Abundances of Ag and Cu in mantle peridotites and the implications for magmatic fractionation of chalcophile elements in the mantle

ZAICONG WANG* AND HARRY BECKER

Insitut für Geologische Wissenschaften, Freie Universität Berlin, Malterserstr.74-100, 14195 Berlin, Germany
*zaicongwang@gmail.com

Silver abundances in mantle peridotites and the behavior of Ag during high-temperature mantle processes have received little attention, and consequently the abundance of Ag in the bulk silicate Earth (BSE) has been poorly constrained. Here we report new abundances of Ag and Cu in mantle peridotites (n=68) from different geological settings with variable extent of melt depletion and refertilization. The data have been obtained by isotope dilution ICP-MS methods. In combination with previously reported abundance data of other chalcophile elements (PGE, Re, S, Se and Te) in these samples and data on basalts, the new Ag and Cu data provide comprehensive constraints on the partitioning behavior of chalcophile elements in mantle processes.

Silver and Cu are depleted in most peridotites compared to basic magmas, and thus are moderately incompatible elements. Althought a small fraction of Ag and Cu may be hosted in silicate phases of mantle peridotites, correlations with S and Se indicate that sulfides are the predominant host phases. Similar ranges of Cu/Ag ratios (3000-4000) of peridotites, MORB glasses and MORB sulfide droplets indicate the similar partitioning behavior of Cu and Ag and limited fractionation of these elements during melting, refertilization and fractional crystallization of basic magma. The limited fractionation of Cu and Ag and the abundance variations of the PGE, Re, Au, S, Se, Te, Cu and Ag in peridotites and basalts are consistent with sulfide melt-silicate melt partitioning and relative bulk partition coefficients in decreasing order of PGE > Au ≥ Te > Cu ≈ Ag > Se ≥ S ≈ Re, consistent with results from experimentally determined partitioning data.

Abundances of Cu, Ag, S, Se, Te, Re and Au in most massif peridotites and in a few xenolith suites show positive correlations and indicate the limited fractionation of these elements during melting and refertilization. These correlations and constant Cu/Ag ratios of peridotites and MORBs constrain the minimum abundances (at 3.5 wt. % Al_2O_3) of Ag and Cu in the BSE at 9±3 (1s) ng/g and 30±6 μg/g (1s), respectively.