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Chlorite Chemistry of the New Afton Alkalic Porphyry Cu-Au-(Pd) Deposit, Canada

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This study delves into the chemical and textural characteristics of chlorite, serving as an initial step toward its potential application as a vectoring tool in alkalic porphyry deposits. Chlorite is ubiquitous, both in the proximal and peripheral alteration zones of the New Afton orebody, occurring in two distinct domains: Chlorite-R, resulting from chloritization of biotite, actinolite, and ferromagnesian phenocrysts, characterized by numerous inclusions, predominantly Ti oxides; and Chlorite-V, found as veinlet infillings, often associated with late-stage chalcopyrite, bornite, specularite, and Co-Ni-rich pyrite. Analysis of major and trace elements from Chlorite-R reveals that its composition mirrors that of precursor minerals, with partial contamination by inclusions, particularly tiny rutile grains contributing to high Ti content. Conversely, Chlorite-V compositions exhibit a distinct and systematic depletion of chalcophile elements, consistent with co-precipitation with sulfides. Moreover, temperature estimations range from ~210° to ~260°C for Chlorite-R and from ~250° to ~330°C for Chlorite-V. These constraints on temperature formation align with a Cu-Au-Pd mineralization pulse in New Afton, resembling other alkalic porphyry deposits in the region. Furthermore, previous studies have proposed that the presence of Co-Ni-rich pyrite serves as an indicator of PGE enrichment in New Afton. Similarly, Chlorite-R compositions exhibit significant enrichment in Ni and Co relative to chlorite from other porphyry deposits, whereas Chlorite-V is depleted in these elements, reflecting its co-precipitation with copper sulfides. Nonetheless, the presence of Co and Ni in chlorite holds promise for exploring PGE-bearing porphyry systems. The coexistence of both chlorite domains in several samples highlights the necessity for comprehensive textural characterization before delving into trace element analysis, thus accentuating the complexity of mineralization processes in alkalic porphyry deposits. Although the prevalence of multiple chlorite generations in these deposits offers potential for temperature estimation, exercising caution is essential to ensure accurate geological interpretations.