Chapter 7

New Advances in Detecting the Distal Geochemical Footprints of Porphyry Systems—Epidote Mineral Chemistry as a Tool for Vectoring and Fertility Assessments

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Abstract

Propylitic alteration halos to porphyry deposits are characterized by low- to moderate-intensity replacements of primary feldspars and mafic minerals by epidote, chlorite, calcite ± actinolite, pyrite, prehnite, and zeolites. The pyrite halo that surrounds porphyry deposits typically extends part way through the propylitic halo and provides strong responses to conventional geochemical and geophysical exploration techniques. When exploring outside of the pyrite halo, porphyry deposits have proven to be difficult to detect based simply on the presence of weak epidote-chlorite alteration.

Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) analyses of epidote from propylitic alteration zones around porphyry and skarn deposits in the central Baguio district, Philippines, have shown that low-level hypogene geochemical dispersion halos can be detected at considerably greater distances than can be achieved by conventional rock chip sampling of altered rocks. Epidote chemistry can provide vectoring information to the deposit center and potentially provides insights into the potential metal endowment of the porphyry system, providing explorers with both vectoring and fertility assessment tools.

Epidote chemistry varies with respect to distance from porphyry deposit centers, with the highest concentrations of proximal pathfinder elements (e.g., Cu, Mo, Au, Sn) detected in epidote from close to the potassic alteration zone. Distal pathfinder elements (e.g., As, Sb, Pb, Zn, Mn) are most enriched in epidote more than 1.5 km from the deposit center. Rare earth elements and Zr are most enriched in epidote from the edge of the pyrite halo. The lateral zonation in epidote chemistry implies that at Baguio the geochemical dispersion patterns were produced by lateral outflow of spent fluids from the porphyry center, rather than from ingress of peripheral, nonmagmatic waters.

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