Metal-silicate partitioning of highly siderophile elements in S-bearing systems- Implications for the formation of Earth's core

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The segregation of Fe-rich metal to form the Earth's core led to a strong depletion of the in highly siderophile elements (HSEs) in the Earth's mantle. From experimental work in S-free systems it is known, that the HSEs should be highly fractionated in the Earth's mantle [1]. However, the HSEs are thought to be present in roughly chondritic proportions [2]. A possible key to this contradiction might be related to sulfur, which was added late during Earth's accretion. Hence, the core-forming metal became more S-rich, which should have a strong effect on the behaviour of the HSEs [3]. Therefore, we studied the partitioning of Pt, Pd, Ru and Ir between a molten peridotite and a S-bearing Fe-HSE alloy or sulfide (0-35 wt.% S). Experiments were carried out at 2200 °C and 11-21 GPa in a multianvil apparatus. Overall, the HSEs become less siderophile with increasing S-content. The individual HSEs are affected to varying degrees so that K_D of Pt, Pd, Ru and Ir converge towards high S concentrations. These results imply that the HSEs can be extracted to the core by a late S-rich melt with only small inter-element fractionation, explaining the observed chondritic HSE-ratios found in the mantle.

[1] Mann U., Frost D. J., Rubie D. C., Becker H. and Audétat A. (2012) GCA 85, 593-316.
[2] Becker H., Horan M. F., Walker R. J., Gao S., Lorand J.-P. and Rudnick R. L. (2006) GCA 70, 4528–4550.
[3] O'Neill H. St. C. (1991) GCA 55, 1159-1172.