Trace element zoning in calcic, pelitic garnet: garnet growth histories and Cr immobility

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X-ray composition maps and profiles for major, minor, and trace elements have been made for four calcic metapelitic garnet grains from the Grenville Province of western Labrador, using electron microprobe and laser ablation ICP-MS. Metamorphic grade in the area ranges from greenschist to upper-amphibolite facies. Zoning patterns for Ca, Mg, Mn, and Y are approximately concentric, defining growth-zoning profiles that were slightly modified by diffusional homogenization at the metamorphic peak. The zoning pattern for Cr, in contrast to those for all other elements, displays zoning patterns parallel to inclusion trails of the garnets, indicating that the garnet overprinted a fabric defined by Cr-rich (chlorite ± muscovite ± epidote ± graphite) and Cr-poor (quartz ± plagioclase) layers *(overprint zoning)*. Garnet porphyroblasts from upper amphibolite facies show a textural unconformity defined by inclusion-free rims, which coincides with changes in the garnet composition for both major and trace elements, including Cr. The textural unconformity inferred to represent a change in the garnet-forming reaction, possibly also associated with a reduction in the growth rate of the garnet. Preservation of original Cr variations within the garnet demonstrates that diffusion of Cr was significantly slower than for the other elements, both during garnet growth and subsequent diffusional re-equilibration. This study explains previously observed non-systematic Cr zoning in metamorphic garnet and irregular partitioning of Cr between co-existing metamorphic mineral pairs. The Cr overprint zoning potentially offers an alternative way to interpret the microstructural history of complexly deformed samples in which garnet growth occurred under greenschist and/or amphibolite facies conditions.

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