

# Porphyry Copper Deposit Density

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## Abstract

Estimating numbers of undiscovered mineral deposits has been a source of unease among economic geologists yet is a fundamental task in considering future supplies of resources. Estimates can be based on frequencies of deposits per unit of permissive area in control areas around the world in the same way that grade and tonnage frequencies are models of sizes and qualities of undiscovered deposits. To prevent biased estimates it is critical that, for a particular deposit type, these deposit density models be internally consistent with descriptive and grade and tonnage models of the same type. In this analysis only deposits and prospects that are likely to be included in future grade and tonnage models are employed, and deposits that have mineralization or alteration separated by less than an arbitrary but consistent distance—2 km for porphyry copper deposits—are combined into one deposit. Only 286 deposits and prospects that have more than half of the deposit not covered by postmineral rocks, sediments, or ice were counted.

Nineteen control areas were selected and outlined along borders of hosting magmatic arc terranes based on three main features: (1) extensive exploration for porphyry copper deposits, (2) definable geologic settings of the porphyry copper deposits in island and continental volcanic-arc subduction-boundary zones, and (3) diversity of epochs of porphyry copper deposit formation.

Porphyry copper deposit densities vary from 2 to 128 deposits per 100,000 km<sup>2</sup> of exposed permissive rock, and the density histogram is skewed to high values. Ninety percent of the control areas have densities of four or more deposits, 50 percent have densities of 15 or more deposits, and 10 percent have densities of 35 or more deposits per 100,000 km<sup>2</sup>. Deposit density is not related to age or depth of emplacement. Porphyry copper deposit density is inversely related to the exposed area of permissive rock. The linear regression line and confidence limits constructed with the 19 control areas can be used to estimate the number of undiscovered deposits, given the size of a permissive area. In an example of the use of the equations, we estimate a 90 percent chance of at least four, a 50 percent chance of at least 11, and a 10 percent chance of at least 34 undiscovered porphyry copper deposits in the exposed parts of the Andean belt of Antarctica, which has no known deposits in a permissive area of about 76,000 km<sup>2</sup>. Measures of densities of deposits presented here allow rather simple yet robust estimation of the number of undiscovered porphyry copper deposits in exposed or covered permissive terranes.

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