

TEKTONIKA

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THE TECTONIC STYLE OF THE KLIPPEN BELT AND THE IDEA ABOUT ITS ORIGIN

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NOVÝ POHLAD NA TEKTONICKÝ VÝVIN
BRADLOVÉHO PÁSMA KARPÁT

НОВЫЕ ВЗГЛЯДЫ НА ТЕКТОНИЧЕСКОЕ РАЗВИТИЕ
ЗОНЫ КАРПАТСКИХ УТЕСОВ

The stratigraphical research of the klippen belt during the few last years advanced very evidently. The greatest part of new results was contemporarily published in Czechoslovakia and in Poland. (K. Birkenmajer 1960, D. Andrusov — E. Scheibner 1960). However, during the last months were found new important facts, the explanation of which brings evident changes in ideas about the geological and tectonical development of the klippen belt.

The author in form of review carries out his own idea about the geological and tectonical development of the klippen belt. As a material for his idea served the critical revaluation of older knowledge, his own investigations in various parts of the klippen belt and he took into consideration also the results of works of many other geologists.

In paleontology, if we introduce the systematical units, we have to carry out the characteristic signs, on the basis of which the subdivision was made. This rule would have been accepted also in introduction of regional geological units. This makes more perfect and correct subdivision into smaller geological units.

The characteristic signs of the klippen belt are: unusual side compression, almost vertical run, chaotic tectonic, which was caused by weak stability of substratum, undoubtedly repeated tectonic movements, in consequence of which the boudinage originated. The rigid beds are mantled tectonically by plastic beds,

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which with them partly stratigraphically connect. In some parts, according to K. Birkenmajer (1959), the diapyric tectonic originated. Further character is the variegation of facieses and zonal character of deposition. The complicated tectonic building became evident after development of typical geomorfology, which in fact gave the name to whole klippen belt.

On the basis of differences in deposition during the Dogger and Malm there were distinguished the series as follows: Pieniny series, Czorsztyn series as basal ones and between them transitional: Kysuca, Podbiel, Pruské series (in Czechoslovakia) and Branisko, Niedzica, Czertezik series (in Poland). Beside the stratigraphic independence they were regarded as single tectonic units and it was supposed, that the above-mentioned series were slipped on themselves. After systematic study of the occurrence of single series we see clearly, that in no profile across the klippen belt we find together five above-mentioned series. The most frequently two series occur together, resp. three ones. Only at two places in whole klippen belt we observe four series, however, these places require systematic revision. This fact, which we can observe in whole klippen belt besides of two mentioned exceptions, speaks about it, that it is a rule and we have to explain it. This phenomenon is in evident discrepancy with the older scheme of the klippen belt.

If we detailed study the klippen belt we see, that the most constant is the Czorsztyn and Kysuca series, sometimes also the Pieniny series, while the other ones laterally pass into the above-mentioned series. The meaning of it is, that the transitional developments have no tectonical independence, but they are always only the part of some of three tectonic units. Some of the facts are of such character that on the basis of them we can simplify the scheme into two main, very variable series and further new: Haligovce series. I suppose to use the term development (instead of series) for Podbiel, Pruské (Niedzica and Czertezik in Poland) „series“ to introduce this fact into life.

In Mesozoic of the Central zones single higher units were divided into several series. It is an consequence of a great progress of the lithological and stratigraphical research. However, this phase of research in the klippen belt ended. The facial variegation in the klippen belt is very great and it made possible the subdivision into more series as it was done up to present. It is clear, that we cannot continue by this way. Instead of it we have to find the relations between developments on the basis of a study of facieses and their situation with acception of the tectonic. Research of the klippen belt is clearly in further stage and it is sure, that in next future also in central zones will come to similar stage.

The stratigraphy in the klippen belt is considerably developed and allows the general paleogeographic reconstruction. Before it allow me, please little idea about the Pieniny particular geosyncline.

This particular geosyncline represents during the Mesozoic to the Turonian

inclusively the most northern particular geosyncline of Téthys. Its different character and action from the central zones are caused by different character of the substratum. The general knowledge about the character of deposition during older Mesozoic in zones north of Pienidy geosyncline are not complete. However, in general we can say, that sedimentation under present flysh zone has no typical signs of geosyncline, but epicontinental ones. It is again caused by substratum. From this follows that at northern border of the Pienidy geosyncline there was a change in the character of substratum. It can be suggested that just here it reached the stabil part of the Czech massiv on one hand and northern and northeastern situated old consolidated blocks on the other one. The Pienidy geosyncline developed just at the district where the stabile blocks ended and nor stabil part of mediterranean region began, in which the geosyncline Téthys was situated. The Czorsztyn series in general is of geanticlinal character and probably originated at the margin of the stabil blocks. Possibly just izostatic movements of these blocks caused emersion of some parts of Czorsztyn district of sedimentation.

In determination of main paleogeographic characters of the Pienidy geosyncline it is the best to begin in the period when existed facies with considerable extent and thus their relations we can explain the most easily. Such period is Dogger — Malm which gave also a criterion for division into single series.

In lower Dogger in whole Pienidy geosyncline the beds with *Posidonia alpina* developed which in details differ in lithological differences and mainly in thickness of deposits. In the Czorsztyn series in the Czertezik development, in Czechoslovakia in Pruské development the thickness of deposits is of no importance characterized among others by the occurrence of pyrites and an abundance of bitumine matter. In the Kysuca, Branisko and Pieniny series Aalenian reaches considerable thickness and contemporarily the main part of the suite is built by sediments of the flysh character. In the Bajocian — Bathonian the Pienidy district of sedimentation was evidently divided and in Pieniny, Kysuca (Branisko) series the sedimentation continues into facies of spotted limestones allied with the beds with *posidonias*. In the Czorsztyn series, Czertezik, Niedzica, Podbiel developments the shallow water deposits developed, mainly crinoid limestones. Later in the Bathonian nodular limestones developed, however, they are of no deep water character. This facies continues into upper Malm in the Czorsztyn series with an alternation with muddy and crinoid limestones and mainly in this series the vertical movements caused locally an interruption of sedimentation during the lower Cretaceous occurred. In the Calloway, Oxford of the Pieniny series, Kysuca (Branisko) series limestones with radiolarians and radiolarites originated, which in the lower Malm we find in the Podbiel, Pruské, Niedzica and Czertezik developments. These sediments are of clearly pelagic character without transport of detritic material. The analysis of contemporary facies during this period in

single series allows the reconstruction of the Pienidy district of sedimentation. To this purpose also situation of facies in the upper Malm serves, i. e. mainly of nodular limestones in the Kysuca series, Podbiel, Pruské, Niedzica and Czertezik developments. Further also limestones of biancone type in the Pieniny, Kysuca series and in transitional developments too. From this follows, that in the Dogger and Malm we have near by facies pelagic without deposition of the detritic material and shallow water ones, in which we observe deposition of the detritic material. These facies we have to situate thus as it follows from their relations. We cannot suggest, that the shallow water facies originated in the central part of the basin and at northern and southern margin the deep series deposited without the deposition of the detritic material, because then we cannot explain and situate the source of the detritic material of the Czorsztyń series and transitional developments. If we suggest, that the Czorsztyń series deposited at the northern part and south of it deeper series done then the detritic material was transported from south and it is very probable, because here was the margin, to some extent of epicontinental character, where occasional emersion is typical. The scheme of situation of single series we simplified thus we have to consider not only the cross situation of facies and developments, but also the longitudinal subdivision and this was up to present done. We have not now enough time to discuss detailed all stages but there are many evidences about the general subdivision of the Pienidy particular geosyncline into northern part, where the shallow water geanticline sedimentation developed and southern one, with deep sedimentation.

A short time ago K. Birkenmajer (1959) included the Haligovce series into the klippen belt and supposed that it was deposited at its southern margin. The Haligovce series has many common signs with the Manín series and although the Manín series was deposited south of the Pienidy geosyncline it was not in direct connection with it and substantially differs from it.

A. Began (1961) and his collective reworked the stratigraphy of the Kłape series. It seems that many correspond characters of this series with the Haligovce series exist. It is mainly crinoidal development of the upper Lias and partly of Dogger and in general of shallow water character. Correspond characters are also in development of the Cretaceous. The Haligovce and Kłape series have a geanticlinal character in Lias, lower Dogger and Cretaceous.

In the Pienidy particular geosyncline we always missed its southern margin which had to have the shallow water character. It seems that we find it just in the Haligovce and Kłape series. There are many evidences of the fact that the district of sedimentation of this series, resp. its part in form of cordillery in the Turonian was emerged and became the source of the clastic material in the lower Turonian. As an evidence of it the composition of pebbles in the upper part of the Orlové beds and mainly in the upper Cretaceous serves.

We said here shortly something about paleogeography of the particular Pieniny geosyncline and adjacent regions. When we compare it with the present state, we have to allow the existence of very complicated development of the klippen belt.

I am right if I say that the complicated building of the klippen belt developed during intensive tectonic movements. The main phase of the tectonic movements in the central zones represents the movements subhercynian or beforegosau. Already this fact and the fact that the Pienidy particular geosyncline represents the weakest part of Téthys in this region speaks about the influence of these strong tectonic movements. Despite of certain objections to the sedimentary gap between the Turonian and Senonian already from this standpoint we have to take up a critical attitude. During the tectonical movements of mentioned age the basal tectonic building of the klippen belt developed characterized by extreme compression, development of recumbent folds and their slipping on along charriage, however, we cannot now reconstrue it. Very important phenomenon is that along the whole klippen belt the tectonic movements were not contemporary, somewhere they began earlier and somewhere later.

Research of the stratigraphy makes this question clearer. In the upper Cretaceous coarse-grained deposits filled up depressions of tectonic or morphological character. Sedimentation during the upper Cretaceous is characterized by a great variegation of facieses; the axis of the sedimentary district of the klippen belt was shifted evidently to the south and the most constant facieses were in the northern part of the former. As an evidence of this the angular discordancy near Zaskal serves.

At this place we have to note that the tectonic movements were not of equal intensity in various parts of the klippen belt as a whole in direction to the north in consequence of pressure of consolidated southern blocks and this caused the prolongation of the klippen belt, its breaking up, the development of boudinage; this of course may originate already during the former folding. Substratum of the klippen belt and also exotic cordillery immersed and hid in deep. The exotic conglomerats, which later in Paleogene occur, in central-Carpathians or in outer Carpathians were probably redeposited, similarly in the Neogene. In the Paleogene the klippen belt represented nearshore flexure, a certain boundary-line of district of sedimentation or evidently anticlinal cordillery, which was a source of clastic material as evidence new investigations in the Paleogene. In the Paleogene mainly in Eastern Slovakia in general the klippen belt acts as manifest tectonic-sedimentary element; after Paleogene, probably during savian phase the axis of the district of sedimentation was replaced and the tectonic building of outer zones developed; the klippen belt was effected tectonically, further laterally compressed and because the centre of gravity of forces acting from the south was in greater deeps then during the former foldings, in the klippen the retrograde

movements occurred, the overturning to the south came up and the southern margin was along steep dislocation. This lot of the klippen belt was caused by a losing of any support in the substratum, which hid into considerable deep.

In conclusion one has to say, that the klippen belt is characterized by unusually complicated tectonic caused by repeated movements and special character of the substratum. The Pieniny particular geosyncline was intensively across and longitudinal divided and we can distinguish two shallow water series at the north and south, two deeper series, the relations of which are a matter of further study and several developments of transitional character in transverse and longitudinal direction. Further progress of our knowledge about tectonic will be in close connection with stratigraphical and paleogeographical studies. The key to that is in still closer connection of lithological, microfacial and biostratigraphical investigations and a study of composition of all detritic suites, looking for an explanation of sources of clastic material. Just the valuation of the last questions makes possible the correctness of our ideas about the tectonic development of the klippen belt.

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