Mineralogy and Trace Element Variations in Cu-(Fe) sulphides of the Munda Resource, Prominent Hill:
Application for mine scale exploration and ore genesis

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ABSTRACT

The Prominent Hill Iron-Oxide Copper-Gold deposit is situated on the southern margin of the Mount Woods Inlier, South Australia. The western Munda Au ± Cu resource is an extensional ore body governed by a subvertical, N-dipping, E-W-striking terrane-boundary. Since its discovery, debate has been focused on the distribution of principal ore components throughout the deposit, with Munda containing endowments of Au not present elsewhere at Prominent Hill. The present study attempts to unravel a complex history of source-fluid chemistry from trace/minor element concentrations in bornite-chalcocite determined by *in situ* laser-ablation ICP mass spectroscopy (LA-ICP-MS). One goal of the work was to establish if distinctions could be made between the mineralogy and textures present in the high-grade Munda gold resource with those elsewhere in the deposit.

By integrating microscopy and electron probe microanalysis with the minor element geochemistry it has been determined that formation of purple bornite predates steely hematite alteration and thus represents stage I of mineralisation. The LA-ICP-MS data shows important concentrations of Au (up to 12 ppm) reside in purple bornite in solid solution or as submicroscopic inclusions. Experimental data also suggest gold saturation occurred at temperatures <400˚C. Concentrations of >1 wt.% Se and Pb, 3208 ppm Te, 974 ppm Bi and 114 Ag have also been documented. Exsolution of clausthalite (PbSe) from purple bornite provides textural evidence for simultaneous deposition favouring a single fluid for the input of exotic elements (i.e. Pb and Se) and metal elements (Au and Ag).

Two principal sequences are constrained by textural analysis. Sequence (1a) Type-A purple bornite → Type-B purple bornite → chalcopyrite illustrates the remobilisation of Cu and crystal lattice-bound Au from mineral-fluid interaction via dissolution. Alternatively sequence (2a) purple bornite → blue chalcocite → white chalcocite shows proximal-to-breccia Cu enrichment via coupled dissolution-reprecipitation reactions (stage II). Microprobe data show that significant fluorine concentrations (0.36 a.p.f.u; total negative charge of 22) are present in Munda sericite and suggest alkali-fluoride complexes have played a role in ore transportation and formation, as well as the development of pervasive sericitization in hydrothermal alteration profiles. Concentrations of Ag in chalcocite show promise for distal-to-source vectoring and suggest grey chalcocite formed during stage III.

Investigations on gold mineralogy show two assemblages are present; native gold forms with chalcopyrite-loellingite and occurs with various Co-Ni-Fe-arsenides, bismuth, Y-bearing coffinite and coffinite. In addition three phases in the system Au-Cu are identified; symplectic intergrowths of unnamed Au_3Cu and Au_9Cu form an assemblage with chalcocite and minor bornite, and tetraauricupride (AuCu) forms homogeneous grains. All three phases rarely occur in nature and have implication for a S-deficient ore forming system.