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ELECTRONIC ARTICLE

The origin of Mn and Y annuli in garnet and the thermal dependence of P in garnet and Y in apatite in calc-pelite and pelite, Gagnon terrane, western Labrador

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ABSTRACT

X-ray compositional maps and zoning profiles for major and trace elements have been measured in garnet, apatite and epidote-group minerals from calc-pelitic and pelitic schists from western Labrador, by electron microprobe and by laser ablation ICP-MS. High Y abundance in apatite adjacent to resorbed garnet and a decreasing modal abundance of apatite with garnet growth indicate that apatite participates in major rock-forming mineral reactions. Phosphorus concentration in garnet porphyroblasts coexisting with apatite decreases smoothly from core to rim and depends moderately on metamorphic grade. Apatite coexisting with xenotime shows high-Y cores and the concentration of Y in apatite increases with metamorphic grade.

Many of the analyzed garnet porphyroblasts exhibit Y annuli which provide information about different physicochemical processes operating during garnet growth. We describe criteria to fingerprint three of these processes in the analyzed garnets. (1) Yttrium annuli produced by *garnet resorption and regrowth* are characterized by an asymmetric shape with a steeper slope on the inner side of the annulus and by a decoupled variation between garnet-compatible and garnet-incompatible elements at the resorption margin. (2) Y annuli produced by *breakdown of Y- and REE-rich trace phases* such as xenotime, monazite, apatite and epidote-group minerals are indicated by REE peaks in LREE (monazite, allanite), MREE (epidote), or HREE (xenotime, zircon). (3) Y annuli associated with *diffusion-controlled growth* occur in garnet with oscillatory textural zoning defined by alternating inclusion-rich and inclusion-poor zones, with increases in concentrations of garnet-compatible elements such as Y and HREE correlating with inclusion-free zones. Mn annuli in some garnets were produced by sporadic local breakdown of Mn-rich epidote and in several cases indicate that thin-section scale equilibrium during annulus formation was not achieved, raising questions concerning the use of Mn concentration as a time marker in garnet growth modeling.

* This article is designed to be read on a computer with internet access. The full text of the article can be obtained in pdf format at http://gmr.minsocam.org/Papers/v4/v4n1/v4n1abs.html.

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