

The Nature and Timing of Magmatic-Hydrothermal Mineralizing Fluid Flow in the Globe-Miami Porphyry District, Arizona, USA

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Porphyry Cu deposits form from magmatic-hydrothermal fluids generated by large magmatic systems. Although extensively studied, the timescales over which sufficient volumes of mineralizing fluids are extracted from magma source regions and focused into narrow, shallow zones of mineralization remain poorly understood. Key questions remain as to how sufficient volumes of ore-forming fluids are released from parent magmas, focused into the deposit-forming environment, and over what timescales this occurs. To address this, we integrate the results of field, micro-textural and high-precision geochronological studies of the Globe-Miami District, Arizona, USA, where multiple depth slices through the porphyry systems can be observed down to ~10 km deep root zones in the Schultze granite.

We show that mineralization at Resolution, Pinto Valley, Diamond H and Copper Cities occurred over a period of ~1.3 Myrs, from ~65.1-63.8 Ma, coincident with the age of porphyry dikes at Pinto Valley and Copper Cities (~64.5 Ma and ~64.1 Ma), but predating the relatively rapid (<600 kyr) emplacement of the Schultze Granite (from ~62.6 Ma). The latter is associated with ~1.1 Myrs (~62.6-61.5 Ma) of hydrothermal mineralization at Miami, Ocelot and Old Dominion. The exposed Schultze Granite root zone contains aplitic porphyry dikes that capture the magmatic-hydrothermal transition (containing miarolitic cavities, USTs, intermixed aplite-quartz segregations and DQ-type veins). Quartz in the aplitic groundmass of these dikes is wormy and geochemically indistinguishable from high temperature (>600°C) DQ-type quartz veins, and distinctly different from Cu-mineralized quartz veins (<~600°C) within the porphyry deposits. 3D micro-CT scanning of this wormy aplitic groundmass shows that 93% of the quartz is interconnected. We suggest this may represent paleo-porosity within the dikes, which were once a permeable magmatic crystal mush of feldspar and quartz, and that this explains the longevity of magmatic-hydrothermal fluid flow compared to magmatic emplacement.