THE TERMINAL EOCENE EVENTS

FIELD GUIDE TO LATE EOCENE (PRIABONIAN) - EARLY OLIGOCENE (KISCELLIAN) PROFILES OF HUNGARY

by

Tamás BÁLDI, Mária HORVÁTH, Miklós KÁZMÉR, Miklós MONOSTORI, András NAGYMAROSY and Péter VARGA

Compiled by Mária HORVÁTH

VISEGRÁD MEETING 1983

Készült az ELTE Sokszorosítóüzemében
150 példányban
Felelős kiadó: Dr.Kubovics Imre
Felelős vezető: Arató Tamás
ELTE 83060

CONTENTS

AN INTRODUCTION INTO THE GEOLOGY OF THE BUDA MTS WITH SPECIAL REGARD TO THE TERMINAL EOCENE EVENTS

Dr. Tamás BALDI

The Buda Hills

This area is located on the right side of the Danube, largely within the municipal area of the city of Budapest. Its highest point (János-hegy) is 529 m above the sea level and around 420 m above the level of the Danube. The right side of Danube (Buda) was built on the Buda Mts. North of the Buda Mts, the Szentendre-Visegrád Mts extend along the Danube to the bend of the river.

Pre-Tertiary rocks

The core of the Buda Mts is formed by Alpino-type, calcareous Triassic. The oldest known rock is Ladinian ("diploporan dolomite"). "Hauptdolomit", cherty dolomite and limestone build up the Carnian, while "Dachsteinkalk" the Norian stages. After WEIN, Gy. (1977), the Triassic was folded in Mid-Cretaceous. After this tectonic event folding has never been reappearing, the Tertiary is strongly block-faulted.

Paleogene

No younger Mesozoic rock than Triassic can be found in the Buda Hills. The Triassic is overlain by the Paleogene, the immense hiatus leaves some 150 million

million years without any record. The oldest Paleogene is of Lutetian. The distribution of the Paleogene facies was controlled by a tectonic belt, to which we refer as the "Buda line" (BÁLDI, T. and NAGYMAROSY, A. 1976) (see Fig. 1).

Lutetian

is limited to the west flank of the "Buda line". There is a transgressional sequence of limnick, brackish sediments (with coal seams), overlain by shallow marine limestone and marl, it was described from the small coal basins of Nagykovácsi, Solymár, Pilisvörösvár, Kósd, etc. Even traces of bauxites with bad quality were recorded from Budakeszi, from the base of the Lutetian. The thickness of the Lutetian hardly exceeds the 100 m.

Priabonian
"Biogenic limestone"

During the Early Priabonien a new, far extending transgression started. At that time the sedimentation occurred on both sides of the "Buda line".

A basal conglomerate of various thickness is overlain by the biogenic limestone (around 50-100 m thick) with Nummulites fabianii, Fabiana, Chapmannina gassinensis, Corallinaceae and other calcareous algae, corals, discocyclinids, molluscs, decapods, bryozoans, echinids, etc. After KÁZMÉR (1982) the main facies of the biogenic limestone are, as follows: abrasional conglomerates of rocky shores, calcareous sand banks, lagoons with normal salinity behind these banks, coral-reef below the wave-base (25-30 m sea depth). This limestone will be studied during the field-trip at the Mátyás-hegy (stop 3) and in Budaörs-Úthegy (stop 5).

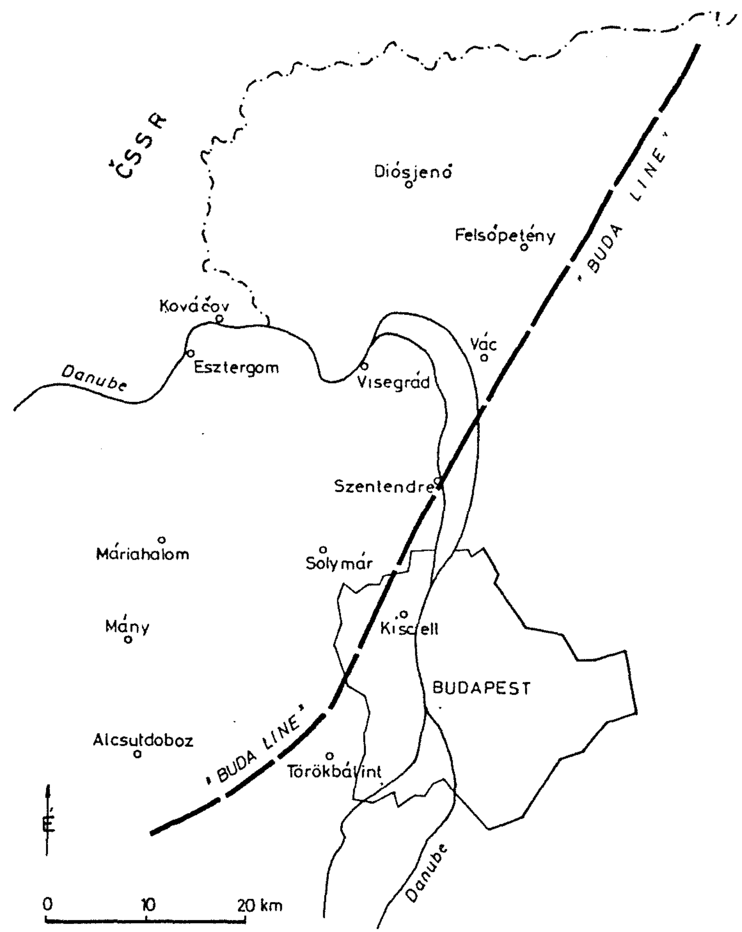


Fig. 1.

"Bryozoa marl"

The limestone is overlain by this formation. The Bryozoa marl, a calcareous one, is rich in bryozoans and/or discocyclinids. Thickness is around 50 m. Its depositional depth was somewhat deeper than the sedimentary environment of the "biogenic limestone" (around 30-100 m sea depth). Some areas of the bottom were, however, much shallower, and here - after KÁZMÉR (1982) - echinid-rich or Gypsina bearing limestones were formed. These limestones are coeval with the Bryozoa marl and they laterally substitute it.

In most sections the Bryozoa marl unconformably overlies the biogenic limestone. One outstanding example is the one at Budaőrs-Úthegy (stop 5) where the steep, $170/50^{\circ}$ dipping lithothamnian coral limestone beds are overlain with erosional and angular unconformity by the $140/20^{\circ}$ dipping bryozoa marl. The biogenic limestone suffered intra-Priabonian karstic erosion before it had been covered by the new transgression of the sea of the bryozoa marl. Hiatuses, unconformities are common even within the limestone. Over extended areas the biogenic limestone was totally eroded during the Priabonian and the Bryozoa marl directly overlies - with basal conglomerates - the Triassic.

All these facts indicate rather vivid crustal movements during the Priabonian, also evidenced by andesitic, volcanic debries among the pebbles of the conglomerates of the bryozoa marl. The andesitic pebbles originate from a Late Eocene, eroded, andesitic arc.

Buda Marl Formation

The bryozoa marl grades upwards into the Buda Marl Formation which is dominated by light gray, greenish gray, if weathered light brown silty marlstone, marly siltstone. After grain-size composition it is clayey silt with 35-40 % $CaCO_3$ content. Less than 0,5 m thick, andesitic, quartzitic sandy tuffs are interlaid in many sections.

The thickness of the formation is 50-100 m. A very well defined horizon is the level of the graded limestone intercalations ("allodapische Kalke") in this formation (BODA and MONOSTORI 1973, BÁLDI 1979, in press). This level occurs in the lower portion of the Buda Marl.

The Buda Marl is pelagic, most probably of shallow bathyal origin, as evidenced by the rich planktonic fauna and by the Propeamussium-rich mollusc community. The material of the intercalated limestone beds was transported by turbidity currents into the deeper areas of the sea. The shallow marine forms of these beds, as the Nummulites fabianii, Chlamys, Ostrea, lithothamnians, etc. lived originally on a nearby shallow, calcareous sea bottom. The graded limestone beds are 0,5-1,0 m thick; their lower boundary is sharp, their upper part grades gradually into the autochtonous pelagic marl. Sole-marks were also recognized (groove marks).

A fine example of the lower level of the Buda Marl with its graded limestone intercalations can be studied at the road cut in Pusztaszeri út (stop 2).

During the deposition of the lower part of the Buda Marl, the collapse of a calcareous, submarine plateau occurred along the "Buda line". The collapse and the extensional crustal motions - causing the collapse - started both turbidity currents and submarine slides towards the already existing deeper depressions of the basin. The tectonic processes were not ceasing also in this time.

Eocene-Oligocene boundary

The more calcareous, lower part of the Buda Marl crops out rather well, therefore, it has been better known. BÁLDI-BEKE (1972), MARTINI (in CICHA et al. 1971) recognized its uppermost Eocene age on the basis of the nannoplankton. SZTRÁKOS (1978) obtained similar results after studying the planktonic foraminifera. These results have been strenghtened by the nannoplankton studies of NAGYMAROSY, A. (in manuscript), and by the studies of M. HORVÁTH on foraminifera. T. KECSKEMÉTI (in BÁLDI 1979, in press) recognized Nummulites fabianii in the graded limestone intercalations. M. HORVÁTH (in manuscript) found the co-occurrence of Globigerina linaperta, G. ampliapertura and Globorotalia centralis (= pomeroli), a good evidence of the latest Eocene age (P 17 zone).

In the upper, less calcareous part of the Buda Marl the Eocene taxa gradually disappear, while in the topmost levels Globigerina tapuriensis occurs the first time. The same change has been found in the nannoplankton after NAGYMAROSY. Therefore, we suggest that the Eocene-Oligocene boundary is located within the upper layers of the Buda Marl. These upper beds are known only from cores originating from borings drilled in the Buda Mts and in Budapest. Unfortunately, we could not find so far a good surface section of this zone. Thus, we cannot demonstrate it in

the Buda Mts, except from cores.

Kiscellian (Oligocene)
The Tard Clay Formation

The Buda Marl is conformably overlain by the Tard Clay Formation.

The Tard Clay is dark gray, sometimes dark brown clayey silt with low carbonate content (less than 10 %). The formation is 60-100 m thick. High organic content of autochtonous, marine, sapropelic origin and 2-7 % pyrite are characteristic. The pyrite is bound to framboids (BÁLDI-BEKE, 1977).

The deeper part of the Tard Clay is built up of alternating fine laminated and non-laminated pelites. Thin white laminae of nannochalk are common in this zone (BÁLDI-BEKE, 1977). Also tuff intercalations in the form of laminae up to several cm thick are present here. The tuffs are of andesitic origin and deposited after aerial transport; they are not eroded and not reworked by the sea (SZABÓ, Cs. in manuscript). Graded limestone intercalations were recorded from a S-Budapest boring core by P. VARGA (1982). From several mm to 10 cm thick intercalations contain Nummulites fabianii and Chapmannina gassinensis, the fossils and other clasts show a normal gradation, they were resedimented by turbidity currents. Sometimes, non-graded kaolinitic, quartzitic sandstone bodies, or - as in Zugliget (stop 4) - calcareous sandstone, sandy limestone layers are intercalated with a shallow marine fauna (molluscs, large foraminifers). In this latter case, some beds show gradation.

A further example is the Csillaghegy, Ibolya utca quarry (stop 1). At this place Discocyclina and Nummulites-rich turbiditic sandy limestone and pebbly mudstone intercalations are present in the Tard Clay with Early Oligocene planktonics. The large forams are probably eroded and reworked from older, Eocene formations. The Tard Clay at this place overlies unconformably the Bryozoan Marl.

Fossils of the deeper part are pelagic in the laminated layers, benthics are restricted to the nonlaminated beds. The lowermost level is especially rich in planktonic foraminifera (100 %) and has still a diverse nannoplankton. Propeamussium fallax still occurs in this level. In the next level an endemic fauna appears. In the laminated layers a Spiratella zone was recognized, right above this zone, in non-laminated beds, an association of Loxocardium lipoldi, Ergenica cimlanica, Janschinella melitopolitana, large ostracods can be recorded (BÁLDI, 1979, 1980). Here, monospecific nannoplankton "blooms" and low diversity foraminifera assemblages are present (with Gl. postcretacea, Gr. liverovskae, etc.).

The upper part of the Tard Clay is dominated by the laminitic facies. Marine-brackish fish remains (WEILER, 1933, 1938), especially scales and plant remains are the more significant fossils in this level.

The Tard Clay was deposited in a rather deep, euxinic basin, where the position of the O_2/H_2S interface was oscillating, causing the alternation of laminitic and non--laminitic layers. In shallow areas sandy and/or calcareous sedimentation occurred. Salinity was normal during the sedimentation of the lowermost Tard Clay, but afterwards it became unstable; often brackish, which is indicated by the ostracods, the nannoplankton and by the molluscs (Ergenica, low diversity fauna).

The age of the Tard Clay is Lower Oligocene, Lower Kiscellian. The nannoplankton covers the zones NP 21, 22 and 23 (BÁLDI-BEKE, 1977, NAGYMAROSY in manuscript). Among the planktonic foraminifera no Eocene taxon is present, only persistent or new, Oligocene forms were found by M. HORVÁTH (in manuscript). After the planktonics even the uppermost part of the Buda Marl belongs also to the Oligocene. At the same time the larger forams and molluscs (Propeamussium fallax) of the lowermost level of the Tard Clay are regarded elsewhere, as Eocene. In my opinion we ought to place the Eocene-Oligocene boundary within the Propeamussium fallax zone.

The Tard Clay is a facies and time equivalent of the "Fisch-schiefer", "Bänder Mergel", "Schistes à Meletta" of the Alps, it is similar (but not so deep marine) to the Menilites of the Carpathians.

There is a good correlation also with the Propeamussium fallax zone, the Spiratella level of the Chadoum Formation, and with the Ergenica, larger ostracoda horizon of the Serogosian and Solenoian of the S-USSR (BÁLDI, 1980).

As a rule, the Tard Clay is restricted to the area, located East of the "Buda line". Around Felsőpetény and Romhány the Tard Clay overlies with a hiatus (unconformably) Triassic or Priabonian biogenic limestones. As also indicated by the graded intercalations and the tuffaceous laminae, tectonic activity remained intensive during the Early Kiscellian, too.

The Hárshegy Sandstone Formation (Late Kiscellian)

This is a coarse sandstone with common intercalations of conglomerates, red and variegated silts and clays, kaolinitic sands. Dominant grain-material is the quartz, quartzite, sometimes limestone, dolomite and chert (abraded from the Triassic and Eocene). The matrix is chalzedon or less frequently $CaCO_3$. Hydrothermal fluids silicified the major part of the formation, as it has been proved by petrological and other studies (BÁLDI and NAGYMAROSY, 1976). This event occurred after the diagenesis of the sands, but before Late Oligocene (Egerian) times. It was connected also with the dissolution of all carbonates, including fossils. Therefore, the silicified Hárshegy Sandstone is poor in fossils. There are layers, however, which escaped dissoluiton and silicification. They contain a rather rich fauna. Such site is the Solymár, Várerdőhegy (stop 6), where large forams (Lepidocyclina, Nummulites vascus), diverse mollusc fauna (dominated by the Chlamys biarritzensis group) were described by BÁLDI et al. 1976. The shallow marine facies is dominating, but brackish interbeddings were also found on the basis of the ostracods (BÁLDI et al. 1976). From silty intercalations the nannozone NP 24 was recognized.

The Hárshegy Sandstone is limited to the western flank of the "Buda line". Since the opposite is true for the Tard Clay, earlier it was thought that they were coeval. But the latest biostratigraphical results have shown that the Sandstone is connected with Kiscell Clay, it is generally younger than the Tard Clay. In the Alcsutdoboz-3 borehole section (S of Bicske) the Tard Clay is really, unconformably overlain by the Hárshegy Sandstone. In the Felsőpetény-Romhány area a similar succession of the Tard Clay and Hárshegy Sandstone was observed, but here the sedimentation remained uninter-

rupted (all these data in BALDI 1979, in press and BALDI et al. in manuscript).

Not considering the above exceptions, as a rule, the Hárshegy Sandstone overlies Triassic or Eocene limestone as an abrasional conglomerate, deposited in the transgressing Late Kiscellian Sea.

The thickness of the formation varies between some meters and 100 m.

The Kiscell Clay Formation (Late Kiscellian)

This formation was deposited during the peak of the Oligocene transgression. Therefore, it is known from a wide area (both sides of the "Buda line") and it has a considerable thickness (800 m in the basin centres).

The Kiscell Clay is a gray clayey, marly siltstone, or silty, clayey marl. Its fine sand content is always less than 6 %, carbonate content is around 25 %. Illite and less kaolinite are the main clay minerals. Fine sand intercalations are known from boreholes. Some of these intercalations were studied and they were found to be graded sands with shallow marine, resedimented fossils (BÁLDI 1979, in press).

Otherwise, the fauna of the Kiscell Clay is shallow bathyal (between 200-400 m sea depth), as it has been proved by the paleoecologic analysis of the diverse and sometimes rich, but not well preserved mollusc-fauna. The foraminifers are well known since the time of HANTKEN (1875), the planktonics indicate the P 19-20 zones. The nannoplankton belongs to the NP 24 zone (see BALDI-BEKE 1972, MARTINI, NAGYMAROSY).

East of the "Buda line" the Kiscell Clay grades out of the Tard Clay by the disappearance of the fine laminated structure and by the occurrence of the rich benthic fauna. West of the "Buda line" the Hárshegy Sandstone grades upwards into the Kiscell Clay without hiatus.

During the trip we can study the Kiscell Clay, cropping out at the Pilisborosjenő brickyard (stop 7) and/or at the Solymár brickyard (stop 7).

Egerian (Late Oligocene)

However famous the Egerian shallow marine and brackish formations around the Buda Hills are (Törökbálint sands - FUCHS, HOFMANN; Máriahalom, Kovácőv - SENEŠ, BÁLDI), we have not time to study them within the frame of our excursion. They grade out of the Kiscell Clay without hiatus and occur on both sides of the "Buda line".

Neogene

The Eggenburgian is still partly bound to the Paleogene tectonic lines. The near-shore Budafok Sand Formation of this age occurs, along the "Buda line", cropping out in the S-Buda Mts and in the Eastern Szentendre-Visegrád Mountains.

The first depressions of the Pannonian Basin were formed in Karpatian and Badenian (16-19 MA) They evolved independently from the old, Paleogene structures, the Pannonian Basin evolution is a new "chapter", not connected strictly to the Paleogene Basin history.

The marginal parts of the Buda Hills and the depressions around them have a fine Paratethyan, Neogene sequence. One of the most important events was the occurrence of andesite volcanoes in the Badenian age. The Danube bend has been cut through such an andesitic area since Late Pliocene, and Visegrád was built in this andesite. All hills are built up of Badenian andesites (16 MA old) here, but near to or even on the surface the underlying Egerian or - less frequently - Karpatian sediments are also present (Kováćov,Sands, schlier, shallow marine sands, etc.).

Main Paleogene events in the Buda Hills
(a summary)

There is a total lack of record between the Upper Triassic and Middle Eocene. During the Lutetian (NP 16 zone), a slow transgression took place, as a consequence of an extensional process, which continued in the Priabonian. The overall transgression in Late Priabonian formed a submarine, calcareous plateau which collapsed by the continuing extension in Latest Eocene. This was the time when shallow bathyal basins occurred (deposition of the Buda Marl with turbiditic intercalations - NP 20).

The turn of the Eocene - Oligocene ages saw the wide distribution of the Buda Marl Sea, with depth more than 200--300 m.

Beside extensional motions and subsidence, also regressions and uplifts can be recorded, since there are some areas where formations, otherwise building conformable sequences occur in these places unconformably overlying older rocks.

Neutral volcanic activity also was considerable during the Late Eocene and Early Oligocene as shown by the tuff intercalations in the Buda Marl and Tard Clay.

The Late Eocene and Early Oligocene can be characterized as a tectonically most restless period, which led to the new configuration of the Hungarien Paleogene Basin (BÁLDI, in manuscript). But no folding occurred, only faulting.

The "oxygen-crisis" in this basin took place during the Oligocene (NP 21, 22 and 23), somewhat later than the beginning of this age. First, the "Spiratella Sea" evolved, afterwards the endemic Eoparatethyan fauna (Ergenica, Cardium lipoldi) occurred. The sea had been isolated from the rest of the Tethys, and the isolation caused also the euxinic facies. The separated Eoparatethys stretched from the W-Alps until the Aral Sea. The Hungarian Paleogene Basin was a bay of the Eoparatethys.

Reoxigenation and new faunal immigrations both from the North and South occurred in NP 24 times. A new extension of the basin is coeval with this event, as it is evidenced by the marginal transgression (Hárshegy Sandstone, Kiscell Clay).

1st day excursion (Buda Mts)

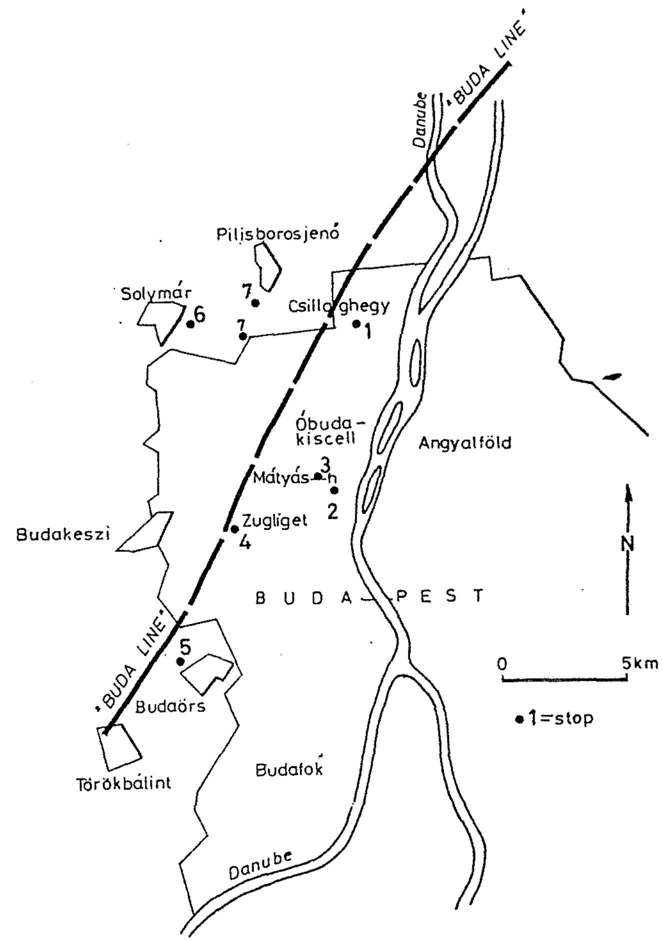


Fig. 2.

Stop 1.

Csillaghegy (Róka-hill), quarry in the Ibolya street, 3rd district Budapest

The outcrop has been cleaned and opened up in SE side of the Róka-hill, in 1981, on the proposition of BÁLDI T. The section exposes a 20 m thick sedimentary sequence in the lowermost quarry of the tectonized and faulted carbonate block of the hill, with a dipping of 130/25°.

The sequence of the outcrop

The lowermost member is a yellowish-brown limestone-limy marl, rich in fossils: molluscs, bryozoans, nummulits, discocyclinids, calcareous algae. Its thickness is about 6 m.

The limestone-limy marl member is overlain unconformly by kaolinite - and illite - bearing, yellowish gray, unstratified clayey marl-marl. Its thickness is about 14 m, till the top of the section. Also some laminated clay interbeddings occur in the clayey marls. The thickness of the laminite beds ranges between 50-70 cm. They are rich in plant-fossils and fish scales.

The other type of interbedded rocks is the allodapic limestone. Ten such limestone beds occur in the section, being especially frequent in the lower part with a thickness 30 cm as maximum. They contain large forams, bryozoans, calcareous algae, etc. In the lower third of the section two fluxoturbidite beds (pebbly clay) can be found. These two interbeddings contain

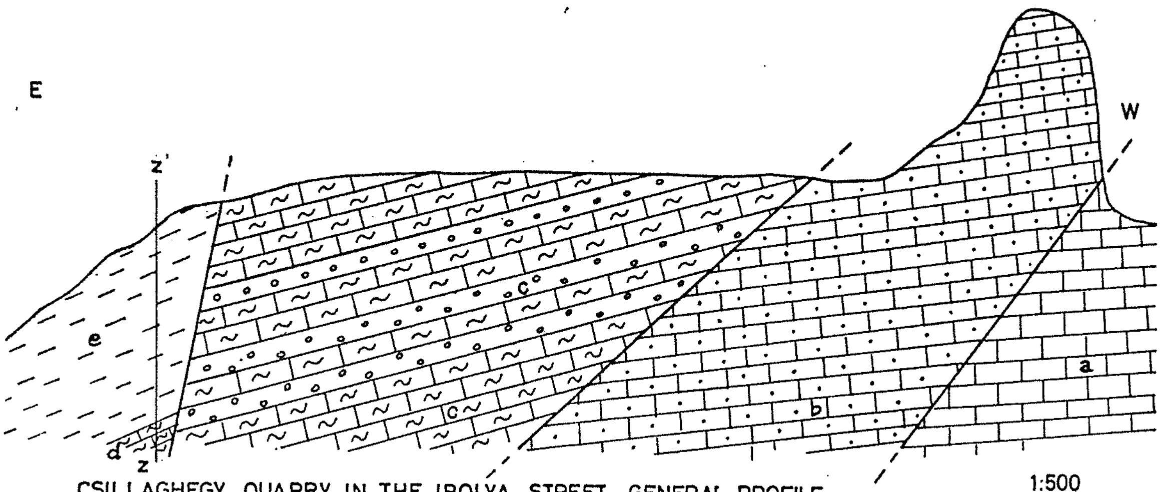
- Upper Eocene reworked largerforams (nummulits, discocyclinids, asterocyclinas) and bryozoans,

calcareous algae,
- few terrigenous quartz pebbles (with a diameter of 4-5 mm),
- pebbles of the Bryozoan marl and Nummulite-Discocyclina bearing limy marl, occurring at the base of this section.

Facies

The lower limy marl member has been deposited in the photic level of a subtropical-tropical sea with normal salinity. Its flora and fauna consists of autochtonous benthic forms. The presence of the discocyclinas and Nummulites fabianii indicates Priabonian.

The hiatus between the Upper Eocene limy marl and the younger clayey marl lithologically is not very convincing, though it can be proved biostratigraphically. Because of the presence of the thin allodapic limestone beds, the depositional depth of the clayey marl can be estimated as at least 80-120 m (see BOUMA, 1964). A strong reworking from the Eocene has been observed throughout the whole clayey marl member. The specimens of Palliolum from the upper part of the section also indicate a shallow bathyal environment and normal salinity.
The planktonic foraminifera and nannoplankton investigations suggest Early Oligocene. The Eocene and the Oligocene forms are mixed in the foraminifera faunas. For example, in the 5th sample reworked Globorotalia cerroazulensis cocoaensis occurs, while in the 10th sample Globigerina sellii indicates the zone P 19.



CSILLAGHEGY, QUARRY IN THE IBOLYA STREET, GENERAL PROFILE

A. Bognár, Cs Bálint 1982

Fig 3/a

a = Dachstein Limestone, b = sandy, calcareous marl, calcaresous sandstone (Priabonian), c = calcareous marl with fossils and with conglomerate lenses (Priabonian), d = marl with larger forams, bryozoans, etc. (Priabonian), e = equivalent of the Tard Clay Formation

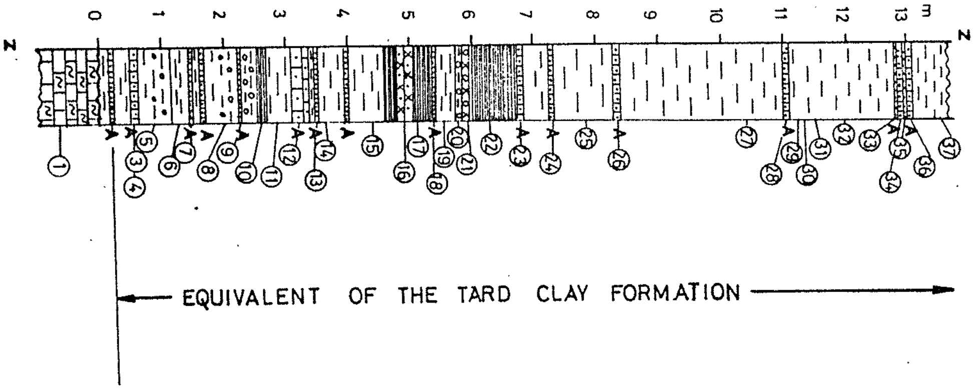


Fig. 3/b. CSILLAGHEGY, QUARRY IN THE IBOLYA STREET

T. Báldi, L. Csontos, M. Kázmér, A. Nagymarosy, P. Varga 1981

— * — * — * —

Historical sites on route

Aquincum's ruins and monuments are dispersed over a large area for there was both a larger and a smaller Roman settlement belonging to the city. The larger was designated as the military city, the city upon which present-day Óbuda (District III) was built. The ruins of the military city were discovered fortuitously during demolition work and building excavations, one of the most important being the Roman city's amphitheatre situated in the area bordered by Nagyszombat utca, Korvin Ottó utca, Szőlő utca and Viador utca. The amphitheatre was unearthed between 1937 and 1940, when the houses built there in the 17th to 18th centuries were being demolished. It was built around the year 160 A.D. and was able to hold up to 16.000 spectators. The 131 m by 110 m structure was one of the largest amphiteatres ever built in the Roman provinces. During the Age of Migrations in the 4th century the amphitheatre was converted into a fortress, and according to archeological evidence, bloody battles repeatedly arose over its ownership. (There are hypotheses according to which the amphitheatre at Aquincum could have been the Etzelburg that figures in the "Nibelung's Ring".)

In contrast to those of the military city, archeologists succeeded in uncovering the remains of the Roman civilian city as a complete settlement in the middle of the 19th century, for when excavations were begun, this area was still a vacant field. Sporadic excavations have been carried on ever since and are still proceeding. Historic objects found during excavations have been collected and placed on exhibition in the Aquincum Museum (No. 139 Szentendrei út), the building standing in the middle of the field containing the ruins of the civilian city.

Excavations carried out in this area have uncovered the middle section of the Roman city. The public baths are in front of the museum building, and the walls of a meat market and other shops are spread out next to it. To the left of the museum are the remains of private homes, ornamental courtyards and private baths, as well as the remains of smaller public baths and the Shirne of Mithras. There are also remains of private homes behind the museum, and to the right are the remains of workshops, more private homes, baths, and a shirne. It is possible to see Roman mosaics, reconstructed wall paintings and furniture in the exhibition premises situated in the south section of the ruins.

The amphitheatre of the civilian city lies outside the excavation site belonging to the museum on the other side of the railway embankment. This one is much smaller than the amphitheatre of the military city (length: 55 m, original capacity: 6.000 spectators). The amphitheatre was built in the second century.

— * — * — * —

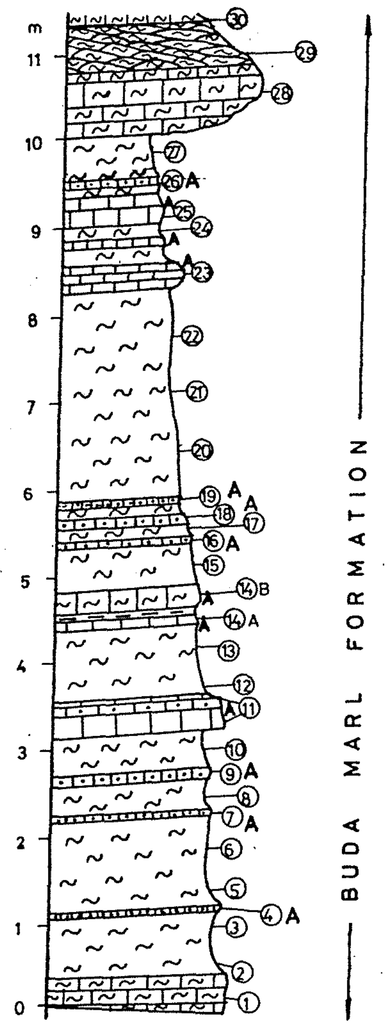


Fig.4. BUDAPEST, PUSZTASZERI STREET

A.Nagymarosy, P. Varga 1981

Stop 2.

Pusztaszeri út, road cut

One of the most classical localities of the Buda Marl can be found at the Nos 7/a-7/b in the Pusztaszeri street, 2nd district, Budapest. Recently it became a protected geological object.

This locality was described at first by Lőrenthey I. (1911) immediately after the road construction. The original road cut exposed a 40 m long sedimentary sequence with alternating compact limy marl and incompact marl layers. Lőrenthey also described terebratulines, abundant pteropods, and a rich microfauna. Nowadays a 12 m thick profile can be studied on the surface with a continous alternation of light yellowish-grey incompact marl-limy marl and yellowish-grey hard and compact allodapic limy marl-limestone layers. The general dipping is 180/20-25°.

The allodapic beds and the Buda Marl represent two essentially different facies types respectively. The allodapic beds are in allochtonous position, having been transported by a gravitational slide from the nearshore-shallow water environment into the deep sublittoral basin. 20 allodapic limestone and limy marl beds can be distinguished in this outcrop. Their thickness ranges from 10 till 350 mm. The graded bedding macroscopically is usually invisible, but the beds show a typical "fluxion" structure in thin sections, and the elongated carbonatic components are parallel with each other and with the direction of the bedding. The thickness of the allodapic beds and the grain size are directly proportional: The thicker is the bed, the bigger are the grains the bed consists of. The lower boundaries of the

the allodapic beds are always very sharp, and their transition upwards into the marl is always gradual.

The 0,06-0,5 mm sized microbioclastics are characteristic in thin sections: Dominantly red algae, echinids, less bryozoans, benthic foraminifers, thin shelled Ostracods.

The X-ray investigations show a rather uniform mineralogical composition through the section: calcite, quartz, illite, kaolinite, montmorillonite. The allodapic beds contain only a small amount of clay minerals.

The Priabonian age of this section has been determined by micropaleontological investigations. Important planktonic forams are: Globigerina linaperta Gg. tripartita, Gg. ampliapertura, Gg. eocaena, Globorolalia increbescens, Globigerinita peral

Stop 3.

Mátyás-hegy, western quarry

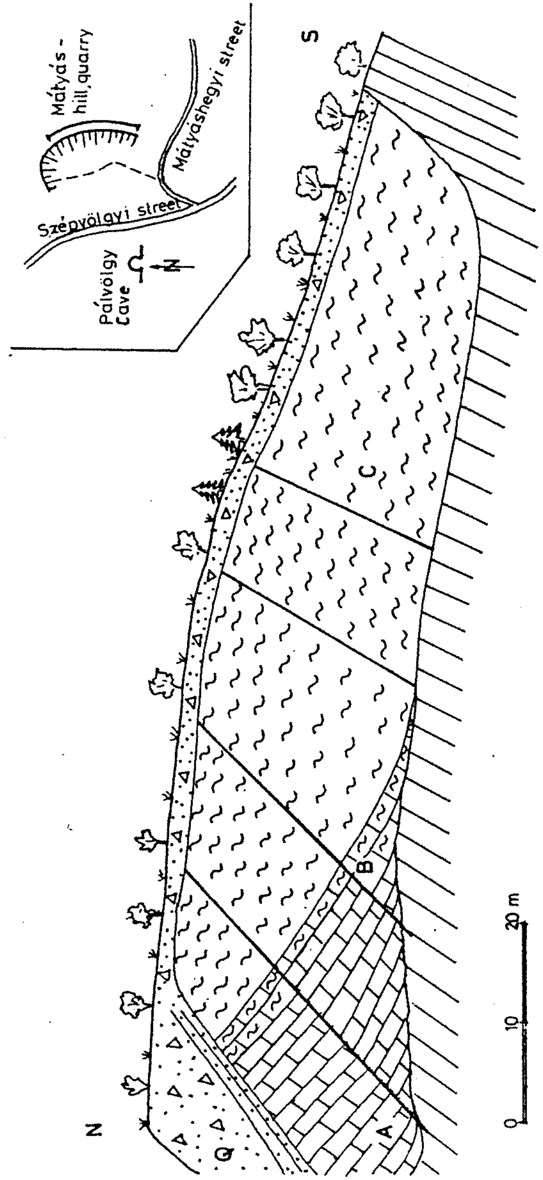
A nearly complete continuous Priabonian sequence is exposed in this quarry, from transgressive conglomerate through neritic limestones to shallow bathyal globigerina marl.

Fig. 5. shows the location and a general view of the Upper Eocene beds in the quarry.

The oldest rocks are Lower Carnian (Upper Triassic) Raibl beds and cherty dolomite exposed at the western end of the quarry. Mottled clay, dolomite conglomerate and chert breccia are contained in a tectonic slice and can be considered as basal transgressive beds of the Upper Eocene limestone. The shallow sublittoral coral-algal beds between the conglomerate and the Discocyclina limestone cannot be observed here, but in Fenyőgyöngye quarry (ca. 1 km NW). We shall see them at Budaörs, Úthegy.

The Discocyclina limestone (A) consists of almost exclusively Discocyclina, Asterocyclina and some Nummulites fabianii (with some Chlamys biarritzensis and Amussium corneum) in a microsparitic-sparitic matrix, generally less than 20 %. It represents a "Didscocyclina-bank" on the outer part of a shallow shelf with open circulation. The number of discocyclinids decreases upwards together with the increase of bryozoans. The boundary between the discocyclina limestone and the bryozoan marl is continuous and is open to discussion. The typical bryozoan marl (C) contains almost exclusively fragments of branching and encrusting Bryozoa, with some Discocyclina and crushed irregular Echinoidea, frequent Chlamys biarritzensis, Spondylus and molds of aragonitic bivalves in the lower part, in a micritic matrix up to 70 %. No corallinacean algae can be found in the upper part of this unit (deposition below photic zone?).

Buda marl blocks containing globigerinids can be found at the top of the quarry wall, in the Quaternary coarse debris.



M. MONOSTORI 1982

Fig.5. BUDAPEST, MÁTYÁS HILL, NORTHERN QUARRY

Stop 4.

Zugliget, Gím utca (small quarry)

The Zugliget locality is in the 12th district of Budapest, in the Gím street, near to the Zugliget church.

The Geological Department of the Eötvös University had an excavating made in the 1981-82 years, and settled the Zug-2 drilling in this place. The borehole penetrated a sequence from the Buda Marl till the Lower Member of the Tard Clay Formation. The exposure on the surface exposes an about 9 m thick section of the Lower Member of the Tard Clay Formation, better to say of its laterally substituting facies. The Fig. 6/a shows the Oligocene strata, which were partly disturbed or/and dislocated by solifluction in the Quaternary. The glacial disturbances have transported by lenses of the incompact clayey-silty rocks, however the succession in the single dislocated units did not change essentially, and all these units can be put in the right order (see theoretical sedimentary column Fig. 6/b). The first 15 samples were collected from the autochtonous block, while the samples 16-20 from the dislocated parts.

The lowermost member of the section is a calcareous sandstone (0,8 m; 1-2 samples) with clay-pebbles. It consists mainly grains of carbonates (limestones, dolomites), the quantity of quartz and other terrigenous materials is much less. The clay from the pebbles (Buda Marl?) contains Upper Eocene (NN 19/20) nannofloras. In the sandstone itself worn and reworked nummulites and Discocyclina specimens have been found.

An alternation of silty clay and sandstone beds lies above the pebbly sandstone bank (2,5 m; samples 3-11). The sandstones are similar to the former calcareous sandstone, though the quantity of terrigenous material becomes higher. The rare graded bedding patterns show their allodapic character due to the subsiding movement during their genesis. In the clayey silt the montmorillonite is the dominating clay mineral, the illite is less important. The presence of clastic dolomite and limestone grains in this member proves, that these sediments have been formed from the eroded material of the Triassic and Eocene rocks of the Buda Mountains.

All these sediments are not typical Tard Clays, but contemporaneous lateral varieties of the lower Tard Member.

The glacially disturbed grey clay (2 m; samples 13,15) represent typical Lower Tard Clay with few white laminae and slight laminated structure. The sample 13 contains fish scales and plant macrofossils, too. A totally altered tuff layer is interbedded (sample 14) into the sedimentary sequence. The dislocated and disturbed blocks (samples 16-20) contain beds of block, strongly laminated and grey, slightly laminated clay (typical Tard Clay), with fish scales and plant fossils.

The lowermost calcareous sandstone represents a nearshore sediment with a shallow depositional depth in the range of the wave action. The alternation of the silty clay and allodapic sandstones can be interpreted, as the production of the deepening procedure of the sedimentary basin in the Early Oligocene. The deposition of the Tard Clay is estimated in a depth more than 100 m. The age of the Zugliget is Early Oligocene, presumably NP 21-22 nannozone. The clay pebbles in

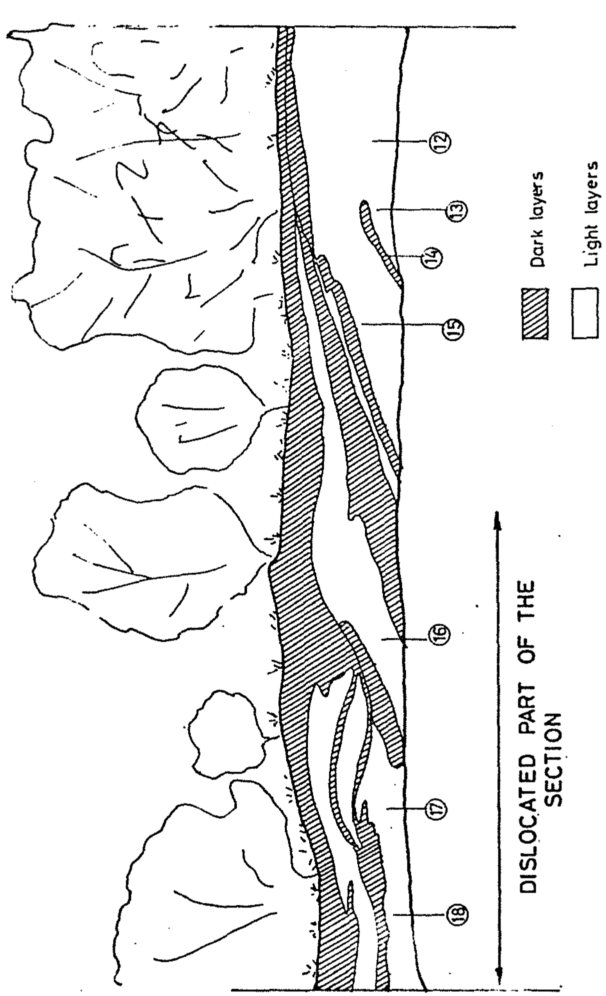


Fig. 6/a. ZUGLIGET

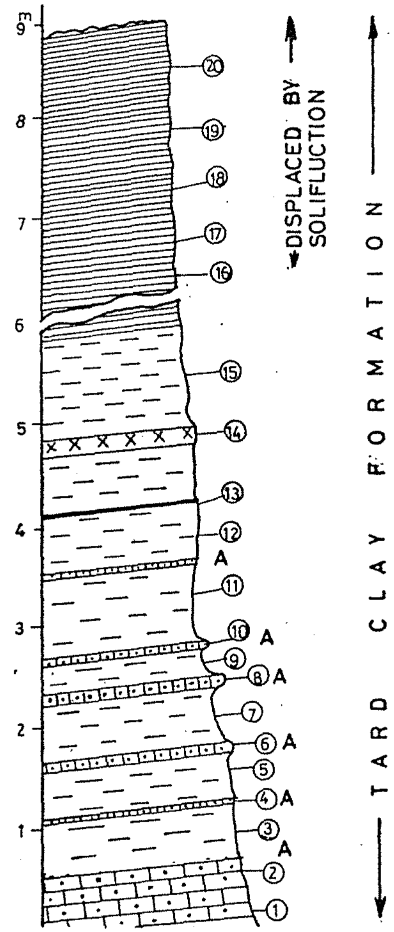


Fig. 6/b. ZUGLIGET, ARTIFICIAL OUTCROP

T. Báldi, M. Horváth, M. Kázmér, A. Nagymarosy, P. Varga 1982 the sample N$^{\underline{o}}$ 1., belong to the NP 19/20 zone. There is a random reworking of Eocene discoasters and other Eocene nannofossils throughout the whole section. The high abundance of the species Reticulofenestra onata MÜLLER in almost all of the samples indicates an increasing unstability in the salinity of the sea water.

Stop 5.

Budaörs, Úthegy

The abandoned quarry of Úthegy exposes four different kinds of Upper Eocene carbonate rocks (coral-algal limestone, calcsiltite, nummulitic limestone and bryozoan marl), separated by unconformities (Fig. 7).

The lowermost, bedded algal-coral liemstone (A) dip: 180/45^{o} contains abundant algal-coated bioclasts, branching corals partly in life position, echinoid fragments and smaller foraminifers. The predominance of micritic matrix indicates a sublittoral environment below wave base (20-50 m) with small coral patches. The 8 metres thick sequence is interrupted by a 10 cm layer of unfossiliferous sandy marl overlain by a 20 cm thick extraclastic limestone bed containing weathered feldspars and quartz of pyroclastic origin.

The algal-coral limestone bears karstic cavities containing laminated, graded calcsiltite and calcareous sandstone beds (B). These beds follow the shape of the cavities. The rounded hole (cave) in the middle part of the western wall of the quarry contains beds of a shape, like an inverted watch-glass. The average dip of these beds is horizontal. The filling of another cavity at the southern end of this wall shows a dip parallel with that of the algal-coral limestone. It was formed by the elongate shape of the cavity among the beds of the limestone. The conclusion can be drawn that between the deposition of the algal-coral limestone and the cavity-filling calcsiltite a tectonic movement, causing emersion, carstification and dip change passed off.

After a new emersion the calcsiltite suffered another erosion. The eroded forms were filled by coarse-grained nummulitic limestone (C) observable below the topmost cliff of the quarry. No bedding can be observed in this limestone.

The last erosion preceded the deposition of the topmost formation of this exposure. A completely silicified bryozoan marl (D) (BÁLDI, 1981, pers. comm.) with a 20° southern dip overlies all the other formations of the quarry.

The repeated emersion, erosion, sedimentation and dip change observable in this quarry give an excellent example of intensive tectonic movements within Upper Eocene age.

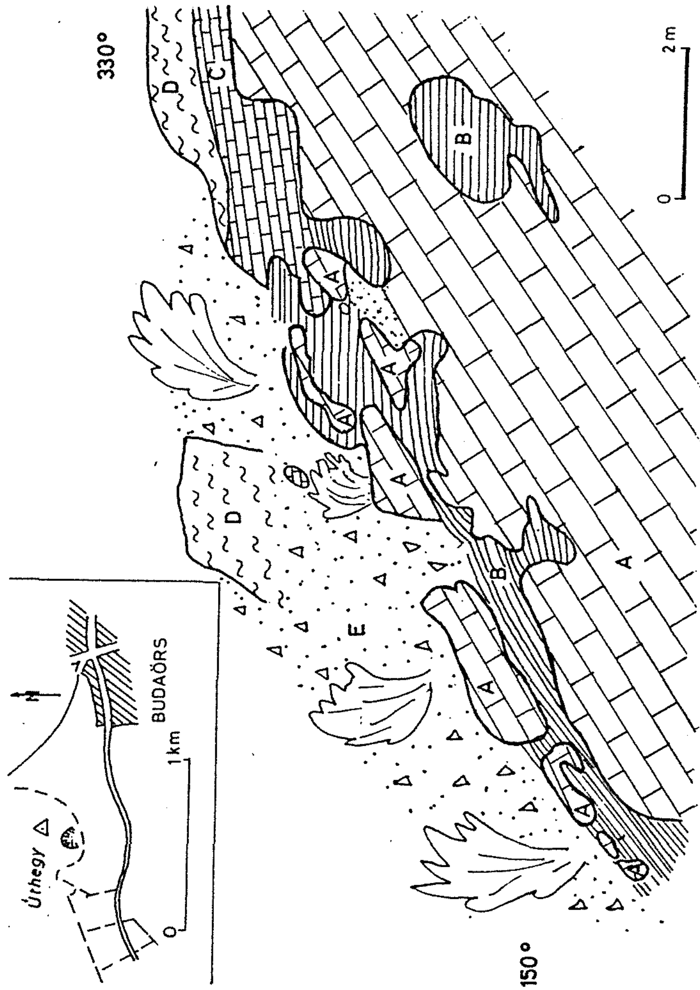


Fig. 7. BUDAÖRS, ÚTHEGY QUARRY

Stop 6.

Solymár, Várerdőhegy (two quarries)

Priabonian, biogenic limestone overlain by Late Kiscellian (Middle Oligocene) Hárshegy Sandstone. The sections are presented in figures 8/a and 8/b.

This is an old, classic locality, described already by A. KOCH (1871). Th. FUCHS (in KOCH, 1871) identified the first molluscs, found here. After him they indicate an Early Oligocene age. Lepidocyclinas were recognized much later by ROZLOZSNIK and MÉHES (1943).

The Priabonian biogenic limestone (Fig. 8/b) is built up of the bioclasts of Nummulites fabianii, discocyclinids, echinids, calcareous algae, bryozoans, mollusc-fragments, etc.

The limestone is overlain unconformably by the fire--clay, kaolinitic sand, calcareous sandstone, conglomerate sequence of the Hárshegy Sandstone. Larger forams are rather common in some layers of the Hárshegy Sandstone at this locality. Discocyclinids are reworked from the Eocene. On the basis of the co-occurence of Lepidocyclina dilatata, L. raulini, L. tournoueri and Nummulites vascus (T. KECSKEMÉTI and P. VARGA, in BÁLDI et al. 1976), the age of the sandstone is Late Kiscellian (Middle Oligocene).

Molluscs are also common in some layers. They were collected by M. MONOSTORI and T. BÁLDI, and described by BÁLDI (in BÁLDI et al. 1976). The following list of molluscs is after BÁLDI et al. (1976):

Pecten arcuatus BROCCHI, Chlamys biarritzensis ARCHIAC (= Ch. thorenti ARCHIAC), Ch. oligosquamosus SACCO, Ch. ex aff. miocenicum MICHELOTTI, Ch. cf. deleta MICHELOTTI, Ch. sp., Lentipecten cf. denudatum SOWERBY, Lima guembeli MAYER in GÜMBEL, Spondilus sp., Ostrea sp., Megacardita arduini roveretoi VENZO, Cardiocardita laurae BRONGNIART, Eucrassatella carcarensis MICHELOTTI, E. carcarensis protensa MICHELOTTI, E. sulcata speciosa MICHELOTTI, Loxocardium pallasianum BASTEROT, Nemocardium anomalum MATHERON, Laevicardium parile DESHAYES, Lucina sp., Callista villanovae DESH. in STUDER (= C. crenata SANDBERGER), C. exintermedia SACCO (= ? C. heberti DESHAYES), Pelecyora politropa ANDERSON, Panopea meynardi angusta NYST, Thracia pubescens bellardi PICTET (= Th. scabra KOENEN), Teredo sp., Turritella archimedis BRONGNIART, T. incisa BRONGNIART, T. asperula simplicula SACCO, T. conofasciata SACCO or T. catagrapha ROVERETO, T. cf. geinitzi SPEYER, Cerithium intradentatum DESHAYES in SANDBERGER, Pirenella ex aff. corrugata BRONGNIART, Diastoma grateloupi ORBIGNY s. str., Globularia gibberosa GRATELOUP s.l., Globularia sp., Amaurellina ex aff. scaligera BAYAN, Natica sp., Cypraea sp., Drepanocheilus specious SCHLOTHEIM s.l., Galeodes dalpiazi VENZO, Ficus oligoficoides SACCO, F. condita BRONGNIART, Semicassis rondeleti BASTEROT, Cassidaria nodosa SOLANDER in BRANDER, Morum dunkeri SPEYER, Babylonia caronis BRONGNIART, Ancilla glandiformis anomala SCHLOTHEIM, Athleta italica FUCHS (= A. rathieri HEBERT), Lyria ex aff. decora BEYRICH, Acteon gmelini BAYAN, Conus sp.

Only Turritella cf. geinitzi, Cerithium intradendatum, Morum dunkeri, Acteon gmelini are typical boreal taxa, the other ones are either cosmopolitan or Mediterranean. The predominating Mediterranean influence, beside the occurrence of some boreal forms, is an important paleogeographic and paleoclimatic evidence from this time.

The overlapping occurrence of such taxa as the Early through Middle Oligocene Lima guembeli, Nemocardium anomalum, Callista villanovae (= C. crenata), Cerithium intradentatum and the Middle through Late Oligocene Morum dunkeri, Semicassis rondeleti, Turritella conofasciata (= T. catagrapha), Callista exintermedia, etc. indicates a Middle Oligocene, Late Kiscellian age.

The environment was a subtropical near-shore shallow shelf.

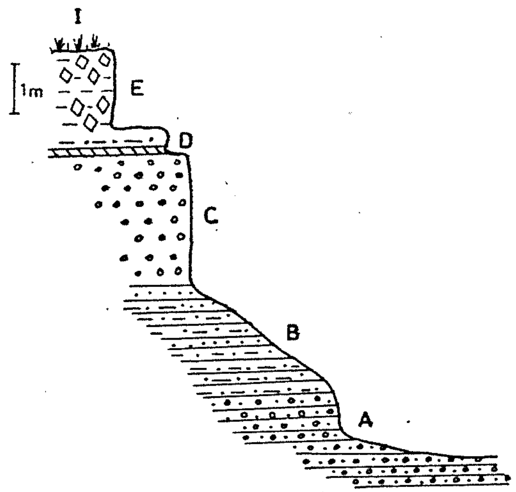


Fig. 8/a SOLYMÁR, VÁRERDŐHEGY

T. Báldi and M.B.-Beke 1982.

A = yellow-brown, coarse quartzsandstone with sporadic Chlamys sp.
B = less hard, somewhat friable, light brown, medium size sandstone with Lepidocyclina, many Chlamys shells, limonitized drift-wood remains with Teredo.
C = conglomerate with dolomite, limestone and chert pebbles (from the Triassic).
D = brown-reddish, clayey sandstone with thin coal intercalation.
E = clayey breccia with red clay matrix.

A-E: Late Kiscellian

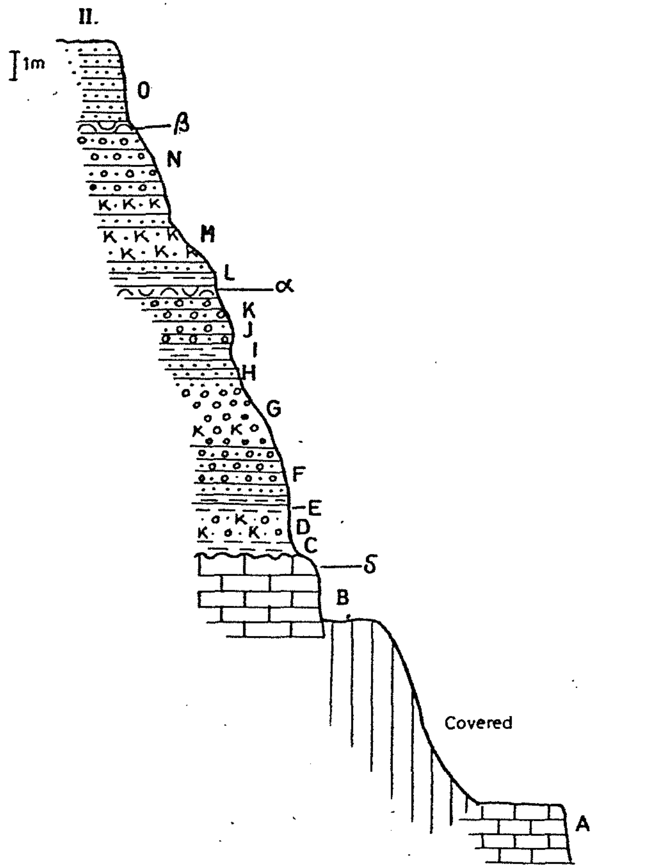


Fig.8/b. SOLYMÁR, VÁRERDŐHEGY

T. Báldi and M.B.-Beke 1982

A = Coarse, biogenic, bioclastic limestone with many *Nummulites fabianii*, *echinids*, less *Chlamys* fragments, bryozoans, calcareous algae, discocyclinids.

B = Light gray, rather hard limestone mainly with *disco-cyclinids*, less calcareous algae, *Nummulites fabianii*. Grain size is smaller than in 1.

δ = unconformity.

C = Light gray, sometimes lilac fire-clay.

D = Light gray, kaolinitic, gravelly, coarse sand.

E = Gray fire-clay.

F = Light gray or light brown gravelly coarse sand with dolomite, limestone pebbles (well rounded), chert fragments (non-rounded), less quartz pebbles (well rounded). Shell fragments.

G = Sandy, kaolinitic gravel. The pebbles are well rounded dolomite, limestone (4-5 cm diam.), smaller chert and some quartzite. Coal-lenses, thin coal layers are common.

H = Brown, mainly coarse grained sandstone with shell fragments.

I = Gray fire-clay.

J = Reddish-brown, gravelly coarse sand. Dolomite is dominant among the pebbles. Coal-traces.

K = Hard reddish-brown sandstone with chert-fragments.

α = fossiliferous level in K . Dominant: *Nummulites vascus*, forma B, few *Lepidocyclina* sp., abundant reworked *Disco-cyclina*, many *Chlamys* div. sp., other molluscs.

L = Well stratified, fine sandy red clay with pebbles on the base.

M = Hard, silicified sandstone with forable kaolinitic sandstone intercalations.

N = Brown and gray sandstone with small pebbles and debries.

β = fossiliferous level in N . *Chlamys*, *Ostrea* and other molluscs.

O = Brown, silicified sandstone.

A-B: Priabonian, biogenic limestone
C-O: Upper Kiscellian, Hárshegy Sandstone.

Stop 7.

Solymár, clay pit

The Solymár brickyard lies just on the administrational border of Budapest, south from the Budapest-Solymár highway.

The enormous clay pit exposes the boundary Kiscellian--Egerian along several hundred meters. For to avoid the spot of the recent working procedure we shall visit another part of the locality, where the raw material has been exploited earlier.

In the lower portion of the profile typical, paralelly stratified Kiscell Clay can be studied. Lithologically it is better a clayey silt than pure clay, however it seems to be the best raw material of the Budapest brick factories. Its colour is bluish-gray due to the relatively high pyrit (hydro-troilit) and organic material content. The macrofossils - except from a few specimens of Gryphaea and Bathysiphon - are rare. The estimated paleodepth of the Kiscell Clay is between 200-400 meters.

The upper portion of the Solymár profile represents the Egerian Törökbálint Sandstone overlying the Kiscell Clay. A 4 m thick alternation of 20-30 cm sandstone and clayey silt beds immediately above the Kiscell Clay shows the transition (elevation period) from the bathyal into the shallow sub-littoral environment. The sandstone layers have been proved to be of turbiditic origin, based on the graded bedding of the layers.

The uppermost cross-bedded strata, of the profile indicate a shallow turbulent water paleoenvironment. This

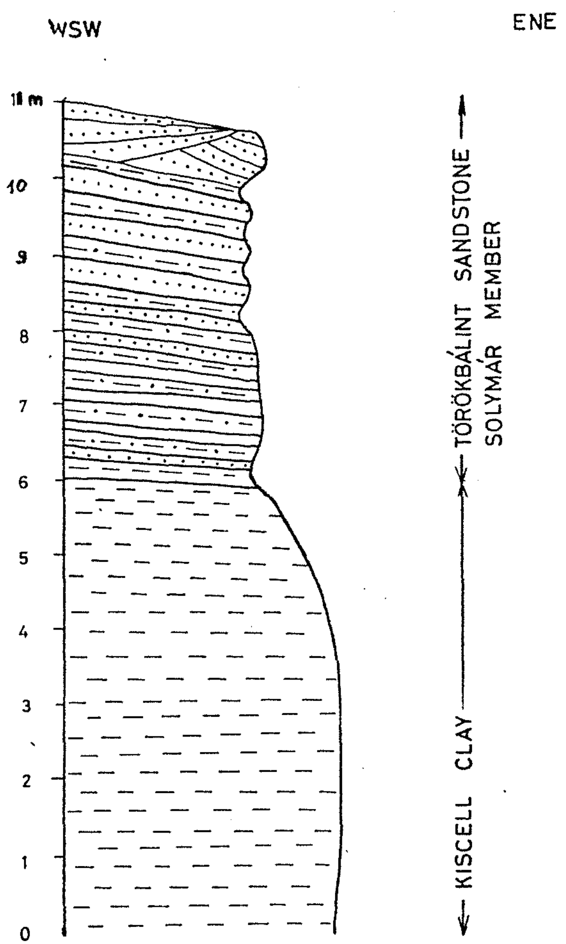


Fig.9. SOLYMÁR, CLAY PIT

A Nagymarosy 1982.

coarse grained sandstone contains no fossils.
The calcareous nannofossils suggest that the Kiscell Clay belongs to the NP 24 Martini zone. Its foraminifera fauna belongs to the Valvulineria complanata Heterolepa costata assemblage.
The lack of Miliolinids shows, that this section is older, than the uppermost - Egerian - level of the Kiscell Clay.
In the overlying alternating sandstone-clay sequence the Asterigerinoides gürichi species indicates the Egerian age. The high abundancy of reworked Cretaceous and Eocene forams is very characteristic in the lowermost Egerian in this area.

Visegrád

In the 4th century the Romans built a castrum on the present-day Sibrik Hill, a fortress that was still used in the 9th and 10th centuries by the Slovaks who had settled here. The name Visegrád is Slavonic for 'high castle'. A monastery was built in Visegrád in the 11th century following the Magyar Conquest, the settlement itself became a country centre. After the Mongol Invasion had subsided, construction was begun in 1250 on the lower castle situated near the river bank for the royal family, and later work was begun on the citadel situated on the mountain. In 1316 Charles Robert, the Angevin King had the royal seat transferred to Visegrád, and had the lower castle reconstructed into a royal palace in the late Gothic style of the trecento. In 1335 Charles Robert received here the Polish king Casimir and the Czech king John Rudolf, the Saxon, and Heinrich Wittelsbach, the Lower Bavarian elector, and the representatives of the Teutonic Order, and entered into an international agreement with them by which territorial disputes were resolved between Poland and the Teutonic Order, and international trade routes were delimited. The monarchs Louis the Great (of the House of Angevin) and Sigismund (of Luxemburg) resided in Buda but the work of construction was continued. In 1438, during the reign of Matthias Corvinus, an envoy of the Pope wrote a letter from the Palace of Visegrád, which had already been enlarged and ornamented in the Renaissance style by Italian architects, sculptors, and stone masons. The letter said: "Ex Visegrado paradiso terrestri" ("from Visegrád, a paradise on earth"). Among the humanist writes of the age, the Hungarian Miklós Oláh and the Italian Bonfini also praised the magnificence of the palace.

Under Turkish rule (1543-1686) the palace fell to ruin. After the expulsion of the Turks the people settling in the area built their homes from stones lying among the ruins. The destruction was completed by nature: over the centuries, landslides on the mountain buried the palace to such an extent that up to 1934, when the ruins were excavated, certain historians, despite the evidence provided by contemporary writes, refused to belive that a famous European palace had once stood here. The 600 m high by 300 m wide palace has not been completely unearthed yet, for there are residential houses situated over much of the site.

Remains of the water bastion (vizibástya) belonging to the lower castle lie next to the pier on the bank of the Danube.

From the 13th-century keep of the lower castle the traffic of the road along the Danube bank.

Popular tradition has named the stocky building the Tower of Solomon, for in the 11th century King Ladislas, in the course of internal struggles over the throne, held the former King Solomon prisoner in Visegrád for a short time, presumably in the castle on Sibrik Hill, since the keep was built only 200 years later.

The area of the former royal palace can be approached from No. 27 Fő utca. Walking from here through an indoor hallway provided with sedilia, one reaches the ornamental courtyard, in the middle of which the Renaissance Hercules fountain stood on an octagonal wellpedestal.

A stairway and hall lead down to the lower ceremonial courtyard, then a hallway provided with sedilia leads back to the starting point. From here another narrow stairway leads up to the foundation walls of the chapel, and to a terrace. Walking through a corridor, we reach the so-called Courtyard of the Lion Well.

The Chapel of the Virgin Mary as well as the Catholic church in Fő tér are both from the 18th century. Remains of a 4th-century Roman watchtower have been disclosed at the end of Fő utca next to the stone quarry.

The Citadel (as well as the Nagy-Villám lookout tower and the Silvanus Hotel) can be approached from Fő tér along Nagy Lajos utca, Mátyás király út, the Panoráma Highway, or by a local bus line that begins at the Mátyás Statue situated on the bank of the Danube, at the corner of Fő utca and Salamon-torony utca. The ruins of the Citadel and the high walls and towers that have remained give some idea, even now, of the former strength of the fortress, where the royal crown was kept for some time.

Eger

Eger lies in the Valley of the Eger, in a hilly area between the thickly-wooded Mátra and Bükk mountains. Because of its past history, historic buildings and world-famous wines, Eger is one of the most frequently visited of all Hungarian towns. (With its 175 historic monuments it takes third place after Budapest and Sopron.)

The area presently occupied by Eger was inhabited as early as the Stone Age. The Eger Valley was settled by the first generation of Hungarians who entered the Carpathian Basin. At the beginning of the 11th century, Stephen 1 made it an episcopal see. In 1241 the town was burned down by the Mongol forces who slaughtered most of the inhabitants. (Large numbers of settlers from the territories now occupied by Belgium, France and Italy came to Eger and helped make up for the loss it suffered in population.) The town was one of Hungary's main centres of Renaissance culture in the second half of the 15th century. Eger again suffered seriously during the Turkish occupation. Helped at the first siege (1552) by the women of Eger, who fought alongside the men, the 2,000 soldiers stationed in the castle managed in a heroic struggle under the leadership of István Dobó, the castle commander of almost legendary fame, to avert an attack by Turkish forces six times as strong. The news of the victory at Eger soon spread throughout all Europe, causing great releif and ending the legends about the invincibility of the Turks. The victory also stopped the spread of the Ottoman Empire for some decades. At the second siege in 1596, however, a garrison consisting of foreign mercenaries gave itself up after barely a week's struggle to Turkish armies under the leadership of Sultan Mohammed III. (The mercenaries could not, however, avoid their fate: they were promised their freedom, but were attached by the Turkish jannissaries who slaughtered a large part of them and took prisoner most of the survivors.)

From 1596 up until it was freed in 1687 Eger was the seat of a newly established Turkish province (vilayet), and many mosques were built for the population. Today there is only one minaret standing and this represents the most northerly monument of Islam. With the exploitation of the natural warm springs lying in the neighbourhood, a series of baths were established here: there are only fragments of these remaining today.

Eger started to develop at a rapid rate in the middle of the 18th century; this was mainly due to its status as an episcopal see with a number of huge estates at its disposal. Within a few decades Eger's still characteristically Baroque appearance developed through the construction of a large number of public buildings (chiefly churches) and private houses.

The result of new construction work, which took into account the city's past history, is a whole series of public buildings, well-adapted to their surroundings, but nevertheless modern. New housing estates have also been built on the outskirts of the town. Eger is also a student town; some ten thousand pupils are now studying in the city's two colleges, and in a number of high schools, vocational schools, and elementary schools.

The famous wines produced in Eger can be sampled in intimate, traditionally furnished wine taverns (Szabadság tér, Dobó István tér, etc.) and in wine cellars (Szépasszony Valley, etc.). Eger's vine-growing area, comprising more than 3,700 hectares, produces the wellknown Egri bikavér (Bull's Blood of Eger) which became famous in the 18th

century. In addition to the dark red, slightly acid Bikavér, with its characteristic taste and bouquet (it is matured for two to three years before bottling), Medoc Noir (a dark red, strong, sweet dessert wine) as well as the honey-coloured, fragrant Egri leányka are among the wines now exported from Eger.

2nd day excursion (Eger-Noszvaj)

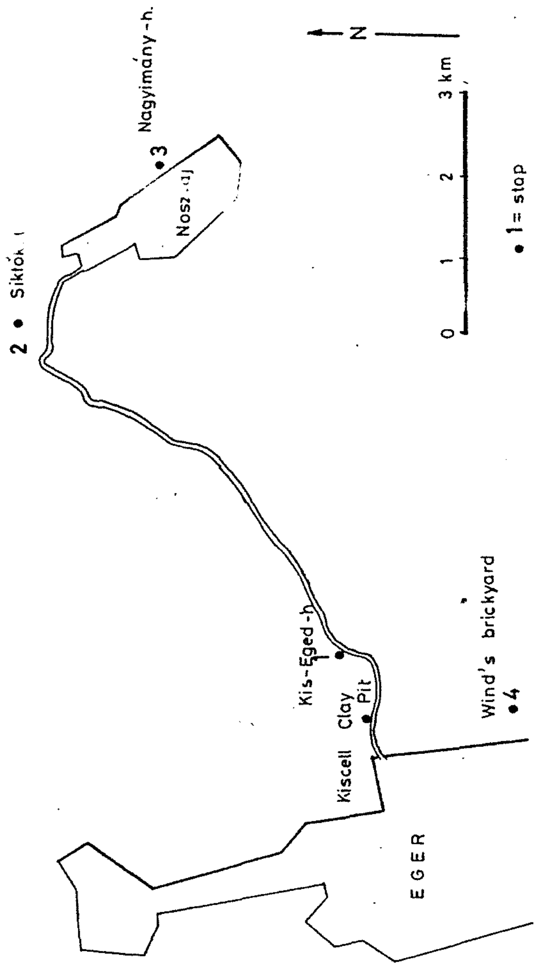


Fig. 10.

AN OUTLINE OF THE GEOLOGY OF THE EGER AREA

Dr. Tamás BÁLDI

Eger is located on the SW flank of the Bükk Mountains. The Bükk is built up of Late Paleozoic-Mesozoic rocks: mainly shallow marine, Triassic accompanied by volcanic rocks and most probably also of deep marine (cherts, limestones) deposits and ophiolites of Jurassic.

The oldest postmesozoic rocks are the Priabonian biogenic limestones, which unconformably overlie the folded Mesozoic with basal conglomerates. The biogenic limestone consists of calcareous algae, corals, Nummulites fabianii and other larger forams, as it has been shown by P. VARGA (in manuscr.). Bryozoa marl is not present in this region, the biogenic limestone is overlain by the Buda Marl, a light gray, sometimes white, sometimes tuffaceous, sandy, silty marl with Propeamussium fallax. At stop 2 (Noszvaj--Síkfőkút) the Buda Marl is definitely tuffaceous. It grades out upwards without hiatus from the limestone of shallow sublittoral origin.

The Buda Marl is conformably overlain by the Tard Clay, in which the Globigerina-rich horizon, the Cardium lipoldi--Ergenica level can be well recognized even on the surface (stop 1: Eger, Kis-Eged).

The E/O boundary lies also within the Buda Marl, the Tard Clay belongs already to the Oligocene.

The Kiscell Clay is well developed (300-500 m thick). Its appearance is similar to the Kiscell Clay of the Buda Mts. A significant difference is, however, the occurrence of manganese ore intercalations, in which the sedimentary rhodochrozite dominates. Redeposited, fluxoturbiditic intercalations are also present in areas, which extended near to the mainland of the Bükk Mountains. An interesting section of such fluxoturbiditic facies can be studied at stop 3 (Noszvaj-Nagyimány), where badly sorted, gravelly intercalations are alternating with the silty Kiscell Clay. Submarine slides transported the gravel from a nearby submerged deltaic cone into the bathyal environment.

Egerian grades out of the Kiscell Clay without hiatus. First, glauconitic sandstone deposited with Miogypsina formosensis and septentrionalis, Lepidocyclina, solitary corals, and molluscs (Pecten burdigalensis). This is overlain by a marine, deep-sublittoral clay with smaller foraminifera and well preserved molluscs. The clay is covered by shallow marine sandstone and clay beds with the famous mollusc-fauna, and at last the sequence is closed by brackish water sand and silty beds with coal lenses and leaf-imprints (BÁLDI, 1973, BÁLDI et al., 1961, BÁLDI, 1966, BÁLDI-BEKE and BÁLDI, 1974). The whole sequence is unconformably overlain by a rhyolite-tuff of 19-21 MA old (Late Eggenburgian). The vine cellars of Eger were cut into this rhyolite-tuff. All these can be studied at stop 4 (Eger, Wind's brickyard), which is the stratotype of the Egerian stage.

Stop 1.

Kis-Eged hill (road cut)

The Kis-Eged hill lies NE from Eger in an altitude of 302 m above the sea level. The outcrop has been established in the early 30ies by the building of the highway between Eger and Noszvaj. This locality was mentioned in the geological literature by WEILER (1933) at first, later by SCRÉTER (1939, 1955).

The Eocene/Oligocene strata of Kis-Eged can be studied in the road cut in a length of 180 m. Though the whole series is exposed in a number of small artificial outcrops, with a probably continuous sequence of Priabonian limestone, Buda Marl, Tard Clay, Kiscell Clay keeping the same steep dipping and a relatively small thickness.

Unfortunately, the contact of the formations can not be seen directly because of the soil and vegetation. SCHRÉTER (1955) earlier observed, that the yellowish-brown Buda Marl was laying conformly on the uppermost Priabonian strata, in fact on a glauconitic marl layer. Based on this observation we can suppose a continuous sedimentation from the Priabonian through the Kiscellian in this area.

Upper Eocene limestone

Compact, slightly laminated limestone with red algae and corals. Its dipping is $150/30^{o}$. The same limestone is exposed in the small abandoned quarry near to the highway.

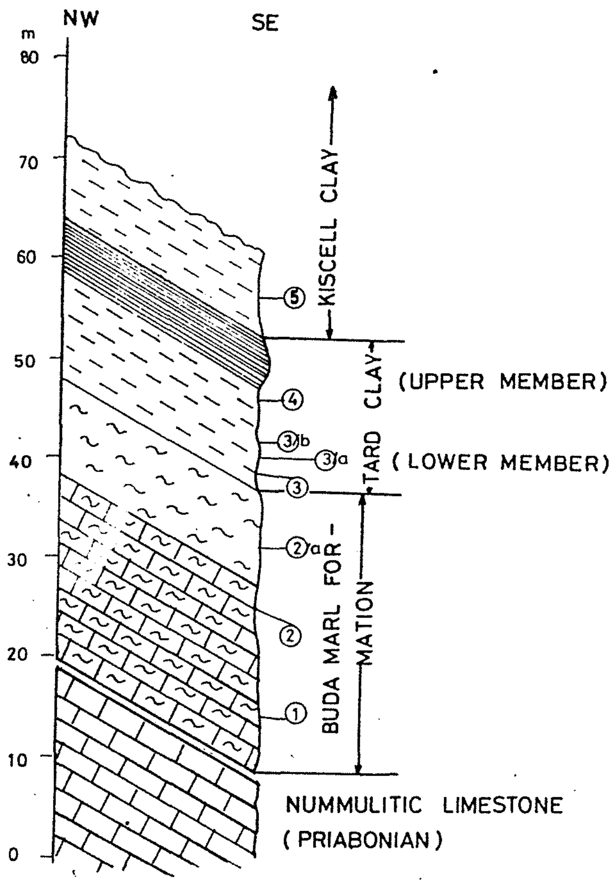


Fig. 11. KISEGED, ROAD CUT

A. Nagymarosy, P. Varga, 1982

Buda Marl

Light yellowish-brown clayey marl. Its dipping is 140/40°, estimated thickness: 25 meters.

Tard Clay, lower member

Poorly stratified, brownish-grey, yellowish-grey clayey marl, which contains slightly laminated interbeddings. Abundant specimens of the Lower Kiscellian mollusc species Loxocardium lipoldi (ROLLE) can be collected in the bed No 4. The dipping of this member is 130/40-45°, its thickness is 10 meters.

Tard Clay, Upper member

Strongly laminated, light grey, silicified clay (shale) with fish relicts and fish scales. Its rich fish fauna has been published by WEILER (1933). The fish fossils recently became very rare in this locality.

The silification procedure worked along a fault zone, the same silification phenomena can be seen in the Priabonian limestone along this zone on the top of the Bikkbérc hill. The dipping of the "fish shale" is: 125/45°.

The upper member of the Tard Clay is covered by some meters of the typical, compact, light grey Kiscell Clay. The profile terminates in the recent erosional surface.

Stop 2.

Noszvaj-Sikfőkút (quarry)

The Sikfőkút locality lies 8 km of NE from Eger, near to the village Noszvaj.

The fauna rich glauconitic limy marl overlying the Priabonian limestone was mentioned at first by SCHRÉTER (1939) from this area.

This time we shall visit a small quarry out of use. This quarry and an artifical outcrop above it exposes an 11 m thick profile of the Sikfőkút beds.

The sequence of the quarry from bottom to the top is the following:

1,2 m: greyish white, slightly glauconitic bioclastic limestone. It is very similar to the Priabonian carbonate formations occurring in the southern margin of the Bükk Mts. The limestone consists of the skeletons of red algae, bryozoans, echinids, mollusc shells. The non-determined Nummulites species are rather rare.

2,5 m: Alternation of more or less compact, greenish-yellowish-brown glauconitic limestone beds.

0,8 m: Thin layered greenish-grey glauconitic limestone with mollusc shells. It contains greenish-grey lenses of Bivalve skeletons often in autochtonous position, and burrowings of different Annelidas.

0,4 m: Dark greyish-brown, slightly laminated clay, clayey marl. In its mineral composition the illite is dominating, the quantity of chlorites is somewhat less.

0,8 m: Compact, light greenish-grey, glauconitic limestone. Its upper 20-30 cm is less compact, and thin layered, with the occurrence of clay lenses.

0,3 m: Slightly laminated, light greyish-white limy clay and clayey marl. A limy crust can be observed on its broken surfaces. The composition of the consisting clay minerals: illite, montmorillonite, kaolinite.

0,15 m: Slightly compact, greenish-grey glauconitic limestone.

0,20 m: Light greyish-white limy clay-clayey marl. Its dominating clay minerals: illite, chlorite, montmorillonite.

The general dipping in the quarry is: 140/25°. An artifical ditch has been established above the quarry with a length of 13,5 m in N-S direction. It exposes very incompact glauconitic limestones and marly limestones in a thickness of 4,7 m.

Facies

The sedimentary sequence represents a transgressional half-cycle. The greyish-white biogenic limestone on the base indicates shallow-water environments, perhaps the neighbourhood of a reef. The glauconite is an important

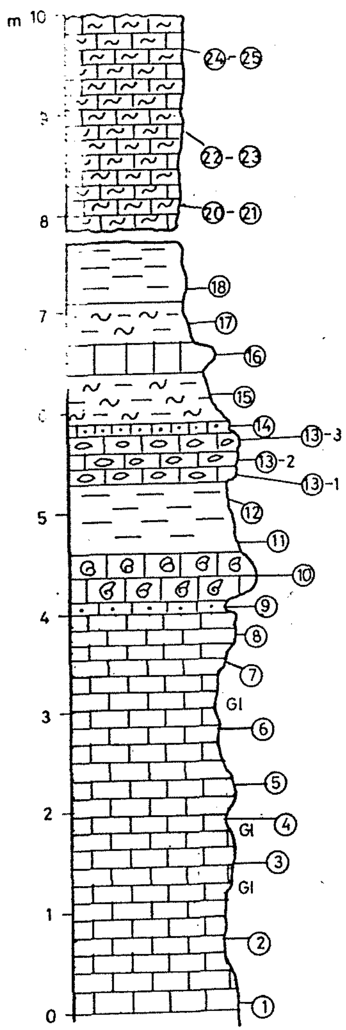


Fig. 12. SIKFŐKÚT, QUARRY

T. Báldi, M. Horváth, A. Nagymarosy, P. Varga 1981

component of the limestones. It occurs in separated grains and sometimes it fills the foram chambers too. The main biogenic components of the glauconitic limestones are the red algae, the echinids, foraminiferas (often planktonic ones), bryozoans, mollusc shells, worms tubes, nummulits. All these components are mainly clastics. The appearance of the autochtonous glauconite upwards in the profile indicates the increasing water depth, while the overlying clayey marls represent the maximum water depth. The dominance of the illite in the clay mineral composition, the high frequency of the planktonic foraminiferas and nannofossils give the same information about the clayey marl. Two limestone beds interbedded into the clayey marl are probably of allodapic origin.

The incompact glauconitic limy marl exposed in the artifical ditch in the uppermost part of the section shows a regressional trend. Summarizing the results on the water depths, the following estimations can be presented: The basal limestones have been formed at 10-20 meter - the glauconitic limestones at 50-100 m, the marls at 150-200 meter water depths in a normal salinity sea water. The temperature of the paleoenvironment shows some centigrade decrease during geological time.

Those Priabonian carbonate layers in the Bükk area, which usually underlie the Sikfőkút beds contain abundant larger foraminifera faunas with a low diversity. The most important species (V. ZILAHY L.1967, KECSKEMÉTI T. 1980): Nummulites fabianii, N. incrassatus, N. chavannesi, Operculina alpina, O. subgranulosa, Spiroclypeus carpaticus, S. granulosus, Grzybowskia multifida, G. reticulata, Chapmanina gassinensis. The overlying Sikfőkút beds contain also low diversity - high abundancy Nummulites fauna. Their dominating form is N. incrassatus, and somewhat less dominating is N. bouillei. Rare occurrence of N. variolarius, N. pulchellus, N. chavannesi, Operculina sp. must be also mentioned. Nummulites fabianii also occurs in the lower part of the profile till the level of the first glauconitic limestone. The size and abundancy of N. incrassatus (A and B forms) is greater in the upper glauconitic limestone than in the lower beds.

The largerforaminiferas do not give exact information on the age of the exposed formations, because the exclusively Oligocene forms are lacking. Nummulites incrassatus and N. bouillei occur both in the Upper Eocene and Lower Oligocene. The disappearance of the rare Upper Eocene species (N. pulchellus, N. chavennesi) may help to put the boundary Eocene/Oligocene into the white clayey marl layers (18. layer).

Stop 3.

Noszvaj-Nagyimány (road cut)

Dirt road cut, East of the village. Kiscell Clay - with fluxoturbiditic intercalations - is cropping out here. The succession is the following (Fig. 13).

A. Kiscell Clay (clayey silt). B. Sandy gravel, hardly graded. The 90 % of the pebbles is radiolarite and silicified limestone, originating from the S-Bükk Mountains. Shallow marine Cardiocardita laurae occurs in this layer in reworked position. C. Pebbly mudstone. Radiolarite pebbles of several cm dispersed in clayey matrix. In the lowermost part a thin layer intercalates full with Cadulus gracilina and Saxolucina deperdita raricostata in autochtonous position (S). Somewhat higher Nuculana obliquestriata, Turricula leganyi, Tugurium subextensum, Galxis cataphracta occur. D. Kiscell Clay (clayey silt) with common leaf--imprints. E. Kiscell Clay (clayey silt) with Propeamussium bronni, Palliolum mayeri, Volutilithes permulticostata, Saxolucina heberti spissistriata. F. Sandy gravel, similar to 2., but not graded.

The age of the whole sequence is Upper Kiscellian on the basis of the molluscs and that of the nannoplankton (NP 24 zone).

It is a very peculiar facies of the Kiscell Clay. In the pelitic part of the section the typical shallow bathyal fauna of the Kiscell Clay can be found. This is contrasting with the two, intercalating sandy gravel and pebbly mudstone occurrence. As it was shown by BÁLDI (1979, in press), the gravel and the pebbles were resedimented from a submerged

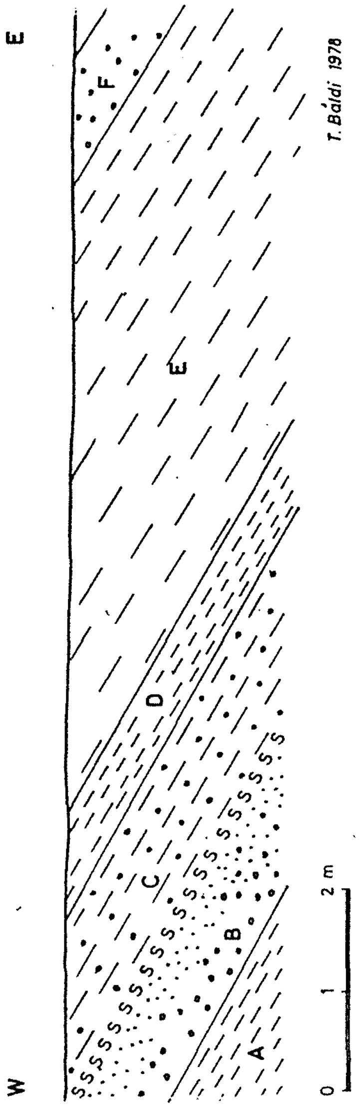


Fig.13. NOSZVAJ, NAGYIMÁNY

A = clayey sandy silt; B = graded sandy gravel; C = clayey silt with pebbles;
D-E = clayey silt without pebbles; F = sandy pebble /not graded/ with clay detritus /"pull-apart structure"/
A-F. Upper Kiscellian, Kiscell Clay Formation, Noszvaj Member

deltaic cone, located not very far, by submarine slumpings and slides. The criteria are perfectly identical with those which were described for the fluxoturbidites by DZULINSKY et al. (1959). So, I suggest a bathyal environment, located not very far from the shore, in which the normal deposition of the Kiscell Clay was interrupted from time to time by the sudden accumulation of sandy gravels, transported by slumpings and by short range turbiditic currents from the coastal region. The pebbly mudstone is also a typical slumped sediment after CROWELL (1957).

Stop 4.

Wind's brickyard

Stratotype of the Egerian. The Egerian grades out of the Kiscell Clay without hiatus. This can be studied only on cores.

The lowermost member of the Egerian type-section is a 20 m thick glauconitic marl and sandstone, more or less tuffaceous. It crops out presently in the clay pit. The first occurrence of Pecten burdigalensis right at the base of the glauconitic marl, overlying the Kiscell Clay, is the marker for the lower boundary of the stage Egerian. Beside Pecten burdigalensis some other molluscs, solitary coralls, shark teeth, brachiopods occur.

In the upper part of this member Miogypsina septentrionalis and Mio. formosensis were found. Some kilometers eastwards, at Novaj, a Lithothamnian limestone bed and Lepidocyclina marls with the same Miogypsinids are intercalated into the glauconitic sandstone (see BÁLDI et al. 1961, DROOGER, 1961). Only conflicting radiometric data were obtained on the glauconite of this member.

The glauconitic member is overlain by the molluscan clay of 40 m thickness. Rich deep-sublittoral foraminifera and mollusc-fauna are known from it.

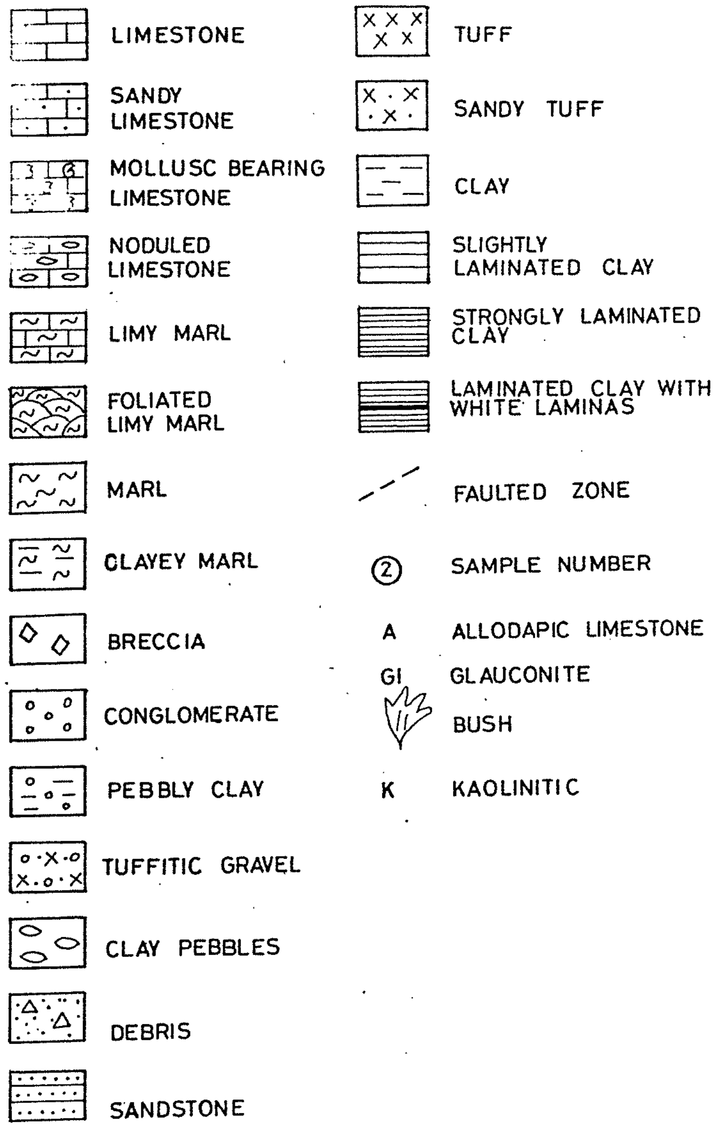
The third member is a silty clay with friable sandstone intercalations. The sandstone layers abound in excellently preserved, shallow sublittoral, marine molluscs, described first time by ROTH von TELEGD (1914).

The topmost member of the stratotype is built up of cross-stratified sand, alternating clay and sandstone with thin gravelly intercalations. The sand body could be a sand bar, the overlying layers originate from a lagoon, which has been barred by the sand from the open sea. The Tympanotonus, Polymesoda, Unio communites indicate a brackish lagoon. A marine intercalation in the topmost part still reappears.

The Eger stratotype has been lately described by BÁLDI (1966, 1973), BÁLDI and SENEŠ (1975). The whole section is unconformably overlain by the "lower rhyolite-tuff" of 21-19 MA old.

The Egerian stratotype section is well below the supposed Oligocene-Miocene boundary.

KEY



REFERENCES

Báldi, T. (1966): Az egri felsőoligocén rétegsor és molluszkafauna újravizsgálata.–Földt. Közl., 96, pp. 171-194.

Báldi, T. (1973): Mollusc fauna of the Hungarian Upper Oligocene (Egerian).–Akadémiai Kiadó, Budapest, p. 511.

Báldi, T. (1979): Magyarországi oligocén és alsómiocén formációk kora és képződésük története.–Doktori értekezés (Manuscript).

Báldi, T. (1979): The age and evolutional history of the Oligocene/Lower Miocene formations in Hungary. (in press).

Báldi, T. /198o/ : A korai Paratethys története /The early history of the Paratethys/ - Földt. Közl. 11o, pp.456-472

Báldi, T., Báldi-Beke, M., Horváth, M., Kecskeméti, T., Monostori, M., Nagymarosy, A. (1976): A hárshegyi homokkő kora és képződési körülményei.–Földt. Közl., 106, pp. 353-386.

Báldi, T., Kecskeméti, T., Nyírő, M.R., Drooger, C.W. (1961): Neue Angaben zur Grenzziehung zwischen Chatt und Aquitan in der Umgebung von Eger (Nordungarn).–Ann. Mus. Nat. Hung., 53, pp. 67-132.

Báldi, T., Nagymarosy, A. (1976): A hárshegyi homokkő kovásodása és annak hidrotermális eredete.–Földt. Közl., 106, pp. 257-275.

Báldi, T., Seneš, J. (1975): OM Egerien - Chronostratigraphie und Neostratotypen. Bd. V., p. 577, VEDA, Bratislava.

Báldi-Beke, M. (1972): The nannoplankton of the Upper Eocene Bryozoan and Buda Marls.–Acta Geol. Ac. Sci. Hung., 16, pp. 211-228.

Báldi-Beke, M. (1977): A budai oligocén rétegtani és fáciestani tagolódása nannoplankton alapján.–Földt. Közl., 107, pp. 59-89.

Báldi-Beke, M., Báldi, T. (1974): A novaji típusszelvény (kiscellien-egerien) nannoplanktonja és makrofaunája. – Földt. Közl., 104, pp. 60-88.

Boda, J., Monostori, M. (1973): Üledékmozgási jelenség a Budai Márgában.–Földt. Közl., 103, pp. 199-201.

Bouma, A.H. (1964): Turbidites. - In: Bouma, A.H. et Brouwer, A. ed.: Turbidites. Development in Sedimentology 3. Elsevier, pp. 247-256.

Cicha, I., Hagn, H., Martini, E. (1971): Das Oligozän und Miozän der Alpen und der Karpaten. Ein Vergleich mit Hilfe planktonischer Organismen.–Mitt. Bayer. Staatssamml. Pal. his. Geol., 11, pp. 279-293.

Crowell, J.C. (1957): Origin of pebbly mudstones.–Bull. Geol. Soc. Amer., 68, pp. 993-1010.

Drooger, C.W. (1961): Miogypsine in Hungary.–Proc. Kon. Ak. Watensch., ser. B., 64, pp. 417-427.

Dzulynski, S., Książkiewicz, M. and Kuenen, Ph. (1959): Turbidites in Flysch of the Polish Carpathian Mountains. – Geol. Soc. Amer. Bull., 70, pp. 1089-1118.

Hantken, M. (1875): A Clavulina szabói rétegek faunája. – Földt. Int. Évk., IV, p. 88.

Kázmér, M. (1982): A budai felső-eocén mészkő mikrofácies vizsgálata. (p. 115, manuscript.)

Kecskeméti, T. (1980): Az eocén/oligocén határ nagyforaminifera vizsgálatok szempontjából.–Őslénytani Viták (Discussiones Palaeontologicae), 25, pp. 47-68.

Koch, A. (1871): A Szt-Endre-Visegrádi és a Pilis hegység leírása.–Földt. Int. Évk., 1, pp. 1-60.

Lőrenthey I. (1911): Újabb adatok Budapest környéke harmadidőszaki üledékeinek geológiájához.–M. thematikai és Természettudományi Értesítő, XXIX/1, pp. 118-139.

Méhes, K. (1943): Alsó oligocén lepidocyclinás képződmény előfordulása Solymáron.–Besz. Vitaül. Munk., Évi jel. függ., pp. 303-307.

Roth v. Telegdi, K. (1914): Felső-oligocén fauna Magyarországról.–Geol. Hung. I, pp. 1-66.

Schréter, Z. (1939): A Bükk-hegység délkeleti oldalának földtani viszonyai.–M. Földt. Int. Évi. Jel., 1933-35., 2., pp. 511-526.

Schréter, Z. (1955): Az Eger környéki oligocén képződmények.– MÁFI Évi Jel. 1953. II., pp. 389-393.

Sztrákos, K. (1978): Stratigraphie et foraminiferes de l'oligocéne du Nordest de la Hongrie - These de doctorat, Paris, manuscript.

Varga, P. (1982): A Tardi Agyag alsó tengeri szintjének kora, allodapikus mészkőbetelepülések alapján.–Földt. Közl., 112, pp. 177-184.

V. Zilahy, L. (1967): Felsőeocén foraminiferák Felsőtárkány környékéről (DNY-Bükk).–MÁFI Évi Jel. az 1965. évről.

Weiler, W. (1933): Két magyarországi oligocénkorú halfauna.– Geol. Hung. Ser. pal., 11. p. 54.

Weiler, W. (1938): Neue Untersuchungen am mitteloligozänen Fischen Ungarns.–Geol. Hung., ser. pal., 15, p. 30.

Wein, Gy. (1977): A Budai-hegység tektonikája.–MÁFI Kiadv. Budapest, p. 76.