Silver in the terrestrial mantle

M.F. HORAN[1]*, R.W. CARLSON[1], R.J. WALKER[2] AND F.E. JENNER[3]

[1]Dept. of Terrestrial Magnetism, CIW, Washington DC 20015 USA (*correspondence: mhoran@ciw.edu)
[2]Dept of Geology, Univ. MD,College Park MD 20742 USA
[3]The Open University, Milton Keynes MK7 6BJ UK

Silver is a moderately volatile, chacophile and slightly siderophile element. The concentration of Ag in the bulk mantle and its elemental and isotopic behavior during melting, metasomatism, and magmatic differentiation is not well constrained. To rectify this situation, we have begun a systematic study of Ag in mantle rocks. Improved understanding of Ag in the mantle will help to better constrain Earth accretionary processes. Silver may also ultimately serve as an important tracer of metasomatic and alteration processes affecting mantle rocks.

Using isotope dilution, we have determined Ag concentrations in samples from several suites of well-characterized peridotite xenoliths from the North China Craton (NCC) and Mongolia, and in peridotites from the Leka ophiolite, Norway. The data display a broad correlation between Al_2O_3 and Ag contents, and are consistent with moderate incompatibility. Peridotitic samples with Al_2O_3 of 1 wt% or lower have Ag concentrations of 0.4-2.5 ng/g, while those with over 3 wt% Al_2O_3 have Ag concentrations of 8-18 ng/g. One Hannouba (NCC) sample has 50 ng/g Ag, and one Mongolian sample has 104 ng/g Ag. Surprisingly, Ag concentrations show little or no correlation with other siderophile/chalcophile elements, such as Pd and Os. Most of the spinel peridotite xenoliths examined have Os contents of 1 to 2 ng/g, which is lower than the 3 to 4 ng/g typical of kimberlite-borne peridotites and orogenic peridototes. The lower Os content of basalt-borne spinel peridotite xenoliths has been interpreted as a sign of sulfide removal, either into the host magma or through weathering [1]. The lack of a Ag-Os correlation, however, bring this explanation into question. Projection of the Ag-Al_2O_3 trend to a primitive mantle Al_2O_3 composition suggests 10-12 ng/g Ag in fertile mantle, consistent with, but slightly higher than previous estimates [2,3]. Ocean ridge basalt glasses have 15-48 ng/g Ag [4], consistent with the evident moderate incompatibility of Ag during mantle melting.

[1] Handler *et al* (1999) *Geology* **27**, 75-78. [2] McDonough (1995) *Chem. Geol.* **120**, 223-253. [3] Palme & O'Neill (2003) in Treatise of Geochemistry **2**, 1-38. [4] Schönbächler et al (2010) *Science* **328**, 884.