Geophysical Research Abstracts
Vol. 14, EGU2012-13276, 2012
EGU General Assembly 2012

Disruption and translation of an orogenic wedge by exhumation of large continental ultrahigh pressure terranes: Examples from the Scandinavian Caledonides

S. Cuthbert (1) and H. Brueckner (2)

(1) School of Science, University of the West of Scotland, Paisley PA1 2BE, UK (simon.cuthbert@uws.ac.uk), (2) Lamont-Doherty Earth Observatory of Columbia University, Palisades, New York 10964, USA

Many collisional orogens are cored by extensive metamorphic terranes composed of reworked continental crust that developed high pressure/ultrahigh pressure (HP/UHP) metamorphic assemblages during subduction into the mantle. The return of these large, buoyant masses to shallow crustal levels has a major effect on orogenic architecture. A model is proposed where thrust-dominated accretion of an orogenic wedge during continental subduction is succeeded by stretching and passive transport of the wedge on top of an exhuming UHP terrane. Initial thrusting occurs when cratons collide and one subducts beneath the other into the mantle. The subducted portion of the craton undergoes HP/UHP metamorphism while an accretionary orogenic wedge develops at its junction with the overlying craton. Subsequent exhumation of the HP/UHP portion occurs either by true extension, which pulls it out of the mantle, and/or by buoyancy-driven extrusion, which inserts it along faults between the lower craton and the base of the wedge. In either case, shearing along the top of the exhuming terrane will reverse from foreland-directed thrusting during subduction to hinterlandward normal displacement during exhumation. The latter shear traction stretches the frontal part of the orogenic wedge away from the rearward part and may even detach it, allowing a fragment to be carried passively towards the foreland on the exhuming plate. The length of displacement would be a function of the amount of exhumation of the UHP terrane, and the total displacement of the leading wedge taper could be considerably further than indicated by palinspastic restorations of thrust allochthons alone.

The Jotun and Trondheim Nappe Complexes form major allochthon elements of the Caledonide orogenic wedge in southern and central Scandinavia, respectively. We propose the late-stage behaviour of these allochthons was a response to the rise and lateral transport of the underlying HP/UHP Western Gneiss Complex (WGC). During the early phases of the Scandian Orogeny these allochthons were thrust across the Baltica craton towards the E/SE as the western edge of Baltica (the WGC) subducted into the mantle beneath Laurentia and underwent HP/UHP metamorphism. Kinematic indicators in the basal wedge's decollement indicate a subsequent change in shear sense to top to the W/NW ca 415 Ma, the same time radiometric dates indicate the WGC began exhumation out of the mantle. The wedge initially slipped hinterlandwards along its basal decollement zone as a relatively intact body while the WGC moved E/SE below it ("mode I" slip) but the shear traction along the top of the exhuming terrane stretched the allochthons A subsequent set of extensional (sensu stricto) faults, associated with late-orogenic basin formation ("mode II" slip), broke the wedge into segments and separated the frontal part of the wedge away from the main body, carrying it passively E/SE as the WGC continued to exhume out of the mantle. The lack of fragmentation and absence of extension structures in the most external part of the orogenic wedge, despite being thin and with a low taper angle, suggests it was carried by passive "piggyback" transport of top of this exhuming HP/UHP terrane.