# Some critical events in the geological history of eastern margin of the Bohemian Massif

## Některé kritické události v geologické historii východního okraje Českého masívu (Czech summary)

*(2 text–figs.)*

ZDENĚK MÍSAŘ – ARNOŠT DUDEK

*Přírodovědecká fakulta University Karlovy, Albertov 6, 128 43 Praha 2*

Presented February 9, 1993

**Demarcation of terranes, interaction of upper mantle/crust rocks and ophiolite events are discussed in the contribution. New designated terrane boundaries and reinterpreted earlier recognized faults delimit terranes of the Brunovistulicum, Moravosilesicum, Moldanubicum, Bohemicum and Lugicum. Interaction of lithospheric laminae of the upper mantle and crust representatives was in consideration of tectonometamorphic events. Ophiolite events were restricted to the Bohemicum or its equivalents in the Saxo–Thuringian zone of the Variscan Belt. Analyses of magmatic and metamorphic events and geotectonic setting of the Brunovistulicum complement the conception on geological evolution of eastern margin of the Variscan Bohemian Massif.**

### Introduction

Since the first period of classical studies of F.E. Suess (1912), Kossmat (1927) and Stille (1951) and regional syntheses of the sixties and seventies much new data has been collected in the fields of geochronology, geochemistry, geophysics, stratigraphy and structural geology. From the many geological studies published in the last decade (see references in Mísař 1993, Mísař – Urban 1993) at least some of them have to be mentioned and discussed in our contribution.

Recently confirmed distinct gravity and magnetic gradients in the Silesicum between the Keprník and Desná Dome (Daňko – Rejl 1990) and a flat dipping overthrust near the base of Lower Carboniferous strata (Tomek 1988, 1991) document the relationship between deep crustal tectonics and shallow tectonics of the whole eastern margin of the Bohemian Massif. Even deeper, but not perfectly understood yet, is a zone of geoelectric inhomogenity marked by the inversion of the electromagnetic Wieses vectors (Praus et al. 1988, Petr et al. 1985, 1987) across the eastern margin from the Moldanubicum in the SW to Lower Carboniferous of the Nízký Jeseník Mts. in NE.

A new approach presented by correlation of peridotites plus eclogites in granulites and tectonostratigraphic events in the Moldanubicum on the eastern Bohemian Massif brought new insight into its development (Beard et al. 1991, 1992, Medaris et al. 1991, 1993).

The nappe structure was described in the Silesikum by Cháb et al. (1984, 1990) and in Moravicum by Jaroš – Mísař (1974), Frasl (1991), Fritz (1991), Matura (1980) – Schulmann et al. (1991). Recent papers still pay attention to the open question of the structure and lithostratigraphy of the eastern Moldanubicum (Frank et al. 1990, Frasl 1991, Fritz 1991, Fuchs 1991, 1992, Höck 1991, Matte et al. 1990, Matura 1980, Kröner et al. 1988, Neubauer 1991). Quite recently a new synthesis of the eastern Bohemian Massif appeared in Dallmeyer ed. (1993).

Except for a few new paleontological finds of Devonian and Lower Carboniferous age in some sediments (Chlupáč 1987) the stratigraphy of metamorphic terranes remains still only indirectly controlled by geochronological data as presented by ample references in the following chapters.

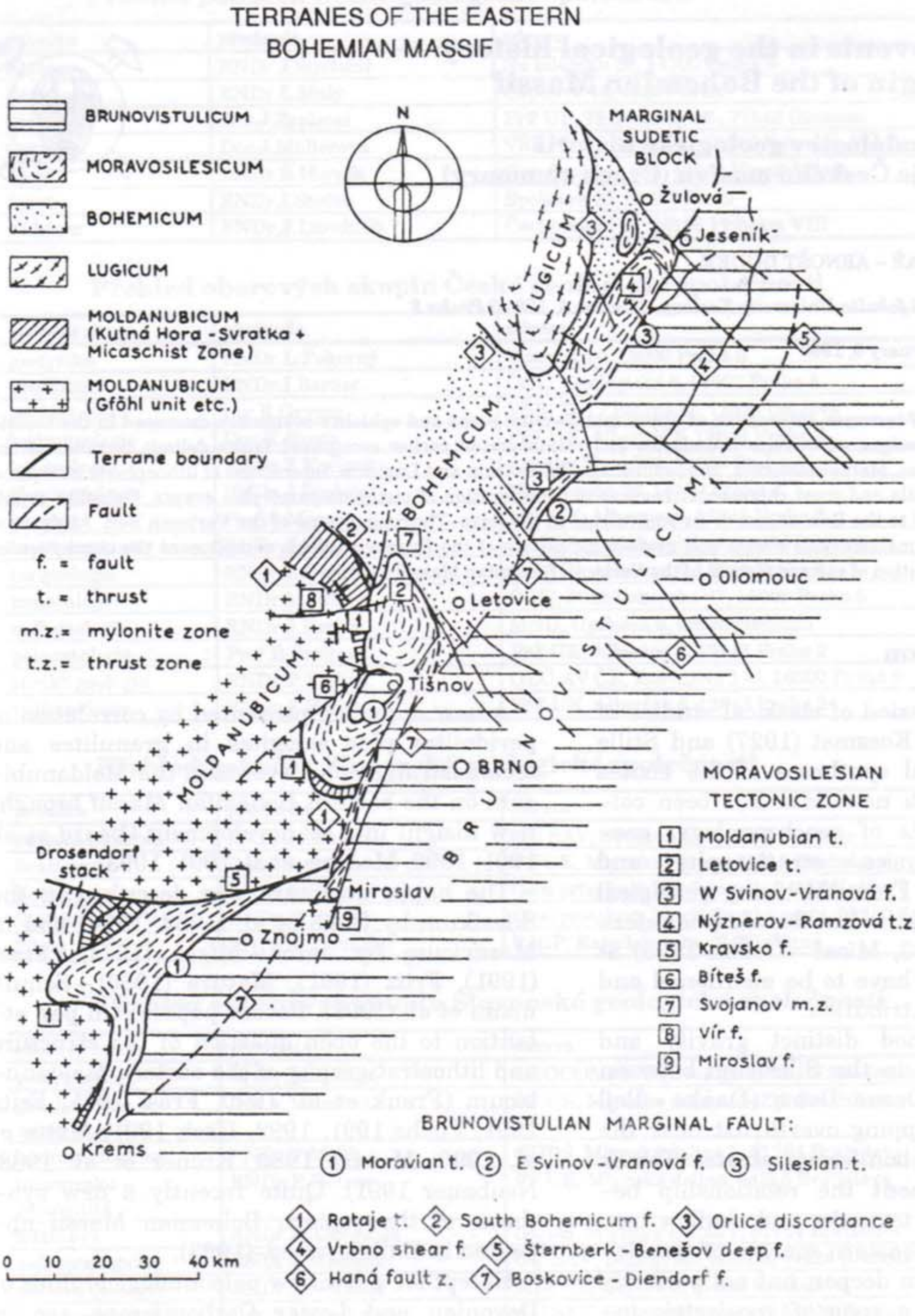

Fig. 1. Tectonic scheme of the Eastern Bohemian Massif

## 1. Terranes and terrane boundaries

Terranes as large geological units should be placed widely apart and diversified in lithology, stratigraphy and tectonics. Before this modern fashion in geology,terms as unit, complex, zone, block, region etc. were generally used. The substitution of these terms by "terrane" in some recent interpretations of Franke (1989), or Matte et al. (1990) in reality obscures the nomenclature. Schematical subdivision of the Moldanubicum (Matte et al. 1990) into Gföhl and Drosendorf Terrane by omitting the Ostrong–Monotonous formation, prolongation of the Gföhl Terrane up to the Lugicum not respecting the Bohemicum and the term Drosendorf Terrane itself is an unfortunate choice. Terranes demarcated e.g. by Franke (1989) or Frasl (1991) and Matte et al. (1990) in classical Suess Moravicum of Dyje and Svratka Dome are more confusing as well.

To deliniate terranes in the eastern Bohemian Massif we have to search for principal tectonic boundaries. Two of them already recognized and characterized earlier were identified with small corrections as terrane boundaries.

**1. Moravosilesian tectonic Zone** (MTZ) of Mísař et al. (1983), corresponds to some extent with the Moldanubian or Lugodanubian overthrust of F.E. Suess (1912) respectively. MTZ represented by a set of thrusts, vertical and horizontal faults, mylonite zones with local names (Fig. 1) separates the Moravosilesicum from all terranes of the central segment of the Bohemian Massif.

**2. Brunovistulian Marginal fault** (BMF – new term), is identical with some earlier recognized overthrusts. The primary Dřínová overthrust in the Svratka Dome (Jaroš - Mísař 1974) was subsequently renamed the Moravian Overthrust (Jaroš 1992). No local name is attributed to the Moravian Overthrust in the Dyje Dome, where a granite mylonite zone developed between the Brunovistulicum and Moravosilesicum (Schulmann et al. 1991). The BMF can be identified as the eastern fault of the Svinov–Vranová tectonic sheet and supposed to be in the Červenohorské sedlo fault Zone – Silesian Thrust Zone (new term).

Other tectonic terrane boundaries were newly recognized or reinterpreted (Fig. 1).

**3. South Bohemicum Fault** (new term) follows the boundary between the Moldanubicum (with the Kutná Hora Crystalline Unit) and the Bohemicum. Tectonically reduced and blotted out by Svojanov Mylonite Zone it appears again as the Letovice Overthrust (new term) along the northern closure of the Svratka Dome. The western fault of the Svinov–Vranová tectonic sheet is of similar significance as the Letovice Overthrust.

**4. The Nýznerov - Ramzová Overthrust System** is actually the continuation of the MTZ in the Silesicum. Particular complexity of this system is due to the imbricated structure along the contact between the Lugicum, Bohemicum (the Staré Město Micaschist Zone) and Moravosilesicum (the Keprník Dome) with incorporated Paleozoic (?) formations.

**5. The Orlice - Sněžník Fault**, identical with the Orlice structural discordance of Fajst (1976), may be also interpreted as a terrane boundary.

In the Variscan architecture of the eastern margin of the Bohemian Massif the following terranes may be recognized (Fig. 1):

1) Brunovistulicum (BV),
2) Moravosilesicum (MS),
3) Moldanubicum (M),
4) Bohemicum (B),
5) Lugicum (L)

**Brunovistulicum** with its Cadomian basement and Devonian sedimentary cover dips between 30–50° to the W. There it is accessible in cores of the Svratka, Desná and partly also Dyje Domes, and as an underthrusted crustal segment may be followed to the W up to the deep zone of geoelectric inhomogenity (about 15 km W of the BMF). The boundary of the BV in the E is hidden below the Carpathians and there are no geological indications for its presence.

An analogous, but more distinct geoelectric inversion zone in the East is parallel to the Carpathian Klippen Belt (Jandowski et al. 1985, Pěčová et al. 1979). Both these geoelectric zones occur in the depth of about 15–20 km and may represent conductivity zones on the margin of underthrusted (subducted) lithospheric slabs.

North of the transversal Haná fault zone the interpretation of the geoelectric inversion zone is more difficult. The zone may indicate the margin of the BV basement, only weakly activated during the Variscan orogeny. The surface projection of the geoelectric zone nearly coincides with the Šternberk–Horní Benešov Deep Fault. Farther to the west of this line, the intensity of deformation increases very rapidly and both the BV basement and Devonian cover are folded and thrusted.

**Moravosilesicum** (MS) reinterpreted, is found between the BV in the E and all terranes of the central segment of the Bohemian Massif in the W. In the southern portion of the MS, in the Dyje Dome and southern Svratka Dome, the MS is in tectonic contact with the Moldanubicum. There are still some disagreements between Bohemian and Austrian geologists as to the place of the Moldanubian thrust. In our interpretation the Moldanubian boundary does not correspond to the western margin of the Bíteš gneiss.

In the northern part of the Svratka Dome the closure of the MS is rimmed by the Letovice crystalline unit, which is a part of the Bohemicum. Similarly the Svinov-Vranová tectonic sheet is separated by its western marginal fault from the Zábřeh unit (the Bohemicum).

The MS north of the transverse Haná fault zone occupies only the western part – the Keprník Dome – of the original Silesicum of F.E.Suess. In addition, we consider the formations of the Velké Vrbno Dome as an underthrusted sheet of MS not as a part of the Moldanubicum.

The MS is characterized by uniform and distinctive lithology, magmatism and metamorphism. The foreign provenance and tectonostratigraphic setting of the MS between the BV and M+B+L allow us to reinterpret and qualify this unit as a terrane.

Terranes to the W of the MTZ represent in the time of Variscan amalgamation, one large fragment of the Earth's crust, overthrusted on the MS. Both units were underthrusted (subducted) by the BV. Although the characteristics of M and B are well known, contradictory interpretations of stratigraphy, geochronology, and tectonics remain. Relevant geological data concerning the selected topics will be mentioned in the next chapters.

## 2. Time for crust/mantle interaction in the easternmost part of the Moldanubicum

The M involves, mainly on its eastern border a unique concentration of diverse mantle derived rocks (Dudek – Fediuková 1974, Machart 1984). Their diversity and tectonostratigraphic setting were much studied in the last decade. Particular attention was given to the peridotite plus eclogite and their host granulite plus granulite gneisses.

The couple of peridotite plus eclogite and granulite is restricted tectonically to the Gföhl Nappe which overlies the lower levels of the M and MS in the Dyje and Svratka Domes. Tectonic sheets of granulite and peridotite and amphibolite have a separate position inside of the Gföhl Nappe. There are geological evidences for the time of nappe transport, in the span between Upper Devonian (c. 374 Ma) and Middle–Upper Viséan (c. 335 Ma). The upper mantle – crust interaction had to take place before the upper limit.

The relative time of interaction can be shown in the field by structural relationships of peridotite, eclogite, granulite, and by geochronological data.

### Geochronology

Using the ages of rocks and minerals we always prefer to consider them as cooling ages, it is ages respecting a function of grain size and cooling history. To know the age of protoliths would be more useful. Unfortunately, protolith age is usually masked by later disturbances or cannot be determined at all.

Although more periods of eclogitization and granulitization have been reported from the western Variscan belt (between c. 500 Ma and 330 Ma e.g. by Gebauer et al. 1989, Pecaut et al. 1989), the data established in our region have been used preferentially. U/Pb zircon and monazite ages for the granulite facies metamorphism (including the granulite at Mohelno) yield a well defined lower intercept age from 367 Ma to 345 Ma (Van Breemen et al. 1982).

Sm/Nd ages of garnet–pyroxene pairs of eclogite fall into two groups, one at 375 Ma and another at 340 Ma (Carswell – Jamtveit 1990, Beard et al. 1992). Garnet–peridotite and garnet pyroxenite of the Nové Dvory show Sm/Nd ages of 342±6 Ma and 342±17 Ma respectively (Beard et al. 1992, Medaris et al. 1993) while the age of the Mohelno peridotite body and the Níhov eclogite is slightly higher, 371±11 Ma (Medaris et al. 1992). According to Brueckner et al. (1991) Sm/Nd ages of the Snieznik Mts (Poland) eclogite in granulite and gneisses are split at 329 Ma, 337 Ma, 341 Ma and 352 Ma.

Summarized, geochronological data demonstrate that garnet peridotite, pyroxenite and high–temperature A–eclogite of Beard et al. (1992) passed the blocking temperature for Sm/Nd exchange at c. 340 Ma and 375 Ma (Medaris et al. 1992). The older age indication seems to be in good harmony with the older period of granulitization (see 375 Ma–377 Ma for eclogite). Whereas values of 467 Ma–345 Ma of Van Breemen et al. (1982) may reflect another disturbance in granulite history.

The younger blocking temperature in eclogite and granulite may be an overprint of these rocks by MP amphibolite facies metamorphism (O'Brien 1989) controlled by shearing, and lasted from c. 341 Ma (U/Pb zircon, l.c.) to 333–331 Ma Rb/Sr (Van Breemen et al. 1982).

However, near the oldest blocking temperature time line or rather before it, the chondritic pre–Devonian (Cadomian, Panafrican) upper mantle had to be differentiated, depleted, metasomatized, contaminated and penetrated by allofacial basaltic melts or asthenospheric diapirs. How far these processes were synchronous in the Variscan belt, and how they are related to pre–Upper Devonian Benioff subduction zones, remains uncertain.

The Bory quarry N of Velké Meziříčí offers another unique chance to see and study the products of crust–mantle interaction (Míisař – Jelínek 1979, Mísař et al. 1984). The exposed sheet of Gföhl gneisses and granulites contains tens of inclusions of diverse rocks representing a vertical section from the upper mantle to the crust (garnet and spinel peridotite, garnet pyroxenite, pyroxenite, eclogite in all stages of symplectitization and retrogression, hornblendite, diorite, opal etc.). Although no geochronological data are known from the rocks of the quarry a comparative approach can be used.

Eclogite–granulite facies metamorphism fits in the time span from 400 Ma to 345 Ma, and was followed by c. 341 Ma–331 Ma old event of amphibolite facies metamorphism and shearing.

## Structural relationships

Layering in the peridotite, conspicuous by garnet pyroxenite and eclogite layers, originating under eclogite–granulite facies metamorphism, differs markedly from the banding and foliation of the granulite.

Dissimilarity in fabric can be easily demonstrated with inclusions of peridotite and eclogite in granulites at the Bory quarry and at Mohelno. The strike of layering in peridotite and eclogite inclusions never coincides with predominant foliation in granulite. Inclusions were rounded and rotated along the granulite foliation, fragmented in boundins, and the small ones completly stretched. Stretching or refoliation of granulite under amphibolite facies metamorphism (porphyroblasts of hornblende, biotite, plagioclase, garnet) weakened, when minerals of the black wall around inclusions started to grow.

The Nové Dvory and Biskupice peridotite plus eclogite bodies in gneisses and migmatites display sharp tectonic contacts with very reduced black wall. In contrast the contact developed between high–temperature Mohelno peridotite body and its surrounding rocks is of specific character. Biotite, hornblende, quartz, and plagioclase dominate in the black wall and are associated at some places with pyroxene and anatectic "dioritic–gabbroic" rocks (Mísař et al. 1985). Recrystalization of granulite into granulite gneisses and pearl gneisses can be followed in a distance of few metres. An internal contact zone in the peridotite body is conspicuous by pyrope with coronas. The stretching of garnet clearly follows the formation of coronas.

## Scenario

On the basis of field relationships and geochronological data of peridotite, eclogite and granulite we present a scenario on tectonostratigraphic interaction or mixing of upper mantle/crust members in eastern part of the Variscan belt. Supporting evidence is from Gföhl granulite–gneiss pile of the eastern Moldanubicum.

1. The age of granulite protolith of volcanic or magmatic affinity (Fiala et al. 1987, Vrána 1989) is unknown. Probably upper Proterozoic–Lower Paleozoic. The age of high temperature granulite facies metamorphism according to time of blocking temperature is estimated at 377 Ma.

2. Reactivation of upper mantle protolith of probably Upper Proterozoic–Lower Paleozoic age. Primary layering of peridotite was followed by penetration of allofacial upper mantle–derived melt into peridotite at minimum age of 377 Ma.

3. Delamination of upper–mantle (peridotite plus eclogite) and lower crust (granulite plus diorite gneisses) lithosphere under high–temperature granulite facies metamorphism and eclogite formation (Sm–Nd in Cpx–Grt ages of 375 Ma – 345 Ma).

$F_1$ folding phase with isoclinal and closed folds in granulite (Urban – Mísař 1989). Local uprise of probably asthenospheric peridotite body at Mohelno.

4. Stacking and uprising of laminated lithosphere with local anatexis of granulite and gneisses, at 341 Ma–333 Ma.

Main period of recrystallization of eclogite under amphibolite facies metamorphism at 341 Ma–333 Ma.

Recrystalization and refoliation (shearing) of the granulite and structural shape conformity of inclusions in granulite.

$F_2$ folding phase with horizontal and recumbent folds and intensive nappe tectonics.

5. Dying out of the nappe transport, connected with ductile up to brittle deformation along shear zones – 331 Ma. $F_3$ folding phase. No change in space relation between peridotite plus eclogite, granulite, and gneisses.

6. Mylonitic processes along NE–SW shear zones with chlorite–muscovite 294 Ma–260 Ma old (Wallbrecher et al. 1991).

No changes as mentioned in point 5.

7. Partial Alpine rejuvenation at 190 Ma (muscovite age, Wallbrecher et al. 1991).

No changes as mentioned in point 5.

### 3. Ophiolite event

Ophiolites reflect remarkably the geotectonic history and architecture of the Earth's crust (opening and closing of ocean, fore– and back–arc basins, ocean ridge, rift structure etc.). Unfortunately, ophiolite sequences are usually allochthonous, dismembered, metamorphosed and apart from the place of origin.

There are several concentrations of ophiolites along the eastern margin of the Bohemian Massif: the Letovice ophiolites, the Staré Město ophiolites and the Circum–Sowie Gory ophiolites.

The Letovice ophiolite complex (of dismembered type) with spinel peridotite, cumulate peridotite, layered and transgressive gabbro and basic volcanites is a part of the Bohemicum (Mísař et al. 1984). It is separated from crystalline complexes of the MS in the Svratka Dome closure by the Letovice thrust. Two synformal structures of the Letovice ophiolite (the Letovice and Roubanina synform) differ in metamorphic grade and in representation of ophiolite members.

The Staré Město ophiolites also of dismembered type, with peridotite tectonites, metagabbros and basic metavolcanites, were incorporated into the complicated imbricate zone between the MS and L.

The Circum–Sowie Gory ophiolites with separated massifs of Nowa Ruda, Sklary, Grochowa–Braszovice and Mt. Sleza are not geologicaly uniform. Ultrabasic, gabbroic and volcanic members were transformed by greenschist facies metamorphism. In contrast to the Staré Město ophiolites related to the B, the ophiolite around the Sowie Gory Mts. are of uncertain provenance.

#### Geochronology

The tectonostratigraphic setting of all ophiolites was essentially established at the time of tectonic stacking of individual units of the Bohemian massif at 360 Ma to 330 Ma.

There are only a few dates of the Letovice ophiolites attributed to Variscan activity. The ages of 345 Ma–340 Ma obtained by argon 40/argon 39 incremental heating experiments and K–Ar analyses of the same amphibole are attributed to the effects of intense Variscan metamorphic activity (Macintyre et al 1992). The age of 345 Ma–340 Ma of hornblende provide confirmation of this metamorphic event, while "intercept" ages of c. 330 Ma may be a most reliable estimate of the time of argon closure in hornblende (rapid uplift). As the K–Ar and Ar–Ar dated amphibolites are parts of an overthrusted sheet we prefer to interpret the ages at 345 Ma as reflecting the structural and metamorphic rearrangement during $F_3$ folding phase of Bowes et al. (1978, 1980). The age of 345 Ma of hornblende is in perfect agreement with the time of retrograde amphibolite facies metamorphism in eclogites and granulites. From this point of view it would be of great significance to confirm some coarse grained garnet amphibolites as retrogressed eclogites at Svojanov.

Any ophiolite member of the Staré Město ophiolites has not been dated until now. However, their tectonostratigraphic setting in a complicated imbricate zone is related to the general tectonic stacking event of the Bohemian Massif between 360 Ma and 330 Ma.

More data on ages of the Circum–Sowie Gory ophiolites were colected in the last decade. A Sm/Nd whole–rock isochron ages of 353±21 Ma has been obtained for gabbro, amphibolite and pegmatitic diallagite of the Mt. Sleza ophiolite complex. Slightly higher ages at 357±12 Ma characterize the gabbro of the Nowa Ruda (Pin et al. 1988). It is a bit uncertain to interpret these values in the same way as in the Letovice ophiolite. The rocks of Mt. Sleza and Nowa Ruda complex underwent greenschist facies metamorphism. This may be the reason while Pin et al. (1988) by rejecting the mixing hypothesis and resetting of Sm/Nd systematics, defined linear arrays obtained in the $^{143}Nd/^{144}Nd$ vs. $^{147}Sm/^{144}Sm$ diagram as isochrons, and the average age c. 350 Ma as the age of magmatic crystalization.

We still prefer the role of blocking temperature when interpreting the age of ophiolites. Stratigraphy of sedimentary rocks and geochronological data of metamorphic rocks of near–by geological units should not be omitted. Folded crystalline formations of the Klodsko unit with Lower Ludlovian limestones on the top are covered by transgressive clastic sediments of Upper Devonian (c. 367 Ma). Metamorphic foliation of the basement had to originate between Upper Silurian and Upper Devonian (Wojciechowska 1992).

Even more helpful are data from the Sowie Gory metamorphic rocks. The Sowie Gory tectonic stack was uplifted and thrusted on ophiolites of Mt. Sleza as early as in the Famenian (c. 367 Ma) and was very rapidly exposed. Famenian conglomerates of the Swiebodzice basin are rich in pebbles of gneisses, granites and pegmatites whose source is considered to be the Sowie Gory block. The geochronological data supporting the time of all these events are given in the paper of van Breemen et al. (1988). U/Pb 381±2 Ma monazite and Rb/Sr 370 Ma muscovite ages of gneisses document at least an Upper Devonian age of the regional metamorphism of Upper Proterozoic sediments.

Summarizing it can be supposed that some geological events, indicated by blocking temperature of about 350 Ma for ophiolites and about 367 Ma for the Sowie Gory uplift modified the character of ophiolites and their tectonostratigraphic setting in eastern Polish Sudeten. But still an open question remains if the ophiolite event actually started by Lower to Middle Devonian rifting (Narebski 1992, Narebski et al. 1988) or even earlier, as is the case in the Western Polish Sudeten and may be in the whole Bohemicum as well.

## Structural relations

There are only few detailed structural studies of ophiolite complexes. Bowes et al. (1978, 1980) analyzed polydeformed amphibolites at Letovice and defined five main folding phase ($F_1$–$F_5$). The predominant $F_3$ folds are probably Upper Variscan in age according to the structural overprint connected with amphibolite facies metamorphism (BT at 341–331 Ma). BT at 345 Ma of studied $F_3$ folds can still obliterate older unknown ages of $F_2$ and $F_1$. As the primary geotectonic position of ophiolites is concerned, the tholeiitic trend of the Letovice ophiolites (metabasalts and metagabbros) marks them as ocean abyssal basalts produced along a rift system probably in a narrow ocean basin (Mísař et al. 1984, Jelínek et al. 1984).

The terminal imbricated tectonic style of the Staré Město Micaschist zone is unfavourable for the study of the relation between dismembered ophiolite members and host rocks. Gabbros and most of the basic volcanites can be geochemically considered as mid-ocean ridge basalts (MORB) and others are more similar to island arc basalts (IAB). In addition, Poubová and Sokol (1992) mention the presence of metamorphosed acid volcanites – dacites, rhyodacites and keratophyres.

The Circum Sowie Gory ophiolites underwent polyphase folding and faulting with terminal overthrust or uplift of the Sowie Gory block. Consanguinity and provenance of now separated ophiolite complexes have not yet been taken into account in the literature. The Nowa Ruda and Mt. Sleza ophiolite bodies may be related to Middle–Lower Devonian rifting and oceanization (l.c.) or even to older rifting in the Middle Sudetic basin. The eastern portion of the Circum–Sowie Gory ophiolite rim is dominated by peridotite tectonic bodies aligned in a N–S trending tectonic zone and could be in some way a link with the Staré Město Micaschist Zone containing similar peridotites.

## Scenario

In our scenario new geochronological data on the Mariánské Lázně ophiolites and paleogeographic correlation became very useful.

1. Differentiation of the Cadomian crustal segment with basinal sedimentary–volcanic activities in the Bohemicum and its equivalents in the Saxo–Thuringicum – 570 Ma–600 Ma.

2. Probably diachronous ophiolite rifting events – Upper Proterozoic – Cambrian, Cambrian–Ordovician, Upper Silurian – Lower Devonian, Lower–Middle Devonian.

a) Ophiolite event in the Mariánské Lázně ophiolite complex may be of Upper Proterozoic–Cambrian age (Pb/Pb 491 Ma zircon age of discordant gabbropegmatite in ophiolite, Bowes – Aftalion 1991). The eclogite metamorphism at Mariánské Lázně Complex definitely occurred at about 375 Ma (Givetien), based on Sm/Nd in Cpx–Grt, although there is some evidence for an older amphibolite–facies metamorphism at about 430 Ma, based on garnet cores in one sample (Beard et al. 1993 – in press).

b) Ophiolite event of the Letovice complex is comparable with that of the Mariánské Lázně (Mísař et al. 1984).

c) Ophiolite event in the Staré Město Micaschist Zone has not yet been sufficiently documented neither by geochronology, nor by geology.

d) Ophiolite event in the Circum–Sowie Gory ophiolite rim seems to be determined by the transgression of Famenian conglomerate and tectonometamorphic and tectonic events in the Sowie Gory block (367 Ma, 381 Ma, 370–360 Ma) than by interpreted time of magmatic age of ophiolite (350 Ma).

3. Metamorphic event was probably older at the Mariánské Lázně ophiolite – pre Silurian, and younger, if not of the same age as at the Letovice ophiolite – Upper Devonian – Lower Carboniferous. The age of Lower–Middle Devonian or Upper Devonian – Lower Carboniferous metamorphic event of the Circum-Sowie Gory ophiolite is unsure.

4. Tectonic events with stacking and thrusting of ophiolite and surrounding rocks reflect metamorphic events in some way.

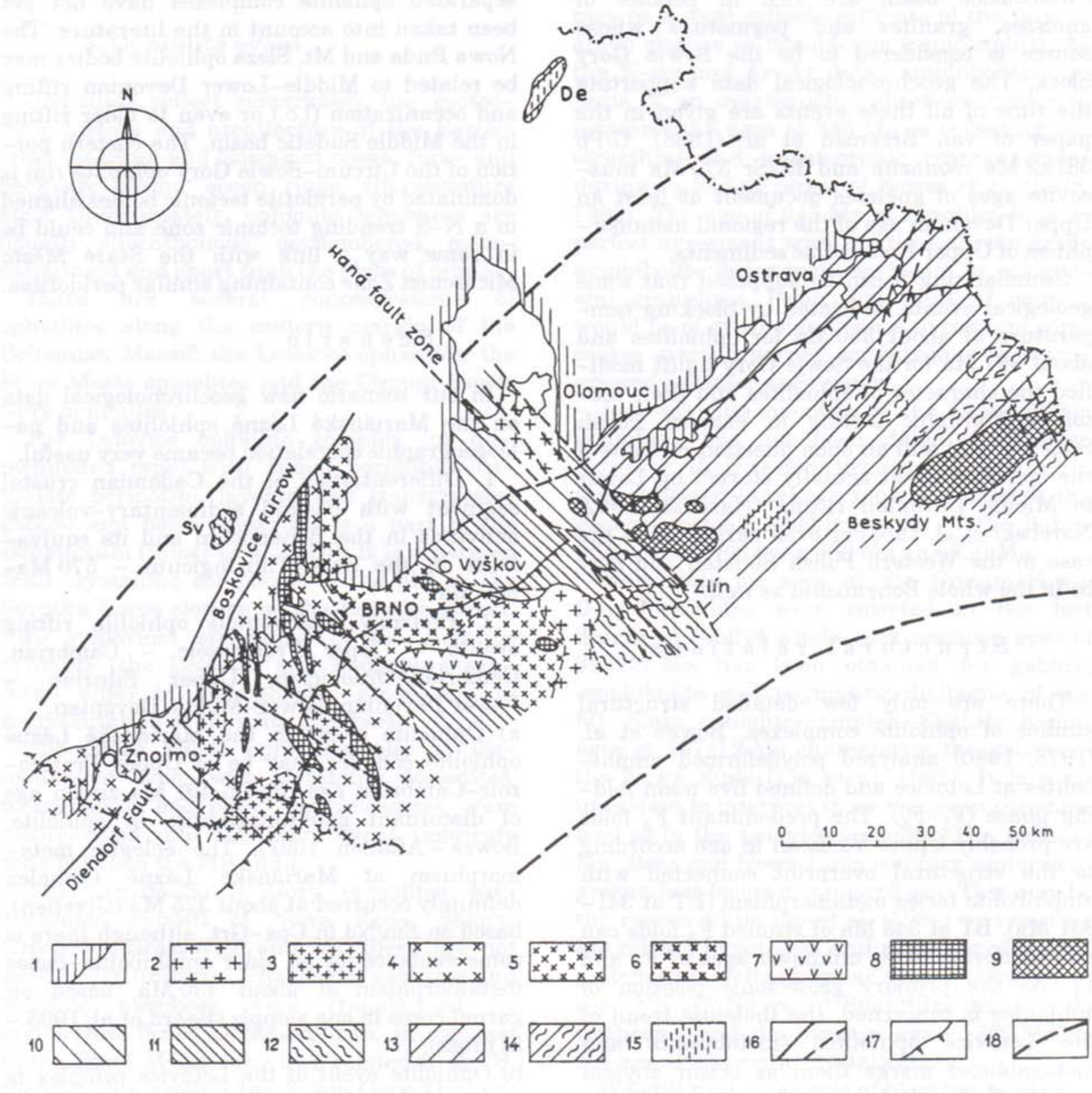

Fig. 2. Geological sketch of the Brunovistulian basement
*1* – The boundary of the exposed parts of the Brunovistulicum. *2–9* – Intrusive rocks of the Brno pluton and small gabbroic massifs: *2* – biotite leucogranites, *3* – biotite granites, *4* – biotite granodiorites, *5* – biotite leucogranodiorites, *6* – Light coloured hornblende-biotite granodiorites to tonalites, *7* – dark biotite-hornblende tonalites to quartzdiorites, *8* – hornblende diorites and quartzdiorites, *9* – gabbros and gabbronorites. *10–12* – Metamorphosed volcanosedimentary sequence with frequent metabasites: *10* – chlorite and biotite phyllites, *11* – muscovite-biotite schists, *12* – migmatitic paragneisses. *13–14* – Metamorphosed clastic sequence: *13* – biotite paragneisses, *14* – migmatitic paragneisses. *15* – Strongly retrogressed rocks. *16* – Important faults. *17* – The front of the Carpathian nappes. *18* – Electromagnetic inversion zone of the Wieses vectors (according to Petr et al. 1987, Praus et al. 1988). Sv, De – cores of the Svratka and Desná Domes

## 4. Magmatic and metamorphic events in the Brunovistulicum

The basement of the BV, as delimited in the preceeding text, is composed of metamorphic and magmatic complexes. Both of these were studied in detail elswehere and pertinent information is given by Dudek (1980, 1993), Jelínek - Dudek (1993), Finger et al. (1989, 1993). In our contribution only some results regarding the origin and tectonic position from geological and petrological data are presented. The main geological features of the BV basement are compiled in Fig. 2.

The metamorphic basement complex is divided by the Haná Fault zone into two different parts. In the N of this zone the metamorphites are represented by gneisses and subordinate schists, metamorphosed in the amphibolite facies and in places weakly migmatized. In the S the range of metamorphic rocks is larger – from phyllites to migmatitic gneisses. The pre-metamorphic sedimentary-volcanic complex was formed by pelitic and psamitic sediments, tuffites, tuffs and tholeiitic basalts.

All metamorphites are characterized by low geochemical variability and primitive geochemical character. In most of them soda predominates over potash. This soda affinity differentiates clearly the BV metamorphites from the M gneisses.

The primitive character of the parametamorphites is demonstrated also by the distribution of REE in contradiction to M gneisses, whose protolith had its source in highly developed continental crust. The protolith of the BV metamorphites corresponds to the material of active regions of the crust, volcanic arcs or continental margins (Jelínek - Dudek 1993).

The BV metamorphites were affected by several metamorphic events. The oldest of them gave rise to schists and gneisses which were later intruded by the large Cadomian postkinematic Brno Pluton and small gabbroic massifs (514–660 Ma, Dudek - Melková 1975). This Cadomian basement was transformed by the Variscan tectonometamorphic events. The highest intensity of deformation and metamorphic overprint can be seen along the contact of BV with MS. Duplex structure and greenschist facies overprint are typical features for autochtonous BV in the Core of the Svratka Dome. Retrograde transformation of BV basement is adequate to prograde metamorphism of Devonian sediments and volcanites in the Desná Dome. In addition, some rejuvenation in time of 340–380 Ma (Dudek - Melková 1975) was documented in the eastern stable parts of the BV.

An even younger tectonic event at 290 Ma-260 Ma (Wallbrecher et al. 1992) was connected with chloritization, epidotization and mylonitization in general with shearing effects especially along NE–SW shearing zones.

The primitive character of the Cadomian metamorphites is comparable to the primitive features of the Brno Pluton (calc-alkaline trend, metaaluminous to peraluminous character, predominance of Na over K, low Sr-initial ratio etc.).

There is good reason to interpret the Brno Pluton as a product of subduction derived I-type plutonism in an island -arc environment (Jelínek - Dudek, 1993, Finger et al. 1989, 1993).

The primary geotectonic position of the BV remains obscure both in the Cadomian and Variscan orogenic belt. Suk (1986) regards the BV as a promontory of the Fennosarmatia, when Máška - Zoubek (1960) held it as a Variscan block loosely attached to the Bohemian Massif. Obvious island–arc affinity of the BV led Jelínek - Dudek (1993) to the conclusion that the BV was a part of a Cadomian island–arc or of a Cadomian active continental margin. Such interpretation seems to be very realistic. Nevertheless, a question at what geotectonic position the BV evolved as to the Fennosarmatia and the Gondwana or even to another not yet defined central microcontinent, remains open.

Both the idea of an active zone south of the Fennosarmatia (Zoubek 1992) or north of the Gondwana (Matte et al. 1990, Franke 1989) may be acceptable. These apparent discrepancies can be moderated by the existence of bivergent strongly diversified Cadomian (Pan-African) mobile zone between the two platforms. During the Variscan orogeny this Cadomian basement was split in a mosaic of separated blocks and incorporated into the Variscan structures.

## Summarizing remarks

The easternmost part of the Bohemian Massif may be divided into several terranes, such as the Moldanubicum, Bohemicum, Lugicum, Moravosilesicum and Brunovistulicum. Two fundamental terrane boundaries are the Moravosilesian Tectonic Zone and the Brunovistulian Marginal Fault.

Upper mantle/crust interaction as shown by geological and geochronological data (these are considered as blocking temperature ages) predated the tectonic stacking event and nappe transport with its final stage at about 341 Ma–333 Ma. The main period of interaction falls into the event of lithospheric delamination indicated by minimum ages of eclogite and peridotite at c. 377 Ma and the minimum age of granulite facies metamorphism at 375–345 Ma. The c. 341 Ma old event with amphibolite facies metamorphism and strong shearing effects sealed the structural unity of peridotites, eclogites, granulites, and gneisses. Later events with lower grade metamophism, ductile to brittle deformation and even later mylonitization did not change the space relationships of upper mantle/crust rocks.

Ophiolite events were restricted to terranes of the Bohemicum and its equivalents in the Saxo–Thuringicum. The time of rifting with related ophiolite emplacement differs probably in particular ophiolite complexes. The pre–Silurian (upper Proterozoic – Cambrian) ophiolite event is demonstrated by the age of the Mariánské Lázně ophiolite.

The age of the ophiolite event in the Letovice complex may correspond to that of the Mariánské Lázně ophiolites or it may be still younger (pre–Devonian).

There are no criteria for the age of rifting and the ophiolite event in the Staré město Micaschist Zone.

A Lower–Middle Devonian or even pre–Devonian age for the circum–Sowie Gory ophiolite is considered.

The Brunovistulicum, with its obvious island–arc affinity, was placed in the Cadomian (Pan–African) mobile belt – strongly diversified paleogeographically and with some central microcontinents – between two platforms. As one of the split segments of the Cadomian orogenic belt the Brunovistulicum was incorporated into the Variscan orogen.

Acknowledgements. The authors are deeply indebted to Prof. A.D. Ptacek from Seattle, for thorough revision of the English text, and for critical comments to Prof. L.G. Medaris, Madison and Prof. M. Suk, Brno.

*Translated by the authors*

## References

*Beard, B.L. – Medaris, L.G. – Johnson, C.M. – Brueckner, H.K. – Mísař, Z.* (1992): Petrogenesis of Vasriscan high–temperature group A–eclogite from Moldanubian zone of the Bohemian Massif.– Contr. Mineral. Petrogr., 111, 468–483. Berlin.

*Beard, B.L. – Medaris, L.G. – Johnson, C.M. – Jelínek, E. – Tonika, J.* (1993): Geochronology and geochemistry of eclogites from the Mariánské Lázně Complex, Czechoslovakia. Implications for Variscan orogenesis.

*Bowes, D.R. – Aftalion, M.* (1991): U–Pb zircon isotopic evidence for early Ordovician and late Proterozoic units in the Mariánské Lázně complex, Central European Hercynides. – Neu. Jb. Mineral,.Mh., 315–326. Stuttgart.

*Bowes, D.R. – Hopgood, A.M. – Mísař, Z.* (1978): Polyphase deformation in amphibolites of the Letovice Crystalline Unit. – Věst. Ústř. Úst. geol., 53, 273–280. Praha.

– (1980): Characterization of tectonic regimes of the Letovice Unit and Bíteš gneiss of the Moravicum using structural imprint of polyphase deformation. – Věst. Ústř. Úst. geol., 55, 331–342. Praha.

*Brueckner, H.K. – Medaris, L.G. – Bakun–Czubarow, N.* (1991): Nd and Sr age and isotope patterns from Variscan eclogites of the Eastern Bohemian Massif. – Neu. Jb. Mineral., Abh., 163, 169–196. Stuttgart.

*Carswell, D.A. – Jamtveit, B.* (1990): Variscan Sm–Nd ages for the high pressure metamorphism in the moldanubian zone of the Bohemian Massif, Lower Austria. – Neu. Jb. Mineral., Abh., 162, 69–78. Stuttgart.

*Cháb, J. – Fediuková, E. – Fišera, M. – Novotný, P. – Opletal, M.* (1990): Variská orogeneze v silesiku. – Sbor. geol. Věd, ložisk. Geol. Mineral., 29, 9–40, Praha.

*Cháb, J. – Fišera, M. – Fediuková, E. – Novotný, P. – Opletal, M. – Skácelová, D.* (1984): Problémy tektonického a metamorfního vývoje východní části Hrubého Jeseníku. – Sbor. geol. Věd., Geol., 39, 27–72. Praha.

*Chlupáč, I.* (1987): Paleontologické nálezy v metamorfovaném devonu centrální části Hrubého Jeseníku. – Čas. Mineral. Geol., 32, 17–26. Praha.

*Dallmeyer, R.D. – Franke, W.* eds. (1993): Tectonostratigraphic evolution of the Central European orogens. – Springer Verlag. Berlin.

*Daňko, J. – Rejl, L.* (1990): Regionální zhodnocení gravimetrických a aeromagnetických podkladů z oblasti Jeseníků. – Sbor. geol. Věd, ložisk. Geol. Mineral., 29, 67–75. Praha.

*Dudek, A.* (1980): The crystalline basement block of the Outer Carpathians in Moravia: Bruno–Vistulicum. – Rozpr. Čs. Akad. Věd, Ř. mat.–přír. Věd, 90, 8, 1–85.

– (1993): Metamorphic evolution. Moravo–Silesian Zone. – in: R.D. Dallmeyer – W. Franke eds.: Tectonostratigraphic evolution of the Central European orogens. Springer–Verlag. Berlin.

*Dudek, A. – Fediuková, E.* (1974): Eclogites of the Bohemian Moldanubicum. – Neu. Jb. Mineral., Abh., 121, 127–199. Stuttgart.

*Dudek, A. – Melková, J.* (1975): Radiometric age determination in the crystalline basement of the Carpathian Foredeep and the Moravian Flysch. –Věst. Ústř. Úst. geol., 50, 257–264, Praha.

*Fajst, M.* (1976): Nová diskordance v prekambriu Českého masívu. – Čas. Mineral. Geol., 21, 257–275. Praha.

*Fiala, J. – Matějovská, O. – Vaňková, V.* (1987): Moldanubian granulites and related rocks: petrology, geo–

chemistry and radioactivity. - Rozpr. Čs. Akad. Věd, Ř. mat. přír. Věd, 97, 1-102. Praha.

*Finger, F. - Frasl, G. - Dudek, A. - Jelínek, E.* (1993): Igneous activity. - Moravosilesian Zone. -in: R.D. Dallmeyer - W. Franke eds.: Tectonostratigraphic evolution of the Central European orogens. Springer - Verlag. Berlin (in print).

*Finger, F. - Frasl, G. - Höck, V. - Steyrer, H.P.* (1989): The granitoids of the Moravian Zone of Northeast Austria: products of a Cadomian active continental margin? - Precambr. Res., 45, 235-245. Amsterdam.

*Frank, W. - Hammer, St. - Popp, F. - Scharbert, S. - Thöni, M.* (1990): Isotopengeologische Neuergebnisse zur Entwicklungs-geschichte der Böhmischen Masse. Proterozoische Gesteinsserien und Variszische Hauptorogenese. - Österr. Beitr. Met. Geophys., 3, 185-228. Wien.

*Franke, W.* (1989): Tectonostratigraphic units in the Variscan belt of Central Europe. - Geol. Soc. Amer., Spec. Pap., 230, 67-80. Boulder.

*Frasl, G.* (1991): Das Moravikum der Thaya-Kuppel als Teil der vasriszisch deformierten Randzone des Bruno-Vistulicums. - Arbeitstagung Geol. Bundesanst. Wien, 44-62.

*Fritz, H.* (1991): Strukturelle Entwicklung am Südostrand der Böhmischen Masse. - Arbeitstagung Geol. B.-A., 89-97. Wien.

*Fuchs, G.* (1992): The Southern Bohemian Massif - its structure and evolution. - Proc. Conf. Bohemian Massif, 89-93. Geol. Surv. Praha.

– (1991): Die Bedeutung der Blätter 8 Geras und 21 Horn für das Verhältnis der Böhmischen Masse. - Arbeitstagung Geol. B.-A., Wien.

*Gebauer, D. - Williams, J.S. - Compston, W. - Grünefelder, M.* (1989): The development of the Central European continental crust since the Early Archean based on conventional and ion-microprobe dating of up to 3.84 b.y. old detrital zircons. - Tectonophysics, 157, 81-46. Amsterdam.

*Höck, V.* (1991): Das Moravikum der Thaya-Kuppel in Österreich - Lithologie und Metamorphose. - Arbeitstagung Geol. Bundesanst., 63-74. Wien.

*Jankowski, J. - Tarlowski, Z. - Praus, O. - Pěčová, J. - Petr, V.* (1985): The results of deep geomagnetic soundings in the West Carpathians. - Geophys. J. Roy. astron. Soc., 80, 561-574. Oxford.

*Jaroš, J.* (1992): The nappe structure in the Svratka dome. - Proc. Conf. Bohemian Massif, 137-140. Geol. Survey. Praha.

*Jaroš, J. - Mísař, Z.* (1974): Der Deckenbau der Svratka Kuppel und seine Bedeutung für das geodynamische Modell der Böhmischen Masse. - Sbor. geol. Věd, Geol., 12, 69-82. Praha.

*Jelínek, E. - Dudek, A.* (1993): Geochemistry of the Precambrian Plutonites of the covered part of the Brunovistulicum (Variscides, Czechoslovakia). - Precambr. Res., 62, 103-125. Amsterdam.

*Jelínek, E. - Pačesová, M. - Mísař, Z. - Martinec, P. - Weiss, Z.* (1984): Geochemistry of a dismembered metaophiolite complex, Letovice. - Trans. Roy. Soc., Earth. Sci., 75, 37-48. Edinburgh.

*Kossmat, F.* (1927): Gliederung des varistischen Gebirgsbaues. - Abh. sächs. geol. Landesamt, 1, 1-39. Freiberg.

*Kröner, A. - Wendt, I. - Liew, T.C. - Compston, W. - Todt, W. - Fiala, J. - Vaňková, V. - Vaněk, J.* (1988): U-Pb zircon and Sm/Nd model ages of high grade Moldanubian sediments, Bohemian Massif, Czechoslovakia. - Contr. Mineral. Petrogr., 29, 257-266. Berlin.

*Mac Intyre, R.M. - Bowes, D.R. - Hamidullah, S. - Onstott, T.G.* (1992): K-Ar and Ar-Ar isotopic study of amphibolites from meta-ophiolite complexes, Eastern Bohemia. - Proc. Conf. Bohemian Massif, 195-199, Geol.Surv. Praha.

*Machart, J.* (1984): Petrology of ultramafic rocks of the Bohemian part of Moldanubicum. - Krystalinikum, 17, 13-32. Praha.

*Máška, M. - Zoubek, V.* (1960): Variscan structural territorial units of the Bohemian Massif and their development. - In: T. Buday et al.:Tectonic development of Czechoslovakia, 25-102. Praha.

*Matte, P. - Maluski, H. - Rajlich, P. - Franke, W.* (1990): Terrane boundaries in the Bohemian Massif: Result of large-scale Variscan shearing. - Tectonophysics, 177, 151-170. Amsterdam.

*Matura, A.* (1980): Hypothesen zum Bau und zur geologischen Geschichte des kristallinen Grundgebirges von Südwestmähren und dem niederösterreichischen Waldviertel. - Jb. Geol. Bundesanst., 119, 63-74. Wien.

*Medaris, L.G. - Beard, B.L. - Mísař, Z. - Jelínek, E.* (1991): Czech eclogite in the Moldanubian zone of the Bohemian Massif. Terra Nova, 3, Abstr. 6, 7-9.

*Medaris, L.G. - Mísař, Z. - Jelínek, E.* (1993): Tectonostratigraphic setting and petrogenesis of Czech moldanubian eclogites.

*Medaris, L.G. - Wang, H.F. - Mísař, Z. - Jelínek, E.* (1990): Thermobarometry, diffusion modelling and cooling rates of crustal garnet peridotites: two examples from the Moldanubian Zone of the Bohemian Massif. - Lithos, 25, 189-202. Amsterdam.

*Mísař, Z.* (1993): Lithostratigraphy of allochthonous units in the Moravo-Silesian Zone. - In: R.D. Dallmeyer - W. Franke eds.: Tectonostratigraphic evolution of the Central European orogens. Springer-Verlag, Berlin.

*Mísař, Z. - Dudek, A. - Havlena, V. - Weiss, J.* (1983): Geologie ČSSR. I. Český masív. Praha.

*Mísař, Z. - Dudek, A. - Paděra, K.* (1985) Jihlava river valley at Mohelno - contact between peridotite and granulite. - Sec. Int. Eclogite Conf., Excursion guide, 17-22. Praha.

*Mísař, Z. - Jelínek, E.* (1979): Uzavřeniny peridotitů, pyroxenitů, eklogitů a opálu v leptinitech moldanubika na lokalitě Bory. - Věst. Ústř. Úst. geol., 56, 19-20. Praha.

*Mísař, Z. - Jelínek, E. - Jakeš, P.* (1984): Inclusions of peridotite, pyroxenite and eclogite in granulite rocks of Pre-Hercynian upper mantle and lower crust in the Eastern Bohemian Massif. - Ann. Sci. Univ., II, 74, 85-95. Clermont.

*Mísař, Z. - Jelínek, E. - Pačesová, M.* (1984): The Letovice dismembered metaophiolites in the framework of the Saxothuringian Zone of the Bohemian Massif. - Miner. slov. 16, 13-28. Košice.

*Mísař, Z. - Urban, M.* (1993): Moravo-Silesian Zone. Introduction. - in: R.D. Dallmeyer - W. Franke eds.: Tectonostratigraphic evolution of the Central European orogens. Springer-Verlag, Berlin (in print).

*Narebski, W.* (1992): Geochemical petrogenetic evidences of Lower and Upper Paleozoic rifting in the Polish Sudetes. - Proc. Int. Conf. Bohemian Massif, 203-204, Geol. Surv. Praha.

*Narebski, W. - Wojciechowska, I. - Dostál, J.* (1988): Initial rifting in Middle Paleozoic Klodsko metamorphic complex (Polish Middle Sudets) evidenced by geochemical data. - Bull. Pol. Acad. Sci., 36, 261-269.

*Neubauer, F.* (1991): Zur Kinematik des intramoldanubischen Deckenbaues und der Platznahme des Südböhmischen Batholits. - Arbeitstagung Geol. Bundesanst., 25-34. Wien.

*O'Brien, P.J.* (1989): A study of retrogression in eclogite of the Oberpfalz Forest, NE Bavaria and their significance in the tectonic evolution of the Bohemian Massif. - Geol. Soc. Amer., Spec. Publ., 43, 507-512.

*Petr, V. - Pěčová, J. - Praus, O.* (1985): Anomaly of geomagnetic variations in the Southeastern margin of the Bohemian Massif. - Stud. geophys. geod., 29, 169-190. Praha.

*Petr, V. - Pěčová, J. - Praus, O. - Pěč, K.* (1987): Anomalous induction zone near the eastern margin of the Bohemian Massif. - Phys. Earth Planet. Inter., 45, 161-175. Amsterdam.

*Peucat, J.J. - Bernard-Griffiths, J. - Ibarguchi, G. - Dallmeyer, R.D.* (1989): Geochronological and geochemical systematics of eclogite-granulite Variscan nappes in Galicia, NW Spain. - Terra Cognita, 1, Ab. 51, 18-19.

*Pin, C. - Majerowicz, A. - Wojciechowska, I.* (1988): Upper Paleozoic oceanic crust in the Polish Sudetes: Nd-Sr isotope and trace element evidence. - Lithos, 21, 195-209. Amsterdam.

*Poubová, E. - Sokol, A.* (1992): The petrology and geochemistry of the metaophiolitic rocks of the Staré Město crystalline unit. - Krystalinikum, 21, 67-88. Praha.

*Praus, O. - Pěčová, J. - Petr, V.* (1988): Anomální geomagnetické pole vnitřního původu při východním okraji Českého masívu. - Výzkum hlubinné geologické stavby Československa, Sborník Smolenice, 116-124. Geofyzika Brno.

*Schulmann, K. - Ledru, P. - Autran, A. - Melka, R. - Lardeaux, J.M. - Urban, M.* (1991): Evolution of nappes in the eastern margin of the Bohemian Massif: a kinematic interpretation. - Geol. Rdsch., 80, 73-92. Stuttgart.

*Stille, H.* (1951): Das mitteleuropäische variszische Grundgebirge im Bilde des gesamteuropäischen. - Geol. Jb., Beih. 2, 138. Hannover.

*Suess, F.E.* (1912): Die moravischen Fenster und ihre Beziehung zum Grundgebirge des Hohen Gesenkes. - Denkschr. Akad. Wiss., 88, 541-631. Wien.

*Suk, M.* ed. (1984): Geological history of the territory of the Czech Socialist Republic. - Ústř. úst. geol. Praha.

- (1986): Das Präkambrium der Böhmischen Masse und des Brunovistulicums in der Tschechoslovakei. - Fortschr. Mineral. Petrogr., 64, 227-234. Stuttgart.

*Tomek, Č.* (1988): Eastern boundary of European Variscides. Large scale oblique continental collision zone. - 28th. Int. Geol. Congress, Abstr., 3, 343. Washington.

- (1991): Deep seismic reflection line across the Svratka Window. - Geol. Workshop Moravský Krumlov, Moravian Windows 1991, 28.

*Urban, M. - Mísař, Z.* (1989): Fold and shear structure of the southern Moldanubicum (Czechoslovakia). - Krystalinikum, 20, 111-130., Praha.

*Urban, M., Mísař, Z.* (1993): Moravo-Silesian Zone - Summary. - In: R.D. Dallmeyer - W. Franke eds.: Tectonostratigraphic evolution of the Central European orogens. Springer-Verlag. Berlin.

*van Breemen, O. - Aftalion, M. - Bowes, R.D. - Dudek, A. - Mísař, Z. - Povondra, P. - Vrána, S.* (1982): Geochronological studies of the Bohemian Massif, Czechoslovakia, and their significance in the evolution of Central Europe. - Trans. Roy. Soc., Earth Sci., 73, 89-108. Edinburgh.

*van Breemen, O. - Bowes, R.D. - Aftalion, M. - Zelazniewicz, A.* (1988): Devonian tectonothermal activity in the Sowie Gory gneissic block, Sudetes, Southwestern Poland: Evidence from Rb/Sr and U-Pb isotopic studies. - Ann. Soc. Geol. Pol., 58, 3-19.

*Vrána, S.* (1989): Perpotassic granulites from southern Bohemia - a new rock type derived from partial melting of crustal rocks under upper mantle conditions. - Contr. Mineral. Petrogr., 103, 510-522. Berlin, New York.

*Wallbrecher, E. - Dallmeyer, R.D. - Brandmayr, M. - Handler, R. - Maderbacher, F. - Platzer, R.* (1991): Kinematik und Alter der Blattverschiebungszonen in der südlichen Böhmischen Masse. - Arbeitstagung Geol. Bundesanst., 35-48. Wien.

*Wojciechowska, I.* (1992): Metabasites in the Klodsko metamorphic unit (Sudetes, Poland). Proc. Int. Conf. Bohemian Massif, 347-350, Geol. Surv. Praha.

*Zoubek, V.* (1992): Position of the brunovistulicum in the geological structure of Europe. - Krystalinikum, 21, 101-128. Praha

## Některé kritické události v geologické historii východního okraje Českého masívu

V příspěvku je diskutováno vymezení jednotlivých oblastí v. okraje Českého masívu, problematika spojování plášťového a korového materiálu a postavení a význam ofiolitových komplexů . Nově vymezené hranice (okrajový zlom brunovistulika, j. okrajový zlom bohemika) a reinterpretované již dříve známé zlomy vymezují oblasti (terény) brunovistulika, moravosilesika, moldanubika, bohemika a lugika. Během tektonometamorfních pochodů v době mezi cca. 380 Ma a 330 Ma proběhlo spojení lamin svrchního pláště s eklogity a peridotity a spodní kůry s granulity a gföhlskými rulami. Ofiolitové komplexy stáří svrchního proterozoika - spodního paleozoika jsou omezeny na bohemikum a jeho ekvivalenty v lugické zóně variského orogénu. Brunovistulikum je chápáno jako segment kadomského stáří, zabudovaný do variského orogénu.