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Porphyry Cu-Mo mineralization at Anabama Hill, Delamerian Orogen, South Australia: Fertility assessment implied from epidote and chlorite chemistry

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Abstract

Porphyry-style hydrothermal alteration has long been recognized in the Delamerian Orogen, Southeastern Australia. However, the fertility of porphyry prospects in this belt, including the Anabama Hill, remains elusive, due to intermittent exploration activities and sparse exposure. Recent significant discoveries of porphyry-epithermal Cu-Au deposits in the adjacent Stavely Arc have led to renewed exploration interest. Reinvestigation of the Anabama Hill drill cores highlights that K-feldspar-rich and epidote-chlorite-dominated alterations are superimposed by extensive quartz-pyrite±chalcopyrite± molybdenite veins with white mica-quartz selvedges, related to early-middle Ordovician granitic stocks. Granodiorite and diorite hosts have diagnostic geochemical characteristics, including high Sr/Y, V/Sc ratios, and listric-shaped REE trends, implying amphibole-leading fractionation due to high water contents in primitive melts. LA-ICP-MS analyses show that characteristic element compositions, e.g., high Fe, Sr, Pb, U, and Bi and low Mg and REEs in the Anabama Hill epidote, and high Mn, Zn, Zr, and U and low Ca, Ba, and Pb in the chlorite, suggest the two minerals resulting from propylitic alteration rather than metamorphism. Compared to well-mineralized porphyry deposits, the epidote shows high Bi, Cu, Sr, Ti, Zr, and U, and the chlorite is high in Ti/Sr and Al/Si ratios, implying that they are most likely deposit-proximal or near a heat center. This is supported by intermediate to high temperatures of 200–420 °C calculated by chlorite geothermometer. Propylitic epidote and chlorite outside pyrite halos typically define geochemical shoulders by anomalous As-Sb and Mn-Zn highs, 1–1.5 km away from the mineralized centers. Given that most of the epidote and chlorite are intergrown with sulfides, their close proximity to a likely mineralized center accounts for low to moderate concentrations of distal pathfinder elements and subdued performances on the As-Sb and Mn-Zn fertility plots. Combined with bulk-rock results, proximal-fertility indicators recorded in epidote and chlorite provide encouraging implications for porphyry exploration in the Delamerian belt.

Keywords: Porphyry mineralization, epidote, chlorite, fertility assessment, Delamerian Orogen