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The Northern Lanzo peridotite massif (Western Italian Alps): sub-continental lithospheric mantle percolated and impregnated by MORB melts.

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The Northern body of the Lanzo peridotite massif (hereafter referred as North Lanzo) in the Western Alps is a small mass (5 km^2), separated by mylonitic shear zones from the main massif. It has been firstly considered part of an asthenospheric mantle diapir emplaced during the early stages of opening of the Jurassic Ligurian Tethys. Bodinier et al. (1991) interpreted it as DMM material separated from the convective mantle and accreted to the sub-continental lithosphere near the Proterozoic-Phanerozoic boundary.

Our ongoing field, structural, petrologic and geochemical studies on the North Lanzo body reveal the dominant occurrence of plagioclase(plg)-enriched peridotites, at which are subordinately associated pyroxene-depleted spinel(sp)-harzburgites. It is evident that all these lithologies replace pristine lithospheric spinel lherzolites.

Lithospheric mantle remnants at North Lanzo are represented by porphyroclastic cpx-rich (12.0-14.5% by volume) lherzolite, with spinel-facies mineral assemblage and abundant cm- to dm-wide spinel pyroxenite banding. Bulk rock compositions are rather fertile compositions, being characterized by relatively high SiO_2 (45.2-45.5 wt%), Al_2O_3(2.5-3.5 wt%) and CaO (2.5-3.0 wt%) and relatively low MgO (38.6-40.2 wt%). They show C1-normalized patterns slightly LREE-depleted (Ce_N/Sm_N = 0.43-0.45) and almost flat in the MREE-HREE region (at more than 2 xC1).

Sp-facies cpx porphyroclasts usually show abundant exsolution lamellae of orthopyroxene (opx) and plg, indicating incipient crystallization during decompression evo-

lution to plg-facies conditions.

Hectometre-scale masses are strongly enriched in plg (up to 14% by volume). The textural and compositional features of these peridotites indicate that they experienced a strong interaction with migrating melts, charcterized by the interstitial crystallization of large melt volumes (melt impregnation). In fact, they consist of an older sp-facies assemblage and a new interstitial, magmatic fine-grained aggregate, consisting of ol+plg. Bulk rocks have slightly lower SiO_2 (43.3-43.9 wt%) and slightly higher Al_2O_3(3.0-4.2 wt%), CaO (2.9-3.6 wt%) and MgO (39.0-41.5 wt%) with respect to lithospheric lherzolites, consistently with ol+plg addition. Bulk rock C1-normalized REE patterns are almost flat in the MREE-HREE region (in the range 2-3 xC1) and show a variable LREE depletion (Ce_N/Sm_N 0.11-0.54).

Clinopyroxenes of plg peridotites, both pristine exsolved porphyroclasts and new magmatic grains, have closely similar trace element concentrations and REE patterns, these latter being characterized by humped spectra with both HREE and LREE fractionation and maximum at Sm-Gd: they show negative anomalies of both Eu_N and Sr_N, indicating equilibration with plagioclase. The closely similar trace element compositions of cpx, irrespectively of the microtextural site, suggest that these impregnated plagioclase peridotites approached the chemical equilibrium with the percolating melts. The constant negative LREE fractionation in the cpx REE patterns indicates the MORB affinity of the equilibrium melts.

In places, decameter-scale masses of sp-harzburgites crop out, which are strongly depleted in pyroxenes. Their modal composition, as represented by sample LN22, is: cpx=6.7%, opx=7.1%, ol=82.5%, sp=3.7%. Bulk rock has relatively low SiO_2 (43.0 wt%), Al_2O_3(1.6 wt%) and CaO (0.9 wt%) and high MgO (45.4 wt%) contents, and are strongly depleted in incompatible trace elements. The C1-normalized REE pattern is broadly concave (minimum at Tb 0.28 xC1), with LREE and HREE concentrations always lower than 0.54 and 0.66 xC1, respectively.

Our data evidence that the North Lanzo lherzolites, after their accretion to the sub-continental lithosphere, underwent a composite tectonic-metamorphic and melt-related evolution consisting of:

1) subsolidus decompression evolution, as indicated by the incipient plg-facies recrystallization;

2) percolation and impregnation by MORB-type melts at relatively shallow conditions, as indicated by petrologic (i.e. the crystallization of ol+plg mineral assemblage), textural and geochemical data.

Accordingly, it can be inferred that the lherzolites from the North Lanzo body are the

remnant of the sub-continental lithospheric mantle of the Europe-Adria realm involved in the tectonic and magmatic evolution linked to the opening of the Ligurian Tethys. The lithospheric mantle underwent subsolidus exhumation from sp-facies conditions (P in the range 2.5-1.0 GPa) to plg-facies conditions ($P < 1.0$ GPa) whilst the underlying asthenosphere underwent partial melting, most probably under decompression and adiabatic upwelling in response of lithospheric extension.

Field relations and textural evidence suggest that asthenosphere partial melting occurred late in the decompression evolution, since asthenospheric melts entered the lithospheric levels when they have been already exhumed to shallow, plg-facies conditions. MORB reactive percolation and impregnation significantly modified the textural and compositional characteristic of the pristine lithospheric sp-facies lherzolites.

This scenario is complementary to that one described for the South Lanzo body (Piccardo et al., 2006) and could represent the structural and magmatic evolution of a more “External” (continent-ward) sector or a more ”shallow” level of the pristine subcontinental lithosphere, with respect to the more “Internal” (ocean-ward), strongly melt-modified peridotites of the South Lanzo body.

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Piccardo G.B., Zanetti A., Poggi E., Spagnolo G., Müntener O. (2006) - Melt/peridotite interaction in the South Lanzo peridotite: field, textural and geochemical evidence. Lithos (in press).