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LOWER MIOCENE SEDIMENTATION IN THE AREA OF JABLONICA DEPRESSION — A MODEL BOUND TO OBLIQUE-SLIP MOBILE ZONE

(Figs. 2, Pls. 4)

Abstract: Geodynamical development of the SW part of the West Carpathians in the Lower Miocene is reflected in the sedimentary record of Jablonica depression. Sedimentation in the basin of longitudinal intramountain depression is represented by the Eggenburgian Rozbehy conglomerates. The change of regime of the sedimentary area during the Karpatian is documented by Jablonica conglomerates. They were deposited in the region of oblique-slip mobile zone. Model of formation of the Jablonica conglomerates body — deltaic-alluvial fan was compiled on the basis of lithological criteria and genetic analysis of pebble material.

Резюме: В последовательности напластования Яблоницкой впадины отражается геодинамическое развитие ЮЗ части Западных Карпат во время нижнего миоцена. Осадконакопление в бассейне продольного межгорного прогиба представлено розбежскими конгломератами эгенбурга. Изменение режима области отложения во время карпата подтверждают яблоницкие конгломераты. Они отлагались в районе мобильной зоны с косым смещением. Модель образования тела яблоницких конгломератов — дельтово-аллювиального конуса была построена на основе литологических критериев и генетического анализа галькового материала.

Present occurrence of conglomerates and sandstones of the Eggenburgian and Karpatian age in the area of the Jablonica depression represents a denudation remnant of sediments belonging originally to sedimentary area spreading from the region of foredeep through the region of outer units of the West Carpathians to the region of the inner units. This Lower Miocene configuration of the sedimentary area, as well as of individual basins was controlled by longitudinal and transversal tectonics caused by Savian and Early Styrian movements. These orogenetic movements were manifested in the outer units especially by space reduction — folding and formation of nappes. In the inner units, on the other hand, extension of the area occurred by release of stress at block junctions and in adjacent block interiors of the West Carpathians segment.

Rozbehy conglomerates known from the region of the Jablonica depression are similarly as conglomerates of Brezová belt and Chropov conglomerates on the NE margin of the Vienna basin of the Eggenburgian age (Buday in Buday—Cambel—Mahel' et al., 1962; Buday et al., 1963: Čtyroký, 1958). By their development they belong to littoral sediments representing sea transgression from the foredeep region to the inner West Carpathians after the Savian orogenetic movements. These movements influenced to a great degree

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configuration of the basins on the boundary of the East Alpine and West Carpathian segments. The NE part of the Vienna basin and the Jablonica depression became a component of longitudinal intramountain depression due to longitudinal tectonics. Transversal tectonics caused marine connection with foredeep basin. The sedimentary area of longitudinal intramountain depression was formed in backland of actively uplifting Magura Group of the outer West Carpathians. It spreads along the boundary of the outer and inner units, from here it interfered the inner ones along the activated old suture zones. Chropov conglomerates (A m b r o ž, 1980; B ř e z i n a, 1956) proving by their textural features a rapid sedimentation on the steep slope of the sedimentary area are considered for marginal facies along the flysch units. Rozbehy conglomerates, on the other hand, represent sedimentation on slightly dipping slope extending on the inner units of the West Carpathians. A common feature of these conglomerates is the fact that petrographic composition of their pebble material coincides with petrographic composition of the base on which their transgression took place.

Ottnangian has not yet been stratigraphically proved in the region of the Jablonica depression. It may (but need not) mean an interruption of sedimentation owing to the fact, that uninterrupted Eggenburgian—Ottnangian sedimentation is known from the region of the Vienna basin and Bánovce depression (B r e s t e n s k á, 1980). But, in general, a considerable reduction of extent of the sedimentary areas occurs during the Ottnangian in the West Carpathians. This reduction is considered for a consequence of compression during completion of formation of the West Carpathian segment suture zone.

An expressive manifestation of compression takes place as late as in the Karpatian. The Early Styrian orogenetic movements caused a mobilization of platform foreland in the region of foredeep, they were markedly applied in formation of the outer units and, at the same time, they were manifested by tectonic activity in the area of the inner units of the mountain chain.

Movement of the West Carpathian segment towards the N, NE was demonstrated in the outer units by further space reduction. Overthrust of nappe fronts to the foredeep is documented by appearance of flysch material in the Karpatian conglomerates above the base of grey sequence in the Ostrava district (K r y s t e k, 1983 a) and later on, in the end of the Karpatian, in Nitkovice and Holešov gravels in the central part of the foredeep in Moravia (K r y s t e k, 1983 b). The course of overthrust Early Styrian front of nappe units, as well as the fact that flysch material appears in conglomerates at first in the NW part of the foredeep means that trajectory of maximum stress in the SW part of the West Carpathians was directed to the NW.

In the inner units of the SW part of the West Carpathians extension of the area occurred in this period. Original sedimentary area of longitudinal intramountain depression disappeared. The centre of sedimentation was shifted to the south, to the backland region of the forming backdeep, dissected from the Badenian by graben horst structures. Oblique-slip mobile zone is formed during the Karpatian in the SW part of thee West Carpathian segment by tectonic stress at block junctions and in adjacent block interiors of this segment.

This group of the mobile zones is in the sense of M i a l l (1984) identical with the term of transcurrent faults which includes a large group of faults bound to various conditions created during the activity of plate (block) tectonics. The

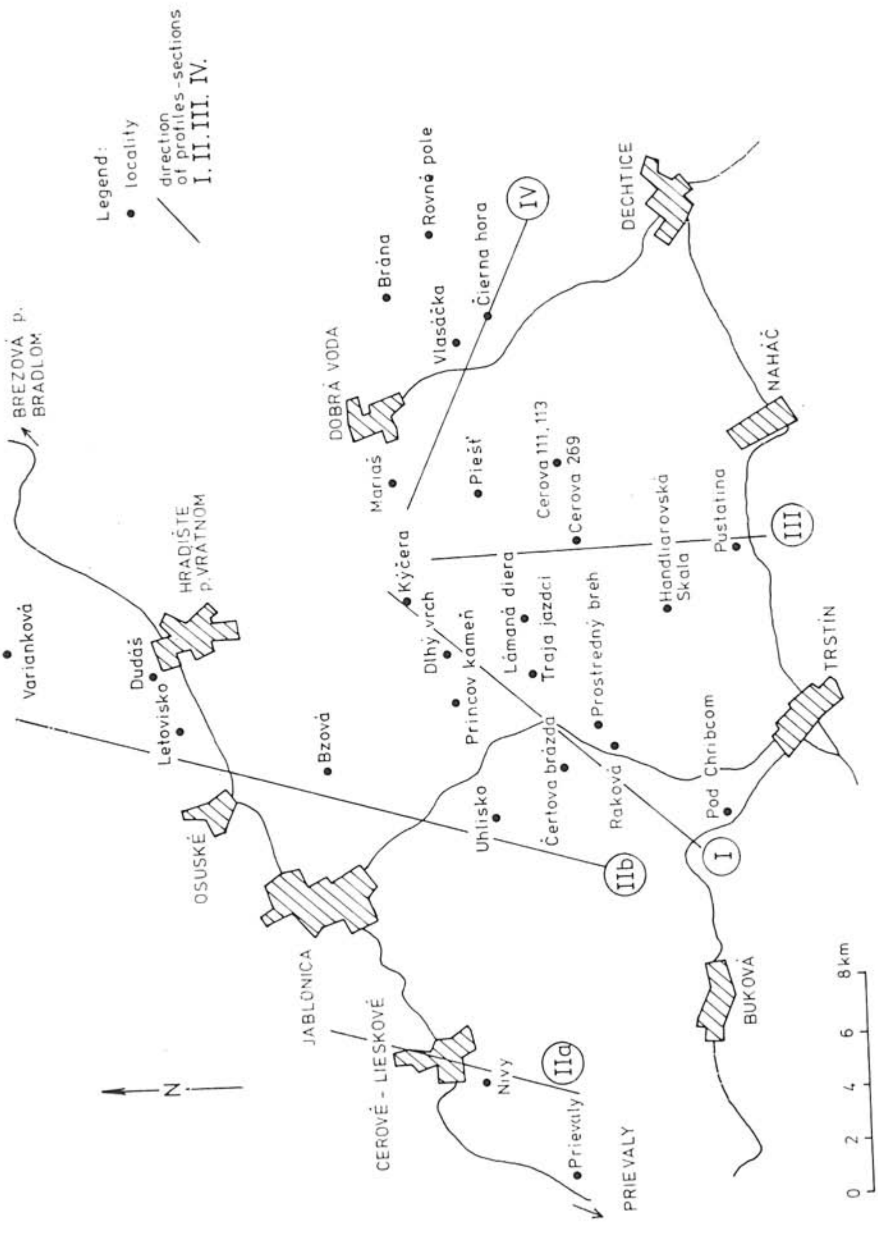


Fig. 1 Map of localities in the area of the Jablonica depression and orientation of idealized profiles (sections), I. II, III, IV (see Plates I, II, III, IV).

faults formed in such way may have different degree of importance: from the faults along the margin of large plates up to local interblock stress. Tectonic stress generally changes along the transcurrent faults, as well as along the oblique-slip mobile zones, only trajectory — direction of stress is constant. It is caused by the fact that regional stress responds to local geological situation.

Sedimentation in the region of the Jablonica depression and adjacent area of the Vienna basin and Danube lowlands during the Karpatian may be characterized as a type coinciding well with the type of sedimentation in oblique-slip mobile zones (in the sense of M i a l l, 1984), whereby the main features are as follows:

a) Basin in the region of the Jablonica depression and adjacent part of the Vienna basin and Danube lowlands had only several tens of km in length and width. Conglomeratic wedge along the faults on the SW margin of the sedimentary area may be considered for an expressive element of syndepositional relief.

b) Internal structural patterns, such as subsidence along antithetic and synthetic strike-slip faults, normal and reverse faults acted during the sedimentation.

c) Expressive change of sedimentary facies occurs in the region of the Jablonica depression, as well as on transition to the region of the Vienna basin and Danube lowlands. This fact may be caused also by later fault activity.

d) Spasmodic and local movements on the faults caused that the sedimentation in the region of the Vienna basin and the Danube lowlands started partly on different stratigraphic level. It is documented by relation of the Jablonica conglomerates body representing continuation of sedimentation of the upper part of the Karpatian towards the Vienna basin and forming the base of sedimentation of the upper part of the Karpatian towards the region of the Danube lowlands.

e) Synsedimentary activity of the faults, angular unconformities in sediments of the same age is typical during the sedimentation.

I.

Fig. 2.I.

f) Clastic material is transported from the close sources, sporadically it has petrographic composition identical with petrographic composition of the basement. The basement is especially the source of large pebbles and boulders.

g) Occurrence of geomorphological elements, such as rivers, alluvial and deltaic-alluvial fans, submarine channels was observed. Sag ponds (small depressions) separated by pressure ridges were formed by rapid subsidence.

h) Rapid rate of sedimentation, especially in the region of the Vienna basin — 8 cm/100 yr (V a s s—Č e c h, 1983).

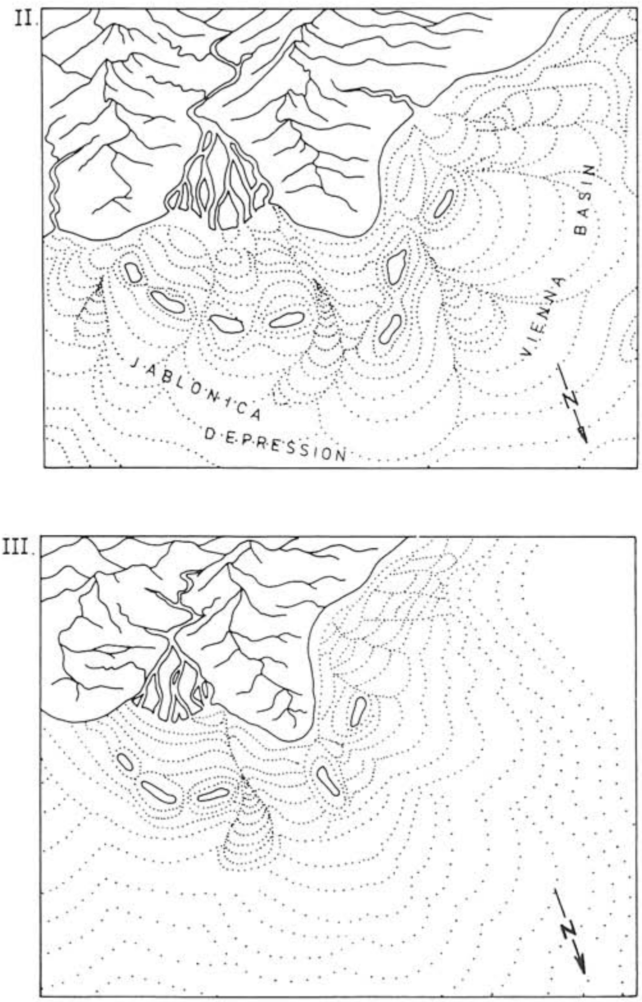


Fig. 2. Blockdiagram representing a geomorphological reconstruction of the area of the present Jablonica depression in the Karpatian — formation of deltaic-alluvial fan (stages I, II, III).

Today's occurrence of Jablonica conglomerates in the region of the Jablonica depression and of the NE part of the Vienna basin of the Karpatian age (Cícha, 1956) is a denudation remnant of the original deltaic-alluvial fan (smaller part of the body). Formation of conglomerates is bound to the tectonic activity of the oblique-slip mobile zone. On the basis of lithological study, study of structural features and genetic analysis of pebble material (Kováč, 1985 a, b; Mišík, in the present issue of Geol. Zbor.) a model — reconstruction of the conditions of formation of alluvial fan is presented (Fig. 2). Graphic documentation is appended to the text; an idealized cross section through the body of Jablonica conglomerates and sandstones in the time of their formation (C) is documented in Pls. I—IV on the basis of 4 sections through the studied area (Fig. 1). The plates contain reconstruction of sedimentation conditions represented by blockdiagram (A) and main current directions with denotation of the localities (B) where the measurements were carried out, values of Wentworth index of roundness of carbonate pebbles from the studied localities (D), average values of axis "a" of 10 largest pebbles from the studied localities (E), values of index of flatness (a + b : 2 c) (F), overwhelming representation of form classes of Zingg (G). Section plane and other figures are oriented according to the marked cardinal points.

By their position (they are lying on diatomaceous clays of the same age, Buday in Buday—Cambel—Mahel' et al., 1962) and rapid transition to sands and schliers, conglomerates represent a change of regime of the sedimentary area during the Karpatian. Active synsedimentary tectonics was manifested by formation of the faults of the NW - SE and NE - SW orientation.

Faults of the NW - SE orientation caused deepening of the sedimentary area of the Jablonica conglomerates body. Normal faults with short period of existence, as well as synthetic faults of first-rate importance with subsidence character were concerned. They are characterized by long-termed existence and

Plate 1

Idealized sections through the area of Jablonica depression during sedimentation of deltaic-alluvial fan (Jablonica conglomerates).

A. Blockdiagram representing sedimentary structures with denotation of the present occurrences in the localities.

B. Direction of flow established in the studied localities.

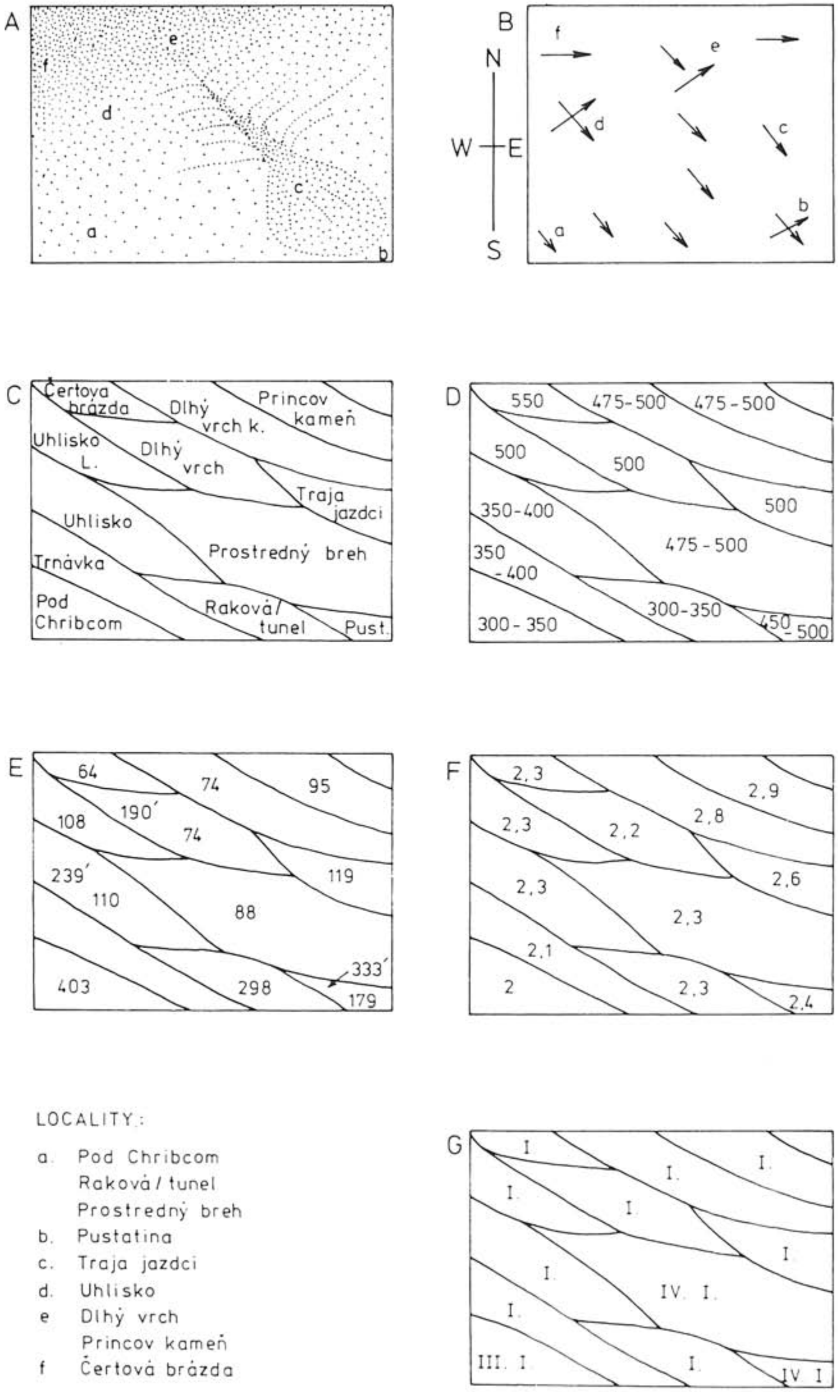
C. Idealized cross section through the part of the fan where the relationships between the overlying and underlying strata of individual localities are marked by the name of typical locality.

D. Values of Wentworth index of roundess of the pebbles in the studied localities.

E. Average values of axis „a" of 10 largest pebbles of carbonates in the studied localities.

F. Values of index of flatness A ÷ B . 2 C in the studied localities.

G. Dominant form classes of the pebbles after T. Zing in the studied localities. Section plane and other figures are oriented according to enclosed rose of cardinal points. Values of index of roundness, index of flatness, average size of 10 largest pebbles and form classes of T. Zingg were observed in pebbles of carbonate rocks (size groups 32—64, 64—128) (Kováč, 1985 b). The same text concerns also the Pls. II, III, IV.


A
a
b
c
d
e
f
B
N
W
E
S
C
Čertova brázda
Dlhý vrch k.
Princov kameň
Uhlisko L.
Dlhý vrch
Traja jazdci
Uhlisko
Prostredný breh
Trnávka
Pod Chribcom
Raková/tunel
Pust.
D
550
475-500
475-500
500
500
500
350-400
475-500
350 - 400
300-350
300 - 350
450 - 500
E
64
74
95
108
190´
74
239´
110
119
88
333´
403
298
179
F
2,3
2,9
2,8
2,3
2,2
2,6
2,3
2,3
2,1
2
2,3
2,4
G
I
I.
I.
I.
I.
I
I.
IV. I.
I.
III. I
I.
IV I
LOCALITY:
a. Pod Chribcom
Raková / tunel
Prostredný breh
b. Pustatina
c. Traja jazdci
d. Uhlisko
e. Dlhý vrch
Princov kameň
f. Čertová brázda

gradual joining into the line of higher order — main fault. Such line of higher order — main fault may be identified in the area of the Jablonica depression with the present Nesvačily — Trnava fault (Čech, 1982). This fault separated the NW margin of the sedimentary area of the Jablonica conglomerates from the source area. The latter was created by a part of the Malé Karpaty Mts. horst and adjacent region of the Danube lowlands base during sedimentation. Synsedimentary activity of the main fault, as well as advance of shoreline southwestward is proved by accretion of the fan where the sediments of central up to distal part of deltaic-alluvial fan are overlying the proximal part near the main fault (Pl. I).

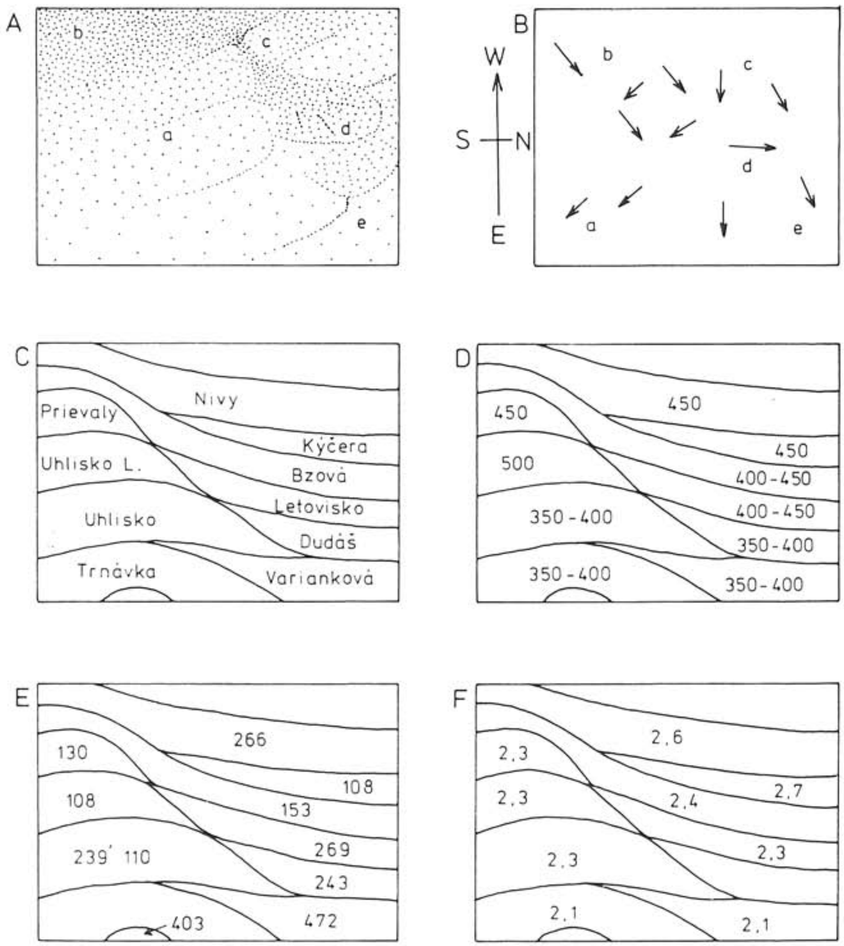
Faults of the NE - SW orientation divided the sedimentary area into individual ridges and depressions which influenced the transport of material to the sedimentary area. In such way different distribution of material occurred, it is reflected now in different petrographic composition, as well as in different properties (roundness) of pebbles in individual parts of the Jablonica depression (Pls. III, IV). Border between the sedimentary area in the Vienna basin and the centre of sedimentation of Jablonica conglomerates was formed also by the faults of the NE - SW orientation (these are the faults on the Prievaly — Jablonica line, southeastern demarcation of the Buková depression, etc.) (Pl. II).

A further phenomenon acting in the NE - SW direction, perpendicularly to the normal faults, was represented by compression structures, such as reverse faults. They were applied in formation of elevations and they probably acted as the last ones. Nowadays they are known on the contact of the Triassic and Palaeogene in Sološnica region, on the NE border of Dobrá Voda depression.

On the basis of facial distribution and sedimentary environment (McGowen—Groat, 1971; in Reading, 1978) it can be presumed that alluvial fan of clastics was formed in the near-shore area. In individual localities it is possible to study its proximal part with cobbles and boulders having a diameter of 70—80 cm and dominant coarse conglomerates (Pls. I, IV), further on, the middle part of deltaic-alluvial fan with alternation of conglomerates, sandy conglomerates and sandstones. The stratification is platy and tabular with horizontal and diagonal bedding (Pls. I, II, III)). The distal part contains especially the sandstones (localities in the NE part — Mariáš, Rovné pole in the surroundings of Dobrá Voda). These sandstones are horizontally and diagonally bedded, whereby thin beds of conglomerates or only the so-called pebble lines (locality Piešť) occur sporadically in them (Pl. IV).

Original transport of material to the region of the Jablonica depression had a fluvial character and it was oriented from the SW. Braided rivers formed alluvial fan, nowadays documented especially by basal members of the conglomerate body. They are imperfect, cross- and lenticularly bedded (it is typical of fluvial sediments). Using Clifton genetic diagram (Kováč, 1985 a, b) individual bodies fall in the field of fluvial environment. Pebble material in the basal part has the characteristic features of the river transport (locality Pod Chribcom) (Pl. I). The pebble material in majority of localities in the middle and upper parts of the conglomerate body shows the features of transport in basin environment (marine) (Pls. I—IV). We suppose deepening of the sedimentary area connected with advance of shoreline towards the source area, it means in the SW direction. It is documented also by the fact that pebble material in the western part of the Jablonica depression (Pls. I, II) is still

Plate II



a. Uhlisko, Bzová
b. Prievaly, Uhlisko
c. Nivy C. L., Letovisko
d. Dudáš
e. Varianková

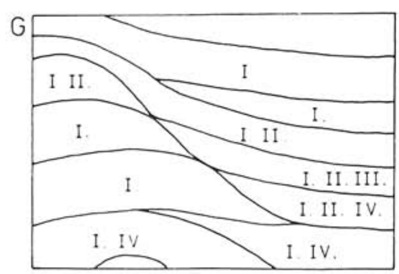


Plate III

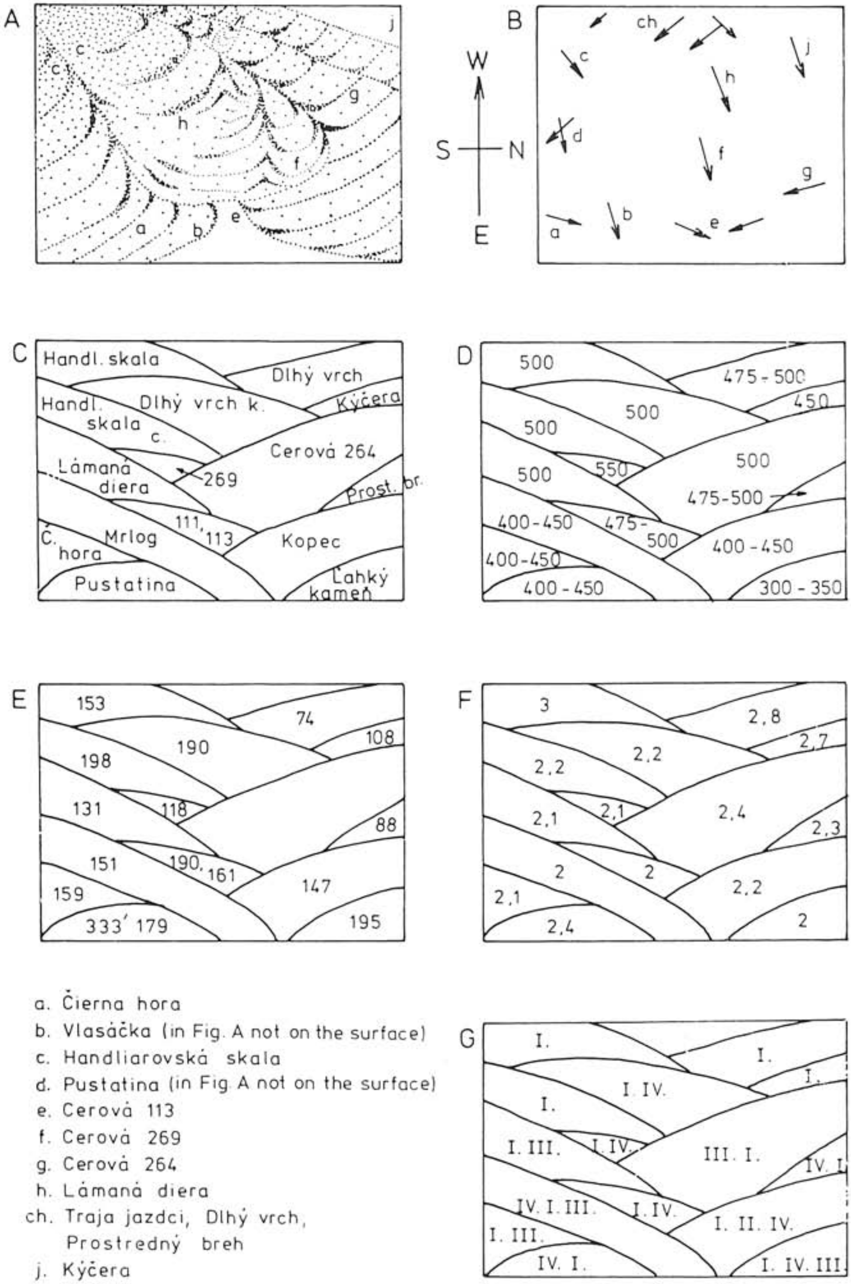
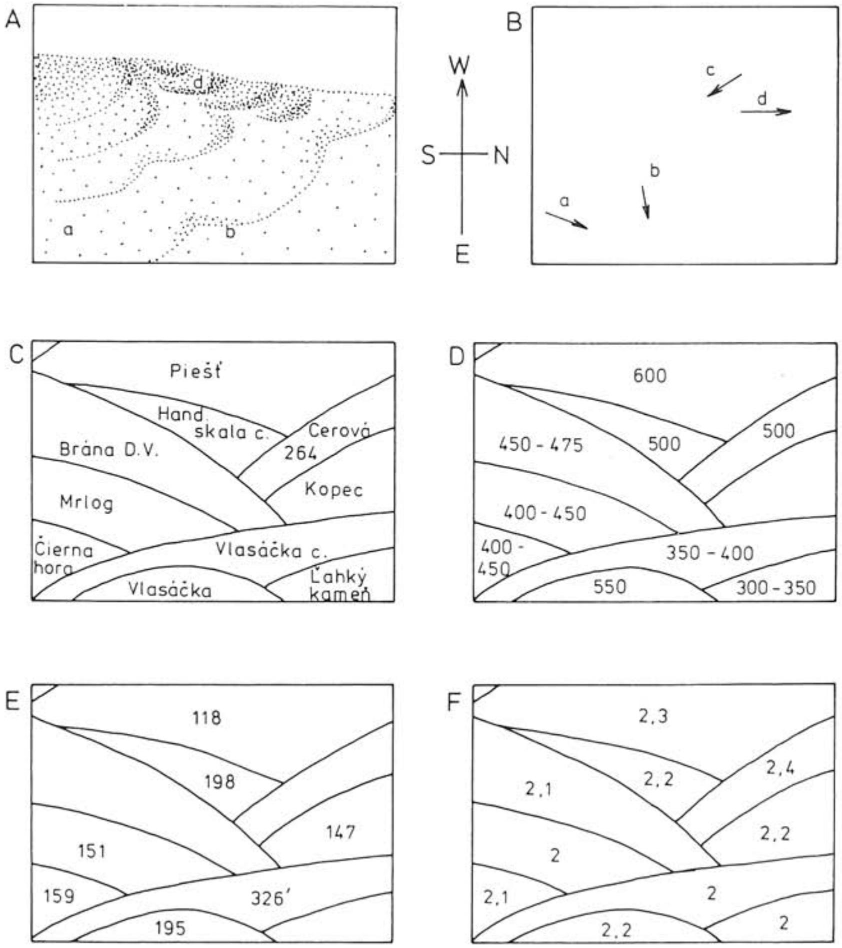
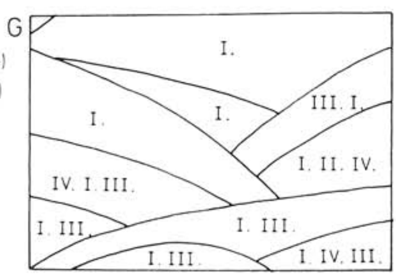

A
B
W
S
N
E
C
Handl. skala
Dlhý vrch
Handl. skala c.
Dlhý vrch k.
Kýčera
Cerová 264
Lámaná diera
269
Prost. br.
111, 113
Kopec
Č. hora
Mrlog
Pustatina
Ľahký kameň
D
500
475 - 500
450
550
475-500
400-450
475-500
400 - 450
300 - 350
E
153
74
108
190
198
131
118
88
151
190, 161
147
159
333' 179
195
F
3
2,8
2,7
2,2
2,1
2,4
2,3
2
2,1
2,4
G
I.
I. IV.
I. III.
III. I.
IV. I.
IV. I. III.
I. II. IV.
IV. I.
I. IV. III.
a. Čierna hora
b. Vlasáčka (in Fig. A not on the surface)
c. Handliarovská skala
d. Pustatina (in Fig. A not on the surface)
e. Cerová 113
f. Cerová 269
g. Cerová 264
h. Lámaná diera
ch. Traja jazdci, Dlhý vrch, Prostredný breh
j. Kýčera

Plate IV



a. Čierna hora, Brána D. Voda
b. Vlasáčka (in Fig. A not on the surface)
c. Cerová 264 (in Fig. A not on the surface)
d. Piešť, Rovné pole, Mariaš (sandstones)



bearing the features of fluvial transport, but the features of marine transport in the beach area is gaining still more importance. Deltaic-alluvial fan divided into individual fans — lobes with the axis of accretion oriented to the NE, E was formed here in the direction to the basin under the dominant influence of depositional current from the NW (Fig. 2, Pls. II, III, IV). Also the marine transport along the shoreline on the border with the Vienna basin in the NE direction occurred. It followed the border of alluvial fan, its steeper margin.

Slides occurred in the places where the sediment did not keep itself on the slope. Localities of the NW part of the Jablonica depression and of the NE part of the Vienna basin (adjacent areas) supported by their structural features this rapid movement of the sediments. Origin of these avalanches was probably affected by synsedimentary tectonics (localities Dudáš, Hradište p. Vrátnom) (Pl. II).

On the basis of the results of pebble analysis we presume on a gradual change of the source of clastic material from the northwest to the southeast, it was manifeested by moving of river delta from the studied area to the south (Fig. 2). Sediments of the bars and tidal plain system protecting river delta from wave activity are found in the SW part of the Jablonica depression. Rounding and sorting of pebble material took place here, in the beach conditions. This material was further transported by a system of channels to deeper parts of the basin along a low angle dip of the fan. Nowadays preserved filling of these channels (localities Traja jazdci, Cerová) documents well a direction of transport of the material from the SW to NE (Pls. I, III). Sedimentation of the middle and upper part of the conglomerate body was influenced by flow from the SW. Besides this flow, distal part was under the influence of depositional current from the NW from the open sea in the area of the NE part of the present Vienna basin (Pls. I, II, III). At the same time, on the basis of increasing features of good roundness of pebble material and decrease of grain size towards the overlying strata (till transition to sandstones) we presume on disappearance of the source area of coarse clastics or its moving back from the sedimentary area due to advancing shoreline of the Karpatian sea from the region of the Jablonica depression southward.

As we have already mentioned above, the present Neogene filling of the Jablonica depression represents only a part of deltaic-alluvial fan (in direction of its accretion a left half). We presuppose that it is spread also southeastward to the region of the present Danube lowlands (it is documented by the results of boreholes in this area, B i e l a, 1978). Transport of material from the SW accompanied by the flow from the S, from the area of the present Danube lowlands acted in this region. This flow documents, besides others, also a better roundness of the lower members of the conglomerate body in the SE of the studied area (localities Pustatina, Vlasáčka — Dobrá Voda) during transgression of the Karpatian sea. These sediments were later overlapped by a rapid sedimentation of new lobe of the fan from the SW, whose pebble material has a worse roundness (Pl. III). Slump structures in the surroundings of Dobrá Voda refer too to the activity of synsedimentary tectonics (K o v á č, 1985 a).

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REFERENCES

AMBROŽ, J., 1980: Studium hrubě klastických sedimentů spodního miocénu v Karpatské předhlubni a Vídenské pánvi na Moravě a Slovensku. Dipl. práca (UJEP Brno), 116 pp.

BIELA, A., 1978: Hlboké vrty v zakrytých oblastiach vnútorných Západných Karpát, Záhorská nížina—Podunajská nížina. Regionálna geológia 10, GÚDŠ, Bratislava, pp. 5—224.

BRESTENSKÁ, E., 1980: Geologická mapa a vysvetlivky k regiónu Bánovskej kotliny 1 : 50 000. Manuscript, Geofond, Bratislava.

BŘEZINA, J., 1956: Vnitroalpský miocén na JV Moravě a Z. Slovensku. Sedimentárno-petrografická studie. Spr. Úst. Geol., Geofond, Praha.

BUDAY, T. — CAMBEL, B. — MAHEĽ, M. et al., 1962: Vysvetlivky k prehľadnej geologikcej mape ČSSR 1 : 200 000, Wien—Bratislava, M-33-XXXVI a M-33-XXXVI, Bratislava, pp. 122—151.

BUDAY, T. et al., 1963: Vysvětlivky k přehledné geologické mapě ČSSR 1 : 200 000, Gottwaldov M-33-XXX, Praha, pp. 135—169.

CÍCHA, I., 1956: Stratigrafické zhodnocení neogenních mikrofaun v SV části Dolnomoravského úvalu a neogénu Považí. Zpr. geol. v roce 1955, Praha.

ČECH, F., 1982: Ložiská palív — vzťah k hlbinnej stavbe panónskej panvy a karpatského oblúka. Západ. Karpaty, Sér. Geol. GÚDŠ (Bratislava), 8, 146 pp.

ČTYROKÝ, P., 1958: Fauna mořských měkkýšú spodního burdigalu Považí. Geol. Práce, Zoš. (Bratislava), 51.

KOVÁČ, M., 1985 a: Stratigrafia a vzťah neogénnej výplne Jablonickej kotliny k ďalším priestorom severnej časti Malých Karpát. Manuscript, ŠPZV-II-4-4. Kontrolovateľná etapą E02, GÚ SAV, Bratislava.

KOVÁČ, M., 1985 b: Origin of Jablonica formation conglomerates in the light of pebble analysis. Geol. Zbor. Geol. carpath. (Bratislava), 36, 1, pp. 95—105.

KRYSTEK, I., 1983 a: Některé poznatky o severovýchodní části Karpatskej předhlubni na Moravě (úsek sever). Manuscript, archív Prírodověd. fak. J. E. Purkyně (Brno), 116 pp.

KRYSTEK, I., 1983 b: Výsledky faciálního a paleogeografického výzkumu mladšího tercieru na jihovýchodních svazích Českého masivu v úseku jih. Folia Univ. Purkyn. brun., Geol. (Brno), 24, 9, p. 47.

MIALL, A. D., 1984: Principes of sedimentary basin analysis. Springer-Verlag (New York), 490 pp.

READING, H. G., 1978: Sedimentary environments and facies. Blackwel Scientific Publications (London), 479 pp.

VASS, D. — ČECH, F., 1983: Sedimentation rates in molasse basins of the Western Carpathians. Geol. Zbor. Geol. carpath. (Bratislava), 34, 4, pp. 411—423.

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