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BASAL SUBDUCTION TECTONIC EROSION (STE), BUTTER MÉLANGES AND THE CONSTRUCTION AND EXHUMATION OF HP-UHP BELTS

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Studies of low-temperature HP-UHP metamorphic belts have concentrated on their metamorphism and exhumation, being handicapped by having only vague ideas as to how they are assembled and attain the depths. Much progress in that direction now appears possible.

A breakthrough came with my recognition (IGC'92; IUGG'99) that subduction downbend is actually a step-faulting process with the property (STE) of incorporating upper-plate material in the step-angles and thus moving forward the downbend position rapidly and shallowly for hundreds of kilometres, yielding flat-subduction convergent margins. In many cases seismology shows the interface profile passes through an inflection nearer the trench. This means that STE is 'taking a second cut' and then disgorges the material along the succeeding flat part of the interface. When a STE-thinned margin imbricates, this diagnostic material appears as a fluid-overpressured tectonic mélange 'buttered' (no shearing at the contact) onto the underside of each. From many examples, globally, I find the floaters (up to several km in size) exhibit a wide range of lithologies, even slickensided, in an ex-oceanic, usually pelitic matrix that protected them from deformation. This 'butter' is the focus of much attention in HP-UHP belts.

Imbrics of such margins may be subducted, one by one, and lodged across the angle of the distant, now steep-angled downbend carved by STE into the hanging wall. Chilled by previous subduction below them, they readily acquire HP/LT mineralogy. Lodgement across the downbend builds an 'accreted' triangular section extending far down the back wall; so this part exhumes the most, breaking through the crust above to form a line prone to strike-slip (Insubric, Møre-Trøndelag, Median Tectonic Line).

In the Alps, 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. Each imbrication event generated a flysch (mostly Cretaceous) up-front and the foreshortening assembled these in the Prealps.

Exhumation by self-reheating cannot begin until ongoing subduction stops cooling it (collision). Usually, today, some 50km of crustal thickness still remains so the original depth extent of the 'triangle' was that much greater. The reheating (melting?) of this deeper part may provide much of the buoyancy for exhumation.

Keywords subduction; mélanges; tectonic erosion; HP-UHP metamorphic belts; exhumation;