Introduction

Abyssal peridotites (AP) are residual after melting that generates mid-ocean ridge basalts (MORB). In fact there is a good correlation between the chemistry of APs and MORB. In general, APs from ridge segments that are influenced by a hotspot are more depleted, in terms of both chemistry and mineralogy, than peridotites from ridge segments that produce N-type MORB only. The chemical and modal variations in peridotites (and complementary variations in Na₂O in associated basalts) are interpreted as variations in the degree of melting, with higher degrees of melting characterizing the sub-ridge mantle as the ridge falls under the influence of a hotspot. However, the co-variations of APs, MORB, ridge depth, and proximity to mantle hot spots do not account for much more than 50% of the variability of the geochemical parameters, leaving considerable room for local and regional variations in mantle composition and the dynamics of melting. The question is thus are the peridotites the only source for the MORB or does another lithology involved. In previous studies Salters and Dick [2] and Cipriani et al. [1] found that the abyssal peridotites exhibit more radiogenic Nd-isotopic compositions than the associated basalts. This would indicate that a second lithology (with a lower solidus) also contributes to MORB. Consequently, melting models based just on peridotite melting are incorrect. We have expanded on the Salters and Dick study and here we report data on the oblique spreading center along the Southwest Indian Ridge.

Results and Discussion

Figure 1 shows the rare Earth Element (REE) pattern of clinopyroxenes from abyssal peridotites and their melts. The LREE depleted patterns are of clinopyroxenes in the matrix peridotite, while the flat patterns are of clinopyroxenes that are associated with pyroxene-rich veins. The LREE depleted patterns are clearly residual after melting. The sharp drop-off in LREE of these clinopyroxenes indicates that these pyroxenes are not in equilibrium with aggregated MORB. The flat REE pattern of the vein-type clinopyroxenes can be in equilibrium with MOR-type melt. Nd-isotope compositions differ in a manner consistent with the REE patterns. The matrix pyroxenes in general have higher \(^{143}\text{Nd}/^{144}\text{Nd}\) than the vein clinopyroxenes, whereby the vein pyroxenites are interpreted as crystallization products from MORB. This implies that partial melts already aggregate before they reach a magma chamber.

Conclusions

This data confirms that melting to generate MORB involves two lithologies. In addition to peridotite a second lithology with a lower solidus must be present. This lithology is most likely garnet pyroxenite. Therefore models of melting that consider only peridotite melting are in error.

References