Geochemistry of As and Sb: Constraints on fluid metasomatism in mantle xenoliths

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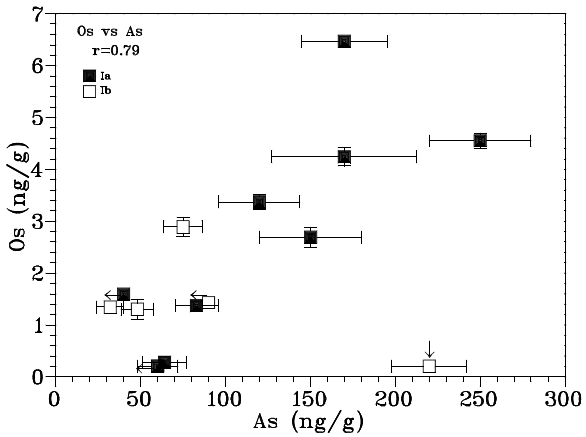
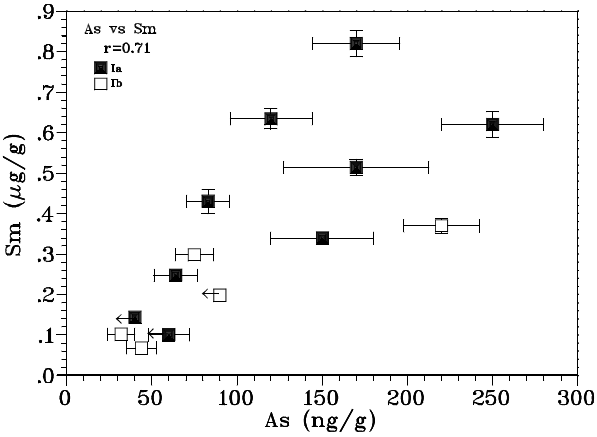
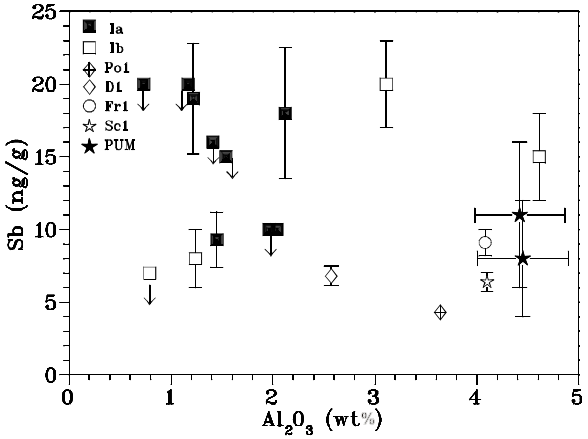
Mantle derived peridotite xenoliths from the Eifel have been analyzed by instrumental neutron activation analysis (INAA) for As and Sb to investigate the behaviour of these rarely determined elements during melt extraction and fluid metasomatism. Aliquots of homogenized sample powder were iradiated for six hours at the TRIGA-Reactor with a thermal neutron flux of $7x10^{11}$ neutrons cm^{-2} sec^{-1} to determine As and Sb. INAA analyses were performed at the Max-Planck-Institute for Chemistry. After irradiation the samples were γ-counted on Ge(Li)- and high-purity coaxial (HP)Ge and planar detectors to determine ^{75}As ($T_{1/2}$=26.32 h) at 559.1 keV after the nuclear reaction ^{75}As (n/γ) ^{76}As and ^{122G}Sb ($T_{1/2}$=2.7 d) at 564.0 keV after the reaction ^{121}Sb (n/γ) ^{122G}Sb, respectively [1].

In the absence of metal the mono-isotopic element As behaves as a chalcophile element. Arsenic is incompatible during mantle melting, similarly to the light REE. After considering the proportion of As in the crust and mantle Sims et al. [2] proposed that the primitive mantle has a As/Ce ratio of about 0.003. McDonough and Sun [3] used this ratio to calculate the As abundance of the Bulk Silicate Earth. These authors estimated the primitive mantle As abundances of about 50 ng/g within a factor of 2. We have measured As concentrations in the range of 32 to 250 ng/g in Eifel xenoliths [1]. The PGE (Os, Ir, Ru, Rh, Pt, Pd) show correlation trends with As (r=0.79, r=0.67, r=0.61, r=0.59, r=0.87, r=0.62, respectively). Some Eifel xenoliths are unusual with high As, PGE and LREE suggesting that fluid-related processes in the subcontinental lithosphere are responsible for this kind of metasomatism. The covariance between PGE enrichment and the abundances of As could be evidence assessing the redistribution of PGE in these rocks [1]directly with the mobility of LREE and As, probably related to metasomatism by aqueous fluids.





Antimony is a moderately siderophile element which should behave like incompatible lithophile elements during mantle melting [4]. Jochum and Hofmann [4] have estimated Sb concentrations of 11 ± 5 ng/g from Sb/Pb ratios and 8 ± 4 ng/g from Sb/Pr ratios for the primitive mantle. Wänke et al. [5] have estimated an Sb content of 5.7 ng/g for the primitive mantle. In comparison to "fertile" mantle xenoliths [6,4] from worldwide occurrences (Fig. 3) our measured Sb concentrations in the range of <7 to 20 ng/g in hydrous as well as anhydrous xenolith samples suggest that aqueous fluids may have enriched the Eifel xenoliths in Sb [1].



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