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Comparison of the style and nature of breccia-hosted Ni-sulphide mineralisation within the Munali intrusion, Zambia

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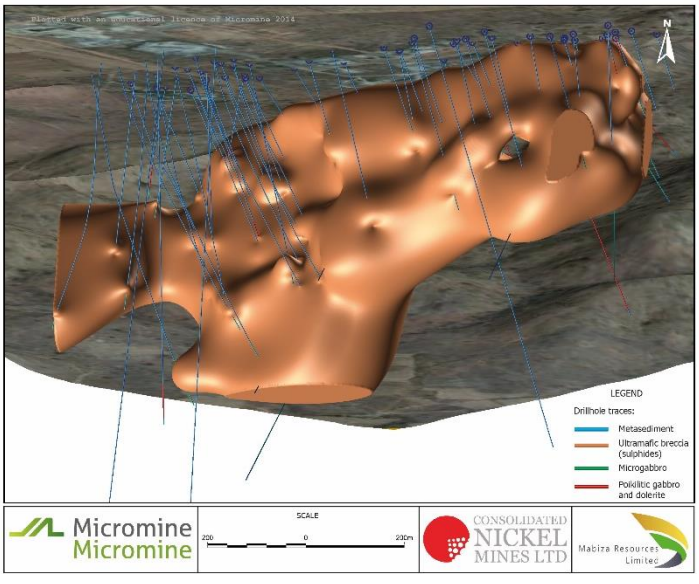
Magmatic deposits which contain exploitable quantities of nickel (Ni), copper (Cu) ± platinum group elements (PGEs) are genetically associated with the concentration of sulphides in mafic and ultramafic rocks. The mafic and ultramafic intrusions which host magmatic sulphide deposits are morphologically diverse and are often associated with deep-seated, vertically extensive magma feeder conduits [1]. Magma conduits are dynamic environments in which sulphides may be upgraded in metal tenor through interaction with continuous pulses of undepleted magma. Consequently, conduits are considered to be highly prospective locations for economic mineralisation [1].

Conduit-hosted Ni-sulphide mineralisation occurs within the Zambezi Supracrustal Sequence (ZSCS) of southern Zambia. The Munali intrusion occurs along a NW-SE trending fault and comprises an unmineralised gabbroic core (855 Ma), and marginal ultramafic breccia with massive to disseminated Ni-sulphide mineralisation [2]. Mabiza Resources' Enterprise deposit contains reserves of 5.8 Mt at 1.02% Ni, however, the base of the intrusion has not yet been intersected and the emplacement history for the sulphides remains poorly understood.

Multi-phase sulphide injection during breccia formation has given rise to three intrusive sulphide phases which comprise the matrix to the breccia; these include 1) massive sulphide, 2) apatite-magnetite-sulphide and 3) calcite-apatite-sulphide. High Y, Sr and REE values obtained by trace element geochemistry are consistent with the occurrence of apatite in the latter two phases. This suggests that apatite equilibrated late in the system in a melt which had already exsolved an early immiscible sulphide liquid. The abundance of apatite-magnetite and Fe-sulphide assemblages suggests mixing of sulphide with an immiscible Fe-Ti-P-rich silicate liquid, most likely within a dynamic magma conduit. This draws parallels with the Babbitt deposit in the Duluth Complex [3] where sulphide and Fe-Ti-P-liquids have also been suggested.

Three-dimensional implicit lithology modelling suggests that the orebody is funnel shaped, and narrows with depth towards the centre of the Enterprise deposit (Fig. 1). This data, combined with an observed increase in Pd tenor from the NE of the ultramafic breccia towards the Enterprise deposit, may vector towards a potential feeder zone location beneath Enterprise and define further resources at depth.



Munali represents a feeder conduit with a marginal ultramafic sulphide breccia with evidence of multiple injections of sulphide, with and without associated Fe-Ti-P immiscible liquids.

Figure 1: Three-dimensional model illustrating the morphology of the orebody beneath Enterprise.

References:

[1] Barnes S. J. et al. (2015) Ore Geology Reviews (in press)

[2] Evans D. et al. (2011) Trans. Inst. Min. Metall. B 120 (4): 176–186

[3] Ripley E. M. et al. (1998) Econ Geol 93: 1052-1062