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Geochemical interaction between slab-derived melts and mantle at high pressure in subduction zones

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The fate of crust-derived melts at warm subduction zones and the transport mechanism of crustal components to the supra-subduction mantle is still matter of debate. Borgo outcrop of Monte Duria Area (Adula-Cima Lunga unit, Central Alps, Italy) is an excellent case study of melt-peridotite interaction occurred under a deformation regime at high pressure, that enabled the combination of porous and focused flow of eclogite-derived melts into garnet peridotites. Migmatised eclogites are in direct contact with retrogressed garnet peridotites and experienced a common high pressure (2.8 GPa - 750 °C) and post-peak (0.8–1.0 GPa - 850 °C) static equilibration. The contact is marked by a tremolitite layer, also occurring as boudins parallel to the garnet layering in the peridotites, derived from a garnet websterite precursor after the interaction between eclogitic melts and peridotites at high pressure. LREE concentrations of retrogressed websterites along a 120 m length profile starting from the eclogite-peridotite contact to the inner part of the peridotite, show a progressive enrichment coupled with a peculiar fractionation. Numerical modelling assuming the eclogitic leucosome as the starting percolating melt reproduces the REE enrichment and LREE-HREE fractionation observed in retrogressed websterites bulks within the first 30 m by two steps of melt-peridotite reaction: a high peridotite assimilation at eclogite-peridotite boundary, followed by reactive melt percolation within the peridotite assuming variable amounts of olivine assimilation and pyroxene + amphibole/phlogopite crystallisation. The numerical simulation aims to model the effect of interaction between crust-derived melts produced by partial melting of mafic slab component with suprasubduction mantle peridotites at sub-arc depths. The comparison between the REE composition of the retrogressed garnet websterites along the profile and the result of our model suggests that reactive melt infiltration at HP is a plausible mechanism to modify the REE budged of mantle peridotites that lie on top of the subducting crustal slab, which show peculiar LREE “spoon-like” fractionations. Moreover, the melt/peridotite interaction and the percolation of slab-derived melts into the overlying mantle may strongly modify the overall REE abundance and LREE/HREE fractionation (*e.g.*, Ce_N/Yb_N) of the residual crustal melt within the first 30 m of slab/mantle interface.