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Selenium and Tellurium concentrations of ultradepleted peridotites determined by isotope dilution ICPMS: implications for Se-Te systematics of the Earth's mantle

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As for highly siderophile elements, selenium and tellurium may constitute key tracers for planetary processes such as formation of the Earth's core and the Late Veneer composition, provided that their geochemical behaviour and abundances in the primitive upper mantle (PUM) are constrained. Within this scope, we have developed a high precision analytical method for the simultaneous determination of selenium and tellurium concentrations from a single sample aliquot and various rock matrices, including ultradepleted peridotites. The technique employs isotope dilution, thiol cotton fiber (TCF) separation and hydride generation MC-ICP-MS. A selection of international mafic and ultramafic rock reference materials BIR-1, BE-N, TDB-1, UB-N, FON B 93, BIR-1 and BHVO-2 with a range of 30 to 350 ppb Se and 0.7 to 12 ppb Te show external reproducibilities of 3 to 8% for Se and 0.4 to 11% for Te (2 relative standard deviations (r.s.d.)). We have applied this method to a suite of refractory mantle peridotites ($Al2O_3$ <1.5 wt. %) from Lherz, previously shown to be strongly and uniformly depleted in Se, Te and incompatible elements by high degree of partial melting (20 $\pm$ 5%). In contrast to fertile lherzolites which remain at broadly chondritic values (Se/Te = 9), the ultradepleted harzburgites show highly fractionated and up to suprachondritic Se/Te (< 35) that correlate with decreasing Te concentrations. The fractionation is displayed by the depleted peridotites as well as multiple analysis of a single Lherz harzburgite sample (64-3). This shows 1) a strong sample heterogeneity effect for Te and 2) a more incompatible behaviour of Te compared to Se on the whole rock scale, once base metal sulfides are highly depleted and in some cases entirely consumed by partial melting. The marked differences in Se-Te systematics observed between fertile lherzolites and depleted harzburgites can be explained by the combined effect of i) different abundances and proportions of residual and metasomatic base metal sulfides ii) discrete micrometric platinum-group minerals. In addition to re-fertilized lherzolites, harzburgites therefore offer new insights into the behaviour of Se and Te during mantle depletion which is a prerequisite to further constrain the Se and Te abundances of the primitive upper mantle.