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Geodynamic modelling of terrane accretion, subduction, and collision

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Accretion, subduction, or collision of terranes can significantly affect subduction zone evolution and lead to reversed subduction polarity, trench jumping, or breaking off the slab. Terranes such as oceanic plateaus, volcanic arcs, and continental fragments have relatively thick crusts, and their size and buoyancy can therefore can be expected to influence subduction dynamics. Geological observations point out that accretion of terranes can lead to continental growth or accretionary orogenesis as evident by the collage of allochthonous terranes composing the western North American margin. Alternatively, subduction of terranes, as in the Andean subduction zone, has been posited to lead to flat slab subduction.

We examine basic models of subduction zones to define the controlling parameters in accretion, subduction, or collision of such terranes with the thermo-mechanical numerical code SULEC. SULEC is a 2-D, Arbitrary Lagrangian-Eulerian, finite element code that incorporates a free surface and a visco-elasto-plastic rheology. Our models test the buoyancy of three end-member terranes; oceanic plateaus, volcanic arcs, and continental fragments by varying terrane length, terrane crustal thickness, and terrane rheology. We seek to evaluate whether terrane buoyancy is enough to induce subduction zone rearrangement or if another variable, such as terrane crustal detachment or a thick subduction accretionary channel, are necessary.