Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14772

Petrochronology of metasomatic rocks: insights into metamorphism, fluid flow and deformation during subduction

FRANCESCA PICCOLI[1], PROF. DANIELA RUBATTO[2], LEO J. MILLONIG[3], AXEL GERDES[4], ALBERTO VITALE BROVARONE[5,6,7] AND JÖRG HERMANN[2]

[1]Institute of Geological Sciences, University of Bern

[2]University of Bern

[3]FIERCE (Frankfurt Isotope & Element Research Center), Goethe University Frankfurt

[4]Goethe-Universität Frankfurt, Institut für Geowissenschaften

[5]Sorbonne Université

[6]Institute of Geosciences and Earth Resources, National Research Council of Italy

[7]Alma Mater Studiorum Università di Bologna

Presenting Author: francesca.piccoli@geo.unibe.ch

The investigation of metasomatic rocks associated with serpentinites is key to understanding the interplay between metamorphism, fluid flow and deformation during subduction. We studied different types of metasomatic rocks associated with subducted serpentinites in three metaophiolitic units: metarodingites from the Zermatt-Saas unit, ophicarbonates from the Lanzo Massif, and carbonate veins from the Val Malenco unit.

In chloritized metarodingites from the Zermatt-Saas unit, 2D major and trace element maps show that garnet preserves chemical zonation with decreasing HREE patterns from core to rim, consistent with fractional garnet growth. In situ U-Pb ages of the garnet core and rim overlap at 44-46 Ma. This age result is consistent with relatively fast garnet growth at HP and overlaps with the age of titanite in the same samples. At the outcrop scale the presence of garnet-chlorite veins suggests element mobility during regional scale deformation. Garnet in the veins is resolvably younger, yielding an age of 36-38 Ma, similar to the age of titanite in the same sample. Notably, 2D major and trace element mapping shows that vein garnet is Ti-Fe^{3+} rich and has no decreasing HREE patterns from core to rim. This indicates that, during exhumation, Ti and oxidized Fe were partially mobile in fluids and that REE supply was not transport limited. Therefore, the garnet veins are indicative of at least one major fluid pulsed event during a period of increasing rock permeability.

Perovsike ($CaTiO_3$) is found in metasomatized and deformed ophicarbonate in the Lanzo Massif and in carbonate veins in serpeninites in the Val Malenco. The occurrence of perovskite in metasomatic rocks and metamorphic veins confirms that Ti is mobile in metamorphic fluids under variable P-T conditions. The trace element composition of perovskite broadly reflects the pre-metasomatism bulk composition, indicating limited trace element mobility at the sample scale, despite successive metasomatism and metamorphism. In both localities, the age of perovskite can be linked to specific stages of deformation that favoured fluid circulation.

In conclusion, we show how elemental maps coupled with texturally controlled in situ geochronology are a powerful tool to disentangle complex metamorphic, metasomatic and deformation evolution of subducted rocks.