Subsolidus effects on clinopyroxene REE variations in residual peridotites

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The studies of abyssal peridotites have given the important constraints for the generation of MORB from the perspective of melting residues. Recently, Hellebrand et al. (2002) demonstrated that clinopyroxene from global abyssal peridotites have ratios of MREE/HREE (e.g. Sm/Yb) that are too low to be explained by melting of spinel peridotite, and concluded that at least 0-6% melting have occurred in the garnet stability field. Although it is possible that typical “garnet signature” found in geochemical data of global MORB can be ascribed to a pyroxenitic heterogeneity in the source region, the “garnet signature” recorded in residual peridotites leads to the direct implication for the high temperature of the upwelling mantle. Here we present clinopyroxene REE variations in certain peridotite xenoliths carried to the surface by 34 Ma alnoite, Malaita, Solomon Islands, to address the role of garnet during melting in a mid-oceanic ridge setting. Previous isotopic study revealed that they can be regarded as a series of melting residue after extraction of Pacific MORB at the time of ~160 Ma, inferring that they are comparable to abyssal peridotites. On a Sm/Yb ratio versus Yb content diagram, the measured clinopyroxenes yield a constrained trend which deviates from the field of global abyssal peridotites toward higher Yb contents at given Sm/Yb ratios, displaying apparently strong signature for the garnet peridotite melting. However, a more likely cause for the deviation would be large extents of subsolidus reequilibration attained by their long residence in the mantle after melt extraction occurred. In response to pyroxene compositional change with decreasing temperature, modal orthopyroxene/clinopyroxene ratio increases and orthopyroxene/clinopyroxene partition coefficients for all REE decrease. As a consequence, subsolidus high-Ca clinopyroxene tends to have higher Yb contents at given Sm/Yb ratios relative to those of magmatic low-Ca clinopyroxene, that mimic the possible garnet signature in residual peridotites. Thus, caution should be exercised while using clinopyroxene REE variation to address the melting history of peridotite because all natural peridotites more or less suffered the subsolidus effects even for ~0 Ma abyssal peridotites.

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