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Experimental determination of the sulfide/silicate melt partition coefficients of siderophile and chalcophile elements

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Knowledge of the geochemical behavior of chalcophile and siderophile elements in magmatic enviroments is fundamental importance in understanding a large number of geological processes such as core-mantle segregation, crust-mantle differentiation, and the formation of econmically important classes of ore deposits. In magmas the geochemical behavior of many chalophile and siderophile elements is largely controlled by the sulfide phases. Therefore, the sulfide/silicate partion coefficiens of chalcophile and siderophile elements need to be precisely determined to fully understand their geochemical behavior in magmas.

We have performed a large number of experiments to determine the partition coefficients of Re, Mo, Au, Ag, Cu, Pt, Pd, Se, Te, Sn, Sb and Cd between crystalline monosulfide solid solution (MSS), Cu-rich and Cu-poor sulfide liquid, and silicate melts. The experimental P-T-fO_2-X were varied largely to cover the crust- mantle conditions. We will show that the variation of Cu in sulfide liquid does not considerably affect the partition coefficients of many chalcophile elements. The MSS/silicate melt partition coeffients of Au (10-10^4) are strongly controlled by sulfur fugacity and the sulfur concentration in silicate melt at fO_2 ranging from ~FMQ-1.7 to FMQ+1.6. The behavior of Au is enssentailly controlled by sulfur in magmas that are rich in sulfur. The MSS/silicate melt and sulfide liquid/silicate melt partition coefficients of Re and Mo change a few orders of magnitute with the change of fO_2 from FMQ-2 to FMQ+1.5 and the change of silicate melt FeO content, and the Mo and Re partition coefficiens are strongly correlated. The partitioning behavior of Pt and Pd appears to be more interesting. We will show that the sulfide liquid/silicate melt partition coefficients of both Pt and Pd appears to be affected by the Pt and Pd concentrations in the sulfide liquid. The ususally accepted extemely high partition coefficents for Pt and Pd (10^5) may need further consideration. We finally show some examples of the application of these new partitioning data to magmatic processes of different tectonic settings.