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# Subduction initiation along a weakened margin: Insights from numerical models of STEP faults

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A preexisting weakness zone in the lithosphere (fracture/transform fault, mid-oceanic ridge or weak back-arc area) is required to initiate subduction. Here, we focus on a new type of weakness zone, one that is inherited from the propagation of a lateral tear along the edge of a previous slab, i.e., a STEP (Subduction-Transform Edge Propagator). Initiation of a new subduction zone may for instance follow from a change in relative plate motion. Using coupled thermal-mechanical models, we show that STEP-perpendicular convergence results into a dipping shear zone, independent of the tectonic setting. In a continent-ocean setting, this shear zone dips towards the continent, which is an excellent starting condition for oceanic subduction. If (far field) convergence persists, both ocean-ocean and ocean-continent STEPs become new subduction boundaries. Whether subduction ever becomes self-sustaining depends on the balance between driving and resistive forces; resistive forces increase by increasing the dip of shear zone, viscosity of shear zone, length of shear zone, or decreasing the width of the shear zone. Driving forces vary with the initial buoyancy (age) of the oceanic lithosphere, and with the convergence rate (Péclet number). A case that appears to be typical in current STEP regions in the Mediterranean, of subduction initiation along a passive margin involving young oceanic lithosphere, is not expected to ever become self-sustaining. STEPs are thus excellent localities for initiation of subduction at ocean-continent or ocean-ocean boundaries.