TWO CONTRASTING ALKALINE VOLCANIC SERIES IN NORTH BOHEMIA

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Late Cretaceous–Tertiary volcanism of the north-eastern arm of the Ohře (Eger) Rift in North Bohemia displays characteristic features of two intraplate magmatic series. The older (79–50 Ma), unimodal ultramafic ultra-alkaline (melilititic) series, pre-dating the rifting, occurs exclusively in external blocks of the Ohře Rift. The younger (40–18 Ma), bimodal (basanite–phonolite) alkaline rock series predominates in the internal blocks of the rift. The latter series is characteristic of high volcanicity types of active rifts; its equivalent, mildly alkaline bimodal alkali basalt/basanite–trachyte association prevails in the central part of the Ohře Rift, in the České středohoří Mts. Both series were followed by picrobasaltic intrusions (9 Ma) associated with regional faults.

The origin of the oldest, ultra-alkaline volcanic association could be linked with an asthenospheric mantle upwelling (rise of a mantle plume?) causing partial melting of the thermal boundary layer at the base of the lithosphere. Subsequent extension resulted in formation of the Ohře Rift structure, that is parallel to the major Variscan boundary between juxtaposed Saxothuringian and Moldanubian units of the Bohemian Massif. The rift formation represents a repercussion of the Alpine orogenic movements accompanied by intense, mostly mildly-alkaline strongly differentiated volcanism. The Ohře Rift thus can be classified as belonging to the group of collision-induced rifts. Its formation was accompanied by upper mantle melting caused by adiabatic decompression in connection with rift extension and primary magma ascent along regional faults.

Primary highly alkaline silica-undersaturated magmas are capable, under low-pressure conditions, of fractionation producing phonolites and forming contrasting bimodal suites. However, phonolites can generally be produced by crystal-liquid fractionation of two different parental magmas. The majority of phonolites in North Bohemia could have been derived from basanitic magma and only a minority probably represent more extreme differentiates of the less evolved first type (cf. phonolites in Cantal, Massif Central). Anomalous phonolites could represent more extreme variety of developed phonolite types and/or rocks with substantial late, post-magmatic enrichment in incompatible elements.

The enrichment of the older series ultramafic magma in incompatible elements (Rb, Cs, REE, Y, U, Th, Zr, Hf, Nb, Ta, P) was probably caused by a low-degree (< 1 %) partial melting of a metasomatized mantle material and/or steady zone refining process. The source of the younger bimodal basanite–phonolite rock series could have been similar, only the degree of partial melting was higher (> 5 %) and their generation took place at a shallower level. However, additional enrichment in incompatible and volatile elements by fluid transport from a high-level crustal magma reservoir is highly probable, at least for the rocks with anomalous concentrations of these elements (olivine melilitolite pegmatoids and anomalous phonolites). These elements are concentrated in the late magmatic and post-magmatic mineral paragenesis (apatite, perovskite, calzirtite, hainite, fluorian eudialyte, zirconian melanite, (OH, F)-bearing titanian andradite and barian phlogopite).

The $^{87}Sr/^{86}Sr$ (0.70327–0.70366) and $^{143}Nd/^{144}Nd$ (0.51267–0.51287) isotopic ratios for the (ultra-) mafic rocks of both volcanic series are similar to each other and close to those of HIMU OIB. Highly evolved phonolites, which originated by low-pressure crustal fractionation of a basanitic magma, were affected by some crustal contamination ($^{87}Sr/^{86}Sr$ = 0.70407–0.70534, $^{143}Nd/^{144}Nd$ = 0.51280). According to the trace-element data (e.g. Zr/Nb), role of crustal contamination, particularly in the genesis of phonolites, cannot be neglected.

The contrasting volcanic series in North Bohemia are comparable with classic areas of bimodal alkaline volcanism such as Hegau, Rhön and the East African Rift.