A new geodynamic model of the Azores archipelago

Preliminary results

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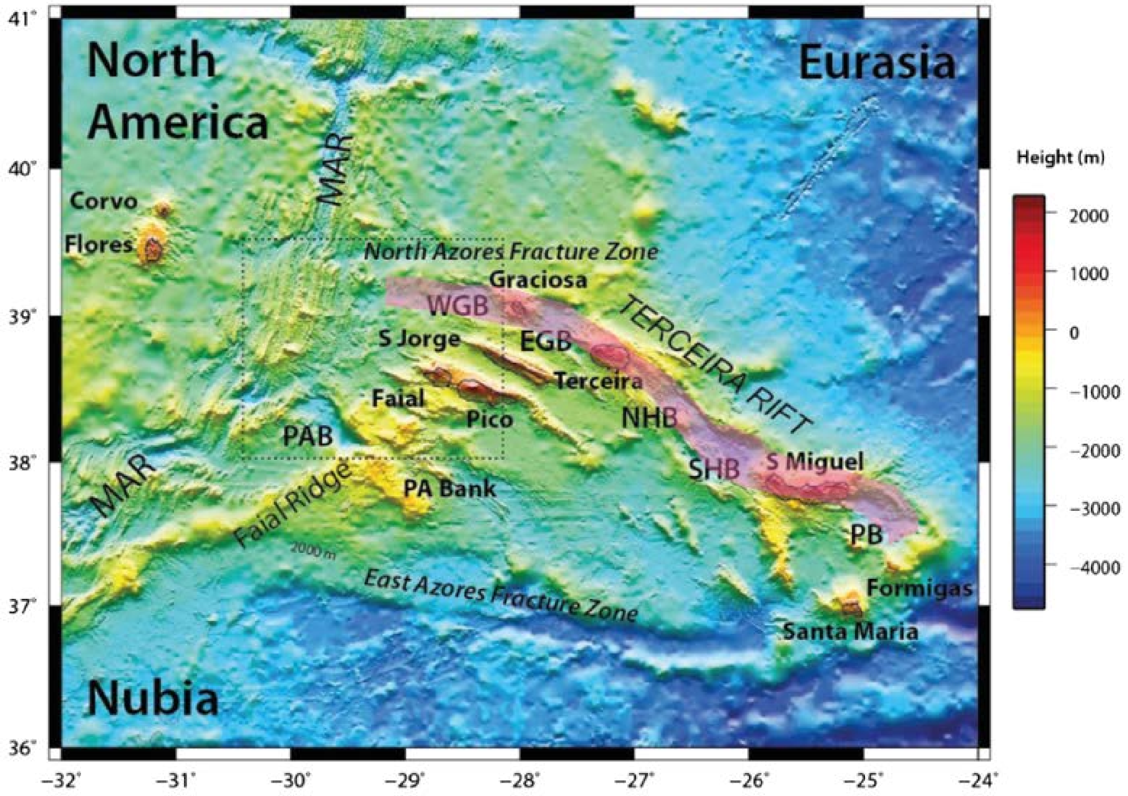
The Azores Archipelago

<u>Major features of the region:</u>

- Located in the middle of the Atlantic Ocean
- Composed by nine islands, unevenly distributed between the North America, Eurasia and Nubia plates
- Three of the islands are located within the slow-spreading Terceira rift (highlighted in red in the figure to the left)

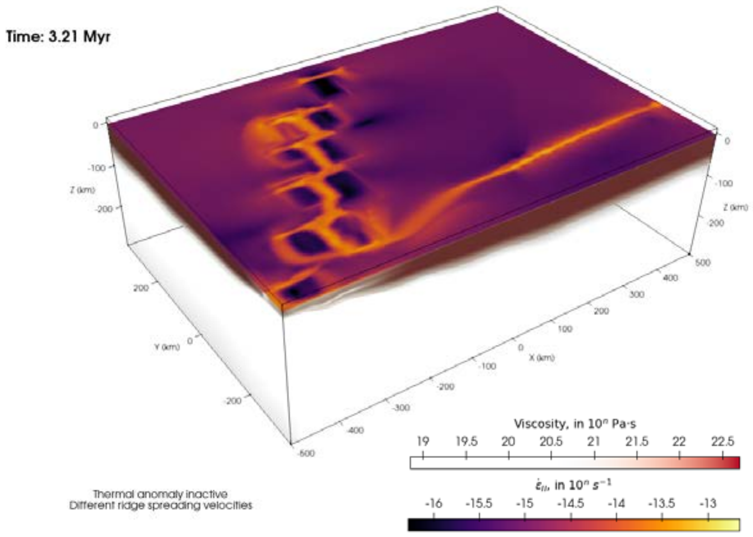


Adapted from Miranda *et al.* (2014)

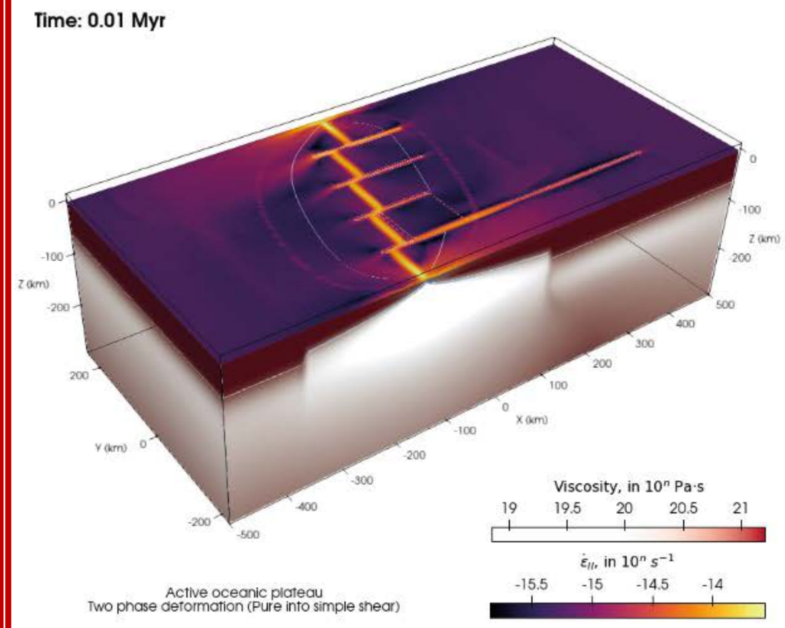
What drove the formation of the Terceira Rift?

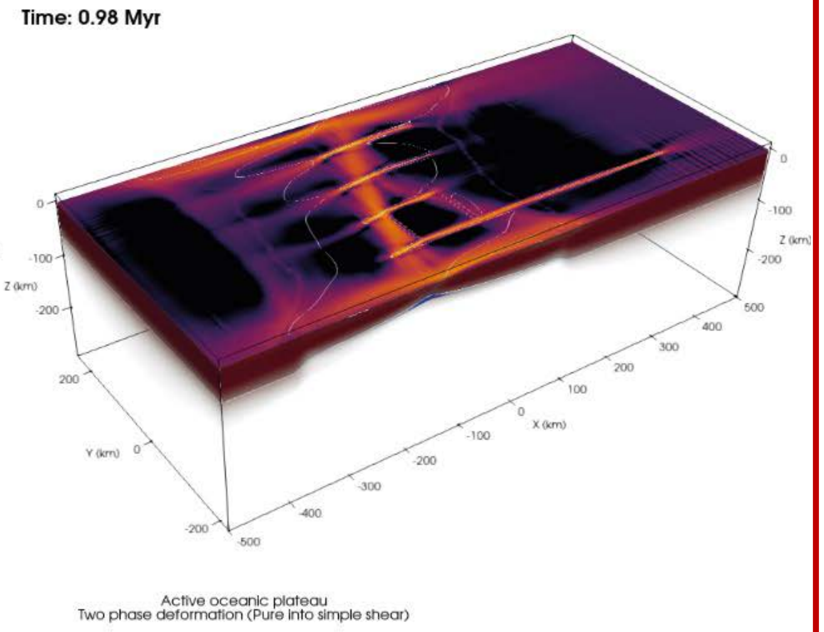
Some of our results

Testing the fault connectedness



Testing the shift in tectonic forcing





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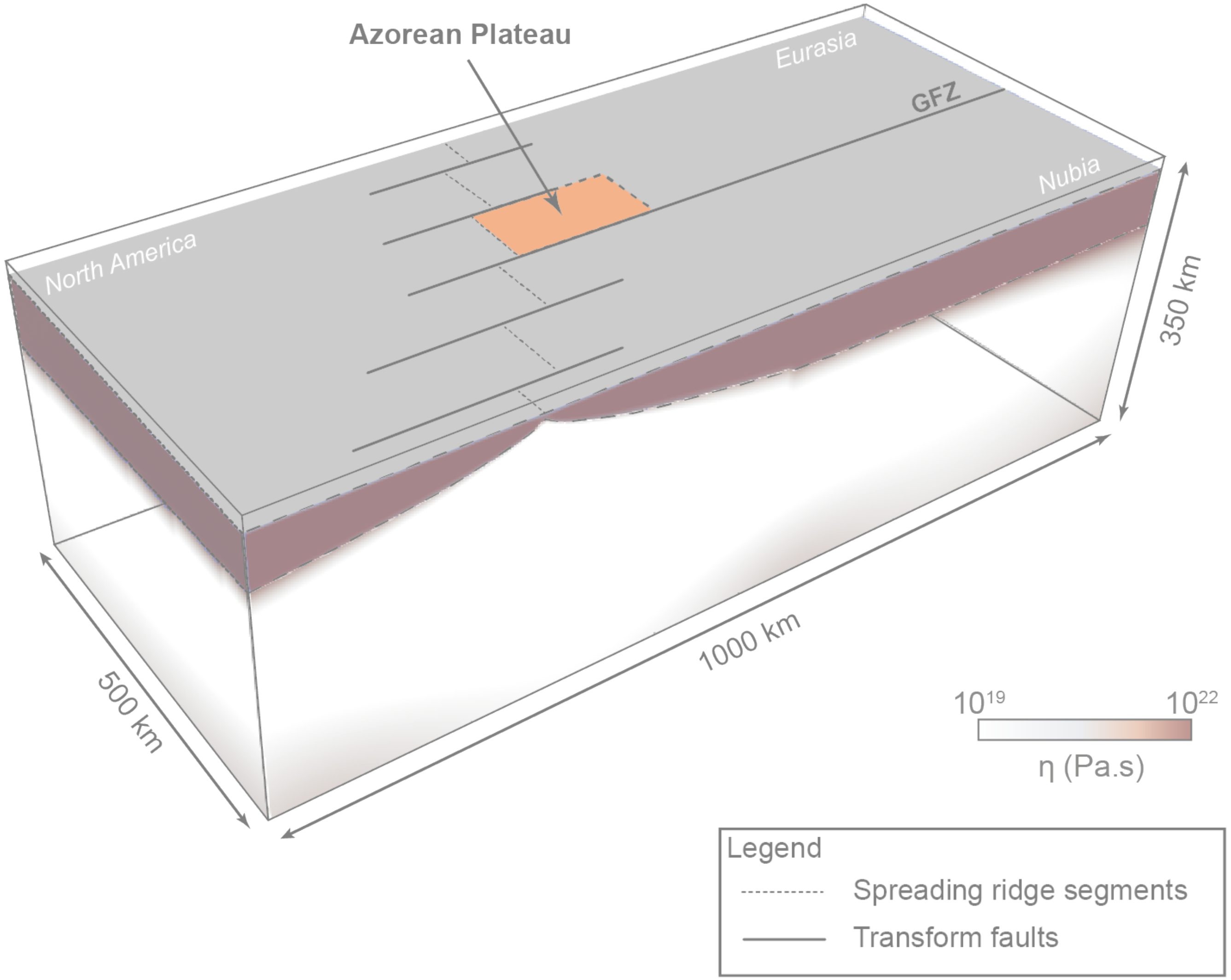
Come see me at my PICO spot to see more! I'll be glad to answer your questions!

Let's get started



Press here to see the <u>fault connection</u> models

Press here to see the <u>tectonic shift</u> models

2 Minute madness

Tectonic setting

Modelling setup details

Conclusions

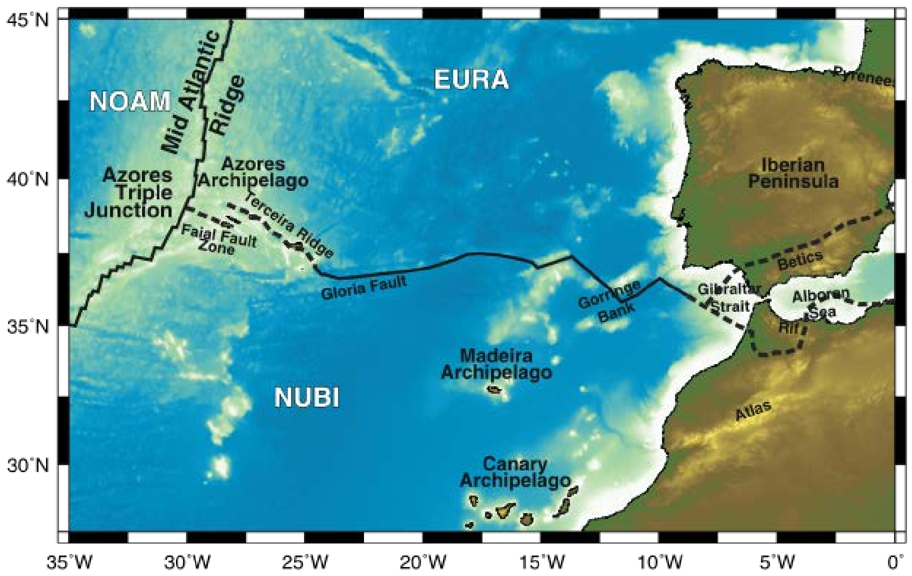
Sharing not permitted

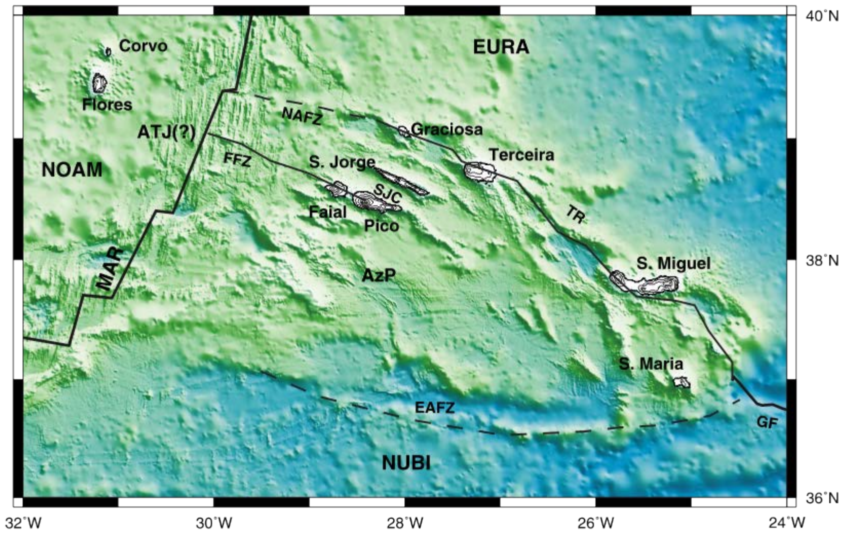
Tectonic setting

- The Azores Archipelago is the expression of the dynamics of the triple junction between the Eurasia, Nubia, and North America tectonic plates.

- The Azores Triple Junction was established circa 25 Ma ago. The Nubia-Eurasia arm of the triple junction follows mainly the Terceira Rift axis, west of 24° W, characterized by a sequence of deep basins and the volcanic highs which correspond to the islands of S. Miguel, Terceira and Graciosa.

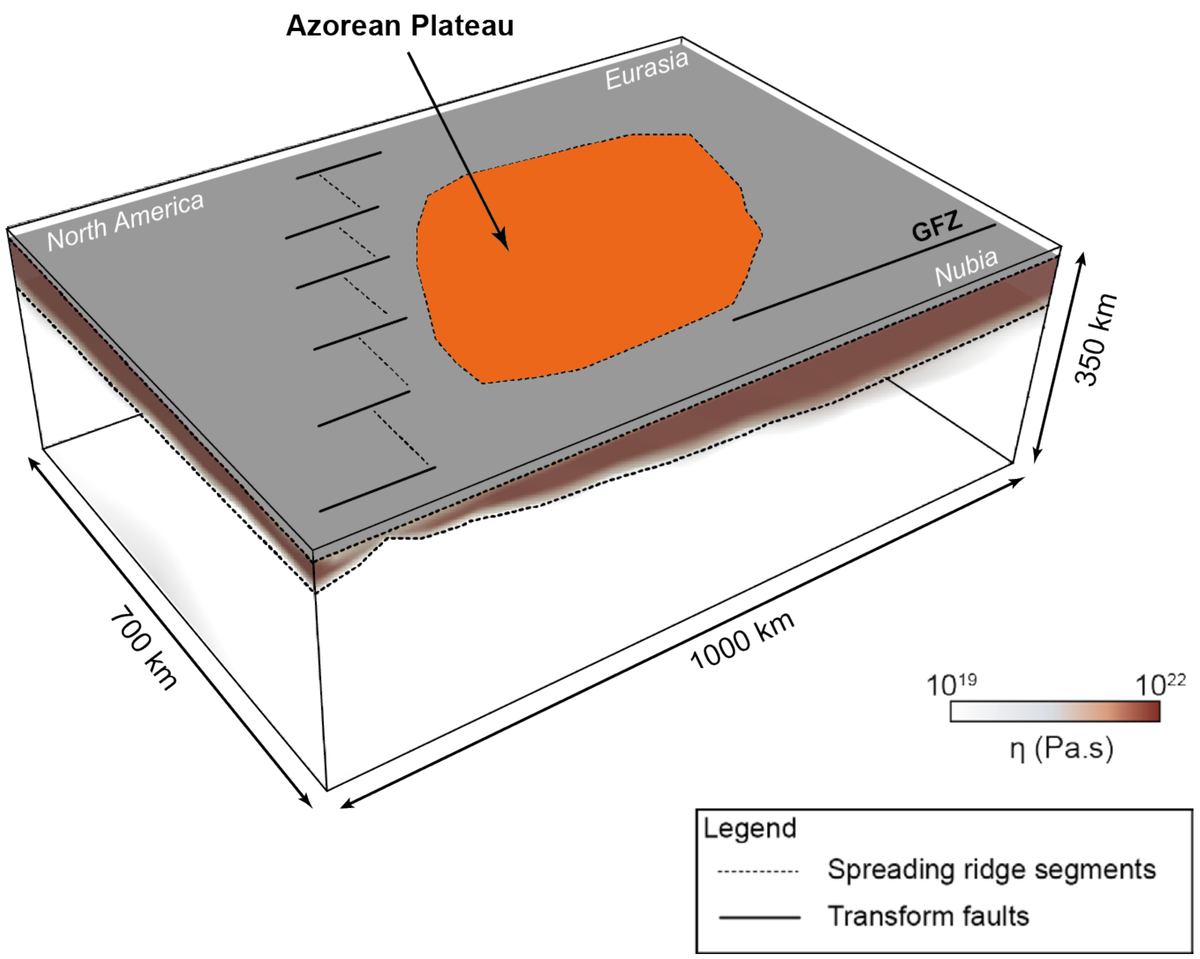
- The Terceira Rift represents an active spreading center, with a diagonal orientation to the MAR, resulting from a transtensive regime which affects the region.





How did we model it?

- Implementation of regional features such as:
  - *Mid-ocean ridge geometry*
  - Pre-imposed transform faults
  - Varying litosphere thickness based in distance to the ridge
  - Thicker crust in the Azorean plateau
- Use of the *LaMEM* code (Kaus *et al*., 2016) under *viscoelastoplastic* conditions
- Top model boundary is free surface, all other boundaries are free slip
- No lateral motion is attributed to the weak zones
- Regionally imposed strain-rate, with local velocities emerging from it



Fault connection

Tectonic shift

GFZ: Gloria Fault zone

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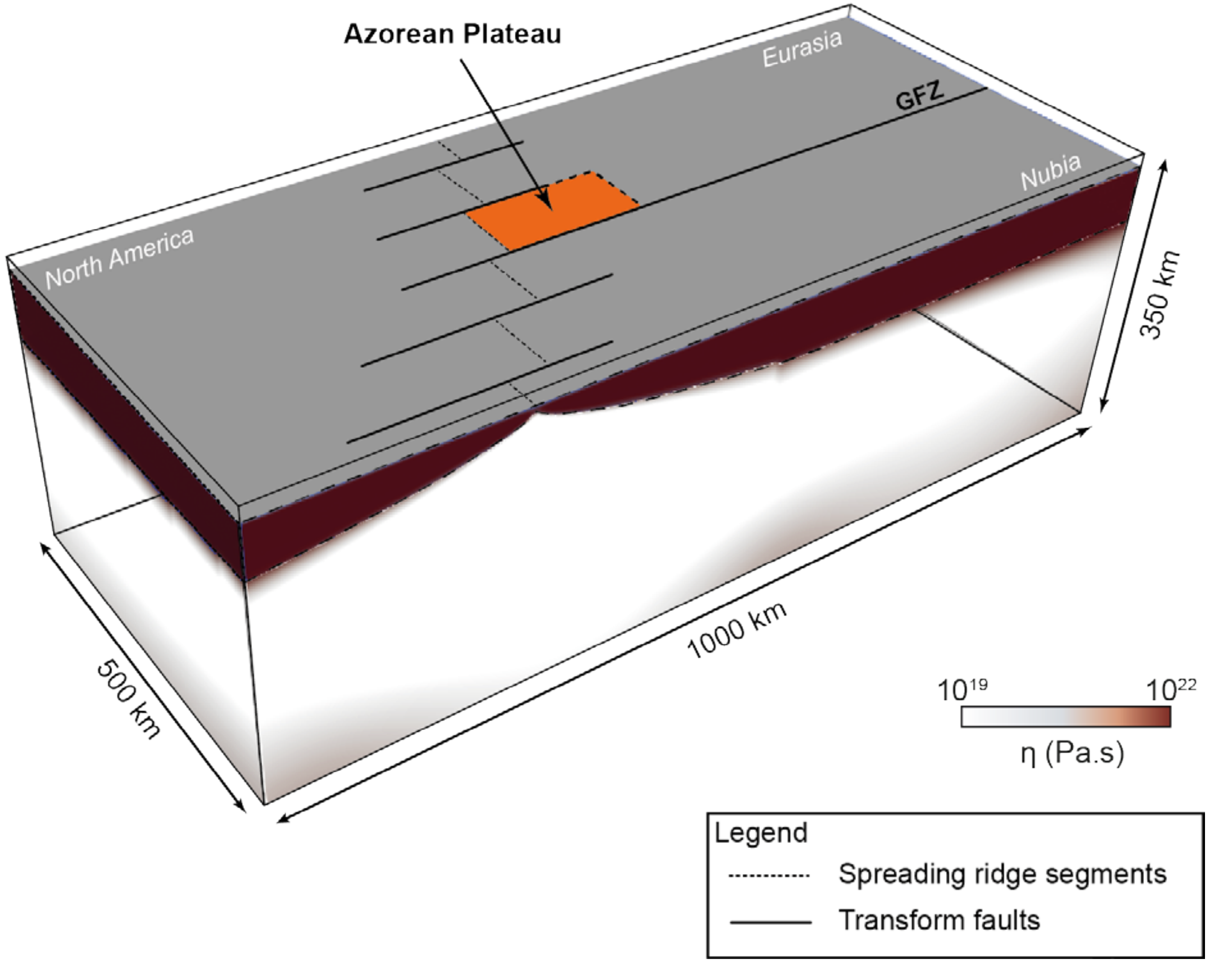

Fault connection

Tectonic shift

GFZ: Gloria Fault zone

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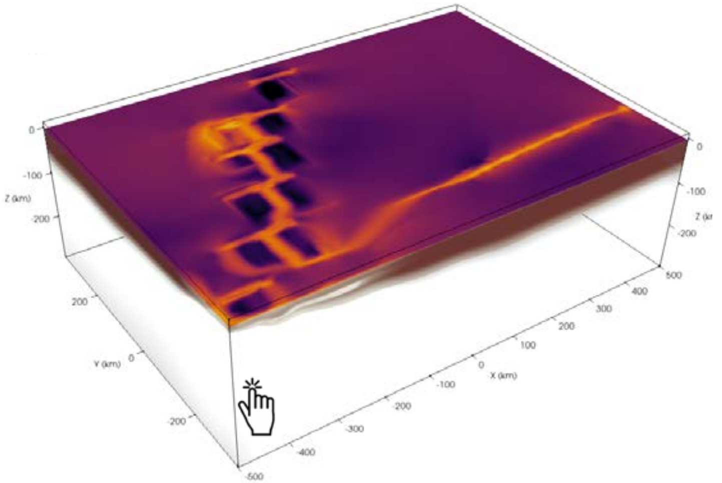
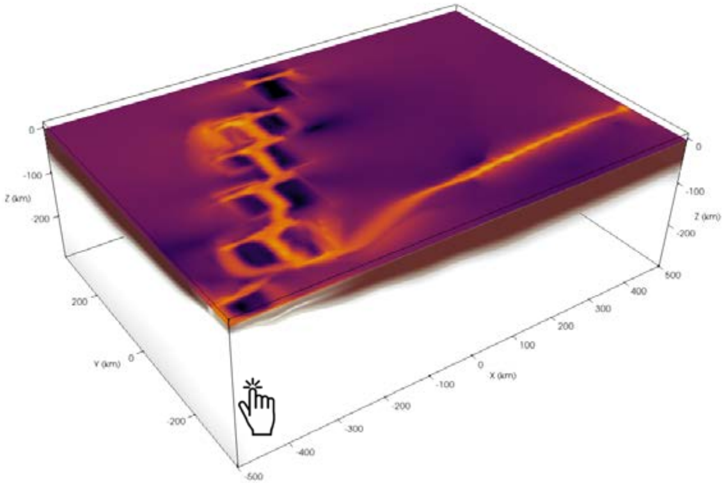
Fault connection tests

Without thermal weakening

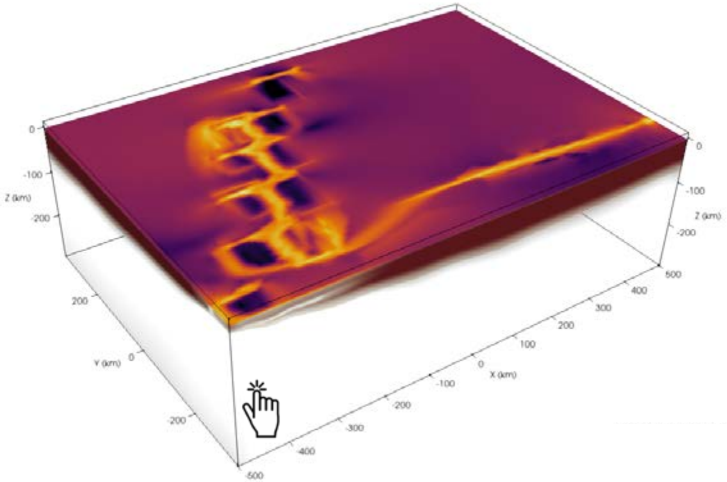


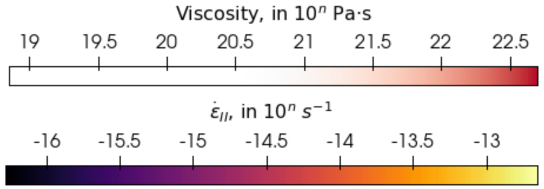
With thermal weakening

South trending GFZ



North trending GFZ





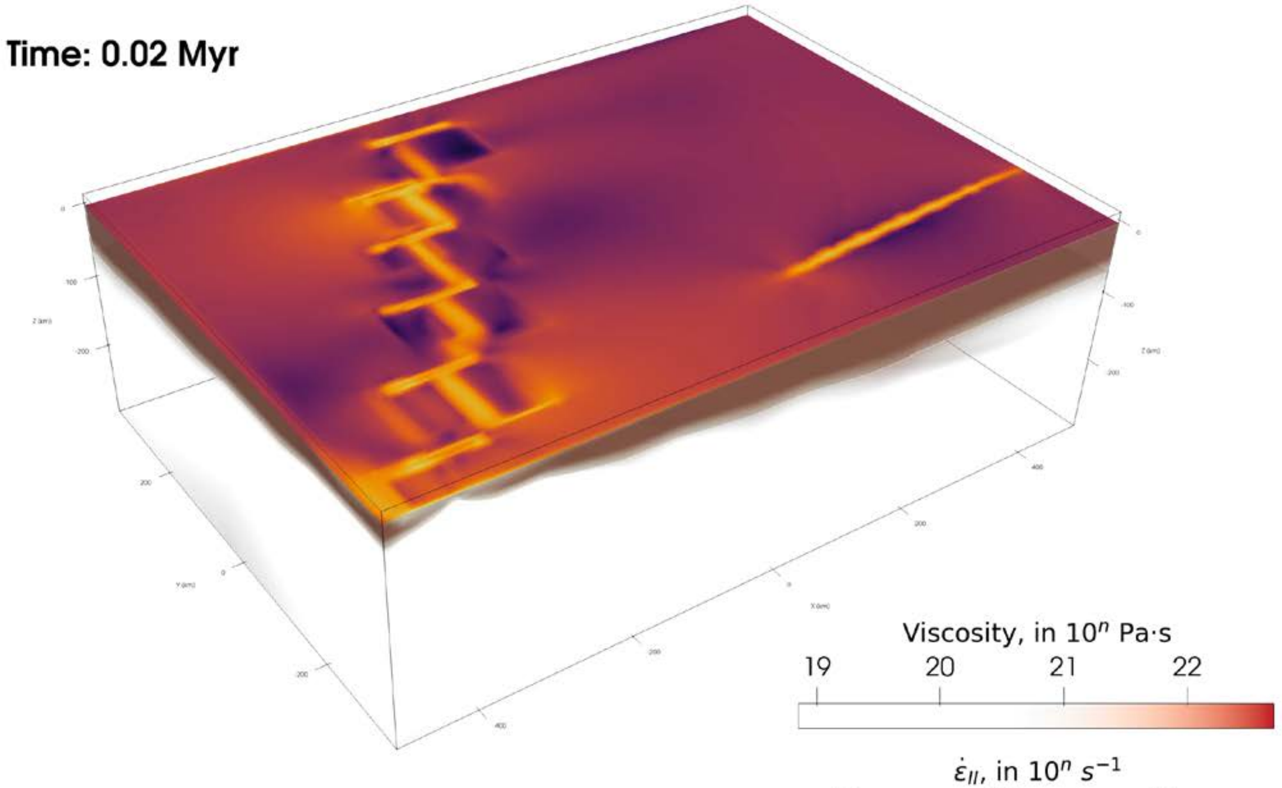
GFZ: Gloria Fault zone

Fault connection tests

Without thermal weakening

Spreading rates:

- *North segment*: ≈ 1.5 cm/yr
- *Other segments*: ≈ 0.5 cm/yr



Fault connection test
Different spreading rates across segments

Interpretation

Back to model selection

Conclusions

No strain accumulates within the target region

The GFZ always connects to the south segments of the mid-ocean ridge

Fault connection tests

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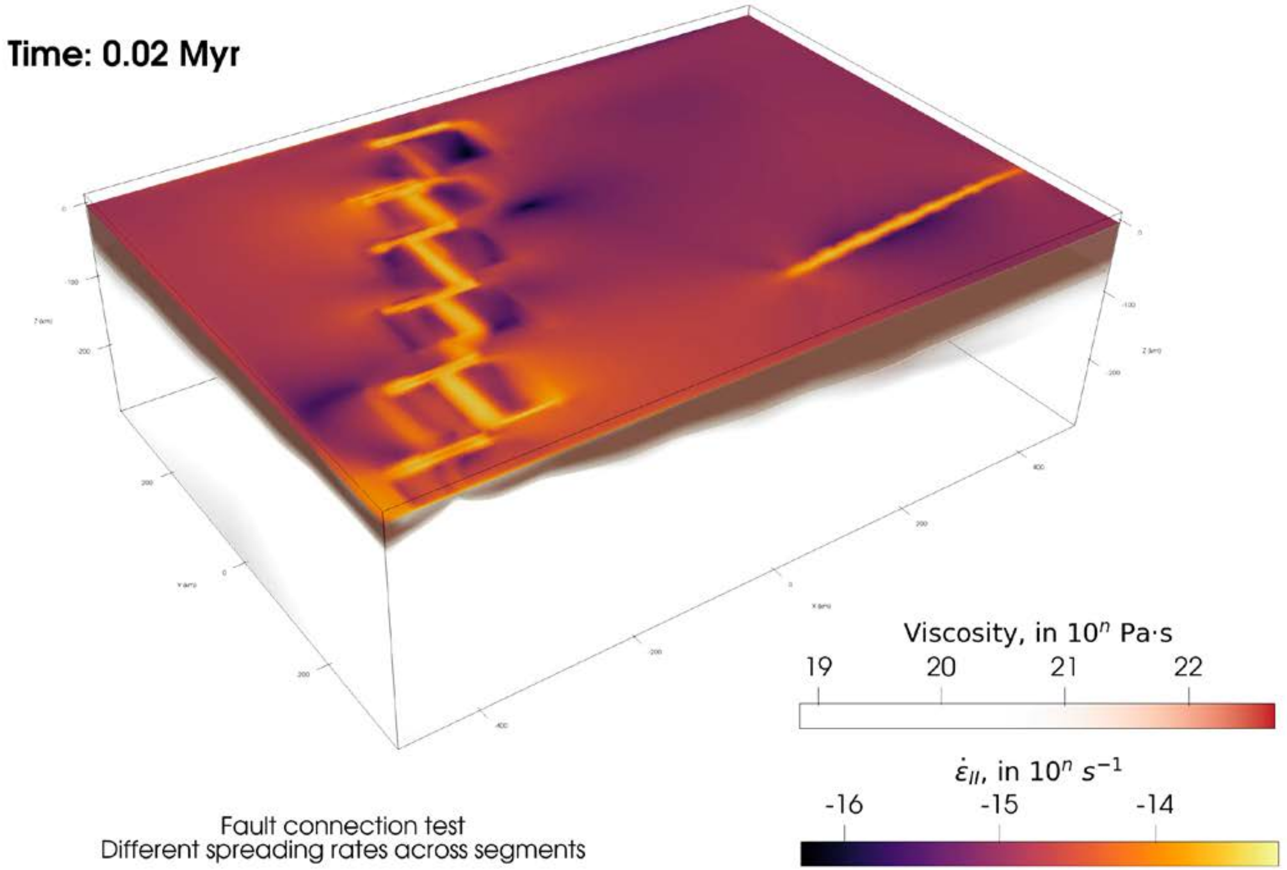

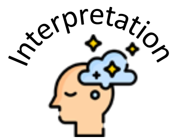

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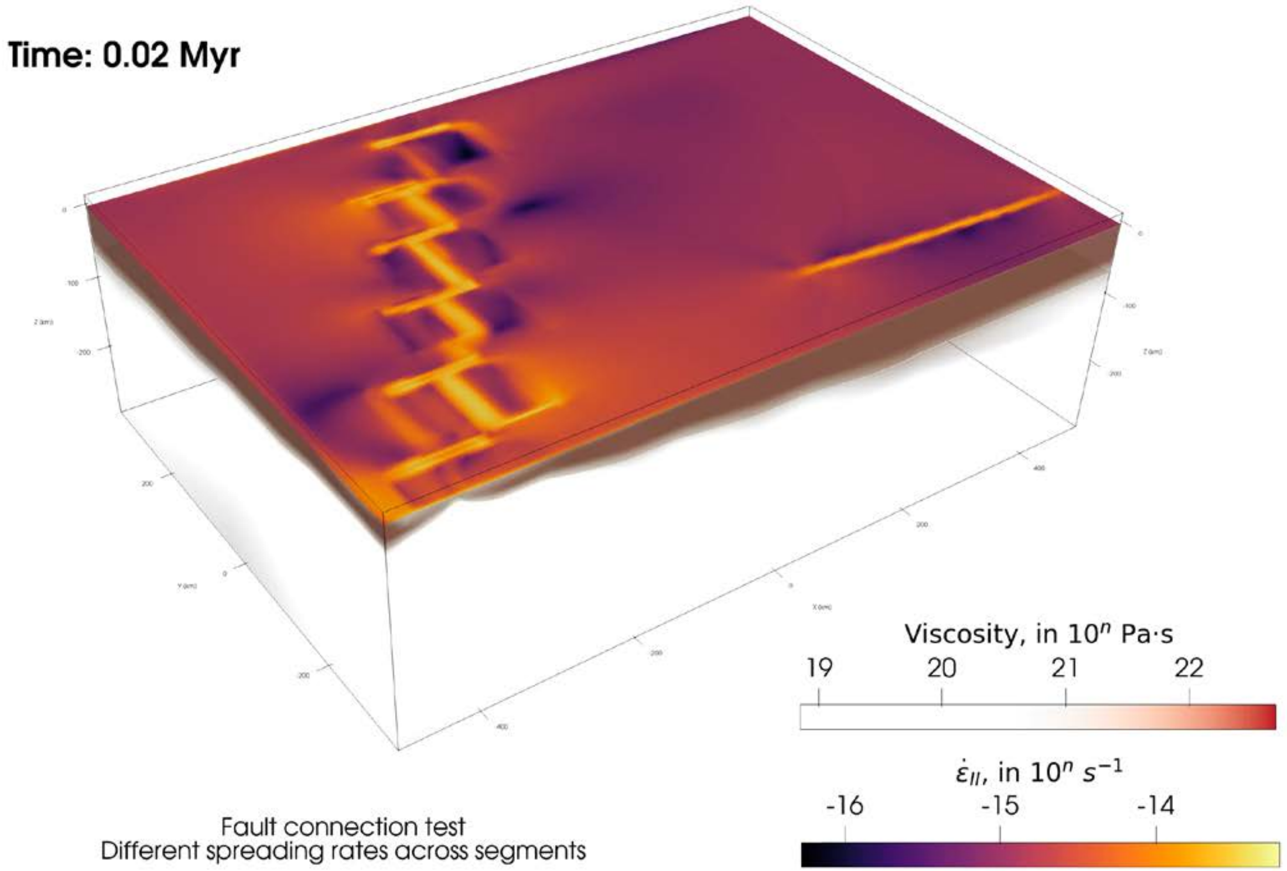

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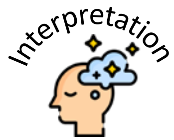
Different spreading rates across segments



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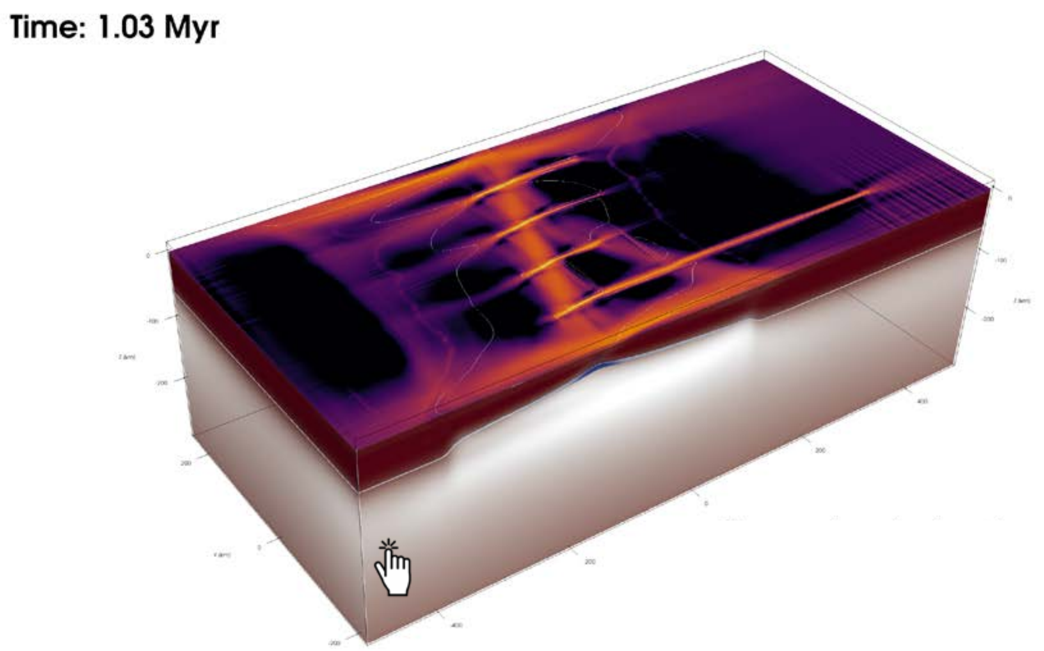
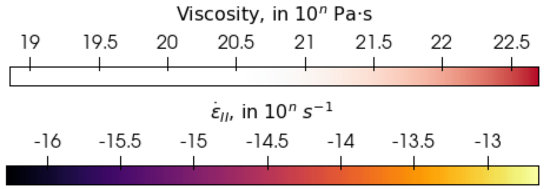
Tectonic forcing shift tests

Without plateau

With plateau



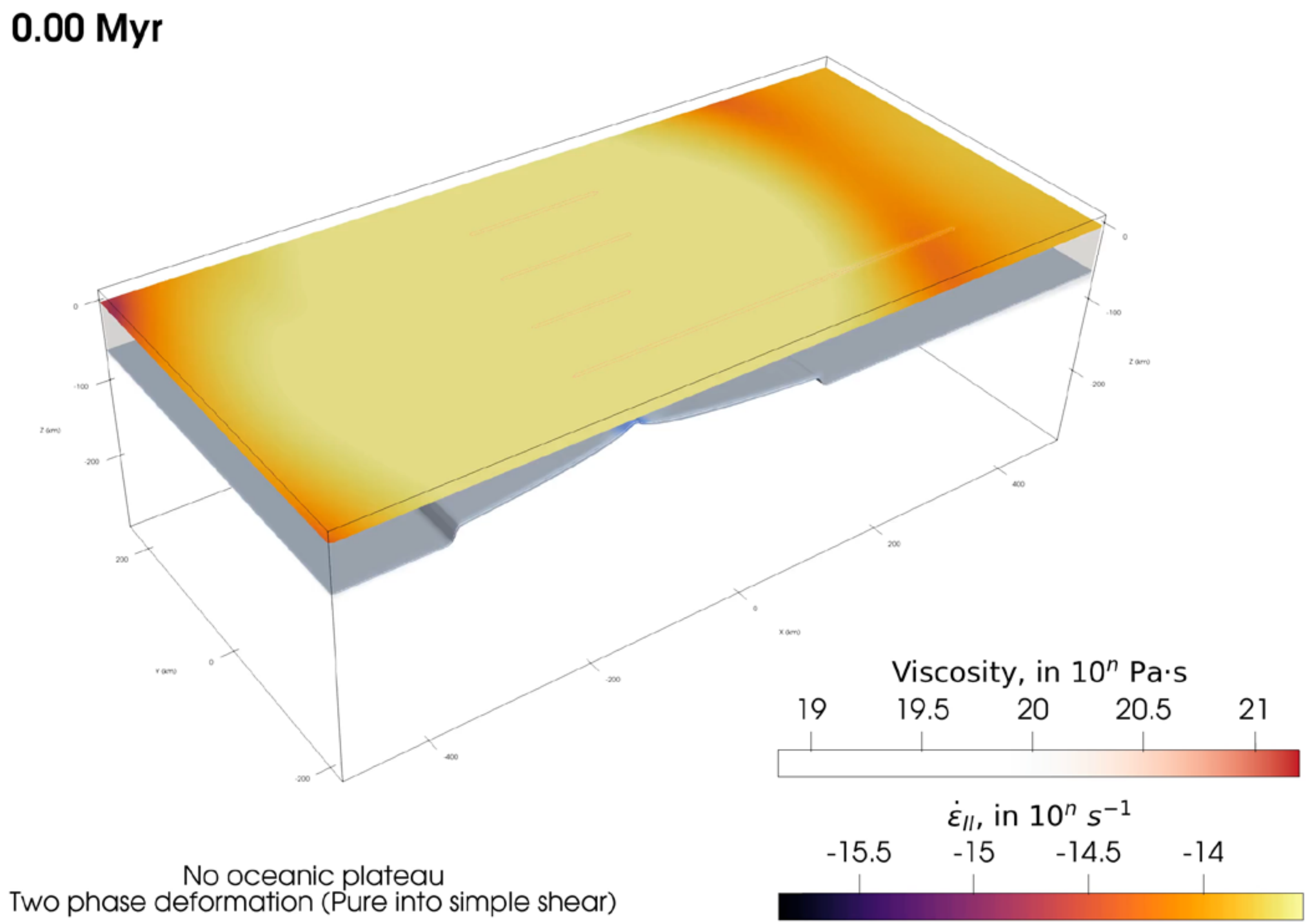


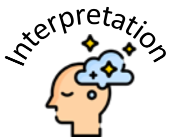
Tectonic forcing shift

No plateau

Extension: Δt < 0.4 Myr
Simple shear: Δt ≥ 0.4 Myr

Maximum velocity ≈ 1 cm/yr





Sharing not permitted

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Conclusions

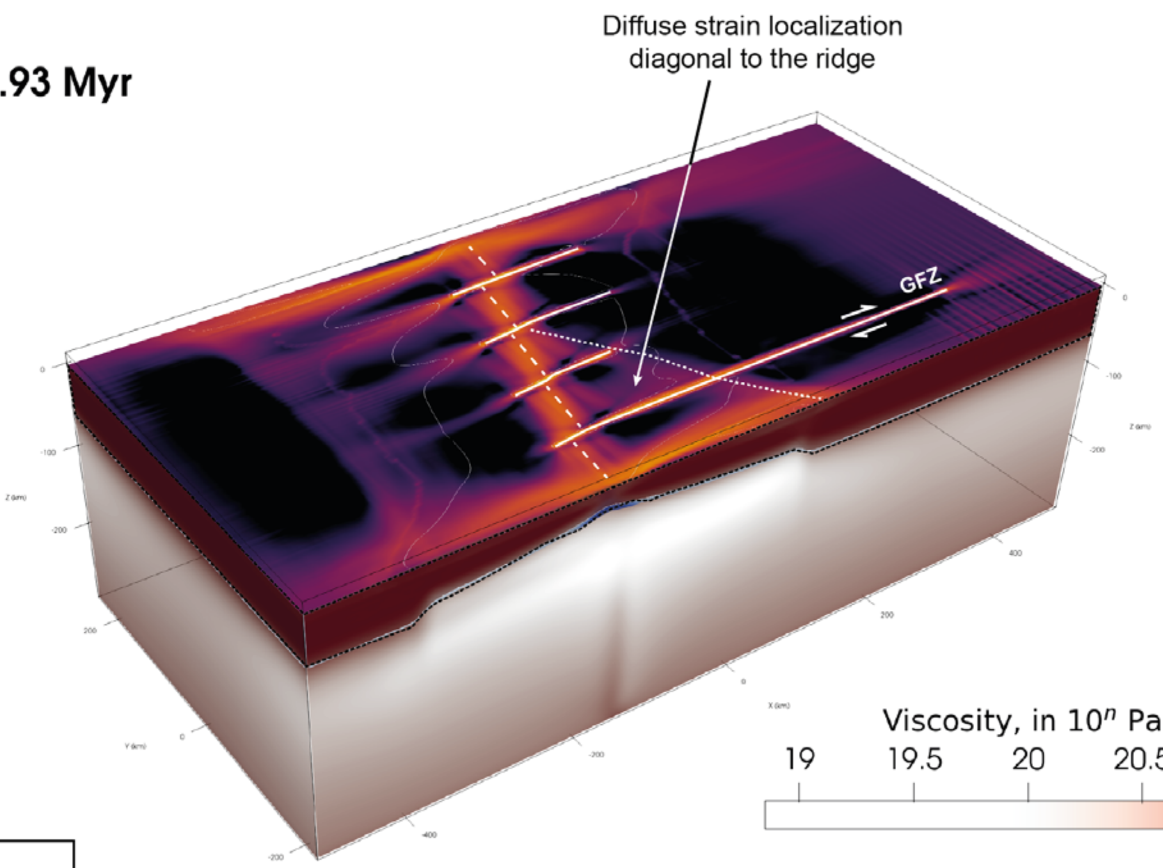
The change in tectonic forcing causes a new strain localization site to form

This new site is disperse but broadly follows the orientation of the Terceira Rift

Tectonic forcing shift

No plateau

Time: 0.93 Myr



Extension: Δt < 0.4 Myr
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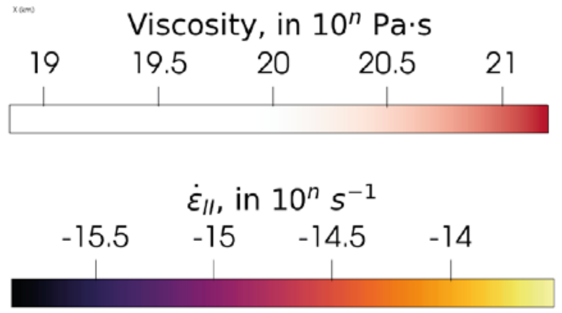
Natural case



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Legend
- - - - Spreading ridge segments
——— Transform faults
.... Strain localization site

Sharing not permitted

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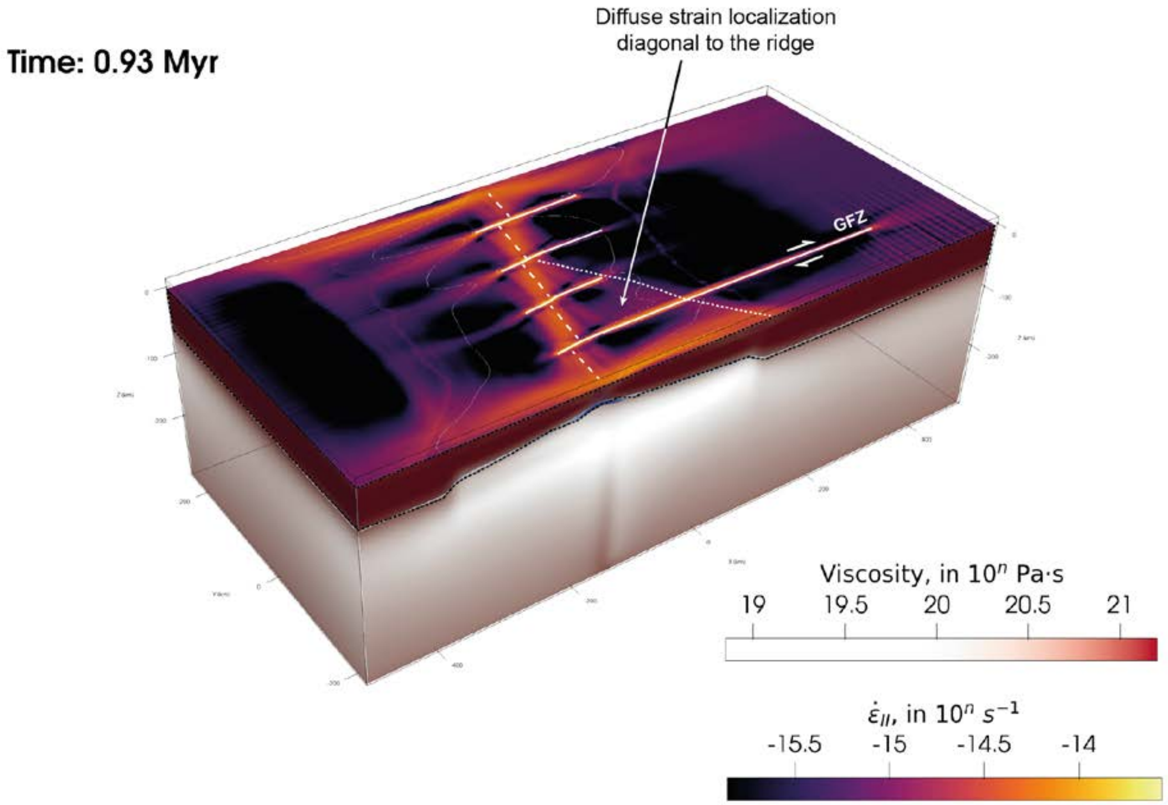

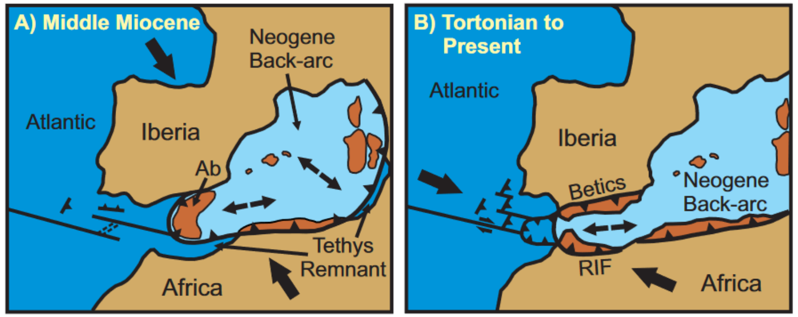

Adapted from Duarte *et al.* (2013)

Adapted from Gente *et al.* (2013)

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Conclusions

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Tectonic forcing shift

With plateau

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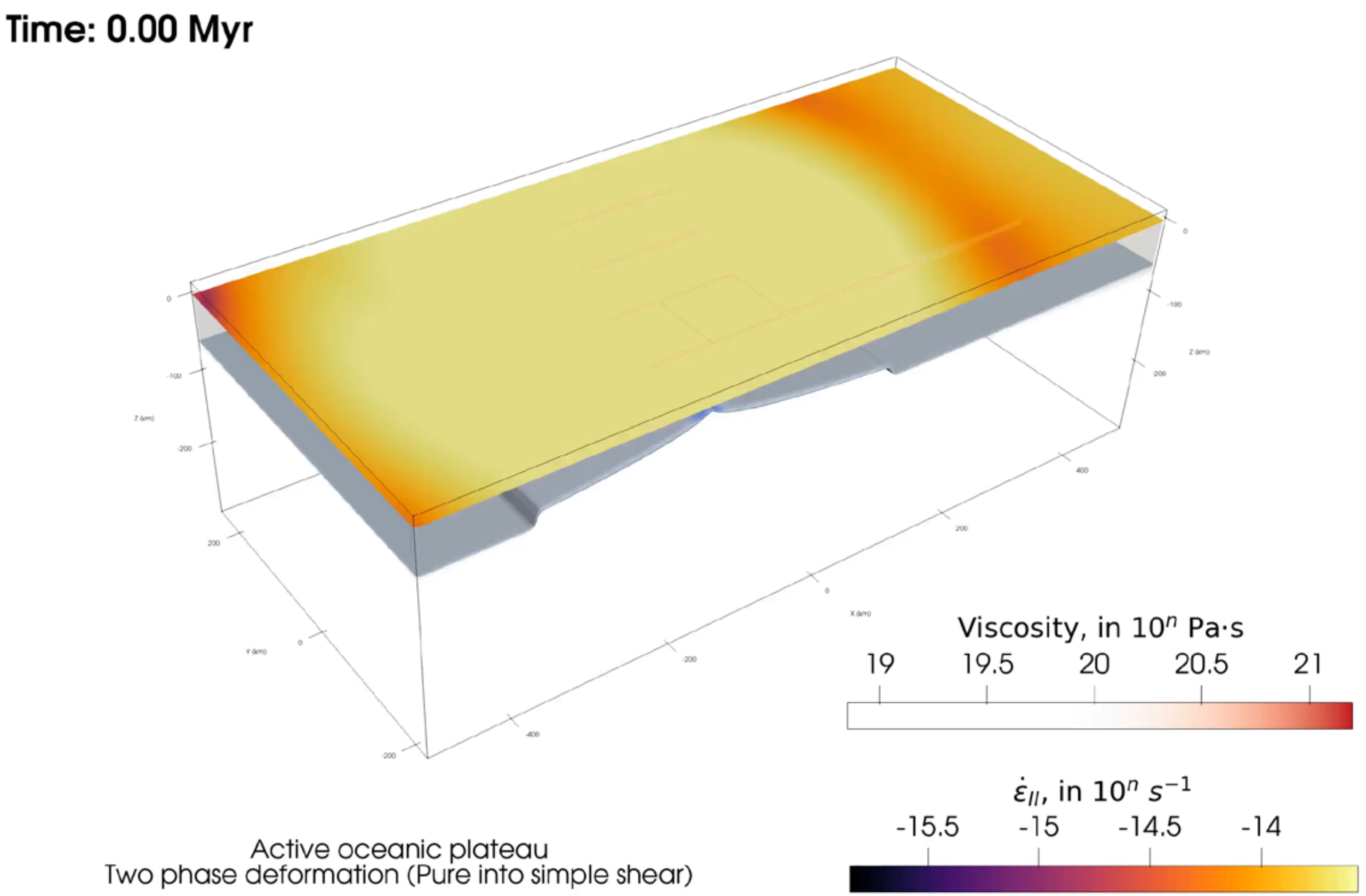

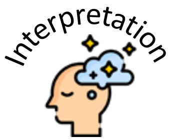

Conclusions

The change in tectonic forcing causes a new strain localization site to form

This new site follows the orientation of the Terceira Rift, and would likely develop into the major spreading center

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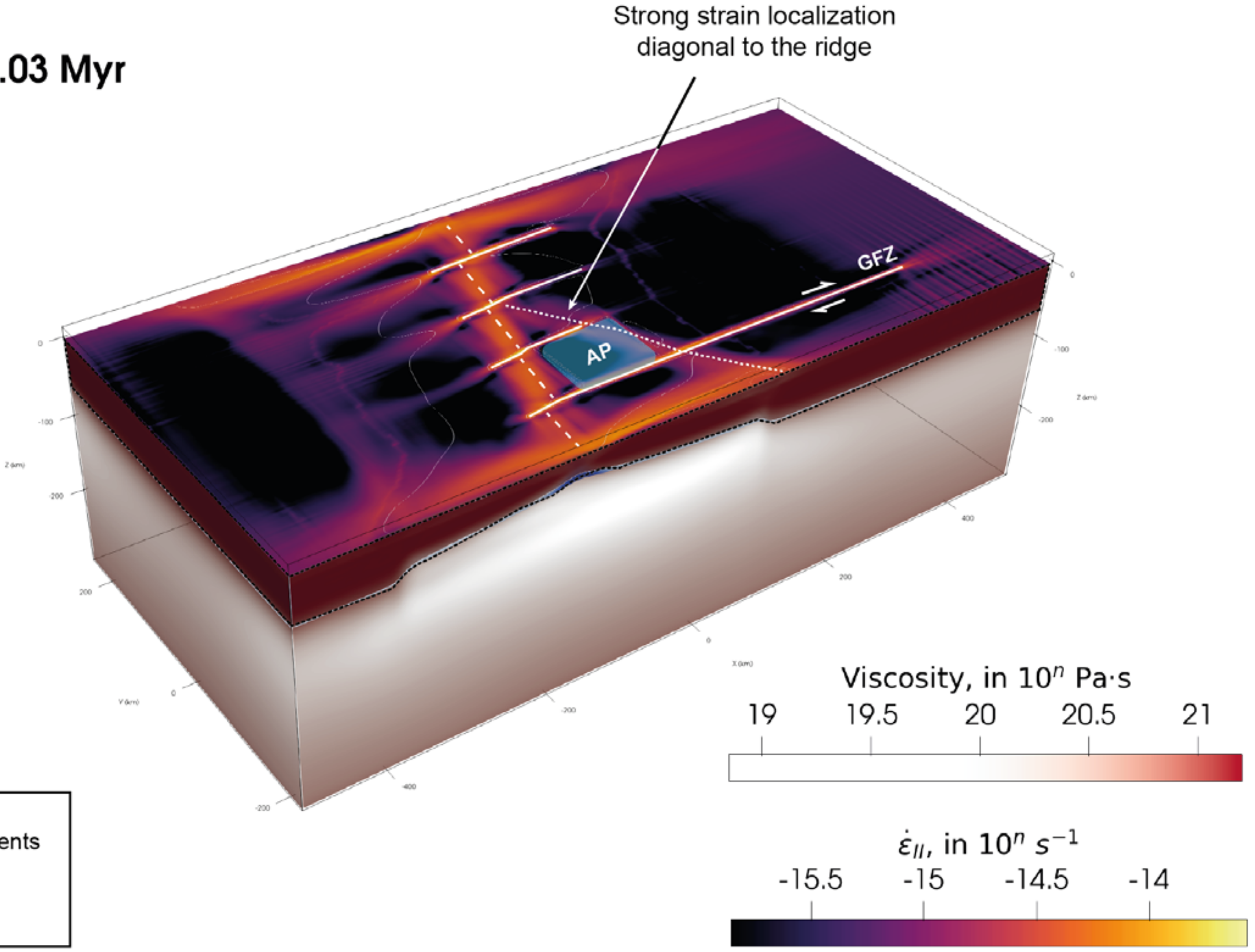
Tectonic forcing shift

With plateau

Time: 1.03 Myr



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Legend
- - - - Spreading ridge segments
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Natural case

Back to video

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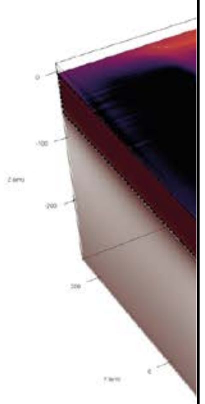
Tectonic forcing shift

W

Time: 1.03 Myr



Back to interpretation

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Back to model selection

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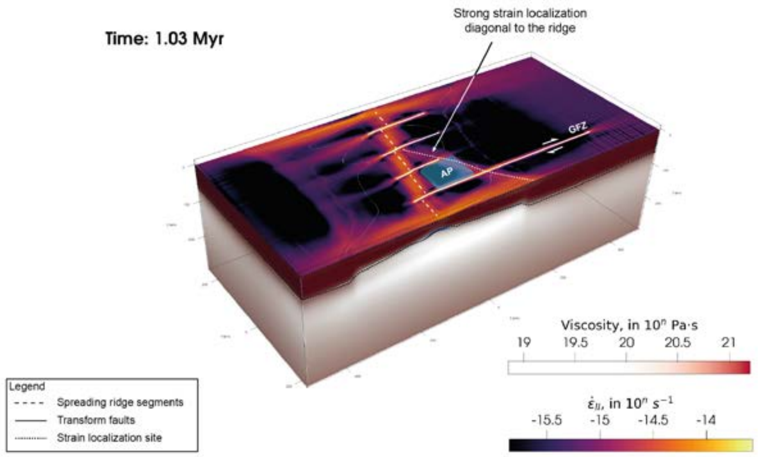

- The change in tectonic forcing induced by the collision of Eurasia and Nubia could suffice is geodynamically viable as formation mechanism for the Terceira Ridge.

- The existence of the oceanic plateau helps to localize the deformation, concentrating it along a single band.

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