Basal subduction tectonic erosion (STE) and the construction of HP-UHP metamorphic belts: a new model for the Alps and its comparison with the Maksyutov Complex, southern Urals

Miles F. Osmaston
The White Cottage Sendmarsh, Ripley, Woking, Surrey GU23 6JT, UK.
miles@osmaston.demon.co.uk

Studies of HP-UHP metamorphic belts concentrate on their metamorphism and exhumation, handicapped by unclear ideas of how subduction constructs slices thinner than whole crust and assembles them at great depths. We report progress. Construction takes very much longer than zircon dating has suggested.

We recognized [IGC'92; IUGG'99] that the downbend of subducting plates is actually an escalator-like step-faulting process with the property (STE) of incorporating upper-plate material in the step-angles, thus advancing the STE-carved downbend position, often very shallowly, for hundreds of kilometres. This must be driven by ridge-push; slab pull is not suitable. A sharp inflection of the profile then often develops up-front. STE action here couples ridge-push to this now thin-crusted upper plate and can cause imbrication. It also creates a tectonic mélange that is discharged onto the ensuing ‘flat’ underside of the margin and is diagnostically present in the imbricate slices of HP-UHP belts, where its floaters and usually-pelitic matrix attract much attention. Crucially, the imbricate foreshortening of margins obscures that many subduction zones may have started life with ocean-crusted forearcs [IGC’92].

In the Alps, imbrication events generated up-front flysch, many of Cretaceous age, juxtaposed by the foreshortening, so southward STE was earlier. Successive imbrication, from the north, transposed the palaeogeographic order, so the Piemont ophiolites were from an ocean-crusted northern forearc, not a separate ocean. Such transpositions cannot happen during collision; they require too much transport.

Chilled by prior subduction below them, subducted imbrics readily acquire HP/LT mineralogy. Lodgement across the distant downbend builds an 'accreted' triangular section reaching far down the back wall; so this part exhumes the most, breaking through the crustal roof above (AustroAlpine in the Alps) to form a line prone to strike-slip. In the Alps this is the Insubric Line, so it is not a suture.

In the Urals, the proto-Uralian ocean was created by Ordovician(?) splitting, from the Russian craton, of a large block on which the Siluro-Devonian Magnitogorsk arc was then developed by E-directed subduction. Collision was much later. The subduction, as in the Alps, proceeded by STE and imbrication to build, at depth, the Maksyutov Complex (MC). In exhumed form, west of the arc, from E to W, the E-dipping Main Uralian Normal Fault is a wide ophiolitic mélange zone at the E boundary of the much-exhumed MC, reminiscent of the Insubric Line. Due to differential exhumation, MC structures dip to W under the Suvanjak Complex (SC), here seen as the remainder of the former (AA-equivalent) roof beneath which the MC was constructed. W of the SC, the Zilair Flysch Nappe may record the imbrications whence the slices of the MC derive. The MC’s Proterozoic rocks derive from a former more-western part of the block supporting the arc, not directly from the Russian craton.