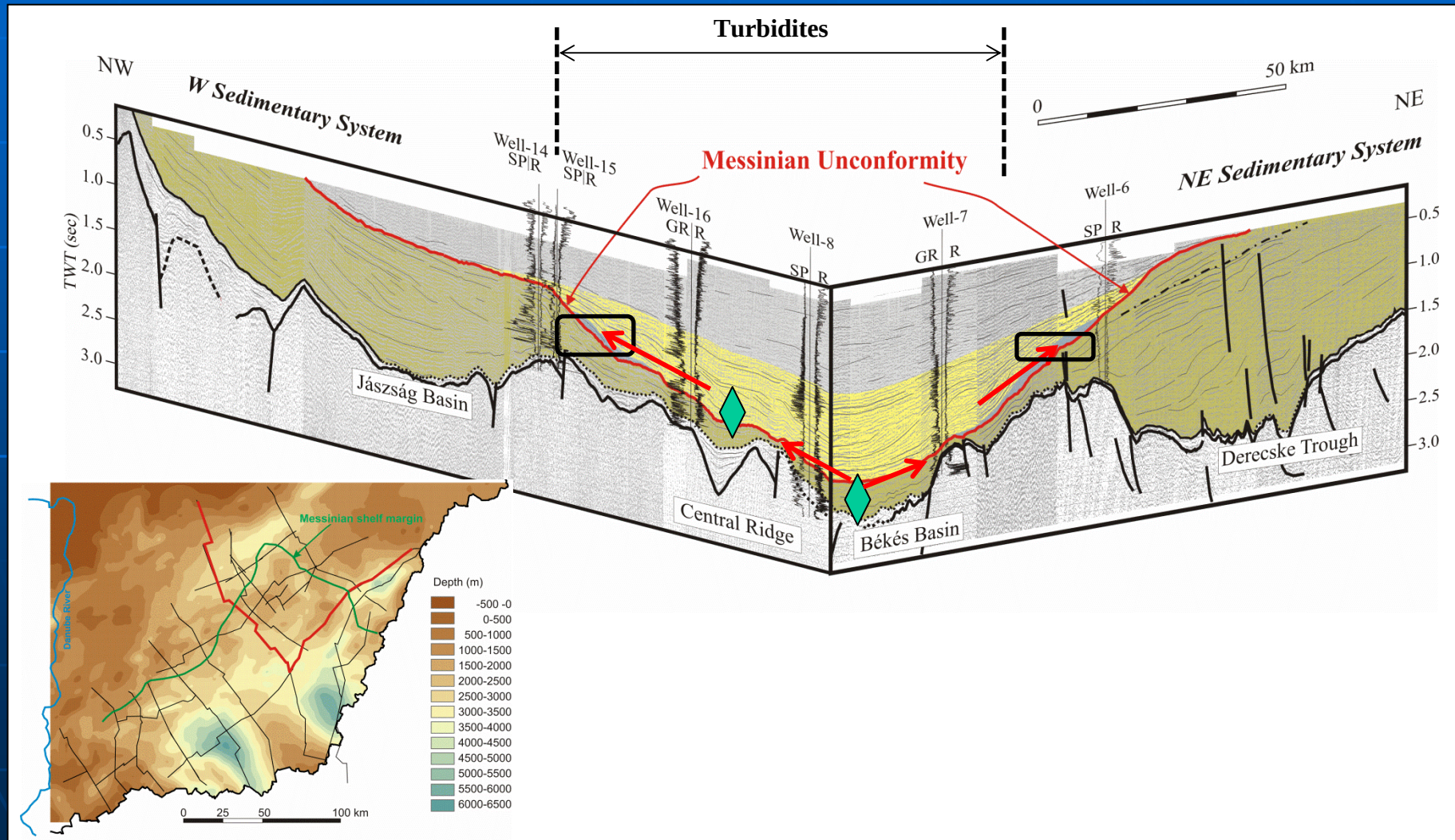


# Stratigraphic Simulations

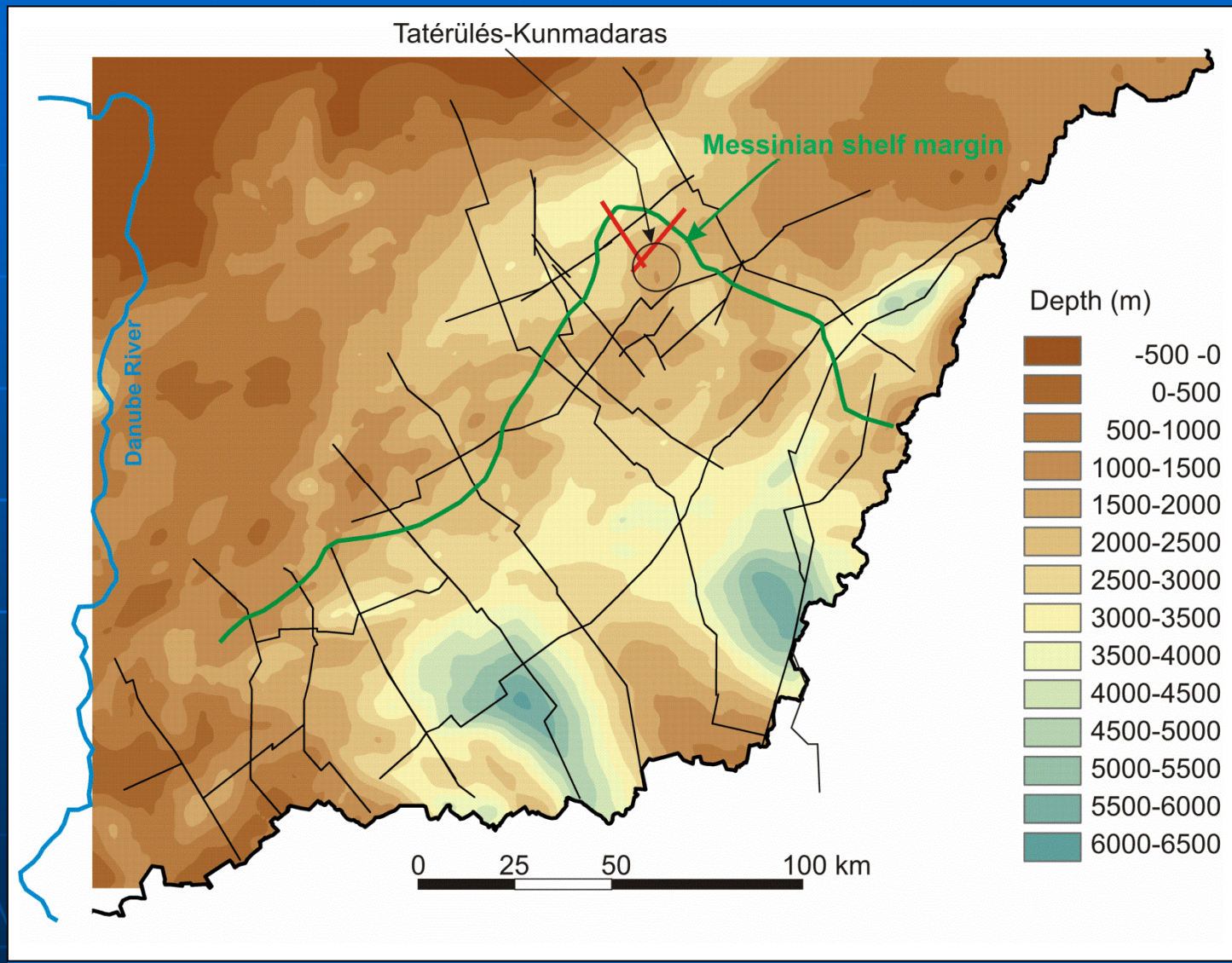


# Stratigraphic Traps

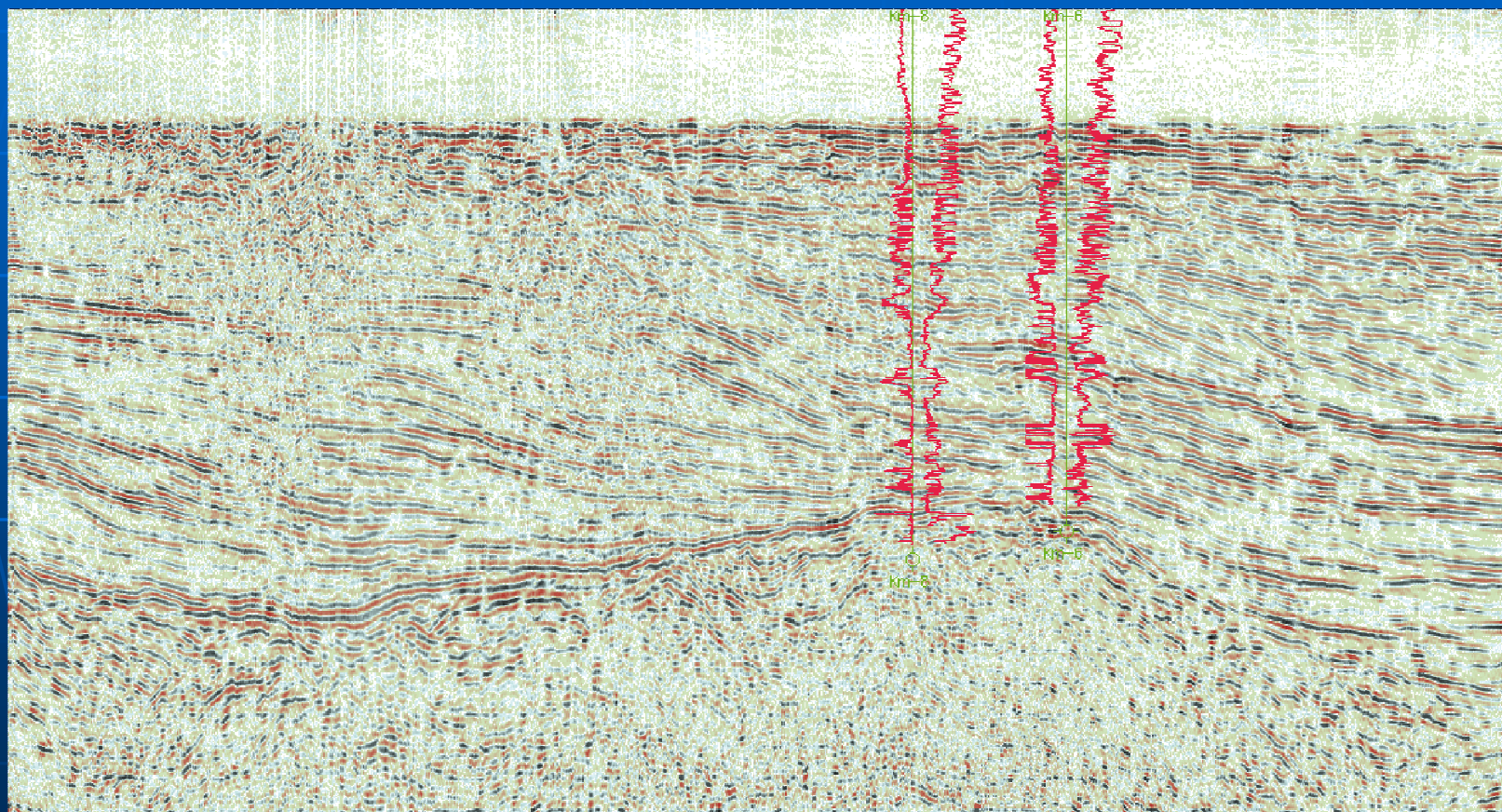
FST, LST onlap layers – stratigraphic traps



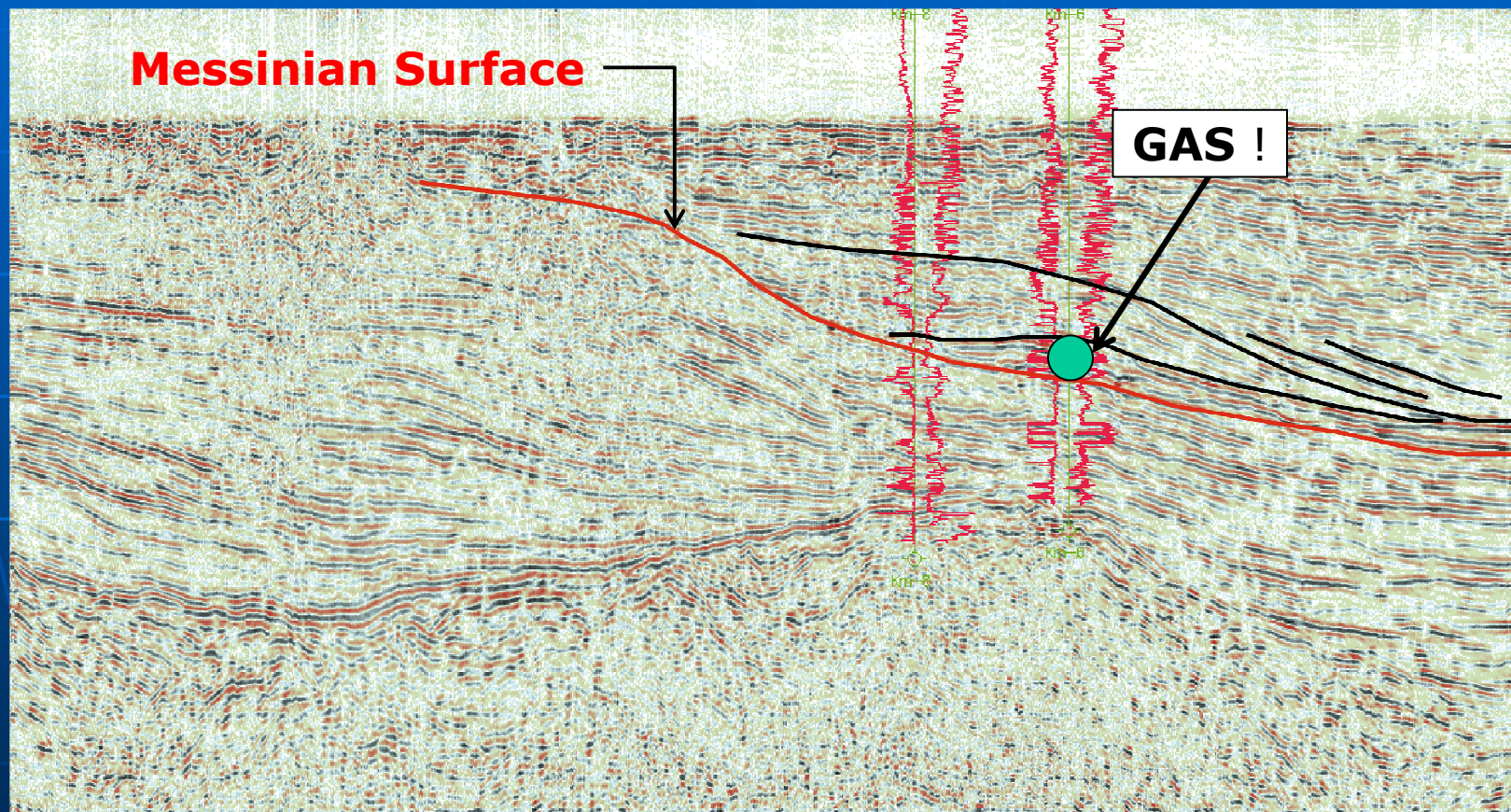
# Stratigraphic Traps



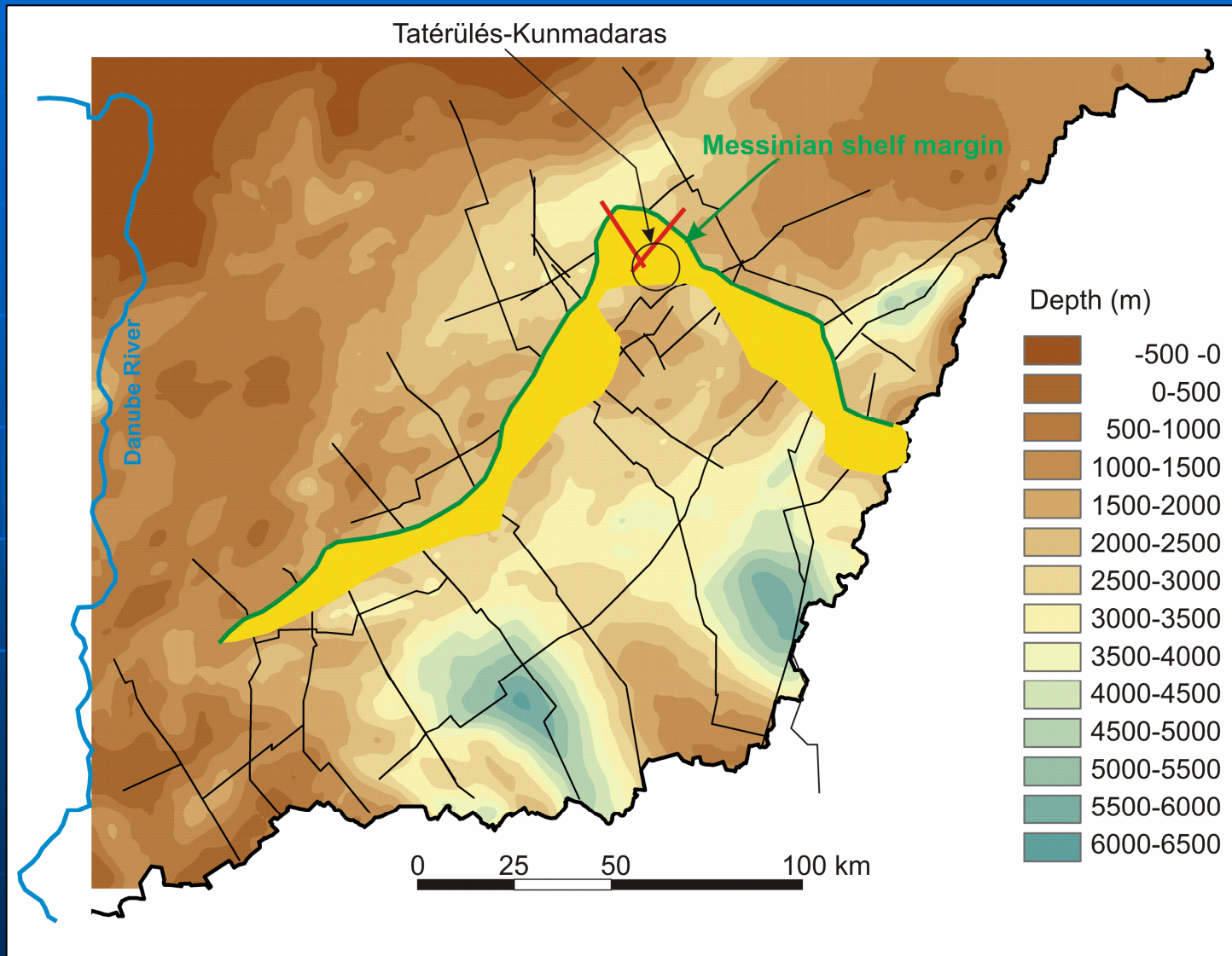
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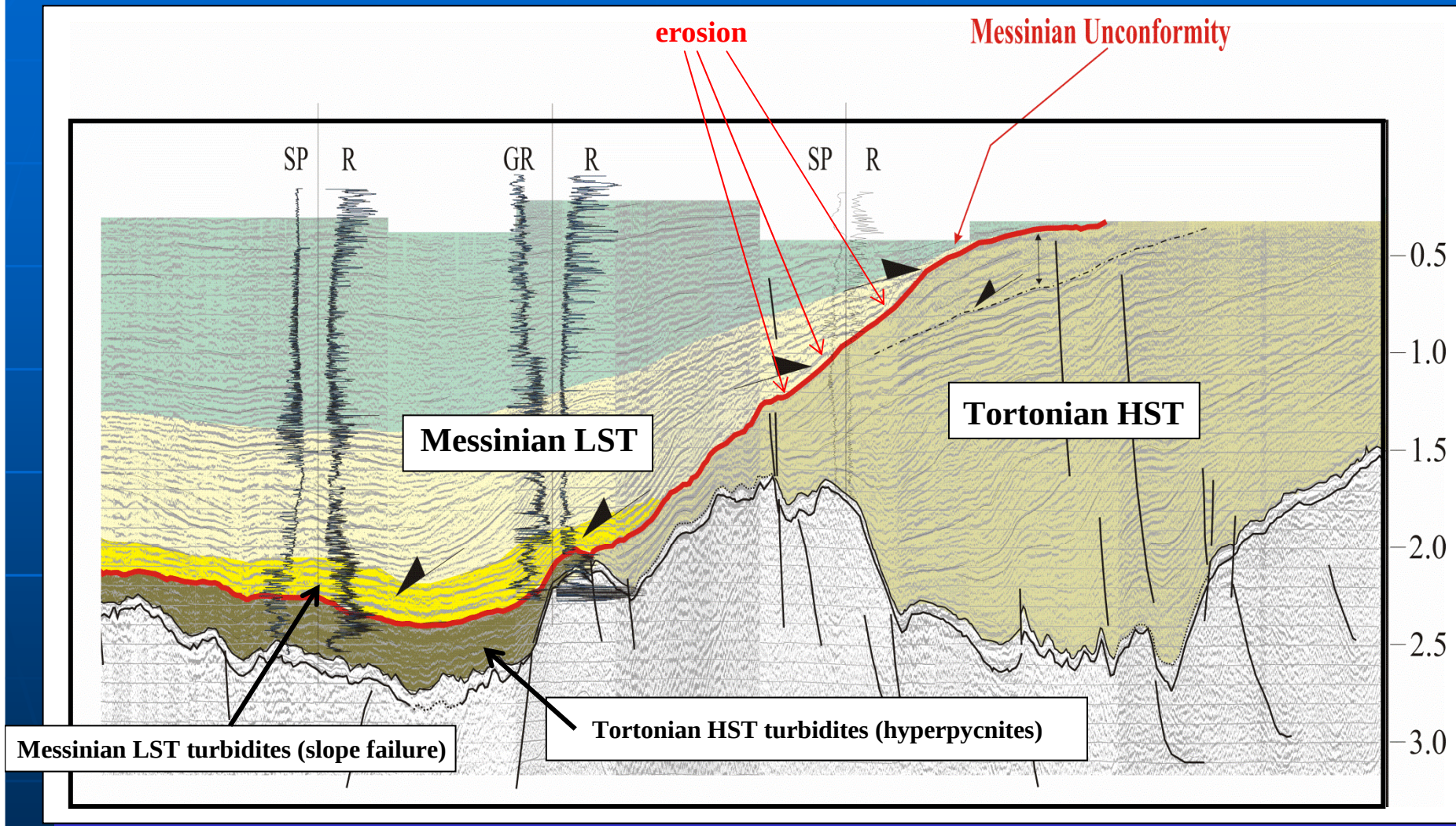
# Stratigraphic Traps



# Stratigraphic Traps



# Two Turbidite Systems



# Summary

- ❖ The late Neogene Pannonian Basin was filled by three major sedimentary systems: (i) NE, (ii) NW-W, (iii) SE.
- ❖ The **Messinian Unconformity** is the single most prominent surface in the basin fill that formed by a dramatic relative lake level fall and basin-wide erosion.
- ❖ The Messinian lake level fall was coeval and followed by tectonic inversions. Subbasins underwent various subsidence/uplift histories.
- ❖ Onlapping Falling Stage and Lowstand Systems Tracts form a significant series of potential STRATIGRAPHIC TRAPS for hydrocarbons!
- ❖ Two turbidite systems occur: (a) Tortonian HST, (b) Messinian LST.