Impact of trench retreat rate on initiating focused back-arc extension within a mobile overriding plate

Zhibin Lei[1], J. Huw Davies[1] ([1]School of Earth and Environmental Sciences, Cardiff University, Cardiff, CF10 3AT, UK)

leiz2@cardiff.ac.uk
@Lei_geodynamics

Cardiff University / Prifysgol Caerdydd
School of Earth and Environmental Sciences
Ysgol Gwyddorau'r Ddaear a'r Amgylchedd

1 Motivation and what we do

Our research is motivated by: 1) plate motion showing that high trench retreat rate often correlates with active back-arc extension, 2) previous research implies that similar spreading back-arc is prone to only develop in models with a fixed overriding plate or an overriding plate containing an arbitrary weak zone.

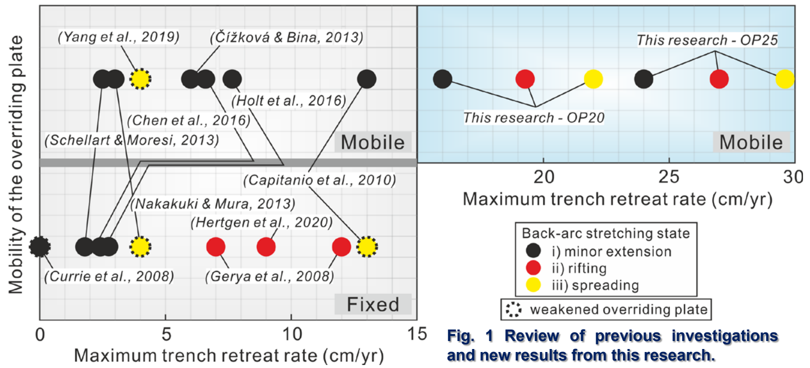


Fig. 1 Review of previous investigations and new results from this research.

2 Methods

- Investigate dynamic internally driven subduction models with mobile overriding plate
- Self-consistently produce high trench retreat rate and rifting, even in mobile plates

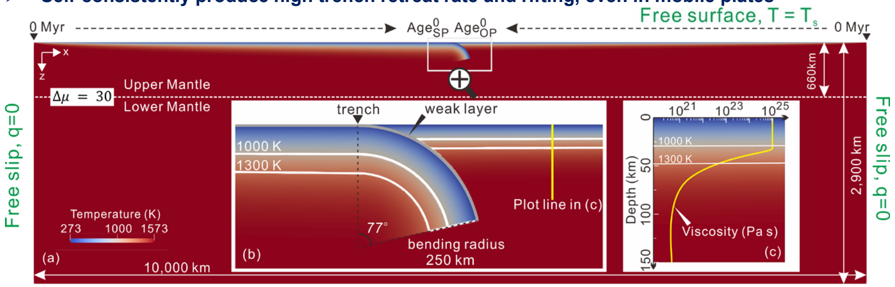


Fig. 2 Model setup. Similar to Garel et al. (2014).

5 Take-home message

- This research demonstrates the capability of initiating back-arc rifting or spreading in a mobile and homogenous (no arbitrary weak zone) overriding plate with non-uniform basal drag due to high trench retreat rate.
- The high trench retreat rate is likely to be achieved during non-steady state subduction when the age of subducting plate is old enough.

Reference

Garel, F., Goes, S., Davies, D. R., Davies, J. H., Kramer, S. C., & Wilson, C. R. (2014). Interaction of subducted slabs with the mantle transition-zone: A regime diagram from 2-D thermo-mechanical models with a mobile trench and an overriding plate. Geochemistry, Geophysics, Geosystems, 15(5), 1739-1765.

3 Results

- Two-stage subduction divided by t660 when slab interacts with the lower mantle (Fig. 3a,4).
- The average and maximum trench retreat rate is dependent on the initial age of the subducting plate during non-steady state subduction (Fig. 3a,3b). The age dependency fades away after t660 (Fig. 3a).

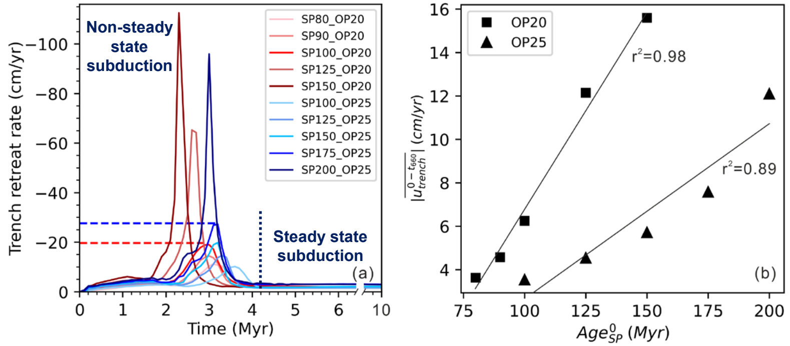


Fig. 3 Trench retreat rate through time (a) and its dependency on the slab age (b).

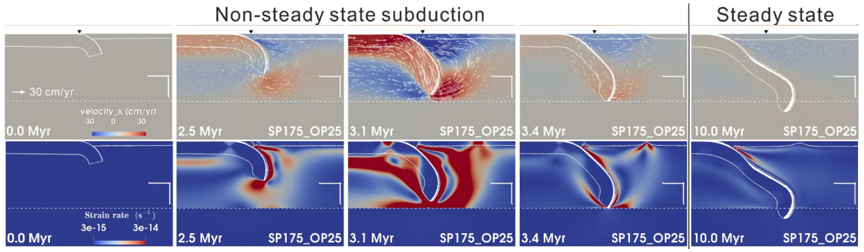
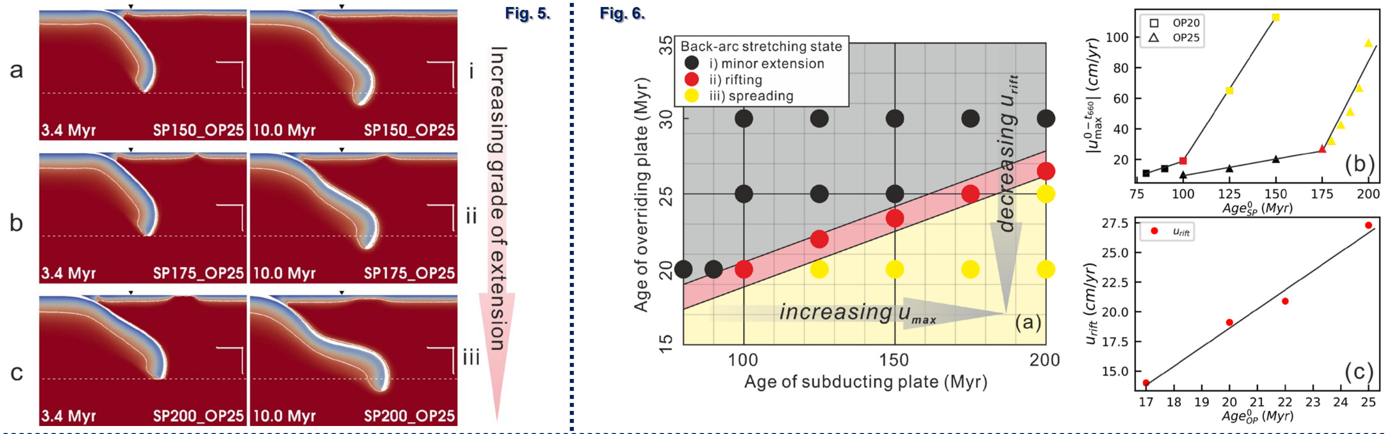


Fig. 4 Velocity field and strain rate evolution of model SP175_OP25 during subduction.

4 Regime diagram and origin of opening back-arc

- Three grades of back-arc extension arises as trench retreat rate increases during non-steady state subduction (Fig. 5).
- A minimum trench retreat rate is required to initiate rifting in the back-arc region (Fig.6).
- The opening back-arc is driven by the non-uniform basal drag due to high trench retreat rate, or slab rollback (Fig. 7).



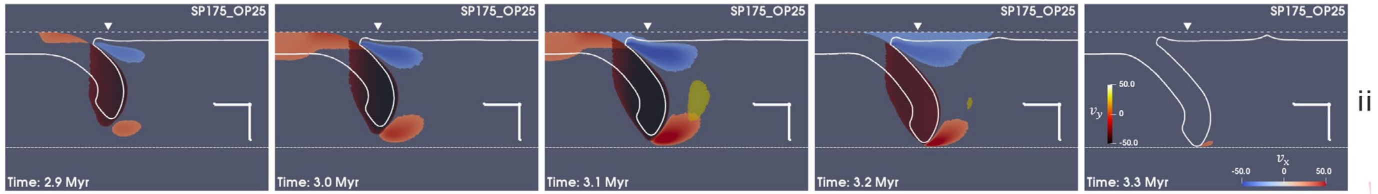


Fig. 7 Non-uniform basal drag visualised by the growing fraction of high trench-ward flow (shaded in blue) during non-steady state subduction in model SP175_OP25.

Acknowledgement

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