Platinum Group Element (PGE) geochemistry as a tool to determine sulfide saturation and magma fertility

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Porphyry systems are considered as the primary source of the world`s Cu, Au and Mo [1]. However, not all porphyries are associated with economic deposit, even though they share similar properties to ore-bearing systems. We hypothesize that the timing of sulfide saturation relative to volatile saturation plays a crucial role in controlling the prospectivity of a porphyry.

We use PGE geochemistry to track the timing of the sulfide saturation in magmatic systems. PGE are used in preference to Au or Cu because they are more sensitive indicators of magmatic processes, and their solubility in hydrothermal fluids is low. Their concentrations in whole-rock reflect magmatic, rather than hydrothermal processes [2].

Modelling using Petrolog3 software and the Rayleigh fractionation equation to calculate incompatible elements variations shows that the ore-bearing Yerington Batholith underwent c.a 70% fractionation prior to sulfide saturation (Fig. 1 b) whereas the barren Mount Hagen suite underwent only c.a 10% fractionation (Fig. 1 a). Fractionation produced an enrichment of over x3 in incompatible Cu and Au in the Yerington suite whereas in the Mt. Hagen suite enrichment is only c.a 1. Furthermore, once the magma becomes sulfide saturated, Cu and Au are sequestered by the sulfide phase and not available to enter the ore fluid. Late sulfide saturation and the prolonged enrichment in Cu and Au, prior to sulfide saturation, make Yerington a favourable suite for ore forming.

a) b)

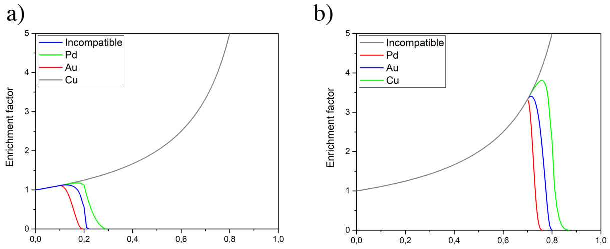

Figure 1: Modelling of Pd, Au and Cu in silicate melts.

[1] Cooke (2013) SEG, 7. [2] Mungal l& Brenan (2014) Geochimica et Cosmochimica Acta, 125, 265-289.