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PALEOGEOGRAPHICAL, LITHOFACIAL AND TECTONOGENETIC DEVELOPMENT OF THE NEOGENE IN EASTERN SLOVAKIA AND ITS RELATION TO VOLCANISM AND DEEP TECTONICS

(Figs. 7)

Abstract: The paper presents a survey of the most important Neogene development periods in eastern Slovakia, their paleogeography and lithological analysis in horizontal as well as in vertical direction. In paleogeographical maps are indicated the source areas, direction of communication with the sea, further are shown the main features of tectonogenesis in relation to adjacent flysch sequences, to volcanism as indirect indicator of the extent of deep tectonics.

Резюме: Статья приносит обзор самых значительных периодов развития неогена в восточной Словакии, его палеогеографию и литофациальный анализ в горизонтальном и вертикальном направлениях. В палеогеографических картах намечены области источников, направления сообщений с морем. дальше в них указаны главные черты тектоногенеза в связи с примыкающими флишевыми зонами, вулканизмом в качестве непрямого показателя размера глубинной тектоники.

The Neogene in eastern Slovakia occupies the territory east of the Slovenské rudohorie Mts. and south of the Central Carpathian Paleogene. From the E and S it is delimited by the state frontier with the USSR and Hungary. This territory is of the shape of approximately to NE deformed lozenge and of total area around 4700 km^2. In the sense of tectonic division of N. S. Šatskij (1938) it was ranged by T. Buday (1968) among the intramontane longitudinal depressions. From the view of division of the East Carpathians this territory forms the western part of the Transcarpathian inner downwarping (V. V. Gluško et al., 1963). According to the latest conceptions of L. Stegena et al. (1975) and D. Vass (1976) the East Slovakian Neogene basin belongs to the system of molasse depressions at the periprhery of the Miocene mantle "diapir".

The work presented refers to the published work by R. Rudinec — J. Slávik (1973), in which a set of paleogeographical maps in relation to the Neogene folding phases in eastern Slovakia was given. The presented set of maps completes and broadens development of the East Slovakian Neogene from the point of view of later results, pointing out the possible presence of further lower Neogene sequences (Egerian?), as well as some corrections in the extent of other higher sequences. The mosaic of variegation of the individual sequences is proved by their lithofacial development in horizontal as well as vertical direction.

As it is known, the East Slovakian Neogene formed contemporaneously with folding of the flysch geosyncline, its development was complicated and pulsative. In the time of several independent sedimentation cycles, which represent molasse development of the East Slovakian Neogene, a thick complex of terrigenous and marine sediments with maximum thickness around 5500—6500 m deposited here.

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Besides typical sedimentary rocks (gravels, conglomerates, sands and sandstones, claystones, mostly polymineral groups of illite and montmorillonite) also rocks of volcanic origin (acid and intermediate effusions and mainly their pyroclastics—tuffs and tuffites) take largerly part in the basin filling.

Sedimentation cycles in the Neogene and their facial development

In development of the Neogene in eastern Slovakia we may distinguish several periods-cycles, manifested in large paleogeographical changes in the sedimentation area. On the whole six greater more distinct periods of sedimentation were distinguished, separated from one another by distinct discordances and breaks of sedimentation -R. Rudinec — J. Slávik (1973).

The first such a period is formation of a primary-embryonic sedimentation area on a weakened zone — of the Egerian (?) in the Prešov part of the Košická kotlina basin (Fig. 1). The presence of this sequence has so far been proved in the overlier of the Lower Oligocene only by one borehole Prešov-1, ranged to the Oligo—Miocene Egerian—Chatian on the basis of not abundant fauna by I. Zapletalová (1974).

The extension of this sedimentary basin was not large and mainly restricted to the Prešov central depression althrough the northern margin exceeded the

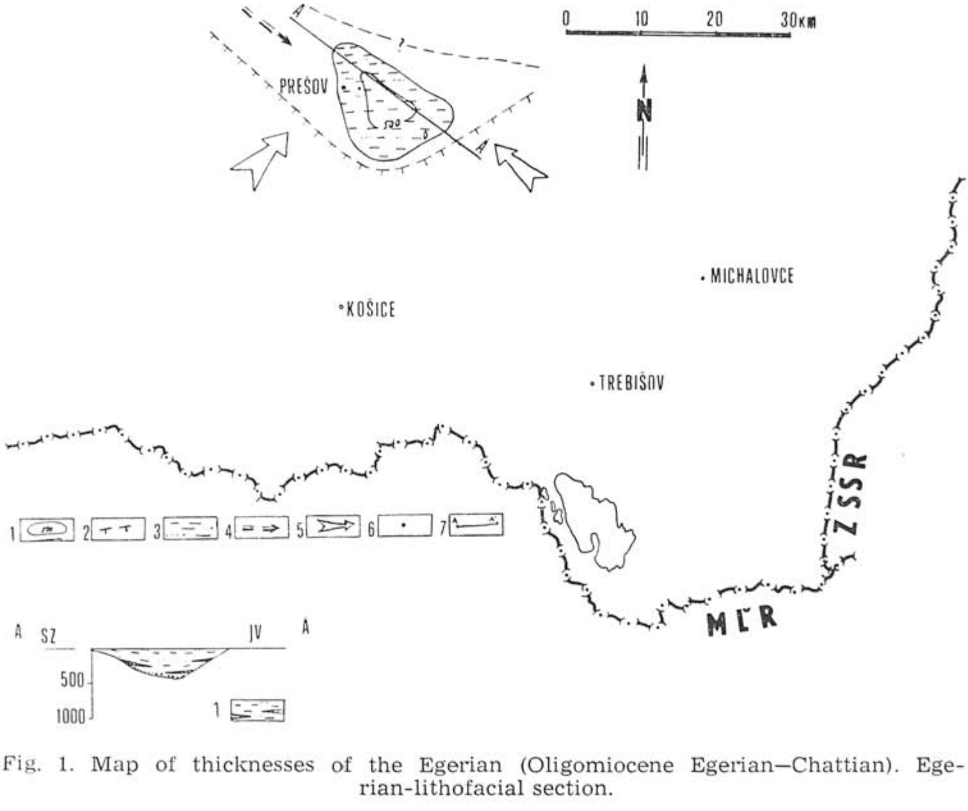

Fig. 1. Map of thicknesses of the Egerian (Oligomiocene Egerian—Chattian). Egerian-lithofacial section.

remnants preserved nowadays. Its communication with the sea of the fore-deep we suppose from the NW through a narrow channel approximately in the area of the present Klippen Belt.

The transport of material into the relatively shallow and gradually deepening basin was mainly from the south. Facially this sequence is built up of grey to dark-grey claystones with sporadical layers of fine-grained calcareous, less greywacke sandstones with abundant coal detritus, which is present to a larger extent at the base and in marginal parts as also the vertical lithofacial section shows. The pebbles in sandstones are semiangular with prevailing quartz, further cherts, feldspars are present and unstable rocks vary up to 10 %. From accessoryc minerals are present garnet, apatite, zircon, rutile, staurolite, anatase,

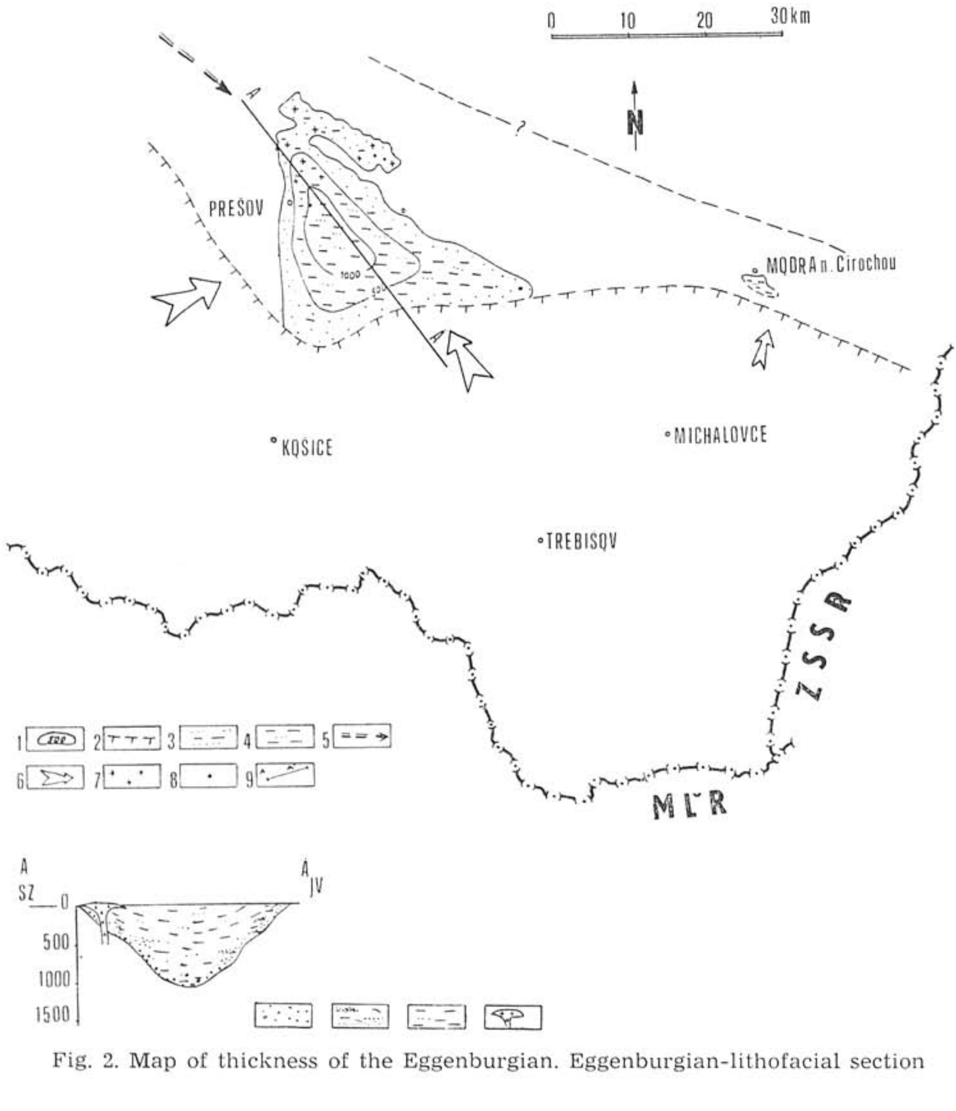

Fig. 2. Map of thickness of the Eggenburgian. Eggenburgian-lithofacial section

tourmaline, titanite and pyrite. In pelites claystones predominate over siltstones, in which much organic detritus is found, testifying to the existence of a shallow-marine facies (J. Magyar, 1975).

Deepening and widening of the sedimentation area in the Egerian carried on continuously also in the Eggenburgian (Fig. 2). Communication with the sea remained through a channel from the NW. The sedimentation area widened mainly to the east, as far as the area of the Choňkovo depression, also the northern basin margin reached far beyond the remnants preserved nowadays and is difficult to reconstruct. The main source areas from where the material was supplied into the basin were in the south.

The remnants of sediments of the Egerian have preserved mainly in the northern part of the Košická kotlina basin, then to a lesser extent in the north of the Potisie lowland and in shreds also behind the Klippen Belt near Modrá n/Cirochou.

The Eggenburgian sequence, similarly as the lower Egerian, is of molasse character and as the results of more recent drilling works have shown (mainly of borehole Prešov-1), there is mainly a complex composed of claystones, sandstones and conglomerates. Polymict conglomerates with relatively well worked up grains are found in the lower part of the sequence. The pebbles are especially composed of quartz and carbonates. The sandstones are mostly fine-grained, less medium to coarse grained, with graded, convolute and cross bedding, mainly found in marginal parts of the profile where they form layers and partings in claystones, the so called sandy-claystone development with rich coal detritus to thin partings of lignite, especially in the Čelovce, depression.

The most essential part of this sequence is formed by dark-grey claystones and siltstones, in which sandstones are found sporadically only. In the claystones mainly illite and chlorite predominate (J. Magyar – 1975) in the central Prešov depression, thickness of this sequence is more than 1000 m.

To the end of the Eggenburian the first products of commencing extensive Neogene volcanic activity start to occur. Concerned is acid rhyolite volcanism, mainly concentrated to the NW part of the basin.

To the end of the Eggenburgian this sedimentation area disappears and break of sedimentation persists throughout the Ottnangian.

The second sedimentary cycle begins in the Karpatian (Fig. 3) when a new sedimentation area formed, the axis of which shifted more to the south as far as SE. In contrast to the preceding one this is deeper and mainly broader. Communication with the sea also in that period we suppose again from NW. Whereas the northern margin of the Karpatian sedimentation area reached far into the present Flysch Zone and is difficult to reconstruct, in the south its margin was nearly situated at the line Košice–Trebišov to SE, reached to the transversal Bešany fault zone near Veľké Kapušany. The material was supplied into the Karpatian sedimentation area mainly from the south and SE (Sobrance island). Regarding to the new results (borehole Trhovište-26), thickness of this sequence will be more than 1500 m in the central and NW parts of the Potisie lowland.

Gradual extension of the Karpatian sedimentation area was from NW to SE; a transgression in this direction is also indicated by the presence of a conglomerate-sandy complex 100–200 m thick as is to be seen from the vertical lithofacial section. This basal complex is mainly known in the Košická kotlina basin, gradually resting on the Eggenburgian, Central Carpathian Paleogene and Mesozoic. In the northern part of the Potisie lowland this facies is perhaps represented by the Mernik conglomerates. The basal detrital complex in the SE part of the Karpatian basin behind the transversal Albinovce–Kolčovo–Rakovec elevation zone will most probably disappear and sandy development will gradually pass into dark-coloured basal claystones, which are resting directly on the Paleozoic pre-Neogene substratum (boreholes Pozdišovce-1, Iňačovce-1, 2 and Rebrín-1) (J. Janáček – I. Pagáč, 1961; R. Rudinec, 1969, 1973; C. Tereska, 1972).

The basal sequence of the Karpatian, described by J. Magyar (1973, 1975), is formed by fine to very fine sandy claystones alternating with highly solidified

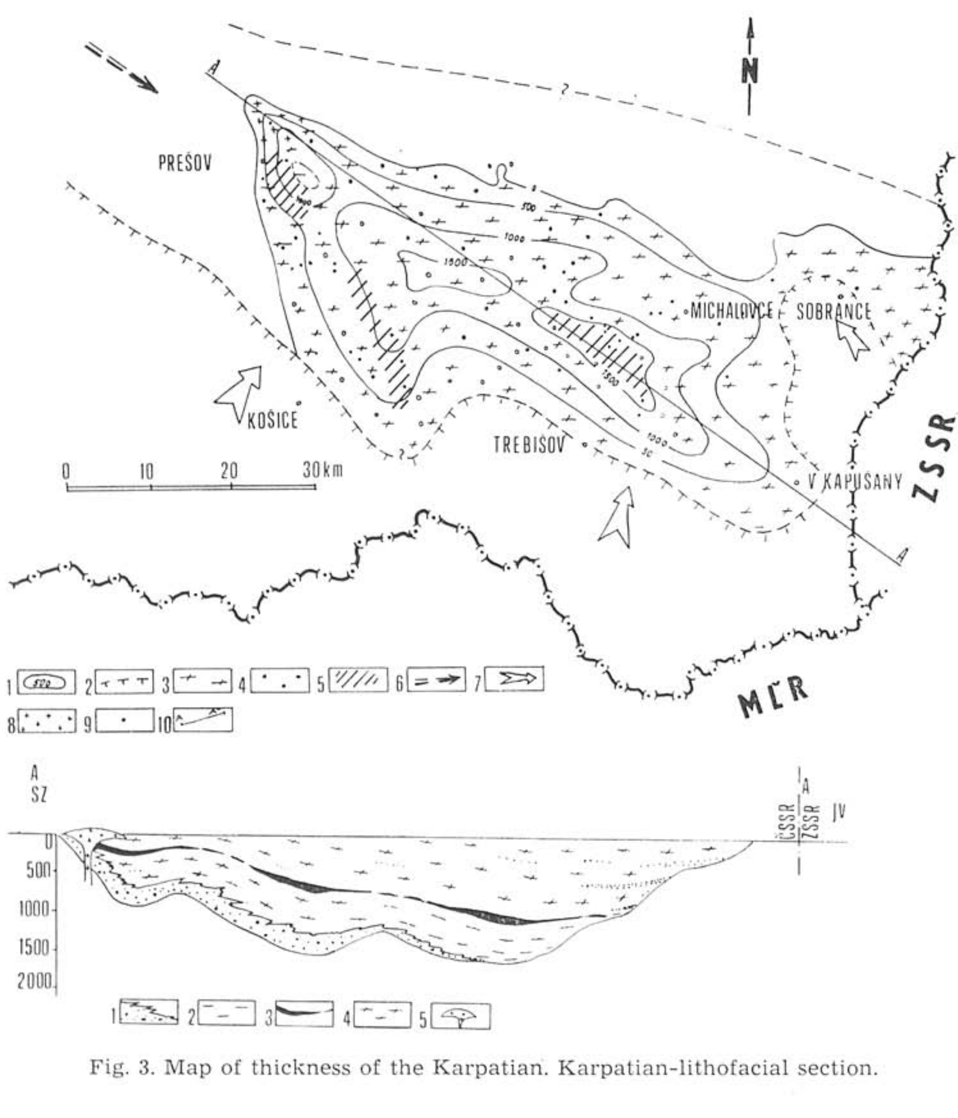

Fig. 3. Map of thickness of the Karpatian. Karpatian-lithofacial section.

micaceous fine to medium grained sandstones, which pass into polymict conglomerates in the basal part, rarely also greywackes are found. The main clastic components are half-worked up quartz, quartzite, then chert, less sericitic metaquartzites, chlorite—muscovitic phyllites, relatively abundant are carbonate rocks. From accessory minerals there are garnet, staurolite, apatite, tourmaline, zircon, rutile, pyrite and ilmenite. The argillaceous groundmass is primary and formed by clay-sandy substance that was partly recrystallized in carbonates with diagenetic processes.

According to the petrographic character of rocks in the basal part of the Karpatian in the Košická kotlina basin J. M a g y a r (1973) supposes that the main source area were massifs built up of sedimentary and less of eruptive and metamorphosed rocks. On the contrary, M. S t a r o b o v á (1962) on the basis of some mineral associations and rocks fragments in the Potisie lowland gives in the first place metamorphosed massifs as sources for the Karpatian.

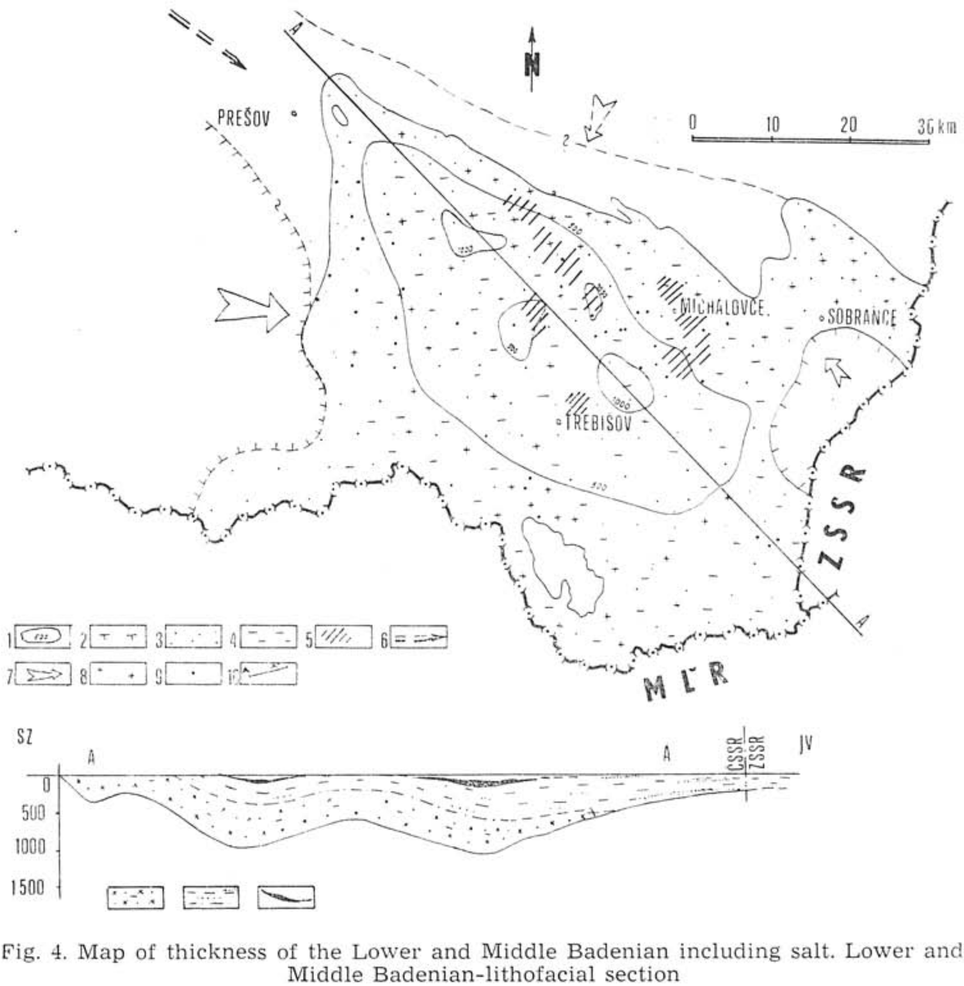

Fig. 4. Map of thickness of the Lower and Middle Badenian including salt. Lower and Middle Badenian-lithofacial section

Towards the overlier the Karpatian complex passes into a mighty complex of variegated (violet-coloured) claystones with sporadical indistinct partings of fine-grained, highly solidified sandstones.

In the lower part of the variegated claystone complex a distinct layer of salt-bearing sequence is found (Prešov salt). As newer results have shown (borehole Trhovište-26), it is of regional extension also in the SE part of the basin. In some parts of the basin the salt-bearing sequence forms lenticular bodies 10—20 m thick or continuous salt horizons, however, mostly there is a complex of darkcoloured salt clays 200—300 m thick, in places with anhydrite-gypsum facies. Thin irregular intercalations of gypsum and anhydrite are found throughout the Karpatian.

Similarly as in the Eggenburgian also in the Karpatian volcanic activity was concentrated to the NW part of the basin only. Manifestations of acid volcanism were concerned.

The Lower and Middle Badenian (Lanzendorf group and Spiroplectamina Zone) coincide with the third sedimentation cycle (Fig. 4). In this time further spreading of the sedimentation area to the S and SE is evident. The boundary of Lower Badenian flood in the SE part takes its course W of the village Ptrukša to the Zemplín island area. In the Middle Badenian the sedimentation area was deepening and shifted to SE and S; flooded was the area of Ptrukša and perhaps also the Paleozoic Zemplín island. There was also communication of the East Slovakian basin with tne Transcarpathian region. To the end of the Middle Badenian was some degradation of the sedimentation area, resulting in formation of a system of lagoons mainly in the northern part of the basin where salt deposits and perhaps also evaporite sulphates deposited. The lagoons were separated from one another by jutting islands-horsts (Trhovište—Pozdišovce, Bánovce . . .). Only in that period the supposed communication of this sedimentation area with the sea, the fore-deep, was interrupted first and so the communication with the North Hungarian and Central Slovakian Intracarpathian region remained.

The transgressive character of the Lower Badenian and partly of the Middle Badenian is to be seen best mainly in the S and SE marginal basin parts. The volcano-detrital complex of the Lower Badenian is in direct contact with the Paleozoic basement (Zemplín island) and Mesozoic (Subvihorlat area). The Middle Badenian is lying directly on the Paleozoic elevation in the SE part of the basin (area of Ptrukša).

The transport of material was from the west (Slovenské rudohorie mts.), then from NE and SE (Sobrance island).

Facially the Lower Badenian is represented by a volcano-detrital complex 500—600 m thick, in which several layers of acid rhyolite pyroclastics alternate with light-gray, highly solidified varigrained calcareous to calcareous—tuffitic sandstones, in places with coal pigment. In the NE marginal part of the basin the sandstones pass into fine polymict conglomerates (area of Vranov). The volcanic and sandy parts are separated from each other by indistinct intercalations of dark-grey, very weakly sandy claystones.

The Lower Badenian complex passes towards the overlier into a sandy-claystone development of the Middle Badenian, which contains much detritus at the base, especially in the northern and NE part of the Potisie lowland. This development gradually passes into pelites towards the overlier where more sandy layers are more or less sporadical. This cycle terminates with relatively extensive salt sedimentation, mainly in the northern part of the Potisie lowland (Zamutov—Albínov—Kolčovo—Rakovec—Krásnovce—Iňačovce—Choňkovce—Ložín). Thickness of this second salt-bearing sequence which forms lenticles, thin banks or intercalations in salt clays, varies 50—300 m.

The period of the Lower Badenian in this cycle of sedimentation is characterized by distinct manifestation of acid magmatism, practically in the whole basin.

The fourth cycle of sedimentation takes up the Upper Badenian (*Bolivina-Bulimina* and *Rotalia* zones). During sedimentation of the Bolivina-Bulimina Zone the western margin of the basin was situated nearly in the area of the present

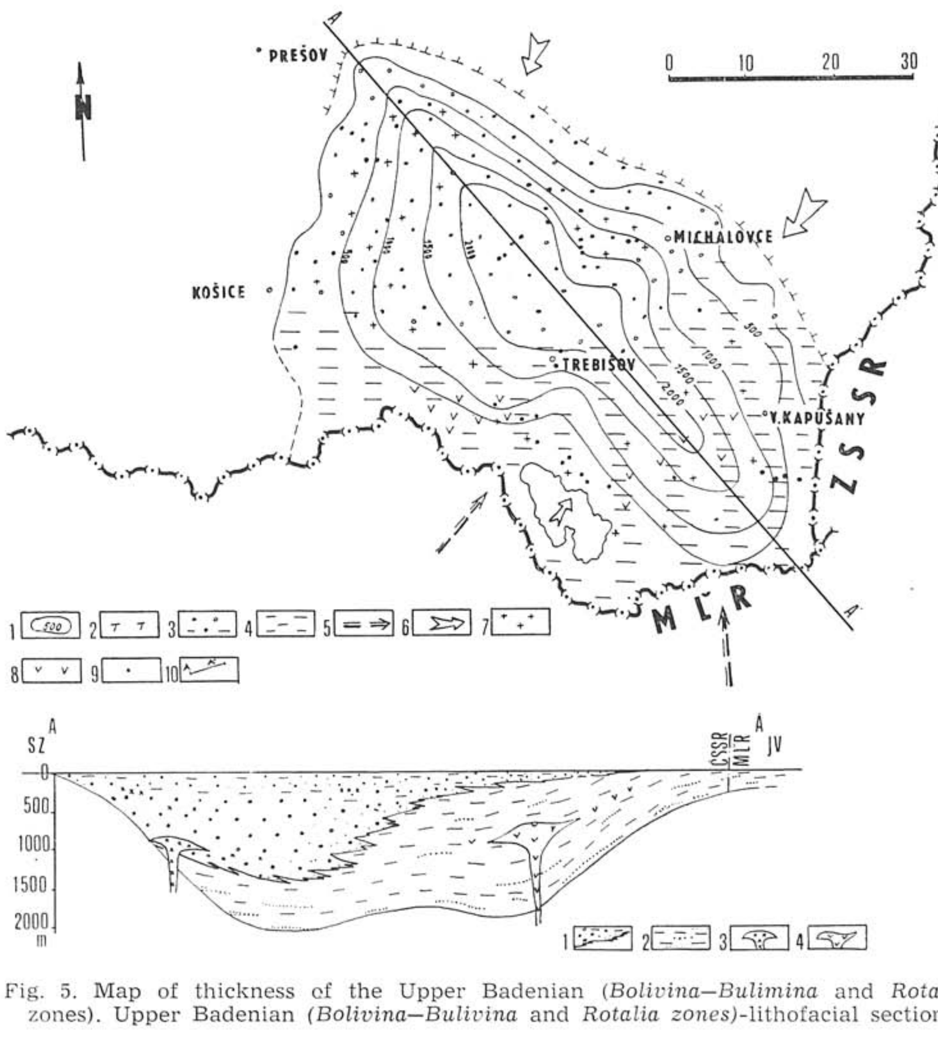

Fig. 5. Map of thickness of the Upper Badenian (*Bolivina—Bulimina* and *Rotalia* zones). Upper Badenian (*Bolivina—Bulivina* and *Rotalia zones*)-lithofacial section

Slanské pohorie mts. (lacking in the Košická kotlina basin). In the south the Zemplín island was still submerged and only gradually emerged in the uppermost Badenian, with successive denudation of the lower, most likely Miocene sequences. The transport of clastic material into the surrounding basin was relatively at a short distance and not manifested in more distinct detrital layers (Žipov). The Zemplín island remained above sea level still also in the lowermost Sarmatian in the Cibicides Zone, it was flooded almost totally repeatedly in the zone of larger Elphidia as will be shown below.

In the northern part of the basin the area of sedimentation rapidly extended towards the west in the Rotalia Zone. In the Košická kotlina basin this sequence gradually transgredes over the Middle and Lower Badenian and even Karpatian (J. Čverčko., 1967).

The whole Upper Badenian cycle is characterized by greatest subsidence, thickness of sediments attaining more than 2000 m. Revolutionary changes took place from the viewpoint of communication with the sea, communication from NW interrupted and remained from the south only. Transport of material into the sedimentation area was mainly from the N and especially from NE, to the end possibly also from NW.

In the lower part of this cycle of sedimentation (*Bolivina-Bulimina* Zone), representing a relatively deep-sea, quiet sedimentation, monotonous, grey, little sandy calcareous clays with indistinct detritus deposited in the SW basin part near the Zemplín island, which got emerged. Towards the overlier, mainly in the northern part of the basin, due to inflow of the fresh waters from NE, freshening of the sedimentation environment occurred. As a consequence, in the northern and central parts of the basin extensive subsidence of the detrital sequence took place, which passes into a sandy-claystone complex to the overlier. The brackish facies of detrital-claystone development, which is of delta character, gradually disappears towards SE to the basin and passes interfingering into pelitic marine development as may be traced very well also in the mixed character of brackish and marine fauna, mainly in the area of Bánovce (J. Jiříček, 1968). Areally this development si approximately bordered in the basin by the line connecting the towns Košice—Trebišov—Michalovce.

The detailed analysis of clastic material from gravel-sandy horizons of the freshened Upper Badenian in the Košická kotlina basin — J. Čverčko et al. (1968) — has shown a prevalence of carbonate rocks (80 %) in the basal part, passing into hard restistant rocks, quartz, vein quartz, metaquartzite and quartz porphyry in the higher horizons. The pebbles are relatively well worked up, testifying to a longer transport. The Upper Badenian detrital-claystone complex is also designated as Kolčov sequence (J. Čverčko et al., 1968).

In the southern and southeastern part of the basin, in the lower pelitic part of this cycle of sedimentation to a larger extent also intermediate volcanism appears first in the form of andesite lavas and pyroclastics.

Further manifestations of acid volcanism mainly fall to the upper part of this period as biotitic rhyolite and its pyroclastics.

The following, fifth cycle of sedimentation coincides with the period of the Sarmatian when reduction of the sedimentation area and its reorientation to the southeastern part of basin was evident (Fig. 6). Gradually, mainly during sedimentation of the sequence with larger Elphidia, the basin extended to SW where the Zemplín island was partly flooded (transgression of larger *Elphidia* over the *Bolivina-Bulimina* Zone) and particularly to NE into the Subvihorlat area, with Sarmatian resting transgressively on the Paleozoic, perhaps the Mesozoic and Lower Badenian (R. Rudinec – J. Čverčko, 1970; R. Rudinec, 1973) and farther to the southern part of the Košická kotlina basin. Permanently emerged remained the area north of Košice and of the line Michalovce–Prešov including the island near Sobrance.

In that period also remained communication with the sea from the south when the sedimentation area in the East Slovakian Neogene was, as a matter of fact, the N promontory of a large Sarmatian basin on the territory of Hungary and Transcarpathia. The principal direction of material transport was from N, partly NW and NE and from jutting islands near Sobrance and Zemplín. The Sarmatian cycle of sedimentation is also characterized by mighty subsidence, with thickness of sediments in the area of Trebišov–Veľké Kapušany more than 2000 m.

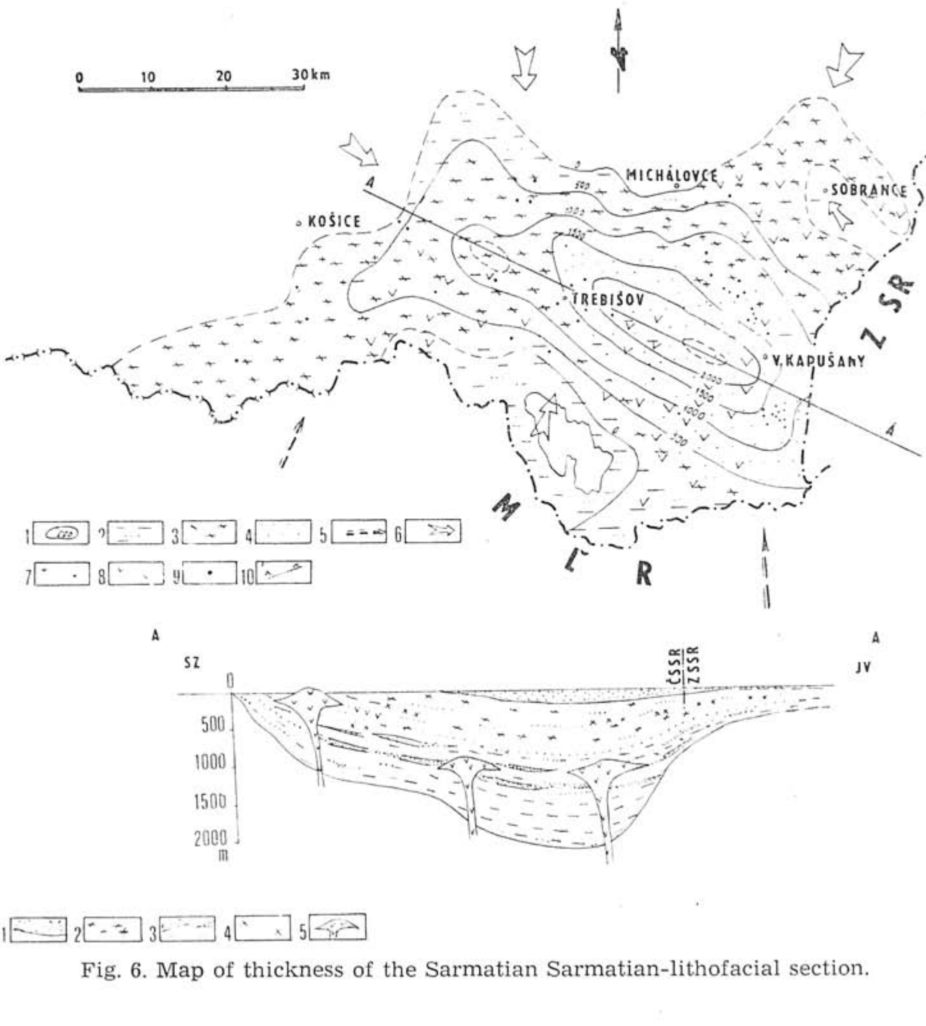

Fig. 6. Map of thickness of the Sarmatian Sarmatian-lithofacial section.

In the Sarmatian complex of sediments, as the longitudinal lithofacial section shows, we may distinguish several facies. The Lower Sarmatian is mainly represented by grey claystones in the central part of the basin, passing into a sandy-claystone complex towards the overlier and marginal parts. The sandy layers are quite abundant and relatively distinctly indicate a higher supply of clastic material into the basin. The analysis of well worked up pebbles and their sorting point to their relatively longer transportation. In the lower part a decrease in hard rocks from older metamorphosed massifs and an increase in particles derived from flysch rocks-sandstones, cherts, lydites, siltstones, claystones and conglomerates may be observed (J. Č v e r č k o et al., 1968). The presence of flysch rocks in the zone of larger *Elphidia* proves gradual uplifting of the Flysch Carpathians, deepening and spreading of the area of sedimentation.

The Middle Sarmatian, of largest areal extension, forms a sandy-tuffogenic complex of sedimentary rocks, mainly in the Subvihorlat area where in places abundant coal clays and lignite intercalations are found.

Towards the overlier gradual freshening of the sedimentation environment may be observed and in the Upper Sarmatian its considerable reduction took place, represented by a regressive sandy complex. The latter may be observed well mainly in the central and SE part of the basin, near Ptrukša where it is up to 100 m thick with intercalations of clays and volcanic products.

Equally also the Sarmatian cycle of sedimentation is rich in volcanic manifestation, mainly in the lower part where mighty masses of intermediate volcanism are found. Further on, layers of products of acid volcanism (pyroclastics) and in the upper part repaetedly andesites and their pyroclastics appear.

The latest, sixth cycle of sedimentation coincides with the P a n n o n i a n as the Upper Miocene and the P l i o c e n e (Fig. 7). At its beginning the sedimentation area was divided. From Hungary to the southern part of the Košická kotlina basin a small gulf extended where variegated Pannonian sediments of little thickness deposited. The main sedimentation area, which preserved the Sarmatian character in degraded form, is found in the SE part of the basin. Between both sedimentation areas is dry land, taking up the wider area of the Zemplín island, mainly to the NW. In that period distinctly appears spreading of the sedimentation area to NE so that also the Sobrance island was flooded and the Pannonian rests in places discordantly directly on the Mesozoic.

Communication of this sedimentation area with the sea was mainly from S and SE, however, gradual inflow of fresh waters resulted in its freshening and complete degradation in the terminal stage. Transport of material was mainly from the north and partly from the wider area of the Zemplín island.

In this whole cycle of sedimentation we may distinguish three more distinct facies. The Pannonian sequence is represented in the lower part mainly by variegated clays, in the marginal parts of which are found sands, coal clays, lignite (deposits Hnojné, Sejkov) and known garnet rhyolite tuffs. This facies as well as the variegated clays are also in the southern part of the Košická kotlina basin. The higher facies of the Pannonian corresponds to the so called Pozdišovce gravel formation, mainly extending near Michalovce (J. J a n á č e k, 1958). There are gravels, which to the south gradually pass into a sandy – clayey facies to variegated clays. In the upper part of this facies in variegated clays coal clays and wood lignite (Iňačovce) are found.

The uppermost facies of this cycle corresponds to the Pliocene-Rumanian, which already indicates gradual degradation of the sedimentation area. Pliocene sediments are developed as sandy—clayey complex, mainly in the central part of the basin, with clastic component predominating, especially at the northern margin.

As the last results of absolute dating have shown (J. Slávik et al., 1976), the youngest volcanic activities in the Neogene of eastern Slovakia are bound to the Lower and Middle Pannonian. There were first acid — rhyolite and rhyodacite pyroclastics and to the end mighty effusions of intermediate lavas.

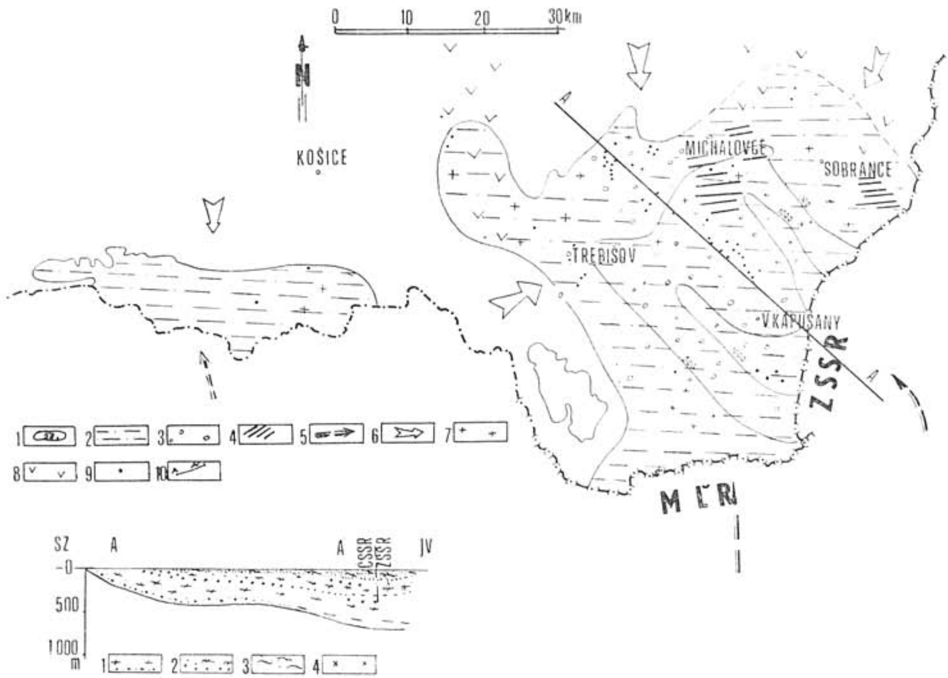

Fig. 7. Map of thickness of the Pannonian and Pliocene. Pannonian and Pliocene-lithofacial section.

Fundamental features of tectogenetic development and its relation to adjacent formations

All the changes with sedimentation of Neogene sequences are, as a matter of fact, a reflection of tectonic development also in the wider hinterland, thus also of folding movements in the flysch. In formation of the tectonic style (picture) of the East Slovakian Neogene tangential as well as radial movements participated.

The analysis of up to present results shows that the tectonic picture of the East Slovakian Neogene has on the whole two fundamental stages of development, with predominanting radial tectonics of normal fault character.

To the first stage of development we range sequences of the Miocene–Egerian?, Eggenburgian, Karpatian, Lower and Middle Badenian. The sedimentation area of these sequences formed in the initial period along faults of approximately east–west direction, which gradually turned into the direction northwest–southeast. The faults are mostly of the character of synsedimentary dislocations as proved in the central part of the Košická kotlina basin by J. Čverčko – R. Rudinec (1975). As these old dislocations are obscured by younger movements and overlapped by a thick complex of younger sequences, their interpretation, especially in the Potisie lowland, is difficult.

In that period most probably communication of the East Slovakian sedimentation area with the fore-deep existed through a narrow gulf approximately in the area north of the Klippen Belt. This communication possibly originated to the end of the Oligocene when the original wider sedimentation area was reduced to a narrow strip, in which the Lower Miocene sediments have not preserved to a larger extent behind the Klippen Belt except for Modrá n/Cirochou. Smaller relicts, which in some places may be partly overlapped by folded Paleogene sequences, cannot be excluded, rather on the contrary, they may be really supposed as communication with the sea of the fore-deep must have existed here.

In that period there was a distinct elevation ridge of E–W direction between the northern Neogene sedimentation area in eastern Slovakia and the sedimentation area on the territory of Hungary, which extended in the wider area of the present Zemplín island.

Communication with the sea from the north disappears with advancing Styrian orogenetic phase, manifested in the Flysch and perhaps also in the Klippen Belt in further folding movements, resulting in gradual overthrusting of the masses of the outer flysch nappes over the fore-deep. In general, the orogenetic phase is identified well by gradual migration of these movements from west to east along the Carpathian arc from the Middle Badenian to the Pliocene.

Linked with these tectonic movements is the second stage of development, resulting in the present-day tectonic picture of the Neogene in eastern Slovakia. Tectonic movements were mainly manifested in fault tectonics of synsedimentary character in NW–SE direction, with renewal of movements along old faults in some cases, but also conspicuously transversal tectonics of NE–SW direction is evident, in the western part of the studied area mainly N–S dislocations are observed. In that period the majority of faults known at present arose, as the Močarany–Topľa, Trebišov–Hornád–Košice, Vrbnice . . . . . . faults.

In time, this process commenced in the upper part of the Upper Badenian in the Rotalia Zone and continued with equal intensity in the Lower Sarmatian. From the end of the Middle Sarmatian tectonic activity was lessening, almost fading out in the Pliocene.

Volcanism

At present the opinion is mostly accepted that acid magmas originate in the earth crust mainly by remelting of the granite zones. To an essentially lesser extent their origin is put into connection with partial melting of the upper mantle, which in general is related with basic magmatic processes.

Characteristic of the lower development stage of the Neogene in eastern Slo-

Table 1

Stratigraphic table of the east slovakian neogene basin with indicated ages of orogenic phases and volcanic activity

Age mil. y.	Stratigraphy		Folding phases according to R. Rudinec-J. Slávik (1973)	Volcanism	Development stages	Paleogeography
7	Pliocene				second	communication of the sedimentation area from the south and south-east only
10	Pannonian			intermediate + acid		
13,5	Sarmatian		sixth fifth	mainly intermediate + acid		
17	Badenian	Upper	fourth	acid intermediate		interruption of communication from NW (Styrian) phase)
		Middle			first	
18		Lower	third	acid		
21	Karpatian			acid		communication of the sedimentation area most probably from NW with the fore-deep
22	Ottnangian		second	hiatus		
23	Eggenburgian			acid		
30	Egerian?		first			

vakia from the Eggenburgian to the Middle Badenian are mighty manifestations of acid volcanism. In the higher-second stage of its development from the Upper Badenian to the Pliocene volcanism of basic character predominates.

Regarding to present-day views of the origin of magmas, the conception offers that volcanism of acid character in the first stage in eastern Slovakia is some indirect indicator of relatively lesser depth of penetration of faults into the earth's crust. Much more intense, with greater reach of depth, were tectonic movements in the second development stage. Along the principal tectonic lines of first order reaching the upper mantle, mighty effusions of andesite lavas occurred.

Conclusion

In development of the East Slovakian Neogene six larger cycles of sedimentation were distinguished generally from the Egerian to the Pliocene (Tab. 1). The tectonic events in the Neogene were also reflected in the surrounding, mainly flysch sediments. In tectonic development of this region on the whole two fundamental stages may be distinguished; to the first stage are assigned the sequences of the Egerian?, Karpatian, Lower and Middle Badenian, to the second stage the Upper Badenian, Sarmatian Pannonian and Pliocene. In the lower stage acid volcanism dominates only, as indirect indicator of lesser penetration of faults into the earth crust. In the upper stage with intermediate volcanism predominating over acid one, the faults of first order reach even the upper mantle.

Translated by J. Pevný

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EXPLAINATION TO FIGURES

Picture N.1
1 – present basin border 2 – presupposed original extension 3 – dark claystones with sporadic sandstones 4 – direction of connection with sea 5 – source area 6 – borehole which caught series of strata 7 — lithofacial section
Egerian – lithofacial section (R. Rudinec 1976)
1 – dark claystones with sporadic sandstones
Picture N.2
1 – present extent – isopachytes 2 – presupposed original extension 3 – sandy-clay development (plenty of carbonised plant rests) 4 – dark claystones with sporadic sandstones 5 – direction of connection with sea 6 – source area 7 – acid vulcanism 8 – boreholes which caught series of strata 9 – lithofacial section
Eggenburgian – lithofacial section (R. Rudinec 1976)
1 – conglomerates 2 – sandy-clay development (plenty of carbonised plant rests) 3 – dark claystones 4 – acid effusions
Picture N.3
1 – present extent – isopachytes 2 – presupposed original extension 3 – varied claystones with anhydrite and gypsum 4 – extent of basal sandy-detrital complex 5 – salt – anhydrite and gypsum 6 – direction of connection with sea 7 – source area 8 – acid vulcanism 9 – boreholes which caught series of strata 10 – lithofacial section
Karpatian – lithofacial section (R. Rudinec 1976)
1 – basal sandy-detrital complex 2 – dark claystones 3 – salt (anhydrite or gypsum) 4 – varied claystones with inexpressive sandy intercalations of anhydrite and gypsum 5 – acid effusions
Picture N.4
1 – present extent – isopachytes 2 – presupposed original extent 3 – vulcanic-detrital complex 4 – grey claystones 5 – salt (anhydrite, gypsum) 6 – direction of connection with sea 7 — source area 8 — acid vulcanism 9 — boreholes which caught series of strata 10 — lithofacial section
Lower and middle Badenian – lithofacial section (R. Rudinec 1976) 1 – lower Badenian – vulcanic-detrital complex, acid pyroclastic rocks, sandstones with intercalations of grey claystones 2 — middle Badenian — sandy-clay turns into grey claystones with sporadic sandstones 3 — salt (gypsum, anhydrite)
Picture N.5
1 — present extent — isopachytes 2 — presupposed original extent 3 — detrital-clay development of delta 4 – clay development 5 – direction of connection with sea 6 – source area 7 – acid vulcanism 8 – intermediate vulcanism 9 – boreholes which bored series of strata 10 — lithofacial section
Upper Badenian (zones with bolivines, bulimines and rotalias) – litho facial section (R. Rudinec 1976)
1 – upper Badenian – zone with rotalias (kolčov series of strata) – detrital-clay development of delta 2 – upper Badenian – zone with bolivines and bulimines – grey claystones with sporadic inexpressive sandstones 3 – acid vulcanism 4 – intermediate vulcanism
Picture N.6
1 – present extent – isopachytes 2 – grey-green calcareous claystones and sandstones of lower Sarmatian 3 – sandy-tuffogenic sediments of middle Sarmatian 4 – detrital development of upper Sarmatian 5 – direction of connection with sea 6 – source area 7 – acid vulcanism 8 – intermediate vulcanism 9 – boreholes which bored series of strata 10 – lithofacial development
1 – upper Sarmatian-regressive sand 2 – middle Sarmatian-sandy-tuffogenic sediments 3 – lower Sarmatian-sandy-clay development which turns into grey claystones 4 – rhyolite pyroclastic rocks 5 – intermediate vulcanism
Picture N.7
1 – present extent – isopachytes 2 – varied clays, sands and sandstones 3 – pozdišov gravel formation 4 – coal sedimentation 5 – connection with sea 6 – source area 7 – acid vulcanism 8 – intermediate vulcanism 9 – boreholes which bored series of strata 10 – lithofacial section
Pannonian and pliocene – lithofacial section (R. Rudinec 1976)
1 – pannonian – varied clays 2 – pozdišov gravel formation 3 – pliocene – sandy-clay complex 4 – rhyolite pyroclastic rocks