Geophysical Research Abstracts, Vol. 7, 04173, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04173
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Origin and emplacement of ultramafic and gabbroic intrusions in the Erro-Tobbio peridotite (Ligurian Alps, Italy)

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The Erro-Tobbio peridotites (Voltri Massif, Ligurian Alps) represent subcontinental lithospheric mantle tectonically exhumed during the Permo-Mesozoic extension of the Europe-Adria lithosphere. Previous studies have evidenced that exhumation started during Permian, and occurred along km-scale lithospheric shear zones which enhanced progressive deformation and recrystallization from spinel- to plagioclase-facies conditions. Ongoing field and petrologic investigations have revealed that the peridotites experienced, during uplift, a composite history of diffuse melt migration, and multiple episodes of ultramafic-mafic intrusions. In this paper we present the results of field, structural and petrologic-geochemical investigations into a sector of the Erro-Tobbio peridotite unit which well preserves this multiple intrusion history. Melt impregnation in the peridotites is testified by significant plagioclase-enrichment, and crystallization of unstrained orthopyroxene replacing deformed mantle olivine and clinopyroxene; impregnating melts were thus opx-saturated. Melt-rock interaction caused chemical changes in mantle minerals (e.g. Al decrease and REE increase in cpx; Ti and Cr# enrichment in spinel). Nevertheless, clinopyroxenes still exhibit LREE depletion (Ce_N/Sm_N =0.006-0.011), indicating a depleted signature of percolating melts. Melt impregnation was thus related to the diffuse porous flow migration of MORB-type depleted melt fractions that modified their compositions towards opx saturation by mantle-melt interaction during ascent. The impregnated peridotites are intruded by a hectometre-scale stratified cumulate ultramafic body, mostly constituted by troctolites and wehrlites, showing gradational, interfingered contacts with the host mantle rocks. Subsequent intrusion events are testified by the occurrence of olivine gabbros as decameter-wide lenses, variably thick (cm- to m-scale) dykes and thin

dykelets, which crosscut both peridotite foliation and magmatic layering in the cumulates. Overall, major and trace element compositions of minerals in the intrusives indicate that they represent variably differentiated cumulus products crystallized by rather primitive N-MORB-type aggregated melts. Slightly more evolved compositions are shown by olivine gabbros, relative to troctolites and wehrlites of the ultramafic body. Peculiar mineral chemistry features (e.g. the Fo-An correlation and high Na, Ti, Mg# in cpx) indicates that the studied intrusive rocks presumably crystallized at moderate pressure conditions (3-5 kbar, i.e. 9-15 km depth). Chemical and petrologic features of ultramafic and gabbroic rocks point to compositional differences between their parental melts (olivine-saturated, N-MORB-type aggregated melts) and melts which impregnated the host peridotites (orthopyroxene-saturated single depleted melt increments). Structural and petrologic studies on the ET peridotites and associated gabbroic rocks thus point to a progressive transition from porous flow melt migration to emplacement of magmas in fractures, presumably related to progressive change of the lithospheric mantle rheology during extension-related uplift and cooling of the ET mantle.