The History of the Brunovistulicum: Total-Pb Monazite ages from the Metamorphic Complex

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Introduction

The Brunovistulicum (BV) is one of the largest well-preserved Precambrian crustal blocks in the Variscan collisional zone (Dudek 1980). Very probably it represents a piece of the cryptic Avalonian-Armorican-Cadomian orogenic belt, which formed in the late Precambrian along the active northern Gondwana plate margin and fragmented again in the early Palaeozoic (Nance and Thompson 1996). Judging from stratigraphic (Dvořák 1995), palaeomagnetic (Tait et al. 1996) and tectonic evidence (Finger and Steyrer 1995), the BV can be correlated with the Rhenohercynicum and Avalonia, respectively. Therefore, the BV may be widely unrelated to the large intra-Variscan Precambrian crustal fragments in Brittany and central Bohemia (Tepla-Barrandian), which are traditionally considered as belonging to the Armorican terrane assembly (Tait et al. 1997).

Although the BV is mostly covered by sediments, and only exposed in two relatively small massifs (Brno Massif, Thaya Massif), its overall structure and lithological composition is broadly known from drillings and geophysical research (Dudek 1980). Accordingly, the western half of the BV including the Brno and Thaya massifs consists mainly of Cadomian "volcanic-arc-type" granitoids (Jelínek and Dudek 1992, Finger et al. 1989). In the eastern half, high-grade paragneisses are dominant.

Finger et al. (1995) and Finger and Pin (1997) have shown that the BV involves two significantly different types of crust. A chemically and isotopically immature island arc type crust builds the eastern three quarters of the BV (granitoids and paragneisses of the Slavkov Terrane), a mature continental crust builds the western quarter (Thaya Terrane). The so-called Central Basic Belt near Brno (Štelcl and Weiss 1986), a N-S striking formation of mainly tholeiitic metabasites (Hanžl and Melichar 1997), appears to constitute the suture between these two contrasting crustal units and may perhaps be viewed as a captured back-arc basin (Finger and Pin 1997).

Formation ages of magmatic rocks

Most of the Brunovistulian granitoids formed during a major tectonothermal event at ca. 580-600 Ma. This can be inferred from zircon ages (van Breemen et al. 1982, Friedl 1997, Friedl et al. 1998) and from Ar-Ar geochronology (Fritz et al. 1996). It would appear that the plutonic activity has widely ceased after 580 Ma. A Rb-Sr isochron of 551 ± 6 Ma published for granitoids of the Thaya massif (Scharbert and Batik 1980) is very probably a mixing line without exact geological significance.

Recently, a first geochronological information was obtained for the volcanic zone of the Central Basic Belt. A zircon evaporation age of 725 ± 15 Ma for a tholeiitic rhyolite suggests that this zone is by far older than the granitoids (Finger et al. 1998). On the other hand, Nd isotope data imply that the source of the

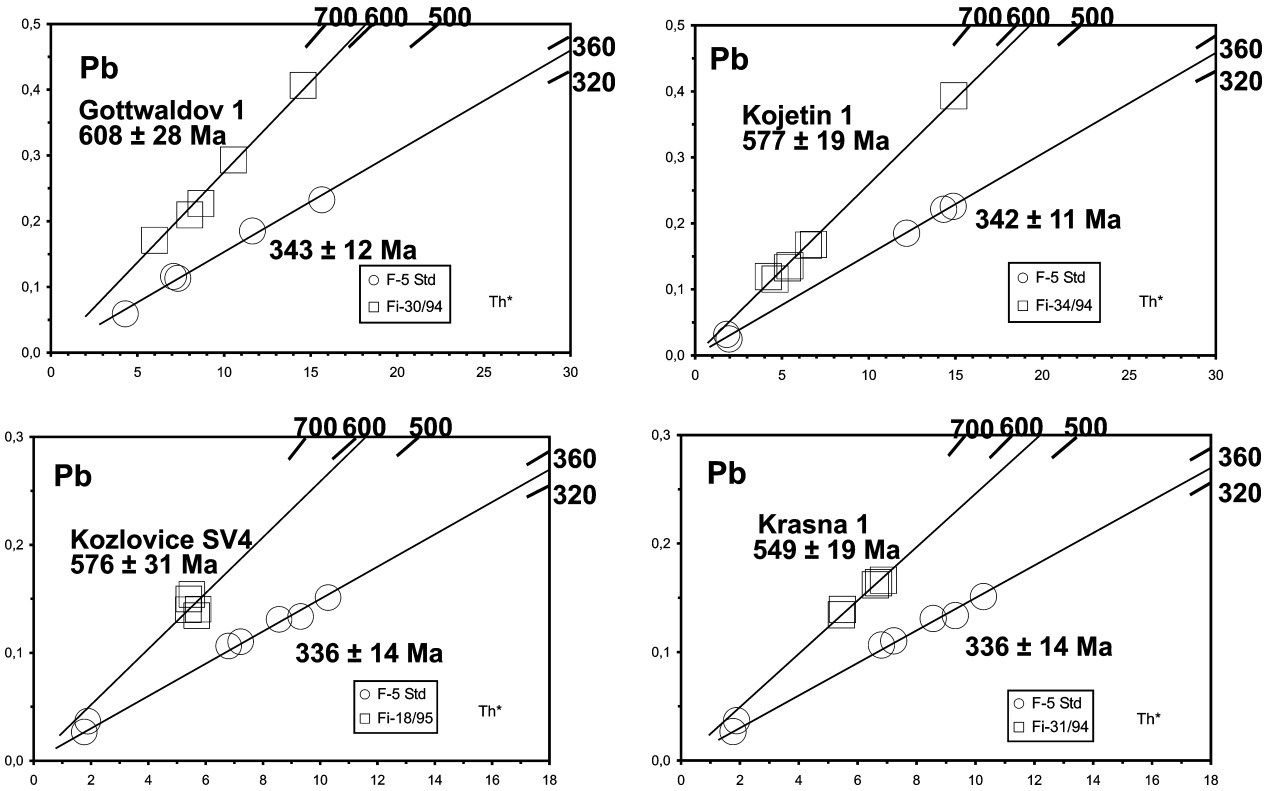

Fig. 1. Th*-Pb isochron diagrams (SUZUKI et al. 1994) with plots of monazite analyses from the investigated paragneiss samples. Open circles are data for standard monazites (recommended age 341 Ma), which were analysed together with the samples to control the quality of dating (Finger and Helmy 1997).

metasediments in the Slavkov terrane was a juvenile late Proterozoic arc, not older than ca. 800 Ma. The Thaya terrane in the west includes recycled components from a much older continental Gondwana crust.

Age of the metamorphic complex

Four samples of paragneisses from boreholes Gottwaldov 1 (3849.6 m), Kojetin 1 (966 m), Kozlovice SV4 (2274.7 m) and Krasna BP824 (1977 m), which have been kindly provided by A. Dudek, were subjected to Th-U-Pb monazite dating with the electron microprobe (for information concerning this method and the analytical procedure see Finger and Helmy 1997). The aim was to investigate whether the previously reported » 600 Ma K-Ar ages from the metamorphic complex (Dudek and Melková 1975) approximately date the age of high-grade regional metamorphism or only a re-heating of a much older metamorphic crust as a consequence of the plutonic activity.

The results of monazite dating are shown in Fig. 1. The weighted average ages calculated for 5-7 monazite grains per sample are 608 ± 28 Ma, 577 ± 19 Ma, 576 ± 31 Ma and 549 ± 19 Ma (2-sigma errors). The first three ages suggest that high-grade regional metamorphism in the BV occurred more or less coeval with granite plutonism and that both are related to the same tectonothermal event. Only the monazite age for sample Krasna is surprisingly young. A repetition of the dating procedure gave the same result again. At the moment we are not sure, if this age has a geological meaning or not. It cannot be excluded that the monazites suffered generally slight lead loss in this sample.

Conclusions

On the basis of the presently available data, the following tentative evolution model is suggested for the BV:

1) A long-lived destructive plate margin setting from ca. 800 to 600 Ma involved the growth of an ensimatic volcanic arc, back-arc extension and deposition of arc-derived flyschoid sediments. Following the work of Tait et al. (1997), this arc system was probably positioned in the subduction realm of the Tornquist ocean, offshore of the Amazonian craton.
2) A major regional metamorphic and plutonic event occurred at around 600-580 Ma, probably as a consequence of a major phase of compressional tectonics (arc-continent collision?). We consider it likely that the Slavkov terrane and the Central Basic Belt attached to the Thaya terrane and the Gondwana continent at that time.

Unlike the Tepla-Barrandian (see e.g. Zulauf et al. 1998), the BV shows no clear signs of major tectonothermal events in the Cambrian. This supports the hypothesis that these two terranes are derived from quite different sectors of the Gondwana margin.

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