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Composition of Lens Form Ca-Al silicates in Biotite from Granitic Rocks of the Canadian Appalachians

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A particular feature of biotite grains from some of the Canadian Appalachian granitic rocks in New Brunswick and Newfoundland is the presence of lenses of Ca-Al silicates developed along cleavage planes. These from the more to less common are prehnite, pumpellyite and grandite garnet, an intermediate composition between andradite and grossular. The rocks containing these secondary Ca-Al silicates range in composition from biotite-muscovite to biotite granite/granodiorite and biotite-hornblende tonalite and granite to hornblende-biotite quartz diorite, diorite and biotite-hornblende/pyroxene gabbro. Textures exhibited by these rocks are generally defined as either foliated or non-foliated.

The Ca-Al silicates can be found exclusively within non-to-partly altered biotite characteristically forms colorless lenticular patches of moderate relief accommodated within the cleavages of biotite. They display a habit of lens form parallel to the host biotite cleavage that might or might not be deformed. Rarely all three minerals can be observed together in one single biotite grain.

Chemical composition of 44 prehnite, pumpellyite and garnet and their host biotites were determined by wavelength-dispersive X-ray spectrometry method using electron microprobe. The results show that Al2O3 contents of prehnite vary from 17.52 to 24.55 and Fe2O3 from 2.38 to 8.88 wt. %, which can be reflected in a substantial and variable substitution of Fe for Al. Furthermore, a fairly positive correlation of MnO values of both prehnite and host biotite may indicate the role of biotite replacement by prehnite. Fe2O3 content in nine analyzed pumpellyite samples varies between 10 and 23 wt%.

There has been a debate on the origin of these secondary Ca-Al silicates that typically occur as lenses parallel to the cleavages of biotite. Two main ideas have been generally presented so far. One idea considers the growth of prehnite within the biotite as a secondary process without replacing its host biotite (Moore 1976 and Freiberger et al. 1998). The other idea considers the occurrence of prehnite within the biotite as result of replacement of biotite (e.g. Tulloch 1979). Therefore, it is not easy to determine whether the occurrence of Ca-Al silicates within biotite of the Canadian Appalachian granitic rocks caused during successive cooling of a pluton or after the cooling of a pluton during a later or a secondary hydrothermal overprint or during a later separate metamorphic phase with its own P-T-time regime. The latter possibility might also be applicable since regional deformation and metamorphism have affected the Canadian Appalachian rocks at the Silurian (e.g. Cawood et al. 1994). In addition, the Fe2O3 contents of pumpellyite, as mentioned earlier, are more than 10 wt% indicating zeolite and prehnite-pumpellyite facies conditions (Schiffman and Liou 1983).

Keywords: prehnite, pumpellyite, garnet, biotite, Appalachian orogen

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