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Modelling the Wilson Cycle: How to NOT initiate subduction at the passive margin

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Since early work on the conversion of a passive margin into an Andean type subduction zone (Dewey, 1969), the issue of subduction initiation has been a heavily debated topic. Despite a wealth of studies that developed a better understanding of the process, many modelling attempts failed. The underlying reason for failures is generally undisclosed in the literature, so that the burden of repeating them is left to future researchers.
In most studies on subduction initiation, a weak zone is prescribed in the lithosphere to constrain the localization and orientation of the slab. Attempts to not rely on this initial prescription have rarely been successful in numerical modelling. Therefore, it is essential to keep tracks of unsuccessful attempts.
We present a 3D thermo-mechanical model of the Wilson Cycle from rifting to subduction initiation. In this new setup, no weak zone is prescribed. Rather, strain localisation is influenced by tectono-magmatic inheritance. Passive to active margin conversion proved to be challenging due to the difficulty of localizing shear deformation at the passive margin. What was inferred from studies using prescribed weak zones does not apply to spontaneously evolving margins as inherited structures (weak zones) with complex 3D geometry form and play a significant role for subduction initiation. Specifically, the thermal structure of the passive margin, inherited from the rifting stage, plays the most significant role for both the initiation of subduction at the margin.

Bibliography:
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