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The partitioning of Se and Te between sulfide liquid and silicate melt

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Near-chondritic relative abundances of sulfur (S), selenium (Se), and tellurium (Te) observed in mantle peridotites have been used to support the hypothesis of a carbonaceous chondrite-like late veneer added to the proto-Earth. However, the extent to which the observed S, Se, and Te compositions represent the signature of the silicate Earth remains a topic of debate. Mantle-derived melts, such as MORBs, may help clarify this debate by offering constraints on Se and Te abundances in the silicate Earth —provided the behavior of Se and Te during MORB genesis and differentiation is well understood. Since Se and Te have a strong affinity for sulfides, and sulfide liquids are present during both MORB genesis and differentiation, the Se and Te concentrations and ratios in MORBs are largely governed by sulfide liquid–silicate melt partition coefficients (D). We conducted laboratory experiments at 1 GPa, 1200–1600 °C, and oxygen fugacity (fO_2) of ~FMQ-1.6 to FMQ+1.5 to examine the effect of temperature, fO_2, and sulfide and silicate melt composition on $D_{Se,Te}$. The preliminary results indicate that D_{Se} range between 180–2200 and D_{Te} between 1000–25400. Temperature has an unresolved effect on $D_{Se,Te}$. $D_{Se,Te}$ exhibit an inverted U-shaped dependence on the FeO_{tot} content in silicate melt. In addition, our $D_{Se,Te}$ show no dependence on the Ni content of sulfide liquid or the experimental fO_2. The D_{Se}/ D_{Te} ratios are smaller than 0.4. The effects of semimetals in sulfide liquid and the melt water content on $D_{Se,Te}$ are still under investigation. Our preliminary $D_{Se,Te}$ enables us to model the behavior of Se and Te during magmatic differentiation and mantle partial melting. We show that the Se, Te, and Cu systematics observed in MORBs and oxidized arc magmas can be explained by our $D_{Se,Te}$. Using high-precision Se and Te data from MORBs collected along the Pacific–Antarctic ridge, we estimated the silicate Earth to contain ~25 ± 5 ng/g of Se and ~1.37 ± 0.7 ng/g of Te. Therefore, the silicate Earth exhibits superchondritic S/Se and S/Te ratios, suggesting that the late veneer was likely not a major source of S, Se, and Te.