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# High pressure melting of phengite-bearing eclogite: evidence for multiple slab-derived melt/fluid-mantle interaction during HP and HT metamorphism of grt-peridotites of Monte Duria (Central Alps, N Italy)

Luca Pellegrino (1), Nadia Malaspina (), Stefano Zanchetta (), Antonio Langone (), and Simone Tumiati ()

(1) Department of Earth and Environmental Sciences, University of Milano Bicocca, Milano, Italy (l.pellegrino3@campus.unimib.it), (2) Istituto di Geoscienze e Georisorse-C.N.R. U.O.S. of Pavia, Pavia, Italy, (3) Department of Earth Sciences, University of Milano, Milano, Italy

The Monte Duria area is located in the southern part of the Adula Nappe on the north-eastern side of the Como Lake (N Italy). Garnet/chlorite peridotites were found within Bt-rich migmatitic gneiss or in direct contact with amphibole-bearing migmatites containing boudins of variably granulitised eclogites. The contact between mafic and ultramafic rocks is marked by the occurrence of a metasomatic rim composed by tremolite and dispersed round-shaped chlorite aggregates. The occurrence of lobes and cusps structures and Qtz+Pl+Kf+Bt leucosomes in eclogites provide evidence for partial melting of these rocks.
Petrographic and mineral chemical data indicate that peridotites and associated eclogites experienced a HP metamorphic peak followed by a granulitic overprint during their exhumation path. Peridotites and associated eclogites reached the eclogitic peak at $\approx$ 2.8 GPa and $\approx$ 730 $\pm$ 20 °C whereas P-T estimates on symplectitic assemblages replacing HP minerals in both mafic and ultramafic rocks yielded conditions of 0.8-1.2 GPa and 850 °C (Tumiati et al. 2018).
The micostructural evidence of Qtz+Pl+Kf+Bt pockets in eclogites support the field evidence of a partial melting event. Eclogites display a HP assemblage formed by Grt+Ky+Omp+Kf, suggesting that a former phengite was completely consumed by the reaction Phe+Cpx+$SiO_2$ = Grt+Ky+Kfs+Melt, further indicating that melting occurred at HP conditions. At this stage a clinopyroxenite reaction front probably results from a Ca-rich mafic silicate melt - peridotite interaction. Therefore, we suggest that tremolite-rich metasomatic rim probably represents a former grt-clinopyroxenite reaction front subsequently retrogressed under green-schist facies conditions through the reaction Cpx+Opx+Grt+$H_2O$ = Tr+Chl.
Bulk rock trace element analyses of peridotites show REE content slightly lower than DM with a fractionation characterised by LREE enrichment (La/NdN = 2.4) indicating that these rocks record an interaction with a silicate melt. A similar REE pattern is also displayed by eclogites, but the nature of such an imprint is likely inherited by a cumulitic gabbro protolith. The metasomatic rim shows REE concentrations slightly higher than DM with a LREE enrichment and a slight Eu negative anomaly. This pattern broadly resembles the trace elements composition of pyroxenites from other localities of eastern Europe (i.e. Gföhl Moldanubian Nappe), interpreted as the product of infiltration of slab-derived melts in the overlying lithospheric wedge (Medaris et al., 2006). The trace elements patterns of peridotites, metasomatic rim, and associated eclogites all show also an enrichment in fluid-mobile elements, such as Cs, Rb, Ba and K, and an high U/Th ratio suggesting that a subsequent fluid-assisted metasomatic event affected both mafic and ultramafic rocks under granulite or amphibolite facies conditions.
The Monte Duria area represents a unique case study where mafic melt - peridotite interaction occurs at high pressure and relatively high temperature in the Adula Nappe complex. The melt-rock interaction recorded by the Monte Duria peridotites could thus represent a proxy for the crust-to mantle mass transfer at great depths in “warm” subduction environments.

References:
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Tumiati S. & Co (2018) J. Petrol. doi:10.1093/petrology/egy021