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Sea ways connecting the Fiľakovo/Pétervására Basin with the Eggenburgian/Burdigalian open sea

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Abstract: The Fiľakovo/Pétervására Basin of Eggenburgian age is situated in southern Slovakia and northern Hungary. Physiographically, the basin was configured as a bay closed towards south. As regards present day erosional extent of basinal marine deposits the foraminifera and calcareous nannoplankton assemblages from the marginal sites indicate that the bay was connected with open sea, i.e. with the marine basins located on the back of the Magura nappe and in front of the ascending Carpathians, by a northeast sea way via East Slovakian - Transcarpathian Basin and by a north - north-west sea way (recent coordinates) via west Carpathian intramountainous depressions, through Vienna Basin to Alpine - Carpathian foredeep.

Key words: Western Carpathians, Fiľakovo-Pétervására Basin, Eggenburgian/Burdigalian paleogeography, Eggenburgian sea ways in Central Europe, foraminifers, calcareous nannoplankton.

A number of authors have addresed the problems related to distribution of original sedimentary basins in the Central Paratethys area during the Eggenburgian (22-19 Ma B.P., VASS et al., 1987). DEPÉRET (1892) defined the range of Burdigalian chronostratigraphical stage as corresponding approximately to the Eggenburgian (compare STEININGER and SENEŠ et al., 1971). The Burdigalian was later redefined to include the Helvetian stage and to combine Eggenburgian, Ottnangian and Karpatian stages of the Central Paratethys in new definition.

Déperet presented "faluns" (lumachelles) from Saucats and Léognan (département Gironde, Southwest France) and calcareous sandstones with Pecten prescabriusculus in Rhône valley as typical Burdigalian sediments. He considered faluns the sediments of the Miocene first phase transgression, which progressed from Rhône valley to the valley of Drôme. Calcareous sandstones with Pecten prescabriusculus are the sediments of the following transgression phase, which progressed into Dauphiné and farther to Savoy, Switzerland (Molasse du Plateau), Bavaria and to "Outer Vienna Basin", where the Alpine Foredeep passes into the Carpathian one. Later papers also describe the Burdigalian (Eggenburgian) sediments in the Carpathian Foredeep near Ostrava, and eastwards and below the Outer Carpathians nappes (OSZCZYPKO and SLACZKA, 1985, Fig. 5). More eastwards in the Carpathian Foredeep the marine Eggenburgian sediments are missing, but the Eggenburgian marine transgression progressed into the sedimentary basins of Stebnica, Boryslav-Pokuty, Skola and partially also into Subsilesian and Silesian units (OSZCZYPKO and SLACZKA l.c., KOVÁČ et al., 1989). Afterwards, these units were folded to form nappes of the Outer Carpathians (Fig. 5). The Eggenburgian sea progressed eastwards (using recent coordinates) into the Central Western Carpathians area, through sedimentary basins of Pouzdřany and Ždánice units (now folded into the Outer Western Carpathians front) into the Vienna Basin and farther eastwards through the Brezová and Vaďovce depressions to the Váh River valley (Trenčín and Ilava depressions) to Bánovce, Horná Nitra and Turiec depressions. From these sedimentary areas could, e.g. Turiec depression communicate through the Mid-Slovakian fault zone and Zázrivá - Budapest fault Belt, respectively, with piggy back marine basin situated on the Magura nappe unit (north of the present day Vysoké Tatry Mts.). To the east the mentioned basin communicated with the marine basin of the Skole unit. The basin was later folded to form the Outer Carpathian Magura Unit (CZIESZKOWSKI, 1992). Other marine sedimentary basin, today parallel with the axis of the Outer Carpathians, existed in the Transcarpathian Basin, which communicated (e.g. through a channel near Modra nad Cirochou, KÁROLI-pers. com.) with NE sedimentary basins of the present Outer Carpathians frontal units (Fig.5)

From the above mentioned it follows that for Central Europe the Alpine and Carpathian Foredeeps were important, if not vital sea ways, through which the marine Eggenburgian (or Burdigalian, respectively) transgression progressed (PAPP et al., in STEININGER, SENEŠ et al. 1971; RÖGL and STEININGER, 1983; BÁLDI, 1986; HÁMOR et al., 1988; KOVÁČ et al., 1989 and others).

Due to various reasons the reconstruction of paleogeographic sea ways with the areas of marine sedimentation in northern Hungary and southern Slovakia (Fiľakovo-Pétervására Basin in sense of VASS, 1995, or the North Hungarian marine bay, respectively, SZTANÓ, 1994) is still problematic. Several authors have proposed a southward communication with open sea (it means with the Mediterranean sea) through the Transdinaric straits via Budapest - Zagreb (PAPP et al. in STEININGER and SENEŠ et al., 1971, Fig. 1) for this basin, situated excentrically relative to the Alpine and Carpathian Foredeeps, as well as for the basins inside Central Western Carpathians. However, this concept has been

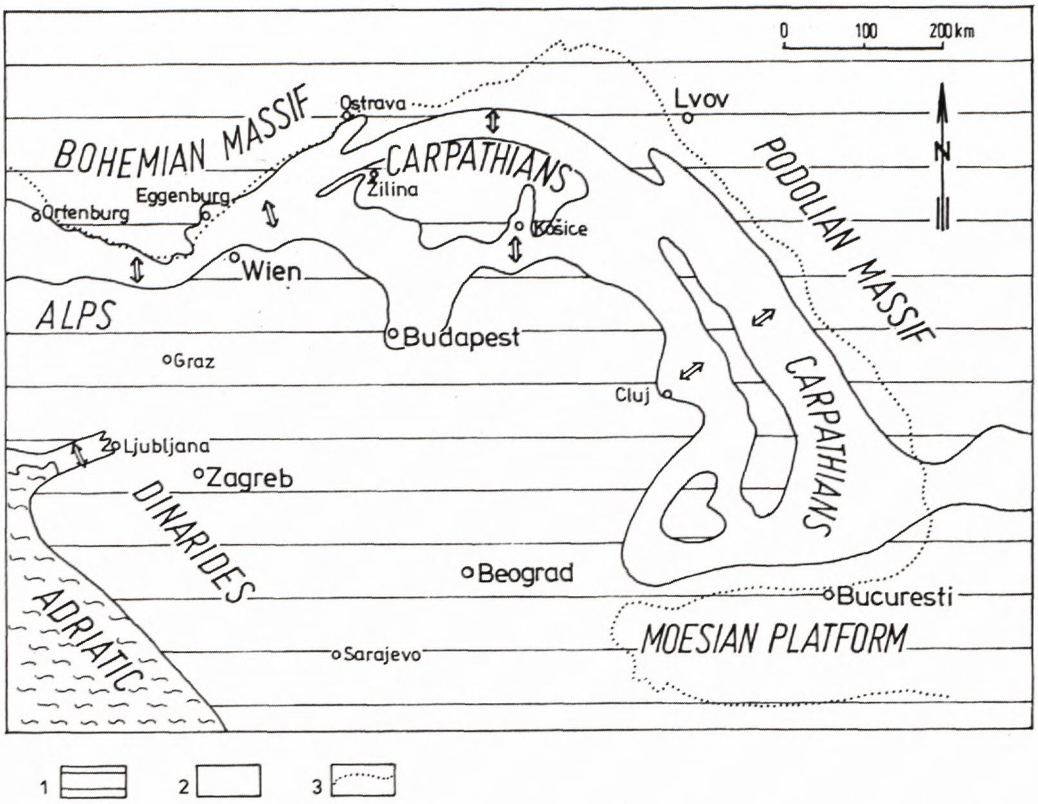


Fig. 1: Scheme of on distribution and mutual conection of marine sedimentary basins in Central Europe during Eggenburgian (Early Burdigalian) according to PAPP et al., in STEININGER, SENEŠ et al. 1971.
1. Dry land; 2. sea and sea ways; 3. recent front of the Eastern Alps and Carpathians.

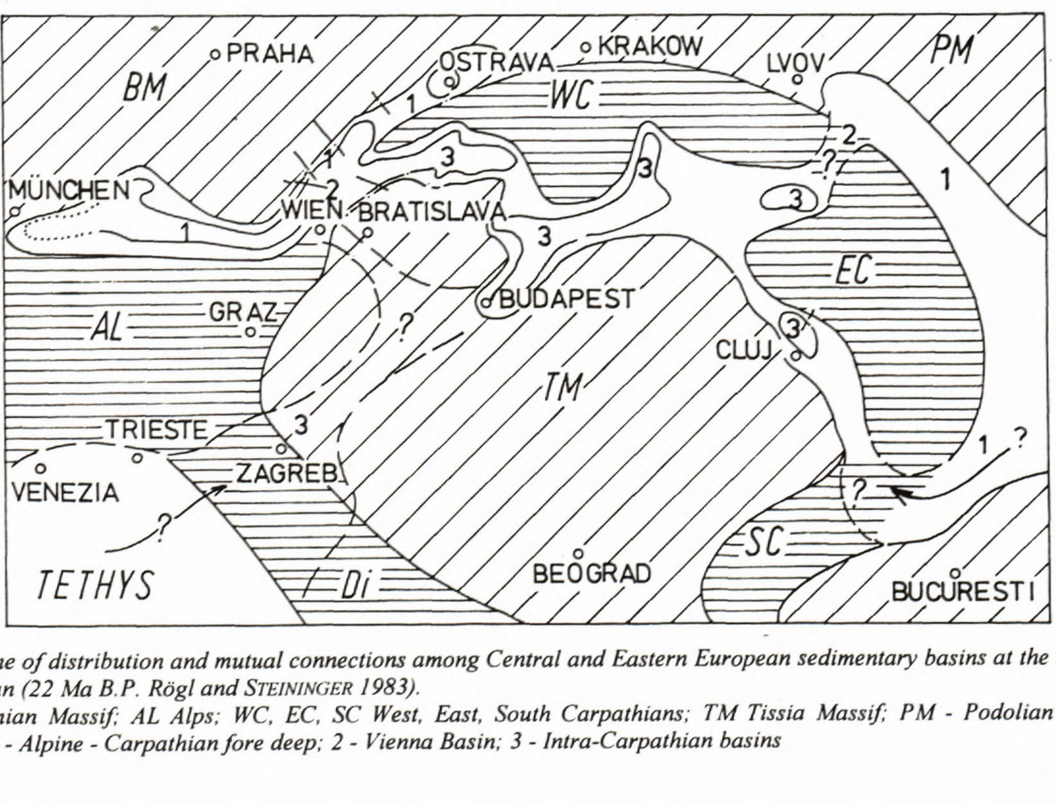


Fig.2: Scheme of distribution and mutual connections among Central and Eastern European sedimentary basins at the beginning of Eggenburgian (22 Ma B.P. Rögl and STEININGER 1983).
BM - Bohemian Massif; AL Alps; WC, EC, SC West, East, South Carpathians; TM Tissia Massif; PM - Podolian massif DI - Dinarides; 1 - Alpine - Carpathian fore deep; 2 - Vienna Basin; 3 - Intra-Carpathian basins

later refused (RÖGL and STEININGER,1983, see Fig. 2; BÁLDI, 1986; HÁMOR et al., 1988; SZTANÓ, 1994). Migration paths of the terrestrial mammals, sedimentation in the south Alpine and Dinaric Foredeeps and evidences for the syn-Eggenburgian erosion in southern Hungary indicate that the Transdinaric corridor has been closed (SZTANÓ, 1994). Another possible sea way from Vienna Basin south-east (using recent coordinates) through the Danube Basin is presumed by RÖGL and STEININGER (1983, see Fig. 2). However, the oldest known Miocene sediments in the Danube Basin are those of Ottnangian, (e.g. Brenberg Formation) or of Karpatian age, respectively, (e.g. Ligederdö Formation) thus, they are younger than Eggenburgian. Communication across the Central Western Carpathians was postulated by PAPP et al. (in STEININGER and SENEŠ et al., 1971) regardless of the fact that no occurrences of marine Eggenburgian sediments in either the Central Slovakian Neogene volcanic basement, or in the area between the Fiľakovo-Pétervására and the East Slovakian Basins were known at that time. This absence was explained by post-Eggenburgian erosion as a consequence of the Central Carpathians uplift. BÁLDI (1986) has later resumed an idea of a connection between the Fiľakovo-Pétervására, the Intracarpathian basins and the Transcarpathian Basin. Moreover, SZTANÓ (1994) emphasized the role of the sea way between the Transcarpathian Basin, the residual Magura Basin (the basin in piggy-back position on the Magura nappe northwards from Vysoké Tatry Mts.; CIEZSKOWSKI, 1992) and other contemporary sedimentary basins, respectively, (folded today in front of the Outer Carpathians), as the only possible way for marine tide waves to progress into northern Hungarian bay. The tide significantly influenced sedimentation there. Especially the Pétervására sandstones and sandstones of the Fiľakovo Formation display sedimentary structures typical for tide dominated coastal deposits. The energy of tidal flood was amplified by the physiography of North Hungarian bay as is the case of today 's Bay of Fundy, Canada. Huge cross-stratified sets of the Jalová member and their equivalents in the Petérvására sandstones have been formed due to tidal ebb, which was stronger than tidal flood (SZTANÓ, 1994).

VASS and ELEČKO et al. (1989, enclosure Nr 4) presumed that the extent of early Eggenburgian Fiľakovo Formation of Southern Slovakia was greater then that of present day. They have not drawn any conclusion since this presumption was based only on rare occurrence of the molluscs *Clio triplicata* and *Laternula fuchsi* described by ONDREJIČKOVÁ (1977) from the borehole VCH-1 near Chanava in the Rimavská kotlina Depression. According to ONDREJIČKOVÁ the species are not older than the Eggenburgian, or Ottnangian, respectively. But the Eggenburgian elements have not been found in foraminiferal and calcareous nannoplankton assemblages.

The presence of Eggenburgian in the NE corner of the Rimavská koltina Depression was recently confirmed

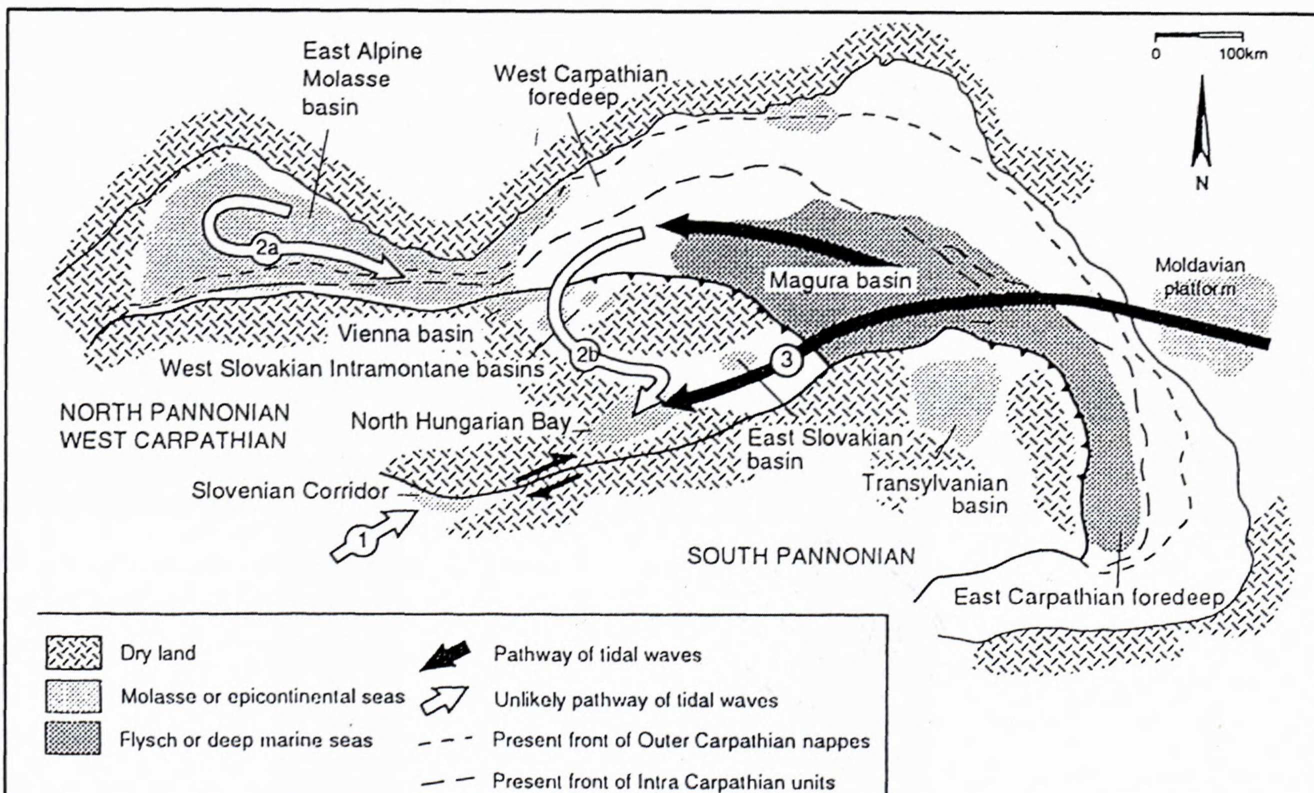


Fig.3: Paleogeographic reconstruction of the Intra - Carpathian area during the Early Eggenburgian (22-20 Ma B.P.) and the sea-ways connecting the North Hungarian Bay and/or Fiľakovo/Pétervásara basin with open sea of the Alpine-Carpathian fore-deep and of Flysch seas via West Carpathian intramountainous basins (according to SZTANO 1994).

by findings of Eggenburgian foraminifers and nannoflora of the NN2 zone, found in a shallow well in the village of Gemerská Panica (Fig. 4, 5, 6). Rich foraminiferal assemblages of Eggenburgian age were found in the calcareous siltstone. The age of mentioned sediments was determined on the basis of Globigerinoides trilobus finds, (first appearance datum: the Eggenburgian; RÖGL, 1986) and *Haplophragmoides vasiceki pentacameratus* (C. et Z.), which occurs in the Eggenburgian (CICHA et al., 1982) exclusively. Agglutinated forms prevailed (28 %) in the well-diversified assemblage, with the most frequent *Bathysiphon* sp., *Cyclamina acutidorsata* (HANT.), *C.* aff. *praecancelata* VOLOSH. (Plate 1). Except for the above mentioned foraminifers the assemblage also contains numerous *Angulogerina angulosa* (WILL.) species. The observed taxa indicate a neritic to bathyal environment (plankton/benthos ratio of 1.6) with cold water and slight oxygen deficit at the bottom (MURRAY, 1991). The occurrence of calcareous nannoflora also confirms this age of the sediment. The *Helicosphaera ampliaperta* BRAM. & WILC., *H. scissura* MILLER, *H. kamptneri* HAY & MOHLER , *Sphenolithus belemnos* BRAM. & WILC., *Discoaster druggi* BRAM. & WILC. species indicate the upper part of the NN2 - NN3 biozone, defined by MARTINI (1971), corresponding to stratigraphical range - Egerian to Lower Ottnangian. Ascertained thanatocoenosis resembles the calcareous nannofossil assemblages determined by LEHOTAYOVÁ (1982) in Eggenburgian sediments of the Western Carpathians (Bánovce, Horná Nitra depressions). Apart from the mentioned Neogene nannofossils the reworked Cretaceous, Eocene and Oligocene calcareous nannoplankton was also determined.

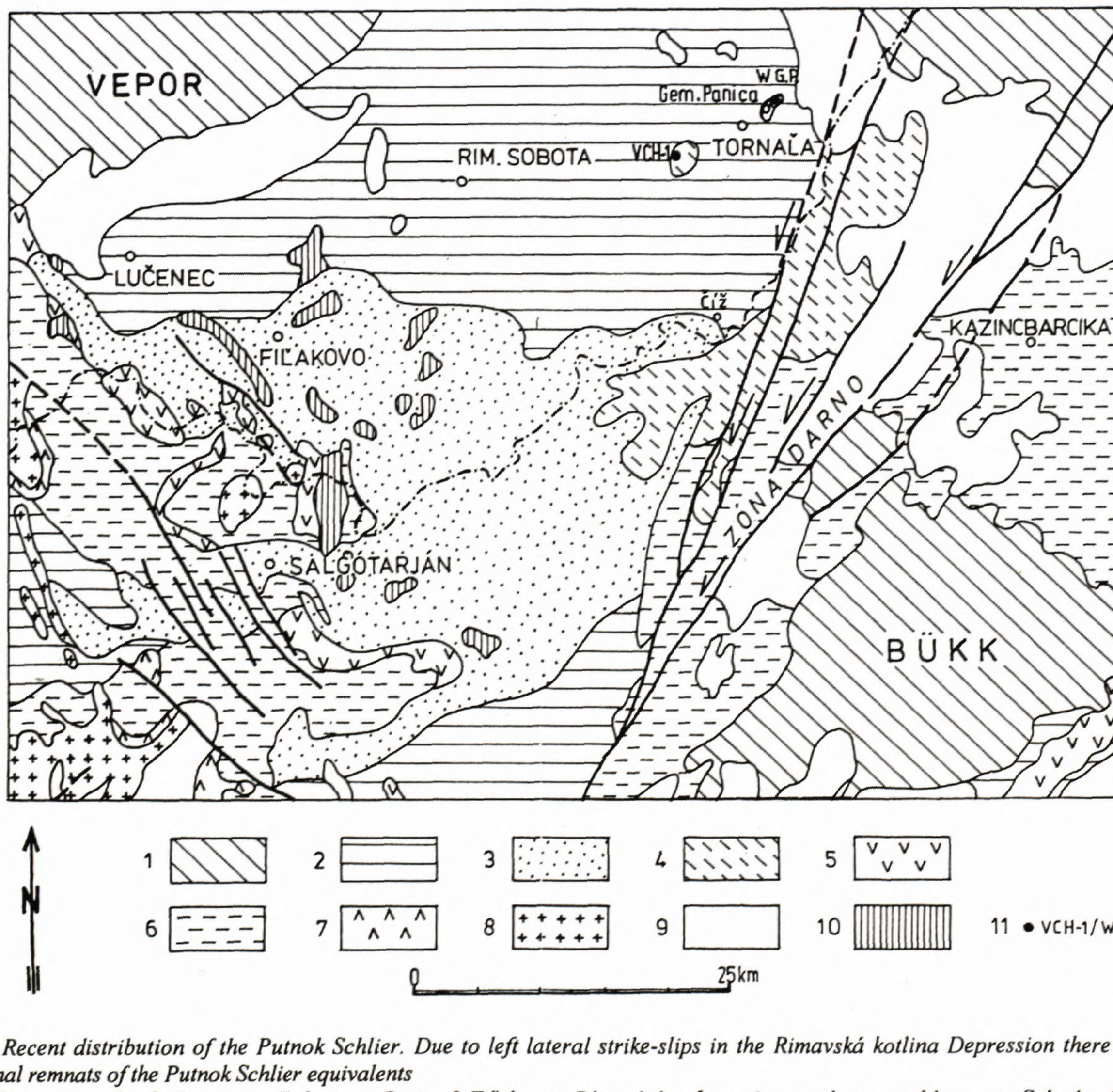


Fig.4: Recent distribution of the Putnok Schlier. Due to left lateral strike-slips in the Rimavská kotlina Depression there are only erosional remnats of the Putnok Schlier equivalents

1 pre-Cenozoic rocks; 2 Hungarian Paleogene Basin; 3 Fiľakovo - Pétervására formation partly covered by upper Szécsény Schlier; 4 upper Szécsény and Putnok Schlier; (3-4 Eggenburgian); 5 Gyulakészi rhyolite tuff (Eggenburgian - Ottnangian) and/or rhyodacite tuff in Bukovinka formation (Eggenburgian); 6 Nógrád /Novohrad Basin (Ottnangian and Karpathian); 7 "middle rhyolite tuff" and/or Tarr tuff; (Upper Karpathian - Lower Badenian); 8 Middle (and Upper) Miocene volcanics; 9 Middle to Upper Miocene sediments; 10 Upper Miocene to Pleistocene basalts; 11 borehole /well (WG.P.-well in the village of Gemerská Panica; VCH-1 : borehole)

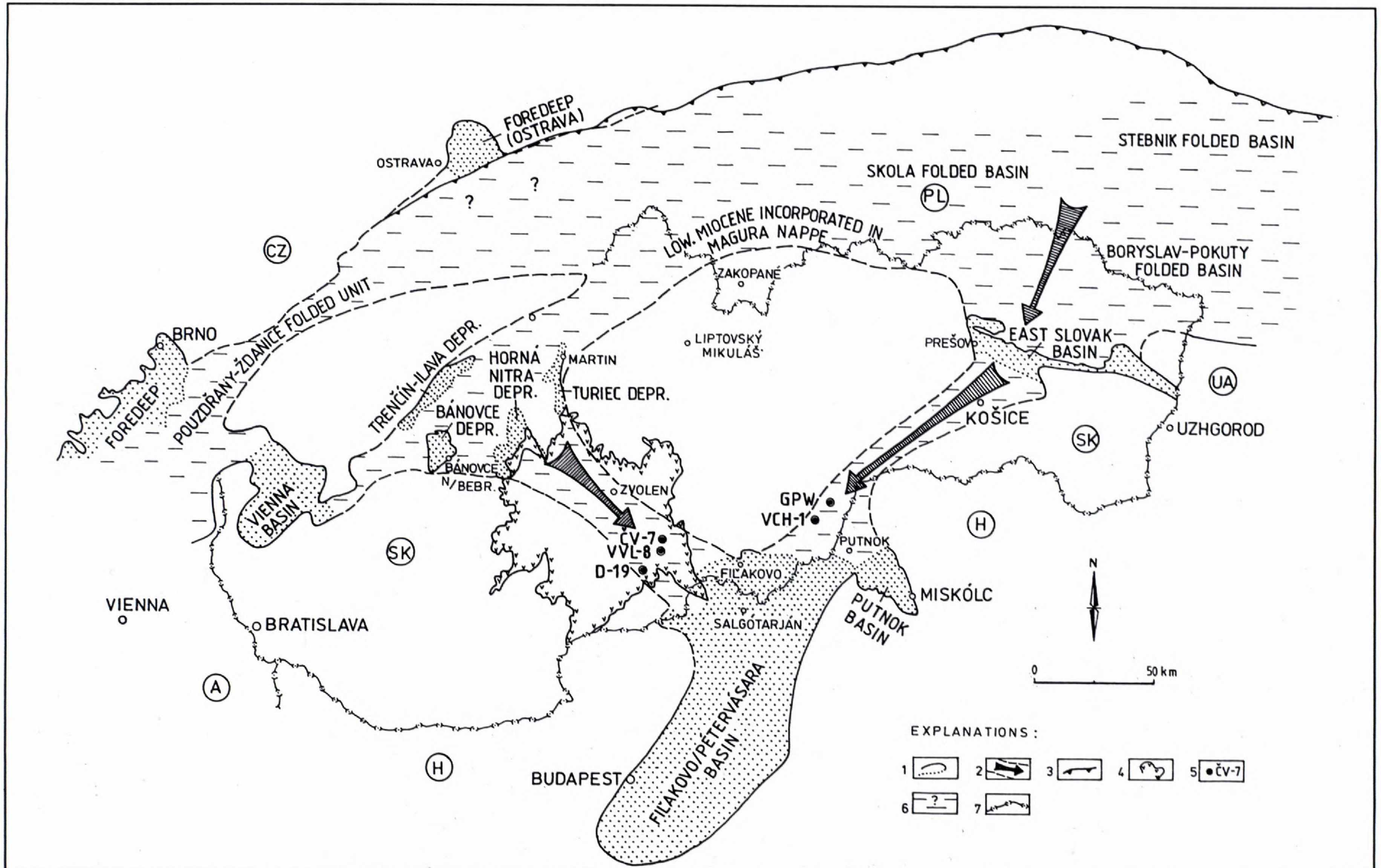


Fig. 5: Sea ways of the Eggenburgian sea in the Western Carpathian territory.
1 Recent distribution of areas with Eggenburgian deposits (deposits incorporated into Outer Carpathian nappe units are not shown); 2 Eggenburgian sea-way inferred; 3 Recent front of Outer Flysch Carpathians; 4 Central Slovakian Neogene volcanics; 5 Borehole and/or well with the Eggenburgian deposits intersected and/or hit; 6 Area covered by sea inferred; 7 National boundary

The occurrence of dinoflagelata assemblages also supports the Lower Miocene age of the sediments from Gemerská Panica (could it be the *Ectosphaeropsis burdigalensis* zone?). Occurence of heterotrophic *Deflandrea* spp. could indicate an existence of nutrient currents in the basin (ESHET, 1994). Most likely, this calcareous siltstone could be the equivalent of Putnok Schlier, which, in the past, evidently continued farther NE, beyond present day border of the Rimavská kotlina Depression.

Since the Eggenburgian fauna and flora assemblages in the Rimavská kotlina Depression are very rare, repeated geological and biostratigraphical campaigns to verify the presence of the sediments Eggenburgian stage in the Rimavská kotlina Depression have all failed. SLAVÍKOVÁ (1953) failed to find the Eggenburgian foraminifers in the wells near the village of Číž, as did Kantorová (fide VASS and ELEČKO, 1989) and later ŠUTOVSKÁ (1990) in the borehole material from the whole depression. Not even Eggenburgian calcareous nannoflora was found in studied samples (LEHOTAYOVÁ in VASS and ELEČKO l.c.). Sporadic findings of molluscs postdating Eggenburgian, and recently also of the Eggenburgian microfauna and nannoflora assemblages show that the Eggenburgian rocks occur as but small occurrences in the Rimavská kotlina depression, namely in its NE part. Original larger extension of Eggenburgian deposits was reduced due to erosion, aided by wrench tectonics. The Darnó tectonic zone (Darnó line accompanied by numerous parallel faults) runs along the eastern margin of the Rimavská kotlina Depression. During Middle Miocene the left strike-slip faults of the Darnó line displaced the bulk of Eggenburgian sediments southwards. Therefore, the Eggenburgian sediments now occur presumably in the Hungarian territory. In the Rimavská kotlina Depression there are only small erosional remnants near the villages Chanava and Gemerská Panica (Fig. 4). These erosional remnants are lithological equivalents of calcareous siltstones of the Szécsény Schlier and/or of the Putnok Schlier, widespread eastwards of the Darnó zone.

The presence of erosional remnants of pelitic, therefore, basinal sediments of the open deeper sea and shortage of the littoral ones at the present basin 's margin suggest their erosional amputation. The Fiľakovo-Pétervására Basin occupied originaly an area more to the NE and was probably connected by a sea way with the Transcarpathian (East Slovakian) Basins. Mentioned sediments were eroded away as a consequence of an uplift of the Slovakian Karst and the whole Slovenské rudohorie Mountains area during Neogene.

Another possible sea way linking the Fiľakovo-Pétervására Basin with the open sea was through present Western Carpathian intramountainous depressions: Turiec, Horná Nitra, Bánovce, Ilava and Trenčín and through Vienna Basin into the Carpathian Foredeep (Fig. 5). This communication postulates a sea way across the area of present day Central Slovakian Neogene volcanics. In spite of the fact that the western and north-western margin of recent Fiľakovo Formation, located below the

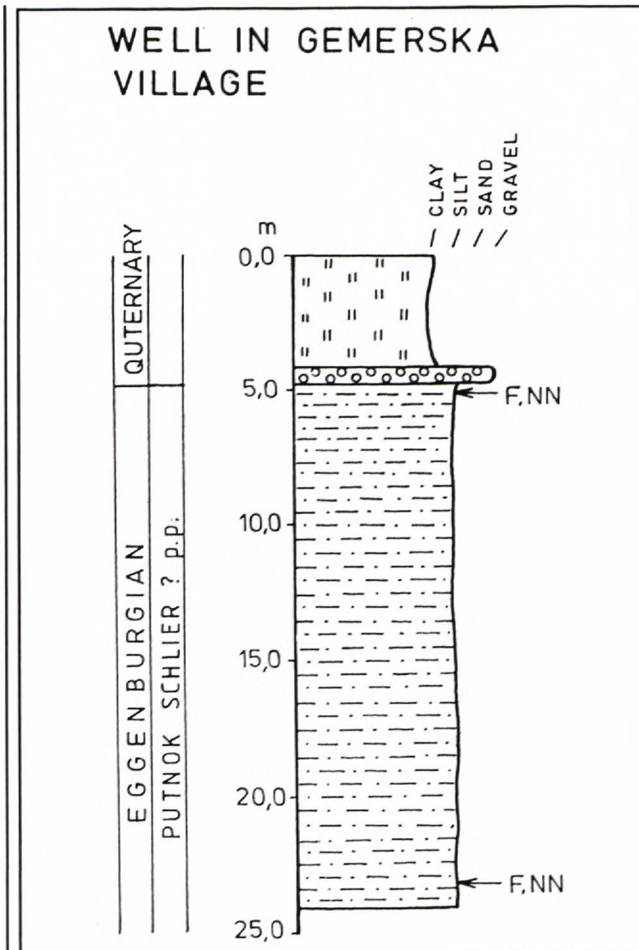


Fig.6 Lithological section through the well in the village of Gemerská Panica NE of the town of Rimavská Sobota (S.Slovakia). For situation see Fig.5; for lithology see Fig.7.

volcanics of the Krupina Plateau and in the Ipeľská kotlina Depression, has been subject to intra-Eggenburgian erosion (its erosional margin is well confirmed by many boreholes), the erosional remnants of Eggenburgian sediments have been found W and NW from the mentioned erosional margin (VASS and ELEČKO et al. in lit.) and in the Ipeľská kotlina depression (SENEŠ, 1952; VASS et al, 1979), where they are known as the Ďarmoty Member (VASS et al., 1983). But they were also ascertained to underlie the Badenian Neogene volcanics and Lower Miocene rocks beneath the Krupina Plateau. The Eggenburgian marine sediments were found in several wells: D-19 nearby the village of Horné S..háre, ČV-7 nearby Červeňany and recently in the well VVL-8 nearby the village of Veľký Lom (Fig. 7).

A foram assemblage with prevailing stenohaline epifytic foraminifers has been found in the sandy sediments in the borehole D-19 at depth of 665 m (Fig. 7). Dominant taxa of *Asterigerinata planorbis* indicates a normal marine environment, with sufficient oxygen supply. A relatively deep water foram assemblage: *Cibicidoides pseudoungerianus*, *Heterolepa dutemplei*,

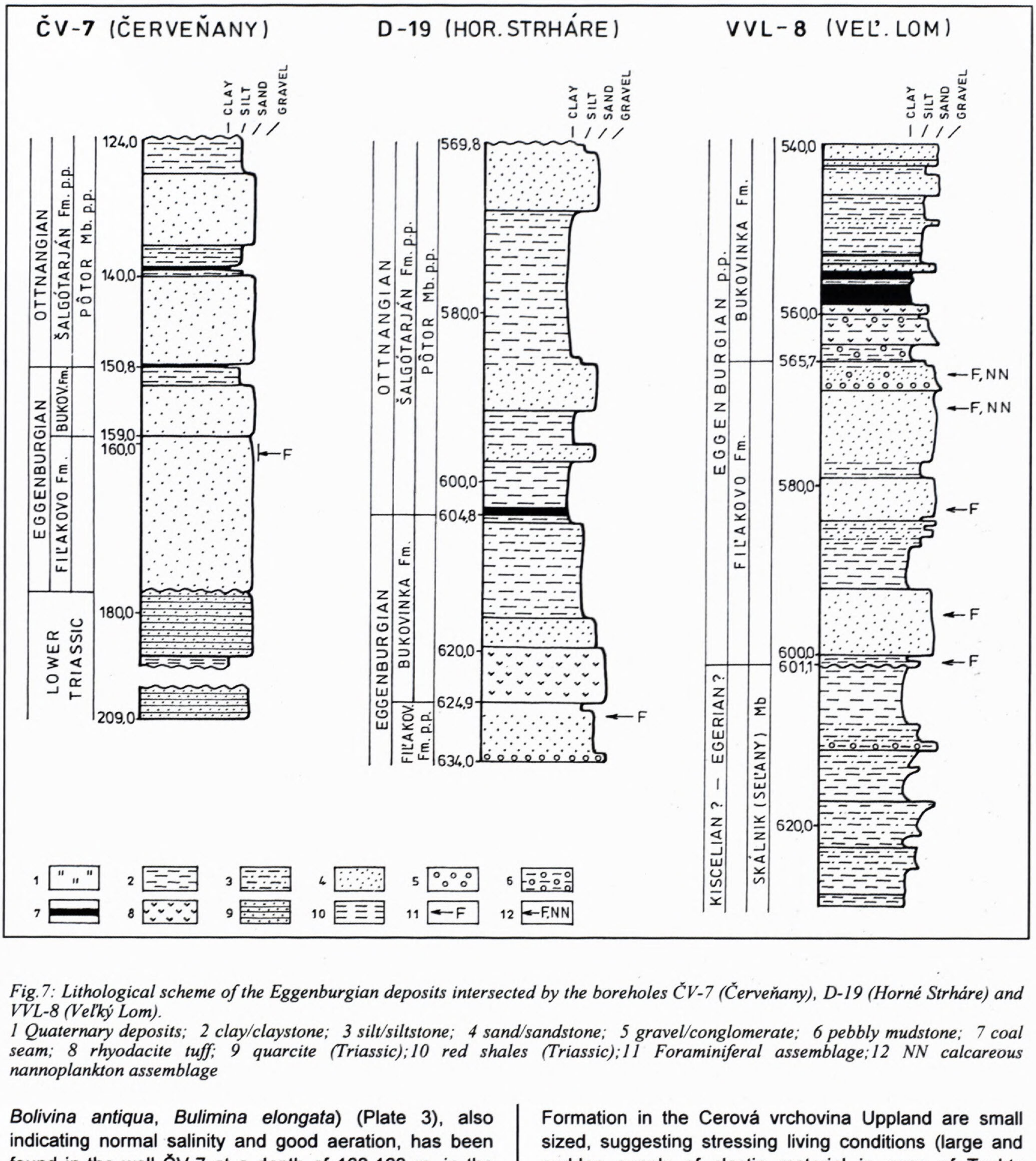


Fig. 7: Lithological scheme of the Eggenburgian deposits intersected by the boreholes ČV-7 (Červeňany), D-19 (Horné Strháre) and VVL-8 (Veľký Lom).
1 Quaternary deposits; 2 clay/claystone; 3 silt/siltstone; 4 sand/sandstone; 5 gravel/conglomerate; 6 pebbly mudstone; 7 coal seam; 8 rhyodacite tuff; 9 quarcite (Triassic); 10 red shales (Triassic); 11 Foraminiferal assemblage; 12 NN calcareous nannoplankton assemblage

Bolivina antiqua, *Bulimina elongata*) (Plate 3), also indicating normal salinity and good aeration, has been found in the well ČV-7 at a depth of 160-162 m, in the sandstone overlying transgressively the Lower Triassic basement (Fig. 7). A significant feature of the assemblages from both wells is large size of the foram individuals, indicating optimal living conditions. Friable calcareous sandstone with marine foram assemblage (Zlinská in Vass and Elečko 1995) was intersected in the well VVL-8 at depth of 565.7-601.1 m (Fig. 7). It is interesting to note that foraminifers from the Tachty and Lipovany sandstones and the Čakanovce Member of the Fiľakovo Formation in the Cerová vrchovina Uppland are small sized, suggesting stressing living conditions (large and sudden supply of clastic material in case of Tachty sandstone, oxygen shortage in case of Lipovany sandstone and Čakanovce Member, respectively). Assemblages of large epifytic and cibicidoid foraminifers, described from the Horná Nitra Depression by Lehotayová (in Steininger and Papp et al., 1971), and by Gašparíková (1970), and from the Ilava Depression by Zlinská and Salaj (1991) prove that good open sea living conditions existed in the mentioned intramountainous depressions. This could have been due to proximal position of the depressions relative to open sea of the Vienna Basin, while the Fiľakovo-Pétervására Basin represented physiographically a bay in distal position relative to the open sea.

Eggenburgian age of sandstones from the boreholes D-19 and ČV-7 is proved by findings of *Globigerinoides trilobus* (its first occurrence is in the Eggenburgian RÖGL, 1986) and its common occurrence with the *Almanea osnabrugensis,* the latter marking the end of Eggenburgian (CICHA et al., 1982). Eggenburgian age is further supported by the fact that the sandstones with described microfauna in two wells (D-19, VVL-8) are situated below rhyodacite tuff (Fig. 7), a member of the Bukovinka Formation. Radiometric age of the rhyodacite tuff in the southern Slovakia is 20.1 and 19.7 Ma respectively, (REPČOK and/or DURKOVIČOVÁ et al., in VASS and ELEČKO et al., 1992), corresponding to the Eggenburgian (comp. VASS et al., 1987).

Conclusion

The Alpine and Carpathian Foredeeps were probably the most significant communication ways for the Eggenburgian marine transgressions to progress from the Mediterranean and/or Atlantic Ocean into the Central Paratethys area of the Middle Europe.

From the Carpathian foredeep and/or from the marine basins in front of ascending Carpathians the sea entered the Western Carpathian intramontane depressions and, crossing the area covered presently by Mid-Slovakian Neogene volcanics, the sea reached as the Fiľakovo/Pétervására Basin, situated nowadays in Southern Slovakia and Northern Hungary.

Connection between the Fiľakovo-Pétervására Basin with the Transcarpathian Basin and between the residual Magura Basin and other contemporary marine basins situated in front of the rising Carpathians is proved by:

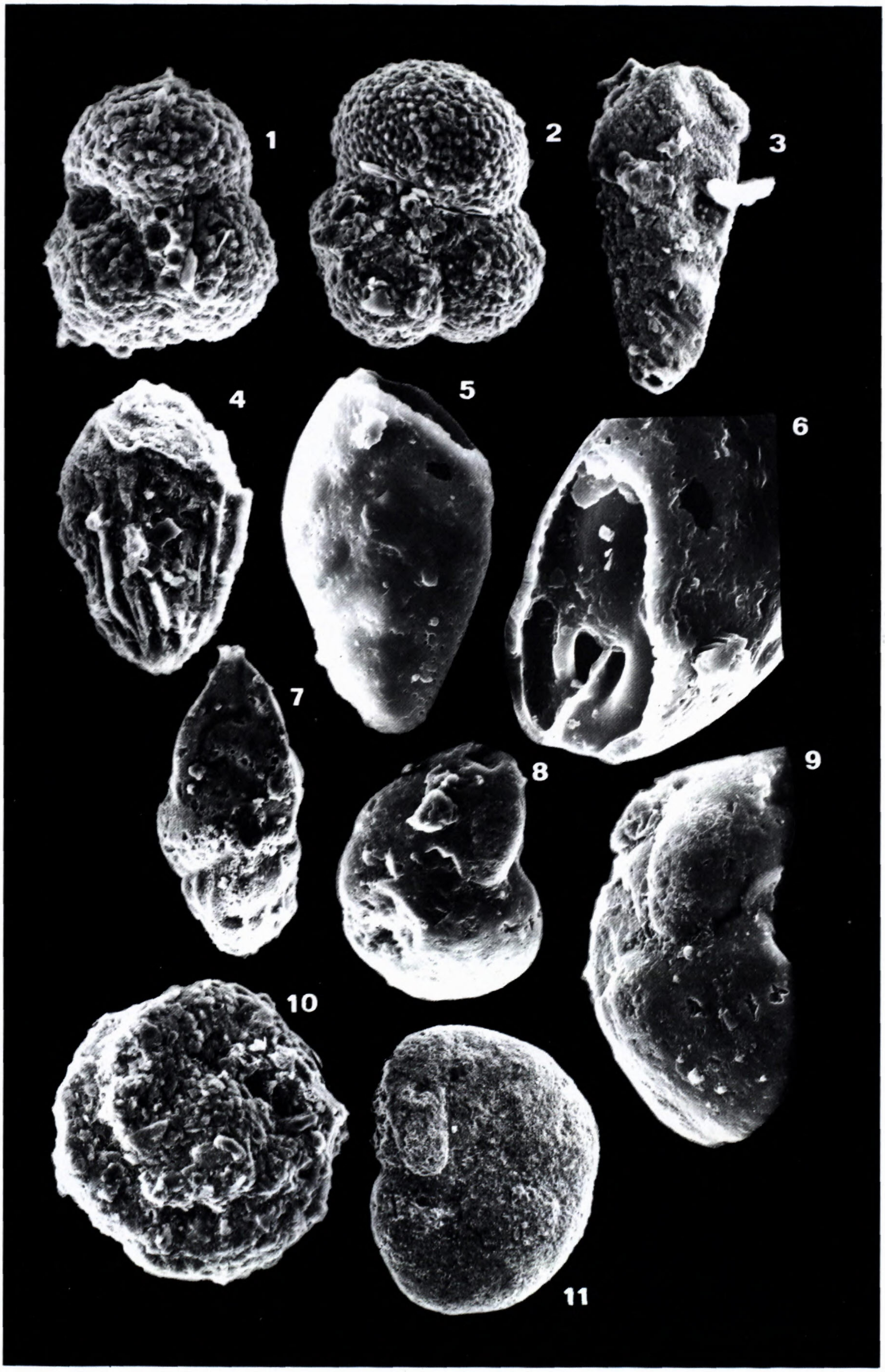
1. impressive tidal sedimentary structures of Pétervására sandstones and sandstones of the Fiľakovo Formation. The tide was comming from NE (SZTANÓ, 1994).

2. presence of open marine, relatively deep sea forams in the erosional sediments remnants near the NE border of the present day Rimavská kotlina depression. This gives an impression of originaly much larger extent of the Eggenburgian marine deposits in the recent Rimavská kotlina Depression, especially in NE direction, where from the sea way, connecting both Fiľakovo/Pétervására and Transcarpathian (East Slovakian) Basins, can be inferred.

Another possible sea way was through the Western Carpathians intramountainous depressions into the Vienna Basin and through this into the Carpathian Foredeep. This is proved by 1) erosional remnants of Eggenburgian deposits in the Ipeľská kotlina depression - Ďarmoty Member (VASS et al., 1983) and by 2) occurrence of marine Eggenburgian deposits beneath the volcanics of the Krupina Plateau, as confirmed by the wells D-19, ČV-7 and VVL-8.

Plate 1 Foraminiferal assemblage from the well in the Gemerská Panica village

1. Globigerinoides trilobus (RSS.), magn 280X; 2. Globigerina praebulloides BLOW, magn.180X; 3. Bolivina antiqua ORB., magn. 240X; 4. Bolivina scalprata retiformis CUSH. magn. 380X; 5. Bolivina dilatata brevis (C. et Z.), magn. 320X; 6. Bolivina dilatata brevis (C.et Z.), magn. 667X; 7. Trifarina brady CUSH., magn. 210X; 8. Hanzawaia boueana (ORB..), magn. 350X; 9. Hanzawaia boueana (ORB..), magn. 600X; 10. Glomospirella sp., magn. 150X; 11. Haplophragmoides vasiceki (C. et Z.) magn. 60X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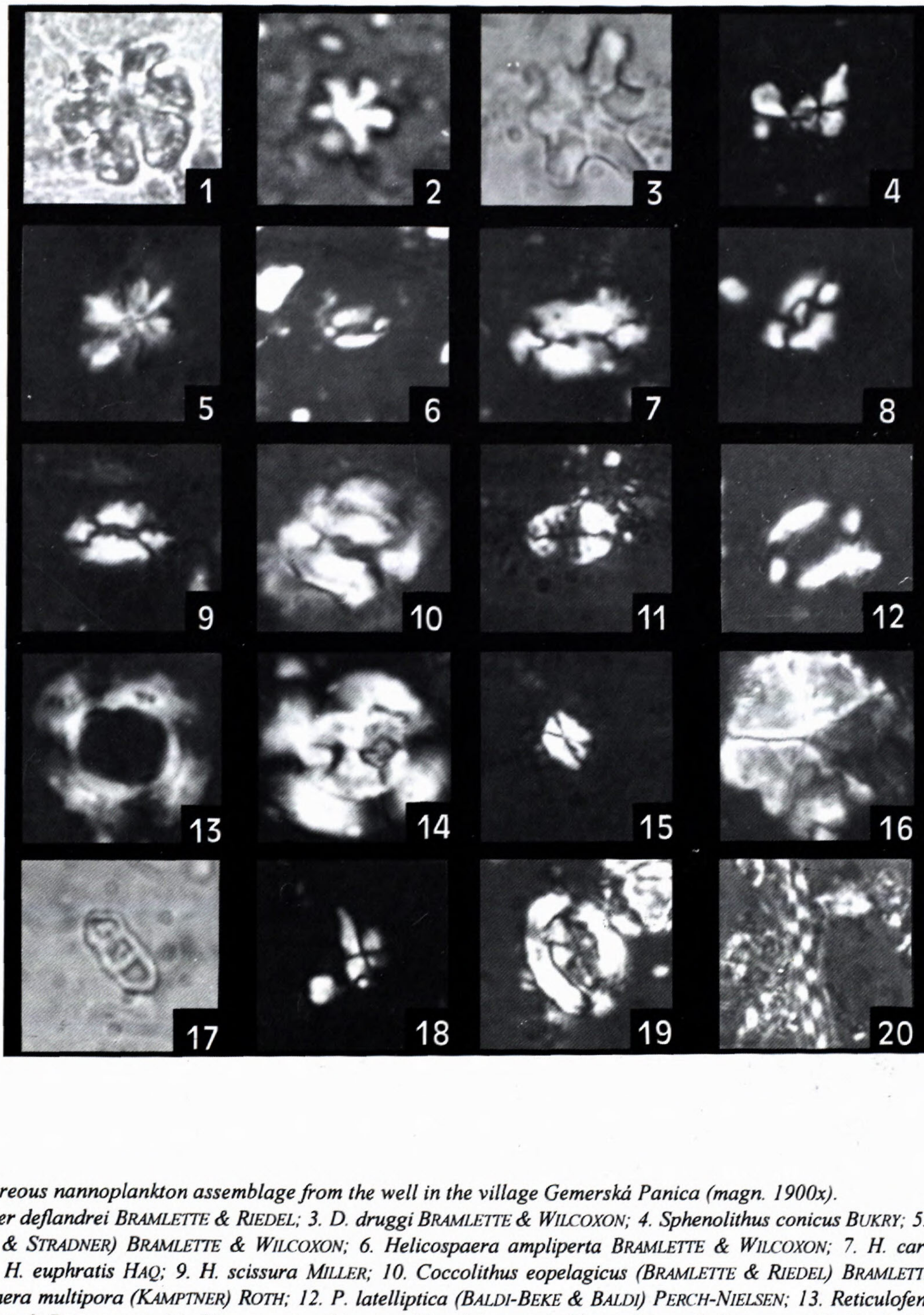

Plate 3 Calcareous nannoplankton assemblage from the well in the village Gemerská Panica (magn. 1900x).

*1.-2. **Discoaster deflandrei** BRAMLETTE & RIEDEL; 3. **D. druggi** BRAMLETTE & WILCOXON; 4. **Sphenolithus conicus** BUKRY; 5. **S. moriformis** (BRONNIMANN & STRADNER) BRAMLETTE & WILCOXON; 6. **Helicospaera ampliperta** BRAMLETTE & WILCOXON; 7. **H. carteri** (WALLICH) KAMPTNER; 8. **H. euphratis** HAQ; 9. **H. scissura** MILLER; 10. **Coccolithus eopelagicus** (BRAMLETTE & RIEDEL) BRAMLETTE & SULLIVAN; 11. **Pontosphaera multipora** (KAMPTNER) ROTH; 12. **P. latelliptica** (BALDI-BEKE & BALDI) PERCH-NIELSEN; 13. **Reticulofenestra umbilica** (LEVIN) MARTINI & RITZKOWSKI; 14. **Dictyococcites bisectus** (HAY, MOHLER & WADE) BUKRY & PERCIVAL; 15. **Zygrhablithus bijugatus** (DEFLANDRE) DEFLANDRE; 16. **Braarudosphaera bigelowii** (GRAN & BRAARUD) DEFLANDRE; 17. **Isthmolithus recurvus** DEFLANDRE; 18. **Sphenolithus radians** DEFLANDRE; 19. **Arkhangelskiella cymbiformis** VEKSHINA; 20. **Microrhabdulus decoratus** DEFLANDRE*

Plate 2 Foraminiferal assemblage from the boreholes ČV-7 and D-19

*1. **Bolivina elongata** HANTKEN, **ČV-7-161m, magn. 100X**; 2. **Elphidium ex gr. macellum** (L.),**ČV-7-161m, magn. 180X**; 3. **Almaena osnabrugensis** (ROEM),**ČV-7-161m, magn. 30X**; 4. **Asterigerinata planorbis** (ORB.), **D-19-665m, magn.250X**; 5. **Bulimina elongata** (ORB.), **D-19-665m, magn. 140X**; 6. **Cibicidoides pseudoungerianus** (CUSH.) **D-19-665m, magn.170X**; 7. **Lobatula lobatula** (W. et J.), **D-19-665m, magn. 240X**; 8. **Elphidium rugulosum** (CUSH. et WIECKEN.) **D-19-665m, magn.240X**; 9. **Bolivinella rugosa** HOWE, **D-19-665m, magn.130X***

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