HSE abundances in mantle xenoliths from the Eifel volcanic field: Constraints on melt-rock reaction

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A suite of mantle derived peridotite xenoliths has been analyzed for highly siderophile elements (HSE) and rare earth elements (REE) to investigate the behaviour of HSE during melt extraction followed by different styles of metasomatism and melt percolation in the subcrustal lithosphere beneath the Eifel, where a plume-like structure has been identified.

Fig. 1

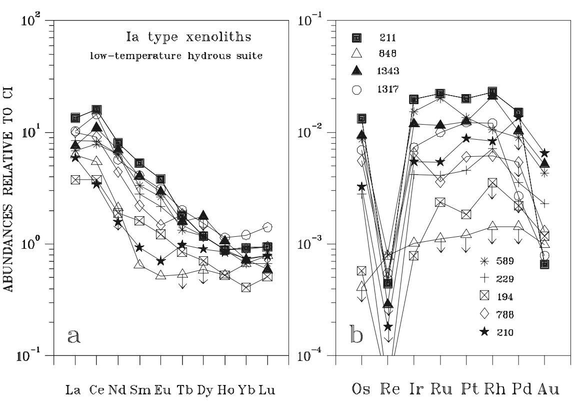
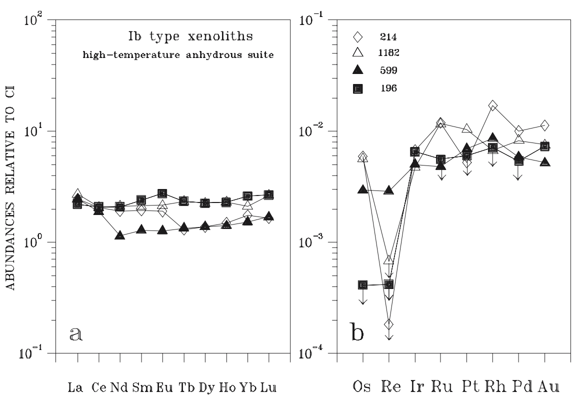
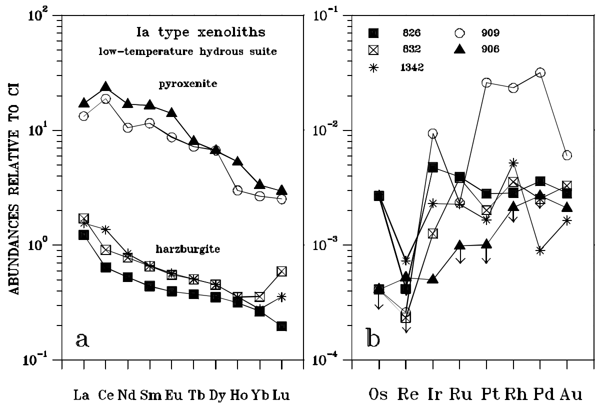


Fig. 2



Comparison of PGE abundances and patterns between hydrous harzburgitic xenoliths (Fig. 1) and anhydrous fertile xenoliths (Fig. 2) shows that PGE-ratios are not significantly fractionated between both groups, although some harzburgites are up to ~30% melt depleted. No systematic dependence of the contents of PGE on the degree of fertility of the host rock have been found. Extensive melt-rock reaction is documented by covariance between LREE enrichment and the concentrations of PGE (e.g. Sm vs. Ir). The Os concentrations range from <0.1 to 6.47 ng/g (total PGE contents range between <5.9 and >43.2 ng/g), far outside the range usually found in mantle rocks. Replicate analysis on PGE reference materials by Schmidt et al. [1] have yielded Os concentrations which compares well with the limited number of published Os concentrations on reference materials by carius tube isotopic dilution procedures [2]. Subchondritic Os/Ir ratios (0.74 ± 0.14) have been found in these rocks. Pyroxenite samples show large variabilities in there PGE concentrations, with Ir contents of 0.23 and 4.30 ng/g, respectively (Fig. 3).

Fig. 3



Some harzburgites (Fig. 1) have significantly higher concentrations of all PGE in comparison to samples of similar fertility reflecting the mobility of these elements in a metasomatized mantle. Two harzburgites (194 and 832) and a lherzolite (848) have almost lost there complete budget on PGE. Percolation of melt may have removed intergranular sulfides and reduced the PGE content of these samples. Approximately unfractionated PGE-patterns and comparatively low Re contents of <2 to <35 pg/g (except sample 599) of the PGE-enriched rocks indicate that the PGE were apparently transported with mobile phases (metasomatic melts), presumably sulfides (or kerogen?), which dominate the budget of highly siderophile elements in the mantle. Melt percolation (possibly related to subduction of crustal material [3]) have significantly modified the PGE chemistry of these rocks obscuring the original signature of melt loss by dissolution and precipitation of PGE bearing phases. The enrichment of organic-rich sedimentary rocks in PGE (and fractionation in Os/Ir, see Ravizza and Pyle [4]) has been known for some time. Recently Ripley et al. [5] have found strong enrichment of PGE concentrations in kerogen relative to whole rock values. The enrichment in kerogen exceeds that of coexisting sulfides. The PGE geochemistry in the Eifel xenolths are probably most influenced by subducting crustal partially melts. These melts could have infiltrated and reacted with the overlying lithospheric mantle.

References

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