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ORIGIN OF JABLONICA FORMATION CONGLOMERATES IN THE LIGHT OF PEBBLE ANALYSIS

(Figs. 6)

A b s t r a c t: The paper is aimed at verification of present views on formation of conglomerates of Jablonica Formation on the basis of structural features and genetic analysis of pebble material, in which effects of sedimentation in river environment and basin development as well are reflected, and at geodynamic interpretation of development of an area in the Lower Miocene (Karpatian) based on alternating activization of the faults of NE-SW and NW-SE orientation function.

Р е з ю м е: Целью настоящей статьи является на основе текстурных признаков и генетического анализа талькового материала проверить существующие мнения о формировании конгломератов яблоницкой формации, в котором отражены действия седиментации как в речной среде, так развития бассейна, и дать геодинамическую интерпретацию развития региона в нижнем миоцене (карпате), основанную на переменном активизировании функции сбросов СВ-ЮЗ и СЗ-ЮВ ориентации.

Formation of coarse-clastic molasse sediments is a good indicator of tectonic activity (in the certain area in the certain period). From this standpoint we have been aimed at investigation of conglomerates of Jablonica Formation (K o v á č, 1983) which form a young sedimentary cover of the NE part of the Malé Karpaty Mts. and a filling of the NE part of the Vienna basin.

Conglomerates and sandstones have been studied in the region between the villages Prievaly and Brezová pod Bradlom in the NW and Trstín and Dechtice in the SE. The field is relatively badly exposed (excluding exceptions), but in spite of this fact, over 250 natural and artificial exposures have been worked up (K o v á č, 1985).

The aim of the work was to verify the present views on formation of this conglomerate sequence (see works of A m b r o ž, 1980; B u d a y — C a m b e l — M a h e ľ et al., 1962; I l l a š o v á, 1977) and to derive a geodynamic interpretation of development of the area in the Lower Miocene (conglomerates are of the Karpatian age, C í c h a, 1956).

Conglomerates and sandstones have been studied directly in the localities, especially their structural features then a genetic analysis of pebble material aimed at the following properties: 1. bedding, 2. orientation of pebbles, 3. grain-size, 4. petrographic composition, 5. morphology has been carried out.

Conglomerates of Jablonica Formation represent typical polymict orthoconglomerates with well rounded pebbles. According to amount of sandy matrix they are represented by a whole scale of types, from conglomerates on one hand up to sandstones on the other (terminology of P e t r á n e k, 1963). They

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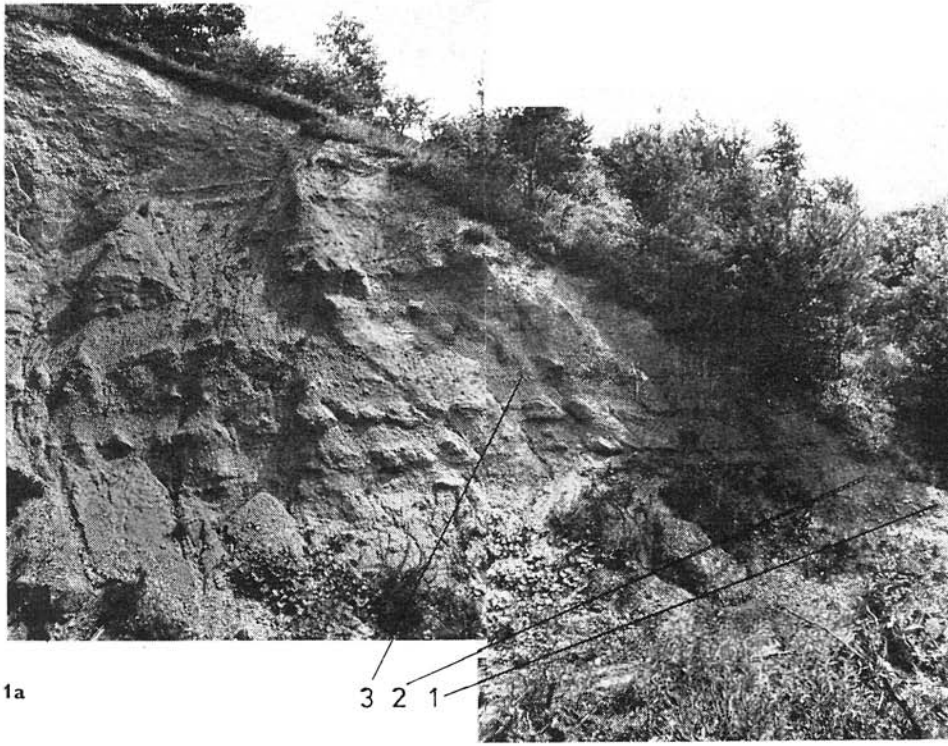

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are imperfectly bedded, only in the central part of the studied area (as well as on the border with the Vienna basin and Podunajská nížina lowlands), sporadically they show flaggy and tabular bedding. Bedding planes have a plane contact, sporadically with indications of sedimentation interruption. The most frequent dip of beds in the area bordering with the Vienna basin is inclined to the W, NW and in the area bordering with Podunajská nížina lowlands to the E, SE from 7 to 22° (cannot be generally accepted due to strong tectonic dislocation). It is little probable that original palaeodips of sedimentary basin are concerned (Figs. 1, 2, 3, 4).

Bedding: On the SW border of the studied area (Rozbehy-Trstín) besides imperfectly bedded conglomerates, cross- and lenticular-bedded ones often occur, what is typical of river sediments. Using Clifton genetic diagram (Clifton, 1973) individual bodies fall in the field of river environment (in the section Prievaly-Rozbehy in the field of transition sediments). Thin sandstone intercalations (slices) in conglomerates can be interpreted in this area as a consequence of overworking by wave activity. In direction to the centre of the studied area, i.e. north-eastwards, bedding is gradually changing to a horizontal, imperfectly developed, graded one of a positive character. In this part of region representation of conglomerate sandstones is rising. In the places where a better sorting is present pebbles are arranged to thin slices in sandstone matrix (the so-called pebble lines; Petránek, 1963). On the

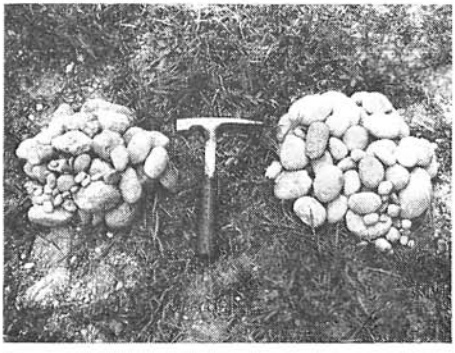

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Fig. 1. Locality Pustatina. Conglomerates of Jablonica Formation are represented by alternation of conglomerate and sandstone beds.

a) Detail of locality Pustatina (Trstín) with denotation of place of imbrication measurements (see c)).

b) Rounding of pebble material of Jablonica beds, on the left — limestones, on the right — red-violet clastics (quartzy conglomerates and arkoses).

c) 1, 2, 3 — imbrication of pebbles in individual beds of locality Pustatina (see a)).

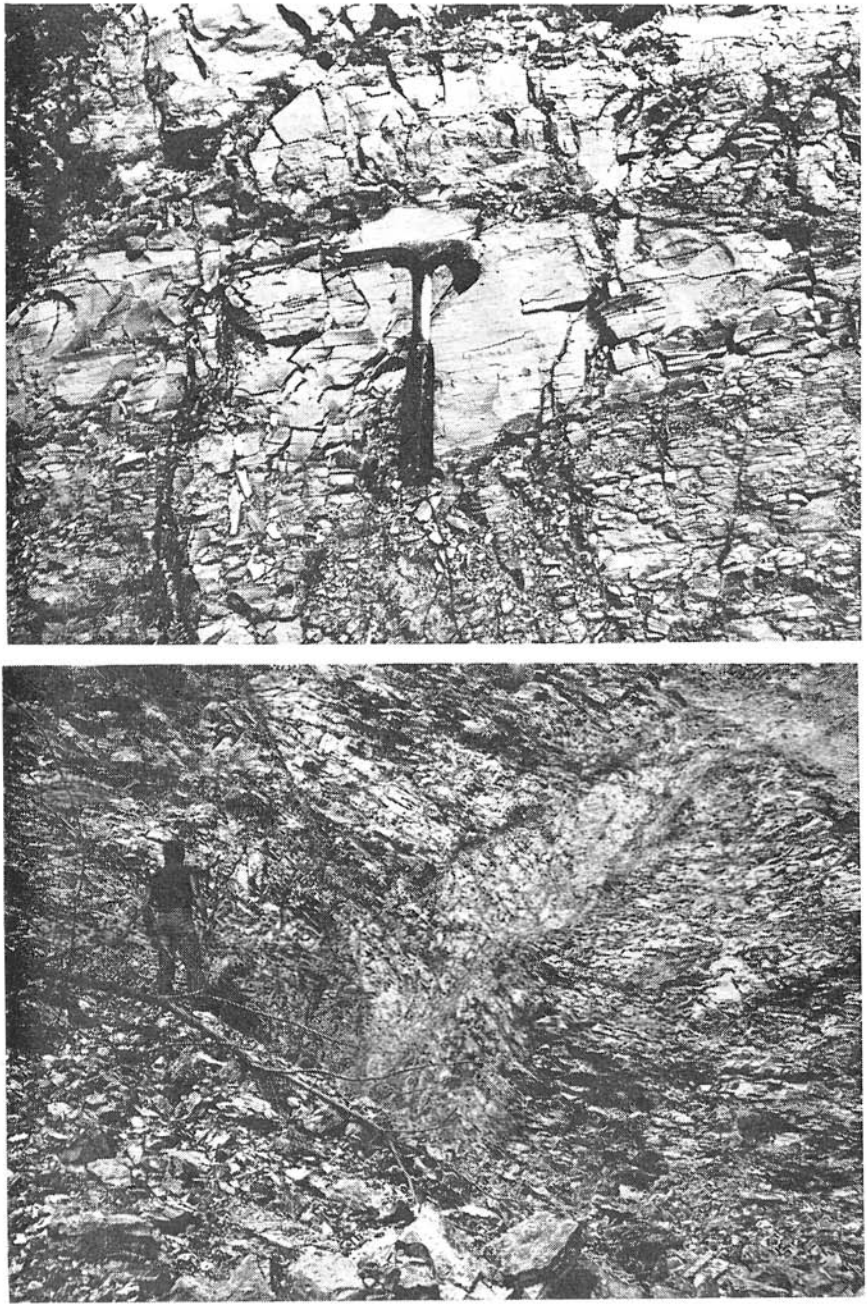

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Fig. 2. Conglomerates of Jablonica beds in direction to the Vienna basin pass to schliers. Old quarry 1.5 km east of the village Cerová-Lieskové.
a) Detail of schlier.
b) General view.

Fig. 3. Locality Dudáš (Hradište p. Vrátnom). Alternation of sandstone and coarse conglomerate beds. Conglomerates show good rounding and imbrication.

basis of Clifton genetic diagram this part can be ranged to sedimentary environment influenced by wave activity. In the NE part (SE of Dobrá Voda) slump structures are found in the lower part of conglomerate body base (similar structures have been described in the surrounding of Senica; Buday — Cícha — Čtyroký, 1959). They were formed by transport of material from the NE to the centre of sedimentary basin. Bedding of this part of region is predominantly imperfect, sporadically horizontal. In the uppermost members a waved bedding has been observed (locality Čierna hora). In the region north of the studied area (Hradište p. Vrátnom) frequent cross and lenticular bedding is found, in direction to the overlying strata it passes to horizontal up to imperfect bedding.

In the whole studied area presence of megarhytms with gradual decrease of granularity from the base upwards is stated. Beds of coarse up to boulder conglomerates on the NW border of the area (Rozbehy, Uhlisko, Hradište p. Vrátnom — Varianková) form an exception, they terminate sequence of beds and their origin depends probably on uplift of the area and regression.

Orientation of pebbles: In majority of localities conglomerate pebbles show an expressive imbrication, whereby orientation of long axis "a" presents the SW-NE direction as a main, the NW-SE direction as a secondary which occurs mainly on the SW border of the studied area (Rozbehy, Trstín) and in a broader environs of Dobrá Voda.

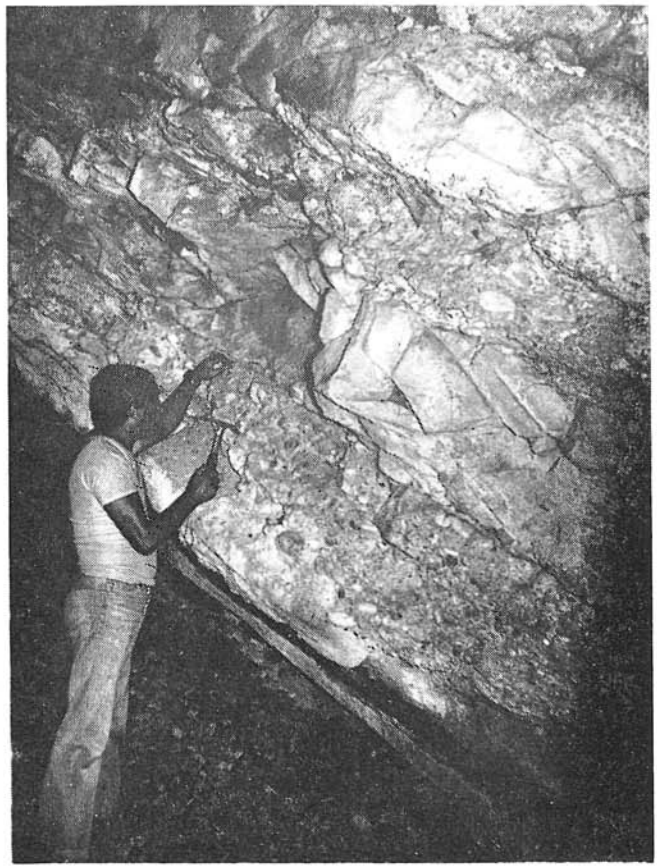

Fig. 4. Locality Nivy (1500 m west of the village Cerová-Lieskové). Alternation of sandstones and conglomerates, whereby in direction to the Vienna basin they pass to sandstones and schlier.

Plane „ab" is inclined to the NW and W (dip up to 15°) especially in the NW part (Prievaly, Rozbehy, Cerová), in the central and SW parts (Bojkové, Trstín, west of Dobrá Voda) inclination of „ab" plane to the W a SW is growing, south of Dobrá Voda also to the S and SE from 20 to 30° on the average. On the basis of ascertained factors river transport of pebbles from the SW may be considered (during slow flow of river — movement by rolling — long axes of pebbles "a" are oriented perpendicularly to direction of transport; V a s s et al., 1977). On the NW border and in the central part of the studied sedimentary area this transport was affected by depositional flow from the NW (in accordance with A m b r o ž, 1980). At the same time transport of coarse-clastic material from the NE may be presumed, but it has not yet the signs of river transport. Our presupposition is proved also by sporadic pebbles (64—32 mm) in sandy beds which show the SW-NE orientation in the SW part and the

NW-SE orientation in the central part and they were probably turned in direction of flow (axis "a" parallel with flow).

Grain size: In major part of the studied area various size classes of pebbles occur, but in spite of this, we succeed in statistical derivation of maximum occurrence of the certain size class of Wentworth (1922) in individual regions.

On the SW border (Rozbehy, Trstín) coarse and boulder conglomerates are mostly represented (size classes 64—128 mm, 128—256 mm and over 256 mm, the latter in section Prievaly, Rozbehy), north-eastwards they pass to medium- and fine-grained conglomerates (64—32, 32—16 and 16—2 mm). On the NE border, SE of Dobrá Voda boulder and coarse conglomerates occur again, similarly as in surrounding of Hradište p. Vrátnom, where northwards coarse and boulder conglomerates occur (64—128, 128—256 and over 256 mm) and southwards (to the village Jablonica) occurrence of coarse- and medium-grained conglomerates prevails (128—64, 64—32 mm). Considering diminution of pebbles in direction of transport, we come to a conclusion that transport of material took place in direction from SW to NE on one hand, and from N, NE to S, SE on the other.

Petrographic composition: Petrographic composition of pebble material of Jablonica beds conglomerates has been dealt by several authors (Ambrož, 1980; Březina in Buday et al., 1962, 1963; Illašová, 1977). Further on just a relationship of most frequent rock types to individual pebble size classes will be given.

In the largest size group (over 256 mm) besides quartzites, predominantly Mesozoic limestones and dolomites composing the closest surrounding are represented. Boulders (blocks) often reach 50—150 cm size and in contrast to other size classes they are often imperfectly rounded or angular (except quartzites). Minimum length of transport is considered (locality Dobrá Voda — Vlasáčka, Hradište p. Vrátnom — Varianková).

In the size class of boulder conglomerates (128—256 mm) in the SW besides Mesozoic carbonates (70—95 %) and quartzites, red-violet fine-grained quartzy conglomerates, sandstones and arkoses together with yellow coarse-grained quartzy sandstones (Malužiná Formation), Cretaceous and Palalogene conglomerates and sandstones, granite and metamorphites occur relatively frequently. Rounding of this size class is good. Spherical and disk forms prevail. Conglomerates of this size class show the similar properties in the NE part of the studied area. Region north of Hradište p. Vrátnom (locality Varianková) is an exception, red-violet clastics form there as much as 45 %.

In the size class of coarse- and medium-grained conglomerates (128—64, 64—32 mm) carbonates (60—95 %) prevail, whereby on the SE border representation of red-violet clastics is increasing (Malužiná Formation). In localities Drotácka hájovňa, Pustatina, Čierna hora they form as much as 15—50 %.

In the size class of medium- up to fine-grained conglonerates (32—16, 16—2 mm) representation of carbonates is very variable, sporadically it falls to 25 %.

On the basis of comparison of petrographic composition and individual size classes the following hypotheses may be expressed:

1. Extent of basin (part of the sedimentary area in which Jablonica beds were deposited during the Karpatian) was not large due to the blocks of rocks which did not overcome a greater transport and whose sources occurred in

direct neighbourhood of the basin. At the same time, their presence refers to uplift of the NE part of the area during sedimentation.

2. Transport of material to sedimentary basin had a river character from the SW (later also from the NE). On the basis of various petrographic composition of individual size classes different distance of individual sources may be presupposed. Lateral and vertical division of individual rock types refers to gradual exposing of the source area by erosion (from younger to older ones), as well as to depositional flow from the NW, from the region of the Vienna basin. This flow is manifested by distribution of more resistant red--violet clastics (Malužiná Formation) to a greater extent on the SW, SE and NE borders of the studied area, whereby size of pebbles decreases from the NW to SE.

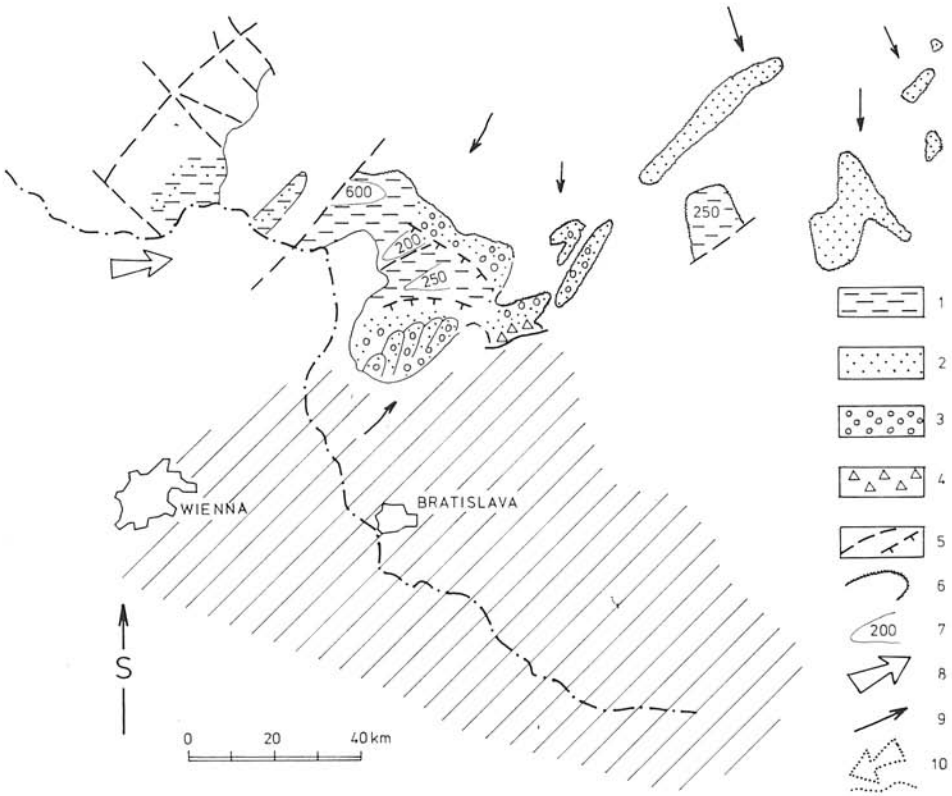

Fig. 5. Schematic map of distribution of the Eggenburgian sediments in the SW part of the West Carpathians.

Explanations: 1 — clays (schliers); 2 — sands; 3 — conglomerates; 4 — breccias; 5 — synsedimentary faults active in the given period (faults affecting during sedimentation); 6 — erosive margin of sediments occurrence; 7 — thickness; 8 — transgression; 9 — supply of clastic material; 10 — regression; presupposed border of regression.

3. Source area consists of the sources: a) directly in area of deposition; b) in the SW in the region of crystalline complex, paraautochtonous and nappe units of the Malé Karpaty Mts. (and adjacent area); c) Cretaceous and Palaeogene sediments which can be found today in the regions spreading N, NE of the studied area (Illašová, 1977) were more spread in the SW, they supplied the sedimentary area with clastic material and they underwent denudation.

Morphology of pebbles (studied in carbonate pebbles): The most frequent form is spherical and flat-disk (Zingg, 1935).

Sphericity of pebbles falls from the SW (Rozbehy, Trstín) to the NE, in the northern part sphericity is decreasing from Hradište p. Vrátnom in direction to Jablonica (S, SW). In individual localities increase of flatness of pebble material can be observed simultaneously with decrease of sphericity, whereby the highest flatness values are in the localities on the NW border of the studied area. Increase of flatness of pebbles has been stated also from the base to overlying strata. Values of rounding index fall from the SW to the centre of the area (north-eastwards) and to overlying strata. In correlation of rounding index with pebble size an indirect proportion has been observed (greater the pebble, worse rounding it has), what suggests a disunited length of transport and disunited origin of pebble material. Small amount of elongated forms (relatively low elongation) may be caused by insufficiently long transport in river environment (by rolling) or by overworking in the sedimentary basin (by wave activity) (Ambrož, 1980). Similarly, indirect proportion between flatness and rounding index in the central part of the studied area (SW of Dobrá Voda) and on its NW border (especially in sandy beds) may be considered on the basis of the work of Wentworth (1922) for manifestation of beach sedimentation.

Morphology of pebbles, as well as other obtained data enable us to make a conclusion that formation of conglomerates of Jablonica Formation depended on environment, in which two components acted. It was river transport from the SW and depositional flow from the NW, from the region of the Vienna basin (in accordance with Ambrož, 1980). Deposition of conglomerates body was also sporadically influenced by depositional flow from the SE, from the present Danube lowlands region. During an uplift of the NE part of the studied area transport of material from the N, NE (in accordance with Illašová, 1977) to this region may be observed.

Sedimentary environment of conglomerates of Jablonica Formation was developing in the Karpatian under the control of tectonic activity presented by origin of the faults of NE-SW and NW-SE orientation. On the basis of sedimentological analysis their alternating activization in the Karpatian as well as in the Lower Miocene is considered. This activization is considered for release of pressure stress due to shifting of the SW part of the West Carpathians to the W, NW manifested in the front of mountain arc during the Karpatian by gradual overthrust of nappes to foredeep of the West Carpathians (Kováč, 1980) (Figs. 5, 6).

Beginning of sedimentation in the Karpatian was affected by the faults of NE-SW direction (this orientation of the faults controlled also origin of sedimentary basins in the Eggenburgian). In this period a depositional fan of river sediments transported from the SW without effect of flow from the Vienna basin was formed. Depositional flow from the region of the Vienna

basin became evident only during activization of the faults of NW-SE direction, which caused deepening of sedimentary area during the Karpatian in the studied region. Owing to this deepening, connection of sedimentary area of the Vienna basin and Podunajská nížina lowlands is presupposed. Reactivization of the faults of NE-SW direction connected with the uplift of the NE part of the area and increased transport of material from the NE occurred

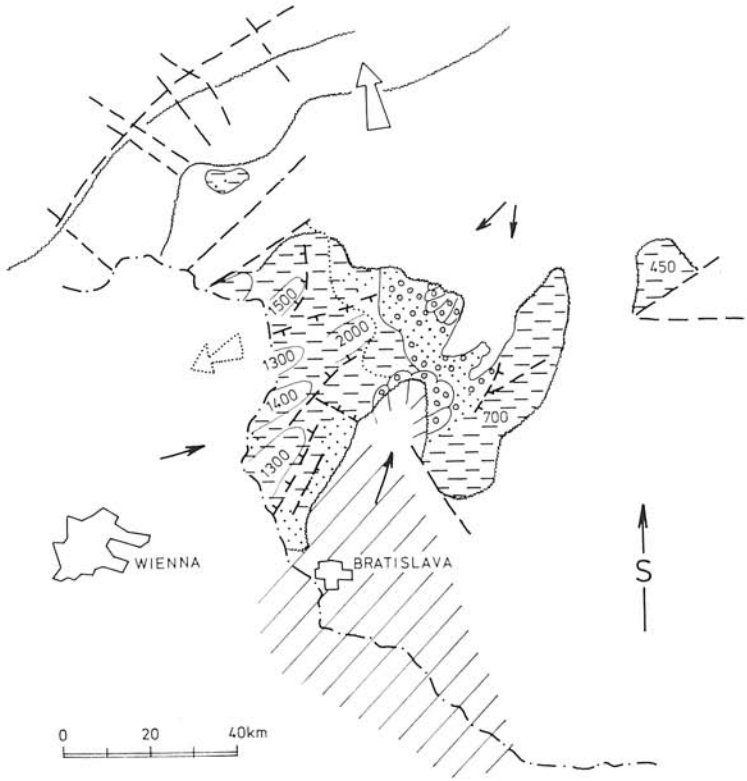

Fig. 6. Schematic map of distribution of the Karpatian sediments in the SW part of the West Carpathians.

For explanations see Fig. 5.

in the end of Karpatian. Continuation of the uplift (of the NE end of the Malé Karpaty Mts., as well as of the NE part of the Vienna basin) brought about sea regression oriented to the SW.

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