

Water stabilizes one-sided subduction

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Subduction represents one of the most prominent plate tectonics processes on the Earth and drives cold negatively buoyant lithospheric rocks into the mantle. In contrast to symmetric convective downwellings subduction is one-sided: the subducting slab sinks while the overriding plate is decoupled and subjected to horizontal movements. This feature is difficult to reproduce in numerical models of mantle convection, which typically predict symmetric subduction in which the mantle on both the subducting slab is dragged downward. On the basis of 2-D numerical experiments with a coupled mineralogical-thermomechanical visco-elasto-plastic model involving spontaneous subduction associated with slab retreat we argue that one-sided subduction on the Earth is caused by the release of water from the subducted slab as a consequence of dehydration. The expulsion of this water into the overriding mantle efficiently decouples the overriding plate from the subducted slab introducing an inherent and self-sustaining asymmetry in convergent zones. Therefore implementation of water transport into global mantle convection model seems to be a necessary requirement for the accurate simulation of Earth-like plate tectonic styles.