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Oceanic subduction in the Alps

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The Alps are amongst the best subduction archives in the world, with abundant blueschists and eclogites in a well-preserved tectono-metamorphic architecture. We show that this record is neither exceptional nor atypical but rather exemplifies the fate of relatively short-lived and small, slow-spreading and slowly closing North Atlantic-type oceans (in this case a ~600 km-wide domain closed over 60 Ma, at ~1 cm/a), characterized by short subducting slabs confined to small-scale convection. Such domains comprise variably refertilized exhumed mantle, irregularly distributed magmatic rocks and pelagic sediments, together with broad OCTs, that feature extensional allochtons and thinned continental fragments.

Contrasts in rock recovery with time and space outline distinct subduction dynamics along the belt. During the first half of subduction lifetime (~30 Ma), no subducted oceanic fragment was recovered. Afterwards, all fragments show P-T conditions matching those of mature subduction worlwide. A marked difference is observed between metasediment- and mafic/ultramafic-dominated units (S and MUM units). While underplating of S units took place discontinuously through time and preferentially at ~30-40 km depth, MUM units deeply subducted to ~80 km (corresponding to mantle fragments and early magmas emplaced immediately outboard of the margin) are only recovered in the W. Alps and late, i.e. within a few Ma at most prior to continental subduction. At the scale of the orogen, the greatest recovery of subducted MUM units coincides with the presence of continental material (Briançonnais, Sesia), demonstrating a strong influence of initial margin architecture and/or continental subduction. These features contrast with those of large oceans and suggest that the subduction archive, whilst typical of subduction thermal regimes, selectively preserves slow-spreading oceans and/or hyperextended margins.

Mots-Clés : subduction dynamics; blueschists; eclogites; slow-spreading ocean; exhumation

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