Re-examination of the origin of quartz-augen schist in light of recent investigations at the Brunswick No. 12 sulphide deposit, Bathurst base-metal camp, Bathurst, New Brunswick

D.R. Lentz

Geological Survey of Canada, P.O. Box 50, Bathurst, New Brunswick E2A 3Z1, Canada

W.D. Goodfellow

Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8, Canada

and

S.J. Juras

Westmine Resources Limited, Myra Falls, P.O. Box 8000, Campbell River, British Columbia V9W 5E2, Canada

It has long been established that there is a common association between the occurrence of quartz porphyroidal rocks and massive sulphide deposits in felsic volcanic sequences. However, there has been some controversy over the origin of the quartz augen and their metallogenic significance, based primarily on textural evidence from numerous deposits including those in the Bathurst base-metal Camp. The quartz augen have been interpreted either as relic phenocrysts in deformed and metamorphosed felsic pyroclastic rocks or as porphyroblasts formed during the greenschist-grade regional metamorphic event that was associated with intense regional deformation.

For the most part, the felsic pyroclastic rocks occurring stratigraphically beneath the "Brunswick horizon" massive sulphides and laterally-equivalent Algoma-type iron formation were originally quartz- and feldspar-rich crystal tuffs. There is overwhelming evidence for a volcanic origin of quartz including vitreous (black) quartz, betaform quartz (dipyramidal, β quartz/high quartz), quartz crystal shards, and embayed quartz. However, the occurrence of quartz-only crystal tuffs is problematic because feldspar generally precedes quartz as a liquidus phase and should therefore be present in porphyritic volcanic rocks. The absence of feldspar in the fine- to coarse-grained quartz-augen schists (QAS) may be attributed to subaerial feldspar weathering, which is supported by sedimentological features and the regional extent of the QAS in the Bathurst Camp. Within the vicinity of the Brunswick No. 6 and 12 deposits however, the similarity in textures, immobile-element contents, and compositional homogeneity between QFAS and the QAS units does not support extensive feldspar weathering. Alternatively, protolysis and hydrolysis submarine hydrothermal alteration reactions associated with exhalative ore-forming processes, proposed originally in 1974, could account for the breakdown of alkali feldspar phenocrysts.

The contact between QAS and quartz-feldspar augen schists (QFAS) may be quite sharp (<20 cm) to gradational (>5 m). In general, the size of the quartz augen in QAS is commonly 1 to 2 mm smaller than the quartz augen in QFAS whereas feldspar in the latter are slightly larger than quartz. Numerous phenocrysts have variably developed fine-grained mica-quartz beards that have mineralogical and textural attributes similar to the those in pull apart structures. The S_1 and S_2 fabrics are usually more pronounced in the QAS by virtue of the higher mica content and absence of feldspars. The strong fabric development may, in part, be responsible for the apparent finer grain size in the QAS due to cataclastic fragmentation of the phenocrysts. Coarse-grained turbid alkali feldspar and quartz phenocrysts hosted in a very fine-grained matrix of sericite, chlorite (brown birefringence), albite, and opaques represent the least-altered, crystal-rich tuffs (QFAS). The weakly to moderately altered rocks consist of cryptic pseudomorphic replacements of quartz, albite, and lesser proportions of mica after alkali feldspar. The transition zone between the QFAS and QAS is identified macroscopically by micaceous and siliceous veinlets within the pseudomorphically replaced alkali feldspar phenocrysts. Within the QAS, the alkali feldspar phenocrysts are totally replaced by quartz, sericite, and chlorite and resemble milky quartz augen in hand specimen. Therefore, the confusion resulting from the occurrence of augen-shaped seriate aggregates of quartz and mica with coarse-grained, subrounded to angular vitreous quartz is a result of submarine hydrothermal alteration of alkali feldspar and is not due to the porphyroblastic growth of quartz. The occurrence of milky quartz-augen pseudomorphs with vitreous volcanic quartz may be used as evidence of submarine hydrothermal alteration and could explain the association of QAS with felsic volcanic-hosted massive sulphide deposits.