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Correlation of in situ measured Ar, Li and B concentrations and isotopic compositions in fluid- and deformation-induced partially recrystallised high pressure rocks

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We investigated zoning of fluid-mobile trace elements and Ar-isotopic information in amphiboles and phengites in partially overprinted eclogite-facies samples from the Western Alpine Sesia-Lanzo zone (SLZ). The samples were taken along a structural profile across a strain- and recrystallisation gradient induced by a km-scale blueschist facies shearzone that separates two tectonometamorphic subunits in the SLZ. The samples were investigated in order to study the fluid flux, recrystallisation mechanisms and associated modification of the trace element content as well as the resetting of the Ar-Isotopic signature in white mica and amphibole.

In all samples phengite and sodic amphibole grains show a significant major element compositional modification concentrated along grain boundaries, cracks and other fluid pathways that is well visible in high contrast back scattered electron (BSE) images and thus allows tracing of the overprinted areas in the mineral grains. Associated with the fluid influx along the retrograde metamorphic path are three different compositional adjustment mechanisms: overgrowth, diffusional equilibration and intra-grain solution-reprecipitation. 40Ar/39Ar ages by in-situ laser ablation as well as trace element concentrations and isotopic compositions were measured in pristine cores and overprinted areas of affected minerals with in situ with laser ablation ICP MS and SIMS at spotsizes between 20 and 100 μm.

Comparison of Li and B concentrations as well as B isotopic compositions in pristine and overprinted areas combined with thermodynamic forward models allow characterization and quantification of the retrograde fluid influxes. which were in the order of $1.4x10^2 m^3 m^{-2}$ in weakly deformed samples and up to $1.8x10^3 m^3 m^{-2}$ in highly strained mylonites.

Depending on strain intensity, deformation mechanism as well as the amount of fluid influx Ar isotopic compositions are reset and show a large scatter in the calculated apparent age determinations. 40Ar/39Ar laser spot ages in the unmodified cores of all samples yielded apparent ages consistently between 84±3 Ma and 87±4 Ma. The calculated ages in the overprinted rims of the weakly deformed samples are between 70±3 and 86±2 suggesting an incomplete isotopic resetting during fluid influx. In contrast, the samples that show an intense deformational overprint associated with a strong mylonitisation of larger mica grains yielded clearly bimodal apparent ages: large mica clasts that are surrounded by the foliation yielded ages around 85±3 Ma, whereas the smaller mylonitic mica have ages around 65±4 Ma. These results suggest a fluid-induced TE and Ar-Isotope resetting in phengitic mica associated with – and controlled by the intensity of – mylonitic deformation and associated fluid fluxes during exhumation and juxtaposition of two tectonometamorphic segments in the SLZ.