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Tectono-metamorphic evolution of meta-ophiolitic units along Susa Valley (Italian Western Alps): new suggestions for the exhumation processes

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In the inner Western Alps, meta-ophiolite units (i.e. the Piemonte Zone) show different stages of the tectono-metamorphic evolution, since the early phases of subduction to the latest exhumation steps.

Tectono-metamorphic data collected through the meta-ophiolite units of the Piemonte Zone along the middle Susa Valley allowed to infer new ideas about the exhumation processes that developed in the (U)HP units. In this area, Zermatt-Saas-like meta-ophiolite unit (i.e. the eclogite-facies Internal Piemonte Zone, IPZ) are tectonically overlain by Combin-like ones (i.e. the blueschist-facies External Piemonte Zone, EPZ), through a thick shear zone (i.e. the Susa Shear Zone, SSZ). Metamorphic history was achieved by analyzing basic rocks (metabasalt and Fe-Ti metagabbro) and sedimentary rocks derived from reworking basic rocks in oceanic environment (basic sandstones and conglomerates, and ophiolitic breccia). Different P-T paths were inferred for IPZ and EPZ, according with mineral assemblages and realizations of pseudosections. In the IPZ, four tectono-metamorphic events, developed under variables metamorphic conditions, were recognized. The first (peak-P) event shows (U)HP conditions, defined by the occurrence of relic mineral assemblage (Grt I+ Omp I + Rt). The paragenesis is completed by Zo + Pg pseudomorphs, implying that Lws-eclogite facies were reached.

The discovery in Grt (and Rt) relics inclusions of black euhedral pseudomorphs of disordered graphite, suggesting to be derived from original microdiamonds, agree with other petrologic constrains. The second event, marked by the Grt II + Omp II + Ph + Gln + Zo assemblage, developed under epidote-eclogite facies conditions. Following a retrograde and decompressional trajectory, the IPZ was then re-equilibrated under greenschist-facies conditions and a new assemblage (Ab + Chl + Mu + Czo + Ttn + Act) overprinted HP paragenesis. The last event is marked by a weak heating, with crystallization of Bt + Ep + Olig + Hbl (Prg) + Ms.

The EPZ shows a different metamorphic evolution, where only two events were recognized. The first event developed under blueschist-facies conditions, with relics of mineral assemblages consisting of Gln + Rt + Ph. Then, a retrograde trajectory re-equilibrated EPZ under greenschist-facies conditions and a new stable mineral assemblage (Ab + Chl + Mu + Ttn + Act + Czo) grew.

The inferred P-T path suggests, for the IPZ, a first isothermal exhumation stage, likely driven by buoyancy forces from the base of the orogenic wedge. In the EPZ, HP peak occurs at the same gradient of the second event in the IPZ, suggesting that, during exhumation of the IPZ, the EPZ was still subducted.

The strong re-equilibration under greenschist-facies conditions suggests a stage of slow exhumation rate, which can be related to the coupling between IPZ and EPZ.