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BIOSTRATIGRAPHIC IMPORTANCE OF CRETACEOUS FORAMINIFERA IN HUNGARY

by

M. SIDÓ

The stratigraphy and correlation of the Mesozic rocks in the Hungarian Basin were primarily based on macrofaunistic studies. Recent micropaleontological studies, however, permit the subdivision and characterization of the sequences on the basis of benthonic and principally planktonic assemblages.

The present paper is a review of the micropaleontological results of the author's detailed studies on the Hungarian Triassic, Jurassic and Cretaceous assemblages, their chrono- and biostratigraphic interpretation, on the example of the Sümeg reference section.

In the Sümeg reference section (Fig. 1.) the lowermost exposed rock-type is large Megalodontid-bearing Dachsteinkalk. On the basis of analogy it is dated as uppermost Triassic (?Rhaetian). It contains only a scarce microfauna.

In the section under consideration the Triassic beds are uncomformably overlain by Jurassic rocks. These beds yield a significant foraminifer fauna (representatives of the families Lagenidae and Nodosaridae). Also the genera Trocholina, Spirillina, Palzovella and Epistomina are stratigraphically important in the Middle and Upper Liassic rocks of the Bakony, Gerecse and Mecsek Mountains.

In the Middle and Upper Jurassic cherty facies the radiolarians are significant. In the Upper Jurassic the frequently concomitant or alternating Globochete, Lombardia, Saccocoma, Cadosina, Stomiosphaera and Tintinnina

associations are dominant and characteristic from the point of view of faciology and stratigraphy. In Hungary the Oxfordian, Kimmeridgian and Tithonian can be well characterized and subdivided on the basis of the above mentioned forms, which are also suitable for tracing paleogeographic relationship, (see NAGY, I. 1966).

The most exhaustive part of our studies concerns the Cretaceous rocks.

The Lower Cretaceous (Neocomian) is chiefly represented by light and dark-grey calcareous marls and limestones. From the Aptian up to the Senonian clays, clay-marls and calcareous marls yielding rich planktonic and benthonic foraminiferal associations become dominant. Whithin the Hungarian Cretaceous three larger division can be separated on the basis of planktonic foraminifers.

The first division is characterized by planktonic forms and extends from the Valanginian to the Middle Albian, inclusive. In the Valanginian and Hauterivian rocks the planktonic foraminifers are still missing, but other planktonic forms, as the tintinnids, the radiolarians and the nannpolanktonic elements are important.
The earliest plankton-foraminiferal assemblage, with tiny, flattened globigerinellids, biglobigerinellids, hedbergellids and clavihedbergellids appears rather sporadically in the Barremian. In the Aptian and Albian rocks various zonal index species and abundant, adult specimens of the genera Ticinella and Globigerinelloides can be found.

The second plankton-foraminiferal division extends from the Upper Albian up to and including the Turonian, and is characterized by the unicarinate rotaliporids. These forms appear first at the lower boundary of the Vraconian, where the flattened rotaliporids, i.e. the Rotalipora appenninica (RENZ) group is still dominant, and in the Cenomanian the rather inflated, more angulate forms, as the Rotalipora greenhornensis (MORROV), Roralipora

cushmani, etc. are characteristic. Here appear firts the praeglobotruncanids, too. The flourishing of the latter marks the Turonian.

The third plankton-foraminiferal division, extending from the Turonian up to and including the Senonian is characterized by the globotruncanids. The ture, double-keeled globotruncanids already appear in the Turonian. In the Senonian the great specimen and species number of the single-keeled, double--keeled and conical forms is characteristic. In the course of the globotruncanid evolution a marked parting line occurs within the Maestrichtian, where the conical forms are dominant. Moreover, certain genera of the family Heterochelicidae and representatives of the genus Rugoglobigerina are also of great importance.

On the basis of foraminiferal studies, different biofacies and faunal associations were distinguished by stages. These are shown in Table 2.

The light- or dark-grey limestones of theValanginian, resting conformably (or sometimes paraconformably) on the Tithonian limestones could be recognized in several localities of the country. The open and shallow-water sediments of "biancone-type" often contain profuse microfaunas, with mainly Radiolaria, Tintinnida, Nannocouns, Coccolithophora, Cadosina, Stomiosphaera, Foraminifera and Echinodermata remains. On the basis of the Tintinnida associations the Tithonian ad Valanginian stages, and even the Berriasian substage can be recognized. (Sidó 1957).

The microfauna of the Berriasian limestone is distinguished beside Calpionella carpatica (CAD.) surviving from the Tithonian, the common Tintinnopsella carpatica (MURG.-FIL.) and some specimen of Globocheta alpina (LOR.) by the typically Berriasian species Coxliellina berriasensis COLOM and Faveolides balearica COLOM.

The Valanginian can also be well characterized by the nannoplankton and the tintinnids. After M. BÁLDI-BEKE the species Nannoconus steinmanni KAMPTER, Coccolithus pelagicus (VAL.) and Discolithus cretaceus (ARCH) are characteristic. The tintinnid assemblage of the Valanginian is dominated by the forms Tintinopsella longa (COLOM), T. cadischiana (COLOM), Calpionellopsis simplex (COLOM), C. undelloides COLOM, Salpingellina simplex COLOM, etc. The foraminiferal association, however, is not so diversified; in the material studied some trocholinids, spirillinids and textulariids are present in great specimen number.

The Hauterivian "biancone-type" sediments recognized also in the Bakony, Vértes, and Mecsek Mountanins overly conformably the Valanginian rocks. The Hauterivian microfauna is less varied and hardly distinguishable from the associations of the previous stage. In the poor foraminiferal assemblage the benthonic spirillinids and trocholinids suggest shallow-water marine environment. The age-determination is mainly based on ammonites.

In the Sümeg reference section the Barremian stage is represented by marine sandy conglomerate and marly facies. In contrast to its rich ammonite fauna the foraminiferal association is rather poor. Here appears the earliest Cretaceous planktonic Foraminifera assemblage, containing small hedbergellids. The clayey marl facies yields a rich nannoplankton, too.

The Aptian stage is represented by grey marls and crinoidal limestones. Within the Cretaceous the flourishing of the Foraminifera, mainly of the planktonic forms, began in the Aptian. It is both the larger and smaller foraminifers occur in greater specimen and species number. The blue and dark-grey clay and clay-marl of the Lower Aptian is characterized by nannoplanktonic and radiolarian assemblages, but the foraminifers take still second place. Beside the lenticulinids, frondicullariids and agglutinate

textulariids, some Hedbergella and Ticinella species, and small, flattened Globigerinelloides species are also present. The foraminifers of the overlying echinoderm-bearing limestone facies and the intercalated clays and clay-marls are much more profuse and characteristic. Here - as a rule - the planktonic elements are dominant, with the zonal index hedbergellid, ticinellid and globigerinelloid forms. The more common species are Hedbergella infracretacea (GLAESSNER), H. trochoidea (GAND.), Ticinella roberti (GAND.) and Globigerinelloides algerianus (CUSHM. et TEN DAM). In the benthonic fauna the following genera are present: Textularia, Spiropectinata, Marsonella, Dorothia, Conorboides, Gyroidia, Globorotalites, Lenticulina, and Frondicularia, and in certain clay-marl intercalations orbitolinids can be found The zonal index Globigerinelloides algerianus (CUSHM. et TEN DAM) indicates undoubtedly the Upper Aptian (SIDÓ 1970).

The ingressive and transgressive variegated clay and clay-marls, light-grey calcareous marls and occasionally limestones indicative of terrestrial, freshwater, brackish-water and marine facies respectively, are missing in the section under consideration, but they are well known in other areas of the Bakony Mts and in the foreland of the Vértes Mts. This sequence of 20 - 200 m in thickness is assigned into the Lower Albian. The assemblages are rich and diversified, i.e. calcareous algae (Munieria baconica)-, foraminifer-, Ostracod- and echinoderm-bearing facies can be distinguished. The characteristic associations are the Ammobaculites-, Lenticulina-, Flabellamina-, Cuneolina-, Involutina-, Choffatella-, Pseudotextularella and Orbitolina-bearing ones. These characteristic associations are of microstratigraphic value.

The shallow-water and pelagic light-grey clays, clay-marls and calcareous marls of 40 - 60 m thickness in the Villány Mts, Bakony Mts, in the Tata basin and in the foreland of the Vértes Mts can be ranged into the Middle Albian or the basal Upper Albian on the basis of the microfauna and the cephalopods. These beds contain rich benthonic and

planktonic foraminiferal associations. The benthonic associations are the Epistomina- Tritaxia-, Spiroplectammina-, Planulina-, Glavelinella- and Orbitolina bearing ones, and the planktonic zonal indices belong to the Globigerinelloides-Ticinella-Hedbergella-Planomalina associations. The Pithonella- and Radiolaria-bearing biofacies are also abundant, but mainly in the calcareous marls and limestones.

The 100-200 m thick dark-grey, often nodular, glauconitic clay-marls and calcareous marls containing rich and characteristic Turrilites and Rotalipora assemblage, missing in the Sümeg reference section, are well exposed in other areas of the Bakony Mts, and can be ranged into the Upper Albian, or Vraconian substage. On the basis of our studies, within the complex three plankton-foraminiferal zones can be distinguished (SIDÓ 1971):

1.) Planomalina buxtorfi - Rotalipora apenninica Zone,

2.) Globigerinelloides aeglefordensis - Rotalipora cf. greenhornensis Zone,

3.) Rotalipora greenhornensis - R. cushmani Zone.

The firstly and secondly mentioned zones belong to to the Vraconian s. str., the third into the Lower Cenomanian s. str.

The Turrilites-bearing marls of the Bakony Mountains represent the Lower Cenomanian Rotalipora greenhornensis - R. cushmani Zone. On the other hand the Flysch -like, pelagic facies from the Vékény Valley of the Mecsek Mountains is younger, containing the characteristic Rotalipora montsalvensis MORROV and Praeglobotruncana stephani (GAND) species. On the basis of the faunal associations the Cenomanian of the Mecsek Mountains shows affinities to the Carpathian flysch-zone, while the Bakony Mountains Cenomanian is of epicontinental type. (The great Cenomanian transgression

can be traced from the West to the South-East).

In Hungary, the only faunistically proved marine Turonian rock is that from the Borehole Kerekegyháza-5, in 850 m depth (SIDÓ 1969). In Hungary in this flysch-like, red-brown clay-marl appear first the globotruncanids, with the double-keeled Gl. lapparenti BROTZEN, Gl. lapparenti cornata BOLLI, Gl. marginata (RSS.), Gl. sigali REICHEL and the genus Praeglobotruncana flourishes also here. The species Praeglobotruncana renzi THALMAN - GAND., Praegl. helvetica BOLLI and Praegl. sigali REICHEL are common and characteristic elements of the assemblage. The foraminiferal associations suggest pelagic facies related to the Carpathian flysch belt.

In the presented Sümeg section there is a hiatus from the Upper Aptian up to the Senonian (Fig. 1.), on the other hand nearly the complete Senonian is represented (Fig. 3.). However, the most complete Senonian sediment-complex is known from certain boreholes of the Zala oil field region and the Bakony Mountains. In these latter profiles the different Senonian facies of nearly 800 m thickness can be studied. On the basis of the appearance and dominance of certain foraminifer species different assemblages and biozones can be separated (SIDÓ 1963.). Succeedingly over the variegated clays the lowermost member of the Senonian is the clayey - marly, freshwater, Pyrgulifera-bearing coal complex overlain by the Lower Santonian succession with near-shore, shallow-water Vidalina-Nummofalothia-Miliolidaea assemblage. The conformably succeeding, similar clayey, marly rocks contain the Upper Senonian Goupillaudina - Epistomina-, Hedbergella-, coral- and mollusc-bearing association. The marly sedimentation continued into the Campanian substage, with shallow-water and pelagic facies. In this substage the Glavellina-, Bulimina-, Exogyra and Gryphaea-bearing biofacies of the Globotruncana globigerinoides and Gl. concava Zones are characteristic. During the Late Campanian a thick, Pachyodont-bearing, shallow-water reef facies, the so-called "Hippuritic limestone of Ugod" developed gradually from the "Exogyra-bearing marls of Jákó".

These two latter rock-types are heteropic facies in other areas of the Bakony Mountains.*

In Hungary the uppermost and the thickest Senonian member is the Inoceramus- and Globotruncana -bearing clay-marl, marl, carcareous marl of Polány. Its foraminifer association is the richest and most diversified, with the predominance of planktonic forms (inc. new forms). Its micro-biostratigraphic subdivision has been established on the basis of the planktonic forms.

1.) In the lower part of the complex, at the Upper Campanian/ Lower Maestrichtian boundary the Globotruncana calcarata association is the zonal index.

2.) The Gl. conica - Gl. stuarti - Gl. contusa zone in the middle portion of the complex marks the Middle Maestrichtian.

3.) The Gl. mayaroensis - Gl. pseudotextularia association of the upper part of the complex marks the Upper Maestrichtian.

The sediments of this latter substage can be traced in some places only and in small thickness in the Zala oil field region, because of the great post-Cretaceous erosion.

The foraminifer fauna of the Senonian is predominantly characterized by the above mentioned forms of zonal index value. The wide areal distribution and strict vertical extension of these forms are suitable to trace the paleogeographic connections.

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*Their Foraminifera associations is characterized by Rhapidionina spp., Rhipidionina liburnica, Dyciclina schlumbergeri, Accordiella conica and Miliolidae.

The Hungarian Senonian sequence suggests a large-scale gradual transgression. The Transdanubian Senonian, with a North-Eastern coastline, show direct Yugoslavian (Croatian) and indirect Italian faunal connections. On the other hand the Senonian of the Great Hungarian Plain and the Bükk Mountains can be correlated with the flysch formation of the Slovakian, Polish and Roumanian Carpathians.

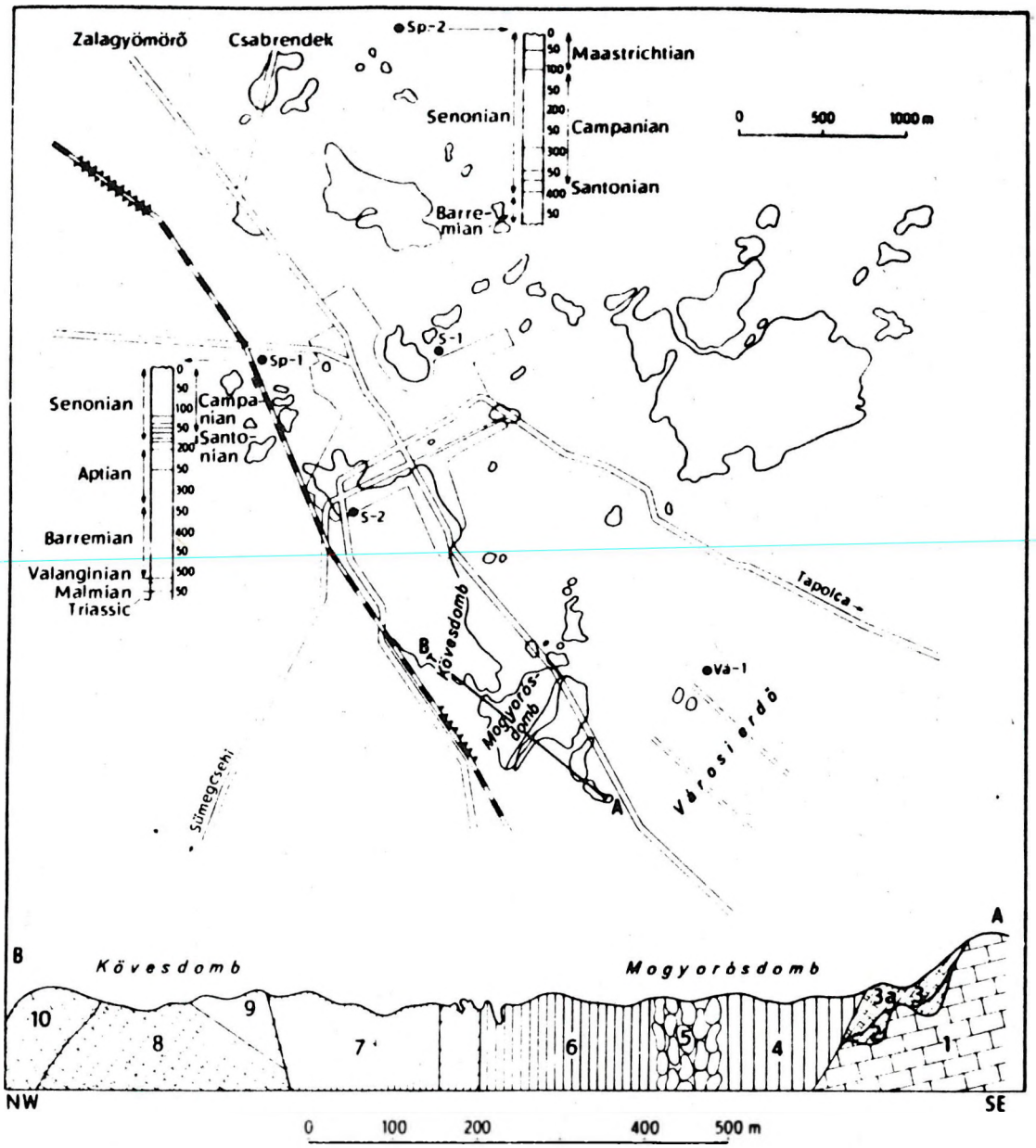

Fig. 1 – Geological sketch map of the Sümeg area and cross section through Mogyorósdomb–Kövesdomb. (The sketch map shows the Mesozoic outcrops only.) – *1.* Upper Triassic "Dachsteinkalk", *2.* Middle Liassic light red limestone, *3•3a.* Upper Liassic brownish-red limestone, *4.* Dogger radiolarite, *5.* Malm cephalopodal nodular limestone, *6.* Tithonian, *7.* Berriasian–Valanginian–Hauterivian–Barremian calcareous marl ("biancone"), *8.* Campanian Hippuritic limestone of Ugod, *9.* Campanian corallian–molluscan clay-marl of Sümeg, *10.* Upper Aptian crinoidal limestone of Várhegy Hill

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CHRONO-, LITHO- AND BIOSTRATIGRAPHICAL SUBDIVISIONS OF THE HUNGARIAN CRETACEOUS

Age			Formations	Characteristic fossils: Foraminifers: Characteristic associations	Foraminifers: Zonal index forms	Other micro- and macro-fossils
CRETACEOUS	Upper	Senonian U	Maestrichtian	Inoceramus- and Globotruncana-bearing claymarl, calcareous marl, oolitic limestone of Polány autigenic limestone-breccia	Siderolites-Vertilabrella-Heterohelix-Globotruncana-bearing, Bolivinoides-Heterostomella-bearing Stensiöina-bearing associations	Globotruncana mayaroensis Pseudotextularia elegans Ventilabrella Gl. conica, Gl. contusa Gl. gagnebeni, Gl. stuarti Globotruncana calcarata	Sporomorphs Dinoflagellata Acritarcha Pithonella Radiolaria Stomiosphaera Inoceramus div. sp. Echinodermata Cephalopoda Fish-remains
		L U	Campanian	Exogyra-bearing limestone of Jóka coral- and mollusc-bearing complex Hiatus with basal conglomerates Hiatus Hippuritic limestone of Úrkút Great Hung. Plain.	Rhipidionina-bearing Dictyoconus-Dicyclina-bearing Cuneolina-Heterohelix-bearing Bulimina-Gavelinella-bearing Hedbergella-Reophax-bearing ass.s.	Globotruncana globigerinelloides Gl. concavata Gl. marginata	Sporomorphs, Dinoflagellata Acritarcha Algae Exogyras, Gryphaeas Echinodermata remains
		L U	Santonian	Terrestrial sediments Coal measure Bakony-Zala area Bükk Mts	Gaudryinella-Vaginulina-bearing Epistomina-Nonionella-Nummofallotia-Rotalia-bearing, Siderolites-Vidalina-bearing, Miliolidea-bearing associations	Hedbergella div. sp. – Globigerinelloides div. sp.	Sporomorphs, Dinoflagellata Acritarcha Corals, Lima spp. Echinodermata, Ostracoda Calcareous algae Bryozoans
			Coniacian				
			Turonian	Globotruncana-bearing clays and marls of Kerekegyháza / Great Hungarian Plain /	Globotruncana-bearing Praeglobotruncana-bearing ass.s Hedbergella div. sp.	Praeglobotruncana renzi – P. helvetica Globotruncana lapparenti	Molluscs
	Middle	L U	Cenomanian	Rotalipora-bearing red claymarls of Vértes / Mecsek Mts, Szigetvidr/	Rotalipora-bearing Praeglobotruncana-bearing Hedbergella-bearing ass.s.	Rotalipora montsalvensis – R. cushmani	Molluscs Fish remains
				Turrilites- and Rotalipora-bearing clay- and calcareous marls	Gavelinella-Hedbergella bearing	Rotalipora greenhornensis – R. cushmani	Sporomorphs Pithonella, Stomiosphaera Radiolaria, Spongia
			Vraconian	/Bakony and Vértes Mts/	Epistomina-bearing Tritaxia-Lenticulina-bearing ass.s.	Globigerinelloides aeglefordensis R. cf. greenhornensis Planomalina buxtorfi	Molluscs Echinodermata Cephalopoda
			Albian	Ammonite-, mollusc- and foraminifer-bearing marls and limestone /Villány, Bakony and Vértes Mts/	Hedbergella-Ticinella-bearing Epistomina-Spirolectinata-bearing Dorothia-Pseudotextulariella and Orbitolina-Miliolidea-bearing ass.s.	Ticinella ticinensis Praeglobotruncana stephanis Schackoina sp. Hedbergella div.sp.	Sporomorphs, Dinoflagellata Acritarcha Radiolaria, Pithonella Stomiosphaera, Cadosina Molluscs, Echinodermata Cephalopoda
				Munieria-bearing clays and claymarls /Bakony and Vértes Mts/	Ammobaculites-Haplophragmoides-Lenticulina-Miliolidea-bearing Flabellammina-Cuneolina-bearing Schoffatella-Involutina-Dorothia-Pseudotextulariella-bearing, Orbitolina-bearing associations	Hedbergella div.sp.	Munieria baconica Sporomorphs Ostracoda association Molluscs, Bryozoans Echinodermata, fish-rem.
		L U	Aptian	Crinoidal limestone calcareous marl of Várhegy /Bakony, Vértes Mts, Tata/	Hedbergella-Ticinella-Globigerinelloides-bearing, Dorothia-Spirolectammina-bearing	Globigerinelloides algerianus	Radiolaria, Spongia Echinodermata Molluscs Bryozoans, Algae
				Dark-grey radiolarian calcareous marls /Bakony and Vértes Mts/	Lenticulina div.sp. Hedbergella div.sp. Globigerinelloides sp.	Globigerinelloides blowi ?	Sporomorphs, Dinoflagellata Acritarcha, Radiolaria Coccolithophora, Molluscs Nannoconus, Echinodermata
	Lower	Neocomian	Barremian	Nodulouse, crinoidal, brachiopod- and ammonite-bearing limestones /Villány, Bakony and Gerecse Mts/	Hedbergella div.sp. Clavihedbergella sp. Globigerinelloides sp. Orbitolinopsis-bearing, Orbitolina-Cuneolina-bearing associations	tiny hedbergellids – Globigerinelloides ?	Sporomorphs, Algae Coccolithophora Nannoconus Radiolaria Cephalopoda Crab and fish remains Brachiopoda Echinodermata
			Hautrivian	Radiolarian, echinodermata brachiopoda- and ammonite-bearing limestones /Mecsek, Bakony, Gerecse Mts/	Trocholina Spirillina sp. Epistomina		Radiolaria Ostracoda Echinodermata Brachiopoda Cephalopoda
			Valanginian	Calcareous marl and limestone of „biancone"-type /Mecsek, Bakony and Gerecse Mts/	Trocholina div. sp. Spirillina sp. Nodosariidae div. gen. Ammodiscus sp.		Tintinnidae div. gen. Nannoconus Coccolithophora Stomiosphaera, Cadosina Radiolaria, Spongia Brachiopoda Echinodermata
			Berriasian	Limestone and calcareous marls /Gerecse, Bakony and Mecsek Mts/	Trocholina div. sp. Spirillina sp.		Coccolithophora Globochaeta, Cadosina Tintinnidae div. gen. Brachiopoda

Fig. 2.

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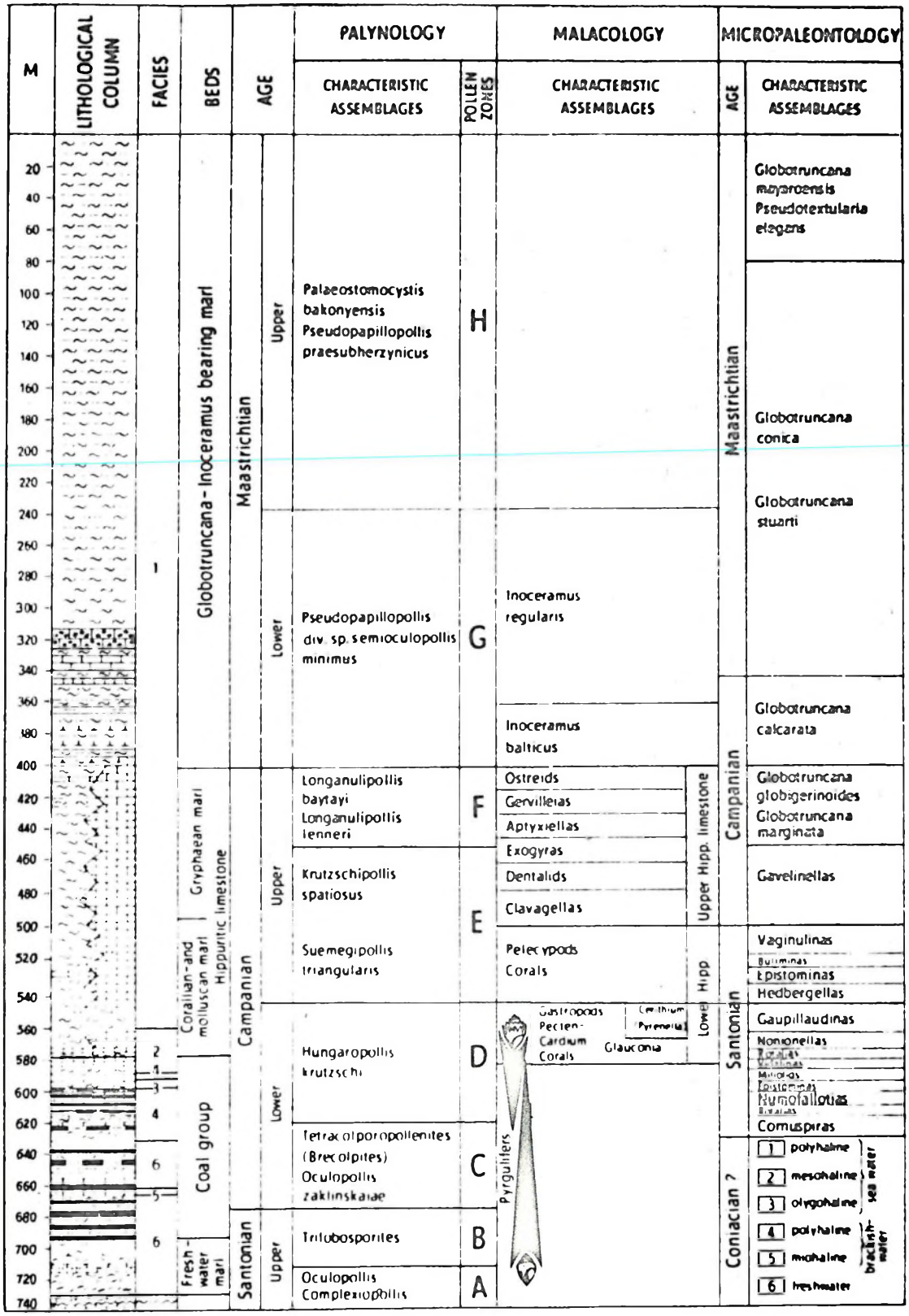

Fig. 3 Stratigraphic subdivision of the Senonian in Hungary

(by F. Góczán)

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