A Low F Pegmatite-Related Mo Skarn from the Southwestern Grenville Province, Ontario, Canada: Phase Equilibria and Petrogenetic Implications

D. R. LENTZ,†

Department of Geology, University of New Brunswick, Fredericton, New Brunswick, Canada E3B 5A3

AND K. SUZUKI

Institute for Geothermal Sciences, Kyoto University, Noguchibaru, Beppa, Oita, Japan 874-0903

Abstract

The Hunt Mo skarn deposit is one of the best examples of a late tectonic, granitic pegmatite-related, skarn system in the Grenville province. An Re-Os age of 1069 ± 11 Ma was obtained from a molybdenite crystal (6.4 ppm Re) hosted in proximal skarn (sample 50O) consistent with a contact metasomatic origin related to the granitic body. Although less evolved than other Grenvillian pegmatites, the Condon Lake granitic pegmatite is a low-temperature, A-type intrusion, with moderate redox characteristics. In contrast to many Mo-bearing skarns in the region, this deposit has low U, Th, REE, F, and P contents. The reduced marginal magnesian skarn is well zoned geochemically, mineralogically, and texturally from the contact outward into the dominant graphite-bearing calc-silicate-calcite-dolomite marble, which is locally intercalated with clinopyroxenite, orthoamphibolite, and pyroxene-biotite quartzofeldspathic gneiss. A narrow zone of endoskarn (<1 m; scapolite-K feldspar-Ca clinopyroxene) and wider, zoned exoskarn (<10 m; scapolite-Ca clinopyroxene (proximal), Ca clinopyroxene-phlogopite, Ca clinopyroxene-tremolite-phlogopite, tremolite-phlogopite (distal), marble), which hosts the bulk of the primary molybdenite (± pyrrhotite) and minor secondary pyrite-pyrrhotite-molybdenite veins. In addition to the obvious Si, Fe, Ti, Mn, S, and Mo addition, Cu, Zn, Y, Nb, and Zr are also slightly enriched. The high $f_{(H2O)}/f_{(HF)}$ ratios (138,000-204,000) and moderate $f_{(H2O)}/f_{(HF)}$ ratios (2,200-1,000) at the Hunt deposit contrast with the lower fugacity ratios from other Mo-bearing U-Th-REE skarns in the region, indicating that Mo transport and deposition is principally related to a hydroxide complex.

The calc-silicate phase equilibria used to describe the zonation sequence have been reinterpreted using quartz-undersaturated (silica) activities; this shifts the calc-silicate-forming reaction boundaries to very low $X_{(CO2)}$ (<0.005), consistent with decarbonation reactions induced via dissolved silica infiltration. The modeled fluid/rock in the skarn based on dissolved molybdenum is greater than 20. The carbon and oxygen isotopes of calcite are consistent with infiltrative metasomatic skarns from the pegmatite and a dominantly igneous source for the sulfur ($\delta^{34}S$ = 2-9‰). Overall, the deposition of Mo is probably facilitated by a reaction with carbonate (increase in $Ca(OH)_2$, $CaCl_2$ resulting in complex destabilization), a decrease in f_{O_2}

triggering an increase H_2S/SO_2, S in the host rocks (fS_2), and a slight decrease in temperature (650°-500°C).