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ISLAND CHARACTER OF KLIPPEN BELT; VAHICUM — CONTINUATION OF SOUTHERN PENNINICUM IN WEST CARPATHIANS

(Figs. 1—4)

Abstract: The island geotectonic character of the Pienides in well reasoned by the following facts: Thick flysch of the Klape and the Manín nappes formed in the Periklippen zone. This (Upper Cretaceous--Paleocene) zone is a „heiress" of an oceanic trough. The trough is an extension of the Piemont trough in the West Carpathians and is called „the Vahicum". The style of tectonic melange of the Klippen Belt and its link with a sudden change in thickness of the earth's crust also are a consequence of the island character of the Pienides.

The southern boundary of the Central-Carpathian flysch, and the northern margin of the zone with the deep tectonic style of the Tatrides are indicative of the extent of the Vahicum in the basement of the Tatrides.

Резюме: Автор в статье толкует доводы для островного геотектонического характера пиенид. Мошные флиши клапского и манинского покровов сформировались в приклипповой зоне. Эта (верхнемелово — палеоценная) зона является „наследницей" после океанического трога. Этот мы назвали вагиком (vahikum) и является продолжением пьемонтского трога в Западные Карпаты.

Стиль тектонической смеси клипповой зоны и его связь со скачком в толще коры является последствием островного характера пиенид.

Южная граница распространения центрально-карпатского флиша и северный край глубинного тектонического стиля татрид являются показателями диапазона вагикума в основе татрид.

The Klippen Belt is certainly one of the most thoroughly investigated regions of the Alpides. Increasing knowledge of the region not only makes the opinions about its history and structure more precise but also brings the demand for revision of both its geotectonical and structural divisions. This, and the explanation of the geotectonic position and the relation of the Klippen Belt to the Alpine units — particularly to the Penninicum — are the purposes of this article.

The new data show the necessity of a change in some generally accepted opinions, and even theories. This is mostly concerning the role of the Ultrapienninian cordillera — one of the most characteristic paleotectonic elements of the Klippen Belt. It has been since long referred to as the southern margin of the Pienides, linking with the geanticlinal zone of the Tatrides (D. Andrusov, 1938, 1968, 1975; M. Książkiewicz, 1977; K. Birkenmajer, 1965; M. Mišík, 1978). Then it seems logical to include in the Pienides also thick Middle- and Upper Cretaceous flysch, ranged partly to the Manín and the Klape nappes, and partly to the Kysuca unit. And here we meet the changes leading to a new approach to the position of the Pienides as an island arc (M. Maheľ, 1979 a).

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In the last years the new opinion about the position of the Klippen Belt follows from:

— the division of the Klippen Belt into two geotectonic zones: the Pieniny and the Periklippen zones (M. Maheľ, 1967, 1980);
— classification of pre-flysch members of the Manín nappe as the partial Krížna nappe (M. Maheľ, 1967, 1978 a).
— determination of the Mesozoic of the trough type in the Outer Tatrides (M. Maheľ, 1973, 1979) and changed opinion about the allochthonous nature of a considerable part of the Tatrides;
— evidenced Mesozoic age of the most part of magmatic exotic material in conglomerates (M. Rybár — J. Kantor, 1978) of flysch sequences;
— finds of ultra-basic rock fragments and of plentiful chrome spinels in the flysch of the units included in the structure of the Klippen Belt and of adjacent units of the Inner Carpathians (M. Mišík et al., 1980);
— evident necessity of a more dynamical approach to the study of relationships among separate flysch sedimentation areas (R. Marschalko, 1978);
— increasing amount of facts indicative of probable existence of pre-Alpine members of the Magura nappe (K. Birkenmajer, 1970; W. Sikora, 1976; M. Maheľ, 1978).

a) After having determined the Periklippen zone on the contact between the Klippen Belt and the Inner Carpathians, we regard the most part of the Cretaceous flysch complexes as tectonically enclosed in the Klippen Belt. In this way the proper paleogeography of the Klippen Belt, its „overfilling" gets evidently reduced and many contradictions concerning its genesis and structure are thus removed. In fact, we see a relation between the Periklippen zone and the genesis of flysch members of both the Manín and the Klape nappes.

b) Ranging the members older than flysch of the Manín nappe to the partial Krížna nappe shows the relation of the Klippen Belt to the Tatrides in a new light. The proved basinal character of the northern part of the Tatrides (M. Maheľ, 1979 a) denies the idea of a wide geanticlinal ridge along the internal margin of the Klippen Belt, and shows that the Manín unit could be replaced by other geotectonic element. This one may be represented on the surface only by its paleotectonic „descendant" i.e. the Periklippen zone. There are, however, many indirect proofs of its existence.

c) Fragments of ultrabasic rocks and glaucophane in Wildflysch conglomerates of the Klape nappe (Upper Albian-Cenomanian), glaucophane in Urgonian limestones of exotic pebbly material, plentiful chrome spinels in the Upper Cretaceous flysch of both the Klape and the Manín nappes, in Tatrid units and in the Krížna nappe (M. Mišík et al., 1980) are indicative of an extensive source area represented by a zone with ultrabasic rocks along the southern periphery and/or south of the Pienides.

d) Mesozoic age (Dogger-Albian) of variegated magmatites from exotic material of Alb-Cenomanian flysch conglomerates is a sign of spatial relation to this source (M. Rybár — J. Kantor, 1979). And thus the classical „Ultrapieninian" cordillera regarded as an element, quite exotically connected with the southern ridge, gets in our minds transformed into a zone of

magmatic activity; a varied, and evidently dissected zone, with extremely conspicuous paleogeographical changes in the Cretaceous time.

e) In addition to this, the analogous situation in the Alps leads us to expecting a continuation of the southern Pienninic trough at the south of the Pienides. We shall call it the Váh oceanic trough, and tectonic elements formed from the trough will be denoted as the Vahicum. The Pienides are an associated element at the margin of the Vahicum. The genetical and structural particularities of the Pienides indicate that the Vahicum has many special features different from the southern Penninicum as well. It is named after the river Váh because its characters are most pronounced along the river. The outer margin of the Vahicum was a zone of active volcanism, its southern part was the Fatra basin of the Tatrides. The Periklippen zone with dominant flysch sedimentation is only „a heiress", a younger post-Middle Cretaceous descendant of an oceanic trough analogous to the Gosau Cretaceous basins in Eastern Alps.

Extensive hiatuses in the Albian, breccias, mostly in the Manín unit (K. B o r z a, 1980), double association of its older sequences with the Krížna nappe (even including the transitional type of sequences — the Submanín unit; M. M a h e ľ, 1967; R. M a r s c h a l k o — J. K y s e l a, 1979) and of its younger sequences with the Periklippen zone can be explained owing to more dynamical approach to folding activity and to shortening of sedimentation areas as early as the end of the Lower and during the Middle Cretaceous. Shortening of the crust — also in the Pienides — reflected in emergence of the ultra-Pieninian „cordillera" — obduction of slices of the marginal part of the Vahicum in the Albian, and its functioning as a source of „exotic" material, mostly during the Albian and the Cenomanian times. In these times the first, extensive subduction of the Vahicum must have taken place. It was followed by formation of a large flysch trough along the inner margin of the Pienides. Neither thrusting of nappes is regarded as one event: it proceeded in several stages with a „carried" sedimentation area and with the frontal part of the Krížna nappe getting closer to the Vahicum as early as the Albian (M. M a h e ľ, 1978, 1979). This is a view, based on formerly revealed facies relations and on structural interrelation of the Manín nappe on the one hand to the Krížna nappe on the other (M. M a h e ľ, 1967, 1978). Explanation of disappearance and tectonic covering of the pre-Albian Vahicum is only possible with a more dynamical approach based on plate tectonics. Abnormal relations among flysch elements show the necessity of considerable shortening, amputations and disappearance of large areas even in later post-Upper Cretaceous periods; especially in the Periklippen zone and in the Klippen Belt (R. M a r s c h a l k o, 1978).

After definition of the Vahicum and its descendant — the Periklippen zone, the Pienides zone is seen as a northward extending, dissected island arc, with a thin continental crust, with a comparatively stable intraoceanic ridge (Czorsztyn) on the north, with a dissected southern slope, associated with a narrow Kysuca trough and a volcanic island arc on the south. The latter with the southern Váh oceanic trough. (Fig. 1).

Looking upon the Pienides as an island arc must be based on presumable existence of a northern trough on the north. North of the Klippen Belt, the Magura nappe consisting mostly of the Paleogene flysch, has an evidenced

proper sequence from the Albian (since the Hauterivian along the eastern margin of the Alps). There, however, are slices of particular facies in the contact zone between the Klippen Belt and the flysch belt in the Pieniny, indicative of apppurtenance to the lower parts of the Magura nappe (K. B i r k e n m a j e r, 1970). The Aalenian flysch — manganese radiolarites — green and red radiolarites — aptychi limestones — spotty pelagic limestones with

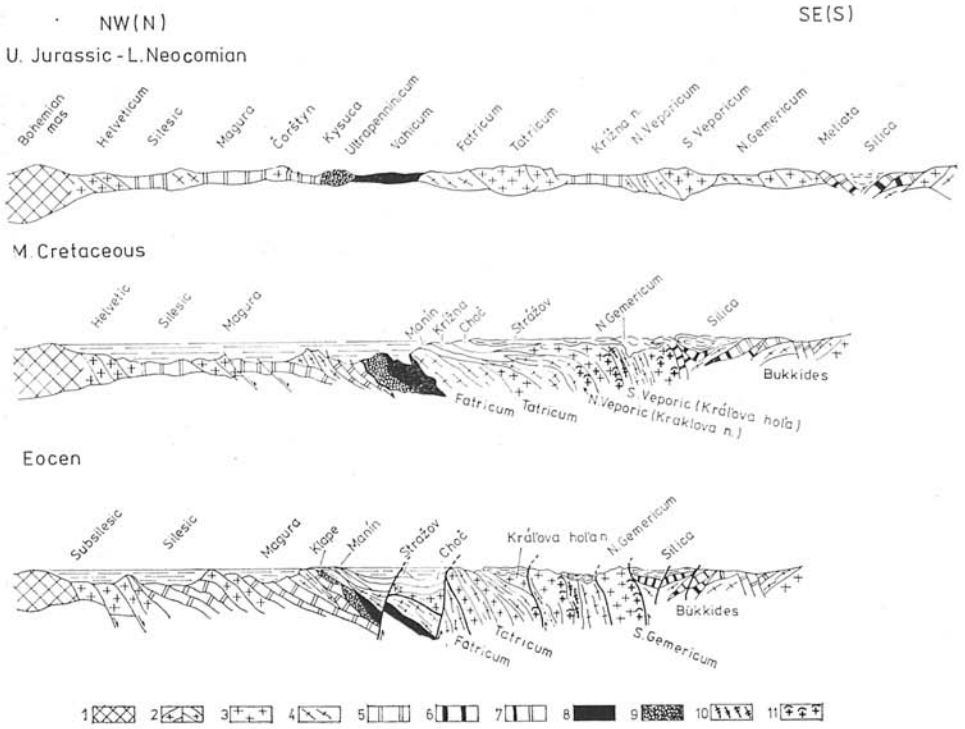

Fig. 1. Scheme of paleotectonic development of the West Carpathians in the period of the Jurassic to Eocene; Michal M a h e ľ.

1. Platform (Bohemian Massif); 2. Alpine — activated older massif, a) margin of platform; 3. Thick sialic crust (granitoids) of intraoceanic ridges; 4. Heavier sialic crust (with basic rocks); 5. Thin sialic crust of throughs; 6. Paraoceanic crust; 7. Unequally dissected paraoceanic (partly oceanic) to sialic crust; 8. Oceanic crust; 9. Paraoceanic crust of volcanic island; 10. Zones of intensive intrasialic subduction; 11. Penetrations of Alpine granites.

silicites (Albian) — prove the existence of the Magura trough. Fragments (D. A n d r u s o v, 1968) are also a proof of the existence of such Jurassic-Lower Cretaceous trough which is a logical consequence of its spatial relation to the Biely potok unit — „Black flysch" with thick basic rocks (M. S a n d u l e s c u, 1980).

The island character of the Pienides is proved in the Carpathians by elsewhere unusual abundance of macro- and microfauna in extremely varie-

gated carbonate facies. It is proved most conspicuously by a comparison of the Barremian-Aptian limestones of the Manín nappe with the synchronous limestones in pebbles of Albian-Cenomanian conglomerates (D. Andrusov, 1968; K. Borza, 1980). There also are great differences shown by comparison of deep-sea Jurassic-Lower Cretaceous members of the Kysuca unit with the Manín nappe, and in comparison of faunal variability of crinoidal

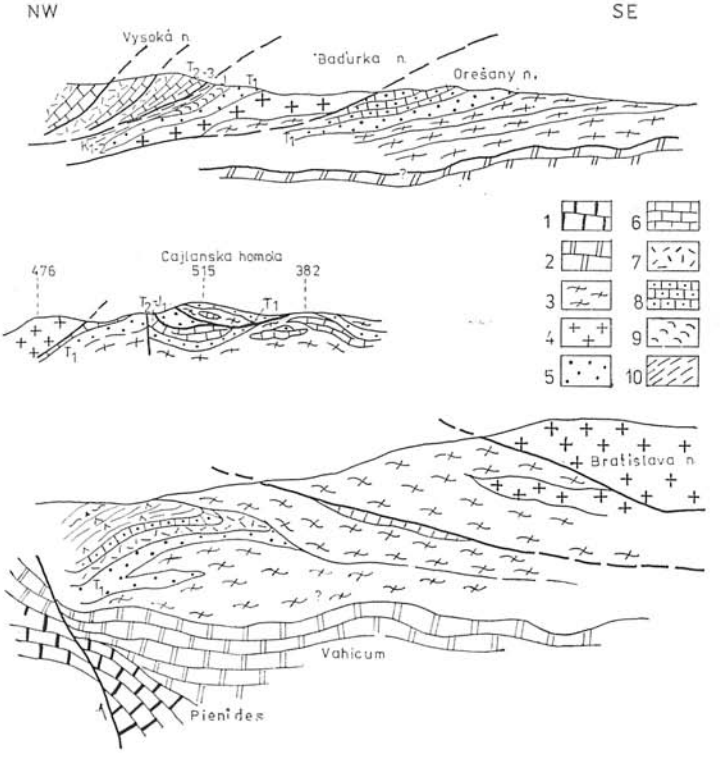

Fig. 2. Geological profiles through the Malé Karpaty Mts. crystalline core Michal Maheľ.

1. Pienides; 2. Vahicum; 3. Crystalline complex, gneisses to phyllites with layers of basic rocks; 4. Granitoids; 5. Lower Triassic, quartzites; 6. Limestones of variegated facies J_1; 7. J_{1-3} Shallow-water variegated limestones; 8. Neocomian — Albian; 9. Limestones, dolomite limestones, brecciated limestones — Triassic-Liassic; 10. Dolomites.

Kostelec limestones with that of spatially related crinoidal Liassic limestones of the Choč nappe.

The Pienides being defined as a dissected island arc, such characteristic features like heterogeneity and facies contrast seem natural. It has been known since long that every formation comprises a scale of facies from shallow-to deep-sea, and many transitional sequences from basical paleotectonic types (the Czorsztyn-cordillera) to the deep-sea (Kysuca, the Pieniny; D. Andrusov, 1938; K. Birkenmajer, 1965).

Besides ascribing the island character to the Klippen Belt, when determining the type and extent of the Penninicum in the West Carpathians it is necessary to know allochthoneity of the Tatrides and their association with the East-Alpine units. The Tatrides were regarded as autochthonous long ago, except their basal parts (D. Andrusov, 1968), and referred to as analogous to the Briançon belt, i.e. equivalent to the central Penninicum (J. Debelmas, 1960; Z. Kotański, 1979; A. Tollmann, 1975, 1978).

Investigations in the last time resulted in interesting data. Mesozoic recumbent folds amidst crystalline masses in the Malé Karpaty Mts. and in the Považský Inovec (M. Maheľ, 1979, 1980), heavy masses in small depth below granitoid massifs, especially in the Malé Karpaty Mts., are indicative of more extensive thrusting of the Tatrides (Fig. 2). Two types of crystalline complexes with different crusts alongside and above each other (granitoid masses and metamorphites with amphibolites) are also signs of tectonical position. Basing on that, and on paleotectonically different types of the Fatra and the Tatra Mesozoic (M. Maheľ, 1978) we regard it very likely that there were intensive overthrusts of the crystalline complexes in the Malé Karpaty Mts., Považský Inovec Mts., in the Malá Fatra Mts. and in the western part of the Tatra Mts. Interestingly in the Malé Karpaty Mts., in the neighbourhood of the Alps, (Fig. 3), the lower units of the crystalline complex (the Pezinok-Pernek Group) are very similar to the lower units of the Unterostalpine, especially to the Wechsel Group (A. Paahr's opinion) overlapping the Penninicum at the eastern margin of the Alps in the tectonic window Rechnitz. It follows that the Tatrides are an analogue of the Un-

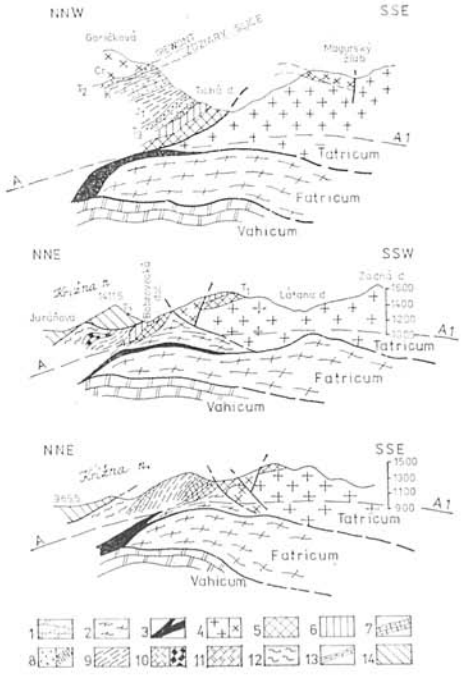

Fig. 3. Geological profiles through the crystalline complex and its Mesozoic envelope in the Tatra Mts. (Upper part of the profiles according to J. Veizer, 1970, the lower part under the line A — A_1 in interpretation of M. Maheľ).

Explanations: 1. Vahicum: Mesozoic and crystalline complex; 2 — 3. Fatricum: 2. crystalline complex, 3. Mesozoic; 4 — 13. Tatricum: 4. Crystalline complex, prevailingly granitoids, a) more distinctly Alpine — affected, 5. T_1 quartzites, 6. T_1' cavernous „dolomites" and Werfen shales, 7. T_1' „Myophoria" beds, 8. T_3r Tomanová beds, a) Rhaetian — Hettangian, 9. J_1 Liassic, 10. Malm — Neocomian, a) with limburgites, 11. Urgonian: Barremian — Aptian, 12. Albian — Cenomanian, 13. Anisian limestones in slices; 14. Krížna nappe — Triassic.

terostalpine of the Alps, with many particularities and lesser alpine reworking. Distribution of positive gravimetric anomalies (L. Pospíšil — M. Filo, 1980) beneath crystalline cores of these mountain ranges, and the above mentioned data are good reasons for the opinion about the extension of the Vahicum — the continuation of the Penninicum — beneath the northern margin of the Tatrides.

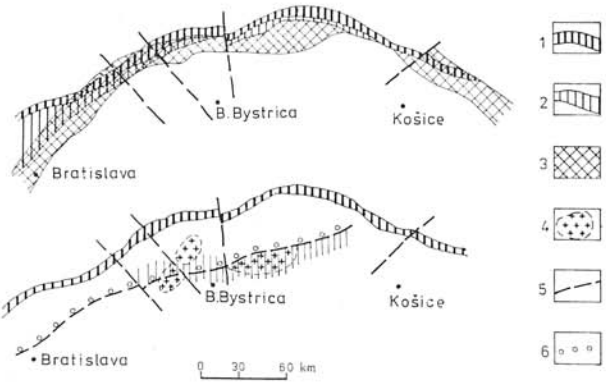

Fig. 4. Sketch map of some indirect manifestations of the Vahicum in the West Carpatians (Michal Maheľ).

1. Klippen Belt; 2. Periklippen Belt; 3. Belt of heavy masses in the basement (according to gravimetry); 4. Light masses — granitoids in the basement; 5. Northern margin of the deep tectonic style of the Tatride crystalline complex; 6. Southern margin of the basins of the Central Carpathian Flysch.

The southern boundary of the Vahicum may be deduced indirectly from two geological phenomena: a) the „deep" tectonic style of southern zones of the Tatrides; b) the southern boundary of the thick Central-Carpathian flysch. (Fig. 4).

Tectonic style of the most part of the Ďumbier massif with tectonically included Mesozoic of the Konský Grúň and the Trangoška syncline, and also a comparatively steep, southward dipping of other structural elements (overthrusts, S_2-planes) are signs of rooting of these parts of the Tatrides. It is presumed, that the rooted zone of the Tatrides ran along the line connecting the eastern part of the Tatra Mts. the Ďumbier massif (except the northwestern part — the area of Prašivá) — Žiar — the major part of the Tribeč Mts. The rooted zone of Tatrides is also characterized by the distribution of light masses.

The northern margin of this zone coincides also with the southern boundary of Central-Carpathian flysch basins. Formation of longitudinal flysch basins, connected with considerable deepening of sedimentation areas, and also with thinning of the crust, could possibly be explained as a consequence of accumulation of heavy masses at depth. The accumulation is due to subduction of the Vahicum beneath the norhern part of the Tatrides at the end of the Paleocene to Middle Eocene. It follows that underthrusting of

the Vahicum, its subduction, proceeded in more stages; during the Middle Cretaceous, perhaps in the Senonian (as indicated by the Senonian flysch in the Periklippen zone) and since the Paleocene to the Lutetian.

This paleotectonic pattern is in accordance with the principal paleotectonic zones of the Alps and of the East Carpathians. The Magura trough is a continuation of a trough in which the Rhenodanubian flysch regarded a continuation of the northern Penninicum, formed (the Valais zone; R. Oberhauser, 1968; W. Śikora, 1976; M. Książkiewicz, 1977); or a trough along the inner margin of the Helveticum (S. Prey, 1978). At the east, the Magura trough joins the East Carpathian inner units of the flysch belt „Black flysch" — Ceahlău. The Pienides are an analogue of the central Penninicum (Sulzfluh, Falknis; R. Trümpy, 1975; R. Oberhauser, 1968). Flysch complexes of the Klape and the Manín nappes are analogues of the „Randcenoman" at the northern margin of Limestone Alps, and of flysch mass of Verspala as well as of the Simen nappe (R. Oberhauser, 1963). Determination of the Vahicum is a solution of the problem concerning the continuation of the southern Penninicum in the Carpathians. It is actualized by plate tectonics based on the principle of the course of the Tethys ocean or oceanic trough running across the separate segments of the Alpides (J. Auboin et al., 1980). So it was not surprising that in the last years there were several variants and every zone of the Inner Carpathians was regarded as a possible continuation of the Penninicum. This problem should be thoroughly analyzed — here we only make some remarks.

The existing views on the Klippen Belt prevented unambiguous explanation of its relation to the units of the Alps and Eastern Carpathians and there still are many contradictory opinions about parallelization of the Carpathian units with the adjacent segments.

Some opinions are based solely upon the complicated structure of the tectonic mélange type of the Klippen Belt and regard it as a continuation of the Penninicum in full extent and/or of the central and the southern Penninicum (J. Dewey et al., 1973; L. Szádeczky-Kardoss, 1973; A. Grubič, 1974; J. Debelmas — M. Sandulescu, 1980).

Others regard the Klippen Belt as the ultra-Helveticum, the Tatrides as the central Penninicum (A. Tollmann, 1975, 1980), or they parallelize the Pienides and the Tatrides with the Briançon zone of the Penninicum (Z. Kotański, 1979); or wedge-out the southern Penninicum on its transition into the Carpathians (D. Andrusov, 1968; Z. Kotański, 1979). Original is the approach of I. Horvath et al. (1977) to the Penninicum: the Klippen Belt is regarded as the northern margin of the Austroalpinicum, thrust over the Veporides referred to as central Penninicum confined by the Lubeník ocean on the south.

Some authors even regard the Klippen Belt and the Veporides, the Gemerides and the Bôrky nappe as the southern Penninicum (B. Leško — I. Varga, 1980). Large-scale parallelizations with the southern Penninicum (G. Wein, 1976) are inspired by ultrabasic rocks and glaucophanes in the Meliata Group. Only they did not notice that the Meliata Group is Triassic: not only its deep-sea carbonate and pelite facies but also the associated radiolarites (personal information by J. Mello). The Triassic also shows its characteristic paleotectonics and paleogeography with irregular paleo-

geographic dissection (practically each so far described profile displays differences; H. Kozur — R. Mock, 1973). The faunal type, mostly of conodonts, is distinctly Dinaric. And alt this is in evident contrast to the Triassic of the Penninicum. Continuation of the Penninicum can only be found in northern zones and in zones characterized by the Triassic with the Keuper and by presence of thicker Cretaceous members. But the Krížna nappe is out of question: here are no ophiolites, and all its members, beginning with the Rhaetian, resemble the Frankenfeld nappe of Eastern Alps (M. Maheľ, 1964; S. Prey, 1978). And since the back parts of the Krížna nappe are rooted in the North Veporides, these can in no case be regarded as the Penninicum. Their alpine metamorphosis is no character of particular significance (this problem will be discussed elsewhere).

Continuation of the southern Penninicum — the Piemont zone — can be found at the southern margin of the Pienides, and south of the ultra-Pieninian „ridge" — the source of exotic material also for the „Randcenoman" of the Eastern Alps. In our parallelizations, particularities of structure of the separate segments in the Alpides are taken in account. The Klippen Belt itself — in spite of rough analogues with the central Penninicum — has many particularities in its genesis and structure. The same most likely concerns the Vahicum — a continuation of the southern Penninicum from the Alps.

Island character reflected in tectonic structure of the Pienides

The Klippen Belt has since long been ranged among tectonic megabreccias, melanges (D. Andrusov, 1938) characterized by a particular mature klippen style (M. Maheľ, 1963): a belt of rigid klippes, slices, and blocks, with a more plastic envelope; a belt of extremely dissected and even chaotic structure. The complicated structure of the Klippen Belt comprises several tectonic phenomena, namely:

— separation from the basement, mostly at the base of the Upper Lias; the lack of Triassic members (with some exceptions) is reflected in the absence of the trunk part or of structural core significant for formation of nappe;
— northern Czorsztyn sequences and transitional sequences tectonically covered by the southern Kysuca Group (D. Andrusov, 1968);
— the Pienid units covered by nappes representing flysch complexes thrust over from the Periklippen zone, the Klape and the Manín nappes with thick Jurassic and Lower Cretaceous complexes of the Inner-Carpathian type (including slices of the Zliechov nappe);
— diapiric „free" movement of larger and smaller rigid elements; their penetration into various levels of the plastic envelope (D. Andrusov, 1938). Heterogeneity of the material and contrasts in competence of the separate sets are especially conspicuous in the Czorsztyn unit in its rigid Jurassic-Lower Cretaceous, mostly limestone members (klipes) amidst the plastic, prevalently Middle-Upper Cretaceous marlstone-shaly envelope. The result is a special tectonic style: the mature klippen style (M. Maheľ, 1963). This concerns only partly the Klape and the Manín nappes.

Besides these known facts it is necessary to take in account the significant

role of the island nature of the Klippen Belt in formation of its complicated structure. The island character of the Klippen Belt showed itself in: a) sudden changes in type of facies and so in changes of material heterogeneity and of thickness of the individual complexes; b) in spatial enclosure of a narrow heterogeneous belt by homogeneous complexes of the Magura belt, the Vahicum and/or of the Periklippen complexes.

Owing to its comparatively small width and varied heterogeneous content, the Pieniny zone enclosed - during the repeated subductions of the Magura trough and of the Vahicum — among homogeneous complexes, offered favourable conditions for crumbling in the course of shortening proceeding in several phases. Thus many structural elements formed, from larger folds, slices, to small blocks and shreds performing free movements. These resulted in tectonic melange with characteristically complicated and chaotic structure in smaller extent yet with well organized distribution of basical units, and basical features of structure along a more than 800 km long belt.

Besides ascribing a considerable significance to geotectonics of island type in formation of structural character, our opinion is also based on the idea about the Klape nappe not as a part of the Pienides but an element thrust from the northern margin of the Periklippen zone. Middle and Upper Cretaceous complexes of the Klape nappe were characterized by thick flysch as early as the Albian, and by conglomerates with exotic material in the Albian-Cenomanian (R. Marschalko — J. Kysela, 1979). Isolated klippes from pre- Middle Cretaceous members with shallow-water facies are most likely olistolites originating from the marginal part of the „ultra-Pieninian cordillera". The Klape nappe as the youngest member, containing the Maastrichtian, covers the upper parts of the Pienides (Santonian — J. Salaj — O. Samuel, 1963).

Since the Middle Cretaceous the Manín nappe has been a part of the Periklippen zone, partly adjacent to the Klape sedimentation area. The youngest member (Campanian) covered by the Manín nappe is indicative of its frontal part having been included in the structure of the Klippen Belt proper at the end of the Upper Cretaceous or during that time simultaneously with the Klape nappe. In the Periklippen zone the Upper Cretaceous of the Manín nappe is continuously joined to the Paleocene to the Lutetian — the members indicative of gradual transgression toward the inside of the Carpathians (O. Samuel — K. Borza — E. Köhler, 1972).

Sudden changes of shallow-water facies into deep-sea flysch getting still younger toward the inside of the Carpathians, can be explained as reaction to gradual subduction of heavy masses, more-or-less related in time to the shortening of the Periklippen zone and of the Pienides, resulting in formation of nappes.

Explaining the structural character of the Klippen Belt, we must notice that in its most part there is a change in crust thickness (in places more than 10 km) known as the Peripieninian lineament. This change in crust thickness is a result of subduction. The change in course of two phenomena resulting from subduction, namely morphostructural plan of the Klippen Belt and deep step in crust thickness, reflected in width and dissection of the Periklippen zone and in different relationship between the Inner and the Outer Carpathians with three segments (M. Mahel', 1980):

— peri-Alpine (south of the Jastrabie fault) with the broad zone of the Vahicum covered by nappes of the Tatrides and by wider Periklippen zone. Change in the course of the Klippen Belt and of the peri-Pieninian lineament may be due to later thrust of the Klippen Belt and of the frontal part of the Inner-Carpathian block over the Flysch Belt „en bloc" — like in Eastern Alps;
— the Central-Slovakian segment with the Manín and Klape nappes and with the narrower zone of the Vahicum covered by nappes of the Tatrides and by Subtatric nappes;
— the East-Slovakian segment with extensive back overthrust of the Flysch Belt and thus covered considerable part of the Periklippen zone.

Extent of the divergence between the Klippen Belt and the change in crust thickness may be controlled by later movements. Both the change of crust thickness and the structural character are associated with the original geotectonic character of island arc with most intensive shortening of sedimentation areas and of the crust. The change in crust thickness can be a scar after repeated subduction along a zone with continental crust of an island arc. Structural type of tectonic melange of the Klippen Belt is an evidence of accumulation of masses on the island barrier.

Translated by E. Jassingerová

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