Evidence for Recycled Crustal Material Within the Upper Mantle Beneath the St Paul Fracture Zone, Equatorial Atlantic

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Abstract

Basalts were carefully collected along intratransform ridges (ITR) within the St Paul Fracture Zone(Equatorial Atlantic) using the submersible Nautile and the R/V Nadir. They come from two intratransform ridge segments A and C at 25°27 W and 27°42W respectively. All samples are tholeiites although samples from segment C (K20 about 0.4%) are more alkalic than those from segment A (K20 $<$ 0.2%). REE patterns exhibit the same contrast, segment C samples being mildly enriched (La/SmN of 1.6) and segment A samples mostly depleted (0.4 $<$ La/SmN $<$1.0). Moreover, Ce/Pb is elevated in segment C (35) and "normal" in segment A (20-25). In $^{87}Sr/^{86}Sr$ vs $^{143}Nd/^{144}Nd$, segment A samples fall within the North Atlantic trend whereas segment C samples fall below it towards the "1°7N anomaly" (Schilling et al. 1994). Pb isotopes display a comparable distribution. Combining Pb and Sr isotopes shows that segment C and 1°7N anomaly samples plot toward an HIMU component. This is supported by the elevated Ce/Pb values which are typical of true HIMU basalts. Our data support the existence of an HIMU component within the Equatorial Atlantic upper mantle, component which is classically thought to reflect the presence of recycled oceanic crust within the mantle for a long time. This is in agreement with the model of a recycled lithosphere within the upper mantle (Maia et al. 2001) based on Os isotope evidence (Esperança et al. 1999). Data on abyssal peridotites from this area have led to Os isochron ages of 0.6-1.1 Ga for this recycled component. This relatively “young” age would explain why this potential HIMU component has not developed yet the characteristic Pb isotope composition whereas its elevated Ce/Pb ratios reflect this origin. This model is also supported by seismic tomography (Maia et al.2001) which predicts the presence of a cold mantle beneath this area within the upper mantle. This thermal anomaly may also indicate the presence of a recycled cold lithosphere.