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Immiscibility and Continuous Felsic Melt-Fluid Evolution within the Rio Blanco Porphyry System, Chile: Evidence from Inclusions in Magmatic Quartz

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Abstract

The 5.2 to 3.9 Ma late porphyries at Rio Blanco are spatially associated with hydrothermal tourmaline-cemented breccias and a significant Cu-Mo deposit. Magmatic inclusions in quartz from these rocks are used to better understand late-stage magmatic processes, particularly those involving melt-melt and melt-fluid immiscibility. Inclusions are represented by glass of common rhyolitic composition (hereafter, type 1), crystallized volatile-rich felsic melt (type 2), H_2O- and salt-rich fluids, and microphenocrysts. Coexistence of types 1 and 2 material within the same growth plane, and within a single inclusion, suggests that crystallizing rhyolitic magma separated into two silicate melts (volatile-poor and volatile-rich). The volatile-rich silicate melt had a prolonged evolution, extending below the solidus of volatile-poor silicate melt, with a progressive reduction of the silicate/volatile ratio, and ultimately to highly saline fluids. The latter may have been the source of hydrothermal fluids that had the potential to transport metals. The occurrence of immiscibility in the Rio Blanco rhyolites may be in some ways comparable to that in volatile-rich pegmatites and strongly suggests that this process may be common in otherwise normal felsic magmas and important in the origin of mineralized porphyries.