Slab tearing caused by trench's dramatic retreat and bending

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Slab tearing is a common phenomenon widely observed in the majority of subduction systems (Özbakır et al, 2020). It refers to the geodynamic process by which different parts of a subducting slab separate from each other vertically or horizontally. However, the mechanisms and dynamics of this process remain controversial. The formation of slab tearing is usually attributed to laterally variable subducting plate with buoyant blocks or pre-existing weakness (Menant et al., 2016). To study the process in a geodynamic context without collision or weak zones, here we use a 3D thermo-mechanical numerical approach (Leng and Gurnis, 2015) to model the subduction of a homogeneous oceanic plate at a trench that has experienced dramatic retreat and bending.

In our simulations, the abrupt change in orientation of the trench leads to tension and thinning of the slab. In the experiment with larger bending angle of the trench ($\geq 60°$), slab vertical tearing develops underneath the turn. We also investigate the effects of subducting plate's age and velocity, which turn out to play a secondary role in the scenario. Thus, we suggest that arcuate shape of the trench contribute to subducting slab's tension and even vertical tearing, which can be observed in many subduction zones (e.g., Marianas, North Caribbean).

References

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