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Contribution of mafic magma and surrounding wall rock to Cu-Mo-Au and Se-Te-Re mineralization in porphyry-type ore deposits: Insights from Dexing

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Porphyry Cu systems represent important resources of Cu-Mo-Au and critical Se-Te-Re. Recent investigations have highlighted the contribution of mafic magmas and surrounding country rocks to porphyry systems, but the roles of mafic injections and wall rock assimilation in the formation of porphyry-type Cu-Mo-Au and Se-Te-Re deposits remain unclear. Dexing was selected to study these processes because of existing evidence for mafic injections and assimilation of metapelites, it is the largest porphyry Cu-Mo-Au deposit in China, and it hosts considerable Se-Te-Re resources.

Petrographic observations performed on 113 drill core samples show that mafic porphyry magma was injected into more evolved feldspar porphyry magma, and that the mixed porphyry magmas assimilated surrounding metapelites, prior to/during mineralization. Whole rock analyses confirm that both magmas evolved through fractional crystallization. The injection of hotter fractionating mafic porphyry magma into cooler fractionating feldspar porphyry magma, might have contributed to enhance the assimilation of surrounding metapelites, leading to cooling and fractional crystallization of the hybrid magma.

At Dexing, the S-Cu-Au appears to have originated from the mafic porphyry magma. The concentrations of S-Cu-Au are highest in mafic porphyry and decrease during mixing with feldspar porphyry magma. Molybdenum, Re, and Se reach highest but similar concentrations in feldspar porphyries and metapelites, but are not systematically enriched in most evolved feldspar porphyries, suggesting that Mo and Re might have been enriched through the combination of fractional crystallization and assimilation of metapelites. Although the concentration of Te is relatively high in metapelites, it is more enriched in mafic- and mixed mafic-feldspar porphyries over feldspar porphyries, and thus appears to have originated, at least in part, from the mafic magma.

A model for the genesis of porphyry Cu-Au-Mo deposits with Se-Te-Re mineralization is proposed according to which porphyry systems evolve in a steady-state fashion, through injections of mafic magmas into more felsic magmas, fractional crystallization, and assimilation of country rocks. The injected mafic magmas are volatile-saturated and provide S-Cu-Au-Te to the hydrothermal system. The hybrid magmas are also volatile-saturated, evolve through fractional crystallization and assimilation of country rocks, thus becoming enriched in Mo-Re-Se.

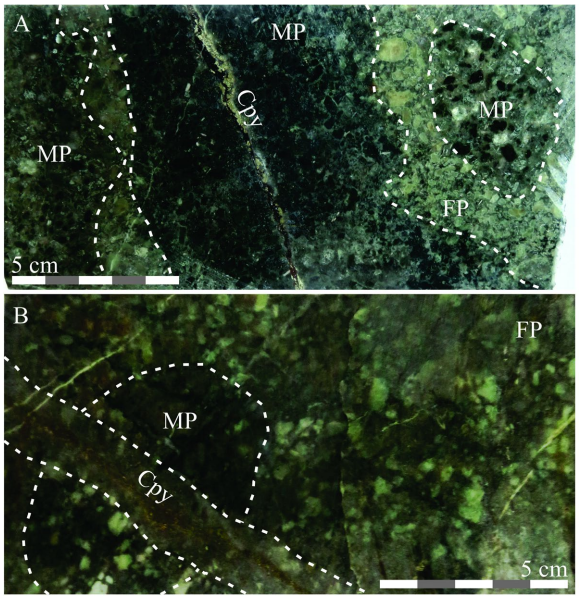

Figure 1. Petrographic relations between mafic porphyry (MP), feldspar porphyry (FP), and chalcopyrite (Cpy) veinlets, at Dexing porphyry Cu-Mo-Au