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Can surface topography at continental collision zones be used to detect slab break off?

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At collision zones, the effect of slab break-off on the production of surface uplift and volcanism is debated. Previous modelling work has led to various different conclusions. Gerya et al. (2004) suggest a rapid changes in topography and significant volcanic activity as possible consequences of slab detachment, and predict topography changes of about 1400m after slab break-off. Surface up-lift has also been modelled by Buiter et al. (2002), and they predicted uplift of the order of 2-6km with large variation being due to difference in the depth of slab break off and friction in the subduction zone fault. Andrews & Billen (2009) show that the timing and to some extent magnitude of surface effects where closely correlated with the rheology of the subducted plate. It has also been proposed that as a slab tears away there will be a zone of depression that propagates across the surface (Meulenkamp et al., 1996; van der Meulen et al. 1998; Wortel & Spakman, 2000). This zone is proposed to be due to the mass of the detached section all being supported by the plate at the point where it is still attached. Mantle flow will have additional dynamic topography effects (Faccenna & Becker, 2010). To fully understand how each of these processes affects topography, , we compare results from numerical dynamical models with available observations from the Zagros mountains (Molinaro et al., 2005) and the European Alps.

To investigate how the topography at collision zone changes over time we numerically simulate collisional tectonics (van Hunen & Allen, 2010). We investigate topography evolution using both idealised and full subduction and collision models. These have been used to investigate the effects of the mantle viscosity has on the topography produced when collision occurs. The size, orientation and composition of the subducted slab is also varied to see what effect this has on topography. Preliminary results indicate a significant influence of mantle flow during the break-off process. Finally, we will discuss whether a topographic slab detachment signal would be lost as noise in the large orogenic surface uplift associated with continental collision.

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