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The behavior of Re and Os during sulfide segregation to the Earth's core

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The origin of the highly siderophile elements (HSEs) in the Earth's mantle is generally explained by segregation of Fe-metal to form the Earth's core and subsequent replenishment of the HSEs by the addition of chondritic material to the mantle. Moreover, it has been proposed that a sulfide melt has also been sequestered to the core [1]. Recent experimental results have shown that sulfide segregation could explain suprachondritic Pd/Ir and Ru/Ir observed for the Earth's mantle, because Ru and Pd are less chalcophile than Ir and Pt under high *P-T* conditions [2,3]. The HSEs include the long-lived Re-Os decay system, offering a powerful tool to constrain the long-term Re-Os ratio of Earth's mantle: The overall enstatite chondrite-like Os-isotope composition of the mantle indicates that the Earth's mantle evolved with a long-term chondritic Re-Os ratio [4], which needs to be reproduced by any core-formation model.

In ordder to assess whether sulfide segregation is consistent with this signature we experimentally investigate the sulfide-silicate partitioning of Re and Os at high pressure and temperature. A molten peridotite composition is equilibrated with a FeS sulfide melt doped with Re and Os (~10 wt. % each). Experiments are performed at 2100-2400 °C and 7-21 GPa. Major element compositions of quenched silicate and sulfide melts are determined by electron microprobe, whereas Re and Os concentrations are analyzed using LA-ICPMS.

Experimental results show, that both Re and Os are chalcophile under high *P-T* conditions Sulfide-silciate exchange coefficients (K_D) of Os are 2-3 orders of magnitude higher than those of Re. Nevertheless, K_D for both Re and Os appear to be high enough to quantitatively remove them from the Earth's mantle during sulfide segregation. Results from our expeiments will be used to model the influence of sulfide segregation on Re and Os during core formation and to test whether they become fractionated, as is the case for low *P-T* sulfide-silicate equilibration during MORB genesis.

[1] O'Neill (1991) GCA 55, 1159-1172. [2] Laurenz et al. (2016) GCA 194, 123–138. [3] Rubie et al. (2016) Science 353, 1141-1144. [4] Meisel et al. (2001) GCA 65, 1311–1323.