Peridotite Xenoliths from the České Středohoří Mts.: Contribution to Petrology of the Lithospheric Mantle beneath Northern Part of the Bohemian Massif

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Tertiary volcanic rocks in Northern Bohemia entrained numerous peridotite xenoliths that can bring up important information on the nature and evolution of the upper mantle beneath this region. We have studied xenoliths from six localities situated roughly on a line traversing the České Středohoří Mts. from ENE to WSW. They are as follows: Michlův vrch and Lysá skála (Provodínské Kameny), Hlupice, Býňov, Dobkovičky and Medvědický kopec. The host volcanic rocks (volcanic necks, dykes and lava flows) are of primitive alkaline composition and correspond mostly to basanite.

Xenoliths are characterized by an anhydrous four-phase mineralogy consisting of olivine, orthopyroxene, clinopyroxene and spinel. Their contacts with the host basanite are always sharp, only where orthopyroxene came into contact with the alkaline melt a narrow reaction rim may occur. The xenoliths exhibit protogranular textures and this implies only a weak deformation. However, the grain-size and textures are far from being uniform. Modal compositions correspond to clinopyroxene-poor spinel lherzolite and harzburgite.

The prevailing olivine ($Fo_{89–92}$, commonly Fo_{91-92}) and orthopyroxene ($En_{87–91}$) have typically coarse and compositionally unzoned grains. Few kink-bands are present in some relatively large olivine crystals. Clinopyroxene is rich in Cr, with the Cr# [100Cr/(Cr+Al)] within a broad interval 13.1–53.2. Spinel is compositionally highly variable, with the Mg# [100Mg/(Mg+Fe^{2+})] ranging 54.2–83.5. Its Cr# vary from 24.1 to 56.1 thus reflecting the increasing levels of the peridotite depletion.

The spinel-bearing mineral assemblage requires an origin in depths less than 70–80 km, i.e. similar to many other alkali-basaltic volcanic regions. Temperature of the last equilibration can be estimated in the range 1064–1144 °C based on the two-pyroxene geothermometer (Wells 1977).

Chemical analyses of 10 representative samples display highly refractive compositions with Al_2O_3 < 2 wt% (0.4–1.6%) and low but variable CaO (0.7–1.7 wt%, only two samples have 2.5–5.8 wt%). With only one exception (the sample that is probably affected by infiltration of a melt), the atomic ratios Mg/(Mg+Fe) are very high ranging from 91 to 92.6. The degrees of depletion do not vary significantly between localities.

Trace element abundances are highly variable and at least partly unrelated to major elements and the degrees of depletion. Despite of their generally depleted nature our xenoliths are markedly enriched in highly incompatible elements. Rare earth elements (REE) display variable patterns in the chondrite-normalized diagram (Fig. 1). All the samples have low, chondritic to only about 0.1 times chondrite contents of the heaviest REE's (Yb, Lu) in accord with the depleted nature. However, contents of LREE are enriched with La abundances from ~3.5 to ~12 times the chondrite value. One half of samples display a marked tendency to the U-shape of the normalized curve with minima at the moderately heavy REE's (Gd to Tm).

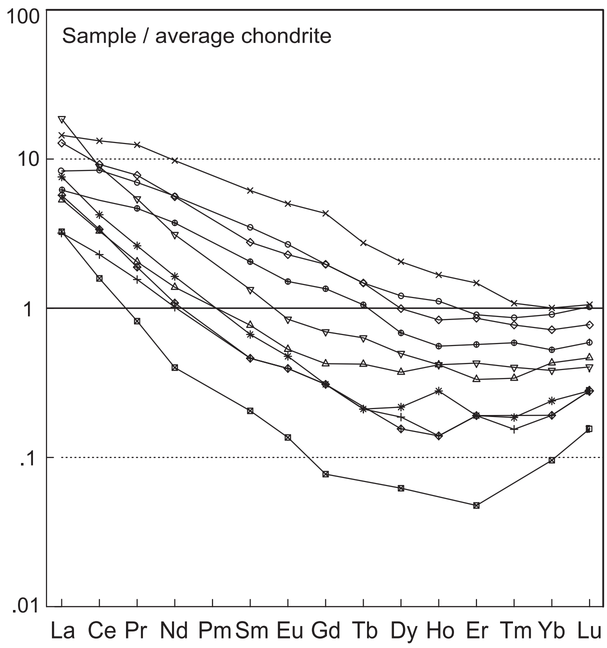

Fig. 1. REE abundances in the peridotite xenoliths normalized to the average chondrite (Boynton 1984).

All the xenoliths under study represent samples from geochemically heterogeneous subcontinental lithospheric mantle. Their highly depleted nature combined with metasomatic enrichment in incompatible elements as well as the peculiar patterns of normalized REE abundances suggest a complex history of the sampled mantle domains. The highly variable ratios of incompatible elements indicate a role of multiple metasomatizing pulses.

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