

Chalcophile and PGE modelling:

In order to evaluate the PGE budget of the eclogitic SCLM, we calculated the bulk concentration of Ni, Cu, Au, Re and the PGE in a silicate magma produced by partial melting of BMS as represented by Roberts Victor eclogite xenolith and compared this to the bulk rock compositions of parental Bushveld magmas (B1, B2 and B3, after Barnes et al., 2010). This method was chosen for two reasons: (i) eclogite xenoliths are small and thus bulk rock analyses are rare or inappropriate and (ii) chalcophile elements, such as the PGE, are primarily controlled by sulphide minerals during partial melting and fractionation, hence the sulphide composition for PGE is of most relevance when considering mantle reservoir compositions and budgets available during partial melting.

We use a batch partial melting model (after Shaw, 2006) from of:

$$\frac{C_L}{C_0} = 1 / (D + F(1 - D))$$

where C_L = concentration in liquid, C_0 = initial concentration, F = fraction of melting, and D = bulk distribution coefficient.

This assumes that the eclogite is primarily composed of clinopyroxene and garnet (in equal proportions) and 0.5 volume % BMS (total). This proportion of BMS is based on our observations of the abundance of BMS in Roberts Victor eclogite xenoliths (see main text for further information). For the purposes of this modelling, we do not distinguish between MSS, ISS or any end-member sulphide mineral but instead assume a total BMS composition and model the partial melting of this whole BMS. Partition coefficients of all chalcophile elements were set to 10^{-7} in clinopyroxene and garnet (i.e., highly incompatible). Partition coefficients for chalcophile elements in BMS were as follows (from Mungall and Brenan, 2014): 500 (Ni), 3×10^5 (Os), 1.9×10^6 (Ir), 4.85×10^5 (Ru), 5.91×10^5 (Rh), 3.45×10^6 (Pt), 5.36×10^5 (Pd), 6307 (Au), 800 (Re), 1472 (Cu).

By multiplying the abundance of each mineral by the partition coefficient of each element, a bulk distribution coefficient (D) for each element for the bulk rock was calculated. This D value was then applied to the batch partial melting equation (above). A range of degrees of partial melting (F) were used to calculate the composition of the liquid (C_L) formed through partial melting. The composition of BMS used in models were also varied (ranging the four 'types' of BMS identified in Roberts Victor xenoliths from this study – table below and see main text for more details). These C_L compositions were then used in compositional plots (e.g., Figs. 9 and 10). As these represent bulk liquid compositions, no recalculation of B1, B2 or B3 is necessary. Multi-element diagrams show concentrations normalized to chondrite (normalization values from Fischer-Gödde et al., 2010).

Table of starting compositions (BMS end-members) used in modelling

	Ni (wt.%)	Os (ppm)	Ir	Ru	Rh	Pt	Pd	Au	Re	Cu (wt.%)
Type i	8.00	0.07	0.07	0.16	0.13	5.06	2.79	0.18	0.61	3.44
Type ii	11.35	0.01	0.01	0.05	0.04	0.02	0.17	0.38	0.41	3.18
Type iii	4.98	0.04	0.05	0.20	0.38	14.44	10.65	0.10	0.83	4.92
Type iv	25.10	12.85	10.76	31.81	12.69	69.72	20.20	0.11	0.15	0.95
RV mean (excluding RV-IM-02, Type iv)	8.34	0.05	0.06	0.15	0.13	4.99	3.04	0.21	0.59	3.53