The role of melt-rock reaction in creating Enriched-MORB mantle sources

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Deep melt intrusion and melt-peridotite interaction are efficient processes in creating chemical and isotopic heterogeneity in the upper mantle at variable scales. These processes generate pyroxenite-bearing lherzolite often invoked as a source of oceanic magmatism. Natural analogs of such veined mantle are very rare, and our understanding of mechanisms governing the chemical modification of MORB sources by pyroxenite emplacement is very limited. Here we discuss the results of detailed spatially-controlled chemical and Nd, Hf isotopic profiles in pyroxenites and host lherzolites from the Ligurian ophiolites (Italy), an ideal proxy of a fertile veined mantle. We show that percolative reactive flow of pyroxenite-derived melts caused systematic chemical modifications in the host peridotites (e.g. increased REE contents coupled with decreased Sm/Nd and Lu/Hf ratios in clinopyroxene) extending well into the peridotite (up to 25 cm) from cm-scale pyroxenite veins. Over time, this resulted in significant Nd and Hf isotopic changes in the infiltrated peridotites, generating an enriched mantle component and signifcant isotopic heterogeneity encompassing the global variability of MORBs. Thus pyroxenite veins emplacement by deep melt infiltration is able to metasomatize a much larger volume of the host peridotite, propagating and amplifying enriched Nd and Hf isotopic signatures. Hybrid mantle domains made of pyroxenite, metasomatized peridotite and unmodified peridotite potentially represent mantle sources of Enriched-MORBs. Overall, results of our work point to the key roles of melt percolation and melt-peridotite reactions in modifying the upwelling mantle prior to oceanic basalts production.