

The Implications of Bornite Occurrence to Porphyry Cu-Au Deposits and Exploration

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Porphyry deposits are known to have ore mineral zonation from a bornite-bearing core outwards to chalcopyrite and then pyrite. But do all porphyry deposits contain bornite, and should an exploration project pursue a bornite-bearing core? This contribution attempts to examine the correlation between bornite occurrence and the metal endowment and Cu-Au grades of porphyry deposits, mainly based on the database of Singer et al (2008) that contains 690 porphyry deposits. Among the 422 deposits with estimated resources, 288 deposits (~68%) contain bornite, while the remaining deposits (~32%) do not. Bornite-bearing porphyries are generally larger than bornite-free porphyries, in terms of tonnage (median 300 vs. 140 Mt; average 919 vs 386 Mt; largest 21,277 vs 6,470 Mt), contained Cu metal (median 1.3 vs 0.6 Mt; average 5.1 vs 1.7 Mt; largest 129 vs 34 Mt), and less differently, contained Au (median 53 vs 37 t; average 196 vs 114 t; largest 4,786 vs 2,250 t). Copper grades are nearly identical between the two groups (median 0.44% vs. 0.43%; average 0.48 vs 0.48%; highest 1.8 vs 1.8%), while Au grades are, in general, lower in the bornite-bearing group, but with exceptions (median 0.20 vs. 0.30 g/t; average 0.26 vs 0.33 g/t; highest 1.3 vs 1.0 g/t). Median Cu/Au grade ratios (Cu in % and Au in g/t) are higher for bornite-bearing deposits (2.44 vs. 2.08, excluding Cu-free porphyries). Among the 340 Cu porphyries (mole Cu/Au >40,000, or Cu%/Au-ppm >1.29), 67% of them (n=229) contain bornite, whereas 72% of the 59 Au porphyries contain bornite. In summary, bornite occurs in most porphyry deposits (about two-thirds), and bornite-bearing porphyries contain overall much more Cu and more Au with higher Cu/Au ratios than bornite-free porphyries, although the Cu grades of the former are similar, while the Au grades are lower than porphyry deposits without bornite.