Geophysical Research Abstracts
Vol. 12, EGU2010-10864, 2010
EGU General Assembly 2010

The “reactive” peridotites of the alpine ophiolites: melt-rock interaction in the subcontinental lithosphere

Giovanni Battista Piccardo and Luisa Guarnieri
University of Genova, DIPTERIS, Genova, Italy (piccardo@dipteris.unige.it)

The Ligurian ophiolitic peridotites [South Lanzo, Erro-Tobbio, Internal Ligurides and Corsica] are characterized by the abundance of spinel(Sp) peridotites showing depleted compositions and ranging from Cpx-poor Sp lherzolites to Sp harzburgites. They were recognized in the last decades as refractory residua by MORB-forming partial melting of the asthenosphere, and were similar to abyssal peridotites. Recent structural and compositional studies promoted a better understanding of their structural and compositional features and their genetic processes. In the field these depleted peridotites replace with primary contacts pyroxenite-bearing fertile Sp lherzolites that have been recognized as sub-continental lithospheric mantle. Field relationships evidence that decametric-hectometric bodies of pristine pyroxenite-veined lithospheric Sp lherzolites are preserved as structural remnants within the km-scale masses of depleted peridotites.

The depleted peridotites show coarse-grained recrystallized textures and reaction micro-structures indicating pyroxene dissolution and olivine precipitation that have been considered as records of melt/peridotite interaction during reactive diffuse porous flow of undersaturated melts. They show, moreover, contrasting bulk and mineral chemistries that cannot be produced by simple partial melting and melt extraction. In particular, their bulk compositions are depleted in SiO2 and enriched in FeO with respect to refractory residua after any kind of partial melting, as calculated by Niu (1997), indicating that they cannot be formed by simple partial melting and melt extraction processes. Moreover, TiO2 content in Sp is usually significantly higher (up to 0.8-1.0 wt%) than typical TiO2 contents of spinels (usually $<$ 0.1-0.2 wt %) in fertile mantle peridotites and melting refractory residua, indicating that spinel attained element equilibration with a Ti-bearing basaltic melt.

The depleted peridotites usually show strongly variable Cpx modal proportions (in range 2-10% vol. modal content) in the same peridotite body. Notwithstanding this strong Cpx modal variation, the Cpx C1-normalized REE patterns are closely similar, at the scale of the same massif. Cpx does not show progressive trace element depletion/fractionation concordantly with progressive decrease of the Cpx content, as expected during progressive partial melting. Cpx shows both: 1) sinusoidal patterns enriched in the L-MREE and depleted in the HREE, and 2) strongly LREE fractionated patterns, almost flat in the MREE-HREE region. Type-1 Cpx sinusoidal REE patterns are consistent with trace element equilibration with melts which record transient geochemical gradients formed during melt-peridotite interaction under long time-integrated melt-rock ratios. Type-2 Cpx fractionated REE patterns are closely similar to those of Cpx that attained trace element equilibration with fractional melts with MORB affinity. The fractionated and sinusoidal Cpx REE patterns indicate that the depleted peridotites underwent melt-peridotite interaction under open system melt migration, both at high melt/rock ratios and long time-integrated melt-rock ratios. The compositional characteristics of the percolating melts in equilibrium with Cpx, assuming that mantle Cpx and percolating liquids attained trace element equilibration during melt-peridotite interaction, are quite similar to those of liquids produced by 4-7% fractional melting of a Sp-facies DM asthenospheric mantle source.

In summary, the micro-structural features and the compositional characteristics indicate that their petrogenetic process is represented by melt/peridotite interaction via reactive diffuse porous flow percolation.

They are closely similar to the Huinan harzburgite xenoliths (Xu et al., 2003) that show a secondary recrystallized texture and compositions that deviate from the partial melting trend of residual peridotites. They are considered “reactive” harzburgites likely resulted from basaltic melt-rock interaction (dissolving pyroxenes and precipitating olivine) at the expense of a lherzolite protolith, transforming lherzolite to harzburgite.

In summary, the depleted Sp peridotites of the Alpine-Apennine ophiolites are recognized as lithospheric “reac-

tive" peridotites, and not asthenospheric refractory residua after oceanic-type MORB-forming partial melting.
Xu Y-G, 2003. Geochim. Cosmochim. Acta, 67, 487–505.
Niu Y., 1997. J. Petrol., 38, 1047-1074.