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Horizontal vs. Vertical Slab Tearing during Subduction and Continental Collision

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Slab tears in subducting lithosphere are commonly interpreted to be the source of magmatism with an uncertain origin. They are suggested to be regions mantle wedge melting is mixed with primitive mantle advecting from the sub-slab once the tear appears.
Whilst horizontal slab tears result during continental collision and subsequent break-off, vertical slab tears are observed in regions with varying rollback velocities, thereby segmenting the lithosphere. These two very distinct settings with slab tears potentially result in different dynamics in the subduction system, mantle flow pattern, and related mixing of the mantle.

In this study, we develop 3-D numerical models to investigate the origins and consequences of horizontal and vertical slab tears. We apply various geometries of the subducting slab and incorporate a subducting continental block to model various rollback velocities as well as continental collision. Preliminary results suggest that the amount of mantle material exchange between the arc and sub-slab mantle is far less for horizontal slab tears than it is for vertical slab tears. In addition, slab windows extend to shallower depths for vertical tears. These results make it far more likely that slab-tear related magmatism occurs for vertical slab tears than for horizontal ones. We compare our model results with real examples from active subduction and collision zones.