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Structural and compositional effects of melt-peridotite interaction: the reactive peridotites of Mt. Arpone (Lanzo South – Western Alps).

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At Monte Arpone (Lanzo South), hectometre-scale bodies of coarse granular, cpx-bearing spinel harzburgites crop out; they transform and replace former spinel-facies peridotites which are characterized by marked tectonite fabric and parallelized spinel pyroxenite banding.

Coarse granular spinel harzburgites preserve structural-mineralogical relics of the pristine spinel peridotites, consisting of: i) broadly rounded intergrowths (clusters) of opx+sp($\pm$cpx), which represent the breakdown product of a preexisting mantle garnet, and ii) micro-symplectites of vermicular spinel at the outer borders of orthopyroxene (Opx) porphyroclasts, which indicate the exsolution of a Mg-Tschermakitic component from a preexisting Al-rich opx, stable at higher temperatures under spinel-facies conditions.

It can be deduced that the mantle protolith underwent exhumation from garnet- to spinel-facies conditions and was recrystallised under cooling, most probably, after isolation from the convecting asthenosphere and accretion to the thermal lithosphere.

Granular harzburgites show widespread textures indicating pyroxene-dissolving, olivine-forming processes, mostly consisting of: i) coarse rims of unstrained olivine surrounding and replacing deformed mantle pyroxene porphyroclasts; ii) small crystals of both pyroxenes interstitial to the mantle assemblage and the reaction textures. Clinopyroxene (Cpx) content is strongly decreased in the granular harzburgites with respect to previous peridotites.

Textural features indicate that the mantle protolith was, at first, diffusely percolated by reactive, pyroxene-undersaturated melts, which dissolved most of mantle Cpx and precipitated olivine. Subsequent interstitial crystallization of magmatic pyroxenes suggest that percolating melts attained pyroxene-saturation during the final stage of reactive percolation and underwent incipient crystallization of liquidus pyroxenes.

Bulk rock compositions of reactive spinel harzburgites are characterized by relatively low contents in fusible components (Al_2O_3 0.95-2.11 wt%, CaO 1.15-1.76 wt%, $TiO_2$0.03-0.04 wt%), high MgO (43.20-44.95 wt%) and low SiO_2(41.75-41.93 wt%) contents. Their compositions do not correspond to those of refractory residua after any kind of partial melting: they show, in particular, significantly lower SiO_2, and higher FeO contents than those of peridotite refractory residua.

Cpx trace element composition is remarkably homogeneous in one sample, irrespectively of the textural site (porphyroclast core or rim, interstitial magmatic grain), suggesting overall equilibration with the percolating melt. By contrast, Cpx shows impressive compositional heterogeneity from sample to sample.

Cpx trace element compositions are, as a rule, by far different with respect to those expected for Cpx in refractory residua after or those in chemical equilibrium with primary asthenospheric melts. Solely: i) the composition of Cpx LAS3, having the highest HREE content, C1-normalized REE patterns almost flat in the MREE-HREE region and a significant LREE fractionation, is consistent with equilibration with a melt increment modelled by 5% fractional melting of spinel-facies DM source, and ii) the composition of Cpx LAF17, having strongly humped C1-normalized REE patterns and strongly fractionated LREE and HREE, with respect to MREE, is consistent with a liquid modelled by 5% fractional melting of garnet-facies DM source.

Conversely, both bulk rock and Cpx from most of the samples show sinusoidal REE patterns which indicate that: i) complicate geochemical gradients were developed during melt-rock interaction, ii) the composition of the percolating melts evolved in response of reaction with ambient peridotite.

Our study describes the structural and compositional effects of melt-rock interaction between a spinel-facies mantle peridotite and asthenospheric melts uprising by porous flow percolation from deep mantle sources.

The percolating primary melts had pyroxene-undersaturated, olivine-oversaturated compositions, showing strong similarity to single melt increments produced by low degrees (about 5%) of near-fractional melting of spinel- and garnet-facies asthenospheric DM sources.

Both structural and compositional characters of the affected lithospheric peridotite were strongly modified by melt interaction: i) percolated deformed peridotites were recovered to coarse granular textures; ii) peridotite modal composition was significantly changed to strongly pyroxene-depleted harzburgites; iii) Cpx trace element compositions record equilibration with the percolating melts, which modified their trace element compositions in response of the assimilation-crystallization processes which characterized the melt-peridotite interaction.