

Rodingitization during Late-Alpine evolution in the Piemonte Zone meta-ophiolites (Aosta Valley, Italian Western Alps): evidence from mineral assemblages and fluid inclusions

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The Bellecombe fine-grained rodingite, a former basaltic dyke, is exposed in the antigorite serpentinite of the Piemonte Zone. The rodingite is characterized by garnet, chlorite, clinopyroxene and vesuvianite and is cut by a network of at least six generations of veins consisting of chlorite, diopside, and grossular-rich garnet (Type I), andradite-grossular garnet + diopside (Type II), andradite garnet + chlorite (Type III), grossular-rich garnet (Type IV), vesuvianite (Type V), and chlorite (Type VI), respectively. Both the rodingite and the veins reveal a tectono-metamorphic history similar to that recognized in the hosting serpentinite and characterized by an earlier HP metamorphism followed by a decompression, with re-equilibration under greenschist-facies conditions, and by a final cooling.

Primary fluid inclusions in vesuvianite from type V veins, and secondary fluid inclusions in andraditic garnet from type III veins reveal that CH₄-H₂ bearing brines (X_{H₂O} = 0.988; X_{H₂} = 0.01 X_{CH₄} = 0.002; salinity 6 wt % CaCl₂ + 6 wt % NaCl) were introduced into the rock during the Late-Alpine evolution at 0.22 GPa and 400°C.

The fluid composition, compatible with the Ca-rich H₂-bearing reducing aqueous solutions present at the serpentinization front, indicates that the growth of vesuvianite in type V veins was promoted by a rodingitisation process, active during a late stage of the Alpine metamorphic evolution, which occurred in the presence of reduced fluids generated through the serpentinization of the metamorphic olivine in the hosting serpentinites. This implies that the Bellecombe rodingites experienced at least two rodingitization events: a first one, which likely occurred during ocean-floor metamorphism, and a second one during late stages of the Alpine tectono-metamorphic evolution.