Fluid-rock interaction and textural changes due to reaction progress during serpentinite dehydration in the Bergell contact aureole (Italian Alps)

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The classic contact metamorphism of the meta-peridotites in the Valmalenco Bergell contact aureole (Northern Italy) offer an excellent possibility to study the textural evolution of olivine and talc as a function of chemistry and metamorphic grade. In parallel, we have studied chemical changes – or lack thereof - associated with the dehydration of serpentine. The rocks of interest ranges from serpentinites crystallized at T < 350°C containing ~13 wt.% H_2O, to forsterite + talc ± anthophylite meta-peridotites (T~ 630°C) with ~2.5 wt.% H_2O. Abundant outcrop in this nearly coherent mantle unit facilitates the study.

Chemical and textural studies reveal that the abundance of talc and forsterite is linked to the primary lithology. We found no clear evidence for major and trace element concentration changes over the metamorphic gradient studied. Variations in Fe^{3+}/Fe^{2+} ratio are large (0.15-3.5), but no systematic correlation with either H_2O content or metamorphic reaction progress was observed. We interpret this to be the result of initial chemical variations, amplified by oceanic alteration.

Forsterite crystal size decreases towards the intrusion. In addition, bladed "jack straw" olivine occurs dominantly at the serpentine breakdown to talc-olivine isograd. Hence, forsterite crystal number increases exponentially approaching the intrusion. Based on similar observations made in other contact aureoles, the change of crystal size and shape appears strongly controlled by the heating rate.

Talc is presented in patches and sub centrimetric veinlets. The talc veins acted as channels for fluid produced by the serpentine breakdown.

The absence of chemical gradients in the aureole suggests that serpentinite dehydration did not result in major element mobility beyond the hand-sample scale, nor did significant redox reactions involving Fe occur, probably because magnetite remained stable. However we highlights the major role of fluids ex-filtration in molding of metamorphic rock textures. Escaping fluid might have contributed to serpentinitization of the peridotites in the far field of the thermal aureole.

Preliminary oxygen isotope measurements for talc and olivine reveal isotopic disequilibrium between talc and forsterite. Hence local equilibrium was not reached, even for product minerals. Further analyses using SIMS are being conducted to investigate this intriguing observation.