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SUCCESSION OF TECTONIC STRUCTURES IN THE CRYSTALLINE AND ENVELOPE PALEOZOIC OF THE POVAŽSKÝ INOVEC MTS.

(Figs. 1—3)

Abstract: The objective of the article is to present characterization of tectonic structures of the crystalline and envelope Paleozoic (Carboniferous, Permian) of the Považský Inovec Mts., to determine their relative age relation and function during geological development. Between the block of northern crystalline (diaphthorite zone) and the block of southern crystalline (zone of paragneisses, postkinematic migmatites and granitoides) neither divergence of direction and style of the oldest structures (E—W) nor metamorphic throw has been established. The Alpine structures are direction E—W (older) and NNE—SSW to NE—SW (younger).

Резюме: Целью работы является дать характеристику тектонических структур кристаллиникума и оберточного палеозоя (карбон, перм) гор Поважски Иновец, определить их относительное возрастное отношение и функцию в течение геологического развития. Между блоком северного кристаллиникума (зона диафторитов) и блоком южного кристаллиникума (зона парагнейсов, послекинематических магматитов и гранитоидов) не было определено несогласие ни в направлении ни в стиле самых старых структур (В-З), ни метаморфический сброс. Альпийские структуры имеют направление В-З (старшие) и ССВ-ЮЮЗ (более молодые).

Introduction

In the article I am mainly setting out from the geological — structural map of the central part of the crystalline and envelope Paleozoic in the Považský Inovec Mts. (M. Putiš in M. Maheľ et al., 1979) and from the geological-structural study of the crystalline north of the mapped area.

The geological sketch-map and profiles (Figs. 1—3) are compiled from the „key" area for solving structural-geological relations of the crystalline and envelope Paleozoic of the Považský Inovec Mts., i.e. roughly between the lines Zlatníky trig. Jakubova—Kálnica in the north and Duchonka — Slivničná dolina valley — Hrádok in the south.

The oldest structures directly observed in the northern (zone of diaphthorites) and southern (zone of paragneisses, mica schist gneisses, postkinematic migmatites and granitoids) crystalline are of E—W direction, however, essential differences are between them:

1. In the southern crystalline B_1 axes of macrofolds in paragneisses and migmatites as well as metamorphic S_1 foliation with progressive metamorphic mineral association, which is of monoclinal setting in the meso-district and indicates the course of B_1 axes of macrofolds, display this course.

2. In the southern crystalline mylonite zone of E—W direction are not present.

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2. In the northern crystalline the B axes of folds of two generations (B_1 || B_2) are of E—W direction, meso-to micro folds are unambiguously predominating, locally the hinges and cores (of size around 10 m) of V_1 macrofolds can be directly observed commoly with detaily refolded limbs. The original macrofold structures are obscured by conformable superimposed meso-to microfolds. The original metamorphic foliation (S_1 surfaces with progressive metamorphic mineral association) in the northern crystalline was detaily refolded (folding V_2 with B_2 axes), contemporaneously mechanic and material destruction — synkinematic diaphthoresis took place (F. Angel, 1965) with formation of diaphthorites s.s. (F. Becke, 1909) of prevailingly mica schist appearance.

4. In the northern crystalline irregular narrow zones (several dm, m and wider) of mylonites to phyllonites of E—W direction are common, obviously originated at the same time with the thrust and mightiest phyllonite zone at the boundary of the northern and southern crystalline (width 200 — 800 m; average thickness about 170 m; dip 20 — 45° S) and with refolding of E—W syncline of flyschoid Carboniferous (with material of pebbles conformable with that from the Horčanská, Novanská and Prostredná dolina-valleys) directly on the overthrust plane of the southern crystalline on the northern. The Alpine age of overthrust was already supposed by J. Kamenický (in B. Cambel — J. Kamenický — E. Krist, 1961) on the basis of concordance of foliation of phyllonites and the Mesozoic near Podhradie.

In the northern crystalline thus structures (V_2) with retrograde metamorphic mineral association are already bound to E—W direction.

The E—W direction of structures in the northern and southern crystalline is originally older than the Alpine and the macrofolded tectonic style is characteristic of it. It is obvious from the area of paragneisses and migmatites of the southern crystalline and locally observed relict hinges and cores of macrofolds in the northern crystalline. The coincidence of Prealpine structures of E—W direction in direction and style of both types of the crystalline is especially distanct in the wider area of the Hrádok fault system. According to the Prealpine structural plan (E—W) also the blocks of the northern crystalline (between the Jastrabie and Hrádok fault systems) were tectonically affected with formation of diaphthorites, the southern crystalline block was thrust over the northern block, mylonite and phyllonite zones of E—W direction formed, the E—W syncline of the envelope Carboniferous north of Panská Javorina and so far three established smaller synclines of the envelope Permian north of trig. Inovec were folded in. The existence of Alpine E—W structures is apparent, in spite of that assignment of diaphthoresis (with the exception of the majority of mylonite and phyllonite zones of E—W direction) to the Alpine cycle of development remains questionable as diaphthoresis cannot be older than slicing.

The E—W direction of structural elements in the envelope Paleozoic of the area under study is local only. The most distinct megastructure is western continuation of the overthrust line from the crystalline to the area of the envelope Paleozoic where it separates the southern deeper structure of the envelope Paleozoic from the northern upper structure. In dark-greyishviolet clayey shales (C_2) in the Hôrčanská dolina-valley distinct minute folding, i.e. lineation of E—W direction (with density 5—6/1cm), accompanied by

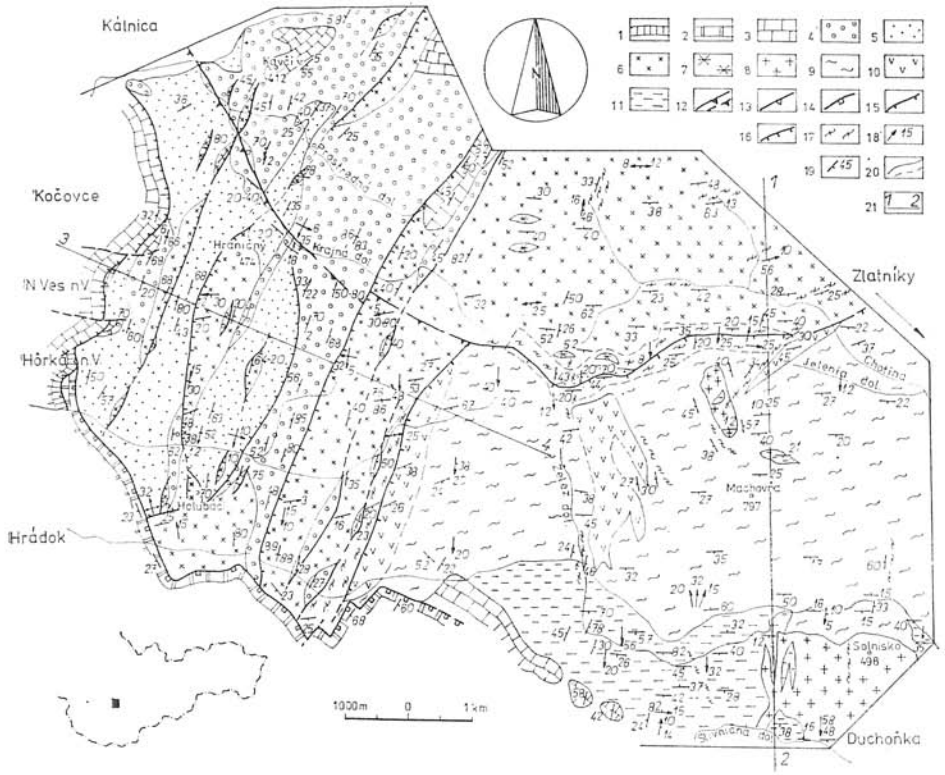

Fig. 1. Geological sketch — map of the crystalline and envelope Paleozoic of the central part of the Považský Inovec mts. (simplified according to M. Putiš, 1979).

Explanations to geological sketch — map and profiles: 1 — Mesozoic of the Choč nappe; 2 — Mesozoic of the Krížna nappe; 3 — envelope Mesozoic; 4 — envelope Permian in continental development, locally with volcanism of quartz porphyries and their pyroclastic; 5 — envelope shallow-marine Carboniferous — volcanogenic-sedimentary formation; 6 — Alpine and older? diaphthorites of the block of northern crystalline; 7 — diaphthorized amphibolites; Hercynian metamorphic — granitization cycle (8—11); 8 — postkinematic granitoids (pegmatite — aplitic granite, granodiorite); 9 — postkinematic migmatites predominantly of nebulite type; 10 — amphibolites, migmatized amphibolites; 11 — paragneisses, migmatized paragneisses, mica schist gneisses-originally Early Paleozoic effusive — sedimentary group; 12 — established and supposed faults; 13 — overthrust line of the Choč nappe; 14 — overthrust line of the Krížna nappe; 15 — overthrust line in the crystalline; 16 — upthrust lines; 17 — Alpine mylonite and phyllonite zones; 18 — B-axes of faults; 19 — strike and dip of strata, metamorphic schistosity; 20 — established and supposed geological boundaries; 21 — lines of geological profiles.

zonal crenulation cleavage, is on bedding schistosity planes (D.R. Gray, 1979). This lineation is disturbed by flexures and connected minute folds with B axes striking NNE—SSW with irregular density usually 3—6/10 cm.

The younger Alpine direction NNE—SSW is distinctly shown in the northern, transitional (thrust zone of phyllonites) and southern crystalline of

the Považský Inovec mts. In the southern crystalline it is evident in transversal mesofolds, flexures, continuous folds to wrinkling of S_1 surfaces with oblique B_2 axes (20—50°) of N—S general trend and with narrow mylonite zones in this direction. Equally deformed is the transitional zone of phyllonites. In the northern crystalline, especially in its northern part with the relatively uppermost structure with numerous synclines of folded in Permian, the E—W direction is considerably suppressed by NNE—SSW and NE—SW directions.

With the origin of structures of NNE—SSW direction folding, refolding and metamorphism of the envelope Paleozoic / green-schist facies, quartz-albite-muscovite-chlorite subfacies (H. C. F. Winkler, 1967), locally of the envelope Mesozoic (folded in and marginal), the origin of steep upthrust zones of the underlying crystalline over the envelope Paleozoic and of fuat upthrust planes of the crystalline and envelope Mesozoic over the envelope Paleozoic, as well as forming of the western margin of the overthrust southern crystalline between the valleys of Hrádocká and Krajná dolina are connected.

The youngest structures are backward upthrusts, which are most evident in the southern, i.e. deeper structure of the envelope Paleozoic, e.g. in the area of Holubákov, with E vergency.

The most distinct megastructure in the crystalline and envelope Paleozoic of the studied area is the Kálnica—Zlaník line, separating two different horizons of the crystalline and envelope Paleozoic. The crystalline of the northern block displays more upper structure with many folded in synclines of the envelope Permian and envelope Mesozoic and the youngest Alpine direction NNE—SSW was distinctly shown here. The envelope Paleozoic of the northern block is characterized at the surface by almost exclusively represented Permian, which is accompanied by mighty development of the Lowep Triassic of the Mesozoic envelope group at the western margin. The crystalline of the southern block belongs partly to the zone of diaphthorites with most distinct ENE—WSW direction with several folded in synclines of the envelope Paleozoic, partly to the southern crystalline (without envelope Paleozoic) in partly allochthonous position on diaphthorites. From the viewpoint of manifestation of structures of E—W direction, of macrofold tectonic style and distinct representation of granitoids and migmatites of nebulitic type, the deepest horizon of the crystalline is concerned in the southern crystalline. The envelope Paleozoic of the southern block with distinct prevalence of the Carboniferous and with three steep upthrust zones of the crystalline represents the lowermore part of the envelope Paleozoic, which displays anticlinore structure (Fig. 3, profile 3—4). Similarly, the envelope Mesozoic of both blocks is mutually different. The envelope Mesozoic of the the northern block, the Selec group, is of Tatric type prevailingly in allochthonous position while the envelope Mesozoic of the southern block, the Inovec, group, is of Fatric type in autochthonous position to the substratum (M. Maheľ in M. Maheľ et al., 1979).

For comparison of both blocks of crystalline I mention original representation of rocks in the northern crystalline, derived from relict minerals of progressive regional metamorphism is formed by: quartz, plagioclase (medium oligoclase — acid andesine), orthoclase, biotite ($\parallel S_1$), muscovite$_1$ ($\parallel S_1$), muscovite$_2$ (porphyroblastic XS_1), garnet-almandine, staurolite, sillimanite I

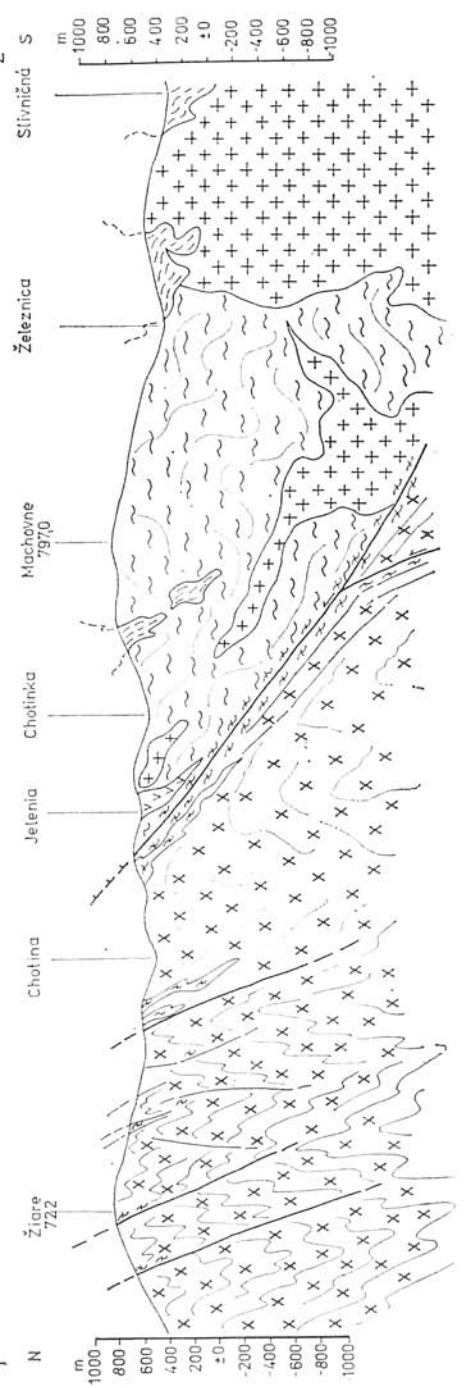

Fig. 2. Geological profile 1—2 through the crystalline.

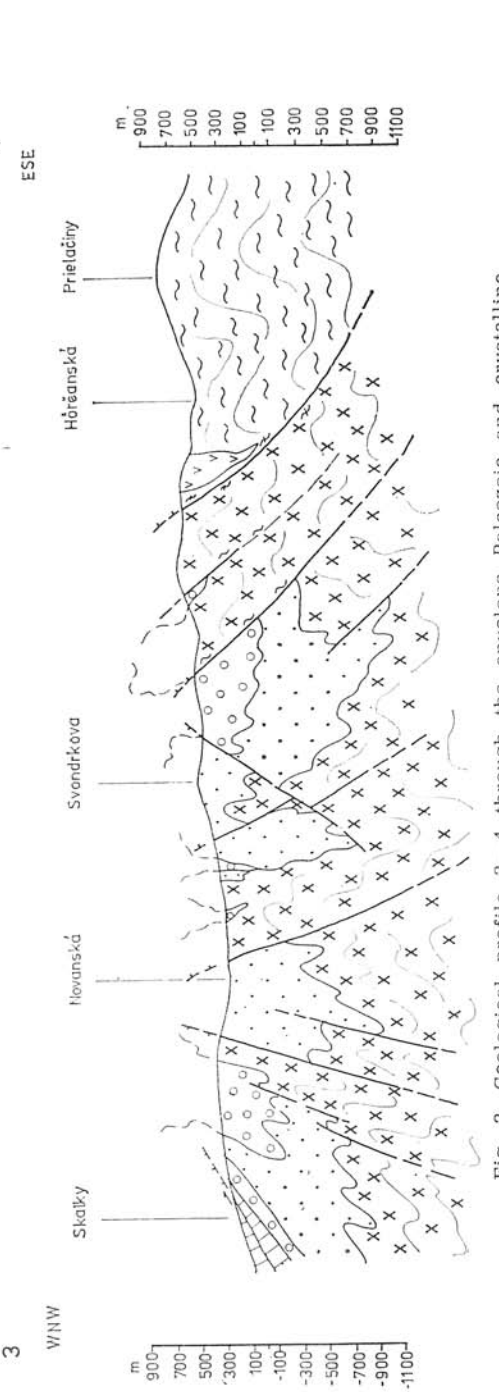

Fig. 3. Geological profile 3—4 through the envelope Paleozoic and crystalline.

(coarse crystalline ‖ S_1), sillimanite II (fibrolite from biotite, less from muscovite), andalusite (closes S_1 surfaces with biotite, and staurolite). It is evident from the mentioned that progressive metamorphism of the northern crystalline reached conditions of facies of almandine amphibolites, subfacies of staurolite-almandine, locally up to sillimanite-orthoclase-almadine (H. G., F. Winkler, l. c.). This is also testified by relict preserved rock structures before diaphthoresis, most often of migmatites, locally also with ptygmatitic folds, less of structures of paragneisses, mica schist gneisses and metaquartzites. The deformed light-coloured aplitic granite with fibrolitic sillimanite (from biotite) and garnets in the environment of diaphthorites S of Jarabice (from Trenčianske Jastrabie) corresponds in mineral composition, texture and structure to pegmatite-aplitic granite of the apophyse south of Duchoňka (southern crystalline), also with fibrolite (from biotite and muscovite) and garnets, which corresponds to the metatect of postkinematic migmatites N of the Železnica valley (southern crystalline). The ptygmatitic — folded metatect of relict migmatites of the northern crystalline is of similar character and is affected by distinct albitization and sericitization of plagioclases.

For completeness it is necessary to add that minerals as garnet, staurolite, sillimanite I, II, andalusite, even with equal relations of crystallization, are also present in paragneisses, mica schist gneisses and migmatites of the southern crystalline. In both crystallines ultrametamorphic conditions were reached.

Between original metamorphites of the northern crystalline and metamorphites of the southern overthrust crystalline is neither metamorphic throw, nor divergence of structure directions.

The analyses of pebbles of Carboniferous conglomerates in the Novanská dolina valley (J. Kamenický in B. Cambel — J. Kamenický — E. Krist, l. c.) need not be an evidence for the existence of Variscan diaphthoresis of the block of northern crystalline. The mentioned locality is situated between two big steep upthrusts of the crystalline and belongs to most distinctly Alpine-metamorphosed areas of the Carboniferous, which could have been an ideal source of waters minimum for static diaphthoresis.

In further investigation it is necessary to found out regional relation between the grade of metamorphism of conglomerate groundmass and diaphthoresis in crystalline pebbles, which is very distinct in the whole extent of the northern crystalline (if we neglect the relatively rare occurrence of relict rocks). This method is, however, also not reliable, because the source area was also the southern crystalline, as proved by the presence of pebbles of light-coloured aplitic granitoids with metasomatic indications, in concrete case also at the locality in the Novanská dolina valley.

The divergence of directions between the most distinct Alpine direction NNE—SSW and E—W direction (Early Kimmerian?) of diaphthorite structures cannot be, however, also omitted. From this aspect it is necessary to carry out structural analysis in he Razdiel part of the crystalline and envelope Paleozoic of the adjacent Tríbeč mts. where it would be rather possible to clear up the importance of E—W Alpine structures in the envelope Paleozoic than in the Považský Inovec Mt., in which this direction is local only, although this also points to minimum two-phase development of Alpine structures.

The question of the age of diaphthoresis also after application of structural

analysis in the „key" area is, in my opinion, not quite solved. A complex palynological analysis of the crystalline and envelope Paleozoic of the Považský Inovec mts. and clearing up of E—W structures in the Tríbeč mts., should contribute to success.

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REFERENCES

ANGEL, F., 1965: Retrograde Metamorphose und Diaphtorese. N. Jb. Min. Abh. Stuttgart) 102, 2, p. 123—176.

BECKE, F., 1909: Über Diaphtorite. Tscherm. Miner. Petr. Mitt., (Wien), 28, p. 364—375.

CAMBEL, B. — KAMENICKÝ, J. — KRIST, E., 1961: Poznámky ku geológii kryštalinika Malých Karpát, Považského Inovca, Tríbeča a západnej časti Vepora, Zjazdový sprievodca XIII. zjazdu Čs. spoločnosti pre mineralógiu a geológiu, slovenský výbor, Bratislava, p. 5—169.

GRAY, D. R., 1979: Microstructure of crenulation cleavages: an indicator of cleavage origin. American Journal of Science, (New Haven) 279, p. 97—128.

MAHEL, M. et al., 1979: Paleotektonická a štruktúrna klasifikácia tatríd. Manuscript — Geofond, Bratislava, 87 p.

WINKLER, H. G. F., 1967: Petrogenesis of metamorphic rocks. Revised second edition, New York, Springer-Verlag, 237 p.

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