Paper Number: 5490

Hydrothermal Fluid Evolution in Porphyry-Type Ore Deposits: Evidence from fluid inclusions, cathodoluminescence, and trace elements in quartz

Rusk, B. [1]

[1] Western Washington University, Bellingham, Washington 8225

Quartz cathodoluminescent (CL) textures in porphyry-Cu (Mo-Au) deposits relate vein minerals, alteration minerals, and fluid inclusions to specific vein forming events. Porphyry-type deposits from around the world are characterized by a consistent pattern of CL textures and quartz trace elements that, when combined with fluid inclusion analysis, demonstrate the progressive changes in the pressure and temperature conditions of the hydrothermal system. Here, we combine CL analysis, quartz trace elements, and fluid inclusion microthermometry to infer the pressure-temperature evolution typical of porphyry-Cu (Mo-Au) deposits.

Taken together, combined fluid inclusion, quartz trace element, and CL textural data demonstrate that magmas exsolve fluids at pressures between ~1.5 and 3 kbars and 650°-750°C. Such P and T conditions are reflected in early quartz-rich veins with potassic alteration. These fluids cool and depressurize along different paths leading to variations amongst deposits. These fluids are metal rich and precipitate copper after unmixing and cooling at hydrostatic pressures and high temperatures. As the fluids cool further under dominantly hydrostatic pressure, later quartz-sericite-pyrite veins form at temperatures between 300° and 400°C and pressures between 300 and 800 bars. Later, epithermal mineralization occurs at subsequently lower pressures and temperatures. The fluid inclusions observed and the metals precipitated depend upon the specific P-T path taken by the fluid, as does the potential for epithermal mineralization.