XXI[st] EUROPEAN MICROPALAEONTOLOGICAL COLLOQUIUM

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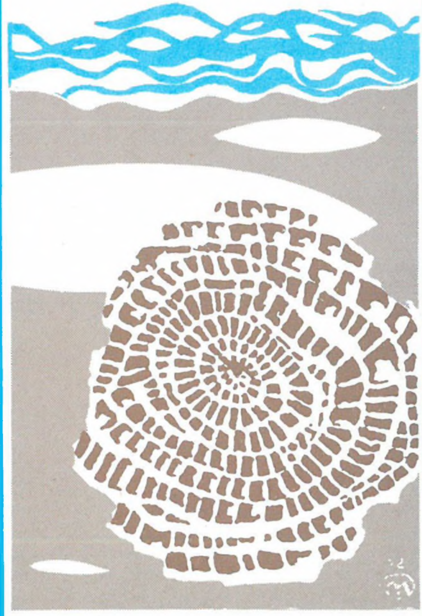

HUNGARY • '89

4–13. 09. 1989
HUNGARY

GUIDEBOOK

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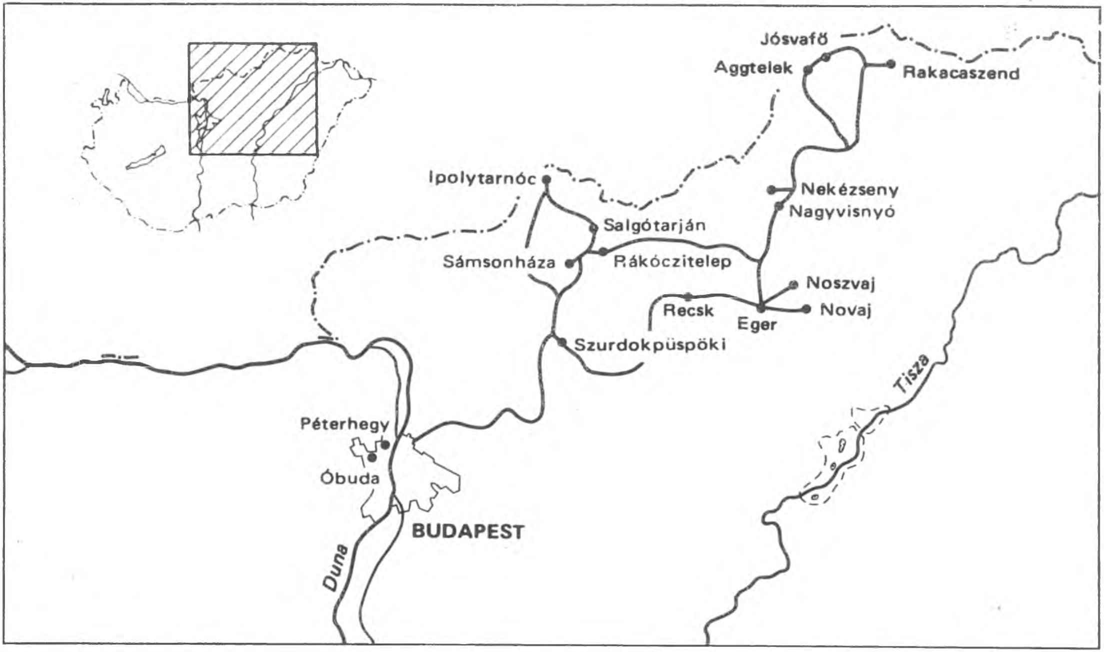

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Hungarian Geological Society

Hungarian Central Office of Geology

Hungarian Academy of Sciences

L. Eötvös University, Budapest

Hungarian Natural History Museum

with the sponsoring of the

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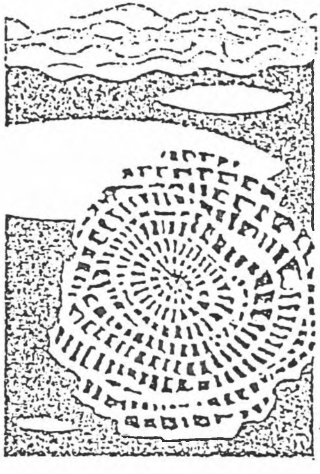

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GUIDEBOOK

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ADDRESS

TO THE PARTICIPANTS OF THE XXIst EUROPEAN MICROPALAEONTOLOGICAL COLLOQUIUM

I have the honour of conveying the best wishes of the International Geological Correlation Programme (IGCP) of Unesco and the International Union of Geological Sciences (IUGS) to the participants of this distinguished Colloquium.

Ever since its birth in 1972, the IGCP has been heavily involved, by definition and "ex officio", in stratigraphic correlation.

A remarkable variety of approaches and techniques of correlation have been applied by the various IGCP projects dealing with widely different geological formations of the Earth, ranging from eco- and chemostratigraphy through magnetostratigraphy and seismostratigraphy to geomathematics. However, biostratigraphy has maintained its priority wherever applicable.

Within biostratigraphy, micropaleontology has been playing a prominent part, historically speaking ever since the pioneering works on Foraminifera of Miksa (Maximilian) HANTKEN.

In Hungary, HANTKEN's achievements were further developed by several other eminent micropaleontologists such as Pál ROZLOZSNIK and László MAJZON.

It is a particular pleasure for me that this Colloquium is hosted by Hungary -- my mother country.

I was initiated to Micropaleontology at the University of Budapest by L. MAJZON, and I had the privilege of working for five years at the Department of Paleontology (headed at that time by Professor László BOGSCH) in the field of paleobryozoology. This Department had M. HANTKEN as its first Professor. He was also the first Director of the Royal Hungarian Geological Institute. This is now the Hungarian Geological Institute where I had been serving before I was appointed Secretary of the IGCP in Paris.

I am convinced that Hungary will meet your expectations which can not be but high after so many successful Colloquia. A wide variety of fossiliferous formations, from the Carboniferous to the Pannonian in age, studied in the spirit of the well-established but constantly rejuvenating Hungarian school of micropaleontology, are at your disposal. The on-the-spot discussions and the subsequent comparative investigations will certainly refine some of the local and regional stratigraphic subdivisions, thus contributing, directly or indirectly, to international correlation, which is the main objective and "raison d' être" of the IGCP.

Last but not least: if proposal(s) of new IGCP projects take shape during your talks, they would be most welcome and given serious consideration by the Scientific Committee and the Board of the IGCP.

Appreciating and warmly acknowledging the efforts exerted by the organizers, and the professional interest of the participants shown by their attending the Colloquium, I wish you full success, to the benefit of the worldwide community of earth scientists.

Paris, 19 April 1989

Endre DUDICH

Assoc. Prof.
IGCP Secretary
Unesco SC/GEO

MEGATECTONIC SETTING AND STRUCTURAL UNITS OF HUNGARY

J. HAAS

Hungary lies in the central part of the Carpathian Basin surrounded by the Alps, the Carpathians and the Dinarides.

Three major geohistorical periods are reflected in Hungary's geology:

- a pre-Alpine evolutionary stage, difficult to reconstruct, connected with Central Europe's Precambrian-Paleozoic history,
- the Alpine stage including the Late Paleozoic, Mesozoic and Paleogene evolution of the Tethys, with orogenic events (Eoalpine, Paleoalpine, Mesoalpine) manifested in napped-folded tectonics and large-scale strike--slip movements,
- the Pannonian (Neoalpine) evolutionary stage lasting from the Early Miocene up to the present; a period characterised by formation of small pull-apart basins and then the Pannonian Basin by high-amplitude subsidence.

According to the development patterns of pre-Tertiary formations, the territory of Hungary can be divided into the following megatectonic units (Fig. 1).

1. Tisza Unit

To the south of the Mid-Hungarian Fault Zone the Tisza Unit can be outlined, including the Mecsek and Villány Mountains and their subsurface extension in the basement of the Great Hungarian Plain (Alföld) showing affinities with the Apuseni Mountains (W Romania).

The high-grade polimetamorphic basement is covered by a Germano-type Permo-Triassic continental-shallow marine sequence. It is followed by Jurassic and Cretaceous series of different developments differences enabling the distinction of the Mecsek, Villány and Békés Subunits.

Mecsek Subunit is characterised mainly by thick Grestein-type Liassic, deep-water facies from the Upper Dogger and an intensive Lower Cretaceous submarine alkalic volcanism.

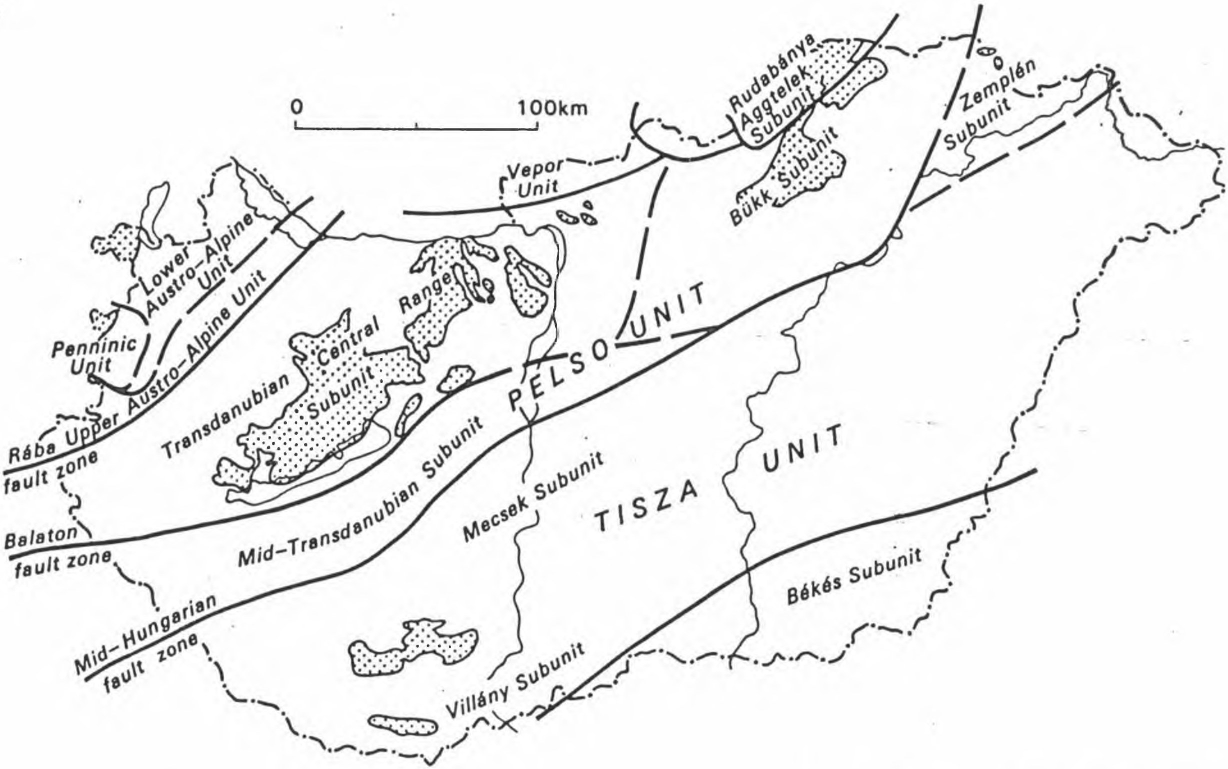

Fig. 1. Megatectonic units of Hungary

Villány Subunit has a Jurassic sequence with a great number of stratigraphic gaps, and Lower Cretaceous or Urgon facies--features showing similarities with the Bihor "autochtonous" unit in the Apuseni Mts.

Békés Subunit contains Upper Jurassic to Lower Cretaceous dark shales as in the case of the higher nappes of the Codru nappe system.

Upper Cretaceous formations of predominantly marine clastic development lie on the older rocks with unconformity. Paleogene is known only in the subsurface part of the Mecsek Subunit (Szolnok Flysch Zone).

2. Pelso Unit

Situated between the Rába-Diósjenő Lines and the Mid-Hungarian Fault Zone, Pelso Unit is characterised by very low-grade and low-grade metamorphic marine Early Paleozoic formations, and continental and marine Late Paleozoic sequences of South Alpine affinity. In the Mesozoic passive continental margin formations are characteristic, but in certain subunits remnants of the oceanic basement are known too.

Development indicates Alpine-Dinaric relationship.

Large-scale intermedier volcanism in the Eocene is an important feature of the unit, what is unknown from the Tisza Unit.

The Pelso Unit can be devided into the following subunits:

Transdanubian Central Range Subunit can be characterised by terrestrial-marine Upper Permian, slow transgression from the Lower Triassic, intrashelf rifting in the Middle Triassic, thick peritidal carbonate sequence in the Upper Triassic, intrashelf rifting with general trend of deepening in the Jurassic, trans-regressive cycles in the Middle and the Upper Cretaceous and in the Eocene.

Mid-Transdanubian Subunit is known only from boreholes. Most important features are the marine Upper Permian and the shallow carbonate platform formations in the Middle and Upper Triassic.

Bükk Subunit is constituted by Late Paleozoic marine sequence from which the Lower Triassic evolved with no break in sedimentation, followed by a Middle and Upper Triassic of carbonate platform facies and volcanites, and by Jurassic formation of schistes lustres type deposited in deeper-water slope and basin, as well as basaltic volcanites.

Aggtelek-Rudabánya Subunit the upper nappe includes Triassic of carbonate platform facies and deeper water Jurassic showing North Alpine affinity. The deeper nappes are composed of Middle and Upper Triassic of slightly metamorphosed deep-water facies and a Jurassic of schistes lustres character similar to its counterpart in the Bükk Mts.

3. Inner West-Carpathian Units

North to the Diósjenő Line crystalline complex of the Vepor Unit extends into the country's territory. It is known only from deep-borings.

4. Austro-Alpine Units

Penninic Unit: Jurassic to Lower Cretaceous metamorphites of greenschist facies in the Hungarian part of the Rechnitz Window (Kőszeg Mts. and its subsurface extension in the basement of the Little Hungarian Plain /Kisalföld/).

Lower Austro-Alpine Unit: Paleozoic mesometamorphic formations known from the Sopron Mts.

Upper Austro-Alpine Unit: very low to low-grade metamorphites known from the basin substratum between the Répce and Rába rivers, representing an extension of the Graz Paleozoic series.

In terms of the present-day interpretation, the above mentioned megatectonic units approached each other only in the Early Tertiary, by sizable plate tectonic reorganization processes that initiated probably in the Cretaceous.

In the Pannonian (Neoalpine) phase of evolution extension of the earth-crust and thinning of the lithosphere were the most important megatectonic phenomena.

Most intensive extension took place in the Middle Miocene when local pull-apart basins were formed together with volcanism in several phases.

In Late Miocene to Pliocene times accelerated subsidence of the Great and Little Hungarian Plains created the most characteristic present-day morphological features of Hungary.

VISITED REGION

GEOLOGY OF NORTH HUNGARY

PALEOZOIC AND MESOZOIC TERRAINES

S. KOVÁCS

The Paleozoic and Mesozoic terraines in Northern Hungary (Fig. 1) form part of the Gemer--Bükk Units, which, in turn, have become part of the Pelso Superunit during the Paleogene major strike-slip faulting activity.They show definite Dinaric affinites, only the northernmost units (Gemer Paleozoic, Silice Nappe) are related to the southernmost North Alpine units (Northern Greywacke Zone and Hallstatt Mesozoic). It is now widely acknowledged by Hungarian geologists, that it means original paleogeographical proximity to those units, from which position the Gemer--Bükk Units have been "expelled" in front of the ENE-ward escaping "Bakony--Drauzug unit" during the Paleogene (KÁZMÉR--KOVÁCS 1985; BALLA in press), in consequence of the Mesoalpine tectogenesis, thus representing one of the displaced terranes of the Pannonian domain.

The Gemer--Bükk Units are bordered from the S by the Mid-Hungarian Fault Zone, while from the N by the Lubenik--Margecany Line. On the E they are separated from the Zemplén Unit (which has also been displaced to its present-day position in front of the ENE-ward escaping "Bakony--Drauzug unit" by Lower Miocene times, c.f. BALLA, in press) by the Hernád Line. The boundary towards the W against the Transdanubian Central Range Subunit (=eastern part of the "Bakony--Drauzug Unit" in sense of KÁZMÉR--KOVÁCS, 1985) is obscure, being hidden below the thick Miocene volcanic masses of the Mátra--Cserhát region.

The Gemer--Bükk Units comprise the following ones from the N to the S:

1. Gemer Unit, containing only Paleozoic rocks, with N-vergent structures.

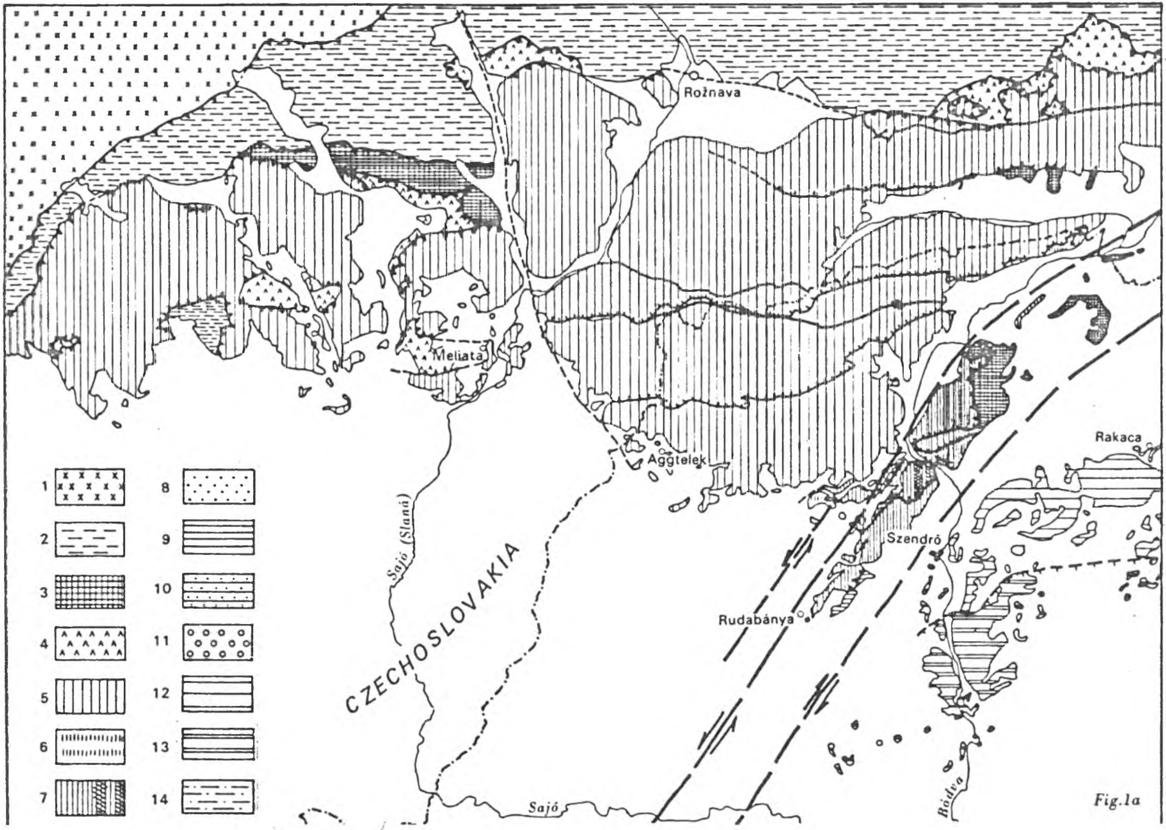
Rožnava
Meliata
Aggtelek
Rakaca
Szendrő
Rudabánya
Sajó (Slaná)
CZECHOSLOVAKIA
Sajó
Bódva
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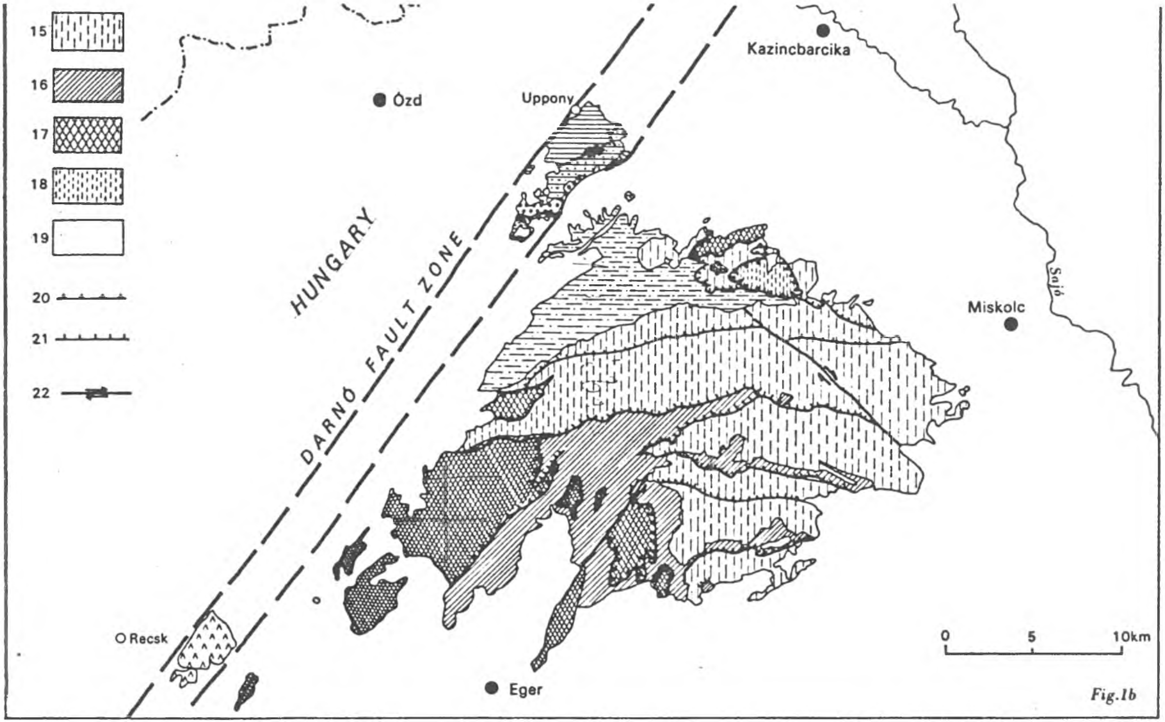
Fig.1a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Ózd
Uppony
Kazincbarcika
Miskolc
Sajó
HUNGARY
DARNÓ FAULT ZONE
Recsk
Eger
0
5
10km

Fig.1b

Fig. 1. Simplified geological map of the Gemer--Bükk units. (Compiled after ÁRKAI--KOVÁCS 1986, GRILL et al. 1984, CSONTOS 1988, BAJANIK et al. 1984, ELECKO et al. 1985; as well as unpublished mapping by KOVÁCS, PELIKÁN and LESS).

1. Veporicum, 2. Gemericum (Paleozoic), 3--8. Aggtelek--Rudabánya--Slovak Karst units: 3. Tornaicum, 4. Meliaticum, 5--8. Silicikum: 5. Silice Nappe, 6. Szőlősardó Unit, 7. Bódva Nappe (a: Jurassic), 8. Komjáti Unit, 9--18. Bükkium: 9--10. Uppony Paleozoic: 9. Uppony Unit (+Uppony-type Paleozoic in the Rudabánya Mts.), 10. Tapolcsány Unit, 11. Gosau-type Senonian conglomerates in the Uppony Mts, 12--13. Szendrő Paleozoic: 12. Rakaca Unit, 13. Abod Unit, 14--16. Fennsík (Tarkő) Parautochton of the bükk Mts.: 14. Upper Paleozoic, 15. Triassic, 16. Jurassic, 17. Szarvaskő--Mónosbél Nappe of the Bükk Mts., 18. Kisfennsík ("Little Plateau") Nappe of the bükk Mts., 19. Tertiary and Quaternary, 20. nappe boundary, 21. major imbrications within nappes, 22. strike-slip fault

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2. Aggtelek--Rudabánya and Slovak Karst Unit, with nappes built of different non-metamorphosed and metamorphosed Upper Permian--Mesozoic rocks. It is separated from the Gemer Unit by the Rožňava Line. With the exception of the northernmost part, this unit is characterized by nappes gravitationally glided towards the S. The northernmost part is thrust upon the Gemer Unit, which carries even isolated "Deckschollen" of the nappes of this unit: they can be found up to the immediate proximity of the Lubeník--Margecany Line.

3. Bükk Unit, containing Paleozoic rocks of the Szendrő and Uppony Mts. and Late Paleozoic--Mesozoic rocks of the Bükk Mts. Most of its subunits were effected by an anchi- to epizonal metamorphism. The Szendrő and Uppony Mts. are characterized by N-vergent overthrusts, while the Bükk Mts. by a S-vergent structure. The Aggtelek--Rudabánya and Bükk Units are separated by the Darnó Fault Zone, a Lower Miocene strike-slip zone.

Only the Hungarian part of the Gemer--Bükk Units will be described here in more details; the Gemer Unit and the Slovak karst are on the Czechoslovakian side and will not be touched by the present excursion.

Bükk Unit

Szendrő Hills

The Paleozoic of the Szendrő Hills is built up by the sequences of the northerly Rakaca Subunit and the southerly Abod Subunit, the latter being thrust upon the former. Mesozoic rocks are unknown. The sequences were effected by a greenschist-facies Alpine metamorphism (400 °C, 3 kbar; ÁRKAI 1983); effects of a Variscan metamorphism cannot be pointed out.

The sequence of the Abod Subunit (Fig. 2) begins with the Tapolcsány Formation (black, graphitic shales and siliceous shales, subordinately with fine-grained sandstone intercalations), most probably of Silurian age. The Szendrőlád Limestone Formation comprises bluish-grey limestones, both of biohermal and basinal facies, sandy limestones, as well as light-

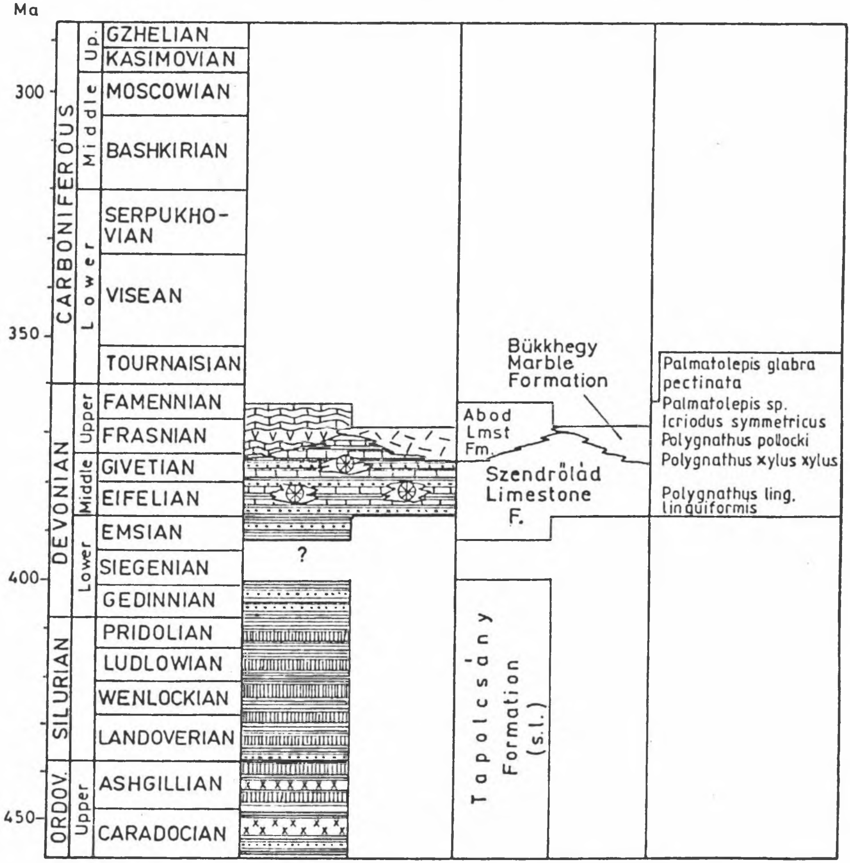

Fig. 2. Lithostratigraphy of the Abod Subunit of the Szendrő Hills with the most important conodonts

-coloured phyllites and metasandstones. Its Middle Devonian (Eifelian--Givetian) age is indicated by its rich coral fauna (MIHÁLY 1978) and conodonts (Polygnathus linguiformis etc. KOVÁCS in prep.[x]). It is overlain, on the one hand, by the Bükkhegy Marble Formation (pinkish--yellowish, thick bedded marbles of carbonate platform facies), most probably of Frasnian age. On the other, the metatuffitic Abod Limestone of basinal facies follows above it, with Frasnian and Famennian conodonts (Palmatolepis glabra, Palmatolepis sp. and others).

The Rakaca Subunit is built up by two, characteristically light bluish-grey and white-banded marble formations of carbonate platform facies, followed by a flysch-like detrital sequence (Fig. 3). The lower marble (Rakacaszend Marble Formation) contains pelagic intercalations and/or fissure fillings with Frasnian conodonts (Ancyrodella rotundiloba, Icriodus symmetricus, Polygnathus pollocki etc). After a long gap, witnessed only by fissure fillings with Upper Frasnian--Lower Viséan mixed conodont associations, follows the Rakaca Marble Formation and the Szendrő Phyllite Formation, interfingering with each other. The patch-reefs of the Rakaca Marble are encountered basinward by dark bluish-grey, originally micritic limestones (Verebes-hegy Member) with conodonts from the Upper Viséan Gnathodus bilineatus bilineatus zone to the Lower Bashkirian Idiognathoides sinuatus zone. The lower part of the Szendrő Phyllite Formation contains olistostromes, olistothrymmas and allodapical limestones originating from the contemporaneous Rakaca Marble buildups, while sandstone turbidites occur both in its lower and upper part (becoming rarer upward).

Uppony Hills

The Paleozoic of the Uppony Hills can also be subdivided into two subunits, namely the southerly, predominantly clastic Tapolcsány Subunit and the northerly, predominantly carbonatic Uppony Subunit. The contact between them is probably of strike-slip character, being the whole Uppony Hills within the Darnó Fault Zone. The Paleozoic sequences were effected by an Alpine metamorphism falling to the boundary of the anchizone and epizone (350 ^{o}C and 2,5 kbar; ÁRKAI 1983).

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[x] The conodont investigations have been carried out by the present author, therefore a separate reference will not be given at each conodont data.

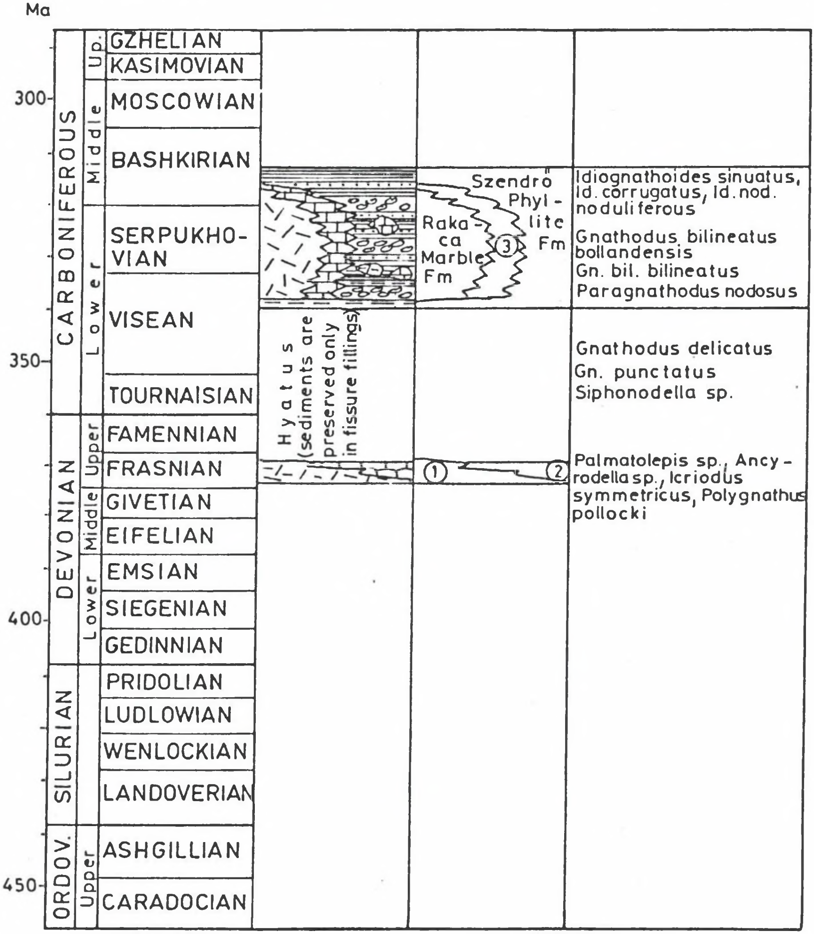


Fig. 3. Lithostratigraphy of the Rakaca Subunit of the Szendrő Hills with the most important conodonts

1. Rakacaszend Marble Fm., 2. Abod Limestone Fm., 3. Verebeshegy Limestone Member

The oldest formations of the Tapolcsány Subunit (Fig. 4) are probably the Rágyincsvölgy Quartz-sandstone Formation and the Csernelyvölgy Sandstone Formation (feldspathic greywacke), which, on the basis of East Alpine analogies (SCHÖNLAUB 1979 and EBNER, p.c.) are placed into the Upper Ordovician. The Tapolcsány Formation contains grey to black shales and siliceous shales, and black lidites, with some basic volcanics. On the basis of the above-mentioned analogies (it corresponds to the Bischofalm Facies of the Carnic Alps; c.f. SCHÖNLAUB 1979) it is most probably of Silurian age, but it may reach up into the Devonian, as well. The late Lower Devonian--Middle Devonian Strázsahegy Formation contains Schalstein--type basic volcanics and olistostrome(s) with basic volcanic matrix and Silurian to lowermost Devonian limestone olistoliths, which are rich in conodonts (see the description of the Strázsahegy locality--C-3). It cannot be excluded, that the Strázsahegy Formation thrust upon the Tapolcsány Formation, constitutes an independent, third tectonic unit. The Éleskő Formation is composed of limestone olistoliths embedded in a sandy--shaly matrix. In the limestone olistoliths Emsian to Famennian conodonts have been found (from Polygnathus serotinus to Palmatolepis glabra), so the formation is younger, probably a Middle Carboniferous olistostrome. The southern part of the Tapolcsány Formation is overlain by Upper Cretaceous (Senonian) conglomerates with pebbles from the underlying Paleozoic and from the Triassic and Uppermost Jurassic of the Bódva Nappe of Rudabánya Mts., thus forming an upper boundary for the age of the metamorphism.

The sequence of the Uppony Subunit (Fig. 5) begins with the Middle Devonian Uppony Limestone Formation of carbonate platform facies, followed by the metatuffitic Abod Limestone Formation with basic metavolcanic bodies. The latter contains Frasnian to Famennian conodonts (Ancyrodella nodosa, Palmatolepis gracilis gracilis and many other species). The Lower Carboniferous is represented by a fairly thin flaser limestone sequence (Dedevár Limestone Formation) with Siphonodella cooperi, Gnathodus delicatus and others. The time-equivalent of the flysch-type Szendrő Phyllite is here the Lázbérc Formation, which, on the contrary is built up by normal alternation of dark bluish-grey limestones and dark-grey shales, without signs of resedimentation. It contains the same Upper Viséan--Lower Bashkirian conodonts. The youngest formation (calcareous sandstone with small quartz and lydite pebbles, sandy limestone) probably corresponds to the Mályinka Formation of the Bükk Mts.

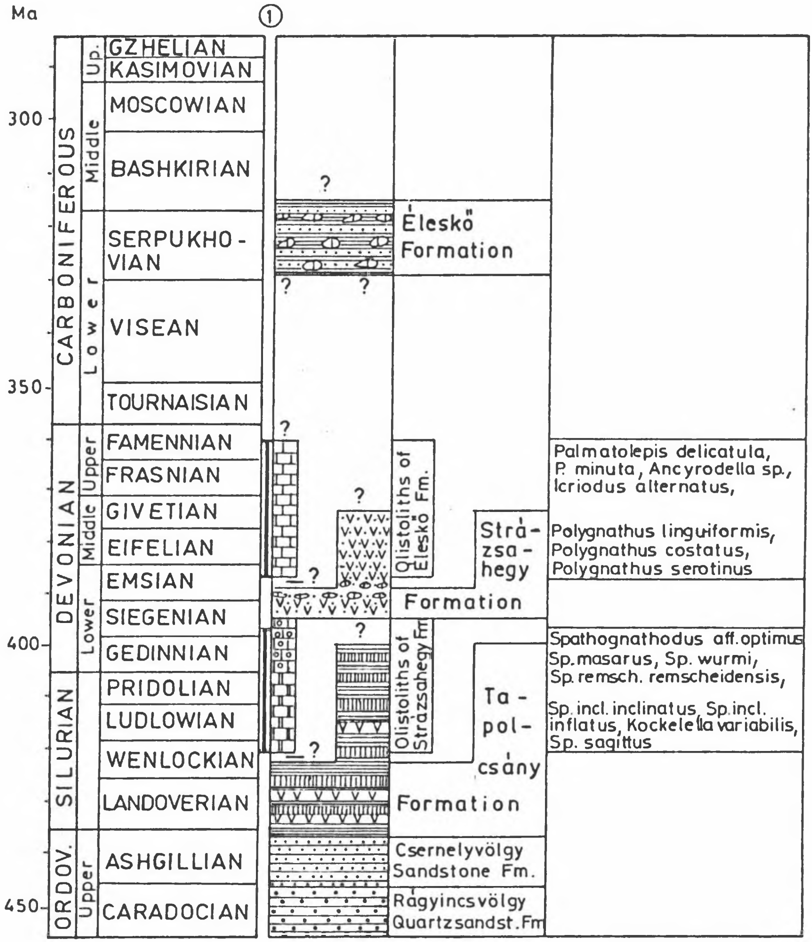


Fig. 4. Lithostratigraphy of the Tapolcsány Subunit of Uppony Hills with the most important conodonts

1. Continuous line indicates biostratigraphically proven age

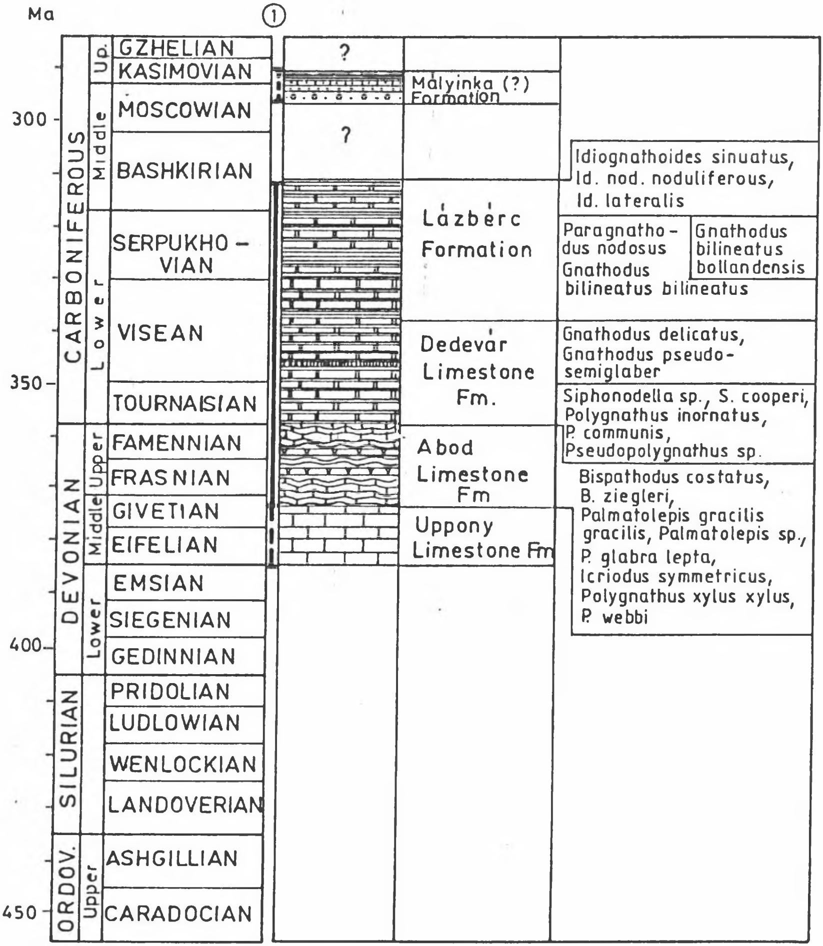


Fig. 5. Lithostratigraphy of the Uppony Hills with the most important conodonts

1. Continuous line indicates biostratigraphically proven age

Bükk Mts.

According to the latest subdivision (CSONTOS 1988), the Bükk Mts. is built up by the following subunits: the Fennsík "Autochton" (including the North Bükk and Fennsík anticlines), the Szarvaskő--Mónosbél Nappe and the Kisfennsík Nappe. The latter two are non-metamorphosed, while the metamorphic degree of the North Bükk anticline changes from the diagenetic zone to the epizone (towards the E); the rest of the Fennsík "Autochton" is anchizonal metamorphosed, reaching in some parts the epizone (350 °C and 3 kbar average; ÁRKAI 1983).

The sequence of the Fennsík "Autochton" (Fig. 6) begins with a Bashkirian--Lower Moscovian flyschoid sequence (Szilvásvárad Formation). It is followed by the Upper Moscovian--Gzhelian (probably reaching even in the Asselian; c.f. KOZUR 1985) shallow-water carbonatic--clastic sequence of the Mályinka Formation, very rich in fossils (calcareous algae, fusulinids, corals, bivalves, brachiopods etc). These two formations correspond to the Hochwipfel flysch and Auernig Group of the Carnic Alps (c.f. SCHÖNLAUB 1979). After a hiatus a thin limestone breccia horizon follows, probably corresponding to the Tarvis Breccia of the Carnic Alps (PELIKÁN, p.c.) overlain by the Middle Permian evaporite-bearing Szentlélek Formation. Besides evaporites, sandstones prevail in its lower part and its sequence becomes more and more dolomitic upwards. In fact, this formation represents the beginning of the Alpine sedimentary cycle here. The Paleozoic is terminated by the Upper Permian Nagyvisnyó Limestone Formation ("Bellerophon Kalk"): black, algal limestones with dolomites and thin intercalations of black shales.

The Nagyvisnyó Limestone is overlain by light-coloured oolitic limestones (Gerennavár Limestone Formation). The position of the Permian--Triassic boundary is still the matter of discussion; according to KOZUR 1985, it would be above the lithological boundary. The rest of the Lower Triassic is made up by a shallow-water clastic--carbonatic sequence in "Werfen Facies" (Ablakoskővölgy Formation). During the Middle and Upper Triassic, the sedimentation took place in an outer shelf environment, with carbonate platforms (Hámor Dolomite, Fehérkő Limestone, Fennsík Limestone) and intraplatform basins (grey, cherty limestones of the Hollóstető and Felsőtárkány Formation). The carbonate sedimentation is interrupted by two thick (up to 200--300 m) volcanic horizons: in the Lower Ladinian by the Szentistvánhegy Porphyrite and in the Carnian by the Óhuta Diabase. In the Middle Carnian a clastic event can be recognized (marly slates and lime schists of the Vesszős Formation). The carbonate platform environment was disrupted near to the Triassic--Jurassic boundary, the deepening of the sedimentary basin below the CCD is documented by variegated basinal limestones (pink, red and grey, often crinoidal or cherty), finally by red, resp. brown and green radiolarites. The sequence is terminated by dark shales with some turbiditic sandstones and black radiolarites and radiolarian shales. The latters, according to KOZUR 1985, contain Bajocian radiolarians (<u>Unuma echinata</u> Zone).

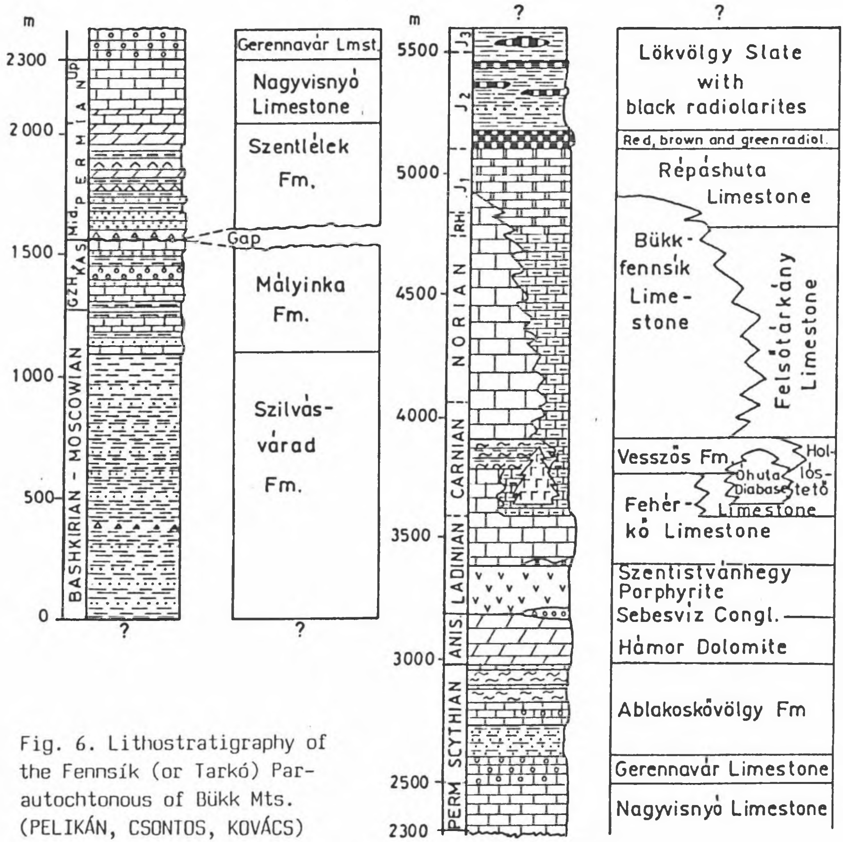


Fig. 6. Lithostratigraphy of the Fennsík (or Tarkó) Parautochtonous of Bükk Mts. (PELIKÁN, CSONTOS, KOVÁCS)

The Szarvaskő--Mónosbél Nappe contains a lower ophiolitic suite (Szarvaskő Group) with sheeted dyke and pillow lava complexes and associated sedimentary rocks (dark shales, sandstones), and a higher olistostromal sequence, the Mónosbél Formation (olistostromes with shaly matrix, limestone olistoliths, allodapical limestones) (Fig. 7). Triassic rocks (mostly grey, basinal limestones with some conodonts) are only known from olistoliths. The age of the basic rocks, according to radiometric determinations, is Liassic--Dogger (165$\pm$, resp. 168$\pm$8 Ma for the age of the gabbroic intrusion; ÁRVA--SÓS et al. 1987), while that of the Mónosbél Formation is Upper Jurassic, as shown by foraminifers from allodapical limestones (*Protopeneroplis striata*; BÉRCZI--MAKK and PELIKÁN 1984).

The Kisfennsík Nappe contains non-metamorphosed, white, thick-bedded to massive limestones with some megalodonts (showing to a probable Upper Triassic age) and porphyrites.

Aggtelek--Rudabánya Unit

The excursion route will touch only the Hungarian part, i.e. the territory of the Aggtelek Karst and Rudabánya Mts.

The most part of the region is built up by the nappes of the non--metamorphosed Silicicum (Silice Nappe in the Aggtelek and Slovak Karst, Bódva Nappe in the Rudabánya Mts.). The underlying metamorphosed units, belonging to the Meliaticum and Tornaicum occur only in tectonic windows or are known only from boreholes.

The sequence of the tectofacies units/subunits building up this region (Fig.8)begins with Upper Permian evaporites (Perkupa Evaporite Formation). The upper part of the evaporitic--lagoonal sequence is tectonically non disturbed and gradually passing into the Lower Triassic marine formations, while its lower part is chaotically (mélange-like) folded, containing obducted slivers of a later-generated oceanic crust (=the Tornakápolna facies of the Meliaticum) ripped up during the southward gliding of the Silicicum.

There is no significant difference in the sequences of the units prior the Middle Triassic rifting, which started in Middle Anisian times. In the Lower Triassic the site of sedimentation gradually shifted from a near-shore setting with clastics (Bódvaszilas Sandstone Formation) to an offshore setting with restricted lagoonal conditions (the vermicular Szinpetri Limestone Formation). The initial stage of the Middle Triassic building up of carbonate platforms was represented by deposition of the euxinic lagoonal Gutenstein Limestone and Dolomite Formation. In late

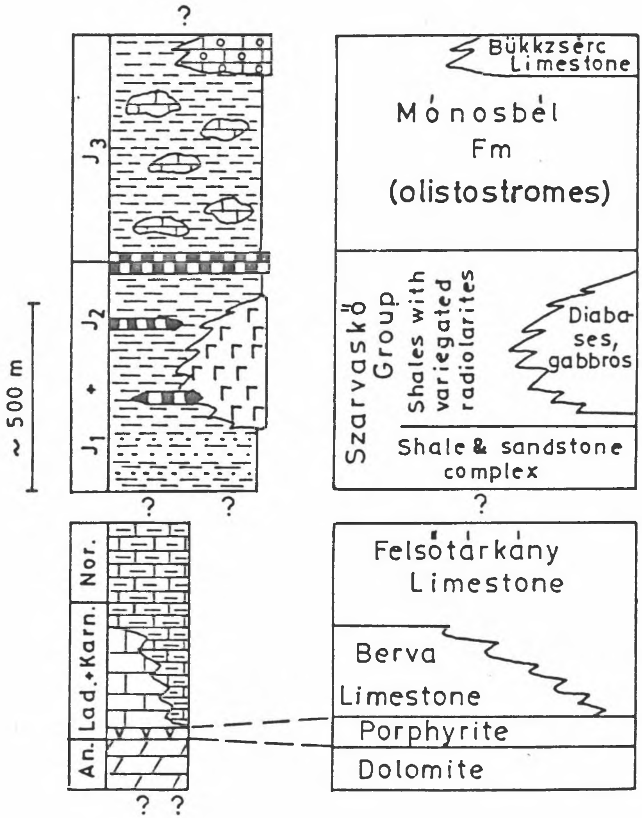


Fig. 7. Lithostratigraphy of the Szarvaskő--Mónosbél Nappe of Bükk Mts.
(PELIKÁN, CSONTOS, KOVÁCS)

Lower and early Middle Anisian times the whole region (with the exception of the Bódvarákó facies) was an open shelf carbonate platform, with dasycladaceans and foraminifers (Steinalm Limestone and Dolomite Formation).

The facies differentiation started with the disruption of the uniform Steinalm carbonate platform. As the rifting proceeded, the following tectofacies units came into existence, which persisted throughout the Triassic (see Fig. 9).

A/ Silicicum

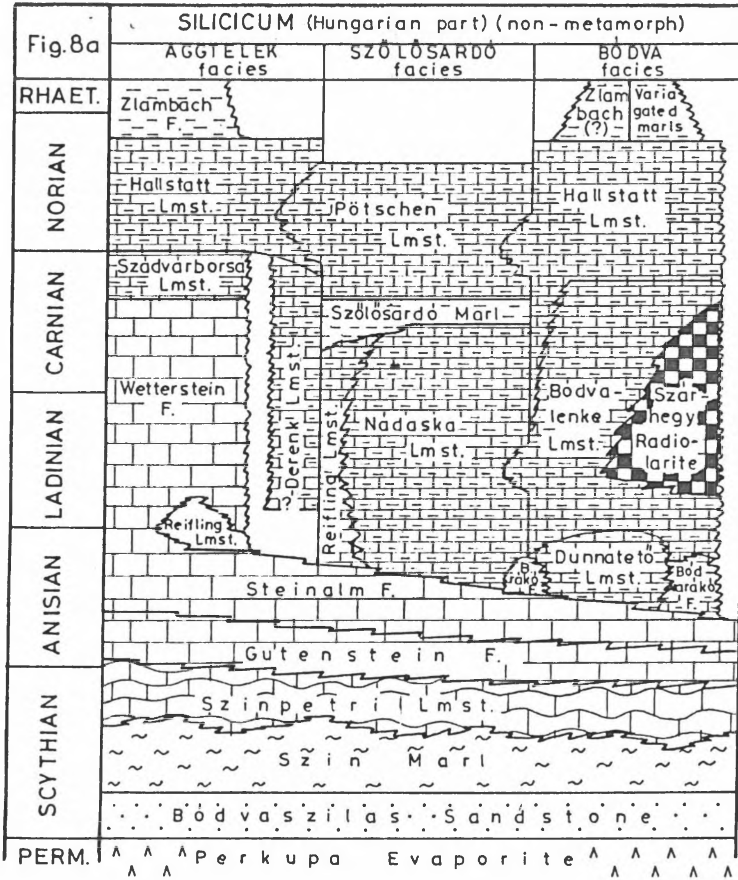
1. Drnava facies: Carbonate platforms until the latest Norian, locally interrupted with intrashelf basinal facies at the Anisian/Ladinian boundary interval. It builds up the northern part of the Silice Nappe and is restricted to the Slovakian territory only.

2. Aggtelek facies: Carbonate platforms (Wetterstein Formation)until the early Late Carnian, with south-facing reefs. This shelf margin domain subsided in the Late Carnian and after a transitional facies (Silická Brezová Limestone) typical Hallstatt limestones deposited from the beginning of the Norian, followed by Zlambach marls in the latest Norian and Rhaetian. It builds up the southern part of the Silice Nappe.

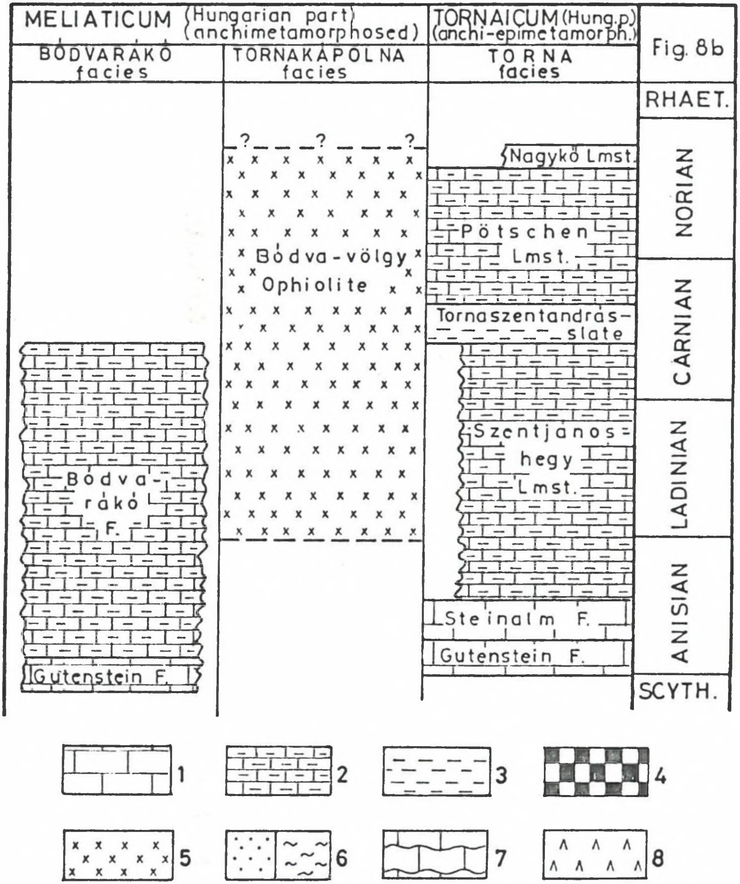
3. Szőlősardó facies: Slope facies, with frequent redepositional phenomena (see BALOGH and KOVÁCS 1981). It is considered to build up a southern, frontal scale of the Silice Nappe.

4. Bódva facies: Predominantly red-coloured, deep water, strongly condensed carbonatic formations (Bódvalenke Limestone, Hallstatt Limestone), passing into siliceous sediments deposited below the CCD (Szárhegy Radiolarite Formation). Conspicuous facies variations, various hiatuses and certain redepositional phenomena are witnesses of uneven bottom topography. It builds up the non-metamorphosed unit of the Rudabánya Mts. (the Bódva Nappe).

5. Bódvarákó facies: The Steinalm Formation is missing and dark-grey to black Gutenstein dolomites are followed immediately by the similarly dark-coloured Bódvarákó Formation of restricted basin facies (strongly cherty limestones with dolomitic marls and siltstones in its lower part).



Figs. 8a-b. Triassic formations of the Aggtelek Karst and Rudabánya Hills (KOVÁCS et al. 1988)



Legend: 1. Carbonate platform facies, 2. pelagic basinal facies, 3. basinal detrital facies (marly-argillaceous). 4. radiolarite, 5. ophiolite, 6. shallow marine detrital and marly facies, 7. restricted lagoonal carbonate facies, 8. evaporite

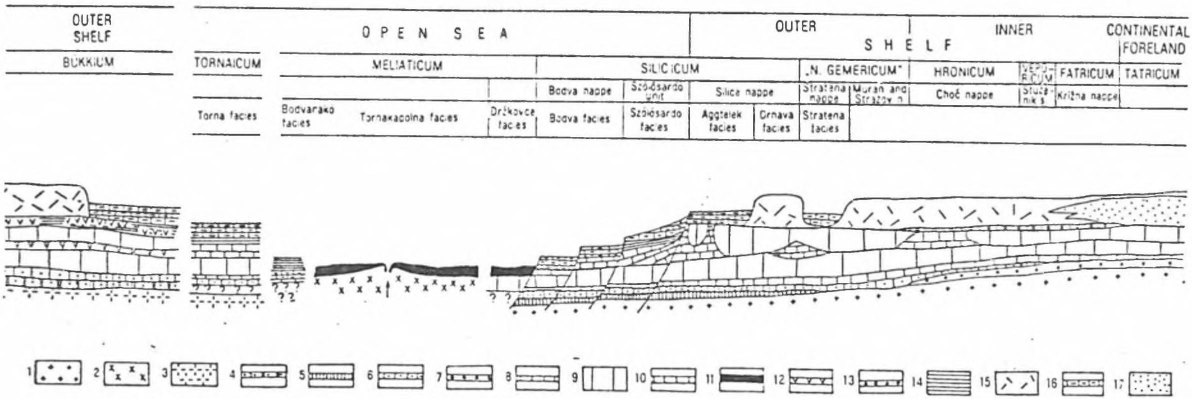


Fig. 9. Triassic palinspastic section across the West Carpathian and the Dinaric-type North Hungarian isopic zones, from the Tatricum to the Bükkium (KOVÁCS 1986, unpubl.)

1. Continental crust, 2. oceanic crust, 3. unconsolidated pre-Alpine basement, 4. Upper Permian limestone, 5. Upper Permian evaporite, 6. Werfen facies (marine Scythian), 7. "Buntsandstein" facies (continental Scythian), 8. Gutenstein Fm. (initial carbonate platform facies), 9. Middle Triassic carbonate platform facies, 11. Triassic radiolarite, 12. Triassic volcanics (non-ophiolitic), 13. Carnian coarse detrital facies, 14. Carnian fine detrital facies, 15. Upper Triassic carbonate platform facies, 16. Upper Triassic basinal facies, 17. Carpathian Keuper

Whether its original setting was to the S or to the N of the rift axis, and belongs to the Silicicum or to the Meliaticum, it is still a matter of debates.

B/ Meliaticum

6. Držkovce facies: Deposited on thin continental crust: Anisian platform carbonates are followed by Ladinian red radiolarites (the type locality at Meliata also belongs here). This facies occurs only in the Slovakian side.

7. Tornakápolna facies (after the borehole Tornakápolna 3; see RÉTI 1985): Deposited on oceanic crust, Ladinian red radiolarites immediately overlie pillow lavas (resp. intercalate them). Those of the Darnó Mt. and its surrounding (Stop Dallapuszta--A-2) also belong here.

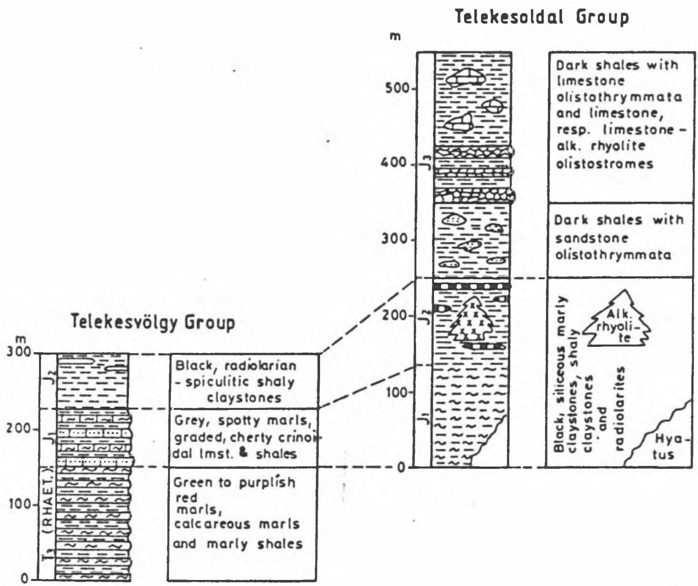


Fig. 10. Lithostratigraphy of the Jurassic of the Bódva Nappe in the Rudabánya Hills (after GRILL 1988, modified)

C/ Tornaicum

8. Torna facies: Predominantly grey basinal carbonatic formations, practically lacking redepositional phenomena. Anchi- to epizonal metamorphosed (250 ^{o}C, 7 kbar; ÁRKAI--KOVÁCS 1986). It builds up the metamorphic unit of the Rudabánya Mts. (Torna Nappe).

Jurassic rocks in the Hungarian territory are known only in the Bódva Nappe (Fig. 10): dark-grey to black shales and radiolarian shales, siliceous marls and sometimes black radiolarites, furthermore spotty marls ("Fleckenmergel"), alkaline rhyolites. Olistostromes, similarly to that of the Bükk Mts., represent likely the uppermost part of the sequence. Biostratigraphic data are known only from the radiolarian shales and radiolarites: a rich radiolarian fauna belonging to the Bajocian *Unuma echinata* zone (GRILL and KOZUR 1986).

Cretaceous rocks are unknown here.

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CENOZOIC FORMATIONS OF NORTH HUNGARY

A. NAGYMAROSY

1. Introduction

Cenozoic events played an important role in the geological history and structural evolution of N Hungary. This part of the country obtained its final shape at a rather late period, i.e. after the Miocene, when the great amplitude processes of sedimentation, volcanism and tectonics had already been completed.

In the geological history of almost all N Hungarian regions the Cenozoic period had played an important role. Both the thick Tertiary sequences of the Cserhát Mts., those of the Salgótarján basin, Ózd-Borsod basin, and footland areas of the Mátra and Bükk Mts. were deposited that time and the volcanic masses of the Börzsöny Mts., Cserhát Mts., Mátra Mts. and Zemplén Mts. emerged at that period. Even Palaeozoic-Mesozoic mountains, like the Bükk, Aggtelek Karst, or the Rudabánya Mts. had undergone important structural changes during the Neogene.

Contrary to former ideas stating that N Hungary's tectonic structure and basic geographical outlines, in a draft form, were already present by the end of the Mesozoic, today it is supposed that even during the Oligocene and Miocene still important lateral dislocations of several 10 km order of magnitude took place and as a result, compressive zones might have been formed, e.g. at the feets of the Mátra of Bükk Mts. The most important tectonic lines, active still in the Tertiary, are the following: the Buda Line, starting from the Buda Mts. across the W Cserhát Mts; the Darnó Line, crossing the E Mátra Mts. and separating the zones of the Bükk and Rudabánya Mts.; the Hernád Line, bordering the Zemplén Mts. from the W and also the so-called Balaton Line, as structural boundary of N Hungary from the south (Fig. 1).

Since most of the Tertiary formations developed in the area of the former Paratethys, in its stratigraphy the regional stage-system of the

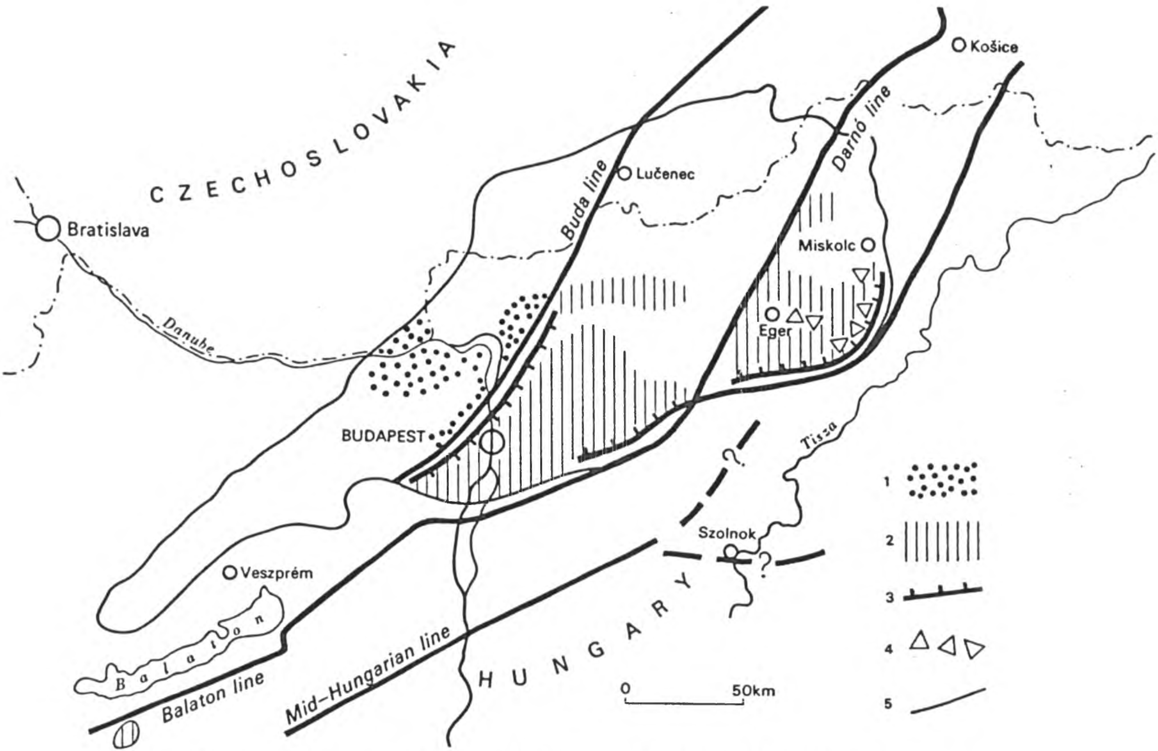

Fig. 1. The most important tectonic lines and Cenozoic formations of N Hungary
1. Occurrence of the Hárshegy Sandstone, 2. occurrence of the Tard Clay, 3. southern and western borders of the Tard Clay, 4. olistostromes and turbidites in the Tard and Kiscell Clay, 5. occurrence of Oligocene rocks (epicontinental type)

Central Paratethys will be used. In order to introduce a special stage--system for the Paratethys, it is required to be ascertained that the Pa-

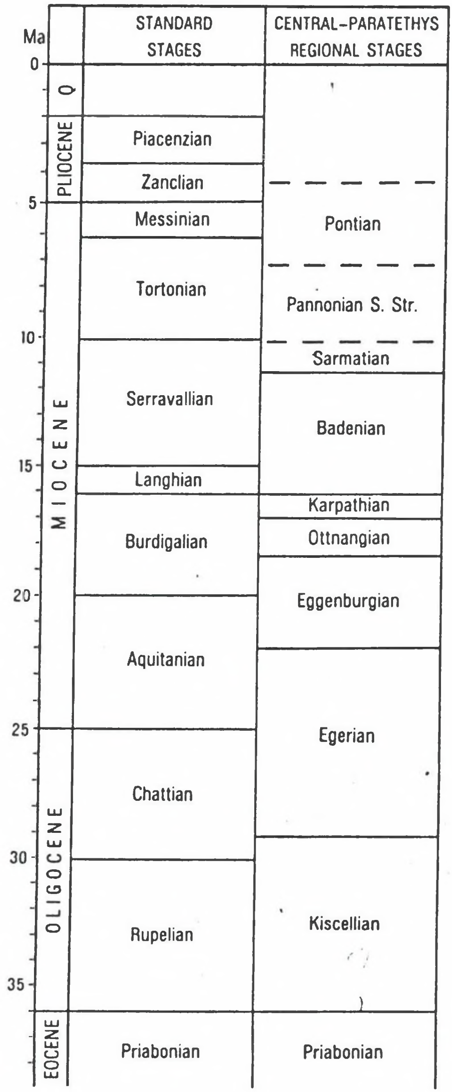

Fig. 2. The regional stages of the Central Paratethys

ratethys, separating from the Mediterranean, had a differring, independent and unanimous bioprovince and sedimentation history. In BÁLDI's (1986) opinion, the first endemic event influencing the whole Paratethys took place in the Early Oligocene, soon after the Eocene--Oligocene boundary, that is why a stage system starting with the Oligocene, differring from the world-scale is used (Fig. 2).

Stratotypes of some regional stages can be found in Hungary's territory. Such are the Kiscellian in Budapest on the Kiscell Plateau (its final definition is still to be worked out), and the Egerian in the town Eger, at the SW margin of the Bükk Mts.

2. Paleogene

2.1. Eocene Formations (Fig. 3)

No Paleocene formations are known from N Hungary. The Eocene transgression reached this region only by the very end of the Priabonian. Sediments of the Upper Eocene sea can be traced only in the W Cserhát Mts., in the N foreland of the Mátra Mts. and in the footland areas of the Bükk Mts.

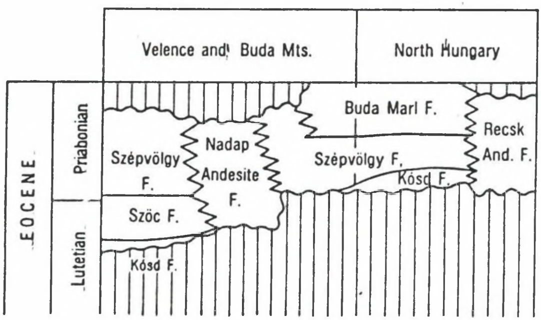

Fig. 3. The Eocene formations of N Hungary (after DUDICH, p.c.)

The corallinacean, sometimes nummulitic, biogenic Szépvölgy Limestone is deposited unconformly upon the older formations with a thickness of hardly 50 m. From this the pelagic, epibathyal Buda Marl develops that reaches even the 200 m thickness toward the S. The allodapic limestones and calcareous turbiditic benches intercalated in the Buda Marl refer to the steep morphology of the slope between the shoreline and the deep basins. In the upper, more pelitic section of the Buda Marl the carbonate content gradually decreases, and this member is ranged already in the Oligocene.

The Recsk region (N Mátra Mts.) is characterized by important andesitic volcanic-subvolcanic activity in the Priabonian. Volcanism is accompanied also by ore formation that led to the formation of Hungary's largest copper ore deposit.

2.2. Oligocene formations (Fig. 4)

From the Buda Marl spanning through the Eocene/Oligocene boundary the Tard Clay develops continuously that can be traced from the Buda Mts. till the Bükk Mts. The sediment accumulation area of the Tard Clay covers the S-SE section of N Hungary.

The lower member of the Tard Clay consists of greyish clayey marl and marl and shows lamination increasing upwards. This phenomenon is due to increasing anoxia, that is to the lack of bioturbation. In the upper part of the member faunas gradually become extinct, that beside the anoxia refer also to the changing salinity.

At the boundary of the upper and lower members, layers characterized by the endemic Cardium lipoldi and endemic nannoflora were deposited.

The upper member of the Tard Clay is a markedly microlaminated, darkish grey, black shaly clay, often rich in fossil fishes. Other faunal elements, due to anoxia and changing salinty of the surface waters, are rather rare. The pebbly--sandy fluxoturbidites within this member of the Tard Clay, found in the foothill region of the Bükk Mts. were transported by submarine slumps. The euxinic nature of the Tard Clay indicates a partial isolation of the Middle Paratethys from the world oceans.

At the boundary of the Lower and Upper Kiscellian substages the connection with the world oceans has been restored. Due to the extremely rapid subsidence of the N Hungarian sedimentary basin an extremely thick sedimentary sequence was deposited, i.e. the Kiscell Clay reaching even an 800 m thickness developed during 2--3 million years. The Kiscellian sea far extended that of the former Paleogene sedimentary basins. Its shoreline can be traced as far as the Buda and Gerecse Mts. to the W and Lucenec (S Slovakia) to the N. Along this coastline the Hárshegy sandstone, the heteropic coastal facies of the Kiscell Clay was deposited. The pelagic features of this basin are increasing toward S-SE. However, this part of the shoreline is not known, because here the basin is bordered by tectonic zones.

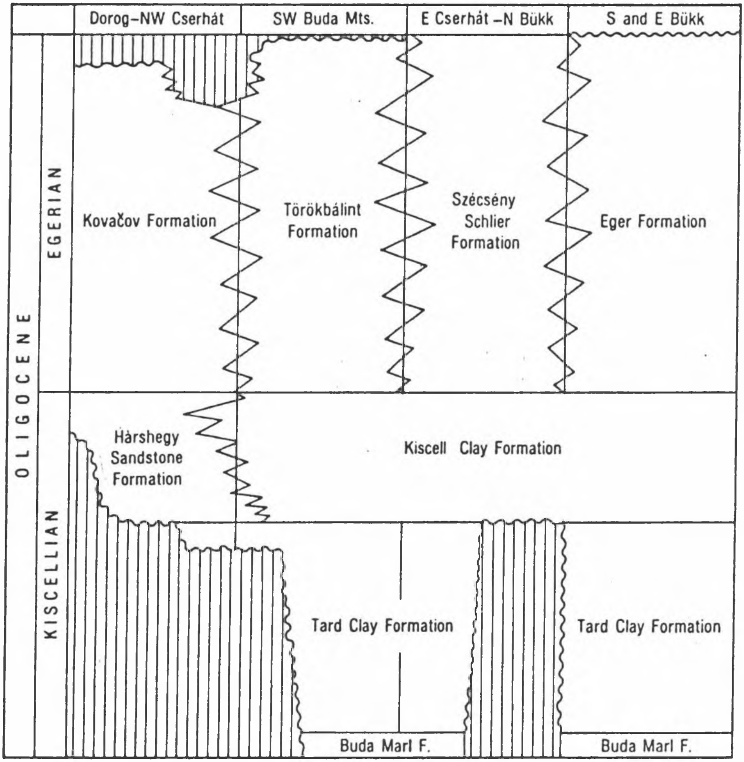

Fig. 4. The Oligocene formations of N Hungary

At the bottom of the well-oxigenated basin of the Kiscell Clay rich benthic Foraminifera existed, a fauna consisting of more than 200 species. No such diversity among the fossils from the water column could be traced.

At the beginning of the Egerian the subsidence got slower and the basin became shallower. The shoreline of the Egerian sea overlapped that of the Kiscellian towards N and W. This was the time when, in N Hungary, the Eger and Kovacov Formations, and the Szécsény Schlier were deposited. All these three formations develop by continuous sedimentation from the Kiscell Clay.

The Kovacov Formation is 300--400 m thick, consisting of alternating sandy and pelitic sediments. In its marine upper part the brackish-water and fresh-water intercalations become more frequent. The formation is most wide-spread in the W Cserhát Mts.

The Szécsény Schlier was formed int the E Cserhát Mts., Salgótarján basin and in the N and S foreland of the Mátra Mts. It is a pelitic formation reaching even a maximum thickness of 400--500 m with frequent sandstone banks. Its depositional depth can be put to 100--200 m. The formation of the Szécsény Schlier was continuous across the Oligocene/Miocene boundary and, in the E Cserhát Mts. it passes over even the Egerian/Eggenburgian boundary.

The Eger Formation occurs at the type area, in the foreland areas of the Bükk Mts. Upon the sublittoral, mollusc-rich clay a regressive sequence consisting alternately of sandstone, silt and clay is deposited with brackish-water intercalations in its higher parts.

2.3. Miocene formations (Fig. 5)

At the end of the Egerian a general regression started that resulted in a temporary "lack" of sedimentation for the whole area concerned. Continuous sedimentation can be found only in the zones enclosed by the Buda and Darnó Lines, i.e. in the Cserhát Mts., the Salgótarján basin and the N foreland of the Mátra Mts. The new, Eggenburgian transgression affected only a smaller area than that of the Egerian one. Its shoreline, indicated ty the Budafok Formation with large Pectens and Anomias can be traced from the Buda Mts., through the W Cserhát Mts. up to Slovakia. The formation of the Szécsény Schlier continued in the E Cserhát Mts., while in the Salgótarján basin and in N Mátra Mts. the 200--300 m thick glauconitic Pétervására Sandstone was deposited upon the Egerian part of the Szécsény Schlier. The Pétervására Sandstone is the shallow marine but not coastal heteropic facies of the Szécsény Schlier.

In the N foreland of the Bükk Mts. the Putnok Schlier Formation transgresses an older, Palaeozoic-Mesozoic basement.

In the Ottnangian a general regression took place in N Hungary. This, after the deposition of the cycle-closing Zagyvapálfalva Formation with

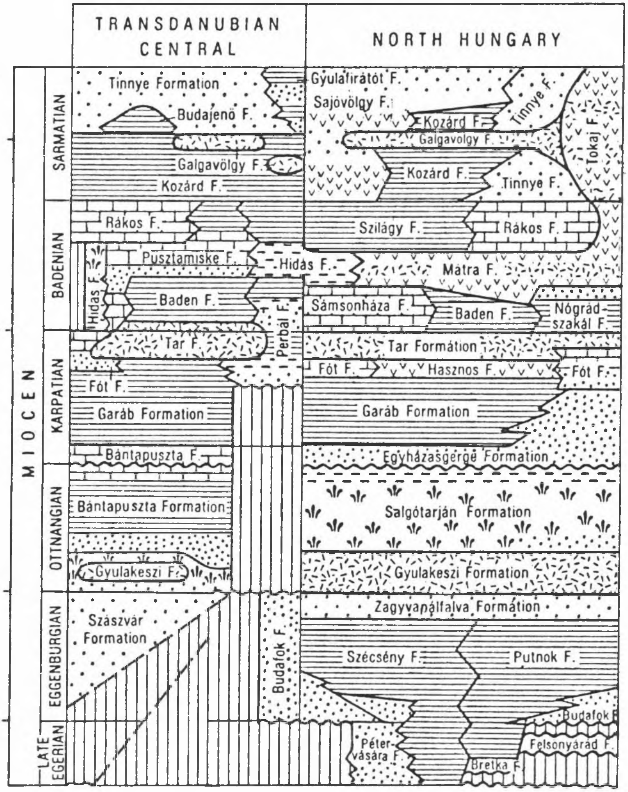

Fig. 5. The Miocene formations of N Hungary
(after HÁMOR and HALMAI, p.c.)

continental, terrigenous sediments led to the complete elevation and erosion of the region. (The famous Ipolytarnóc footprint sandstone also belongs to this formation).The formation of the Gyulakeszi Rhyolite Tuff ("lower rhyolite tuff") can be also ranged in the earliest Ottnangian, and it is an important stratigraphic guide horizon for the whole territory of Hungary. Based on thickness data, the epicentre of the eruption can be located N of the Mátra Mts.

While the pre-Lower Ottnangian facies and formations do not "trespass" the already mentioned megatectonic zones, from the end of the Ottnangian these zones do not already coincide with paleogeographic boundaries. Thus it can be concluded that the large-scale lateral rearrangements had been completed by the end of the Ottnangian.

First product of the Ottnangian transgression is the Salgótarján Coal Formation of the Salgótarján and the Ózd-Borsod basins. Within the thick, terrigenous sequence in the Salgótarján region three, while in the Ózd region five coal-measure units can be found. Above the coal measures, by advancing of the transgression brackish-water Rzehakia (Oncophora) beds deposited first and later the Pecten-rich Egyházasgerge Formation. This latter contains fossils already from the Karpathian. The Garáb Schlier represents the climax of the Karpathian transgression. This pelitic formation was deposited in the internal, deepest, deep-sublittoral zone of the basin, while at the margins the calcareous, sandy, shallow-marine and coastal sediments of the Fót Formation were developed. Generally speaking, the Karpathian basin could neither in extension, nor in depth, reach the size of the Paleogene basin.

The most important period of Tertiary volcanism in Hungary began at the boundary of the Karpathian and Badenian.

After the deposition of the Tar Dacite Tuff ("middle rhyolite tuff"), an extremely heterogeneous stratovolcanic complex, the Mátra Andesite Formation has formed. The elimination of the term "Formation" would be perhaps more advisable, since the term "Mátra Andesite" refers rather to a horizon with several sites of eruptions than to one continuous rock-body. Main eruption centres were the Börzsöny and Mátra Mts. The 1500 m thick stratovolcanic complex of the Mátra foreland and the volcanic area of the Cserhát Mts. also belong to this volcanism. The contemporaneous formation of the Selmecbánya (Stiavnicky) and Ostrovsky Mts. can be due to the same rhyolite to pyroxenic andesite volcanic event. Between the Lower Badenian volcanic horizons and upon the volcanic complex the Nógrád-szakál and Sámsonháza Formations of extremely heterogeneous petrographical composition were deposited. The first is a shallow-marine, coarse, detrital sediment coming from the denudation of volcanic rocks, while the other is a sand containing also volcanic debris, tuffitic marl and limestone (="lower Leithakalk"). Due to the progressing Badenian transgression sandy sediments were deposited around the Börzsöny Mts. too, while in the N foreland of the Bükk Mts. marly sediments (Szilágy Formation) can be found.

The Badenian sea covered all the territory of N Hungary, except for its island-type volcanic mountains and the Bükk Mts. This period coincides with the beginning of the subsidence of the Pannonian Basin. The Lower and Middle Badenian sediments can be found mainly in the N, while the southern part of the territory is characterized by a full Badenian sedimentary sequence.

At the beginning of the Sarmatian Stage the (now final) isolation of the Paratethys from the world-oceans had started. At the coastline of the brackish Sarmatian sea the calcareous-sandy Tinnye Formation, while within the internal part of the basin the Kozárd Formation developed. The Gyulafirátót Rhyolite Tuff ("upper rhyolite tuff") level can be also found in the Sarmatian sediments. The enormous volcanic complex of the Zemplén Mts. was also formed in this period.

In the upper parts of the Miocene (Pannonian and Pontian Stages) N Hungary represented only the marginal zone of the large Pannonian lacustrine system. Thicker, pelitic-sandy sequences, could be deposited only at the S margin of the North Hungarian Range, including also endemic Pannonian-type mollusc assemblages. In the immediate neighbourhood of the mountains, thinner layers of variegated clays and redeposited volcanic debris represent the Upper Miocene rocks. In the S foreland of the Mátra and Bükk Mts., the widespread Bükkalja Lignite Formation is important. The eruption of the Salgótarján basalt volcanoes can be put to the Pliocene/Pleistocene boundary.

The Quaternary is rather an interval of erosion than sediment accumulation. This period is represented by thin loess, variegated clay and boulder sediments.

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GEOLOGY OF THE TRANSDANUBIAN CENTRAL RANGE

PALEOZOIC AND MESOZOIC FORMATIONS

J. HAAS

The Transdanubian Central Range is bounded in the northwest by the Rába Fault Line; in the southeast it borders on the Mid-Transdanubian (Igal) zone along the so-called Balaton Fault Line running parallel to Lake Balaton.

Structurally, the Central Range is of synclinorium nature. In its axis there are younger Mesozoic, Jurassic and Cretaceous formations flanked by progressively older and older Mesozoic and Paleozoic sequences as one proceeds towards the limbs.

Oldest rocks are the Lower Ordovician anchimetamorphic shales. Their age were evidenced by Acritarchs.

Formations of similar lithology are known up to the Lower Silurian. The phyllite sequence contains volcanoclastic intercalations in several horizons.

Devonian pelagic limestones were found in some boreholes on the Balaton Highland and east to Lake Balaton. Slightly metamorphosed platform carbonates are known also on the latter area. That might be Devonian too. Under this platform limestone body Lower Carboniferous coral-bearing limestone is situated with tectonic contact.

Minor Upper Paleozoic granite plutons are known to occur along the Balaton Fault Line, (e.g. the Velence Mountains).

The Late Permian continental sedimentation was a manifestation of the subsidence that initiated the Alpine cycle. The average grain size in the red detrital, fluviatile-alluvial-lacustrine sedimentary sequence tends to decrease upwards. To the northeast the continental sediments are replaced by an anhydrite-dolomite sequence of lagoonal facies, to be followed with no break in sedimentation, by the Triassic sediments. In the southwest, however, the contact is sharp, probably with a considerable hiatus.

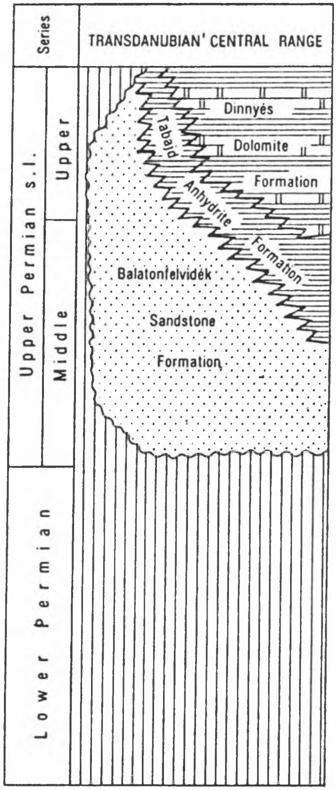

Fig. 1. Permian formations of the Transdanubian Central Ranga Subunit

In the Early Triassic a transgressive sequence was deposited with considerable terrigenous influx. Consequently silty dolomites, siltstones and marls were accumulated in shallow-water, more or less restricted lagoonal facies.

During the Early Anisian dolomite and bituminous limestone were formed in shallow lagoon preparing the generation of the first carbonate platform in the Middle Anisian.

At the Anisian-Ladinian boundary, K-trachyte tuffs (pietra verde) are known as interbedded layers within several horizons. In the southwest the

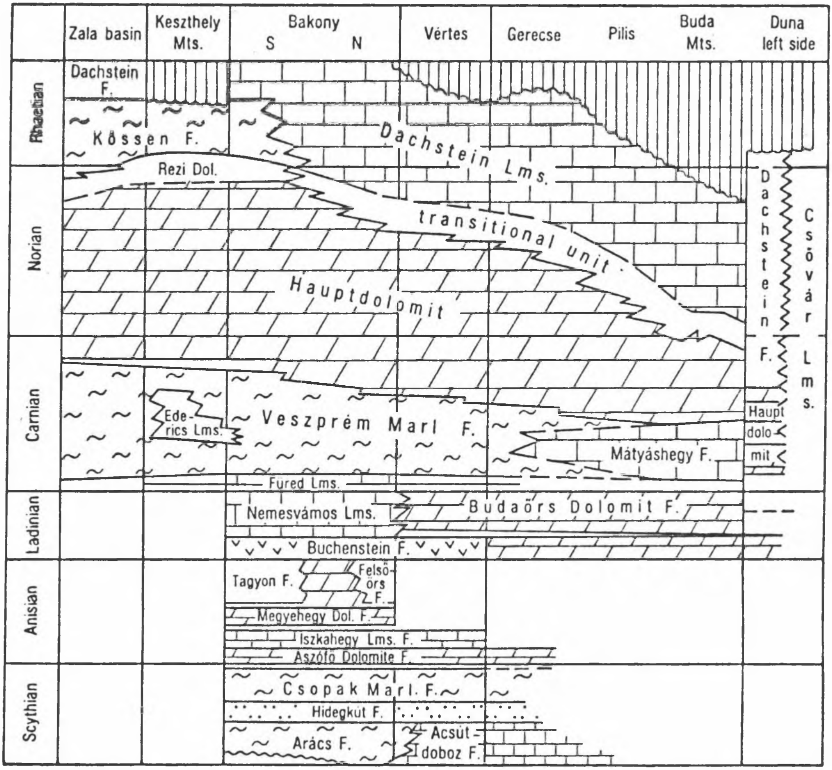

Fig. 2. Triassic formations of the Transdanubian Central Range Subunit

greatest sea depth seems to have been reached in Ladinian time when a thin-bedded cherty limestone sequence was deposited. At the same time, in the northeast a thick Diplopora dolomite complex suggesting a shallow-water carbonate platform environment was formed. In the lower part of the Carnian Stage, as a consequence of the intensive terrigenous influx, large parts of the former carbonate platforms became deeper basin, while in the deep pelagic basins process of infilling commenced. On the top of the elevated ranges shallow carbonate sedimentation continued.

From the Late Carnian to the beginning of the Liassic thousands of metres of dolomite and limestone of backreef Loferite facies (Hauptdolomit and Dachstein Limestone) were deposited on a steadily subsiding carbonate platform.

From the Upper Norian to the Upper Rhaetian restricted basin was formed behind the shallow platform in the southwestern part of the Transdanubian Range, where the marly, bituminous Kössen Formation accumulated.

At the beginning of the Jurassic, the initially coherent carbonate platform was split up into faulted blocks involved in vertical movements of different direction and size. On the relatively more elevated blocks, discontinuous, condensed sedimentary sequences were formed, while the deeper ones were characterized by continuous sedimentation. The Lower and Middle Liassic is represented by brachiopodal-foraminiferal and crinoidal-silicospongial limestones, i.e. sediments containing a rich benthonic fauna. In the Late Liassic the water depth increased. At the turn of the Mid- and Late Liassic a manganese ore deposit was formed. The Late Liassic and Early Dogger witnessed the deposition of thin Ammonitico Rosso and Bositra limestone beds in a deeper-water basin environment, while the Late Dogger was a time of radiolarite deposition. During the Malm the marine sedimentary basin became shallower again, and the microplankton "explosion" at the end of the Jurassic led to the formation of Lombardia-, Tintinnina- and Nannoconus-bearing limestones.

During Early Cretaceous times two sedimentary basins, very dissimilar sedimentologically and in paleontological record, were formed: the Gerecse and the Bakony basins.

In the central Gerecse area of the northeastern Central Range a Jurassic sequence similar to counterparts elsewhere in the mountain range is overlain by detrital sedimentary formations. The Berriasian is represented by calcareous sandstones and limestone breccias, the Valanginian and Lower Hauterivian by grey and red marls with interbedded sandstone layers, and the Upper Hauterivian and Lower Barremian by sandstones with interbedded marls. The lattermost formation shows many features typical of flysch sediments (graded bedding, flute casts, characteristic trace fossils, etc.). In the eastern Gerecse area the final member of the Early Cretaceous sedimentary cycle consists of chert breccias and conglomerates with olistolites of biogenic limestone. In the western Gerecse area sandy facies is characteristic throughout the Lower Cretaceous, and the transition to the Aptian is gradual.

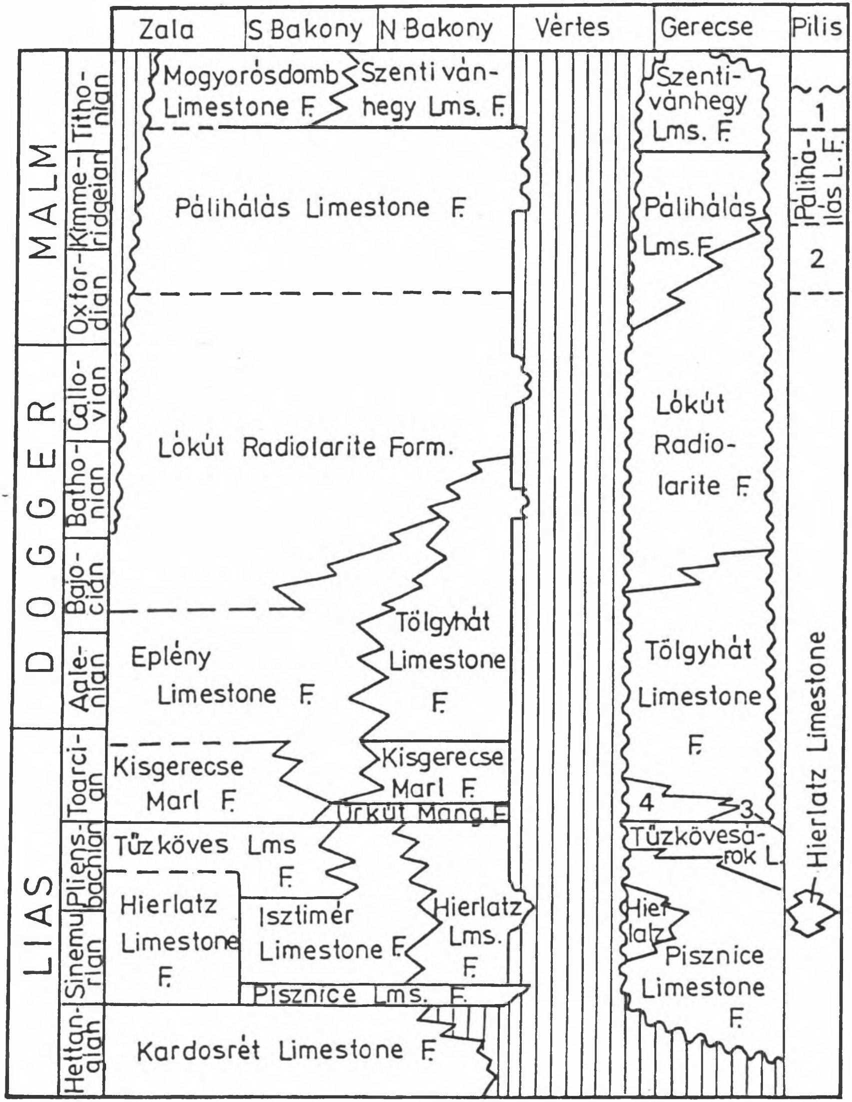

Fig. 3. Jurassic formations of the Transdanubian Central Range Subunit
1. Szentivánhegy Limestone F., 2. Lókút Radiolarite F., 3. Úrkút Manganese F., 4. Kisgerecse Marl F.

In the Bakony area of the southwestern Central Range, the Jurassic sequence is overlain, without any break in sedimentation, by a Cretaceous sequence consisting of a lower, carbonate to pelitic facies which grades into an upper, silty one.

The Berriasian is represented by white cherty limestones of Maiolica facies which become slightly more argillaceous and less siliceous upwards in the sections. The Barremian to Early Aptian interval is represented by grey, Radiolaria-bearing siltstones and marls.

The northeastern margin of the basin is delimited by echinid-crinoid--brachiopod-bearing Neocomian limestones interrupted by hiatuses.

Connection between the separated northeastern and southwestern Neocomian basins was established during the Aptian. A neritic, locally cross--bedded crinoidal limestone, which may be considered as the final member of the Early Cretaceous sedimentary cycle, developed.

The second, Mid-Cretaceous sedimentary cycle was brought about by a transgression that started from northeast. Thus the Albian shows a gradual transition from the Aptian in the northeastern part of the mountain range. Here a pelagic silty formation was developed interfingering towards southwest with limestones of reefal and littoral facies. Further westward and upward reef limestones are replaced by variegated clay of brackish--water facies. Freshwater sediments occur very frequently as intercalations. The fossil assemblage is characterised by endemic forms.

The overlying shallow-water Zirc Limestone Formation consists mainly of pachyodont-bearing, reefal limestone. In the westernmost occurrence of the formation the carbonate deposition was interrupted several times by intercalations of clayey bauxite or by episodic emergences with concomitant erosional processes.

The Zirc Formation is followed by the open but relatively shallow marine Pénzeskút Marl Formation in much of the considered area. A hiatus exists between the two formations which increases somewhat in duration northeastwards. On the basis of the very rich fossil content (ammonites, foraminifers, nannoplankton, sporomorphs) the formation can be divided reliably into chronozones indicating the age of the formation to span the Late Albian-Cenomanian interval.

The Mid-Cretaceous transgression cycle terminated in the Cenomanian, and regional emergence and considerable denudation took place generally

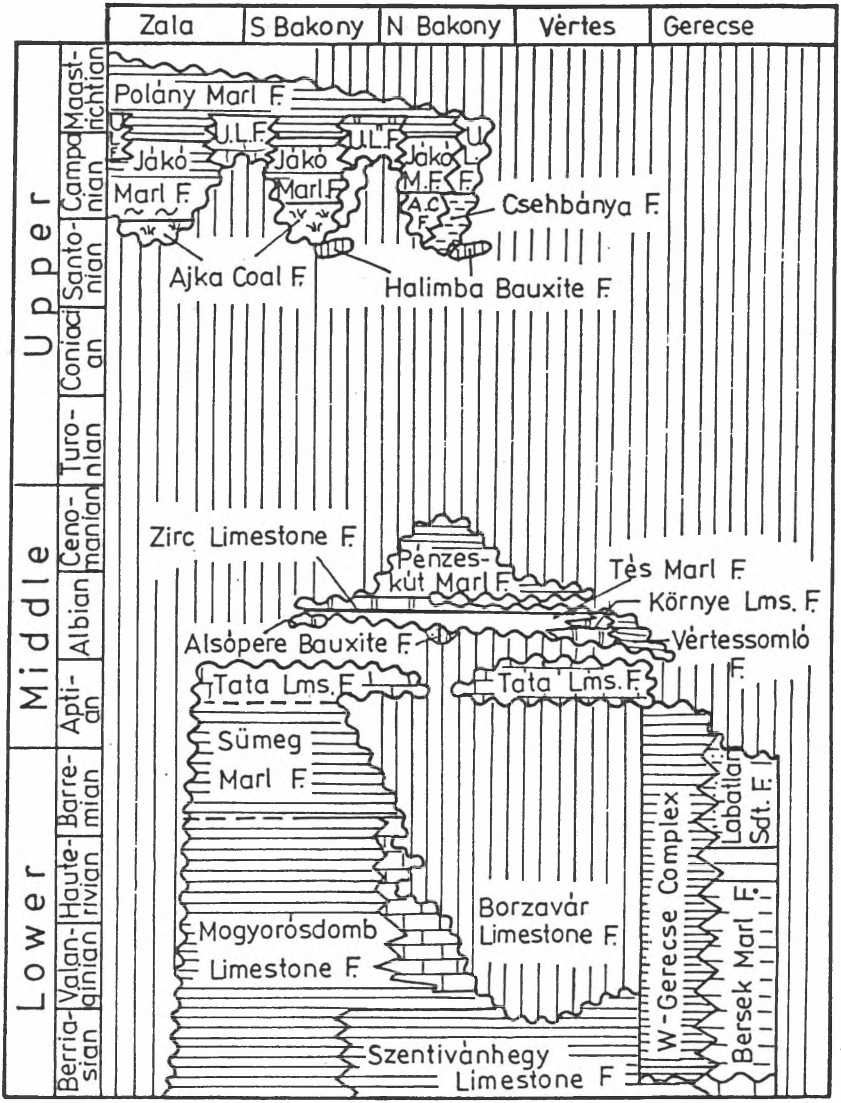

Fig. 4. Cretaceous formations of the Transdanubian Central Range Subunit
U.L.F. = Ugod Limestone Formation

from the Turonian to the Santonian. In Late Senonian times a new phase of subsidence set in on the western side of the Transdanubian Central Range Subunit.

During the weathering of the crystalline rocks exposed on the margins of the sedimentary basin, bauxites were formed and accumulated within karstic depressions of pre-Senonian dolomites and limestones. Subsequently, in Late Santonian to Early Campanian times, a succession formed, which consists of detrital, terrestrial, fluvial and limnic sediments. Locally coal measures were formed, consisting of limnic coal seams in the lower, and of paralic ones in the upper part.

During the Campanian the relatively elevated platforms witnessed the formation of rudist reef limestones (Ugod Limestone). In deeper channels, however, the deposition of pelitic sediments of neritic facies continued (Jákó Marl).

In Early Maastrichtian time the rudist reefs were buried by pelagic pelitic-carbonate sediments deposited in several phases (Polány Formation). The Polány Formation contains a fossil assemblage suitable for chronostratigraphic correlation. The basal part, which is interfingered with the Ugod Limestone and locally contains its reworked detritus can be assigned to the topmost Campanian and Lower Maastrichtian.

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CENOZOIC FORMATIONS

T. KECSKEMÉTI

Following the Cretaceous Period, in the Palaeocene the region of the Transdanubian Central Range with its N and S forelands was a terrestrial area.

The advance of the sea in the Eocene influenced structurally and morphologically sharply articulated areas. Accordingly, the shoreline of the Eocene sea must have been articulated by gulfs and peninsulas. Deltas with mangroves, lagoons of different salinity, and reef chains also are constituents of this region that can be paleogeographically hardly reconstructed in every details.

The Transdanubian marine Eocene sequence is not complete: at the bottom it is incomplete, at the top it is truncated. The missing of the Lower Eocene must have been primary, while that of the upper part of the Upper Eocene is secondary and must have been the result of denudation. Distribution of the Eocene formations is shown on Fig. 1, while the table of Eocene formations is shown on Fig. 2.

The Transdanubian Eocene sequence is the result of at least three transgressions. These transgressions arrived from W-SW and the date of their first wave, based on the dating of all the important fossils can be put into the Lower Lutetian. The date of the first transgression, based on the larger foraminifera investigations by GIDAI and JÁMBOR-KNESS (1965-1988) was put to the beginning of the Cuisian. This view, differring from that generally accepted by the Hungarian experts reflects differences in the opinions on concepts, taxonomy and faunal evaluation.

Following the elevation and karstification at the end of the Cretaceous the first cycle started by bauxite, bauxitic clay, and/or variegated clay accumulation. This was followed by the sedimentation of freshwater-paludal-brackish-water, more ore less coal-bearing or at least richly organic material bearing materials (Darvastó Formation). This, however, was soon followed by shallow marine sedimentation. The result is a significantly thick calcareous, biogenic, larger foraminifer-rich

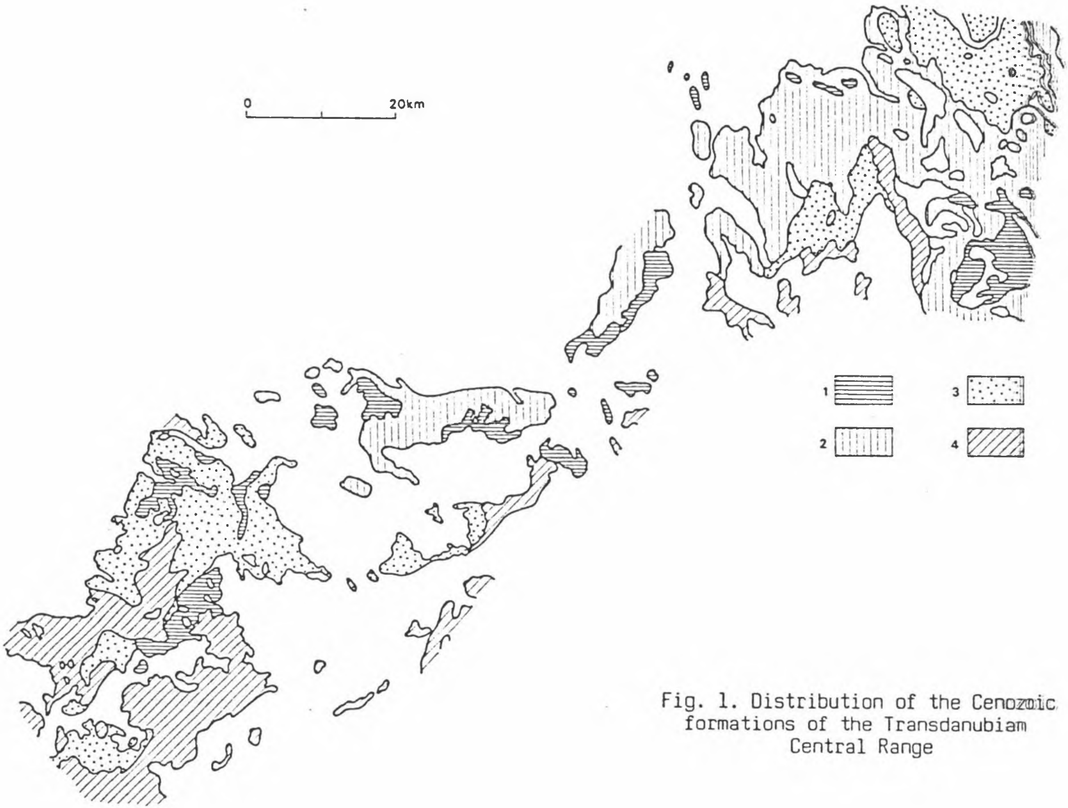

Fig. 1. Distribution of the Cenozoic formations of the Transdanubiam Central Range

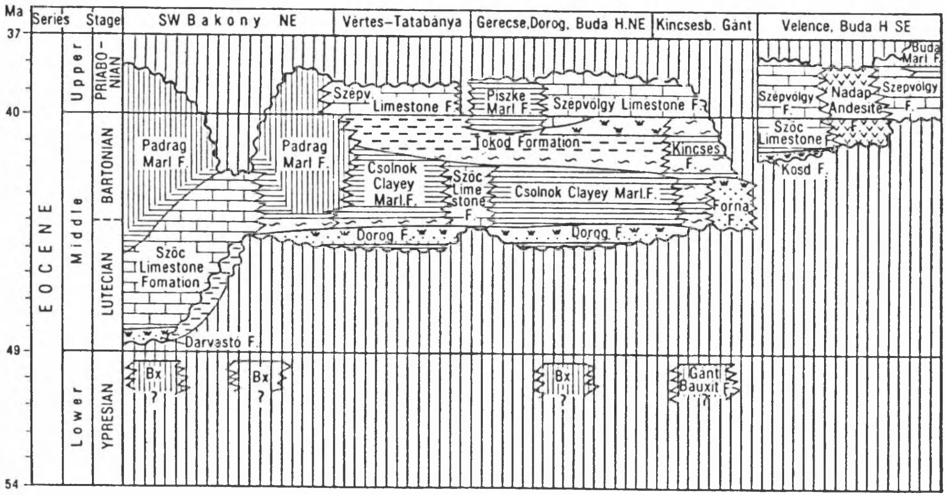

Fig. 2. The Eocene formations of the Transdanubian Central Range

formation (Szőc Limestone Formation) that is characteristic to the Lower Lutetian represented in the region ranging from the SW Bakony Mts. and further NE areas till the Bakonybél-Városlőd line. In this region several localities (Nyirád, Halimba, Ajka, Úrkút, Magyarpolány, Kislőd, etc.) are known which are at least as rich in larger foraminifers (first of all in Nummulites) as the most famous localities of the Tethys region.

In the SW part of the Transdanubian Central Range, in the Lutetian, the shallow-marine sedimentation continued. In the central part of the Bakony Mts. (Bakonybél, Pénzesgyőr, Zirc), due to the transgression, archipelagic environment developed in which, by the end of the Lutetian, oscillatory sedimentation can be also observed. At the NE part of the Bakony Mts. there was a minor elevation causing the slight, so-called intra-Lutetian denudation. The sea had not yet intruded the NE part of the Transdanubian Central Mts.

At the Lutetian-Bartonian boundary a significant change took place. The basement started to subside suddenly and significantly, while the rate of sedimentation remained practically the same.

The resulted transgression (the same as the Upper Lutetian transgression influencing the whole Tethyan region) was large-scale and influenced the whole Transdanubian Central Range. Its beginning is characterized by freshwater and brackish-water sedimentation. By the formation of shallow basins at Dudar, Balinka, and then towards the NE at Oroszlány, Tatabánya and Dorog swamps had been formed and paralic coal measures of significant thickness were deposited (Dorog Formation). For the exploitation of these brown coal deposits the mines providing the greatest yields from the Eocene coals (Dudar, Oroszlány, Tatabánya, Dorog) were opened.

Due to further subsidences, first shallow marine sediments were deposited. These are rich in larger foraminifers, the presence of N. perforatus is characteristic and predominating. During the accelerating subsidence deeper marine (bathyal) sediments were also formed. The sedimentation characterized by the production of pelitic rocks such as clay, clayey marl and marl, started in this period, resulting in the Bakony Mts. in the Padrag Marl Formation, and in the NE in the Csolnok Clayey Marl Formation. Their thickness is 400--600 m and 100--200 m, respectively. In these formations the plankton/benthos ratio is increasing upwards, and in the topmost layers it reaches 80--90/20--10 ratio in percentage.

The trend of subsidence characteristic of the Bartonian was not completed at the NE margin of the Transdanubian Central Range. Here the subsidence was slower, while the sedimentation was relatively quicker. This is shown by the renewed coalification in the Dorog-Csolnok area, (the so-called "striatus seam"), and the sandy sedimentation at Tokod (Tokod Sandstone Formation).

Due to the pre-Pyrenean tectonic movements at the boundary of the Bartonian/Priabonian an elevation occured. The related denudation was most remarkable in the higher Bakony Mts. and at the basin margins. The predominating facies of the Priabonian transgression that in size exceeded all the former ones towards NE is a biogene, larger foraminifer-rich limestone (Szépvölgy Limestone Formation) with or without abrasion conglomerates. Upon this limestone, due to the subsidence starting in the second part of the Priabonian, Bryozoa-bearing calcareous marl (Piszke Marl Formation), or directly marl with planktonic foraminifers (Buda Marl Formation) was deposited in the N part of the Gerecse Mts. and in the Buda Mts. The most remarkable exposures of these two formations can be seen in the Buda Mts. The Nummulites and Discocyclina faunas of the limestone and the Bryozoa-bearing marl perfectly agree with those of the Priabonian stratotype. The Buda Marl is a bathyal sediment that is proved by the large amount of plankton and bathyal mollusc fauna. The Eocene--Oligocene boundary can be drawn within the topmost part of the Buda Marl.

Though, traces of spreading of volcanic tuff can be observed at several localities (mainly in the SW Bakony Mts.) already in the Middle Eocene, volcanic activity was most characteristic of the Upper Eocene. This activity, in quite a great area (Tab, Balatonvilágos, Lovasberény, Tabajd, Csákvár), resulted in the production of significantly thick andesitic volcanodetritic sequence. Based on the rate of accumulation the centre of the eruption must have been in the Velence Mts. Presence of the pyroclastic, mainly in the Eocene sea of the SW Transdanubian Central Range might have contributed to the glauconitization.

At the beginning of the Oligocene the Transdanubian Central Range was elevated and a significant denudation (the infra-Oligocene denudation) took place. The denudation process influenced first of all the Upper

Eocene formations but at certain places it intruded even into the Middle Eocene. That is why, in most parts of the region there is a hiatus at the beginning of the Oligocene, and continuous transition from the Upper Eocene (Buda Marl Formation) into the Lower Oligocene (Tard Clay Formation) occurs only in the Buda Mts. The Tard Clay is a laminated clay of euxine facies that is considerably thick. The surface extension of the Oligocene formations is shown in Fig. 1, while its lithostratigraphic units in Fig. 3.

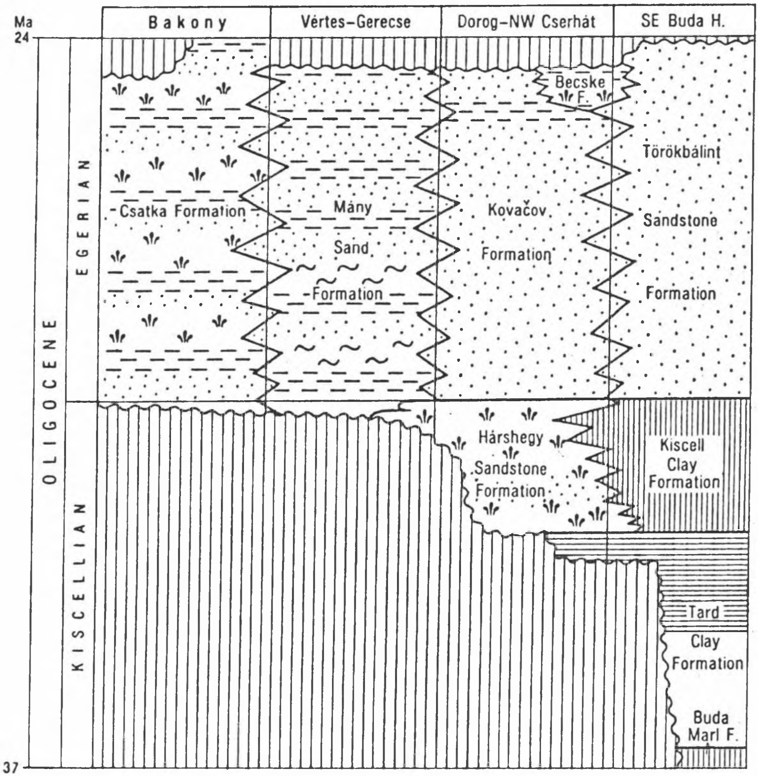

Fig. 3. The Oligocene formations of the Transdanubian Central Range

Sedimentation became more significant in the second part of the Kiscellian. A sudden subsidence and accompanied increasing sedimentation had started, that resulted in the 600--800 m thick Kiscell Clay Formation, visible at several classical exposures in the Buda Mts. Due to the richness, features and detailed analyses of its foraminifer fauna it can be considered as reference standard ("Clavulina Szabói Schichten" of HANTKEN). The considerable amount (40--80 %) of the represented planktonic foraminifers indicates bathyal sedimentary environment of normal salinity. The littoral-sublittoral heteropic facies of the Kiscell Clay is the widely distributed and considerably thick Hárshegy Sandstone Formation in the Buda Mts. and the Dorog basin.

At the beginning of the Egerian the basement of the basin was suddenly elevated and that is why shallow marine clastic sediments were deposited. Such sediments are the littoral-neritic Törökbálint Sand Formation in the cover of the Kiscell Clay in the SE part of the Buda Mts., the thick fluvial-marine Mány Sand Formation in the Gerecse and Vértes Mountains deposited partly upon the Hárshegy Limestone, and the fluvial Csatka Gravel Formation in the Bakony Mts. This latter unconformably overlies the Lutetian--Bartonian reliefs.

In the Transdanubian Central Range the Miocene formations can be divided into three parts: Lower, Middle and Upper Miocene. (Their extension is shown in Fig. 1, while the formations in Fig. 4).At the beginning of the Early Miocene the compressive stage of the Savian orogenic phase elevated the Alpine background in the W-SW, in the internal foreground of which thick, continental fluvial coarse clastics (Csatka Gravel Formation) and variegated clays were formed. In the expansional stage of this phase, in the Várpalota and Bántapuszta region local marine formation (the Bántapuszta Formation) can be observed. During the Early Miocene the NW-SE palaeogeographical connections were the determining factors.

In the middle of the Miocene, upon the impact of the Styrian orogenic phase, direct connection was opened towards the Mediterranean. In the basins of the Transdanubian Central Range, the sea transgressing from SW to NE, deposited a more then 600 m thick cycle starting sediment sequence consisting of coarse clastics and schlier (Garáb Formation). In the near-shore regions shallow-water calcareous-pebbly, Balanus- and Bryozoa--bearing sandstone was formed, while at the margins Congeria-bearing limestone was developed. At the end of the Karpathian the intensive volcanic activity was started that resulted in forming the Szentendre--Visegrád andesite mountains in the NE part of the Transdanubian Central Range. At the beginning of the Badenian the sea advanced significantly. At the near-shore, shallow-water areas coarse conglomerates, Chlamys- and Lithothamnium-bearing (Leitha facies), Heterostegina-bearing limestone and sandstone were formed. Among open water conditions fine-grain sediments were deposited (Baden Clay Formation). Oscillative motions of the basement strongly influenced the sedimentation. Upon their impact, among extremely marginal conditions brackish-water to paludal brown-coal deposits developed, as the Várpalota deposits (Várpalota Brown-coal Formation).

The Upper Miocene consists of the Upper Badenian and Sarmatian formations belonging to the same cycle.

In this region the products of the regressive phase of the cycle, the Sarmatian sediments are the more important. The regression is manifested by the shallowing, the advance of the littoral facies and the decrease in salinity. These features are reflected by the limestones that are frequent mainly in the S and W foreland of the Buda Mts. (Tinnye Formation) and in the vicinity of Tapolca.

The Pannonian formations (Fig. 5), in the region, are most important in the intramontaneous basins stretching between the units of the Transdanubian Central Range (at Tapolca, Nagyvázsony and Zsámbék), and can be found also at the margins of the mountains. These are shoreline and nearshore clastic sediments. The sedimentary material and fossils show well the division of the Pannonian internal sea, its gradual filling up and decrease in salinity.

The Lower Pannonian sequences are rather varied by facies but are generally characterized by a grey clayey marl. In the basins it is represented by grey siltstone (Imárthegy Formation) while at the margins the Csákvár Clayey Marl and Szák Clayey Marl Formations are characteristic. An interesting formation of the Nagyvázsony, Peremarton, Várpalota and Csákvár basins is a laminated diatom-rich calcareous marl (Monostorapáti Formation).

Upon the Lower Pannonian formations the Upper Pannonian ones are deposited generally unconformably, except for the W margin of the Transdanubian Central Range where the transition is gradual. Of the sequence the Kálla Gravel Formation is characteristic that can be best observed in the N of the Balaton area. Upon this a thick sequence consisting of clay, clayey marl, sandy clay (with Congeria ungula caprae), and sand and clay (with Congeria balatonica) are deposited. At certain localities paludal and lacustrine sediments (Pula Alginite Formation) and freshwater limestone are intercalated.

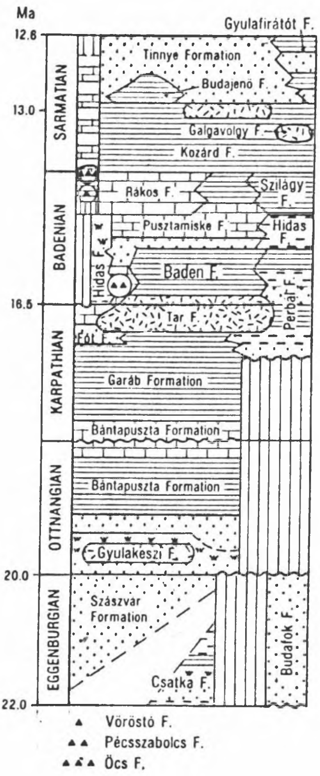

Fig. 4. The Miocene formations of the Transdanubian Central Range

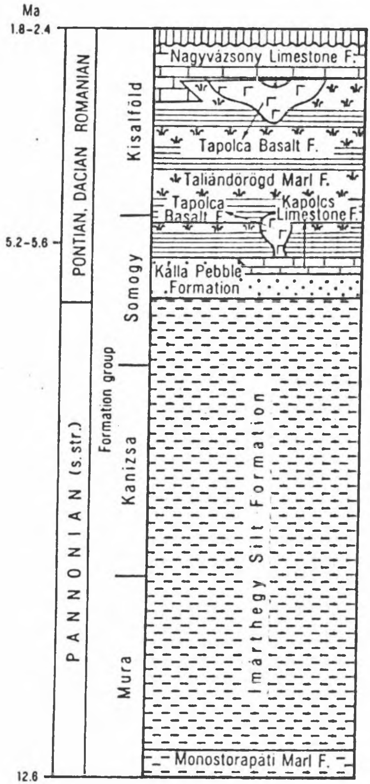

Fig. 5. The Pannonian formations of the intramontan basins of the Transdanubian Central Range

In the course of the deposition of the Upper Pannonian sequences significant basalt-volcanic activity took place in the SW part of the Bakony Mts. that resulted in the formation of basalt and basalt tuff bodies with nearly 70 eruption centres. Most of them, due to the deflational-erosional process during the Pleistocene became volcanic "buttes", with a basalt cap on the top.

From the end of the Pannonian the area became completely terrestrial and in the Quaternary a large-scale erosion started with fluvial, lacustrine and aeolian loess accumulation. From this period important paleolithic and neolithic shelters and chert mines of prehistoric man were found by the achaeologists. In this region the most important localities are those at Vértesszőlős, Tata and Sümeg.

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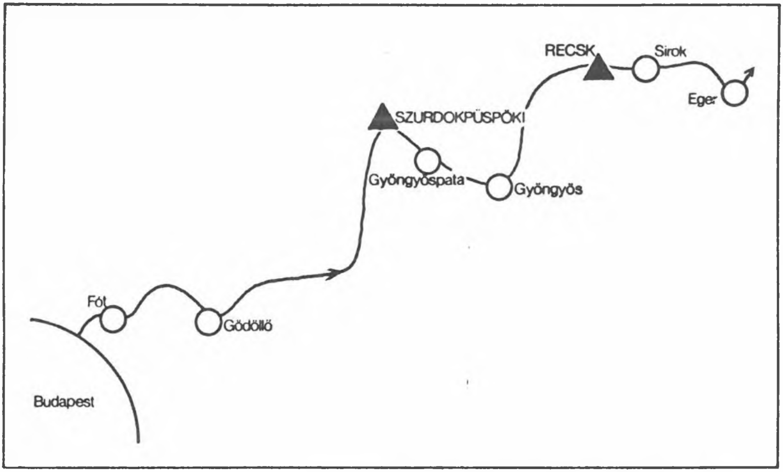
EXCURSIONS

5 September: A: BUDAPEST--SZURDOKPÜSPÖKI--RECSK--EGER



FÓT

The castle and the church were built by István KÁROLYI between 1847 and 1856. The church was designed in a mixture of romanesque and byzantine style by Miklós YBL.

GÖDÖLLŐ

The Gödöllő Castle is one of the most prominent relics of rural baroque architecture in Hungary. It was built by the order of Antal GRASSALKOVICH according to the plans of A. MAYERHOFFER, between 1744 and 1750. Later the castle was used as a royal resort place. The baroque Calvaria we can see in the garden is also the work of MAYERHOFFER (1771).

Gödöllő gives home to the University of Agricultural Sciences as well as an experimental campus of the Scientific Institute of Forestry.

A-1

SZURDOKPÜSPÖKI, diatomite quarry

M. HAJÓS

Topography

The diatomite quarry is located to the north of the town Hatvan, 4 kms to the southeast of Szurdokpüspöki, on the western border of the andesite body of the Mátra Mts. (Fig. 1).

Age

Lower and Middle Miocene, Badenian.

History

The Szurdokpüspöki diatomite quarry is the most complete series of diatomaceous Badenian sequences in Hungary, amply documented with floristical and faunistical remains. Since the elaboration of PANTOCSEK, published in 1889, it is well known all over the world. PANTOCSEK described 77 diatom taxa from two samples of Szurdokpüspöki, probably coming from the lowermost clayey--laminated beds of the recent quarry (Fig. 2, Bed 5).

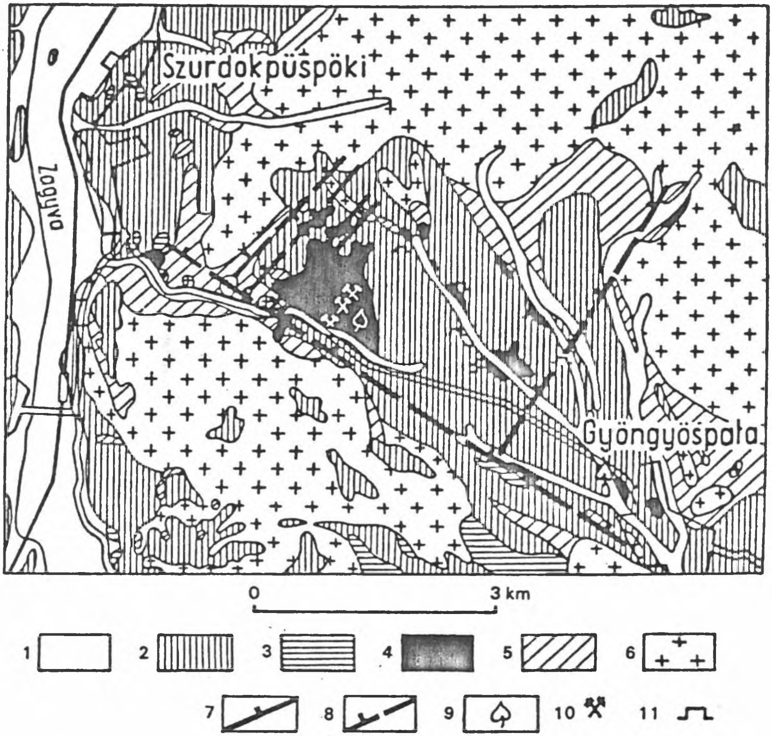


Fig. 1. Sketch-map of the Szurdokpüspöki diatomite region
1. Holocene, 2. Pleistocene loess and adobe, 3. Upper Pannonian s.l. sand, clay and marl, 4. Badenian diatomite sequence and rhyolitic tuff, 5. andesite tuffaceous agglomerate, 6. pyroxene andesite, 7. fault, 8. probable faults, 9. locality of fossils, 10 quarry, 11. outcrop

Stratigraphy

The succession of formation is based on the sequence established for the immediate surroundings of the quarry: The underlying bed is a pyroxene-andesite tuffaceous agglomerate, the uneven surface of which is overlain by Badenian sediments mainly composed of skeletal remains of siliceous algae flourished around the contemporary postvolcanic siliceous springs.

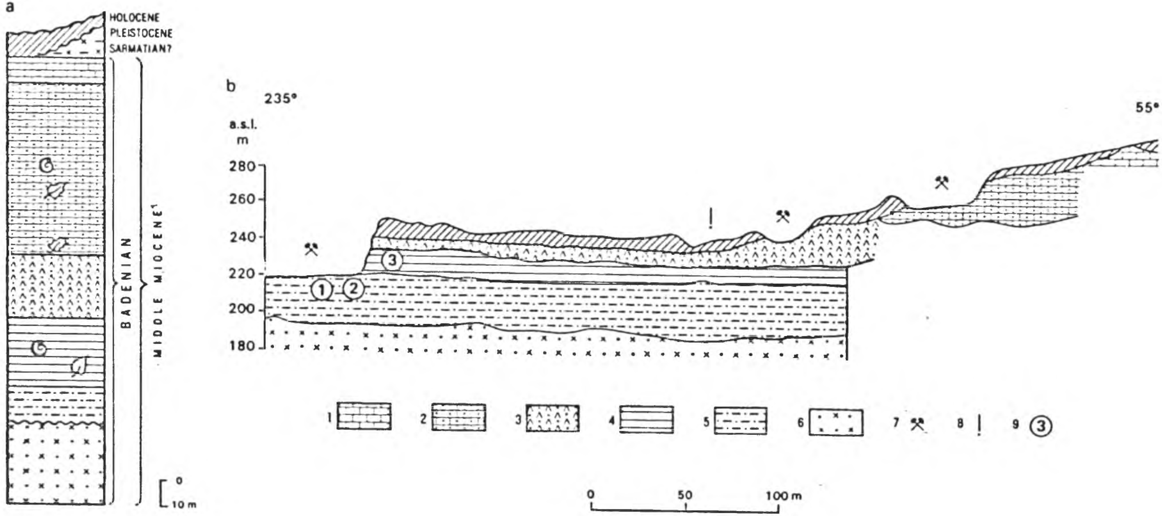


Fig. 2. The Szurdokpüspöki diatomaceous formations (a: stratigraphical column, b: geological section)
1. Platy limestone "Leitha Limestone", 2. upper, marine diatomite beds, 3. rhyolitic tuff, 4. white diatomite, 5. grey, argillaceous diatomite (Beds 4-5 are the freshwater--brackish water lower diatomite layers), 6. andesite tuff and agglomerate, 7. open cast quarry, 8. location of boreholes, 9. samples

Immediately overlying the uneven volcanic surface, we can find the freshwater--limnobrackish water "Lower diatomaceous unit" (Fig. 2, Beds 4 and 5) in about 45 m of total thickness, the rhyolite tuff (25 m, Bed 3) and the marine "Upper diatomaceous earth" (15--60 m, Bed 2).

The uppermost beds of the "Lower diatomaceous earth" yielded the remains of a new fossil turtle and *Rhinocerotidarum* gen. et sp. indet. (KRETZOI and PÁLFALVY 1969) (Table 1).

The overlying bed is Leitha-type Badenian limestone, laminated, porose (Fig. 2, Bed 1), followed by Sarmatian and Pliocene--Pleistocene--Holocene layers (Fig. 2, Table 1).

The Szurdokpüspöki quarry exposes the layers of the freshwater-limno-brackish- and marine diatomaceous earth beds.

Flora and fauna

a) Lower freshwater-limnobrackish-water diatomaceous earth unit (Fig. 3). The organic content of the clayey, calcareous, finely-laminated rock of the lower greyish-greenish grey layers (Fig. 2, Bed 5) is gradually decreasing upwards. The clayey and calcareous diatomaceous formations are characterized, apart from the presence of the limnobrackish *Melosira*, *Stephanodiscus* species, by the assemblages of the epiphytic and eutropheous species like *Amphora*, *Cocconeis*, *Podosira* and *Surirella*. The freshwater--oligohaline *Navicula hungarica* GRUN. and *N. cincta* (EHR.) KÜTZ. appears in great abundance, indicating an almost completely freshwater environment. The presence of *Pinnularia microstauron* (E.) CL. var. *brébissonii* (KÜTZ.) HUST. and *P. viridis* (NITZSCH) EHR. denotes a shallow lake, poor in carbonate, and the presence of many springs. *Synedra pulchella* (RALFS) KÜTZ. and *S. tabulata* (AG.) KÜTZ. are euryhaline forms, characteristic of restricted near-shore waters. *Neidium dilatatum* var. *jacutica* J. KISS, *Navicula halionata* PANT., *N. cincta* (EHR.) KÜTZ., *Surirella costata* NEUP., *Amphora* sp. and *Nitzschia* sp. as well as their variants suggest a nearly fresh-water lagoon environment. On the basis of these, the shallow water of their environment was eutropic, poorly ventillated, its salt content could be around 0,3‰ that is, oligohaline according to the notions of BROCKMANN 1940 (Fig. 4, Samples 1--2).

In the lower, clayey layers, accumulation of the brackish *Surirella striatula* TURP. and the *S. ovata* var. *crumena* (BREB.)V. HEURCK indicate gradual mudding as well as the fact that detritophil forms like Amphora, Fragilaria, Nitzschia and Surirella become dominant.

The sporomorphs of the lower diatomite layers denote a mixed, subtropical deciduous forest with many coastal elements: Taxodium, Podocarpus, Tricolpopollenites sibiricum (LUBOMIROVA), Liquidambarpollenites sp., Caryapollenites simplex (R. POT.) R. POT., Myricipites myrocoides (KREMP) NAGY, Betulaepollenites betuloides (PF.) NAGY, Laevigatosporites haardti (R. POT. et VEN.) TH. et PF., Polypodiisporites alienus (R. POT.) NAGY, Leiotriletes maximus W. KR., Polypodiaceoisporites hamulatus NAGY, Chenopodipollis multiplex (WEYL. et PF.) W. KR., Graminidites media (COOKSON) R. POT., etc. Tropical elements are rare: Sapotaceae, Engelhardtioidites, etc.(determined by ESZTER NAGY).

The floral assemblage is dominated by laurel trees and bushes. Tropical elements are rare in the macroflora as well (HAJÓS--PÁLFALVY 1961), completed by several evergreens and deciduous arboreal plants. These remains were transported by wind and currents into the sediments of near-shore calm water.

The lower grey, clayey beds of the diatomaceous earth sequence are typically microlaminated. There are carbonized plant remains, prints of insects (Hymenopterae). Ostracoda (Candona sp., Cypris sp., Cytheridea perforata ROEM.; ZALÁNYI in HAJÓS 1968, p. 11) suggest an oligohaline environment. The shells of the mollusc species Hydrobia stagnalis BAST. occur, partly, hinted about in the layers, partly accumulated along the bedding planes to form a joint surface.

Overlying the grey, carbonaceous clayey layers we find yellowish white, then snow-white, light, loose, carbonate-free layers of diatomaceous earth in about 10--15 m thickness (Fig. 2, Bed 4). There are no pollens or spores in these layers. The diatomes are small planktonic forms. Dominating species are the Stephanodiscus minutulus PANT., Melosira minima HAJÓS, M. menilitica PANT., M. bituminosa PANT. and Nitzschia frustulum PANT. and their variations. Epiphytic forms are rare. The water turned gradually clear and, the carbonate and plant content diminished. The eutrophic forms like Surirella and Campilodiscus disappeared, the representatives of the epiphytic genera Achnantes, Amphora, Cocconeis became subordinate (Fig. 3, Sample 3). From the upper, white diatomaceous earth layers of the sequence, remains of plants and fishes were recovered (Leiciscus sp., Clupea longimana HECK.; BEM in HAJÓS 1968 p. 11). Both genera are characteristic of freshwater or limnobrackish-water environment.

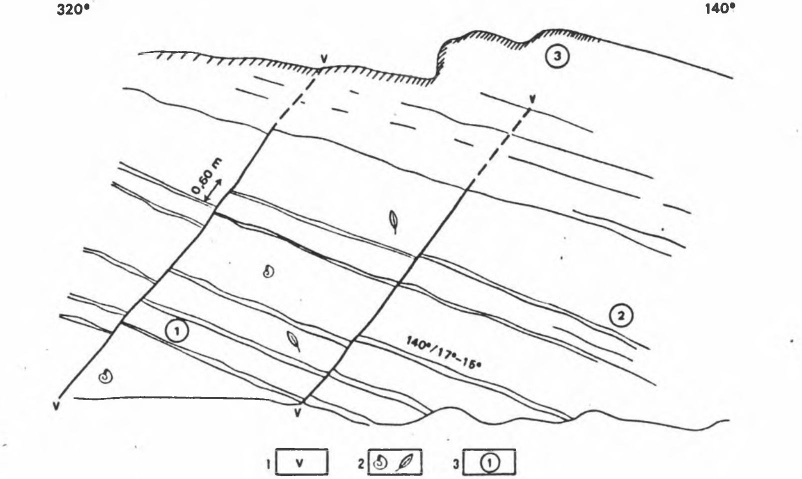


Fig. 3. Diatomite quarry at Szurdokpüspöki, 1987. Lower freshwater sequence (Bed 4 on Fig. 2)
1. Fault, 2. megaflora and fauna, 3. samples

After the accumulation of the rhyolitic tuff this area submerged and became connected to the Badenian open sea. The upper (marine) diatomaceous earth unit (45--60 m thick) was formed as a result of further postvolcanic activity (Fig. 2, Bed 2).

b) The upper diatomaceous earth unit is a marly formation containing remains of pelagic, planktonic unicellulars with siliceous skeletal elements. This unit is not satisfactorily exposed, therefore there is no chance for a detailed sampling. The most characteristic forms: Coscinodiscus antiquus GRUN., Liradiscus ovalis GREV., Actinoptychus splendens (SHADB.), Chaetoceras and Xanothiopyxis sp., Triceratium balearicum CL. et GRUN. cf. biquadrata (JAN.) HUST., Hemiaulus sp., Grammatophora sp., Plagiogramma sp., Mastogloia splendida (GREG.) CL., Navicula lyra EHR., Trachyneis aspera CLEVE. All are pelagic forms, most of them are living in warm seas, in the Mediterranean. The relatively high number

Table 1

Summarized sequence of the diatomaceous formations in the surroundings of Szurdokpüspöki and Gyöngyöspata

Series-Stage		Formation	Thickness (m)	Fossils
HOLOCENE-PLEISTOCENE		Brown earth, lymph, talus	0--19	
PLIOCENE		Tuffaceous clay, andesite pebbles	29--36	
MIOCENE	SARMATIAN	Andesitic tuff, weathered clastic pyroxene andesite	0--31	
	BADENIAN	Leitha limestone *	0--24	Lithothamnium, Foraminifera, sponge spines, Mollusca, Ostracoda, Echinodermata
		Upper limnobrackish--freshwater diatomaceous beds	0--73	Diatoma, skeletal elements
		Upper marine diatomaceous beds	50--91	Diatoma, siliceous plant debris, skeletal elements of siliceous sponges, Foraminifera, Echinoderm spines, Pereireia gervaisi VÉZ., Abra alba (WOOD) var. pellucida (BROOCHI), Corbula sp., Natica sp., Meretrix sp., Cardium sp., Ostrea neglecta MICHT., Turritella (Haustator) badenensis SACCO, Turritella turris BAST., Venus sp., Pecten sp., Lucina incrassata DUB., shark teeth, fish scales
		Rhyolite tuffs, tuffite	13--23	Extremely scarce Diatoma, spines of siliceous sponges, gemmula, spherical concretions
		Lower white and grey argillaceous, calcareous, freshwater and limnobrackish diatomaceous beds	5--53	Siliceous protists, Diatoma, fossils of plants, Hydrobia stagnalis BAST., Ostracoda, Hymenoptera, fossils of fish, leaf casts, Testudo strandi SZALAI, Palaeomeryx sp., Eotragus sp., Rhinocerotidarum g. et sp. ind., Brachypotherium brachypus (LARTET), Gomphotherium angustidens (CUVIER), Macrotherium grande (LARTET)

*Only in the section of Szurdokpüspöki.

of Archeomonas cysts, Silicoflagellata species and the Ebriids is also characteristic of these formations.

The foraminifers of the formation are: Bulimina elongata D'ORB., Amphistegina sp., Nonion granosum (D'ORB.), N. boueanum (D'ORB.), Cibicides dutemplei (D'ORB.), Dentalina elegans D'ORB., Cassidulina subglobosa BRADY, Orbulina universa D'ORB., Reusella spinulosa (RSS.), Rotalia papillosa BRADY (determined by KORECZ-LAKY, Fig. 2, Bed 2).

The layers immediately overlying the marine diatomite formations are composed of platy limestone, the remains of which can be observed on the hillside. The loose of this limestone yielded foraminifers: Rotalia beccarii (L.) Globigerina bulloides D'ORB., G. triloba (RSS.) Elphidium sp., E. cf. crispum L., Nonion sp., sponge spicules, gastropod internal casts and ostracods. These fossils represent Leitha type limestone of the Badenian.

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GYÖNGYÖSPATA

The village used to serve as the centre of the archdeaconry since the second half of the 12th century. In the 16--17th centuries, it was the second largest settlement of the county after Gyöngyös. In its Gothic church built on Romanesque foundations there are mural paintings of the 15th century. The special attraction of the main altar is a carved wooden image of "The tree of Jesse".

GYÖNGYÖS

Among its architectural relics built in Gothic style, the St. Bartholomew church, the St. Orban church (built around 1530 A.D.) as well as the former Franciscan church built by the BÁTHORY family around 1400 are of considerable interest. In the crypt of the latter church, the Kuruc general Vak (Blind) BOTTYÁN is buried. The library of the former Franciscan monastery is very rich in Western European scientific books on natural history from the 16th century. Most of them were inventarized in Gyöngyös in the year of their publication. The origins of the ORCZY castle can be traced back as far as the 18th century, though its main period of construction is dated about the beginning of the 19th century, yielding on of the most beautiful rural classicist castles in Hungary. Today, the Mátra Museum is operating within the castle, containing a rich scientific collection on the Mátra mountains and its environs, and serving as a basis for the scientific elaboration as well.

A-2

RECSK, Dallapuszta

L. DOSZTÁLY and S. KOVÁCS

Topography

The exposure is a small abandoned quarry, about 2 kms to the south-east of the village Recsk, some 100 m north of the main road leading towards Sirok, at the SW border of the Darnó Mt. (Fig. 1).

Age

Middle Triassic, Ladinian.

Lithostratigraphy

The Ladinian pillow lava and the red radiolarite building up the bulk of the Darnó Mt. and its immediate surroundings, are typical formations of the bathyal-oceanic sequence of the Darnó--Mellète unit (in the sense of BALLA 1987). Around the locality, however, the copper ore exploratory

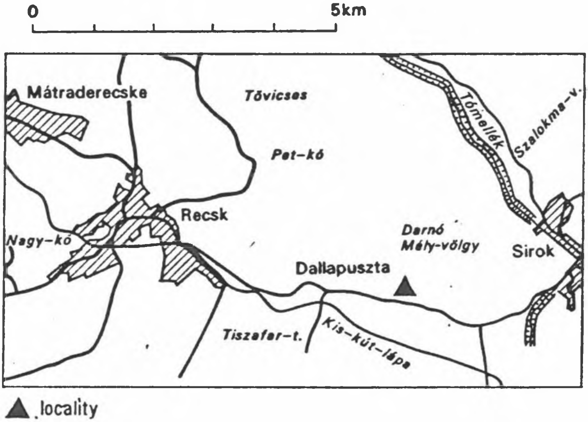

Fig. 1. Topographic map showing the exact location of the outcrop, east of Recsk--Dallapuszta (after DE WEVER 1984)

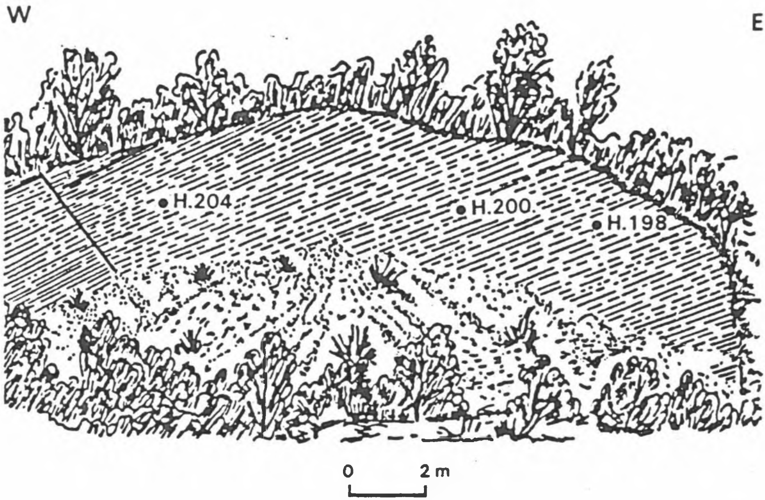

Fig. 2. Sketch of the Dallapuszta section, redrawn after DE WEVER (1984) with sampling points of DE WEVER (H-198, -200 and - 204)

boreholes revealed further, mainly sub-surface nappes, the stratigraphical and structural position of which is avaiting for a detailed study (p. c. of PELIKÁN).

The 15 m long, 3 m high exposure shows dark red, well-bedded radiolarite (Fig. 2). Between the radiolarite layers, generally 5--7 cms thick, we can find platy clay layers, the thickness of which is in the mm order. The texture of the rock in thin section is carbonate-free radiolarian biomicrite, wackestone. The biogene constituents comprise only radiolarians, there are no traces of organisms with carbonate skeletal elements (not even silicified ones). This fact unambiguously denotes a sedimentary environment below the carbonate compensation level. The original sediment must have been a radiolarian ooze, with minimal amount of terrigenous red clay influx.

History

So far, the section has been studied, from the point of view of Radiolaria, by DE WEVER and KOZUR. KOZUR mentioned the presence of the species Sarla kretaensis (KOZUR and KRAHL 1984). DE WEVER examined 13 samples of the section, and found 3 among them positive. In his article (DE WEVER 1984) he published a faunal list of the radiolarian species found in the section. He enumerated 10 genera and 12 species from the site. During my recent studies (DOSZTÁLY), there were 9 species of 12 genera found. Comparing the two faunal lists we find only 4 genera and 2 species in common. The difference in the representatives of the Oertlisponginae subfamily is especially remarkable. DE WEVER described the members of 7 species and 4 genera among them, while my observations yielded only a few badly preserved specimens of Spongoserrula raruana DUMITRICA.

Stratigraphy

In the sequence we can observe significant changes within the Radiolaria fauna. At the deeper parts of the section the representatives of the species "Emiluvia" cochleata NAKASEKO et NISHIMURA were abundant. Above sample 14, there were no representatives of the species found. As opposed to this, the typical representatives of the species Sarla kretaensis KOZUR and KRAHL appeared in sample 10, getting gradually more and more frequent upwards. It should be mentioned that a bulky, short-spined variant of the species S. kretaensis was spotted already in the deepest layers. The transitional forms between the two variants can be found all along the sequence from Sample 4. The typical specimens with long, thin spicules appear from Sample 10 only.

Fossils

Radiolaria (by DOSZTÁLY)

Sampling of the section was performed along its total length, comprising altogether 24 sampling points (Fig. 2). The distance of the sampling points was generally about 0.5 m. Radiolarians were found in all but two samples. Generally speaking, the bulky, massive species dominated the assemblages. The distribution of radiolarians was fairly uneven within the rock. They are accumulated, typically, in thin lenses and stripes. In course of the dissolution we could observe that a part of the radiolarians were already injured within the rock. The damage of arms and spicules was fairly frequent. These facts seem to corroborate that the radiolarians were partly washed together by bottom currents.

Species published by DE WEVER (1984):

Sample H-198:

Baumgartneria curvispina DUMITRICA
Baumgartneria stellata DUMITRICA
Falcispongus falciformis DUMITRICA
Falcispongus hamatus DUMITRICA
Falcispongus rostratus? DUMITRICA
Oertlispongus inaequispinosus DUMITRICA, KOZUR et MOSTLER
Spongoserulla rarauna DUMITRICA
Capnuchosphaera? sp. A. DE WEVER et al.
Triassocampe deweveri (NAKASEKO et NISHIMURA)
Eptingium manfredi DUMITRICA
Plafkerium abboti PESSAGNO
Poulpus piabyx DE WEVER
Sepsagon longispinosum (KOZUR et MOSTLER)

Table 1

The distribution of the Radiolarian species within the samples examined by DOSZTÁLY

Number of layer	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
	Astrocentrus sp.	Canoptum sp.	Capnuchosphaera sp.	Cenosphaera sp.	"Emiluvia"cochleata NAKASEKO et NISHIMURA	Nakasekoellus politus (HINDE)	Poulpus sp.	Pseudostylosphaera coccostyla (RUST)	Pseudostylosphaera helicanta (NAKASEKO et NISHIMURA)	Sarla kretaensis KOZUR et KRAHL var.A	Sarla kretaensis KOZUR et KRAHL var.B	Spongoserrula? rarauna DUMITRICA	Spongostylus tortilis KOZUR et MOSTLER	Triassocampe sp.	Triassocampe deweveri (NAKASEKO et NISHIMURA)	Triassocampe sulovense KOZUR et MOCK
29																
28		X		X												
27			X	X					X	X	X			X		
26	X			X					X					X		
25				X					X	X	X			X		
24				X					X		X			X		
23		X		X							X			X		
22				X		X			X	X	X			X		
21		X		X					X	X	X			X		
20			X	X						X	X			X		
19																

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
18			X	X		X				X	X	X	X	X		
17		X		X					X	X				X		
16				X					X	X	X			X		
15		X		X		X			X	X	X			X	X	
14			X	X	X	X			X	X	X	X		X		
13																
12	X	X	X	X	X	X			X	X	X		X	X		
11																
10			X	X	X				X	X				X	X	X
9																
8			X		X		X		X		X			X		
7																
6		X		X	X		X	X	X		X			X	X	
5																
4		X	X		X			X	X		X	X		X	X	
3																
2					X				X		X		X	X	X	
1				X	X			X	X		X	X		X		

Samples-H 200 and H-204

Eptingium manfredi DUMITRICA

Sarla sp.

Triassocampe deweveri (NAKASEKO et NISHIMURA)

Comprehensive faunal list of recent examinations see on Table 1.

The age of the formation, based on the radiolarian fauna, is Ladinian. On the basis of the species "Emiluvia"cochleata NAKASEKO et NISHIMURA, the Middle Longobardian age can be supposed. On the basis of the species Sarla kretaensis KOZUR et KRAHL, an Upper Longobardian age can be supposed for the upper parts of the section.

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SIROK

The fortress, which used to belong to the ABA noble family is mentioned first in 1320. In the second half of the 16th century it was rebuilt and modernized by Italian military architects working in Eger. It was occupied by the Turks between 1596-1687.

EGER

The Eger episcopal centre was founded by St. STEPHEN, the first Hungarian king. The fortress of the town was under practically continuous construction and reconstruction since 11th century. Within the walls of the fortress there were the episcopal cathedral, built in Gothic style, corresponding in its dimensions to the great European cathedrals of the age and the episcopal palace. The row of Gothic arcades belonging to the latter can be seen today in complete beauty, reconstructed after the excavations. Most of the fortification walls we can see today were built after the great siege of 1552.

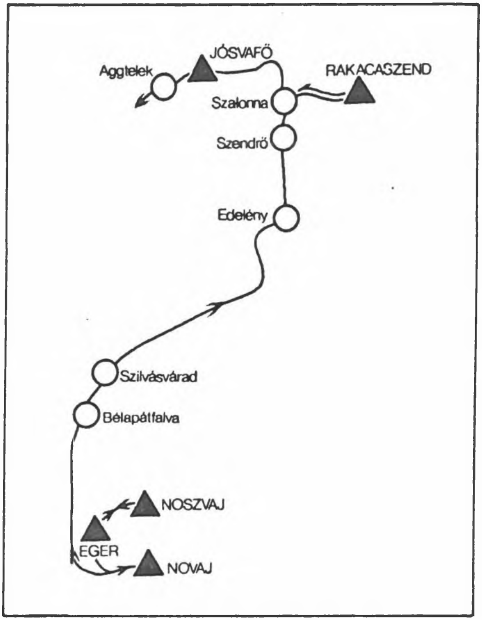
The Basilica of Eger, built in Classicistic style is the second largest church of Hungary today. The building was designed by József HILD, the construction of the church lasted from 1831 to 1837. The archiepiscopus László PYRKER, who had the Basilica built, entrusted the Italian master CASAGRANDE with the preparation of the sculptural ornamentation (1833--1840).

Opposits to the Basilica we find the building of the former Lyceum - today, the Teacher Training Highscool. Archbishop Károly ESTERHÁZY had it built for the purpose of a university, and this aim left its consequence on the construction as well. The examination room is decorated by the frescoes of SIGRIST, the library has mural paintings on the ceiling by KRACKER, the astrological observatorium was made by Miksa HELL and we find frescoes of MAULBERTSCH in the chapel. The building is a fortunate mixture of several architectural styles; containing Baroque, Rococo and even Zopf ("braided") elements.

In the lane leading towards the fortress (Kossuth street) we find the row of Baroque houses belonging to the canons of the chapter. Outstanding among them, we can see the harmonic building of the palace of the "Minor Praepost" (1758).

The former Minorite Church is one of the outstanding pieces of Hungarian Baroque ecclesiastic architecture. It was built between 1758-1773, but we have no authentic source on the builder and the architect. Among the other Baroque churches of the town we find the former Franciscan, Cistercian and Servite churches as well as the Greek Catholic orthodox or "rác" church.

The minaret is one of the most important, and at the same time, northernmost relics of the Turkish occupation period (17th century).



B-1

EGER, Wind's Brickyard

M. BÁLDI-BEKE

after T. BÁLDI and J. SENEŠ 1975, T. BÁLDI 1973 and M. HORVÁTH 1985

Topography

Eger is located in Northern Hungary, southward from the Pre-Tertiary Bükk Mountains. The locality known as Wind's Brickyard is in the eastern part of the town (Fig. 1).

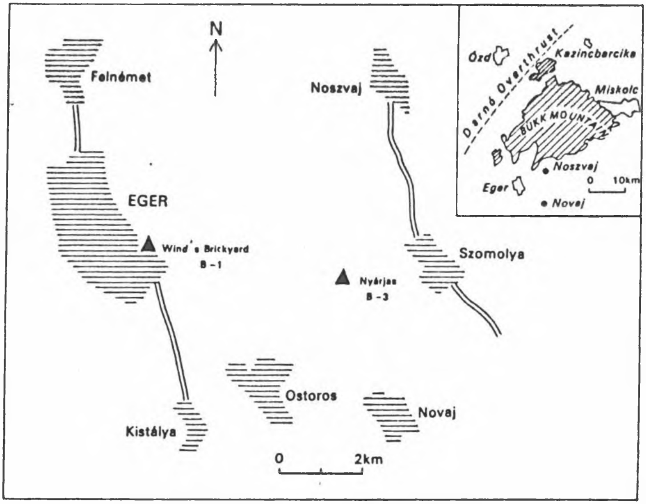


Fig. 1. Sketch map of the Eger--Novaj area (after BÁLDI and SENEŠ 1975, BÁLDI 1973)

Age

Oligocene, Egerian Stage.

Lithostratigraphy

Eger Formation, holostratotype for the Egerian Stage.

The Egerian Stage

The regional stage system of the Central Paratethys was proposed after the RCMNS Congress in Bologna, 1967 and accepted later at the RCMNS Congress in Bratislava, 1975. In this sense the Egerian represents the Upper Oligocene and lowermost Miocene time span. For holostratotype, the Eger Wind's Brickyard section was suggested (boundary stratotype for Kiscellian). One of the facio-stratotype sections for the Egerian Stage is situated at Novaj-Nyárjas, not far to the southeast of Eger, rich in larger foraminifers.

The lower boundary of the Egerian has been put to the first appearances of Globigerinoides and Miogypsinoides as well as some mollusc species. In the planktonic zonation the Egerian is correlated with the zones P 21 and P 22 (HORVÁTH 1985), with Globorotalia opima opima and Globigerinoides quadrilobatus primordius zones (BÁLDI and SENEŠ 1975), associated with nannoplankton zones NP 24 (partly), NP 25 and NN 1 of MARTINI (BÁLDI and SENEŠ 1975).

History

One of the most splendid geohistorical sites of Hungary, the pit of the Eger (former Wind's) Brickyard with its rich fauna, has kept the Upper Oligocene deposits in the focus of geological interest.

The profile of the brickyard pit and the description of 73 mollusc taxa was published first by TELEGDI-ROTH (1914). BÁLDI (1966) revised the mollusc fauna on the basis of new collecting and gave a new description of the profile based not only on the outcrop that was somewhat larger than in TELEGDI-ROTH's time, but he could supplement it with the section of a 80 m deep borehole section drilled on the floor of the pit in 1961.

The Eger profile, a bonanza for palaeobotanists too with its extremely well preserved and rich flora, was studied by ANDREÁNSZKY (1966). Palynological data were published by E. NAGY (NAGY and PÁLFALVY 1963, NAGY 1979).

Little attention has been paid to the microfauna of this unique profile. MAJZON (1942) delivered some data on the benthic foraminifers, while KENAWY (1968) tried to correlate it with the planktonic zones. Recently, HORVÁTH (1985) studied the microfauna in details and evaluated the Foraminifera assemblages ecologically. Her biostratigraphical data are younger than those of KENAWY (1968) and agree well with the concept of the"Egerian volume"(BÁLDI and SENEŠ 1975).

Stratigraphy

The stratotype is represented by the section of the clay pit and by the cores of a 80 m deep borehole drilled on the floor of the pit. The contact of the Kiscell Clay and the Eger Formation can be studied only in the drilling cores (Fig. 2).

The following formations occur, from the bottom of the drilling upwards:

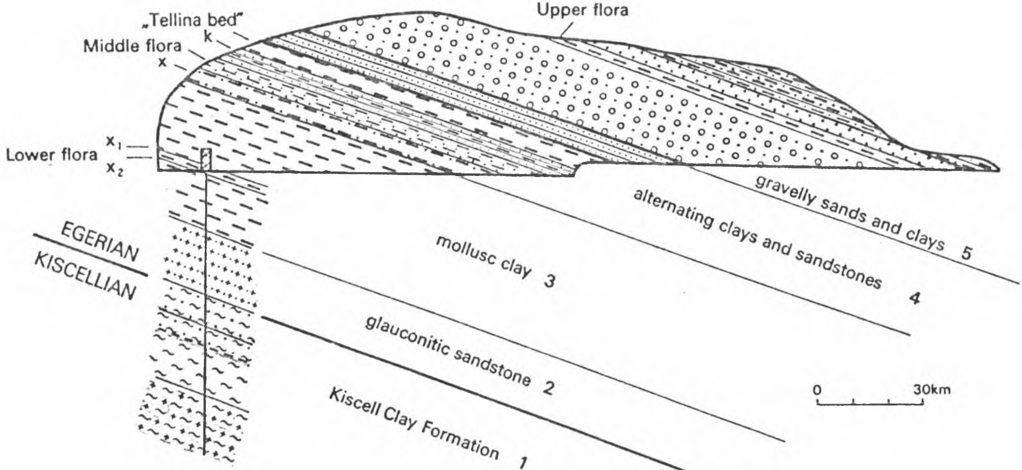


Fig. 2. Exposures of the Wind's Brickyard at Eger, and the profile of the 80 m borehole on the bottom of the pit (after BÁLDI 1973, the chronostratigraphy after BÁLDI and SENEŠ 1975). Holostratotype for the Egerian Stage

Kiscellian

1. Kiscell Formation (between 36.2--80.0 m in the borehole). Marl, marly silt with tuffite lenses, a marine, bathyal formation with abundant smaller foraminifers (Uvigerina steyri association with common U. steyri and Heterolepae: Heterolepa eocaena, H. costata, H. simplex -- HORVÁTH 1985).

Egerian

The Eger formation rests on the Kiscell Clay without any traces of unconformity. The microfauna, too, indicates a gradual transition.

2. Glauconitic, tuffitic sandstone (18 m) (Eger Formation) between 18.3--36.2 m in the borehole section, its uppermost part was exposed earlier in the clay pit, too. Pectinids (with the marker species Flabellipecten burdigalensis), solitary corals, larger foraminifers (e. g. Miogypsina formosensis) and smaller foraminifers (Spiroplectammina carinata--Heterolepa dutemplei association -- HORVÁTH 1985) can be found. Among the rare planktonic forms Globigerina ouachitaensis ciperoensis, G. praebulloides group and Turborotalia obesa occur.

3. Mollusc clay (48 m) (Eger Formation), monotonous clay with thin aleuritic intercalations, containing a rather rich and well-preserved micro- and macrofauna, macroflora. In the lower 40 metres, the Spiroplectammina carinata--Heterolepa dutemplei association occurs with frequent Quinque- and Triloculinas. In its upper 10 m portion a Caucasina--Cassidulina association is characteristic. Important planktonic taxa are the Globigerina angulisuturalis, Gg. ouachitaensis ciperoensis, Globigerinoides quadrilobatus primordius, Miogypsina septentrionalis and M. formosensis occur as well. In the mollusc clay there are some well-preserved ostracods suggesting marine deep sublittoral facies (MONOSTORI p. c., BRESTENSKÁ in BÁLDI--SENEŠ 1975):

Cytherella compressa (MÜNSTER)
Cytherella dentifera (MÉHES)
Cytherella elliptica (MÉHES)
Cytherella hyalina (MÉHES)
Cytherella mehesi BRESTENSKÁ
Cytherella pestiensis (MÉHES)

Costa hermi WITT

Henryhovella asperrima (REUSS).

4. Alternating clay and sandstone (15 m) (Eger Formation). There is a very rich shallow marine mollusc fauna in some silty sandstone beds. The microfauna is getting sparse and less characteristic (Caucasina elongata association: HORVÁTH 1985).

5. Coarse-grained sand with intercalating brackish-limnic clay and gravel (40 m) (Eger Formation). In some levels, Ammonia beccarii occurs (HORVÁTH 1985).

The Eger Formation is overlain unconformably by rhyolite tuff of Early Miocene age.

The most significant microfaunistical elements for the Eger section are presented on Table 1 after HORVÁTH (p.c.). More detailed lists are available for both localities in BÁLDI and SENEŠ 1975 and in the paper of HORVÁTH (1985) with paleoecological evaluations.

Comment: No detailed collecting at fixed points was planned; those who intend to take samples, please take them independently.

References

ANDREÁNSZKY G. 1966; BÁLDI, T. 1966, 1973, BÁLDI, T.--SENEŠ, J. 1975; BÁLDI-BEKE, M.--BÁLDI, T. 1974; HORVÁTH, M. 1985; KENAWY, A. J. 1968; MAJZON, L. 1942a; NAGY E. 1979, NAGY E.--PÁLFALVY I. 1963; TELEGDI ROTH K. 1914.

Table 1

Foraminiferas of the Eger, Wind's Brickyard section

(M. HORVÁTH)

Taxon	Kiscell Clay Form.	Eger F.			
		glauconitic sandst.	mollusc clay	alternating layers	gravelly sand, clay
	1	2	3	4	5
Rhabdammina eocaenica CUSHMAN et HANNA	x				
Bathysiphon filiformis M. SARS	x				
Bathysiphon taurinense SACCO	x		x		
Saccammina sphaerica M. SARS		x			
Ammodiscus incertus d' ORBIGNY	x		x		
Glomospira charoides (PARKER et JONES)	x	x	x		
Haplophragmoides canariensiformis SZTRÁKOS			x	x	x
Haplophragmoides deforme (ANDREAE)	x		x		
Haplophragmoides latidorsatus (BORNEMANN)	x				
Cyclammina acutidorsata(HANTKEN)	x	x	x		
Cyclammina rotundidorsata (HANTKEN)	x	x	x		
Spiroplectammina carinata (d'ORBIGNY)	x	x	x	x	
Spiroplectammina pectinata (REUSS)	x	x	x	x	
Vulvulina capreolus d'ORBIGNY	x	x			
Vulvulina haeringensis (GUEMBEL)	x	x			
Vulvulina pectinata HANTKEN	x		x	x	
Textularia agglutinans d'ORBIGNY	x	x			
Textularia deperdita d'ORBIGNY	x	x	x	x	
Textularia gramen d'ORBIGNY	x	x	x	x	
Textularia pala CŽJŽEK	x	x			
Textularia sagittula DEFRANCE			x		
Textularia speyeri (REUSS)	x				

	1	2	3	4	5
Textularia turris d'ORBIGNY	x				
Bigenerina nodosaria d'ORBIGNY	x				
Planctostoma oligocaenica SZTRÁKOS	x	x			
Siphotextularia concava (KARRER)			x		
Trochammina globigeriniformis (PARKER et JONES)	x				
Trochammina nobensis ASANO			x		
Gaudryina rugosa d'ORBIGNY	x				
Tritaxia haeringensis (CUSHMAN)	x				
Tritaxia havanensis (CUSHMAN et BERMUDEZ)	x				
Tritaxia szabói (HANTKEN)	x	x			
Dorothia parri CUSHMAN	x	x			
Karreriella chilostoma (REUSS)	x				
Karreriella hantkeniana CUSHMAN	x				
Karreriella siphonella (REUSS)	x	x	x	x	
Tritaxilina reussi (HANTKEN)	x	x			
Martinottiella communis (d'ORBIGNY)	x	x		x	
Cyclogyra involens (REUSS)	x	x	x		
Spiroloculina canaliculata d'ORBIGNY	x	x	x		
Spiroloculina dorsata REUSS	x				
Spiroloculina tenuissima REUSS	x	x	x	x	
Quinqueloculina agglutinans d'ORBIGNY	x	x	x		
Quinqueloculina akneriana d'ORBIGNY		x	x	x	
Quinqueloculina carinata d'ORBIGNY	x	x	x		
Quinqueloculina impressa REUSS		x	x	x	
Quinqueloculina seminula (LINNE)		x	x	x	
Cycloforina badenensis (d'ORBIGNY)			x		
Cycloforina contorta (d'ORBIGNY)		x	x	x	
Adelosina longirostra (d'ORBIGNY)			x		
Sigmoilina celata (COSTA)	x	x	x	x	
Spirosigmoilina tenuis (CŽJŽEK)		x	x	x	
Sinoloculina consobrina (d'ORBIGNY)	x		x	x	
Triloculina gibba d'ORBIGNY	x	x	x		
Triloculina tricarinata d'ORBIGNY		x	x		
Triloculina trigonula (LAMARCK)			x		

	1	2	3	4	5
Nodosaria acuminata HANTKEN	x	x			
Nodosaria bacillum DEFRANCE	x	x	x		
Nodosaria bacilloides HANTKEN	x	x	x		
Nodosaria badenensis d'ORBIGNY	x	x	x	x	
Nodosaria exilis NEUGEBOREN	x	x	x		
Nodosaria latejugata GUEMBEL	x	x	x	x	
Nodosaria longiscata d'ORBIGNY	x	x	x		
Nodosaria minor HANTKEN	x				
Nodosaria pyrula d'ORBIGNY	x	x	x		
Amphicoryna marginuliniformis NYIRŐ			x		
Amphicoryna tunicata (HANTKEN)	x		x		
Astacolus kochi (REUSS)			x		
Astacolus recurrens (REUSS)	x				
Dentalina acuta d'ORBIGNY	x	x	x		
Dentalina approximata (REUSS)	x	x	x	x	
Dentalina budensis HANTKEN			x		
Dentalina capitata (BOLL)	x				
Dentalina elegans d'ORBIGNY	x	x	x	x	
Dentalina guembeli HANTKEN	x	x	x		
Dentalina inornata d'ORBIGNY				x	
Dentalina intermedia HANTKEN	x		x		
Dentalina obliquestriata REUSS	x	x			
Dentalina pungens REUSS	x		x		
Dentalina soluta REUSS	x	x	x		
Dentalina spinescens REUSS			x		
Dentalina subtilis NEUGEBOREN			x		
Frondicularia budensis (HANTKEN)	x	x			
Frondicularia tenuissima HANTKEN	x				
Lagena div. sp.	x	x	x	x	
Lenticulina div. sp.	x	x	x	x	x
Marginulina behmi (REUSS)	x	x	x		
Marginulina bullata REUSS	x				
Marginulina glabra d'ORBIGNY	x		x		
Marginulina hirsuta d'ORBIGNY	x	x	x		

	1	2	3	4	5
Marginulina indifferens HANTKEN	x	x			
Marginulina minuta HANTKEN	x				
Marginulina.pediformis BORNEMANN	x	x	x		
Marginulina splendens HANTKEN			x		
Marginulina subbullata HANTKEN	x	x	x		
Marginulina tumida REUSS	x	x	x		
Marginulina variabilis NEUGEBOREN	x		x		
Marginulina fragaria (GUEMBEL)	x	x	x		
Palmula oblonga (ROEMER)			x		
Planularia bullata (HANTKEN)	x	x	x		
Planularia budensis (HANTKEN)	x	x	x		
Planularia kubinyii (HANTKEN)	x	x			
Pseudonodosaria acuta (LEROY)	x	x	x		
Pseudonodosaria aequalis (REUSS)	x	x	x		
Pseudonodosaria disrecta (REUSS)	x	x	x		
Saracenaria hantkeni CUSHMAN	x	x	x		
Saracenaria italica DEFRANCE			x		
Saracenaria propinqua (HANTKEN)	x				
Saracenaria senni HEDBERG	x	x	x		
Vaginulina plana NYIRŐ	x	x			
Vaginulina sp.	x	x	x		
Vaginulinopsis gladius (PHILIPPI)	x	x			
Vaginulinopsis pseudodecorata HAGN			x		
Vaginulinopsis schwageri (HANTKEN)	x	x	x		
Bolivinella rugosa HOWE		x			
Globulina gibba (d'ORBIGNY)	x	x	x		
Globulina globosa (MÜNSTER)	x	x	x		
Globulina inaequalis REUSS	x	x	x		
Guttulina hantkeni CUSHMAN et OZAWA	x	x			
Guttulina communis d'ORBIGNY	x	x	x		
Guttulina deltoidea (REUSS)	x	x	x	x	
Pseudopolymorphina obscura (ROEMER)	x		x		
Pyrulina fusiformis (ROEMER)	x		x	x	x
Pyrulina cylindroides (ROEMER)			x		

	1	2	3	4	5
Sigmomorphina regularis (ROEMER)	x	x			
Glandulina dimorpha (BORNEMANN)	x				
Glandulina ovula d'ORBIGNY	x	x	x		
Oolina marginata (MONTAGU)	x	x	x		
Oolina orbignyana (SEGUENZA)		x	x		
Fissurina laevigata REUSS	x	x	x		
"Neobulimina" budensis (HANTKEN)	x	x			
Sphaeroidina bulloides d'ORBIGNY	x	x	x	x	x
Bolivina antiqua d'ORBIGNY	x	x	x		
Bolivina beyrichi beyrichi REUSS	x				
Bolivina beyrichi carinata HANTKEN	x	x	x	x	
Bolivina crenulata trunesis HOFMANN		x	x		
Bolivina elongata HANTKEN	x	x			
Bolivina fastigia CUSHMAN	x	x	x		
Bolivina liebusi HOFMANN		x	x		
Bolivina nobilis HANTKEN	x	x			
Bolivina oligocaenica oligocaenica SPANDEL	x	x	x		
Bolivina reticulata HANTKEN	x	x	x		
Bolivina semistriata HANTKEN	x	x			
Rectobolivina zsigmodyi (HANTKEN)	x	x			
Cassidulinoides oblongus (REUSS)			x		
Stilostomella adolphina (d'ORBIGNY)	x	x	x	x	
Stilostomella consobrina (d'ORBIGNY)	x	x	x		
Siphonodosaria verneuili (d'ORBIGNY)	x		x		
Bulimina affinis d'ORBIGNY	x		x		
Bulimina alsatica CUSHMAN et PARKER	x	x			
Bulimina aksuatica MOROZOVA	x	x			
Bulimina kasselensis BATJES	x	x	x	x	
Bulimina pyrula d'ORBIGNY	x	x	x	x	
Reusella spinulosa (REUSS)	x	x	x	x	
Uvigerina farinosa HANTKEN	x	x	x		
Uvigerina hantkeni CUSHMAN et EDWARDS	x	x	x		
Uvigerina steyri PAPP		x	x	x	
Trifarina angulosa (WILLIAMSON)	x		x	x	

	1	2	3	4	5
Trifarina globosa (STOLZ)			x		
Trifarina gracilis (REUSS)	x	x	x		
Trifarina tenuistriata (REUSS)	x	x	x		
Trifarina tubulifera (KAASSCHIETER)		x	x		
Discorbis biapertura (POKORNY)		x			
Discorbis discoides (d'ORBIGNY)		x			
Escornebovina cuvillieri (POIGNANT)		x			
Escornebovina leganyii (KENAWY et NYIRŐ)	x	x			
Rosalina globularis d'ORBIGNY		x	x		
Baggina philippinensis (CUSHMANN)	x	x			
Cancris auriculus (FICHTEL et MOLL)	x	x	x		
Cancris turgidus CUSHMAN et TODD		x	x		
Valvulinera complanata (d'ORBIGNY)	x	x	x		
Siphonina reticulata (CŽJŽEK)	x	x			
Asterigerinata falcilocularis (SUBBOTINA)	x				
Asterigerinata planorbis (d'ORBIGNY)		x	x		
Rotalia propinqua REUSS					x
Ammonia beccarii (LINNE)			x	x	x
Elphidium crispum (LINNE)			x		
Elphidium flexuosum s.l. (d'ORBIGNY)			x		
Elphidium latidorsatum (REUSS)		x			
Cribrononion hiltermanni (HAGN)		x			x
Cribrononion minutum (REUSS)					x
Protelphidium subgranosum (EGGER)		x		x	x
Miogypsina (Miogypsinoides) formosensis YABE et HANZAWA			x		
Miogypsina (Miogypsina) septentrionalis DROOGER			x		
Globorotalia (Turborotalia) munda (JENKINS)	x	x			
Globorotalia (T.) obesa (BOLLI)		x	x		
Globorotalia (T.) opima nana (BOLLI)	x	x	x		
Globorotalia (T.) opima opima (BOLLI)		x	x		
Globorotalia (T.) permicra (BLOW et BANNER)			x		
Globigerinita dissimilis dissimilis (CUSHMAN et BERMUDEZ)	x		x		
Gn. martini scandretti (BLOW et BANNER)	x		x		
Gn. unicava primitiva BLOW et BANNER			x		

	1	2	3	4	5
Globorotaloides suteri BOLLI	x	x	x		
Globigerina anguliofficinalis BLOW	x				
Globigerina angulisuturalis BOLLI			x		
Globigerina angustiumbilicata BOLLI	x	x	x		
Globigerina euapertura JENKINS	x	x			
Globigerina gortanii gortanii (BORSETTI)	x				
Globigerina officinalis SUBBOTINA	x	x	x		
Globigerina ouachitaensis ciperoensis BOLLI	x	x	x		
Globigerina ouachitaensis ouachitaensis HOWE et WALLACE	x	x			
Globigerina ouachitaensis gnaucki BLOW et BANNER	x				
Globigerina praebulloides leroyi BLOW et BANNER	x	x	x	x	
Globigerina praebulloides occlusa BLOW et BANNER	x	x	x		
Globigerina praebulloides praebulloides BLOW	x	x	x	x	
Globigerina senilis BANDY	x	x	x		
Globigerinoides quadrilobatus primordius BLOW et BANNER			x		
Neoeponides schreibersi (d'ORBIGNY)	x	x	x	x	
Planulina ambiqua (FRANZENAU)	x	x			
Planulina costata (HANTKEN)	x		x		
Planulina wuellerstorfi (SCHWAGER)	x	x	x		
Cibicides americanus (CUSHMAN)	x	x			
Cibicides borislavensis AISENSTAT			x		
Cibicides lobatulus (WALKER et JACOB)	x		x		
Cibicides pseudoungerianus (CUSHMAN)	x	x	x	x	
Cibicides pygmeus (HANTKEN)	x	x	x		
Cibicides roemeri (REUSS)	x	x	x		
Cibicides tenellus (REUSS)			x		
Cibicides ungerianus (d'ORBIGNY)	x	x	x		
Dyocibicides cubensis CUSHMAN et BERMUDEZ	x	x			
Pleurostomella acuta HANTKEN			x		
Pleurostomella eocaena (GUEMBEL)	x				
Fursenkoina schreibersiana (CŽJŽEK)	x	x	x	x	x
Coryphostoma limbata (BRADY)		x			
Coryphostoma sinuosa (CUSHMAN)		x			
Caucasina elongata (d'ORBIGNY)	x	x	x	x	x

	1	2	3	4	5
Cassidulina crassa d'ORBIGNY	x	x	x	x	x
Cassidulina laevigata d'ORBIGNY		x			
Globocassidulina globosa (HANTKEN)	x	x			
Allomorphina trigona REUSS			x		
Florilus buxovillana (ANDREAE)	x	x			
Nonion boueanum (d'ORBIGNY)			x	x	x
Nonionella liebusi HAGN			x	x	x
Pullenia bulloides (d'ORBIGNY)	x	x	x		
Pullenia quinqueloba (REUSS)	x	x	x		
Alabamina tangentialis (CLODIUS)	x	x	x	x	
Alabamina wolterstorfi (FRANKE)	x	x			
Gyroidina soldanii d'ORBIGNY	x	x	x	x	
Gyroidina girardana (REUSS)	x	x	x	x	
Gyroidina mamillata (ANDREAE)	x	x			
Svratkina perlata (ANDREAE)	x	x	x	x	
Osangularia umbonata (REUSS)	x	x	x		
Gyroidinoides parvus (CUSHMAN et RENZ)	x		x		
Gyroidinoides planulatus (CUSHMAN et RENZ)	x				
Anomalina affinis (HANTKEN)	x	x			
Anomalina crassiseptata CUSHMAN et SIEGFUS			x		
Anomalina cryptomphala (REUSS)	x	x	x		
Anomalina similis (HANTKEN)	x	x	x		
Anomalina granosa (d'ORBIGNY)	x	x	x		
Cibicidoides conspiciendus (PISHVANOVA)	x	x	x		
Hanzawaia boueana (d'ORBIGNY)		x	x		
Hanzawaia americana (CUSHMAN)	x				
Heterolepa bullata FRANZENAU	x	x	x		
Heterolepa costata FRANZENAU	x	x	x		
Heterolepa dutemplei (d'ORBIGNY)		x	x	x	x
Heterolepa eocaena (GUEMBEL)	x	x	x		
Heterolepa simplex FRANZENAU	x				
Melonis affinis (REUSS)	x	x	x		
Melonis pompilioides (d'ORBIGNY)	x	x			
Almaena osnabrugensis s.l. (ROEMER)	x	x	x	x	

	1	2	3	4	5
Ceratobulimina contraria (REUSS)	x	x	x		
Hoeglundina eocaenica (CUSHMAN et HANNA)	x	x			
Hoeglundina elegans (d'ORBIGNY)			x		
Alliatina nitida (TOLLMANN)			x	x	

B-2

NOSZVAJ, Kiseged, road cut

A. NAGYMAROSY

with the contribution of M. HORVÁTH and M. MONOSTORI

Topography

The outcrop is situated at the SW border of the Bükk Mountains, on the southern slopes of the Kiseged Hill, between Eger and Noszvaj. The road has a very heavy traffic, thus we should warn our guests that staying on the road is dangerous! The road cut exposes the Upper Eocene--Lower Oligocene succession in 600 m length and 50 m thickness. The area is dissected by several fault lines of NE-SW direction (Fig. 1).

Age

Lower Oligocene, Kiscellian Stage.

Lithostratigraphy

Tard and Kiscell Clay Formations.

History

The Kiseged section has been investigated by BÁLDI et al. (1984) as well as MONOSTORI (1985a, 1985b, 1986).

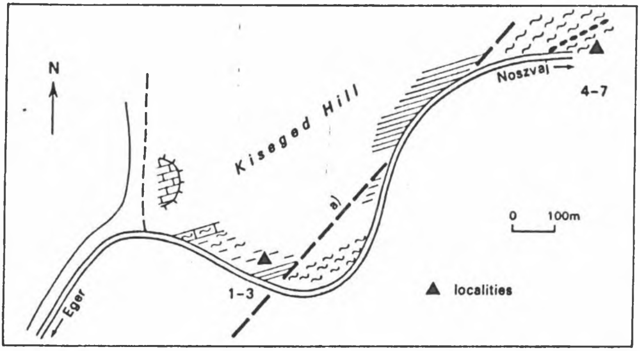


Fig. 1. Noszvaj--Kiseged, road cut. Map of the locality with the exposures a) Supposed direction of normal fault. 1--7 = samples. Other key see on Fig. 2.

Stratigraphy

Superposed on the Szépvölgy Limestone (the uppermost part of the Priabonian Stage) (Fig. 2) we find an atypical series of the Buda Marl. The Buda Marl turns upwards into the Tard Clay Formation. Its lower member is not microlaminated, or only to a very small extent and contains the endemic Cardium lipoldi mollusc fauna. Its upper member is a considerably microlaminated fish shale, deposited in anoxic water (Samples 1-3, Fig.3).

Over the Tard fish shale we find at the higher parts of the section the Kiscell Clay with manganese seams in a superposed position (Samples 4--7, Fig. 4).

Fossils

Samples from the Tard Clay:

As it is apparent on Fig. 3, Samples 1 and 2 were taken from the Cardium lipoldi beds, while Sample 3 was taken from the boundary of the lower and upper member of the Tard Clay. The level of the Cardium lipoldi beds is composed of parallel layers of not laminated, light-grey clay-marl including few mollusc remains. The fish shale is hard, considerably laminated, carbonate-free mudstone.

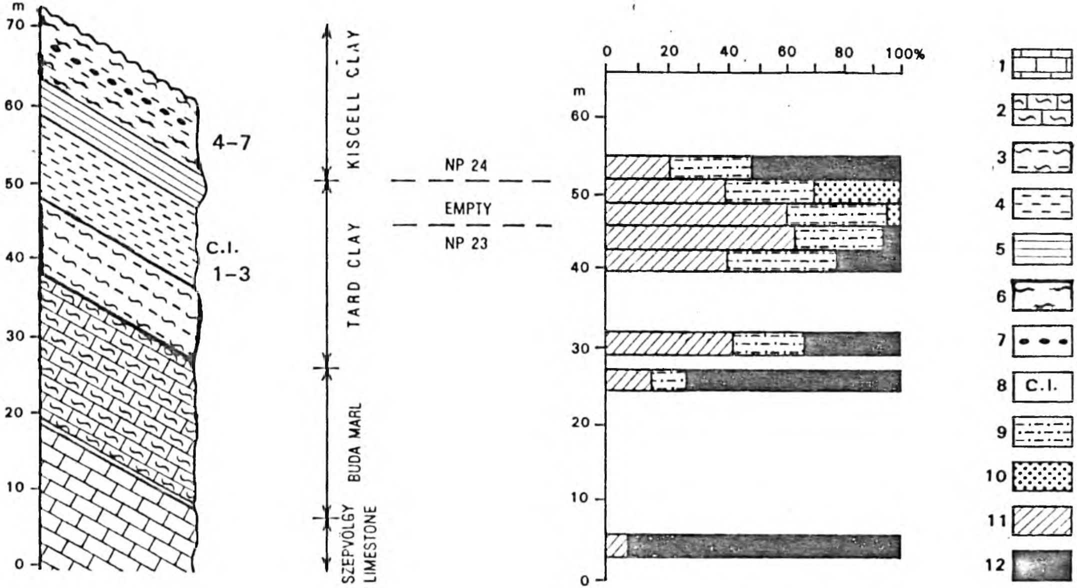


Fig. 2. Comprehensive vertical section of the outcrop with the nannoplankton zones and the lithological composition

1. Szépvölgy nummulitic limestone, 2. calcareous marl (Buda Marl), 3. clay marl (lower member of the Tard Clay), 4. clay (lower member of the Tard Clay), 5. fish shale, silicified laminated clay (upper member of the Tard Clay), 6. clay (Kiscell Clay), 7. horizon with manganese oxide concretions, 8. fossiliferous horizon with Cardium lipoldi, 9. silt, 10. sand, 11. measured clay content, 12. measured carbonate content

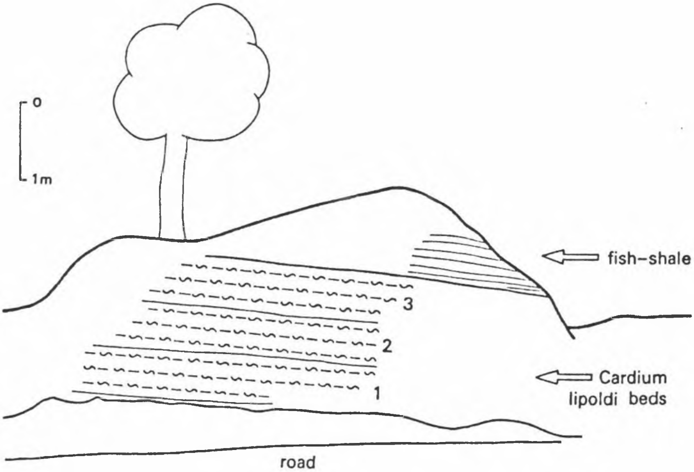


Fig. 3. Location of the samples from the Tard Clay

The Cardium lipoldi beds contain, due to their brackish character, a few microfossils only, the most significant of which is the well-preserved nannoplankton, present in small species and great specimen number (Table 1).

As a result of the changing salinity different from that of normal seawater, certain species do not occur here, or they are represented in very small specimen number, while other species with better ecological tolerance can be present in high specimen number, sometimes in masses like Transversopontis latus, Orthozygus aureus (see also NAGYMAROSY 1983). The initial stage of the restriction of the Paratethys is marked by the abundant presence of the endemic species Reticulofenestra ornata and Transversopontis fibula. This endemic nannoplankton-level can be traced from the Austrian molasse along the Carpathians as far as the Caspian Sea. The age of the samples: Lower Oligocene, Kiscellian Stage, NP 23 nannoplankton zone.

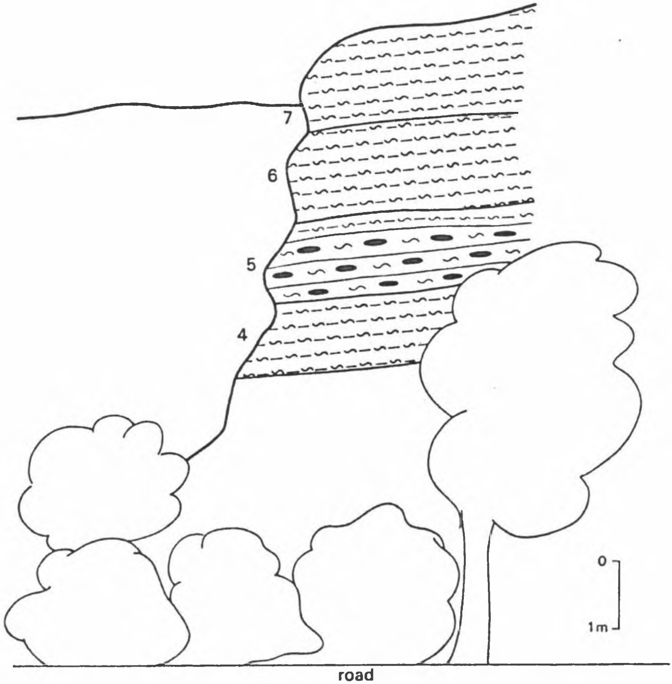


Fig. 4. Location of the samples from the Kiscell Clay with manganese nodules

Table 1

The nannoplankton of the Noszvaj--Kiseged outcrop

Taxon	Samples						
	Tard Clay			Kiscell Clay with manganese seams			
	1	2	3	4	5	6	7
Reticulofenestra bisecta (HAY, MOHLER and WADE)	R	R	1	K	K	K	R
R. hesslandii (HAQ)	1	1					
R. lockeri MÜLLER				S	S	TS	S
R. minuta ROTH	R			K		S	T
R. ornata MÜLLER	T	T	T				

	1	2	3	4	5	6	7
R. hillae BUKRY and PERCIVAL	R						
R. clathrata MÜLLER				K	K	AK	K
Coccolithus pelagicus (WALLICH) SCHILLER	R	K	R	A	KA	A	K
Cyclicargolithus abisectus (MÜLLER) WISE						A	A
C. floridanus (ROTH and HAY) BUKRY	R		R	R		A	K
Pyrocyclus sp.	1						
Calcidiscus protoannulus (GARTNER) LOEBLICH and TAPPAN		1					
Helicopontosphaera bramlettei MÜLLER	1			RK			1
Pontospaera multipora (KAMPTNER) ROTH				R	RK	K	A
Transversopontis fibula GHETA	AK	AK	R				
T. latus MÜLLER	RK	R	AK				
T. obliquipons (DEFLANDRE) HAY, MOHLER and WADE				R	R		
T. pygmaea (LOCKER) PERCH-NIELSEN				R	K	K	KA
Sphenolithus ciperoensis BRAMLETTE and WILCOXON						1	
S. distentus (MARTINI) BRAMLETTE and WILCOXON						R	K
S. moriformis (BRÖNNIMANN and STRADNER) BRAMLETTE and WILCOXON	R	1	1	S	R	S	S
S. predistentus BRAMLETTE and WILCOXON							1
Braarudosphaera bigelowii (GRAN and BRAARUD) DEFLANDRE					1	KA	KA
Rhabdosphaera vitrea (DEFLANDRE)						R	KA
Cricolithus cf. jonesi COHEN	R	R		K	K	KA	A
Orthozygus aureus (STRADNER) BRAMLETTE and WILCOXON	KA	KA					
Zygrhablithus bijugatus (DEFLANDRE) DEFLANDRE	1	R	R	S	S	S	S
Lanternithus minutus STRADNER	RK		R				
specimens reworked from the Paleogene			R				
specimens reworked from the Cretaceous	K	K	K	1	R	KA	KA

Key: T = abundant A = common R = rare
S = frequent K = few

F o r a m i n i f e r a

The samples contain only a few foraminifers which were elaborated by HORVÁTH. The silting residuum contains mainly casts of Pteropods, fish teeth, completed by some limonitic-pyritic casts of foraminifers in very bad state of preservation. As a result of the anoxic water in the lower levels of the sea, planktonic forms dominate the assemblage:

Sample 1:

Subbotina cf. angiporoides (HORNIBROOK) - 1 specimen
Globorotalia (Turborotalia) obesa (BOLLI) - 1 specimen
pyritic casts

Sample 2 (only 1 specimen of each taxon was collected):

Lenticulina div. sp. (calcitic shell)
Uvigerina eocaena GÜMBEL (fragment of calcitic shell)
Globigerina gortanii (BORSETTI)
Gg. ouachitaensis gnaucki BANNER et BLOW
Gg. praebulloides occlusa BANNER et BLOW
Gg. praebulloides praebulloides BANNER et BLOW
Globorotalia (T.) opima nana BOLLI
Globigerinita martini scandretti BANNER et BLOW
(pyritic cast with traces of thin calcitic shell).

Sample 3 (only 1-1 specimen of each taxon was collected):

Lagena isbella (d'ORBIGNY)
Pseudonodosaria disrecta (REUSS)
Sphaeroidina bulloides d'ORBIGNY
Cribrononion dolfussi gr. (CUSHMAN)
Globigerina officinalis SUBBOTINA
Gg. ouachitaensis ouachitaensis HOWE et WALLACE
Gg. praebulloides occlusa BANNER et BLOW
Subbotina (Gg.) angiporoides (HORNIBROOK)

O s t r a c o d a

There is an ostracod fauna of considerable specimen number and medium state of preservation collected from the samples, elaborated by MONOSTORI. The species indicate mixed shallow- and deep-water with variable salinity and fluctuating euxine environment. The age of the fauna: Lower Oligocene, Kiscellian Stage.

Sample 1:

Eucytheridea reticulata GOERLICH
Schuleridea rauracica OERTLI
Cuneocythere marginata anterodepressa MONOSTORI
Pterygocythereis sp.
Megahemicythere oertlii WITT
Bosquetina reticulata SCHEREMETA
Bosquetina zalanyii BRESTENSKÁ
Loxoconcha carinata tardense MONOSTORI
Cytheropteron emmeneggeri SCHERER
Candona? recta LIENENKLAUS
Curvopsis curvata (LIENENKLAUS)
Cypridacea gen. et sp. indet. (div.)

Sample 2:

Cytheromorpha subalpina dorsodepressa MONOSTORI
Eucytheridea reticulata GOERLICH
Cuneocythere marginata anterodepressa MONOSTORI
Megahemicythere oertli WITT
Bosquetina sp.
Loxoconcha carinata tardense MONOSTORI
Cytheropteron emmeneggeri SCHERER
Candona? recta LIENENKLAUS
Curvopsis curvata (LIENENKLAUS)
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Loxoconcha carinata tardense MONOSTORI
Cytheropteron emmeneggeri SCHERER
Candona? recta LIENENKLAUS

Curvopsis curvata (LIENENKLAUS)
Cypridacea gen. et sp. indet. (div.)

Samples from the Kiscell Clay

Some 200 m upwards along the road we can reach the Kiscell Clay with manganese seams overlying the Tard Clay fish shale. This uniform clay marl, sedimented in thick beds, was deposited on a well aired sea floor, with traces of bioturbation. The brown, oxidic manganese ore is sedimented in nodular--lenticular form, with traces of slight microlamination. The sand content is somewhat higher in this layer. Samples 4--7 taken from the cca. 4 m high section we can see on Fig. 4.

The nannoflora of the Samples 4--7 (see Table 1) comprises characteristic euhaline assemblages of the NP 24 nannoplankton zone. This is proved by the simultaneous presence of the species Sphenolithus distentus, S. ciperoensis and Cyclicargolithus abisectus. The high number of the species Reticulofenestra lockeri and Braarudosphaera bigelowii shows that this level corresponds to the lower part of Kiscell Clay.

F o r a m i n i f e r a

The Oligocene foraminifer fauna of the region was formerly treated by MAJZON (1961, 1966). The comprehensive faunal list of Samples 4--7 is the following (after HORVÁTH):

Benthos:
Rhabdammina eocaena CUSHMAN et HANNA
Bathysiphon filiformis M. SARS
Ammodiscus incertus (d'ORBIGNY)
Haplophragmoides deforme (ANDREAE)
Cyclammina acutidorsata (HANTKEN)
Cyclammina rotundidorsata (HANTKEN)
Ammomarginulina expansa (PLUMMER)
Ammobaculoides humboldti (REUSS)
Haplophragmium sp.
Triplasia hungarica MAJZON
Spiroplectammina carinata (d'ORBIGNY)
Vulvulina haeringensis GUEMBEL
Semivulvulina pectinata (HANTKEN)

Textularia aff. agglutinans d'ORBIGNY
Siphotextularia aff. concava (KARRER)
Tritaxia szabói (HANTKEN)
Gaudryina fortiuscula BERMUDEZ
Tritaxilina reussi (HANTKEN)
Pyrgo sp.
Nodosaria div. sp.
Dentalina approximata REUSS
Dentalina debilis HANTKEN
Dentalina elegans d'ORBIGNY
Dentalina intermedia HANTKEN
Frondicularia tenuissima HANTKEN
Lenticulina div. sp.
Marginulina hantkeni BANDY
Marginulina pediformis BORNEMANN
Planularia nummulitica (HANTKEN)
Pseudonodosaria disrecta (REUSS)
Saracenaria conferta (REUSS)
Saracenaria senni HEDBERG
Globulina guttula REUSS
Glandulina ovula d'ORBIGNY
Turrilina pupoides (NYIRŐ)
"Neobulimina" budensis (HANTKEN)
Sphaeroidina bulloides d'ORBIGNY
Bolivina antiqua d'ORBIGNY
Bolivina elongata HANTKEN
Bolivina fastigia CUSHMAN
Bolivina nobilis HANTKEN
Bolivina reticulata HANTKEN
Bolivina semistriata HANTKEN
Rectobolivina zsigmondyi (HANTKEN)
Bulimina alazanensis CUSHMAN
Bulimina alsatica CUSHMAN et PARKER
Uvigerina eocaena GUEMBEL
Uvigerina hantkeni CUSHMAN et EDWARDS

Uvigerina farinosa HANTKEN
Trifarina angulosa (WILLIAMSON)
Trifarina globosa (STOLTZ)
Epistominella oweyi (BHATIA)
Siphonina reticulata (CŽJŽEK)
Asterigerinata falcilocularis (SUBBOTINA)
Planulina compressa (HANTKEN)
Planulina costata (HANTKEN)
Cibicides lobatulus (WALKER et JACOB)
Cibicides pseudoungerianus CUSHMAN
Cibicides tenellus (REUSS)
Cassidulina margareta KARRER
Cassidulina vitalisi MAJZON
Globocassidulina subglobosa (BRADY)
Chilostomella cylindroides REUSS
Allomorphina trigona REUSS
Nonionella liebusi HAGN
Pullenia bulloides (d'ORBIGNY)
Pullenia quinqueloba (REUSS)
Alabamina tangentialis (CLODIUS)
Gyroidina mamillata (ANDREAE)
Gyroidina soldanii (d'ORBIGNY)
Svratkina perlata (ANDREAE)
Osangularia umbonata (REUSS)
Anomalina affinis (HANTKEN)
Lingulina seminuda HANTKEN
Globulina guttula REUSS
Globulina gibba d'ORBIGNY
Guttulina deltoidea (REUSS)
Sphaeroidina bulloides d'ORBIGNY
Bolivina antiqua d'ORBIGNY
Bolivina elongata HANTKEN
Bolivina nobilis HANTKEN
Bolivina oligocaenica SPANDEL
Bolivina semistriata HANTKEN
Rectobolivina zsigmondyi (HANTKEN)

Siphonodosaria verneuili (d'ORBIGNY)
Bulimina alazanensis CUSHMAN
Bulimina alsatica CUSHMAN et PARKER
Bulimina pyrula d'ORBIGNY
Uvigerina eocaena GUEMBEL
Uvigerina farinosa HANTKEN
Uvigerina hantkeni CUSHMAN et EDWARDS
Uvigerina steyri PAPP
Trifarina globosa (STOLZ)
Rosalina subvilardeboana (RZEHAK)
Baggina philippinensis BUTT
Valvulineria budensis (HANTKEN)
Valvulineria palmarealensis (NUTTALL)
Asterigerinata falcilocularis (SUBBOTINA)
Neoeponides schreibersi (d'ORBIGNY)
Amphistegina choctawensis (CUSHMAN et McGLAMERY)
Planulina compressa (HANTKEN)
Planulina costata (HANTKEN)
Planulina wuellerstorfi (SCHWAGER)
Cibicides pseudoungerianus (CUSHMAN)
Cibicides tenellus (REUSS)
Cibicides ungerianus (d'ORBIGNY)
Fursenkoina schreibersiana (CŽJŽEK)
Globocassidulina globosa (HANTKEN)
Globocassidulina subglobosa (BRADY)
Anomalina cryptomphala (REUSS)
Anomalina similis (HANTKEN)
Cibicidoides borislavensis (AISENSTAT)
Cibicidoides conspiciendus (PISHVANOVA)
Cibicidoides pygmeus (HANTKEN)
Heterolepa bullata FRANZENAU
Heterolepa costata FRANZENAU
Heterolepa eocaena (GUEMBEL)
Melonis affinis (REUSS)

Plankton:

Globorotalia (Turborotalia) munda (JENKINS)
Globorotalia (Turborotalia) trefa (BYKOVA)
Globigerinita dissimilis dissimilis (CUSHMAN et BERMUDEZ)
Globigerinita martini scandretti BLOW et BANNER
Subbotina angiporoides (HORNIBROOK)
Globigerina cf. ampliapertura BOLLI
Globigerina anguliofficinalis BLOW
Globigerina angustiumbilicata BOLLI
Globigerina eocaena GUEMBEL
Globigerina euapertura JENKINS
Globigerina gortanii gortanii (BORSETTI)
Globigerina officinalis SUBBOTINA
Globigerina ouachitaensis ciperoensis BOLLI
Globigerina ouachitaensis gnaucki BLOW et BANNER
Globigerina praebulloides group

Age: Upper Kiscellian, the lower part of the Kiscell Clay (near to the base) P 20 zone.

Facies: euhaline, deep sublittoral-bathyal region.

The plankton is rich in specimens, mainly in the fraction between 0.2--0.1 μm. Characteristic taxa are the Gg. praebulloides and its varieties as well as the Globorotalias. The benthos is richer in species, dominant are the agglutinated forms: Bolivinas, Uvigerinas, Heterolepas. In addition to the foraminifers there are echinoid spines, pyritized shells of pteropods, fish teeth and ostracods in the silted residuum.

O s t r a c o d a

The Kiscell Clay with manganese seams can be characterized by an ostracod fauna in medium state of preservation, with small species and specimen number, elaborated by MONOSTORI. This fauna represents euhaline, deep sublittoral-epibathyal conditions. Its age is Lower Oligocene, Kiscellian Stage.

	Samples		
	4	6	7
Cytherella pestiensis (MÉHES)			x
Cytherella sp.	x		x
Krithe pernoides (BORNEMANN)	x		x
Parakrithe? sp.			x
Paracypris rupelica MONOSTORI	x	x	
Encytherura dentata LIENENKLAUS			x
Argilloecia? sp.		x	
Gen. et sp. indet.		x	

References

BÁLDI, T.--HORVÁTH, M.--NAGYMAROSY, A.--VARGA, P. 1984; MAJZON, L. 1961, 1966; MONOSTORI, M. 1985a, 1985b, 1986; NAGYMAROSY, A. 1983

B-3.

NOVAJ, Nyárjas Hill

M. BÁLDI-BEKE
with the contribution of M. HORVÁTH and GY. LESS

Topography

Novaj is located southeast from Eger, the locality lies about 5 km to the north of Novaj in the old vineyards, on the flanks of the Nyárjas Hill (Fig. 1 at the Eger locality - B-1).

Age

Oligocene, Kiscellian and Egerian Stages.

Lithostratigraphy

Kiscell Clay and Eger Formations.

History

The surface outcrop at Novaj, Nyárjas Hill is a complete section, similar to the Wind's Brickyard. Its Lepidocyclina limestone had been mistaken for an Upper Eocene Orthophragmina limestone by earlier mapping. The Egerian-like mollusc fauna collected from here called the attention of mollusc specialists CSEPREGHY-MEZNERICS and BÁLDI to this antagonism.

The first description of the profile and the fauna was given by BÁLDI et al. (1961). Miogypsina septentrionalis was recognised by DROOGER (1961). For a more detailed study a trench was made later, in 1972 (BÁLDI and SENEŠ 1975, BÁLDI-BEKE and BÁLDI 1974 - nannoplankton and molluscs, HORVÁTH 1985 - smaller foraminifers).

Stratigraphy

Compared to the very similar Eger holostratotype, this profile seems to be more condensed (Fig. 1). At this locality the lowermost portion of the outcrop is formed by the Kiscell Clay Formation, with tuffaceous clay-clayey silt with tuffitic intercalations (Samples 1--3). It is overlain, without any traces of unconformity, by the Eger Formation. Only the two lower members of the Eger Formation are exposed here: the glauconitic tuffaceous sandstone and the lower part of the mollusc clay. The main difference from the Eger section is the intercalation of a Lithothamnium-bearing limestone of 1 m thickness in the glaukonitic sandstone. The limestone is bordered by, below and above, Lepidocyclina and Miogypsina marls.

The succession of the Egerian formations from the bottom to the top is as follows:

- 2.5 m glauconitic sand, sandstone (Samples 4--5), yielding a poorly preserved but rich mollusc fauna, with solitary corals. The microfauna is dominated by Spiroplectammina carinata and Planulina costata.
- 0.3 m oil-grey marl (Sample 6) full with Lepidocyclina. The larger foraminifers in this level are as follows (after LESS, p. c.):

Planoperculina complanata (DEFRANCE) few

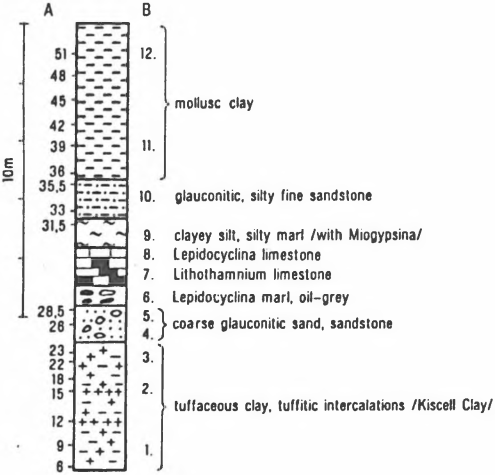


Fig. 1. Columnar section of Novaj, Nyárjas (after BÁLDI in BÁLDI and SENEŠ 1975). Faciostratotype section for the Egerian

Lepidocyclina (Eulepidina) dilatata (MICHELOTTI)	abundant
Lepidocyclina (Nephrolepidina) morgani LEMOINE et R. DOUVILLÉ	common
Miogypsina (Miogypsina) septentrionalis DROOGER	rare

- 1 m limestone with Lepidocyclina in its lower part (Sample 7), and grading upwards into Lithothamnium-bearing limestone (Sample 8).

- 1-2 m clayey silt, silty marl with frequent Miogypsina (Sample 9) and other larger foraminifers (identified by LESS):

Nummulites sp. (the same as N. bouillei from Escornebéou, Upper Chattian, in DROOGER et al., 1971)	common
Planoperculina complanata DEFRANCE	common
Planoperculina heterostegina (SILVESTRI)	few
Heterostegina assilinoides BLANCKENHORN	rare
Lepidocyclina (Nephrolepidina) morgani LEMOINE et DOUVILLE	common
Miogypsina (Miogypsina) septentrionalis DROOGER	common

- 1-2 m glauconitic silty fine sand (Sample 10), also with larger foraminifers, with sporadic solitary corals and molluscs.

Mollusc clay (Samples 11--12), the same as in Eger. It contains a nicely preserved mollusc fauna, and smaller foraminifers. The larger foraminifers disappear.

The succession ends with the unconformably overlying Lower Miocene rhyolitic tuff fairly widespread in the vicinity of the outcrop. The smaller foraminifer fauna has been studied for the Colloquium by HORVÁTH. Her results were summarized in Table 1. Her data had been published in the Egerian volume (BÁLDI and SENEŠ 1975), the palaeoecological results were published in HORVÁTH 1985.

The nannoplankton of the Novaj section was published earlier (BÁLDI-BEKE and BÁLDI 1974). Novaj is the type locality of Discolithina latelliptica BÁLDI-BEKE, which is a common species in the lower part of the section (Table 2).

Recently, earlier data on the biozonation of the Novaj section had to be modified. The lower part of the succession belongs to the NP 24 nannoplankton zone, while the uppermost part belongs to the NP 25 zone. The presence of the zone NN 1 in the Novaj section supposed earlier has not been proved, because it was based on the occurrence of a single specimen misidentified as Sphenolithus belemnos. The boundary between NP 24 and NP 25 cannot be fixed exactly, because of the absence of the main tropical zone markers.

The upper part of the Egerian belongs already to the Miocene (nannoplankton zone NN 1) but this part is missing in Eger and Novaj.

References

BÁLDI, T.--KECSKEMÉTI, T.--NYÍRŐ, R.--DROOGER, C. W. 1961, BÁLDI, T.--SENEŠ, J. 1975; BÁLDI-BEKE, M.--BÁLDI, T. 1974; DROOGER, C. W. 1961, DROOGER, C. W.--MARKS, P.--PAPP, A. 1971; HORVÁTH, M. 1985.

Table 1

Smaller Foraminifera fauna of the Novaj, Nyárjas section

(M. HORVÁTH)

Taxon	Sample Nr				
	4, 5	6	9	10	11 12
Glomospira charoides (JONES et PARKER)					x
Haplophragmoides canariensiformis SZTRÁKOS					x
Cyclammina cf. placenta (REUSS)					x
Spiroplectammina carinata (d'ORBIGNY)	x	x	x	x	x
Vulvulina pectinata HANTKEN			x		
Textularia gramen d'ORBIGNY			x	x	x
Textularia pala CŽJŽEK			x	x	
Tritaxia haeringensis CUSHMAN	x				
Tritaxia havanensis (CUSHMAN et BERMUDEZ)	x				
Tritaxia szabói (HANTKEN)	x	x			
Karreriella siphonella (REUSS)	x	x	x	x	x
Martinottiella communis (d'ORBIGNY)	x	x	x	x	x
Nummoloculina sp.				x	x
Spiroloculina canaliculata d'ORBIGNY			x	x	
Spiroloculina tenuissima REUSS			x	x	x
Quinqueloculina akneriana d'ORBIGNY			x		
Quinqueloculina agglutinans d'ORBIGNY			x	x	x
Quinqueloculina impressa REUSS			x		
Quinqueloculina ludwigi REUSS			x		
Quinqueloculina seminula (LINNE)	x		x		x
Sigmoilina celata (COSTA)	x		x	x	x
Spirosigmoilina tenuis (CŽJŽEK)			x		
Triloculina gibba d'ORBIGNY			x		
Triloculina tricarinata d'ORBIGNY			x		x
Nodosaria acuminata HANTKEN			x		
Nodosaria badenensis d'ORBIGNY	x	x	x	x	x
Nodosaria latejugata GUEMBEL				x	
Nodosaria raphanistrum (LINNE)			x	x	x
Dentalina acuta d'ORBIGNY				x	x

	4, 5	6	9	10	11 12
Dentalina approximata (REUSS)	x	x	x	x	x
Dentalina inornata d'ORBIGNY				x	x
Dentalina intermedia HANTKEN	x		x	x	
Lagena div. sp.	x	x	x	x	x
Lenticulina div. sp.	x	x	x	x	x
Marginulina behmi (REUSS)	x		x	x	x
Marginulina hirsuta d'ORBIGNY	x		x	x	x
Marginulinopsis fragaria (GUEMBEL)	x	x	x	x	x
Planularia kubinyii (HANTKEN)	x				
Pseudonodosaria aequalis (REUSS)				x	x
Saracenaria hantkeni CUSHMAN	x		x	x	x
Saracenaria italica (DEFRANCE)				x	
Vaginulina plana NYIRŐ		x	x		
Vaginulina sp.	x		x		
Vaginulinopsis pseudodecorata HAGN			x		x
Bolivinella rugosa HOWE			x		
Globulina gibba d'ORBIGNY	x		x	x	x
Globulina granulosa EGGER		x	x		
Globulina inaequalis REUSS					x
Guttulina communis d'ORBIGNY	x		x	x	x
Guttulina deltoidea (REUSS)	x	x	x		x
Glandulina dimorpha (BORNEMANN)	x				
Glandulina ovula d'ORBIGNY	x		x		x
Oolina orbignyana (SEQUENZA)	x				
Oolina scarenaensis (HANTKEN)			x	x	
Fissurina laevigata REUSS	x		x		x
"Neobulimina" budensis (HANTKEN)	x				
Sphaeroidina bulloides d'ORBIGNY	x			x	x
Bolivina antiqua d'ORBIGNY		x	x	x	x
Bolivina beyrichi carinata HANTKEN			x	x	x
Bolivina fastigia CUSHMAN			x	x	
Bolivina liebusi HOFMANN		x	x	x	
Bolivina oligocaenica SPANDEL			x	x	
Bolivina reticulata HANTKEN			x	x	x

	4, 5	6	9	10	11 12
Bolivina semistriata HANTKEN			x	x	
Rectobolivina zsigmondyi (HANTKEN)	x		x	x	
Cassidulinoides oblongus (REUSS)		x			x
Stilostomella consobrina (d'ORBIGNY)	x			x	x
Bulimina alsatica CUSHMAN et PARKER			x	x	
Bulimina kasselensis BATJES					x
Bulimina ovata d'ORBIGNY					x
Bulimina pyrula d'ORBIGNY		x	x	x	x
Reussella spinulosa (REUSS)		x	x	x	
Uvigerina farinosa HANTKEN			x	x	
Uvigerina steyri PAPP			x	x	x
Uvigerina hantkeni CUSHMAN et EDWARDS	x	x	x	x	x
Trifarina angulosa (WILLIAMSON)				x	
Trifarina brady CUSHMAN				x	
Trifarina gracilis (REUSS)			x	x	
Trifarina tenuistriata (REUSS)				x	
Trifarina tubulifera (KAASSSCHIETER)		x	x	x	
Discorbis biapertura (POKORNY)		x	x	x	
Discorbis discoides (d'ORBIGNY)		x	x	x	
Discorbis squamosa (REUSS)				x	
Neoconorbina terquemi (RZEHAK)		x	x	x	
Escornebovina cuvillieri (POIGNANT)		x	x	x	
Patellina corrugata WILLIAMSON			x		
Rosalina globularis d'ORBIGNY		x	x	x	
Baggina philippinensis CUSHMAN			x	x	
Cancris auriculus (FICHTEL et MOLL)			x	x	x
Cancris turgidus CUSHMAN et TODD	x	x	x	x	
Valvulineria complanata (d'ORBIGNY)					x
Siphonina reticulata (CŽJŽEK)	x	x			
Asterigerinata planorbis (d'ORBIGNY)		x	x	x	
Rotalia propinqua REUSS			x	x	
Elphidium crispum (LINNE)		x	x	x	
Elphidium flexuosum (d'ORBIGNY)			x	x	
Cribrononion dollfusi dollfusi CUSHMAN			x	x	

	4 5	6	9	10	11 12
Cribrononion hiltermanni (HAGN)			x		
Cribrononion subnodosum (ROEMER)			x		
Globorotalia (Turborotalia) obesa (BOLLI)			x	x	x
Gr. (T.) opima nana (BOLLI)				x	x
Gr. (T.) opima opima (BOLLI)			x	x	x
Gr. (T.) permicra (BLOW et BANNER)			x	x	x
Gr. (T.) sp.				x	x
Globigerinita dissimilis dissimilis (CUSHMAN et BERMUDEZ)			x	x	x
Gn. martini scandretti BLOW et BANNER			x	x	x
Globorotaloides suteri BOLLI			x	x	x
Globigerina angulisuturalis BOLLI			x	x	
Gg. angustiumbilicata BOLLI			x	x	x
Gg. officinalis SUBBOTINA			x	x	x
Gg. ouachitaensis ciperoensis BOLLI			x	x	x
Gg. o. gnaucki BLOW et BANNER			x	x	
Gg. o. ouachitaensis (HOWE et WALLACE)			x	x	
Gg. praebulloides leroyi BLOW et BANNER			x	x	x
Gg. p. occlusa BLOW et BANNER			x	x	x
Gg. p. praebulloides BLOW			x	x	x
Globigerina-Globigerinoides transitional forms			x	x	
Globigerinoides quadrilobatus primordius BLOW et BANNER					x
Neoeponides schreibersi (d'ORBIGNY)		x	x	x	
Amphistegina hauerina d'ORBIGNY			x	x	
Planulina costata (HANTKEN)	x	x	x	x	x
Planulina wuellerstorfi (SCHWAGER)	x			x	x
Cibicides americanus (CUSHMAN)			x	x	
Cibicides borislavensis AISENSTAT			x	x	
Cibicides lobatulus (WALKER et JACOB)					x
Cibicides pseudoungerianus (CUSHMAN)					x
Cibicides pygmeus (HANTKEN)	x			x	
Cibicides roemeri (REUSS)	x		x	x	
Cibicides tenellus (REUSS)			x	x	
Cibicides ungerianus (d'ORBIGNY)			x	x	x
Cycloloculina annulata HERON-ALLEN et EARLAND			x		

	4, 5	6	9	10	11 12
Planorbulina mediterranensis d'ORBIGNY			x		
Caucasina elongata (d'ORBIGNY)					x
Cassidulina crassa d'ORBIGNY					x
Cassidulina laevigata d'ORBIGNY		x	x	x	
Globocassidulina globosa (HANTKEN)	x	x	x	x	x
Chilostomella ovoidea REUSS					x
Allomorphina trigona REUSS					x
Nonion boueanum (d'ORBIGNY)				x	x
Nonionella liebusi HAGN					x
Pullenia bulloides (d'ORBIGNY)	x		x	x	x
Pullenia quinqueloba (REUSS)	x	x	x	x	
Alabamina wolterstorfi (FRANKE)	x		x	x	
Alabamina tangentialis (CLODIUS)	x	x	x	x	x
Gyroidina soldanii (d'ORBIGNY)	x	x	x	x	x
Gyroidinoides planulatus (CUSHMAN et RENZ)			x	x	
Anomalina affinis (HANTKEN)	x		x	x	
Anomalina crassiseptata CUSHMAN et SIEGFUS	x		x		
Anomalina cryptomphala (REUSS)	x	x	x	x	x
Anomalina similis (HANTKEN)					x
Anomalina granosa (d'ORBIGNY)	x	x	x	x	x
Cibicidoides conspiciendus (PISHVANOVA)	x	x	x	x	
Hanzawaia americana (CUSHMAN)			x	x	x
Heterolepa bullata FRANZENAU			x		
Heterolepa costata FRANZENAU			x	x	x
Heterolepa dutemplei (d'ORBIGNY)		x	x	x	x
Heterolepa eocaena (GUEMBEL)	x	x	x		
Melonis affinis (REUSS)	x		x	x	x
Almaena osnabrugensis s. l. (MUENSTER)	x	x	x	x	x
Ceratobulimina contraria (REUSS)			x	x	x
Hoeglundina elegans (d'ORBIGNY)			x	x	x
Stomatorbina concentrica PARKER et JONES			x		
Robertina declivis (REUSS)					x
Alliatina nitida (TOLLMANN)					x
Gypsina sp.			x		

Table 2

Nannoplankton of the Novaj, Nyárjas section (M. BÁLDI-BEKE)

1 = 1-2 specimens
2 = rare
3 = few
4 = common
5 = frequent

	Sample numbers	Stage	Discocyclina multipora (KAMPTNER)	D. enormis LOCKER	D. pygmaea LOCKER	D. plana (BRAMLETTE et SULLIVAN)	D. latelliptica BÁLDI-BEKE	Pontosphaera sp.	Helicosphaera recta HAQ	H. euphratis HAQ	Helicosphaera sp.	Rhabdosphaera pannonica (BÁLDI-BEKE)	Zygrablithus bijugatus (DEFL.)	Coccolithus pelagicus (WALLICH)	C. eopelagicus (BRAML. et RIED.)	Cyclicargolithus floridanus (ROTH et HAY)	C. abisectus (MÜLLER)	Reticulofenestra bisecta (HAY et al.)	R. lockeri MÜLLER	Braarudosphaera bigelowi (GRAN et BRAAR.)	Sphenolithus moriformis (BRÖNN. et STRAD.)	S. delphix BUKRY	coccosphaere	Reworked forms from the Cretaceous	Reworked forms from the Eocene
Mollusc clay	12	Egerian	2	1			1	1	1		1		1	2		3	1	1	1					2	
Mollusc clay	11		2							1	2		1	1		3	1	1	2			1	1	2	
Glauconitic fine sand	10		1	1	1		1				2	1		2		3			1		1		1		
Clayey silt with Miogypsina	9							1			2			2		3	1				1			2	1
Lepidocyclina limestone	8																								
Lithothamnium limestone	7																								
Lepidocyclina marl	6		4				3						2	4		4	1	3	2						
Glauconitic sand	5		2			1	2		1		2		1	3		3	1	3	2	1					
Glauconitic sand	4		2		1		2				1			2			1	1	1				1		
Clayey silt	3	Kiscell.				1	5							1	1	5	1		2		1		1	1	
Clayey tuff bentonite	2						2						1	2		2			1						
Tuffaceous clay	1			1		2	5							4		3		2	4	2					1

BÉLAPÁTFALVA

The former Cistercian abbey was founded under the "Bélkő", a prominent cliff of the Bükk Mountains, by CLETUS II., archbishop of Eger in 1232. The wheel window and the decorated main portal of the church, as well as the ogival cross-vaulting inside are equally remarkable. The ruins of the surrounding monastery were excavated recently.

SZILVÁSVÁRAD

There was a well-known pottery factory working here in the last century. The classicistic church with circular ground-plan was built by József HILD (1837-1841). The PALLAVICINI castle was designed by Miklós YBL in 1860. The park of the castle is protected on account of its special flora. The main attraction of Szilvásvárad is the Lipizzian stud and the international carriage race grounds. On the annual races held here, the British Prince PHILLIP took part several times.

EDELÉNY

The castle of the general of French origin, L'HUILLIER is the seventh largest one in Hungary. During the construction of the castle (1727-1730) the general was the leader of the Eger fortress. Later (after 1820) the castle got into the possession of the COBURG principal family. The stucco-ornamented ceilings, the Rococo frescoes and the Zopf style tiled stoves are interesting relics of the Baroque castle.

SZENDRŐ

Its fortress built by the BEBEK family used to play important role among the border fortresses in the 16th century. The modernization of the building was performed by the Italian architect Cristoforo della STELLA by 1590. The system of Italian old- and new bastions are attached to his name.

SZALONNA

Its church with circular foundations was built in the 11th century, that was later extended in Romanesque style during the 12-13th century. The valuable fresco remains depicting topics taken from the life of St. MARGARET were painted later. The series of mural paintings visible on the vault-arch are attached to István SZEPESI, dated to 1426.

B-4

RAKACASZEND, road-cut

S. KOVÁCS and CS. PÉRÓ

Topography

The road-section is located in the northern part of the Szendrő Hills, about 1 km west of the village Rakacaszend (Fig.1).

Age

Middle Carboniferous, Bashkirian Stage.

Lithostratigraphy

The section exposes the transition of the Rakaca Marble Formation into the Szendrő Phyllite Formation.

Stratigraphy

The uppermost part of the Rakaca Marble Formation s. s. of carbonate platform facies can be seen in the western part of the section: white and

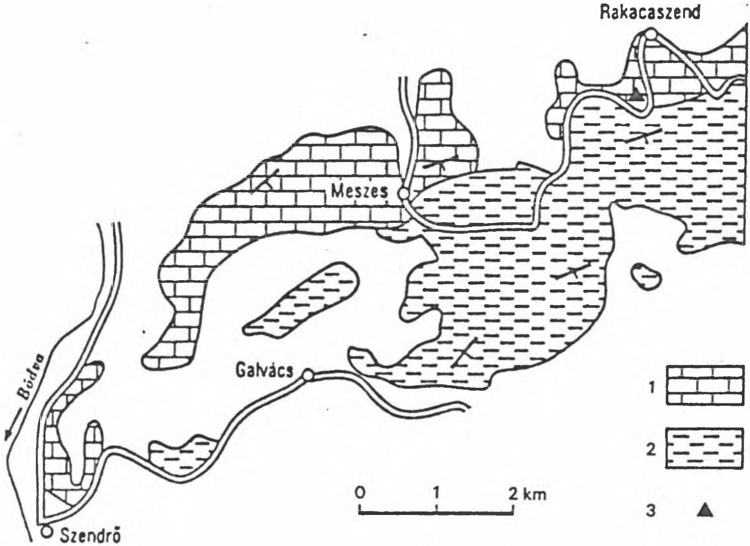


Fig. 1. Sampling locality in the Szendrő Mts. (Geological map after BALOGH 1964)
1. Rakaca Marble Formation, 2. Szendrő Phyllite Formation, 3. locality

light bluish-grey banded, coarse crystalline, thick bedded marble interfingering laterally, as visible in the top part of the exposure and higher up in the hill-slope, with brownish, finer crystalline, slightly sericitic marble of basinal facies (Beds numbered 1 to 10 on Fig. 2). The light-coloured, coarse crystalline marble is overlain by a few metres thick dark bluish-grey, finer crystalline, bedded marble of basinal facies containing conodonts (Beds 11-27). Higher up slate intercalations occur within the finer crystalline marble, indicating a gradual transition into the overlying Szendrő Phyllite Formation exposed in the western part of the section (Beds numbered from 28 upwards on Fig. 2).

The sequence has been affected by an Alpine metamorphism of low greenschist facies (400 °C and 3 kbar; ÁRKAI 1977). Due to the metamorphism, all original textural components of the marbles (both in the coarse and finer crystalline varieties) have been vanished and in thin-section a homogenous sparite texture of matrix character with a preferred orien-

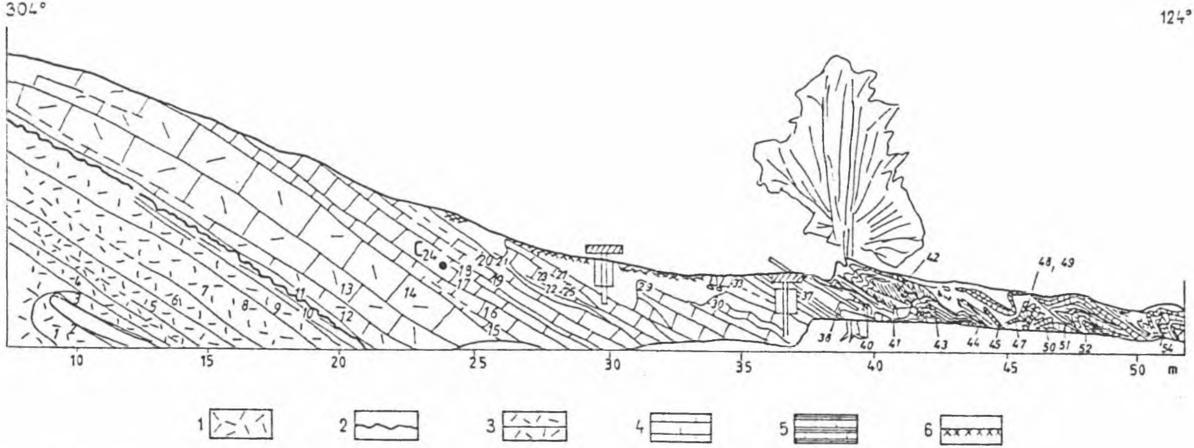


Fig. 2. Geological section of the artifical exposure (PÉRÓ 1988). Numbers indicate the number of beds. C_{24} = sampling point of conodonts listed in the text
1. Carbonate platform facies, light-coloured, coarse crystalline thick-bedded marble (Rakaca Marble Formation s. s.), 2. iron-coated surface (tepee structure), 3. transitional facies, bluish-grey, finer crystalline, thick-bedded marble, 4. basinal facies, dark bluish-grey, finer crystalline, bedded marble (3-4: Verebeshegy Limestone Member), 5. alternation of dark bluish-grey platy limestone, limeschist and dark grey phyllite (basal part of the Szendrő Phyllite Formation), 6. soil

tation can be seen. Conodonts are the only fossils which could survive the metamorphism; however, they are also strongly recrystallized and deformed, showing a high colour alteration index (CAI = 6-7; KOVÁCS and ÁRKAI 1987).

From the dark bluish-grey, finer crystalline marble the following Middle Carboniferous conodonts have been recovered (sample C-24):

Idiognathoides corrugatus HARRIS et HOLLINGSWORTH
Idiognathoides lateralis (HIGGINS et BOUCKAERT)
Idiognathoides noduliferous inaequalis HIGGINS
Idiognathoides noduliferous noduliferous (ELLISON et GRAVES)
Idiognathoides sinuatus HARRIS et HOLLINGSWORTH
Idiognathoides sulcatus sulcatus HIGGINS et BOUCKAERT

This fauna, fairly numerous in specimens, points to a lower Bashkirian age (I. corrugatus -- I. sulcatus zone of HIGGINS 1975). There is a full transitional series between I. noduliferous noduliferous and I. sinuatus (most of the specimens of the fauna fall to the transitional field between these two species). Based on their study (with special emphasis on the deflection of carina on the parapet) the authors suggest that the genus Declinognathodus (set up by DUNN in 1970 for "I". lateralis and "I". noduliferous) should not be separated from Idiognathoides HARRIS and HOLLINGSWORTH, 1933 and should be regarded as a younger synonym.

References

ÁRKAI,P. 1977; DUNN, D. L. 1970; HARRIS, R. W.--HOLLINGSWORTH, R. V. 1933; HIGGINS, A. G. 1975; KOVÁCS, S. 1983, KOVÁCS, S.--ÁRKAI, P. 1987, KOVÁCS, S.--KOZUR, H.--MOCK, R. 1983, KOVÁCS, S.--PÉRÓ, CS. 1983.

RAKACASZEND

Its outstanding architectural monument is the church from the age of the ÁRPÁD dynasty, with small tower and shingled roof cover. The church was built in the 12th century in Romanesque style and later extended during the 13th century. There are fragments of medieval mural paintings (probably St. PETER) in the sanctuary and on the vault-arch.

B-5

JÓSVAFŐ, Vöröstó branch-off

A. BÉRCZI-MAKK
with the contribution of S. KOVÁCS and O. PIROS

Topography

On two sides of the Jósvafő--Aggtelek road, 50 m before the Vöröstó branch-off we can find an exposure of the Oncoidic Steinalm Limestone (Fig. 1). On the northern side of the road nearly parallel to the strike a key section was opened (PIROS 1988a). The section shown on Fig.2 was taken at the left side of the exposure.

Age

Middle Triassic (Anisian).

Lithostratigraphy

Steinalm Limestone Formation.

Stratigraphy

The rock is light-grey, thick-bedded, and has an uneven fracture. The lowermost 60 cm contains only occassional oncoids. The texture of the rock is biomicrite, with fragments of foraminifers [Ammobaculites sp., Ammobaculites radstadtensis KRISTAN-TOLLMANN, Endothyra badouxi ZAN. et BRÖNN., Endothyra cf. obturata BRÖNN. et ZAN., Endothyra sp., Endothyranella wirzi (KOEHN-ZANINETTI), Meandrospira dinarica KOCH.-DEV. et PANT., Dentalina sp., Diplotremina astrofimbriata KRISTAN-TOLLMANN)], ostracods

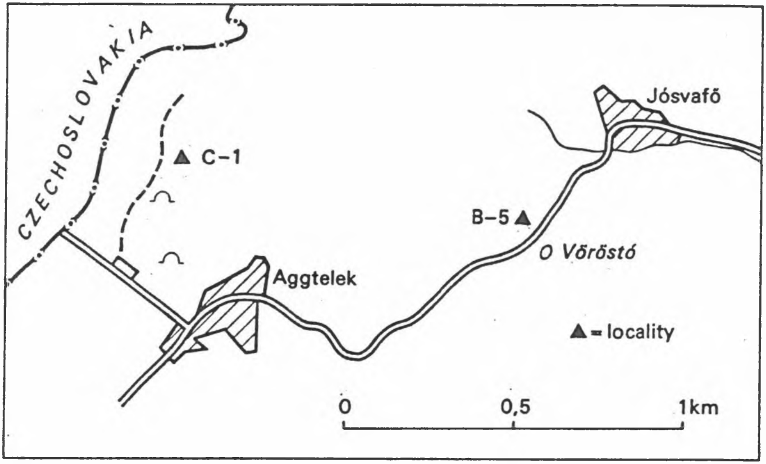


Fig. 1. The map of the exposure of the Steinalm Limestone Formation (oncoidic lagoon facies) at Jósvafő--Vöröstó branch-off (B-5) and that of the Wetterstein Limestone Formation (lagoon facies) at Aggtelek--Baradla plateau (C-1)

and gastropods. The oncoids can reach the size of 2--3 cm.

From 0.60--1.10 m the oncoids are smaller, their number is increasing, and their position within the layer is parallel to that of the stratification of the loferite. In the oncoidal stripes (oncolite) the matrix is washed out, the cavities are filled with palisade at the margins and mosaic spar in the middle. In the biogenic fragments between the oncoids we find Diplopora hexaster PIA, Physoporella sp. and Oligoporella sp., gastropod fragments and foraminifers /Trochammina almtalensis KOEHN-ZANINETTI, Ammobaculites radstadtensis KRISTAN-TOLLMANN, Earlandinita oberhauseri SALAJ, Endothyra aff. küpperi OBERHAUSER, Endothyra malayensis GAZDZICKI, Endothyra sp., Endothyranella wirzi (KOEHN-ZANINETTI), Endothyranella sp. Haplophragmella inflata ZAN. et BRÖNN. Meandrospira dinarica KOCH.-DEV. et PANT., Diplotremina astrofimbriata KRISTAN-TOLLMANN/.

The 1.11 to 1.36 m part composed of biopelmicrite contains foraminifers /Trochammina almtalensis KOEHN-ZANINETTI, Earlandinita oberhauseri

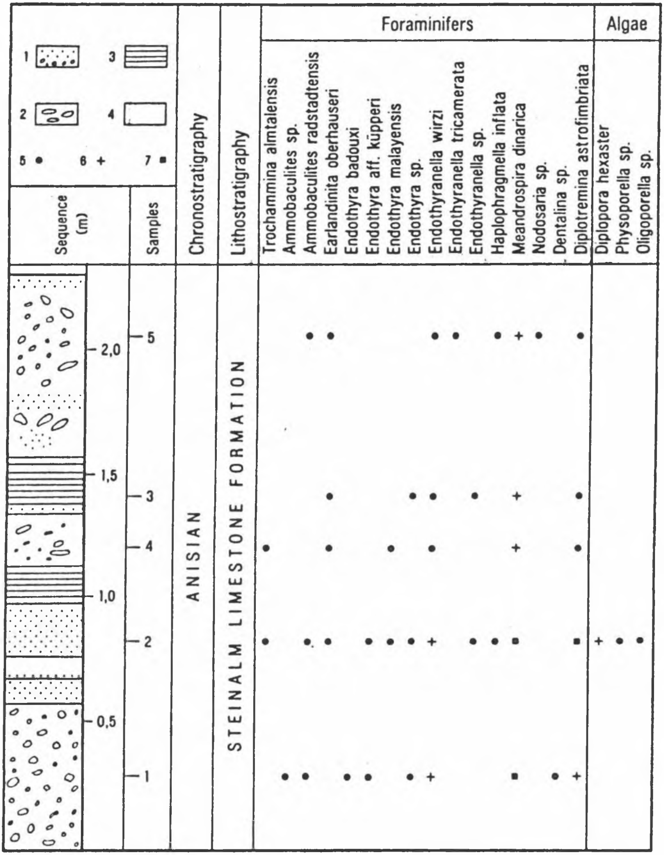


Fig. 2. The outcrop of the Jósvafő--Vöröstó branch-off with the distribution and frequency of fossils
1. Oncoid, 2. stromatactis, 3. loferite, 4. bioclastic limestone, 5. few, 6. frequent, 7. abundant

SALAJ, Endothyra malayensis GAZDZICKI, Endothyranella wirzi (KOEHN-ZANINETTI), Meandrospira dinarica KOCH.-DEV. et PANT., Diplotremina astrofimbriata KRISTAN-TOLLMANN/, fragments of small molluscs and ostracods. Oncoids are only sporadically present.

Above this layer there is an oncoid bed followed by, up to 1.53 m, homogenous loferite. Its texture is oncoidic biopelsparite. The position of the pores results in a horizontal lamination. The layer contains foraminifers / *Earlandinita oberhauseri* SALAJ, *Endothyra* sp., *Endothyranella wirzi* (KOEHN-ZANINETTI), *Endothyranella* sp., *Meandrospira dinarica* KOCH.-DEV. et PANT., *Diplotremina astrofimbriata* KRISTAN-TOLLMANN/ and ostracods.

Following the loferite layers again we find a biomicrite layer, rich in foraminifers /*Ammobaculites radstadtensis* KRISTAN-TOLLMANN, *Earlandinita oberhauseri* SALAJ, *Endothyranella wirzi* (KOEHN-ZANINETTI), *Endothyranella tricamerata* SALAJ, *Haplophragmella inflata* ZAN. et BRÖNN., *Meandrospira dinarica* KOCH.-DEV. et PANT., *Nodosaria* sp., *Diplotremina astrofimbriata* KRISTAN-TOLLMANN/, ostracods and mollusc fragments. It is overlain by a stripe of oncoids as well.

The Foraminifera fauna can be characterised by the low species and high specimen number. The frequency of the species *Meandrospira dinarica* KOCH.-DEV. et PANT. and *Diplotremina astrofimbriata* KRISTAN-TOLLMANN, as well as the general frequency of the taxa belonging to the genera *Ammobaculites*, *Earlandinita*, *Endothyra*, *Endothyranella* is striking. There are mainly agglutinated and thick-shelled forms present. The forms resistant to intensive water currents indicate carbonate platform margin facies.

It is important to note the presence of the species *Meandrospira dinarica* KOCH.-DEV. et PANT., which is very sensitive to facies, preferring clear, shallow water, occurring in the micrites and intramicrites of the carbonate platform.

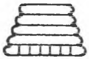
The species *Earlandinita oberhauseri* SALAJ is a frequent species in all examined samples. It is sensitive to facies, characterising the marginal part of the platform in lagoon facies.

The species *Diplotremina astrofimbriata* KRISTAN-TOLLMANN is one of the few foraminifer species which is not sensitive to facies. Its first appearance dates back the lowermost Pelsonian. It can be found both in the oolitic or bioclastic limestone of the carbonate platform, as well as in the marginal facies of the platform.

References

PIROS, O. 1988a.

JÓSVAFŐ



There were traces of 10-11th century iron smelting in the village. Iron foundries are mentioned from here in charts from 1399.

B-6

FACULTATIVE EXCURSION TO THE BARADLA CAVE

O. PIROS

Outcrop at the "Octopus" dripstone

The outcrop is situated in the Jósvafő part of the Baradla cave, at 1650 m. Proceeding from the Vöröstó (Red lake) entrance, the autigene brecciated part of the outcrop follows when crossing the bridge after the dripstone formation called "Octopus". Crinoids in rock-forming quantity can be found, partly in the form of nests on this wall and by the walls of the passage in weathered state.

The outcrop belongs to the reef body of the Jósvafő--Aggtelek region. This is a patch reef surrounded by extended reef debris zone. Within the cave we find this reef debris zone exposed. The brecciated reef debris layers alternate with pink, fine-grained limestone beds. The microfacies of the reef debris limestone is biosparite (grainstone).

Fossils: echinoderms, gastropods, reef-dwelling sponges and brachiopods. Most frequent are crinoidal stems, of 3--15 mm in diameter.

The microfacies of the pink layers is micrite. Within the generally 20 cm thick beds lateral grey calcite veins appear at 2--3 cm intervals. This formation can be considered as sedimented in a little bit deeper water than the reef debris limestone, and is occasionally replaced by brecciated reef limestone debris due to more intensive water agitation.

Age: Middle Triassic, Anisian.

Tiger- room

Outcrop of Wetterstein limestone of lagoonal facies

The key section outcrop is situated at the Aggtelek parts of the Baradla cave, in the so-called "Tiger-room". On the surface of the medium-grey, flaky fractured, thick-bedded limestone calcareous algae, gastropods and ammonites are visible due to weathering. The texture of the limestone is biosparite, biopelsparite (grainstone). The fossils on the surface of the rock represent the trichophorous and the vericulipherous types of the dasycladacean Diplopora annulata. Dominant is the trichophorous type. The skeletal elements of the dasycladaceans are of 6--8 mm in length and 2--3 mm in diameter. The annulate character is observable macroscopically as well. Besides the species Diplopora annulata, we find specimens of Aciculella sp. also, however, this form is not observable macroscopically. The chambers of a single ammonite of 3--4 cm diameter are also visible.

Age of the limestone: Middle Triassic, Ladinian.
The facies of the rock can be determined, based on the textural features and the fossils, the limestone is of lagoonal facies.

Dragon's Head (Fig. 1)

Within the medium-grey Steinalm limestone of lagoonal facies, we can find an intercalation rich in ammonites, leaving the dripstone formations called "Dragon's Head" and the "Arrival of the Hungarians" on the right side of the passage leading towards Jósvafő. The fossils which are excellently visible due to wheathering are about 2 cm in diameter.

The best casts of ammonites, however, which are 3--7 cm in diameter can be observed in the Dragon cave on the surface of a large boulder detached from the ceiling.

Microfacies: intrabiomicrosparite, intrabiosparite.

Apart from ammonites, there are casts of nautiloids and brachiopods visible near the key section. On the basis of its fossils, the ammonitic

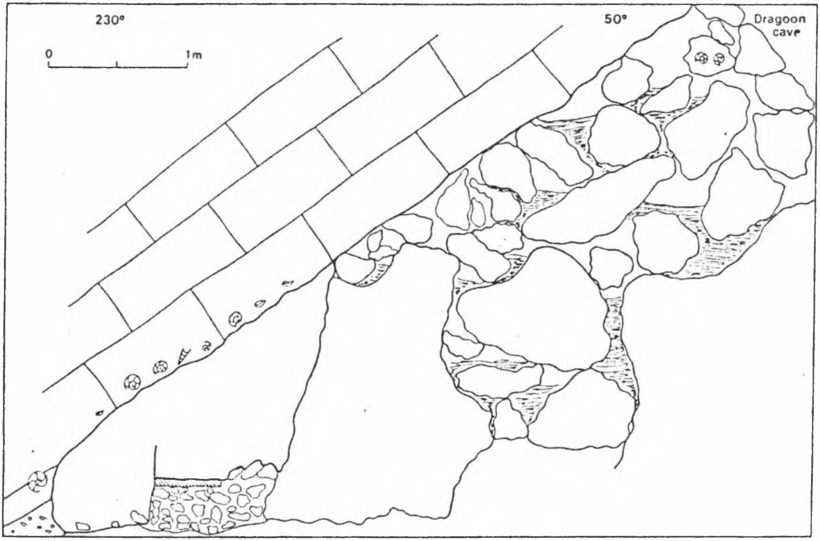


Fig. 1. Dragon's Head

bank can be assigned to the sediments of back-reef slope of the Steinalm-Wetterstein reef.

The age of the limestone: Middle Triassic, Anisian.

Exposure at the point "5700 m"

Red, brachiopodal limestone

The exposure is represented by a solitary boulder situated at the 5700 m point within the illuminated Jósvafő part of the Baradla cave in the bed of the underground creek, which is a 0.5 m thick fallen-off piece of the ceiling.

It is a brownish-red limestone of conchoidal fracture. Its microfacies is biomicrosparite (wackestone). The shells of brachiopods occurring abundantly are 1--1.5 cm in diameter. Apart from the brachiopods, fragments of bivalves, crinoids and echinoids are frequently occurring. Conodonts were also found here.

Fauna:

Bivalvia: Daonella sp.

Brachiopoda: Coenothyris vulgaris (SCHLOTH.)
Koeveskallina koeveskallyensis (SUESS)
Mentzellia mentzelii DUNK.
Tetractinella trigonella (SCHLOTH.)

Crinoidea: fragments

Echinoidea: spines

Conodonta: Gondolella aff. regalis (MOSHER)

Age of the limestone: Middle Triassic, Anisian.

Swallow-hole in the Giant's room

The exposure is situated in the illuminated Jósvafő part of the Baradla cave, before the swallow-hole in the Giant's room, on the eastern wall.

The limestone is of flaky fracture, medium grey, sometimes pinkish. It is striped with layers of cavities filled with calcite crystals. The exposed rock is well-bedded, within the layers we find three types of alternating microfacies:

1. loferite (algal mat), biopelmicrosparite, with oriented loferitic stripes

2. biosparite with rich dasycladacean flora:

Physoporella pauciforata pauciforata
Physoporella pauciforata undulata
Physoporella sulcata
Teutloporella peniculiformis

3. brecciated limestone with pinkish matrix containing irregular oncoid intraclasts.

The alternation of three types results in a kind of structure similar to the "Lofer cyclotheme". In the case of this structure, however, A member is not typical.

Age of the limestone: Middle Triassic, Anisian.

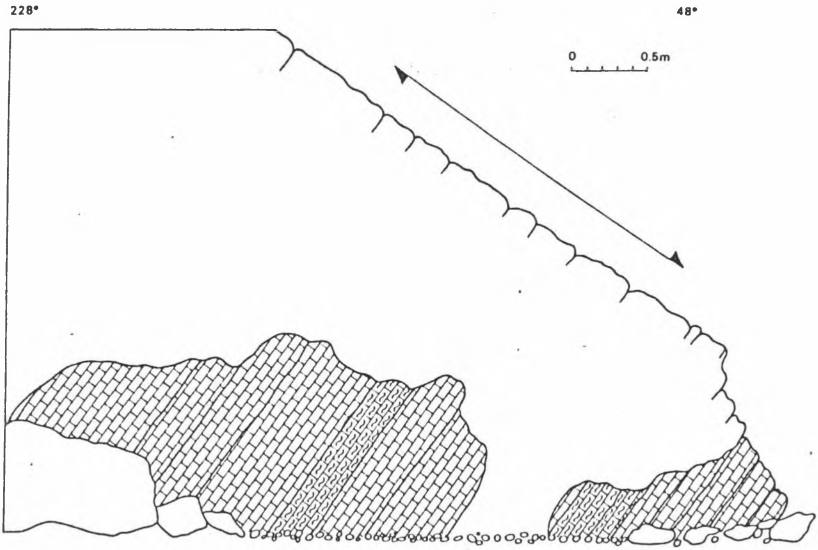


Fig. 2. "Stage"

"Stage"

Gutenstein Limestone, marl, calcareous marl series (Fig. 2)

The exposure serving as a key section is visible on the eastern wall of the room called "Stage" in the Jósvafő illuminated part of the Baradla cave. There are 19 layers of alternating dark-grey, grey, sometimes beige or reddish layer of limestone, marl and calcareous marl. The formation of the sequence can be explained by repeated inflow of fine grain sediments. There was more or less, fine-grained terrigenous material transported in the shallow water, restricted lagoon where the Gutenstein Limestone was formed. Depending on the quantity of the terrigenous material, more or less marly layers were formed.

Age of the rock: Middle Triassic, Lower Anisian.

"Fault-room"

Key section exposure of the Gutenstein Limestone Formation (Fig. 3)

The section is located at the W wall of the so-called "Fault-room" in the Jósvafő illuminated part of the Baradla cave.

We can observe here the oscillatory transitional series of two different types of the Gutenstein Limestone Formation.

Type a is dark-grey, black dolomitic limestone, with flaky-conchoidal fracture, composed of small or fine crystalline grains, spreading the smell of bitumen when hit against. This type is well-bedded in the section, but at several points of the cave it is known to occur in any varieties from the thinly-layered to the thick-bedded one. The surface of the layers are smooth. There are stylolites coloured by limonite within the layers, which can be interwoven with dense network of white calcite veins.

Microfacies: micrite, dismicrite, microsparite (mudstone).

Solution remnants: 0.65--2.5 wt%.

CaO/MgO: 73.1--8.4.

Type b is a light-grey, medium grey, fine- or small-crystalline limestone and dolomite, with chonchoidal fracture. It is bedded, platy, with parallel bedding. The stylolites coloured by limonite are fairly frequent.

Microfacies: intramicrite (packstone, wackestone). The intraclasts in the limestone are of micritic texture, the bulk of which fall into the order of 0.1--0.5 mm, well-sorted, rounded.

Solution remnants: 1.00--6.55 wt%.

CaO/MgO: 7.1--2.6 (after BORKA 1982).

On the alternation of the two types within the key section, see above.

Age of the limestone: uppermost Scythian--Middle Anisian.

The dark grey Anisian limestone was possibly formed in shallow, undisturbed, normal salinity sea water, poor in oxygene, then underwent the diagenesis of the calcipelite sediment type (early diagenesis with dolomitization). The light-coloured type suggests an environment which was richer in oxygene.

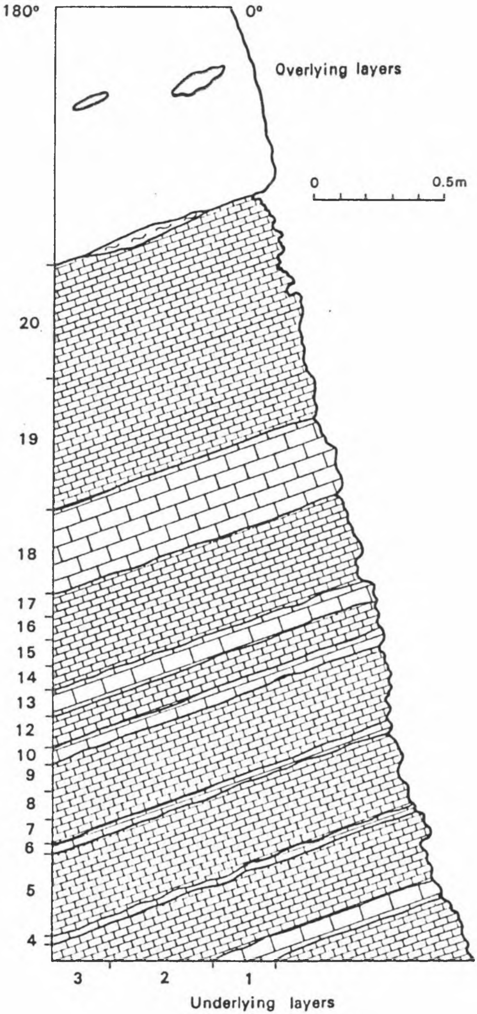


Fig. 3. Fault-room. Exposure of the Gutenstein Formation

Key section (after BORKA 1982)

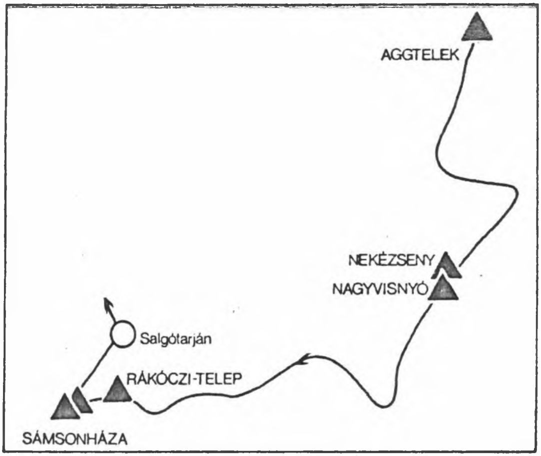
AGGTELEK

The name of the village became well-known on account of the Baradla cave system, one of the largest cave systems in Europe. The Baradla cave is already mentioned by Matthias BÉL in his "Notitia Hungariae" (1742). The map of the cave published in 1794 by József SARTORY is the first speleological map issued on the world. The distinguished Hungarian poets CSOKONAI (1801) and PETŐFI (1845) also visited the cave. The dripstone ornaments of various shape represent immense value. In the great hall of the cave concerts are held regularly.

The cave system contains the richest cave flora and fauna described from Europe (21 plant and 262 animal species). The known length of the cave system is constantly increasing even today due to speleological investigations.

The 5 km long Béke cave (Cave of Peace) situated nearby was discovered in 1952 by László JAKUCS. The cave is utilized as a health and therapy centre.

7 September: C: AGGTELEK--NEKÉZSENY--NAGYVISNYÓ--RÁKÓCZITELEP (BÜKKZSÉRC-SZOKOLYA)--SÁMSONHÁZA--SALGÓTARJÁN



C-1

AGGTELEK, Baradla plateau

A. BÉRCZI-MAKK
with the contribution of S. KOVÁCS and O. PIROS

Topography

The exposure is in the vicinity of the entrance of the Baradla cave. Coming by car, proceeding towards the border station you have to turn right immediately after the camping. Leaving the entrance of the cave by some 150 m, after a sharp left turn of the track we can reach the locality (see map for C-4: Fig. 1).

Age

Middle Triassic, Ladinian.

Lithostratigraphy

Wetterstein Limestone Formation, lagoonal facies.

Stratigraphy

The thick banks of the Wetterstein limestone are exposed in the thickness of cca. 4 m here (Fig. 1). The colour of the rock is atipically dark-grey, medium-grey, at the top of the section, from 3.45 m, light-grey. On the surface of the rock, weathered dasycladaceans can be observed. The texture of the rock is biosparite, biopelsparite (grainsupported grainstone). At the parts containing more Dasycladaceae (Fig. 1) the voids between the bioclasts are larger and not oriented. The margin of the voids is lined with fibrose-, their interior parts by mosaic-sparite. In the parts which are poor in Dasycladaceae (see Fig. 1) we can observe a horizontal stromatactis structure, where the sparitic crystals filling the cavities are smaller. Among the Dasycladaceae, the type trichophor of Diplopora annulata is dominating, however, the vesiculifer type of the same species occurs as well. Aciculella sp. is also frequently occurring. Apart from the algae, we find foraminifers (Glomospira sp., Trochammina almtalensis KOEHN-ZANINETTI, Trochammina alpina KRISTAN-TOLMANN, Trochammina sp., Ammobaculites sp., Earlandinita oberhauseri SALAJ, Endothyra cf. kuepperi OBERHAUSER, Endothyranella sp., Diplotermina astrofimbriata KRISTAN-TOLMANN, Diplotremina altoconica KRISTAN-TOLMANN, Variostoma sp., Aulotortus sinuosus (WEYNSCHENK) as well as indeterminable gastropod fragments in the limestone.

The foraminifer fauna, which is relatively good state of preservation, is poor in species and specimens, characterized by the general distribution of species Earlandinita oberhauseri SALAJ and the genus Diplotremina.

The species Earlandinita oberhauseri SALAJ is sensitive to facies, typical of the platform marginal, lagoonal facies. Its frequency clearly indicates the lagoonal facies.

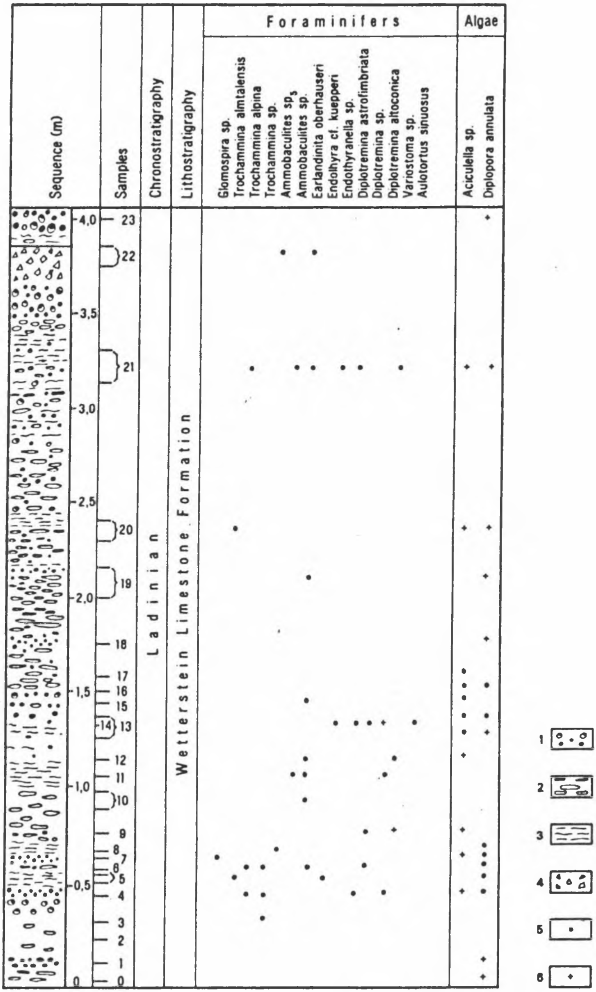


Fig. 1. Profile of the section at the NW foot of the Baradla plateau, Aggtelek, with the frequency and distribution of the fossils

1. Dasycladaceae, 2. stromatactis, 3. algal mat, 4. bioclast, 5. few, 6. frequent

References

PIROS, O. 1988b.

C-2

NEKÉZSENY, Strázsa Hill

S. KOVÁCS

Topography

The southwestern ridge (called Harka-tető) of Strázsa Hill, rising at Nekézseny on the southern margin of the Uppony Mts. (Fig. 1) represents the type locality of the volcano-sedimentary Strázsahegy Formation.

Age

Higher Lower Devonian or Middle Devonian.

Stratigraphy

In the two quarries on the southwestern tip of the ridge, Schalstein-type (det. ÁRKAI 1982) basic volcanic rocks are exposed, overlain higher up on the ridge by an olistostrome of about 30 m thickness, with basic volcanic matrix and limestone olistoliths. On the southeastern slope of the ridge, however, a white, coarse-crystalline metasomatic dolomite slide-mass is wedged in between them, with small basic volcanic inclusions in some places.

In the former literature (SCHRÉTER 1945, PANTÓ 1954, BALOGH 1964, see in KOVÁCS 1981) before having the possibility to make artificial exposures, volcanic rocks and limestones were thought to be contemporaneous and alternating with each other, and, based on lithological similarities, assigned to the Middle Triassic (Ladinian). Only in 1978, when investigating the age of the basic volcanic rocks of the Uppony Mts. with VETŐ-ÁKOS, could the present author find early Lower Devonian conodonts on the

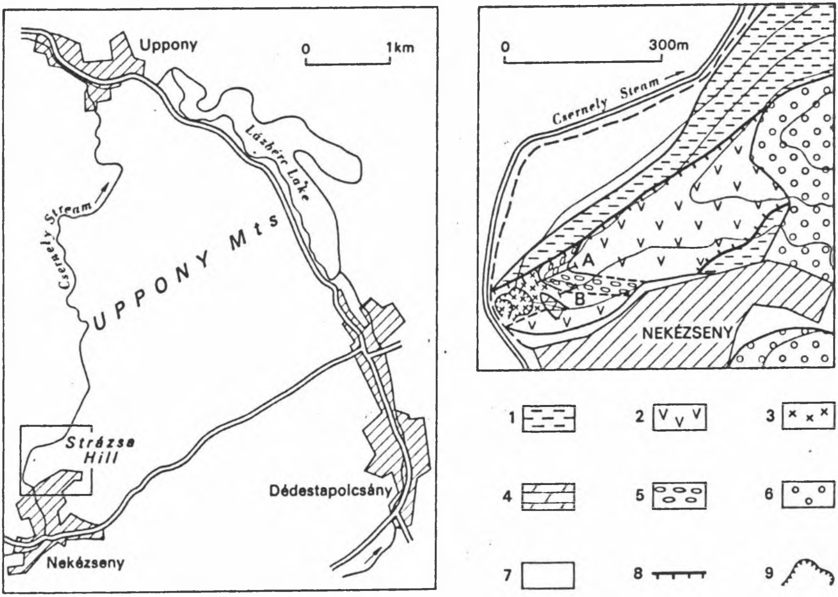


Fig. 1. Locality map and simplified geological map of the Strázsa Hill at Nekézseny, on the southern margin of the Uppony Mts
1. Tapolcsány Formation (?Silurian), 2. Strázsahegy Formation (Devonian) in general, 3. Schalstein unit of the Strázsahegy Formation, 4. metasomatic dolomite body, 5. olistostrome unit of the Strázsahegy Formation, 6. Upper Cretaceous Gosau-type conglomerates(Nekézseny Conglomerate Formation, Senonian), 7. Quaternary, 8. overthrust, 9. quarry. -- "A" and "B" shows the location of artificial exposures

ridge (Sample N-3 on Fig. 2). However, still without having the possibility of having artificial exposures, he followed the opinion of the former authors about the contemporaneity of volcanites and limestones (KOVÁCS 1981, KOVÁCS and VETŐ-ÁKOS 1983).

In 1982 we had the possibility in the framework of the mapping of the Uppony Mts. to prepare the artificial exposures to be visited during this excursion. These exposures and the subsequent detailed investigation of the whole locality allowed us to recognize that the sequence on the ridge represented a typical olistostrome with two major types of olistholiths (KOVÁCS 1982, KOVÁCS--PÉRÓ 1983).

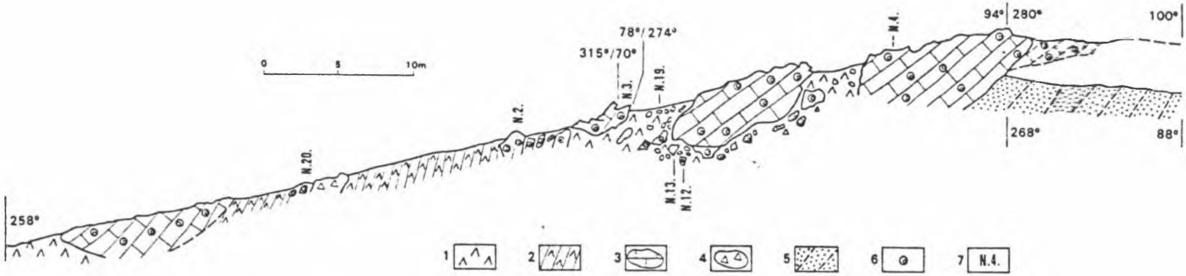


Fig. 2. Geological profile of the artificial section "A", shown on Fig. 1, on the ridge of Strázsa Hill
1. Basic volcanics (Schalstein in the lowermost part and lava), 2. metabasalt with gentle schistosity, 3. limestone olistoliths, 4. limestone-metabasalt breccia olistoliths, 5. ankerite, 6. crinoidal limestone, 7. number of conodont samples

The matrix, as investigated by ÁRKAI 1982, is made up by metabasalt lava, amygdaloidal lava and only subordinately by basaltic tuff. Limestone olistoliths belong to two major types:

1. Silurian purplish red and green, sometimes light pink, pelagic limestones. Blocks of this type are usually fist- to head-sized, in some cases up to a few m^3. They are less frequent, than the other major type. Their microfacies is ostracod-, or ostracod-spiculiferous biomicrite (wackestone); the micrite, however, is mostly recrystallized into microsparite. Other biogenic components recognizable in thin section are echinoderm fragments, sometimes nautiloids, brachiopods and even conodonts. Macrofossils are represented by orthoconic nautiloids (enriched in certain horizons in a few blocks) and sometimes by brachiopods. Conodonts in this facies are very numerous (Samples N-10, N-11^x, -15, -17, -18, -19), however, they are mostly of single cone type having less value as zonal indicators. From among spathognathodiform elements, only Spathognathodus inclinatus inclinatus WALLISER and its associated ramiform elements are frequent (building up together the "Ozarkodina excavata excavata" multielement). We have found the following Pa-elements of stratigraphic importance:

Kockelella variabilis WALLISER (Samples N-11, N-10)
Spathognathodus inclinatus inflatus WALLISER (Samples N-10)
Spathognathodus sagittus WALLISER (Sample N-15)

S. sagittus is a zonal index species of the Wenlockian Stage, while the other two species are characteristic of the Ancoradella ploeckensis and Polygnathoides siluricus zones of the Ludlowian Stage.

2. Early Lower Devonian (Lochkovian) light grey, sometimes dark bluish-grey crinoideal limestone. Blocks of this type constitute the majority of the olistoliths and they are usually larger than those of the former type (may be as large as a smaller house). The crinoid detritus shows gradation within a few olistoliths. Broken crinoid stems sometimes may reach finger-size. In addition, brachiopods and fragments of corals can also be found rarely. In thin section it can be seen (if the rock is not completely recrystallized), that the original matrix was micritic and the textural type was crinoidal rudstone. The depositional environment can be interpreted as base-of-slope (reef-slope).

Conodonts are less abundant in this type, though they can be fairly numerous in a few olistoliths. The Lochkovian age is indicated by the following Pa-elements:

Spathognathodus masarus (SCHÖNLAUB) (Sample N-3)
Spathognathodus remscheidensis remscheidensis ZIEGLER (Samples N-3,-9, -12, -16)
Spathognathodus wurmi BISCHOFF et SANNEMANN (Samples N-3, -8, -9)
Spathognathodus aff. optimus MOSKALENKO (Sample N-3)

S. remscheidensis remscheidensis and S. wurmi range practically throughout the Lochkowian, while S. masarus and S. aff. optimus are indicative of its uppermost part (=Gedinnian/Siegnian boundary interval in the West European chronostratigraphic subdivision).

While the present author's field and laboratory investigations (KOVÁCS 1982) were ongoing and shortly after, H. KOZUR also made a few excursions to the locality and published conodonts from here (KOZUR 1984b and in BALOGH--KOZUR 1985). Unfortunately, it is difficult to evaluate his data because he has not marked his sampling points on the field (it seems, that partly he resampled the present author's marked sampling points with different numbers). Nevertheless, his data support a similar age assignment for the olistoliths as our findings. Similarly to KOVÁCS and PÉRÓ (1983), he also compared the olistoliths with the pelagic Silurian of the Carnic Alps. However, his "formation to formation" lithostratigraphical correlation with the Celloni type section of the Carnic Alps (based on SCHÖNLAUB 1980) seems to be rather exaggerated: in fact, it is merely a correlation of the conodont zones recognized in the olistoliths with those of the continuous Celloni section.

In addition, he described a few new species of coniform conodonts from here (KOZUR 1984b):

Belodella striata n. sp.
Decoriconus magnistriatus n. sp.
Neopanderodus hungaricus n. sp.
Neopanderodus praesemicostatus n. sp.
Panderodus barricki n. sp.
Panderodus recurvatus densistriatus n. ssp.

From this locality, too, KOZUR (1984a) published Armstrongisphaera n. gen. n. sp. belonging to Muellerisphaerida n. ord. of uncertain taxonomic position (from the sample signed as N 3 in KOVÁCS 1981 an as Sh-5 in BALOGH--KOZUR 1985, in which it was found associated with lowermost Devonian conodonts).

References

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C-3

NAGYVISNYÓ, Mihalovits quarry

A. BÉRCZI-MAKK and P. PELIKÁN

Topography

The Mihalovits quarry is located NW of Nagyvisnyó, W--NW of the railway station, E of the Cigány valley (Fig. 1).

Age

Upper Permian.

Lithostratigraphy

Nagyvisnyó Limestone Formation.

History

The classical section of the marine Permian of the Bükk Mts., including its rich fossil content, has been investigated by a number of experts, e. g.: ANTAL--BALOGH (1980), BALOGH (1964), HERAK--KOCHANSKY

(1963), KOZUR (1985a, 1985b), ROZOVSKAYA (1963), SIDÓ--ZALÁNYI--SCHRÉTER (1974).

Sequence

The cca. 35 m thick Upper Permian series represents the higher levels of the Nagyvisnyó Limestone Formation. Its immediate connection with the underlying and the overlying formations can be traced in the neighbouring reference sections (Mál-slope, I, II, III, IV.) and boreholes (Mályinka-8, Nagyvisnyó-18). The overlying layers are known on

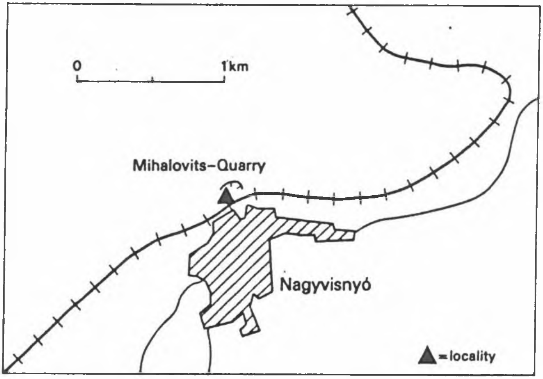

Fig. 1. Map of the locality

the basis of Borehole Mályinka-8, where upper Changsingian foraminifers were collected. The underlying layers were opened by the sections located at the Mál-slope sections lying to the W of the quarry (Lower Changsingian and Dzhulfian). The age of the sequence exposed in the quarry is, according to KOZUR (1985a) higher Abadehian.

The section presented on Fig. 2 is proceeding from the plateau (as point 0), from the younger formations towards the older ones at the left (W) side of the quarry. The section is currently under complex lithostratigraphical and biostratigraphical evaluation. The part of the quarry serving as a type section of the Nagyvisnyó Limestone Formation

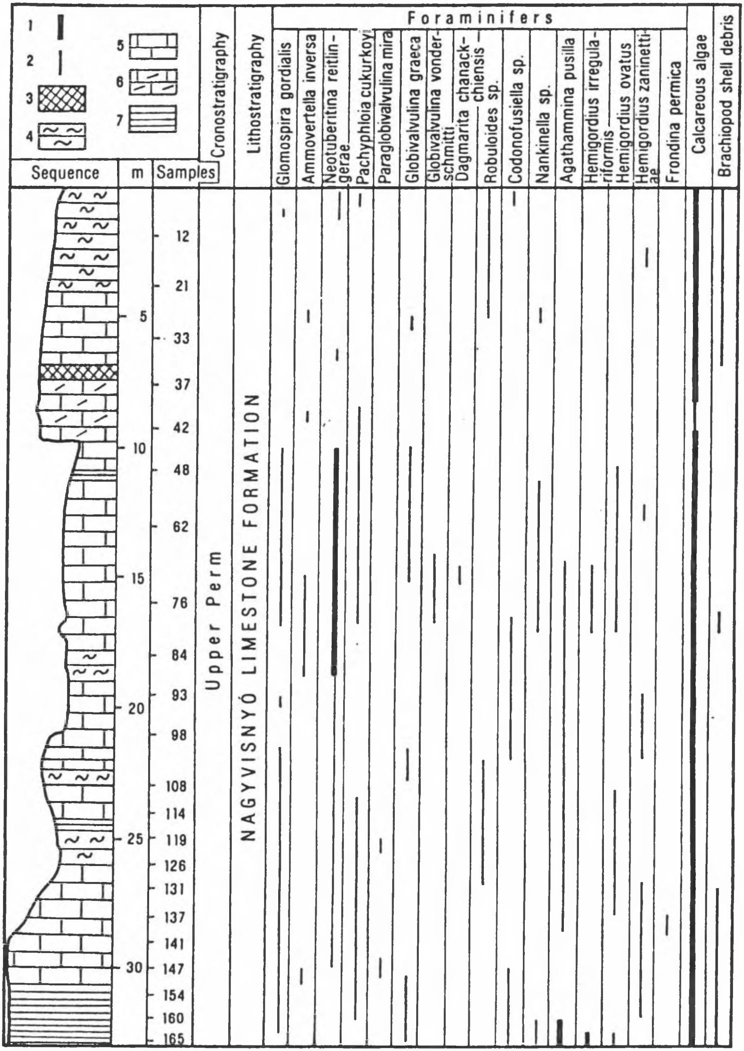

Fig. 2. Nagyvisnyó, Mihalovits bigger quarry, geological section (measured by PÉRÓ, 1978) with characteristic fossils. Key see by Fig. 3

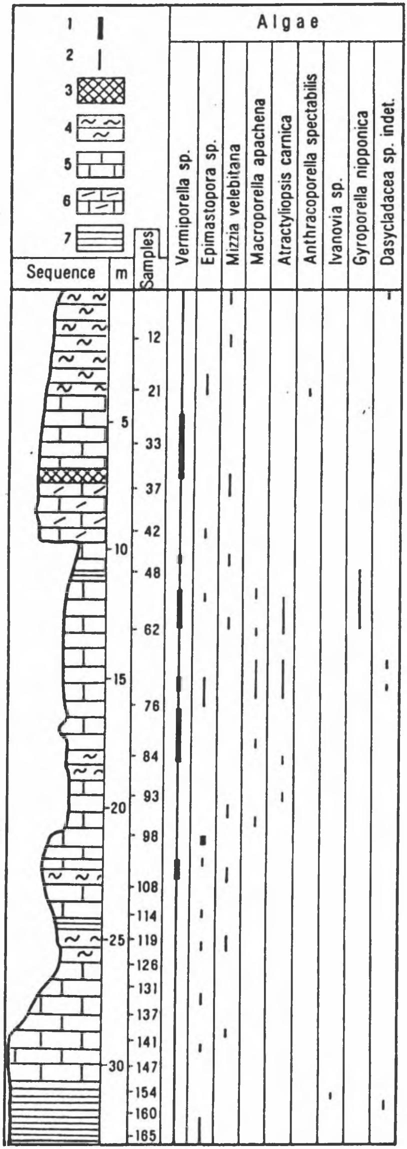

Fig. 3. Nagyvisnyó, Mihalovits bigger quarry, geological section (measured by PÉRÓ 1978), with algal remains

1. Mass occurrence, 2. few, 3. fault zone, 4. black marl, calcareous marl, 5. grey limestone, 6. grey dolomitic limestone, 7. grey, thinly bedded limestone

is dark grey, black, comprising thin banks or sometimes thinly-bedded limestone, often with intercalations of black foliated marl and clay-marl. On the weathered surface of the rock, remains of Dasycladaceae are visible. There is a fault zone between layers 36 and 37, and under layer 165 we can observe a tectonically disturbed zone. Remains of corals (Waagenophyllum), brachiopods, Nautiloidea and gastropods (Bellerophon), and bivalves are frequently found in the rock. According to the microfacies analysis of thin sections the most frequent type is biomicrite and biosparite with calcareous algae and foraminifers. The texture of the rock is packstone-wackestone.

Among the biogenic elements, dominant are calcareous algae represented by Gymnocodium, Macroporella, Vermiporella and Mizzia species (Fig. 3). In frequency order, the calcareous algae are followed by foraminifers. The older layers of the quarry (layers 45-190) are rich in foraminifers, both in species and specimens, with special regard to representatives of the genus Hemigordius. It is remarkable to note the general distribution of some members of the Tuberitinidae family as well as one species of the genus Nankinella.

Sample 3:

Ammodiscus sp.
Cyclogyra sp.
Glomospira gordialis (JONES et PARKER)
Ammovertella inversa (SCHELLWIEN)
Earlandia dunningtoni (ELLIOTT)
Neotuberitina reitlingerae (MIKL.-MAKL.)
Tuberitina collosa REITLINGER
Monogernerina sp.
Pachyphloia cukurkoyi S. de CIVR. et DESS.
Pachyphloia gefoensis (MIKL.-MAKL.)
Paraglobivalvulina mira REICHEL
Globivalvulina bulloides (BRADY)
Globivalvulina cyprica REICHEL
Globivalvulina graeca REICHEL
Globivalvulina vonderschmitti REICHEL
Dagmarita chanakchiensis REITLINGER

Robuloides acutus REICHEL
Robuloides lens REICHEL
Codonofusiella sp.
Nankinella sp.
Staffella sp.
Reichelina sp.
Agathammina pusilla (GEINITZ)
Hemigordius bronnimanni ALTINER
Hemigordius irregulariformis ZAN., ALT., CAT.
Hemigordius ovatus GROZDILOVA
Hemigordius zaninettiae ALTINER
Lapparentidiscus sp.
Kamurana?? sp.
Baisalina pulchra REITLINGER
Nodosaria mirabilis LIPINA
Geinitzina postcarbonica SPANDEL
Geinitzina caucasica MIKL.-MAKL.
Frondina permica S. de CIVR. et DESS.

The dolomitic beds of the layers 36-45 are practically almost free of foraminifers:

Sample 2:
Glomospira sp.
Tuberitina collosa REITLINGER
Pachyphloia sp.
Agathammina pusilla (GEINITZ)
Hemigordius sp.
Geinitzina postcarbonica SPANDEL

In the youngest layers of the quarry (layers 1-35) the foraminifer fauna is poorer both in species and specimen number, compared to the lower layers, besides the dominance of calcareous algae:

Sample 1:
Glomospira sp.
Ammovertella inversa (SCHELLWIEN)
Neotuberitina reitlingerae (MIKL.-MAKL.)

Tuberitina collosa REITLINGER
Pachyphloia sp.
Globivalvulina bulloides (BRADY)
Globivalvulina graeca REICHEL
Globivalvulina sp.
Robuloides lens REICHEL
Codonofusiella sp.
Nankinella sp.
Staffella sp.
Reichelina sp.
Hemigordius zaninettiae ALTINER
Hemigordius sp.
Nodosaria cf. sumatrensis LANGE
Protonodosaria sp.
Geinitzina sp.

The fossil record of the series of limestone, marly limestone, dolomitic limestone of the Nagyvisnyó Limestone Formation exposed in the Mihalovits quarry suggests well-illuminated warm, shallow water.

The rock containing carbonized organic remains of submicroscopic distribution, bituminite and pyrite, was deposited in a restricted lagoon of euxinic facies. The fossils were transported from different biotopes by the currents and the waves, together with the calcareous mud, into the depressions of the sea floor, where they were sedimented alternating and, partly, mixed with terrigenous argillaceous mud. This mixing is often visible in the thin section of the rocks as well.

The Nagyvisnyó Limestone Formation is also rich in ostracods, elaborated by KOZUR. He could separate four ostracod zones within the formation. The sequence of the Mihalovits quarry is the type section of the second one (Parvikirkbya transita zone). This zone was assigned by KOZUR (1985a) into the higher parts of the Abadehian Stage.

References

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RÁKÓCZITELEP

The building of the school designed by the architect Károly KÓS, creating a special national style in architecture is used as one of the country deposits of the Hungarian Geological Institute. An essential part of the collection is stored here.

C-4

BÜKKZSÉRC, Patkó cliff quarry(packed samples)

A. BÉRCZI-MAKK
with the contribution of I. FRIDEL-MATYÓK and P. PELIKÁN

Topography

The quarry is to NNW of Bükkzsérc, at the southern foot of the Hódos plateau (Fig. 1). Here deep-water argillaceous-clayey shale with interbedded radiolarite and olistostromal ooidal limestone bodies, a sequence common in the SW Bükk Mts. is exposed.

Age

Upper Jurassic.

Lithostratigraphy

Mónosbél Formation.

History

This is the first site in the Bükk Mts. where Jurassic foraminifer fauna was found (BÉRCZI-MAKK--PELIKÁN 1984).

Stratigraphy

The samples from the abandoned quarry under the Patkó cliffs yielded an Upper Dogger--Malm foraminifer fauna. The oolitic limestone of grainstone texture fors thin banks, the very small lithoclasts increasing only on the bedding planes. On the upper part of the quarry chert lenses and siliceous marly intercalations occur (BÉRCZI-MAKK--PELIKÁN 1984). The cherty and marly intercalations (Samples 15-16 and 22, Fig. 2) contain abundant radiolarians.

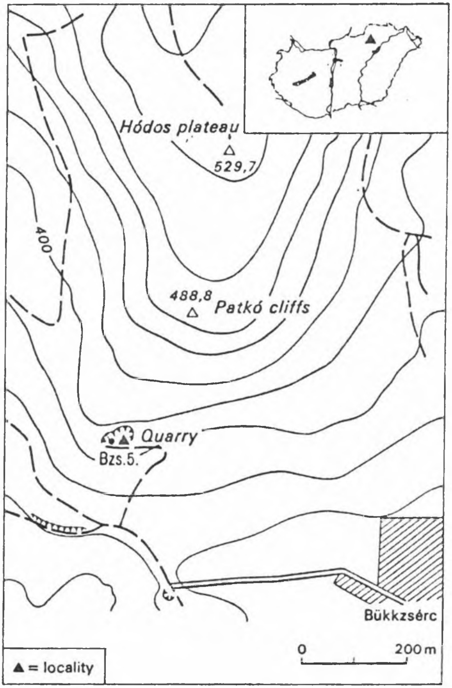

Fig. 1. Map of the quarry situated under the Patkó cliffs, Bükkzsérc

Most of the samples taken from the left (Fig. 2) and the right side of the quarry (Fig. 3) (Samples 1-14, 17-21) can be characterized by Protopeneroplis-dominated microbiofacies. This Foraminifera association agrees with the fauna between 3.1--44.5 m in the borehole Bükkzsérc-5,

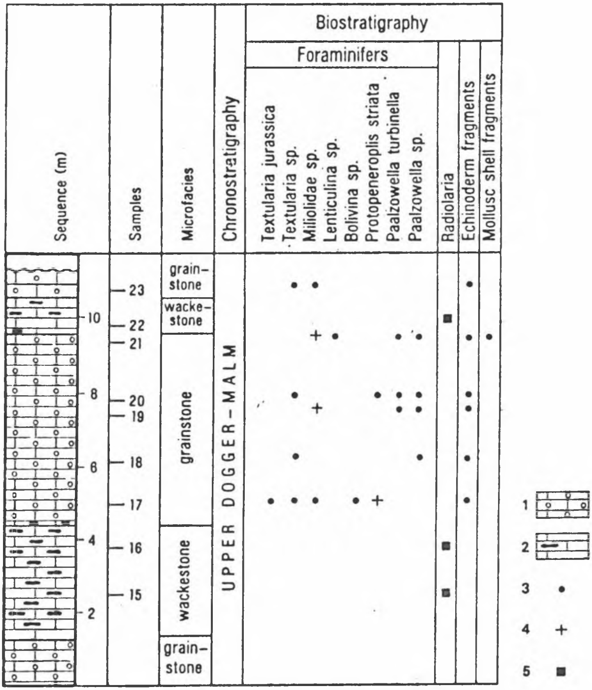

Fig. 2. The surface section of the left side of the quarry under the Patkó cliffs with the distribution and frequency of the fossils
1. Ooidic--oncoidic limestone, 2. cherty limestone, 3. few, 4. frequent, 5. abundant

deepened in the yard of the quarry (BÉRCZI-MAKK--FRIDEL-MATYÓK--PELIKÁN in press).

The foraminifer assemblage is characterized by the frequency of the species Protopeneroplis striata, and of the Textulariidae and the general distribution of the species of the genus Paalzowella /Ataxophragmiidae sp., Textularia jurassica GÜMBEL, Textularia sp., Miliolidae, Nodosariidae, Mesoendothyra sp., Bolivina sp., Protopeneroplis striata WEYNSCHENK, Paalzowella turbinella (GÜMBEL), Paalzowella sp., Valvulinae/.

The presence of the species Protopeneroplis striata WEYNSCHENK suggests high energy environment, very shallow water and normal salinity, indicating the carbonate platform margin.

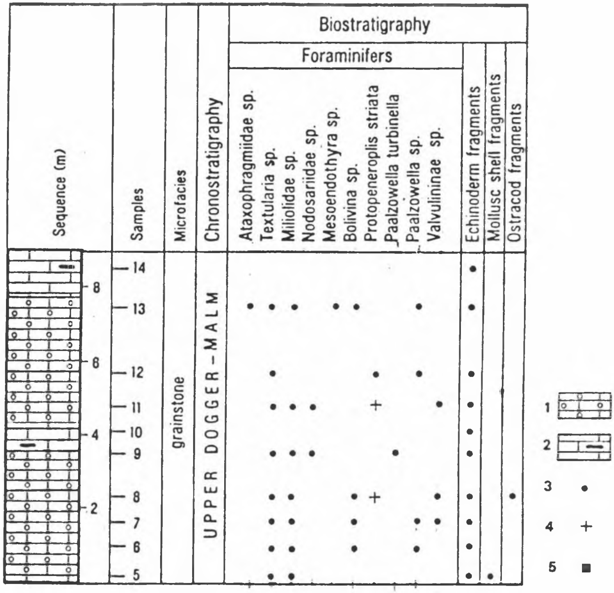

Fig. 3. The surface section of the right side of the quarry under the Patkó cliffs with the distribution and frequency of the fossils
1. Ooidic--oncoidic limestone, 2. cherty limestone, 3. few, 4. frequent, 5. abundant

The species Protopeneroplis striata was described by WEYNSCHENK (1950, 1956) from the Dogger--Malm limestone of the Tyrolian Alps, deposited in the neritic belt of the Tethys. Its occurrence is known in the Appenines from the Upper Dogger--Lower Malm (FARINACCI 1964). The Dogger--Lower Malm epinerithic oolithic limestones found in Northern Italy (=Vajont limestone) can be characterized by a Protopeneroplis--Trocholina microbiofacies (MARTINIS--FONTANA 1968). In the microfaunal zonation of the Alpine Mediterranean Jurassic the species Protopeneroplis striata WEYNSCHENK is widely distributed in the Dogger--Lower Malm "threshold" facies (FLÜGEL 1978). In the Voralpes (Switzerland) the foraminifer species Protopeneroplis striata WEYNSCHENK is the member of a typical faunal assemblage restricted to the carbonate platform margin facies. This is the so-called "threshold facies", characterized by high energy level, very shallow water and normal salinity (SEPTFONTAINE 1978). In the incomplete Jurassic sequence of Gorski Kotar (Yugoslavia) the Protopeneroplis--Trocholina assemblage represents the littoral part of the shallow shelf region (DOZET--SRIBAR 1981).

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C-5

SZOKOLYA -- packed samples

M. BÁLDI-BEKE

with the contributions of M. HORVÁTH, A. NAGYMAROSY and M. MONOSTORI

Topography

Of the sedimentary formations lying at the border of the andesite body of the Börzsöny Mts., the richest fauna was recovered from the Miocene claymarl occuring in the vicinity of Szokolya, 1 km to the North of the village Szokolya on the hills Agyigácsó and Magyarma (Fig. 1).

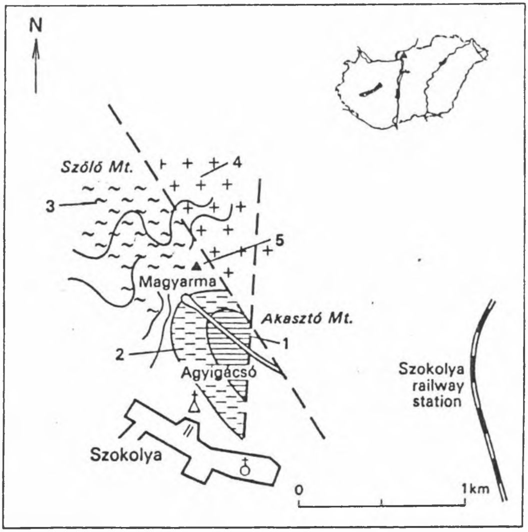

Fig. 1. The geological sketch of the Szokolya area (after BÁLDI 1960)
1. Siliceous clay, 2. Nassa--Pleurotoma clay, 3. Dentalium--Pteropoda marl, 4. andesite agglomerate, 5. locality

Age

Middle Miocene, Badenian Stage.

Lithostratigraphy

Baden Clay Formation.

History

Microfaunistical data on the Baden Clay of Szokolya were published first by NYIRŐ (in BÁLDI 1960), later KORECZ-LAKY published the foraminifer fauna on the basis of borehole sections (in KORECZ-LAKY--NAGY-GELLAI 1985) and HAJÓS (1986) published the diatom flora. The nannoplankton of the surface outcrop was elaborated by BÁLDI-BEKE (1960) and, together with the borehole sections, by NAGYMAROSY (1980, 1985).

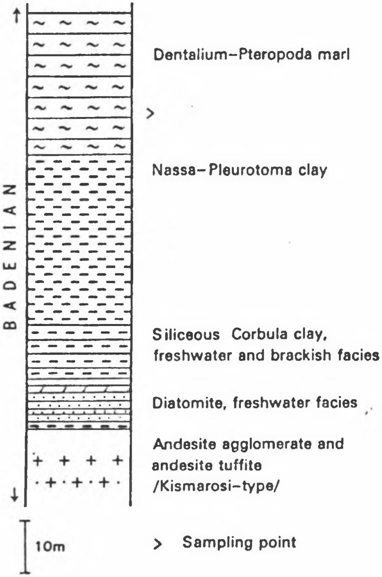

Fig. 2. Szokolya, Magyarma Hill top, geological sketch of the area (after BÁLDI 1960 and NAGYMAROSY 1980)
Biostratigraphy: NN 5 nannozone, Globigerina--Orbulina Foraminifera assemblage

Stratigraphy

The claymarl is superposed on the andesite (Fig. 2), covered by a thin soil layer. On the basis of the mollusc fauna, BÁLDI (1960) considered the formation as normal saline, well-areated marine sediment, deposited in the aphotic zone, well below the wave-base. Similar formations characterized by a rich macrofauna, and microfossils with globigerinids and lagenids, as well as abundant phytoplankton are fairly widely distributed in the Central Paratethys (Baden - Vienna Basin, Korytnica - Holy Cross Mts., Central Poland, Transylvania, Slovakia etc.).

Fossils

The samples collected from the Magyarma Hill contained a rich and very well preserved foraminifer fauna, characterized by great species and specimen number. According to HORVÁTH, the assemblage corresponds to the upper lagenid zone of the Early Badenian, indicating medium sublittoral marine environment. The composition of the fauna is the following:

Plankton:

Globigerina bulloides d'ORBIGNY
Globigerina concinna REUSS
Globigerina praebulloides group
Globigerina obesa (BOLLI)
Globigerina quinqueloba NATLAND
Globigerina regularis d'ORBIGNY
Globigerina tarchanensis SUBBOTINA et CHUTZIEVA
Globigerinoides grilli SCHMID
Globigerinoides quadrilobatus (d'ORBIGNY)
Globigerinoides trilobus (REUSS)
Praeorbulina cf. transitoria BLOW
Orbulina suturalis BORNEMANN
Orbulina bilobata (d'ORBIGNY)
Globorotalia bykovae (AISENSTAT)
Globorotalia mayeri CUSHMAN et ELLISOR
Globorotalia scitula (BRADY)
Globoquadrina altispira CUSHMAN et JARVIS

Benthos:

Spiroplectammina carinata (d'ORBIGNY)
Spiroloculina sp.
Nodosaria badenensis d'ORBIGNY
Nodosaria hispida (SOLDANII)
Dentalina antennula (d'ORBIGNY)
Lenticulina echinata (d'ORBIGNY)
Plectofrondicularia sp.
Amphimorphina digitalis NEUGEBOREN
Bolivina dilatata dilatata REUSS
Cassidulinoides oblongus (REUSS)
Bulimina elongata d'ORBIGNY
Uvigerina aculeata aculeata d'ORBIGNY
Uvigerina szakalensis (MAJZON)

Rosalina globularis d'ORBIGNY
Cancris auriculus (FICHTEL et MOLL)
Asterigerinata planorbis (d'ORBIGNY)
Elphidium flexuosum (d'ORBIGNY)
Cibicides boueanus (d'ORBIGNY)
Fursenkoina schreibersiana (CŽJŽEK)
Cassidulina crassa d'ORBIGNY
Nonion commune (d'ORBIGNY)
Heterolepa dutemplei (d'ORBIGNY)
Ceratocancris haueri (d'ORBIGNY)

The rich nannoplankton was assigned by NAGYMAROSY into zone NN 5, comprising the following species:

Reticulofenestra minuta ROTH	abundant
Coccolithus pelagicus (WALLICH)	much
Cyclicargolithus floridanus (ROTH et HAY)	common
Calcidiscus rotula (KAMPTNER)	rare
Helicosphaera carteri (WALLICH)	few
Helicosphaera mediterranea MÜLLER	few
Pontosphaera multipora (KAMPTNER)	rare
Sphenolithus heteromorphus DEFL.	few
Sphenolithus moriformis (BRÖNN. et STR.)	few
Discoaster deflandrei BRAML. et RIEDEL	1
Discoaster musicus STRADNER	1
Holodiscolithus macroporus (DEFL.)	1
Rhabdosphaera pannonica (BÁLDI-BEKE)	1
Micrantholithus vesper DEFL.	1

In the poor ostracod fauna, MONOSTORI found the following species, indicating normal saline, sublittoral environment for the Badenian:

Incongruellina sp.
Buntonia subulata (RUGGIERI)
Loxoconcha carinata tortonica STANCHEVA
Loxoconcha hastata (REUSS)
Phlyctenophora? sp.
Gen. et spec. indet.

The state of preservation of the ostracods is good, the specimen number is low.

References

BÁLDI T. 1960; BÁLDINÉ BEKE M. 1960; HAJÓS M. 1986; KORECZNÉ LAKY I.-- NAGYNÉ GELLAI Á. 1985; NAGYMAROSY 1980, 1985.

C-6

SÁMSONHÁZA, Várhegy

A. NAGYMAROSY
with the contribution of M. HORVÁTH and P. VARGA

Topography

The Várhegy is situated in the valley of the Kis-Zagyva stream, N of the village Sámsonháza (Fig. 1). At both (NE and SW) sides of the valley, near to each other the Lower Badenian formations can be observed in abandoned quarries. (For further data, see JÁMBOR 1981 and HÁMOR 1985). Now the two quarries form a protected geological area.

Age

Middle Miocene, Badenian Stage.

Lithostratigraphy

Sámsonháza Formation (see HÁMOR 1985).

Stratigraphy (Figs. 2-3)

The quarry on the left side of the creek exposes the Tar Dacitic Tuff of the Middle Miocene Karpathian, superposed on the Garáb Schlier Formation, and overlain by the Mátra Andesite Formation. This latter is represented by a stratovolcanic sequence composed of andesitic lava, tuff and

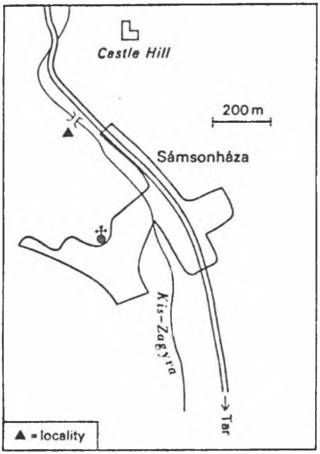

Fig. 1. Map of the locality

volcanic breccia. In the lower parts of the sequence, frequent remnants of the torn fragments of the schlier sequence can be found.

The volcanic sequence is covered by the Rákos Limestone Formation (=Leithakalk). This formation can be studied already at the right side of the creek. Resting immediately upon the andesite, we find a bank of 40--50 cm thickness composed of Isognomon casts, overlain by alternating banks of algal limestone--calcareous marl, Ditrupa--Bryozoa-bearing marl and limestone, getting gradually sandy upwards, turning into a Lithothamnium-bearing calcareous sand. This sequence, immediately overlying the volcanic series is called Sámsonháza Formation. It contains a molluscan fauna suggesting shallow, normal saline nearshore, marine environment. The Badenian formations are discordantly covered by a Sarmatian gravel sequence.

Samples were taken at the northern end of the village, 5 m of the small bridge over the creek, from the hillside (Fig. 3).

Samples (from the top to the bottom):

0.5 m hard bryozoan limestone (Sample 5)

0.8 m Bryozoa-bearing calcareous marl--marl (Sample 4 in its upper part and Sample 3 in its lower part)

0.1 m sandy marl

2.5 m part covered by mixed soil and debris

0.45 m algal limestone bank

0.6 m Isognomon-bearing marl

0.6 m Lithothamnium-bearing sandy limestone (Sample 2 from its upper part, Sample 1 in its lower part).

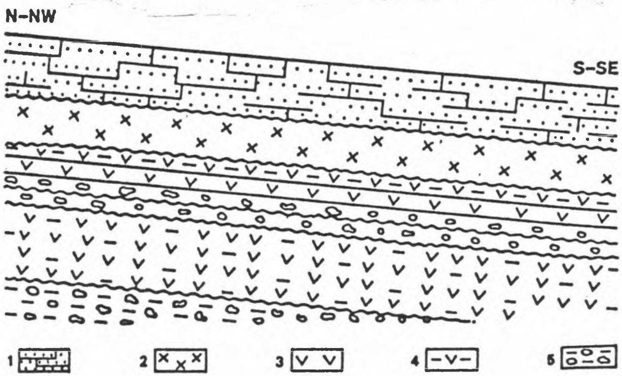

Fig. 2. Composite section of the Sámsonháza--Várhegy (Castle Hill) section (after HÁMOR and HALMAI 1985)
1. Lithothamnium--Bryozoa-bearing calcareous sandstone, 2. andesite, 3. andesite tuff, 4. red clay with andesite tuffite, 5. volcanic breccia

Fossils

Poor nannoplankton was found only in Sample 4:

Coccolithus pelagicus (WALLICH) SCHILLER

Sphenolithus moriformis (BRÖNNIMANN and STRADNER) BRAMLETTE and WILCOXON

It is known from analogies of the neighbouring regions that the formation can be assigned to the NN 5 nannoplankton zone, i. e., to the Badenian Stage of the Middle Miocene (see NAGYMAROSY 1985).

The microfacies of the No. 1 limestone sample can be assigned to floatstone with red algae. Mollusc shell fragments, as well as echinid fragments and bryozoans are fairly frequent. Amphisteginids are rare. Sample 2 is similar, but here spicules of siliceous sponges are also observable, as well as characteristic intraclastic grains in the texture

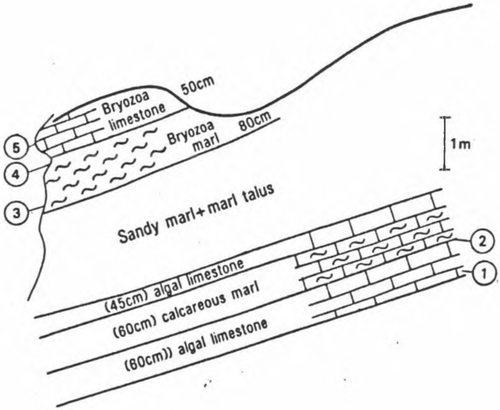

Fig. 3. Sampling site at the right bank of the stream

of the rock. Sample 5 is a Bryozoa--Ditrupa packstone.

It is observable in all three samples that the biogenic components suffered shorter or longer transport. The depositional depth could be well below the wave base. The biogenic components indicate well-aired and photic warm tropical sea. We can find in the whole sequence more or less volcanic constituents. The grains of the debris are mainly cemented by micrite, less frequently, sparite. Samples 3 and 4 contained normal saline small-foraminifer fauna with low species and specimen number. The state of preservation of the fauna is good, containing, however, some casts and recrystallized forms as well.

Textularia gramen d'ORBIGNY
Uvigerina pygmoides PAPP et TURNOWSKY
Uvigerina semiornata d'ORBIGNY
Discorbis cf. patelliformis (BRADY)
Rosalina globularis d'ORBIGNY
Cancris auriculus (FICHTEL et MOLL)
Asterigerinata planorbis (d'ORBIGNY)
Elphidium crispum (LINNE)

Cribroelphidium sp.

Heterostegina costata d'ORBIGNY

Globigerina diplostoma REUSS

Hastigerina cf. opinata (PISHVANOVA)

Eponides boueanus (d'ORBIGNY)

Amphistegina hauerina d'ORBIGNY

Cibicides lobatulus (WALKER et JACOB)

Anomalina badenensis d'ORBIGNY

Heterolepa dutemplei (d'ORBIGNY)

Heoglundina elegans (d'ORBIGNY)

Age: Lower Badenian, Moravian Substage.

Facies: euhaline, shallow- and middle sublittoral with rich vegetation.

The plankton is practically missing from the Foraminifera fauna. The dominant species of the assemblage is Amphistegina hauerina, the other taxa are rare and their occurrence is sporadic.

References

HÁMOR G. 1985, HÁMOR G.--HALMAI J. 1985; JÁMBOR Á. (edit.) 1981; NAGYMAROSY A. 1985.

C-7

SÁMSONHÁZA, Buda Hill

M. MONOSTORI

with the contribution of M. HORVÁTH and A. NAGYMAROSY

Topography

The outcrop is located 5 km to the NNE of Sámsonháza, on the top of the Buda Hill (Fig. 1).

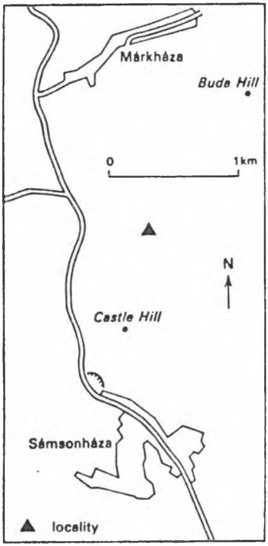

Fig. 1. Map of the locality

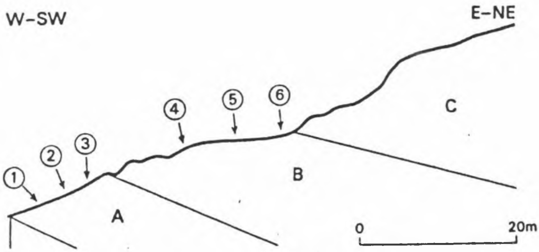

Fig. 2. Sketch of the Sámsonháza--Buda Hill section (formations after HÁMOR 1985)
1--6: Sampling points, A: Garáb Schlier Formation, Miocene, Karpathian; B: Sámsonháza Formation, Miocene, Badenian; C: Rákos (Leitha) Limestone Formation, Miocene, Badenian

Age and lithostratigraphy

Middle Miocene (18--15 Ma). Samples 1--3 belong to the upper part of the Karpathian Stage according to the Central Paratethys stratigraphical scheme (CICHA et al. 1967; NN 4 nannoplankton zone), while Samples 4--6 from the Sámsonháza Formation represent the lower part of the Badenian Stage, Moravian Substage, lower Lagenida zone (PAPP et al. 1978).

History

The section is the stratotype of the Sámsonháza Formation (HÁMOR 1985). Its unusually rich mollusc fauna, and especially the dwarf fauna, has been mentioned many times since the 1920s (STRAUSZ 1923, 1924, BOGSCH 1943) (under the name of Mitteler-puszta). CSEPREGHY-MEZNERICS (1954) elaborated the mollusc fauna.

Stratigraphy

Due to the conditions of the surface, bed by bed collection could not be realized. The lower collection spots were taken at the bottom of the section, from the upper parts of the Garáb Schlier Formation comprising several hundred meters of silt and clay-marl (Samples 1--3, Fig. 2). In the upper parts we find sandy argillaceous beds mixed with volcanic material belonging to the Sámsonháza Formation (Samples 4--6). Between them, lava banks of the Mátra Andesite Formation are interbedded. The stratigraphic cover of the Sámsonháza Formation is the Rákos (Leitha) Limestone Formation. The section used to be well exposed and discussed in details by HÁMOR (1985).

Fossils

The Sámsonháza Formation contains a rich macrofauna. The number of mollusc taxa described from here so far exceeds 400, completed by bryozoans, worm tubes and, among the plants, red algae in great quantities.

Garáb Schlier Formation (Samples 1--3):

Sample 1:

N a n n o p l a n k t o n

Reticulofenestra minuta ROTH
Reticulofenestra pseudoumbilica (GARTNER) GARTNER
Coccolithus pelagicus (WALLICH) SCHILLER
Cyclicargolithus abisectus (MÜLLER) WISE
Cyclicargolithus floridanus (ROTH and HAY) BUKRY
Coronosphaera mediterranea (LOHMANN) GAARDER
Helicopontosphaera carteri (WALLICH)
Pontosphaera multipora (KAMPTNER) ROTH
Sphenolithus moriformis (BRÖNNIMANN and STRADNER) BRAMLETTE and WILCOXON
reworked Paleogene forms
reworked Cretaceous forms

F o r a m i n i f e r a

Bathysiphon sp.
Spiroplectammina carinata (d'ORBIGNY)
Bolivina hebes MACFADYEN
Uvigerina bononiensis primiformis PAPP et TURNOWSKY
Cancris turgidus (CUSHMAN et TODD)

Elphidium sp.
Ammonia beccarii (LINNÉ)
Globigerina div. sp.
Globorotalia sp.
Fursenkoina schreibersiana (CŽJŽEK)
Gyroidina soldanii (d'ORBIGNY)
Florilus boueanus (d'ORBIGNY)
Heterolepa dutemplei (d'ORBIGNY)

Sample 2:

N a n n o p l a n k t o n

Reticulofenestra minuta ROTH
R. pseudoumbilica (GARTNER) GARTNER
Coccolithus miopelagicus BUKRY
Coccolithus pelagicus (WALLICH) SCHILLER
Coronosphaera mediterranea (LOHMANN) GAARDER
Helicopontosphaera carteri (WALLICH)
Pontosphaera multipora (KAMPTNER) ROTH
Sphenolithus cf. heteromorphus DEFLANDRE
Discoaster adamanteus BRAMLETTE and WILCOXON
Cricolithus jonesi COHEN
reworked Paleogene forms

Sample 3:

N a n n o p l a n k t o n

Reticulofenestra minuta ROTH
Reticulofenestra pseudoumbilica (GARTNER) GARTNER
Coccolithus pelagicus (WALLICH) SCHILLER
Cyclicargolithus abisectus (MÜLLER) WISE
Cyclicargolithus floridanus (ROTH and HAY) BUKRY
Helicopontosphaera ampliaperta BRAMLETTE and WILCOXON
Helicopontosphaera carteri (WALLICH)
Pontosphaera multipora (KAMPTNER) ROTH
Sphenolithus moriformis (BRÖNNIMANN and STRADNER) BRAMLETTE and WILCOXON
reworked Paleogene forms
reworked Cretaceous forms

F o r a m i n i f e r a

Lenticulina inornata (d'ORBIGNY)

Uvigerina graciliformis PAPP et TURNOWSKY

Ammonia beccarii (LINNÉ)

Globigerina sp.

Florilus boueanus (d'ORBIGNY)

These three samples contain relatively poor but well preserved microfaunas. On the basis of the nannoplankton, they belong to NN 4 zone.

Sámsonháza Formation (Samples 4--6):

Sample 4:

O s t r a c o d a

Bairdia subdeltoidea (MÜNSTER)

Bairdia sp.

Cnestocythere truncata (REUSS)

Eucythere sp.

Costa sp.

Aurila cicatricosa (REUSS)

Grinioneis haidingeri (REUSS)

Occultocythereis sp.

Cytheretta sp.

Loxoconcha punctatella (REUSS)

Loxocorniculum hastata (REUSS)

Xestoleberis sp.

Samples 5--6:

N a n n o p l a n k t o n

Reticulofenestra minuta ROTH

Coccolithus pelagicus (WALLICH) SCHILLER

Umbilicosphaera rotula (KAMPTNER)

Umbilicosphaera jafari MÜLLER

Cyclicargolithus floridanus (ROTH and HAY) BUKRY

Helicopontosphaera carteri (WALLICH)

Syracosphaera sp.

Sphenolithus moriformis (BRÖNNIMANN and STRADNER) BRAMLETTE and WILCOXON

reworked Cretacous forms

F o r a m i n i f e r a

Globigerina obesa (BOLLI)
Globigerina regularis (d'ORBIGNY)
Globigerinoides quadrilobatus (d'ORBIGNY)
Globigerinoides trilobus (REUSS)
Globorotalia mayeri CUSHMAN et ELLISOR
Globorotalia siakensis LE ROY
Globoquadrina altispira (CUSHMAN et JARVIS)
Textularia sp.
Lenticulina cultrata (MONTFORT)
Globulina gibba d'ORBIGNY
Oolina sp.
Bolivina antiqua d'ORBIGNY
Bolivina scalprata miocenica MACFAYDEN
Reusella spinulosa (REUSS)
Uvigerina pygmoides PAPP et TURNOWSKY
Trifarina angulosa (WILLIAMSON)
"Rosalina dubia" d'ORBIGNY
Asterigerinata planorbis (d'ORBIGNY)
Elphidium crispum (LINNÉ)
Elphidium fichtelianum (d'ORBIGNY)
Neoeponides schreibersi (d'ORBIGNY)
Cibicides boueanus (d'ORBIGNY)
Cibicides lobatulus (WALKER et JACOB)
Cibicides lobatulus ornatus (CUSHMAN)
Cassidulina crassa d'ORBIGNY
Cassidulina sp.
Ehrenbergina serrata (REUSS)
Nonion commune (d'ORBIGNY)
Pullenia quinqueloba (REUSS)
Gyroidina soldanii d'ORBIGNY
Osangularia umbonata (REUSS)
Anomalina badenensis d'ORBIGNY
Heterolepa dutemplei (d'ORBIGNY)
Stomatorbina sp.

O s t r a c o d a (only in Sample 5):

Bairdia sp.
Callistocythere sp.
Grinioneis haidingeri (REUSS)
Aurila sp.
Loxoconcha sp.

The foraminifer fauna is rich, other microfossils are not so abundant, state of preservation variable.

Facies

The samples coming from the Garáb Schlier Formation (Samples 1--3) suggest euhaline, low energy, deep sublittoral marine environment. Samples coming from the Sámsonháza Formation (4--6) represent normal salinity, higher energy, shallow and medium-deep sublittoral marine environment.

References

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SALGÓTARJÁN

Though both constituents of the name "Salgó" and "Tarján" denote old Hungarian names of the Hungarian Conquest period, the significance of the town is mainly connected to recent industrial developments of the last hundred years. The first step in this process was the beginnings of coal mining in the region, started in 1861. The Underground Museum of Mining situated in the former József shaft is an object of European fame. After Wieliczka, this was the second institution of this type on the European continent.

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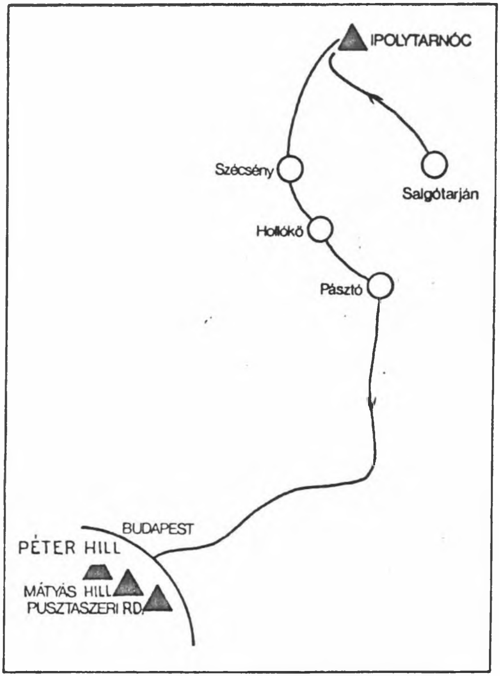
8 September: D: SALGÓTARJÁN--IPOLYTARNÓC--BUDAPEST: Pusztaszeri road, Mátyás Hill, Csillaghegy



D-1

IPOLYTARNÓC, Nature Protection Area

L. KORDOS

Topography

Ipolytarnóc is situated 25 kms to the north of Salgótarján, at the Hungarian--Czechoslovakian border. The exposures are east of the village.

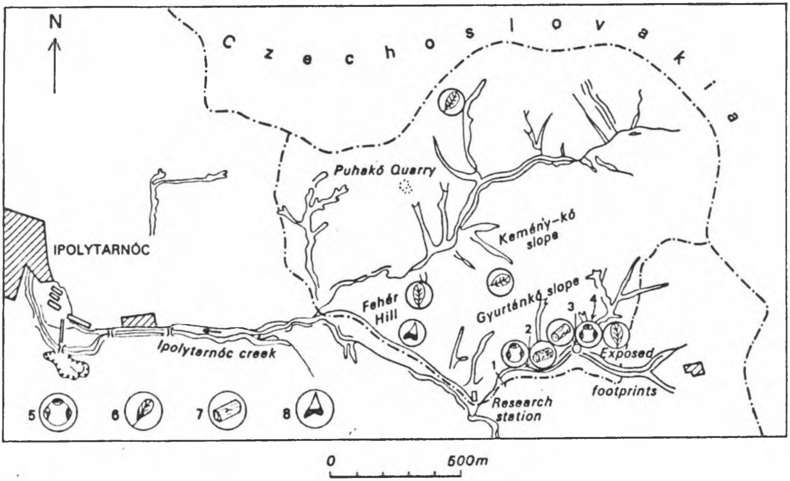


Fig. 1. Map of the Ipolytarnóc Nature Protection Area showing the locality of the fossils
1--4. Exposures, 5. footprint, 6. plant, 7. tree-trunk, 8. shark-teeth

Age

Lower Miocene, Eggenburgian Stage.

Lithostratigraphy

Zagyvapálfalva Formation.

History

The locality is a Nature Protection Area, because of the Lower Miocene sequence preserving silicified tree-trunks, plant remains, shark teeth and footprints of terrestrial animals on the surface of the sandstone, presented to the public in the last years.

The area and exposures of Ipolytarnóc belong to the classical sites of Hungarian geology. The history of research conducted on the site dates back to 1836, when KUBINYI visited the locality for the first time. He published the giant petrified tree-trunk in 1842, together with the outlines of a geological description.

The turning point in the scientific elaboration of the Ipolytarnóc sequence, considered as a mere curiosity only, had taken place in 1900 with the discovery of the sandstone surface preserving footprints. The underlying beds of the sandstone were examined by KOCH (shark teeth), NOSZKY SEN. (Oligo/Miocene boundary) and later MAJZON, CSEPREGHY-MEZNERICS, NYÍRŐ, KORECZ-LAKY, NAGY-GELLAI (micro- and macrofauna). The tree trunks, lying mainly in gravel and conglomerate were evaluated by KUBINYI, TUZSON and later by GREGUSS. The footprints were published by LAMBRECHT, ABEL, TASNÁDI KUBACSKA and VIALOV. In 1900, in the late 1920's and in 1937 there were several large pieces among the sandstone plates bearing the footprints removed and taken to the Hungarian Geological Institute and Hungarian Natural History Museum, Budapest. The evaluation of the numerous leafprints and plant remains found in the sandstone bearing the footprints and the overlying tuff was performed by JABLONSZKY, RÁSKY and PÁLFALVY.

The monographical elaboration of the Ipolytarnóc sequence was prepared by 1985, the VIIIth RCMNS Congress held in Budapest (Geologica Hungarica ser. Palaeontologica, Fasc. 44--46). The geological data were summarized by BARTKÓ, the revision of the plant remains was performed by HABLY, the footprints were evaluated by KORDOS.

Stratigraphy (Figs. 2--3)

The Paleozoic crystalline core mountain is lying in the depth of 600 m at Ipolytarnóc. There are no Mesozoic formations known over them. The crystalline basement is immediately overlain by Upper Eocene reef limestone, followed by Oligocene transgressional molasse formations. The Lower Oligocene Kiscell Clay Formation can be detected, to the SW of Ipolytarnóc, in great thickness, as well as the sediments of the Egerian and Eggenburgian Szécsény Schlier Formation and the Pétervására Sandstone Formation, respectively. The latter two can be located at Ipolytarnóc as well, especially the Szécsény Schlier, present in 300--400 m thickness, observable in the Protected Area at the Botos and Borókás ditches in surface exposures. It is a characteristic bluish grey clay, argillaceous sand with fine grain mica and glauconitic sandstone. The age of the upper part is Eggenburgian, based on the marine macrofauna and the foraminifers, belonging to the NN3 nannoplankton zone (NAGYMAROSY p.c.) On the territory of Ipolytarnóc, the Szécsény Schlier Formation is overlain by the glauconitic Pétervására Sandstone, comprising cross-bedded

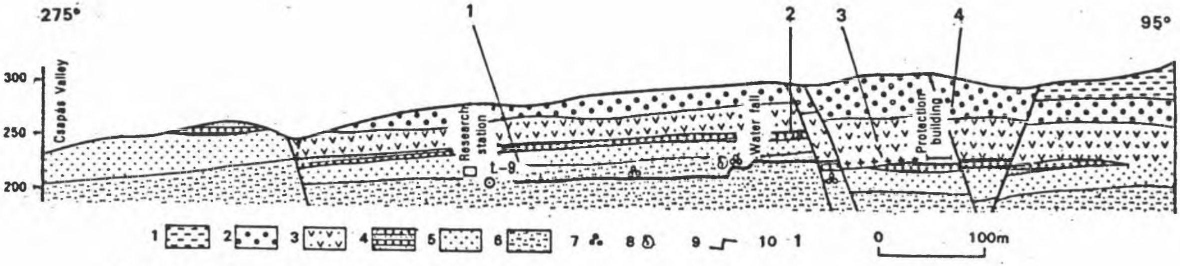


Fig. 2. Geological section of Gyurtyánkõ slope--Borókás ditch. (After BARTKÓ 1985)
Ottnangian: 1. Mottled clay, 2. tuffaceous quartzite sandstone--sandstone with rhyolite pebbles--gravelly sandstone conglomerate, 3. rhyolite tuff. -- Eggenburgian: 4. footprint sandstone, sand, conglomerate--gravel, 5. micaceous sandstone, 6. Szécsény Schlier Formation, 7. microfauna, 8. Mollusca fauna, 9. ground surface in projection, 10. localities

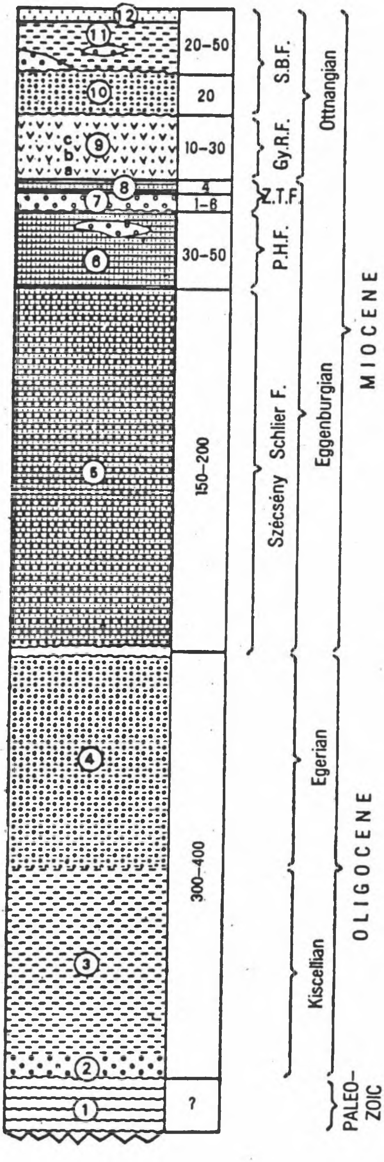


Fig. 3. Schematic lithological column of the Ipolytarnóc Nature Protection Area. (After BARTKÓ 1985)
1. Phyllite, gneiss, amphibolite, 2. gravel, 3. clay, 4. silty sandy clay, 5. silty, argillaceous sandstone (Schlier), 6. glauconitic sandstone with interbedded conglomerate layers, 7. gravel-conglomerate, 8. footprint sandstone, 9. rhyolite tuff: (a) pumiceous rhyolite tuff and tuffite, (b) airborn tuff, (c) bentonithic tuff, 10. cross-bedded rhyolite tuff and gravelly sandstone, 11. mottled clay with interbedded conglomerate layers, 12. sand. -- P.H.F. = Pétervására Sandstone Formation, Z.T.F. = Zagyvapálfalva Variegated Clay Formation, Gy.R.F. = Gyulakeszi Rhyolite Tuff Formation, S.B.F. = Salgótarján Brown Coal Formation

sediments of crystalline rocks. Shark teeth have been collected from this layer since the turn of the century. The marine sediments are overlain by the terrestrial sediments of the Zagyvapálfalva Formation. The lower parts comprise of gravel and conglomerate sedimented on the surface of the underlying glauconitic sandstone, while the upper parts consist of the so-called "footprint sandstone", bearing on its surface the footprint traces of numerous terrestrial animals. The closing unit of the sequence is the 2--30 m thick flood tuff of the Gyulakeszi Rhyolite Tuff Formation, immediately overlying the footprint sandstone, with a radiometric age (K/Ar) 19,6 ± 1,4 Ma.

Exposure 1:

Ipolytarnóc, Borókás ditch, Szécsény Schlier Formation. In the exposure representing the top of the Schlier beds, the bulk of the rocks comprises glauconitic sandstone. In the varied sequence the wedging out of the sand and clay layers denotes shallow sea-coastal facies. On the basis of the 96 Foraminifera taxa, as well as the occasional mollusc remains, the age of sequence can be dated as Eggenburgian, its faunistical connections pointing towards S Slovakia.

Exposure 2:

Ipolytarnóc, Borókás ditch, the section of the II. site with foot-prints. This exposure was opened in 1985, during the preparation for the Neogene Congress. It shows the sand, gravel and conglomerate unit forming the lower member of the Zagyvapálfalva Variegated Clay Formation, as superposed over the Pétervására Glauconitic Sandstone. The overlying layer is the 30--50 cm footprint sandstone(covered by, on its surface, some 300 footprints of birds and mammals), followed by the flood tuff of the Gyulakeszi Rhyolite Formation overlying the whole sequence.

Exposure 3:

Ipolytarnóc, silicified tree-trunk. In the second half of the last century, a protective cover was constructed over the 42 m long pine-tree trunk published in 1842. The restored parts of this, as well as the remains of the famous tree-trunk are exhibited in the exhibition hall. Apparently the footprint sandstone is situated under the tree, and the rhyolite tuff is lying over.

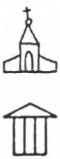
Exposure 4:

Ipolytarnóc, exhibition place in the protective hall. The exposed surface of the footprint sandstone can be observed in a large hall (20x25 m) erected over the relics. On the rock surface, preserved in situ on its original place we can see 1298 footprints of 11 animal species (four birds, four carnivores, one rhynoceros and two artilodactyls). In the vicinity of the contemporary springs there are footprints of animals arriving to the water holes and ponds observable in several layers over each other. At the same spot, the conglomerate underlying the sandstone can be observed in the NE corner, also containing footprints and plant remains. In the SE corner we can see the remains of the recently found large tree-trunk as well. A permanent exhibition in the hall gives information on the major attractions of Ipolytarnóc.

References

BARTKÓ L. 1985; KORDOS L. 1985. (Further references see in these papers.)

SZÉCSÉNY



The town used to serve as an important political and administration centre since the age of Charles ROBERT of Anjou (14th century) till the Turkish occupation period. King MATTHIAS I. is known to visit the fortress of the town personally. During the "Kuruc" times, the insurrection war of the early 18th century, the town used to serve as the scene of important events. During the Diet held in Szécsény, Ferenc RÁKÓCZI was elected ruling prince of the country, and the Diet declared a Union with Transylvania. Among the architectural monuments we must mention the Franciscan church built in 1332, bearing stylistic features of the 14th century Gothic architecture. The architectural and ornamental features of its oratorium represent unparalleled beauty. The surviving parts of the castle belonging to the Forgách family, built in the 17th century serve as the building of the regional museum today.

HOLLÓKŐ

The village represents a unique value for the ethnographical heritage and folk art. It is a part of the "World Heritage" protected by UNESCO. The road structure and the image of the village formed during centuries is intact even today. The buildings preserved the best traditions of Palóc architecture. The church of the village was built in the 15th century in gothic style. In the Village Museum we can find the relics and environment of the everday life of the Palóc people. The medieval fortress played an important role among the border castles of the Turkish period.

PÁSZTÓ

The settlement was an ancient Medieval town. Its Cistercian abbey was founded in 1190. The old monastery, rebuilt in 1715 is still standing, preserving some Gothic elements as well. The double arcade of the church is ranked among the important architectural remains of Gothic style in Hungary. We have evidence on the renovation of the church on a memorial stone from 1421. There are Early Baroque citizen's houses in the small town. A unique monument among the Hungarian medieval buildings is the "Schoolmaster's house", built in the 15th century, as a gothic style dwelling house. The contemporary equipment was preserved and used today as an interesting exhibition of late medieval life and education history.

BUDAPEST II, Pusztaszeri road, road cut

A. NAGYMAROSY
with the contribution of M. HORVÁTH, M. MONOSTORI and P. VARGA

Topography

The exposure is located at the beginning of the Pusztaszeri road, in the first bend of the road at the right side (Fig. 1), opening the typical Buda Marl in about 11 m thickness.

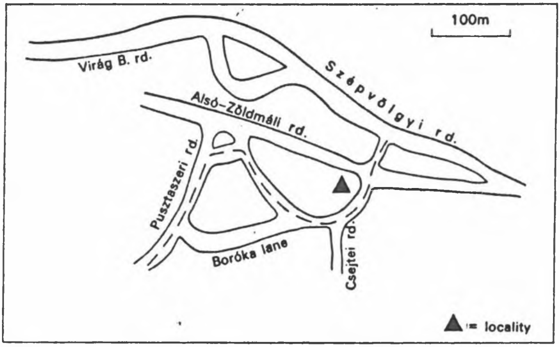


Fig. 1. Budapest--Pusztaszeri road, road cut. Sketch-map of the exposure

Age

Upper Eocene, Priabonian Stage (NP 21 zone; P 17 zone).

Lithostratigraphy

Buda Marl Formation.

History

The investigation of the microfauna of the Buda Marl, distributed on large areas within the Buda Mts., had been started already during the last century, including the environs of this outcrop as well. For example, HANTKEN dealt with the age of the formation several times in the frames of a long discussion with HOFMANN. While HANTKEN assigned the Buda Marl, basically, into the Oligocene, HOFMANN placed this formation into the Eocene. MAJZON joined this latter opinion in course of his studies performed in the middle of this century. The elaboration of the microfauna of the Buda Marl was published, mainly, in their studies (HANTKEN 1871, 1872, 1873, 1875, 1880, 1885, MAJZON 1962, 1966). Further studies devoted to this outcrop include LÖRENTHEY (1911) and, recently, BÁLDI et al. (1984).

Stratigraphy

The Buda Marl is a shallow bathyal formation of normal salinity, extending about 100 m of total thickness. It overlies the Priabonian Nummulites-Discocyclina-bearing Szépvölgy Limestone, and the overlying formation of the sequence is the Lower Oligocene euxine Tard Clay. These latter formations, however, are not exposed in this outcrop.

The exposure is composed of marl and calcareous marl banks in parallel layers of $180/20\text{--}25^{0}$ dipping (Fig. 2). The hard, compact layers of limestone and calcareous marl are 10--35 cm thick, of allochtonous origin, representing the distal parts of a submarine talus. The Upper Eocene seashore was possibly consisting of carbonate-mud, because the terrigeneous sand- and aleurite content of the allochtonous layers is insignificant. In the case of some banks we can observe traces of gradation. The lower plane of the allodapic layers is always distinct while the transition into the higher marl is frequently continuous. The coarser are reworked shallow-water carbonate grains, the thicker are the beds we find.

The limestone--calcareous marl layers can be characterized by micro-bioclasts of 0.06-0.5 mm size. Red algae and skeletal elements of crinoids are dominant. There are some bryozoans and tests of benthonic foraminifers too. The characteristic texture is of "fluxion" type, where the carbonate grains are placed parallel to their longitudinal axis. The microfacies of the allodapic banks can be assigned uniformly to red algae--Crinoidea--Bryozoa--Foraminifera grainstone.

Fossils

The n a n n o p l a n k t o n (Table 1) of the more pelitic marl layers is relatively poor in species and specimen number--this is typical for the

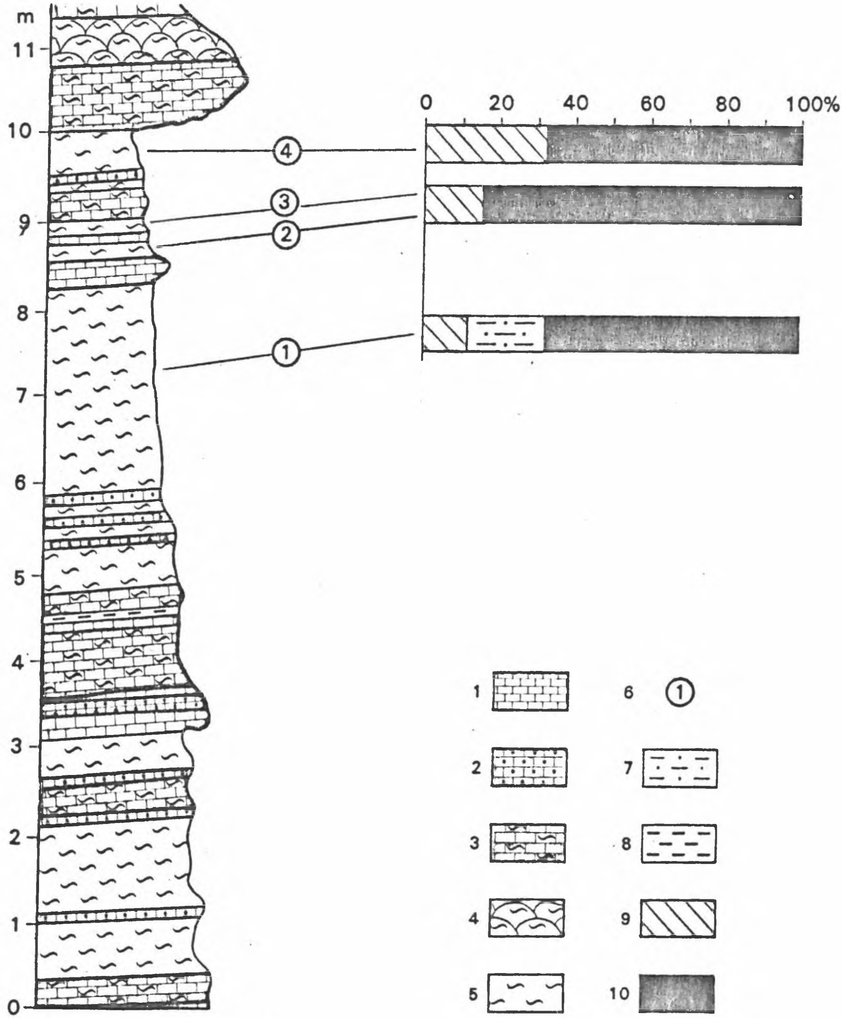


Fig. 2. Budapest--Pusztaszeri road, road cut. Section of the exposure with the petrographical composition of the samples
1. Limestone, 2. allodapic calcareous sandstone, 3. calcareous marl, 4. platy calcareous marl, 5. marl, 6. sample number, 7. aleurite, 8. clay, 9. measured clay content, 10. measured carbonate content

Table 1

The nannoplankton of the Pusztaszeri road outcrop

Taxon	Sample 2	Sample 3	Sample 4
Reticulofenestra bisecta (HAY, MOHLER, WADE)	A	A	A
R. hesslandii HAQ	A	A	A
R. cf. ornata MÜLLER			R
R. umbilica (LEVIN) MARTINI and RITZKOWSKI	R		
Coccolithus eopelagicus (BRAMLETTE and RIEDEL) BRAMLETTE and SULLIVAN	R	R	K
C. pelagicus (WALLICH) SCHILLER	A	A	A
Cyclicargolithus floridanus (ROTH and HAY) BUKRY	A	S	S
Ericsonia obruta PERCH-NIELSEN	K	K	K
E. subdisticha (ROTH and HAY) ROTH		1	1
Pontosphaera plana (BRAMLETTE and SULLIVAN) HAQ	1		
Sphenolithus moriformis (BRÖNNIMANN and STRADNER) BRAMLETTE and WILCOXON	K	A	A
Sphenolithus radians (DEFLANDRE			r
Blackites spinosus (DEFLANDRE and FERT) HAY and TOWE			1
Discoaster deflandrei BRAMLETTE and RIEDEL	1		
Zygrhablithus bijugatus (DEFLANDRE) DEFLANDRE	R	R	R
Lanternithus minutus STRADNER	K	K	R
reworked from the Cretaceous	R	R	K

Key: S = abundant K = few r = reworked
A = common R = rare

Buda Marl in general. The specimens of medium state of preservation are generally calcitized, thickened.

From the deeper levels of the outcrop, our previous studies yielded the following nannoplankton as well:

Reticulofenestra callida (PERCH-NIELSEN)
Ericsonia formosa (KAMPTER) HAQ
Helicopontosphaera compacta BRAMLETTE and WILCOXON
H. euphratis HAQ
Transversopontis obliquipons (DEFLANDRE) HAY, MOHLER and WADE
Braarudosphaera bigelowi (GRAN and BRAARUD) DEFLANDRE
Micrantholithus vesper DEFLANDRE
Rhabdosphaera tenuis (BRAMLETTE and SULLIVAN)
Isthmolithus recurvus DEFLANDRE

Foraminifera

The most abundant smaller foraminifer fauna of the outcrop was found in the thickest layer of the marl

Sample 1

Benthos

Cyclammina acutidorsata (HANTKEN)
Vulvulina capreolus d'ORBIGNY
Vulvulina haeringensis (GUEMBEL)
Tritaxia alpina (CUSHMAN)
Tritaxia szabói (HANTKEN)
Dorothia textilaroides (HANTKEN)
Lenticulina div. sp.
Pseudopolymorphina sp.
Glandulina ovula d'ORBIGNY
Oolina sp.
"Neobulimina"budensis (HANTKEN)
Bolivina antegressa SAAKJAN-GAZELYAN
Bolivina beyrichi carinata HANTKEN
Bolivina reticulata HANTKEN
Bulimina sculptilis CUSHMAN
Bulimina subtruncana HAGN
Reusella triquetra FRANZENAU

Uvigerina eocaena GUEMBEL
Uvigerina rippensis COLE
Escornebovina sp.
Asterigerina rotula (KAUFMANN)
Asterigerinata falcilocularis (SUBBOTINA)
Elphidium sp.
Cribrononion sp.
Chilostomella ovoides REUSS
Gyroidina girardana (REUSS)
Osangularia umbonata (REUSS)
Anomalina similis (HANTKEN)
Melonis affinis (REUSS)

P l a n k t o n

Globorotalia (Turborotalia) cerroazulensis cerroazulensis (COLE)
Globorotalia (Turborotalia) increbescens (BANDY)
Globorotalia (Turborotalia) liverovskae (BYKOVA)
Globigerinita pera (TODD)
Subbotina angiporoides (HORNIBROOK)
Subbotina linaperta (FINLAY)
Globigerina ampliapertura BOLLI
Globigerina angustiumbilicata BOLLI
Globigerina eocaena GUEMBEL
Globigerina gortanii gortanii (BIRSETTI)
Globigerina gortanii praeturritilina BLOW et BANNER
Globigerina officinalis SUBBOTINA
Globigerina ouachitaensis gnaucki BLOW et BANNER
Globigerina prasaepis BLOW
Globigerina praebulloides BLOW
Globigerina tripartita KOCH
Globigerina venezuelana BLOW
Globigerina cf. pseudovenezuelana BLOW et BANNER
Globigerapsis aff. index tropicalis (BLOW et BANNER)

Facies: euhaline, deep sublittoral--bathyal formation.

The foraminifer fauna is rich, its state of preservation is good-adequate. The role of the benthos is generally subordinate. Uvigerina rippensis is a permanent constituent. At some levels, specifically, in the higher parts of the Buda Marl an abundance of Buliminas can be observed (B. sculptilis, B. subtruncana). The plankton is dominant, comprising 80-90% of the total foraminifer assemblage. The "large" globigerinids are characteristic (Gg.eocaena, Gg. prasaepis, Gg. tripartita, Subbotina linaperta), Gg. ampliapertura and Gr. (T.) increbescens. The forms of the Gr. (T.) cerroazulensis group are rare, Hantkenina is missing.

The small foraminifer fauna of Sample 2, 3 and 4 are poorer. The specimens, maintaining their specific characters, are considerably recrystallized. The faunas comprise, uniformly, globigerinid assemblages living in deep, euhaline sea water.

Sample 2

B e n t h o s

Cyclammina acutidorsata (HANTKEN)
Vulvulina eocaena GÜMBEL
Tritaxia szabói (HANTKEN)
Tritaxia haeringensis (GÜMBEL)
Clavulina cylindrica HANTKEN
Dorothia sp.
Lenticulina div. sp.
Oolina sp.
Pseudopolymorphina sp.
Glandulina sp.
Bolivina reticulata HANTKEN
Uvigerina eocaena GÜMBEL
Reusella triquetra FRANZENAU
Asterigerinata sp.
Elphidium sp.

P l a n k t o n

Globigerina eocaena GÜMBEL
Globigerina ampliapertura BOLLI
Globigerina tripartita KOCH
Globigerina officinallis SUBBOTINA
Globigerina ouachitaensis gnaucki BANNER et BLOW
Globorotalia (T.) increbescens BOLLI

Globigerinita sp.
Gyroidina girardana (REUSS)
Melonis affinis (REUSS)

Sample 3

B e n t h o s

Tritaxia szabói (HANTKEN)
Tritaxia haeringensis (GÜMBEL)
Gaudryina sp.
Uvigerina eocaena GÜMBEL
Asterigerina sp.
Asterigerinata sp.

P l a n k t o n

Globigerina eocaena GÜMBEL
Globigerina ampliapertura BOLLI
Globigerina tripartita KOCH
Globigerina galavisi BLOW
Globigerina officinalis SUBBOTINA
Globigerina ouachitaensis gr. HOWARD et WALLACE
Globigerina praebulloides gr. BLOW
Globorotalia (T.) increbescens BOLLI
Globigerinita sp.
Subbotina linaperta FINLAY

Sample 4

B e n t h o s

Rhabdammina sp.
Lenticulina sp.
Asterigerinata sp.
Cibicides sp.

P l a n k t o n

Globigerina sp.

O s t r a c o d a

In samples 2, 3 and 4, euhaline bathyal ostracods were found. Occasionally sublittoral and shallow-water forms occur as well, drifted into the deeper basin from the near-shore regions lying not very far, joining the basin with steep slopes. The specimen number of the species ranges from medium to great. The state of preservation is medium. For the description of the ostracod fauna of the exposure, see also MONOSTORI (1982, 1985a, 1985b, 1986, 1987).

Sample 2

Cytherella ex gr. pestiensis (MÉHES)
Bairdia rupelica MONOSTORI
Cardobairdia sp.
Krithe cf. pernoides (BORNEMANN)
Uroleberis cf. odessensis SCHEREMATA
Xestoleberis sp.
Argilloecia sp.
Cypridacea spp. div.

Sample 3

Cytherella ex gr. pestiensis (MÉHES)
Bairdia rupelica (MONOSTORI)
Cardobairdia sp.
Schizocythere sp. juv.
Krithe pernoides (BORNEMANN)
Uroleberis cf. odessensis SCHEREMETA
Argilloecia sp.
Cypridacea sp. div.

Sample 4

Cytherella cf. pestiensis (MÉHES)
Bairdia sp.
Agrenocythere bensoni (POKORNY)
Gen. et sp. indet.

References

BÁLDI, T.--HORVÁTH, M.--NAGYMAROSY, A.--VARGA, P. 1984; HANTKEN M. 1871, 1872, 1873, 1875, 1880, 1885; LŐRENTHEY I. 1911; MAJZON L. 1962, 1966; MONOSTORI, M. 1982, 1985a, 1985b, 1986, 1987.

BUDAPEST, Mátyás Hill, W

T. KECSKEMÉTI
with the contribution of M. KÁZMÉR and M. MONOSTORI

Topography

The exposure is situated in Budapest district 3, at the fork of the Virág Benedek and Mátyáshegyi streets (Fig. 1). The quarry is part of the Buda Natural Protection Area, on account of the Eocene sequence exposed and, partly, because of the Mátyáshegy cave system formed in the limestone.

Age

Upper Eocene, Priabonian Stage.

Lithostratigraphy

Szépvölgy Limestone and Buda Marl Formations.

History

For more than a hundred years the exposure has been a classical section of Upper Eocene succession. The beds and their fauna was investigated in the last century by HANTKEN (1875,1884) and recently by DUDICH (1959) and MONOSTORI (1965, 1983). The taxonomical problems of certain species collected from here were investigated by LANTERNO and RÓVEDA (1957); the nummulitids analysed by them reached the Lausanne collection of DE LA HARPE, by the courtesy of HANTKEN. Reccently KÁZMÉR conducted intensive investigations (1985) concerning the microfacies of the formations: the following summary is based on the results of this study.

Sequence and fossils

The comprehensive section of the Eocene sequence is presented on Fig. 1. The section selected with the sampling points is shown on Fig. 2. The total thickness of the section is 21.0 m.

The oldest formations of the section are the Upper Eocene basal con-

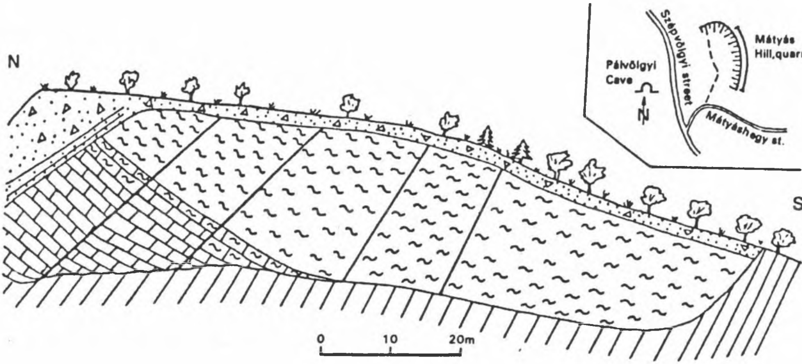
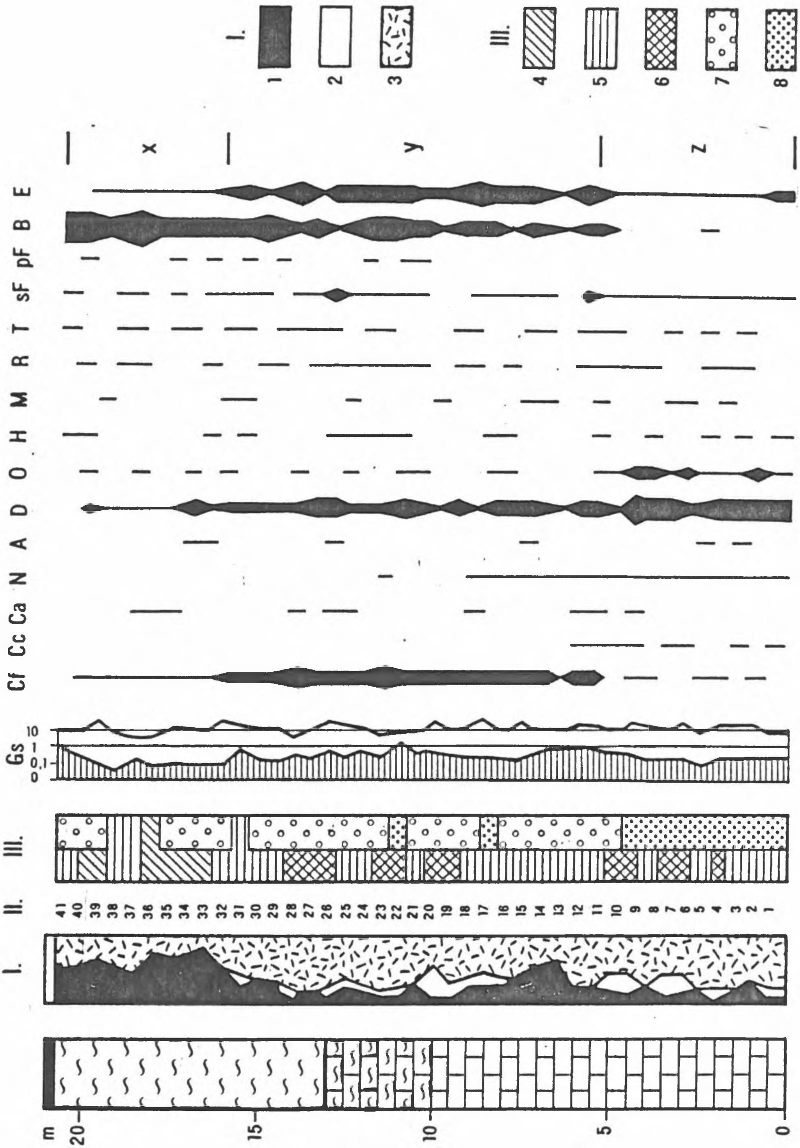


Fig. 1. Sketch of the Budapest, Mátyás Hill, Western quarry and its comprehensive section (after MONOSTORI 1982)

glomerate, a chert-breccia with red clay, in tectonic contact on the Upper Triassic cherty dolomite, and the Corallinacea-limestone exposed at the W end of the quarry. The contact is tectonically disturbed here, but it can be studied well in the Fenyőgyöngye quarry lying 1 km NW of the site.

The tectonically undisturbed sequence can be divided, lithologically, into three units (from the bottom upwards):

1. 10.0 m of ochreous, hard, compact limestone (0.0--10.0 m, Samples 1--20) containing great quantity of "Orthophragmina", in lowermost 5 metres in rock-forming quantity. The term "Orthophragmina" here stands for not a taxonomical category but according to the interpretation of LESS (1987), as a collective term for the revised Discocyclina, Aktinocyclina and Asterocyclina genera. The most frequently occurring taxa of the "Orthophragmina" fauna in this sense are Discocyclina pratti pratti (MICHELIN), D. dispansa sella (D'ARCH.), D. dispansa dispansa (SOW.), D. radians radians (D'ARCH.), D. augustae augustae WEIJDEN, Orbitoclypeus varians varians (KAUFM.), O. varians roberti (DOUV.), Asterocyclina stellata stellata (D'ARCH.). Besides the "Orthophragmina", accessory but stratigraphically important elements of the fauna are the sporadically occurring Nummulites fabianii (PREVER), N. incrassatus DE LA HARPE, N. pulchellus DE LA HARPE, N. chavannesi DE LA HARPE, Operculina alpina DOUV., O. gomezi COLOM et BAUZÁ, moreover Heterostegina Asterigerina and Miliolina as well as other benthonic



I.
1
2
3
III.
4
5
6
7
8
x
y
z
E
B
pF
sF
T
R
M
H
O
D
A
N
Ca
Cc
Cf
Gs
10
1
0,1
0
III.
II.
I.
m
20
15
10
5
0

Fig. 2. Microfacies diagram of the Mátyás Hill, Western quarry (after KÁZMÉR 1985)
I. Components and matrix: 1. micrite, 2. sparite, 3. bioclast. II. Number of samples. III. Depositional texture: 4. wackestone, 5. packstone, 6. grainstone, 7. floatstone, 8. rudstone. Gs=grain size (log mm), Cf=Corallinacea fragments, Cc=Corallinacea crustose, Ca=Corallinacea articulate, N=Nummulites, A=Asterigerina, D=Orthophragmina, O=Operculina, H=Heterostegina, M=Miliolina, R=Rotaliina, T=Textularina, sF=smaller benthonic Foraminifera, pF=planktonic Foraminifera, B=Bryozoa, E=Echinoidea, X=bryozoa floatstone in bryozoa-wackestone/packstone matrix, Y=orthophragmina-floatstone in alga-orthophragmina-bryozoa-echinoidea-packstone matrix, Z=orthophragmina-rudstone in orthophragmina-packstone matrix

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small foraminifers which cannot be exactly determined in thin section. Other accessory elements are bryozoans and echinoid fragments. Among the algae, the Corallinacea occur in considerable quantity.

2. 3 m ochreous, in its upper parts, slightly grey marly limestone (10.0--13.0 m, Samples 21--25), the fauna of which is basically identical with that of the underlying formations, the difference is only in the ratio of the individual elements of the fauna. Apart from the "Orthophragmina" (the same taxa as in the previous formation), the bryozoans are accumulated in rock-forming quantities, and the number of echinoid fragments was essentially increased as well. Nummulitids occur in decreasing quantities: N. fabianii (PREVER), N. incrassatus DE LA HARPE, N. pulchellus DE LA HARPE, N. chavannesi DE LA HARPE , Operculina (O. alpina DOUV.) as well as Heterostegina and Asterigerina. New element in the fauna are represented by some Sphaerogypsina, agglutinated foraminifers and some Ditrupa section. The Corallinacea are accessory elements of the assemblage here as well.

3. 8 m of ochreous marl, getting increasingly less compact upwards (13.0--21.0 m, Samples 26--41). The rock-forming fossils here are the bryozoans. They are represented almost exclusively by branching and incrusting species observable in thin section. Besides them, the "Orthophragmina" are subordinate (practically represented by the species occurring in the limestone), and they are included among the rest of the accessory elements (Heterostegina, Miliolina, echinoids). In the argillaceous facies --such beds occurring mainly in the uppermost part of the marl--planktonic foraminifers occur (Globigerinidae), as well as some sponge spicules.

Microfaciologically, the sequence can be divided also into three parts. The boundaries of the microfacies, however, do not coincide with the macroscopically separable lithological units. The three types of microfacies (Fig. 2) are the following (from the bottom upwards):

a) 6 m of Orthophragmina rudstone in an Orthophragmina-packstone matrix (0.0--6.0 m, Samples 1--10)

b) 10 m of Orthophragmina floatstone in an algal-Orthophragmina-bryozoan-echinoid packstone matrix (6.0--16.0 m, Samples 11--31)

c) 5 m of Bryozoa-float in bryozoa-wacke/packstone matrix (16.0--21.0 m, Samples 32--41).

Paleoecology

The gradual change in the quantity of fossils from the bottom upwards --the presence of the Corallinaceae and their disappearance, the disappearance of the nummulitids, the decrease of the Orthophragmina, the gradual and rapid accumulation of the bryozoans and the decrease in the quantity of the echinoids--denote a continuous sinking, the gradual increase of the water depth (a transition from the shallow sublittoral to deep sublittoral facies).

Biostratigraphical evaluation

Among the rich microfauna, the nummulitids and the operculinids have considerable stratigraphical value. N.fabianii (PREVER) is a good zonal index; coupled with N. incrassatus DE LA HARPE, N. pulchellus DE LA HARPE and N. chavannesi DE LA HARPE they form a characteristic association confining the age of the whole sequence unambiguously to Priabonian. This is corroborated by the presence of Operculina alpina DOUV., as well as Op. gomezi COLOM et BAUZÁ.

References

DUDICH, E. 1959; HANTKEN, M. 1875, 1884; KÁZMÉR, M. 1985; LESS, GY. 1987; MONOSTORI, M. 1965, 1983.

BUDAPEST III, Péterhegyi road, clay-pit

A. NAGYMAROSY
with the contribution of M. HORVÁTH and M. MONOSTORI

Topography

The exposure is located in Budapest district 3, on the E slopes of the Péter Hill in the clay-pit of the Csillaghegy brickyard, beside the open air bathing pool (Fig. 1).

Age

Lower Oligocene, Kiscellian Stage (NP 24 zone; P 20 zone).

Lithostratigraphy

Kiscell Clay Formation.

History

The type area of the Lower Oligocene Kiscell Clay is the Kiscell plateau lying parallel to the Danube in districts 2 and 3 of the capital. (This geographical unit was the eponymc region of the regional name of the Lower Oligocene stage, i.e., Kiscellian.) In the last century, a range of clay mines, brickyards and natural exposures opened in the area. By our days, however, nearly the complete area is built in. Thus, the s.s. Kiscell Clay of the type area can be studied practically only in the abandoned clay-pit of Péter Hill (Csillaghegy brickyards).

The foraminifer fauna of the Kiscell Clay was studied already by HANTKEN (1868, 1875), describing a number of new species from it. The name of MAJZON should be also emphatically mentioned here, who divided the Kiscell Clay into four assemblage zones, though not all of these zones are considered valid today (MAJZON 1942,1948, 1953, 1960).

Stratigraphy

The three yards of the clay mine opens, approximately, some 50 m thick sequence of the Oligocene (Fig. 2). The mine is separated by a fault of 78^0--258^0 strike. Along this fault the block of the Ist yard moved downward compared to the IInd and IIIrd yards. Therefore the older formations are located to the NW of the fault line.

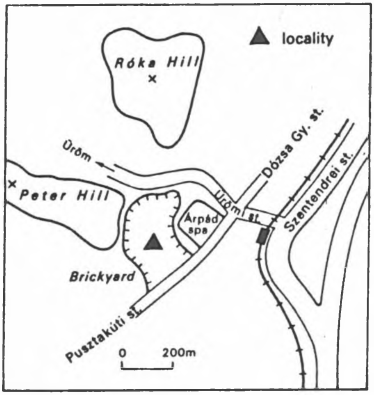


Fig. 1. Location of the Budapest— Péter Hill Brickyard clay-pit

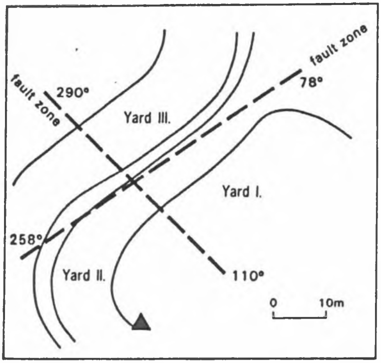


Fig. 2. Oligocene beds in the clay-pit

In the NW tectonical block presented on Fig. 3, the upper member of the anoxic Tard Clay Formation can be studied. Intercalated in the argillaceous shale we find some 10 m of tuffitic sandstone. Proceeding upwards, the Tard Clay gradually turns into the euhaline Kiscell Clay. The eroded surface of the latter is covered by Pleistocene freshwater limestone.

As the Tard Clay and the lower, transitional member of the Kiscell Clay are nearly free of fossils or contain relatively few microfossils, we turn our attention towards the Kiscell Clay of the lower yard very rich in microfossils. Let us note, however, that the layers of the Tard Clay contain sometimes interesting monospecific nannofloras, leafprints and shark teeth.

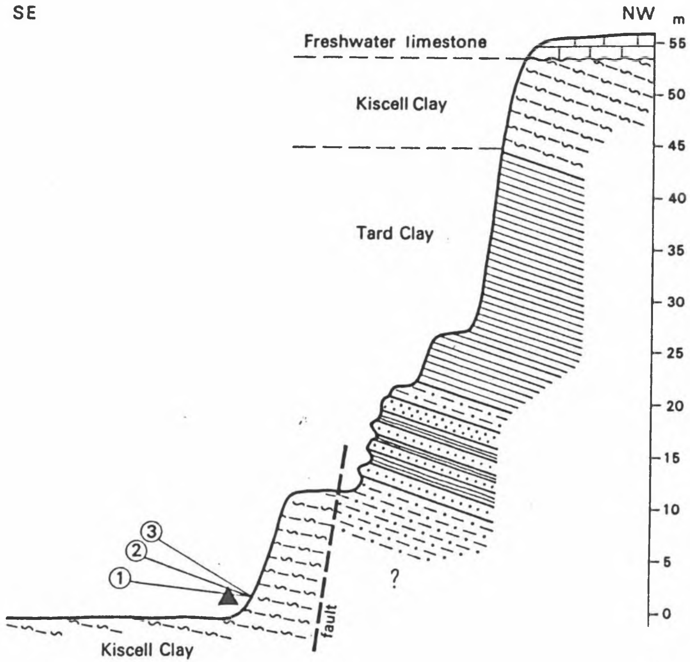


Fig. 3. Section of the clay-pit

The Kiscell Clay of the lower yard is a lithologically uniform grey clay-marl. The thick beds show traces of bioturbation (e.g., worm burrows). Its biogenic pyrite content is fairly high. Sometimes the layers yield remains of bathyal molluscs as well. In the followings, results of the investigation from three samples taken at 80 cm intervals will be presented, from the bottom upwards.

Fossils

The euhaline n a n n o f l o r a (Table 1) of the Kiscell Clay indicates a colder mass of water than that of the Eocene. This is reflected by the high specimen number of Reticulofenestra bisecta of the small abundance of Sphenolithus and Discoaster. The age of the nannoflora: Oligocene, Kiscellian Stage, NP 24 zone.

Table 1

Nannoplankton of the Péterhegyi road clay-pit

Taxon	Samples 1	2	3
Reticulofenestra bisecta (HAY, MOHLER and WADE)	S	S	S
R. lockeri MÜLLER	S	A	A
R. minuta ROTH	S	S	A
Coccolithus eopelagicus (BRAMLETTE and RIEDEL) BRAMLETTE and SULLIVAN	R		
C. pelagicus (WALLICH) SCHILLER	A	A	A
Cyclicargolithus abisectus (MÜLLER) WISE	R		
C. floridanus (ROTH and HAY) BUKRY	S	A	A
Coronocyclus nitescens (KAMPTER) BRAMLETTE and WILCOXON	R	R	
Ericsonia obruta PERCH-NIELSEN	R		
Helicopontosphaera euphratis HAQ	R		
H. intermedia MARTINI	R		
H. recta HAQ	R		R
Pontosphaera multipora (KAMPTNER) ROTH	A	K	K
Transversopontis pulchra (DEFLANDRE) PERCH-NIELSEN	R		
T. pygmaea (LOCKER) PERCH-NIELSEN		K	R
Sphenolithus ciperoensis BRAMLETTE and WILCOXON	R	K	
S. distentus (MARTINI) BRAMLETTE and WILCOXON		R	
S. moriformis (BRÖNNIMANN and STRADNER) BRAMLETTE and WILCOXON	S	S	R
S. predistentus BRAMLETTE and WILCOXON	R	R	
Braarudosphaera bigelowi (GRAN and BRAARUD) DEFLANDRE		R	
Zygrhablithus bijugatus (DEFLANDRE) DEFLANDRE	A	A	K
reworked from the Eocene	R		R
reworked from the Cretaceous	R		R

Key: S = abundant K = few
A = common R = rare

F o r a m i n i f e r a:

B e n t h o s

Rhizammina sp.
Bathysiphon div. sp.
Ammodiscus incertus (D'ORBIGNY)
Reophhax scorpiurus MONTFORT
Cyclammina acutidorsata (HANTKEN)
Ammobaculites agglutinans (D'ORBIGNY)
Ammomarginulina expansa (PLUMMER)
Spiroplectammina carinata (D'ORBIGNY)
Vulvulina haeringensis (GUEMBEL)
Semivulvulina pectinata (HANTKEN)
Textularia gramen D'ORBIGNY
Textularia cf. marielensis LALICHER et BERMUDEZ
Trochammina globigeriniformis (PARKER et JONES)
Gaudryina asiphonia ANDREAE
Gaudryina fortiuscula BERMUDEZ
Dorothia textilaroides (HANTKEN)
Karreriella siphonella (REUSS)
Tritaxilina reussi (HANTKEN)
Martinottiella rhumbleri (CUSHMAN)
Spiroloculina tenuissima (REUSS)
Nodosaria acuminata HANTKEN
Nodosaria latejugata GUEMBEL
Nodosaria bacilloides HANTKEN
Dentalina acuta D'ORBIGNY
Dentalina contorta HANTKEN
Dentalina elegans D'ORBIGNY
Lenticulina div. sp.
Marginulinopsis fragaria (GUEMBEL)
Planularia kubinyii (HANTKEN)
Pseudonodosaria inflata (BORNEMANN)
Saracenaria böttcheri (REUSS)
Saracenaria propinqua (HANTKEN)
Sarcenaria senni HEDBERG

Pullenia bulloides (D'ORBIGNY)

Pullenia quinqueloba (REUSS)

Alabamina tangentialis (CLODIUS)

Gyroidina girardana (REUSS)

Gyroidina soldanii D'ORBIGNY

Gyroidinoides byramensis (CUSHMAN et TODD)

Anomalina cryptomphala (REUSS)

Anomalina granosa (HANTKEN)

Cibicidoides borislavensis (AISENSTAT)

Cibicidoides conspiciendus (PISHVANOVA)

Hanzawaia americana (CUSHMAN)

Heterolepa bullata FRANZENAU

Heterolepa costata FRANZENAU

Heterolepa cubensis (VAN BELLEN)

Heterolepa eocaena (GUEMBEL)

Heterolepa peelensis (TEN DAM et REINHOLD)

Heterolepa praecincta FRANZENAU

Melonis affinis (REUSS)

Almaena osnabrugensis (MUENSTER)

Plankton

Globorotalia (Turborotalia) aff. brevispira (SUBBOTINA)

Globorotalia (Turborotalia) liverovskae (BYKOVA)

Globorotalia (Turborotalia) munda JENKINS

Globorotalia (Turborotalia) opima nana BOLLI

Globigerinita martini scandretti BLOW et BANNER

Globorotaloides suteri (BOLLI)

Subbotina angiporoides (HORNIBROOK)

Globigerina anguliofficinalis BLOW

Globigerina angustiumbilicata BOLLI

Globigerina eocaena GUEMBEL

Globigerina ouachitaensis gnaucki BLOW et BANNER

Globigerina aff. ouachitaensis HOWE et WALLACE

Globigerina praebulloides group BLOW

The benthonic small foraminifers of the samples suggest euhaline, well-aired sea floor and epibathyal environment. The agglutinated forms are frequent. The benthos is characterized by an Uvigerina--Heterolepa assemblage, frequent species are the Uvigerina eocaena, U. hantkeni, Heterolepa bullata, H. costata, H. eocaena. The specimen number of planktonic foraminifers is also considerable, with numerous Turborotalia species.

The age of the formation is Lower Oligocene, Upper Kiscellian Substage, upper part of the P 20 planktonic foraminifera zone.

The list of foraminifers published here does not contain, unfortunately, many of the species described by HANTKEN from the Buda area because the deeper levels of the Kiscell Clay cannot be studied on the surface anymore. The samples from this locality contain about one third of the 200 species described so far from the Kiscell Clay, including 10 nov. sp. of HANTKEN.

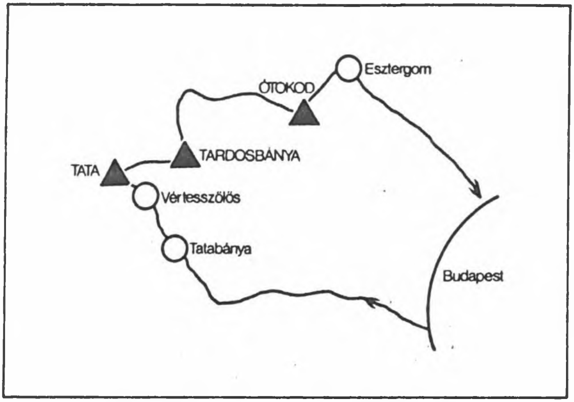
There are well-preserved ostracods in the Samples 2 and 3 of the exposure. The small assemblage comprising few species and specimens lived in an euhaline shallow bathyal-deep sublittoral environment:

Cytherella pestiensis (MÉHES)
Cytherella aff. méhesi BRESTENSKÁ
Cytherella sp.
Costa hermi WITT

References

HANTKEN, M. 1868, 1875; MAJZON L. 1942b, 1948, 1953, 1960.

9 September: E: BUDAPEST--TATA--TARDOSBÁNYA--ÓTOKOD--BUDAPEST



ÓBUDA

The northern parts of the capital called Óbuda, today's IIIrd district used to form one of the units constituting the present capital. It has been an important centre since Roman times. The Romans occupied Pannonia, today's Transdanubia around 10 A. D. The capital of Pannonia Inferior was Aquincum, the city of which was formed in the first half of the second century. The permanent camp of the "Legio II. adiutrix" was erected here. The excavations of the Roman city were started already in the 18th century under the auspices of Queen MARIE-THERESE, the Habsburg emperess. She ordered, apart from the excavation, the preservation of the monuments as well. Prominent relics of the Roman city are the Amphiteatrum of the military city (Nagyszombat street), the dwelling houses (Korvin Ottó street), the great bath at the Flórián square, the marbles of the palace of the praefectus, the civil city of Aquincum with its own Amphiteatrum, the water pipes (Aquaductus) along the Szentendrei road and the Museum of Aquincum. Apart from the objects made of stone, glass, bronze and pottery, there is a unique find among the relics, the Aquincum

Organ. This is a pneumatic instrument with 52 pipes. The Angster Organ Factory made a functionable model of the piece. The excavations on the site are continuously going on, resulting in interesting finds even today.

TATABÁNYA

The largest mining town in Hungary. Among the Baroque churches of the settlement, the most interesting piece is the Bánhida church built on Early Medieval Romanesque foundations. On the mountain over the town we can see the statue of a bird, the Turul (mythical eagle-like bird), the biggest of its kind in Europe. The distance of the expounded wings is 14 m. The memorial statue was made by Gyula DONÁTH in 1896. Tatabánya gives home to the only geological secondary school in Hungary.

VÉRTESSZŐLŐS

Remains of the prehistoric settlement from the Lower Palaeolithic period excavated in the 60s can be seen here in an open-air museum built around the locality. Apart from the footprint of prehistoric man, encountered as a rarity, abundant flora (comprising more than 200 species) and fauna was recovered from here. The church and the restaurant of the village are the works of the builder Jakab FELLNER (1747 and 1774, resp.).

E-1

TATA, Kálvária Hill, Nature Conservation Area

G. CSÁSZÁR

Topography

Tata, Kálvária Hill.

Age

Ages represented in the locality range from the Upper Triassic (Rhaetian) to the Cretaceous (Upper Aptian). Sampling in the Nature Conservation Area is forbidden.

History

The area (Fig. 1) is unique both for experts and amateurs, and its importance is international. About the formations, found in the quarry several studies have been published both by foreign and Hungarian scientists. The locality, cared and maintained by the Hungarian Geological Institute, shows formations ranging from the uppermost Triassic (Rhaetian) up to the upper part of the Lower Cretaceous (Aptian). The limestone succession contains two significant gaps (Fig. 2). A speciality of the section is the 42 m thickness of the almost continuous Jurassic sequence. A monographic study of the region and the immediate surroundings of the locality was published by FÜLÖP (1976).

Stratigraphy, fauna and flora

Oldest unit of the sequence is the Rhaetian Dachstein Limestone Formation. The section consisting of complete Lopher cycles (Fig. 3) can be seen in the lower level of the quarry. Two of its most frequent members are the yellow and greyish-yellow dolomitic and algal limestone of intertidal origin (member B) and the greyish-white megalodontid limestone of subtidal origin with calcite speckles (member C). In its microfauna foraminifers predominate, which are almost exclusively restricted to member C. Most frequent is Triassina hantkeni MAJZON. From the surface exposures Mrs. J. VADÁSZ could identify the following species: Frondicularia woodwardi HOWCH., Pseudonodosaria sp., Involutina tumida (KRISTAN), I. sinuosa (WEYN.), I. communis (KRISTAN), I. impressa KRISTAN, I. turgida (KRISTAN), Glomospira sp., Glomospirella sp., Dentalina sp., Trochammina sp., Tetrataxis sp., Lenticulina sp., Agathammina austroalpina KRISTAN, Ophtalmidium sp., Gaudryina racena TRIFONOVA and Trocholina crassa KRISTAN.

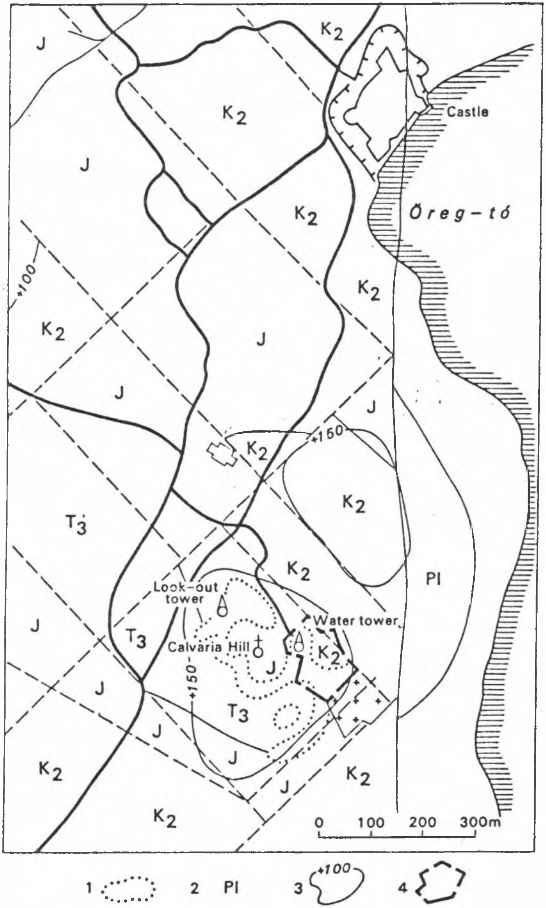
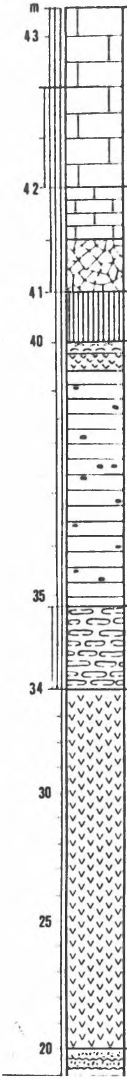


Fig. 1. Mesozoic formations at the Kálvária Hill, Tata and at the adjacent areas (after FÜLÖP 1976)
1. Surface outcrops of the Mesozoic formations. -- Subsurface Mesozoic formations: K_2 = Middle Cretaceous (Albian silty marl, Aptian crinoidal limestone), J = Jurassic (Malm--Dogger limestones and cherts, Liassic limestones), T_3 = Upper Triassic (Rhaetian Dachstein Limestone). -- 2. Pleistocene freshwater limestone, 3. surface contour line of the Mesozoic formations, 4. border of the Tata Nature Conservation Area

In the limestone indeterminable ostracods are concentrated in members D and B, though they rarely occur at other levels too. Rarely Echinoidea and Holothuroidea shell fragments, gastropods and calcareous algae may be also observed. Radiolaria, Crustacea coprolite and Globochaete also occur. The exposed part of the formation belongs to the Rhaetian.

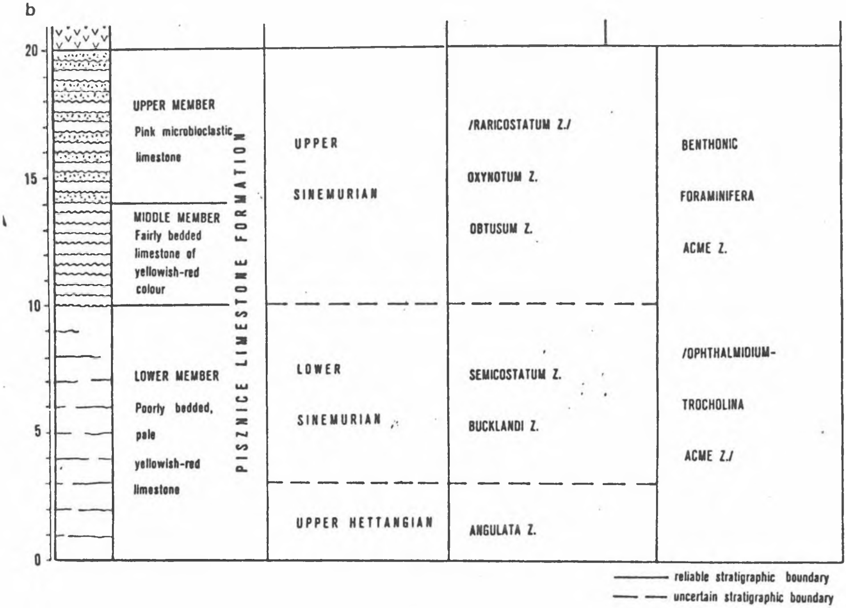
After considerable gap the smoothed surface of the Dachstein Limestone is paraconformably overlain by the Pisznice Limestone Formation. Both its lithology and fauna are significantly different from the former one. The light yellowish-red limestone of aphaneritic, microbioclastic, intraclastic (or sometimes brecciated) structure, containing brachiopods, cephalopods and crinoid stems can be divided lithologically into three members. The lowermost 10 m is poorly-bedded or massive, the middle, 4 m thick part, due to the clayey hard-grounds and stylolitic joints are well-bedded, while the upper 6 m is darker red and is distinguished from the former ones by its intraclastic feature and small ferromanganese nodules.

The limestone of predominantly biomicritic texture is rich in microfossils. These, according to D. ZILAHI's determination, in order of their approximate frequency are the following: sponge spicules, Globochaete alpina, ostracods, crinoids and different benthic foraminifers. Quantity of the sponge spicules, with more or less continuity, is increasing upwards reaching the greatest frequency in the upper part of the upper member. Frequency of the Globochaete is rather varied, reaching its maximum in the middle part of the upper member. Change in frequency of the ostracods is insignificant while the crinoids with marked changes have peaks near the base and in the upper part of the upper member. The rich foraminifer assemblage, as a whole, shows a comparatively small variability. Quantity of Nodosaria (N. mutabilis TERQUEM, Pseudonodosaria sp.) is increasing mainly in the lower part of the lower member and in the upper member (Nodosaria sp.). Lower part of the lower member is characterized first of all by Ophtalmidium. Lenticulina is mostly present in the lower part of the lower, and upper part of the upper member. Involutina liassica (JONES), Trocholina turris FRENZEN and T. conica SCHLUMBERGER are of great importance, all being most frequent in the lower part of the lower member. Frondicularia occurs with the similar frequency with the determinable species of F. bryzaeformis BORNEMANN. Rarely occurring foraminifers are the following: Ammodiscus sp., Gaudryina sp., Pseudonodosaa



LITHOSTRATIGRAPHY	CHRONOSTRATIGRAPHY		BIOSTRATIGRAPHY
SZENTIVÁN-HEGY FORMATION	VALANGINIAN ?	THURMANNI Z.	CALPIONELLITES DARDERI Z.
	BERRIASIAN	BOISSIERI. Z. GRANDIS Z.	CALPIONELLOPSIS OBLONGA Z. CALPIONELLOPSIS SIMPLEX Z.
	TITHONIAN	CHAPERI Z. SUBCALLISTO Z. DELPHINENSIS Z. SEMIFORME Z. VIMINEUS Z. HYBONOTUM Z.	CALPIONELLA ALPINA-C. ELLIPTICA Z. C. ALPINA-CRASSICOLARIA PARVULA Z. CRASSICOLARIA-LOMBARDIA Z. LOMBARDIA-GLOBOCHAETE Z.
ARGILLACEOUS, NODULAR, CEPHALOPODAL LIMESTONE	KIMMERIDGIAN	BECKERI Z. PSEUDOMUTABILIS Z. TENUILOBATUS Z.	LOMBARDIA-AXOTRIX Z.
INFORMATIONAL LIMESTONE BRECCIA	OXFORDIAN	BIMAMMATUM Z. TRANSVERSARIUM Z.	
CHERT /LÓKÚT RADIOLARITE/	BATHONO-CALLOVIAN		RADIOLARIA ACME Z.
BOSITRA LIMESTONE AND CRINOIDITE BEDS RED ARGILLACEOUS LIMESTONE	BAJOCIAN	/PARKINSONI Z./ /GARANTINA Z./ /SUBFURCATUM Z./ HUMPHRIESIANUM Z. SAUZEI Z. /SOWERBYI Z. ?/	PROTOGLOGLOBIGERINA-BOSITRA ACME Z.
TÖLGYHÁT LIMESTONE	AALENIAN	/CONCAVUM Z. ?/ MURCHISONAE Z. /SCISSUM Z. ?/ /OPALINUM Z. ?/	CADOSINA NOV. SP.-GLOBOCHAETE ACME Z.
RED NODULAR CALCAREOUS MARL KISGERECSE MARL	UPPER TOARCIAN	MENEGHINI Z. ERBAENSE Z. /VARIABILIS Z. ?/ BIFRONS Z. ?	
RED CRINOIDAL LIMESTONE TÜZKÖVESÁROK LIMESTONE FORMATION	UPPER PLIENSBACHIAN	/SPINATUM Z./ MARGARITATUS Z. /?/ STOKESI Z.	CRINOIDEA-LARGE BENTHONIC FORAMINIFERA ACME Z.
	LOWER PLIENSBACHIAN	/DAVOEI Z./ /IBEX Z./ /JAMESONI Z./	

Legend:
Oxyn........ Zone evidenced by index fauna
....../?/ Zone supposed on the basis of fauna
/...../ Zone supposed on the basis of geological features
/....?/ the presence of the Zone is not excluded



Figs 2a-b. Jurassic sequence at Kálvária Hill, Tata

ria sp., Dentalina sp., Marginulina, Cornuspira and Astacolus. At the base of the formation Frondicularia woodwardi HOWCHIN also occurs.

Further biogenic elements such as fragments of radiolarians, Holothuroidea, Posidonia and other macrofaunal groups can be also recognized in thin-sections.

Age of the formation is determined by ammonites as ranging from the Middle Hettangian Alsatites liassicus to the Upper Sinemurian Asteroceras obtusum zone.

The only Middle Liassic formation is the red crinoidal limestone that lithostratigraphically is named as Tűzkövesárok Limestone. The formation consisting of biocalcarenite (crinoidite) and calcipelite in an alternating manner yielded a rather poor macrofauna with only a few brachiopods and cephalopods. The rock is characterized by biomicritic texture but subordinately pelmicrites and intrabiomicrites also occur. Among biogenic constituents the crinoids predominate though echinoid and holothuroid fragments can be also identified. Foraminifers are generally present but with a small frequency and are less varied than in the previous formations: mainly large and thick-shelled forms can be found, such as Lenticulina, Nodosaria, Pseudonodosaria, Rectoglandulina, Frondicularia bryzaeformis and some Ophtalmidium and Trocholina sp. The sponge spicules are restricted to the upper part of the formation while ostracods are present everywhere with an alternating frequency. Beside the above mentioned ones, shell fragments of other macrofaunal elements can be also found with a scattered frequency.

The Kisgerecse Marl Formation is separated from the former one by a hard-ground. The formation of only 60--80 cm in thickness is constituted by red fauna-poor marl of nodular structure. It is one of the most widespread Jurassic formations of the Transdanubian Central Range. On the basis of ammonites it can be dated as Upper Liassic. Its foraminifer assemblage is rather rich.The following forms has been determined by SIDÓ in the washing residue: Nodosaria tenera FRANKE, N. simplex (TERQUEM), N. candela FRANKE, Dentalina integra (K. et ZW.), D. pseudocommunis FRANKE, D. subulata FRANKE, D. varians TERQUEM, D. cf. nodigera TERQUEM, D.glandulinoides FRANKE, Pseudonodosaria sp., Lingulina sp., Marginulina simplex (TERQUEM), Marginulina cf. dumortieri TERQUEM, Frondicularia sp., Astacolus cf. plebeia TERQUEM et BERTHOLIN, A. pulchra TERQUEM, A. cf. matutina d'ORB., A. cf. antiquata d'ORB., Lenticulina varians BORN, L. convoluta BORN, L. metensis TERQUEM, L. gottingensis (BORN), Euguttulina simplex (TERQUEM), Spirilina sp., Ammodiscus sp.

Oldest member of the Middle Jurassic is the Tölgyhát Limestone Formation which is also red, thinly-bedded and clayey in a varied manner. It contains few ammonites, Chondrites and small ferromanganese oxide nodules. The uppermost beds of the 4 m thick formation are coarse-grained crinoidal limestones. Texture of the rock in thin-section is biomicritic. Its fossil assemblage is rather poor: Globochaete, new Cadosina species, radiolarians, sponge spicules, a small amount of benthic foraminifers and frequent Protoglobigerina (in the upper part). The most frequent constituent is Bositra shell. From the pulverized material BÁLDI-BEKE could identify the presence of the nannoplankton form Watznaueria communis REINHARDT. Based on ammonites, the Middle Aalenian Ludwigia murchisonae

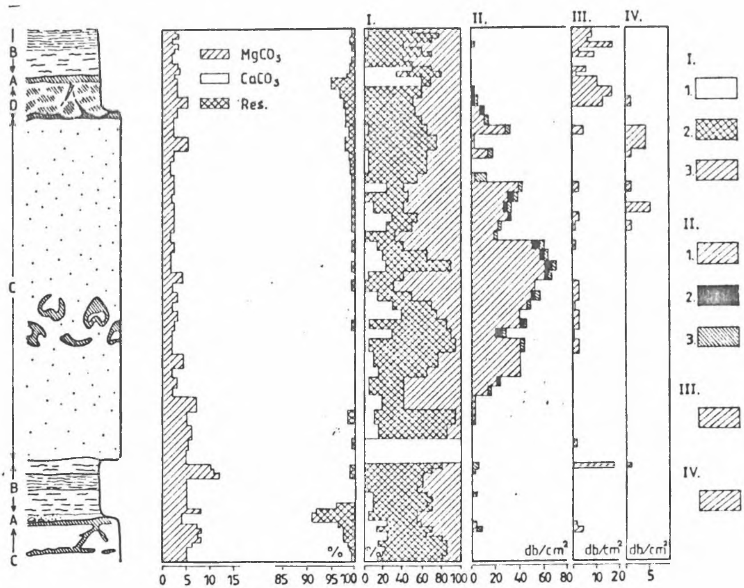


Fig. 3. Dachstein Limestone cyclotheme, typical section in the lower quarry wall at the Kálvária Hill of Tata, and analytical results (after FÜLÖP 1976)
I: 1. Micrite, 2. crystalline micrite, 3. drusy calcite, II. foraminifers: 1. Triasina hantkeni, 2. Involutina, 3. Frondicularia, III. ostracods, IV. echinoderms

and the Bajocian Otoites sauzei and Stephanoceras humphriesianum zones could be also indicated.

The Eplény Limestone Formation which is deposited upon the crinoidal limestone of the previous formation is only 30 cm thick here. The rock is greyish-red or reddish-grey, thinly-bedded or laminated, and consists exclusively of Bositra shells. In the lowermost 10 cm these are crushed to small pieces and sometimes are mixed with fine crinoidal fragments.

The Eplény Limestone is separated from the Lókút Radiolarite Formation by a hard-ground that is represented here by liver-brown, well-bedded chert layers, at an average thickness of 1 m. Sometimes thin limestone and siliceous limestone intercalations can be observed. Radiolarians are the predominant elements of the microfauna. Additionally, a small amount of sponge spicules, Globochaete and badly preserved foraminifers could be recognized. BÁLDI-BEKE has proved Watznaueria communis REINHARDT also from here.

The radiolarite is overlain by the Pálihálás Limestone Formation of untypical development with sharp contact. The formation consists of two, lithologically different rock types here. The lower part is a max. 90 cm thick, greyish-white limestone breccia of submarine slope origin from which the pelitic matrix had been washed out by the bottom currents at most places. In the rock both the macrofauna (belemnites) and microfauna (radiolarians, Protoglobigerina, sponge spicules, ostracods, Cadosina fibrata and C. parvula) are rather scarce. Based on ammonites, the formation can be dated as Upper Oxfordian.

The characteristic upper part of the formation is red, clayey limestone with manganese nodules and ammonites. Its thickness ranges in the region only between 20 and 60 cm. The extremely rich ammonite assemblage is associated with rich microfossil associations predominantly with Globochaete, Cadosina and Protoglobigerina. Cadosina is represented by C. parvula NAGY, C. lapidosa VOGLER, C. carpathica (BORZA), Stomiosphaera moluccana WANNER. Planktonic crinoids (Lombardia), Axothrix malmica NAGY, shell fragments of macrofossils, microbrachiopods and microgastropods are also frequent. A few nannoplankton species could be indicated only: Watznaueria communis REINHARDT and Braarudosphaera bigelowi (GRAN and BRAARUD).

On the basis of ammonites, all zones of the Kimmeridgian could be identified in the formation.

The Szentivánhegy Limestone Formation continuously develops from the former one. The condensed formation streches up to the Lower Valanginian. Total thickness of the purple, greyish-white, cephalopodal limestone is only 1.5 m. The lower part is characterized by the presence of great amount of Oxfordian and Kimmeridgian limestone cobbles and boulders (their size may reach several tens of cm in diameter) that slid in along the submarine slope. The formation can be excellently subdivided on the basis of both ammonites and microfossils.

The base of the Tithonian (according to LÉNÁRD, in FÜLÖP 1976, p. 70,

73) is characterized by planktonic crinoids (Lombardia), Globochaete, and a smaller amount of Cadosina.

Microfossils of the Middle Tithonian to Lower Valanginian are studied by TARDI-FILÁCZ (1986). On the basis of microfossils she distinguished 9 zones. Middle Tithonian Chitinoidella zone is proved by Chitinoidella dobeni BORZA, Ch. boneti DOBEN and Ch.tithonica BORZA. Planktonic crinoids (Lombardia) still predominate and Globochaete (G. alpina LOMBARD), Protoglobigerina, Cadosina and various echinoderm debris are also frequent.

Praetintinnopsella sp. has been identified at the Middle and Upper Tithonian boundary.

Within the Upper Tithonian Crassicollaria (A) zone two subzones could be distuingished. The A_1 subzone is characterized by various Crassicollaria species as Cr. brevis REMANE, Cr. intermedia DURAN-DELGA, Cr. massutiniana COLOM and Cr. parvula REMANE. There are still some Lombardia, Globochaete and radiolarians. Beside the afore-listed, in the A_2 subzone Calpionella alpina LORENZ also occurs.

Berriasian starts with the Calpionella standard zone which is represented by the alpina (≈B) and elliptica (≈C) subzones. In the alpina subzone the following species are worth mentioning: Calpionella alpina LORENZ (in rock forming quantity), Tintinnopsella carpathica MURG. et FIL., Crassicollaria parvula REMANE (at the base of the zone only) and Calpionella elliptica CADISH. In the elliptica subzone beside C. elliptica CADISH there are Tintinnopsella carpathica MURG. et FIL., C. alpina LORENZ and Remaniella cadischiana COLOM as well. Globochaete alpina LOMB., Watznaueria communis REINH., Protoglobigerina, radiolarians, microgastropods, microbrachiopods and ammonite shell fragments can also be observed as accompanying fossils of the B and C zones.

The Calpionellopsis standard zone is subdivided into three subzones which can be differentiated from each other due to the appearance of the index calpionellid species. In D_1 subzone the following calpionellids have been identified: Calpionellopsis simplex COLOM, Calpionella alpina LORENZ, Tintinnopsella carpathica MURG. et FIL., T. longa COLOM, Remaniella cadischiana COLOM and Calpionellites? dadayi KNAUER. D_2 zone is marked at the first appearance of Calpionellopsis oblonga CADISCH, while D_3 zone is characterized by the appearance of Lorenziella hungarica

KNAUER et NAGY. From among the fossils listed above Calpionellopsis simplex is the only form missing from D_3 zone.

The only Valanginian -- Calpionellites or E -- zone is represented by its lowermost cm-s. New element of the zone is Calpionellites darderi COLOM. The other calpionellid components are as follows: C.? dadayi KNAUER, Lorenziella hungarica KNAUER et NAGY, Calpionellopsis oblonga CADISH and Tintinnopsella carpathica MURG. et FIL.

These latter two (D and E) zones are characterized by the presence of Cadosina fusca WANNER, radiolarians, ostracods, some nannoplankton species /Markalius circumradiatus (STOVER), Parhabdolitus embergeri (NOËL) and Nannoconus steinmanni (KAMPTNER)/, and also by small shell debris of several macrofaunal groups.

It is worth mentioning that the complete thickness of the afore-described calpionellid zones is about one m only.

Upon the unevenly eroded varied surface of the above formations the Tata Limestone Formation, belonging to the Aptian, is deposited. In the Nature Conservation Area only a few m of the latter formation can be observed. The rocky basement is encrusted by several cm thick stromatolite overlain by transgressive, sandy, glauconitic limestone with small pebbles from the underlying formations and echinoderm fragments of upwards increasing quantity. At certain places of its base, fossils, such as ammonites, brachiopods, gastropods can be found in washed pockets.

Due to lack of terrigenous clastics, the rock is characterized by bioextrasparitic and bioextramicrosparitic texture in thin section. Sandstone of micritic matrix with bioclasts can be also found.

Beside the predominant echinoderm (mainly crinoid) skeletal fragments, rich microfossil assemblage is also known from the Nature Conservation Area and its immediate vicinity (FÜLÖP 1976: 104-105; SIDÓ 1975).

Spores and pollen (H.-DEÁK)

Appendicisporites sp.

Cicatricosisporites sp.

Gleichenia nigra BOLCH.

Caytonathus oncodens HARRIS

Podocarpus sp.

Pinus haploxylon RUDOLPH

Nannoplankton (BÁLDI-BEKE)

Prediscosphaera cretacea (ARKHANGELSKIJ)
Glaukolithus bochotnicae (GÓRKA)
Cyclolithus sp.
Zygodiscus sp.
Rhabdolithus sp.
Watznaueria barnesae (BLACK)
Markalius cf. circumradiatus (STOVER)
Tetralithus sp.
Braarudosphaera bigelowi (GRAN et BRAARUD)
Peritrachinella sp. (?)

Foraminifera (SIDÓ, EDELÉNYI, HAAS)

Ticinella roberti (GAND.)
Hedbergella infracretacea (GLAESSNER)
Globigerinoides algerianus CUSHMAN et TEN DAM
Dorothia (Marssonella) trochus (d'ORB.)
D. (M.) oxycona (REUSS)
D. praeoxycona (MOULLADE)
D. filiformis (BERTHELIN)
Arenobulimina sp.
Cuneolina sp.
Spiroplectinata robusta MOULLADE
Bigenerina loeblichae CRESPIN
Textularia anglica LALICHER
Meandrospira washitensis LOEBLICH et TAPPAN
Spiroloculina sp.
Triloculina sp.
Quinqueloculina sp.
Nodosaria sp.
Dentalina sp.
Marginulina sp.
Bulimina sp.
Anomalina sp.

The age of the formation is indicated first of all by the washed ammonites as Diadochoceras nodosocostatum zone of the Clansay Substage of the Aptian.

The Early Albian Vértessomló Siltstone Formation covering the Tata Limestone,.due to erosion, is missing in the Nature Conservation Area.

References

FÜLÖP, J. 1976; SIDÓ, M. 1975; TARDI-FILÁCZ, E. 1986.

TATA

The attractive environment of the town was formed by the interaction of several springs and lakes. The town and its surroundings are rich in prehistoric remains. After the events of the Middle Ages and the Insurrection wars (János BOTTYÁN), the basic impression of the city is determined by the style of the 18th century. The Baroque character of the town can be attributed, to a great extent, the building activity of Jakab FELLNER (1722-1780). One of his outstanding works is the Great Church (1751-1784). In front of the church we can find his statue as well. The system of the lakes were regulated by Samuel MIKOVINY, roughly at the same time. The church and the monastery of the Capuzins was built between 1743-1746, probably in the vicinity of the former Franciscan monastery where Elisabeth SZILÁGYI, mother of King MATTHIAS HUNYADI died.

One of the attractions of the city is the Watch Tower on the Országgyűlés square (Square of the Diet). Its specific wooden structure bears the traces of the inventious carpenter of Tata, József ÉDER. The name of the square recalls the Diet of 1510 held in the town. The old mills of the city are important documents of art history and industrial history (Nepomucenus 1758, Cifra 1587, József mill around 1770).

The former Tata fortress gives home to the museum named after Domonkos KUNY. Inside we can see the relics of the first faience manufacture.

E-2

TARDOSBÁNYA, Gorbabánya

A. ORAVECZ-SCHEFFER

Topography

The quarry is NW of Tardosbánya at a distance of 400 m on the slope of the Gorba Hill (Fig. 1).

Age

Upper Triassic, Rhaetian.

Lithostratigraphy

Dachstein Limestone Formation.

Stratigraphy

The quarry exposes the characteristic, most widespread formation of the Gerecse Mts., the Dachstein Limestone Formation. Here the uppermost part of the limestone succession lying nearly horizontally and showing the typical cyclic structure (Lofer cycles) can be studied.

Sampling and analysis took place in two parallel, overlapping sections, I and II (Figs 2 and 3), of which representative samples 36, 37, 38, 59, 60 and 61 may be collected.

In the exposure the subtidal C members of the cycles are predominant. These are well-bedded, thick banks (from 2 m to some dms) of light-grey, pinkish, at certain places purple, compact limestone with splintery fracture. According to microscopic examination of their thin sections, most frequently they are biomicrites and biospars with pellets, peloids,

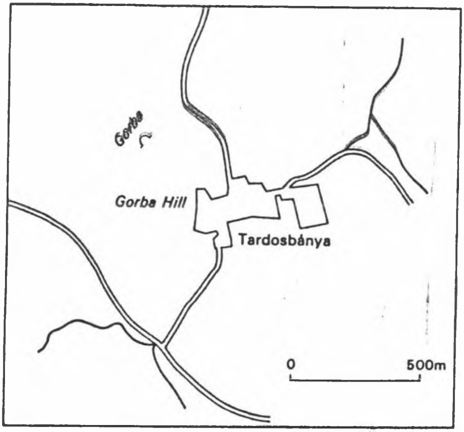


Fig. 1. Sketch map of the locality

sometimes with oolites and a large amount of biogene components. The original calcareous mud matrix is present only in the form of lumps and spots; partly it was washed out and partly it was recrystallized as microspar. The biogenic components are composed of Megalodus species, small gastropods, fragments of corals and hydrozoans on the one hand, while of algal fragments and foraminifer shells on the other. These latter, in certain samples, are present in rock-forming quantities. Their state of preservation is characterized by micritic crust, their internal chambers are often recrystallized (macroscopically they appear as shiny calcite spots).

According to DUNHAM's categories they are rather packstone type and less frequently of wackestone or grainstone types (oolites, calcareous sandstone intercalations).

Between the C members testifying to the continuous subaquatic conditions, thin (some cms to 2 dm), laterally wedged B members of algal mats and stromatolitic type are deposited. These typical intercalations formed in the tidal zone are finely and undulatorily laminated, snow-white and become less frequent upwards. Traces of algal mat fragments and dark, small intraclast grains can be observed also in the lower cms of the members C, deposited immediately on the B. The red, supratidal members A indicating short, temporary desiccation are missing in the exposure. Some very thin, greyish-green clay film and clay intercalations can be observed, however, on the dissolved, uneven limestone surfaces (samples 15, 16 and 27). The intercalations of the locally or nearby reworked, rolled, redeposited and cross-bedded calcareous sandstone (grainstone) intercalations that are usually rare in Dachstein Limestone can be observed in the uppermost part of section II (sample 11). Here also some large-oolitic, bioclastic, algal limestone beds may be observed that generally is characteristic of the uppermost beds of the Dachstein Limestone.

Microfossils

Complex sedimentological and faunistical analysis of sections I and II is now in progress. Microfaunal contents of samples 59, 60, 61 (section I), and 36, 37, 39 (section II) recommended for collection is the following:

Triasina hantkeni MAJZON
Aulotortus sinuosus WEYNSCHENK
Aulotortus tumidus (KRISTAN-TOLLMANN)
Aulotortus friedli (KRISTAN-TOLLMANN)
Glomospira sp.
Glomospirella minima MICHALIK et al.
Trocholina permodiscoides OBERHAUSER
Planiinvoluta carinata LEISCHNER
Frondicularia woodwardi HOWCHIN
Aciculella sp. (Dasycladacea)
Parafavrenia (koprolite)

Facies

The sedimentary environment is a typical backreef lagoon in which, in this area, sedimentation took place mostly in the subtidal zone (Lofer cycles, members C). The thin algal mat intercalations indicate temporary submergence into the tidal zone (members B).

Biostratigraphy

Predominance of the species Triasina hantkeni indicates the Rhaetian. This is also proved by the Paramegalodus sp. in bed 60.

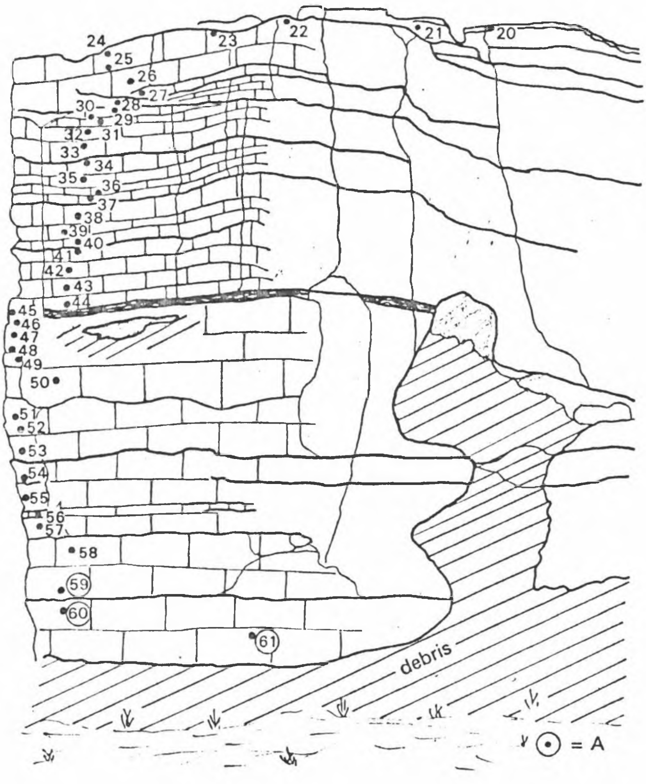


Fig. 2. Gorbabánya, Dachstein Limestone quarry, section I
A = points for collection

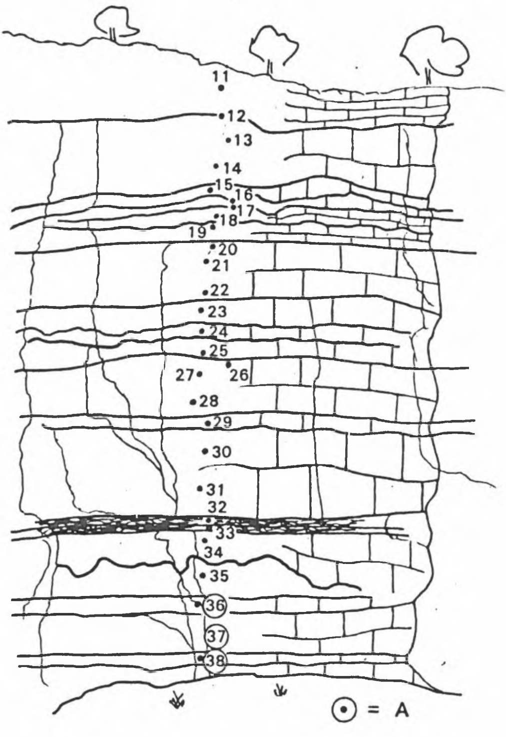


Fig. 3. Gorbabánya, Dachstein Limestone quarry, section II
A = points for collection

Triasina hantkeni MAJZON was described by MAJZON (1954) from Dorog, from the washing residue of the greenish-grey marl intercalated between the Dachstein Limestone beds. Since that time it has been known from several localities of the Tethyan region, like N Italy (Lombardy, Dolomites), N Alps, W Carpathians, the Dinarides, the Toros Mts. and also from sections in the Atlas Mts.

It appears in the Upper Norian, but its dominant, rock-forming occurrence always indicate the Rhaetian in the lagoonary mainly backreef facies of the Tethyan carbonate platforms.

In Hungary, beside the classical surface localities (Dorog, Nagykőszikla; Bajót; Leányvár; Tardos; Poczkő; Tata) the Triasina hantkeni faunas can be also observed in several borehole sections (e. g. Halimba-1516, Tés-28, Szend-1, Tata-5 etc.).

References

MAJZON, L. 1954.

E-3

ÓTOKOD OPEN-PIT MINE, Quarry of Kerék Hill

T. KECSKEMÉTI

with the contribution of M. BÁLDI-BEKE, K. HORVÁTH-KOLLÁNYI and M. MONOSTORI

Topography

It is E of village Tokod, on the N side of Kerék Hill in the Ótokod Open-pit Mine.

Age

Middle Eocene, Upper Lutetian.

Lithostratigraphy

Csolnok Formation (formerly Operculina-bearing marl, then Dorog Formation).

History

The Dorog (formerly Esztergom) basin is a classical area of the Eocene formations, with several excellent exposures. The surroundings of the village Tokod is extremely rich in localities, since the surface coal mines, operated here at the beginning of the century, provided excellent sections. One of the most complete sections, ranging from the basement to the upper cover, can be found in the Ótokod Open-pit Mine (Fig. 1).

Several publications deal with the formations, e. g. HANTKEN (1871), ROZLOZSNIK, SCHRÉTER and TELEGDI ROTH (1922) as fundamental ones, and recently those of GIDAI (1971) and JÁMBOR-KNESS (1973).

Stratigraphy (Fig. 2)

The underlying formation of the nannoflora- and fauna-rich Eocene sequence are the coal seams of the brown coal measures and the intercalating and covering freshwater limestones, which may be well observed at the foot of the section in some places.

The Eocene sequence recommended for collection (section A) starts with a 2.5 m thick clayey marl (Samples 92-95). Upon this, gradually, a 3 m thick pale brown clay is deposited (Samples 96-102). Then, within 2 m, calcareous marl (Sample 103), clay (Sample 104), sand (Sample 105), calcareous marl (Sample 106), clay (Sample 107).and calcareous marl (Sample 108) follow each other. The upper part of the section is a brown clay (Samples 109-112). The excavation is continued 6 m to the W (section B) with the same clay (Sample 113), and here the clay is 0.5 m thick. Then 0.8 m thick yellowish-brown clayey marl (Sample 114) follows, and the closing member is 1.5 m thick grey clay (Sample 115) which in its upper part is somewhat clayey. The higher Eocene beds, due to the quarrying, are missing.

Fossils

The deepest fossiliferous formation of the section is a greyish-brown

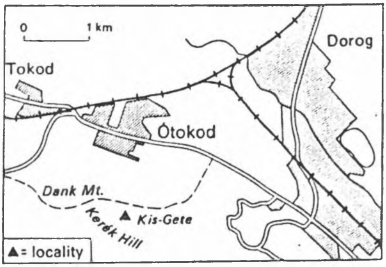


Fig. 1. Ótokod, Open-pit Mine. Locality of the exposure

clayey marl (Samples 92-95) that, based on its fauna, is already a marine formation. From the fauna of the further part of the section (Samples 96-115 where clay, clayey marl, calcerous marl and sandy marl are alternating), Nummulites are most important and characteristic. Additional larger foraminifer genera are Operculina and Discocyclina. In the small fractions benthonic smaller foraminifers, nannoplankton and ostracods are most frequent.

In Samples 92-95 the Nummulites succession is characterized by N. subplanulatus HANTK. Besides, the upwards increasingly abundant N. variolarius (LAMK.) , N. praegarnieri SCHAUB, Operculina schwageri SILVESTRI and Discocyclina pratti (MICHELIN) of medium amount, and scarcely Discocyclina radians (D'ARCH.) also occur. In the part between Samples 96 and 110, in the rock-forming amount of the Nummulites fauna N. variolarius (LAMK.), N. anomalus DE LA HARPE, N. discorbinus (SCHLOTH.), N. praegarnieri SCHAUB and N. perforatus (MONTF.) are present as dominant, while N. striatus (BRUG.), N. garnieri sturi VANOVÁ and N. praefabianii MENNER and VORONCOV are present as additional elements. Predominant species of the fauna is N. perforatus (MONTF.) that is represented by both generations. Among the other larger foraminifers the most conspicuous and important is Operculina schwageri SILVESTRI. In Sample 111 a change in the fauna may be observed. After the disappearance of the granular and reticulate Nummulites, a Nummulites fauna of small diversity becomes predominating with N. striatus(BRUG.) as the most important form. This, towards the top of the section, becomes increasingly predominant, and its frequency approaches the rock-forming amount. It is associated by N. dis-

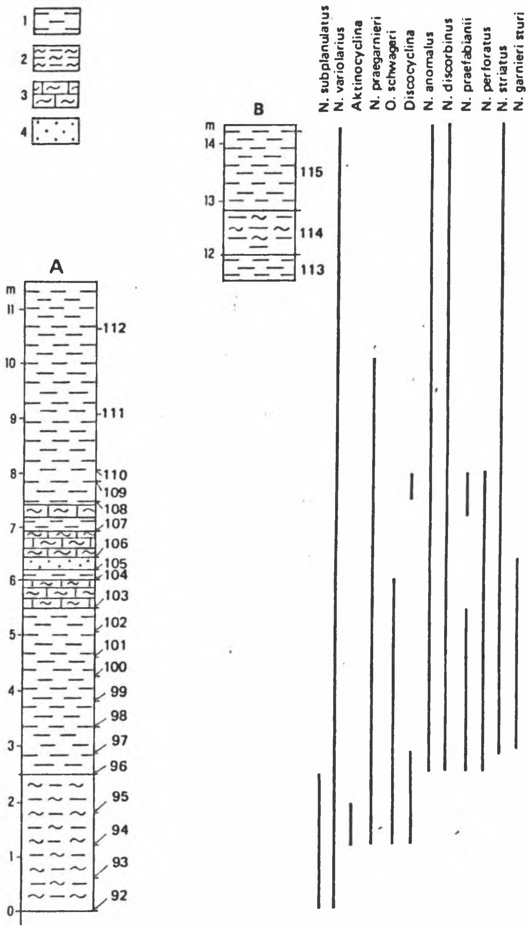


Fig. 2. Lithostratigraphical distribution of the larger foraminifers of the Ótokod Open-pit Mine
1. Clay, 2. clayey marl, 3. calcareous marl, 4. sand

corbinus (SCHLOTH.), N. anomalus DE LA HARPE, and, in large amounts, by the persisting N. variolarius (LAMK.). Stratigraphical distribution of the larger foraminifers is shown in Fig. 2.

Within the generally abundant and varied smaller foraminifer fauna two associations can be differentiated. Of the Samples 92-95 Spiroplectammina carinata (d'ORB.), Verneuilina tokodensis HANTK., Marginulina fragaria GÜMB., Globulina gibba d'ORB., Guttulina irregularis (d'ORB.), Bolivina elongata HANTK. Uvigerina multistriata HANTK. Gyroidina soldanii (d'ORB.), Anomalina affinis (HANTK.), Heterolepa dutemplei (d'ORB.), "Globigerinoides" higginsi BOLLI, Globigerinotheka index index (FINLAY), G. mexicana kugleri BOLLI are the most characteristic. The most important species of Samples 96-112 are Discorbis rotata (TERQUEM), D. perplexa LE CALVEZ, Rotalia beccarii (LINNÉ), Pararotalia inermis (TERQUEM) and Cibicides sublobatulus (GÜMB.). In the full sequence of samples Asterigerina rotula (KAUFM.) and Nonion elongatum (TERQUEM) occur in an alternating quantity, while Quinqueloculina are scarcely present. Stratigraphical distribution of the smaller foraminifers is shown in Table 1.

In the upper part of the section (from Sample 105) occurrence of coccoliths is accidental and they are also scarce in the lower part (Samples 95-104, Table 2). The state of preservation of the coccoliths is rather fair. Of the assemblage (Samples 95-104, where 95 and 99 are comparatively richer) the following species are characteristic: Neococcolithes dubius (DEFL.), Transversopontis pulcher (DEFL.), Blackites creber (DEFL.), Lanternithus minutus STRADNER, Coccolithus pelagicus (WALLICH), Cyclococcolithus formosus KAMPTNER, Cyclicargolithus floridanus (ROY et HAY), Reticulofenestra placomorpha (KAMPTNER), R. bisecta (HAY et al.), Pemma basquensis (MARTINI). Transversopontis pulcher, Coccolithus pelagicus and Reticulofenestra placomorpha are the most frequent among them.

No regularity can be observed in the vertical distribution of the rich but low diversity ostracod fauna. The most important species of the fauna indicating normal (sometimes slightly changing) saline, sublittoral environment are the following: Schizocythere depressa (MÉHES), Sch. hungarica MONOSTORI, Schuleridea perforata (ROEMER), Monsmirabilia triebeli KEIJ, Krithe bartonensis (JONES), "Echinocythereis" dadayana (MÉHES), Grimioneis haidingeri paijenborchiana KEIJ, Quadracythere vahrenkampi MOOS, Paracypris contracta (JONES) and Noxocypris gantensis MONOSTORI.

Paleoecology

The sequence is the marine part of a characteristically transgressive series. All the members of the fauna are of normal salinity, except for some ostracods tolerating minimum changes in salinity. The bottom, in spite of its clastic rock formation, contains more or less carbonate, and it is also reflected by the frequency of the fauna. The small sand contents (Sample 115 is already definitely sandy) indicates that this interval is already near to the regressive period producing the Tokod Sandstone that is characteristic in the neighbourhood. Size, shape and ornamentation of the larger foraminifers reflect the influence of the fine-clastic bottom environment. Nummulites, Operculina and discocyclinids suggest optimum water depth of 15-40 m.

Biostratigraphy

According to some authors, first of all GIDAI (1971) and JÁMBOR-KNESS (1973) the formations of the exposure can be regarded considerably older, belonging to the Lower Eocene. On the basis of the here and formerly evaluated fossils, the present authors, also in their earlier papers, proved that they belong to the Middle Eocene.

Of the microfossils the Nummulites provide the best possibility for stratigraphical subdivisioning. From bottom to top three associations can be distinguished:

Samples 92-95: N. subplanulatus association,

Samples 96-110: N. perforatus association, and

Sample 111-115: N. striatus association.

N. subplanulatus appears in the first marine formations covering the coal measures, its stratigraphical extension is limited, and its layers grade into beds with N. perforatus. Largest part of the section is dominated by the N. perforatus association. This fauna, from Sample 111 upwards, changes and the association characterized by N. striatus takes its place.

Since the N. subplanulatus-bearing beds are limited not only stratigraphically but also geographically, their separation as independent unit is not justified; it can be considered only as the lower member of the N. perforatus zone.

All the three associations belong to the Upper Lutetian Substage of the Middle Eocene, representing the N. perforatus (including N. subplanulatus) and N. striatus assemblage zone.

Table 1

Stratigraphical distribution of the smaller foraminifers
(K. HORVÁTH-KOLLÁNYI)

Taxa	Samples:																				
	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112
Spiroplectammina carinata (d'ORB.)	2	2	2	2																	
Verneuilina tokodensis HANTK.	4	2	4	3		1								2							
Dorothia textilaroides HANTK.		1		1																	
Clavulina parisiensis d'ORB.										1				1							1
Spiroloculina sp.														1							
Quinqueloculina sp.	2	2	4				1	1	1	1		3	2	3	1	1	3	1	1	1	1
Qu. bicarinata d'ORB.				5																	
Pyrgo bulloides d'ORB.			1																		
Lenticulina arcuatostriata (HANTK.)			2	2									1								
L. depauperata (REUSS)			1	2																	
Marginulina fragaria GÜMBEL	2	2	3	2	1	1															
M. splendens HANTK.			1																		
Globulina gibba d'ORB.	2	2	2																		
G. gibba var. punctata d'ORB.	1	2	2	1																	
Guttulina irregularis (d'ORB.)	2	2	2	2				1													
Bolivina elongata HANTK.	2	2	4	3																	
B. nobilis HANTK.	1	2	2	1																	
Bulimina sp.				2																	

	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112
Uvigerina multistriata HANTK.	5		5	2																	
Discorbis sp.				1																	
D. rotata (TERQUEM)						1											1				
D. perplexa LE CALVEZ							1						1	2							
Asterigerina rotula (KAUFMANN)			1	5	3	5	5	4	3	3	1	4	3								1
Rotalia beccarii (LINNÉ)											2			3	5	5	5	5	5	5	5
Pararotalia inermis (TERQUEM)				4	2	3	2	3	3	3		2	3								
Cibicides sublobatulus (GÜMBEL)				2	1	2	1														
"Globigerinoides" higginsi BOLLI				2																	
Globigerinatheka index index (FINLAY)			2																		
G. mexicana kugleri (BOLLI, LOEBLICH and TAPPAN)			1																		
Globigerina sp.	1	1																			
Eponides sp.			2	3																	
Fursenkoina hungarica (HANTK.)	1	1	2																		
F. schreibersii (ČZJŽEK)			2																		
Nonion elongatum (TERQUEM)	3	2	2	2	2	2	2		1	1				3		1	2		1	1	1
Gyroidina soldanii (d'ORB.)	2	2	2	2																	
Anomalina affinis (HANTK.)	2	3	3	3																	
Heterolepa dutemplei (d'ORB.)			5	5																	

Key: 1 = 1-5 specimens, 2 = 6-15 specimens, 3 = 16-30 specimens, 4 = 31-50 specimens, 5 = abundant

Nannoplankton of the Ótokod Open-pit Mine
(Ótokod, Kerék Hill)
(M. BÁLDI-BEKE)

1 = 1-2 specimens 2 = some 3 = few	Neococcolithes dubius (DEFL.)	Transversipontis pulcher (DEFL.)	Blackites creber (DEFL.)	Helicosphaera intermedia MARTINI	Zygrablithus bijugatus (DEFL.)	Lanternithus minutus STRADNER	Coccolithus pelagicus (WALLICH)	Cyclococcolithus formosus KAMPTNER	Cyclicargolithus floridanus (ROTH et HAY)	Chiasmolithus consuetus (BRAML. et SULL.)	Reticulofenestra placomorpha (KAMPTNER)	R. bisecta (HAY et al.)	Discoaster sp. ind.	Sphenolithus radians DEFL.	Pemma basquensis (MARTINI)	Watznaueria barnesae (BLACK) (Cretac.)	coccosphaera	siliceous debris
Sample 112							1											
111							1	1										
110																		
109								1										
108																		
107																		
106		1					1	1								1		
105																		
104	1	1					1	1				1		1		1	1	
102							1	1			1				1			
101		1		1?			1	1	1		1				1			
100		1		1		1	1	1			1		1					
99	1	3					3	1	1		2							1
98							1			1	1					1		
97							1				1							1
96	1	1	1				2	1		1						1		
95			1			2	2		2		2							

The visited Ótokod exposure is not too rich in smaller foraminifers, and planktonic forms are completely missing. The beds, studied in the previous years from the same exposure, contain the rich foraminifer association of the so-called *Operculina*-bearing marl, sometimes with planktonic species. Table 1 shows the summarized faunal association of the two collections.

Based on the joint occurrence of *"Globigerinoides" higginsi* BOLLI and *Globigerinatheka mexicana kugleri* (BOLLI) the succession can be ranged into the *Globorotalia lehneri* zone, or perhaps into the upper part of the *Globigerinatheka subconglobata subconglobata* zone.

The nannoplankton of the samples in question belongs to the NP 16 zone: it may not be older because of the presence of the *Reticulofenestra placomorpha*, *R. bisecta* and *Lanternithus minutus*, while due to the occurrence of *Sphenolithus radians* and *Chiasmolithus consuetus* determination of an older age must be excluded.

References

GIDAI, L. 1971; HANTKEN, M. 1871; JÁMBORNÉ KNESS M. 1973; KECSKEMÉTI, T. 1988; ROZLOZSNIK P.--SCHRÉTER Z.--TELEGDI ROTH K. 1922.

ESZTERGOM

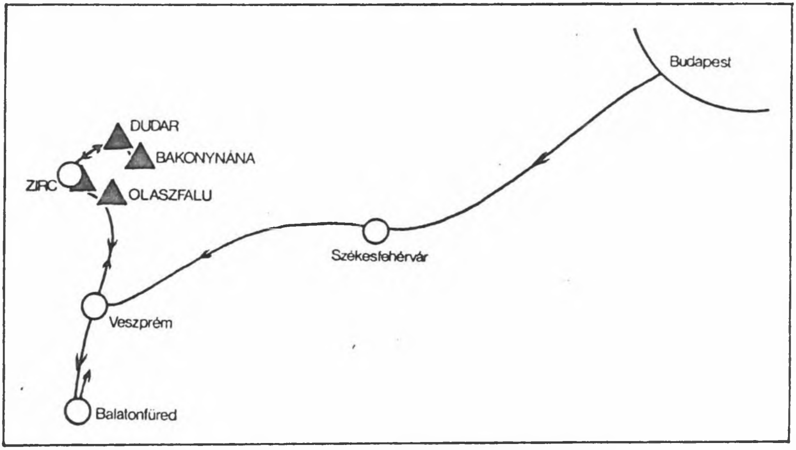
The town used to be a permanent centre of the Hungarian royal court. The construction work of the pálace was started in 972.

The episcopacy founded by St. STEPHEN is the centre of the Hungarian Catholic church, the seat of the cardinal archbishop. The first cathedral here was built by St. STEPHEN in 1010. The

devastations during the Turkish and subsequent wars had considerable effect on the city. The French phylosopher, René DESCARTES took part in the struggles around Esztergom personally in the year of 1621.

The construction of the present Basilica, which is the 11th biggest church in the World, was started in 1822 by P. KÜHNEL, J. PACKH and J. HILD and finished by 1869. The Bakócz chapel, one of the most remarkable relics of the Hungarian Renaissance, built by cardinal Tamás BAKÓCZ between 1506-1511, is placed in the Basilica. The treasury of the cathedral has a world-famous collection of ecclesial jewellery and textiles. On the Castle hill we can see the relics of the palace built during the Árpád dinasty, partly excavated. The panel paintings of the Esztergom Christian Museum have considerable estimation among the European collections.

10 September: F: BUDAPEST--DUDAR--BAKONYNÁNA--ZIRC--OLASZFALU--BALATONFÜRED



SZÉKESFEHÉRVÁR

The environs of the city were inhabited since prehistoric times. The Roman city of Gorsium is situated nearby. The territory of the town attained special importance from the conquering Hungarians: the principal seat of chief ÁRPÁD and his ruling tribe, the first centre of the Hungarian state.

The monumental equastrian statue of St. STEPHEN reminds us to the activity of the king founding the Hungarian State. He had a cathedral and a royal palace built here. The ruins of the cathedral can be seen in the "Park of Ruins". There were 37 kings crowned here and 17 kings buried in the cathedral.

The only Gothic relic preserved in the city is the St. ANNA chapel (built before 1478). The episcopal cathedral founded by St. STEPHEN can be found nearby. The two "neighbouring" church buildings, the Carmelite and the Franciscan churches are relics of the 18th century Baroque architecture. The mural paintings of the Carmelite church are the works of MAULBERTSCH. The episcopal palace is one of the most prominent buildings built in Zopf style in Hungary, built at the turn of the 18th/19th centuries. The Cistercian church and the secondary school are also the relics of the Baroque period. The prominent teachers of the latter were György PRAY, Dávid BARÓTI-SZABÓ, Benedek VIRÁG and Pál ÁNYOS, the famous students of the school were, among others, Mihály VÖRÖS-MARTY and János VAJDA. The István Király Museum (named after the King St. STEPHEN) has one of the biggest collection in the country after the Hungarian National Museum.

VESZPRÉM

Veszprém is known as the "town of the Queen" or the "capital of the Bakony". It is an estate of the Árpád clan already in the 10th century, and the first Hungarian episcopacy was founded here. The first highschool of the country operated here since the 12th century. After the devastations of the Turkish and the "Kuruc" times, this town acquired its present shape in the Baroque area.

The greek Basilite nunnery in the Veszprém valley was founded by the reigning prince GÉZA in the 10th century. Probably, the royal cloak was sewn here, originally as a ceremony gown, under the auspices of the spouse of the first Hungarian king, the Bavarian Queen GISELLA. The cathedral of the city named after Saint MICHAEL is already mentioned in the Pannonhalma chart of 1001. Beside the episcopal palace built by Jákab FELLNER (1756--1776) we find the GISELLA chapel, one of the prominent remains of Early Gothic style in Hungary. Also from the 13th century we find here the St. GEORGE chapel, built upon, according to historical records, the ruins of an even older church. The renaissance memorial stone of the famous bishop Albert VETÉSI from 1486 was unearthed here.

The former Piarist college (built between 1773--1782) is also a monument of the Baroque era. Among the prominent teachers of the college we find Dezső LACZKÓ (1860--1932), explorer of the geology of the Bakony mountains. He founded the Bakony Museum in

Veszprém, inaugurated in 1924. His statue (by Ferenc MEDGYESSY) is situated in front of the museum.

ZIRC

The Zirc Abbey was the regional centre of the Hungarian Cistercian order. The first Cistercite monks were settled here by King BÉLA III in 1182. A bunch of pillars built at this time can be seen today in the park by the stone wall. The carved stones of the medieval monastery and the church are kept in the convent's garden, in the "circular building" erected in the 18th century, situated nearby.
The Abbey church in its present form was built in Baroque style (1732--1752). The special attractions of the church are the mural paintings by MAULBERTSCH and the excellent wooden carvings of the "stallum".
The former monastery library -- today, museum -- is situated in the Classicist building of the abbey. The pavement and the bookshelves decorated by inlay work were made by the local carpenter, Michael WILDE. Among the rarities stored in the library, books on contemporary natural history are especially valuable.
The Natural History Museum of the Bakony Mts. is situated within the building, including the geological evidences of the research program devoted to the Balaton environs conducted between 1903--1917 under the leadership of L. LÓCZY. In the interior yard we find the Bakony Pantheon; the memorial tables of the scientists dealing with the investigation of the Bakony Mts. are placed here. The famous and protected Arboretum also belongs to the garden of the Abbey.

DUDAR, Ördögárok, valley head, Forestry road

T. KECSKEMÉTI
with the contribution of K. HORVÁTH-KOLLÁNYI and GY. LESS

Topography

The exposure is ca. 2 km NW of the village Dudar. The Eocene sequence is exposed by a northwardly running sub-graben of the Ördög-árok valley in the W side of the Sűrű Hill. The forestry road follows the valley head of the steeply incutting graben emerged along. The graben and the forestry road constitute the section together and the locality is shown on Fig. 1.

Age

Middle Eocene, Upper Lutetian.

Lithostratigraphy

The section is the best to show the transition between the hard, compact limestone of the Szőc Limestone Formation and its loose calcareous marl member developing from it.

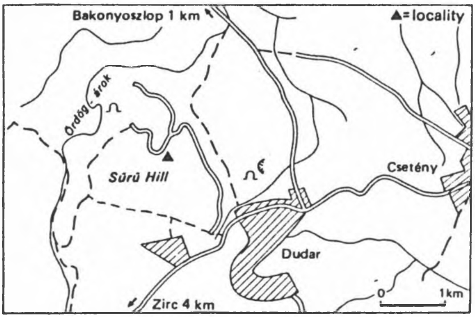


Fig. 1. Sketch map of the vicinity of Dudar

History

Concerning previous investigations of the region the following studies are worth mentioning: TOMOR THIRRING (1934, 1935), KECSKEMÉTI (1988), KOPEK (1964, 1980), MAJZON (1943) and SZŐTS (1956).

Stratigraphy and fossils (Fig. 2)

The Eocene sequence rests unconformably upon the Triassic Dachstein Limestone. This underlying formation, being in greater depth and in bigger distance, is not shown on the figure. The deepest Eocene member is of packstone texture, compact, hard and white, sometimes reddish or yellowish nummulitic limestone (Szőc Limestone Formation). Microfacies features of the rock: biomicritic matrix, biodetrital characteristics, poor sorting and the lack of higher carbonate contents and terrigenous grains. Total

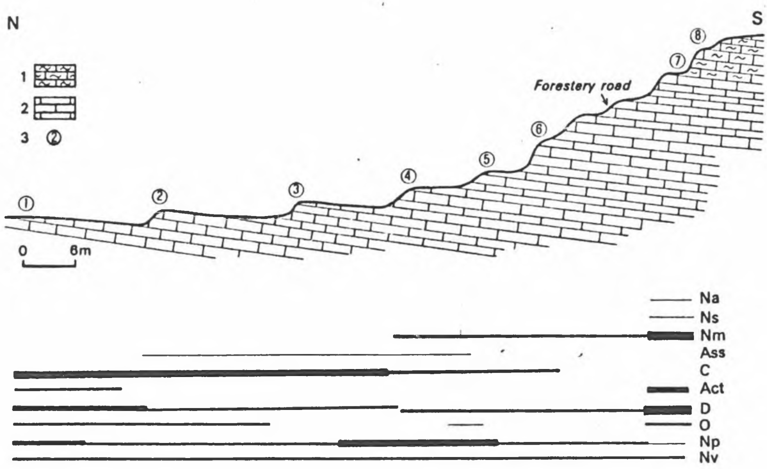


Fig. 2. Dudar, Ördögárok valley head, Forestry Road. Profile of the exposure and its larger foraminifer fauna
1. Calcareous marl, 2. limestone, 3. number of samples. Na = Nummulites anomalus, Ns = Nummulites striatus, Nm = N. millecaput, Ass = Assilina, C = Corallinaceae, Act = Actinocyclina, D = Discocyclina, O = Operculina, Np = N. perforatus, Nv = N. variolarius

thickness of the limestone exceeds 45 m. The section, shown here, is the upper 25 m of the sequence. The pure limestone (Samples 1--6) becomes increasingly clayey and gradually it turns into clayey limestone, and then into calcareous marl (Samples 7--8). This latter is already exposed in the cut of the forestry road and is covered with Quaternary slope debris.

Most characteristic and most frequent fossils are the large foraminifers. The species of the following genera are represented: *Nummulites*, *Assilina*, *Operculina*, *Discocyclina*, *Nemkovella*, *Orbitoclypeus*, *Asterocyclina*, *Alveloina* and *Gyroidina*. From stratigraphic and quantitative points of view the *Nummulites* are the most important. Numerically, especially in the uppermost part of the section, Discocyclinidae are equally important. Among the other microfossils smaller foraminifers and calcareous algae (*Corallinaceae*) are the most significant. Smaller foraminifers are frequent both in the limestone and in calcareous marls. In the limestone facies they are strongly recrystallized, and that is why, by their thin section, they are not the most suitable for taxonomic determination. In the calcareous marl isolated specimens occur. *Corallinaceae* are present sometimes abundantly only in limestone facies. This facies is not favourable for nannoplankton.

The limestone contains *Nummulites* mostly in rock-forming quantities. Generally, the same species occur in the whole limestone sequence. A slight change is that *N. perforatus* (MONTF.), predominating in the lower part of the section gradually decreases upwards, and is accompanied by the gradually increasing number of *N. millecaput* BOUB. in the upper parts. While appearance of *N. millecaput* BOUB. can be recorded in Sample 4, significant decrease of the quantity of *N. perforatus* (MONTF.) can be observed in Sample 6. The diversity of the *Nummulites* fauna is rather low. In the lower part of the section *N. perforatus* (MONTF.) occurs practically monospecifically, and it is accompanied only by *N. variolarius* (LAMK.) in small quantities. Some sections of *Alveolina* and *Gyroidina* makes the fauna little more varied.

In the calcareous marl, beginning with Sample 7, a significant change occurs in the fauna. The quantity of *N. millecaput* BOUB. (incl. form B) is suddenly becoming rock-forming, and dominant in the *Nummulites* fauna of higher diversity. As accompanying species *N. variolarius* (LAMK.), *N. striatus* (BRUG.), *N. anomalus* DE LA HARPE are also present. Discocyclinids are also rock-forming constituents. Most frequent taxa are Discocyclina discus (RÜTIM.) dudarensis LESS, D. dispansa(SOW.) hungarica KECSKEMÉTI, D. pratti pratti (MICHELIN), Nemkovella strophiolata tenella (GÜMB.), Orbitoclypeus varians (KAUFM.) scalaris (SCHLUMB.), O. chudeaui (SCHLUMB.) pannonicus LESS, Asterocyclina stellata stellata (D'ARCH.), Ast. alticostata alticostata (NUTT.).

Disregarding some planktonic species, smaller foraminifers are represented only and mostly with benthic forms. They include Textularia sp., Discorbis limbata (TERQUEM), D. perplexa LE CALVEZ, Asterigerina rotula (KAUFM.), Rotalia tuberculata SCHUBERT, Globigerina yeguaensis WEINZIERL et APPLIN, Globigerina sp., Epinodes budensis (HANTK.), Cibicides lobatulus (GÜMB.) and Nonion elongatum (TERQUEM).

Palaeoecology

The sequence contains exclusively stenohaline floral and faunal elements, indicating that the contemporary sea was of normal salinity. The formation of both the limestone and calcareous marl refers to normal conditions of sedimentation. Texture of the limestone indicates calcareous ooze bottom while its micritic matrix suggests relatively low agitation. The quantity, diversity, ecological needs of the fauna, and also the great frequency of the red algae (Corallinaceae) show that the marine environment was shallow, warm, well-illuminated, and rich in oxygene and nutrients. All these factors favoured also size increase. The largest Nummulites specimens ever found in Hungary were collected from the vicinity of Dudar. The largest one is a N. millecaput with a diameter of 106 mm.

Biostratigraphy

Stratigraphic evaluation can be carried out on the basis of the species N. perforatus and N. millecaput. The vertical distribution of the above two zonal index species serve as a basis of the subdivisioning. In the section including Samples 1 to 6 the N. perforatus assemblage zone is represented, while the N. millecaput assemblage zone is represented by the part including Samples 7--8. Both zones belong to the Middle Eocene, and are the middle and upper parts of the Lutetian.

References

KECSKEMÉTI T. 1988; KOPEK G. 1964, 1980; LESS GY. 1987; MAJZON L. 1943; SZŐTS E. 1956; TOMOR-THIRRING J. 1934, 1935.

F-2

BAKONYNÁNA, Zsidó Hill

M. MONOSTORI
with the contribution of I. BODROGI and G. CSÁSZÁR

Topography

The exposure is SE of the village Bakonynána, at a small roadside quarry in the valley of Gaja brook (Fig. 1).

Age

On the basis of planktonic foraminifers, the whole section from the uppermost part of the Zirc Limestone Formation belongs into the lower (*Rotalipora ticinensis*--*Planomalina buxtorfi*) subzone of the *Rotalipora appenninica* zone, Middle Cretaceous, Upper Albian (Vraconian) (BODROGI 1985, 1986). (Absolute dating from CSÁSZÁR 1986, table on p. 84: ca. 95--96 Ma.)

Stratigraphy

The Zirc Limestone Formation forming the lower part of the exposure (CSÁSZÁR 1986) overlies the Middle Albian Tés Clayey Marl Formation (CSÁSZÁR 1986). The section does not show, but the Pénzeskút Marl Formation (CSÁSZÁR 1985) forming the upper parts of the outcrop, is overlain by Senonian or Tertiary beds, with considerable stratigraphic gap in between.

In the lower part of the section the upper 2 m of the Zirc Limestone Formation can be seen, with 15--40 cm thick beds. This is a brownish, greyish, bioclastic limestone. In the upper part inclined stratification, then increasing clay, sand and glauconite contents are the characteristic.

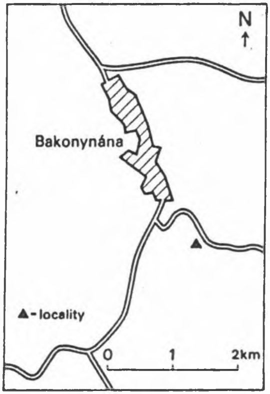


Fig. 1. Sketch map of the locality

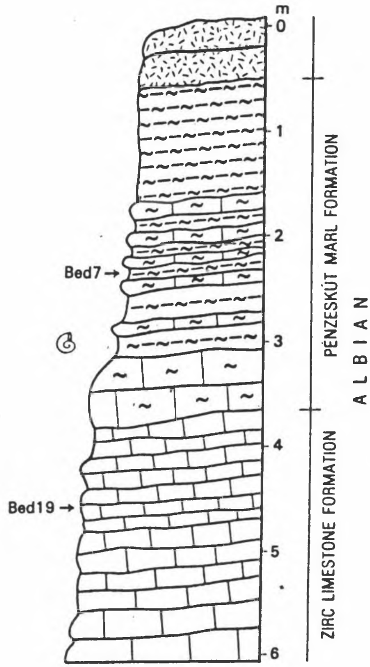


Fig. 2. Section of the exposure (after CSÁSZÁR 1986)

Upon the surface of the Zirc Limestone Formation in a thickness of ca. 3.5 m, the alternating calcareous marl, marl, clay-marl of the Pénzeskút Marl Formation are deposited, with increasing sand content in the uppermost layers. They are especially glauconitic in the lower part (Fig. 2).

Fossils

As for the macrofaunal elements, some echinoids and ammonoids could be found in the Zirc Limestone Formation. The following microfossils are known:

N a n n o p l a n k t o n :

Watznaueria barnesae (BLACK)

Tranolithus orionatus (REINH.)

Braarudosphaera discula BRAMLETTE et RIEDEL
Cyclagelosphaera rotaclypeata (BUKRY)
Manivitella pemmatoidea (MANIVIT)
Solasites horticus (STRADNER, ADAMIKER et MARESCH)
Lithraphidites carniolensis (DEFL.)
Rhagodiscus angustus (STRAD.)
Eiffelithus turriseiffeli (DEFL.)
Cretarhabdus crenulatus BRAMLETTE et MARTINI

Foraminifera:

Globigerinelloides bentonensis (MORROW)
Hedbergella planispira (TAPPAN)
Hedbergella delrioensis (CARSEY)
Hedbergella infracretacea (GLAESSNER)
Favusella washitensis (CARSEY)
Planomalina buxtorfi (GANDOLFI)
Praeglobotruncana stephani (GANDOLFI)
Marssonella oxycona (REUSS)
Dorothia gradata (BERTH.)
Nodosaria cf. lilli REUSS
Spirillina minima (SCHACKO)
Lenticulina macrodisca (REUSS)
Valvulineria gracillima TEN DAM
Gavelinella intermedia (BERTH.)

/From the uppermost part single specimens of Rotalipora appenninica (RENZ) and Praeglobotruncana delrioensis (CARSEY) were also found, also several forms that can be determined only on generic lével./

The macrofauna of the lower part of the Pénzeskút Marl Formation, besides the numerous echinoids, yields rich mollusc, mainly ammonites and gastropods. The following microfossils were identified:

Nannoplankton:

(Additionally to those of described from the Zirc Limestone):

Nannoconus truitti BRONNIMANN
Parhabdolithus embergeri (NOËl)
Parhabdolithus granulatus STOVER
Prediscosphaera columnata (STOVER)
Stephanolithion laffittei NOËL

F o r a m i n i f e r a :

Globigerinelloides bentonensis (MORROW)
Planomalina buxtorfi (GANDOLFI)
Praeglobotruncana stephani (GANDOLFI)
Praeglobotruncana delrioensis (PLUMMER)
Hedbergella planispira (TAPPAN)
Hedbergella delrioensis (CARSEY)
Hedbergella infracretacea (GLAESSNER)
Favusella washitensis (CARSEY)
Rotalipora ticinensis (GANDOLFI)
Rotalipora appenninica (RENZ)
Planulina schloenbachi (REUSS)
Marssonella oxycona (REUSS)
Marssonella trochus (D'ORBIGNY)
Dorothia gradata (BERTH.)
Tritaxia pyramidata REUSS
Tritaxia tricarinata (REUSS)
Spirillina minima (SCHACKO)
Valvulineria gracillima TEN DAM
Gavelinella intermedia (BERTH.)
Gavelinella rudis (REUSS)
Lenticulina macrodisca (REUSS)
Lenticulina nuda REUSS
Lenticulina münsteri (ROEMER)
Turrispirillina subconica TAPPAN
Patellina subcretacea (CUSHMAN et ALEXANDER)
Globulina prisca REUSS
Pleurostomella obtusa BERTH.
Eoguttulina anglica CUSHMAN et OZ.
(and several other forms determinable only on generic level).

O s t r a c o d a :

Cytherella ovata (ROEMER)
Schuleridea jonesiana (BOSQUET)
Rehacythereis reticulata (JONES)

As further microfossils, calcareous algae, radiolarians, spores and pollens, and Calcisphaerulidae are also known.

Facies

Beds of the Zirc Limestone Formation emerged mostly among shallow sublittoral marine conditions of normal salinity. Layers of the Pénzeskút Marl Formation indicate a rapid deepening of the sea, i.e. a deep sublittoral, shallow-bathyal basin of normal salinity was developed.

References

BODROGI, I. 1985, 1986; CSÁSZÁR, G. 1985, 1986; CSÁSZÁR, G.--BODROGI, I.--CZABALAY, L.--HORVÁTH, A.--JUHÁSZ, M.--MONOSTORI, M. 1987.

F-3

ZIRC, Cigányárok

M. MONOSTORI
with the contributions of I. BODROGI and G. CSÁSZÁR

Topography

The exposure is in the immediate vicinity of the town Zirc (Fig. 1).

Age

Middle Cretaceous, Middle Albian (ca. 97--99 Ma, CSÁSZÁR 1986).

Lithostratigraphy

Tés Clay-marl Formation belonging to the Middle Albian (formerly *Munieria*-bearing clay).

Stratigraphy

The section exposes only a part of the oscillatory sequence, because further shallow-marine to freshwater bed may be present below, and a considerably thick part of the formation might have been present above. All these members represent the Tés Clay-marl Formation, known in 60 m thickness from boreholes in the area (CSÁSZÁR 1986).The Tés Clay-marl Formation

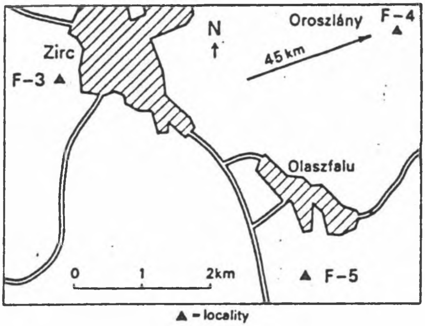


Fig. 1. Zirc, Cigányárok: Sketch map with the locality

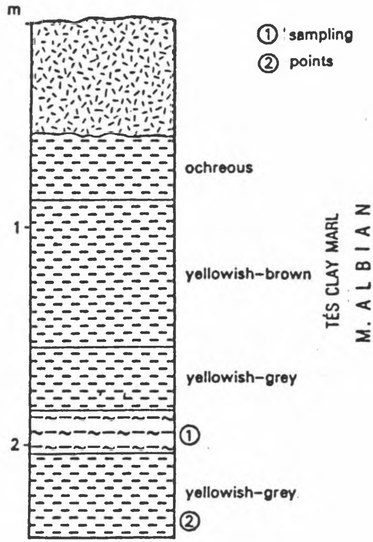


Fig. 2. Simplified section of the Zirc, Cigányárok, Tés Clay-marl Formation, Middle Albian (CSÁSZÁR 1988)

unconformably overlies here the Aptian Tata Limestone Formation, and its cover is the gradually developing Zirc Limestone (CSÁSZÁR 1986).

At the bottom 80 cm yellowish-grey clay can be found with a 20 cm thick brownish-yellow clayey marl intercalation. Microfauna was studied from these two sediments (Fig. 2, Samples 1 and 2). 80 cm thick yellowish-brown, grey mottled clay then a 20-30 cm thick ochreous clay follows and this is covered by soil. Debris of Munieria- and Orbitolina-bearing limestone from the unexposed part of the sequence occur frequently.

Fossils

Sample 1:

Foraminifera

Patellina subcretacea CUSHMAN et ALEXANDER

Spirillina minima SCHACKO

Lenticulina cf. muensteri ROEMER

Globulina prisca REUSS
Ammobaculites coprolithiformis SCHWAGER
Ammobaculites agglutinans D'ORBIGNY
Ammobaculites texanus CUSHMAN
Choffatella decipiens SCHLUMBERGER
Verneuillinoides schizeus (CUSHMAN et ALEXANDER)
Marssonella trochus (REUSS)
Flabellammina compressa (BEISSEL)
Flabellammina alexanderi CUSHMAN
Haplophragmoides rugosus CUSHMAN et WATERS
Ammobaculites cf. subcretaceus CUSHMAN et ALEXANDER

Ostracoda

Cytherella ovata (ROEMER)
Cytherella parallela (REUSS)
Schuleridea jonesiana (BOSQUET)
Dusormidea sp.
Paracypris ex gr. jonesi BONNEMA
Clithrocytheridea baconica (ZALÁNYI)

Calcareous algae

Munieria baconica DEECKE

Sample 2:

Foraminifera

Hedbergella planispira (TAPPAN)
Pseudoglandulina humilis (ROEMER)
Choffatella decipiens SCHLUMBERGER
Haplophragmoides rugosus CUSHMAN et WATERS

Ostracoda

Cytherella ovata (ROEMER)
Cytherella parallela (REUSS)
Schuleridea jonesiana (BOSQUET)
Paracypris ex gr. jonesi BONNEMA
Clithrocytheridea baconica (ZALÁNYI)

Calcareous algae

Munieria baconica DEECKE

In both samples also radiolarians can be observed.

Facies

The examined samples indicate shallow sublittoral environment with alternating salinity (from time to time either the stenohaline or euryhaline marine elements are predominant). A few badly-preserved forms (Dusormidea, Munieria) were reworked from freshwater areas.

References

CSÁSZÁR G. 1986.

F-4

OROSZLÁNY

(Pre-packed samples are available in Zirc)

M. MONOSTORI and Á. GÖRÖG

The sequences (Vértessomló Aleurite Formation and Környe Limestone Formation) partly interfinger with the Tés Clay-marl Formation and well-known from boreholes in the surroundings of Oroszlány. These yielded rich Orbitolina fauna of which pre-packed samples are distributed here.

Topography

Oroszlány is situated ca. 40 kms east of Zirc, at the western margin of the Vértes Mts. (see Fig. 1 at F-3).

Age

Middle Cretaceous, Lower and Middle Albian.

Fauna

Orbitolina (Mesorbitolina) texana (ROEMER)
Orbitolina (Mesorbitolina) subconcava LEYMERIE

References

CSÁSZÁR G. 1986.

F-5

OLASZFALU, Eperkés Hill

M. MONOSTORI

with the contribution of I. BODROGI, G. CSÁSZÁR and Á. GÖRÖG

Topography

Natural and artificial outcrops on the slope of Eperkés Hill, S of the village Olaszfalu at a distance of ca. 700 m (Fig. 1 in F-3).

Age

Middle Cretaceous, Upper Albian Substage (96--97 Ma). (The radiometric dating is given after CSÁSZÁR 1986, Table on p. 84.)

Lithostratigraphy

Stratotype section for the Zirc Limestone Formation (CSÁSZÁR 1986).

Stratigraphy (Fig. 1)

The underlying of the Zirc Limestone Formation, exposed in the sequence is the Middle Albian Tés Clay-marl Formation at Olaszfalu that however can not be seen at this site. The covering Pénzeskút Marl Formation and also the upper part of the Zirc Limestone Formation is also missing from the exposure.

The sequence exposed in a thickness of 20 m is built up of the massive, thickly bedded limestone of the Zirc Limestone Formation. Beds rich in rudists, and those rich mainly in shell fragments and other faunal elements are alternating in a characteristic, rhytmic manner.

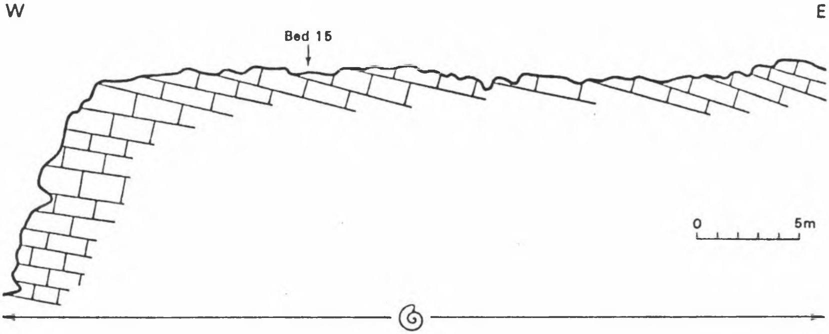


Fig. 1. Type section of the Zirc Limestone Formation (Albian) on Eperkés Hill, Olaszfalu (after CSÁSZÁR 1986)

Fossils

Additionally to the mass-occurring macrofaunal elements (mainly bivalves and gastropods), the following microfossils are known:

C a l c a r e o u s   a l g a e :

Salpingoporella hasi CONRAD, REY et RADOICIC

Diversocallis undulatus DRAGASTAN

F o r a m i n i f e r a

Orbitolina (Mesorbitolina) subconcava LEYMERIE

Gavelinella cf. intermedia (BERTHELIN)

Charentia cuvillieri NEUMANN

and also several specimens that can be determined only for genus.

I n c e r t a e   s e d i s

Cadosina species

Facies

It is a marine formation of normal salinity, shallow sublittoral, and of reef type.

References

BODROGI, I. 1985, 1986; CSÁSZÁR, G. 1985, 1986.

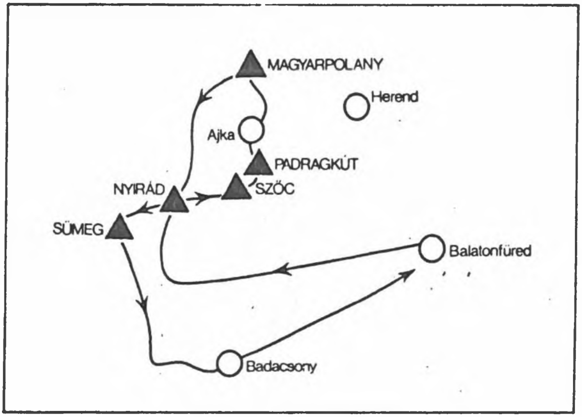
BALATONFÜRED

An ancient resort place with medical spas, the water of the springs were analysed and claimed as curing already in 1772. The place had prominent social significance in the first half of the 19th century. The first permanent theatre of the Transdanubian region was built here in 1831. The first Hungarian steamer was started from here in 1846. A well-known heart clinic is operating here.

The memorial tables of the eminent personalities concerning the research and the development of the Balaton environs can be found in the roofed alleys of the Balaton Pantheon. A local speciality here is the row of memorial trees, planted by famous personalities. Among the planters we find the poets Rabindranath TAGORE, Salvatore QUASIMODO, politicians like Indira GANDHI and Radjiv GANDHI and the cosmonaut LEONOV. Memorial tables and museums commemorate the resort houses of the famous actress Lujza BLAHA and the writer Mór JÓKAI.

In the cemetery of Arács, partaining to Balatonfüred we find the grave of the great Hungarian geologist, Lajos LÓCZY Sen. (1849--1920). His name is associated with, apart from his world-famous results in the exploration of Asian geology, the start of the Balaton research program at the turn of the century. The row of scientific publications produced are good examples of pioneering complex investigations. On his gravestone we can see the bunch of edelweiss sent by the geograph Aurél STEIN from the Himalayas.

11 September: G: BALATONFÜRED--SZŐC--PADRAGKÚT--MAGYARPOLÁNY--NYIRÁD--SÜMEG--BALATONFÜRED



G-1

SZŐC, BALATON Hill

T. KECSKEMÉTI

with the contribution of E. DUDICH and G. KOPEK

Topography

Balaton Hill is a flat hill by the Halimba--Nyirád road NW of the village Szőc. Near the road at the SW foot of the hill the Eocene sequences are exposed in an old quarry (Fig. 1). It is the type exposure of the Szőc Limestone Formation.

Age

Middle Eocene, Lower Lutetian and beginning of the Upper Lutetian.

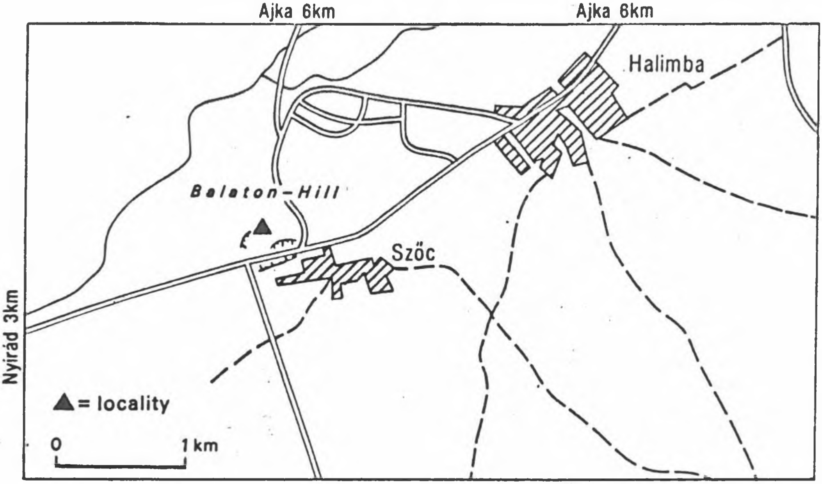


Fig. 1. Sketch map of the exposure Szőc, Balaton Hill

Lithostratigraphy

Darvastó, and mainly Szőc Limestone Formation.

Location and exposure of the section

The Eocene sequence overlying the Upper Triassic Hauptdolomit is excavated in three trenches. Trench I exposes the lower, Trench II the lower and middle, and Trench III the middle and upper part of the sequence. Position of the quarry, that of the Trenches I-III, and the distribution of the samples according to trenches are shown in Fig 2. Parallel columns of Trenches I and II with their faunas are shown in Fig. 3, while those of Trench III in Fig. 4. At several places the numbers of samples do not follow each other in a continuous order but are arranged according to sampling at different dates.

Stratigraphy and fossils

The lower part of the sequence is exposed by Trench I and in the bottom of Trench II. This sequence is bauxitic, gypsum-bearing lagoonal complex that petrographically can be divided into five units:

1. Bauxitic clay, clayey bauxite, at its bottom bauxitic iron ore while at its top coaly clay can be found (Samples 41--48).

2. Calcareous variegated clay (Samples 105--108).

3. Limestone, clayey limestone with molluscs (Samples 109 and 39).

4. Limestone, clayey limestone with gypsum-bearing claymarl in its upper part (Samples 33-38 and 6--12).

5. Claymarl, clayey limestone, limestone with mollusc fauna (Samples 4--5).

The fauna of this part of the section is rather poor and monotonous: small Foraminifera: Rotalia kiliani ANDREAE, Cibicides lobatulus (W. et J.), Sphaerogypsina globula (REUSS), Discorbis cf. parisiensis (D'ORB.). In the

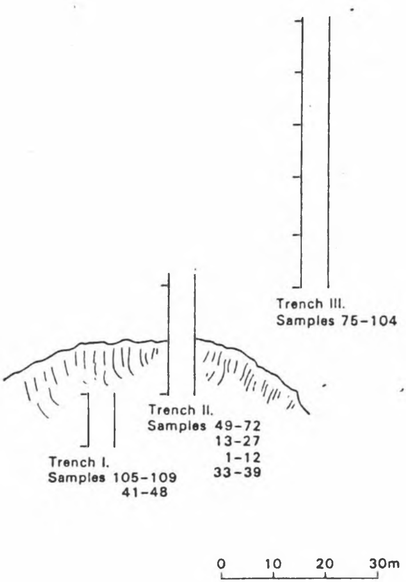


Fig. 2. Position of Trenches I--III and the distribution of samples by trenches. Samples 1--12, 13--27, 33--39: Trench II; Samples 41--48: Trench I; Samples 49--72: Trench II; Samples 75--104: Trench III; Samples 105--109: Trenches I--II

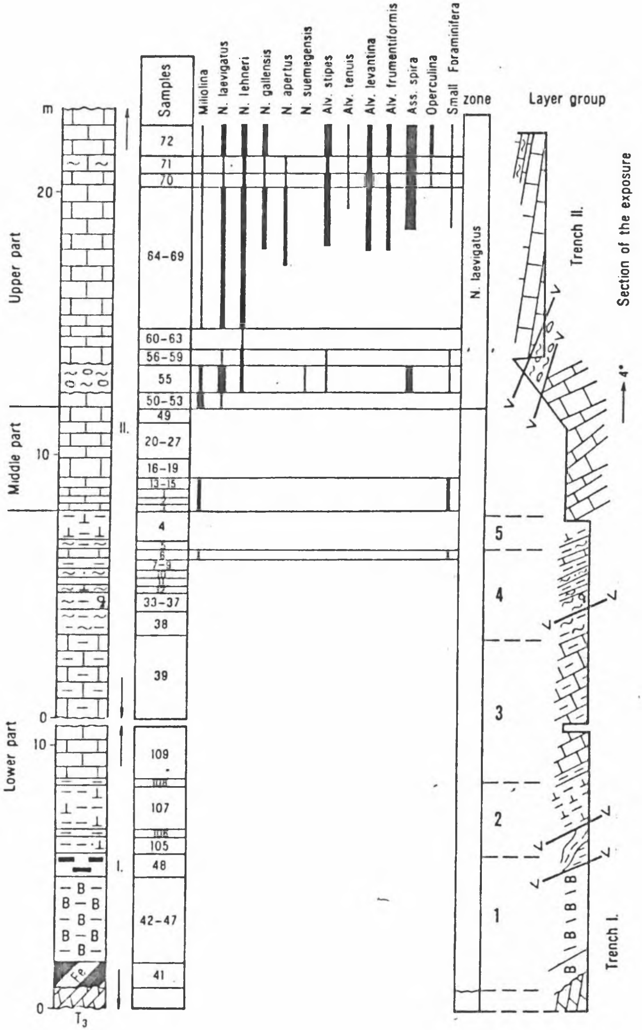


Fig. 3. Stratigraphic column of Trenches I--II and stratigraphic distribution of the faunas

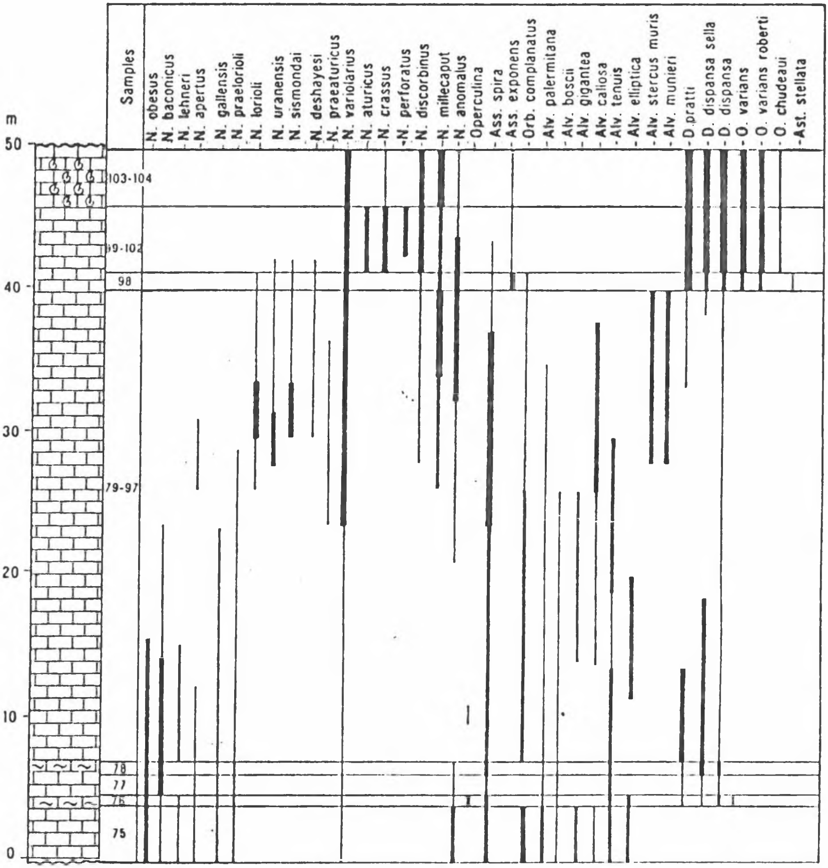


Fig. 4. Stratigraphic columns of Trench III and stratigraphic distribution of its fauna

upper part of the sequence also fragmented molluscs can be found but they are present at a characteristic rate only in Samples 109 and 39.

The middle part of the sequence is exposed by the upper part of Trench II. Petrographically it is rather unanimous: predominantly it is thinly-bedded limestone with small clayey limestone and claymarl intercalations (Samples 1--3, 13--27, and 49). Faunistically the Miliolinae are predominating with differing quantities, though in some cases they are abundant. Besides some molluscs are also present. The fauna generally is of brackish water type, but some fragmented marine faunal elements (Nummulites, Alveolina, Orbitolites) indicate the coming propagation of the sea.

The upper part of the sequence starts with a tectonically disturbed marine limestone group on the face wall of the quarry (Samples 50--55). Among the pure limestone beds clayey limestone and calcareous marl are intercalated. The limestone is benched and nodular, and rich in larger foraminifers and molluscs. Upon this, with continuous sedimentation a basically nodular limestone is settled, containing rock forming quantity of larger foraminifers (Samples 56--72 from Trench II, and 75--104 of Trench III). Among them the Nummulites, Assilina and Alveolina are the most frequent, discocyclinids, Orbitolites and Operculina are additionally also present, in certain samples in greater quantities.

The 73.0 m thick marine sequence, providing the overwhelming part of the exposure can be well subdivided on the basis of successive Nummulites faunas. From the bottom to the top, by way of continuous formation, the following assemblage zones can be separated:

N. laevigatus assemblage zone (Sample 50--72):

The more important taxa: N. laevigatus (BRUG.), N. lehneri SCHAUB, N. gallensis HEIM, N. apertus GOLEV et SOVCHIK, N. suemegensis KECSKEMÉTI, Alv. stipes HOTT., Alv. tenuis HOTT., Alv. levantina HOTT., Alv. frumentiformis SCHWAGER, Ass. spira (DE ROISSY), Operculina sp.

N. obesus-baconicus assemblage zone (Samples 75--90):

The more important taxa: N. obesus D'ARCH. et HAIME, N. baconicus HANTKEN, N. lehneri SCHAUB, N. apertus GOLEV et SOVCHIK, N. gallensis HEIM, N. praelorioli HERB et SCHAUB, N. iohannis KECSKEMÉTI, N. majzoni KECSKEMÉTI, N. variolarius (LAMK.), N. anomalus DE LA HARPE, N. aff. millecaput BOUB., Operculina sp., Ass. spira (DE ROISSY), Alv. palermitana HOTT., Alv. boscii D'ORB., Alv. tenuis HOTT., Alv. elliptica (SOW.), Alv. gigantea CHECCHIA-RISPOLI, Alv. callosa HOTT., Discocyclina pratti (MICHELIN), D. dispansa sella (D'ARCH.), Orbitolites complanatus LAMK.

N. lorioli assemblage zone (Samples 91--98):

The more important taxa: N. lorioli DE LA HARPE, N. apertus GOLEV et SOVCHIK, N. uranensis DE LA HARPE, N. sismondai D'ARCH. et HAIME, N. deshayesi D'ARCH. et HAIME, N. praeaturicus SCHAUB, N. iohannis KECSKE-

MÉTI, N. majzoni KECSKEMÉTI, N. variolarius (LAMK.), N. discorbinus (SCHLOTH.), N. anomalus DE LA HARPE, N. aff. millecaput BOUB., Ass. spira (DE ROISSY), Alv. palermitana HOTT., Alv. callosa HOTT., Alv. muniera HOTT., Alv. stercus muris MAYER-EYMAR, Discocyclina pratti (MICHELIN), D. dispansa sella (D'ARCH.), D. dispansa (SOW.), Orbitolites complanatus LAMK.

N. millecaput assemblage zone (Samples 99--104):

The more important taxa: N. millecaput BOUB., N. perforatus (MONTF.), N. aturicus JOLY et LEYM., N. crassus BOUB., N. variolarius (LAMK.), N. discorbinus (SCHLOTH.), N. anomalus DE LA HARPE, Ass. exponens (SOW.), Discocyclina pratti (MICHELIN), D. dispansa sella (D'ARCH.), D. dispansa (SOW.), Orbitoclypeus varians (KAUFM.), O. varians roberti (DOUV.), O. chudeaui (SCHLUMB.), Asterocyclina stellata (D'ARCH.), D. augustae WEIJDEN, D. radians (D'ARCH.), Operculina sp.

Biostratigraphy

The sequence consists mostly of limestone that is hardly suitable for obtaining or analyzing planktonic and benthic smaller foraminifers. That is why these organisms cannot be directly used for stratigraphic subdivision. The formation, however, is favourable for obtaining larger foraminifers, and thus a great amount of material is available for investigation. Among them the Nummulites and Alveolina successions can be best used for stratigraphic subdivisions. Since the Nummulites occur in the whole section in rock-forming quantity, the zonation is based upon them. The zones are assemblage ones.

The layers characterized by N. laevigatus, N. obesus, N. lorioli and N. millecaput zonal index specimens succeed each other by continuous sedimentation, and differ from the zonation generally observable in the Transdanubian Central Range only in that here the N. perforatus zone seems to be missing, or perhaps is replaced by N. aturicus and N. crassus beds at the bottom of the N. millecaput zone with a thickness of a few m. The Nummulites and Alveolina zones can be well correlated: the N. laevigatus and N. obesus-baconicus zones correspond to the Alv. stipes zone, while the N. lorioli and N. millecaput zones to the Alv. munieri zone.

References

BÖCKH J. 1874, 1877; HANTKEN M. 1875b, 1875c; JÁMBORNÉ KNESS M. 1981; KECSKEMÉTI, T. 1970, 1971, 1973, 1974, 1982; KOPEK G.--DUDICH E.--KECSKEMÉTI T. 1969, 1971; LESS GY. 1987; LÓCZY, L. Sen. 1916; TAEGER, H. 1917.

G-2

PADRAGKÚT

M. BÁLDI-BEKE

EOCENE STRATIGRAPHY OF THE SW BAKONY MTS
(To G-1: Szőc, G-2: Padragkút G-4: Nyirád)

The Eocene of the SW Bakony Mts. is well-known from several boreholes. The sequence, in a draft, was compiled on the basis of several published boreholes (Halimba H. 849, Devecser Dv. 4: BÁLDI-BEKE 1984; Somlóvásárhely Sv. 1: BERNHARDT et al. 1985, 1988), and also by using the data obtained from the borehole Ajka 206 deepened in the immediate vicinity of the Padrag exposures (Fig. 1).

The Darvastó Formation overlies discordantly different Mesozoic formations, petrographically it is rather varied clastic sequence, variegated clay, greyish clay, sand and gravel (Lower Lutetian, NP 14). Above this the shallow marine Szőc Limestone follows that, based on its larger foraminifer fauna, can be well subdivided (Middle Eocene). In the upper part of the Middle Eocene, the clay content of the limestone is increasing, and is followed by calcareous marl and marl (at in its lower part it is glauconitic), then turns into the Padrag Formation, a mainly clayey sequence with tuffite and sand intercalations (formerly Halimba Formation, see e.g. in BÁLDI-BEKE 1984, NP 16--19 nannoplankton biozonation). Its bathyal fauna, richness in plankton, and the gradation of the sand portions indicate a deeper water environment. Locality of the different exposures within the section is approximatively shown in Fig. 1.

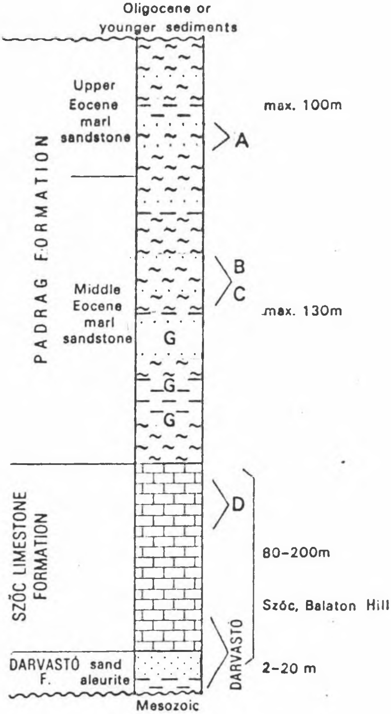


Fig. 1. Combined sketch of the section of the Eocene of the SW Bakony Mts. (Based on exploration boreholes) A—D: exposures

Contrary to the good exposures of Szőc Limestone, e.g. Szőc, Balaton Hill and Nyirád, Darvastó (G-1 and G-4), the Padragkút Formation hardly occurs on the surface (Padragkút, G-2).

Topography

Several exposures in ravines E of the village Padragkút (Fig. 2).

Age and lithostratigraphy

Middle Eocene Szőc Limestone Formation: exposure D. Middle and Upper Eocene Padrag Formation: exposure A: Upper Eocene marl; exposure B: Middle Eocene marl with intercalated sandstone; exposure C: sandstone. Exposures A-B-C are type localities of the Padrag Formation.

Table 1a

Smaller foraminifer fauna of the Padragkút A and B exposures

A: Priabonian, Globigerinatheca semiinvoluta zone

B: Bartonian, Truncorotaloides rohri zone

(After K. HORVÁTH-KOLLÁNYI)

Taxa	A	B Left bank of the brook. -- Marl. Sampling points: 14	12	7	6	5	4	3	2	1
Lenticulina budensis (HANTKEN)		2							1	1
Palmula budensis (HANTKEN)										1
Uvigerina havanensis (CUSHM. et BERM.)						1			2	2
Nuttallides truempyi (NUTTALL)						1	1		2	1
Globorotalia c. pomeroli TOUMARK. et BOLLI	3									2
G. spinuloinflata (BANDY)						1	1			2
G. spinulosa CUSHMAN									2	2
Truncorotaloides rohri BRÖNN. et BERM									1	1
Globigerina corpulenta SUBBOT.		2		2	2	2	2	2	4	4
G. eocaena GÜMBEL	2			2	2		2	2	2	2
G. hagni GOHRBARDT		3		2	2	2	2		3	3
G. linaperta FINLAY		2			2	2	2	2	2	2
G. yeguaensis WEINZIERL et APPLIN		2		2	2	2	2	2	2	2
Globigerinatheca index tropicalis (BLOW et BARKER)		1		1			1	1	1	1
Planulina costata (HANTKEN)				2	2	1			2	2
Pleurotomella eocaena GÜMBEL									1	1
Globocassidulina inexculpta (FRANZENAU)		1								1
Plectina dalmatina (SCHUBERT)						2		1	3	2
Dentalina elegans D'ORBIGNY						1			2	2
Dentalina sp.	1	2		2	2	1	2		2	2
Vulvulina haerigensis (GÜMBEL)						1	1		1	
Lenticulina arcuatostriata (HANTKEN)		1		2	2			2	2	
Marginulina fragaria GÜMBEL										1
Uvigerina eocaena GÜMBEL					1		1	2	2	

Table 1b

Taxa	A	B 14	12	7	6	5	4	3	2	1
Globorotalia c. cerroazulensis (COLE)	3	3			2		2		3	
Globigerina cryptomphala GLAESSNER	3								2	
Cibicides ungerianus (D'ORBIGNY)									2	
Globigerina medizzai TOUMARK. et BOLLI							2			
Dorothia traubi (HAGN)						1				
Lenticulina sp.		1				1				
Gyroidina soldanii (D'ORBIGNY)						1				
Globigerina venezuelana HEDBERG	2	2		2						
Globigerina sp.			2							
Bulimina midwayensis CUSHM. et PARKER		2								
Globigerinatheca mexicana barri (BRÖNN.)	2									
G. s. luterbacheri BOLLI	2									
Bulimina sp.	1									
Uvigerina sp.	1									
Globigerinatheca semiinvoluta (KEIJZER)	2									
Ostracoda					+		+			+
Echinodermata	+		+	+	+	+	+	+	+	+
fish teeth				+	+		+	+	+	
sponge spicules		+								
Mollusca			+							

Key: 1 = 1--2 specimens; 2 = 2--10 specimens; 3 = 10--30 specimens; 4 = 30--50 specimens; 5 = 50 specimens

Table 2a

Nannoplankton of the Padragkút B and C exposures

Biozone NP 17, Bartonian

(After M. BÁLDI-BEKE)

Taxa	B Left bank of the brook -- Marl									C Right bank of the brook- - Sandstone wall				
	Sampling points:													
	14	12	7	6	5	4	3	2	1	1	4	7	12	13
Neococcolithes dubius (DEFL.)						1		1						
Discolithina multipora (KAMPTNER)	1		1	1	1	1		1						
D. plana (BRAML. et SULL.)					1									
Transversopontis pulcher (DEFL.)			1	1	2	1	1	1	2					1
Helicosphaera bramlettei (MÜLLER)			1	1	1	1	1	1	1					
H. compacta BRAML. et WILC.				1	2	1	2	1	1					
H. intermedia MARTINI								1						
H. lophota (BRAML. et SULL.)					1		1							
H. reticulata BRAML. et WILC.								1						
Scyphosphaera sp.									1					
Blackites sp.						1								
Zygrhablithus bijugatus (DEFL.)					1				1					3
Coccolithus pelagicus (WALLICH)		2	4	4	4	4	4	3	4					3
C. eopelagicus (BRAML. et RIEDEL)	2		1						1					
C. cf. marismontium BLACK	1													
Ericsonia obruta PERCH-NIELSEN						1	1							
Cycloccolithus formosus KAMPTNER	3	2	3	4	4	4		3	3					3
C. kingi ROTH						1	1							
Cribrocentrum reticulatum (GARTNER et SMITH)	2		4	2	2	3	3	2	3					3
C. coenurum (REINHARDT)			1	1	1	1	1							
Cyclicargolithus floridanus (ROTH et HAY)	3	2	4	3	4	4	4	3	4					4
Cruciplacolithus delus (BRAML. et SULL.)							1							

Taxa	B 14	12	7	6	5	4	3	2	1	C 1	4	7	12	13
Chiasmolithus grandis (BRAML. et RIED.)	2			1	1									1
Ch. titus GARTNER					1				1					
Chiasmolithus sp.	1													
Reticulofenestra placomorpha (KAMPT.)	3		2	3	3	3	3	3	3					
R. bisecta (HAY et al.)	3	2	4	4	4	4	4	3	4					2
R. callida (PERCH-NIELSEN)				1	1	1	2		1					
R. oamaruensis (DEFL.)								1						
Discoaster barbadiensis TAN	1		1	1	1		1	2	2					
D. saipanensis BRAML. et RIED.	1			1	1	1			2					
D. nodifer (BRAML. et RIED.)				1	1									
D. crassus MARTINI									1					
D. cf. tani BRAML. et RIED.	1			1		1		1						
Discoaster sp.							1							
Pemma papillatum MARTINI								1						
Sphenolithus moriformis (BRÖNN. et STRAD.)			3		3		1	2						2
S. spiniger BUKRY			1	1		1	1	1	1					
S. predistentus BRAML. et WILC.								1	1					
coccosphaera				1	1	1								
sponge spicules									1					

Key: 1 = 1--2 specimens, 2 = rare, 3 = few, 4 = common, 5 = abundant

Table 3

Larger foraminifer fauna of the sand beds of the Padragkút B exposure
Nummulites millecaput assemblage zone
(T. KECSKEMÉTI and GY. LESS)

Taxa	Samples: 10	11	12
Nummulites variolarius (LAMK.)	1-2	3	1-2
N. millecaput BOUB.	aff. 2-3	4	1
N. anomalus DE LA HARPE		1	
Nummulites sp.		2-3	1
Operculina gomezi COLOM et BAÜZA	1	1	
Discocyclina dispansa (SOW.) hungarica KECSKEMÉTI			2
D. radians radians (D'ARCH.)			1
D. discus (RÜTIM.) dudarensis LESS		1	
D. pratti pratti (MICHELIN)	1	2	
D. trabayensis NEUM. concentrica KECSKEMÉTI		1	
D. pulcra (CH.-RISPOLI) balatonica LESS		1	
Nemkovella strophiolata strophiolata (GÜMB.)		3	1
Orbitoclypeus chudeaui (SCHLUMB.) pannonicus LESS			1
O. varians (KAUFM.) roberti (DOUV.)	2	4	1
O. furcata (RÜTIM.) rovasendai (PREVER)		3	
O. daguini (NEUM.)		1	
Asterocyclina stella GÜMB. taramellii (MUN.-CHALM.)	1-2	1	1
A. stellata stellata (D'ARCH.)	1-2		
A. alticostata (NUTT.) cuvillieri NEUM.		4	
A. kecskemetii LESS			1

Key: 1 = 1--5 specimens
2 = 6--15 "
3 = 16--30 "
4 = 31--50 "

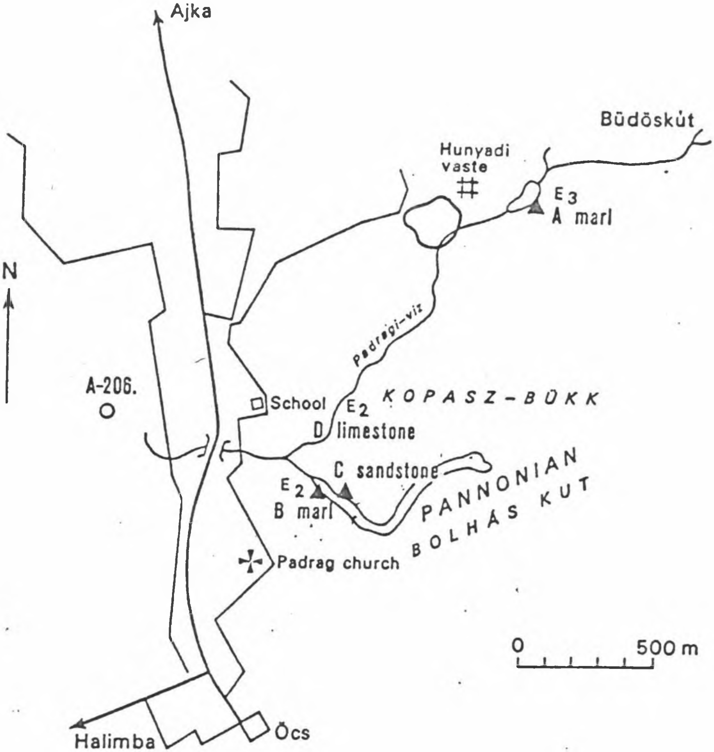


Fig. 2. Sketch map of the Padragkút region with the exposures (A--D). (After MÉSZÁROS 1969)

History

In the ravines E of Padragkút some new exposures could be found in the recent years, where beside the formerly known limestone and sandstone, loose marl could be also found. This work was based on references by ROZLOZSNIK (1925) and MÉSZÁROS (1976), and was carried out by VARGA and BERNHARDT (Fig. 2).

Detailed analyses of the marl and sandstone have been carried out by a joint effort of the scientists of the Department of General and Historical Geology of the L. Eötvös University and the Hungarian Geological Institute.

Geological environment

On the surface, below the Pleistocene loess the occurrence of the Upper Miocene--Pannonian sand and gravel is generally widespread. In the incuts of the ravines, however, the Eocene limestone and sandstone, and even the least preservable marl also appear sporadically.

Exposure A (the samples are pre-packed):

In the N branch of the Padragi Víz brook, E of the former Hunyadi shaft (at a ca. 1 km distance from the village Padragkút), from a small washed out exposure (Fig. 2) Upper Eocene darkish grey carbonate-poor clay and light gray marl combined with sandstone beds can be collected. The rich plankton of this latter type was indicated already by ROZLOZSNIK (1925).

The darkish grey, carbonate-poor rock type, hardly contains foraminifers, the nannoplankton is rather scarce, but well preserved. The light-greyish marly sequence yields a more frequent, but ill-preserved nannoplankton of same composition, and rich, similarly ill-preserved foraminifer fauna. Nannoplankton of exposure A can be ranged into the biozone NP 19:

Isthmolithus recurvus DEFL.	R
Discolithina plana (BRAML. et SULL.)	R
Transversopontis obliquipons (DEFL.)	1
Helicosphaera bramlettei MÜLLER	R
Zygrhablithus bijugatus (DEFL.)	F
Lanternithus minutus STRADNER	R - C
Coccolithus pelagicus (WALLICH)	F
Cyclococcolithus formosus KAMPTNER	R - F
Cyclococcolithus kingi ROTH	1
Cribrocentrum reticulatum (GARTNER et SMITH)	R
Cyclicargolithus floridanus (ROTH et HAY)	A
Chiasmolithus oamaruensis (DEFL.)	R - F

Reticulofenestra placomorpha (KAMPTNER)	F - C
Reticulofenestra bisecta (HAY et al.)	R
Discoaster barbadiensis TAN	R - F
Discoaster saipanensis BRAML. et RIEDEL	R
Discoaster div. sp.	R
Sphenolithus moriformis (BRÖNN. et STR.)	R - F

Key: 1 = 1 specimen, R = rare, F = few, C = common, A = abundant

Foraminifera fauna of the exposure (Table 1) was ranged into the Globigerinatheca semiinvoluta biozone by HORVÁTH-KOLLÁNYI.

Exposure B (Fig. 3):

T o p o g r a p h y: In the SE branch of the Padragi Víz brook, SE of the school at a distance of 500 m (Fig. 2), below the Pannonian sand, the Middle Eocene section of the Padrag Formation is exposed at several places in a thickness of about 10 m.

S t r a t i g r a p h y: On the left bank of the brook greyish, then upwards brownish, roughly bedded clay-marl can be seen (Exposure B, Fig 3). In the upper part of the section there is a ca. 2 m thick reddish-brown, at certain places greenish, loose sandstone intercalation, with a marked lower boundary that upwards with ever finer grain size turns into marl. Bathyal mollusc fauna is scarce but foraminifers are abundant. The surface of the marl, mainly due to the presence of the planktonic foraminifers, is covered by white spots that are visible with naked eye or with magnifier. In the sandstone small-size rather varied large foraminifer fauna is present.

The rich, well-preserved nannoplankton and small foraminifer fauna of the marly beds are shown in the attached tables (Table 1 and Table 2 by BÁLDI-BEKE and HORVÁTH-KOLLÁNYI, respectively). In the intercalated loose sandstone beds the large foraminifer fauna is rather varied (Table 3 by KECSKEMÉTI and LESS). In the upper part, in the finer-grain sands ostracod fauna that is both of average variety and of average preservation occurs, suggesting bathyal facies (MONOSTORI):

Cytherella ex gr. compressa (MÜNSTER)
Cytherella ex gr. transversa SPEYER
Krithe cf. ardoniensis SCHNEIDER

Agrenocythere bensoni POKORNY

Trachyleberidea prestwichiana (JONES et SHERBORN)

Henryhowella sp.

Cytheretta sp.

Age and facies: Based on the complete faunal assemblage, the formation belongs into the Bartonian Stage (upper part of the Middle Eocene), i.e. NP 17 nannozone, Truncorotaloides rohri planktonic foraminifer zone and Nummulites millecaput assemblage zone. The character of the benthonic foraminifers, the ratio of planktonic and benthonic foraminifers,

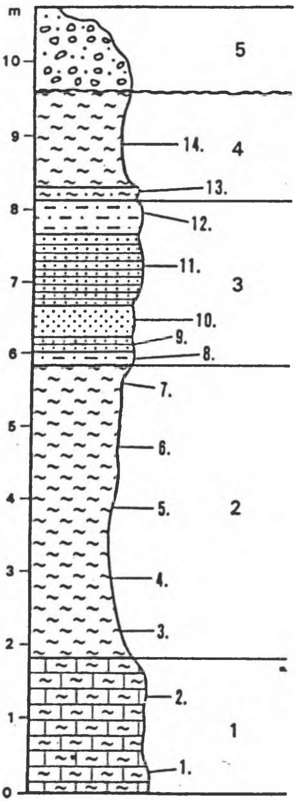


Fig. 3. The section of the Padragkút exposure B (after P. VARGA). SE branch of the Padragi Víz brook, left side bank (Bartonian)
1. Grey, hard clay-marl, 2. brownish-purple clay-marl, 3. reddish-brown, greenish, variegated sandstone sequence, sometimes clayey, 4. brownish-purple clay-marl, 5. yellow, gravelly sand (Pannonian). 1--14: sampling points

and the features of sedimentation all indicate deeper water, bathyal conditions.

Exposure C (Fig. 4):

T o p o g r a p h y : Upwards along the right bank of the brook from the former locality (Fig. 2) there is a high sandstone wall (Exposure C).

A g e a n d l i t h o s t r a t i g r a p h y : Middle Eocene, Bartonian Stage, Padrag Formation.

S t r a t i g r a p h y : The section in sketch form (Fig. 4) shown the approximate place of sampling in the monotonous sandstone. The sandstone is of various grain-size, thickly bedded, reddish brown or greyish. It contains frequently occurring coloured minerals, mainly biotite, small chert and quartz pebbles often occur, the carbonate content is low, the matrix is either tuffitic, or clayey.

F a u n a a n d f l o r a : The fauna and flora from the sandstone is rather scarce: molluscs by chance and in certain beds large foraminifers can be found. These are mainly small-size Nummulites, Discocyclina. The fauna is similar to that of the sand intercalated into the marl of the nearby exposure (B) (after KECSKEMÉTI and VARGA). At certain places, where

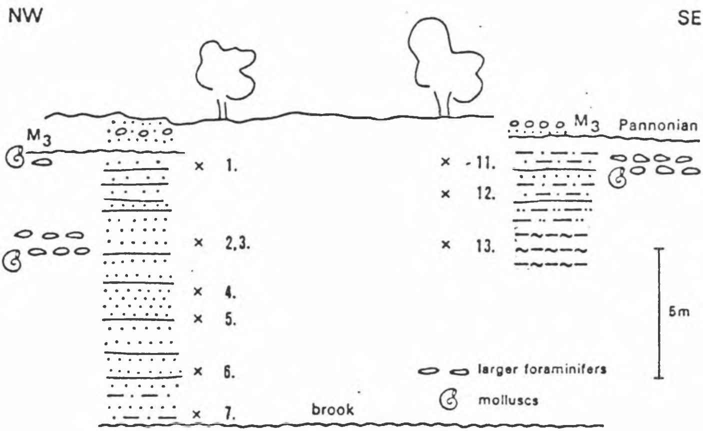


Fig. 4. The section of the Padragkút C exposure. SE branch of the Padragi Víz brook, right side bank (Bartonian)
1--13: Sampling points

they are the most frequent, the large foraminifers are arranged parallel to the bedding planes. In the more clayey layer ill-preserved nannoplankton occurs (Table 2).

A g e : identical with that of Exposure B, i.e. Bartonian.

Exposure D:

Nearby, the oldest outcroping member of the sequence represents the upper part of the Szőc Limestone, with the most frequent faunal element of the B form of Nummulites millecaput (D on Fig. 2). Specimens from this formations may be collected later, at the Szőc, Balaton Hill locality section (G-1) and that is why in this case we do not go into details.

References

BÁLDI-BEKE, M. 1984; BERNHARDT, B. et al. 1985, 1988; MÉSZÁROS J. 1976; ROZLOZSNIK P. 1925.

AJKA

The Mining Museum planted on the Ármin shaft in the Csinger-valley is of considerable interest, presenting the technical and documentary evidences of coal mining at Ajka.
It is an important industrial centre of the Southern Bakony (coal mines, power station, aluminaceous earth factory, aluminium furnace, glass factory).

MAGYARPOLÁNY

F. GÓCZÁN
with the contribution of Á. SIEGL-FARKAS, L. FÉLEGYHÁZI, I. BODROGI and E. BODNÁR

Topography

The surface exposure is located just opposite the village church (Fig. 1). The material of borehole Mp. 42 is also shown.

Age

Upper Cretaceous, Campanian Stage.

Lithostratigraphy

Rendek Member of the Polány Marl Formation.

Stratigraphy

Among the Senonian formations of Hungary the Polány Marl is of the greatest thickness and extension. Its lower part consisting of clayey limestone and calcareous marl layers is the Rendek Member.

It overlies either the Jákó Marl, or the Ugod Limestone Formation. The sedimentation is continuously transitional in both cases, and its thickness is ranging between 62-80 m. Based on the boreholes around Magyarpolány (Mp. 41, Mp. 42) its cover is either intraclastic limestone or authigeneous limestone breccia. In case of the Magyarpolány surface exposure these covering formations are missing but in the samples taken from the Mp. 42 borehole from a depth of 370.0--430.0 m, stored now in core cases, they can be excellently observed.

The $CaCO_3$ content of the calcareous marl and clayey limestone layers of the Rendek Member ranges between 60--95%. Half of the non-carbonate fraction is of the grain size of pelite or aleurite, respectively. The calcareous marl is laminar, frequently with worm tracks on its surface. Clayey limestone layers are frequently separated by calcareous marl layers

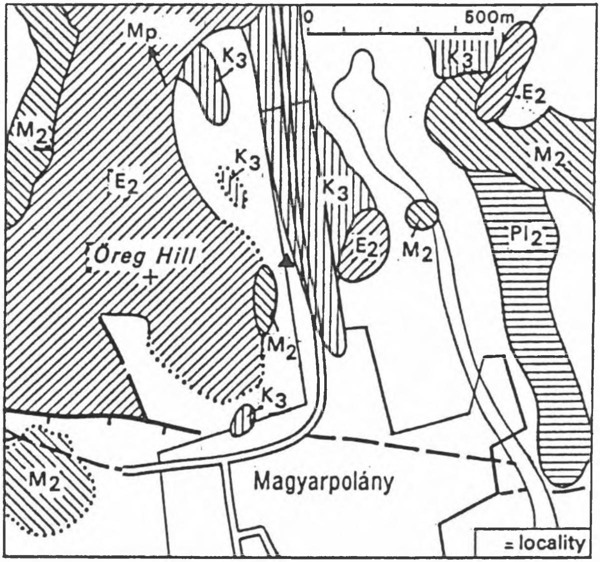


Fig. 1. Geological environment of the exposure (after BIHARI, 1986)

of some mm to a few cm thickness (HAAS 1979, HAAS et al. 1985).

The rock of the exposure is biomicrosparite, with wackestone texture. The matrix is homogeneous, it is micrite developed from fine calcareous mud, that in case of most of the samples, due to slight recrystallization, was transformed into microsparite. Most of the components are of biogenic origin, scattered and at some places they are arranged in a composite manner. Lamination could be not observed. Most of the biogenic elements are foraminifers. Both the planktonic and benthic elements are intact, well-preserved. The ratio of the planktonic and benthic elements is 4:1 as an average. Beside the foraminifers, ostracods, spines and skeletal elements of echinoderms and, to a smaller extent, Inoceramus shell fragments can be found. These, however, are bioclasts.

Inorganic components are extremely scarce. Only some quartz-grains of aleurite size and a very few pyrite and limonite spots can be recognized. The energy index, calculated from component/matrix ratio ranges between 1--3.

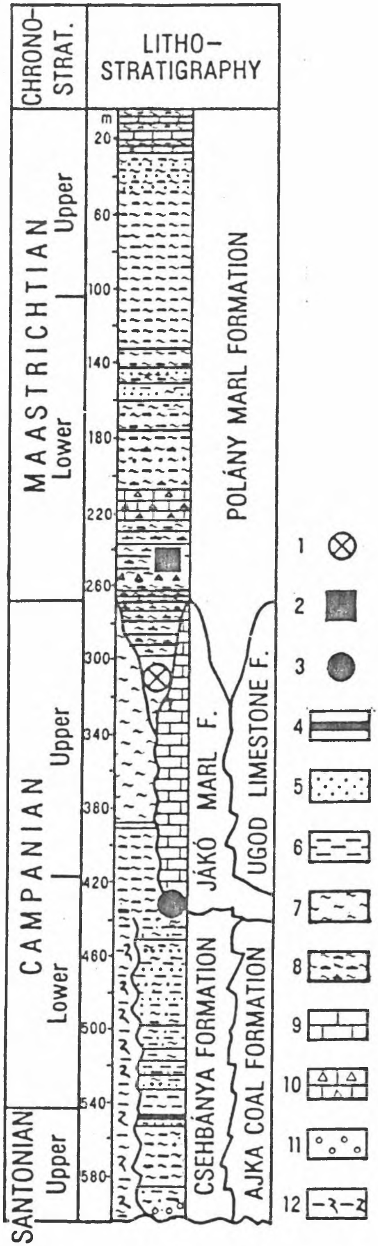


Fig. 2. Stratigraphical zonation of the Upper Cretaceous in the Transdanubian Central Range
1. Presented part of the Polány Marl Formation, 2. Parapachydiscus neubergicus, 3. Placenticeras polyopsis, 4. coal, 5. sand, 6. clay, 7. marl, 8. calcareous marl, 9. limestone, 10. authigenous limestone breccia, 11. conglomerate, 12. variegated clay

Stratigraphical position of the member within the Senonian is shown on Fig. 2.

Fossils

N a n n o f l o r a (determination by L. FÉLEGYHÁZY)

Arkhangelskiella cymbiformis VEKSHINA (1959)	F
Aspidolithus parcus parcus (STRADNER, 1963) NOEL 1969	1
Calculites obscurus (DEFLANDRE, 1959) PRINS and SISSINGH 1977	R
Ceratolithoides aculeus (STRADNER, 1961) PRINS and SISSINGH 1977	R
Chiastorygus amphipons (BRAMLETTE and MARTINI 1964) GARTNER 1968	1
Cribrosphaerella ehrenbergii (ARKHANGELSKY, 1912) DEFLANDRE 1952	R
Cyclagelosphaera margerellii NOËL (1965)	1
Eiffellithus eximius (STOVER, 1966) PERCH-NIELSEN 1968	A
Eiffellithus parallelus PERCH-NIELSEN (1963)	1
Eiffellithus turriseiffeli (DEFLANDRE 1954) REINHARDT 1965	F
Microrhabdulus attenuatus (DEFLANDRE, 1959) DEFLANDRE 1963	1
Microrhabdulus decoratus DEFLANDRE (1959)	R
Microstaurus chiastius (WORSLEY 1971) GRÜN 1975	1
Placozygus fibuliformis (REINHARDT 1964) HOFFMANN 1970	1
Quadrum gothicum (DEFLANDRE 1959) PRINS and PERCH-NIELSEN 1977	1
Quadrum sissinghi PERCH-NIELSEN (1984)	R
Stradneria crenulata (BRAMLETTE and MARTINI 1964) NOËL 1970	R
Tetrapodorhabdus decorus (DEFLANDRE 1954) WIND and WISE 1977	1
Watznaueria barnesae (BLACK 1959) PERCH-NIELSEN 1968	VA

Key: 1 = 1 specimen, F = few, VA = very abundant
R = rare, A = abundant,

S p o r o m o r p h s (determined from borehole Mp. 42 by Á. SIEGL-FARKAS)

Acritarcha div. sp.	F
Dinogymnium nelsonense (COOKSON) EVITT et al.	R
Dinogymnium westralium (COOKSON et EISENACK) EVITT et al.	R
Bikolisporites toratus (WEYL. et GR.) SRIV.	A

Trilites asolidus W. KR.	A
Devecserisporites campanicus Á. SIEGL-FARKAS	R
Vadaszisporites minutireticulatus JUHÁSZ	F
Vadaszisporites sacali DEÁK et COMBAZ	F
Echinatisporites maastrichticus GÓCZÁN	F
Gleicheniidites senonicus (ROSS) BOLCH.	F
Polipodiaceoisporites sp.	R
Coronatipollis lenneri GÓCZÁN	F
Endopollis latiporus GÓCZÁN	R
Hungaropollis div. sp.	A
Hungaropollis bullae GÓCZÁN	F
Hungaropollis bacsalmasensis Á. SIEGL-FARKAS	A
Hungaropollis minor GÓCZÁN	F
Hungaropollis noszkyi GÓCZÁN	F
Hungaropollis trudoformis GÓCZÁN	A
Krutzschipollis div. sp.	A
Krutzschipollis capus GÓCZÁN	A
Krutzschipollis cornauritus GÓCZÁN	F
Krutzschipollis monstruosus GÓCZÁN	A
Krutzschipollis longanulis GÓCZÁN	A
Krutzschipollis magnoporus GÓCZÁN	F
Krutzschipollis spatiosus GÓCZÁN	F
Longanulipollis bajtayi GÓCZÁN	F
Longanulipollis longianulus GÓCZÁN	F
Oculopollis div. sp.	F
Oculopollis campanicus GÓCZÁN	R
Oculopollis serratus GÓCZÁN	R
Semioculopollis minimus GÓCZÁN	F
Suemegipollis triangularis GÓCZÁN	F
Subtriporopollenites anulatus TH. et PF.	R
Trudopollis maastrichticus GÓCZÁN	F

Key: R = rare, F = few, A = abundant

F o r a m i n i f e r a

Determined from thin section by E. BODNÁR:

Globotruncana falsostuarti SIGAL
Globotruncana arca (CUSHMAN)
Globotruncana aff. carinata DALBIEZ
Globotruncana cf. bulloides VOGLER
Globotruncana lapparenti BROTZEN
Globotruncana cf. ventricosa WHITE
Globotruncanella cf. havanensis (VOORWIJK)
Globotruncanita cf. elevata (BROTZEN)
Globotruncanita cf. stuarti (DE LAPPARENT)
Globotruncana cf. angusticarinata GANDOLFI
Heterohelix globulosa (EHRENBERG)
Hedbergella sp.
Archaeoglobigerina sp.
Archaeoglobigerina cf. blowi PESSAGNO
Rosita cf. dornicata (PLUMMER)
Globigerinelloides cf. prairiehillensis PESSAGNO
Dorothia sp.
Reusella sp.
Bolivina sp.
Lenticulina sp.
Eponides sp.

Determined from washing by I. BODROGI:

P l a n k t o n

Globotruncana arca (CUSHMAN)
Globotruncana bulloides VOGLER
Globotruncana lapparenti BROTZEN
Globotruncana linneiana (D'ORBIGNY)
Globotruncana ventricosa WHITE
Globotruncana cf. ventricosa (WHITE)
Globotruncanita elevata (BROTZEN)
Globotruncanita stuartiformis (DALBIEZ)
Rosita fornicata (PLUMMER)

Globotruncana sp.
Hedbergella holmdelensis OLSSON
Heterohelix striata (EICHENBERG)

B e n t h o s

Haplophragmoides rugosus CUSHMAN et WHITE
Spiroplectammina laevis (ROEMER) var. cretosa CUSHMAN
Textularia agglutinans D'ORBIGNY
Textularia subconica FRANKE
Tritaxia plummerae CUSHMAN
Tritaxia pyramidata (RSS.)
Tritaxia tricarinata (RSS.)
Arenobulimina murchinsoniana (RSS.)
Arenobulimina preslii (RSS.)
Dorothia pupa (RSS.)
Marssonella oxycona (RSS.)
Eggerella trochoides RSS.
Ataxophragmium crassum (D'ORBIGNY)
Ataxophragmium variabile (D'ORBIGNY)
Nodosaria sp.
Dentalina communis D'ORBIGNY
Dentalina concinna RSS.
Lenticulina muensteri ROEMER
Lenticulina rotulata (LAMARCK)
Astracolus sp.
Frondicularia sp.
Globulina lacrima RSS.
Globulina prisca RSS.
Bulimina ovulum RSS.
Reusella szajnochae (GRZYBOWSKI)
Cibicides constrictus (HAGENOW)
Cibicides stephensoni CUSHMAN
Globorotalites conicus (CARSEY)
Globorotalites sp.
Gavelinella clamentiana (D'ORBIGNY)
Stensioeina excolata CUSHMAN

Age and facies

The nannoflora examined from the Magyarpolány surface exposure of the Rendek Member of the Polány Marl Formation belongs to the Quadrum sissinghi (CC 21) nannozone. In the flora, beside the zonal index, Arkhangelskiella cymbiformis is present too, that is also characteristic of this zone. Their joint occurrence is characteristic of the Middle Campanian. The zonal index of the uppermost Cretaceous, the Quadrum trifidium, entering at the base of the CC 22 zone, is missing from the analyzed samples. In the thin sections of the very same rock, in the Foraminifera association determined by BODNÁR, a Globotruncanella species also occurs which is most similar to the zonal index of the havanensis zone of the Lower Maastrichtian planktonic foraminifers. Characteristic species of the Upper Campanian, i.e. the Globotruncanita calcarata could not be found either in the thin sections, or after washing. Based on the association of the planktonic and benthic foraminifers and the consequently joint occurrence of Gl. ventricosa and Gl. elevata, and also due to the lack of Gl. calcarata, this formation is to be ranged into the Globotruncana ventricosa zone. This classification rather well matches the nannoplanktonic evaluation for chronostratigraphy, i.e. it is Campanian.

Palynological investigation of the evaluable members of the Magyarpolány region boreholes' sections were carried out in the following cases: Mp. 37, Mp. 38, Mp. 41, Mp. 42, since palynologically the calcareous marl beds in question proved to be absolutely negative. By means of the predominating sporomorph taxa the member can be unanimously ranged into two palynozones:

The lower part of the member, corresponding to samples between 426.3-440.9 m in the borehole Mp. 42 shown in the core boxes, can be ranged into the upper part of the Upper Campanian triangularis--spatiosus dominance-zone on basis of the frequency of the Krutzschipollis and Hungaropollis species, and also on the basis of the consequent occurrence of the Coronatipollis and Longanulipollis, and the lack of the species Devecserisporites, Endopollis, Pseudopapillopollis (GÓCZÁN and SIEGL-FARKAS 1989). The upper part of the member (367.6—426.3), due to the appearance of the Devecserisporites campanicus and the Pseudopapillopollis praesubhercynicus, and also to the regular occurrence of the Dinogymnium westralium and Echinatisporites maastrichticus, and with a tendency of the disappearance of the predominating species of the previous zone, belongs already to the upper part of the Upper Campanian, to the bajtayi--lenneri palynological dominance-zone (SIEGL-FARKAS 1983). In the surface exposure the upper part of the member is missing.

These chronostratigraphical observations are also justified by macrofaunal data collected earlier in the region, i.e. by the occurrence of Inoceramus regularis and I. balticus (BENKŐ-CZABALAY 1964).

Based on microfacies analyses, this part of the basin during the time of sedimentation of the Rendek Member must have been a slightly disturbed, open water environment of low energy and normal salinity. As the fauna indicates the depth of the water could not exceed that of the shelf seas. The composition and preservation of the imbedded sporomorphs refer to reductive conditions at the bottom, and this is also proved by the observable, sporadic pyrite contents.

References

BENKŐNÉ CZABALAY L. 1964; GÓCZÁN, F. 1964; GÓCZÁN, F.--SIEGL-FARKAS, Á. 1989; HAAS J. 1979; HAAS, J. et al. 1977, 1985; SIEGLNÉ FARKAS Á. 1983, 1986.

G-4

NYIRÁD, Darvastó

T. KECSKEMÉTI

with the contributions of A. VÖRÖS, M. BÁLDI-BEKE, K. HORVÁTH-KOLLÁNYI and M. MONOSTORI

Topography

The exposure is located on the SW part of the Bakony Mts. between Sümeg and Nyirád, W of the village Nyirád, in the bauxite quarry Darvastó VI (Fig. 1).

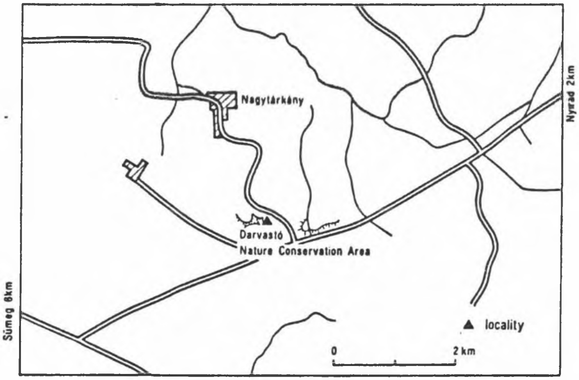


Fig. 1. Sketch map of the exposure Nyirád, Darvastó

Age

Middle Eocene, Lower Lutetian.

Lithostratigraphy

Darvastó and Szőc Limestone Formations; it is the type section of the Darvastó Formation.

History

The one-time bauxite quarry is now Nature Conservation Area. In attractive environment the uneven surface of the Upper Triassic Hauptdolomit, serving as footwall, and in the side walls the covering Eocene formations of the quarry, respectively, can be observed. The bauxite-cover sequence formerly was considered as Lower and Middle Eocene, drawing the boundary of this latter at the mass appearance of Nummulites laevigatus (member IV on Fig. 3). Alveolina, frequent in the lower part were though to be of Lower Eocene species (KOPEK, DUDICH and KECSKEMÉTI 1969, 1971, JÁMBOR-KNESS 1981), and based on Discoaster lodoensis they were ranged into the Lower Eocene NP 13 nannoplankton zone (BÁLDI-BEKE 1971, BROKÉS 1978). KECSKEMÉTI (in KECSKEMÉTI and VÖRÖS 1975), based on a detailed collection and the revision of the larger foraminifer fauna, put the whole section into the Middle Eocene. (The Middle Eocene Alveolina species, and

Nummulites laevigatus occur also at greater depth). Based on the zonal indices of NP 14 zone, observed in the same formation at several nearby locality, the nannoplankton can be ranged also into the Middle Eocene (BÁLDI-BEKE 1984). Further data on the larger foraminifer fauna of the section are published by KECSKEMÉTI (1973 and 1974).

Stratigraphy and fossils

Different members of the exposed Eocene sequence show striking spatial changes. For plotting these changes, three sections had to be made (Fig. 2). Section A shows the whole sequence, while Sections B and C reveal the conditions of the settling of the upper and lower members, respectively. Our account is based upon Section A (the sequence is shown on Fig. 3) that is elaborated in details by KECSKEMÉTI and VÖRÖS (1975).

In the 17.4 m thick section in the northern wall of the quarry there are four well distinguishable members.

Member I, that is also the deepest seated, is a 0.3 m thick yellow ochre clay (Sample 90) deposited discordantly upon the bauxite. It contains only scarcely occurring mollusc shell fragments and echinoid spines. From the fossils only conclusions concerning the marine origin of the clay can be drawn.

In the 4.5 m thick darkish grey clay of the member (Samples 81--89) poor nannoplankton material can be found with Discoaster lodoensis BRAMLETTE et RIEDEL, accompanied by a few indistinct placoliths and redeposited older species (BÁLDI-BEKE 1984). Besides, scarce, predominantly normal saline, shallow marine Ostracoda fauna can be observed with Cytherella gantensis MONOSTORI, Platella gyrosa (ROEMER), Schizocythere tessellata (BOSQUET), Phalocythere horrescens (BOSQUET), Grinioneis haidingeri paijenborchiana (KEIJ) and Quadracythere angusticostata (BOSQUET) species. The associated fauna is represented by some mollusc and echinoid fragments. Darkish grey colour of the clay is given by the browncoal grains it contains.

The 0.7 m thick grey marl (Samples 78--80) upon this is already richer in fauna. Its predominant elements are the Miliolinae (Pyrgo, Triloculina, Quinqueloculina, Spiroloculina) and their quantity is uniformly significant in each sample. The first larger foraminifers, and not in a negligible amount, appear with Alveolina and Orbitolites. They are

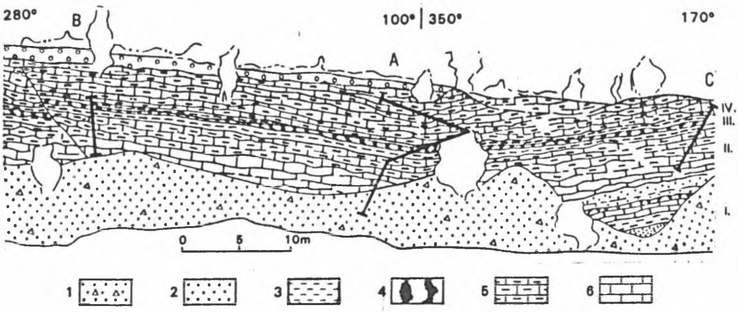


Fig. 2. Section of the exposure
1. Clastics, 2. clay, 3. clay-marl, 4. carbonaceous clay, 5. calcareous marl, 6. limestone

ill-preserved, and determination of the species is not possible. The other faunas shown by the thin sections consist of scarce, exactly undeterminable benthic small foraminifers, bryozoans, brachiopods and ostracods, and also fragmented molluscs and echinoids.

The next, 1.0 thick yellow clay with thin sand stripes (Samples 71--77) does not contain any fauna.

The lower, 3.6 m thick part of member II (Samples 37--69) consists of comparatively pure, biogene limestone beds separated by clay intercalations of varied thickness (0.02--0.10 m). Their larger foraminifer fauna is extremely rich. Alveolina occurs in rock forming quantity, and then, numerically Orbitolites and Nummulites follow.

The most characteristic species of the Alveolina are Alv. levantina HOTT., Alv. frumentiformis HOTT. and Alv. rugosa SCHWAGER. Beside them first of all the guide forms Alv. stipes HOTT. and Alv. tenuis HOTT. are more frequent, while at certain places and less frequently Alv. stercus-muris MAYER-EYMAR, Alv. callosa HOTT. and Alv. gigantea CHECCHIA-RISPOLI also occur. Among the Orbitolites, Orb. complanatus LAMK. is the most frequent. Nummulites are scarce. Among them the important guide form N. laevigatus (BRUG.) and the small N. suemegensis KECSKEMÉTI species are the most frequent.

The most frequent associated elements are the Miliolinae, but bryozoans, and based on their fragments the echinoids also played important role.

The upper, 2.2 m thick part of member II (Samples 19--36) consists of calcareous marl. From Sample 36 a change takes place in the fauna. The change is directly caused by the reduction of energy and salinity of the environment. The environmental change was unfavourable for the larger foraminifers. Their number sharply decreases, and they loose their importance. Generally the Alveolina and Nummulites species are the same as in the previous part. Contrary to the large-scale decrease of larger foraminifers the Miliolinae are hardly reduced, that is why here they become the main faunal elements (Miliolina-bearing calcareous marl).

Member III, again, is a pelitic sequence. By further decrease of the carbonate content, yellow ochre clay-marl (Samples 16--18), yellow ochre clay (Sample 15) and then coaly clay (Samples 11--14) follow in a total thickness of 1.5 m. Going upwards the salinity is gradually reduced, that beside scarce ubiquitous benthic small foraminifers, bivalve and ostracod faunas, is also indicated by the enrichment of the coalified plant fossils. The process between Samples 11--13 is closed by the deposition of a faunal-free, fine-grained coaly clay of large organic matter content.

The uppermost member IV of the sequence is a 3.6 m thick carbonate series. The series starts with greenish clay (Sample 10) that scarcely contains already typical stenohaline fauna. In the further, purely biogenic, nodular limestone layers (Samples 1--9) rapid and remarkable enrichment of the fauna can be observed. Nummulites occur in rock-forming quantity /N. laevigatus (BRUG.), N. obesus (D'ARCH. et HAIME), N. baconicus HANTK., N. lehneri SCHAUB, N. praelorioli HERB et SCHAUB, N. variolarius (LAMK.)/. Beside them, Alveolina are frequent (Alv. stipes HOTT., Alv. tenuis HOTT., Alv. boscii DE GREGORIO, Alv. palermitana HOTT., Alv. frumentiformis SCHWAGER), while Assilina /represented mainly by Ass. spira (DE ROISSY)/ and Operculina are less frequent. Among the small foraminifers, Miliolinae are significant. Due to its position in the living conditions and food chain the rich Corallinacea and Dasycladacea floras must have played an important role.

The Anthozoa, molluscs and decapods were the more important macrofaunal groups.

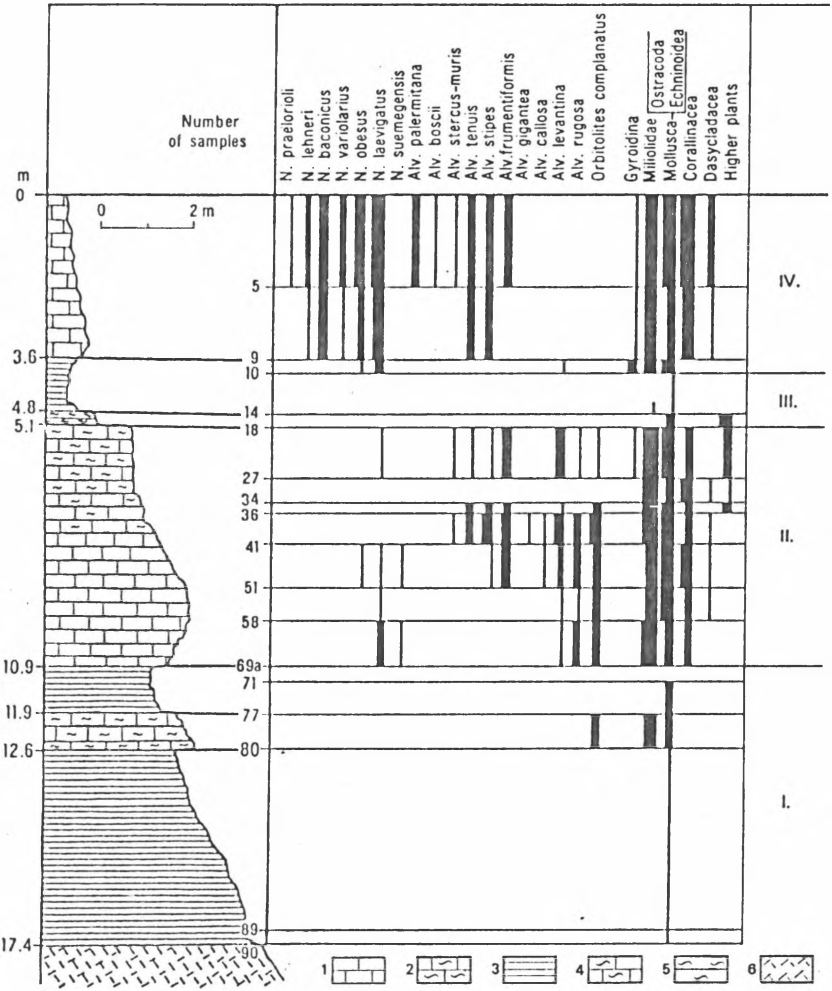


Fig. 3. Stratigraphic column of the exposure Nyirád, Darvastó, and the stratigraphic distribution of the fauna (after KECSKEMÉTI--VÖRÖS, 1975)
1. Limestone, 2. marl, 3. clay, 4. calcareous marl, 5. clayey marl, 6. bauxite

Distribution and frequency of the more significant faunal and floral elements are shown on Fig. 3.

Biostratigraphy

At two places in the section, in members II and IV there are sequences characterized by larger foraminifer fauna. Members I and III are poorer in fauna or partly faunal-free.

In the lower larger foraminifer-bearing beds Alveolina species are predominating while Nummulites are subordinated; in the upper beds this ratio is just the opposite.

Among the species constituting the faunas two species play stratigraphically outstanding role: N. laevigatus and Alv. stipes. These are the most characteristic larger foraminifer guide forms of the Lower Lutetian. Since these two species and the accompanying larger foraminifer faunas are present both in the lower and upper marine sequence, though in different quantities, stratigraphically both successions belongs to the same stage, i.e. to the Lutetian.

Based on the temporal changes of the petrographical and palaeontological features, the change in the environment can be well followed, from the lagoon to the warm shallow marine environment providing the optimum living conditions.

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SÜMEG, Mogyorós Hill
(Nature Conservation Area)

F. GÓCZÁN
after J. NOSZKY 1957 and 1961, J. FÜLÖP 1964 and J. HAAS et al. 1985

Topography

SE of Sümeg, along Road 84, on the Mogyorós Hill in the Nature Conservation Area (Fig. 1).

Age and lithostratigraphy

In Trench I to be shown on the Mogyorós Hill, the Lókút Radiolarite Formation (Upper Dogger), the Pálihálás Limestone Formation (Oxfordian--Kimmeridgian--Lower Tithonian), and the biancone-type Mogyoródomb Limestone Formation (Upper Tithonian--Berriasian--Valanginian--Hauterivian) are exposed (Fig. 2). This is the type section of the Mogyorósdomb Limestone Formation (HAAS et al. 1985).

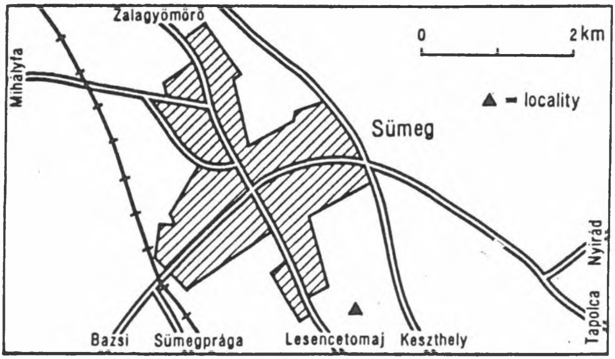


Fig. 1. Sketch map of the Sümeg region

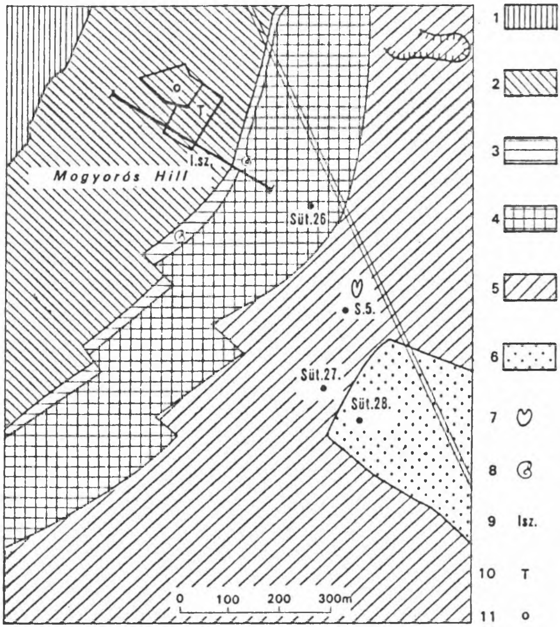


Fig. 2. Geological setting of the Mogyorós Hill Trench I
(after HAAS et al. 1985)
1. Sümeg Marl Formation, 2. Mogyorósdomb Limestone Formation (1--2: Lower Cretaceous), 3. Pálihálás Limestone Formation, 4. Lókút Radiolarite Formation (3--4: Jurassic), 5. Dachstein Limestone Formation, 6. Kardosrét Limestone Formation (5--6: Triassic), 7. Megalodontidae, 8. Cephalopoda, 9. Trench I, 10. Nature Conservation Area, 11. training camp for geologists

History

In the late 1950s FÜLÖP, in the course of studying the Lower Cretaceous formations of the Bakony Mts. made excavations for collecting material for micropalaeontological investigations. Exploration of deeper and deeper parts of some "disturbed" portions the sequence facilitated the recognition of tool fragments used by the prehistoric man.

Due to its unparalleled geological features and prehistoric chert mining relics, Mogyorós Hill was declared Nature Conservation Area that, since 1980, is in the care of the Hungarian Geological Institute. Here a training base was developed for students and postgraduate students in geology, geophysics and engineering geology, for practicing field work during summers.

The establishment of this base, the initiation to declare the area to be conserved, and the foundation of the open air museum are all closely linked to the efforts of Prof. J. FÜLÖP.

The Mogyorós Hill trench exposes the nearly vertically-bedded sequences of the Mogyorósdomb Limestone Formation in its whole thickness, important even from stratigraphic aspects. The prehistoric chert mines can be found in the middle limestone and chert alternating part of the Mogyorósdomb Limestone of biancone facies. To follow the chert layers, the prehistoric man could excavate mining cavities of a depth of even 5 m, about 6000 years ago, in the Neolithic or Copper Ages.

Due to its abundant fossil finds, the Jurassic-Cretaceous boundary section of the Mogyorós Hill exposure proved the necessity of detailed analyses (FÜLÖP 1964, HAAS et al. 1985, TARDI-FILÁCZ 1986).

Lókút Radiolarite Formation

Based on different exploratory trenches and the borehole Süt. 26 its footwall is constituted by the calcareous Bositra- marl beds of the Eplény Limestone Formation (Middle --Upper Dogger) while its cover is represented by the Pálihálás Limestone Formation. Its thickness, according to HAAS, is 150--160 m. The trench at the Mogyorós Hill exposes only the upper few metres (Fig. 3). Here darkish-grey or black chert can be observed that on the surface is thinly laminated because of the intercalated thin pelitic carbonate film.

SiO_2 content of the rock formation ranges between 85--100%, while $CaCO_3$ is in 0--15%.

According to thin section analyses in the microcrystalline, often silicified matrix radiolarian shells can be found in an amount of 20--90% of which the Spumellaria type is predominant, while the Nassellaria type is subordinated. Preservation of this latter is better than that of the previously mentioned ones. Beside them sponge spicules, some benthic foraminifers, and ostracod shells can be also observed in thin-sections.

Age and facies: The age, in lack of the detailed analysis of the Radiolaria fauna, on the basis only of analogies taken from the

Mid-Mountains, is probably between the Upper Bathonian and the beginning of the Oxfordian. The radiolarian ooze from which the beds formed were deposited at a relatively greater depth in open sea, divided by reefs and islands.

Pálihálás Limestone Formation

It overlies the Lókút Radiolarite Formation, while its cover is the Upper Tithonian sequence of the Mogyorósdomb Limestone Formation. Its thickness is ca. 18 m and based on the microfacies features 3--4 characteristic parts can be observed within the formation. The lower part of the Mogyorós Hill Trench I is a ca. 3.4 m thick light-coloured calcareous marl, which is followed by a 13.5 m thick limestone sequence that petrologically can be divided into four subunits. In most cases reddish-brown or grey, often nodular limestone are present. Distributional, petrological, micropalaeontological and chronostratigraphic features of the formation are shown in Fig. 3.

Age and facies: No palaeontological evidence is available for the exact determination of the age of the calcareous marl unit but, with great probability, it is Oxfordian. Lower part of the upper unit of the limestone sequence is Kimmeridgian, based on the predominance of Lombardia, and regular occurrence of Cadosina parvula and Stomiosphaera molluccana. On the basis of the rich ammonite fauna and the microfauna (appearance of Cadosina malmica and C. pulla, and decrease in the quantity of Lombardia) the upper part is Tithonian.

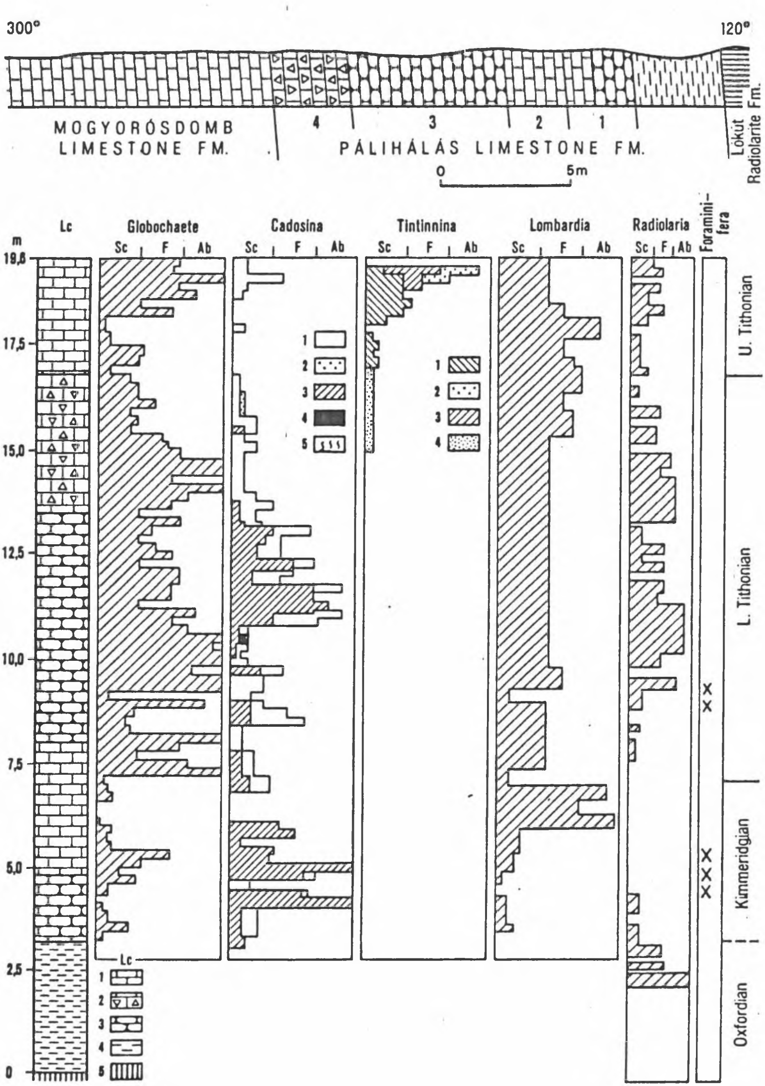
Sedimentation took place under the wave base, under quiet, pelagic conditions at a water depth of some hundred meters (in the deep-neritic, shallow bathyal zone), where only an extremely small amount of fine terrigeneous debris is present.

Mogyorósdomb Limestone Formation ("biancone")

The whole formation was exposed by the Mogyorós Hill Trench I, and it was recommended by HAAS as the surface type section of the formation.

It overlies the Pálihálás Limestone Formation of which it succeeds by continuous sedimentation.

Its cover is known from the borehole Sp. 1 in which upper part, by the increase of the silt content and by decrease of the carbonate content the Sümeg Marl Formation develops by means of continuous sedimentation. This cover is missing in Trench I, since here the upper, already chert



300°
120°
MOGYORÓSDOMB LIMESTONE FM.
4
3
2
1
PÁLIHÁLÁS LIMESTONE FM.
Lókút Radiolarite Fm.
0
5m
m
Lc
Globochaete
Cadosina
Tintinnina
Lombardia
Radiolaria
Foraminifera
Sc
F
Ab
19,6
17,5
15,0
12,5
10,0
7,5
5,0
2,5
0
U. Tithonian
L. Tithonian
Kimmeridgian
Oxfordian

free part of the formation is in tectonic contact with the Upper Cretaceous formations.

Its thickness is ca. 300 m in the type section.

Petrologically it consists of light, yellowish white limestone and calcareous marl layers with chert nodules, lenses and intercalations. $CaCO_3$-content ranges between 80--90%. In the middle part of the formation chert and limestone layers are rhytmically alternating. Prehistoric men of the Neolithic Ages opened chert quarries in this part.

The limestone is light-coloured, greyish-white and yellowish-white. Its microscopic texture is micrite or biomicrite. A major part of its constituents is given by Nannoconus steinmanni (KAMPTNER).

F a u n a : Poor in macrofossils, only some ammonite moulds, and from certain strata aptychi were found. The microfauna is rich, the predominance ratios of the characteristic groups are shown, together with the biostratigraphic distribution in Fig. 4. In the structure of the contemporaneous biocenoses, in the lower part (Kimmeridgian--Lower Tithonian) the Lombardia, while in the upper part (Upper Tithonian--Berriasian) the calpionellids and the radiolarians were predominant.

The determined calpionellid taxa (TARDI-FILÁCZ): Calpionellites darderi COLOM, Lorenziella sp., L. hungarica KNAUER et NAGY, Calpionellites daday KNAUER, Calpionellopsis simplex COLOM, C. oblonga (CADISCH), Remaniella cadischiana (COLOM), Tintinopsella carpathica (MURG. et FIL.), Calpionella elliptica CADISCH, C. alpina LOMBARD, Crassicolaria massutiniana (COLOM), Cr. parvula REMANE, Cr. intermedia (DURAND-DELGA), Chitinoidella sp., Tintinopsella doliphormis COLOM, Sturiella oblonga BORZA.

A g e a n d f a c i e s : The rich microfauna provided the possibility for a reliable chronostratigraphic subdivision within the Upper Jurassic and Lower Cretaceous stages. By recognition of the calpionellid

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Fig. 3. Upper Jurassic section of the Mogyorós Hill Trench I and the results of analyses (after HAAS et al. 1985)
Section (LC): 1. limestone, 2. authigen brecciated limestone, 3. nodular limestone, 4. white marl, 5. chert. -- Sc = scarce, F = few, Ab = abundant. -- Cadosina: 1. lapidosa, 2. tenuis, 3. parvula, 4. malmica, 5. pulla. -- Tintinnina: 1. Crassicollaria intermedia, 2. Calpionella alpina, 3. Crassicollaria parvula, 4. Chitinoidella

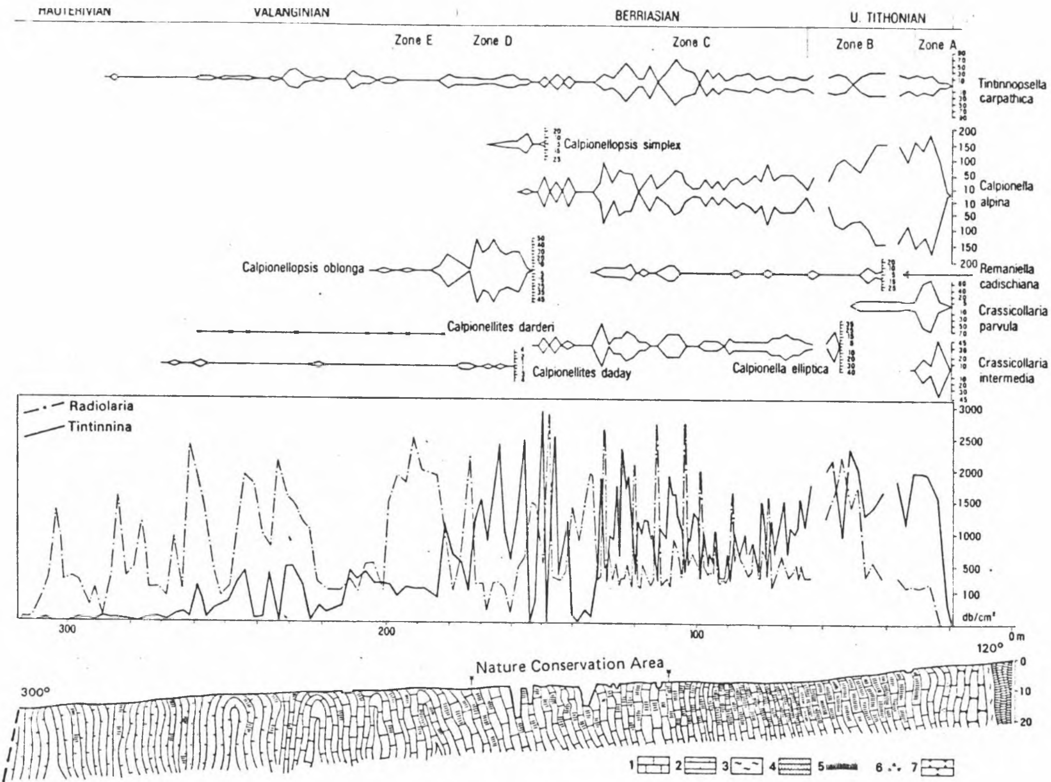

Fig. 4. Mogyorós Hill, the geological key section (after HAAS et al. 1985)
1. Limestone, 2. calcareous marl, 3. marl, 4. radiolarite, 5. chert lenses, 6. authigene breccia, 7. nodular structure

zones drawing of the Tithonian--Berriasian and Berriasian--Valanginian boundaries, became also possible (Fig. 4).

The biancone-type development of the formation, the presence and rhythmical occurrence of chert, and furthermore the typical microfossil assemblages, and the only sporadically occurring organic matter content of floral origin unanimously refer to pelagic, off-shore, deeper neritic environment.

References

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SÜMEG

During the period of the Turkish occupation of Veszprém, Sümeg served as the episcopal centre for nearly 200 years. The magnificent episcopal palace was built by the order of the bishop Márton PADÁNYI-BIRÓ between 1748--1755. The parish church was built between 1756--1759. It is world-famous because of the excellent mural paintings of MAULBERTSCH, ordered also by the bishop Márton BIRÓ. The former Franciscan church was built by bishop György SZÉCHENYI already between 1649--1653. The fortress of the town is one of the biggest in the country, preserved in fairly good state.

The Memorial Museum of Sándor Kisfaludy is situated in a 18th century baroque manor house with portico, the birth place of the poet Sándor KISFALUDY (1772--1844). In the former stable built by the orders of Márton BIRÓ we find the Museum of Horse Harness.

BADACSONY

One of the most beautiful sights of the Tapolca Basin bordered by basalt volcanoes, a typical cone mountain. The hexagonal basalt columns are placed like pipes of the organ.

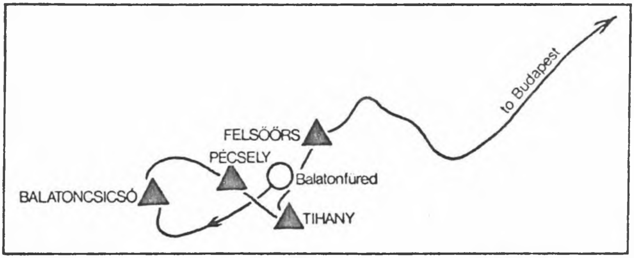
The district is well known by its wine- and vineyard cultivation culture. Important relics of the Hungarian cultural history can

be found here as well: the nicest building of the mountain is the house of the poet Sándor KISFALUDY and his wife, Róza SZEGEDY. The house furnished by contemporary furniture is a memorial museum today. Near the shore we find the former house or studio of the painter József EGRY, serving as a memorial museum. The paintings of the artist called as "the painter of the Balaton" are exceptional artistic impressions.
A local curiosity is the Neoromanesque church of Badacsonytomaj, built exclusively of local basalt.

BALATON-SHORE

Passing along the shore of the Lake Balaton we are crossing a beautiful environment inhabited since prehistoric times. On one side we can see varied ladscape of the Balaton Highlands, settled with vineyards while on the other side, the Balaton, called Lacus Pelso by the Romans.
The Balaton is the largest lake in Central Europe. Its lenght is 78 km, its width varies between 5--12.5 km, while in the Tihany strait, it is 1.5 km wide. The total surface of the water is 595 km^2. The average depth of the lake is 3 m. The basin of the lake is a young tectonical depression formed by the end of the Pleistocene. The lake has a great economical importance. Fishing and cutting of the reed are equally important here, but the main economical value of the region is certainly tourism. The beautiful landscape, the basalt volcanoes (cone mountains), attractive sloping hills and the excellent beach render it suitable to be the most popular resort place in Hungary, visited by masses of foreign tourists as well. Along the northern shore, the mineral bathes (Hévíz, Balatonfüred) and the historical monuments add up to its attractions.

12 September: H: BALATONFÜRED--BALATONCSICSÓ--PÉCSELY--TIHANY--FELSŐÖRS--BUDAPEST



H-1

BALATONCSICSÓ, Csukrét Ravine

F. GÓCZÁN and A. ORAVECZ-SCHEFFER
with the contribution of G. CSILLAG, L. DOSZTÁLY, S. KOVÁCS and K. LENNER

Topography

About 2 kms to NW from the village Balatoncsicsó.

Age and lithostratigraphy

Carnian, Cordevolian and Julian, the surface key section of the Veszprém Marl Formation.

Stratigraphy, fauna and flora

One of the most widespread Triassic formations of the Balaton Highland is the Veszprém Marl (Fig. 1). It overlies the light-grey-yellow-spotted, sometimes cherty, nodular Füred Limestone Formation, from the upper part of which it develops by gradual decreasing of the carbonate content, and by increasing of the pelitic content. This transitional part is becoming more compact upwards and is characterized by marl and calca-

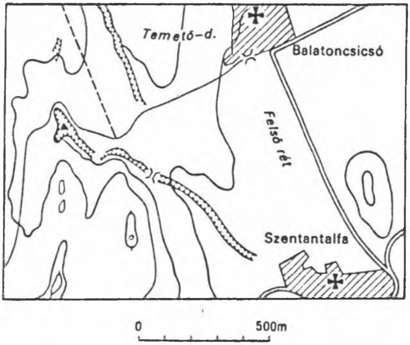


Fig. 1. Location of the exposure

reous marl intercalations. Due to its Trachyceras aon content it can be ranged into the lower part of the Cordevolian Substage. The Veszprém Marl Formation is overlain by the transitionally developping Sándorhegy Limestone Formation, that, according to the Megalodus carinthiacus and Cornucardia hoernigi contents, was formed in the Tuvalian Substage.

Lithostratigraphically the Veszprém Limestone Formation consists of three parts: Mencshely Marl Member, Nosztor Limestone Member, and Csicsó Marl Member.

The Csukrét Ravine at Balatoncsicsó exposes all the three members of the Veszprém Marl Formation, that is why this section is considered to be the surface key section of the formation (Fig. 2). The direct contact of the formation to the cover and footwall can be traced in the sequences of the nearby reference sections (the surface exposures at Meggy Hill, Száka Hill and Sándor Hill, and the boreholes at Mencshely, Met.1, Balatonfüred, Bf. 1 (ORAVECZ-SCHEFFER 1987).

The Triassic section of the steep-walled valley cut by the Csukrét brook was re-mapped by geologist G. CSILLAG, on 1:10,000 scale. He was also the author of the lithostratigraphical subdivisioning of the Veszprém Marl Formation.

The section follows the brook, exposing the younger formations down towards the older ones, from the valley-head in a ca. 500 m length. The sequence is practically exposed from the upper part of the Csicsó Member down to the base of the Mencshely Member but the first third part of the

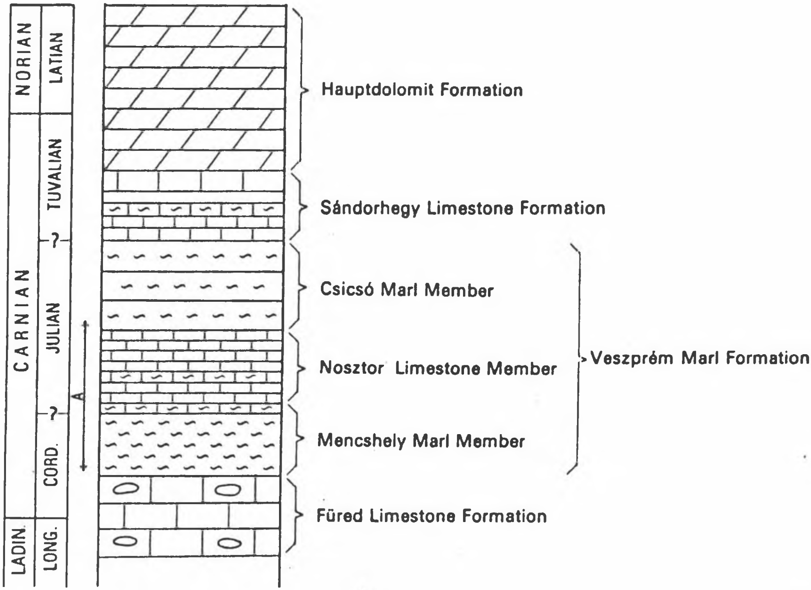


Fig. 2. Composite section of the Carnian formations of the Balaton Highland
A = The representative section part of the Csukrét ravine at Balatoncsicsó

section is difficult to approach. Sites of measurements are shown at 25 m intervals on Fig. 3 that marks the sampling points also.

The section is currently under a complex paleontological and biostratigraphical analysis. The lower part of the Mencshely Marl Member (representative sample: No. 24, Fig. 4) will be shown on the one hand, that based on microflora and microfauna is ranged into the Cordevolian Substage, and on the other hand two samples of the section representing the microfauna and sporomorph association of the Julian Substage of the Nosztor Limestone Member, i.e. the so-called Austriacum limestone ("M"), and of the Csicsó Marl Member (No 8/a).

I. The beds of the Mencshely Marl Member to be shown are dipping at an angle of $270^{0}/25^{0}$, consist of well-bedded, dark-grey, soft, exfoliated clayey marl and marl layers. As an average it contains 15--20% terrigeneous silt of angular quartz grains. Its clay mineral contents exceeding

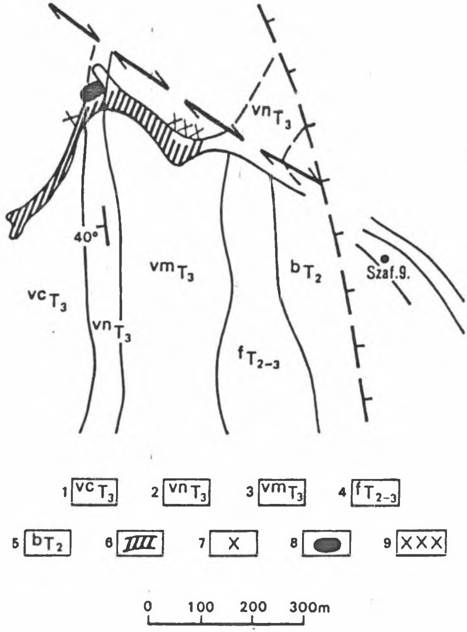


Fig. 3. Geological map of the surroundings of the Csukrét Ravine, Balatoncsicsó
1. Csicsó Marl Member, 2. Nosztor Limestone Member, 3. Mencshely Marl Member (1--3: Veszprém Marl Formation), 4. Füred Limestone Formation, 5. Buchenstein Formation, 6. the measured and sampled section of the ravine, 7. sampling site of the Csicsó Marl Member, 8. sampling site of the Nosztor Limestone Member, 9. sampling site of the Mencshely Marl Member

50% is mostly composed of illite, vermiculite and montmorillonite that is accompanied by 3--4% chlorite and kaolinite. Its carbonate content is alternating, as an average it is 20%. At its lower part, however, a calcareous marl layer reaching even the 76% also occur.

Its macrofauna is represented by a few, not exactly determinable mollusc fragments. The microfauna and microflora is characteristic, rich and well-preserved. As representative sample, that can be collected, that of No. 24 is appointed.

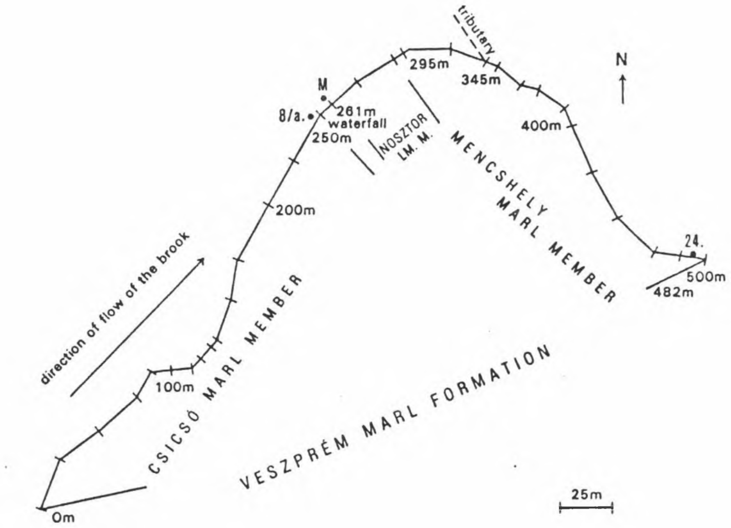


Fig. 4. Measured and sampled section of the Csukrét Ravine, Balatoncsicsó. Representative section parts: 24, M, 8/a

Microfauna

The sporomorphs are as follows (GÓCZÁN):

1.	Camerosporites secatus LESCHIK 1955	CO
2.	Camerosporites pseudoverrucatus SCHEURING 1970	CO
3.	Duplicisporites granulatus LESCHIK 1955	F
4.	Paracirculina scurrilis SCHEURING 1970	CO
5.	Paracirculina tenebrosa SCHEURING 1970	CO
6.	Paracirculina maljavkinae KLAUS 1960	VR
7.	Praecirculina granifer (LESCHIK 1955) KL. 1960	F
8.	Enzonalasporites tenuis LESCHIK 1955	P
9.	Enzonalasporites vigens LESCHIK 1955	F
10.	Enzonalasporites obliquus LESCHIK 1955	F
11.	Patinasporites densus LESCHIK 1955	CO
12.	Sulcatisporites kraeuseli MÄDLER 1964	R
13.	Staurosaccites quadrifidus DOLBY 1976	R
14.	Ovalipollis ovalis KR. 1955	F

15.	Ellipsovellatisporites rugosus SCHEURING 1970	CO
16.	Alisporites toralis (LESCHIK 1955) CLARKE 1965	F
17.	Triadispora boelchi SCHEURING 1970	CO
18.	Triadispora modesta SCHEURING 1970	CO
19.	Triadispora verrucata (SCHULZ 1966) SCHEURING 1970	CO
20.	Triadispora suspecta SCHEURING 1970	CO
21.	Triadispora stabilis SCHEURING 1970	CO
22.	Triadispora obscura SCHEURING 1970	CO
23.	Triadispora crassa KL. 1964	CO
24.	Lunatisporites acutus LESCHIK 1955	F
25.	Lueckisporites junior KL. 1960	CO
26.	Infernopollenites sulcatus (PAUTSCH 1958) SCHEURING 1970	F
27.	Veryhachium sp.	F

Key: VR = very rare F = frequent CO = consequently occurring
R = rare P = predominant

Predominant: the association of the Monosaccites--Kryptaperturates--Circumpolles groups

Subdominant: the bisaccat group. Their ratio is changing between 23:77 and 29:71

F o r a m i n i f e r a (A. ORAVECZ-SCHEFFER)

Duostomina alta KRISTAN-TOLLMANN (frequent)
Duostomina biconvexa KRISTAN-TOLLMANN (frequent)
Turriglomina carnica (DAGER)
Gsollbergella spiroloculiformis (ORAVECZ-SCHEFFER)
Frondicularia sulcata BORNEMANN
Ophthalmidium exiguum KOEHN-ZANINETTI
Pachyphloides aghdarbandi (OBERHAUSER)
Nodosaria primitiva ZWINGLI et KÜBLER
Dentalina subsiliqua TERQUEM
Lenticulina varians (BORNEMANN)
Lenticulina gottensis (FRANKE)
Vaginulinopsis protacta (BORNEMANN)
Dentalina zlambachensis KRISTAN-TOLLMANN

Cyclogyra pachygyra (GÜMBEL)
Nodosaria raibliana (GÜMBEL)
Nodosaria soluta (REUSS)

H o l o t h u r o i d e a

Theelia cf. lata KOZUR et MOSTLER
Theelia sp.
Achistrum sp.

Ophiuroidea and Echinoidea fragments

Ostracoda div. sp.

Estheria sp. (Phyllopoda)

II. Nosztor Limestone Member (Austriacum limestone). Beginning from Sample 12 a remarkable change can be observed upwards in the litho- and biofacies. The marl layers turn gradually into dolomitic, and then into pure limestone layers. These are light, greyish-brown, sometimes cherty, nodular limestone benches with undulating surface, and with few cm thick marl intercalations. Their dipping is changing between 280^{o}--$295^{o}/30^{o}$.

The representative sample to be collected is that of marked "M".

According to the microfacies analysis of the thin sections (ORAVECZ-SCHEFFER) the most frequent type is the filament biomicrite and biomicrosparite. Texturally these are wackestones. Pellets are at some places, frequent among the components. The biogenic components consist predominantly of pelagic elements: pelagic bivalves, radiolarians, sponge spicules, fragile Roveacrinidae (Osteocrinus div. sp.), Holothuroidea, Conodonta and fish teeth. There are very few recognizable f o r a m i n i f e r s :

Tolypammina cf. discoidea TRIFONOVA
Tolypammina indistincta TRIFONOVA
Lituotuba sp.
Dentalina sp.
Pilaminella kuthani SALAJ
Dentalina arbuscula TERQUEM
Dentalina minuta ORAVECZ-SCHEFFER

The R a d i o l a r i a fauna of Sample M (L. DOSZTÁLY):

?Canoptum sp.
?Capnuchosphaera sp.
Hagiastrum sp.
Paleosaturnalis sp.
Paronaella sp.
?Praeorbiculiformella sp.
Sarla sp.

C o n o d o n t a (S. KOVÁCS):

Gondolella polygnathiformis BUDUROV et STEF.
Gladigondolella sp.

Characteristic to the microbiofacies of the marl intercalations that they exclusively consist of well-rounded, but not decomposed, moderately coalified woods and a small amount of oxidized sporomorphs belonging to the so-called "small" fraction (20--30um). Their majority belongs to the Circumpolles group. Beside them 1--2 organic-walled marine microplankton forms can be also observed (GÓCZÁN).

III. Csicsó Marl Member. Macroscopically, and in petrological composition it is very similar to the Mencshely Marl. At some places it is a little lighter-grey, and is of somewhat higher carbonate content. Sample 8/a is the representative one to be collected as the direct cover of the Austriacum limestone.

M a c r o f a u n a (K. LENNER):

Halobia rugosa HAUER
Trachyceras sp.
Gonodus astartiformis MÜNSTER

Beside them some crinoid and brachiopod fragments can be also found.

S p o r o m o r p h association (F. GÓCZÁN):

1.	Paraconcavisporites lunzensis KL. 1960	CO
2.	Camarozonosporites rudis (LESCHIK 1955) KL. 1960	CO
3.	Zebrasporites kahleri KL. 1960	VR
4.	Lycopodiacidites kuepperi KL. 1960	CO

They are jointly subdominant from 5 to 16:

5.	Aratrisporites scabratus KL. 1960	R
6.	Aratrisporites paraspinosus KL. 1960	R
7.	Duplicisporites mancus (LESCHIK 1955) KL. 1960	CO
8.	Duplicisporites granulatus LESCHIK 1955	CO
9.	Camerosporites secatus LESCHIK 1955	R
10.	Camerosporites pseudoverrucatus SCHEURING 1970	R
11.	Paracirculina scurrilis SCHEURING 1970	F
12.	Paracirculina tenebrosa SCHEURING 1970	F
13.	Paracirculina maljavkinae KL. 1960	R
14.	Praecirculina granifer (LESCHIK 1955) KL. 1960	F
15.	Enzonalasporites div. sp.	F
16.	Patinasporites densus LESCHIK 1955	F

They are jointly predominant from 17 to 31:

17.	Sulcatisporites kraeuseli MÄDLER 1964	CO
18.	Brachisaccus neomundanus (LESCHIK 1955) MÄDLER 1964	F
19.	"Succintiporites" grandis LESCHIK 1955	CO
20.	Staurosaccites quadrifidus DOLBY 1976	CO
21.	Parillinites div. sp.	CO
22.	Ellipsovellatisporites rugosus SCHEURING 1970	CO
23.	Alisporites aequalis MÄDLER 1964	F
24.	Alisporites div. sp.	F
25.	Vitreisporites pallidus (REIS. 1950) NILSSON 1958	R
26.	Lunatisporites acutus LESCHIK 1955	F
27.	Lueckisporites junior KL. 1960	CO
28.	Lueckisporites cf. singhi BALME 1970	R
29.	Ovalipollis ovalis KR. 1955	F
30.	Ovalipollis brutus SCHEURING 1970	F
31.	Triadispora div. sp.	CO

32.	Dictyotidium reticulatum SCHULZE 1965	F
33.	Veryhachium sp.	CO

Key: VR = very rare   F = frequent
R = rare   CO = consequently occurring

The bisaccat group is the predominant, while the association of the Monosaccites--Kryptaperturates--Circumpolles groups is the subdominant. Their ratio is changing between 52:48% and 54:46%.

Microfauna (A. ORAVECZ-SCHEFFER)

Foraminifera

Astacolus karnicus (OBERHAUSER)
Lenticulina gottensis (FRANKE)
Pseudonodosaria cf. plöchingeri (OBERHAUSER)
Dentalina zlambachensis KRISTAN-TOLLMANN
Dentalina arbuscula TERQUEM
Ophthalmidium tori KOEHN-ZANINETTI
Gsollbergella spiroloculiformis (ORAVECZ-SCHEFFER)

Coprolite

Bactryllum canaliculatum HEER

Roveacrinidae

Osteocrinus rectus FRIZZEL

Gastropoda and Bivalvia

Echinoidea fragments

Environment

According to the analyses, the exposed part of the Mencshely Member of the Veszprém Marl Formation (Sampled section No.24) was deposited in a near-shore (but not coastal), normal salinity, reductive environment, protected from strong waves, where the upper photic zone waters remained in permanent connection with the open sea. This protected shallow-water environment changed gradually into deeper water one towards the Nosztor Member, as shown by the predominance of pelagic elements in the microfauna and high proportion of well-rounded coal grains in the water transported terrigeneous plant remains in the single, "small" fraction of the organic microfacies. In the Csicsó Marl Member, also by gradual transition, a somewhat shallower-water marine environment with terrigeneous material influx can be inferred, what is, however, more pelagic than that of the Mencshely Marl Member. This is shown by data from the samples: the inorganic terrigeneous material is fewer than in the Mencshely Member, and the organic microfacies shows more wind-blown pine pollens and fewer water-transported tracheid pine debris in the coarse fraction, and in the macrofauna pelagic elements appear.

Chronostratigraphy

The exposed part of the Mencshely Member of the Veszprém Marl Formation overlies the so-called marl-interbedded, Roveacrinidae-containing sequence above the upper part of the *Trachyceras aon*-bearing Füred Limestone Formation within the Carnian of the Balaton Highland (Száka Hill section, boreholes Met. 1, Bf. 1). Accordingly, it may belong into the *Trachyceras aonoides* Zone.

Its microfauna is characteristic in composition, consisting of a *Duostomina alta*--*D. biconvexa* foraminifer association having been described from the Pralongia--St. Cassian type locality of the Upper Cassian Beds. Associated to these dominant elements, Nodosariids enduring from the Longobardian, and *Gsollbergella spiroloculiformis* known so far only from the Carnian are represented subordinately in the fauna. According to ULRICHS (1974), the part of the St. Cassian type locality yielding this fauna belongs into the Cordevolian Substage.

The rich sporomorph association is characterized by the predominance of the *Circumpolles* group and by the subdominance of the bisaccates. (The represented taxa and their ratio is shown in the sporomorph list given for Sample 24.) In the chronostratigraphic evaluation of this fossil assemblage important is the role of the consequent occurrence of taxa frequent in the Upper Ladinian (*Infernopollenites* div. sp., *Paracirculina scurrilis* SCHEURING 1970, *Camerosporites* div. sp., *Triadispora* div. sp.) and also of the appearance of forms predominating (*Ovalipollis brutus*

SCHEURING 1970) or being more common /Paracirculina maljavkinae KL. 1960, Patinasporites densus (LESCHIK 1955) SCHEURING 1970, Brachisaccus div. sp./ in the Trachyceras austriacum-bearing formations.

The Nosztor Limestone Member chronostratigraphically can be unambiguously ranged into the Julian Substage by the occurrence of Trachyceras austriacum MOJS. in the type section, i.e. in the Nosztori valley quarry. Thus the microfaunistically correlated Csicsó occurrence can be ranged also into this unit.

The visited 8/a sampled part of the Csicsó Marl Member is clearly ranged also into the Julian by its extremely rich sporomorph association (see the sporomorph list) with the taxonomical composition and dominances: dominance of the bisaccates over the Circumpolles group; Paracirculina maljavkinae becomes consequently-occurring; Ovalipollis brutus appears; Patinasporites densus and Brachisaccus becomes common; the species and specimen number of Triadispora complex decreases significantly; Infernopollenites div. sp. almost disappears; etc. This evaluation is supported by the presence of Halobia rugosa HAUER in the poor macrofauna, because in the Southern Alps this species is known only in Julian formations.

References

ORAVECZ-SCHEFFER, A. 1987; ULRICHS, M. 1974.

H-2

PÉCSELY, Meggy-hegy Quarry

L. DOSZTÁLY, S. KOVÁCS, T. BUDAI
with the contribution of A. ORAVECZ-SCHEFFER

Topography

The quarry on the Meggy-hegy (Meggy Hill) is located at about 1 km SE of Pécsely village, near the road leading to Aszófő (Fig. 1).

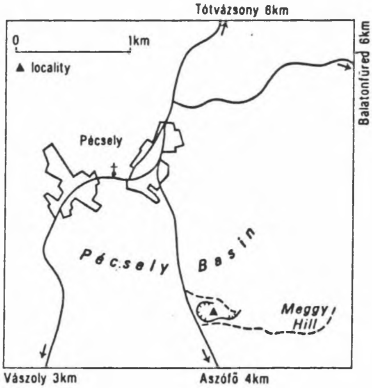


Fig. 1. Sketch map of the locality

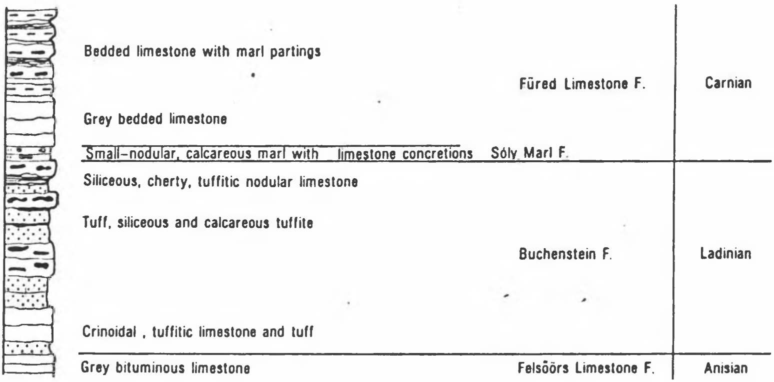


Fig. 2. Composite section of Pécsely Meggy-hegy

Age

Upper Triassic, Lower Carnian.

Lithostratigraphy

Füred Limestone Formation.

Lithology

Grey, weathering brownish-grey, thick-bedded limestone often with thin marly intercalations and dark-grey chert nodules. Marly intercalations became thicker upwards, indicating a gradual transition to the overlying Veszprém Marl Formation. They contain sometimes coalified plant remnants. On the densely nodular surfaces of limestone beds brachiopods, bivalves and very rarely ammonoids can be found. (A composite section of the hill Meggy-hegy, showing its whole Middle and Upper Triassic sequence, can be seen on Fig. 2.)

Ammonoids found so far are represented by Dittmarites aff. rueppeli (KLIPSTEIN), Dittmarites sp., Neoprotrachyceras sp. and indeterminable trachyceratid fragments (det. VÖRÖS).

Three sections have been sampled for microfaunistic investigations, representing the bulk of the thickness of the Füred Limestone Formation. Sampling interval was between 0.3--0.5 m, the weight of samples between 5--10 kg. The insoluble residue contained a fairly rich microfauna, comprising conodonts, radiolarians (mostly limonitized), echinoderm fragments, foraminifers, fish teeth, holothurian sclerites, ostracods, roveacrinids, sponge spicules and microproblematics.

In addition a few samples have been investigated from the lowermost beds of the Füred Limestone, exposed at the upper end of the vineyards SE of the quarry, in the immediate overlier of tuffaceous Buchenstein beds.

Fauna

C o n o d o n t s

All the samples (even those from the lowermost beds of the formation) yielded the same fauna:

Gladigondolella tethydis (HUCKRIEDE)
Gladigondolella malayensis malayensis NOGAMI
Gondolella foliata inclinata KOVÁCS
Gondolella foliata foliata (BUDUROV et STEFANOV)
Gondolella polygnathiformis (BUDUROV et STEFANOV)
as well as ramiform elements of the Gladigondolella and Gondolella apparatus. The number of specimens is a few tens in each samples.

The presence of Gondolella polygnathiformis throughout the sections (even the lowermost beds) proves that the whole sequence of the Füred Limestone Formation belongs to the Carnian Stage. It should, however be noted, that in the Balaton Highland Triassic the Cordevolian (= Trachyceras aon and T. aonoides subzones, in sense of KOVÁCS 1984) and the Julian (= Austrotrachyceras austriacum zone, in sense of KOVÁCS 1984) substages could not be distinguished so far on the basis of conodonts. Even in the "Austriacum limestone" member of the overlying Veszprém Marl Formation representatives of the Gondolella auriformis group indicating in deep pelagic environments the austriacum zone (= zone of G. auriformis; cf. KRYSTYN 1983) are missing.

F o r a m i n i f e r a (from the insoluble residues of conodont samples and wash-out residues of marl intercalations):

Tolypammina discoidea TRIFONOVA
Tolypammina indistincta TRIFONOVA
Tolypammina rotula GUTSCH et TRECKMAN
Tolypammina labyrinthica TRIFONOVA
Ammovertella cf. bulbosa GUTSCH et TRECKMAN
Pseudonodosaria obconica (REUSS)
Pseudonodosaria lata (TAPPAN)
Pseudonodosaria simpsonensis (TAPPAN)
Lenticulina polygonata FRANKE
Dentalina zlambachensis KRISTAN
Dentalina sp.
Astacolus karnicus (OBERHAUSER)

R o v e a c r i n i d a e

Osteocrinus rectus rectus (FRIZZEL-EXLINE)
Osteocrinus rectus goestlingensis KRISTAN-TOLLMANN
Osteocrinus virgatus KRISTAN-TOLLMANN
Ossicrinus reticulatus KRISTAN-TOLLMANN

This foraminifer and roveacrinid association characterizes the Cordevolian substage, too.

Table 1

Radiolarians of the Meggy-hegy sections

Fauna	I.								II.		III.		
	3.	6.	7.	13.	14.	15.	16.	21.	4.	36.	3.	4.	7.
Acanthosphaera mocki KOZUR et MOSTLER					X				X				
Astrocentrus pulcher KOZUR et MOSTLER		X	X		X			X	X		X		
Capnuchosphaera triassica DE WEVER											X		
Dumitricasphaera sp.									X				
Hagiastrum triassicum KOZUR et MOSTLER											X		
Hindeosphaera bispinosa KOZUR et MOSTLER											X		
Hindeosphaera sp.								X	X	X			
"Hsuum" cordevolicum KOZUR et MOSTLER									X				
Paleosaturnalis triassicus (KOZUR et MOSTLER)	X	X	X	X	X	X	X	X	X	X	X	X	X
Paleosaturnalis cf. zapfei (KOZUR et MOSTLER)				X									
Paratriassoastrum sp.		X											
Paronaella sp.			X										
Pentactinocarpus aff. bispinosus KOZUR et MOSTLER											X		
Pentactinocarpus sp.										X			
Pentaspongodiscus sp.									X				
Praeheliostaurus cf. goestlingensis KOZUR et MOSTLER									X				

Fauna	I. 3.	I. 6.	I. 7.	I. 13.	I. 14.	I. 15.	I. 16.	I. 21.	II. 4.	II. 36.	III. 3.	III. 4.	III. 7.
Praeheliostaurus levis KOZUR et MOSTLER					X			X	X				
Praeorbiculiformella vulgaris KOZUR et MOSTLER					X				X		X		
Pseudostylosphaera hellenica (DE WEVER)		X							X	X	X		
Sarla sp.					X								
Spongostylus cf. tortilis KOZUR et MOSTLER			X										
Tetraporobrachia haeckeli KOZUR et MOSTLER					X				X				
Tetraporobrachia sp.			X				X				X		
Tetrapylomella carnica KOZUR et MOSTLER											X		
Veghicyclia sp.											X		
Vinassaspongus sp.										X			
Zhamojdasphaera latispinosa KOZUR et MOSTLER			X	X	X				X				

Section I: western wall of the worked quarry (central part);
Section II: western, abandoned part of the quarry;
Section III: eastern wall of the worked quarry
3--7, etc.: Bed Nos

R a d i o l a r i a n s

Exposure SE of the quarry, at the upper end of the vineyards:

Paleosaturnalis triassicus (KOZUR et MOSTLER)
Praeorbiculiformella cf. vulgaris KOZUR et MOSTLER
Stylosphaera sp.

Section I--II--III: see on Table 1.

The radiolarian fauna is nearly the same throughout the sections, without remarkable changes. Paleosaturnalis triassicus KOZUR et MOSTLER), indicating the Cordevolian Substage, occurs from the lowermost beds to the uppermost ones. This age assignment is supported by other taxa, too.

References

KOVÁCS, S. 1984; KRYSTYN, L. 1983.

H-3

TIHANY, Fehérpart

A. SZUROMI-KORECZ and P. MÜLLER

with the contribution of L. HABLY, E. NAGY-BODOR and E. KROLOPP

Topography

S of the village Tihany along the road leading from the port to the ferry along the shoreline of Lake Balaton (Fig. 1).

Age and formation

Upper Miocene; Pontian, according to the stage division of the Central Paratethys; (Upper Pannonian, according to Hungarian authors) Tihany Formation. The exposure is the type section of the Tihany Formation.

Geological setting

The Fehérpart section at Tihany is one of the most characteristic

▲ locality

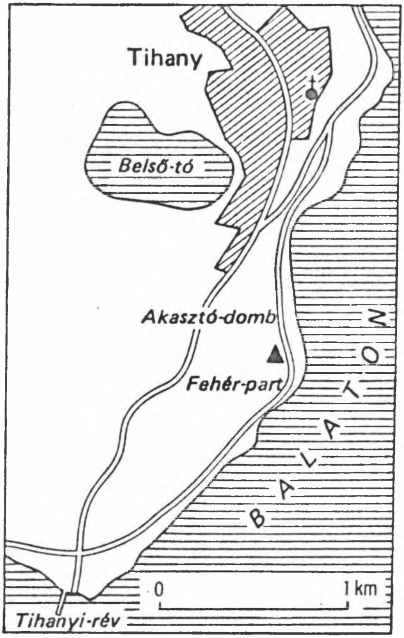


Fig. 1. Sketch map of the W part of the Tihany Peninsula

exposures of the Tihany Formation (JÁMBOR 1980). The formation itself consists of frequently alternating layers of sand, clay, clayey marl, aleurite, huminitic clay and lignite. In this section the cover and footwall formations cannot be observed, but boreholes in the Balaton region show that it develops from the Somló Formation (JÁMBOR 1980) below and passes into the Torony Formation (JÁMBOR 1980) above continuously. The footwall (Somló Formation) is made up of aleurite and clayey marl, while the cover (Torony Formation) consists of variegated clay, aleuritic clay, coaly clay, lignite and sand layers.

History

Till the earliest Sarmatian the Paratethys was in a restricted connection with the Mediterranean and Atlantic seas. During this period

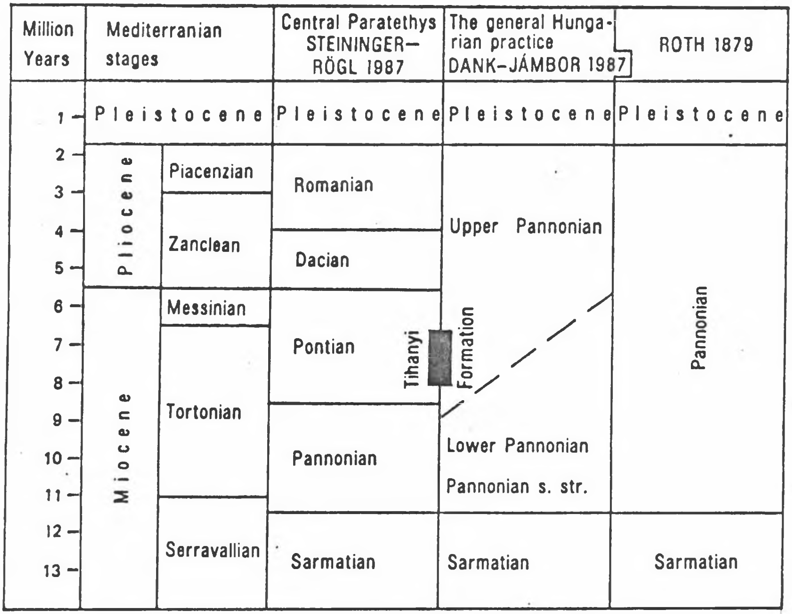


Fig. 2. Stage division of the Upper Miocene--Pliocene in the Central Paratethys

lithologically and paleontologically similar, well correlable sediments were deposited in the Paratethys. After the Early Sarmatian, due to the elevation of the Carpathians, the Carpathian basin becáme enclosed, and developed independently. After the Sarmatian the salinity of the water further decreased and the filling up of the basin started.

The Pannonian formations represent the final stage of the existence of the Paratethys. The name "Pannonian" was introduced by ROTH (1879) who used this term for the sequence between the Sarmatian and the Pleistocene. Since that time the name "Pannonian Stage", has been used in a slightly modified sense, and in differing interpretation by the different authors.

BARTA (1971) proposed the Tihany, Fehérpart section to be selected as the neostratotype of the middle part of the Upper Pannonian. JÁMBOR (1980),

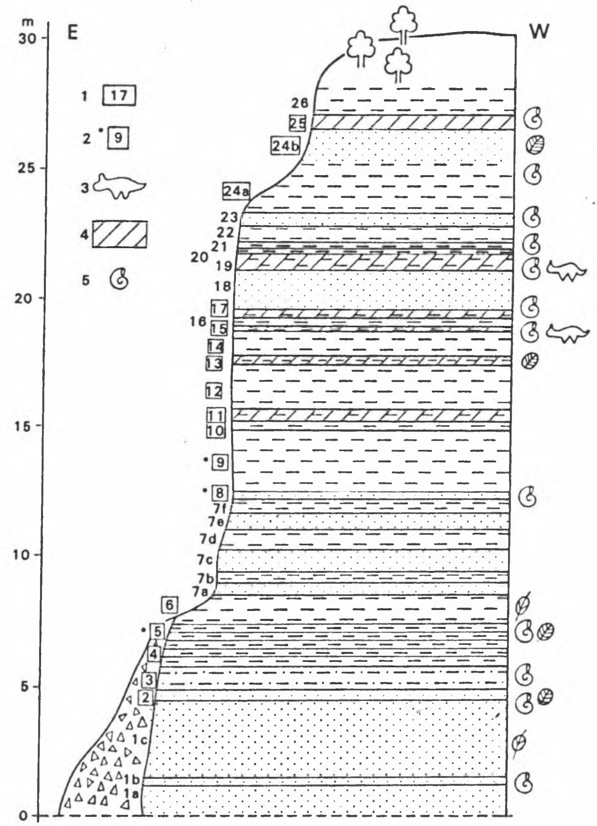


Fig. 3. The Tihany, Fehérpart section (after MÜLLER and SZÓNOKY, 1988b)
1. Studied layers, 2. the layer recommended for collection, 3. vertebrate fossils, 4. humic layer, 5. molluscs

following BARTHA's (1971) suggestion, designated the Tihany Member from this exposure. Later this member was declared as formation (FÜLÖP et al. 1983). Following this MÜLLER and SZÓNOKY (1988a) designated this section as the facies stratotype of the Tihany Formation.

One of the earliest known Congeria locality in Hungary was probably the Tihany, Fehérpart, since PARTSCH designated the genus Congeria on the basis of fossils coming from here (1835). Later, already in this century, HALAVÁTS, LŐRENTHEY, I. VITÁLIS and BARTHA studied the mollusc fauna of the locality. The first micropaleontological investigation was carried out by ZALÁNYI (1959) who described several new ostracod species from this site, and on the basis of the percentage distribution of the freshwater and brackish-water species, he also drew conclusions concerning the ecological features of the biotopes.

Stratigraphy

The Fehérpart exposure at Tihany is about a 30 m high, steep wall consisting mainly alternating fine-grained sand, clay and aleurite layers of different grain size and structure (Fig. 3). The first few layers, up to about 8 m, is covered by debris. The layers are nearly horizontal and can be well followed in the exposure.

The section, already at first sight, can be divided into two parts. In the lower one, up to ca. 15 m paludal seams can not be observed, while in the upper part the dark, huminitic layers are alternating with sandy, aleuritic layers.

In the section, beside the cross-bedded layers, well-bedded and unstratified parts may be also observed. In some layers traces referring to wave activity, such as ripple marks, lenticular intercalations and lumachellas can be also seen. In the upper part of the sequence the variegated clay, terrestrial gastropods and small vertebrate remains indicate that the area became terrestrial repeatedly.

Fossils

M a c r o f o s s i l s

Angiospermatophyta (Determination by L. HABLY in MÜLLER—SZÓNOKY 1988a)

Salix cf. varians GÖPPERT

Alnus ducalis (GAUD.) KNOBLOCH

Alnus gaudini (HEER) KNO. et KVAČ.
Alnus juliannaeformis (STERNB.) KVAČ. et FOLLY
Cedrela sarmatica É. KOV.
Liquidambar europea A. BR.
Platanus platanifolia (ETT.) KNOBL.
Sapindus falcifolius A. BR.
Acer tricuspidatum BRONN.
Lithocarpus longifolius KOLAK.
Ulmus plurinervia UNG.
Fagus haidingeri KOV.
Smilax weberi WESS. et WEB.
Phragmites oeningensis A. BR.

Bivalvia (Determination by P. MÜLLER in MÜLLER--SZÓNOKY 1988a)

Congeria balatonica PARTSCH
Congeria triangularis PARTSCH
Dreissenomya unioides FUCHS
Margaritifera cf. flabellatiformis (GRIG.-BER.)
Lymnocardium decorum (FUCHS)
Lymnocardium apertum (MÜNSTER)
Pseudocatillus simplex (FUCHS)
"Theodoxus" radmanesti (FUCHS)
"Theodoxus" turbinatus (FUCHS)
"Valvata" balatonica ROLLE
Viviparus sadleri (NEUMAYR)
Prososthenia radmanesti (FUCHS)
?Micromelania laevis (FUCHS)
Goniochylus schwabenaui (FUCHS)
Melanopsis cylindrica STOLICZKA
Melanopsis decollata STOLICZKA
Melanopsis sturii FUCHS
"Gyraulus" varians (FUCHS)

Pulmonata (Determination by E. KROLOPP in MÜLLER--SZÓNOKY 1988a)

Planorbarius cf. corneus (LINNAEUS)
Segmentina cf. loczyi (LŐRENTHEY)
Ancylus (?=Ferrissia) hungaricus BRUSINA

Mammalia (Determination by L. KORDOS in KORDOS 1987)

Allospalax cf. petteri (BACHMAYER et WILSON)

Hipparion sp.

M i c r o f o s s i l s (The number after the species marks the number of the layer within the section)

Sporomorphs (Determination by E. NAGY-BODOR)

Gonyaulacysta sp. (5)

Botryococcus braunii KÜTZG. (4, 5, 6)

Pinuspollenites labdacus (R. POT.) (2, 4, 5, 6)

Abietinaepollenites neogenicus E. NAGY (4)

Tsugaepollenites igniculus (R. POT.) R. POT.-VAN. (6)

Tsugaepollenites spinulosus W. KR. (6)

Piceapollenites sp. (6)

Abiespollenites absolutus THIERGART (6)

Cedripites sp. (3, 4, 5, 6)

Nymphaeaepollenites pannonicus E. NAGY (4)

Ulmipollenites sp. (5)

Betulaepollenites betuloides (PF. 1953) E. NAGY (5)

Sparganiacrearumpollenites polygonalis THIERGART (2)

Spiniferites validus SÜTŐNÉ (5)

Quercuspollenites sp. (5)

Myriophyllum sp. (6)

Caryapollenites simplex R. POT. (6)

Ostracoda (Determination by A. SZUROMI-KORECZ)

Hungarocypris pannonica (ZALÁNYI) (2, 8)

Hungarocypris sp. (2, 3)

Amplocypris dorsobrevis SOKAČ (2, 5, 8)

Amplocypris pavlovici KRSTIČ (2, 3)

Amplocypris sp. (5)

Candona (Caspiolla) zalanyii KRSTIČ (2, 3, 4, 5, 6, 8, 9, 10, 14, 15a, 15b, 24a, 24b, 25)

Candona (Caspiolla) ossoinae milanovici KRSTIČ (5, 6)

Candona (Zalanyiella) venusta (ZALÁNYI) (2, 3, 8)

Candona (Zalanyiella?) rurica KRSTIČ (2, 8, 9)
Candona (Pontoniella) acuminata (ZALÁNYI) (2)
Candona (Pontoniella) naniae VEKUA (2, 3, 4)
Candona (Hastacandona) cf. granulosa (ZALÁNYI) (2, 3, 4, 5, 8, 9, 15a, 24a)
Candona (Bakunella) dorsoarcuata (ZALÁNYI) (2, 3, 8)
Candona (Bakunella) sp. (4)
Candona (Typhlocypris) centropunctata (SUZIN) (3, 4, 24a)
Candona (Typhlocypris) sp. (14)
Candona (Ochridiella) tihanyensis ZALÁNYI (8, 9, 15a, 15b, 17)
Candona (Ochridiella) sp. (10, 12)
Candona (Fabaeformiscandona) cf. arcana KRSTIČ (2, 5, 8)
Candona (Candona) balatonica affinis ZALÁNYI (15b, 24b, 25)
Candona (Candona) neglecta G. O. SARS (24b)
Candona (Candona) sp. (10, 15b, 17, 24a, 24b, 25)
Candona (Pseudocandona) compressa KOCH (15b)
Candona (Pseudocandona) sp. (10, 15b, 24b)
Cypria candonaeformis (SCHWEYER) (2, 3, 5, 8)
Cyprinotus salinus (BRADY) (9, 24b)
Leptocythere (Amnicythere) cf. propinqua (LIVENTAL) (2)
Leptocythere (Amnicythere) sp. (10)
Leptocythere? (Maeotocythere) ex gr. bosqueti (LIVENTAL) (2, 3)
Hemicytheria sp. (2, 3, 4, 8)
Mediocytherideis cf. kleinae MARKOVA (3, 5)
Mediocytherideis sp. (3, 8)
Cyprideis triangulata KRSTIČ (2)
Cyprideis seminulum (REUSS) (2, 5, 9, 15a, 15b, 17, 24b, 25)
Cyprideis torosa (JONES) (14, 15b)
Cyprideis sp. (3, 4, 12, 14, 15a, 17, 24a, 24b)
Loxoconcha petesa LIVENTAL (3, 24b)
Ilyocypris gibba (RAMDOHR) (15b, 24b, 25)
Potamocypris arcuata (G. O. SARS) (15b, 24b, 25)
Cyclocypris laevis (O. F. MÜLLER) VAVRA (15b, 24b)
Darwinula stevensoni BRADY et ROB. (24b)
Limnocythere cf. sanctipatricii BRADY et ROB. (25)

Age and facies

Layers of the Tihany, Fehérpart section were deposited in near-shore, shallow-water environment, under fresh-water to mesohaline salinity conditions in an area becoming repeatedly subaerial. Based on the quantitative analysis of the ostracods requiring different salinity, changes in the salinity of the basin can be well traced (Fig. 4).

During the formation of the lower part of the section (layers 2--9) mesohaline salinity could have been characteristic. In about the middle of the section, in layer 10, ostracods indicating fresh-water to oligo-

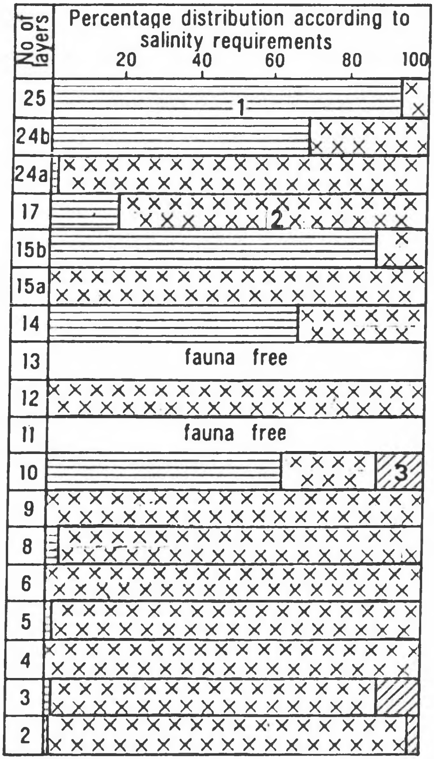


Fig. 4. Evaluation of the ostracod fauna of the Tihany, Fehérpart section according to salinity requirement
1. Freshwater--oligohaline (0.0--2‰) /Candona (Candona), Candona (Pseudocandona), Potamocypris, Limnocythere, Ilyocypris, Cypria, Cyclocypris). -- 2. Mesohaline (2.0--16.5‰) (Amplocypris, Hungarocypris, Mediocytherideis, Cyprideis). -- 3. Eurihaline (Leptocythere, Loxoconcha)

haline salinity appear at mass-scale and then, upwards, ostracods suggesting fresh-water--oligohaline and mesohaline salinity are alternating. The area might have been desiccated temporally as it is shown by the presence of variegated clay layers and terrestrial gastropods.

Chronostratigraphy

Upper Miocene (about 7--8 million years), Tihany Formation. Within the stage division of the Central Paratethys it is the middle part of the Pontian, while Hungarian authors use the term "Upper Pannonian".

The extremely rich and well-preserved ostracod fauna of the Tihany Fehérpart section consists of species that are well known also from the Pontian of the Eastern and Central Paratethys (HANGANU 1974, KRSTIČ 1975, STANCHEVA 1965). One of the species of the faunal assemblage, Cyprideis seminulum (REUSS) is described by KOLLMANN as characteristic element of the Pannonian G zone of the Vienna basin.

The age determined on the basis of the ostracods is in accordance with the data provided by the other faunal elements. In KORDOS's opinion (1987) the presence of the Allospalax cf. petteri (BACHMAYER and WILSON) proves that the sequence is older than the MN 13 zone. Most probably the succession is of the same age as the MN 11 or MN 12 zones. Based on the pollen analysis carried out by NAGY-BODOR the age of the sequence can be put to the middle part of the Upper Pannonian. The same age can be determined also from the mollusc fauna (MÜLLER--SZÓNOKY 1988a).

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TIHANY

The name of the village is mentioned first in the chart issued by King ENDRE I, founding the Benedictine monastery here. The

chart itself is a most valuable relics of the Hungarian language, including about a hundred Hungarian words and suffixes in the text. The grave of the king founding the monastery is situated in the crypt of the church (in 1061).

After the Turkish and Kuruc times, the recent abbey church was built in Baroque style (1719--1754). Its wooden carvings, made by Sebestyén STUHLHOF are well known. In the former monastery building we find a museum today with historical collection.

Not far from here a range of skanzen-like buildings are situated, presenting the relics of fishing and peasant culture. In the basalt tuff easy to carve forming the main body of the hill we can find cavities, so-called "monks homes", that used to serve as the home of Basilite monks settled here by King ENDRE I from Kiev.

Among the natural attractions of the peninsula we find the geisire cones situated by the Inner Lake (e.g., the so-called "Golden House"), relics of former postvolcanic activity.

Not very far from the harbour we can find the Biological Research Institute, which is primarily concerned with the hydrobiological investigation of the Lake Balaton.

H-4

FELSŐÖRS, Forrás Hill, Malomvölgy section

A. ORAVECZ-SCHEFFER

Topography

East of Felsőörs, on the southern slope of the Forrás Hill, in the valley Malomvölgy (Fig. 1).

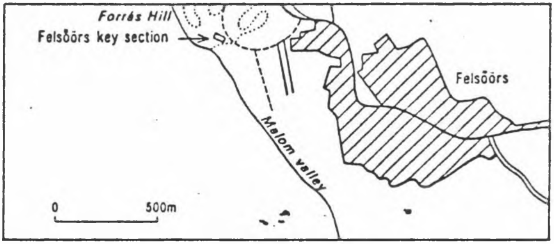


Fig. 1. Sketch map of the exposure

Age

Middle Triassic, Anisian and Ladinian.

History

The Middle Triassic section of the Forrás Hill at Felsöörs is the earliest standard stratigraphic key section ever designated in the Balaton Highland area. After observations and evaluation of the faunas by TELEGDI RÓTH (1872), BÖCKH (1873), STÜRZENBAUM (1875), MOJSISOVICS (1882) and FRECH (1912), it was LÓCZY SR. (1916) who gave a comprehensive description of the sequence.

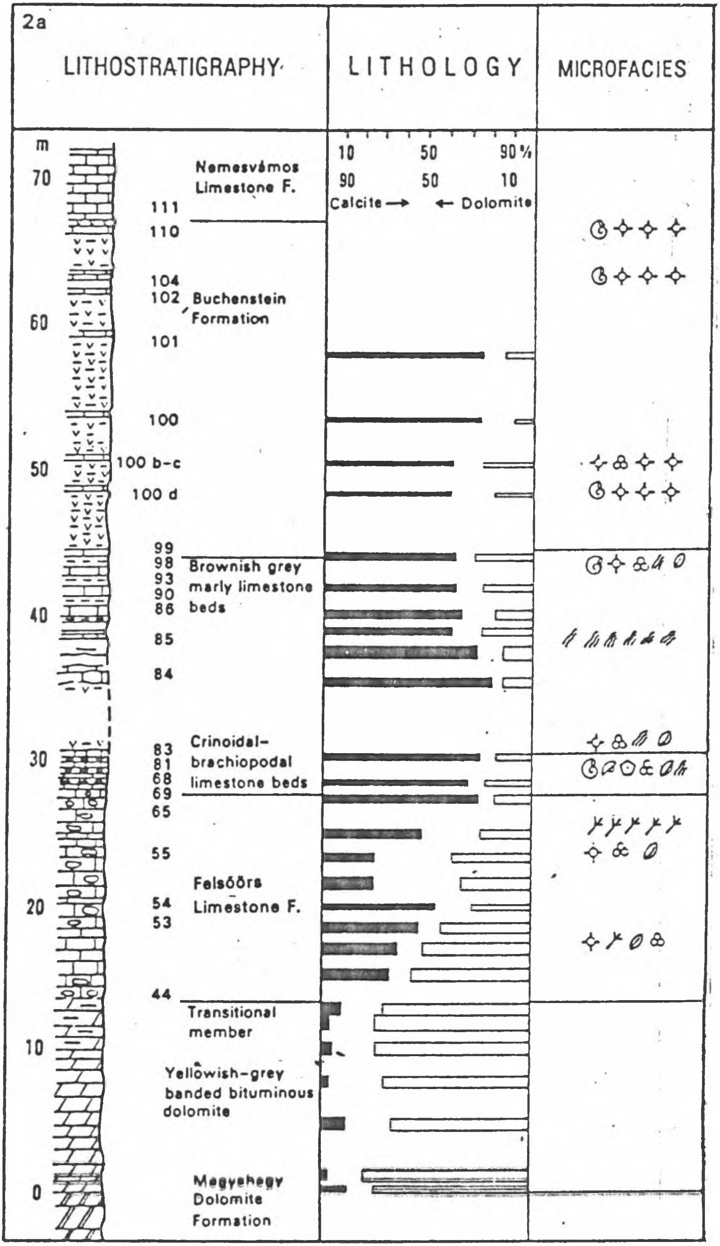
Recently the section was sampled again in details and the following fossils have been investigated:

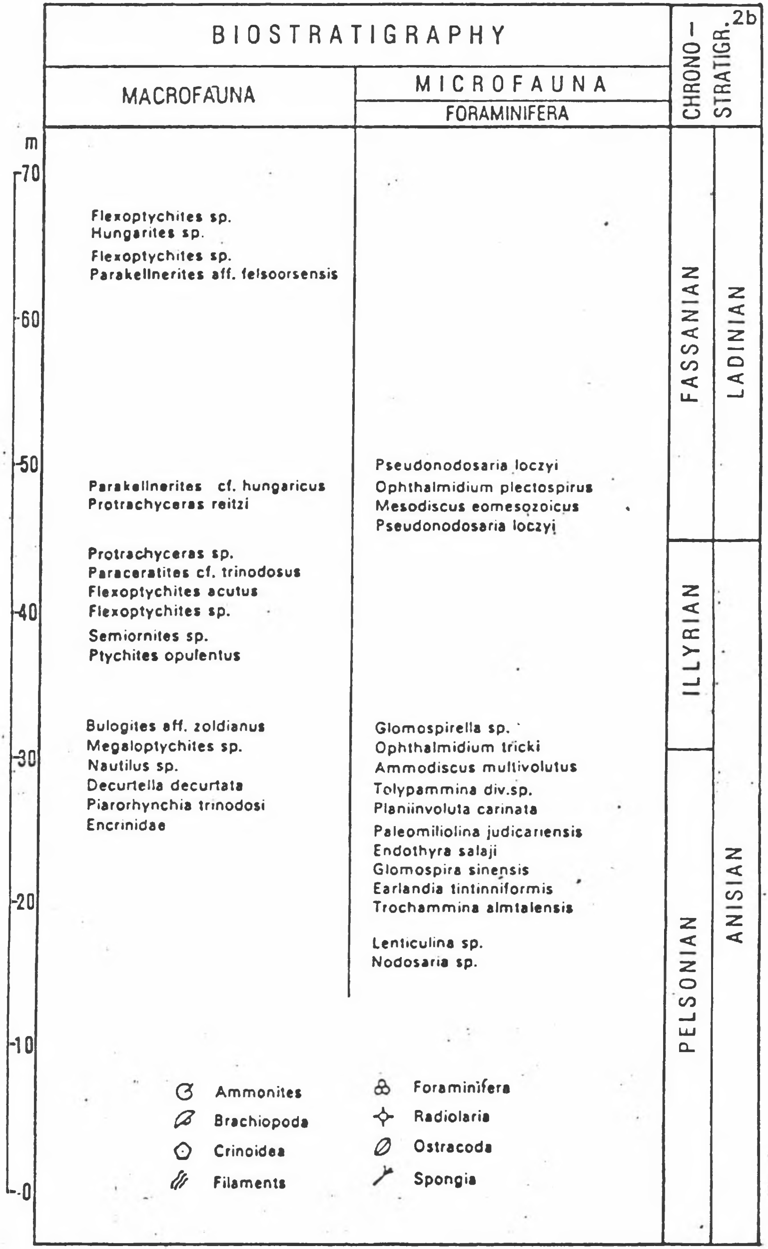
Macrofossils: by I. SZABÓ
Foraminifera: by A. ORAVECZ-SCHEFFER
Radiolaria: by H. KOZUR, H. MOSTLER and L. DOSZTÁLY
Conodonta: by S. KOVÁCS
Ostracoda: by H. KOZUR
Microfacies analysis: by GY. LELKES

This classical section, well-known in the literature since the last third of the last century is a possible candidate for defining the Anisian/Ladinian boundary because of its richness in ammonoids and microfauna.

Stratigraphy

The Felsöörs key section includes the following stratigraphic succession:

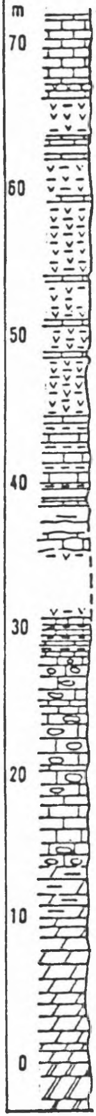

2a
LITHOSTRATIGRAPHY
LITHOLOGY
MICROFACIES
m
70
60
50
40
30
20
10
0
10 50 90 %
90 50 10
Calcite → ← Dolomite
Nemesvámos Limestone F.
111
110
104
102
Buchenstein Formation
101
100
100 b-c
100 d
99
98
93
90
86
Brownish grey marly limestone beds
85
84
83
81
68
69
Crinoidal-brachiopodal limestone beds
65
55
Felsöörs Limestone F.
54
53
44
Transitional member
Yellowish-grey banded bituminous dolomite
Magyehegy Dolomite Formation


2b
BIOSTRATIGRAPHY
MACROFAUNA
MICROFAUNA
FORAMINIFERA
CHRONO-STRATIGR.
m
70
60
50
40
30
20
10
0
Flexoptychites sp.
Hungarites sp.
Flexoptychites sp.
Parakellnerites aff. felsoorsensis
Parakellnerites cf. hungaricus
Protrachyceras reitzi
Protrachyceras sp.
Paraceratites cf. trinodosus
Flexoptychites acutus
Flexoptychites sp.
Semiornites sp.
Ptychites opulentus
Bulogites aff. zoldianus
Megaloptychites sp.
Nautilus sp.
Decurtella decurtata
Piarorhynchia trinodosi
Encrinidae
Pseudonodosaria loczyi
Ophthalmidium plectospirus
Mesodiscus eomesozoicus
Pseudonodosaria loczyi
Glomospirella sp.
Ophthalmidium tricki
Ammodiscus multivolutus
Tolypammina div.sp.
Planiinvoluta carinata
Paleomiliolina judicariensis
Endothyra salaji
Glomospira sinensis
Earlandia tintinniformis
Trochammina almtalensis
Lenticulina sp.
Nodosaria sp.
FASSANIAN
ILLYRIAN
PELSONIAN
LADINIAN
ANISIAN
Ammonites
Brachiopoda
Crinoidea
Filaments
Foraminifera
Radiolaria
Ostracoda
Spongia

2c

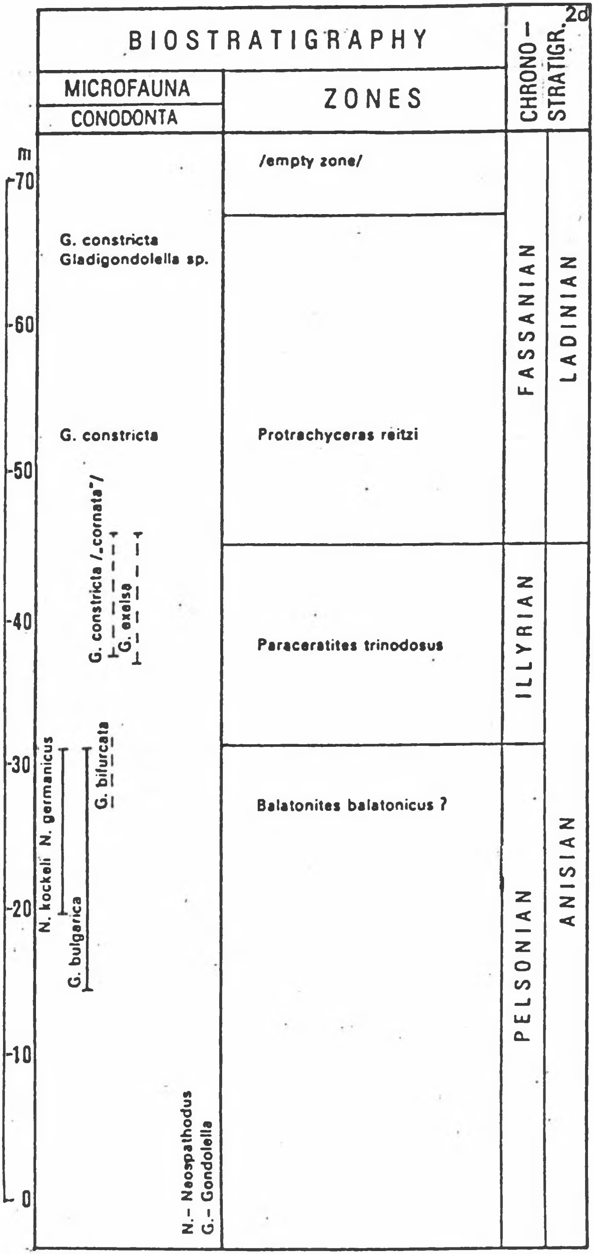
BIOSTRATIGRAPHY

MICROFAUNA



OSTRACODA	RADIOLARIA
	Oertlispongus calcareus Triassocampe scalaris
	Oertlispongus inaeguispinosus Spongosilicarmiger italicus transitus
Acratina n.sp. Hungarella div.sp.	
Acanthoscapha bogschi bogschi Acratina goemoery Healdia anisica Paraberounella oertlii Praeptychobairdia mostleri mostleri Tuberoceratina binodosa	Triassocampe baloghi Yeharaia sp. Anisicyrtis hungarica Baratuna excentrica Eonapora mesotriassica Planispinocyrtis baloghi Pseudostylosphaera coccostyla
Acanthoscapha bogschi interrupta Paraberounella oertlii Praeptychobairdia mostleri praecursor Ptychobairdia dentata	
Hungarobairdia martinssoni Lobobairdia zapfei Mirabairdia balatonica	

Fig. 2a-d. Felsőörs, Forrás Hill, Middle Triassic section analytical results and fauna



2d
BIOSTRATIGRAPHY
MICROFAUNA
CONODONTA
ZONES
CHRONO–STRATIGR.
m
70
60
50
40
30
20
10
0
/empty zone/
G. constricta
Gladigondolella sp.
G. constricta
Protrachyceras reitzi
G. constricta /„cornata"/
G. exelsa
Paraceratites trinodosus
N. kockeli
N. germanicus
G. bifurcata
G. bulgarica
Balatonites balatonicus ?
N.– Neospathodus
G.– Gondolella
FASSANIAN
LADINIAN
ILLYRIAN
PELSONIAN
ANISIAN

1/ The section begins with the non-fossiliferous Megyehegy Dolomite (Beds 0--43). As observable in thin sections, these rocks are dolomicrosparite and fine-grained dolosparite. The light-grey beds of this part of the section show a striking contrast with the overlying yellowish-grey bituminous, banded dolomitic marls referred to as "transitional beds". In spite of the lack of fossils in them, these can be assigned to the Lower Pelsonian or Bythinian, being in the underlier of the fossiliferous Felsőörs Limestone Formation.

2/ The next part of the section consists of grey chert-nodular, bedded limestones (Beds 44--67) with rough bedding surfaces: Felsőörs Limestone Formation. These are locally interbedded with slightly dolomitic, yellow, cherty, argillaceous limestones (Beds 54--55), to alternate then with thin marl and siliceous marl layers. This portion ends with thick bedded to massive limestones containing big chert nodules (Beds 63--67). Microscopic observation reveals that this part is represented mainly by spiculiferous biomicrites and spongiolites of wackestone and packstone texture.

There are two foraminiferal assemblages in this unit. In the lower part foraminifers are very scarce, only Trochammina almtalensis KOEHN--ZAN., Earlandia tintinniformis (MISIK) and some specimens of the genera Ammodiscus, Nodosaria and Lenticulina are recognizable.

The upper portion is characterized by the presence of Paleomiliolina judicariensis (PREMOLI SILVA). In other reference sections, the range of this species coincides with that of Balatonites balatonicus, referring higher Pelsonian.

The brownish-grey cherty limestone has yielded a rich Pelsonian conodont fauna. Gondolella bulgarica (BUDUROV-STEFANOV) is very common (over 100 specimens in a few samples) from the first limestone bed (Bed 44) up to Bed 78. The first representative of Neospathodus kockeli (TATGE) occurs only in Bed 53, coupled with Neospathodus germanicus KOZUR. The Felsőörs Limestone was formed in a non-agitated environment below the wave-base. Age: Upper Pelsonian.

3/ The crinoidal-brachiopodal limestones (Beds 68--81) contain no ammonite of zonal index value. Principal elements of the macrofauna are: Coenothyris vulgaris (SCHLOTHEIM), Tetractinella trigonella (SCHLOTHEIM), Decurtella decurtata (GIRARAD), Dadocrinus gracilis BUCH.

The crinoidal-brachiopodal limestone contains a rather rich sessile foraminiferal assemblage: Planiinvoluta carinata LEISCHNER, Tolypammina gregaria WENDT, Placopsilina cf. hyrensis (BRÖNNIMAN et al.). These common forms always appear attached to different fragments of brachiopods, crinoids and molluscs. In addition there are some Endothyra badouxi ZAN. et al., Endothyra obturata BRÖNN. et ZAN., Ammodiscus sp., and a few Nodosariidae in the association.

In the conodont fauna Gondolella bulgarica is common, and Neospathodus kocheli and N. germanicus become more frequent.

Ostracods such as Hungarobairdia martinssoni (KOZUR), Lobobairdia zapfei (KOZUR) and Mirabairdia balatonica (KOZUR) indicate a heavily agitated, shallow-water environment. Age: topmost Pelsonian to lowermost Illyrian.

4/ Higher up, a brownish-grey marly limestone unit represents the Paraceratites trinodosus Zone (Beds 82-99). Viewed in thin sections, this rock is biomicrite with thin-walled bivalves ("filaments"), radiolarians and ostracods. Texture: wackestone-packstone In a few samples a strongly altered material of volcanic origin is found.

This limestone beds contain Ptychites cf. domatus (HAUER), Flexoptychites flexosus (MOJS.) Semiornites sp. and Paraceratites trinodosus (MOJS.). In the intercalations of marly beds upwards there are some Daonella sturi BENECKE, and in Sample 99 one specimen of Protrachyceras sp.

The foraminiferal fauna is represented by Ophthalmidium tricki (LANGER), Ophthalmidium cf. amylovolutum HO, Ammodiscus multivolutus REITLINGER and at the top of the sequence (Bed 98), Triadodiscus eomesozoicus (OBERHAUSER), Ophthalmidium plectospirus ORAVECZ-SCHEFFER and Pseudonodosaria loczyi ORAVECZ-SCHEFFER.

From the marl intercalations of this sequence a rich ostracod fauna was recovered. Zonal index species are: Praeptychobairdia mostleri praecursor (KOZUR), Acantoscapha bogschi KOZUR, Praeptychobairdia mostleri mostleri (KOZUR).

In Beds 86-98, more than 100 radiolarian species occur, a great deal of the new species were described from the Bed 87 (KOZUR et MOSTLER 1979, 1981). Recently L. DOSZTÁLY has investigated this fauna again, according to his determination the following taxa have been registrated:

Crystostephanidium cornigerum DUMITRICA

Helioentactinia oertlii (KOZUR et MOSTLER)
Heliosoma riedeli KOZUR et MOSTLER
Hinedorcus alatus DUMITRICA, KOZUR et MOSTLER
Hozmadia reticulata DUMITRICA, KOZUR et MOSTLER
Parasepsagon sp.
Paroertlispongus rarispinosus KOZUR et MOSTLER
Pentaspongodiscus ladinicus DUMITRICA, KOZUR et MOSTLER
Pentaspongodiscus mesotriassicus DUMITRICA, KOZUR et MOSTLER
Pentaspongodiscus symmetricus DUMITRICA, KOZUR et MOSTLER
Plafkerium? confluens DUMITRICA, KOZUR et MOSTLER
Plafkerium nazarovi KOZUR et MOSTLER
Pseudostylosphaera coccostyla (RÜST)
Pseudostylosphaera longispinosa KOZUR et MOSTLER
Squinabolella cf. parvispinosa KOZUR et MOSTLER
Staurocontium trispinosum KOZUR et MOSTLER
Triassocampe scalaris DUMITRICA, KOZUR et MOSTLER
Triassospongosphaera cf. latispinosa KOZUR et MOSTLER
Weverisphaera sp.

In Bed 99 there appears the first Triassocampe species showing features of transition to the Lower Ladinian index genus Yeharia.

The first limestone beds (Beds 82-83) of the brownish-grey limestone member are rich in conodonts as well. From the Bed 78 onwards, Gondolella bulgarica abruptly decreases in quantity, while G. bifurcata grows increasingly more frequent. Higher up, in the ostracod-bearing beds conodonts became rather rare, only a small number of G. constricta specimens are present, representing different ontogenetic stages.

All in all, this unit represents a deep-water, open sea facies of Upper Anisian (Illyrian) age. The Ladinian boundary (according to the traditional Hungarian view; cf. LÓCZY, 1916) is situated at the top of this member.

5/ Tuffaceous and tuffitic layers (pietra verde) with thin limestone intercalations belong to the Ladinian Stage. These were compared to the Buchenstein Beds of the Southern Alps already by BÖCKH (1873). The folded tuffaceous-argillaceous unit is constituted by predominantly green and brown tuffite layers identified as K-trachyte tuffs. The thin limestone laminae between the tuffite layers contain cephalopod species of the

Protrachyceras reitzi Zone, as follows: Protrachyceras reitzi (BÖCKH), Parakellnerites boeckhi (ROTH), Parakellnerites hungaricus (MOJS.), Hungarites costosus (MOJS.), Ptychites angustoumbilicatus (BÖCKH) etc.

Conodonts are almost missing in the limestone intercalations of the tuffaceous sequence. As regards the forms of stratigraphic importance, Bed 100/A and Bed 110 yielded a few specimens of Gondolella constricta (BUDUROV and STEFANOV).

In the washing residues of the tuffaceous samples and in the limestone intercalations there are lots of well-preserved radiolarians. The first typical Lower Ladinian genus (Yeharia) appears in Bed 100/D. From Bed 104, a rich Oertlispongus assemblage was recovered, showing a marked change in radiolarian fauna. From here onwards about 50 % of the Illyrian radiolarian species are no longer present.

Regarding the foraminifers: in thin section of Bed 100/B two specimens of Pseudonodosaria loczyi ORAVECZ-SCHEFFER were also found.

All microfossils indicate a Lower Ladinian age and a rather deep water environment.

6/ The next unit consists of red chert-nodular limestone: Nemesvámos Limestone Formation (Beds 111-166). Conodonts are fairly numerous in this and Gondolella trammeri is frequent from the first bed (N. 115) of the unit. Metapolygnathus hungaricus occurs only in the uppermost beds (N. 165-166). Accordingly, the major part of the unit belongs to the Nevadites Zone and only the uppermost beds to the Protrachyceras curionii Zone. Viewed in thin sections it is typical pelbiomicrite with filaments, ostracods, and radiolarians. Forams are very rare: fragile Nodosariidae, Tolypammina sp. and Lituotuba sp. Microfossils indicate an open, stenohaline rather deep-water environment.

Remarks:

In the vicinity of Felsőörs there are two other sections (Vörösberény section and borehole Felsőörs 2) exposing the same transitional beds of the Illyrian-Fassanian. In these sections the already mentioned foraminifers: Ophthalmidium plectospirus occurs in the same level, too, just below the tuffaceous beds.

We suppose that the appearance of this species indicates the latest Illyrian-earliest Fassanian, just before the striking lithological changes have taken place.

Age and facies

Establishing the bearings of the faunistical results from the point of view of palaeoenvironments: a typical transgressional succession have been outlined. Beginning with the intertidal platform dolomite sequence of Megyehegy Formation, followed by the shallow marine biogenic limestone with crinoids, brachiopods and ammonites (Felsőörs Formation), overlying by tuffitic, tuffaceous limestone beds (Buchenstein Formation), concluding with the rather deep (more than 100 m), open marine, cherty, nodular pelagic limestone series of Nemesvámos Limestone Formation.

According to the bio-chronostratigraphical results the ammonite fauna of orthostratigraphic value and the parastratigraphical scales based on different groups of microfossils as well, assign to a continuous sedimentation from the Lower Pelsonian to the Upper Ladinian.

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FELSŐÖRS

The church built in the 13th century is the most beautiful monument built in Romanesque style in the Balaton Highlands. The so-called "Hercules-knots" on the pillars separating the twin windows are the only specimens of this kind preserved in Hungary.

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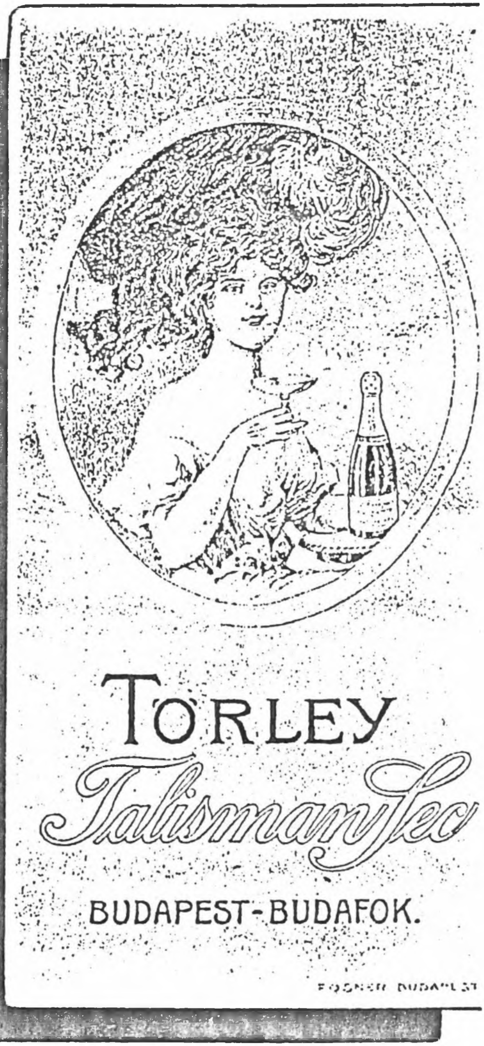

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