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Exhumation of HP/UHP rocks by normal ductile shearing on top of the Eocene extruding wedge

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A popular model for the exhumation of HP-UHP rocks is the 'extruding wedge' model, where a crustal slice is bounded at its base by a 'thrust shear-sense' fault and to the top by a 'normal shear-sense' fault. In the Western Alps, the late Eocene Combin Shear Zone (CSZ) allowed extrusion of a wedge made by the Briançonnais-Piemonte-Liguria ('Penninic') stack.

Geological mapping has established the geometry and continuity of the CSZ from the frontal part of the Dent Blanche Tectonic System to the western boundary of the Sesia Zone. The CSZ has been cut during the Miocene by the brittle Aosta-Ranzola Fault, with an estimated downthrow of the northern block of c. 2.5 km with respect to the southern block. Consequently, the sections observed north (Monte Rosa) and South (Gran Paradiso) of the Aosta Fault display different structural levels in the Alpine nappe stack. The CSZ has been folded (Vanzone phase) during the final part of its history (i.e. when displacement along the CSZ was no more taking place), due to the indentation of the Adriatic mantle. This offers us the unique opportunity to study the change in deformation mechanisms along the shear zone (for a distance parallel to its displacement of about 50 km).

Salient characteristics of the CSZ are the following. (i) The thickness of the ductile shear zone increases from NW (frontal part of the Dent Blanche) to SE (frontal part of the Sesia Zone), from a few hundred metres to several kilometres. The type of lithologies pervasively reworked by the ductile shear changes along strike (dominantly calcschists from the topmost oceanic units in the Combin Zone, possibly up to the whole of the 'Gneiss Minuti' in the frontal Sesia Zone). (ii) The main ductile deformation along the CSZ was taking place at greenschist-facies conditions, overprinting eclogite-facies to greenschist-facies deformations of Cretaceous to Middle Eocene age. The CSZ is cutting and reworking eclogite-facies structures developed in its hangingwall (Sesia) as well as in its footwall (Zermatt). (iii) Ductile displacement along the CSZ is associated with the development in its footwall of south-east-verging, kilometre-scale, folds (Mischabel phase). The sedimentary sequences of the Pancherot-Cime Bianche-Bettaforca Unit may be used to estimate the minimum amount of 'normal shear sense' displacement of the order of 15-20 km.

A kinematic model integrating slab roll-back, 'thrust shear-sense' at the base and 'normal shear-sense' displacement on top of the Eocene eclogite-facies stack will be presented.

