
Carbonic fluid inclusions in the Greendale (Nova Scotia) and Lac Des Iles (Ontario) complexes: constraints on mafic pegmatite crystallization and platinum-group element (PGE) mineralization

EVAN GLADNEY AND JACOB HANLEY

Mineral Exploration and Ore Fluids Laboratory, Department of Geology, Saint Mary's University, 923 Robie Street, Halifax, Nova Scotia B3H 3C3, Canada <egladney@eastlink.ca>

The study constrains the conditions of mafic pegmatite formation in the Lac Des Iles (LDI) and Greendale (GC) complexes leading to better understanding the processes responsible for precipitation and redistribution of associated platinum-group elements. The main ore zone at LDI, Roby Zone, is hosted in gabbro, with high-grade PGE mineralization occurring in gabbro pegmatite dikes (up to 37ppm Pt + Pd + Au). The GC in Nova Scotia consists of porphyritic hornblende gabbro and diorite, with minor gabbroic pegmatite composed of actinolite, plagioclase (oligoclase–andesine), and quartz. PGE mineralization in the GC is sub-economic and contains grains of Pt-Sb (genkinite) hosted in pyrite and pyrrhotite in pegmatite. Intercumulus quartz at LDI hosts primary and pseudo-secondary assemblages of pure CO₂ inclusions and secondary, late aqueous fluid inclusions. The GC quartz hosts primary, pure CH₄ inclusions and secondary, late aqueous inclusions. Microthermometric measurements showed that carbonic fluid inclusions in the coarse-grained LDI pegmatitic quartz homogenize to liquid, vapor, or by supercritical behavior. Carbonic fluid inclusions from the fine-grained LDI pegmatitic quartz homogenize only to liquid. Methane fluid inclusions from the Greendale complex homogenize either to liquid, or rarely by supercritical homogenization. A variety of thermobarometers were used in conjunction with microthermometrically derived carbonic fluid isochores to obtain pressure-temperature conditions of pegmatite formation. Quartz hosting the inclusions at LDI crystallized between ~550 and 630 °C, with pressure varying between 460 and 1660 bars. Quartz hosting the inclusions at GC crystallized at very similar temperature between ~510 °C and 550 °C, with pressure varying between 470 and 1930 bars. The results indicate that (i) the primary fluid involved in pegmatite formation in both locations were not aqueous but anhydrous carbonic in composition; (ii) CO₂ and CH₄ entrapment at both LDI and GC occurred over a similar and relatively large range in pressure, consistent with the transition from lithostatic to near hydrostatic conditions.