Epigenetic conceptual geochemical modelling of the Century deposit, Mount Isa

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Knowledge of ore-forming processes, identification of mineralogical and geochemical proxies, and discrimination between barren and mineralised units are crucial steps towards the exploration of new orebodies. Reactive transport modelling is useful to predict mineral alteration assemblages, test hypotheses of ore-forming processes, and potentially develop mineralogical and geochemical proxies. The formation of clastic-dominated systems and mineralogical and geochemical proxies is largely based on ore-deposit characterisation. The scope of our study is to use thermodynamic equilibrium modelling to predict mineral assemblages associated with metasomatism in order to strengthen the understanding of sediment-hosted Pb-Zn mineral system formation and their exploration.

We focus on the Century deposit in Mount Isa, where the base-metals are believed to derive from underlying basalts (Peters Creek Volcanics) and the sulfur from an evaporite-bearing sequence (Lady Loretta Formation). Transport occurred via the Termite Range Fault and base-metal deposition in a shale-siltstone sequence of the Lawn Hill formation.

Our approach consists of undertaking 1D reactive transport models that predict the composition of the metalliferous brine which is then used for modelling the deposition of base-metals in the host-rock. Preliminary results for the generation of metalliferous brine show that interaction of one litre of highly saline brine (~20-25 wt% salinity) at a temperature of ~200°C with 10 kg of basalt and anhydrite will result in oxidised fluids (fO_2 =-41) with pH 5.6 that can carry around 16 ppm of Zn. However, the interaction of these fluids with organic-rich shales yield brines with fO_2 of-44 and pH of 5.2 which does not support sphalerite precipitation. Additional models are under development focussing on evaluating the impact of S and C contents in the evaporite and basalt respectively. We also suggest that further dissolution of Zn from the basalt is required and this must occur under more oxidised conditions.