Conditions of core segregation constrained by metal-silicate partitioning experiments

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Experiments to determine metal-silicate partition coefficients ($D^{Met/Sil}$) can be used to predict the effects of core-formation on the trace-element composition of primitive upper mantle (PUM). Comparison of model predictions with estimates of the PUM derived from mantle xenoliths, suggest metal-silicate equilibrium occurred at high pressures (*P*), high temperatures (*T*), and under progressively more oxidising conditions (e.g. [1] [2]). These conditions do not, however, provide a unilateral explanation for the PUM abundance of all siderophile elements. Highly siderophile elements (HSE) are elevated in PUM relative to experimental predictions, often explained by the addition of chondritic material subsequent to core-formation [3]. Although comprising the PUM budget for the most siderophile elements, late-accreted material has a negligable effect on more abundant moderately and slightly siderophile elements. Gold occupies a unique position; partitioning sufficiently into silicate melt at high *P-T* to explain it's PUM abundance, yet remaining sensitive to late-accretion [4]. Coupled with the independence of $D^{Met/Sil}$ (Au) on fO_2, Au is well positioned to constrain the maximum *P-T* of metal-silicate equilibrium.

Reproducing the PUM abundance for some elements requires not only high *P-T* but also a light element component in the metal phase [e.g. 5]. The database of experiments done at the conditions suggested for metal-silicate equilibrium however, remains limited. Interaction parameters that describe activity-composition relationships in liquid Fe alloys may change significantly at high pressure; suggesting a need for experiments performed at >30 GPa to better understand the effect of light-elements on trace element partitioning [6].

We have performed continuous accretion models, using both literature data and the results from new experiments, to explore the difficulty associated with recreating the PUM abundance of multiple siderophile elements.

[1] Wade & Wood (2005), *EPSL* **236**, 78-95. [2] Siebert, Corgne & Ryerson (2011) *GCA* **75**, 1451-1489. [3] Kimura, Lewis & Anders (1974) *GCA* **38**, 683-701. [4] Bennett & Brenan (2013) *EPSL* **361**, 320-332. [5] Wade, Wood & Tuff (2012), *GCA* **85**, 58-74. [6] Siebert, Badro, Antonangeli & Ryerson (2013) *Science* **339**, 1194-1197.