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Partial melting versus source composition from basalts dredged inside the cold mantle environment of the St. Paul Fracture Zone (Equatorial Atlantic)

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The St. Paul multi-transform system is formed by four slow-slipping transform faults bounded by three short intra-transform ridge segments (ITRS), which offset the Equatorial Mid Atlantic Ridge by 630 km. Spreading style in the three segments varies: more magmatic in the northern ITRS, dominated by tectonic processes in both central and southern ITRS. Basalts were sampled in the axial domain of the three ITRS and have been analyzed for major and trace elements as well as for radiogenic isotopes (Sr, Nd, Pb and Hf). All samples analyses were glassy. They were collected during the dive expedition St PAUL in 1999 on the R/V Nadir and the dredging expedition COLMEIA in 2013 on the R/V L'Atalante. All samples but two come from the ITR grabens, the two others from the off axis domain west of the northern ITRS. All samples from the northern ITRS exhibit enriched REE patterns with positive slopes on light and heavy REE. The two old axis samples whose age is approximate at 3.3-4.6 Ma show an even stronger REE enrichment. The south and central ITRS have produced depleted to flat REE pattern samples, the central ITRS samples having overall higher concentrations. Radiogenic isotopes overall also show contrast between the three ITRS: the northern ITRS has radiogenic compositions compatible with an input of enriched mantle material in its source such as proposed by Schilling et al. (1994) from the anomaly of composition noted on the Mid Atlantic Ridge just north of the St Paul region at 1.8°N. Overall the northern ITRS samples fall into the trends defined by the on axis MAR samples to the north of the St Paul region. Regarding isotope ratios, the southern ITRS samples fall onto a trend defined by samples collected south of the St Paul region, a mantle region clearly more depleted and rather homogeneous. The central ITRS reveals samples that are for isotopes, in an intermediate position between north and south ITRS. However, they are rather homogeneous but tend to be distinct and more radiogenic in Hf isotopes from the southern ones, which were also found also REE depleted. Therefore, the St Paul region is a rather clear border between tow mantle domains but the central part of it is not a simply mixing zone; it shows specific compositions likely to be related to a particular melting regime as exemplified by the tectonic style of it.

Schilling J.G., Hanan B.B., MCCully B., Kingsley R.H., 1994, Influence of the Sierra Leone mantle plume on the equatorial Mid-Atlantic Ridge : a Nd-Sr-Pb isotopic study. J. Geophys. Res. 99, 12005-12028