GEOLOGICKÝ ZBORNÍK — GEOLOGICA CARPATHICA, 32, 6, BRATISLAVA, DECEMBER 1981, Pp. 679—705

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THE AMPHIBOLITE FACIES METABASITES OF THE RAKOVEC GROUP OF GEMERICUM (THE WESTERN CARPATHIANS)

(Tabs. 4, Figs. 22)

A b s t r a c t: In the Rakovec Group of gemericum which is a part of the north gemeride tectonicaly exponed zone, the presence ot the amphibolite facies metabasites were locally found. Their origin in the regions of Vyšný Klatov, Slovinky, Kojšov, Mlynky and Dobšiná under conditions of amphibolite facies (low-grade amphibolite facies) results from the study of depositional conditions and texture of these rocks, from the composition of amphiboles studied by the aid of the microprobe (calcic amphiboles, „magnesio hornblendes" type, B. E. L e a k e, 1978) and from the composition of coexisting plagioclases optically studied by the aid of universal stage (An_{28-36}). From geochemical discrimination criteria applied on the studied metabasites results that their parent rocks were probably originated under conditions of the back-arc basin in the adjacent zone to the island arc.

Р е з ю м е: В раковецкой группе гемерика, которая является составной частью северогемеридной тектонически видной зоны, мы территориально обнаружили присутствие метабазитов амфиболитовой фации. Их возникновение в областях Вышны Клатов, Словинки, Койшов, Млынки и Добшина в условиях амфиболитовой (low-grade amphibolite facies) фации вытекает из изучения условий отложения и структур этих горных пород, из состава амфиболов изучаемых при помощи электронного микроанализатора (calcic amphiboles, тип „magnesio hornblendes", Б. Э. Л и к, 1978) и из строения сосуществующих плагиоклазов, изучаемых оптически при помощи универсального столика микроскопа (An_{28-36}). Из геохимических дискриминационных критериев примененных к изучаемым метабазитам вытекает, что их материнские породы возникли вероятно в условиях заднего дугообразного бассейна (back-arc basin) в зоне прилегающей к островной дуге.

Introduction

In the innermost tectonic unit of the Western Carpathians on the Czechoslovak territory — in gemericum — there are distinguished two basic sedimentary volcanic group : the Gelnica and Rakovec ones. Their mutual space position is understood differently. According to a part of authors (O. F u s á n — J. K a m e n i c k ý — M. K u t h a n, 1953 and many others after them) the mentioned Lower Palaeozoic groups are in supperposition (normal contact, somewhere tectonic), whereby the Gelnica Group occurs in the underlying bed of the Rakovec Group. Further authors (P. G r e c u l a — I. V a r g a, 1979) consider the present relation of these groups as tectonic, whereby both groups are understood as partial nappes (the low Rakovec and the upper Gelnica).

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The Gelnica and Rakovec groups are mutually different from each other by the type of sedimentation (scarcity of rhythmic sedimentation in the Rakovec Group) and by character of volcanic activity (volcanics of the tholeiite series with majority of the basic rock types in the Rakovec Group; in the Gelnica Group volcanics have a calc-alkaline character — acid rock types prevail). A stratigraphic range of the Rakovec Group (meanwhile without direct paleontological proofs) probably corresponds to the Middle Devonian till the Lower Carboniferous (?).

From the view-point of formational analysis the association of volcanic rocks of the Rakovec Group belongs to the spilite — (diabase) — keratophyre formation. For this group presence of ultrabasic bodies is characteristic, which where found in the last time in the Klatov region (I. D i a n i š k a — P. G r e c u l a, 1979) and Dobšiná (D. H o v o r k a — P. I v a n, 1980), whose pertaining to the Rakovec Group is probable regardless their tectonic position.

Fold-metamorphic processes overprinted on the rock complexes of the Rakovec Group in a complicated form. An opinion that tectonic processes during which the Rakovec Group was deformed and metamorphosed for the first-time and they were connected with the Pre-Upper Carboniferous Hercynian processes (the most probable Bretonian phase), is supported by following discoveries:

i) 2 systems of planar and linear elements are known in the rocks of the Rakovec Group. These systems are in the asymmetric relations to each other. The second (younger) system in the Rakovec Group is symmetric with the system of bed schistosity of rock complexes of the Upper Palaeozoic.

i) It is known that pebbles of metamorphites in the Upper Palaeozoic having their origin in the rocks of the Rakovec Group are characterized only by older planar tectonic element, the bed schistosity.

i) Radiometric dating of the origin of amphiboles from the Rakovec Group metabasites (B. C a m b e l et al., 1980; J. K a n t o r, 1980) confirm an occurrence of the Hercynian metamorphic recrystallization of these rocks.

The mentioned facts contradict with opinions of some authors (J. V a r g a, 1973; I. D i a n i š k a — P. G r e c u l a, 1979), who metamorphic recrystallization of the Rakovec Group rocks (that means also the origin of rocks studied by us) connect especially with the Alpine tectonic recrystallization processes.

The heterogeneity among opinions on genesis of amphibolites of the Rakovec Group of gemericum (magmatic oriented intrusives (?) or metamorphites) lead us to study this problematics whose significance is in the last stressed even by discovery of new bodies westward from Slovinky (the Poráčsky jarok — brook), eastward from Kojšov and in the bore-hole BM-1 near Mlynky (Fig. 1).

Since the problematics of the metabasite bodies in the Dobšiná region (J. K a m e n i c k ý, 1950; L. K a m e n i c k ý — M. M a r k o v á, 1957; L. R o z l o ž n í k, 1965) and the Klatov region (L. K a m e n i c k ý — M. M a r k o v á, 1957; I. D i a n i š k a — P. G r e c u l a, 1979) is sufficiently known, we do not analyse it further on.

New investigated occurrences of the amphibolite facies metabasites in the Poráčsky jarok — brook, westward from Slovinky, and occurrences eastward from Kojšov are concordantly deposited in metasediments, i. e. in fine-grained

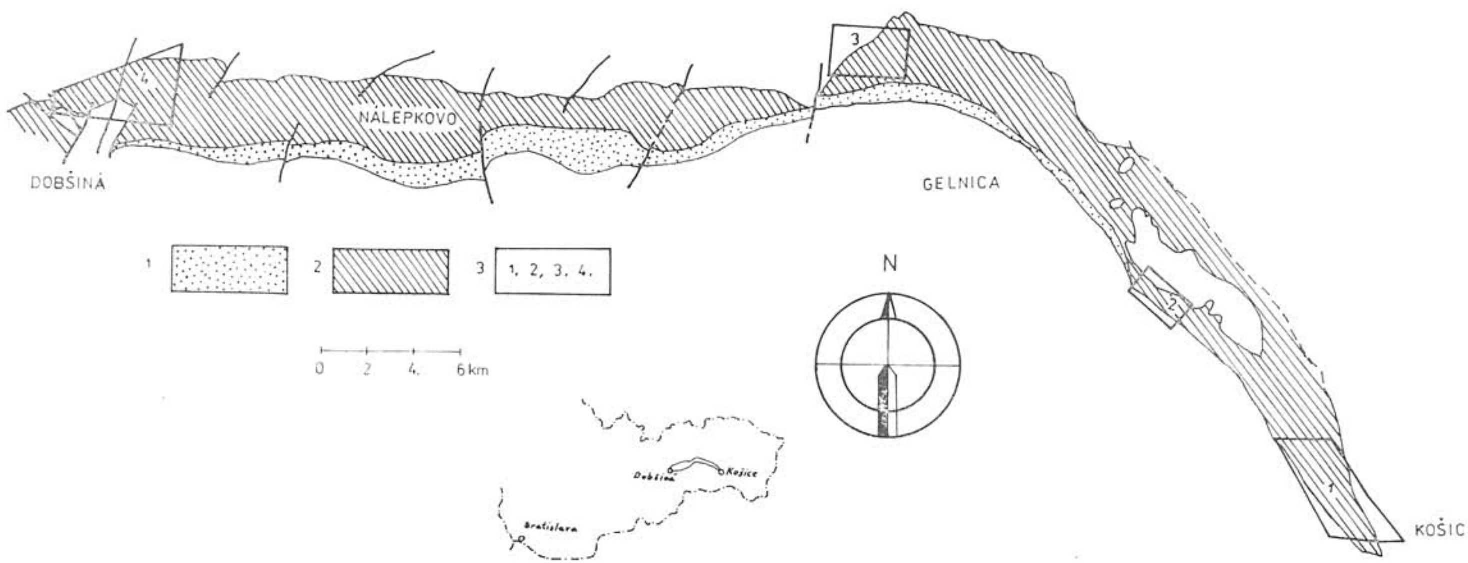

Fig. 1. Situational scheme of the studied amphibolites of the Rakovec Group. 1 — the Smrečinka formation, 2 — the Sykavka formation (1 — 2=the Rakovec Group), 3 — marked studied regions.

metaextrusives. Characteristic is their gradual transposition into the mentioned rocks or also into spilites. For studied metabasites of the mentioned localities heterogeneous structural order of basic mineral associations, amphiboles and plagioclases is characteristic. Within the studied complexes of metabasites we have obtained also facies with evidently planar parallel texture next to the facies with unevidently planar parallel texture. Metamorphic mineral associations of the studied metabasites are concordant with the original schistosity; they are mechanically deformed by a younger planar system of the Alpine age. In the underlying bed of the Carboniferous — the Rakovec Group with metamorphosed volcanoclastic rocks (the greenschist facies) and metavolcanics of basaltoid composition was found by the structural bore-hole BM-1 near Mlynky and in the low parts of the bore-hole metabasites of the amphibolite facies.

From the metamorphic view-point rock complexes of the Rakovec Group of gemericum have uneven character. Except for prevailing metamorphites of the greenschist facies (I. Varga, 1973; J. Kamenický, 1968 in M. Maheľ et al., 1968) in dependence on structural and material predisposition of a rock of given group have locally preserved relic primary structures and textures, on the other hand, they are somewhere metamorphosed till the amphibolite facies. This paper deals with the last mentioned problematics.

Geological position and characteristics of metabasites

The whole position of the studied bodies of metabasites within the Rakovec Group is sketched in Fig. 1. In the marked range the individual occurrences are characteristic even in the following text:

1. The Vyšný Klatov — Nižný Klatov region

Metabasites of this region are a part of the largest body of metamorphites of the amphibolite facies of the Rakovec Group, occurring between Košická Belá and Bukovec. Longitude of the body reaches 10 km. In its underlying and overlying rocks volcanoclastic positions of basic volcanics occur, locally with intercalations of metasediments of the Rakovec Group. In the discussed area the Rakovec Group is in tectonic contact with the Gelnica Group or with the Upper Palaeozoic (Fig. 2). The discussed body was in past considerably interpreted as intrusive body (magmatically directed gabbro (L. Kamenický — M. Marková, 1957). Newer, I. Dianiška — P. Grecula (1979) consider the body for a metamorphic equivalent of the Rakovec Group rocks, whereby the metamorphic recrystallization is a consequence of p-t conditions and also of presence of granitizating agence. Interpretation of the mentioned authors (l.c.) is similar to the interpretation of genesis of gneissic bodies and amphibolites in the Dobšiná region (L. Rozložník, 1965). But meanwhile L. Rozložník (l.c.) presupposes the Hercynian age for metamorphic recrystallization in the Dobšiná region, I. Dianiška — P. Grecula (l.c.) thought and justified the Alpine age of metamorphic recrystallization under the amphibolite facies conditions. Radiometric dating of amphibole metabasites from Vyšný Klatov (B. Cambel et al., 1979; J.

Kantor, 1980) testifies to their Hercynian age and therefore confirms applying of the Hercynian tectonometamorphic processes.

The individual facies of metabasites are cropping out the best in the quarry near Vyšný Klatov (elevation point 552,0), in abandoned quarries in the valley of the Myslavský potok — brook near Nižný Klatov and in the Nižný Klatov — Zlatá Idka road — cut. Next is mentioned a brief characteristic of metabasites among these key localities.

Vyšný Klatov — quarry

Metabasites in the hole — quarry working (situation in 1980) have macroscopically even microscopically heterogeneous character. Considerably it

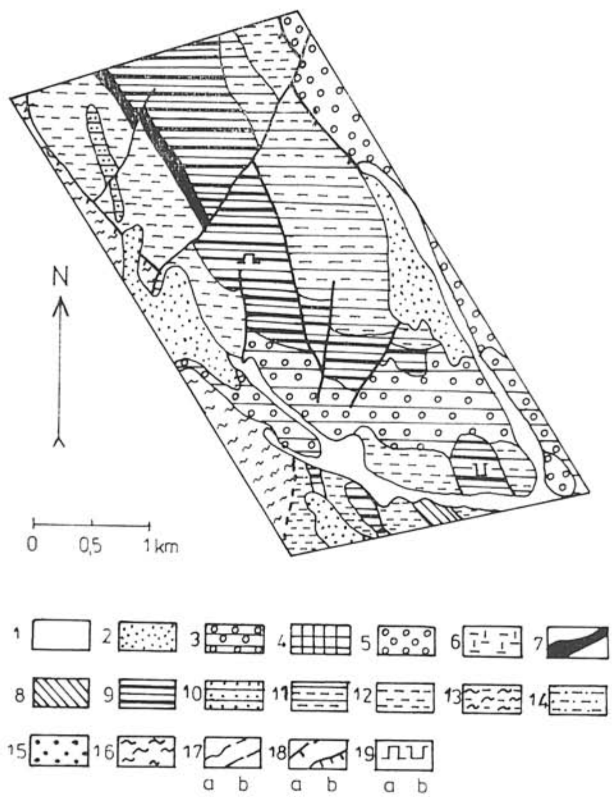

Fig. 2. Region of Vyšný Klatov. 1 — alluvium, 2 — slope washes and clays, 3 — Neogene, 4 — Mesosoic, 5 — the Krompachy Group, 6 — the Dobšiná Group, 7 — ultrabasites, 8 — metadiabases and spilites, 9 — amphibolites (locally with intercalations of paragneisses), 10 — volcanoclastics, 11 — metamorphosed tuffites with positions of metasediments, 12 — sericite-chloritic phyllites, 13 — quartz-sericitic phyllites, 14 — quartz phyllites and metasandstones, 15 — metasandstones; (7 — 15 = the Rakovec Group), 16 — the Gelnica Group, 17 — a) boundaries of rock types and stratigraphic units; b) faults, 18 — a) faults with known dip; b) reversal faults, 19 — quarries, a) working; b) abandoned.

is the question of evidently directed rock types of deep-green till green and grey colours. Grainity of rocks varies in the range O.X— 3 mm. On the basis of mineral composition following basic types can be distinguished:

a) Fine-grained (about 2 mm) schistose amphibolites — they are formed by deep-green columnar amphiboles with a brownlike shade (γ) and plagioclases (Fig. 3). These are in majority intensively secondary altered (epidotization, albitization), in several cases we were successful to determine An- contents of plagioclases — An_{32-36} on the universal stage. Ore minerals and sphenes are present in the accessory amount. Products of overlying hydrothermal alteration are chlorite, quartz, albite and carbonates. Except for pseudomorphing of plagioclases of the generation and amphiboles form also a filling of veinlets.

b) Fine-grained amphibolites by increasing their amphibole content alter into melaamphibolites. Their quantity mineral composition is equal to the preceding type. In the melaamphibolites there occurs also fine-grained aggregate of plagioclases of the IInd generation (albite) in a form of veinlets. On contact of albite or quartz-albite veinlets and matrix of melaamphiboles there is evident the origin of amphiboles of the IInd generation. It is long columnar amphibole of light-green colour (γ) which somewhere overgrows the deep-green amphibole I.

c) Fine-grained scaly rock with unevidently planar parallel structure. It is formed by green-brown biotite, chlorite, albite, ore minerals and carbonates. Scarcely a part of fine-grained albite is evidently increasing. In accessory amount quartz and apatite are present. The rock by its mineral association, grainity and texture corresponds to phyllite.

The mentioned results in following generalizations of the problematics:

a) in the given quarry there occur next to themselves rocks of various facial pertaining : amphibolites (the amphibolite facies) and phyllites (the greenschist facies). The mentioned observations are valid even for further studied localities (bodies) — discussion about this problematics is described further on.

b) For all rocks types mentioned at a-c action of hydrothermal processes is characteristic, documented mainly by the origination of veinlets with a filling of epidote, carbonates along with sulphides, albites and other. On the contact of thicker veinlets and matrix rock evidences of recrystallization can be seen, especially amphiboles during origination of the amphiboles of the IInd generation. These rim the amphibole I or they form long-columnar new formations in the albite-amphibole aggregate.

N i ž n ý K l a t o v — the quarry in the M y s l a v s k ý p o t o k — brook valley

Metabasites in the abandoned quarry occur in two basic varieties:

a) fine-grained schistose amphibolites with the equal amounts of amphiboles and plagioclases. Amphibole is deep-green (γ) without any significant secondary alterations. It is evidently parallelly orientated. For a part of columns microscopically grained ore pigment is characteristic, occurring in central parts of columns. Plagioclases rocks are usually intensively altered (seritization, argilization). Sporadically there are present also thin columns of the light-green amphibole II. In this type the usual accessory and secondary minerals are present.

b) By increasing of amphibole contents fine-grained amphibolites are gradually altered in melaamphibolites. In some thin section evidences of banded structure can be observed, which is conditioned by concentration of light (in majority totally altered plagioclases) and dark (amphiboles) into planparallel bands.

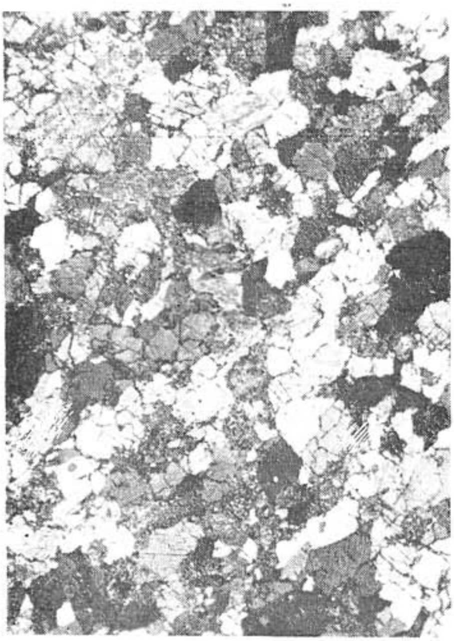

Fig. 3. Granonematoblastic structure of fine-grained amphibolite (amphibole — plagioclase) — Vyšný Klatov. Magn. 30 x, X pol.

Fig. 4. Porphyroblastic structure of albite-actinolite schist (albite — light green amphibole) — the Nižný Klatov — Zlatá Idka roadcut. Magn. 48 x, X pol.

Similarly as on preceding locality also in the quarry near Nižný Klatov hydrothermal alterations (epidotization, carbonitization, argilitization, chloritization) intensively occurred on metabasites. For the differentiated types (a,b) at the same time processes of intensive albitization (plagioclase II) are characteristic. Albite (An_{4-8}) forms aggregates of fine grains or filling of the parallel positions and transversal veinlets.

The Nižný Klatov — Zlatá Idka road-cut

Rocks in the studied profile have appearance of actinolite-albite rocks of massive till unevidently directed texture. They are light-green, fine-grained, somewhere significantly porphyroblastic with blasts of clear tabular albites in the amphibole matrix.

a) Actinolite-albite schists have evidently porphyroblastic structure (albite). Plagioclase (An_{4-8}; Fig. 4) forms clear tables and irregular grains which are often albitically twinned. Scarcely inclusions of acicular (fibrous) amphiboles can be seen in porphyroblasts. Except for prevailing albite (60—80 vol.%) and actinolitic amphibole also sphene, quartz, ore minerals, chlorite, the epidote group minerals and products of their alterations are present in this rock type.

b) Anchimonomineral, fine-grained, equable and significantly heterogeneous grain albite rocks of massive, scarcely unevidently directed (banded) structure. Albite occurs in the form of fine-grained aggregate, or in several positions — in the form of tabular (to 2 mm) grains. It is clear in majority without alterations, simple and even winned. An content is low : An_{4-8}. In the amount of subsidiary mineral the actinolitic amphibole, longcolumnar, somewhere nearly fibroas, is present. Within these aggregates the individual crystals have planparallel orientation. In the characterized rocks there are present zones of intensively younger hydrothermal epidotization and chloritization.

On the basis of mineral compositions and textures of the rocks of this type they represent the metamorphosed equivalents of volcanics of keratophyre type, or their volcanoclastics of fine-fragmental type.

Concluding the problematics of metabasites in the studied road-cut can be mentioned that:

i) rocks by their mineral association belong to the greenschist facies (albite + actinolitic amphibole). Their mutual relation significantly varies.

ii) anchimonomineral rock types formed by albite of different habit and size, probably represent metamorphosed equivalent of volcanics of keratophyre type or their volcanoclastics of fine-grained type.

Kojšov (loc. 2)

New obtained metabasites of the amphibolite facies occur about 2 km SE from Kojšov on the southern slope of the Murovaná skala — hill. With surrounding metasediments they are deposited concordantly (Fig 5). In the underlying bed of amphibolites and also in the form of intercalations in the amphibolite body there are present fine-grained metatuffs with pronounced planar parallel texture. Transition of these rocks into amphibolites is gradual within 5 m. For transitional facies relicly preserved bed texture of tuffs is characteristic at only consequent local direction of metamorphic columns of amphiboles. These facies can be seen also in the amphibolite body. In the overlying bed of amphibolite body in concordant position there occur sericite-chloritic phyllites with positions of metamorphosed tuffites of basic volcanics (the greenschist facies) of total thickness about 40 m. In their overlying bed in a tectonic position there is the Mesozoic of the Murovaná skala — hill.

Metabasites of the given locality pertain to following basic types:

a) Fine-grained schistose till unevidently schistose amphibolites are considerably intensively tectonicaly and hydrothermally influenced. Plagioclases of the Ist generation are intensively saussuritized. In scarce, partially preserved grains An — contents (the universal stage) correspond to An_{28-38}. Changes are determined by the presence of parallel positions with the plagioclase II (An_{-8}) filling groups of carbonates and positions of the epidote group minerals. Veinlets often oriented transversally to foliation of the rocks are filled with fine-grained aggregate of albite and quartz. For amphibolites a presence of 2 amphibole generations is characteristic : amphibole I is deep-green till green-brown (γ); amphibole II is light-green, it forms individual, evidently elongated columns or it rims amphibole of the Ist generation.

b) The second basic rock type of the discussed locality are chlorite — albite schists (with majority of albite over chlorite) of unhomogeneous structure. In rocks of this type there are somewhere present clasts of quartz or plagioclases of the size till 4 mm. Rocks of this type represent metamorphosed fine-grained extrusive rocks of basic volcanics.

c) In chlorite — albite schists long-columnar light-green actinolite amphibole occurs scarcely. The rock has character of the actinolite — chlorite — albite schist. Characteristic is locally banded structure.

S l o v i n k y (loc. 3)

On the west boundary of Slovinky, on the north slope of the Poráčsky jarok — brook the amphibolite body was found in the last time of a thickness about 60 m. The amphibolites themselves and also metasediments around are declined in angle 60° westward. In their immediate overlying bed there are

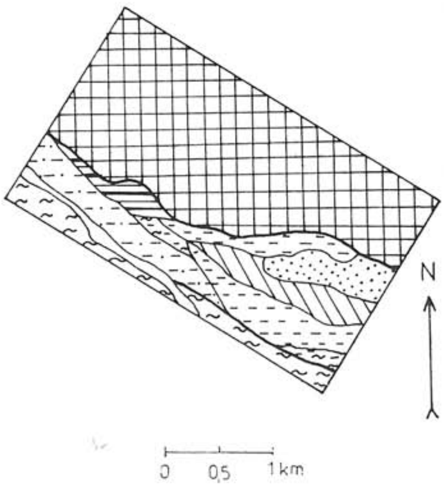

Fig. 5. Region east of Kojšov. Explanations as at Fig. 2.

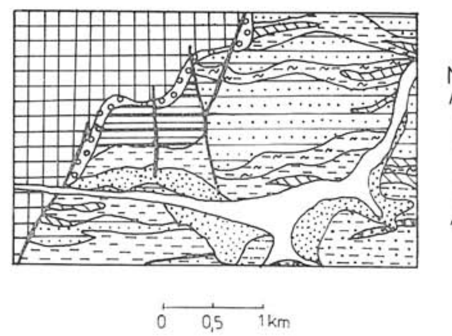

Fig. 6. Region of Slovinky. Explanations as at Fig. 2.

the Permian conglomerates. It is necessary to stress that although scarcely, pebbles of amphibolites are present in these conglomerates. Geological situation in the simplified form is shown in figs. 6 and 8 b. Underlying and overlying beds of the amphibolite body are represented by sericite — chlorite phyllites. In the amphibolite body itself there is possible to differentiate several basic rock types which change among them mutually. Near by thicknesses of the individual types vary within 3—15 m. A prevalent type of metabasites are fine-grained, often banded amphibolites with parallel texture. These are altered to the fine-grained till macroscopically aphanatic varieties (the last ones near to metadiabase type). The amphibolite body itself is divided by position of metasediments into two parts.

By microscopic study we have differentiated two basic types:

a) Fine-grained schistose amphibolites altering into unevidently directed types having grainity 1—2 mm. The basic mineral phases are amphibole and plagioclase. Both are present in two generations, of these minerals is present only in the accessory amount. Amphibole I is represented by deep-green (γ) short-columnar amphibole. It overgrows by light-green amphibole of the IInd generation which somewhere forms even aggregates of thin columns (especially in the medium of plagioclases II. Plagioclases I are intensively secondary altered. In the scarce preserved grains the An-contents An_{34-37} was obtained by the aid of universal stage. Plagioclases II rim plagioclases I or they occur in a form of fine clear tables — often in form of aggregates and as a filling of veinlets. Their An-contents is equal to 8 %. Rocks of this type are often intensively hydrothermally altered (chloritization and carbonatization, locally epidotization — especially on veinlets).

b) Melaamphibolites represent a next basic type of metabasites of the given locality. Similarly as for the type ad a) also for melaamphibolites banded structure is locally characteristic.

c) A different type is represented by fine-grained, significantly schistose light-green rocks with evident foliation. They are formed by albite, chlorite and light-green amphibole, whereby ratio of the mentioned minerals varies. Locally in the rock green-brown biotite was observed. The rock has character of the amphibole — chlorite — albite schist which by its mineral association pertain to the greenschist facies.

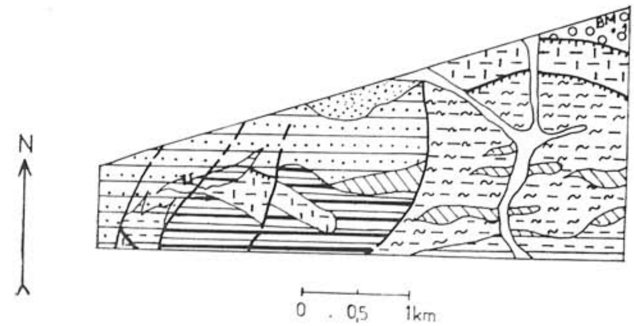

Fig. 7. Region of Mlynky. Explanations as at Fig. 2.

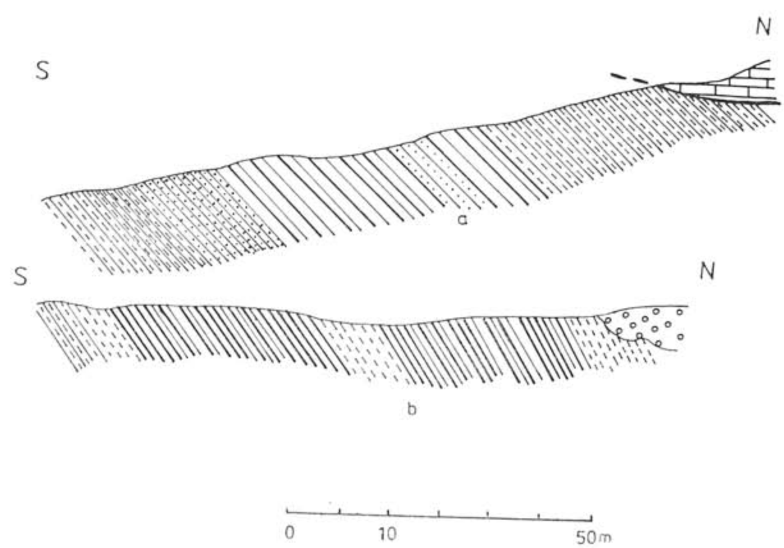

Fig. 8. Schematic profiles: a) region east of Kojšov, b) region of Slovinky. Explanations as at Fig. 2.

As results from deposition ratios of metabasites on localities 1—3, from connection pertaining of amphibolites and surrounding rocks and also from the presence of metasediments or metamorphosed volcanoclastics in the

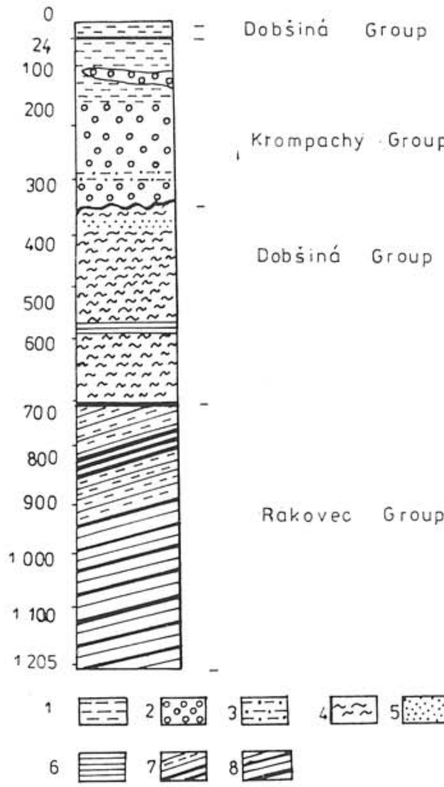

Fig. 9. Schematic profile of the bore-hole BM-1 (Mlynky): 1 — schists, grey wackes, 2 — conglomerates, 3 — sandstones with schists (1—3 = the Krompachy Group), 4 — graphitic, quartz-graphitic schists, 5 — sandstones, 6 — sericite-chloritic schists (4—6 = the Dobšiná Group), 7 — metamorphosed basic volcanoclastics with positions of metadiabases, 8 — amphibolites (7—8 = the Rakovec Group).

bodies themselves, the opinion that these are original rocks of the Rakovec Group, locally Hercynian metamorphosed till the amphibolite facies, seems to be the most probable.

M l y n k y (loc. 4)

Structural bore-hole BM-1 (Mlynky), locallized NE from Mlynky (Fig. 7) after penetrating the Upper Palaeozoic from the depth 711 m to the final depths (1205 m) penetrated by metabasites and metasediments of the Rakovec Group. Contact of the Upper Palaeozoic with the rocks of the Rakovec Group is in the given profile of bore-hole tectonic. Interval 711 — 900 m is represented by metamorphosed fine-grained volcanoclastics of basic volcanics, naked-eye aphanatic and locally even by fine-grained metadiabases (metabasalts) and intercalations of the chlorite — sericite phyllites.

Amphibolites are represented considerably by grained (2—3 mm) schistose, often also banded types. They pass to fine-grained (about 1 mm) types. Locally the presence of tectonicaly stressed zones can be observed, which are accompanied by mechanic destruction of rocks (Fig. 10) with their hydrothermal alteration.

a) Schistose, fine-grained amphibolites (2—4 mm) of the deep-green colour which are locally changed in banded types (Fig. 11) on one side, and on the other side, into melaamphibolites. Thickness of strips varies within 3—50 mm. The prevailing mineral of amphibolites is amphibole; it is present in two generations. The dominant, Ist generation of the amphibole is represented by deep-green to green-brown amphibole γ/c = about 17 %. The second generation represented by amphibole of light-green colour (γ) usually overgrows the amphibole I, or it follows the individual columns. Similarly plagioclases are represented. Plagioclases of the Ist generation (0.7 — 1.3 mm) are usually intensively saussuritized. In locally preserved grains have been determined ($An_{27\,33}$) by the aid of universal stage. Plagioclases of the IInd generation are represented by albite. They form a part of mineral filling of veinlets (albite, quartz, carbonate, chlorite) a part of groups, oriented considerably conformly with the general schistosity of the rocks, or they are present in the form of isolated grains.

b) Fine-grained varietes do not differ by their mineral structure from the types mentioned ad a) Glomeroblastic mineral aggregates are macroscopically evident.

The mentioned basic varieties of amphiboles, found in the bore-hole BM-1 are in the profile locally represented by intercalations of fine-grained, somewhere macroscopically aphanatic rocks which have unsignificantly and even clearly directed textures. On the basis of their mineral composition they can be marked as the chlorite — actinolite — albite schists.

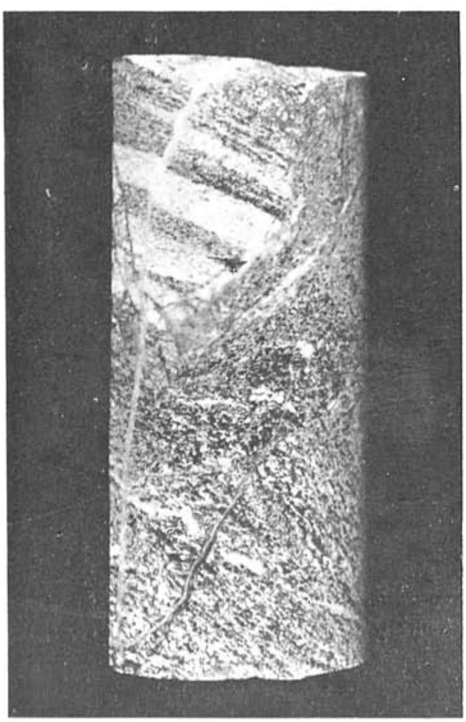

Fig. 10. Tectonic breccia formed by various types of amphibolites (fine-grained schistose, banded and other). Diameter of drill-core = 55 mm.

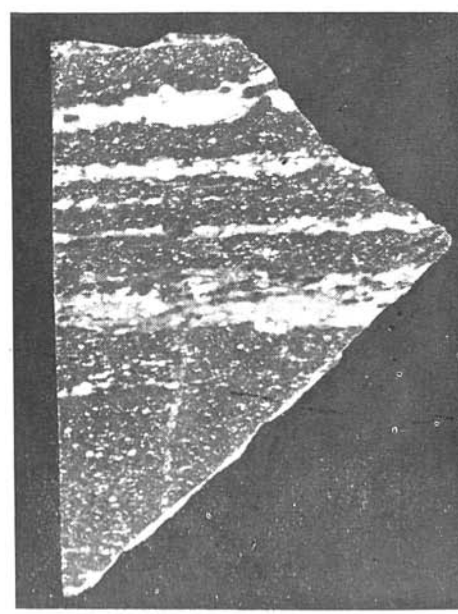

Fig. 11. Banded type of amphibolite. Light strips = albite + quartz. Dobšiná — Gúgl. A half of natural size.

From provided microscopical studies of rock samples from the given bore--hole results:

i) in metabasites can be differed two mineral generations. Amphibole I and plagioclase I, sphene and some ore minerals pertain to the first generation. To the second one, especially amphibole II and plagioclase II pertain.

i) Metabasites are intensively secondary altered. The product of secondary processes is various association of minerals. Locally alterations have character of mechanic destruction accompanied by hydrothermal alteration.

Chemical composition of amphiboles

For determining of conditions of the studied metabasite origin we have provided also a study of amphibole compositions. We concentrated to amphiboles of grained schistose rock types of the „amphibolite" appearance, green

Table 1

Analyses of amphiboles

		1	2	3	4	5	6
	TiO_2	1.31	1.34	1.41	1.05	1.23	1.58
	MnO	0.26	0.27	0.31	0.21	0.24	0.26
	SiO_2	45.74	44.47	44.61	47.05	45.82	45.46
	FeO	16.65	16.17	17.37	13.55	15.62	17.96
	K_2O	0.17	0.71	0.22	0.22	0.24	0.48
	Na_2O	1.29	1.66	1.33	1.70	1.36	1.44
	MgO	11.71	11.70	10.82	12.88	11.19	10.29
	CaO	10.06	10.33	10.74	10.81	10.87	10.15
	Al_2O_3	10.86	11.20	8.89	10.92	9.56	9.86
	$\Sigma =$	98.05	97.31	95.50	98,39	96.13	97.48
	Si	6.73	6.61	6.86	6.81	6.87	6.80
	Al^{IV}	1.27	1.39	1.14	1.19	1.13	1.20
	Al^{VI}	0.61	0.53	0.31	0.66	0.56	0.53
	Ti	0.14	0.15	0.16	0.11	0.14	0.18
	Mg	2.57	2.59	2.48	2.74	2.50	2.29
	Fe^{2+}	1.68	1.73	2.03	1.45	1.80	2.02
	Fe^{3+}	0.37	0.29	0.20	0.23	0.16	0.24
	Mn	0.03	0.03	0.03	0.03	0.03	0.03
B	Ca	1.59	1.64	1.77	1.66	1.74	1.62
B	Na	0.01	0.04	0.02	0.12	0.07	0.09
A	Na	0.36	0.35	0.39	0.36	0.33	0.32
A	K	0.03	0.03	0.04	0.03	0.05	0.09
	$\frac{Mg}{Mg + Fe^{2+}}$	0.605	0.599	0.548	0.655	0.581	0.531
		(n = 1)	(n = 5)	(n = 4)	(n = 7)	(n = 4)	(n = 3)

Explanations: 1 — Vyšný Klatov, quarry (P—38); 2 — Vyšný Klatov, quarry in the valley of the Myslavský Potok — brock (P—41); 3 — Kojšov (P—42); 4 — Slovinky (P—45); 5 — Slovinky (S—137); 6 — Mlynky (BM—1/1150) or brown-green (γ') pleochroic colour. Analyses were carried out by the aid of microprobe ARL SEMQ at the Central Geological Survey in Prague. The average values of composition of different number (n) of the analysed amphibole grains of 1 type from one thin section (of the rock type) are shown in Table 1.

Although the fact that in present era there do not exist any uniform criteria for differentiation especially of calcic amphiboles of erruptives and metamorphites of the amphibolite facies, neverthless the known chemical com-

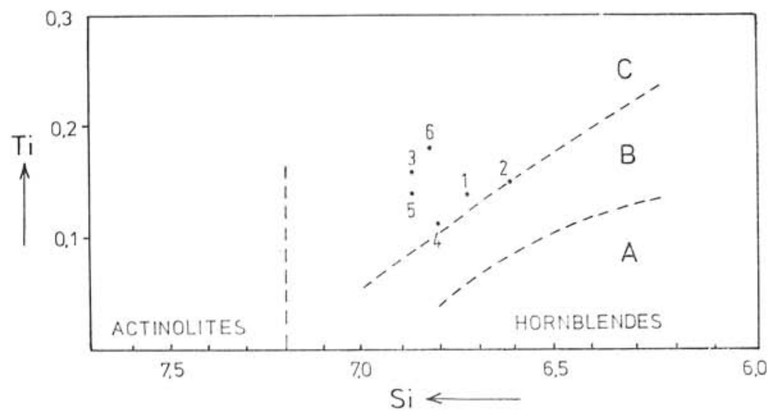

Fig. 12. Ti : Si diagram of amphiboles (Z. Vejnar, 1977). A — light green amphibole, B — deep-green amphibole, C — green and brown till brown amphibole (always γ).

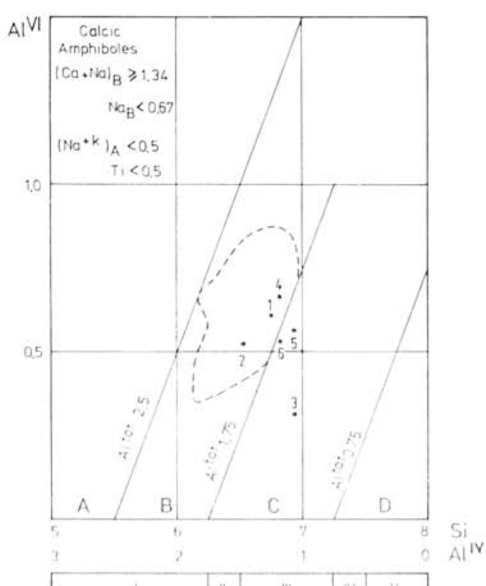

Fig. 13. Classification diagram of calcic amphiboles (E. Wenk et al., 1974). *Explanations:* A — tschermakitic hornblende, B — Mg — Fe hornblende, C — actinolitic hornblende, D — actinolite, tremolite; I — tschermakite, II — tschermakitic hornblende, III — Mg — Fe hornblende, IV — actinolitic hornblende, V — tremolite, actinolite. In the dashed limited field there occur plotted points of amphiboles of the amphibolites from the Lepontine Alps (E. Wenke et al., 1974). Position of the plotted points of amphiboles of metabasites studies is in accordance with their projection in diagram by B. E. Leake (1978 — Fig. 14).

position of amphiboles in combination with the known depositional conditions and metabasite textures allow us to decipher conditions of their origin.

In Fig. 12 (A. M i y a s h i r o, 1973) with the co-ordinates Si and Ti there are limited fields for calcic amphiboles of different pleochroic shade. With it a change of pleochroic colours of amphiboles already in the part was used for facial differentiation of amphiboles of metamorphites in certain metamorphic facies (viz. A. M i y a s h i r o, 1973). In the whole a change of pleochroism of amphiboles of metabasites from the light-green (blue-green)

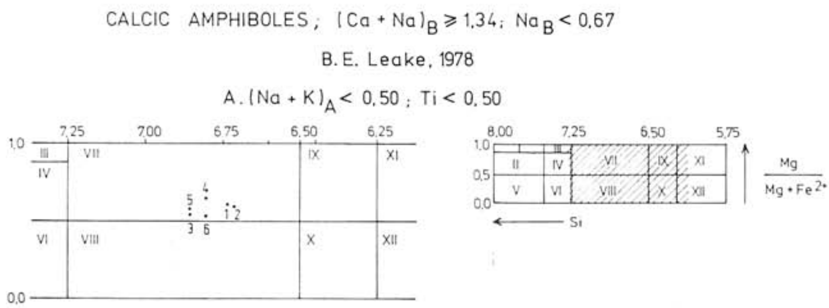

Fig. 14. Classification diagram of calcic amphiboles according to B. E. L e a k e (1978). *Explanations:* VII — Mg-hornblende, VIII — Fe-hornblende. Analyzed amphiboles have the ratio $Mg/Mg+Fe^{2+}$ = 0.5—0.65; ratio $(Na + K)_A$ <0.5 determines their ranging to the field VII (Mg — hornblende of partial diagram A of the mentioned classification scheme of calcic amphiboles).

across green till brown (γ) can be observed. Differentiated fields A, B, C (Fig. 8) correspond to this graduality of changes of γ-pleochroism of the amphiboles. All the plotted points of analysed amphiboles occur in the field C or in the field of green-brown till brown amphiboles. This their position is in accordance with the observed deep-green (locally with brown shade) colour of (γ) amphiboles of the studied metabasites of the Rakovec Group of gemericum.

In the diagram with co-ordinates Al^{VI}: Al^{IV} and Si (Fig. 13) plotted points of amphibole analyses occur in fields „Mg—Fe hornblende" and „actinolitic hornblende". Except for analysis No. 3 which has a low part of Al^{VI}, the rest analysed amphiboles are significant mainly by rather stable value of Al^{VI} which varies within 0.50—0.68. The analysed amphiboles by their plotted projections in a given diagram occur inside the field of amphiboles of the Lepontion Alps (E. W e n k et al., 1974) or in its close position (analyses Nos. 5, 6, 7). Only analysis No. 3 has external position however, whereby it always occurs in the „actinolitic hornblende" field.

In present time the most used classification of amphiboles is by B. E. L e a k e (1978). On the basis of criteria, shown by this author (l.c.) the analysed amphiboles (Fig. 14) pertain to „calcic amphiboles" group. Projections of the analysed amphiboles have a small dispersion in the field VII of the mentioned classification — it is „magnesio — hornblendes" cf. This their position in the mentioned classification scheme uniformly confirm their origination under the higher p—t conditions as they are conditions of the greenschist facies at which there in metabasites are originated amphiboles of the „actinolite", „tremolite", occasionally even „tremolite/actinolitic hornblende" or „ferroactinolitic hornblende" types, i.e. calcic amphiboles with higher part of Si as 7.25 or 7.50. It is interesting that majority of the analysed amphiboles of metabasites occurring in the Carboniferous of the Rudňany region (D. Hovorka — J. Spišiak in print) has similar chemical composition and from this resulting projections in the discussed classification diagram.

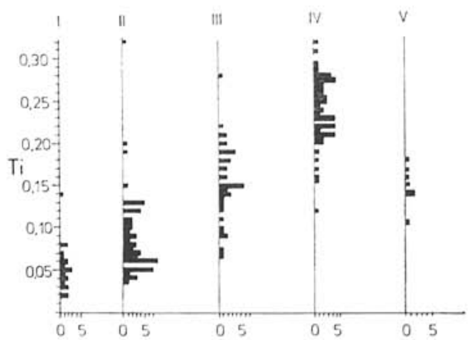

Fig. 15. Histograms of distribution of Ti in amphiboles of different facial metabasites (P. Raase, 1974). I — amphiboles of metabasites of greenschists facies; II — amphiboles of metabasites of the low thermal subfacies of amphibolite facies, III — amphiboles of metabasites high — thermal subfacies of amphibolite facies, IV — amphiboles of metabasites of the amphibole-granulite facies, V — amphiboles of metabasites of the Rakovec Group of gemericum (n — number of analyses).

The empiric reality that with increasing temperature of origination, calcic amphiboles have substantially increasing Ti content (which along with the farther cations influences the pleochroic shades of amphiboles) was confirmed by P. Raase (1974), who in diagram (Fig. 15) drew contents of Ti in metabasites of various facial pertaining. Ti contents in the studied amphiboles of metabasites (colum V) are concordant with contents of this element in metabasites of the amphibolite facies (column III) according to the mentioned author.

Discussion

In a consequence with solving problematics of metabasites of the amphibolite facies in the Palaeozoic of gemericum (the Rakovec Group) especially following problems became important:

a) character of original rocks of the studied metabasites,
b) facial pertaining of metabasites,
c) geotectonic conditions of their origin.

Character of the original rocks of metabasites:

14 new analyses of metabasites from the studied regions are shown in Table 2. In consequence of the younger alterations (albitization) composition of samples P-40 a and BM-1/959 (partially in some cases also P-40 b) do not correspond to the composition of matrix rocks anymore, therefore we do not mention them any further. Although the fact that we presuppose a regional

Table 2

Chemical composition of metabasites

	P 39a	P 40b	P 41a	P 41c	P 41d	P 42c	P 44a	P 45a	BM_1 1050	BM_1 1110	BM_1 1150	BM_1 1153
SiO_2	47.78	49.92	45.73	46.15	47.63	50.33	44.00	46.64	48.09	46.61	47.70	47.19
TiO_2	1.26	1.74	1.31	1.35	0.92	0.99	1.05	0.28	1.18	0.80	1.58	1.46
Al_2O_3	12.35	16.56	12.87	13.95	12.46	13.92	13.76	14.53	12.38	12.84	14.28	13.21
Fe_2O_3	4.13	3.71	3.88	5.52	4.30	3.68	4.67	3.23	2.84	3.30	2.61	2.74
FeO	10.29	8.55	9.74	7.01	9.63	8.05	8.77	9.70	9.79	7.76	12.00	12.07
MnO	0.21	0.13	0.19	0.10	0.21	0.18	0.16	0.17	0.21	0.16	0.24	0.21
MgO	8.48	5.87	8.86	9.16	8.96	7.37	10.08	10.35	9.05	9.00	6.47	7.22
CaO	8.38	2.91	10.11	3.60	9.14	7.34	5.95	6.55	8.39	10.85	8.03	7.25
Na_2O	2.74	5.80	2.66	2.56	2.74	4.02	2.82	2.74	2.98	2.82	3.36	3.30
K_2O	0.50	0.18	0.36	2.50	0.36	0.18	0.42	1.18	0.20	0.20	0.40	0.56
P_2O_5	0.21	0.15	0.15	0.13	0.10	0.07	0.09	0.07	0.28	0.10	0.16	0.29
H_2O (110°)	0.90	0.10	0.08	0.47	0.01	0.19	0.41	0.39	0.95	0.45	0.20	0.62
H_2O (900°)	2.18	3.45	1.85	7.00	1.96	2.87	7.21	2.82	3.02	4.27	1.60	3.05
$\Sigma =$	99.41	99.07	97.79	99.50	98.42	99.19	99.39	99.19	99.36	99.16	98.63	99.17

Explanations: P-39 a — fine-grained schistose amphibolite, quarry in the valley of the Myslavský Potok — brook near Vyšný Klatov; P-40 b — fine-grained schistose amphibolite, quarry in the valley of the Myslavský Potok — brook near Vyšný Klatov; P-41 — fine-grained schistose amphibolite, Vyšný Klatov, quarry; P-41 c — fine-grained schistose amphibolite, Vyšný Klatov, quarry; P-41 d — fine-grained schistose amphibolite, Vyšný Klatov, quarry; P-42 — fine-grained schistose amphibolite, Kojšov; P-44 a — fine-grained schistose amphibolite, the Poráčsky Jarok — brook near Slovinky; BM_1/1050 — fine-grained schistose amphibolite, Mlynky bore-hole BM—1; BM—1/1110 — fine-grained schistose amphibolite, Mlynky; BM—1/1150 — fine-grained schistose amphibolite, Mlynky; BM—1/1153 — fine-grained schistose amphibolite, Mlynky;

Table 3

Trace elements in metabasites

	Ni	Co	Cr	Ba	Sc	Sr	Ti	V	Y	Zr
P—39 a	78	48	191	85	46	93	7500	470	34	104
P—39 b	53	38	68	28	44	170	7600	470	29	56
P—39 c	59	44	120	49	59	214	8700	410	26	63
P—40 a	8	29	5	107	24	101	7400	269	4	135
P—40 b	7	21	6	53	24	162	10400	263	44	135
P—40 c	10	30	4	36	30	295>	10000	288	40	145
P—41 a	71	49	48	35	46	165	7800	410	28	84
P—41 b	132	56	263	50	32	71	6800	282	12	55
P—41 c	101	45	135	60	35	40	8100	316	18	75
P—41 d	79	46	102	32	48	87	5500	355	34	56
P—42 a	76	40	135	20	44	165>	10000	356	36	63
P—42 b	65	36	112	11	66	10>	10000	257	28	110
P—42 c	66	38	89	32	24	91	6800	355	37	68
P—43 a	101	46	229	46	47	37	6800	282	31	51
P—43 b	98	46	224	50	45	68	6500	302	32	40
P—44 a	83	69	204	69	45	55	6300	320	28	71
P—45 a	110	46	224	123	48	51	4900	350	25	46
P—45 b	112	49	229	63	35	49	5400	288	24	47
P—46 a	102	51	186	54	35	50	6600	302	22	56
BM—1/ 959	72	36	132	288	13	69	6000	204	30	151
BM—1/ 1050	79	48	138	126	44	390	7100	288	32	132
BM—1/ 1110	112	50	390	36	50	104	4500	245	19	48
BM—1/ 1150	49	48	22	123	35	81	4800	810	15	79
BM—1/ 1153	49	45	79	126	30	85	8700	400	34	138

Localization of samples see table 2

applying of albitization processes in rock complexes of the Rakovec Group (and from this resulting higher content of the alkalies mainly Na) yet the analysed rocks are the closest to rocks of the tholeiite type. This type of volcanics of the Rakovec Group was stated by Š. Bajaník (1981).

CIPW norm of the analysed metabasites is shown in Table 4. From the calculated norm results that the original rocks of metabasites (if we presuppose higher mentioned applying only of regional albitization) belong to series of saturated basalts, whose projections fall in the ol : Di : Hy field of classification diagram (Fig. 16).

Within interest of application of some among discrimination criteria for geotectonic ranging of the studied metabasites in Table 4 there are shown contents of some elements in the trace concentrations. In accordance with simultaneously accepted images about pertaining of the volcanics of tholeiite series to several geotectonic types of volcanic activity, further on we tried to apply the used discrimination criteria for ranging of the studied metabasites to some of the basic geotectonic types of volcanics.

Table 4

Normative composition of metabasites

	P 39 a	P 40 b	P 41 a	P 41 c	P 41 d	P 42 c	P 44 a	P 45 a	BM-1 1050	BM-1 1110	BM-1 1150	BM-1 1153
Q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C	0.00	1.90	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OR	2.95	1.06	2.13	14.77	2.13	1.06	2.48	6.97	1.18	1.18	2.36	3.31
AB	23.17	49.05	22.50	21.65	23.17	34.00	23.85	23.17	25.20	23.85	28.42	27.91
AN	19.93	13.45	22.12	17.01	20.64	19.41	23.65	23.87	19.82	21.79	22.71	22.71
DI	16.54	0.00	22.00	0.00	19.55	13.44	4.25	7.03	16.27	25.35	13.35	11.98
HY	19.54	11.34	7.53	21.55	14.55	17.10	14.83	7.93	18.55	2.37	10.63	12.44
OL	5.23	9.68	12.12	5.38	8.09	3.73	13.73	20.70	7.36	12.86	12.22	12.86
MT	5.99	5.38	5.63	8.01	6.24	5.34	6.77	4.69	4.12	4.79	3.79	3.97
IL	2.39	3.31	2.49	2.57	1.75	1.83	2.00	1.56	2.24	1.52	3.00	2.77
AP	0.49	0.35	0.35	0.30	0.23	0.16	0.21	0.16	0.65	0.23	0.37	0.67
CPX EN	4.89	0.00	6.76	0.00	6.01	4.17	1.43	2.21	4.89	8.35	3.16	2.98
CPX FS	3.19	0.00	3.94	0.00	3.50	2.37	0.62	1.21	3.05	3.91	3.47	2.96
CPX WO	8.46	0.00	11.29	0.00	10.04	6.90	2.20	3.62	8.34	13.10	6.71	6.05
OPX EN	11.89	6.73	4.76	16.91	9.26	10.91	10.37	5.13	11.42	1.95	5.06	6.24
OPX FS	7.76	4.60	2.77	4.64	5.39	6.20	4.46	2.81	7.13	0.91	5.56	6.20
OL FO	3.04	5.52	7.38	4.13	4.93	2.30	9.32	12.92	4.36	8.48	5.52	6.14
OL FA	2.19	4.16	4.74	1.25	3.16	1.44	4.42	7.79	3.00	4.38	6.69	6.72

In the diagram Ti/100 : Zr : 3.Y (J. A. Pearce — J. R. Cann, 1973) plotted points of the analysed rocks (in this and next diagrams there are used only plotted points of samples, from which complete analysis for petrogenic and selected trace elements — Tabls. 2, 3 are for disposition) occur considerably in the field of ocean domain basalts; scarce analyses even in the field of island arc rocks. The two among analyses seem to be beside the determined

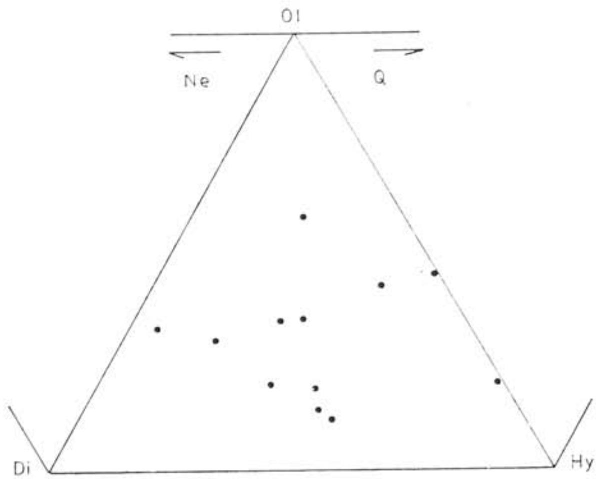

Fig. 16. Position of the plotted points of the analysed metabasites in diagram with apexes 01:Di:Hy (normat.).

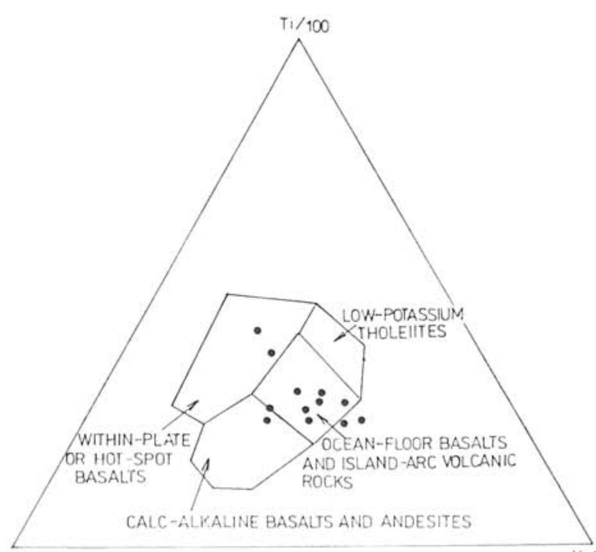

Fig. 17. Discrimination diagram Ti/100:Zr:Yx3 (J. A. Pearce — J. R. Cann, 1973).

fields, one analysis is plotted in the field of calc-alkaline rocks and, at last, 2 analyses are plotted in the field of the within plate basalts or basalts of the „hot spots" type (Fig. 17). An unambiguous picture affords projection Ti : Zr (J. A. Pearce — J. R. Cann, 1973), whereby projections of all analysed rocks fall in the „ocean floor basalts" field or in the „low K tholeiites of island arcs" field (Fig. 18). Trend of the plotted points in this projection follows the elongation of basaltoid field of the ocean floor.

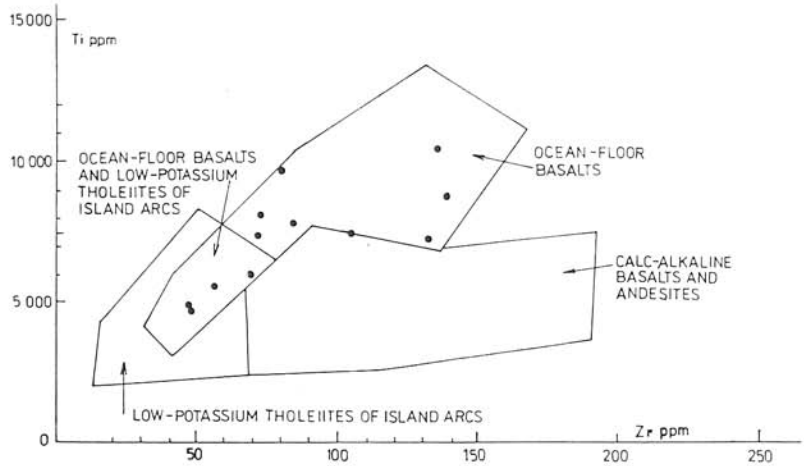

Fig. 18. Ti:Zr discrimination diagram (J. A. Pearce — J. R. Cann, 1973).

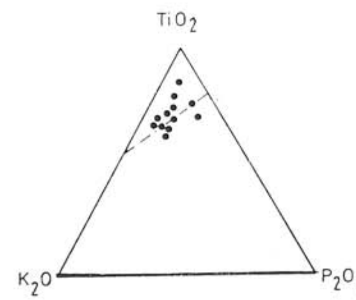

Fig. 19. Discrimination diagram $TiO:_2K_2O$: $:P_2O_5$
Field near the apex TiO_2 belongs to the ocean floor tholeiites.

In the diagram TiO_2 : K_2O : P_2O_5 (T. A. Pearce et al., 1975) in whose upper part near the TiO_2 apex there is limited the field of basalts (of the tholeiite series) of the ocean floor (Fig. 19) the most majority on plotted points is within this field. A part of analyses is beside the limited OFB field, however, they are locallized along the limiting abscissa or there is not observed a trend in direction to some diagram given at the next apexes, whose picture is characteristic for volcanics, e.g. of the island arcs (trend in direction to the K_2O apex and other). Similar conclusions result from projection of Ti/Cr : Ni ratios (Fig. 20).

Varience of problematics of differentiation of volcanic rocks on the basis of their chemical composition (petrogenic mainly or trace elements) can be demonstrated on an example of the diagram $FeO_{tot}/MgO : TiO_2$ (Fig. 21 — W. G l a s s l e y, 1974). On the basis of the mentioned relations of oxides the studied metabasites can be ranged to the island arc tholeiite series, whereby projections of the plotted points follow a border of the island arc tholeiites and the field, limited for „ridge basalts" (i.e. the ocean floor tholeiites). In the Ti/100 : Cr diagram (Fig. 22 — J. A. P e a r c e, 1975) the plotted points of the studied metabasites occur in the field of basalts of the ocean floor and also in the island arc tholeiite field.

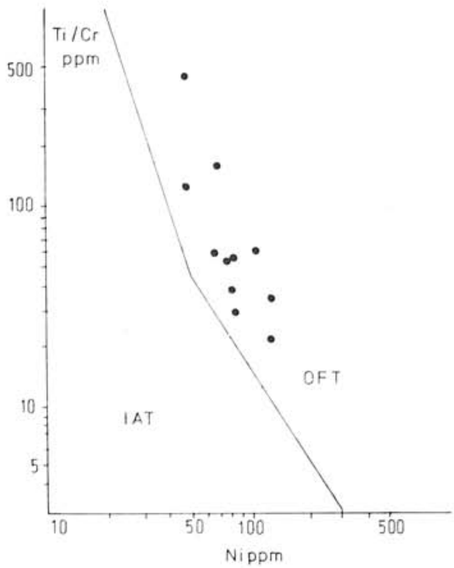

Fig. 20. Discrimination diagram Ti/Cr:Ni (B e c c a l u v a, L. et al., 1979) OFT — ocean floor tholeiites, IAT — island arc tholeiites.

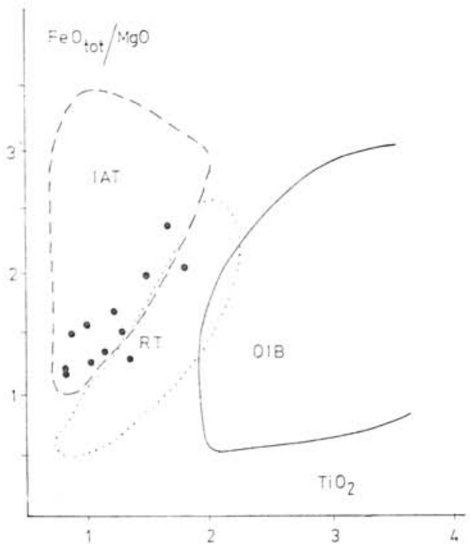

Fig. 21. Discrimination diagrams FeO_{tot}/MgO:TiO_2 (W. G l a s s l e y, 1974). IAT —island arc tholeiites, RT — ridge tholeiites, OIB — ocean island basalts.

Concluding the problematics of differentiation of the studied metabasites in some of the basic geotectonic series of volcanics can be mentioned that in a part of used discrimination criteria the studied metabasites belong unambiguously to the ocean floor tholeiite series („ridge tholeiites"), while the other (Fig. 18) confirm also a presence of rocks, comparable to island arc tholeiites. Taking into consideration microscopically obtained and chemically confirmed presence of rocks with increased Na content (spilitic till keratophyric metavolcanics) and at the same time even trend of curve of chondrite contents of RRE in volcanic rocks of the Rakovec Group (Š. B a j a n í k, 1981) volcanics of the mentioned group can be put among rocks, originated under conditions of the back arc basin, the most probable with zone, adjacent to volcanic arc.

Facial classification of the studied metabasites

One of the basic questions of this problematics is classification of the studied rock complexes in the Rakovec Group of gemericum with some of the basic genetic rock series, with eruptives or with metamorphites. It is known that opinions on genesis of the Dobšiná region bodies (whose NE continuation can be considered the studied profile of the bore-hole near Mlynky) were different. In the past practically all authors considered them for intrusives (in L. K a m e n i c k ý — M. M a r k o v á, 1957).

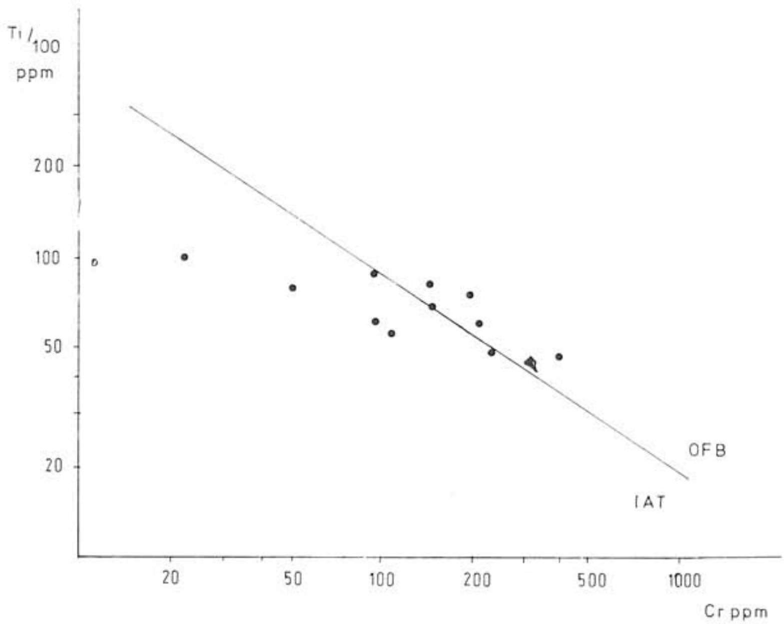

Fig. 22. Discrimination diagram Ti/100:Cr (J. A. P e a r c e, 1975), OFB — ocean floor basalts, IAT — island arc tholeiites.

L. R o z l o ž n í k (1956) classified them as the amphibolite facies metamorphic rocks. Analoguous situation was also in the case of bodies in the Košická Belá — Bukovec zone (L. K a m e n i c k ý — M. M a r k o v á, 1957 — synkinematic intrusives; I. D i a n i š k a — P. G r e c u l a, 1979 — metamorphites). New found bodies near Slovinky and Kojšov were understood till now as isometamorphic (the greenschist facies) members of the Rakovec Group.

One of the basic arguments in support of the opinion that the mentioned rock complexes were originated by metamorphic recrystallization of the original eruptive or volcanoclastic material wits different part of sedimentogeneous component is obtaining the gradual transitions of the studied metabasites into the surrounding sediments. Characteristic is the conform deposition of metabasites and metasediments, whereby transitions can be observed within several meters distance. From genetic view-point the presence of significantly sedimentogeneous metamorphites is important, in a form of intercalations of various thicknesses (carbonates) — Vyšný Klatov, locally intercalations of sediment with and admixture of organic material and other). In support of metamorphigenic origin of the studied metabasites also absence of any evidence of contact-thermic or contact-metasomatic effects of occasional intrusives on rocks of their mantel justifies. Contact effects in the case of basic intrusion have to be expected especially for the mantel is formed by rocks of the greenschist facies and on the other hand by high thermic capacity of the basic magmatic body. Neither in the past, nor during our field study we have found any initions of contact thermic action of anyone among the studied metabasite bodies.

For all studied rocks porphyroblastic structure is characteristic without any relics of structures of eruptives (e.g. recrystallized amygdales in the case of subvolcanic bodies). In support of metamorphic origin also often present banded textures of metabasites justify (although their genesis is variously explained).

From the view-point of mineral composition only the obtained chemical composition of calcic amphiboles do not enable to solve problematics of magmatogenic versus metamorphogenic origin unambiguously. But at the same time the amphibole composition indicates their origination under P—T conditions of the amphibolite facies. Characteristic is deep green or brown-green (γ) pleochroism of amphiboles and this pleochroism is characteristic for amphiboles of the metamorphic origin. The determined An-content of plagioclases (plagioclases were studied by aid of universal stage) An_{28-36} justifies unambiguously for origin of given coexisting association (amphibole—plagioclase) under conditions of the amphibolite facies. It is necessary to stress here that besides amphiboles and plagioclases of Ist generation of the mentioned character, practically in all the studied thin sections there are present also plagioclases II and amphiboles II of different character (viz. descriptions of rock types).

Although considerably intensive alteration of plagioclases I the preserved relics (study by the aid of universal stage) do not show features of a zonal structure — the most often this concerns simple grains. Epidote which is present the most often as a filling of the veinlets is a mineral of the younger alterations of metabasites (along with plagioclase II and amphibole II, chlorite and other) where changes have considerably hydrothermal but locally also metamorphic origin. The mentioned younger mineral association is in the phase unequilibrium with association plagioclase I — amphibole I; the second generation of the mentioned minerals, considered for metamorphic ones, was originated under greenschist facies conditions and it is relatively younger that amphibole I and plagioclase I.

Geotectonic conditions of origination of metabasites

Solving this problem we have to start especially from position of obtained metabasites of the amphibolite facies near to the Lubeník—Margecany line (lineament) or as a part of tectonically exponed North Gemeride Zone on one, and from observed transitions of amphibolites into metamorphites of the greenschist facies on the other side.

By founding of amphibolite bodies in the Rakovec Group there is partially removed in past pointed out sharp metamorphic difference between tatroveporide complexes (northward from the Ľubeník—Margecany Lineament) and the Older Palaeozoic of gemericum (southward from the mentioned lineament). With it the tectonic position of the Palaeozoic complexes, classified as gemericum on the tatroveporide complexes is accepted in substance without exceptions. Existence of the amphibolite facies metamorphites confirm opinion proved by more authors about dominant character of the Bretonian phase within the variscan tectogenesis.

Solving conditions of the metamorphite origin of the amphibolite facies in the Rakovec Group we have to take into consideration also a presence of metamorphites of concordant facial pertaining arising in a rock complex in Rudňany which are doccumented on the basis of sporomorphs and by flora as the Upper Carboniferous (D. H o v o r k a et al., 1979; D. H o v o r k a — J. S p i š i a k in print). Occurrences of these metamorphites spacially fall within belt of occurrences of the amphibolite facies metabasites in the Older Paleozoic of gemericum.

Dillema of problematics is in finding that in the Dobšiná region the Upper Carboniferous conglomerates already contain fragments of amphibolites of the studied type, while amphibolites in the presupposed Upper Carboniferous lay conformly in complexes classified usually as the Upper Carboniferous. Excluding the contact-thermic origin of the amphibolite facies metabasites of the studied zone in the Rakovec Group or their origin in consequence of the subduction processes (absence of high pressure metamorphites of the eclogite type and blue schists) we consider the origin of the studied metabasites as a result of the variscan (the Bretonian phase) fold-metamorphic processes in zone of intensive tectonic activity in which against the surrounding zones the elevated heat flow. Appropriate lithology of the studied rocks (presence of appropriate grainy fractions, presence of sufficient amount of water) are probably the suitable conditions for origination of the studied amphibolite facies metamorphites in medium of rock complexes of the greenchist facies of the gemeride Palaeozoic.

Conclusion

By the field study of metabasite bodies known still more ago (Dobšiná, Klatov) and the new found bodies (Kojšov, Slovinky, Mlynky), by the study of coexisting amphiboles by the aid of the microprobe and plagioclases by the universal stage and evaluation of geochemical data we came to following conclusions:

a) The studied metabasites (of the „Klatov, Kojšov, Slovinky, Mlynky, Dobšiná" localities) belong unambiguously among metamorphic rocks. This confirm geological criteria, composition of coexisting amphiboles and plagioclases of the Ist generation and the texture features of these rocks. On the basis of evaluation especially the composition of plagioclases and amphiboles, the studied rocks are classified as the amphibole facies metamorphites (low-grade amphibolite facies). By their grade of metamorphic recrystallization they are close to the rocks, described from the presupposed Upper Carboniferous in the Rudňany Region (D. H o v o r k a — J. S p i š i a k, in print).

b) The analysed, deep green, locally with a brown shade amphiboles (γ) belong to a series of calcic amphiboles, type Mg — hornblende (B. E. Leake, 1978). Obtained relics of plagioclases of the Ist generation are simple, not zonal, only scarcely simply twinned. Their An-content in the studied bodies varies within An_{28-35}. The mentioned coexisting amphiboles I and plagioclases I are often pressed by minerals of the younger alterations (amphibole II, plagioclase II, minerals of the epidote group, chlorite and other) which represent unequillibric association with minerals of the Ist generation; the mineral association of the IInd generation was originated considerably under conditions of the greenschist facies a part is of hydrothermal origin.

c) On the basis of analysis of appearance of the amphibolite facies metabasites, their textural and structural development with regard to special relations to surrounding rock complexes, metamorphosed under conditions of greenschist facies we presuppose that given rocks were originated in the zone of intensive tectonic activity with elevated heat flow.

Acknowledgements: The authors should like to express their sincere thanks to RNDr. Peter Jakeš, Geol. Survey in Prague for careful microprobe analyses of amphiboles, presented in this paper, and to RNDr. Juraj Macek, Geological Institute of the Slovak Acad. of Sci. in Bratislava for valuable help in plagioclase determination.

Translated by E. Lehotská — Halmová

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Review by L. KAMENICKÝ Manuscript received July 7, 1981

This article was presented in the Symposium on geochemistry of endogenous and exogenous processes, petrogenesis and minerogenesis, which took place in Smolenice on 4 — 8 May 1981.