Geometallurgy of the Mount Carlton Au-Ag-Cu Deposit: Using geochemical and spectral data to model alteration and sulphide-sulphosalt mineral distribution

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ABSTRACT

The Mount Carlton high sulphidation epithermal Au-Ag-(Cu) deposit is located in the northern Bowen Basin, Northeast Queensland, Australia. The deposit is hosted in coherent and proximal clastic facies of a rhyolite unit belonging to the Lizzie Creek Volcanics, a sequence of Early Permian andesitic to rhyolitic calc-alkaline volcanics deposited during the early phases of continental back-arc rifting. The deposit shows alteration zonation characteristic of high sulphidation epithermal deposits, from residual quartz and quartz-alunite-pyrite assemblages zoned outwards to quartz-dickite-pyrite ± kaolinite (together termed advanced argillic), illite-smectite-pyrite ± kaolinite ± chlorite (argillic) and chlorite-smectite-illite-carbonate-zeolite (propylitic). High grade gold, silver and copper are associated with structurally controlled, multi-phased veins and breccias of pyrite-enargite-sphalerite-galena-barite-alunite (plus other minor sulphosalts, sulphides and tellurides) that cross-cut the advanced argillic altered rhyolite. Lower grade ore is associated with sulphide-sulphosalt disseminations and veinlets marginal to high grade structures.

The Mount Carlton deposit provides an example of how a mineralogically complicated ore system can be better understood, modelled and mined through use of routine geochemical and spectral datasets. A large dataset of short wave infrared spectral analyses has effectively constrained alteration zones through and around the deposit, while geochemical data for a suite of elements occurring in ore and alteration minerals has been used to map mineralogical domains and semi-quantitatively calculate the abundance of ore and gangue minerals throughout the deposit. Sulphide-sulphosalt and pathfinder element distribution defines plume-like geometries interpreted to be controlled by the interplay of active faults and lithologically controlled alteration zones displaying contrasting rheological and permeability characteristics. From the base geochemical and spectral datasets, 3-dimensional modelling of alteration and sulphide-sulphosalt mineral domains provides valuable constraints for resource domaining and prediction of material performance during mining and processing.