GEOLOGICA CARPATHICA, FEBRUARY 2008, 59, 1, 3–18

Cambrian-Ordovician metaigneous rocks associated with Cadomian fragments in the West-Carpathian basement dated by SHRIMP on zircons: a record from the Gondwana active margin setting

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(Manuscript received January 31, 2007; accepted in revised form June 13, 2007)

Abstract: The Central West-Carpathian basement, included in Cretaceous-Early Tertiary structures, shows remnants of pre-Alpine, mainly Variscan tectonics. The paper documents in-situ U-Pb zircon (SHRIMP) ages of a major Cambrian to Ordovician magmatic event, recorded in the West-Carpathian basement. Cambrian to Ordovician, less Early Silurian concordia magmatic ages, with older 525–470 Ma and younger 480–440 Ma age intervals were dated in layered amphibolites and granitic orthogneisses of the tectono-stratigraphically Upper Variscan structural Unit. The zircon cores, especially in orthogneisses, often show Cadomian, mainly magmatic source (protolith) ages, spanning 638–549 Ma, with a concordia age at 617 ± 11 Ma. Older Proterozoic to Archean protolith ages (2000 up to 3400 Ma) are much less common. Cadomian ages highly predominate in kyanite-garnet orthogneisses, tectonically incorporated into the medium-grade metasediments of the Middle Variscan structural Unit. Kyanite-garnet orthogneisses show idiomorphic, magmatically zoned zircons with ages spanning 649–554 Ma, with concordia ages at 607 ± 10 and 558 ± 7 Ma, and metamorphic ages between 540–530 Ma. These ages corroborate the protolith ages of hosting metasediments with a lower intercept around 500 Ma. Early Ordovician ages were also found from the calc-alkaline metavolcanics (482 ± 6 Ma, metarhyolite, or 476 ± 7 Ma, metadacite) of low-grade volcano-sedimentary complexes in the Lower Variscan structural Unit. Long-term magmatic/volcanic activity due to melting of the crust and subcrustal lithosphere is coeval with the rifting of Cadomian crust and evolution of the Gondwana northern active continental margin. The ages of 430–380 Ma of layered amphibolites and orthogneisses reflect the Eo-Variscan subduction/collision metamorphic event in the Prototethyan realm, coeval with the collision of the eastern Avalonian-Cadomian/western Hunic terranes, as part of the Armorican microplate, with Laurussia/Avalonia. The collapse of the Eo-Variscan collisionally thickened crust led to partial melting within the Upper Variscan structural Unit, generating 370–340 Ma old zircons in dated metaigneous rocks.

Key words: Proterozoic/Archean, Paleozoic, Cadomian, Gondwana, West-Carpathian basement, SHRIMP zircon dating.

1. Introduction

The pre-Mesozoic basement of the Slovak Western Carpathians is supposed to derive from the south-eastern-European Variscides (Matte 1991), which were in part incorporated into the Alpine orogenic belt (Fig. 1). The basement complexes of the Central Western Carpathians (Figs. 2, 3) are part of the Cretaceous Tatric, Veporic and Gemeric structural Superunits (Plašienka et al. 1997), analogous to the Austroalpine realm in the Eastern Alps (Putiš 1992, 2002; Gebauer 1993; von Raumer & Neubauer 1993; Dallmeyer et al. 1996, 2005).

The Variscan nappe-stack is southeast-vergent (Fig. 3 after Putiš 1992; Bezák 1994; Putiš et al. 2003, and citations therein) and despite Alpine tectonics, is still recognizable in domains outside the Cretaceous shear zones. The tectono-stratigraphically Upper Variscan structural Unit, or the Tatra Nappe, includes the mid-crustal Jarabá complex (para- and orthogneisses, amphibolites, scarce calc-silicate marbles, migmatites, intruded by granitic plutons) and a lower-crustal layered amphibolite complex (with rare lenses of garnet-clinopyroxene amphibolites as relic eclogites and granulites, antigorite serpentinites, garnet-kyanite ortho- and paragneisses). These overlie the Middle Variscan structural Unit or the Hron Nappe (staurolite-garnet, or kyanite/andalusite, sillimanite-garnet micaschists to gneisses, subordinate amphibolites). The collisionally accreted Lower Variscan structural Unit is composed of the Paleotethyan ophiolitic (Zlatník/Rakovec) complexes and the continental margin related (Gelnica, Hladomorná Dolina, Harmónia, Pezinok and others) complexes. The time of thrusting of the Tatra Nappe over the Hron Nappe is constrained by $^{40}Ar/^{39}Ar$ amphibole ages of mylonitized layered amphibolites at ca.

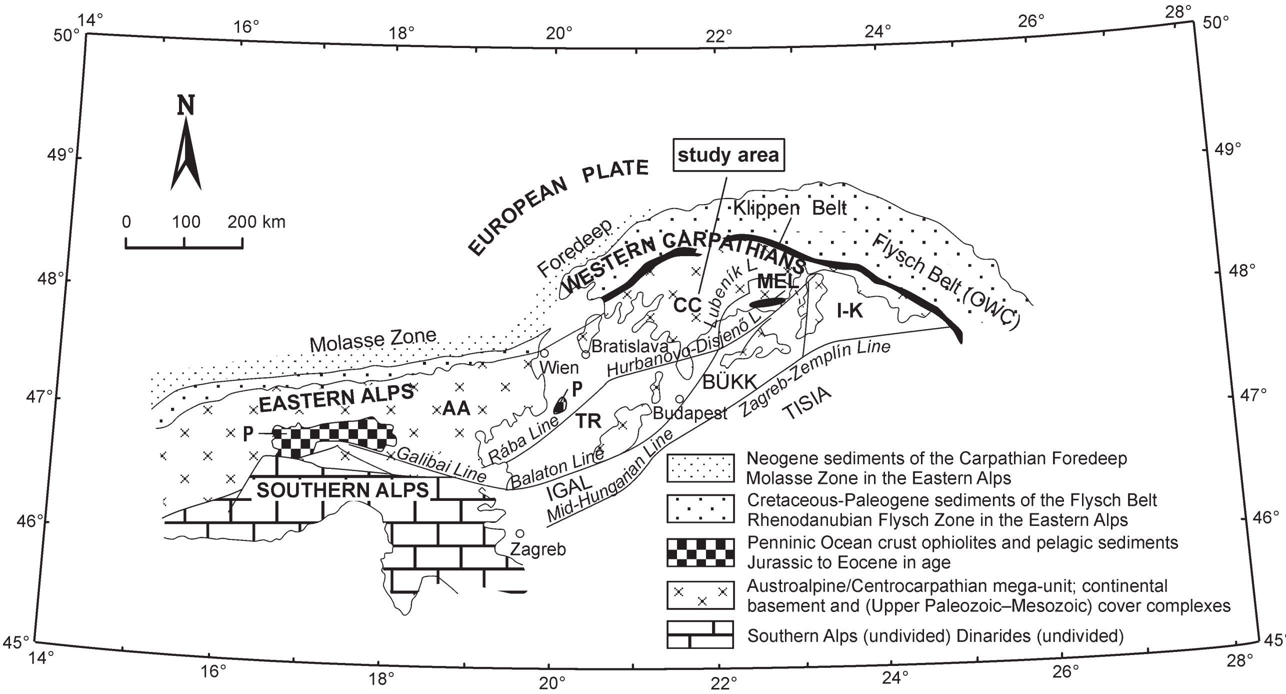

Fig. 1. Tectonic scheme of the Eastern Alps and Western Carpathians (modified after Plašienka et al. 1997; see Haas et al. 1995 for comparison). **AA** — Austroalpine unit, **CC** — Centrocarpathian unit, **P** — Penninic unit. Igal-Bükk zone — S of the Transdanubian range, includes a covered suture after closure of a back-arc basin generated by Jurassic southward subduction of the Meliata oceanic crust.

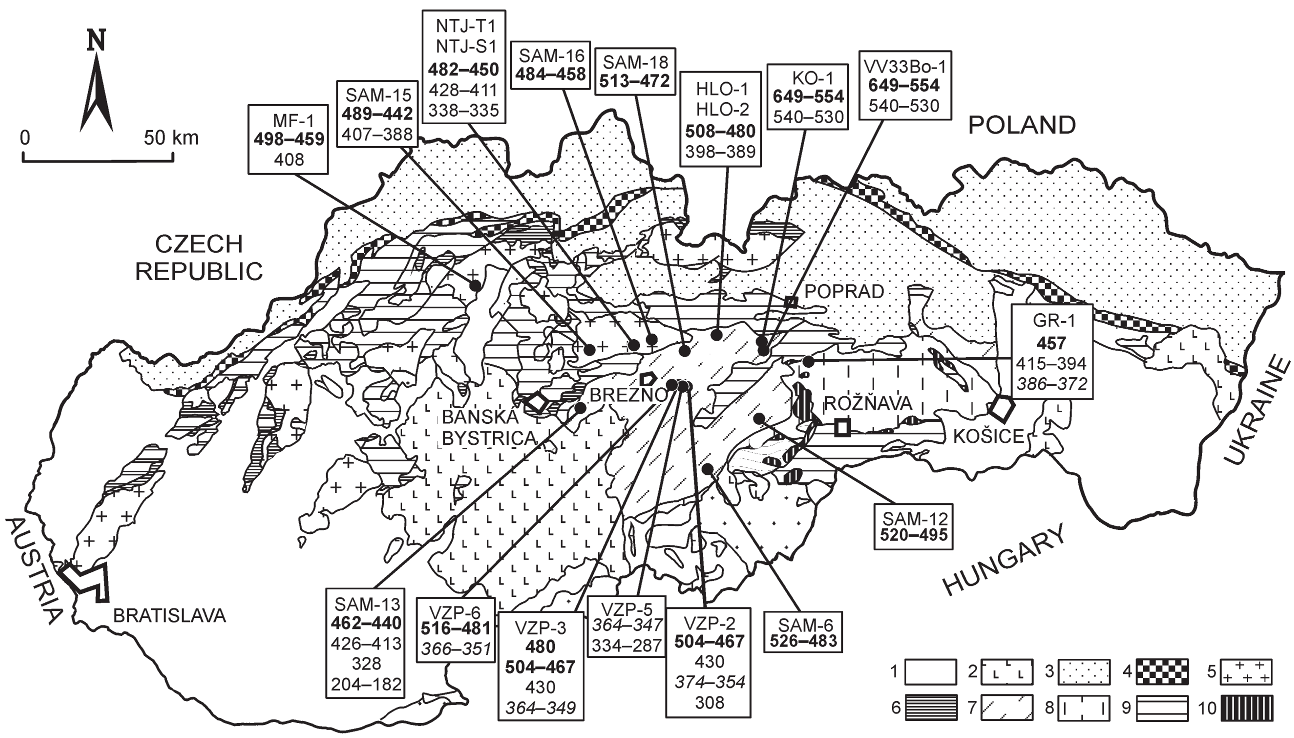

Fig. 2. Schematic geological map of the Slovak Western Carpathians (after Biely et al. 1996) with location of dated samples. **1** — Quaternary and Neogene sediments, **2** — Neogene volcanics, **3** — Paleogene sediments, **4** — Mesozoic rocks of the Pieniny Klippen Belt, **5** — Tatric pre-Mesozoic basement rocks, **6** — Tatric sedimentary cover rocks, **7** — Veporic pre-Mesozoic basement rocks, **8** — Gemeric pre-Mesozoic basement rocks, **9** — Mesozoic cover nappes, **10** — Meliata nappe blueschists and metasediments. There are three age categories in boxes: magmatic ages (top, in bold, 649–554, or 526–440 Ma), metamorphic/melting overprint (430–388, or 386–349 Ma) and/or a thermal rejuvenation (younger ages); see also the tables of analytical data on the journal web-site; interpretation in the text.

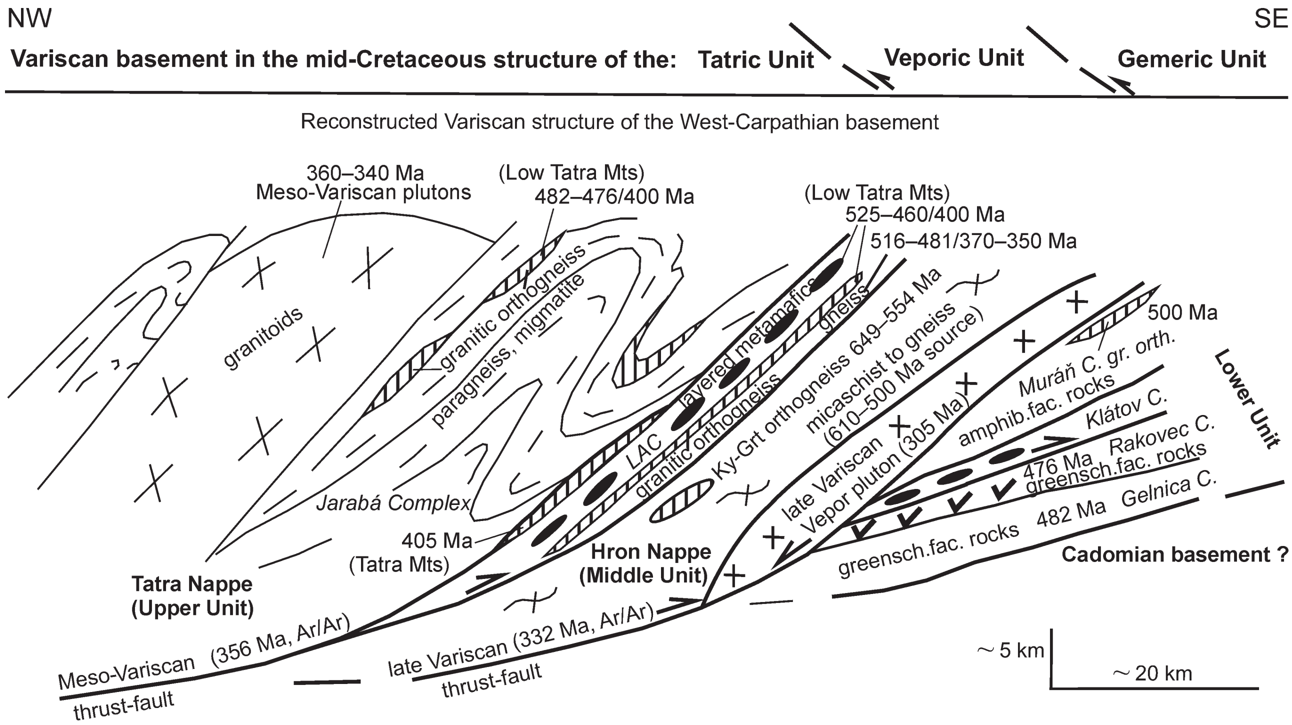

Fig. 3. Generalized cross-section of the pre-Alpine West-Carpathian basement (modified after Putiš et al. 2003) showing principal Variscan structural units with south-east vergent thrusting. Top of the figure indicates an opposite north-west vergent Cretaceous nappe thrusting. The figure is provided with chosen SHRIMP ages (explanation in text).

356 Ma (Dallmeyer et al. 1993, 1996). The collision-accretion of the Lower Variscan structural Unit is estimated to have occurred between late early Carboniferous and early Permian, based on different geological criteria. The West-Carpathian basement is included in Cretaceous to Early Tertiary tectonic structures within the Tatric, Veporic and Gemeric zones.

Published isotopic ages from the West-Carpathian basement complexes are usually not older than Early Paleozoic (Cambel et al. 1990; Krist et al. 1992). A meta-leucotonalite layer of the layered amphibolites from the North-Veporic basement Hlôžková (Hoškova) Valley yields U-Pb zircon ages of 514±24 and 348±31 Ma (upper and lower discordia intercept ages, Putiš et al. 2001). A dioritic gneiss layer from the North-Veporic Veľký Zelený Potok Valley, dated at 346±1 Ma (the lower intercept age, Putiš et al. l.c.) was interpreted as a remelting product of the layered amphibolites (Putiš 2002). Gaab et al. (2005) published possible metamorphic ages (360–330 Ma) of the felsic layers from the North-Veporic Hlôžková (Hoškova) Valley and from Drotačka. Three North-Veporic orthogneisses (from the Koleso and Úplaz Valleys as well as from Mihálikovo) yielded Ordovician ages (470–460 Ma and 440 Ma, respectively) and are identical to ages obtained by CHIME from the North-Veporic Koleso Valley orthogneiss (490–450 Ma, Janák et al. 2002). The South-Veporic Muráň granitic orthogneiss showed a conventional multigrain zircon U-Pb age of ca. 500 Ma (Putiš et al. 2003; Kováčik et al. submitted; A. Kotov, pers. comm.). Gaab et al. (2006) constrained an Ordovician age for the Muráň orthogneiss (464±40 Ma). Kováčik et al. (2005) dated a thermal overprint of the Muráň orthogneiss at 312±15 Ma by CHIME. The granitic orthogneisses from the Jarabá complex in the Tatric basement yield U-Pb zircon ages spanning from ca. 405 to 380 Ma (Poller et al. 2000; Putiš et al. 2003). Late Proterozoic to Cambrian protolith ages (ca. 650 to 500 Ma) were obtained from metasedimentary rocks from the Middle Variscan structural Unit (Kohút et al. 2007). Calc-alkaline (Vozárová & Ivanička 1996; Hovorka & Méres 1997) metavolcanics of the Lower Variscan structural Unit were dated in a wider age interval of 500–400 Ma (Shcherbak et al. 1988).

The obtained multi- and single-grain zircon U-Pb or CHIME ages are quite variable, many of them spreading ±30–40 Ma, which was also a reason for the application of the "*in situ* SIMS" or SHRIMP dating method. Until now, only two West-Carpathian granitoids, which experienced Cretaceous mylonitization (from Kráľova Hoľa Massif in the Nízke Tatry Mountains), were dated by the SHRIMP method (359–345 Ma, Gaab et al. 2005).

Considering the different ages known from the West-Carpathian basement, the following questions arise: 1. Is there a clear cut limit between Neoproterozoic magmatic/metamorphic events and the Early Paleozoic break-up in the Gondwana northern margin, recorded in the West-Carpathian basement? 2. What type of (Cadomian?) basement was rifted in Early Paleozoic times? 3. Which are the rift and/or active margin-settings preserved within the remnants of the Variscan tectonic structure in the alpidic West-Carpathian orogenic belt? It is the goal of this paper to present the first SHRIMP zircon age data constraining the evolution of Early Paleozoic magmatic rocks in some West-Carpathian basement complexes interpreted as representing an active continental margin setting at the northern Gondwana margin. These ages are compared to published basement ages from the south-eastern European Variscides, which are considered to be of Gondwanan origin too.

2. Analytical technique

Zircons have been extracted applying standard heavy liquid and magnetic separation. Half-sectioned zircons mounted in epoxy puck were first imaged by cathodoluminescence (CL) and BSE in order to reveal internal structure and surface features for analytical spot positioning. In-situ U-Pb analyses were performed on a SHRIMP-II in the Center of Isotopic Research (CIR) at VSEGEI during three analytical sessions.

The results are acquired with a secondary electron multiplier in peak-jumping mode following the standard procedure (e.g. Williams 1998; Larionov et al. 2004). Primary O_2-beam with ion current −2 to −3 nA produced elliptic ca. 25×20 μm size analytical crater. Typical mass-resolution at 254 AMU (^{238}UO) was M/ΔM >5000 (1 % valley), allows resolution of possible isobaric interferences. One-minute rastering over a rectangular area of ca. 65×50 μm is employed before each analysis in order to remove the gold coating and possible surface Pb contamination.

The following ion species are measured in sequence: 196(Zr_2O)–^{204}Pb–background (ca. 204 AMU)–^{206}Pb–^{207}Pb–^{208}Pb–^{238}U–^{248}ThO–^{254}UO with integration times ranging from 2 to 30 seconds. Four cycles for each analysed spot were acquired. Each fourth measurement is carried out on the standard zircon TEMORA (Black et al. 2003) or 91500 (Wiedenbeck et al. 1995). The latter was used as "U-concentration" standard.

The raw data were then processed with the SQUID v1.13a (Ludwig 2005a) and ISOPLOT/Ex 3.22 (Ludwig 2005b) software, with decay constants of Steiger & Jäger (1977). The common lead correction is done using measured ^{204}Pb/^{206}Pb following the model of Stacey & Kramers (1975). The age data from samples of complicated multi-stage evolution are processed by the "Unmix Ages" tool of the ISOPLOT, in order to distinguish the main age groups.

Almost all the measured spots gave concordant ages, shown in concordia diagrams. Discordant results of multiple analyses from the same crystal were used to construct a discordia line. On average, analyses of 10 zircon grains have been performed on each rock-sample. The resulting ages have a 2σ error.

3. Description of investigated rocks

A major Early Paleozoic magmatic event seems to be reflected by both, the lower-crustal layered amphibolites and associating granitic orthogneisses of the Upper Variscan structural Unit (the Tatra Nappe), and the upper-crustal volcano-sedimentary complexes of the Lower Variscan structural Unit. Candidates for the rifted pre-Paleozoic type of basement appear to be the kyanite-garnet-rutile or garnet orthogneiss fragments, tectonically emplaced into the micaschist-gneisses of the Middle Variscan structural Unit, having an origin in the northern Gondwana margin. These rocks were dated by SHRIMP. The geological time scale of Gradstein & Ogg (2004) is used.

3.1 Layered amphibolites

Layered amphibolites (or banded amphibolites after Spišiak & Pitoňák 1992, or leptyno-amphibolite complex after Putiš 1992; Hovorka & Méres 1993) show structures of pre-metamorphic compositional layering (D0), with (meta)tonalitic to (meta)leucotonalitic layers of relatively felsic mineral composition a few decimeters thick, alternating with amphibole-rich dark layers of (meta)gabbro-dioritic to (meta)gabbroic and Pl-free Cpx-bearing hornblenditic (meta)cumulate-like layers. These layers have typical metamorphic (D1) — granoblastic to nemato-granoblastic textures. Preserved primary magmatic structures such as compositional layering are seen in straight, more or less sharp boundaries between the layers.

A younger generation of layering (D2) formed in a few decimeters wide zones of layer-parallel shear. Synmetamorphic, stretched interlayer folds are often separated, or sheared off, and their cores are filled by pale fine- to medium-grained quartz-plagioclase leucosomatic seggregates. Aplitic to pegmatitic leucosomes, with leucotonalitic mineral composition and magmatic microstructures are rimmed by typical amphibole-, rarely amphibole-diopside rich melanosome. The mesoscopic/textural relationships suggest that meta-tonalite and meta-leucotonalite layers outside the melting zones could be older than the leucosome layers, the latter being a product of partial melting. The most conspicuous newly-formed layers are plagioclase-rich dioritic gneisses, product of partial melting of metagabbroic layers. They are often crosscut by extensional shear bands filled by leucotonalitic pegmatitoids.

The development of ductile straight bands (D3) is inferred to be connected with the formation of low-angle extensional normal faulting during the exhumation. The whole complex, after ductile deformation, varies in thickness of the first hundreds of meters. The latest generation of layers is composed of clinozoisite, chlorite, albite and quartz, and could represent the closure of the D3 stage or Alpine-type veins. The D1 to D3 structures are crosscut by veins of aplites, pegmatites, as well as volcanic dikes, dated as Permian to Early Triassic (Kotov et al. 1996; Putiš et al. 2000, 2001).

Some antigorite serpentinite lens-shaped bodies observed in the footwall of the Upper Variscan structural Unit are interpreted as tectonic slices of upper mantle origin hosted by micaschist-gneisses of the Middle Variscan structural Unit (Korikovsky & Putiš 2002).

The pre-Alpine metamorphic conditions of the layered amphibolite complex of the Upper Variscan structural Unit was estimated at a temperature of ca. 610 °C and

600–700 MPa of pressure on the southern margin of the North-Veporic area, or 630 °C at 700–800 MPa in the northern part of the North-Veporic area. The *P-T* conditions of the superimposed Alpine deformation and recrystallization in the North-Veporic area did not exceed medium-pressure greenschist-facies conditions (T_{max} 400 °C at P_{max} = 600–700 MPa) (Putiš et al. 1997; Korikovsky et al. 1997). However, temperatures slightly over 500 °C at P_{max} = 800–900 MPa were found along the Cretaceous Pohorelá tectonic line. This evolution is compatible with the resetting of the K-Ar system in amphiboles (Kráľ et al. 1996; Kováčik et al. 1996). The estimated metamorphic conditions of the Alpine basement reactivation in the Veporic area could not reset the pre-Alpine zircon ages.

Typical members of layered amphibolites from the Tatric and Veporic basement were chosen for SHRIMP dating (Figs. 2 and 3).

3.2 Granitic orthogneisses

They are characteristic of the high-grade crystalline complexes of the Upper Variscan structural Unit, forming several kilometers long and hundreds of meters wide lens-shaped bodies hosted by paragneisses and migmatites. The Jarabá structural complex in the Tatric basement, or Ľubietová and Čierny Balog structural complexes in the Veporic basement contain the largest granitic to tonalitic orthogneiss bodies (Putiš et al. 2003, and citations therein). These orthogneisses often show well preserved magmatic fabrics, defined by oriented feldspars and micas, forming domains almost free from a ductile overprint. The original rock was a porphyric granite or granodiorite to tonalite with aligned prismatic K-feldspars and plagioclase crystals, surrounded by oriented muscovite and biotite flakes, giving evidence of syntectonic magmatic flow at subsolidus to solidus temperatures (~700–600 °C). In other domains, larger quartz crystals are weakly elongate, parallel to foliation. The remaining quartz grains keep their interstitial location. Abundant strain-induced myrmekites are developed parallel to the foliation along the K-feldspars megacrysts. Large, plastically strained domains have macroscopically recognizable σ- and δ-type rotated feldspar porphyroclasts enclosed in a dynamically recrystallized quartz-feldspar-mica mylonitic matrix. Shape asymmetries around porphyroclasts point to a top-to-the-SE ductile thrusting of the Upper Variscan structural Unit (the Tatra Nappe) over the Middle Variscan structural Unit (the Hron Nappe), in present-day geographical coordinates (Putiš 1992; Fritz et al. 1992; Madarás et al. 1999; Putiš et al. 2003).

Some orthogneisses occur in close neighbourhood to the layered amphibolite complex, showing common deformation-recrystallization stages, for example garnet orthogneiss at the base of this complex in the Veľký Zelený Potok Valley (southern part of the North-Veporic basement).

Orthogneisses are present as rare tectonic fragments in the footwall micaschists and gneisses of the Middle Variscan structural Unit. Kyanite-garnet-rutile ortho- and paragneisses, locally with migmatitic layering, are partly re-equilibrated (e.g. kyanite is locally replaced by andalusite) with the hosting MP-MT metamorphics in the area north of Heľpa. The peculiar features are lenses of mafic eclogites (Janák et al. 2003, 2007) or HP granulites (Putiš et al. 2006a) enclosed in this type of orthogneiss. Orthogneisses from all three domains were chosen for SHRIMP dating (Figs. 2, 3).

3.3 Metavolcanic rocks

We dated two metavolcanic rocks from the Lower Variscan structural Unit Gemeric basement (Figs. 2, 3). A metarhyolite or porphyroid was sampled from the volcano-sedimentary sequence overlying the flyschoid metasediments of the Gelnica complex. Metadacite occurs at the base of the Rakovec greenschist complex. They preserve magmatic structures — relics of feldspar and quartz phenocrysts, partly recrystallized, surrounded by greenschist-facies metamorphic matrix minerals.

4. SHRIMP ages

Besides rare data indicating Cadomian magmatic or metamorphic events, mainly Cambrian to Ordovician and few Early Silurian age data were encountered. These will be presented in the following subchapters.

4.1 Layered amphibolites

Different lithologies from the layered amphibolite complex in the Tatric, Veporic and Gemeric basement were dated.

Decimeter-thick amphibolitic and metaleucotonalitic layers were sampled in the *Tatric basement* in a gallery ca. 6 km north of Jasenie in the western part of the Nízke Tatry Mountains (Figs. 2, 3). Euhedral zircons with fine oscillatory zoning, typical of magmatic origin, were dated from both major lithotypes (*samples NTJ-T1* and *NTJ-S1*) and gave concordia ages of 481 ± 4 Ma (Th/U = 0.2–0.47; Fig. 4) and 480 ± 5 Ma (Th/U = 0.24–0.42; Figs. 5, 6), respectively. Outer discordant zircon zones rarely indicate ages of 428 and 411 Ma (a metamorphic event?; Th/U = 0.12–0.15), or 338 ± 6 Ma (extensional collapse?).

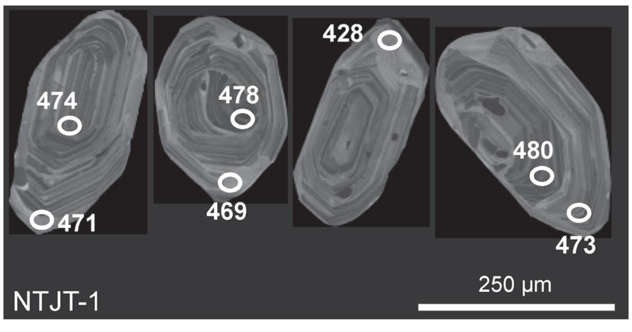

Fig. 4. CL images of dated zircons from a dark *NTJ-T1* layer. Nízke Tatry Mountains, Jasenie, Tatric basement.

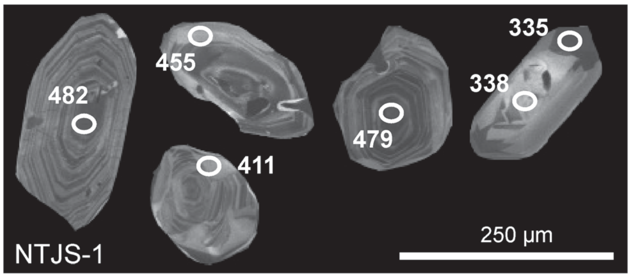

Fig. 5. CL images of dated zircons from a pale *NTJ-S1* layer. Nízke Tatry Mountains, Jasenie, Tatric basement.

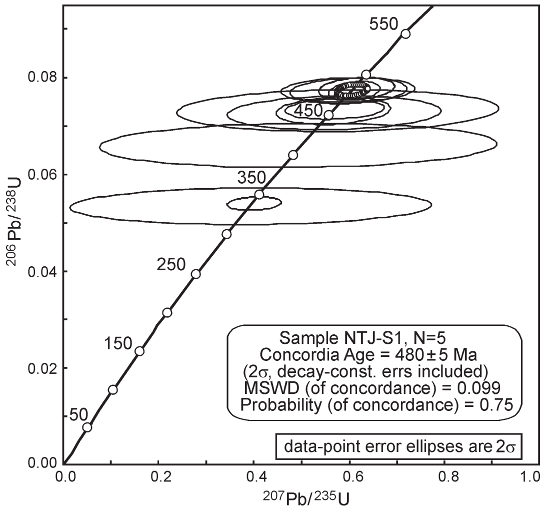

Fig. 6. Concordia diagram of dated zircons from a pale *NTJ-S1* layer. Nízke Tatry Mountains, Jasenie, Tatric basement.

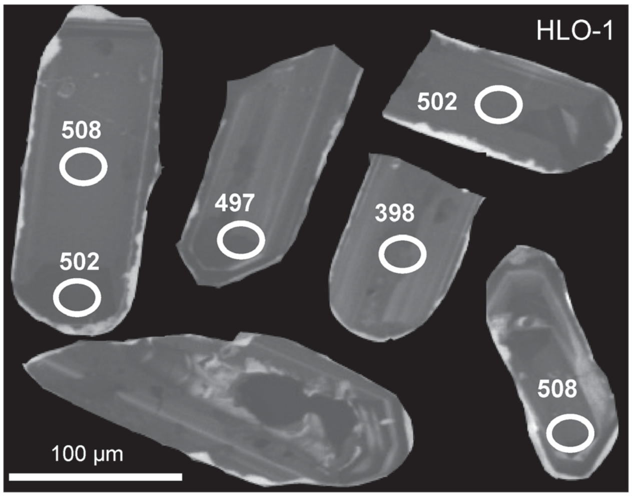

Fig. 7. CL images of dated zircons from a metatonalite *HLO-1* layer from the layered amphibolite complex. Nízke Tatry Mountains, Hlôžková Valley, North-Veporic basement.

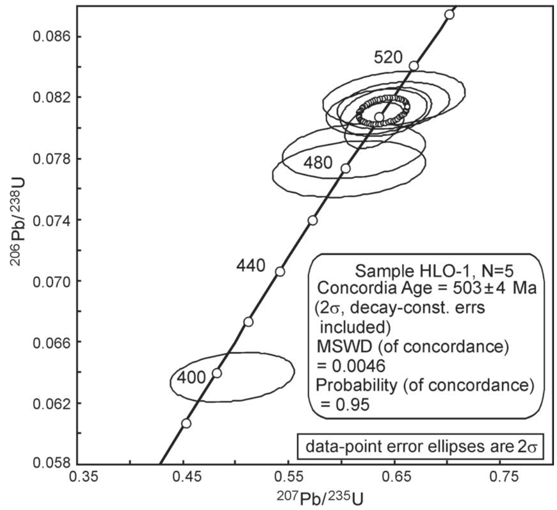

Fig. 8. Concordia diagram of dated zircons from a metatonalite *HLO-1* layer from the layered amphibolite complex. Nízke Tatry Mountains, Hlôžková Valley, North-Veporic basement.

Layered amphibolites from the *Veporic basement* were dated in the eastern part of the Nízke Tatry Mountains, in Hlôžková (Hoškova) Valley, and in the Vepor Mountains (Veľký Zelený Potok Valley), both areas representing the North-Veporic basement (Figs. 2, 3). The partly resorbed anhedral zircon crystals with lobate outlines still have well preserved inner "wide mono-" or "sector-zoned" parts, typical of magmatic origin. The zircon resorption occurred during partial melting of metaigneous layers. Both dated metatonalite and metaleucotonalite layers (*samples HLO-1, 2*) give U-Pb ages ranging from 508 to 480 Ma, with concordia ages at 502±3 Ma (Th/U=0.26–0.46; Figs. 7, 8) and 492±4 Ma (Th/U=0.26–0.45), respectively. The outer discordant zircon zones of 398 and 389 Ma (Th/U=0.12) could be related to the evolution of HP-HT rare boudins of clinopyroxene-garnet rocks in layered amphibolites.

The hanging wall of the Upper Variscan structural Unit (Tatra Nappe, Fig. 3) in the Veľký Zelený Potok Valley, the Vepor Mts (*samples VZP-2, 5*) was subjected to a higher degree of partial melting and provides newly-formed migmatitic layers of different petrographical composition. The concordia age of the dioritic gneiss layer (*sample VZP-5*) is 363±3 Ma (Th/U=0.38–0.59; Figs. 9, 10). On the other hand, an inherited zircon core of 2400 Ma indicates older sources. An age of 549±18 Ma obtained again from a zircon core, could represent the protolith age of the partially melted metagabbro. Younger age-data ranging from 349 to 287 Ma are interpretable as disturbance of the U-Pb system due to a post-orogenic extension collapse/melting event, synchronous with the intrusion of the Vepor granitoids (Bibikova et al. 1990; Gaab et al. 2005). A leucotonalitic leucosome (*sample VZP-2*) was dated at 373±6 Ma (Th/U=0.16–0.45). Zircons 609–550 Ma old might represent contamination of a gabbroic melt by Cadomian crust or the protolith age of partially melted metagabbro. The ages of 504–467 Ma fit the time of a gabbroic intrusion well. An age of 430 Ma (Th/U=0.03) probably indicates an early collision metamorphic event. One zircon records an age of 308 Ma.

A metaleucotonalite (*sample GR-1*) of the *Gemeric basement* comes from decimeter-size pebbles of the Pennsylvanian metaconglomerates (locality of Grajnár). Only

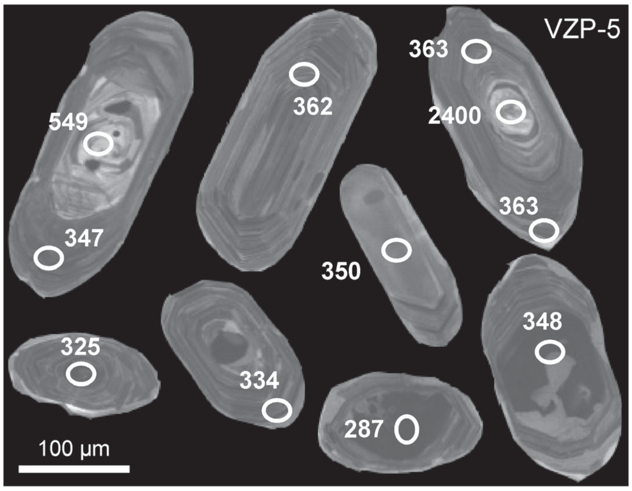

Fig. 9. CL images of dated zircons from a gneissic dioritic *VZP-5* layer from partially melted layered amphibolite complex. Vepor Mountains, Veľký Zelený Potok Valley, North-Veporic basement.

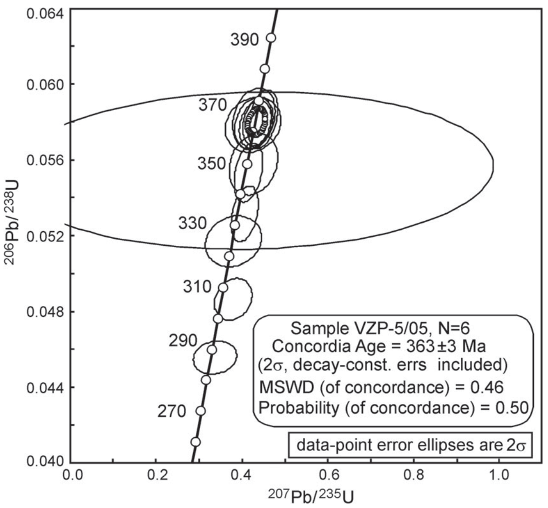

Fig. 10. Concordia diagram of dated zircons from a gneissic dioritic *VZP-5* layer from partially melted layered amphibolite complex. Vepor Mountains, Veľký Zelený Potok Valley, North-Veporic basement.

one regularly zoned zircon grain yields a magmatic age of ca. 457 Ma. Most of the ages cluster around 398 ± 4 Ma. They have wider, less regular (metamorphic?) oscillatory zoning in comparison to those of magmatic origin, with Th/U ~ 0.1. Equally, three spots in outer zones give ages of 386–372 Ma. An inherited zircon core shows a Late Proterozoic protolith age of 634 Ma.

4.2 Granitic to tonalitic orthogneisses

Kyanite-garnet-rutile orthogneisses and garnet granitic orthogneisses often occur at the base of the layered amphibolite complex (Fig. 2). Granitic orthogneisses, associated with the layered amphibolites, were dated in the *North-Veporic basement*. One body of them (*sample VZP-6*) occurs in the Veľký Zelený Potok Valley (*southern part of the North-Veporic basement*). Oscillatorily zoned magmatic zircon was dated to 516 ± 7 Ma (Th/U = 0.2–0.6; Fig. 11). Two outer zones and one newly-formed zoned crystal document the age of superimposed partial melting as 359 ± 5 Ma. An inherited zircon core gave a Late Proterozoic protolith age of 577 Ma. In one case, a relic Archean zircon core, a ca. 3400 Ma old (upper intercept age; Fig. 12), was detected within an approximately 351 Ma old zircon (Fig. 13). A granitic orthogneiss (*sample SAM-18*) from the Čertova Svadba Hill (close to the Čertovica thrust-fault zone, dividing the Tatric and North-Veporic nappes) was dated 485 ± 6 Ma. The analyses were performed from euhedral, oscillatorily zoned magmatic zircons in an age interval from 513 to 472 Ma. Two inherited zircons gave Neoproterozoic protolith ages of 659 and 581 Ma. A granitic orthogneiss (*sample SAM-13*) near Podbrezová was dated to 462 ± 6 Ma.

Magmatically zoned zircons from the tonalitic orthogneiss (*sample SAM-12*) from the Čierna Valley near Ratkovské Bystré, *South-Veporic basement*, gave a concordia magmatic age of 507 ± 4 Ma (Th/U = 0.1–0.4; Figs. 14, 15). The sample contains grains with Neoproterozoic magmatic type zoning with a concordia age of 577 ± 8 Ma. A similar magmatic concordia age of 497 ± 4 Ma was found in a granitic orthogneiss (*sample SAM-6*) from the Chorepa pass.

For comparison, we dated granitic orthogneisses from the *Tatric basement*. Granitic orthogneiss from the Lomnistá Valley in the Nízke Tatry Mountains (*sample SAM-15*) gave a concordia age of 472 ± 6 Ma (Th/U = 0.15–0.53; Figs. 16, 17). However, a morphologically different zircon indicates a younger thermal overprint at 407–388 Ma (Th/U = 0.1–0.3). A granitic orthogneiss from the Vajsková Valley in the Nízke Tatry Mountains (*sample SAM-16*) gave a concordia magmatic age of 470 ± 6 Ma (Th/U = 0.1–0.35; Figs. 18, 19). It contains many magmatically zoned zircons with a concordia age at 617 ± 11 Ma (Th/U = 0.85–1.45) and lower intercept age at 531 ± 29 Ma. A concordant age of 497 ± 6 Ma was found in the *sample MF-1* from the Malá Fatra Mountains.

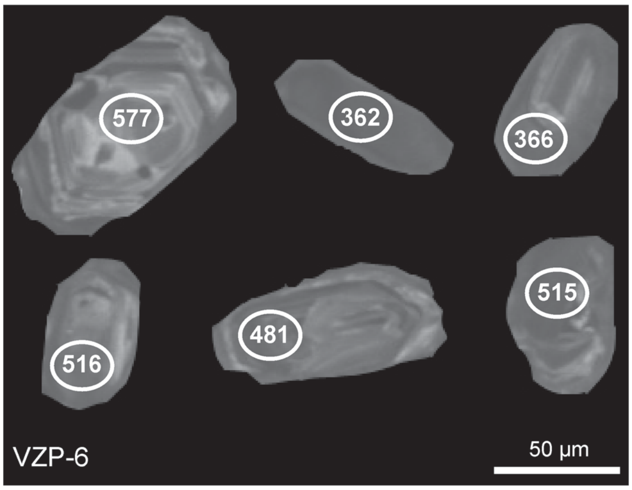

Fig. 11. CL images of dated zircons from a granitic *VZP-6* orthogneiss at the base of the layered amphibolite complex Vepor Mountains, Veľký Zelený Potok Valley, North-Veporic basement.

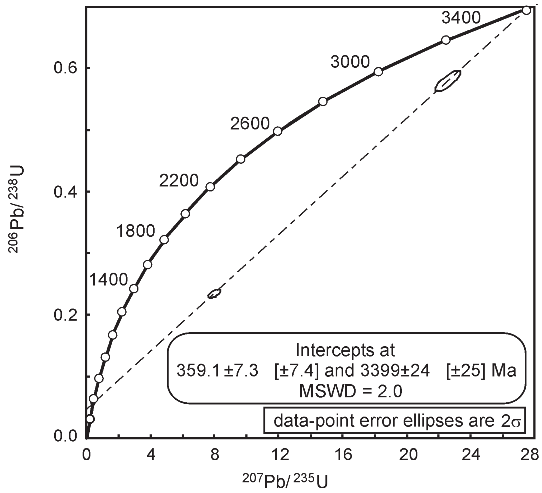

Fig. 12. Discordia diagram of dated zircons from a granitic *VZP-6* orthogneiss at the base of the layered amphibolite complex. Vepor Mountains, Veľký Zelený Potok Valley, North-Veporic basement.

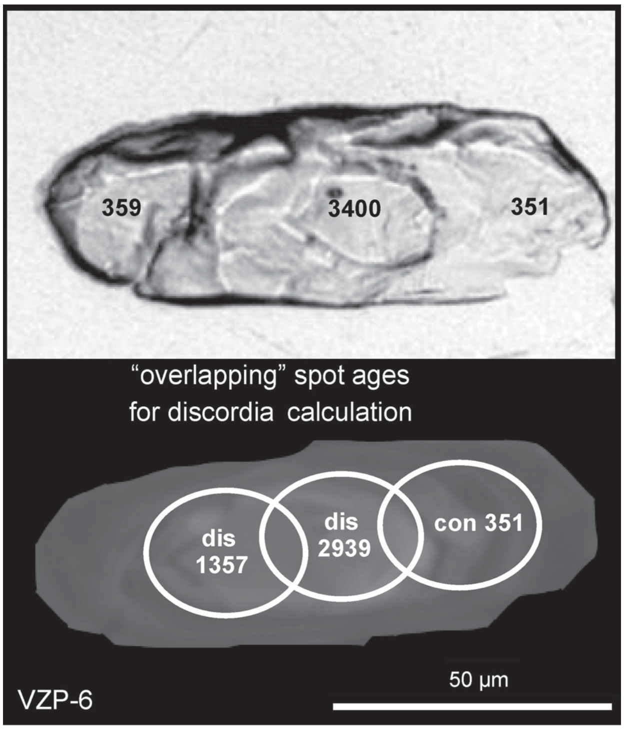

Fig. 13. Image of Middle/Early Archean core in Devonian zircon from a granitic *VZP-6* orthogneiss at the base of the layered amphibolite complex. Vepor Mountains, Veľký Zelený Potok Valley, North-Veporic basement.

Special attention was given to a kyanite-garnet-rutile orthogneiss (*sample KO-1*; Figs. 20, 21) forming tectonic slices within the MP-MT metapelites of the Middle Variscan structural Unit, close to the footwall of the Upper Variscan structural Unit in the North-Veporic area (Figs. 2, 3). Cadomian ages highly predominate in this type of orthogneiss. Oscillatorily zoned zircons (Th/U = 0.26–0.46) show magmatic ages spanning 608–586 Ma, with concor-

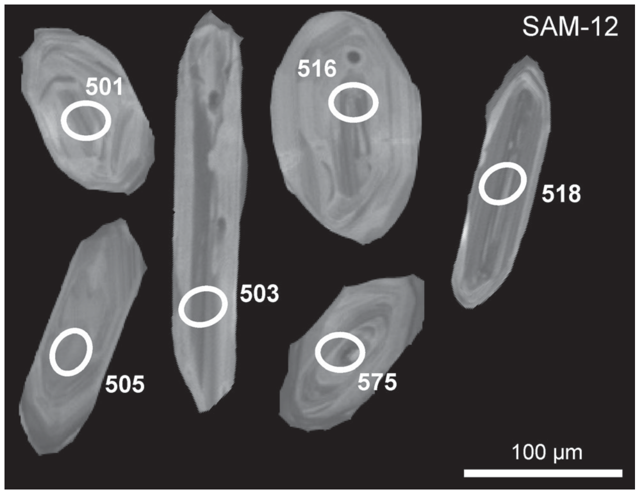

Fig. 14. CL images of dated zircons from a tonalitic *SAM-12* orthogneiss from the Čierna Valley near Ratkovské Bystré, South-Veporic basement.

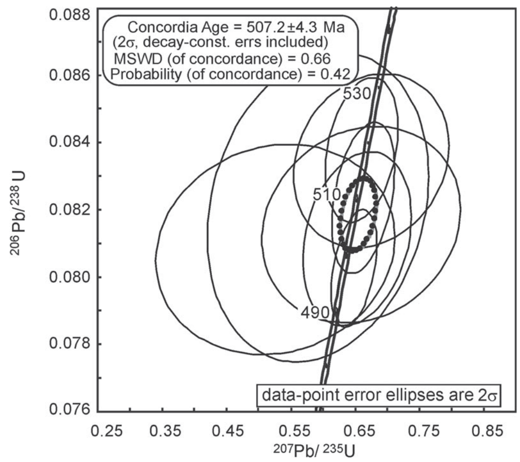

Fig. 15. Concordia diagram of dated zircons from a tonalitic *SAM-12* orthogneiss from the Čierna Valley near Ratkovské Bystré, South-Veporic basement.

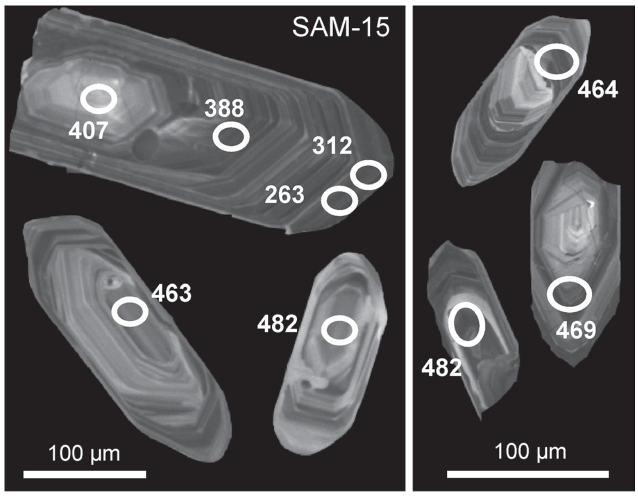

Fig. 16. CL images of dated zircons from a granitic *SAM-15* orthogneiss from the Lomnistá Valley in the Nízke Tatry Mountains, Tatric basement.

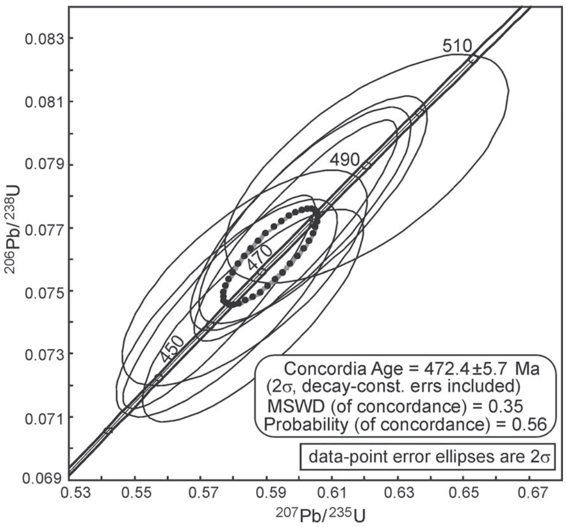

Fig. 17. Concordia diagram of dated zircons from a granitic *SAM-15* orthogneiss from the Lomnistá Valley in the Nízke Tatry Mountains, Tatric basement.

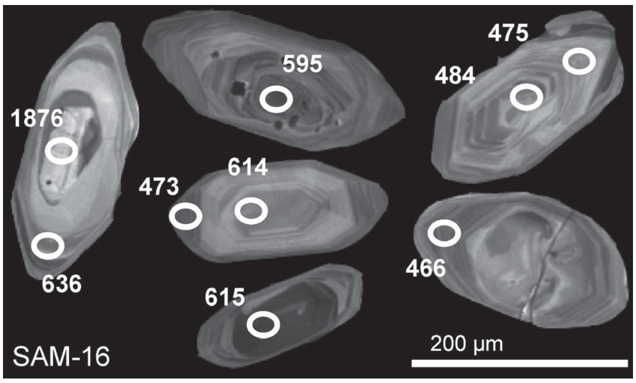

Fig. 18. CL images of dated zircons from a granitic *SAM-16* orthogneiss from the Vajsková Valley in the Nízke Tatry Mountains, Tatric basement.

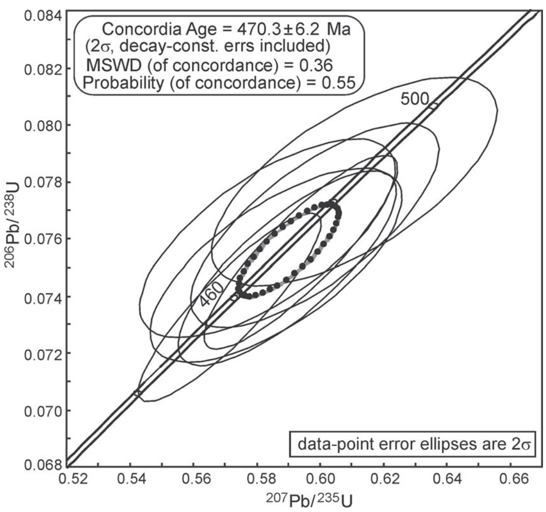

Fig. 19. Concordia diagram of dated zircons from a granitic *SAM-16* orthogneiss from the Vajsková Valley in the Nízke Tatry Mountains, Tatric basement.

dia age at 607±10 Ma and/or metamorphic ages between 540–530 Ma measured from wide non-oscillatory zones (Th/U=0.11–0.14). The lower intercept at 326±10 Ma (besides the upper one at 607±10 Ma) indicates a Variscan thermal overprint. Oscillatorily zoned zircons in garnet-rutile orthogneiss (*sample VV33Bo-1*; Th/U=0.37–1.55; Figs. 22, 23) show magmatic ages spanning 649–554 Ma, with the concordia age at 558±7 Ma. It is important to notice that medium- to coarse-grained *sample VV33Bo-1* represents melting (sillimanite-bearing) domains in tiny- to fine-grained laminated kyanite-garnet-rutile or garnet-rutile K-feldspar-bearing orthogneisses. Older Proterozoic to Late Archean protolith ages (1300 up to 2700 Ma) are much less common. For the age statistics and interpretation see discussion.

4.3 Metavolcanics

Early Ordovician magmatic concordia ages were also found in the calc-alkaline metavolcanics (482±6 Ma, metarhyolite, *sample HE-1*, or 476±7 Ma, metadacite, *sample ZA-1*) of low-grade volcano-sedimentary complexes in the Lower Variscan structural Unit of the Gemeric basement.

5. Results and discussion

The new U-Pb zircon ages improve our knowledge on the age and evolution of the West-Carpathian pre-Mesozoic basement, hitherto based mainly on conventional U-Pb zircon, Rb-Sr isochrone, CHIME and $^{40}Ar/^{39}Ar$ dating methods. Considering the above presented new SHRIMP data, different age groups can be distinguished (Fig. 2). Metaigneous rocks were preferably dated. Magmatic zircons, besides nearly idiomorphic form and fine oscillatory growth zoning usually have relatively higher Th/U values (usually >2; § 4) in comparison to measured metamorphic zircon zones or newly-formed metamorphic zircons. The obtained age groups are reviewed, interpreted and discussed in chronologic order.

U-Pb ages of zircons from investigated rocks are given in Tables 1–20 as an Appendix of this paper in web version at www.geologicacarpathica.sk.

The ***oldest (mid-Proterozoic-Archean) group***, preserved as ***relics in zircon cores***, is probably of detrital origin from an older hinterland. For example, one zircon core from the North-Veporic granitic orthogneiss, at the base of the layered amphibolite complex, closely associating with the kyanite-garnet paragneisses (Veľký Zelený Potok Valley), gave a Middle/Early Archean age of 3400 Ma (Putiš et al. 2006b, 2007a–c) thus representing the oldest geological/geochronological record described in the Western Carpathians (Figs. 12, 13). Such a rare Archean age resembles the oldest parts of the Central European continental crust (Gebauer et al. 1989, 3840 Ma).

Neoproterozoic–Cadomian ages in the time span of ca. 640–530 Ma are found in zircons from different types of orthogneisses.

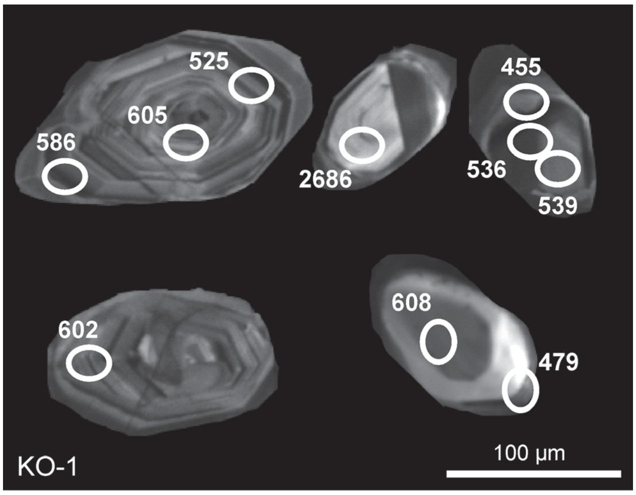

Fig. 20. CL images of dated zircons from *KO-1* orthogneiss from the Koleso Valley in the Nízke Tatry Mountains, North-Veporic basement.

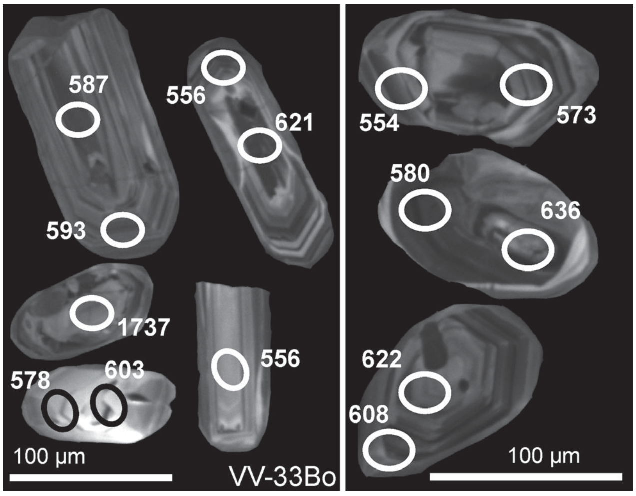

Fig. 22. CL images of dated zircons from *VV33Bo-1* orthogneiss from the Jaškovec (Krivuľa) Valley in the Nízke Tatry Mountains, North-Veporic basement.

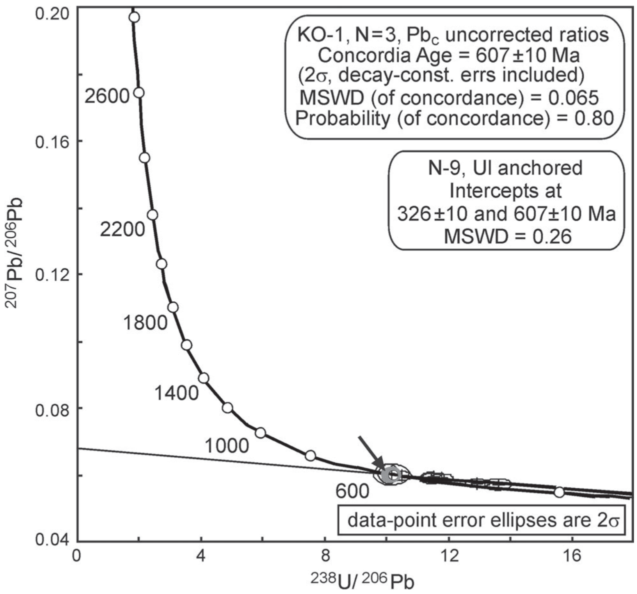

Fig. 21. Concordia diagram of dated zircons from *KO-1* orthogneiss from the Koleso Valley in the Nízke Tatry Mountains, North-Veporic basement.

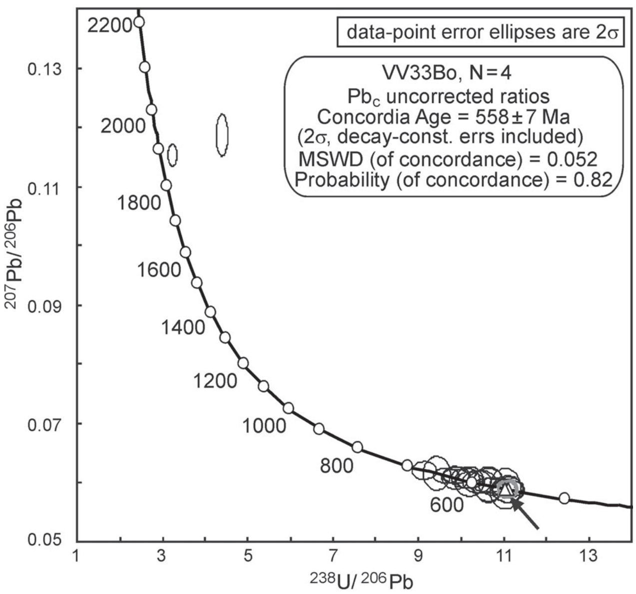

Fig. 23. Concordia diagram of dated zircons from *VV33Bo-1* orthogneiss from the Jaškovec (Krivuľa) Valley in the Nízke Tatry Mountains, North-Veporic basement.

Zircon cores of Cambrian-Ordovician orthogneisses often show magmatic protolith ages spanning 638–549 Ma (Figs. 9, 11, 14, 18), with the concordia age at 617±1 (*sample SAM-16*, Fig. 18). Therefore the measured age interval probably includes two different age groups (ca. 650–600 Ma and/or ca. 600–550 Ma).

The orthogneisses of the North-Veporic basement formerly interpreted as Ordovician (Gaab et al. 2005) were found to contain almost exclusively zircons of Neoproterozoic (Cadomian) magmatic ages spanning 608–586 Ma (*sample KO-1*, Figs. 20, 21), or 649–554 Ma (*sample VV33Bo-1*, Figs. 22, 23), with concordia age of 607±10 Ma (*sample KO-1*, Fig. 21), or 558±7 Ma (*sample VV33Bo-1*, Fig. 23). The ages between 540–530 Ma (*sample KO-1*, Fig. 20) are interpreted as Cadomian metamorphic overprint. From the 31(10+21) measured spots in both samples, 23(4+19) spots gave Cadomian magmatic ages, 3(1+2) spots — older Proterozoic to Late Archean ages, 2(2+0) spots — Cadomian metamorphic ages, and only 3(3+0) spots, located on outer zircon zones, gave Cambrian-Ordovician ages. Thus, Cadomian magmatic zircon ages suffered from a late-Cadomian metamorphic and a Cambrian-Ordovician thermal rejuvenation (Figs. 20, 22).

The *sample VV33Bo-1* although formed by melting of kyanite-garnet-rutile orthogneiss (*sample KO-1*), shows nearly the same zircon magmatic ages. Supposed melting temperatures between 600–700 °C were probably not sufficient for the zircon resolution in the orthogneiss. The age of lenses of HP eclogites and granulites (Janák et al. 2003, 2007; Putiš et al. 2006a), enclosed in partially melted orthogneiss, is unknown.

Similar Neoproterozoic magmatic ages were found in the Austroalpine basement to the south of the Tauern Window in the Eastern Alps (Schulz et al. 2004; Dekant et al. 2005, and submitted).

Metamorphic ages (540–530 Ma) fit a hiatus in sedimentation on Cadomian terranes (Cadomian unconformity), related to the Cadomian orogeny. Magmatic ages, around younger concordia age of ca. 558 Ma, are coeval with magmatism in the Avalonian-Cadomian arc, reconstructed between 570 and 540 Ma in Saxo-Thuringia (Linnemann & Romer 2002). Magmatic ages, around the older concordia age of ca. 607 Ma, are consistent with an older magmatic phase in the Avalonian-Cadomian arc, reconstructed before 607 Ma, the cooling age from $^{40}Ar/^{39}Ar$ dating of magmatic hornblendes in the Cadomian orogen exposed in NW France and the Channel Islands (Dallmeyer et al. 1991). D'Lemos et al. (2001) confirmed both age groups by dating magmatic zircons to 610 ± 2 Ma and 572 ± 1 Ma.

The orthogneisses from the West-Carpathian Middle Variscan structural Unit could therefore represent remnants of the Cadomian crust detached from the continental margin of Gondwana and tectonically emplaced into MT-MP micaschist gneisses, derived from Neoproterozoic/Early Cambrian Gondwana margin flyschoid sediments. Although the time of tectonic emplacement of the orthogneisses, hosting rare boudins of HP-HT metamafics, is not well constrained, the orthogneiss ages corroborate well the Neoproterozoic to Cambrian source ages (ca. 650 to 500 Ma, Kohút et al. 2007, and in press) of the hosting metasedimentary rocks.

The measured Cadomian ages thus indicate that some of the West-Carpathian (Tatric-Veporic) basement fragments shared a common geological history with the eastern Avalonian-Cadomian/western Hunic terranes throughout the Neoproterozoic and Early Cambrian.

Cambrian to Ordovician ages spanning 525–440 Ma are characteristic for the dated layered amphibolites, granitic orthogneisses and acid metavolcanics.

Layered amphibolites: The layered amphibolites formerly interpreted as Ordovician (Gaab et al. 2005), or Cambrian (Putiš et al. 2001) yielded Ordovician SHRIMP ages (482–450 Ma, Figs. 4–6) in the Tatric (Nízke Tatry Mountains) basement, but Cambrian to Ordovician (508–467 Ma, Figs. 7, 8) in the North-Veporic (Vepor Mountains) basement, with concordia ages of 480 ± 5 Ma or 503 ± 4 Ma, respectively (Figs. 6, 8). They may represent two magmatic (Cambrian/Early Ordovician and/or Ordovician/Early Silurian) phases of a gabbroic(-dioritic) intrusion into the continental lower crust. Preliminary geochemical data infer a fractionated gabbroic to dioritic origin for the layered amphibolites (Putiš et al. 2006a).

Granitoid orthogneisses: The hitherto known conventional U-Pb data distinguished two granitic orthogneiss generations — one Ordovician (Gaab et al. 2005), and the other Early Devonian (Poller et al. 2000; Putiš et al. 2003). SHRIMP dating confirmed a wider, but still single principal Cambrian-Ordovician age interval in both the Tatric and Veporic domains. As in the layered amphibolites, two main age intervals are distinguishable: a highly predominating Cambrian/Early Ordovician (Figs. 11, 14–17), and Ordovician/Early Silurian (Figs. 18, 19 and sample SAM-13 in Fig. 2) in S- and I-type (Putiš et al. 2003 and citations therein) granitic/tonalitic orthogneisses.

The Early Ordovician ages of two dated samples of calc-alkaline acid *metavolcanics* (482 ± 6 Ma and 476 ± 7 Ma) fit in well with the first magmatic phase of a gabbroic intrusion found in layered amphibolites, or to the first generation of orthogneisses. Acid volcanism could have been triggered by partial melting at the base of the extensionally thinning continental crust due to injection of basic magmas of a gabbro-basalt composition.

Major Cambrian-Ordovician magmatism/volcanism, detected in the West-Carpathian basement, could be related to rifting, followed by more recent magmatic/volcanic activity above the southward subducting Panthalassa Ocean slab in the Gondwana active continental margin. Gabbroic to dioritic intrusions, generated by suprasubduction melting of the subcrustal lithosphere, were emplaced and differentiated in the continental lower crust as a precursor of the dated layered amphibolites. Contemporaneous melting of the lower crustal rocks enabled formation of granitic to tonalic bodies, precursors of the dated orthogneisses. The Early Ordovician acid calc-alkaline metavolcanics of the low-grade volcano-sedimentary complexes in the Lower Variscan structural Unit also fit in well with this scenario. They might be related to break-up of the Gondwana northern active continental margin by splitting it into microplates like Avalonia (by the opening of the Prototethyan Rheic Ocean at ca. 480–470 Ma) and Armorica (by the opening of the Prototethyan (2) Massif Central-Galicia Ocean at ca. 450–440 Ma), as suggested by the two main age intervals measured of 525–470 Ma and 480–440 Ma, respectively. From this point of view, a time boundary between the Neoproterozoic, or Cadomian magmatic-metamorphic event (from ca. 650 to 530 Ma) and the Early Paleozoic rifting/active margin setting (starting at ca. 525 Ma), recorded in the West-Carpathian basement, should be the Early Cambrian. Detrital white mica from the Early Paleozoic low-grade metamorphosed flyschoid sediments of the Lower Variscan structural Unit of the Gemeric basement (Ochtiná Carboniferous complex) was dated by the $^{40}Ar/^{39}Ar$ method to ca. 508 Ma (Cambrian; Dallmeyer et al. 1996). Vozárová et al. (2005) found detrital mica of Ordovician age (ca. 465 Ma) in the Late Paleozoic sandstones of the North-Gemeric unit, and both these ages fit in well with the Cambrian-Ordovician magmatic ages preserved in the Upper/Middle Variscan structural Unit of the Tatric-Veporic basement.

The Cambrian to Early Ordovician age interval is coeval with the separation of the Avalonian microplate from the northern Gondwana margin (Pin & Marini 1993) and opening of the Prototethyan Rheic Ocean at ca. 470 Ma (e.g. Banka et al. 2002; Winchester et al. 2002). The end of the younger interval at ca. 440 Ma is usually interpreted as separation of the Armorican microplate from northern Gondwana by the opening of the Paleotethys Ocean (l.c.). However, fauna analysis (Robardet 2003) proves, for example, very high values of the coefficients of similarity (CS=0.90) for Early Devonian (Lochkovian) chitinozoan assemblages, precluding any important difference in latitude and also the existence of a wide ocean between the Armorican Massif (Armorica) and the Algerian Sahara (Gondwana). Conversely, these coefficients are much weaker (CS=0.37–0.48) between these regions and northern Europe (Podolia and Poland) situated on the southern margin of Laurussia (Paris 1993). This suggests that there was a noticeable difference of latitude for North Gondwana and northern Europe. The above mentioned fauna analysis is, however, not in contradiction to a later opening of the Paleotethyan Ocean (or a system of basins) — in the Midle/Late Devonian, as suggested by the ages of the dated incomplete Paleotethyan ophiolitic complexes in the Western Carpathians (ca. 385–350 Ma, Putiš et al. 2006b, 2007a–c). Therefore the younger magmatic phase (480–440 Ma) we relate to the opening of the Prototethyan (2) Massif Central-Galicia Ocean dividing the Armorica from the Gondwana. This oceanic basin was eastward reducing to an extensionally thinned continental crust, including the West-Carpathian basement. Northward directed subduction/collision under thrusting (430–380 Ma) below the Armorican microplate initiated formation of a back-arc basin (Pernek oceanic back-arc basin in the Western Carpathians; Putiš 1992 — Fig. 5, top) on the southern Armorican margin. Contemporaneous and continuing extension of the northern Gondwana (passive) continental margin led to opening of the Paleotethys Ocean in Middle/Late Devonian times (385–350 Ma, Putiš et al. 2006b, 2007a–c).

The two distinguished magmatic phases overlap with the whole period of the Cambrian-Ordovician extension in the eastern Avalonian-Cadomian/western Hunic terranes, the fragments of which were identified in the Upper Variscan structural Unit (Tatric and Veporic basement) of the Western Carpathians. This evolution confirms the mentioned terranes as an integrated part of the Armorican microplate (s.l.) before the opening the Paleotethys Ocean.

Silurian to Middle Devonian ages (ca. 430–390 Ma) are well preserved in outer, often discordantly grown zircon zones, or in newly crystallized zircons of layered amphibolites and orthogneisses (Figs. 4–8, 16, and samples GR-1, VZP-2, 3, SAM-13 and MF-1 in Fig. 2). They have decreased Th/U values, typical of a metamorphic overprint, in comparison to magmatic zircons. Although both principal Cambrian-Ordovician extension intervals are recorded in the Upper Variscan structural Unit (the Tatra Nappe) of the Tatric-Veporic basement, the latter also indicates an important Eo-Variscan northward dipping subduction/collision suture zone (Fig. 3) observable as a nappe surface between the Upper and Middle Variscan structural Units (Putiš 1992; Putiš & Grecula in Plašienka et al. 1997; Fig. 6). The ages of 430–390 Ma are consistent with the closure of the Prototethyan (2) Massif Central-Galicia Ocean (Matte 1991, 2001; or Galicia ± Southern Brittany, Massif Central ± Moldanubian Ocean after Tait et al. 1997), subduction (a HP metamorphic event; e.g. von Quadt et al. 1997) and collisional suture formation at the southern Armorica margin, contemporaneous with the rifting and a more recent opening of the Paleotethys Ocean along the northern Gondwana margin.

Late Devonian to Mississippian ages (385–340 Ma) are well preserved in outer zircon zones, or in newly crystallized zircons of layered amphibolites and orthogneisses (Figs. 9, 11–13, 21). These ages, found from the southeast-vergent collision nappe stack in the Tatric and Veporic basement (Fig. 3), clearly indicate a superimposed metamorphic/melting event due to extensional collapse of the thickened Variscan crust, producing large granitic-tonalitic plutons mostly 360–320 Ma old (Petrík & Kohút 1997).

The ages corroborate collision of the Armorican microplate (with included eastern Avalonian-Cadomian/western Hunic terranes fragments) with Laurussia/Avalonia, following the closure of both Prototethyan Oceans limiting the Armorican microplate. The West-Carpathian basement, however preserves only the southern side of this microplate.

The newly identified age groups enable a general correlation of the West-Carpathian Paleozoic complexes with other fragments of the European(/African) Variscides, likely derived from the northern Gondwana continental margin (Piqué et al. 1993; von Raumer 1998; Franke 2000; Shelley & Bossière 2000; Matte 2001, 2007; Cartier et al. 2001; von Raumer & Stampfli 2007). For example, similar Cambrian-Ordovician magmatic ages of metaigneous rocks from the Saxothuringian and Moldanubian zones indicate that the European Variscides share the evolution of the northern Gondwana margin (Linnemann et al. 2000; Banka et al. 2002). This major Cambrian-Ordovician magmatic event, reconstructed from orthogneisses, was dated by the Pb-Pb and U-Pb methods in eastern Bohemia (Kröner et al. 1994, 2000, 2001) or in the Polish Sudetes (Kryza & Pin 1997; Štípská et al. 2001; Żelaźniewicz et al. 2006). Cambrian plutonism is known within the Bohemian Massif from U-Pb zircon ages and structural development of metagranitoids of the Teplá crystalline complex (Dörr et al. 1998) and the Moldanubian domain (Friedl et al. 2004; Schulmann et al. 2005). Dörr et al. (2002) proposed a tentative model for the evolution of the Avalonian-Cadomian terranes, which is compatible with the oldest history of the West-Carpathian basement.

Despite this paper is far from a comparitive study, it is remarkable, how distant European Variscan areas can show very close analogies. For example, the Upper Variscan structural Unit (the Tatra Nappe) of the Tatric and North-Veporic basement shows analogies to the Upper Gneiss Unit of the French Massif Central, including a HP Eo-Variscan event ca. 415 Ma old registered in eclogitic and HP granulitic boudins in the layered amphibolite complex, and later 370–340 Ma migmatitization. The North-Veporic (Ľubietová) and South-Veporic (Čierny Balog) structural complexes with MP/MT paragneisses and large bodies of Cambrian-Ordovician granitic-tonalitic orthogneisses resemble the Lower Gneiss Unit of the French Massif Central (Faure et al. 1997). The Middle Variscan structural Unit (the Hron Nappe) seems to be analogous to the Paraautochthonous Unit of the French Massif Central, both with predominating MP-MT micaschists to paragneisses. The Lower Variscan structural Unit could be analogous to the Southern Paleozoic Fold and Thrust Belt (Montagne Noire, Cévennes) including the Southern Foreland Carboniferous cover (Faure et al. 2005). The Devonian metaophiolitic complexes occur in both regions. The Devonian Brévenne metaophiolitic complex resembles the Pernek complex in the Western Carpathians. The southward directed sequence of thrusting is roughly compatible too. Similar analogies can be seen in the south-vergent Moldanubian Unit of the Bohemian Massif, at least concerning the positioning of the "Upper Variscan" Gföhl structural Unit (with layered amphibolites and HP metamafics) thrust over the "Middle Variscan" Drosendorf structural Unit (micaschists to gneisses). All the regions compared above have many similarities pointing to a Gondwana/Armorica origin.

6. Evolution and origin of the West-Carpathian basement — conclusion

In conclusion, we would like to summarize the results and new aspects of the West-Carpathian basement evolution.

They include relics of Cadomian basement, characterized by orthogneisses yielding magmatic concordia ages at 617±1, 607±10 and 558±7 Ma (from a Cadomian magmatic arc?) and metamorphic ages between 540–530 Ma. The corresponding zircons contain cores of 700–3400 Ma, testifying a Proterozoic to Archean hinterland.

During the Early Paleozoic times, two main magmatic phases become evident, a Cambrian/Early Ordovician phase, interpreted as representing a Middle Cambrian rifting event, followed by magmatic rocks of a Late Cambrian to Early Ordovician first magmatic phase (525–470 Ma), or Ordovician to Early Silurian as the second magmatic phase (480–440 Ma), representing a more recent crustal extension in active continental margin setting. Magmatically layered upper mantle gabbroic(-dioritic) intrusions were emplaced in the vicinity of granitic rocks in partially melted domains of the extensionally thinned continental lower crust. These magmatic phases, found in layered amphibolites and orthogneisses of the Upper Variscan structural Unit were accompanied by the formation of volcanosedimentary complexes, the latter mainly present in the Lower Variscan structural Unit. The metasediments of the Middle Variscan structural Unit appear to be a remnant of the Proterozoic-Early Cambrian northern Gondwana margin.

Evidently, the area, represented now by the Tatric and Veporic medium- to high-grade complexes (the Upper and Middle Variscan structural Units), underwent the large-scale transformations of the Variscan age, including an Eo-Variscan northward subduction (430–390 Ma), south-vergent syncollisional nappe stacking (385–360 Ma) and collapse (360–340 Ma), resembling the evolution of the eastern Avalonian-Cadomian/western Hunic terranes, or Armorica (s.l.) in the Prototethyan realm. The Eo-Variscan continental subduction/collision (430–370 Ma), running along the southern margin of the Armorican microplate (no Prototethyan Ordovician-Silurian ophiolites have been found in the West-Carpathian basement), initiated rifting and a more recent extensional magmatism/volcanism in the active south-Armorican and the passive northern Gondwana margin (385–350 Ma), the latter transforming into a system of Paleotethyan basins in the Late Devonian to Mississippian. This evolutionary stage is in good agreement with the ages of the Lahn-Dill type volcano-sedimentary as well as those of the incomplete ophiolitic complexes in the Western Carpathians (385–350 Ma, Putiš et al. 2006b, 2007a–c). The latter had been subducted northward (350–330 Ma) in front of the accreted (330–300 Ma) Upper Devonian/Mississippian volcano-sedimentary complexes of the northern Gondwana margin to Armorica, before the late Variscan post-collisional collapse (300–270 Ma). The Paleotethyan subduction/accretion complexes, exposed in the Gemeric basement, developed to the north of the passive northern Gondwana margin Noric terrane. Therefore the West-Carpathian basement shows a strong Gondwana/Armorica affinity.

Acknowledgments: Support from Slovak Research and Development Agency (No. APVT 20-016104; APVV 12504, 0557-06) and VEGA Agency (No. 1/4038/07) is greatly acknowledged. Fruitful discussions and a constructive review by Prof. Dr. J.F. von Raumer contributed to decisive improvement of the original manuscript. The suggestions of Prof. Dr. W. Siebel and Prof. Dr. W. Frisch as the reviewers are appreciated very much.

References

Banka D., Pharaoh T.C. & Williamson J.P. 2002: Potential field imaging of Paleozoic orogenic structure in northern and central Europe. *Tectonophysics* 360, 23–45.

Bezák V. 1994: Proposal of the new division of the West Carpathian crystalline based on the Hercynian tectonic building reconstruction. *Miner. Slovaca* 26, 1–6 (in Slovak with English summary).

Bibikova E.V., Korikovsky S.P., Putiš M., Broska I., Golzman Y.V. & Arakeliants M.M. 1990: U/Pb, Rb/Sr and K/Ar dating of Sihla tonalites of Vepor pluton (Western Carpathians). *Geol. Zbor. Geol. Carpath.* 41, 427–436.

Biely A. (Ed.), Bezák V., Elečko M., Gross P., Kaličiak M., Konečný V., Lexa J., Mello J., Nemčok J., Potfaj M., Rakús M., Vass D., Vozár J. & Vozárová A. 1996: Geological Map of Slovakia 1:500,000. *D. Štúr Inst. Geol. Publ.*, Bratislava.

Black L.P., Kamo S.L., Allen C.M., Aleinikoff J.N., Davis D.W., Korsch R.J. & Foudoulis C. 2003: TEMORA 1: a new zircon standard for Phanerozoic U-Pb geochronology. *Chem. Geol.* 200, 155–170.

Cambel B., Kráľ J. & Burchart J. 1990: Isotopic geochronology of the Western Carpathian Crystalline Complex with catalogue of data. *VEDA*, Bratislava, 1–183 (in Slovak with English summary).

Cartier C., Faure M. & Lardeux H. 2001: The Hercynian orogeny in the South Armorican Massif (Saint-Georges-sur-Loire Unit, Ligerian Domain, France): rifting and welding of continental stripes. *Terra Nova* 13, 143–149.

Dallmeyer R.D., D'Lemos R.S., Strachan R.A. & Müller P.A. 1991: Tectonothermal chronology of early Cadomian arc development in Guernsey and Sark, Channel Islands. *J. Geol. Soc.* 148, 691–702.

Dallmeyer R.D., Neubauer F. & Putiš M. 1993: $^{40}Ar/^{39}Ar$ mineral age controls for the Pre-Alpine and Alpine tectonic evolution of nappe complexes in the Western Carpathians. *PAEWCR Conference, Excursion guide, Stará Lesná*, 11–20.

Dallmeyer R.D., Neubauer F., Handler R., Fritz H., Müller W., Pana D. & Putiš M. 1996: Tectonothermal evolution of the internal Alps and Carpathians: Evidence from $^{40}Ar/^{39}Ar$ mineral and whole-rock data. *Eclogae Geol. Helv.* 89, 203–227.

Dallmeyer R.D., Németh Z. & Putiš M. 2005: Regional tectonothermal events in Gemericum and adjacent units (Western Carpathians, Slovakia): Contribution by the $^{40}Ar/^{39}Ar$ dating. *Slovak Geol. Mag.* 11, 155–163.

Dekant Ch., Wölfler A., Siebel W., Putiš M., Markl G. & Frisch W. 2005: New U-Pb investigations in the Austroalpine of the Kreuzeck Massif, Karinthia (Eastern Alps). *Geophys. Res. Abstr.*, Vol. 7, 04857, 2005 SRef-ID: 1607-7962/gra/EGU05-A-04857© European Geosciences Union 2005.

Dekant Ch., Wölfler A., Siebel W., Putiš M., Frank W. & Frisch W. submitted: Geochronological constraints on the evolution of the Kreuzeck Massif, Austria: a U/Pb and $^{40}Ar/^{39}Ar$ study. *Int. J. Earth Sci. (Geol. Rdsch.)*.

D'Lemos R.S., Miller B.V. & Samson S.D. 2001: Precise U-Pb zircon ages from Alderney, Channel Islands: growing evidence for discrete Neoproterozoic magmatic episodes in northern Cadomia. *Geol. Mag.* 138, 719–726.

Dörr W., Fiala J., Vejnar Z. & Zulauf G. 1998: U-Pb zircon ages and structural development of metagranitoids of the Teplá crystalline complex: evidence for pervasive Cambrian plutonism within the Bohemian massif (Czech Republic). *Geol. Rdsch.* 87, 135–149.

Dörr W., Zulauf G., Fiala J., Franke W. & Vejnar Z. 2002: Neoproterozoic to Early Cambrian history of an active plate margin in the Teplá-Barrandian unit — a correlation of U-Pb isotopic-dilution-TIMS ages (Bohemia, Czech Republic). *Tectonophysics* 352, 65–85.

Faure M., Leloix Ch. & Roig J.-Y. 1997: Polycyclic evolution of the Hercynian Belt. *Bull. Soc. Géol. France* 168, 695–705.

Faure M., Mézème E.B., Duguet M., Cartier C. & Talbot J.-Y. 2005: Paleozoic tectonic evolution of medio-europa from the example of the French Massif Central and Massif Armorican. *J. Virt. Expl.* 5, 19.

Franke W. 2000: The mid-European segment of the Variscides: tectonostratigraphic units, terrane boundaries and plate tectonic extension. In: Franke W., Altherr R., Haak V., Oncken O. & Tanner D. (Eds.): Orogenic processes: Quantification and modelling in the Variscan Belt. *Geol. Soc. London, Spec. Publ.* 179, 35–61.

Friedl G., Finger F., Paquette J.L., von Quadt A., McNaughton N.J. & Fletcher I.R. 2004: Pre-Variscan geological events in the Austrian part of the Bohemian Massif deduced from U-Pb zircon ages. *Int. J. Earth Sci.* 93, 802–823.

Fritz H., Neubauer F., Janák M. & Putiš M. 1992: Variscan mid-crustal thrusting in the Carpathians II: Kinematics and fabric evolution of the Western Tatra basement. *Terra Nova* 4, 2.

Gaab A.S., Poller U., Janák M., Kohút M. & Todt W. 2005: Zircon U-Pb geochronology and isotopic characterization for the pre-Mesozoic basement of the Northern Veporic Unit (Central Western Carpathians, Slovakia). *Schweiz. Mineral. Petrol. Mitt.* 85, 69–88.

Gaab A.S., Janák M., Poller U. & Todt W. 2006: Alpine reworking of Ordovician protoliths in the Western Carpathians: Geochronological and geochemical data on the Muráň Gneiss complex. *Lithos* 87, 261–275.

Gebauer D. 1993: The pre-Alpine evolution of the continental crust of the Central Alps: an overview. In: Raumer J. von & Neubauer F. (Eds.): The pre-Mesozoic geology in the Alps. *Springer,* Berlin, Heidelberg, New York, 93–117.

Gebauer D., Williams I.S., Compston W. & Grünenfelder M. 1989: The development of the Central European continental crust since the early Archean based on conventional and ion-microprobe dating of detrital zircons up to 3.84 billion years old. *Tectonophysics* 157, 81–96.

Gradstein J.G. & Ogg A.G. (Eds.) 2004: A geologic time scale 2004: *Cambridge University Press*, and the official website of the International Commission on Stratigraphy (ICS) under *www. stratigraphy.org*.

Haas J., Kovács S., Krystyn L. & Lein R. 1995: Significance of Late Permian–Triassic facies zones in terrane reconstructions in the Alpine–North Pannonian domain. *Tectonophysics* 242, 19–40.

Hovorka D. & Méres Š. 1993: Leptyno-amphibolite complex of the Western Carpathians: occurrences and lithology. *Miner. Slovaca* 25, 1–9 (in Slovak with English abstract).

Hovorka D. & Méres Š. 1997: Geochemistry of the Early Paleozoic felsic metavolcanics of the Gemeric unit (Western Carpathians). In: Grecula P., Hovorka D. & Putiš M. (Eds.): Geological evolution of the Western Carpathians. *Miner. Slovaca, Monograph*, Bratislava, 289–300.

Janák M., Finger F., Plašienka D., Petrík I., Humer B., Méres Š. & Lupták B. 2002: Variscan high P-T recrystallization of Ordovician granitoids in the Veporic unit (Nízke Tatry Mountains, Western Carpathians): New petrological and geochronological data. *Geolines* 14, 38–39.

Janák M., Méres Š. & Ivan P. 2003: First evidence for omphacite and eclogite facies metamorphism in the Veporic unit of the Western Carpathians. *J. Czech Geol. Soc.* 48, 1–2, 69.

Janák M., Méres Š. & Ivan P. 2007: Petrology and metamorphic *P-T* conditions of eclogites from the northern Veporic unit, Western Carpathians, Slovakia. *Geol. Carpathica* 58, 121–131.

Kohút M., Poller U., Todt W. & Konečný P. 2007: Detrital zircon and monazite dating: useful tool for tracking Pan-African orogeny remnants in the Western Carpathians. *CzechTec 07 Meeting*, *Abstr.* 42–44.

Kohút M., Poller U., Gurk Ch. & Todt W. in press: Geochemical composition, isotopic signature and U-Pb zircon ages of metasedimentary rocks: Implications for the evolution of the pre-Variscan basement at the eastern border of Central Europe. *Swiss J. Geosci.*

Korikovsky S.P., Putiš M. & Plašienka D. 1997: Cretaceous low-grade metamorphism of the Veporic and North-Gemeric Zones: a result of collisional tectonics in the central Western Carpathians. In: Grecula P., Hovorka D. & Putiš M. (Eds.): Geological evolution of the Western Carpathians. *Miner. Slovaca, Monograph,* Bratislava, 107–130.

Korikovsky S.P. & Putiš M. 2002: Olivine-orthopyroxene-amphibole-talc-chlorite meta-serpentinites in the medium-temperature metamorphic complex of Northern Veporic, Western Carpathians: phase equilibria, metamorphic parameters, comparison with gneiss and amphibolite associations. *Petrology* 10, 3–29.

Kotov A.B., Miko O., Putiš M., Korikovsky S.P., Salnikova E.B., Kovach V.P., Yakovleva S., Bereznaya N.G., Kráľ J. & Krist E. 1996: U/Pb dating of zircons of postorogenic acid metavolcanics and metasubvolcanics: A record of Permian-Triassic taphrogeny of the West-Carpathian basement. *Geol. Carpathica* 47, 73–79.

Kováčik M., Kráľ J. & Maluski H. 1996: Metamorphic rocks in the southern Veporicum basement: their Alpine metamorphism and thermochronologic evolution. *Miner. Slovaca* 28, 185–202.

Kováčik M., Konečný P., Kollárová V., Holický I. & Siman P. 2005: Electron microprobe dating of monazite in basement metamorphites from the Kohút zone of Veporicum and case correlation aspects (Western Carpathians). *Slovak Geol. Mag.* 11, 91–105.

Kováčik M., Kotov A.B. & Salnikova E.B. submitted: Concordia U-Pb zircon ages from the south-Veporic Muráň orthogneiss (Western Carpathians): evidence for Cambrian granitic magmatism. *Miner. Slovaca.*

Kráľ J., Frank W. & Bezák V. 1996: ^{40}Ar–^{39}Ar spectra from amphibole of Veporic amphibolic rocks. *Miner. Slovaca* 28, 501–513 (in Slovak, English summary).

Krist E., Korikovsky S.P., Putiš M., Janák M. & Faryad S.W. 1992: Geology and petrology of metamorphic rocks of the Western Carpathian crystalline complexes. *Comenius University Press*, Bratislava, 1–324.

Kröner A., Jaeckel P. & Opletal M. 1994: Pb-Pb and U-Pb zircon ages for orthogneisses from eastern Bohemia: further evidence for a major Cambro-Ordovician magmatic event. *J. Czech Geol. Soc.* 39, 61.

Kröner A., Štípská P., Schulmann K. & Jaeckel P. 2000: Geochronological constraints on the pre-Variscan evolution of the northeastern margin of the Bohemian Massif, Czech Republic. In: Franke W., Altherr R., Haak V., Oncken O. & Tanner D. (Eds.): Orogenic processes: quantification and modelling in the Variscan Belt. *Geol. Soc. London, Spec. Publ.* 179, 175–197.

Kröner A., Jaeckel P., Hegner E. & Opletal M. 2001: Single zircon ages and whole-rock Nd isotopic systematics of early palaeozoic granitoid gneissess from the Czech and Polish Sudetes (Jizerské Hory, Krkonoše Mountains and Orlice-Sněžník complex). *Int. J. Earth Sci.* 90, 304–324.

Kryza R. & Pin C. 1997: Cambrian/Ordovician magmatism in the Polish Sudetes: no evidence for subduction-related setting. EUG9 Meeting, Strasbourg, *Terra Abstracts. Cambridge Publications*, Cambridge, UK, 144.

Larionov A.N., Andreichev V.A. & Gee D.G. 2004: The Vendian alkaline igneous suite of northern Timan: ion microprobe U-Pb zircon ages of gabbros and syenite. In: Gee D.G. & Pease V.L. (Eds.): The Neoproterozoic timanide orogen of Eastern Baltica. *Geol. Soc., London, Mem.* 30, 69–74.

Linnemann U., Gehmlich M., Tichomirowa M., Buschmann L., Nasdala L., Jonas P., Lutzner H. & Bombach K. 2000: From Cadomian subduction to Early Paleozoic rifting: the evolution of Saxo-Thuringia at the margin of Gondwana in the light of single zircon geochronology and basin development (central European Variscides). In: Franke W., Altherr R., Haak V., Oncken O. & Tanner D. (Eds.): Orogenic processes: Quantification and modelling in the Variscan Belt. *Geol. Soc. London, Spec. Publ.* 179, 131–154.

Linnemann U. & Romer R.L. 2002: The Cadomian Orogeny in Saxo-Thuringia, Germany: geochemical and Nd-Sr-Pb isotopic characterization of marginal basins with constraints to geotectonic setting and provenance. *Tectonophysics* 352, 33–64.

Ludwig K.R. 2005a: SQUID 1.12 A User's Manual. A Geochronological Toolkit for Microsoft Excel. *Berkeley Geochronology Center Spec. Publ.,* 1–22.

Ludwig K.R. 2005b: User's Manual for ISOPLOT/Ex 3.22. A geochronological toolkit for Microsoft Excel. *Berkeley Geochronology Center Spec. Publ.*, 1–71.

Madarás J., Putiš M. & Hók J. 1999: Structural features of the Hercynian tectonics in the southern part of the Ďumbier crystalline complex (Low Tatra Mts., Western Carpathians). *Miner. Slovaca* 31, 17–30.

Matte P. 1991: Accretionary history and crustal evolution of the Variscan belt in Western Europe. *Tectonophysics* 196, 309–337.

Matte P. 2001: The Variscan collage and orogeny (480–290 Ma) and the tectonic definition of the Armorica microplate: a review. *Terra Nova* 13, 122–128.

Matte Ph. 2007: Variscan thrust nappes, detachments, and strike-slip faults in the French Massif Central: interpretation of the lineations. *Geol. Soc. Amer. Mem.* 200, 1–12.

Paris F. 1993: Evolution paléogéographique de l'Europe au Paléozoique inferieur: le test des Chitinozoaires. *C.R. Acad. Sci. Paris* 316, 273–280.

Petrík I. & Kohút M. 1997: The evolution of granitoid magmatism during the Hercynian orogen in the Western Carpathians. In: Grecula P., Hovorka D. & Putiš M. (Eds.): Geological evolution of the Western Carpathians. *Miner. Slovaca, Monograph*, Bratislava, 235–252.

Pin C. & Marini F. 1993: Early Ordovician continental break-up in Variscan Europe: Nd-Sr isotope and trace element evidence from bimodal igneous associations of the southern Massif Central, France. *Lithos* 29, 177–196.

Piqué A., Bossière G., Bouillin J.P., Chalouan A. & Hoepffner Ch. 1993: Southern margin of the Variscan belt: the northwestern Gondwana mobile zone (eastern Morocco and northern Algeria). *Geol. Rdsch.* 82, 432–439.

Plašienka D., Grecula P., Putiš M., Kováč M. & Hovorka D. 1997: Evolution and structure of the Western Carpathians: an overview. In: Grecula P., Hovorka D. & Putiš M. (Eds.): Geological evolution of the Western Carpathians. *Miner. Slovaca, Monograph*, Bratislava, 1–24.

Poller U., Janák M., Kohút M. & Todt W. 2000: Early Variscan magmatism in the Western Carpathians: U-Pb zircon data from granitoids and orthogneisses of the Tatra Mountains (Slovakia). *Int. J. Earth Sci.* 89, 336–349.

Putiš M. 1992: Variscan and Alpidic nappe structures of the Western Carpathian crystalline basement. *Geol. Carpathica* 43, 369–380.

Putiš M. 2002: Tectonothermal evolution of the Austro-Alpine–Centro-Carpathian Microplate: microstructural-P-T-t-d trends — a correlation. *Geol. Carpathica, Spec. Issue* 53, 151–155.

Putiš M., Filová I., Korikovsky S.P., Kotov A.B. & Madarás J. 1997: Layered metaigneous complex of the Veporic basement with features of the Variscan and Alpine thrust tectonics (the Western Carpathians). In: Grecula P., Hovorka D. & Putiš M. (Eds.): Geological evolution of the Western Carpathians. *Miner. Slovaca, Monograph*, Bratislava, 175–196.

Putiš M., Kotov A.B., Uher P., Korikovsky S.P. & Salnikova E.B. 2000: Triassic age of the Hrončok pre-orogenic A-type granite related to continental rifting: a new result of U-Pb isotope dating (Western Carpathians). *Geol. Carpathica* 51, 59–66.

Putiš M., Kotov A.B., Korikovsky S.P., Salnikova E.B., Yakovleva S.Z., Berezhnaya N.G., Kovach V.P. & Plotkina J.V. 2001: U-Pb zircon ages of dioritic and trondhjemitic rocks from a layered amphibolitic complex crosscut by granite vein (Veporic basement, Western Carpathians). *Geol. Carpathica* 52, 49–60.

Putiš M., Kotov A.B., Petrík I., Korikovsky S.P., Madarás J., Salnikova E.B., Yakovleva S.Z., Berezhnaya N.G., Plotkina Y.V., Kovach V.P., Lupták B. & Majdán M. 2003: Early- vs. Late orogenic granitoids relationships in the Variscan basement of the Western Carpathians. *Geol. Carpathica* 54, 163–174.

Putiš M., Demko R., Kromel J. & Filová I. 2006a: Geochemical trends and metamorphic conditions of the LAC meta-igneous rocks in the North-Veporic zone (Western Carpathians). *Conferences, Symposia, Seminars, D. Štúr State Geological Institute Press*, Bratislava, Conf. Geochemistry 2006 (Ďurža O. & Rapant S. Eds.), 91–93 (in Slovak).

Putiš M., Ondrejka M., Siman P., Spišiak J., Uher P., Larionov A. & Paderin I. 2006b: The first SHRIMP age-data on magmatic-metamorphic events in the Western Carpathians basement. *Conferences, Symposia, Seminars, D. Štúr State Geological Institute Press*, Bratislava, Conf. Geochemistry 2006 (Ďurža O. & Rapant S. Eds.), 91–93 (in Slovak with English abstract).

Putiš M., Ondrejka M., Sergeev S., Larionov A., Radvanec M., Siman P., Spišiak J., Kohút M., Uher P. & Paderin I. 2007a: Insitu U-Pb (SHRIMP) zircon dating of the West-Carpathian pre-Mesozoic basement rocks. *Symposium on Petrology and Dating. Comenius University, May 2007, Abstr.*, 16–20.

Putiš M., Sergeev S., Chovan M., Radvanec M., Kohút M., Larionov A., Ondrejka M., Siman P., Spišiak J., Uher P. & Paderin I. 2007b: The pre-Mesozoic basement of the Western Carpathians, Slovakia: SHRIMP ages and mineralizations of a Gondwana/Armorica fragment in Variscan-Alpine orogenic structure. *International Symposium on Crust-Mantle Evolution and Mineralization. Nanjing University, March 2007, Abstr.*, 44–46.

Putiš M., Sergeev S., Larionov A., Radvanec M., Siman P., Spišiak J., Kohút M., Uher P., Ondrejka M., Filová I. & Paderin I. 2007c: Evolution and origin of the West-Carpathian pre-Mesozoic basement, dated by SHRIMP. *International Symposium on Mechanics of Variscan Orogeny: a modern view on orogenic research. Orleans, September 2007, Abstr.*, 147.

Quadt A. von, Günther D., Frischknecht R., Zimmermann R. & Franz G. 1997: The evolution of pre-Variscan eclogites of the Tauern window (eastern Alps): a Sm/Nd conventional and laser ICP-MS zircon U-Pb study. *Schweiz. Mineral. Petrogr. Mitt.* 77, 265–273.

Raumer J.F. von 1998: The Paleozoic evolution in the Alps: from Gondwana to Pangea. *Geol. Rdsch.* 87, 407–435.

Raumer J.F. von & Neubauer F. 1993: Late Precambrian and Paleozoic evolution of the Alpine basement: an overview. In: Raumer J.F. von & Neubauer F. (Eds.): The Pre-Mesozoic geology in the Alps. *Springer,* Berlin, Heidelberg, New York, 625–640.

Raumer J.F. von & Stampfli G.M. 2007: Paleozoic Oceans at the Gondwana margin — a discussion. La Coruńa: IGCP 497 Annual Meeting Abstract. In: Arenas R., Martinez Catalan J.R., Abati J. & Sanchez Martinez S. (Eds.): The rootless Variscan suture of NW Iberia (Galicia, Spain). *Publicaciones del Instituto Geologico y Minero de España*, 131–133.

Robardet M. 2003: The Armorica 'microplate': fact or fiction? Critical review of the concept and contradictory palaeobiogeographical data. *Palaeogeogr. Palaeoclimatol. Palaeoecol.* 3076, 1–24.

Schulz B., Bombach K., Pawlig S. & Brätz H. 2004: Neoproterozoic to Early-Paleozoic magmatic evolution in the Gondwana-derived Austroalpine basement to the south of the Tauern Window (Eastern Alps). *Int. J. Earth Sci.* 93, 824–843.

Shcherbak N.P., Bartnitsky E.N., Mitskievich N.Y., Stepanyuk L.M., Cambel B. & Grecula P. 1988: U-Pb radiometric determination of the age of zircons from Modra granodiorite, Malé Karpaty Mts., and porphyroid from Spiš-Gemer Ore Mts., Lower Paleozoic (Western Carpathians). *Geol. Zbor. Geol. Carpath.* 39, 427–436 (in Russian, English abstract).

Shelley D. & Bossière G. 2000: A new model for the Hercynian orogen of Gondwanan France and Iberia. *J. Struct. Geol.* 22, 757–776.

Spišiak J. & Pitoňák P. 1992: Banded amphibolitic rocks — pre-Variscan basement of the Western Carpathians? *Terra Abstr. to Terra Abstr. Suppl.* 4, 2, 63.

Stacey J.S. & Kramers J.D. 1975: Approximation of terrestrial lead isotope evolution by a two-stage model. *Earth Planet. Sci. Lett.* 26, 207–221.

Stampfli G.M. & Borel G.D. 2002: A plate tectonic model for the Paleozoic and Mesozoic constrained by dynamic plate boundaries and restored synthetic oceanic isochrons. *Earth Planet. Sci. Lett.* 196, 17–33.

Steiger R.H. & Jäger E. 1977: Subcommission on geochronology: convention on the use of decay constants in geo- and cosmochronology. *Earth Planet. Sci. Lett.* 36, 359–362.

Štípská P., Schulmann K., Thompson A.B., Ježek J. & Kröner A. 2001: Thermo-mechanical role of a Cambro-Ordovician paleorift during the Variscan collision: The NE margin of the Bohemian Massif. *Tectonophysics* 332, 239–253.

Tait J.A., Bachtadse V., Franke W. & Soffel H.C. 1997: Geodynamic evolution of the European Variscan fold belt: paleomagnetic and geological constraints. *Geol. Rdsch.* 86, 585–598.

Vozárová A., Frank W., Kráľ J. & Vozár J. 2005: ^{40}Ar/^{39}Ar dating of detrital mica from the Upper Paleozoic sandstones in the Western Carpathians (Slovakia). *Geol. Carpathica* 56, 463–472.

Vozárová A. & Ivanička J. 1996: Geodynamic position of acid volcanism of the Gelnica Group (Early Paleozoic, Southern Gemericum; Inner Western Carpathians). *Slovak Geol. Mag.* 3–4, 96, 245–250.

Wiedenbeck M., Allé P., Corfu F., Griffin W.L., Meier M., Oberli F., Von Quadt A., Roddick J.C. & Spiegel W. 1995: Three natural zircon standards for U-Th-Pb, Lu-Hf, trace element and REE analyses. *Geostandards Newsletter* 19, 1–23.

Williams I.S. 1998: U-Th-Pb geochronology by ion microprobe. In: Applications in microanalytical techniques to understanding mineralizing processes. *Reviews in Economic Geology* 7, 1–35.

Winchester J.A. The PACE TMR Network Team 2002: Paleozoic amalgamation of Central Europe: new results from recent geological and geophysical investigations. *Tectonophysics* 360, 5–21.

Żelaźniewicz A., Nowak I., Larionov A. & Presnyakov S. 2006: Lower Ordovician migmatite and post-tectonic Upper Viséan syenite in the western limb of the Orlica-Śnieżnik Dome, West Sudetes: U-Pb SHRIMP data from zircons. *Geol. Sudetica* 38, 63–80.

Appendix

U-Pb ages of zircons from investigated rocks (Tables 1–20).

Table 1: U-Pb *in situ* ages of zircons from a dark (*NTJ-T1*) layer of the layered amphibolite complex. Nízke Tatry Mountains, Jasenie, Tatric basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
NTJ-T1_7.1	0.24	457	51	0.12	27.0	427.9	4.6	542	84	27	14.57	1.1	.0583	3.8	0.55	4.0	.0686	1.1	.281
NTJ-T1_10.1	0.85	152	42	0.28	9.5	450.2	7.8	450	231	0	13.82	1.8	.0559	10.4	0.56	10.6	.0723	1.8	.169
NTJ-T1_8.1	0.39	636	163	0.26	40.5	459.0	4.2	494	76	8	13.55	0.9	.0571	3.4	0.58	3.6	.0738	0.9	.267
NTJ-T1_5.1	0.20	575	143	0.26	37.3	467.9	4.5	478	66	2	13.28	1.0	.0566	3.0	0.59	3.1	.0753	1.0	.314
NTJ-T1_4.2	1.49	491	211	0.44	32.4	471.1	5.7	492	147	4	13.19	1.3	.0570	6.7	0.60	6.8	.0758	1.3	.187
NTJ-T1_2.2	0.25	606	143	0.24	39.8	473.2	4.3	527	62	11	13.13	0.9	.0579	2.8	0.61	3.0	.0762	0.9	.313
NTJ-T1_3.2	1.81	133	19	0.15	8.9	473.9	9.0	469	312	–1	13.11	2.0	.0564	14.1	0.59	14.2	.0763	2.0	.139
NTJ-T1_4.1	---	317	102	0.33	20.6	474.2	6.2	491	186	3	13.10	1.4	.0570	8.4	0.60	8.5	.0763	1.4	.160
NTJ-T1_3.1	0.03	1091	493	0.47	72.3	478.5	4.1	543	38	13	12.98	0.9	.0583	1.7	0.62	1.9	.0770	0.9	.461
NTJ-T1_2.1	0.26	346	121	0.36	23.0	479.4	5.5	467	107	–3	12.95	1.2	.0564	4.8	0.60	5.0	.0772	1.2	.238
NTJ-T1_1.1	0.35	801	342	0.44	53.5	481.2	4.2	490	98	2	12.90	0.9	.0570	4.4	0.61	4.5	.0775	0.9	.199
NTJ-T1_6.1	0.44	880	286	0.34	58.9	481.6	4.7	494	80	3	12.89	1.0	.0571	3.6	0.61	3.8	.0776	1.0	.267
NTJ-T1_9.1	---	223	42	0.20	14.8	481.9	7.5	494	91	3	12.88	1.6	.0571	4.1	0.61	4.4	.0776	1.6	.363

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.41 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 2: U-Pb *in situ* ages of zircons from a pale (*NTJ-S1*) layer of the layered amphibolite complex. Nízke Tatry Mountains, Jasenie, Tatric basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
NTJ-S1_1.1	1.99	119	1	0.01	5.6	334.9	9.4	346	893	3	18.75	2.9	.0534	39.5	0.39	39.6	.0533	2.9	.073
NTJ-S1_1.2	0.96	748	2	0.00	35.0	338.4	3.4	366	129	8	18.55	1.0	.0539	5.7	0.40	5.8	.0539	1.0	.178
NTJ-S1_3.1	5.60	120	17	0.15	7.2	411.6	11.3	381	776	–7	15.17	2.8	.0542	34.5	0.49	34.6	.0659	2.8	.082
NTJ-S1_11.1	1.95	180	42	0.24	11.5	452.3	8.6	482	355	6	13.76	2.0	.0567	16.1	0.57	16.2	.0727	2.0	.121
NTJ-S1_7.1	0.56	215	62	0.30	13.6	454.8	6.9	462	189	2	13.68	1.6	.0562	8.5	0.57	8.7	.0731	1.6	.182
NTJ-S1_5.1	2.95	175	27	0.16	11.3	455.0	10.6	496	526	9	13.67	2.4	.0571	23.9	0.58	24.0	.0731	2.4	.101
NTJ-S1_4.1	1.34	507	157	0.32	32.4	456.9	5.2	464	163	2	13.62	1.2	.0563	7.4	0.57	7.5	.0734	1.2	.157
NTJ-S1_8.1	0.06	964	390	0.42	64.0	479.2	4.1	487	48	2	12.96	0.9	.0569	2.2	0.61	2.4	.0772	0.9	.376
NTJ-S1_2.1	0.00	542	150	0.29	36.0	479.6	4.7	506	77	6	12.95	1.0	.0574	3.5	0.61	3.7	.0772	1.0	.280
NTJ-S1_10.1	1.03	312	73	0.24	20.9	479.7	6.5	461	183	–4	12.94	1.4	.0562	8.3	0.60	8.4	.0773	1.4	.169
NTJ-S1_.9.1	2.27	578	162	0.29	39.3	480.6	6.2	452	211	–6	12.92	1.3	.0560	9.5	0.60	9.6	.0774	1.3	.139
NTJ-S1_6.1	0.12	504	195	0.40	33.7	482.1	5.7	512	113	6	12.88	1.2	.0575	5.2	0.62	5.3	.0777	1.2	.232

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.41 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 3: U-Pb *in situ* ages of zircons from a metatonalite (*HLO-1*) layer of the layered amphibolite complex. Nízke Tatry Mountains, Hlôžková (Hoškova) Valley, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1) Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
HLO-1_1.1	0.53	2147	936	0.45	150.3	502.4	3.6	480	65	–5	12.34	0.8	.0567	2.9	0.63	3.0	.0810	0.8	.249
HLO-1_1.2	0.62	930	238	0.26	62.1	479.9	4.5	492	103	3	12.94	1.0	.0570	4.7	0.61	4.8	.0773	1.0	.205
HLO-1_2.1	0.18	1351	471	0.36	94.3	502.4	3.9	510	56	1	12.34	0.8	.0575	2.6	0.64	2.7	.0810	0.8	.302
HLO-1_3.1	0.81	832	227	0.28	56.5	487.1	4.4	474	95	–3	12.74	0.9	.0565	4.3	0.61	4.4	.0785	0.9	.214
HLO-1_4.1	0.82	1757	676	0.40	124.0	504.8	3.8	522	70	3	12.28	0.8	.0578	3.2	0.65	3.3	.0815	0.8	.237
HLO-1_5.1	0.37	726	84	0.12	39.8	397.8	4.1	478	102	20	15.71	1.1	.0567	4.6	0.50	4.7	.0636	1.1	.223
HLO-1_7.1	0.26	1122	340	0.31	79.2	507.7	4.3	512	89	1	12.20	0.9	.0575	4.0	0.65	4.1	.0819	0.9	.214
HLO-1_6.1	---	1761	601	0.35	121.2	497.1	3.7	497	36	0	12.47	0.8	.0571	1.6	0.63	1.8	.0802	0.8	.429

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.39 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 4: U-Pb *in situ* ages of zircons from a metaleucotonalite (*HLO-2*) layer of the layered amphibolite complex. Nízke Tatry Mountains, Hlôžková (Hoškova) Valley, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1) Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
HLO-2_1.1	---	739	37	0.10	39.5	389.2	3.9	391	60	0	16.07	1	0.0545	2.7	0.467	2.9	0.06224	1	0.362
HLO-2_2.1	0.73	433	152	0.40	30	495.3	5.9	402	150	–19	12.52	1.2	0.0547	6.7	0.603	6.8	0.07986	1.2	0.18
HLO-2¯3.1	0.84	505	177	0.40	35.6	504.5	5.5	393	150	–22	12.28	1.1	0.0545	6.6	0.612	6.7	0.08141	1.1	0.17
HLO-2_4.1	0.59	492	155	0.30	33.5	489.2	5.5	375	150	–23	12.68	1.2	0.0541	6.6	0.588	6.7	0.07884	1.2	0.175
HLO-2_5.1	0.42	532	163	0.30	36.6	494.1	5.1	452	91	–8	12.55	1.1	0.056	4.1	0.615	4.2	0.07966	1.1	0.254
HLO-2_6.1	0.24	404	108	0.30	27.1	483.1	5.6	527	100	9	12.85	1.2	0.0579	4.6	0.621	4.7	0.07782	1.2	0.253
HLO-2_6.2	0.29	490	168	0.40	32.9	484.6	5	501	80	3	12.81	1.1	0.0572	3.6	0.616	3.8	0.07808	1.1	0.285
HLO-2_7.1	0.91	374	122	0.30	25.4	485.6	6.1	354	160	–27	12.78	1.3	0.0536	7.1	0.578	7.2	0.0782	1.3	0.18
HLO-2_8.1	---	490	158	0.30	34.2	504.5	5.7	642	130	27	12.29	1.2	0.0611	5.8	0.685	5.9	0.08141	1.2	0.197

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.51 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 5: U-Pb *in situ* ages of zircons from a dioritic gneiss (*VZP-5*) layer of the layered amphibolite complex. Vepor Mountains, Veľký Zelený Potok Valley, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
VZP-5_6.1	4.46	5578	11602	2.15	228.8	287.5	2.2	349	137	21	21.93	0.8	.0535	6.0	0.34	6.1	.0456	0.8	.128
VZP-5_10.1	0.49	1002	749	0.77	42.1	306.3	2.8	470	102	54	20.55	0.9	.0565	4.6	0.38	4.7	.0487	0.9	.195
VZP-5_2.1	0.66	1371	797	0.60	61.3	325.0	3.3	339	157	4	19.34	1.1	.0532	6.9	0.38	7.0	.0517	1.1	.150
VZP-5_3.1	---	729	409	0.58	33.3	333.7	3.7	427	66	28	18.82	1.1	.0554	2.9	0.41	3.2	.0531	1.1	.359
VZP-5_1.1	0.00	657	245	0.38	31.2	347.0	3.9	385	68	11	18.08	1.1	.0543	3.0	0.41	3.3	.0553	1.1	.352
VZP-5_5.1	9.90	1169	99	0.09	61.8	347.7	10.3	421	1208	21	18.05	3.0	.0552	54.1	0.42	54.2	.0554	3.0	.056
VZP-5_8.1	---	449	253	0.58	21.4	349.7	4.0	430	118	23	17.94	1.2	.0554	5.3	0.43	5.4	.0557	1.2	.218
VZP-5_7.1	0.41	829	409	0.51	41.4	362.3	3.6	342	138	−6	17.30	1.0	.0533	6.1	0.42	6.2	.0578	1.0	.164
VZP-5_5.1A	0.37	1620	82	0.05	80.8	362.4	3.1	373	78	3	17.29	0.9	.0540	3.5	0.43	3.6	.0578	0.9	.247
VZP-5_4.1	0.43	643	316	0.51	32.1	362.8	3.4	351	94	−3	17.27	1.0	.0535	4.1	0.43	4.3	.0579	1.0	.226
VZP-5_4.3	0.13	772	367	0.49	38.5	363.3	3.2	388	68	7	17.25	0.9	.0544	3.0	0.44	3.1	.0580	0.9	.286
VZP-5_9.1	---	495	285	0.59	24.7	364.2	3.8	447	66	23	17.21	1.1	.0559	3.0	0.45	3.2	.0581	1.1	.343
VZP-5_9.2	0.44	751	373	0.51	37.7	364.4	3.9	341	103	−7	17.19	1.1	.0533	4.6	0.43	4.7	.0582	1.1	.237
VZP-5_1.2	4.30	81	56	0.71	6.5	549.7	18.0	558	622	1	11.24	3.4	.0587	28.5	0.72	28.7	.0890	3.4	.119
VZP-5_4.2	0.02	119	23	0.20	27.0	1508.9	18.4	2125	36	41	3.79	1.4	.1320	2.1	4.80	2.5	.2637	1.4	.554

Errors are 1-sigma; Pb_c and Pb^* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.41 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 6: U-Pb *in situ* ages of zircons from leucotonalitic leucosome (*VZP-2*) layer of the layered amphibolite complex. Vepor Mountains, Veľký Zelený Potok Valley, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1)Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
VZP -2_1.1	0.51	2059	322	0.16	133.7	467.5	3.5	520	79	11	13.29	0.8	.0577	3.6	0.60	3.7	.0752	0.8	.209
VZP -2_2.1	3.96	241	104	0.45	17.5	504.3	10.2	494	552	−2	12.29	2.1	.0571	25.0	0.64	25.1	.0814	2.1	.083
VZP -2_3.1	0.53	467	198	0.44	35.9	549.8	6.2	787	85	43	11.23	1.2	.0654	4.0	0.80	4.2	.0890	1.2	.279
VZP -2_4.1	0.00	5372	134	0.03	318.1	429.7	3.1	571	23	33	14.51	0.8	.0591	1.0	0.56	1.3	.0689	0.8	.586
VZP -2_5.1	2.76	3807	1319	0.36	200.7	373.6	2.8	548	113	47	16.76	0.8	.0585	5.2	0.48	5.2	.0597	0.8	.148
VZP -2_5.2	0.38	3703	241	0.07	248.2	482.4	3.2	464	47	−4	12.87	0.7	.0563	2.1	0.60	2.2	.0777	0.7	.305
VZP -2_1.2	33.70	1203	544	0.47	88.0	354.0	11.6	502	994	42	17.72	3.4	.0573	45.2	0.45	45.3	.0564	3.4	.074
VZP -2_6.1	7.88	4993	4060	0.84	227.5	307.6	2.6	483	181	57	20.46	0.9	.0568	8.2	0.38	8.2	.0489	0.9	.107
VZP -2_7.1	0.03	684	302	0.46	52.9	555.7	5.0	715	54	29	11.11	0.9	.0632	2.5	0.78	2.7	.0900	0.9	.349
VZP -2_8.1	1.36	91	31	0.35	7.9	609.3	14.5	878	340	44	10.09	2.5	.0683	16.4	0.93	16.6	.0991	2.5	.150

Errors are 1-sigma; Pb_c and Pb^* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.39 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 7: U-Pb *in situ* ages of zircons from a gabbrodioritic gneiss (*VZP-3*) layer of the layered amphibolite complex. Vepor Mountains, Veľký Zelený Potok Valley, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
VZP-3_1.1	**0.93**	**1107**	**718**	0.67	54.9	**358.6**	**3.4**	**284**	**136**	−21	17.48	1.0	.0520	6.0	0.41	6.0	.0572	1.0	.159
VZP-3_1.2	**0.73**	**966**	**565**	0.60	46.8	**351.0**	**3.7**	**452**	**190**	29	17.87	1.1	.0560	8.5	0.43	8.6	.0560	1.1	.126
VZP-3_2.1	**1.54**	**583**	**351**	0.62	28.3	**348.6**	**4.3**	**336**	**217**	−4	17.99	1.3	.0532	9.6	0.41	9.7	.0556	1.3	.130
VZP-3_3.1	**0.00**	**77**	**28**	0.38	5.1	**480.0**	**11.5**	**1269**	**121**	164	12.94	2.5	.0830	6.2	0.88	6.7	.0773	2.5	.372
VZP-3_4.1	**0.46**	**706**	**358**	0.52	34.2	**351.8**	**3.5**	**352**	**99**	0	17.83	1.0	.0535	4.4	0.41	4.5	.0561	1.0	.229
VZP-3_5.1	**1.17**	**251**	**175**	0.72	12.5	**359.7**	**7.4**	**343**	**410**	−5	17.43	2.1	.0533	18.1	0.42	18.2	.0574	2.1	.116
VZP-3_6.1	**0.50**	**937**	**455**	0.50	46.2	**358.4**	**3.9**	**497**	**120**	39	17.49	1.1	.0571	5.5	0.45	5.6	.0572	1.1	.201
VZP-3_7.1	**0.96**	**649**	**354**	0.56	32.5	**361.5**	**4.0**	**351**	**167**	−3	17.34	1.1	.0535	7.4	0.43	7.5	.0577	1.1	.152
VZP-3_8.1	**1.82**	**268**	**64**	0.24	13.7	**364.3**	**6.4**	**349**	**374**	−4	17.20	1.8	.0535	16.6	0.43	16.7	.0581	1.8	.109
VZP-3_9.1	**1.39**	**830**	**525**	0.65	40.9	**354.5**	**4.2**	**189**	**251**	−47	17.69	1.2	.0499	10.8	0.39	10.8	.0565	1.2	.113

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.39 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 8: U-Pb *in situ* ages of zircons from a metaleucotonalite (*GR-1*) pebble (of the layered amphibolite complex) in upper Carboniferous metaconglomerates. Gemer Mountains, Grajnár, Gemeric basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
GR-1_1.1	0.28	2225	46	0.02	127.6	415.4	3.1	481	44	16	15.02	0.8	.0567	2.0	0.52	2.1	.0666	0.8	.356
GR-1_1.2	---	285	125	0.45	25.3	634.4	8.1	726	73	15	9.67	1.3	.0635	3.4	0.91	3.7	.1034	1.3	.364
GR-1_2.1	0.44	566	55	0.10	31.2	399.2	4.4	428	144	7	15.65	1.1	.0554	6.5	0.49	6.6	.0639	1.1	.174
GR-1_1.3	2.94	363	50	0.14	19.8	386.1	6.2	404	348	5	16.20	1.7	.0548	15.5	0.47	15.6	.0617	1.7	.106
GR-1_2.2	1.58	1154	19	0.02	60.0	373.2	3.5	423	145	13	16.78	1.0	.0553	6.5	0.45	6.6	.0596	1.0	.147
GR-1_2.3	0.65	651	40	0.06	33.5	372.2	4.0	371	119	0	16.83	1.1	.0540	5.3	0.44	5.4	.0594	1.1	.203
GR-1_3.1	0.36	1140	192	0.17	62.0	394.6	3.6	419	122	6	15.84	0.9	.0552	5.5	0.48	5.5	.0631	0.9	.168
GR-1_3.2	0.37	1341	21	0.02	74.1	400.5	3.3	462	73	15	15.60	0.8	.0562	3.3	0.50	3.4	.0641	0.8	.249
GR-1_5.1	0.16	559	424	0.78	35.4	457.4	4.7	579	66	27	13.60	1.1	.0593	3.1	0.60	3.2	.0735	1.1	.327
GR-1_4.1	0.68	1111	90	0.08	61.1	397.5	3.5	371	99	−7	15.72	0.9	.0540	4.4	0.47	4.5	.0636	0.9	.202

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.39 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 9: U-Pb *in situ* ages of zircons from a granitic orthogneiss (*VZP-6*) associated with the layered amphibolite complex. Vepor Mountains, Veľký Zelený Potok Valley, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1) Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
VZP-6_1.1	1.08	274	135	0.50	22.3	577.4	8.1	447	240	−23	10.67	1.5	0.0559	11	0.722	11	0.0937	1.5	0.135
VZP-6_2.1	0.06	788	479	0.60	52.5	481.2	4.4	495	51	3	12.9	0.94	0.0571	2.3	0.61	2.5	0.0775	0.94	0.378
VZP-6_3.1	0.29	1476	294	0.20	106	515.4	4	567	53	10	12.012	0.81	0.059	2.4	0.677	2.6	0.08324	0.81	0.315
VZP-6_4.1	1.23	674	25	0.00	34.2	365.6	4.5	118	270	−68	17.13	1.3	0.0484	12	0.389	12	0.05836	1.3	0.108
VZP-6_5.1	0.84	370	87	0.20	26.8	516.5	6.6	539	220	4	11.98	1.3	0.0582	10	0.67	10	0.0834	1.3	0.131
VZP-6_6.1	0.44	1291	4	0.00	64.4	362.2	3.4	275	160	−24	17.3	0.98	0.0518	7.1	0.412	7.1	0.05779	0.98	0.137
VZP-6_7.1	0.04	233	61	0.30	116	2939	28	3375	13	15	1.731	1.2	0.2821	0.83	22.46	1.5	0.5776	1.2	0.821
VZP-6_7.2	0.47	660	21	0.00	31.9	351.4	3.9	383	110	9	17.84	1.1	0.0543	4.8	0.419	4.9	0.05603	1.1	0.23
VZP-6_7.3	0.04	182	75	0.40	36.7	1357	15	3160	23	133	4.266	1.3	0.2462	1.5	7.95	1.9	0.2343	1.3	0.646

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.51 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 10: U-Pb *in situ* ages of zircons from a granitic orthogneiss (*SAM-18*). Nízke Tatry Mountains, Čertova Svadba Hill, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1) Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
SAM-18_1.1	0.55	901	234	0.30	64.5	513.5	5.2	577	69	12	12.06	1.1	0.0593	3.2	0.677	3.4	0.08291	1.1	0.314
SAM-18_1.2	0.33	483	125	0.30	39.3	581.4	6	568	90	−2	10.59	1.1	0.059	4.1	0.768	4.3	0.0944	1.1	0.254
SAM-18_2.1	0.41	1530	93	0.10	105	492.9	4	446	91	−9	12.58	0.83	0.0559	4.1	0.612	4.2	0.07945	0.83	0.199
SAM-18_3.1	0.45	493	90	0.20	32.4	472.8	5.2	457	140	−3	13.14	1.1	0.0561	6.2	0.589	6.3	0.07611	1.1	0.179
SAM-18_3.2	1.9	308	52	0.20	20.5	472	7	220	310	−53	13.16	1.5	0.0505	13	0.529	13	0.076	1.5	0.115
SAM-18_4.1	0.2	1041	94	0.10	70.2	486.6	4.1	533	66	9	12.75	0.88	0.0581	3	0.628	3.1	0.07841	0.88	0.281
SAM-18_5.1	0.47	741	36	0.10	49.3	479.1	4.5	461	87	−4	12.96	0.98	0.0562	3.9	0.598	4	0.07716	0.98	0.242
SAM-18_6.1	0.19	1064	136	0.10	98.6	659.4	5.2	698	40	6	9.283	0.83	0.0627	1.9	0.931	2.1	0.10771	0.83	0.403
SAM-18_7.1	0.33	1064	204	0.20	73.1	494.6	4.2	482	69	−3	12.54	0.89	0.0567	3.1	0.624	3.2	0.07974	0.89	0.275

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.51 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 11: U-Pb *in situ* ages of zircons from a granitic orthogneiss (*SAM-13*). Vepor Mountains, Podbrezová–Predajnianske Čelno Valley, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1) Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
SAM-13_1.1	0.56	1308	166	0.10	80	440.5	3.7	475	72	8	14.14	0.86	0.0566	3.3	0.552	3.4	0.07072	0.86	0.253
SAM-13_2.1	0.48	913	413	0.50	58.6	462.7	4.2	405	93	−12	13.44	0.94	0.0548	4.1	0.562	4.2	0.07441	0.94	0.221
SAM-13_3.1	1.52	597	125	0.20	35.6	426.3	5.6	508	260	19	14.62	1.4	0.0574	12	0.541	12	0.06836	1.4	0.114
SAM-13_4.1	1.31	3325	413	0.10	83	182.1	1.7	444	130	144	34.88	0.93	0.0558	5.9	0.22	6	0.02865	0.93	0.154
SAM-13_5.1	1.36	1417	391	0.30	64.4	327.7	3.1	346	150	5	19.17	0.96	0.0534	6.7	0.384	6.8	0.05215	0.96	0.141
SAM-13_6.1	0.43	1132	380	0.30	72.4	460.5	4	481	93	4	13.5	0.91	0.0567	4.2	0.579	4.3	0.07404	0.91	0.211
SAM-13_7.1	0.94	1754	739	0.40	84.8	349.6	2.9	418	84	20	17.94	0.86	0.0552	3.8	0.424	3.9	0.05573	0.86	0.222
SAM-13_8.1	1.95	2477	364	0.20	69.8	203.8	1.9	263	150	29	31.11	0.96	0.0515	6.7	0.228	6.7	0.03213	0.96	0.143
SAM-13_9.1	0.94	887	235	0.30	50.9	413.2	4.1	278	140	−33	15.1	1	0.0518	6	0.473	6.1	0.0662	1	0.166

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.51 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 12: U-Pb *in situ* ages of zircons from a tonalitic orthogneiss (*SAM-12*). Vepor Mountains, Ratkovské Bystré village, Čierna Valley, South-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1) Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
SAM-12_1.1	0.79	392	105	0.30	28.3	516.6	6.3	554	160	7	11.98	1.3	0.0586	7.2	0.675	7.3	0.0834	1.3	0.174
SAM-12_2.1	---	920	377	0.40	63.4	497.5	4.3	552	44	11	12.46	0.89	0.0586	2	0.648	2.2	0.08023	0.89	0.405
SAM-12_3.1	1.36	219	17	0.10	15.6	508	11	301	260	−41	12.18	2.3	0.0524	12	0.592	12	0.0821	2.3	0.195
SAM-12_4.1	0.8	483	139	0.30	39.5	580.9	6.3	411	140	−29	10.6	1.1	0.055	6.2	0.715	6.3	0.0943	1.1	0.181
SAM-12_5.1	0	467	21	0.00	33	510.1	5.5	544	61	7	12.14	1.1	0.0584	2.8	0.663	3	0.08235	1.1	0.371
SAM-12_6.1	0.26	523	190	0.40	37.8	518.6	5.2	498	73	−4	11.94	1.1	0.0572	3.3	0.66	3.5	0.08377	1.1	0.302
SAM-12_7.1	2.07	240	50	0.20	17	500.9	7.6	63	340	−87	12.37	1.6	0.0473	14	0.527	14	0.0808	1.6	0.11
SAM-12_8.1	---	1039	93	0.10	83.1	575	5.3	583	51	1	10.72	0.97	0.0594	2.4	0.765	2.5	0.09329	0.97	0.381
SAM-12_9.1	1.03	268	11	0.00	19	505.3	7.1	555	200	10	12.26	1.5	0.0587	9.4	0.66	9.5	0.0815	1.5	0.154
SAM-12_10.1	0.27	370	111	0.30	25.9	502.8	6.3	544	110	8	12.33	1.3	0.0584	5.1	0.653	5.2	0.0811	1.3	0.249

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.51 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 13: U-Pb *in situ* ages of zircons from a granitic orthogneiss (*SAM-6*). Vepor Mountains, Chorepa pass between Klenovec and Kokava nad Rimavicou villages, South-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1) Age $^{206}Pb/^{238}U$ Myr	±	(1) Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
SAM-6_1.1	0.75	611	31	0.10	41.9	491.5	5.3	379	160	−23	12.62	1.1	0.0542	7.1	0.592	7.2	0.07923	1.1	0.155
SAM-6_2.1	0.8	763	43	0.10	52.8	495.3	4.7	439	100	−11	12.52	0.98	0.0557	4.7	0.613	4.8	0.07986	0.98	0.205
SAM-6_2.2	0.39	1260	41	0.00	89.6	510.5	4.1	514	60	1	12.13	0.84	0.0576	2.7	0.654	2.9	0.08241	0.84	0.296
SAM-6_3.1	0.6	576	162	0.30	39.2	488.5	5	513	110	5	12.7	1.1	0.0576	5.1	0.625	5.2	0.07872	1.1	0.206
SAM-6_4.1	0.4	879	36	0.00	58.2	476.9	4.4	442	82	−7	13.02	0.95	0.0557	3.7	0.59	3.8	0.07678	0.95	0.25
SAM-6_5.1	0.23	1093	29	0.00	75.9	500.1	4.1	546	54	9	12.4	0.86	0.0584	2.5	0.65	2.6	0.08066	0.86	0.329
SAM-6_5.2	0.58	628	469	0.80	46.2	526.3	5.1	519	98	−1	11.75	1	0.0577	4.5	0.677	4.6	0.08506	1	0.22
SAM-6_6.1	0.88	537	189	0.40	38.2	508.8	5.4	437	130	−14	12.17	1.1	0.0556	5.9	0.63	6	0.08212	1.1	0.182
SAM-6_7.1	0.41	1183	182	0.20	82.5	501.5	4.1	524	71	4	12.36	0.85	0.0578	3.2	0.645	3.3	0.08089	0.85	0.255
SAM-6_8.1	0.08	330	14	0.00	22.1	483.3	6	579	76	20	12.84	1.3	0.0593	3.5	0.637	3.7	0.0779	1.3	0.344

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.51 %.
(1) Common Pb corrected using measured ^{204}Pb.

Table 14: U-Pb *in situ* ages of zircons from a granitic orthogneiss (*SAM-15*). Nízke Tatry Mountains, Lomnistá Valley, Tatric basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$	±	(1)Age $^{207}Pb/^{206}Pb$	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
SAM-15_9.1	2.43	2884	99	0.04	106.0	263	4.8	182	160	−31	23.98	1.9	0.0497	6.9	0.286	7.2	0.04168	1.9	.261
SAM-15_9.1*	0.92	2375	89	0.04	102.0	312	5.6	430	37	38	20.14	1.8	0.05544	1.7	0.3794	2.5	0.04964	1.8	.740
SAM-15_9.2	0.07	2735	265	0.10	146.0	388	6.9	458	16	18	16.13	1.8	0.05614	0.72	0.4797	2	0.0620	1.8	.930
SAM-15_9.3	2.45	214	66	0.32	12.3	407	8.1	321	200	−21	15.33	2.1	0.0528	8.6	0.474	8.9	0.0652	2.1	.232
SAM-15_12.1	0.14	878	408	0.48	53.6	442	7.9	427	26	−4	14.08	1.8	0.05536	1.2	0.542	2.2	0.0710	1.8	.849
SAM-15_11.1	0.11	710	166	0.24	45.3	462	8.2	500	31	8	13.47	1.8	0.05722	1.4	0.586	2.3	0.0742	1.8	.797
SAM-15_7.1	0.00	482	170	0.36	30.8	463	8.4	463	31	0	13.42	1.9	0.05626	1.4	0.578	2.3	0.0745	1.9	.802
SAM-15_3.1	0.05	1105	158	0.15	71.0	464	8.3	449	20	−3	13.39	1.8	0.05591	0.9	0.576	2	0.0747	1.8	.899
SAM-15_4.1	0.28	749	50	0.07	48.7	469	8.3	456	40	−3	13.25	1.8	0.05609	1.8	0.584	2.6	0.0755	1.8	.719
SAM-15_8.1	0.00	1072	36	0.03	70.9	478	8.5	471	22	−2	13.00	1.8	0.05646	0.97	0.599	2.1	0.0769	1.8	.885
SAM-15_2.1	0.00	506	146	0.30	33.6	480	8.6	466	28	−3	12.93	1.9	0.05633	1.3	0.601	2.3	0.0773	1.9	.822
SAM-15_5.1	0.00	399	204	0.53	26.6	482	8.8	471	30	−2	12.89	1.9	0.05648	1.3	0.604	2.3	0.0776	1.9	.814
SAM-15_1.1	0.16	419	42	0.10	28.5	489	8.8	493	46	1	12.68	1.9	0.057	2.1	0.62	2.8	0.0789	1.9	.671
SAM-15_6.1	0.05	297	124	0.43	22.8	553	10	524	34	−5	11.16	1.9	0.05786	1.5	0.715	2.5	0.0896	1.9	.776
SAM-15_13.1	0.14	422	10	0.02	37.9	641	11	708	29	11	9.57	1.9	0.06301	1.4	0.908	2.3	0.1045	1.9	.804
SAM-15_10.1	0.01	838	637	0.78	317.0	2349	36	2771	9.9	18	2.28	1.8	0.1933	0.6	11.72	1.9	0.4396	1.8	.950

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.63 % .
(1) Common Pb corrected using measured ^{204}Pb.

Table 15: U-Pb *in situ* ages of zircons from a granitic orthogneiss (*SAM-16*). Nízke Tatry Mountains, Vajsková Valley, Tatric basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$	±	(1)Age $^{207}Pb/^{206}Pb$	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
SAM-16_3.1	0.00	961	30	0.03	60.8	458	8.1	464	21	1	13.58	1.8	0.05631	0.95	0.572	2.1	0.0736	1.8	.888
SAM-16_9.1	0.11	529	41	0.08	34.1	466	8.4	493	32	6	13.34	1.9	0.05704	1.50	0.589	2.4	0.0750	1.9	.784
SAM-16_10.1	0.27	658	41	0.06	42.6	467	8.3	476	44	2	13.31	1.9	0.05660	2.00	0.586	2.7	0.0751	1.9	.678
SAM-16_5.1	0.05	838	47	0.06	54.4	469	8.3	493	23	5	13.24	1.8	0.05703	1.00	0.594	2.1	0.0755	1.8	.873
SAM-16_6.1	0.23	387	37	0.10	25.4	473	8.5	439	46	−7	13.14	1.9	0.05570	2.10	0.584	2.8	0.0761	1.9	.675
SAM-16_1.2	0.00	228	61	0.28	15.0	475	8.8	482	40	2	13.07	1.9	0.05680	1.80	0.599	2.6	0.0765	1.9	.724
SAM-16_1.1	0.16	224	75	0.35	15.0	484	8.9	484	50	0	12.81	1.9	0.05680	2.30	0.611	3.0	0.0780	1.9	.647
SAM-16_4.1	0.00	435	355	0.84	36.1	595	15	577	28	−3	10.34	2.7	0.05926	1.30	0.790	3.0	0.0967	2.7	.904
SAM-16_6.2	0.26	150	211	1.45	12.9	614	11	637	59	4	10.01	1.9	0.06090	2.70	0.839	3.3	0.0999	1.9	.579
SAM-16_7.1	0.03	770	634	0.85	66.2	615	11	634	19	3	9.99	1.8	0.06086	0.88	0.840	2.0	0.1001	1.8	.901
SAM-16_8.1	0.02	451	198	0.45	39.9	632	11	638	24	1	9.71	1.9	0.06096	1.10	0.866	2.2	0.1030	1.9	.861
SAM-16_2.2	0.00	325	22	0.07	29.1	638	11	1200	39	88	9.61	1.9	0.08010	2.00	1.149	2.7	0.1040	1.9	.685
SAM-16_2.1	0.00	372	95	0.26	108.0	1876	30	2372	7.6	26	2.96	1.8	0.15229	0.45	7.090	1.9	0.3377	1.8	.972

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
Error in Standard calibration was 0.63 % .
(1) Common Pb corrected using measured ^{204}Pb.

Table 16: U-Pb *in situ* ages of zircons from a granitic orthogneiss (*MF-1*). Malá Fatra Mountains, Malá Valley (western), Tatric basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1)Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
MF-1_5.1	0.24	1602	18	0.01	78.41	356	4	369	39	4	17.600	1.3	0.05	1.7	0.4226	2.2	0.0568	1.3	0.597
MF-1_7.1	0.22	1233	51	0.04	69.44	408	5	395	63	−3	15.288	1.3	0.05	2.8	0.4922	3.1	0.0654	1.3	0.421
MF-1_2.1	0.30	1069	420	0.41	67.94	459	6	393	52	−14	13.554	1.3	0.05	2.3	0.5548	2.7	0.0738	1.3	0.500
MF-1_5.2	0.61	465	44	0.10	30.35	469	6	300	149	−36	13.240	1.4	0.05	6.5	0.5450	6.7	0.0755	1.4	0.209
MF-1_4.2	0.46	594	110	0.19	39.63	480	6	358	72	−25	12.930	1.4	0.05	3.2	0.5726	3.5	0.0773	1.4	0.390
MF-1_4.1	0.33	698	50	0.07	46.91	484	6	396	65	−18	12.821	1.3	0.05	2.9	0.5872	3.2	0.0780	1.3	0.417
MF-1_3.1	0.19	2476	206	0.09	170	495	6	442	28	−11	12.537	1.3	0.06	1.3	0.6129	1.8	0.0798	1.3	0.704
MF-1_8.1	0.18	2232	897	0.42	153.6	496	6	446	35	−10	12.503	1.3	0.06	1.6	0.6158	2.0	0.0800	1.3	0.627
MF-1_6.1	0.04	2747	538	0.20	188.9	496	6	488	20	−2	12.498	1.3	0.06	0.9	0.6279	1.5	0.0800	1.3	0.813
MF-1_1.1	0.11	2439	188	0.08	168.4	498	6	464	23	−7	12.456	1.3	0.06	1.0	0.6232	1.6	0.0803	1.3	0.774

Errors are 1-sigma; Pb_c and Pb* indica te the common and radiogenic portions, respectively.
1σ Error in 91500 Standard calibration was 0.28 % (average of 35).
(1) Common Pb corrected using measured ^{204}Pb.

Table 17: U-Pb *in situ* ages of zircons from kyanite-garnet orthogneiss (*KO-1*). Nízke Tatry Mountains, Koleso Valley, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1)Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
KO-1_4.3	0.53	742	39	0.05	46.84	455	6	331	79	−27	13.689	1.3	0.05	3.5	0.5344	3.7	0.0731	1.3	0.351
KO-1_5.2	0.12	1189	40	0.03	78.89	479	6	474	23	−1	12.958	1.3	0.06	1.1	0.6017	1.6	0.0772	1.3	0.765
KO-1_2.3	0.05	1127	317	0.29	82.11	525	6	559	19	7	11.796	1.3	0.06	0.9	0.6871	1.5	0.0848	1.3	0.819
KO-1_4.2	0.11	1408	192	0.14	105	536	6	555	25	4	11.539	1.2	0.06	1.2	0.7009	1.7	0.0867	1.2	0.732
KO-1_4.1	0.18	612	67	0.11	45.91	539	7	519	39	−4	11.467	1.3	0.06	1.8	0.6940	2.2	0.0872	1.3	0.585
KO-1_2.2	0.17	901	401	0.46	73.77	586	7	547	27	−7	10.513	1.3	0.06	1.2	0.7668	1.8	0.0951	1.3	0.722
KO-1_1.1	0.33	578	772	1.38	48.77	602	7	517	38	−14	10.213	1.3	0.06	1.8	0.7784	2.2	0.0979	1.3	0.591
KO-1_2.1	0.12	817	209	0.26	69.08	605	13	578	53	−4	10.171	2.3	0.06	2.4	0.8038	3.4	0.0983	2.3	0.695
KO-1_5.1	0.44	300	113	0.39	25.6	608	8	487	66	−20	10.113	1.3	0.06	3.0	0.7757	3.3	0.0989	1.3	0.411
KO-1_3.1	0.10	250	145	0.60	111.3	2686	28	2666	8	−1	1.934	1.3	0.18	0.5	12.9298	1.4	0.5170	1.3	0.935

Errors are 1-sigma; Pb_c and Pb^* indicate the common and radiogenic portions, respectively.
1σ Error in 91500 Standard calibration was 0.28 % (average of 35).
(1) Common Pb corrected using measured ^{204}Pb.

Table 18: U-Pb *in situ* ages of zircons from migmatitic garnet orthogneiss (*VV33Bo-1*). Nízke Tatry Mountains, Jaškovec (Krivuľa) Valley, North-Veporic basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1)Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
VV33BO_5.1	0.41	458	277	0.63	35.5	554	7	435	63	−21	11.135	1.3	0.06	2.8	0.6881	3.1	0.0898	1.3	0.431
VV33BO_2.1	0.37	396	343	0.89	30.8	556	7	449	69	−19	11.107	1.4	0.06	3.1	0.6941	3.4	0.0900	1.4	0.404
VV33BO_12.1	0.27	869	536	0.64	67.4	556	7	485	52	−13	11.105	1.3	0.06	2.4	0.7057	2.7	0.0900	1.3	0.487
VV33BO_4.1	0.11	441	378	0.89	34.4	560	7	532	58	−5	11.029	1.4	0.06	2.7	0.7260	3.0	0.0907	1.4	0.453
VV33BO_5.2	0.20	883	1326	1.55	70.8	573	7	521	33	−9	10.748	1.3	0.06	1.5	0.7412	2.0	0.0930	1.3	0.645
VV33BO_1.2	0.37	247	120	0.50	20.0	578	8	480	79	−17	10.662	1.4	0.06	3.6	0.7332	3.9	0.0938	1.4	0.371
VV33BO_13.1	0.19	321	120	0.39	26.0	579	7	535	61	−8	10.638	1.3	0.06	2.8	0.7537	3.1	0.0940	1.3	0.433
VV33BO_7.2	0.04	1349	146	0.11	109.1	580	7	573	21	−1	10.628	1.3	0.06	1.0	0.7674	1.6	0.0941	1.3	0.801
VV33BO_8.2	0.11	548	363	0.68	45.0	587	7	574	33	−2	10.481	1.3	0.06	1.5	0.7787	2.0	0.0954	1.3	0.648
VV33BO_8.1	0.27	525	205	0.40	43.6	593	7	531	46	−11	10.380	1.3	0.06	2.1	0.7707	2.5	0.0963	1.3	0.531
VV33BO_1.1	0.18	293	106	0.37	24.7	603	8	555	56	−8	10.199	1.4	0.06	2.6	0.7934	2.9	0.0981	1.4	0.470
VV33BO_3.1	0.08	1092	693	0.66	92.1	604	7	593	26	−2	10.188	1.3	0.06	1.2	0.8082	1.8	0.0982	1.3	0.738
VV33BO_6.2	0.12	689	662	0.99	58.7	608	8	593	31	−3	10.102	1.3	0.06	1.4	0.8149	1.9	0.0990	1.3	0.682
VV33BO_3.2	0.09	1070	660	0.64	93.0	621	8	622	25	0	9.888	1.3	0.06	1.2	0.8436	1.7	0.1011	1.3	0.740
VV33BO_12.2	0.29	497	281	0.58	43.3	621	8	547	51	−12	9.881	1.3	0.06	2.3	0.8158	2.7	0.1012	1.3	0.495
VV33BO_6.1	0.11	1264	400	0.33	110.2	622	8	608	23	−2	9.867	1.3	0.06	1.1	0.8402	1.7	0.1013	1.3	0.769
VV33BO_7.1	0.13	1148	214	0.19	102.3	636	8	607	30	−5	9.647	1.3	0.06	1.4	0.8588	1.9	0.1037	1.3	0.676
VV33BO_11.1	0.33	301	178	0.61	27.5	649	9	565	60	−13	9.441	1.4	0.06	2.8	0.8609	3.1	0.1059	1.4	0.448
VV33BO_4.2	0.08	801	21	0.03	75.5	670	8	652	24	−3	9.125	1.3	0.06	1.1	0.9274	1.7	0.1096	1.3	0.758
VV33BO_9.1	0.18	1166	86	0.08	228.3	1322	15	1917	23	45	4.395	1.3	0.12	1.3	3.6825	1.8	0.2275	1.3	0.706
VV33BO_10.1	0.18	370	268	0.75	98.6	1739	20	1863	18	7	3.230	1.3	0.11	1.0	4.8646	1.7	0.3096	1.3	0.786

Errors are 1-sigma; Pb_c and Pb^* indicate the common and radiogenic portions, respectively.
1σ Error in 91500 Standard calibration was 0.28 % (average of 35).
(1) Common Pb corrected using measured ^{204}Pb.

Table 19: U-Pb *in situ* ages of zircons from a metarhyolite (*HE-1*). Gemer Mountains, Helcmanovce quarry, Gemeric basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1)Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
HE-1_6.2	0.27	523	282	0.56	32.35	447	6	458	67	2	13.930	1.3	0.06	3.0	0.5556	3.3	0.0718	1.3	0.399
HE-1_9.2	0.21	314	167	0.55	19.84	457	6	464	55	1	13.606	1.4	0.06	2.5	0.5704	2.9	0.0735	1.4	0.486
HE-1_1.1	0.14	293	87	0.31	18.77	463	6	478	46	3	13.439	1.4	0.06	2.1	0.5812	2.5	0.0744	1.4	0.550
HE-1_9.1	0.23	275	124	0.47	17.67	464	6	487	57	5	13.403	1.4	0.06	2.6	0.5850	3.0	0.0746	1.4	0.472
HE-1_1.2	0.23	389	99	0.26	25.2	467	6	458	52	−2	13.296	1.4	0.06	2.4	0.5823	2.7	0.0752	1.4	0.506
HE-1_8.1	0.10	318	108	0.35	20.67	469	6	488	64	4	13.248	1.4	0.06	2.9	0.5923	3.2	0.0755	1.4	0.424
HE-1_7.2	0.20	312	138	0.46	20.32	469	6	500	53	7	13.238	1.4	0.06	2.4	0.5961	2.8	0.0755	1.4	0.495
HE-1_6.1	0.29	671	324	0.50	43.79	471	6	464	39	−1	13.207	1.3	0.06	1.8	0.5878	2.2	0.0757	1.3	0.589
HE-1_8.2	0.10	575	227	0.41	37.47	471	6	514	35	9	13.188	1.3	0.06	1.6	0.6021	2.1	0.0758	1.3	0.627
HE-1_7.1	0.05	351	91	0.27	22.93	473	6	511	41	8	13.141	1.3	0.06	1.8	0.6034	2.3	0.0761	1.3	0.590
HE-1_2.1	0.28	251	132	0.54	16.47	474	6	486	62	3	13.119	1.4	0.06	2.8	0.5975	3.1	0.0762	1.4	0.448
HE-1_7.3	0.02	1159	345	0.31	75.97	474	6	476	22	1	13.113	1.3	0.06	1.0	0.5952	1.6	0.0763	1.3	0.780
HE-1_5.1	0.07	245	85	0.36	16.22	477	6	485	49	2	13.009	1.4	0.06	2.2	0.6025	2.6	0.0769	1.4	0.535
HE-1_5.2	0.31	283	101	0.37	18.89	482	7	473	69	−2	12.890	1.4	0.06	3.1	0.6046	3.4	0.0776	1.4	0.420
HE-1_4.2	0.51	498	239	0.50	33.39	482	9	466	475	−3	12.872	1.9	0.06	21.4	0.6036	21.5	0.0777	1.9	0.086
HE-1_3.1	0.07	616	226	0.38	41.16	483	6	472	31	−2	12.862	1.3	0.06	1.4	0.6057	1.9	0.0777	1.3	0.690
HE-1_4.1	0.14	1295	433	0.35	87.18	486	6	488	26	0	12.780	1.3	0.06	1.2	0.6139	1.7	0.0782	1.3	0.724

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
1σ Error in 91500 Standard calibration was 0.28 % (average of 35).
(1) Common Pb corrected using measured ^{204}Pb.

Table 20: U-Pb *in situ* ages of zircons from a metadacite (*ZA-1*). Gemer Mountains, Žakarovce, Gemeric basement.

Spot Name	% $^{206}Pb_c$	ppm U	ppm Th	$^{232}Th/^{238}U$	ppm $^{206}Pb^*$	(1)Age $^{206}Pb/^{238}U$ Myr	±	(1)Age $^{207}Pb/^{206}Pb$ Myr	±	%D	(1) $^{238}U/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{206}Pb^*$	± %	(1) $^{207}Pb^*/^{235}U$	± %	(1) $^{206}Pb^*/^{238}U$	± %	err corr
ZA-1_2.2	1.01	127	46	0.38	8.4	473	8	451	177	−5	13.137	1.7	0.06	8.0	0.5875	8.2	0.0761	1.7	0.213
ZA-1_1.2	0.40	294	142	0.50	19.3	474	7	513	76	8	13.105	1.5	0.06	3.5	0.6055	3.8	0.0763	1.5	0.396
ZA-1_3.1	0.45	184	109	0.61	12.1	475	8	523	100	10	13.086	1.6	0.06	4.5	0.6092	4.8	0.0764	1.6	0.341
ZA-1_5.1	1.33	186	94	0.52	12.4	476	8	482	181	1	13.046	1.6	0.06	8.2	0.5998	8.4	0.0767	1.6	0.196
ZA-1_1.1	0.32	167	58	0.36	11.1	481	7	541	85	13	12.920	1.6	0.06	3.9	0.6221	4.2	0.0774	1.6	0.374
ZA-1_2.1	0.00	166	69	0.43	11.5	501	7	659	57	32	12.383	1.5	0.06	2.6	0.6855	3.1	0.0808	1.5	0.504
ZA-1_4.1	0.00	125	45	0.38	10.0	577	9	1021	53	77	10.671	1.6	0.07	2.6	0.9465	3.0	0.0937	1.6	0.526
ZA-1_4.2	0.20	1284	208	0.17	272.2	1419	16	1870	10	32	4.060	1.3	0.11	0.6	3.8830	1.4	0.2463	1.3	0.913

Errors are 1-sigma; Pb_c and Pb* indicate the common and radiogenic portions, respectively.
1σ Error in 91500 Standard calibration was 0.28 % (average of 35).
(1) Common Pb corrected usingmeasured ^{204}Pb.