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Slab melt and intraplate metasomatism in Kapfenstein mantle xenoliths (Styrian Basin, Austria)

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Abstract

Anhydrous and amphibole-bearing mantle peridotite xenoliths from Kapfenstein (Styrian Basin) have been studied with the aim of understanding both the processes responsible for amphibole formation and the nature of metasomatizing agents which affected this portion of lithosphere. This area of the Pannonian Basin underwent a subduction event which was followed after about 15 Ma, by alkaline intraplate magmatism. Primary clinopyroxene (cpx1) in four-phase lherzolite xenoliths is characterized by LREE-depleted to slightly LREE-enriched patterns. LREE-depleted cpx1 have low Th and U contents and Zr (and Hf) anomalies varying from slightly negative to positive. LREE-enriched cpx have high Th and U contents and remarkable positive anomalies of Zr and Hf. Primary clinopyroxenes in amphibole-bearing lherzolites present a comparable compositional variation from LREE (and Th, U, Zr, Hf)-depleted type to LREE (and Th, U, Zr, Hf)-enriched type. LREE-depleted cpx1, with strong negative Zr and Ti anomalies, are also recognized in the peridotite matrix of a composite sample cut by a large amphibole vein. Textural and geochemical evidence indicates that amphibole disseminated within the matrix grew at the expense of primary spinel and clinopyroxene, mimicking the trace element patterns of the latter. As a consequence, the geochemical features of amphibole vary in relation to those of clinopyroxene, from enriched to depleted. On the other hand, the composition of vein amphibole in the composite xenolith compares well with amphibole megacrysts and microphenocrysts, suggesting that it represents a fractionation product of alkaline melt that passed through the lithosphere. Two kinds of metasomatism, superimposed on a slightly depleted lithospheric mantle, were identified. A slab-derived melt (proto-adakite?) metasomatic agent was responsible for the first enrichment in Th, U, Zr and Hf observed in clinopyroxene, whereas an alkaline within-plate metasomatic agent caused the formation of the Nb (and Ta)- rich disseminated amphibole. The final process was the alkaline magmatism, which was responsible for the formation of the large amphibole vein and megacrysts. It is proposed that the Nb-poor and Nb-rich amphiboles record the transition between the suprasubduction slab melt-related and the intraplate alkaline metasomatism.

These geochemical features are consistent with a lithospheric portion enriched in slab melt components which was subsequently metasomatized by alkaline melt. Alternatively an asthenospheric uprising could have scavenged a previously slab melt-enriched region of the lithosphere.

Keywords: Suprasubduction and intraplate metasomatism; Lithospheric mantle; Xenoliths; Styria Basin

1. Introduction

The widespread Miocene to Pleistocene alkaline volcanism of the Pannonian Basin is characterized by the

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occurrence of abundant mantle xenoliths (Kurat et al., 1980; Embey-Isztin et al., 1989; Kurat et al., 1991; Downes et al., 1992; Szabó et al., 1992, 1995; Embey-Isztin and Dobosi, 1995; Downes and Vaselli, 1995; Vaselli et al., 1995, 1996; Chalot-Prat and Bouillier, 1997). This volcanism was preceded by the eruption of a large variety of calk-alkaline s.l. magmatic products in the Carpathian Arc and Pannonian Basin. Spatial-time relationships between alkaline and calk-alkaline s.l. magmatism are very complicated (Pécskay et al., 1995;

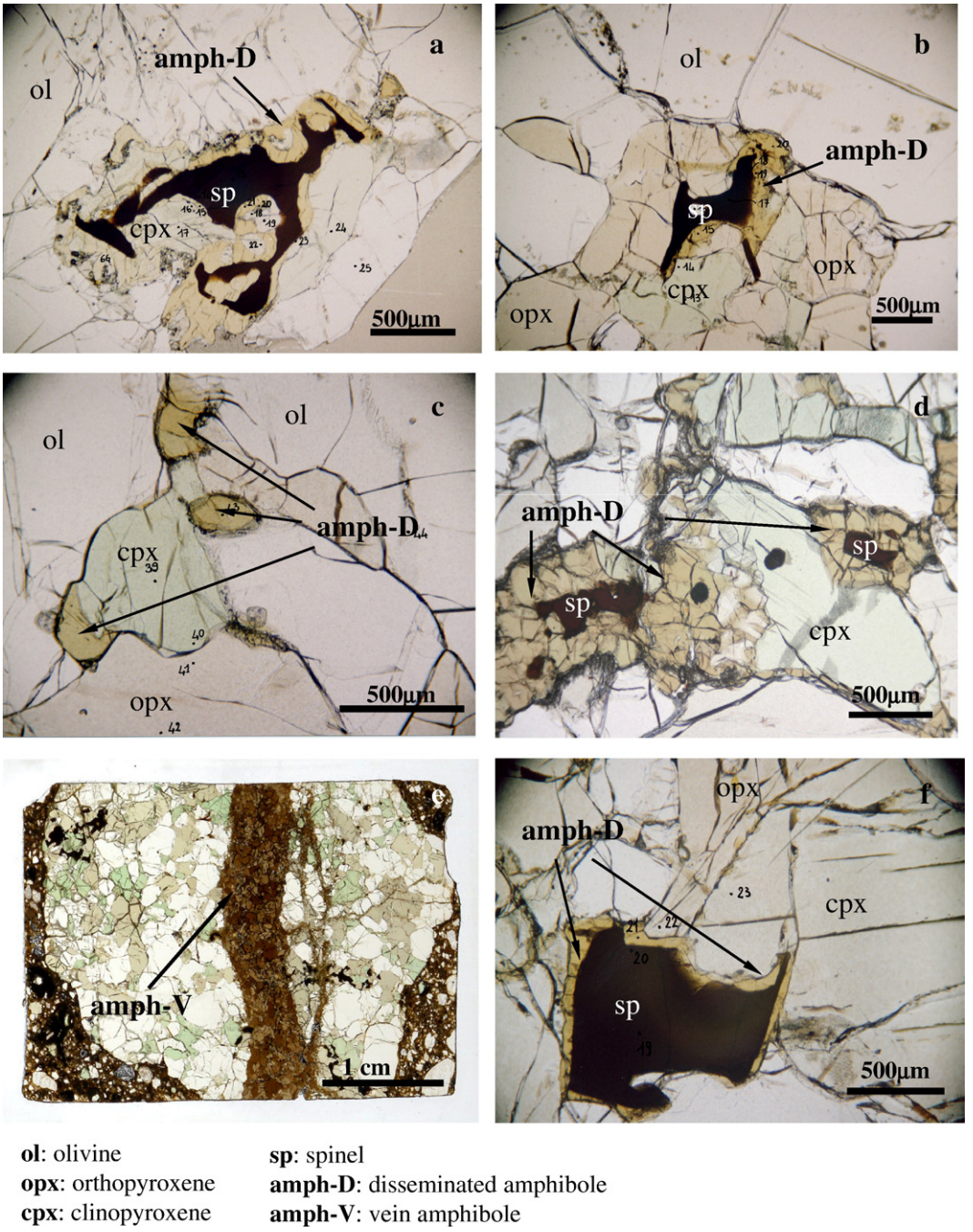

Fig. 1. Photomicrographs of Kapfenstein peridotite xenoliths. a) "holly-leaf" spinel surrounded by disseminated amphibole (Be-1C); b) disseminated amphibole sandwiched between spinel and clinopyroxene (Be-1A); c) disseminated amphibole surrounding clinopyroxene (KAP68); d) disseminated amphibole surrounding spinel and clinopyroxene (KF4); e) amphibole vein cutting lherzolites KAP1; f) disseminated amphibole growing around spinel near the vein (KAP1).