Dioritic and Gabbroid Rocks from Southern Bohemia and Lower Austria: Geochemical and Mineralogical Constraints on their Role in Genesis of the South Bohemian (Moldanubian) Batholith

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The South Bohemian Batholith (SBB) comprises prevailing granitic rocks with several satellite bodies of more mafic composition. As these dioritic and gabbroic bodies are volumetrically subordinated (forming less than 0.5% of plutonic rocks at the present erosion level) and insufficiently exposed, almost nothing is known about their petrogenetic significance and their temporal relations to surrounding granitic intrusions. Our research supported by the grant No 32p27 from the Aktion Programme and partly also of Grant 205/02/0514 from the Grant Agency of the Czech Republic has been focused on petrographic and geochemical correlation of these bodies from Czech and Austrian sides of the state border and on evaluation of their possible role in the origin of large granitic intrusions of the SBB.

Gabbroic rocks crop out in a close spatial relation with granites. Majority of them correspond to gabbronorite or norite. Only two samples, from Kuří (near Benešov nad Černou) and from Harbach (W of Weitra, Waldviertel), contain subordinated amounts of fresh olivine. Dioritic rocks are volumetrically more significant. Besides some inclusions within granites the dioritic rocks form several masses (each 0.X to X km^2 in area), namely in surroundings of Chlum u Třeboně, Velešín – Třebonín and Gebharts. They are dominated by biotite, hornblende is less abundant and relics of clinopyroxene are scarce. Individual samples may correspond to hornblende-biotite diorite, quartz diorite and even tonalite; the K-feldspar bearing varieties are quartz monzonites to granodiorites. Any transitional varieties to gabbro and norite are lacking. Durbachite has been found in a close spatial association to dioritic rocks within the Třebonín-Velešín massif.

All the dioritic rocks under study are relatively rich in potassium and correspond with the high-K calc-alkaline to shoshonitic series. They share many compositional features with some varieties of the so-called redwitzites from W and SW marginal parts of the Bohemian Massif. Dioritic rocks of the Třebonín massif are more potassic and higher in Rb and Cr compared to the Chlum massif. The major and trace element geochemistry define a strong enrichment of K and Rb from gabbros to the quartz diorites, a more moderate enrichment for most of the immobile trace elements, and highly scattered contents of Ba. A simple crystal fractionation model cannot explain the chemical variations.

Fig. 1 displays some geochemical characteristics on the MORB-normalized spidergram. All the analysed rocks are enriched in LILE (large-ion lithophile elements, e.g., K, Rb, Sr, Ba) relatively to HFSE (high-field-strength elements, e.g., Nb, Zr, Ti) similarly as in calc-alkaline and shoshonitic mafic magmas from supra-subduction magmatic arcs. As the whole sub-continental lithospheric mantle (SCLM) may have similar characteristics, the original mafic magmas can be derived also from enriched parts of the SCLM without any contemporaneous subduction activity. Origin in the SCLM, perhaps followed by significant interaction of magmas with the continental crust, is in accordance also with the published isotopic analyses. The evolution towards diorite and quartz-diorite compositions seems to be controlled by crustal assimilation rather than by fractionation process.

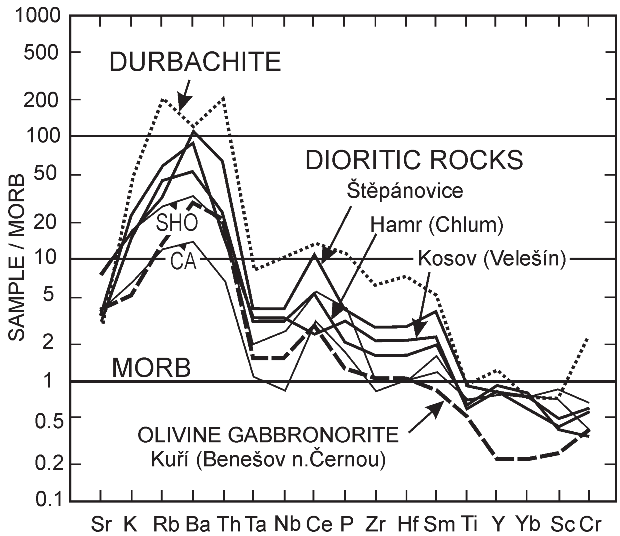

Fig. 1. Spidergram of trace element abundances normalized to the N-MORB composition (Pearce 1982) for representative analyses of mafic rocks from the SBB and a typical durbachite from S. Bohemia.

As both the mafic magmas of the durbachite and high-K diorite groups originated in various domains within the sub-continental lithospheric mantle (SCLM), the transitional rocks could originate either from a "mixed" source or due to mixing of the two magmas during their ascent and emplacement in the crust. In any case, partial melting of the SCLM and, consequently, of the lower crust could have a common cause such as (1) the hydrous fluid influx from dehydrating subducted slab, (2) heating of the SCLM due to breaking off the subducted slab, (3) lithospheric mantle delamination without subduction or (4) asthenospheric mantle upwelling leading to the crustal extension. Whatever the mechanism was the most important, we believe that mantle-derived mafic magmas and their thermal input contributed to the origin of the South Bohemian Batholith as well as many other granitic batholiths substantially.