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On the link between orogenic shortening and back-arc extensional collapse in low topography orogens

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Classical models of orogenic evolution assume that back arc basins form in the hinterland of orogens, collapsing the upper plate above oceanic subduction zones. This is a common characteristic commonly thought to apply to all low-topography orogens of Mediterranean type driven by the fast roll-back of subducted slabs, or other analogues such as the Miocene to recent evolution of the SE Asia subduction zones. This extension may take place far at the interior of the upper plate, as is the case in various segments of the Carpathians or in the core of the SE Asian domain, but in most cases of the Dinarides, Apennines or Hellenides it take place superposed or far into the foreland of oceanic suture zones. Therefore, the term back-arc extension in many cases is misleading, as exhumation along major detachment zones takes place in the core of the orogen (Rif, Betics), in the accreted crustal material of the lower plate (Apennines, Dinarides) or even in a presumed former fore-arc (Aegean, Sunda-Banda arc). In all these subduction zones, collision has largely duplicated crustal blocks from the lower plate and has gradually shifted subduction zone far towards the lower plate. As a result, crustal thickening takes place in the foreland of the orogen, in contrast with the typical crustal roots of the high convergence orogens, such as the Alps or Himalaya. This demonstrate an active shift of the main subduction zone, the position of slabs detected by teleseismic mantle tomography is displaced to the foreland and cannot be connected with the position of the lower plate crust beneath the orogen. This shift is associated with large scale magmatism with unusual large crustal signatures, atypical for subduction related magmas. These observations demonstrate the need for an active reconsideration of existing orogenic models which should include displacements of subduction zones during orogenic shortening and an active investigation of the role of continental subduction and associated magmatism during various phases of mountain build-up.