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STRUCTURE OF THE ĎUMBIER METAMORPHITES (WEST CARPATHIANS)

(1 table, 13 figs.)

Abstract: The structure of gneisses and migmatites of the Ďumbier crystalline complex originated by polydeformation. The older group of D_1 deformations was accompanied by Variscan metamorphism and migmatization, the younger D_2 by Alpine cataclasis and minor recrystallization. According to the style and orientation, beside joints, veins and faults, 5 fold and 6 foliation generations were differentiated. Macrostructure originated during D_2 by overprinting of imbricated faults on folds and incorporation of the envelope Mesozoic into the structure of metamorphites.

Резюме: Структура гнейсов и мигматитов дюмбьерского кристаллиникума возникла полидеформацией. Старшую группу деформаций D_1 сопровождал прогрессивный метаморфизм и мигматизация, младшую D_2 альпийский катаклаз и ретроградный метаморфизм. В соответствии со стильем и с ориентацией было диференцированных, кроме трещин, жил и сбросов, 5 генераций складок и 6 генераций листоватостей. Макроструктура возникла во время D_2 наложением чешуйчатых сбросов на складки и одновременного включения мантиевого мезозоя во внутреннюю структуру метаморфитов.

1. Introduction

The southern slopes of the western part of Low Tatra mountains are built by a metamorphite zone forming along with the northernmore granitoids the so caled Ďumbier crystalline complex. In the southern section of this zone biotite and two-mica oligoclase gneisses appear alternating with quartzite gneisses and metaquartzites, sporadically with amphibole gneisses and amphibolites. Migmatized equivalents of these rocks predominate in the northern and central part. Gneisses containing garnet, pyroxene, sillimanite and graphite make up only rare and thin intercalations. Neosome content and homogenization increases towards the northernmore granitoids, into which migmatites pass over on sites undisturbed by faults. Pre-metamorphic lithology is considered to be the product of eugeosynklinal sedimentation accompanied by basic volcanism (V. Z o u b e k, 1961), the chemism of paragneisses points to the origin from rocks of the graywacke suite (D. H o v o r k a, 1975). Plant relics from paragneisses are held for Silurian to Carboniferous in age (O. Č o r n á, L. K a m e n i c k ý, 1976). Absolute ages from clastic and recrystallized zircons from migmatites are in average 390 m.y. and from monazites 315 m.y. (A. K. B o j k o, 1975). The age of muscovite from a migmatite of another locality is 260 m.y. (J. K a n t o r, 1961), and that of amphibole from an amphibolite is 350 m.y. (E. W. B a r t n i c k i j in L. K a m e n i c k ý, 1973). Prograde metamorphism is in the range of the garnet

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to granitoids as well as their fabric are some of so far investigated problems (K. S i e g l, 1967, 1970, 1973, 1976, 1976 a). This paper deals with basic amphibolite facies (J. K a m e n i c k ý, 1967) up to anatexis (V. Z o u b e k, 1951), local retrograde metamorphism in the greenschist facies.

One of the first conceptions of the West Carpathian crystalline structure had its origin in the Ďumbier crystalline complex. J. K o u t e k (1931) found by geological mapping its structure to be Alpine. It was interpreted as a complex deep and rooted fold (see also R. K e t t n e r, 1927; D. A n d r u s o v, 1968). Other works confirmed again the significance of Alpine faults and folds (V. Z o u b e k, 1935, 1937, 1961; D. K u b í n y, 1960). Folding of the metamorphites and its relations to metamorphism, the relations of the mantle to granitoids as well as their fabric are some of so far investigated problems (K. S i e g l, 1967, 1970, 1973, 1976, 1976 a). This paper deals with basic information on mesoscopic and macroscopic structure of the Ďumbier metamorphites.

2. Mesoscopic structures

In the poorly exposed region relations of basic directly observable structures are clear only in the domain of specimen up to outcrop. The hierarchy of foliations and folds established in these domains is the basis for further cosiderations.

In one exposure appears usually only a small part of the structural elements sampled in the whole studied area in domains with different lithology and state of deformation. In a region with complicated metamorphic and structural history, by this mode of study correlation of the individual mesoscopic structures from various domains is usually exposed tu subjective errors. Their minimalization suggested indexing only the most important, in mesocopic domains penetrative structural elements found at several sites of the relative succession of element formation so that structures with higher index are always younger. This rule may be doubtful in cases of convergence of deformation regimes of different ages in various structural levels. Some minor folds from the upper Variscan and low Alpine structural levels may serve as example.

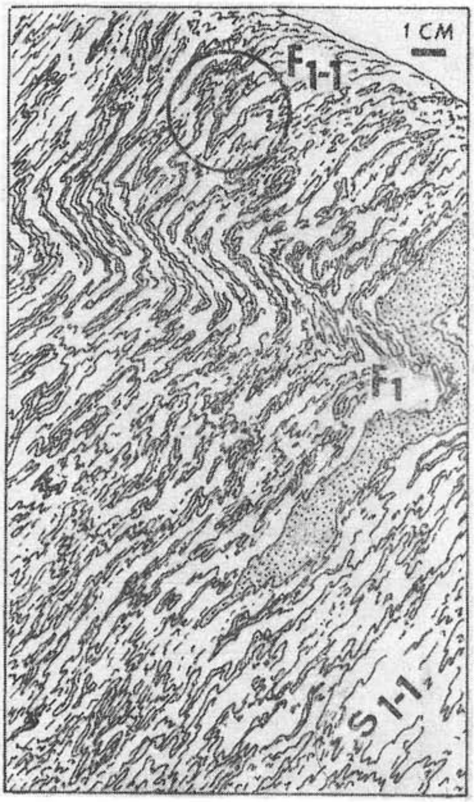
The deformations by which mesoscopic and macroscopic structures had originated may be divided into two groups D_1 and D_2. Most of the substantial deformations of D_1 were accompanied by prograde medium grade to anatec-

Table 1

Division of deformations, folds and foliations. Folds and axial surface foliations connected by dots.

Deformations	Folds		Foliations
D_1			S_{1-0}
	F_{1-1}	. . . .	S_{1-1}
	F_{1-2}	. . . .	S_{1-2}
D_2	F_{2-1}	. . . .	S_{2-1}
			S_{2-2}
	F_{2-2}		
	F_{2-3}		
			S_{2-3}

Fig. 1. Relict minor folds F_{1-1} and s_{1-1} planes in synkinematic migmatite of a biotite paragneiss with quartz-rich intercalation (grey). Štelerova valley.



tic metamorphism, while D_2 was accompanied by cataclasis and local low grade retrograde metamorphism. The deformation groups may be approximately dated on the basis of absolute ages, from the relations crystallization — deformation and from comparison with the structure of the envelope Mesozoic. Thus D_1 is Variscan and D_2 Alpine. The affiliation of the most frequent structures to the deformations is in Table 1.

Quantitative representation of mesoscopic structures varies from site to site. From more than a dozen of structures only some are so widespread to be significant for regional analysis. The most frequent are foliations s_{1-0} s_{1-1}, in fault zones s_{2-3}. Minor folds were found only in each tenth outcrop, F_{1-1} being twice as abundant as F_{2-1}. Mesoscopic lineations of mineral growth are rare.

2. 1 Foliations

The principal structural element of metamorphites is s_{1-0} foliation marked by material inhomogeneities which originated by synmetamorphic crystallization of rock-forming minerals. It is mostly parallel with primary bedding marked by the alternation of laminae with contrasting lithology. This foliation is penetrative in the entire macrodomain of the metamorphites devoid of intensive migmatization or cataclasis. Only in folded migmatites it is transposed by two other D_1 foliations.. By shearing parallel with axial surfaces of the folds F_{1-1} foliations s_{1-1} were formed. In migmatites with predominating neosome transposition of the planes s_{1-0} may be perfect. The presence of s_{1-1} is usually indicated by relics of fold hinges, or intrafolial folds (Fig. 1 and 2). In the axial surface of F_{1-2} nonpenetrative foliation s_{1-2} originated in places, contributing to material homogenization in one part of the migmatites (Fig. 2).

In domains of postcrystalline Alpine deformation a number of foliations originated accompanied by cataclastic and retrograde metamorphism. In hinge zones of mesoscopic folds F_{2-1} nonpenetrative foliations s_{2-1} in direction of axial surfaces may be found in mica rich gneises. In fold limbs shears parallel with the early s_{1-0} had formed. These surfaces s_{2-2} often growed

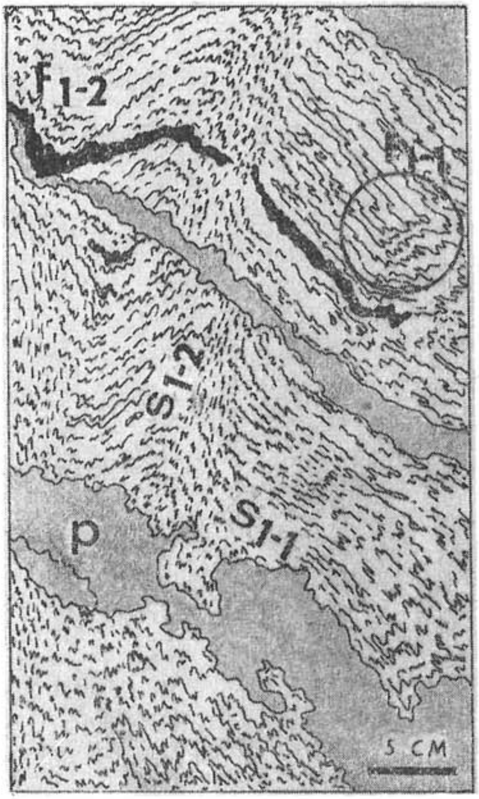


Fig. 2. Relations between folds F_{1-1}, F_{1-2} and planes s_{1-1} and s_{1-2} in a synkinematic migmatite with biotite-rich gneiss restites (dark) and younger pegmatites (p). Vajsková valley.

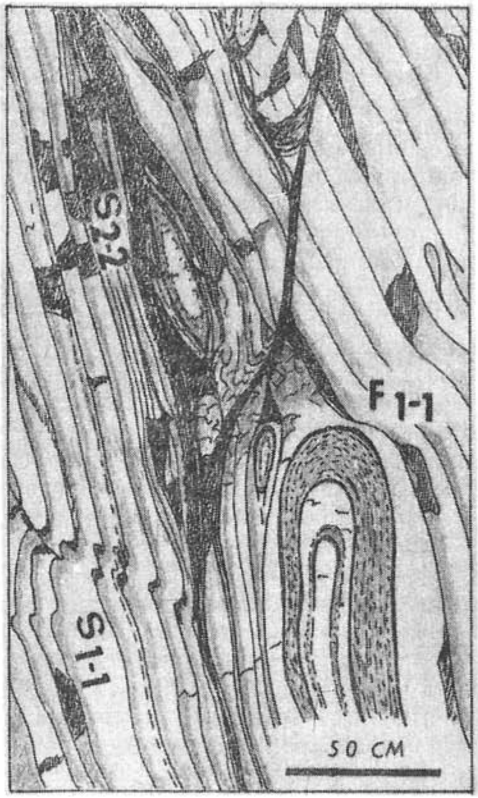


Fig. 3. Structures in banded gneisses. Bystrá valley.

over even beyond more intensively folded domains in form of systematic minor faults. Here they are not necessarily parallel with the s_{1-0}. Their density varies considerably according to mineral composition, s_{1-0} density and state of folding. They often transpose s_{2-1} and obliterate also minor folds F_{1-2}.

In fault zones of major Alpine faults occurs penetrative foliation s_{2-3}. Its density increases towards the centre of the fault zone filled up by gouge in places. Outside the zone its density is 1—10/1m and similarly as in the granitoids (K. S i e g l, 1976) it may be designated spaced cleavage. In mylonites and tectonic brecciae it transposes early fabrics, often without leaving relics. These surfaces were identified in places as the oldest in the group of shear planes within fault zones (K. S i e g l, 1978).

The majority of joints belongs to the youngest planar structures. Many of them disturb s_{2-3} or F_{2-1} and belong to D_2 group. In exposures joints perpendicular and parallel to penetrative foliation (s_{1-0}, s_{1-1} and s_{2-3}) or perpendicular to fold axes (mostly F_{2-1}) are the most abundant.

Fig. 4. Limb of isoclinal macrofold F_{2-1} with minor F_{1-1} in the left part (detail in frame see Fig. 3) and conform overprinting of s_{1-1} by s_{2-2} in the right part. Banded gneisses (g) and amphibolite gneisses (a) in the Bystrá valley.

2. 2 Folds

The oldest minor fold F_{1-1} population occur in banded gneisses and migmatites (Figs. 1, 2 and 3). Fold profiles are variable, generally in class 1C to 3 of Ramsay's classification (J. R a m s a y, 1967). In migmatized paragneisses they often form similar folds with synkinematic neosome accumulated in hinges. Beyon the migmatization zone they converge by shape and orientation with Alpine F_{2-1} and they can be differentiated sometimes by microscopic analysis (K. S i e g l, 1973). The younger non-penetrative folds F_{1-2} occur in migmatites in places only. Like the older folds they use to be destructed by shearing in hinge zones and contribute to homogenization of neosome distribution (Fig. 2).

Mesoscopic folds of the D_2 group are penetrative only in domains with intensive Alpine deformation and apropriate lithology. F_{2-1} folds appear preferentially in paragneisses near to the infolded envelope Mesozoic at the northern and western margin of the metamorphites. Their formation is usually accompanied by retrograde metamorphism with crystallization of chlorite, quartz, albite, muscovite, rare garnet as well as by reorientation of older minerals. In more competent banded gneisses and migmatites retrograde metamorphism is weak or lacking, folds are larger and s_{2-1} sporadic. With advanced folding minor folds are incorporated in the fabric of larger folds and are destructed by s_{2-2} (Figs. 3 and 4). The shape of minor folds of this population is variable. In paragneisses for example depends on phylosilicate content. Being lower the folds belong to 1A and 1B class, at higher content they are susally in class 1C to 2. Younger minor folds F_{2-2} are rare, unlike the macroscopic folds of the same N to NW orientation. They may be differentiated from F_{2-1} only in case of their joint occurence and transposition. In fault zones appear minor folds and kink bands F_{2-3} folding the s_{2-3} foliation. They are not penetrative in the whole fault zone. In places they were generated by younger faulting.

3. Macroscopic structures

For the recognition of metamorphite macrofabric the structural and geological map in the scale 1:25 000 was used as well as statistic diagrams of the penetrative mesoscopic structures. Unpunctualities follow not least from unsufficient exposure which is the reason of inhomogenous sampling and a less number of measurements. The incomplete fault and fold pattern is unfortunately part of our present conception of Carpathian tectonics.

3. 1 Folds

Directly observable folds exceeding 10m are rare. They are usually narrow to isoclinal, often overturned and belong to the F_{2-1}. Larger folds may be

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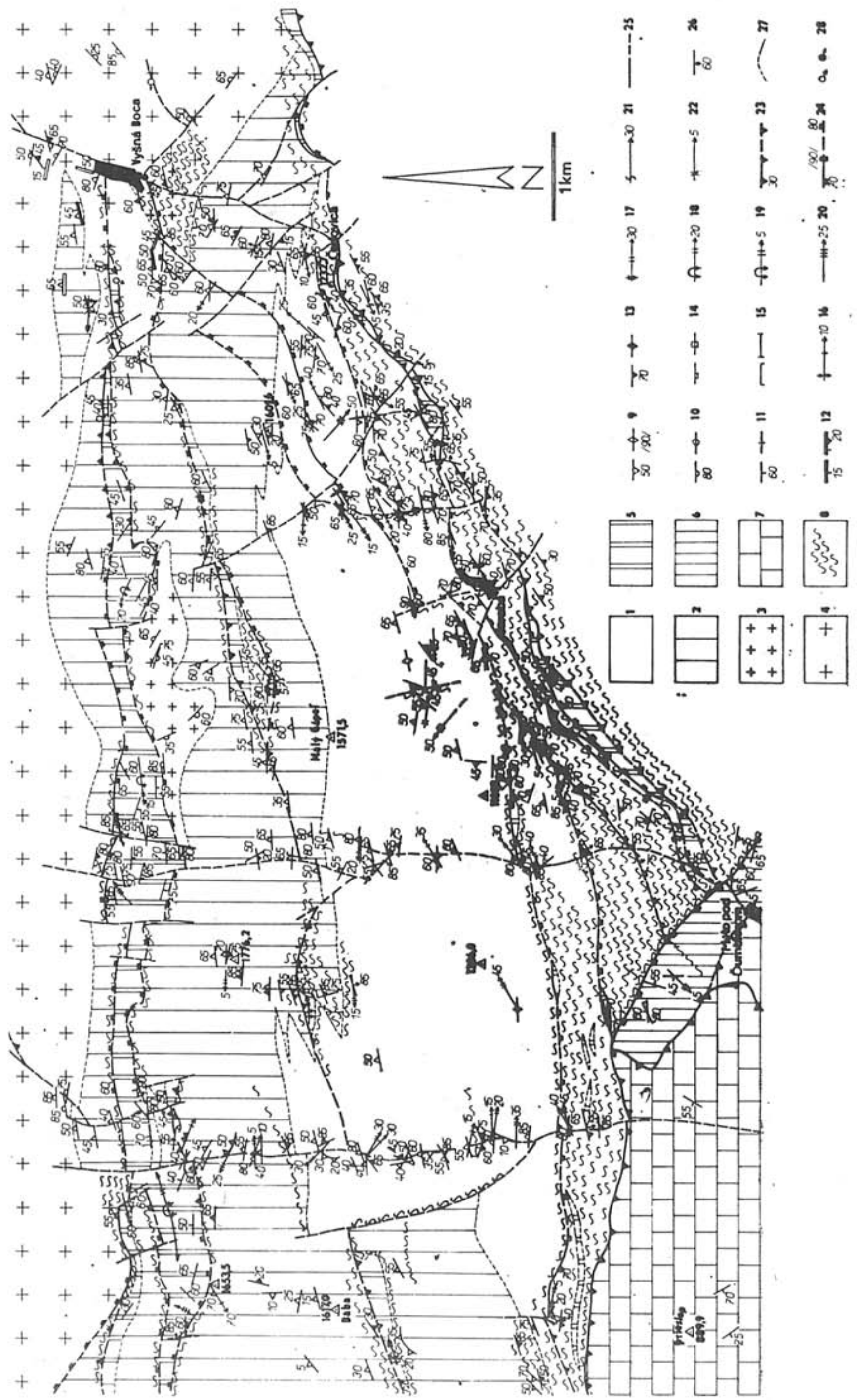
Fig. 5. Structural map of the eastern part of the Ďumbier metamorphites. A part of the geological boundaries according to maps of D. Andrusov, J. Koutek, V. Zoubek (1951). 1 — metamorphites without major migmatization; 2 — migmatites; 3 — leukocratic granite; 4 — granodiorite and tonalite; 5 — envelope Mesozoic ± Permian of the Ďumbier group; 6 — envelope Mesozoic of the Veľký Bok group; 7 — nappe Mesozoic ± Permian; 8 — cataclastic and retrograde metamorphic rocks; 9 — s_{1-0}, in migmatites ± s_{1-1}; 10 — foliation of modal inhomogeneity in anisotropic granitoids; 11 — bedding in the Mesozoic; 12 — vein or dyke (parallel to s_{1-0}); 13 — s_{2-3} (± s_{2-2}); 14 — surface conjugated to s_{2-3} in the fault zone; 15 — dense systematic jointing; 16 — axis of the mesoscopic F_{1-1} fold (antiform); 17 — axis of the mesoscopic or macroscopic F_{2-1} fold (synform); 18 — relics of the overturned syncline F_{2-1}; 19 — relics of the overturned anticline F_{2-1}; 20 — axis of the macroscopic fold F_{2-2}; 21 — axis of the minor fold F_{2-3}; 22 — intersection lineation of s_{1-0} and s_{2-3}; 23 — macroscopic fault with dip of the fault surface less than 45°; 24 — macroscopic fault with dip more than 45°; 25 — fault with unestablished dip and assumed fault; 26 — mesoscopic fault; 27 — geologic boundary; 28 — abundant spring and mineral spring.


Vyšná Boca
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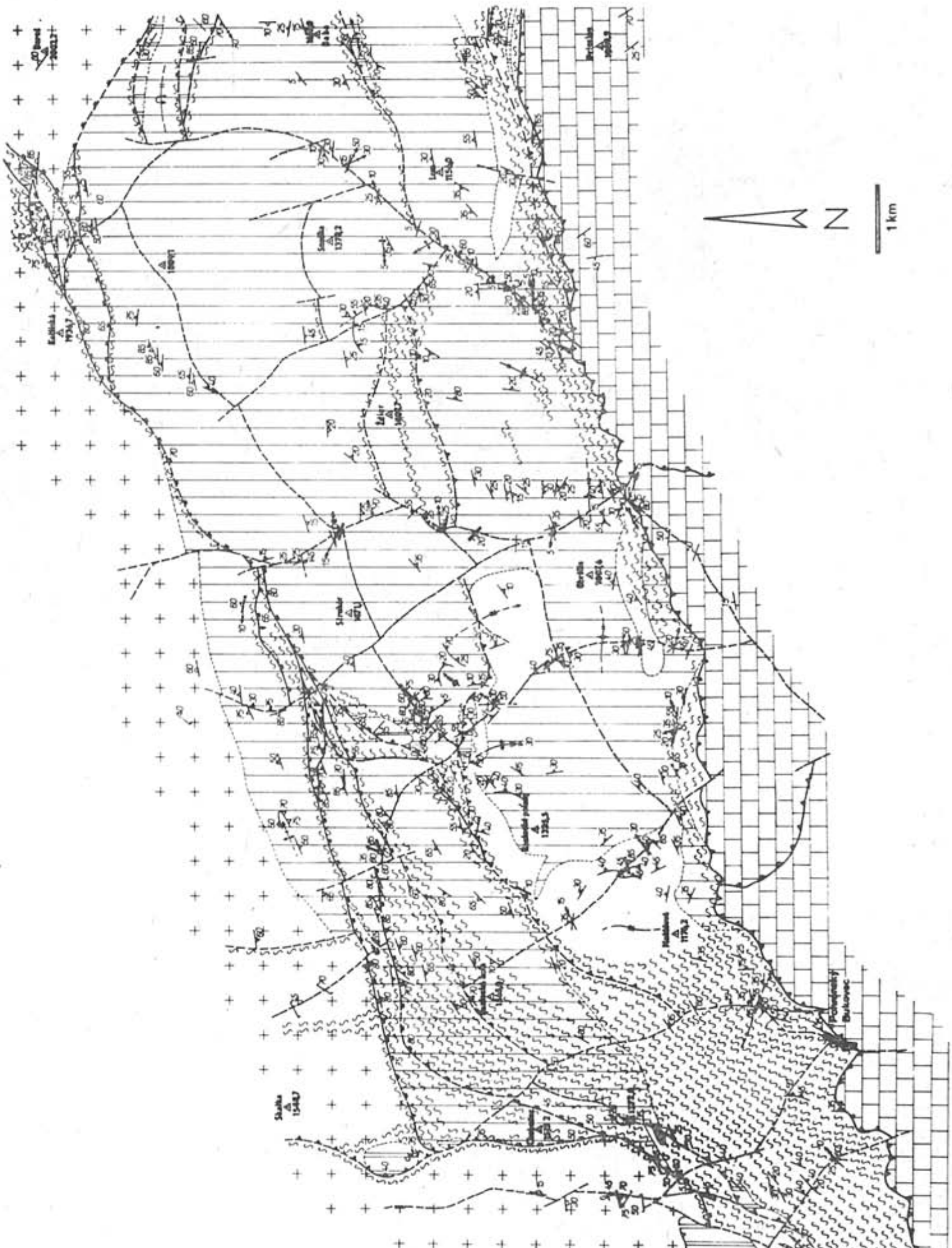


Fig. 6. Structural map of the western part of the Ďumbier metamorphites. Explanations see Fig. 5.

rather assumed from the map and assigned according to remnants of the synclinally arranged envelope Mesozoic. In the eastern part of the metamorphites the wedges of Low Triassic quartzites and Middle Triassic carbonates build several belts (Fig. 5). In geologic sections of V. Zoubek (1961) they are interpreted as the Trangoška and Malý Gápeľ syclines with the Králička anticline between them. In the southern and southeastern part at least three further structures in the stage of advanced fault destruction might be considered. The trend of these structures is E to ENE and axis

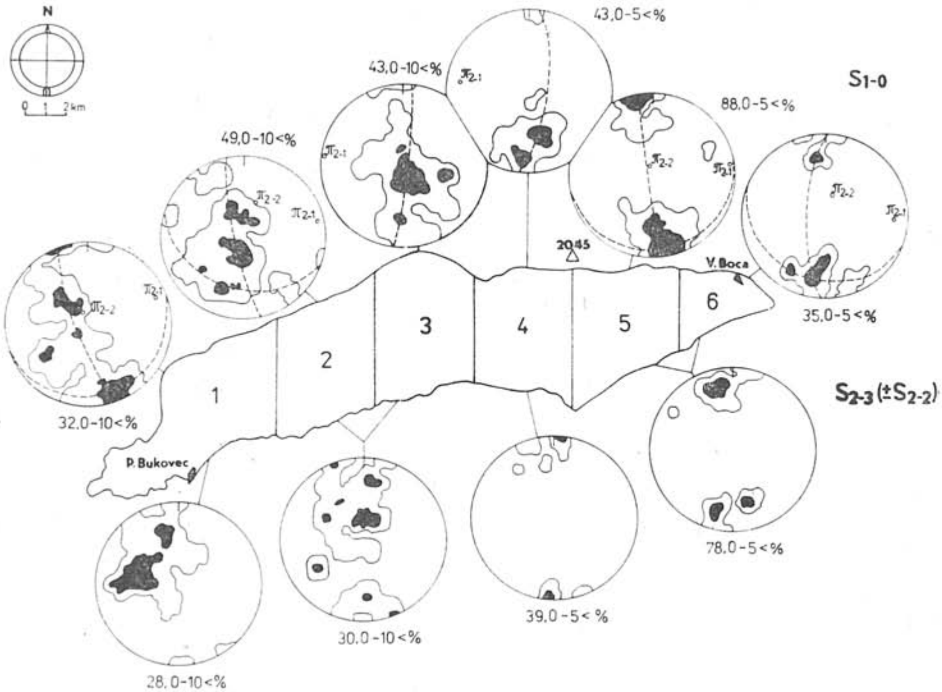
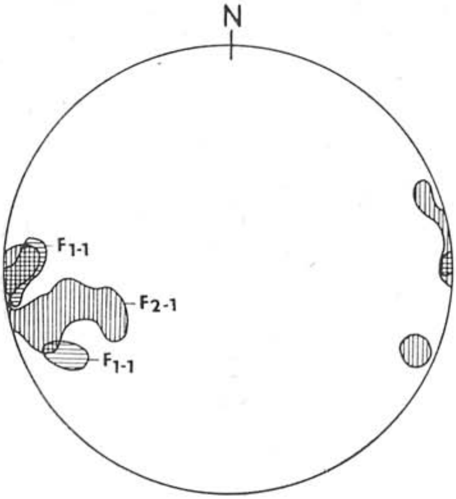


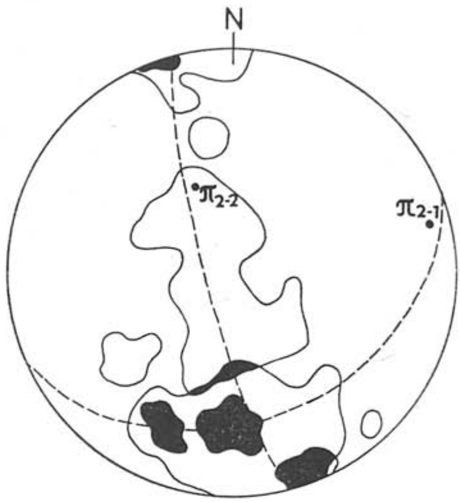
Fig. 7. Orientation diagrams of s_{1-0} and s_{2-3} ($\pm$ s_{2-2}) poles in the metamorphites. Number of measurements and interval at the diagram.

of synclinal structures is horizontal or plunging westward. Also in the marginal western part appearing Mesozoic wedges indicate some isoclinal, returned and by faults destructed folds of 0,1 up to 1 km sizes. Several of them are already part of fault zones (Fig. 6). Macrofolds F_{2-1} characterize in s_{1-0} pole diagrams from six subdomains elongated and doubled maxima (Fig. 7). In the cummulative diagram of the whole domain the π_{2-1} axis direction of their large circle is 75/10° ENE (Fig. 9).

By younger Alpine folding originated open macrofolds F_{2-2}. They flexure F_{2-1} and a part of reverse faults and thrusts allied to them. They occur preferentially in the western and eastern intensely Alpine folded metamorphite region. In some s_{1-0} pole diagrams they display by elongation of the submaxima to a great circle. In the cummulative diagram the direction of $\pi_{2\text{-}2}$ axis of the great circle is 337/55° NWN (Fig. 9).

Recent orientation of minor fold axes in the macrodomain is for the most abundant $F_{1\text{-}1}$ and $F_{2\text{-}1}$ similar. Their maxima are of E — W direction and generally slight westernd plunge (Fig. 8). The primary $F_{1\text{-}1}$ orientation is not known, it was likely more heterogenous. Greater dispersion to NW and SE in domains with less intensive alpine folding proves for it. Minor folds





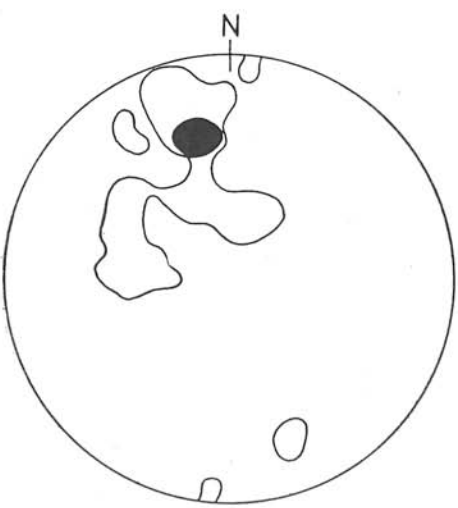


Fig. 8. Orientation diagram of **minor fold** axes in the metamorphites. 56 $F_{1\text{-}1}$, 27 $F_{2\text{-}1}$, 6% isoline.

Fig. 9. Orientation diagram of $s_{1\text{-}0}$ poles in the metamorphites. 2% isoline from two cummulative diagrams with 290 measurements.

Fig. 10. Orientation diagram of $s_{2\text{-}3}$ ($\pm$ $s_{2\text{-}2}$) poles in the metamorphites. 4% isoline from two cummulative diagrams with 175 measurements.

and macrofolds $F_{2\text{-}1}$ are not precisely coaxial as it is evident also from comparison of $\pi_{2\text{-}1}$ and $F_{2\text{-}1}$ maximum orientations (Figs. 8 and 9). Rotation by folding $F_{2\text{-}2}$ is important only in the western part of the metamorphites and contributed to maxima repartition.

3. 2 Faults

The majority of significant geological boundaries in the Ďumbier crystalline complex is built by faults. They are overprinted for example on the boundary between the metamorphites and granitoids as well as on the transgessive surface of the envelope Mesozoic. The marginal eastern and western parts show pronounced inbricated fabric. Perpendicularly to fault surfaces 2 to 5 faults may be found on 1 km. In the central part fault density is lower but the fabric is not blocky. According to orientation fault groups striking to E to NE and N to NW may be differentiated. According to extent and grade of cataclasis they may be divided in those accompanied by a broad zone of breccians, mylonites, blastomylonites and phyllonites and fault zones devoid of these. The former are usually allied with wedges of the originally infolded envelope Mesozoic of E to NE strike and make up imbricated fabric. They are dipping predominantly southward, nevertheless even opposite dip occurs in the northern and eastern part. The largest among them are confining the metamorphite body and they may be designated as limiting faults. The second group is generally transversal, to the first, shifting them, wihtout Mesozoic relics and a distinct wider zone of cataclasis.

The limiting fault Šífrová (according to the valley of the same name north of the Struhár, 1941,1 m and north of the settlement Jasenie) builds the greater part of the northwestern and western boundary of the metamorphites towards the granitoids. It is made up of several sometimes conjugated or subparallel fault planes. It may be traced in a length of approx. 25 km between the valleys Sopotnička and Demänovka (Figs. 6 and 13, 14 in K. S i e g l, 1976). Its strike is NE and the dip 40° to 80° towards SE. It is marked by a zone of intensive cataclasis and recrystallization of several 100 m thickness, lenticles of envelope Triassic and by valleys and saddles. At the crossing with the fault Biele Vody (V. Z o u b e k, 1951) a mineral water springs. By this fault the metamorphites were trusted over the northwestern granitoids.

The southeastern boundary of the Ďumbier metamorphites builds a fault system the best known of which is the Čertovica fault. Morphology of the fault zone, its orientation and dislocation are rather similar to the Šífrová fault. The faults of this region were described in a separate paper (K. S i e g l, 1978).

The fault system Trangoška (D. K u b í n y, 1956) borders the relics of the originally synclinal structure of the envelope Mesozoic in the northern part of the eastern halve of the metamorphites. The disclocation zones in the metamorphites may be followed approx. 13 km between the valley Vajsková and the settlement Vyšná Boca. Their dip in the western part is steep northward, in the central part towards south and in the eastern part again northward. Change of dip is partly due to rotation on transversal northward trending faults.

The fault Baba (according the elev. point Baba, 1617, Om) cuts the whole metamorphite zone longitudinally. It may be followed in a length of approx. 25 km between the valley Jasenská and Vyšná Boca. Except for the eastern ending the dip is prevelently medium to slight southward. On several places relics of the envelope Mesozoic occur in the fault zone (from the eastern part described by V. Z o u b e k, 1935).

The faults of the southern metamorphite margin show E to ENE strike and medium to gentle S dip. They are situated in a 0,2 up to 2 km wide zone with intensive cataclasis and recrystallization. Its southern boundary is made up at the surface by the thrust plane of Mesozoic nappes. It passes over on southeast into the mentioned fault system in the environment of the Čertovica fault. The origin of this zone was interpreted by uplift of the mountain chain or by „massage" of the crystalline by the nappes (R. K e t t n e r, 1927; V. Z o u b e k, 1935). It seems more probable that the zone continuing also in the nappe basement had generated originally by folding of paragneisses under the formation of $s_{2\text{-}2}$ and $s_{2\text{-}3}$. Faults related to uplift and assumed already by V. Uhlig (1903) overprinted them conformly.

In fault zone domains planes $s_{2\text{-}3}$ are penetrative. In some cases they cannot be distinguished from $s_{2\text{-}2}$ of identic quality and orientation, so that they are in part included also in the diagrams. The $s_{2\text{-}3}(\pm s_{2\text{-}2})$ orientation in the subdomains is represented by the lower set of diagrams in Fig. 7.

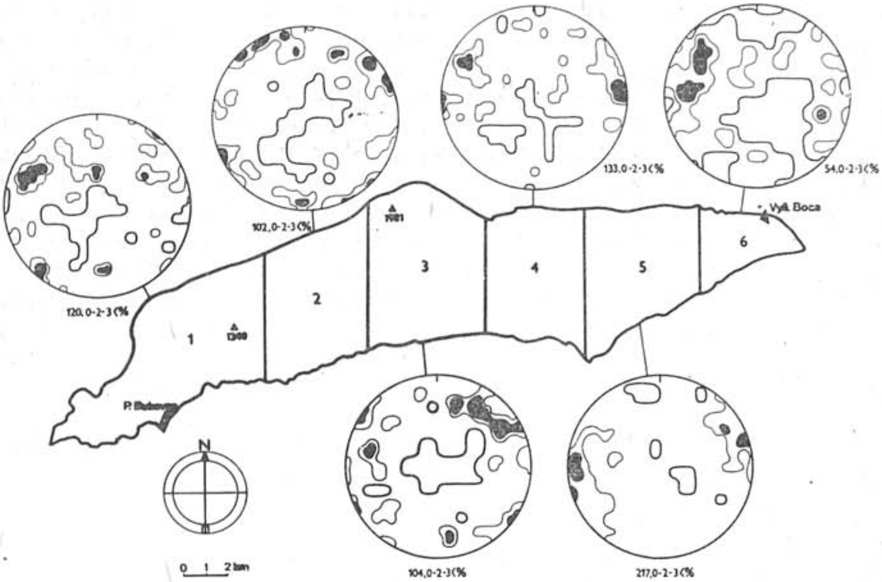


Fig. 11. Orientation diagrams of joint poles in 6 subdomains of the metamorphites. Number of measurements and interval at the diagram.

Measurements were collected firstly from domaines affected by cataclasis (marked by an s-hachure in the map). The individual maxima correspond regulary to individualized faults (in Fig. 7 domain 2+3 and 5+6), sometimes even to a single fault system with variable orientation (domain 1). In the macrodomain of the metamorphites are predominating the faults with $s_{2\text{-}3}$ of ENE strike and S dip (Fig. 10). Comparing fabrics $s_{2\text{-}3}$ and $s_{1\text{-}0}$ in diagrams from a particular subdomain it should be taken in account that they were sampled usually in different mesoscopic domains. In several subdomains they are parallel to one another, in other transversal. The later more frequent case is reflected also in the diagrams of the macrodomain, where the pole maxima of both foliations include an angle of 70°—80° (compare Fig. 9 and 10).

3. 3 Joints and veins

Unfilled joints occur usually in subparallel sets and their size is 10 —100m. In one exposure usually 2—3 joints were measured only, representing dominant systems, so that preliminary selected sets were statistically elaborated. In six subdomains of metamorphites joints with steep up to vertical dip and one or two strikes are predominating (Fig. 11). In more homogenous domains a system perpendicular to s_{1-0} planes and F_{2-1} fold axes predominates (e.g. subdomain 4,5,6 in Fig. 11). In less homogenous domains and where fault deformation was intensive, also a joint system subparallel to s_{2-3} is conspicous (subdomain 1 and 2 in Fig. 11). Dense jointing cannot

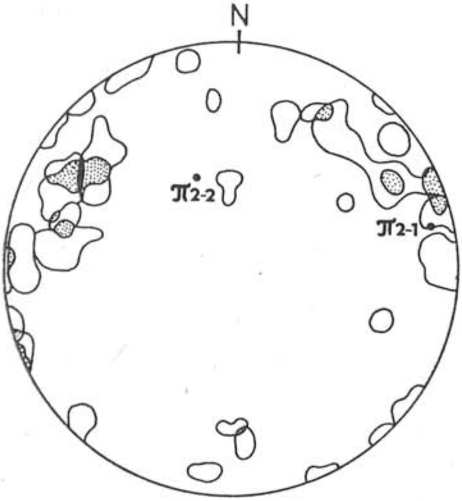


Fig. 12. Cummulative orientation diagram of joint poles in the metamorphites. 3% isolines from 6 diagrams with 730 measurements.

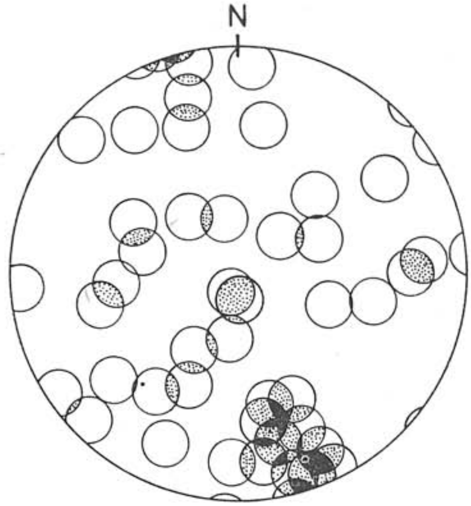


Fig. 13. Orientation diagram of quartz veins, aplites and pegmatites in the metamorphites. 43 poles.

be differentiated there virtually from these planes. Thus in joint poles orientation diagrams maxima appear in the rule at the E—W or NE—SW margin and in the NW quadrant. The joints are heterotactic, they originated in course of a long-lasting time span under the action of tectonic and residual stresses. The majority of the unfilled joints is Alpine and in respect to folds F_{2-1} and F_{2-2} they are either extension (ab), or shear joints. Their orientation in the entire macrodomain is depicted in the diagram on Fig. 12.

The filled joints may be divided into a pegmatite and aplite vein groups and a quartz vein group, sometimes with chlorites, carbonates and ore minerals. The first two are owing to the unestablished occurence of alpine granitoids in the investigated area regarded as pre-Triassic, the third as prevalently, though not uniquely Alpine. Aplite and pegmatie veins of up to 30 cm thicknesses are more abundant in migmatized paragnesisses, i.e. in a zone nearer to the granitoids. According to the relation to folds, texture and mineral composition it is evident, that they were developing in various stages D_1 prior to, as well as after F_{1-1} and F_{1-2}. Quartz veins of up to 10 cm thickness are common in the whole zone of metamorphites, particularly in domains of dislocation and retrograde metamorphism. Most of the filled joints are parallel with the s_{1-0} and s_{1-1} surfaces, which is apparent in the cummulative diagram even from small number of measurements (Fig. 13). Sporadic lamprophyre dykes from the eastern part of metamorphites show ENE strike and steep dip. Similarly to majority of the ore veins with Cu, Pb, Zn, W and Sb mineralization of NE and N trend, they seem to fill up Alpine fractures.

4. Conclusion

The structure of the Ďumbier metamorphites had originated by deformations which based on syntectonic metamorphism may be divided into two groups. Earlier deformations D_1 were accompanied in regional extent by metamorphism of medium grade up to anatexis. They gave rise at least to two mesoscopic fold generations F_{1-1} and F_{1-2} with axial surface cleavages s_{1-1} and s_{1-2} transposing in migmatites in places older structures inclusive the oldest one s_{1-0} marking the primary bedding. In the whole metamorphite domain only one F_1 generation is penetrative devoid of penetrative axial surface cleavage. D_1 macrofabric is not preserved and orientation of structural elements of this deformation group was rotated by younger deformations.

Younger deformations D_2 were in the rule accompanied by retrograde or cataclastic metamorphism. They induced the formation of nonpenetrative mesoscopic and macroscopic F_{2-1} and macroscopic F_{2-2} folds. Axial surface cleavage s_{2-1} and shears s_{2-2} parallel with the fold limbs F_{2-1} are nonpenetrative. Along with younger shears s_{2-3} accompanying faulting they often wholly destruct the fold fabric. These planes are penetrative in fault zones where they transpose perfectly all the older structures. They effected the substantial part of cataclasis. Sporadic minor folds F_{2-3}, majority of the joints and minor faults are younger in age.

Faults of 10 km order build the imbricated structure and border the metamorphite body with exception of short sections. They destructed the macrofolds F_{2-1} and induced the thrusting of the metamorphites over the granitoids on the west. They differ by intensity of allied metamorphism, orientation and linkage to F_{2-1} folding. The major ENE and NE trending faults contain in cataclasite zones lenticles of the envelope Mesozoic. They originated presumbly from narrow isoclinal macrofolds F_{2-1}. Macrofabric of the metamorphites originated by deformations of the D_2 group.

Polydeformation, the nonpenetrative character of the individual deformations, partial convergency of tectonic styles, lack of lithologic markers and poor exposure offer the possibility to future students to precise considerably the Variscan and Alpine deformation history of this area.

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