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# NON—TRADITIONAL VIEW OF EAST—SLOVAKIAN KLIPPEN BELT

*(Figs. 1—4)*

Abstract: The author deals with slump bodies in the Klippen Belt. Resistant rocks are regarded as olistolites in olistostromes. Resistant rocks, Upper Cretaceous Púchov marls destroyed by denudation and the Gregorian breccia associated with the former, are ranged among clastic sedimentary rocks in the flysch Proč beds of the Jarmuta lithofacies. Angular Gregorian breccia are reprezentative of parent rocks deposited in a strange environment. Position of platy klippes in the flysch Proč beds is not controlled by stratigraphical succession.

Резюме: Автор занимается телами оползни в зоне утесов. Крепкие породы считают олистолитами в олистостромах. Крепкие породы, верхнемеловые Пуховские мергели уничтоженные денудацией и Григорианская брекчия связанная с напомянутными выше мергелями, относятся к кластическим осадочным породам во флишевых прочских слоях Ярмутской литофации. Остроугольная Грегорианская брекчия представляет первичные породы отложенные в чужой среде. Положение таблитчатых утесов в флишевых прочских слоях не согласно со стратиграфической последовательностью.

It is characteristic of the Klippen Belt that the Triassic and Lower Cretaceous rocks are more resistant than rocks which they are in. The more resistant rocks form elevations, cliffs and klippes according to which the zone is called the Klippen Belt, pas skalkowy, utesovaja zona, Klippenzone.

The history of opinions about the genesis and structure of the Klippen Belt was presented by D. Andrusov (1931, 1938) in our country and later on by K. Birkenmajer (1953, 1960) in Poland. The two authors not only informed comprehensively about investigations in the Klippen Belt but contributed to the explanation of the origin of the Klippen Belt by their own works. Both stratigraphical and tectonical data on the Klippen Belt brought new problems unsoluble from the view of tectonic explanation of the genesis of the Klippen Belt its tadial tectonic history is the most discussed topic. Contradictory opinions about the genesis of the main tectonic units in the Klippen Belt causel vivid discussions among those investigating the Klippen Belt. It is most likely that the origin of this narrow and about 600 km long Klippen Belt cannot be explained from purely tectonical viewpoint.

Many authors dealing with the Klippen Belt meet the problem of slump bodies, quite frequent in the narrow belt (D. Andrusov, 1965, III, vol. 215; M. V. Muratov, 1947 a.o.). Olistolites or olistostromes must have been a much more significant phenomenon in the genesis of the Klippen Belt than presumed.

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*Resistant rocks and their position*

The French term „melange" widely applied in the Klippen Belt indicates failing in attempt for finding regularities and logic in its genesis and structure. So many authors turned to „melange" — the mappable body without logic. This is the best illustration of difficulties in explaining the genesis and structure of the Klippen Belt but it also resulted in too little data for the explanation.

Klippes, cliffs, slumps in their poorly resistant sedimentary cover are dispersed throughout the narrow belt now regarded as a boundary between Central and Outer Carpathians. Triassic and Lower Cretaceous resistant rocks ranged to the Czorsztyn group, Pieniny group or some transistory group on the grounds of lithological-stratigraphical criteria, are historically reasoned. Corse-clastic material (limestone) — is generally ranged to the northern Czorsztyn facies whereas sedimentary rocks regarded as deep-sea are ranged to the southern facies (D. Andrusov, 1959, p. 181, vol. II.). Since in some klippes were both the shallow- and the deep-sea lithofacies it was necessery to distinguish intermediary facies.

At present such mixture of shallow- and deep-sea lithofacies in the Klippen Belt does not always fit in with the scheme of the distinguished sedimentation areas. The mixed lithofacies cannot even be well explained by repeated tectonic events. In the East-Slovakian Klippen Belt the bedded klippes are more likely to be in the southern part of the narrow belt. Non-bedded or partly bedded spherical klippes are nearer to the northern part. It is also reflected in the size of klippes: the largest klippes are at the southern margin i.e. on the contact of the Klippen Belt with the Central-Carpathian Paleogene, and the smaller ones are at the north.

Tithonian-Neocomian limestones are very interesting in respect of study of the Klippen Belt. According to older authors (D. Andrusov, 1931—1965; K. Birkenmajer, 1958) the Tithonian and the Neocomian of the Pieniny group were represented by light, bedded cherty-calpionellar limestones of the Biancone type. In the Czorsztyn group, and in some intermediary facies close to it (the Pruské facies, the Nedzica group in Poland) the Tithonian and the Neocomian are represented by crinoidal limestones, limestones with brachipods, calpionelles and with cherts, and nodular limestones with calpionelles. The Tithonian-Neocomian bed succession of this type used to be denoted as breccia and referred to the Czorsztyn group. The breccia-like Rogoznik limestones are stratigraphically ranged according to Macrofauna and Microorganisms. So the Rogoznik breccia and light cherty limestones of the Biancone type are coeval. In the area of Litmanová, Jarabina, Kamenica on Torysa and elsewhere the Rogoznik breccia are actually angular fragments of limestones with cherts (Biancone type) bound by carbonate binder (see photograph, microphotograph). Sedimentological and petrographical-sedimentological research of the Rogoznik breccia have proved that they are Tithonian-Neocomian limestones, disintegrated and deposited anew whose fragments were not transported over longer distance. Cross-bedding on faunal fragments from the Rogoznik klippe, SSW of Kyjov (near Zadné Skalie) is olso indicative of deposition not far from the source area. Besides fragments of Tithonian-Neocomian light-coloured limestones (Biancone type) the Rogoznik breccia-like limestones also contain crinoidal layers. Their lithological content is identic with that of Bajocian crinoidal limestones of the Czorsztyn group. Damaged crinoid segments and other crusher fauna fill the spaces among fragments or blocks of limestones.

*Variegated Upper Cretaceous marls and their position (D. Štúr, 1860)*

K. Birkenmajer (1958, p. 85) refers the Púchov beds (lower) and the red shales (upper) exclusively to the Czorsztyn group. Recent researches in the East-Slovakian klippen zone confirmed the close connection of the Púchov marls with coarse-clastic Proč beds of the Jarmuta lithofacies. The brick-red Púchov marls and green marls in the coarse-clastic Proč sediments

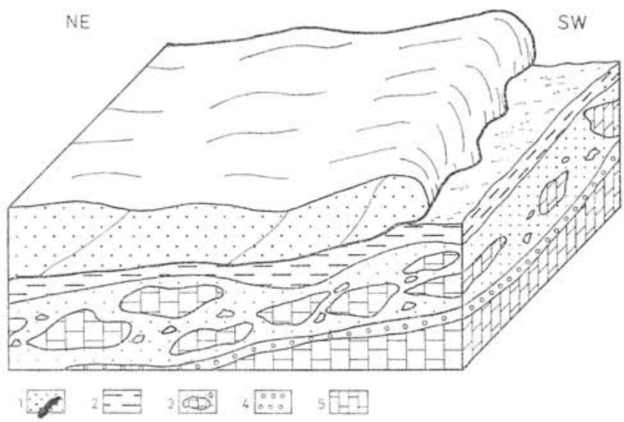


Fig. 1. A scheme of the Čerhov lithofacial unit of the Magura nappe thrust over olistolites of the Klippen Belt. 1 — sandstones of the Čerhov unit; 2 — flysch sediments of the Klippen Belt; 3 — olistolites of the Klippen Belt; 4 — basal sediments; 5 — basement (undivided).

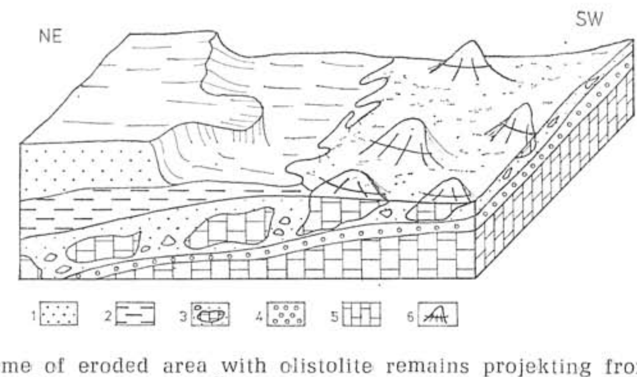


Fig. 2. A scheme of eroded area with olistolite remains projekting from mantle sediments. 1 — sandstones of the Čerhov unit; 2 — flysch sediments of the Klippen Belt; 3 — olistolites of the Klippen Belt; 4 — basal sediments; 5 — basement (undivided); 6 — morphology of projecting klippes (resistant rocks).

are the main building element of the beds. In other words, the Púchov marls were such pebble material in the formation of the Proč beds like carbonates and exotic pebbles. Large layers and blocks of the Púchov marls would now form similar klippes like Jurassic and Lower Cretaceous limestones — only they are too easily weathering. Good examples of the Púchov mrls being the component part of coarse-clastic conglomerates of the Proč beds may be found north of the village Milpoš (in the area of Gregúrka). Probbles of the Púchov marls are easily weathered as shown by conglomerates of the Proč beds: the Púchov marls of the exposed part are rapidly weathered whereas the rest of the pebble material remains almost fully preserved. Large blocks of the Púchov marls around Gregúrka disintegrate into extensive areas of red eluvia distorting thus their actual appearance in field. Whereas Jurassic and

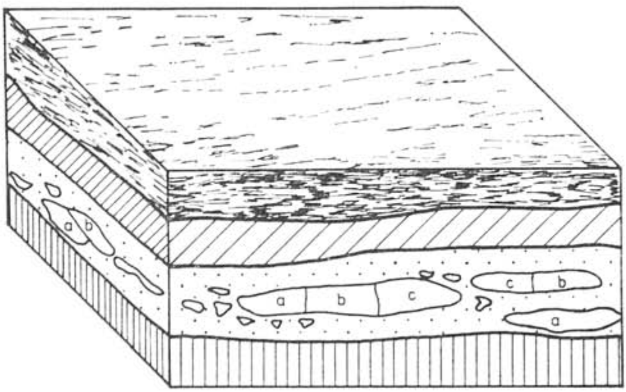


Fig. 3. Block diagram of deposition of olistolites and associated breccia in the flysch succesion. a, b, c — stratigraphical-lithological succesion in olistolites.

Lower Cretaceous limestones form isolated klippes, the Púchov marls are almost completely destroyed by the same erosive processes. Investigations of Upper Cretaceous varigated Púchov marls are not only in the nearness of klippes formerly ranged to the Czorsztyn group or to the Pieniny group but that they are first of all a part of coarse-clastic sediments of the Proč beds of the Jarmuta lithofacies. It may be a proof of the Proč-Jarmuta lithofacies deposition having commenced in the Upper Cretaceous or Paleocene and ended most likely in the Middle Eocene.

Since pebbles and blocks of the Púchov marls and blocks of Jurassic and Lower Creteaceous limestones are parts of the Proč-Jarmuta coarse-clastic sediments, their genesis must have been contemporary with the genesis of the Proč-Jarmuta beds.

Coarse-clastic sediments of the Proč-Jarmuta lithofacies contain both poorly rounded Púchov marls and porrly rounded Tithonian-Neocomian crinoidal limestones. Since there are also well rounded exotic rocks there is a question of their origin: are they from primary rock sor from disintegrated conglomerates. The occurrence of almost unrounded Jurassic and Cretaceous sediments together with perfectly spherical pebbles mostly of exotic rocks may

Fig. 4. Klippen Belt near Litmanová, a — crinoidal limestones, b — radiolarian limestones, c — nodular Czorstyn limestones, d — cherty-calpionellar limestones.

be indicative of a fact that the material from a close source area — therefore unrounded — got into pebble material transported over a great distance (or into well rounded material of littoral area).

The Jarmuta beds encompassing conglomerates, calcareous sandstones and sandy limestones are stratigraphically ranged higher than the Púchov marls, in the Polish literature. As regards lithology, the Proč beds are actually identic with the Jarmuta beds. According to lager foraminifers they are Paleogene.

*Coarse clastic rocks and their position*

About 1000 mm large boulders, blocks (C. K. Wentworth, 1922) are regarded as largest parts of clastic sediments by many authors (see Table in J. Petránek, 1963).

In the East-Slovakian Klippen Belt in the medium-clastic sediments of the Proč beds of the Jarmuta lithofacies are also coarse-clastic rocks. Slump conglomerates (olistostromes; see Fig. 1, 2) are loosely bound by loamy-sandy or loamy-calcareous binder. Diagenetically compacted conglomerates form interformational layers in the Proč beds of the Jarmuta lithofacies. There is a relation between the two seemingly different types of conglomerates. Less compact conglomerates (olistostromes) are nearer to the source area and form thicker beds. More compact conglomerates are farther from the source and interfinger with less clastic beds of the Proč beds. They are also better rounded. Near the source area they contain few poorly rounded pebbles. There, however, are intermediary rocks with plentiful poorly rounded breccia-like clasts and with few well rounded pebbles. When they contain only angular, mostly monomict clasts, then they are termed as the Gregorian breccia (J. Nemčok, 1979, in print).

In the East-Slovakian Klippen Belt the klippes are the largest clastic elements (Fig. 2, 4). Sometimes they are up to tens of meters in size. Angular Gregorian breccia indicative of the composition of the klippe with which it is associated, sedimented around them, but mainly in their prolongation in the original place of deposition. The breccia were frequently regarded as a transgressive Paleogene member. It is most likely that breccia of variegated marls in Orava (between the villages Záskalie and Kňažia) are also Gregorian breccia. Gregorian breccia, considered for a transgressive basis indubitably contributed to the fact that from the times of V. Uhlig (1903, 1907) up to the present (K. Birkenmajer, 1963, D. Andrusov, 1965), the geotectonic explanation of the genesis of the Klippen Belt is being accepted. The form and position of klippes are also important for the explanation of the genesis of the Klippen Belt. The bedding of klippes is most distinct in places of Tithonian-Neocomian klippes of the Biancone type. Platy positions of klippes are conform with the surrounding course of the Proč beds of the Jarmuta lithofacies. Similarly, elongated platy klippes are conform with the bedding, with the stratigraphic succession, however, perpendicular to the course of the Proč beds (Fig. 3). This phenomenon cannot be explained by tectonic pressing inside of the stratigraphic succession. Joint planes of klippes crossing stratigraphical boundaries form deposition planes for klippes among the Proč flysch beds.

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