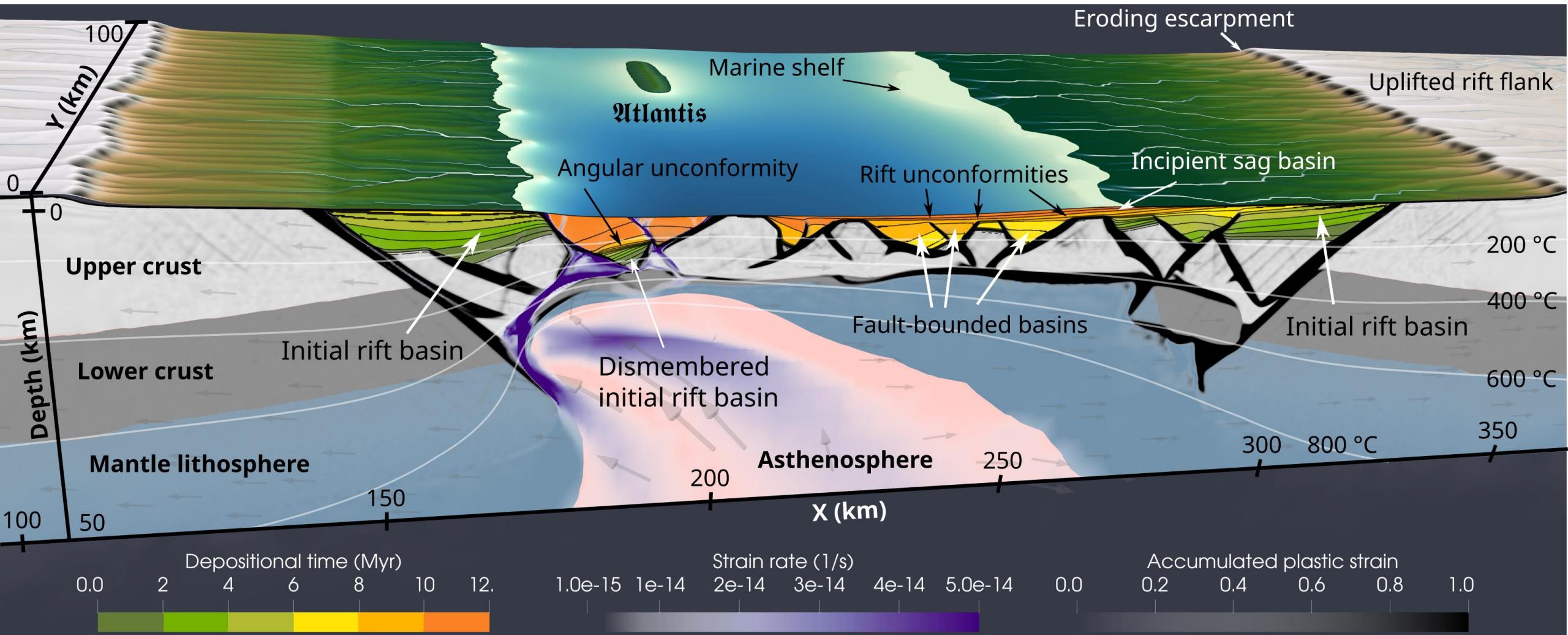


# Evolution of rift systems and their fault networks in response to surface processes

**CRYSTALS**  
| | | | |

Derek Neuharth, Sascha Brune, Thilo Wrona, Anne Glerum,  
Jean Braun, and Xiaoping Yuan



# Question

**How do surface processes affect an evolving rift's fault network?**

# Model setup

## ASPECT:

- 450x200 km 2D box
- 10 mm/yr total extension rate

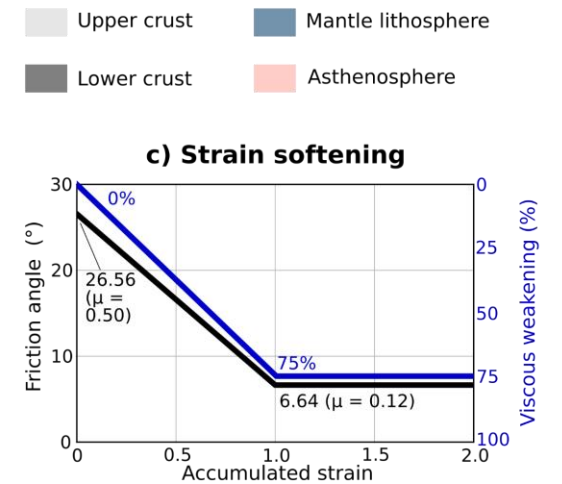
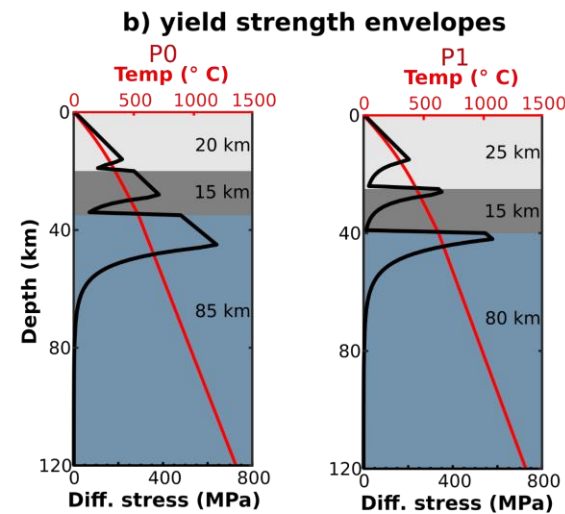
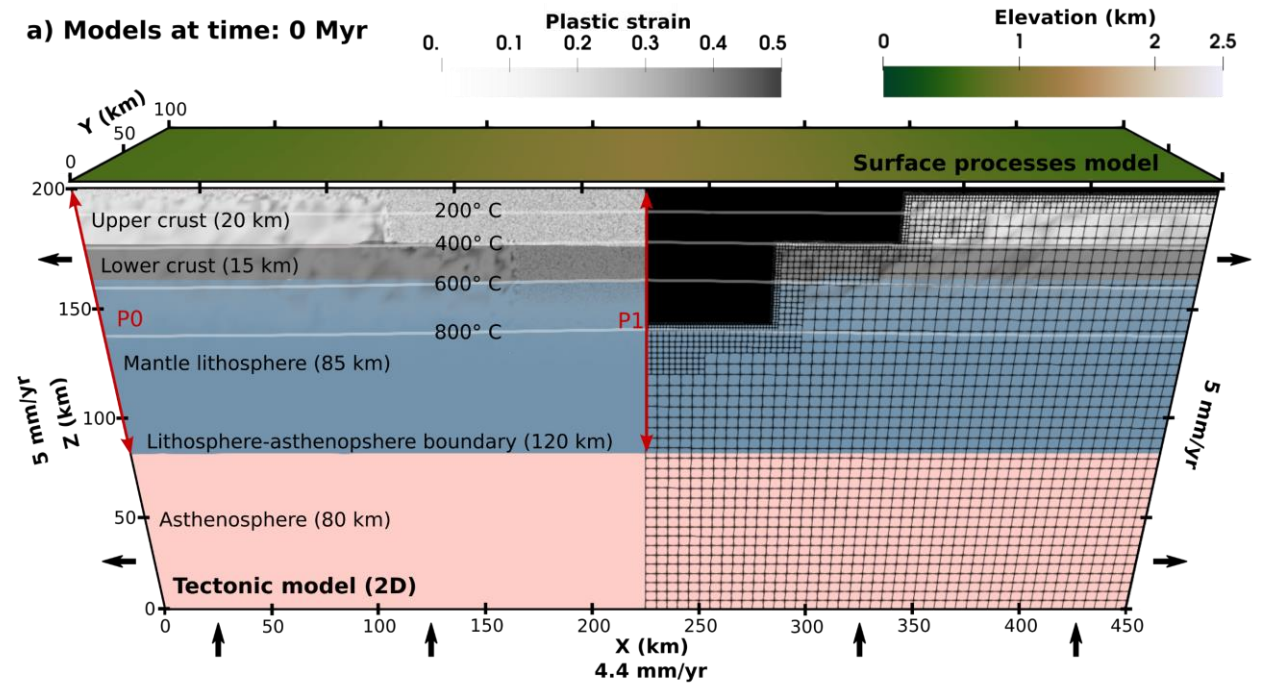
## Fastscape:

- 450x100 km 2D surface

## Variable parameters:

- Efficiency of surface processes
- Rift type (wide, asymmetric, symmetric)

*Kronbichler et al., 2012; Braun and Willet, 2013*



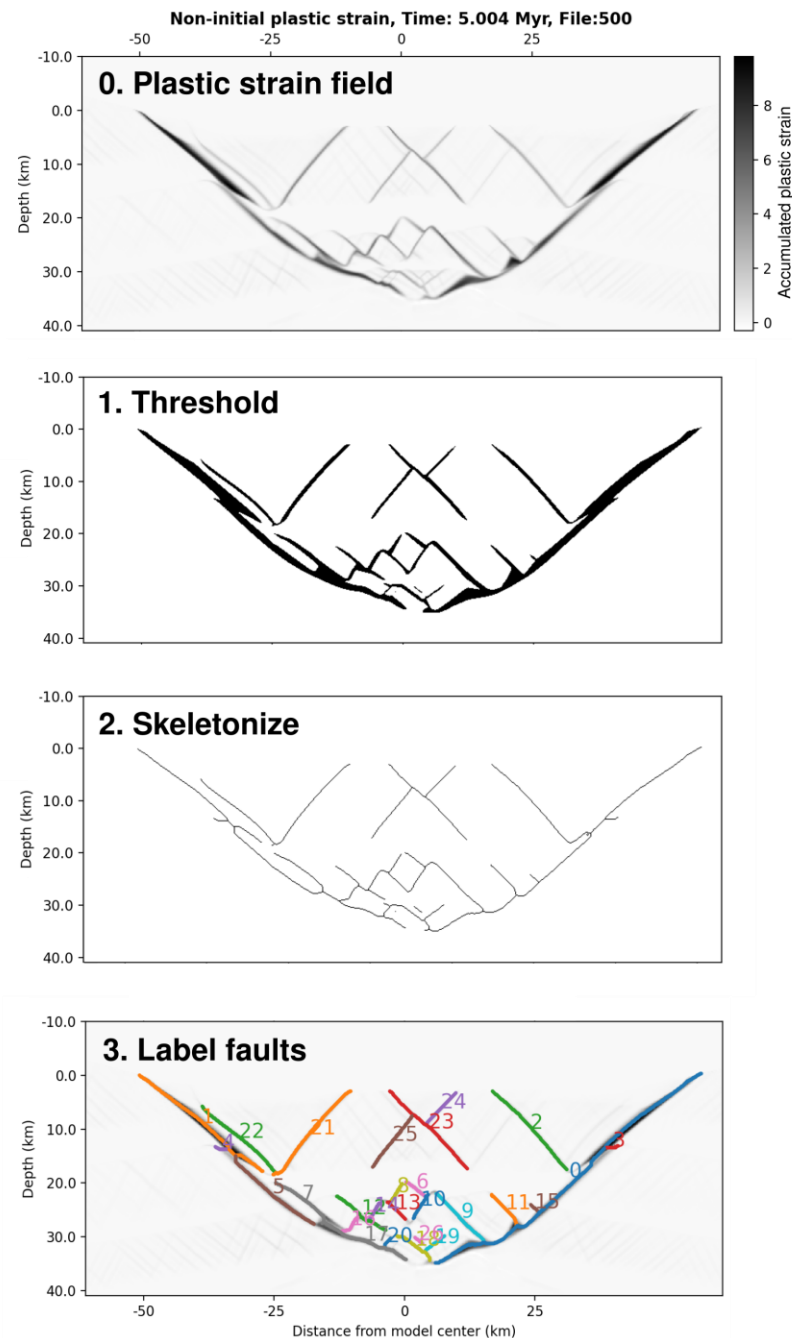
*Neuharth et al., 2022, tectonics*

# Fatbox – Fault analysis toolbox

1. Extract faults based on plastic strain.
2. Skeletonize faults.
3. Label discrete faults.
4. Track faults through time.

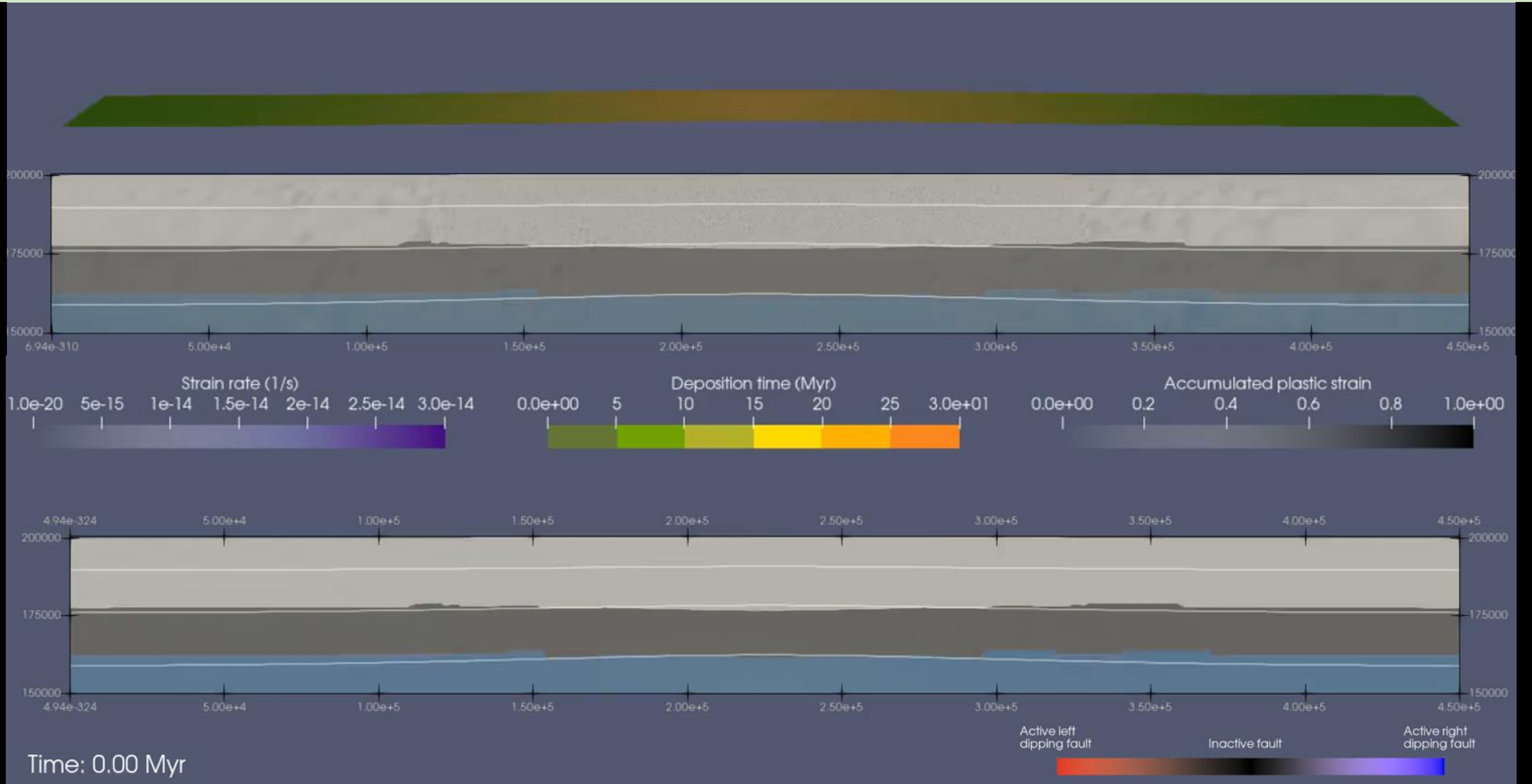
<https://github.com/thilowrona/fatbox>

*Wrona et al., in prep*



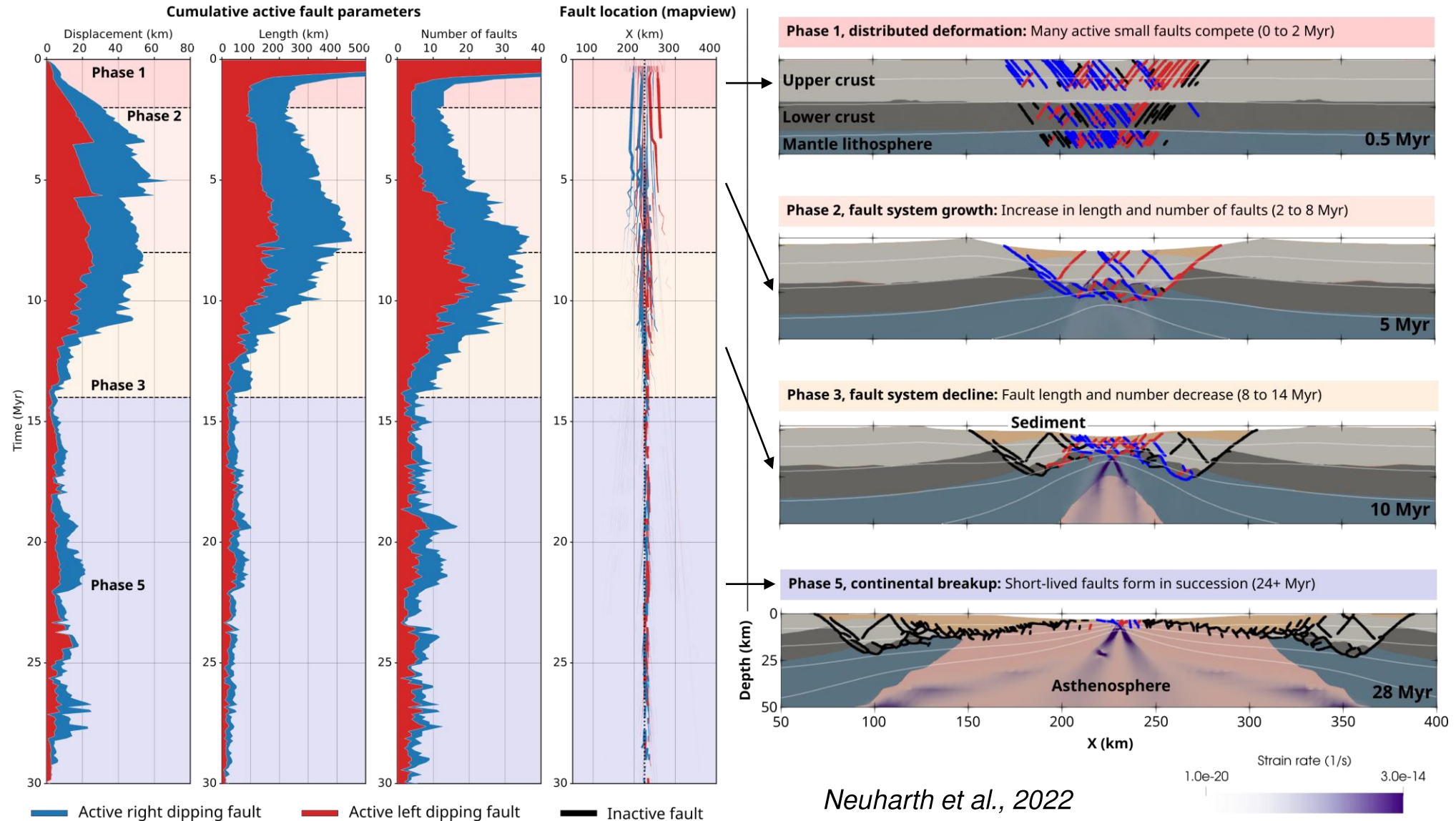


# Symmetric model evolution



# Fault network evolution

## Symmetric rift model: fault system evolution



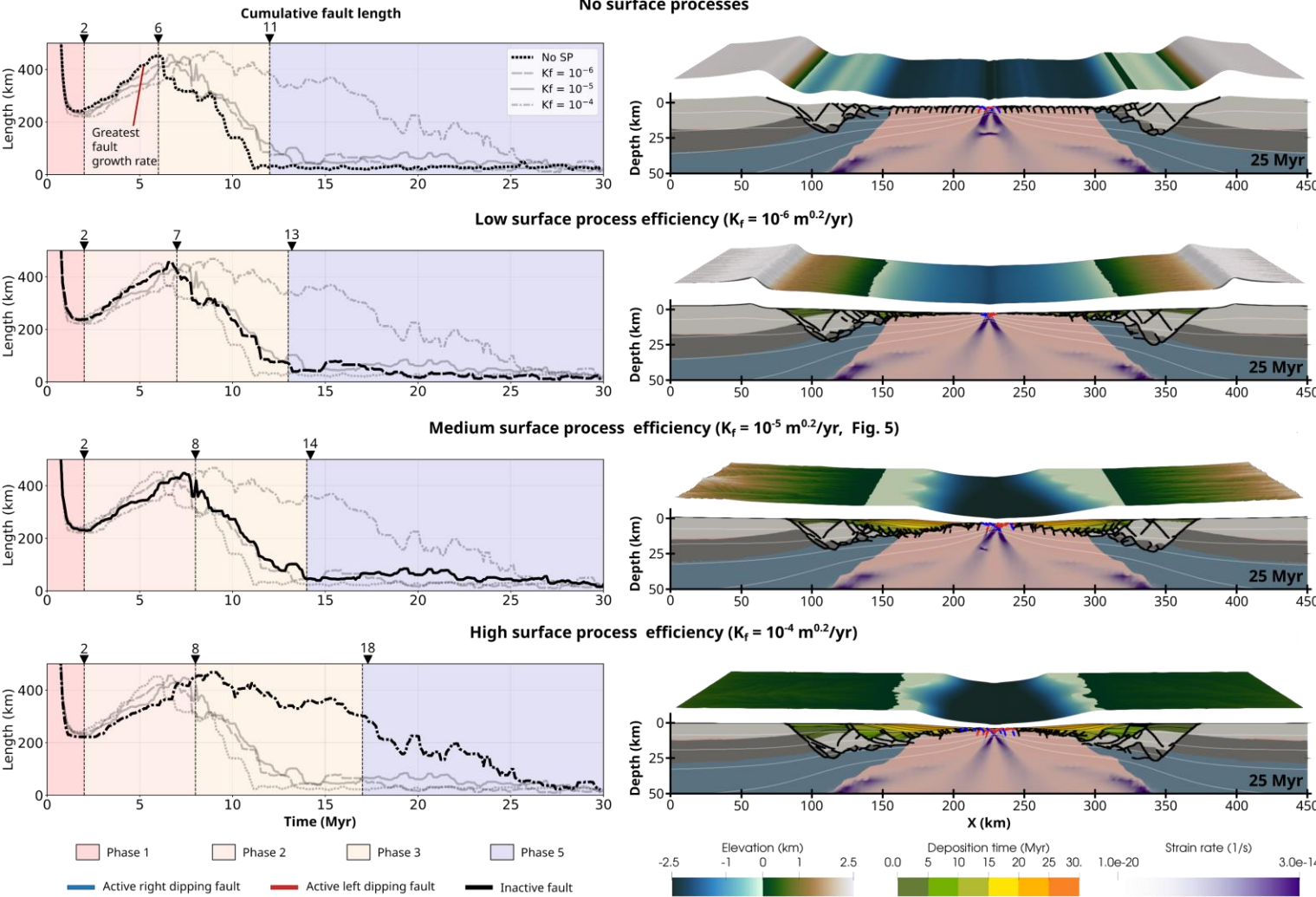
# Effects of surface processes

## With increasing SP efficiency:

1. Enhances fault localization, leading to longer lived faults (e.g., Andres-Martinez et al., 2019; Beucher and Huismans, 2020).
2. Delay of continental breakup
3. Fewer faults and less complex network

Symmetric rift model: impact of surface process efficiency

No surface processes



Neuharth et al., 2022

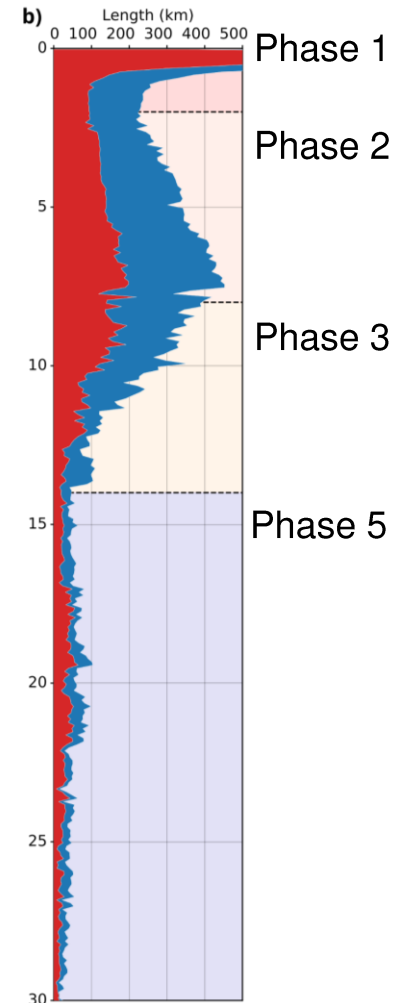
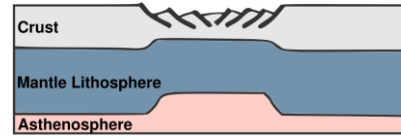
# Rift type comparison

Regardless of rift type:

- 4 or 5 Distinct phases.
- Surface processes work similarly

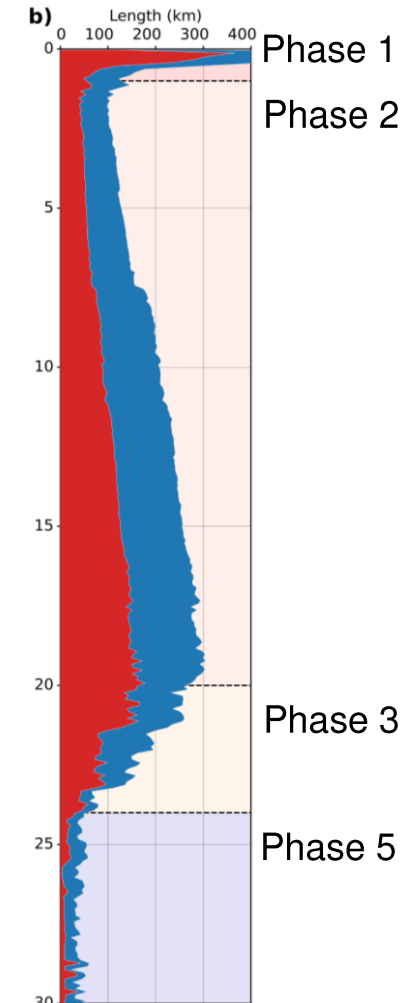
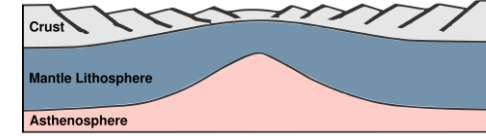
*Modified from Huismans and Beaumont, 2008*

## Symmetric



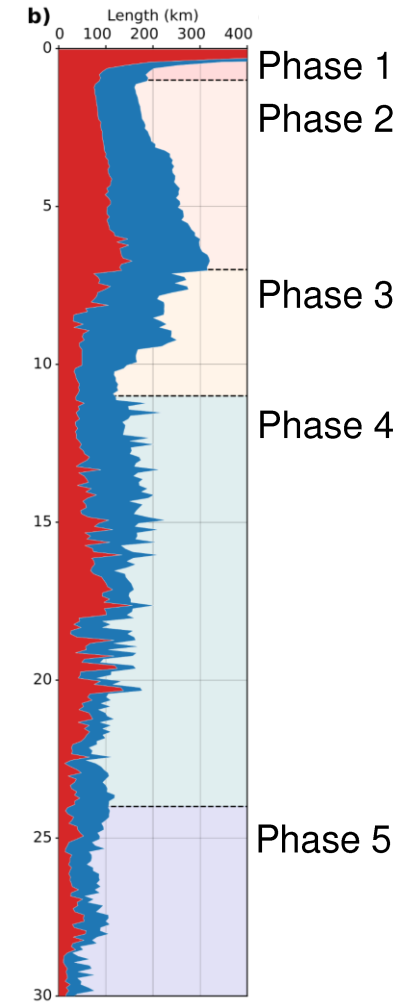
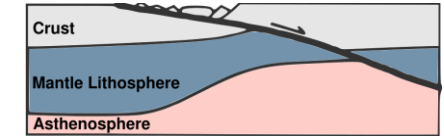
Active right dipping fault

## Wide



Active left dipping fault

## Asymmetric

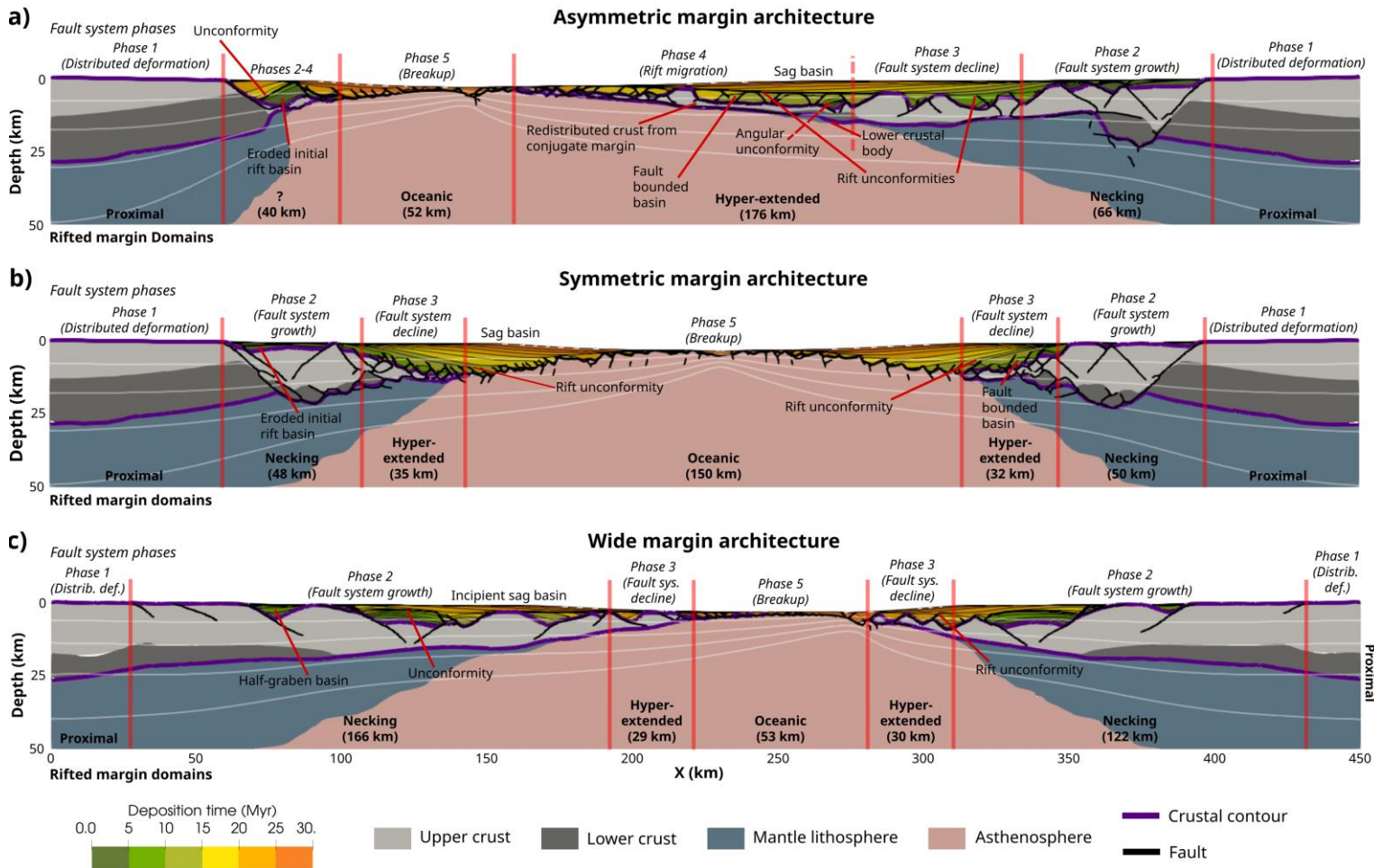


Neuharth et al., 2022



# Conclusions

- Fault network evolves through 4-5 phases regardless of rift type and efficiency of surface processes.
- Surface processes:
  - Delays continental breakup
  - Reduces fault network complexity

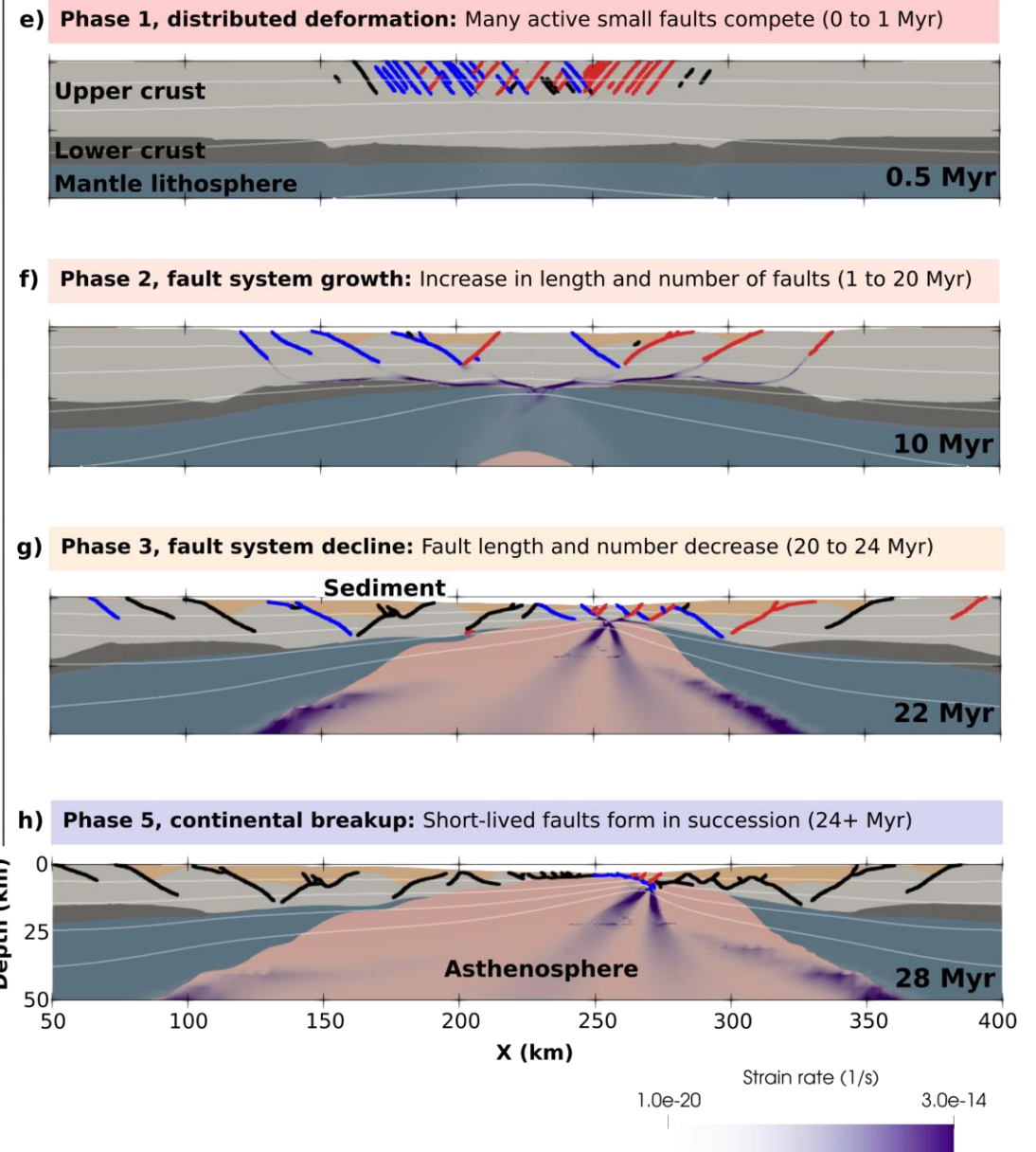
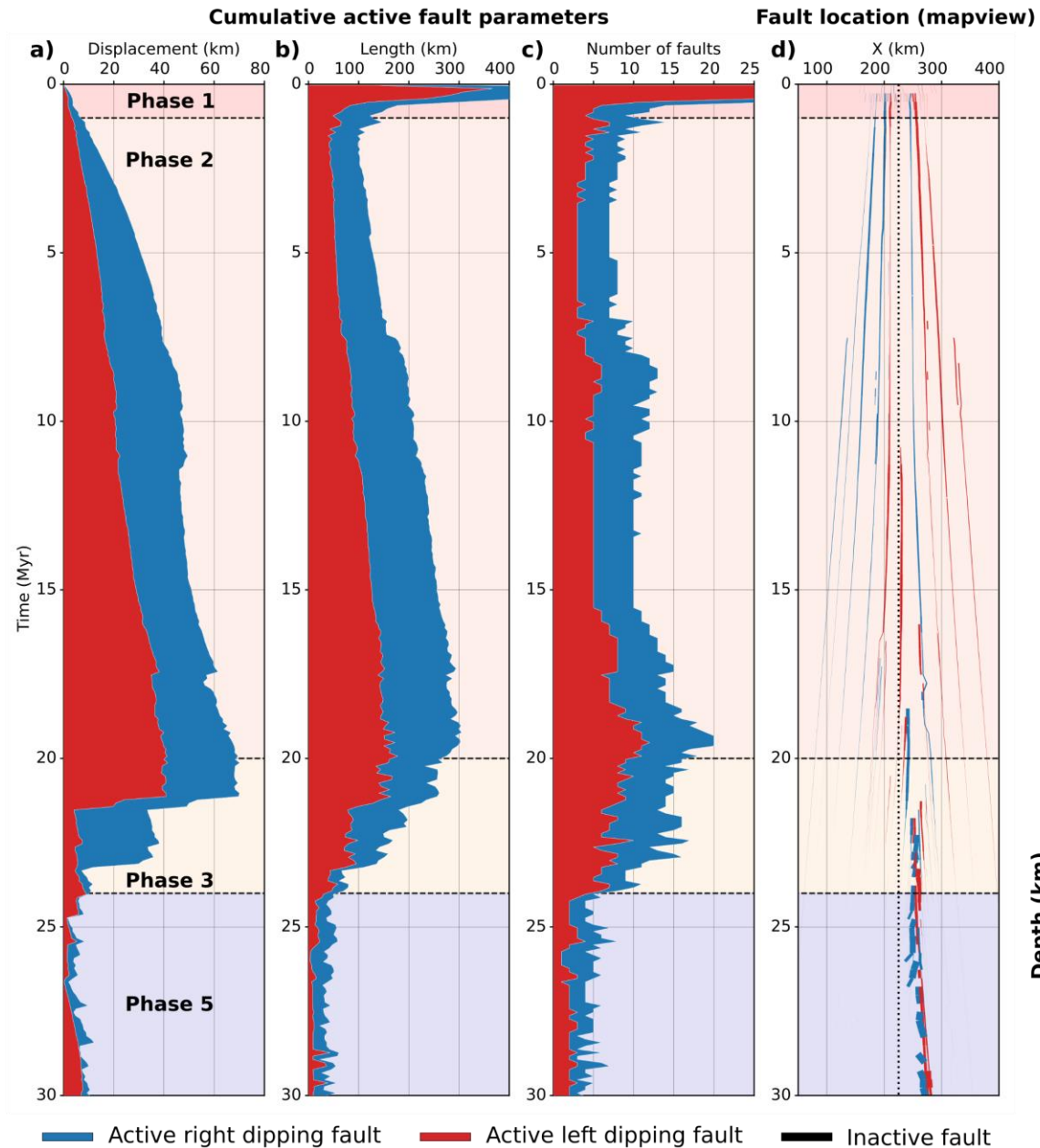


*Neuharth et al., 2022*

# References

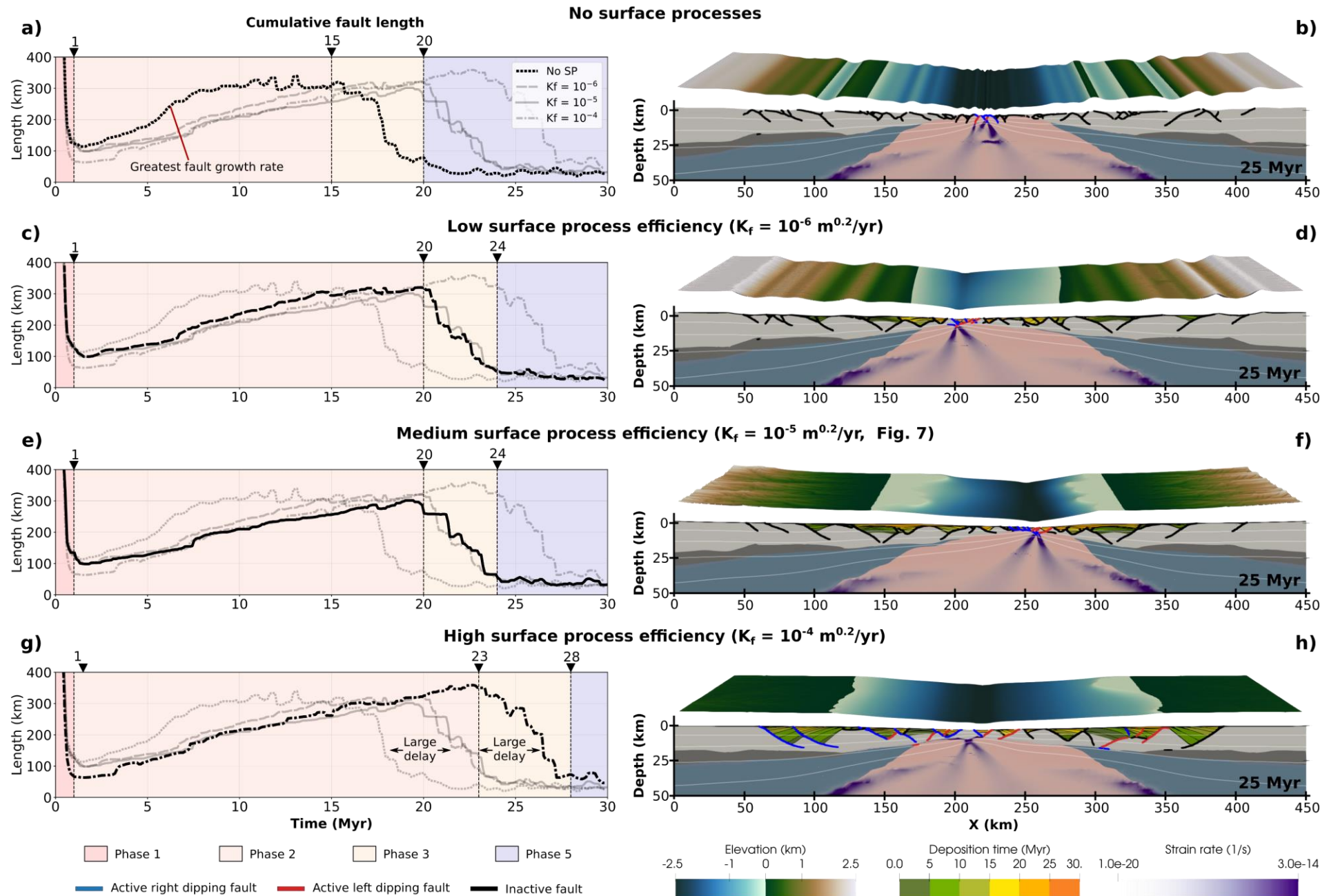
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## Wide rift model: fault system evolution



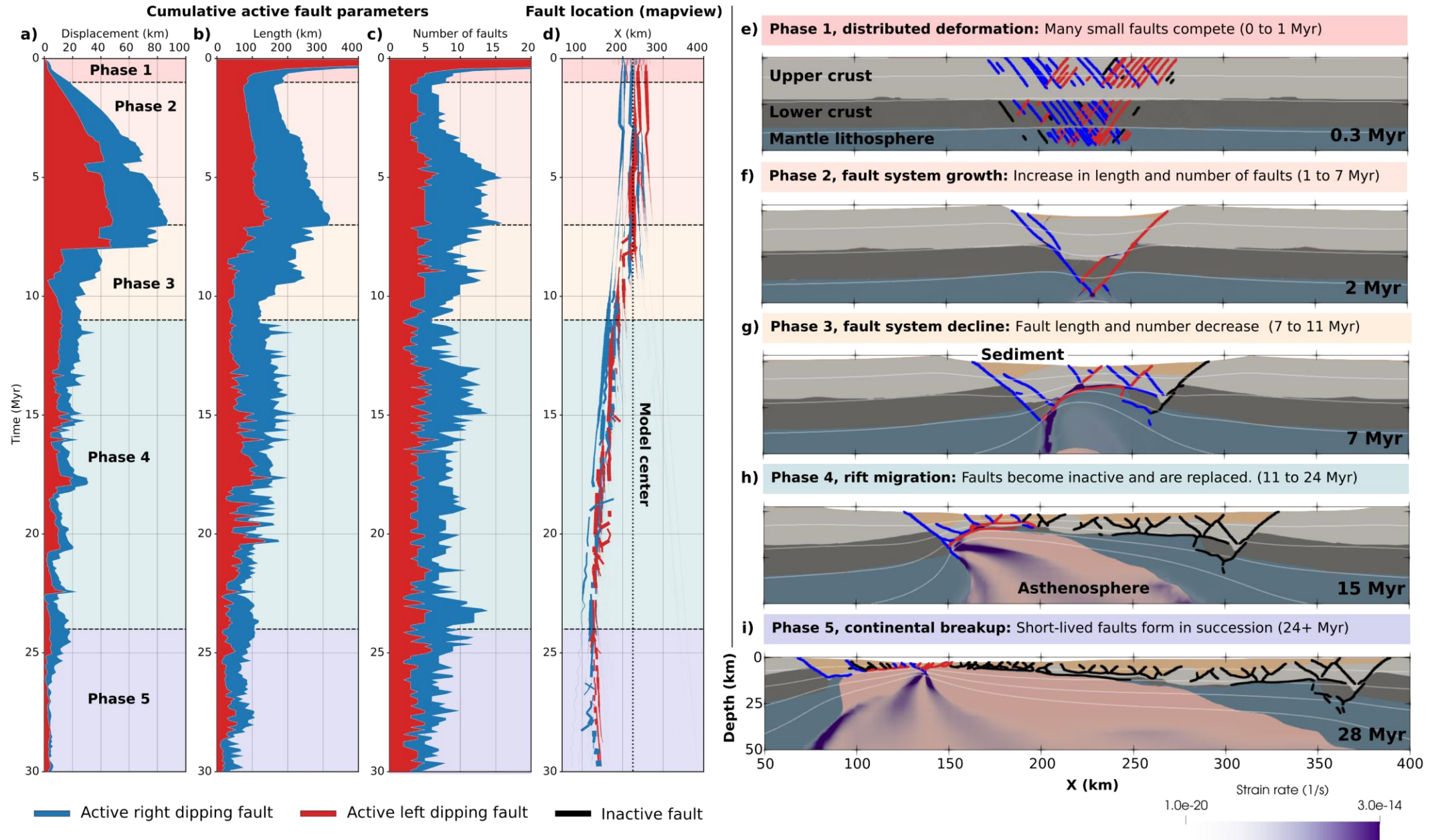


# Wide rift model: impact of surface process efficiency





## Asymmetric rift model: fault system evolution



# Asymmetric rift model: impact of surface process efficiency

