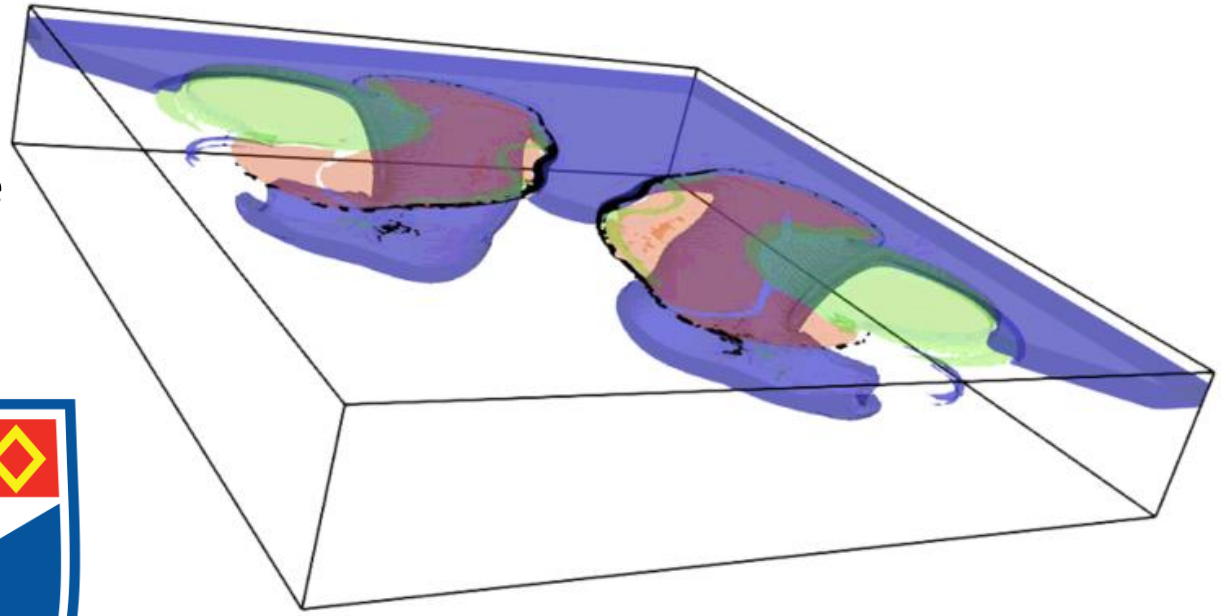
Feasibility of plate tectonics during the Archean: Insights from 3D numerical thermo-mechanical modelling

Andrea Piccolo, Nicolas Arndt, Boris Kaus & Richard White
Mail to: piccolo@uni-mainz.de



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UNIVERSITÉ Grenoble Alpes

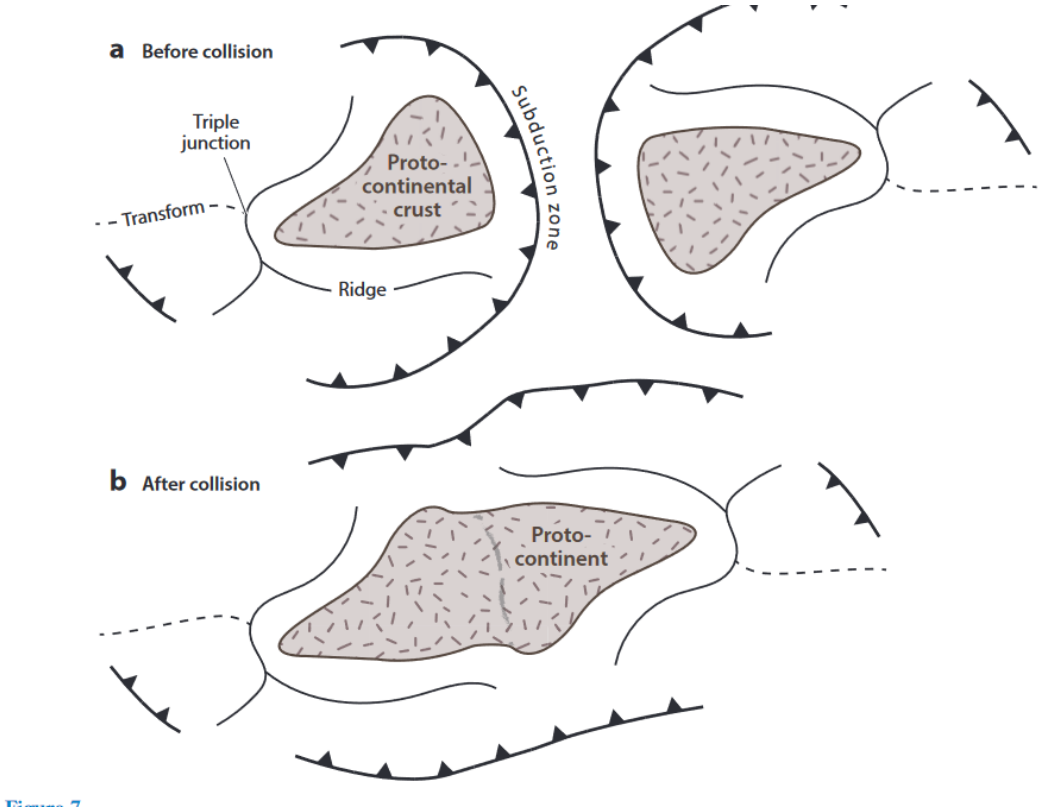
Introduction

- Plate tectonic or at least subduction processes could have started during the **Archean**.

- Subduction could had been been induced by **plume-lid interaction** .

- It is still not clear how several plume-induced subduction could have been interacting and forming network of plates.

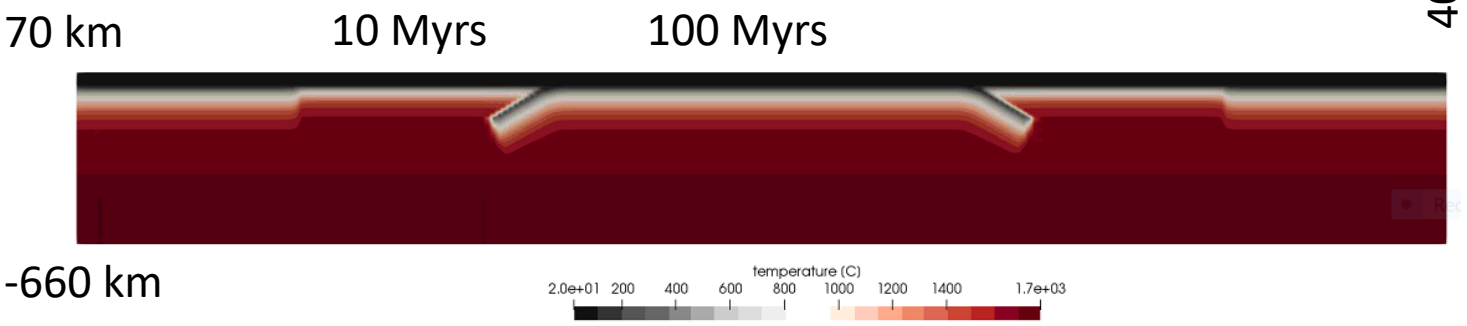
- Here we study the first order processed caused by the interaction between two subduction system associated with oceanic plateau.

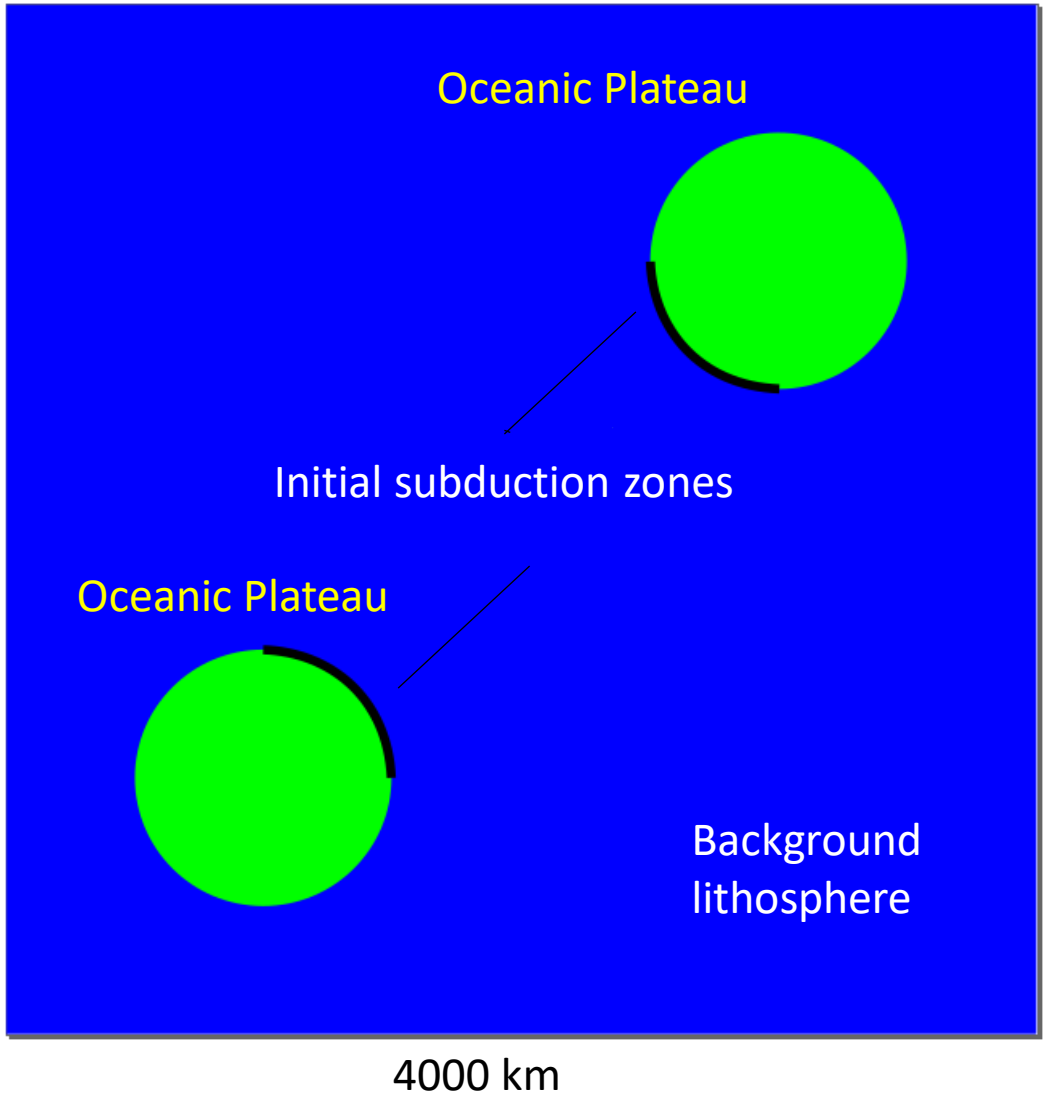


Sketches coming from Brown et al 2020 **[2]** illustrating interacting plume-induced subducted cells.

Methods & Initial setup

In order to study these processes we performed several numerical studies using a 3D numerical finite difference code, LaMEM.



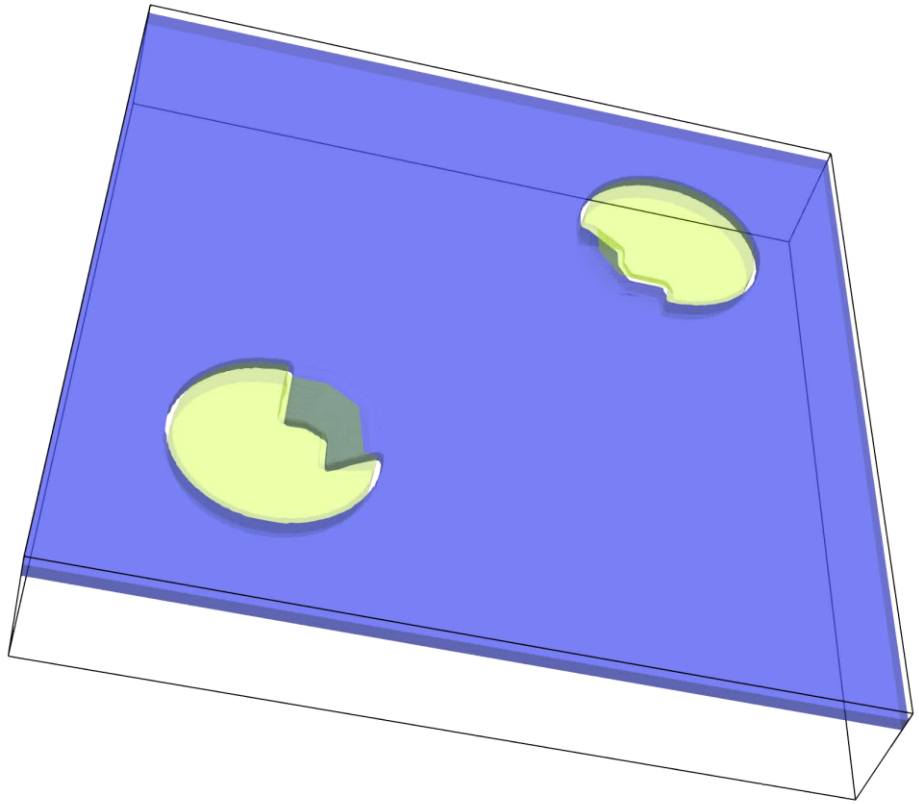


Background lithosphere has a variable thickness as a function of the mantle potential temperature. **Oceanic plateaus** are thicker (140 km) and feature a more buoyant **lithospheric mantle** ($\Delta\rho$ = 20, 50, 100 kg/m3 wtr asthenosphere)

RESULTS ($\Delta\rho = 20$) and low friction angle (5°), TP = 1450 °C

Time: 0.000000

- Trench initially migrates and its length increases.
- The oceanic plateau extends due to the differences of gravitational potential energy
- The slab retreat allows the exhumation of the underlying asthenosphere and generate small “oceanic” basins



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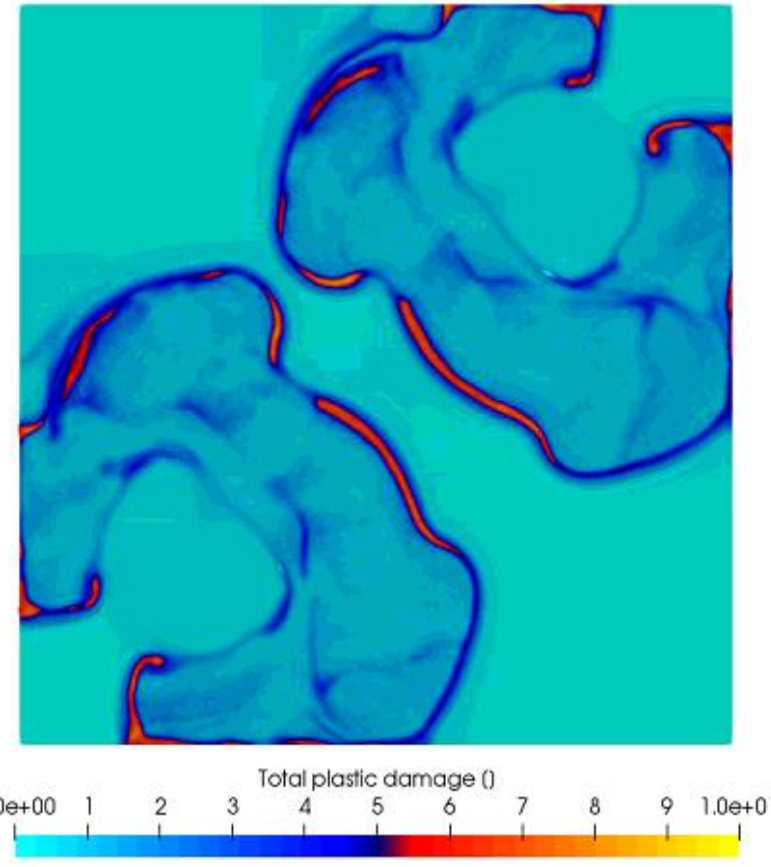
RESULTS (Δρ = 20) and low friction angle (5°), TP = 1450 °C

- Low friction angle & plastic weakening promote the generation transform/normal shear zone forming plate-like boundaries

- The subduction trenches preferentially migrate perpendicularly respect the original direction.

Time = 9.34 Myrs



Conclusion

- The interaction between plume-induced subduction do not promote collision-like processes.

- As soon as the two subduction are approaching, slab breaks off and the subduction start migrating perpendicularly to the original direction of propagation.

- Subduction processes are extremely dynamics and forces continuous reorganization of microplates.

Future perspectives

- **Integrating realistic phase transition to account of the lower mantle, eclogitic and dehydration reactions**

- **Increase the geometrical complexity and exploring a wider numerical domain**