New structural, petrological and geochronological constraints from the Susa Shear Zone (Susa Valley, Western Alps)

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A multidisciplinary approach to the study of collisional orogenic belts can improve our knowledge of their geodynamic evolution and may suggest new tectonic models. In the Western Alps, nappes of different origin are stacked, having recorded different metamorphic peaks at different orogenic evolution stages. This study focuses on the meta-ophiolites of the Piedmont Zone outcropping in the mid-Susa Valley (Western Alps), where the relationships between different units are well exposed. The Piedmont Zone is conventionally subdivided in the Internal Piedmont Zone (IPZ) and the External Piedmont Zone (EPZ), which recorded metamorphic peak under eclogite-facies and blueschist-facies conditions, respectively. IPZ is a remnant of the Mesozoic Alpine Tethys and consists of meta-ophiolites with thin metasedimentary cover, whereas EPZ consists of minor meta-ophiolites and thick oceanic metasedimentary cover (i.e., the Schistes Lustrès). Both IPZ and EPZ were deformed throughout four regional deformation phases (D1 to D4), which developed different axial plane foliations (S1 to S4). These units are coupled through a first-order polyphasic shear zone, the Susa Shear Zone (SSZ). The SSZ consists of a thick mylonitic zone, wherein two distinct generations of kinematic indicators occur (ME1 and ME2), showing Top-to-E and Top-to-W shear sense, respectively. Each mylonitic event developed a mylonitic foliation (Sm1 and Sm2).
S1 and S2 foliations are almost perpendicular each other at the mesoscale, along D2-related fold hinges in both IPZ and EPZ. These foliations are mostly defined by iso-oriented white mica flakes. Microstructural features reflect the same geometrical relationships as at the mesoscale. S1 likely developed at HP conditions (Ep-eclogite vs. Lws-blueschist facies conditions for IPZ and EPZ, respectively), as suggested by the composition of white mica (i.e. phengite). By contrast, S2 developed at LP conditions (Ep-greenschist facies conditions in both IPZ and EPZ) and is defined by muscovite. White mica defining the mylonitic foliations records a continuous transition from the first to the second tectono-metamorphic event: Sm1 is mostly defined by phengite, while Sm2 is defined by muscovite. The relative chronology inferred from meso- and micro-structural observations suggests that Sm1 was syn- to post-S2, while Sm2 developed later, likely syn-D4.
A new set of radiometric ages have been obtained by *in situ* Ar/Ar dating on white mica, performed at Potsdam University. Different generations of white mica defining S1, S2 and Sm1 foliations in both the IPZ and EPZ and in the SSZ, have been dated. Two main groups of ages have been obtained: S1 foliation developed at ~46-41 Ma in both IPZ and EPZ, while S2 foliation developed at ~40-36 Ma in both the units. The Sm1 mylonitic foliation was nearly coeval with the S2 (~39-36 Ma).
White mica defining the Sm1 mylonitic foliation has higher Si contents compared to that grown coevally outside the shear zone. This feature might suggest different metamorphic conditions for the S2 and Sm1 foliations, with an "anomalous" P increase along the ME1-related shear zone, possibly indicating the development of an overpressure field. Further investigations are still ongoing and alternative hypothesis (e.g. effects of local compositional variations) are also plausible.