Convergence at continental collision zones: Insights from long-term 2D geodynamic models buoyancy-driven subduction and collision.

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Continental collision succeeds long term subduction of oceanic lithosphere into the earth’s mantle whereby the negative buoyancy of the downgoing oceanic lithosphere (slab) provides the principal driving force for plate motions. Previous studies have shown that subduction-induced mantle flow could drive overriding plate shortening and orogenesis, and the arrival of the positively buoyant lithosphere at the trench affects the dynamics of the overriding plate and plate motions. The subsequent slab detachment at the subducted continent-ocean margin removes the driving force in the system and eventuates in cessation of subduction (Cloos, 1993) and plate convergence. The India-Eurasia subduction-collision system has multiple inferred slab break-off episodes (Replumaz et al., 2010), yet convergence is still ongoing. Here, we present 2D-cartesian buoyancy-driven numerical models of continental collision after subduction of a long oceanic plate (~6000 km) in a whole mantle reservoir (2880km), investigating the dynamics of such systems in the presence of detached slabs. These models’ wide aspect ratio (6:1) allows for exploring deep subduction of oceanic slabs and detached slab(s), approximately at the centre of the domain, thereby minimising the effect of free slip sidewalls on obtained slab morphology in the mantle and associated mantle flow. Our results indicate that poloidal mantle flow induced by the sinking of the detached slab sustain long term convergence in collisional settings. Although 2D models lack the 3D components of mantle flow, these models can be used to understand the dynamics of the centre of >4000km wide subductions zones and facilitate interpretation in light of tomographic and plate reconstruction studies.

References:

