

Glacial-interglacial variations in the $^{87}\text{Sr}/^{86}\text{Sr}$ composition of seawater

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Many natural radiogenic isotopes in seawater show variations on glacial-interglacial timescales that can be related to either local or global changes in continental weathering and/or changes in Ocean circulation. On such timescales the long residence time of Sr necessitates very large changes in the continental flux to the Oceans to cause a measurable shift in the $^{87}\text{Sr}/^{86}\text{Sr}$ value of seawater (Richter & Turekian, 1993). Early studies reported fluctuations in marine $^{87}\text{Sr}/^{86}\text{Sr}$ over glacial-interglacial cycles (Dia *et al.*, 1991; Clemens *et al.*, 1993) but later work indicated that at the ± 13 ppm level there was no evidence for any change (Henderson *et al.*, 1994). However, changes of 6-9 ppm could not be ruled out, which, though small, correspond to a $\sim 30\%$ change in the riverine Sr flux.

Since that time a new generation of TIMs instruments, has enabled a 5-10 fold improvement in the precision of absolute isotope ratio measurement. This study presents very-high precision $^{87}\text{Sr}/^{86}\text{Sr}$ measurements for planktonic foraminifera from ODP site 758 in the Indian Ocean, that complement existing $^{143}\text{Nd}/^{144}\text{Nd}$ and $^{187}\text{Os}/^{188}\text{Os}$ isotope data for the same samples. Repeat measurements of NBS 987 demonstrate a long term reproducibility of ± 3.4 ppm 2 s.d (n = 30). Size restricted samples of the species *G. conglobatus* and *N. dutertrei* were subject to oxidative-reductive cleaning and Sr separated using Elchrom Sr-spec resin. Preliminary results indicate the presence of 3-9 ppm cycles over glacial-interglacial timescales, but unlike Nd and Os these cycles are not in phase with the oxygen isotope curve (as predicted by Richter & Turekian, 1993). The simplest interpretation is that these variations reflect changes in continental input accompanying climate cycles, corresponding to a $\sim 10\text{-}30\%$ change in the riverine Sr flux.

References

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The origin of Tertiary intraplate volcanism in the Siebengebirge volcanic field, Germany

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The Miocene (~ 25 Ma old) Siebengebirge volcanic field, belonging to the Central European Volcanic Province (CEVP), is located at the SE end of the Northern Rhine Embayment near Bonn, Germany. For its relatively small size of ca. 900 km², mafic magma compositions are unusually diverse, ranging from basanites to alkali basalts. Differentiated rocks comprise both silica saturated (latitic to trachytic) and undersaturated compositions (phono-tephritic to tephri-phonolitic), which only occur in a small area in the central part. In contrast to other volcanic provinces in Germany, nearly all magmas appear to be subvolcanic.

In order to unravel mantle sources of the magmas, trace element and isotope compositions were determined for representative mafic and felsic samples. In mafic samples (MgO > 7 wt.%), ϵ_{Hf} range from +6.5 to +8.0, ϵ_{Nd} from +3.1 to +4.4, $^{87}\text{Sr}/^{86}\text{Sr}$ from 0.7034-0.7038, and Pb isotope compositions from 19.46-19.69 ($^{206}\text{Pb}/^{204}\text{Pb}$), 15.63-15.66 ($^{207}\text{Pb}/^{204}\text{Pb}$) and 39.34-39.62 ($^{208}\text{Pb}/^{204}\text{Pb}$). Together with the Hoheifel volcanic field, the mafic Siebengebirge samples display the highest Pb isotope compositions amongst all other volcanic provinces in Germany (i.e., Hessian Depression, Westerwald, West Eifel, East Eifel, Vogelsberg).

Trace element patterns show a strong enrichment of LREE compared to the HREE, indicating enriched sources in the spinel and garnet peridotite transition zone. Isotopically, the primitive samples cover a range between a “HIMU-like” endmember composition, compositions reflecting the influence of subducted sediments (“EM-2 like”) and depleted endmembers. High Zr/Hf ratios and positive Nb anomalies confirm the presence of HIMU-like domains, originating from recycled oceanic crust.

Alkali basaltic compositions reflect higher melting degrees and lower average melting depths than basanitic compositions, indicating a variable lithosphere thickness. Negative K-anomalies in primitive mantle normalized trace element diagrams reveal the influence of a volatile- and K-rich phase, most likely amphibole in the lithospheric mantle. Notably, the K anomalies are neither correlated with trace element or Pb isotope variations, suggesting a minor role of lithospheric components. Hence, the enriched signatures rather originate from locally enriched domains in the convecting asthenospheric mantle.

The silica saturated group of differentiated rocks can be shown to originate from alkali basaltic parental magmas whereas the undersaturated group crystallized from basanitic parental magmas. High $^{87}\text{Sr}/^{86}\text{Sr}$ (up to 0.7062), low ϵ_{Nd} and ϵ_{Hf} (as low as -2.3 and +0.4, respectively) indicate significant upper crustal contamination for both groups.