Os isotopes in geochemical reference materials and mantle xenoliths from the Eifel volcanic field and the Vogelsberg

Gerhard Schmidt [1,2] and Jonathan Snow [3]
[1] Institut für Mineralogie und Geochemie, Universität zu Köln
[2] Institut für Kernchemie, Universität Mainz
[3] Max-Planck-Institut für Chemie, Mainz

A suite of mantle derived peridotite xenoliths has been analyzed for Os isotopes. The Os isotopic systematics provide insight into the effects of melt extraction followed by different styles of metasomatism and melt percolation and place constraints on the evolution of the lithospheric mantle beneath the Eifel.

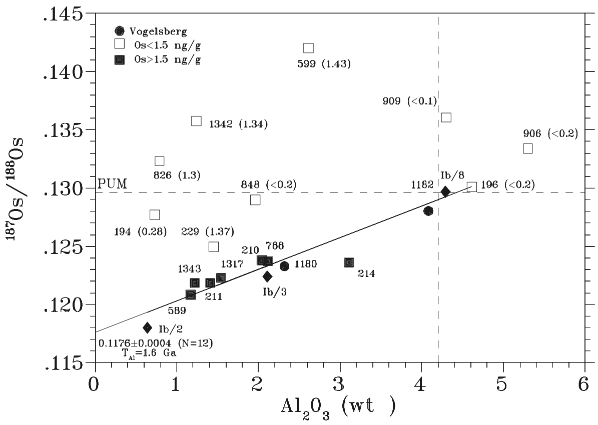
During this study, total chemistry (Bl-C: <0.2 ng, $^{187}Os/^{188}Os = 0.15547 \pm 0.00024$; Bl-D: <0.2 ng, $^{187}Os/^{188}Os = 0.15599 \pm 0.00047$) and mass spectrometry blanks were 1 pg for Os, with a $^{187}Os/^{188}Os$ of 0.20850 ± 0.00997 (Bl-E1) and 0.18656 ± 0.00662 (Bl-E2), respectively. Analyses of an Os isotopic mass spectrometry standard yielded a mean $^{187}Os/^{188}Os$ external reproducibility of 3%. Comparable external reproducibility was obtained on measured $^{189}Os/^{188}Os$ and $^{190}Os/^{188}Os$ for all samples. At present there is no accepted international rock standard for Os and Re concentrations and Os isotopic composition to permit laboratories to monitor overall analytical accuracy. We have attempted to assess our analytical accuracy by measuring the Os isotopic composition in the proposed peridotite PGE standard “WPR-1“ provided by the Canadian Certified reference Materials Project. Replicate analysis on this reference material on 3.07 g and 5.31 g aliquots have yielded Os concentrations of 16.8±0.6 and 17.1±0.5 ng/g Os, respectively [1]. This concentration compares well with the limited number of published Os concentrations available for WPR-1: 16.8 ng/g (Ripley et al. [2]; Carius tube isotopic dilution procedure).

Our measured Os-isotopic ratio on this standard material ($^{187}Os/^{188}Os = 0.14561 \pm 0.00014$) compares well with published isotopic analyses available for WPR-1: $^{187}Os/^{188}Os = 0.14543 \pm 0.00018$ (n = 3; Cohen, 1996), $^{187}Os/^{188}Os = 0.14599 \pm 0.00073$ (n = 7; Ripley et al. [2]) and $^{187}Os/^{188}Os = 0.14549 \pm 0.00018$ (n = 6; G. Pearson data from DTM, quoted in Cohen [3]). Our measured $^{187}Os/^{188}Os$-isotopic ratio on the low level PGE standard “WGB-1“ provided by the Canadian Certified reference Materials Project is 0.15824 ± 0.00019 and 0.15815 ± 0.00017, respectively. No published isotopic analyses are available for WGB-1.

Os isotopic systematics in metasomatized rocks in general have proven to be rather more complicated than was generally thought to be the case. Previously, the compatibility of Os and the incompatibility of the elements most involved in mantle metasomatism led most people to assume that the Re-Os isotopic system should be relatively resistent to being disturbed by this type of event. In reality, the results presented here show that in metasomatized rocks, the Os isotopic systematics are liable to be profoundly disturbed. In this study we have identified both highly disturbed and nearly undisturbed Os isotopic systematics of individual samples as a result of melt depletion followed by extensive melt-rock reaction. The disturbed samples all have in common a relatively low concentration of Os (i.e., less than 1.5 ng/g). However, the relationship of the Os disturbance to the metasomatism is not straightforward. Some of the most disturbed samples are highly metasomatized, and some of the least metasomatized samples are highly disturbed. The only real connection we can infer between these two processes lies in the fact that both seem to have been operative in this set of samples of the central European mantle (Fig. 4).

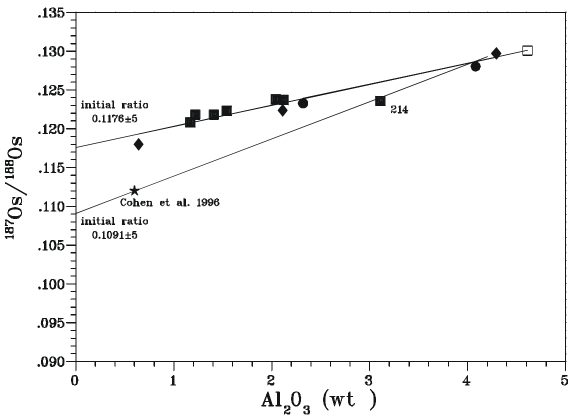
The disturbance of the Os isotopic calls somewhat into question the significance of any age results one might derive from them. However, those samples having higher (i.e., "mantle-like") concentrations of osmium (greater than 1.5 ng/g) appear to lie on a good correlation with Al_2O_3, which

Fig. 4



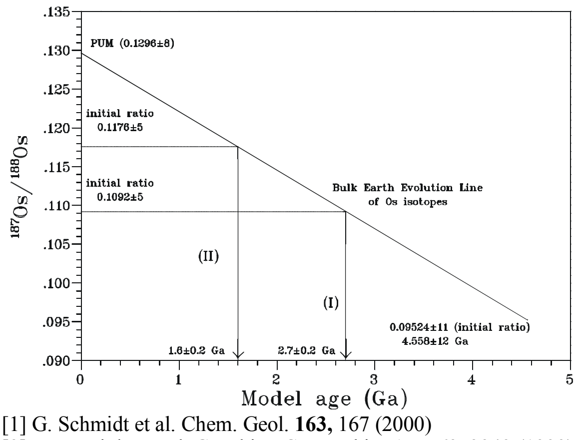
has frequently been used to infer age information. The high statistical significance of this correlation leads us to infer that it does indeed convey useful geologic information about the timing of the formation of the central European crust and mantle. The ages obtained in this way is ~ 1.6 Ga. It appears that the existence of a major mantle-forming event around 1.6 Ga in Europe is documented by these results (Figs.5,6).

Fig. 5



One sample would suggest a much older melt extraction event, perhaps in the Archean, if considered together with results of previous investigations [4].

Fig. 6



[1] G. Schmidt et al. Chem. Geol. **163,** 167 (2000)
[2] E.M. Ripley et al. Geochim. Cosmochim Acta **62**, 3349 (1999)
[3] A.S. Cohen Analyt. Chim. Acta **332**, 269 (1996)
[4] A.S. Cohen et al. J. Conf. Abs. **1**, 116 (1996)