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Multiple fluid sources for eclogite-facies veins in the Monviso Massif; implications for subduction zones

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It is widely accepted that metamorphic devolatilisation of subducting slabs produces aqueous fluids that are critical for the transfer of elements from the slab into the mantle wedge. Nonetheless, we currently lack a clear understanding of the mechanisms and pathways of fluid movement through deeply subducted crust. In order to improve our understanding of these processes, we investigate high-pressure veins from the eclogite-facies ($\sim$2.0 GPa and 600 ˚C) Monviso Ophiolite of the Western Alps. Eclogites of Fe-Ti gabbro protolith contain distinctive omphacite-rich veins that formed at, or close to, peak metamorphism (e.g., see Philippot and Selverstone 1991). The investigated veins consist mainly of oscillatory- and sector-zoned omphacite with minor garnet, rutile (up to cm-sized), talc and accessory zircon. In places, talc ($\sim$3000 ppm Ni) may form up to 30% of the veins. Throughout the veins are thin but discrete zones of recrystallised omphacite that contain up to 20 mol% kosmochlor ($NaCrSi_2O_6$) component. Vein garnets are pyrope rich and may have up to four distinct Cr-rich zones (up to 6000 ppm). In some grains these zones form oscillatory and concentric zones. Other garnet grains show highly irregular Cr zoning patterns, which are likely formed by episodic fracturing and fluid infiltration of the garnet. Rutile grains also feature multiple zones with high Cr contents (wt% levels), which can be petrographically correlated to distinct high Cr zones in nearby garnet grains.

We support previous suggestions (e.g., Philippot and Selverstone, 1991) that these veins were largely formed by localized and highly restricted (mm to cm scale) fluid related alteration at high pressures. However, to account for the distinct Cr-, Mg- and Ni-rich mineral zones, we suggest that these veins were subject to episodic infiltration of fluid from neighbouring Mg-rich gabbroic eclogites or serpentinites. This requires

episodic fluid movement over metres to 10s of metres along transient brittle fractures that preferentially form along pre-existing vein structures. Based on our results, we support previous suggestions that deep fluid flow through subducted oceanic crust is likely to be highly channeled and episodic. The progressive development of vein systems in mafic rocks may be crucial for forming channelways for large-scale fluid flow at depth in subduction zones.

Reference:

Philippot, P. & Selverstone. J. (1991) Trace-element-rich brines in eclogitic veins: implications for fluid composition and transport during subduction. Contributions to Mineralogy and Petrology 106, 417-430.