Partitioning of Pb, Zn, Cd, Se, and Te during terrestrial core formation: no evidence for sulfide melts

M. LAGOS[1], C. BALLHAUS[1,2], C. WOHLGEMUTH-UEBERWASSER[1] J. BERNDT[1] AND C. MÜNKER[2]

[1] Institut fuer Mineralogie, WWU Muenster, Germany, lagos@uni-muenster.de
[2] Mineralogisch-Petrologisches Institut und Museum, University of Bonn, Germany

From Hf-W and U-Pb chronometry it is assumed that core formation involved several episodes of melt segregation [1]. In an early phase, dated by Hf-W chronometry to around 30 - 45 Myr after solar system formation, an (Fe,Ni)° metal melt was segregated followed by a sulfide-dominated melt, which might has established the present U/Pb ratio of the mantle. Absolute and relative abundances of Fe-Ni-Co and noble metals in the mantle also require multiphase core segregation [2]; an early (Fe,Ni)° melt that constrained the Fe-Mg ratio of the mantle followed by a sulfide liquid that sequestered the highly siderophile elements to the core, leaving behind the near-chondritic Ni-Co ratio of the upper mantle. We have determined the sulfide-silicate and metal-silicate partition coefficients (D) of Pb, Zn, Cd, Se, and Te at upper mantle P-T conditions in order to test core formation scenarios, in particular the involvement of a discrete sulfide melt.

Starting mixtures were a basaltic melt coexisting with sulfide and/or metal melts, doped with Pb, Zn, Cd, Se and Te in the 100 ppm concentration range. $f(O_2)$ relative to IW was approximated from FeO in silicate glass to ca. IW-3 to -0.5. Phases were analysed using electron microprobe and an Excimer laser coupled to a single-collector sector ICPMS. The metal-silicate and sulfide-silicate partition coefficients were calculated from count rates normalized to ^{57}Fe and known Fe contents of the phases. Metal-silicate Ds for Pb, Zn, Cd, Se, and Te at IW-2 are 0.21 ± 0.12, 0.12 ± 0.03, 0.06 ± 0.01, 8 ± 5, and 8 ± 5, respectively. Sulfide-silicate Ds of our most oxidized experiment for these elements are 5.8 ± 0.4, 0.28 ± 0.04, 3.4 ± 0.3, 15 ± 3, and 55 ± 8, respectively. Our results indicate that it is nearly impossible to deplete Se and Te relative to Pb, Cd and Zn by segregation of a sulfide melt in order to match the abundances observed in the Earth’s mantle [3]. We therefore suggest that no discrete sulfide melt was segregated into the Earth´s core. Consequently U-Pb model ages most likely provide a time constraint on early degassing on Earth due to the high volatility of Pb relative to U.

References

[1] Wood B.J. and Halliday A.N. (2005) Nature **437**, 1345-1348.
[2] O'Neill H.S.C. (1991) GCA **55**, 1159-1172.
[3] Palme H. and O'Neill H.S.C. (2003) Treatise on Geochemistry Vol. **2**, 1-38.