Geophysical Research Abstracts, Vol. 9, 07569, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07569

Melt migration and melt/rock interaction in the lithospheric mantle at slow spreading extensional settings: insights from the Erro-Tobbio peridotites (Ligurian Alps, Italy).

E. Rampone (1) and G. Borghini (1)

(1) Dipartimento per lo Studio del Territorio e delle sue Risorse, University of Genova, Genova, Italy (betta@dipteris.unige.it / Fax: +39 10 352169 / Phone: +39 10 3538315)

Non-volcanic rifted margins and ultra-slow spreading ridges are geodynamic settings where large km-scale sectors of lithospheric mantle are exhumed at the ocean floor. The Alpine-Apennine ophiolites (e.g. the Erro-Tobbio, ET, Unit, Ligurian Alps, Italy) are a well known analogue of such settings, being mostly constituted by subcontinental mantle peridotites which were exposed at shallow environments. Recent studies have revealed that peridotites experienced multiple stages of melt/rock interaction and various melt intrusion events which occurred at different lithospheric depths, thus providing insights on mantle dynamics and lithosphere-astenosphere interactions during progressive lithosphere extension. Here we present an overview of this multi-stage melt migration and intrusion history, as recorded in the ET mantle. In the ET spinel peridotites, the oldest intrusion event is represented by the diffuse occurrence of cm-scale pyroxenite (mostly spinel websterite) bands. They often display isoclinal folds crosscut by mantle tectonite foliation, their primary intrusion relationships thus being transposed by old deformation events. Pyroxenites display variable bulk Al_2O_3 (5.92–10.16 wt%) and CaO (7.52-10.89 wt%) contents, and variably fractionated REE spectra, marked by LREE depletion (Ce_N/Yb_N = 0.034-0.15) and absent Eu_N anomaly. Their compositions are similar to those of spinel websterites from the French Pyrenees (Bodinier et al., 1987), and indicate an origin as high-P cumulates. In a few pyroxenite layers, clinopyroxenes hold an unusual trace element signature (high Sc,V contents and strong MREE/HREE fractionation), witness of a precursor garnet-bearing magmatic assemblage. The likely occurrence of garnet in the

primary magmatic assemblage constrains the depth of intrusion and crystallization at $P > 15$-20 kbar (Hirschmann and Stolper, 1996), and it is consistent with preserved opx+spinel $\pm$cpx clusters in the spinel peridotites, indicative of garnet-bearing peridotite protoliths. Structural and petrologic features point that spinel pyroxenites represent deep-seated intrusions which preceded the lithospheric exhumation of the ET mantle. In the spinel peridotites, textural and compositional features (e.g. olivine embayments replacing pyroxene porphyroclasts, increasing modal olivine, up to 85 wt%, at rather constant bulk Mg values), indicate that peridotites experienced open-system melt migration by reactive porous flow. Melt/rock interaction (causing olivine precipitation and pyroxene dissolution reactions) occurred at high melt volumes at deep lithospheric levels. At shallower lithospheric depths, the ET peridotites were diffusely impregnated by melts. Melt impregnation is documented by significant enrichment of interstitial plagioclase, and crystallization of unstrained poikilitic orthopyroxene replacing deformed mantle olivine and clinopyroxene. Reacted clinopyroxenes preserve strong LREE depletion, thus indicating that melt impregnation was related to porous flow migration of opx-saturated depleted MORB-type melts. After impregnation, peridotites experienced multiple gabbroic intrusion events. Structural and geochemical features of melt impregnation and melt intrusion products point to a progressive change in melt composition and dynamics. Peridotite impregnation was caused by diffuse migration of opx-saturated depleted melts, and is consistent with cooling and crystallization of migrating melts when the peridotites, due to lithosphere extension and thinning, became part of shallower and colder lithospheric environments. The subsequent intrusion events originated by MORB-type aggregated magmas which did not experience significant compositional modifications during ascent. The transition from porous flow melt migration to emplacement of magmas in fractures reflects progressive change of the lithospheric mantle rheology, across the ductile to brittle transition, during extension-related uplift and cooling of the ET mantle.