New Insights for the Porphyry Model from Complex Overprinted Porphyry Systems

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Within the porphyry system a transition zones exists in the region between the deep potassic core and shallow epithermal environment. Complex and variable alteration assemblages of overprinting white micas and clays may occur in this region as a result of variations in fluid pH and temperature, fluid to rock ratio, and lithology. Assemblages may be synchronous or temporally distinct, grade additive or grade destructive. This complexity presents challenges to both explorers and miners.

The spatial and temporal distribution of minerals, and their compositional variation, in the transition zone have been explored though five detailed case studies at Northparkes (Australia), Resolution (USA), Tujuh Bukit (Indonesia), Spence and Encuentro (Chile). Geological logging, petrography, whole rock geochemistry, hyperspectral and mineral chemistry (by EMPA, SEM and LA-ICP-MS) datasets were collected at each deposit during the project. Based on these case studies, three new models for weak, moderate and strong alteration overprints are presented.

Our observations have important implications for the porphyry genetic model and provide new insights to aid exploration, including vertical and lateral alteration vectors. Mineral chemistry studies (specifically looking at white mica and pyrite) have enabled a greater understanding of trace element deportment that enhances our interpretations of whole rock geochemistry data and provides a new frame of reference for levels of anomalism. These datasets reveal consistent patterns in chemical zonation between regions and degrees of overprint. Whilst the absolute concentrations may vary, we observe that the same patterns are repeated. Mapping of mineral species and their abundance has also generated new mineral maps for different degrees of porphyry overprint that provide a foundation framework for ore body knowledge studies in complex porphyry systems.