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I was not born cubic, said low-temperature metamorphic garnet

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Garnet is the paradigmatic cubic mineral of metamorphic and igneous rocks, and is generally regarded as optically isotropic. Nonetheless, evident birefringence is observed, particularly in the rare Ca-Fe^{3+} hydrogarnets, which is attributed to the coexistence of two or more cubic phases. A weak birefringence, with rare examples of optical sector zoning, has also been documented in much more common Fe^{2+}-Mg-Mn garnets, but an adequate explanation for its cause is, so far, lacking.
Here we show that optically anisotropic garnets are much more widespread than previously thought, both in blueschists and blueschist-facies rocks, as well as in lower greenschist-facies phyllites, but they are frequently overlooked when working with conventional, 30-μm-thick thin sections.
Utilizing a multi-technique approach including optical microstructural analysis, BSEM, EMPA, EBSD, FTIR, TEM, EDT and single-crystal XRD, we demonstrate here that the birefringence in these garnets is related to their tetragonal symmetry, that it is not due to strain, and that crystals are twinned according to a merohedral law.
We also show that the birefringent garnets from blueschists and phyllites are anhydrous, lacking any hydrogarnet component, and have compositions dominated by almandine (58-79%) and grossular (19-30%) with variable spessartine (0-21%) and very low pyrope (1-7%).
Considering the widespread occurrence of optically anisotropic OH-free garnets in blueschists and phyllites, their common low-grade metamorphic origin, and the occurrence of optically isotropic garnets with similar Ca-rich almandine composition in higher-grade rocks, we conclude that garnet does not grow with cubic symmetry in low-temperature rocks (< 400 °C). The tetragonal structure appears to be typical of Fe-Ca-rich compositions, with very low Mg contents.
Cubic but optically sector-zoned garnet in a lower amphibolite-facies metapelite from the eastern Alps suggests that preservation of tetragonal garnet is favored in rocks which did not progress to T> $\approx$500 °C, where transition to the cubic form, accompanied by change of stable chemical composition, would take place.
Our data show that the crystal-chemistry of garnet, its thermodynamics and, in turn, its use in unravelling petrogenetic processes in cold metamorphic environments need to be re-assessed.