



## Vertical slab tearing controlled by the rheology of subducting oceanic plates

Yaguang Chen<sup>1,2</sup>, Hanlin Chen<sup>1</sup>, Taras Gerya<sup>2</sup>, and Mingqi Liu<sup>2</sup>

<sup>1</sup>Zhejiang University, School of Earth Sciences, Hangzhou, China

<sup>2</sup>ETH Zürich, Institute of Geophysics, Department of Earth Sciences, Zürich, Switzerland

Vertical tearing of subducting oceanic slabs plays an important role in the subduction dynamic worldwide, accommodating slabs motion and segmentation in subduction zones. In previous studies, several models have been proposed for the origin of vertical slab tearing – they were related to variations in the slab age, rollback rate, buoyancy, moving direction, etc. However, the physical mechanism of vertical slab tearing remains elusive. Here, we propose a new model that stable vertical tearing of subducting oceanic slabs can be generated by inversion of transform margins and controlled by the strain-weakening rheology of subducting oceanic plates that facilitate out of plane (mode-III) shear deformation inside subducting slabs. Through 3D thermo-mechanical numerical modeling, we systematically investigate the effects of transform margins length and the rheology of subducting oceanic plates on the vertical slab tearing. Numerical results show that (1) interaction between two neighboring subducting slabs decreases as the transform margins length and the resulting trench offset increase. Once the offset reaches the critical offset, sustained vertical slab tearing occurs spontaneously. (2) Strain weakening parameters are crucial in the lithospheric deformation. An intense strain weakening, with a strong and rapid lowering of internal friction coefficient, greatly facilitates the initial slabs tear and makes it sustained. (3) Slab age is also an important factor in vertical slab tearing. A longer critical offset is required for the older oceanic lithosphere. (4) The vertical tear and resulting slab segmentation can operate as a self-sustained dynamical process (i.e., can be defined as dynamical instability of oblique subduction that gives preference to segmented slabs). Once a vertical tear is formed, it can propagate steadily for a long time.