

Partitioning of Se, As, Sb, Te and Bi between monosulfide solid solution and sulfide melt – Application to magmatic sulfide deposits

The chalcogenes (S, Se, Te), semimetals (As, Sb) and the metal Bi are important ligands for noble metals and form a wide range of compositionally diverse minerals with the platinum-group elements (PGE). With the exception of S, few experimental data exist to quantify the behavior of these elements in magmatic sulfide systems. Here we report experimental partition coefficients for Se, Te, As, Sb, and Bi between monosulfide solid solution (mss) and sulfide melt, determined at 950 °C at a range of sulfur fugacities (f_{S_2}) bracketed by the Fe–FeS (metal-troilite) and the Fe $_{1-x}$ S $_x$ (mss-sulfur) equilibria. Selenium is shown to partition in mss-saturated sulfide melt as an anion replacing S $^{2-}$. Arsenic changes its oxidation state with f_{S_2} from predominantly anionic speciation at low f_{S_2} , to cationic speciation at high f_{S_2} . The elements Sb, Te, and Bi are so highly incompatible with mss that they can only be present in sulfide melt as cations and/or as neutral metallic species. The partition coefficients derived fall with increasing atomic radius of the element. They also reflect the positions of the respective elements in the Periodic Table: within a group (e.g., As, Sb, Bi) the partition coefficients fall with increasing atomic radius, and within a period the elements of the 15th group are more incompatible with mss than the neighboring elements of the 16th group.