Rare earth abundances in the eastern Alpine peridotites, Nonsberg area, Northern Italy

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Abstract: REE and minor element analyses were carried out on spinel lherzolite, garnet-bearing and garnet-free peridotites, garnet pyroxenites and some separated minerals from the Nonsberg area, Eastern Alps, Northern Italy. Chondrite normalized whole-rock REE patterns for all but one of the coarse-grained spinel lherzolites are very different from previously reported Alpine peridotites. The spinel lherzolites from the Nonsberg are LREE enriched (La/Yb > 1) and show a distinct U-shaped REE pattern. The REE abundances in whole rocks and minerals – as well as the cpx/opx partition coefficient data – are similar to the majority of spinel lherzolite xenoliths from alkaline basalts. The same features (La/Yb from 1.7 to 14.2) are shown by the fine-grained recrystallized peridotites. The close similarity between the Nonsberg peridotites and lherzolite xenoliths suggests that the observed LREE enrichment is due to upper mantle metasomatism. Alternatively, comparison of coarse and fine samples from the same outcrop reveal a very large increase in K, Sr and to a lesser extent, Li in all the fine-grained recrystallized peridotites. Since the fine-grained garnet peridotites are the metamorphic derivatives of coarse-grained spinel lherzolites at lower-crust P-T conditions, metasomatism for the fine-grained peridotites probably occurred within the lower crust. Such an enrichment in REE, K, and Sr has never been reported in high temperature peridotites and this makes the Nonsberg Alpine peridotites somewhat unusual.

Key-words: REE, peridotites, metasomatism, Northern Italy.

Introduction

Garnet-bearing peridotites are known to occur in medium- to high-grade metamorphic rocks and have been studied from several European localities, e.g. Western and Central Alps (O’Hara and Mercy, 1963; Trommsdorff and Evans, 1974; Ernst, 1978; Ottonello et al., 1984), Eastern Alps (Andreatta, 1935; Herzberg et al., 1977; Rost and Brenneis, 1978; Morten and Obata, 1983; Obata and Morten, 1987), Bohemian Massif (Fiala, 1966; Kopecky and Sattran, 1966), Massif Central, France (Lasnier, 1971), northern Pyrénées, France (Fabriès and Conquére, 1983), Ronda, Spain (Obata, 1980), and Western Norway (O’Hara and Mercy, 1963; Carswell, 1968; Lappin, 1974; Medaris, 1984; Griffin and Brueckner, 1985; Griffin et al., 1985). Although these rocks have been intensely studied, their origin and significance are still debated. Different and contradictory hypotheses have been proposed for almost all the European occurrences: (a) the garnet-bearing peridotites represent mantle material intruded as solid slices within the crust; (b) they are in situ metamorphic products of a subducted slab of continental crust, or (c) they are the results of subsolidus reactions which transform spinel lherzolite to garnet lherzolite.

Nevertheless, researchers agree that garnet peridotites from orogenic zones are important...