Abstract

The purpose of this dissertation is geochemical study of upper mantle rocks at two sites from different geological settings of the Bohemian Massif (Czech Republic) – Kozákov and Horní Bory.

The first part of dissertation represents a review of petrological and geochemical studies of upper mantle rocks found in the Bohemian Massif, which have been published or presented so far. These include information about type and occurrences of mantle-derived rocks with individual Bohemian Massif units and summarized present state of knowledge on depletion and metasomatism of these rocks. The principal questions related to the mantle beneath the Bohemian Massif which remain opened are presented at the end of this part.

The most important part of the dissertation represents three comprehensive papers on geochemical studies of upper mantle rocks from Kozákov and Horní Bory.

In the second part, a geochemical study of major elements, trace elements, and Sr-Nd isotopes combined with mineral chemistry of upper mantle xenoliths from the Kozákov volcano have been presented. This unique suite of xenoliths samples upper 2/3 of the upper mantle in this region and, therefore, provides a great possibility to study upper mantle composition variations with depth. The results show that upper mantle beneath Kozákov volcano underwent different degrees of partial melting which increase with decreasing depth. Subsequent metasomatism, most likely by basaltic melt, occurred as a result of mantle upwelling and mantle interacted with percolating melt at variable melt/rock ratios. Progressive changes in trace element ratios through the mantle profile point to a significant fractionation of percolating melt with its ascent and suggest Cenozoic age of metasomatism.

The third part deals with the effects of melt percolation on highly siderophile element (HSE - Os, Ir, Ru, Rh, Pd, Pt, Re) geochemistry and osmium isotopes. The Kozákov suite of samples was chosen for this study to provide a complex picture of HSE behaviour with respect to major/trace elements and Sr-Nd isotopes. Whole-rock HSE analyses combined with high-precision osmium isotopic data revealed large-scale incompatible behaviour of HSE during melt percolation, suggesting a sulphur-undersaturated character of the melt. In contrast to other studies, our investigation did not document an import of rhenium and, as a consequence, demonstrated that osmium isotopes were not affected by melt percolation and should provide geochronologically meaningful data even in pervasively metasomatized mantle. On the other hand, in case of some samples, I-PGE (Os, Ir, Ru) were imported from the percolating melt, suggesting precipitation of I-PGE-bearing alloys from the melt.

In the fourth part, geochemistry and origin of unusually Fe-rich peridotites and associated pyroxenite boudins in Moldanubian granulites from Horní Bory have been investigated. Two different types of peridotites can be distinguished at Horní Bory based on Mg-numbers and modal composition: (1) Mg-Cr lherzolites similar in composition to other mantle-derived rocks elsewhere and (2) Fe-rich dunite-wehrlite rocks accompanied with pyroxenites. A major/trace element study combined with Sr-Nd isotopic constrains and numerical models have shown that Fe-rich peridotites originated during melt-rock reactions between peridotite and basaltic melt with a subduction-related signature at different melt/rock ratios.

The last part provides overall conclusions, emphasizes the differences between the Kozákov and Horní Bory mantle suites and presents general notes to the composition and evolution of the upper mantle beneath the Bohemian Massif.