TRACE-ELEMENT PATTERNS IN ULTRAPOTASSIC ROCKS OF THE BOHEMIAN MASSIF: IMPLICATIONS FOR HETEROGENEITY OF THEIR MANTLE SOURCES

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In the Bohemian Massif various types of Hercynian K-rich to ultrapotassic plutonic and dyke rocks are widespread. Petrological and geochemical investigations focused on the Moldanubian area including the Central Bohemian Pluton (CBPC). This pluton intruded the Central Bohemian Suture, a boundary between the Moldanubian and Barrandian blocks, and consists of various types of calc-alkaline to shoshonitic granitoids accompanied by less abundant mafic rocks. In the area studied, the most voluminous are ultrapotassic rocks of the durbachite series (amphibole–biotite melasyenite to melagranite), whose occurrences are restricted to the Moldanubian unit (including the peri-Moldanubian part of CBPC). They are accompanied by less voluminous varieties of melasyenitic K- and Mg-rich granitic rocks as well as subordinate phlogopite ultramafitites. Dykes of mica lamprophyres, namely minettes, are common but represent much lesser volumes. In CBPC, the mica lamprophyres are associated with other mafic dyke rocks, such as dolerites and spessartites as well as much less mafic to felsic granitoid porphyries. As an extreme, some peralkaline dykes occur in the Moldanubian crystalline complex.

All the mafic K-rich rocks display high contents of incompatible (hygromagmatophile) elements (namely Rb, Cs, Th, U) despite of their relatively primitive nature in respect to Mg, Cr and Ni. Chemistry of durbachitic rocks and their microgranular enclaves is similar to many minettes from the Moldanubian block and can be characterized by very high Rb/Sr (durbachites 0.7 to 1.2, minettes 0.5 to 3), Ba/Sr, Th/Ta and low K/Rb, K/Cs, etc. Characteristic are also low contents of Na, Ca and Sr as well as a weak negative Eu-anomaly. However, minettes are much more variable and some of them have a rather extreme composition. K-rich lamprophyres occurring within the Barrandian block are much less common and their composition differs, namely in lower abundances of Rb, higher K/Rb, lower Rb/Sr and usually also an absence of the Eu anomaly.

In CBPC, some systematic changes in trace-element abundances are typical of the sequence of dolerite–spessartite–kersantite–minette, which cannot be related to any fractionation process. In this direction, contents of K, Rb, Ba, Pb, Zr, Hf, Nb, Ta, Th, U and LREE as well as K/Na, Mg/Ca, Rb/Sr, Th/Ta and La/Yb ratios increase, whereas Ca, Na, K/Rb and also Sc/Cr, V/Cr decrease. Though the high abundances of Cs are much more typical of the mica lamprophyres, there are large non-systematic variations in Cs contents as well as in Rb/Cs and K/Cs ratios. The negative Eu anomaly of mica lamprophyres is shallow to pronounced but is completely absent in the dolerite–spessartite group. These differences in abundances and elemental ratios of incompatible elements cannot be explained by various degrees of fractional melting of a common mantle source or by contamination of mafic magmas during their ascent through the continental crust. Therefore, it is argued that most of the variable geochemical characteristics are due to an important compositional heterogeneity, both horizontal and vertical, of the Hercynian lithospheric mantle under the Bohemian Massif. Composition of the durbachitic rocks and minettes from the Moldanubian area (including CBPC) point to a lithospheric mantle source which underwent a strong depletion (indicated by low Na, Ca, Sr, high Mg/Ca and relatively high Si) and subsequently a strong re-enrichment in incompatible elements, namely those which can be transported by hydrous fluids. The small-volume ultrapotassic rocks of extreme composition (some minettes, subaluminous to peralkaline microsyenites, etc.) could have been derived from highly anomalous mantle domains. For less extreme rock compositions, a less strongly depleted lithospheric source or involvement of an asthenopheric component is assumed. For all the rocks studied, high LILE/HFSE elemental ratios and very high Th/Ta (up to 40 in some minettes) are compatible with the subduction-related origin of the enriching fluid.