Highly siderophile elements (PGE, Re and Au) and Os isotopes in xenoliths from the Eifel volcanic field and the Vogelsberg

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NiS fire assay for HSE

Highly siderophile element (HSE) abundances were obtained on xenoliths from the Eifel by NiS fire assay and instrumental neutron activation analysis at the Institut für Kernchemie. The INAA procedure involved two irradiations: a short irradiation for Rh and a long irradiation for Os, Re, Ir, Ru, Pt, Pd and Au.

Os separation for N-TIMS

Os isotope measurements were made on fire assay HSE concentrates that had been previously irradiated to produce the HSE results. The HSE concentrates were allowed to decay to sufficiently low residual activity. The filter paper containing the HSE concentrates was re-attacked with aqua regia, and Os was separated by solvent extraction into liquid Br_2 (Birck et al. 1997). The chemical procedures used to extract Os from the filter paper was those developed by Snow and Schmidt (1999). Os separation was accomplished in three steps: (1) dissolution of filter papers; (2) extraction of Os in Br_2; (3) microdistillation of Os.

Negative thermal ionization mass spectrometry (N-TIMS)

Purified Os was loaded on Pt filaments and the Os isotopes are being measured as OsO_3^- trioxide with N-TIMS at the Max-Planck-Institut für Chemie. $Ba(OH)_2$ was used as emission enhancers. Negative thermal ionization mass spectrometry was conducted in single collector peak jumping mode on a modified Finnegan MAT 262 with ion counting on a secondary electron multiplier at a count rate of about 50 to 100 kHz on $^{240}OsO_3^-$.

Os-Al_2O_3 systematics and age

Whole rock samles of the Eifel xenoliths have Os concentrations in the range of <0.1 to 6.47 ng/g. Highly variable $^{187}Os/^{188}Os$ isotopic ratios could indicate that some samples have been variably overprinted by addition of radiogenic Os (metasomatic sulfides). Nine samples with low Os contents (<1.5 ng/g) show higher than primitive upper mantle (PUM) $^{187}Os/^{188}Os$ ratios and thus are not consistent with their melt-depleted character. The large variation from subchondritic $^{187}Os/^{188}Os$ to superchondritic $^{187}Os/^{188}Os$ ratios are coupled with a large dispersion in Al_2O_3 concentrations. One group of 8 samples (including two samples from the Vogelsberg) displays a good correlation of $^{187}Os/^{188}Os$ vs. Al_2O_3 similar to Ronda and Zabargad peridotites and reflects high degrees of melt depletion. There slope can be used to constrain the age of this related xenolith group assuming that the melt depletion event removed all of the Re and the Re/Os ratio is therefore 0. It has been proposed by Reisberg and Lorand (1995) that the Al_2O_3 content of mantle rocks can be used as a proxy for the Re/Os ratio in an $^{187}Os/^{188}Os$ vs. Al_2O_3 diagram which presumable reflects an isochronous relationship. Since the Re concentrations were disturbed by recent metasomatism the age of the xenoliths can be estimated from the initial $^{187}Os/^{188}Os$ isotopic ratio from the $^{187}Os/^{188}Os$-Al_2O_3 correlation diagram. The initial ratio thus calculated for one xenolith group is 0.1187 ± 0.0004 (R^2 = 0.98, N=8) and would indicate a Proterozoic age (~1.4 Ga) of separation of the subcontinental lithospheric mantle (SCLM) from the convecting asthenosphere. From our study we can conclude that the previously estimated igneous age of ~1.5 Ga by Stosch and Lugmair (1986) for parts of the lowermost crust derived from Nd and Sr isotopes on lower crustal granulites under the Eifel is indeed related to a major melt depletion event under the Eifel of ~1.5 Ga before. Probably a much older melt depletion event occured ~2.7 Ga ago.