

Cryptic, Lithology-Controlled Alteration Revealed Using pXRF–SWIR Data in the Bermingham Area, Keno Hill Ag–Pb–Zn District, Yukon

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The Keno Hill Ag–Pb–Zn district (Yukon, Canada) is a structurally controlled, narrow-vein system where alteration remains poorly constrained and is not widely used as an exploration vector. This study investigates hydrothermal alteration in the Bermingham area through integrated portable X-ray fluorescence (pXRF) and shortwave infrared (SWIR) spectroscopy, focusing on transects proximal to a well-mineralized vein. pXRF data were matrix-corrected using calibration curves and supported by a subset of whole-rock geochemical analyses, while SWIR data were used to characterize variations in white mica and chlorite chemistry.

Quartzites do not exhibit detectable, laterally extensive alteration; however, graphitic schists and greenstone sills display subtle to pronounced geochemical gradients extending up to ~100–150 m within the studied transect. These gradients are characterized by Na and Ca depletion and localized K enrichment, consistent with sericitization of plagioclase. The expression of alteration is lithology-dependent, with Na depletion dominating in graphitic schists and Ca depletion more pronounced in greenstones. In greenstone sills, these trends are accompanied by systematic variations in Ca/Mg and Mn/Fe ratios, likely reflecting changing proportions of plagioclase, chlorite, and carbonate during fluid–rock interaction. In contrast, ore-related pathfinder elements do not exhibit laterally extensive halos in the wall rock.

These results indicate that alteration at Keno Hill is cryptic and strongly lithology-dependent. The spatial decoupling between alteration signatures and ore-related pathfinder elements suggests that fluid–rock interaction may have occurred over a broader footprint than metal deposition, and potentially during multiple fluid events. These results highlight that alteration halos in structurally controlled vein systems can be cryptic and lithology-dependent, and may not be readily apparent without detailed geochemical analysis. Ongoing work aims to further quantify these patterns and assess their applicability as exploration vectors.