Partitioning of chalcophile and Highly Siderophile Elements (HSEs) between sulfide and carbonated melts – Implications for HSE systematics of kimberlites and carbonatites

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Highly Siderophile Elements (HSEs; Os, Ru, Ir, Rh, Pt, Pd, Au and Re) combined with their isotopic systematics (e.g. Re-Os) are powerful tools to track evolution and genesis of mantle derived magmas. Given sulfides are the chief hosts of HSEs in the mantle and low-degree carbonated melts are stable over the largest mantle volume, partitioning of HSEs between sulfide and carbonated melt must play a critical role in distributing HSEs between the mantle and crustal reservoirs. Although, partitioning of HSEs and chalcophile elements (ChE) between sulfide melt and silicate melt is extensively studied, partitioning of these elements between sulfide melt and carbonated melts have not received much attention.

Here we experimentally determine the partitioning of HSEs and ChEs (Ni, Co, Mo, Os, Ru, Pd, Pt and Re) between sulfide melt and two carbonated melts (high CO_2 and low CO_2) at a pressure (P) of 3 GPa and temperatures (T) of 1300-1600 °C in graphite capsules. All experiments produced quenched Fe-sulfide melt blobs + carbonated silicate melt matrix. Concentrations of major elements were measured using electron microprobe and HSEs and ChEs are measured using LA-ICP-MS. We find that all the elements measured are compatible in the sulfide melt to varying degrees and their $D^{\text{sulfide/carbonated melt}}$ sequence is Mo < Co < Ni < Re < Pt ≤ Pd < Ru ≤ Os yet the D values are lower than those in sulfide-silicate melt systems. Calculating bulk D ($\overline{D}$) for carbonated peridotite using our measured D values, we model the HSE contents of mantle derived low-degree partial melts and compare the primitive mantle normalized HSE patterns of our model melts with natural kimberlites and carbonatites. To explain the difference between our model low-degree melts and natural carbonatites and kimberlites, we calculate proportions of sub-continental lithospheric mantle (SCLM) xenolith detritus for kimberlite and carbonatite samples from Finland, South Africa, Canada, and North China by using mass balance calculations based on Ru

concentration in the primary carbonated melt and the SCLM xenolith. Our calculations show that detritus proportion in natural kimberlites are 2-28% for Finland, 25-40% for South Africa, and 6-16% for Canada, which are comparable to modelled calculations by previous studies using various other proxies [1].

[1] Tappe et al., 2017, *Chem. Geol.*