$^{40}Ar/^{39}Ar$ and trace element in-situ laser spot analyses from compositionally zoned phengite grains from the Sesia-Lanzo Zone (Western Alps, northwestern Italy)

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We investigated trace element and Ar-isotopic zoning in three metapelitic and two metabasic high-pressure samples from the Sesia-Lanzo zone (SLZ) in the western Alps. The samples were taken from a structural profile across a deformation gradient within a crustal scale, blueschist-facies shear zone that separates two major tectonometamorphic subunits in the SLZ. Our aim was to study the fluid flux and associated modification of the trace-element content and the resetting of the Ar-Isotopic signature within and around a crustal-scale high-pressure shear zone, as well as to constrain the exhumation history of the SLZ rocks. Ar isotopies as well as trace element concentrations were measured in-situ with a laser spot size of 20-100 µm. Phengite and sodic amphibole grains in all samples show a significant modification of major-element composition that is typically concentrated along grain boundaries, cracks and other fluid pathways. The most visible chemical modification in high-contrast back-scattered electron (BSE) images (Fig. 1a) involves an exchange in Mg and Fe2+ in sodic amphibole, and an increase in the celadonite component in phengite. Thermodynamic forward models indicate that the compositional change in amphibole and mica can best be explained by a fluid influx along the retrograde metamorphic path of the samples.

The concentrations of presumably fluid-mobile trace elements, such as Li, Be, B, Sr and Pb differ largely between cores and rims of both minerals and show similar trends in amphibole and mica. Typically, the concentrations of these elements are higher in the cores than in the rims (Fig. 1b). Whereas the trace element concentrations in the cores differ between the samples, rim compositions suggest a trend towards chemical equilibrium among the samples, possibly achieved by a percolating fluid.

$^{40}Ar/^{39}Ar$ laser spot ages in the unmodified cores of all samples yield consistent apparent ages 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 Ma suggesting 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 yield clearly bimodal apparent ages: 85±3 Ma for large mica clasts that are surrounded by the foliation, and 65±4 Ma for smaller mylonitic mica grains. These results suggest a fluid-induced TE and Ar-Isotope resetting in phengitic mica associated with – and controlled by- the intensity of mylonitic deformation during exhumation and juxtaposition of two tectonometamorphic units in the SLZ.

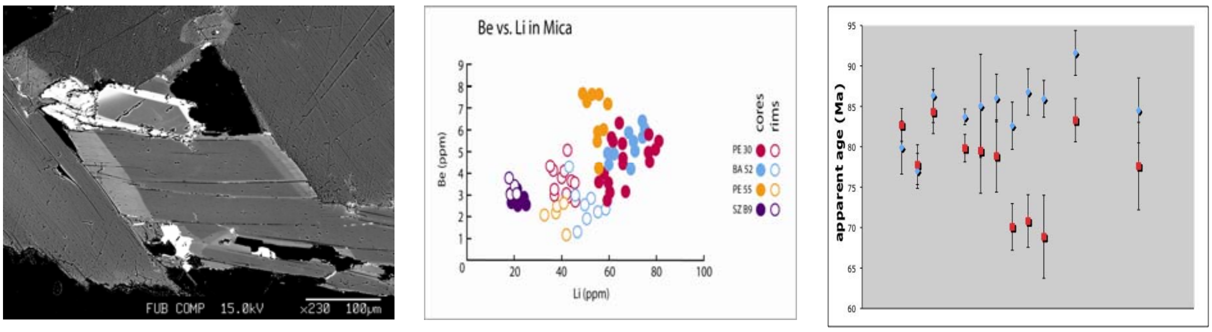

Fig. 1: a)compositionally zoned sodic amphibole and mica grains. b) Trace element core-rim zonation in mica. c) apparent Ar/Ar ages from cores and rims in mica from weakly overprinted SLZ rocks.