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Slab-derived melt metasomatism: an example from Patagonia

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Slab-melts travelling through the mantle wedge induce various kinds of reactions in the peridotite, and, depending on melt/rock ratio, can cause cryptic and/or modal enrichments with the production of orthopyroxene + amphibole and phlogopite at the expense of olivine. The generation of new opx is a peculiar petrographical feature both as crystals formed at the expense of olivine and as fibrous aggregates in the peridotitic matrix, and veins.
Ultramafic xenoliths found in Quaternary volcanics at Cerro del Fraile, Patagonia, only 150 km from the trench, represent fragments of the mantle wedge above the subducting Antarctic plate. Samples are protogranular lherzolites, with minor harzburgites, dunites and plagioclase-bearing orthopyroxenites and websterites. Two composite samples are characterized by dunites cut by orthopyroxenite or clinopyroxenite veins.
Primary cpx of peridotites (cpx1) and of the clinopyroxenite vein have mg# ranging from 88.5 to 93.5 with very low TiO2 contents, whereas cpx in orthopyroxenites have lower mg# and higher Al2O3 and TiO2 contents. Mg#, Al2O3 and Na2O of peridotitic opx range from 87.9 to 91.4, 1.33 to 4.20 wt% and 0.02 to 0.17 wt%, respectively. Opx in orthopyroxenites and websterites are characterized by lower and more variable mg# (71.9-86.9), higher Al2O3 (2.98-5.35 wt%) and similar Na2O values.
Based on trace element contents cpx1 can be divided into two groups. Group1 has convex downward pattern from Gd to Lu, and variable enrichments from Eu to La: (La/Yb)N, 0.05-4.04. It has positive Sr anomaly, variable Th and U contents and a positive Zr-Hf anomaly. Group2 has lower HREE content with respect to Group1 at comparable LREE, leading to higher (La/Yb)N (1.83-14.23). It has the highest Th and U contents, the widest Zr-Hf positive anomalies and a huge Ti through. Cpx of clinopyroxenite vein have a flat REE pattern [(La/Yb)N, 1.24-1.74] with a marked positive Sr spike. Opx in peridotites are of two types (even in the same sample): the first, more abundant, is characterised by fractionated HREE, a negative Sr anomaly and low LREE [(La/Yb)N, 0.01 - 0.70]. The second type has identical HREE values but it is enriched in LREE [(La/Yb)N, 1.18 - 2.81]. Opx of orthopyroxenites and websterites are different, with flat REE pattern at about 1 x Ch, and Sr and Ti contents higher than opx in peridotites.
Opx and cpx composition in peridotite xenoliths is consistent with interaction and hybridization with a Si-Al-rich melt, deriving from melting of the Antarctic subducting plate. This melt hybridized with peridotites, caused LREE-enrichments in both pyroxenes and the onset of positive Zr-Hf anomalies in cpx1. Calculated melts in equilibrium with cpx of all lithologies closely resemble the composition of adakitic magmas erupted in the Austral Volcanic Zone.