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# The use of surface topography at continental collision zones to understand the dynamics of collision and break-off

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The effect of collision and slab break-off on the surface topography is still debated. Previous modelling work has led to various different conclusions. Rapid changes in topography of about 1400m after slab break-off were found by Gerya et al. (2004). Surface up-lift has also been modeled by Buiter and Pfiffner (2003), who predicted greater amounts of uplift on the order of 2-6km with large variation being due to differences in the depth of slab break off and friction in the subduction zone fault. Andrews and Billen (2009) show that the timing and to some extent magnitude of surface effects where closely correlated with the rheology of the subducted plate. The magnitude and timing of topographic changes was also found to be highly dependent on the rheology of the slab material and hence the depth of break off (Duretz et al. 2011) To fully understand the the topography at collision zones consideration needs to be given to both the subducted buoyant material as well the dynamic forces induced by flow in the mantle (Lithgow-Bertelloni and Silver 1998). Estimates of the dyanmic effects on topograhy vary even for the simpler case of ongoing subduction, with different estimates for the depths and size of back arc basins (Husson, 2006) (Melosh and Raefsky 1980).

To investigate how the topography at collision zone changes over time we numerically simulate subduction and collisional tectonics (van Hunen and Allen 2011). Our models contain two converging continental terrains, with a small oceanic basin closing in between. Topography is generated from these models using the normal stress field at the surface subjected to an elastic filter. Linking the topography to the deep dynamics of the models allow us to identify features in the topography that provide information about the dynamics of the situation. Preliminary results indicate a significant influence on topography of mantle flow during continental collision and slab break-off processes. A correlation between the subduction velocity and the depth of the back-arc basin has been found with basin depths as predicted by Husson (2006) have been successfully replicated. Collision and slab detachment alters the convection in the mantle wedge which causes topography changes. One of these effects is the steepening of the slab angle after collision which causes a deepening of the back arc basin to 2-3km. This is then followed by uplift moving into the overriding plate after break-off. This is due to buoyant continental material in the remains subducted slab rising once it is longer dragged down by the slab. We compare our model results with the geological history of the Arabia-Eurasia collision zone, and show that our predictions of uplift and subsidence explain some of the first order patterns observed in the geological record. In particular, a hitherto enigmatic basin across SW Eurasia after initial collision at 35 Ma (Morley et al. 2009) is consistent with steepening of the slab angle post-initial collision inducing subsidence in the overriding plate.

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