ERVÍN SCHEIBNER[1]

THE POSSIBILITY OF PALEOGEOGRAPHICAL RECONSTRUCTIONS IN THE KLIPPEN BELT ON THE BASIS OF ANALYSIS OF TECTONIC BUILDING

MOŽNOSTI PALEOGEOGRAFICKÝCH REKONŠTRUKCIÍ V BRADLOVOM PÁSME NA ZÁKLADE ANALÝZY TEKTONICKEJ STAVBY

(Textfigs. 1–6)

A b s t r a c t. On the basis of supposed radial lift of the klippen belt to the north is being reconstructed an approximate localisation of the Pieniny geosyncline in the geological past. An attempt to reconstruct the distribution of the Upper Liassic-Lower Dogger facies in the Pienidy geosyncline.

In solution of questions of migration of faunas (mainly Cephalopoda), facial and sedimentological problems as well as stratigraphical, arose necessity of paleogeographical reconstructions. Compilation of paleogeographical maps in the folded chain mountains of alpine type is very complicated. Unusually complicated tectonic building of the klippen belt makes an arrangement of such maps very difficult.

On the basis of study of facial development of single pienidy series in the klippen belt it is possible to arrange the paleogeographical scheme of the Pienidy geosyncline (D. A n d r u s o v, 1945, K. B i r k e n m a j e r, 1957, D. A n d r u s o v, E. S c h e i b n e r, 1960). To some degree, it is possible with more or less accuracy to determine the width of this geoscyncline (about 30 km).

Very important, however, is to determine the original position of the sedimentary district before tectonic movements in regard to some point which were only insignificantly effected by movements which caused the folding of this geosyncline. Such stable points are in the Silesia-Kraków platform.

Doubtless, the Carpathian geosyncline was folded in direction to the north. From this follows, if we take into consideration an appreciable compression in the north-south direction, that the sedimentary district extended to the south off the recent extension of mountains. From this also follows that the Pienidy particular geosyncline extended south of the recent klippen belt.

The klippen belt we may characterize as extremely from both the sides compressed belt with almost vertical position (deepened) with "chaotic" tectonic caused by little stability of substratum and repeated tectonic movements. Rigid complexes are broken up into blocks, lenses, fragments and tectonically mantled by plastic suites. This building resembles to some degree a boudinage of a great size. It developed not only by extreme compression from aside, but also by

[1] Prom. geol. E. S c h e i b n e r, Dept. of geology of the Faculty of Natural Sciences of J. A. Comenius Univ., Gottwald's sq. 2, Bratislava.

moving of whole the belt to the north; this caused phenomena of longitudinal dilatation. In essentiality it was a rectilinear radial movement and the move to the north was proportional to enlargement of length or arch (Textfig. 1). Due to this enlargement the rigid suite of the Pienidy series were broaken up. By retrograde analysis, measuring of length of distances between single members of the "boudinage" in whole the klippen belt we obtain directly the length of enlargement of arch of the sedimentary district of the klippen belt by move to the north. If we subtract this length from the recent length of the klippen belt we obtain the original length of the Pienidy particular geosyncline (respectively of its part which we took into consideration). To find an amplitude of move northwards we must find the centre of radial movement. The last we may construct by such manner that we construct a series of perpendicular lines to the recent extension of the klippen belt and in place where they cut is an approximate centre of the radial movement. In our case this centre is in the vicinity of Hungarian town Keczkemét (south-south-east of Budapest). (Textfig. 2). Some perpendicular lines are quite a distant from the centre due to the cross flexures in the klippen belt, which disturb on whole regular arch of the klippen belt.

When the centre of the radial movement is marked 0 (Textfig. 1), then a marks a distance of the centre from original course of the klippen sedimentary district. A distance between an original course of the Pienidy particular geosyncline and recent klippen belt represent an amplitude of move northward. Our tast is to reckon this amplitude of move to determine where extended the particular Pienidy geosyncline. Before this we must find recent (Sa) and original (Sx) lenght of the klippen belt (see Textfig. 1). These values we found for the klippen belt in section Podbranč (at the west) and Sobrance (at the east). Sa — approximately 415 km.

With help of statistics and measurements mainly on the geological map of the klippen belt in scale 1 : 50 000 we obtained results in Table 1.

Table 1

Recent length of the klippen belt (in %)	Enlargement (in %)	Enlargement (in km)	Original length of the Pienidy particular geosyncline
20	25	83,00—20,750	62,250 km
30	15	124,50—18,675	105,825 km
50	10	207,50—20,750	186,750 km
			354,825 km

I. e. the original length was approximately 355 km. We know also further datum, a distance of the klippen belt to Keczkemét — the centre of the radial movement (from the topographical map):

$$a + x = 260{,}7 \text{ km},$$

see Textfig. 2.

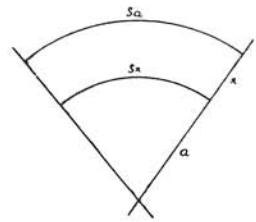

Fig. 1. Nomogramm.

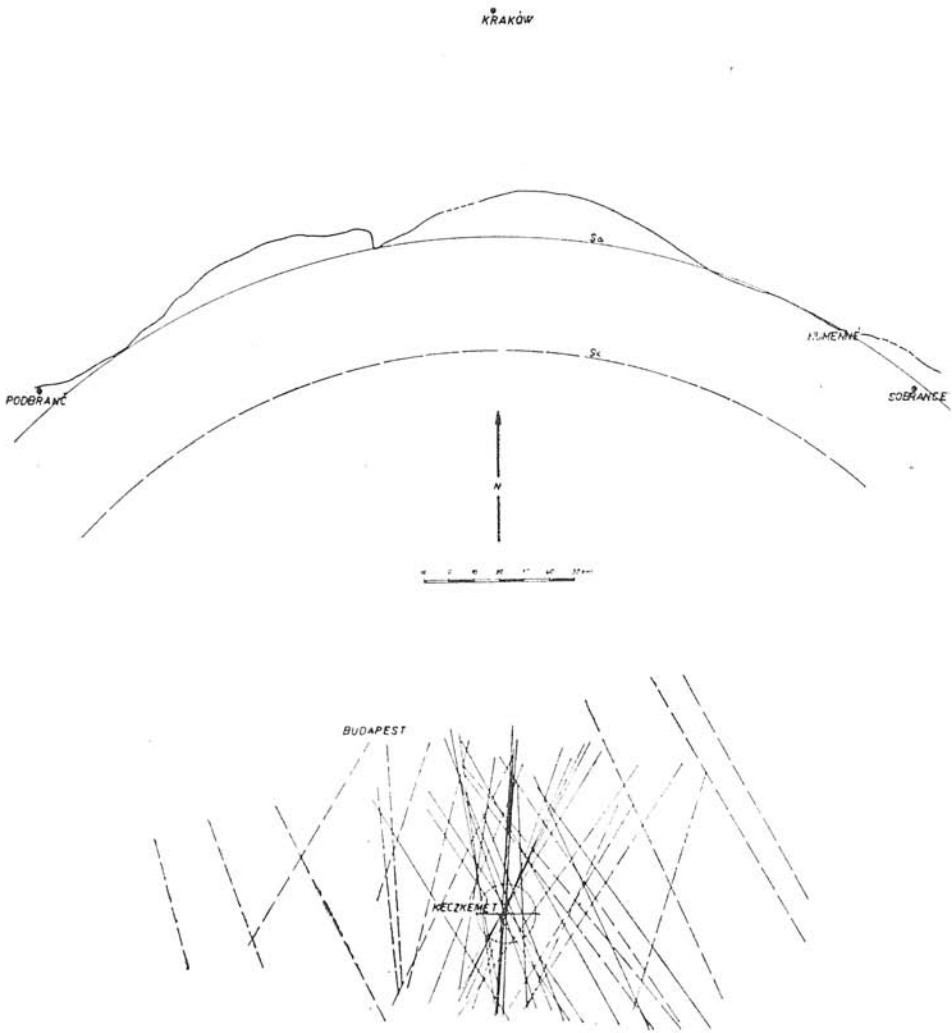

Fig. 2. Schematic map showing relationships between the present run of the klippen belt (Sa) and approximate run before the Cretaceous folding (Sx).

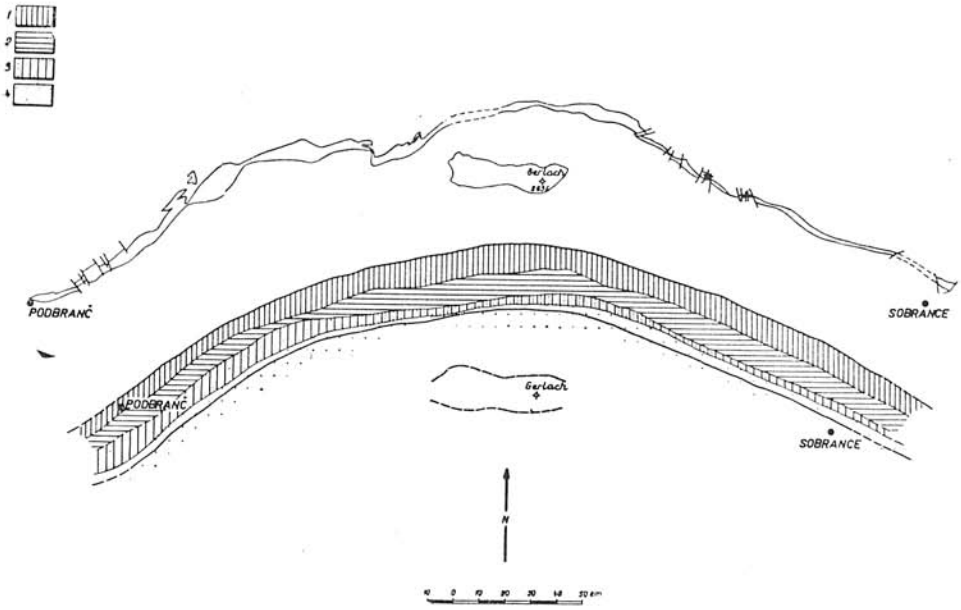

Fig. 3. Schematic map showing the present run of the klippen belt and approximate position of the Pienidy particular geosyncline with distribution of facies at the end of Aalenian. 1. The Murchisonae beds (Czorsztyn series and transitional development). 2. The Posidonia beds. 3. The Posidonia beds with crinoidal limestones (transitional development). 4. Grey cherty crinoidal limestones (Haligovka-Klape series) A couple of the same local names shows a lift and narrowing of space.

Now on the basis of Textfig. 1 with help of the mentioned data we may reckon an amplitude of move northward x:

$$a : (a + x) = S_x : S_a,$$

$$a + x = \frac{a \,.\, S_a}{S_x},$$

$$x = a \left(\frac{S_a}{S_x} - 1 \right) \text{km},$$

$$a + x = \frac{a \,.\, S_a}{S_x},$$

$$a \,.\, S_x + x \,.\, S_x = a \,.\, S_a,$$

$$a \,.\, S_x - a \,.\, S_a = -x \,.\, S_x,$$

$$a(S_x - S_a) = -x \,.\, S_x.$$

1. $a = \dfrac{x \,.\, S_x}{S_x - S_a}$, 2. $a + x = 260{,}7\,\text{km}$,

$$a = 260{,}7 - x.$$

1. $$260{,}7 - x = \frac{x \,.\, S_x}{S_x - S_a},$$

$$260{,}7 - x = \frac{355 \,.\, x}{355 - 415} = \frac{71x}{12},$$

$$260{,}7 - x = \frac{71x}{12},$$

$$3128 - 12x = 71x,$$

$$83x = 3128,$$

$$x = \frac{3128}{83},$$

$$x = 37\,6 \text{ km}.$$

2. $$a = 260{,}7 - 37{,}5 = 223{,}1 \text{ km},$$

$$x = 223\left(\frac{415}{355} - 1\right) \text{km},$$

$$x = 35{,}6 \text{ km},$$

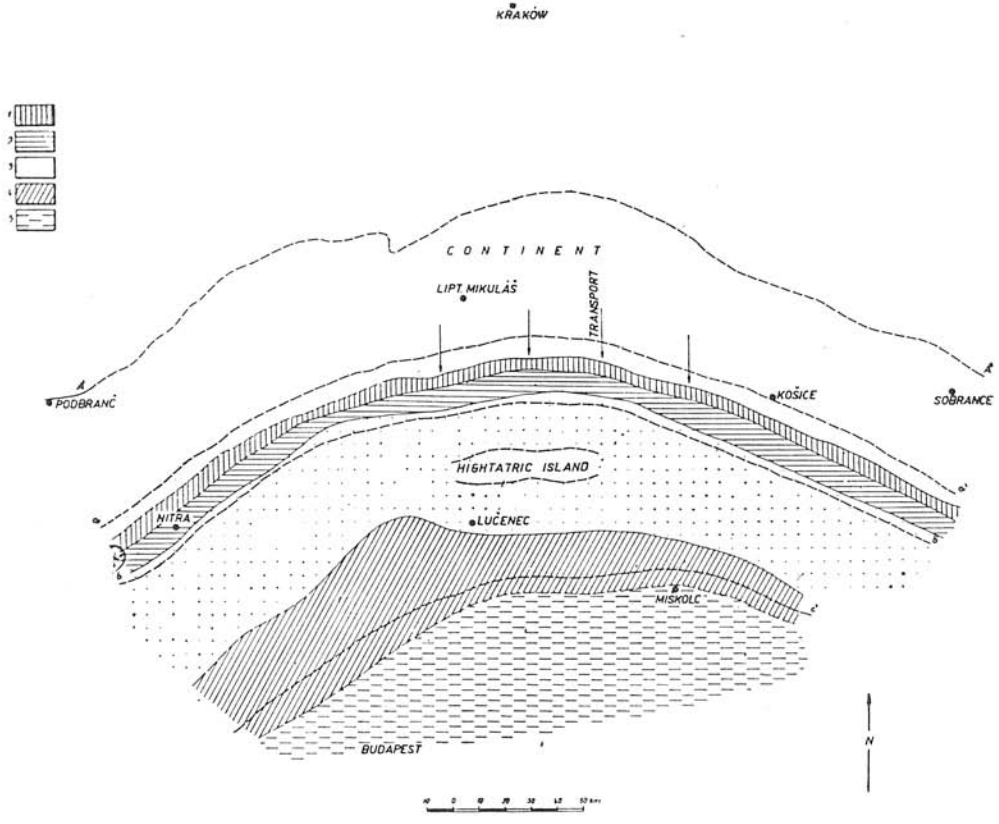

Fig. 4. Schematic paleogeographical map of the part of the sedimentary district of West Carpathian in Toarcian (subzone with *Dumortieria laevesquei*). 1. The flysch-like beds (Branisko series and transitional development). 2. Spotted marly limestones and marls. 3. Sandy and crinoidal limestones. 4. Spotted marls and limestones. A′—A″ present run of the klippen belt, a—a′ — an approximate boundary between the klippen belt and exterior zone; b—b′ an approximate boundary between the klippen belt and Tatrid zone; c—c′ an approximate boundary between the Tatrid and sub-Tatrid zones.

An amplitude of move northward is minimally 35 km. I. e. the original Pienidy particular geosyncline extended at least 35 km south of the recent klippen belt. If we take into consideration data about reduction of space in the flysch Carpathians we must redouble this number. We shall suggest a move about 40 km (see schematic maps on the Textfigs. 2 and 3). On the maps we see a move of identical points themselves.

On the schematic paleogeographical map on the Textfig. 4 on the recent topography is designed extension of the Pienidy particular geosyncline with distribution of facies at the end of Toarcian. In northern foreland of the Pienidy geosyncline and in northern part it was probably a dry land which represented a source of material for the so called flysch Aalenian. Distribution of facies in the Tatrid and subtatrid region is only schematic.

On further two maps on the Textfigs. 5 and 6 is designed distribution of dry land and marine facies between the Lias and Dogger (*Leioceras opalinum* zone) and at the end of Aalenian (*Graphoceras concavum* zone).

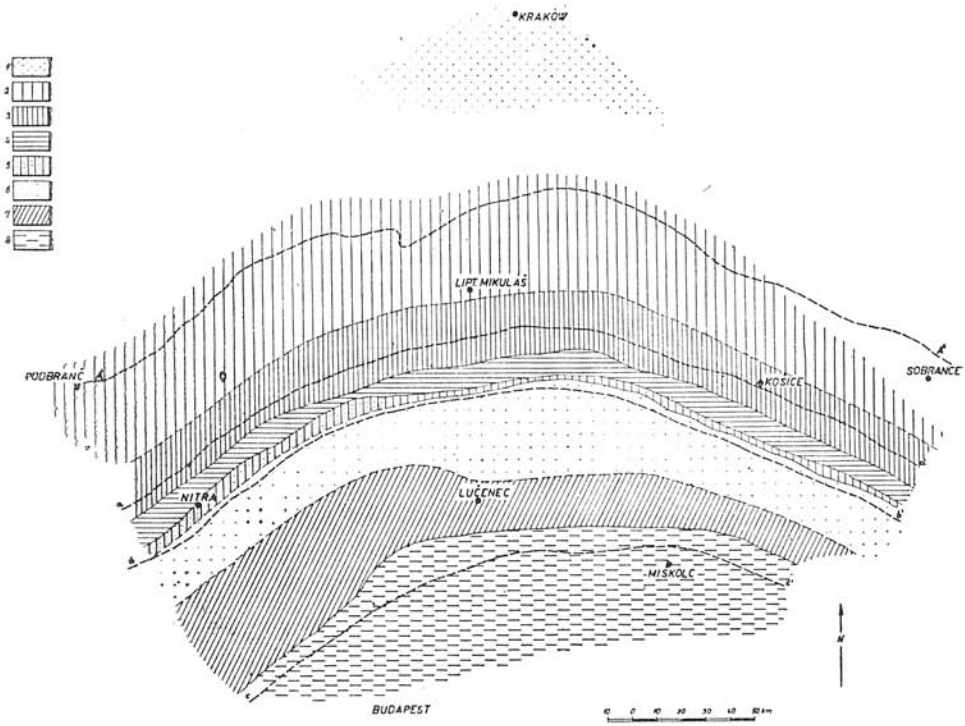

Fig. 5. Schematic paleogeographical map of the part of the sedimentary district of West Carpathians at the boundary between the Lias and Dogger (zone with *Leioceras opalinum*); 1. dark sandstones with Fe-ooids (Bachowice); 2. the Posidonia slates (exterior klippens); 3. the Opalinum beds (Czorsztyn series and transitional developments); 4. the Posidonia beds (the Pieniny series, part of the Branisko–Kysuce series); 5. slates with sandstones and crinoidal limestones (Haligovka-Klape series and part of Tatrids); 6. dark slates, limestones, silicites, crinoidal limestones (Tatrids); 7. grey spotted marls and limestones.

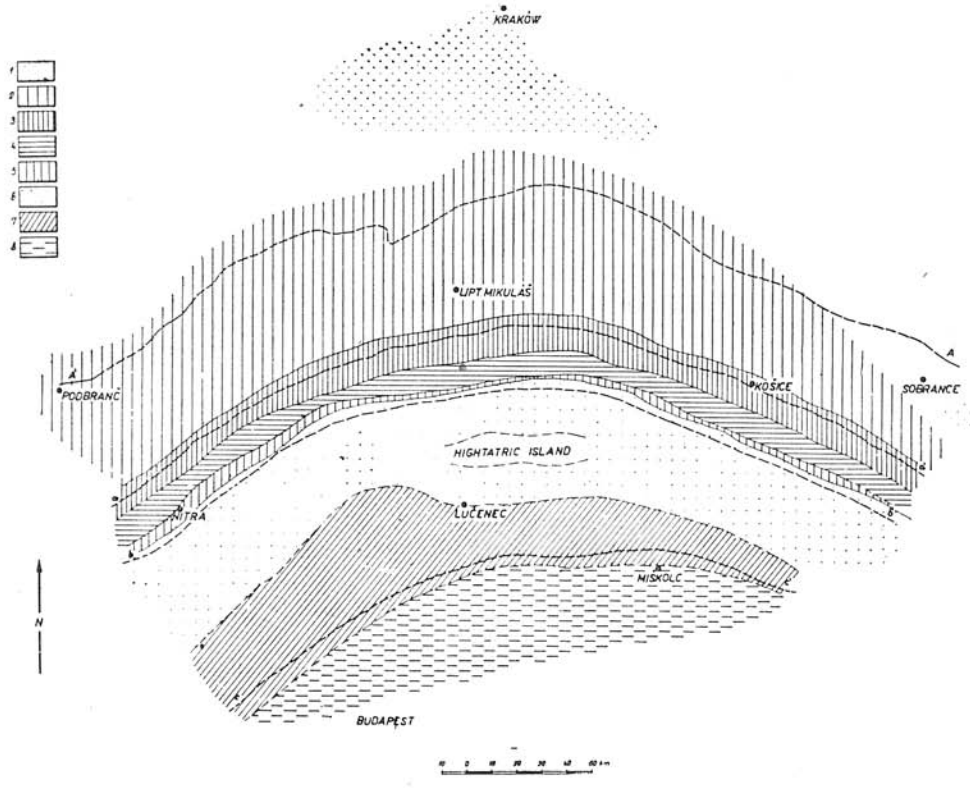

Fig. 6. Schematic paleogeographical map of the part of the sedimentary district of West Carpathians at the boundary of the Lower and Middle Bajocian (zone with *Graphoceras concavum*); 1.–7. as in map on the Textfig. 5; 8. the Radiolarian limestones (subtatric).

The mentioned maps represented an attempt to solve some problems of elaboration of paleogeographical maps of folded mountains with nappe building. We tried to use an analysis of tectonic building and obtain to some degree exact results by logical mathematical method.

Translated by V. Scheibnerová.

REFERENCES

Andrusov D., 1945: Geologický výskum bradlového pásma v Západných Karpatoch. Práce Št. geol. úst. 13, Bratislava. — Andrusov D., Scheibner E., 1960: Prehľad súčasného stavu poznatkov o geológii bradlového pásma medzi Vlárou a Tvrdošínom. Geol. sbor. Slov. akad. vied 11, 2, 239–272, Bratislava. — Birkenmajer K., 1957: Nové výskumy stratigrafie pieninského bradlového pásma v Poľsku. Geol. sbor. Slov. akad. vied 8, 1, 72–95, Bratislava.

Review by D. Andrusov.