338–335 Ma old intrusions in the E Bohemian massif – a relic of the orogen-wide durbachitic magmatism in European Variscides

(2 figs)

J. KOTKOVÁ[1] – U. SCHALTEGGER[2] – J. LEICHMANN[1]

[1] Masaryk University, Brno, Czech Republic, kotkova@sci.muni.cz, leichman@sci.muni.cz
[2] Université de Genéve, Genéve and ETH Zürich, Switzerland, urs.schaltegger@terre.unige.ch

Durbachites represent one of the crucial rock types for understanding the Variscan history of the Bohemian Massif. Durbachites from the Moldanubian Zone – the internal part of the European Variscan belt – are generally coarse-grained, porphyritic K-Mg-rich plutonic rocks, typically containing large phenocrysts of K-feldspar, with high amounts of biotite, plagioclase, some amphibole, and pyroxene relics. Petrologically they correspond to melanocratic granites, granodiorites or syenites. Their bulk rock composition (perpotassic character with high LILE but also Mg, Ni and Cr), indicative of both crustal and mantle source, is consistent with their formation at great depths by melting of old mantle or slab material. One of the results of the complex and possibly multistage evolution of these rocks is a mostly discordant geochronological data set, difficult to interpret. Combined petrological and geochronological information is needed to unravel the age of formation and emplacement of these rocks. We present here preliminary U-Pb zircon age data from durbachite intrusions in the eastern part of the Moldanubian Zone.

A sample from Kosov quarry in Jihlava Batholith (SU-02-4) is a coarse-grained and biotite-rich rock of syenitic composition with K-feldspar phenocrysts, containing also plagioclase, quartz, and accessory zircon, apatite, rutile and ilmenite. It shows signs of high-temperature crystallization, such as cryptoperthitic K-feldspar, exsolution lamellae of Opx in Cpx and needles of rutile exsolved from perthitic K-feldspar. Zircons are isometric to short prismatic grains (Fig. 1) partly resembling the multifacetted zircons described from granulite-facies rocks. The surfaces of some zircons are modified by resorption. CL images of the isometric zircons show distinct sector zoning, in some grains with a transition to oscillatory zoning towards the margins, without any sign of inherited cores. They contain inclusions of apatite and other phases. Four single zircon U-Pb analyses are perfectly concordant at 335.2 ± 0.54 Ma and yield a mean εHf of –6.5; since no inherited cores were detected, important crustal contamination may be discarded and the Hf isotopic values may be related to a very enriched mantle source, or to remelting of mafic lower crust.

The melanosyenite SU-02-5 (roadcut E of Třebíč) is a typical representative of the dark durbachites of the Třebíč Batholith. It is a porphyritic (K-feldspar) medium- to coarse-grained, undeformed rock, rich in biotite, containing also plagioclase, quartz, amphibole and accessory apatite and rutile. Accessory zircon is associated with biotite. Zircons are of two types: short to long prismatic crystals (Fig. 2) as well as tabular grains. Only some grains show a clear evidence of an inherited core. The prismatic zircons feature mostly a continuous simple oscillatory zoning pattern under CL, typical of magmatic crystallization. Some grains feature zones of nonplanar growth or replacement at the rim, which is taken as evidence for a young overprinting and has been removed by abrasion. SEM a CL images document presence of numerous long-prismatic apatite inclusions especially in the marginal zones of the zircons.

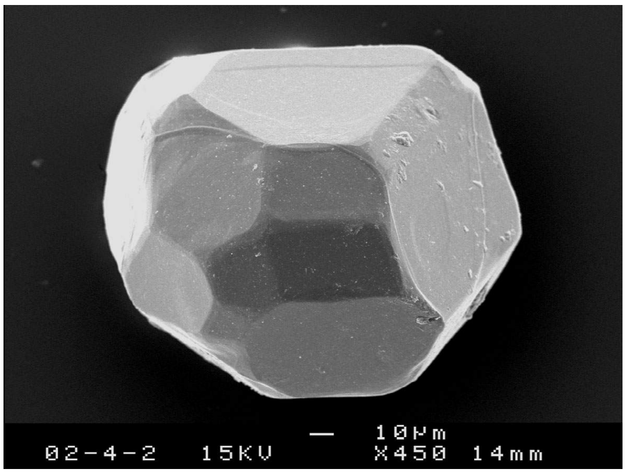

Fig. 1 SEM image of a Kosov syenite zircon.

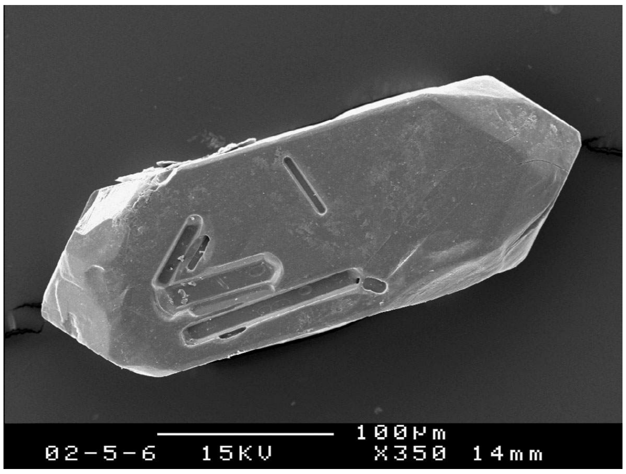

Fig. 2 SEM image of a prismatic zircon from Třebíč durbachite with holes after acid-leaching of abundant apatite crystals.

The first multigrain U-Pb analysis of prismatic zircons points to an old inheritance of 1.42 Ga. Two subconcordant analyses yield $^{238}U/^{206}Pb$ ages of 338 and 332 Ma, the latter being most probably biased by lead loss. An age around 338 Ma is estimated to date the crystallization of this rock. Hf isotopes are variable (εHf = –3.5 and –6.5) and not related to the degree of inheritance. Currently, morphologically distinct tabular zircons are being analysed.

The U-Pb zircon ages of 335–338 Ma are in good agreement with the existing zircon ages of similar rocks in the Moldanubian Zone of the Bohemian Massif: U-Pb zircon age of 338±2 Ma for Rastenberg granodiorite (Klötzli and Parrish, 1996), interpreted as age of intrusion into the middle crust. Only Pb-Pb zircon age of 340±8 and 343±6 Ma are available for Třebíč durbachite and Central Bohemian Pluton melagranite (Čertovo břemeno type, Holub et al., 1997). Durbachitic rocks in other areas of the Variscan Belt were dated at slightly higher (Southern Vosges, 340 ± 2 Ma; Schaltegger et al., 1996) or slightly lower ages (Aar massif, 333 ± 2 Ma; Schaltegger and Corfu, 1992; durbachite dyke in the central Vosges at 332 ± 3 Ma; Schulmann et al., in press).

The uniform U-Pb ages of the single-phase zircons along with a rather simple rock structure, characteristic of the Jihlava Batholith sample (SU-02-4), are consistent with a single high-temperature event forming the zircons and an emplacement in the middle crust without important interaction with the host rocks. On the contrary, the more complex U-Pb systematics and structures of the Třebíč and Rastenberg Batholith rocks reflect their more complex evolution, including an important contribution of an older component. The new data suggest that the intrusion of all three important batholiths at the eastern margin of the Bohemain Massif (Rastenberg, Jihlava and Třebíč) is contemporaneous and is part of an orogen-wide durbachitic magmatism of approximately the same age and of ~ 10 m.y. duration. We suggest that the nature for such large-scale magmatic activity has to be at a plate-tectonic scale.

References

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