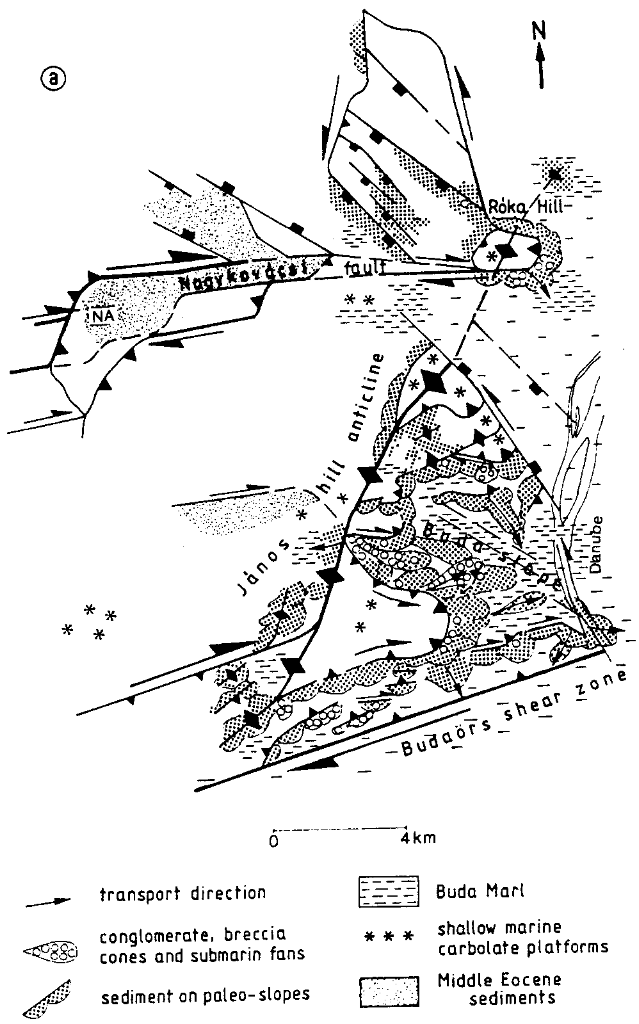

Fig. 10: Tectono-sedimentary model of the Buda Hills. Middle Eocene in the Nagykovácsi depression and Upper Eocene in the rest of Buda Hills (Fodor et al., 1992). Most of the marine sediments were deposited on the southeastern slope of the NE trending Jánoshegy anticline. Mátyás-hegy quarry is within the circle.

cerroazulensis cocoaensis). The calcareous nannoplancton indicates the transition of the NP 18/19-20 zones. In the basal 0,5 m of the marls *Chiasmolithus oamaruensis* is already rather frequent, however, *Isthmolithus recurvus* is still missing. Thus this basal part still belongs to the NP 18 zone. However, *I. recurvus* occurs in the more upper part, marking already the NP 19-20 zone for it.

Facies: The matrix with its rich planktonic assemblage indicates a pelagic basin into which the olistoliths were slided from the slopes. The very frequent existence of isolated, resedimented larger foraminifera in the matrix show that the olistoliths were not fully diagenetized not only here but also in the Raibl-patak quarry (see at Stop 3C) and in the famous outcrop of Nyergesújfalu, Sánchegy (Sztanó & Fodor, 1998).

Buda Hills

P. Ozsvárt, M. Kázmér, L. Fodor, T. Kecskeméti, & Gy. Less

Buda Hills is the easternmost outcrop of the Bakony tectonic unit, the earliest recognized of the escaping wedges in the Alpine-Carpathian region. During Eocene time the Bakony unit occupied a position immediately to the north of the Southern Alps. Their 500 km separation observed today is the result of mostly Oligo-Miocene dextral displacement along the Periadriatic-Balaton fault system (Kázmér & Kovács, 1985). The displacement was initiated not later than late Eocene time: results of synsedimentary deformation within the escaping wedge are spectacularly displayed in the Buda Hills.

STRATIGRAPHY

P. Ozsvárt, M. Kázmér & Gy. Less

Eocene clastic and carbonate sediments of the Buda Hills were deposited on the so-called Buda slope, the southeastward dipping flank of a complex Upper Eocene anticline system, trending obliquely to the southern border fault of the escaping wedge (Fig. 10) (Fodor et al., 1992, 1994). Sedimentary environments on the slope ranged from subaerial to shallow bathyal. There are frequent redeposition features: practically any sediment in a higher position on the slope could be redeposited by sliding, slumping, grain flow or turbidity currents onto a sediment in a lower position (Kázmér et al., 1993; Fodor et al., 1992, 1994). Fortu-

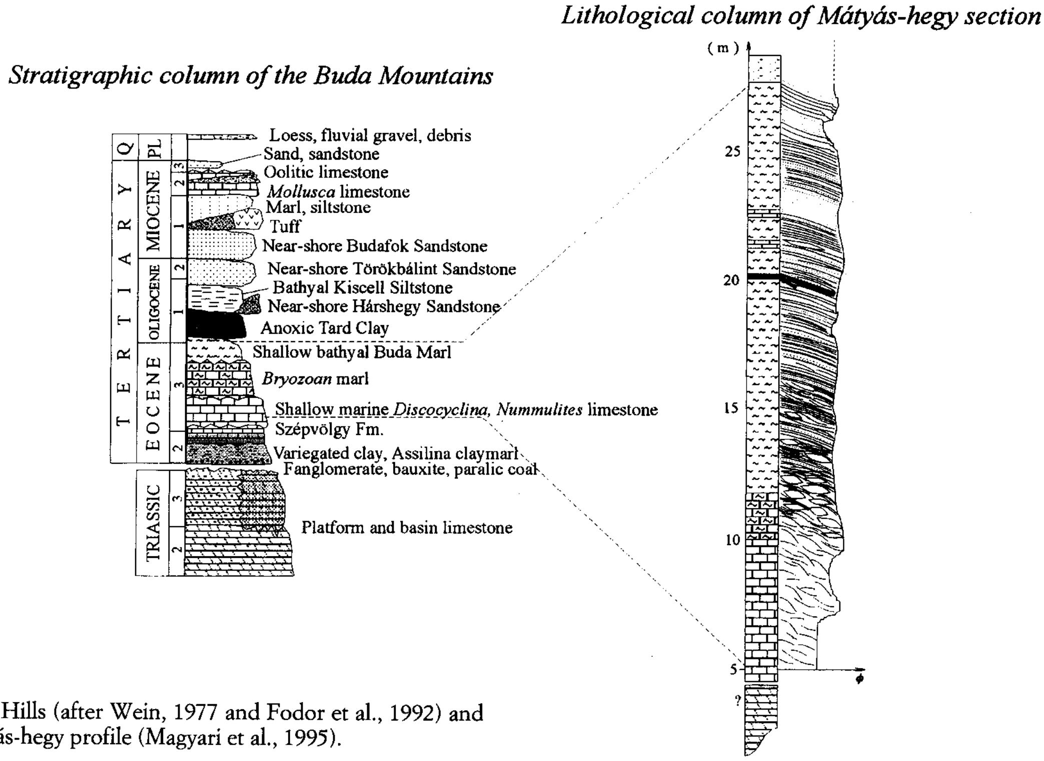

Fig. 11: Stratigraphy of Buda Hills (after Wein, 1977 and Fodor et al., 1992) and lithology of the Mátyás-hegy profile (Magyari et al., 1995).

nately, the depositional succession at Mátyás-hegy was preserved intact. In the southern and eastern parts of the Buda Hills the Eocene transgression starts only at the beginning of the Late Eocene. The ideal Upper Eocene section is displayed in Fig. 11. It is very similar to that of the Bükk Mts. (see there), however the change from neritic to pelagic facies (the transition from Szépvölgy Limestone to the Bryozoan/Buda Marl) is slightly older in the Buda Hills (NP 20 calcareous nannoplankton zone) than in the Bükk Mts. (NP 21). The Oligocene Tard and Kiscell Clays are also common in the two regions.

STOP 4: Mátyás-hegy, western quarry: "*Discocyclina*" beds (SBZ 19) and Bryozoa beds

P. Ozsvárt, M. Kázmér, Gy. Less,
L. Fodor & T. Kecskeméti

The Mátyás-hegy, western quarry has been a classical section of Upper Eocene carbonate and marl succession studies for more than a century. Maximilian von Hantken, founder of the Department of Palaeontology at Budapest University (today Eötvös University) investigated the sequence and the fauna the first time in the 1870s (Hantken, 1873). Based on the analysis of carbonate microfacies (Kázmér, 1985), calcareous nannoplankton (Báldi-Beke, 1972), larger foraminifera (Kecskeméti, 1989, this work), echinoids (Bartha, 1992), bivalves (Bodó, 1992), bryozoans (Zágorsek, 1993; Zágorsek & Kázmér, 2000), benthonic foraminifera (Sztrákos, 1987; Ozsvárt 2000), and planktonic foraminifera (Sztrákos, 1987), the initiation and process of subsidence of the area occurred in Priabonian time (Kázmér et al., 1993).

Location: The section is situated in Budapest, district 3, at the fork of the Virág Benedek and Mátyáshegyi streets (Fig. 12), opposite the entrance of Pálvölgy Cave. The quarry is part of the Buda Natural Protection Area. It hides several entrances to the Mátyás-hegy Cave, member of a more than 10 km long cave system lying within a 1 km-radius circle.

Lithostratigraphy, lithology and fossil content: A nearly complete continuous Priabonian sequence (Fig. 13) is exposed in this quarry: palaeoenvironments range from transgressive conglomerate (Kosd Formation) through neritic limestone (Szépvölgy Limestone) and bryozoan marl to shallow bathyal globigerina marl (Buda Marl).

The oldest formation of the section is Norian marlstone beds and cherty dolomite exposed at the western end of the quarry. Mottled clay, dolomite conglomerate and chert breccia are considered as basal transgressive beds of the Upper Eocene limestone (Fig. 15).

The sequence is subdivided into three units (from bottom upwards):

1) "*Discocyclina*" limestone: hard compact limestone (0–10 m) containing great quantity of ortho-

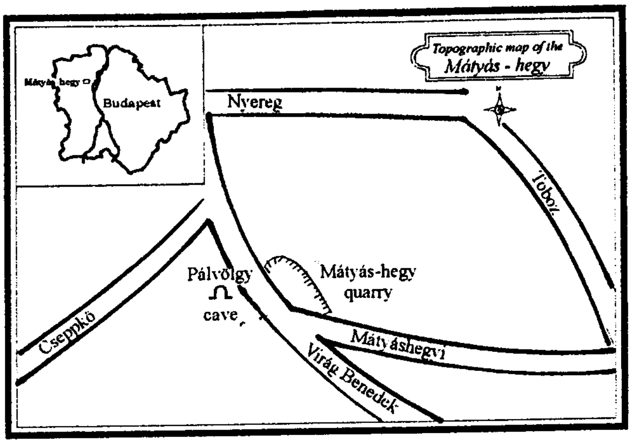

Fig. 12: Location of Mátyás-hegy, western quarry.

phragminids, in the lower 5 m in rock-forming quantity. Besides orthophragminids, there are rare *Nummulites, Assilina, Operculina, Spiroclypeus* and *Heterostegina* (Tab. 7), *Asterigerina* and *Miliolina* as well as other benthonic smaller foraminifers. Their most common elements are *Cibicides, Cibicidoides, Eponides* and *Lenticulina* with an increasing frequency in the section from the bottom upwards (Tab. 8). Other accessory elements are bryozoan and echinoid fragments. There are corallinacean algae in considerable quantity. *Chlamys* and *Cardita* are frequent in this part of the section. The most frequent echinoids are the *Echinolampas* and *Schizaster* (10 m);

2) Marly limestone–"*Discocyclina*" calcareous marl (10–13 m). The fauna is basically identical with that of the underlying formations, differing only in the ratio of the elements. Apart from the orthophragminids, the bryozoans are accumulated in rock-forming quantity, and the number of echinoid fragments is significantly increased as well. A few *Sphaerogypsina*, agglutinated foraminifers and *Ditrupa* sections represent new elements in the fauna. The corallinaceans are accessory elements of the assemblage (3 m);

3) Marl–Bryozoa marl and Buda marl – increasingly less compact upwards (13-30 m). In the section above 15 m there are angular extraclasts. These are micrite clasts without orthophragminids and other bioclasts, and fine grained clasts with some Orthophragminae. At 20 m there is a 10-20 cm thick, white rhyolite tuff layer. The rock-forming fossils are bryozoans (Zágorsek, 1993). These are represented almost exclusively by branching and encrusting species. There are subordinate orthophragminids, *Heterostegina, Miliolina,* and echinoids. In the argillaceous facies – mainly in the uppermost part of the section – there are benthonic and planktonic foraminifers (Tab. 8), as well as sponge spicules (17 m).

Boundaries drawn upon carbonate microfacies studies (Kázmér, 1985), however, display a minor shift compared to the lithological boundaries. There are three microfacies types (Fig. 14), from bottom upwards:

1) "Orthophragmina" rudstone in an "Orthophragmina" packstone matrix (0–6 m; samples 1–10);

2) "Orthophragmina" floatstone in an algal-"Orthophragmina" –bryozoan–echinoid packstone matrix (6–16 m; samples 10–31);

3) Bryozoa floatstone in bryozoa-wacke/packstone matrix (16– 21 m; samples 32–41).

Age: Among the rich microfauna, larger foraminifera have considerable stratigraphical value. Tab. 7 shows that it is a characteristic Priabonian assemblage. It can be put more precisely into the SBZ 19 zone based on two arguments. On the one hand, two important taxa, characteristic for the SBZ 20 zone and also quite frequent there (see the Kisgyór outcrops, Stop 6, Bükk Mts.), namely *Nummulites retiatus* and *Discocyclina trabayensis vicenzensis* are missing. On the other hand the overlying Buda Marl belongs still to the NP 20 calcareous nannoplankton zone showing that the transition from neritic to pelagic conditions could happen well before the Eocene/Oligocene boundary (unlike in the Bükk Mts. – see there).

Facies: Synsedimentary tectonic movements just at the beginning of the Late Eocene sedimentation can be observed at the western end of the quarry where a small,

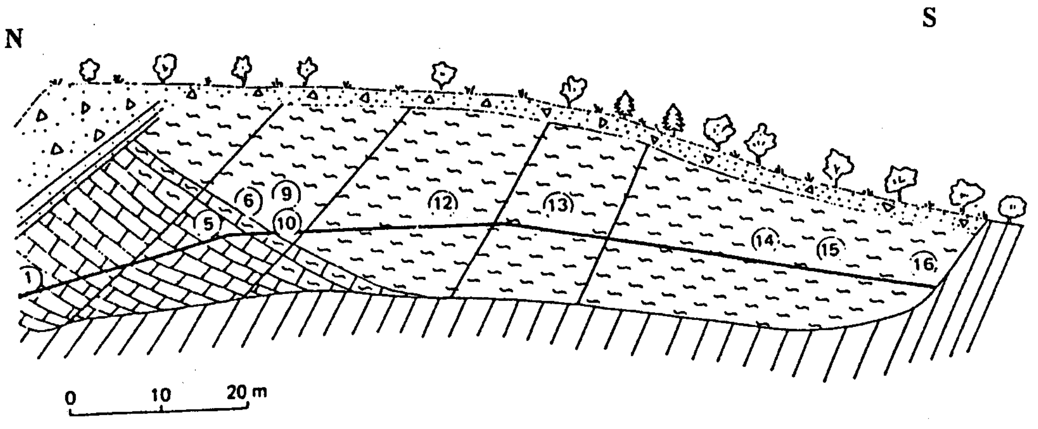

Fig. 13: Sketch of the southern face in Mátyás-hegy quarry (Monostori, 1982).

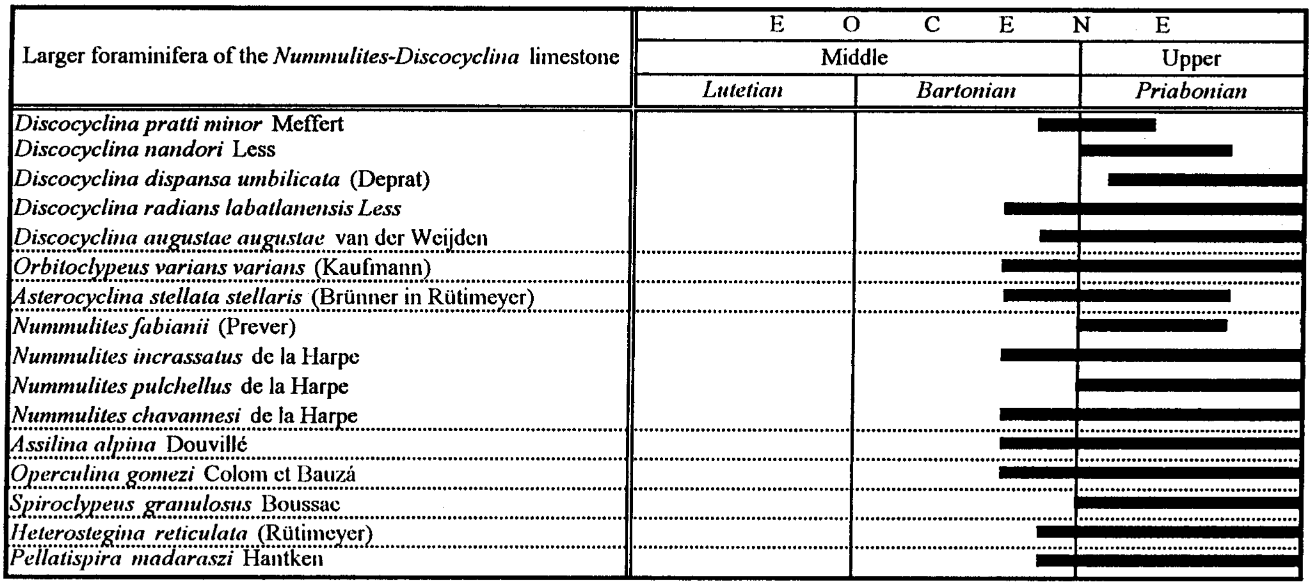

Table 7: Larger foraminiferal fauna of the Mátyás-hegy (partly after Kecskeméti, 1989, with additional new data of Gy. Less).

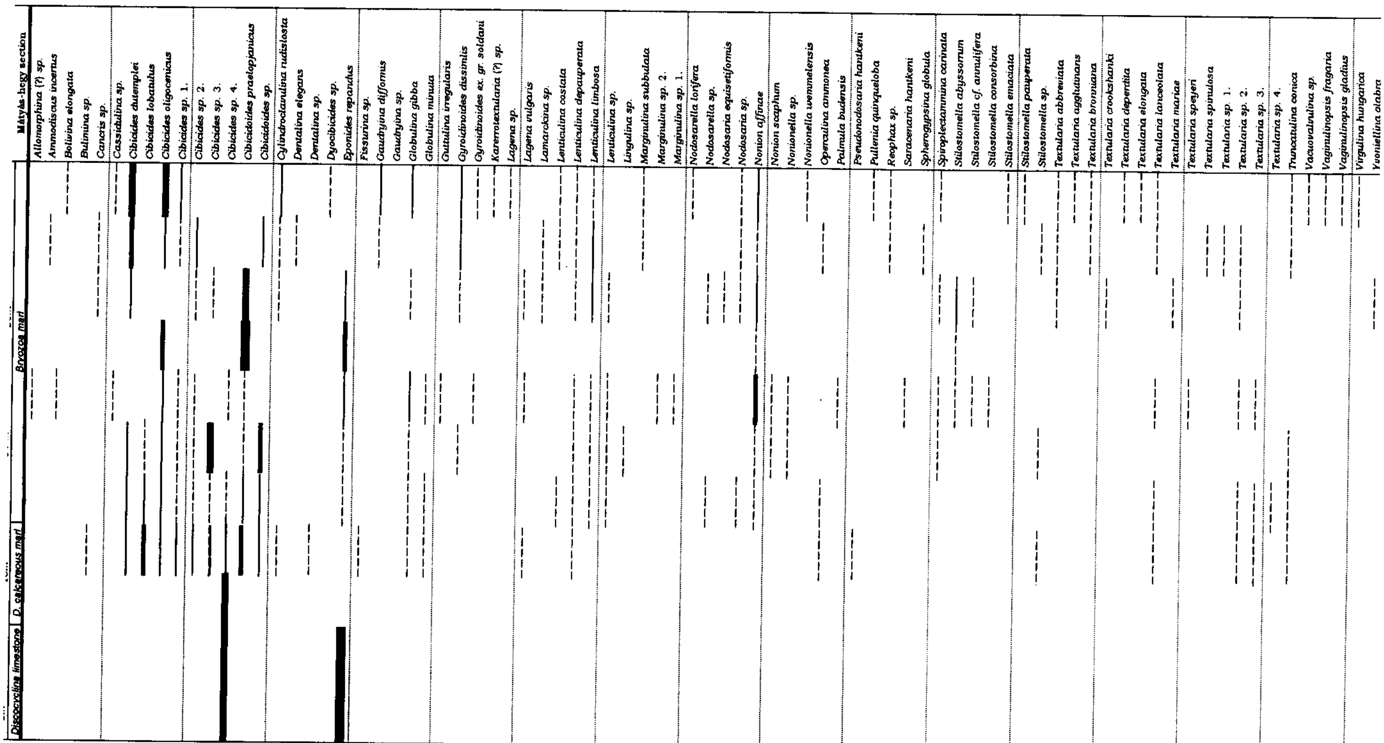

Table 8: Benthic foraminiferal fauna of the Mátyás-hegy (Ozsvárt, 2000).

semicircular conglomerate talus cone is bounded by a fault (Fig. 15). The conglomerate body bears no internal structure but contains thin sand/silt intercalation capping the cone. These acted as sliding planes as shown by slumped bodies overlying the sandstone. Bioclastic limestone displaying conspicuous downslope shear overlies both the cone and Triassic basement, thus dating the tectonic displacement (Fodor et al. 1992, 1994).

The following subsidence history is documented by the "*Nummulites*" limestone and "*Discocyclina*" limestone, both deposited in the euphotic zone, in probably

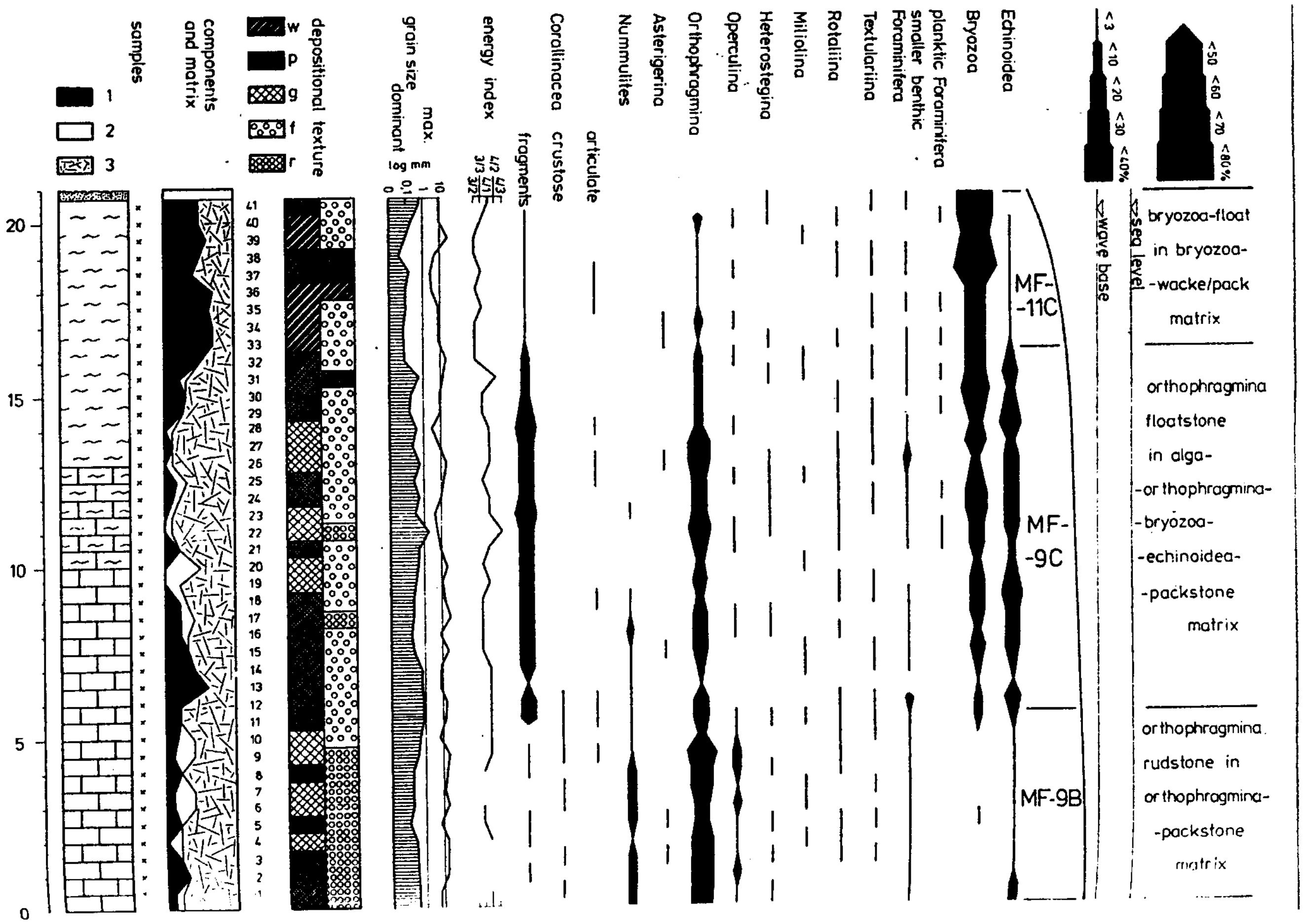

Fig. 14: Microfacies plot of Mátyás-hegy quarry (Kázmér, 1985).

not more than 100 m depth (middle sublittoral zone). Although authors mostly agree that Buda Marl was deposited in bathyal depth, exact values vary: Báldi (1986, p. 10) suggests 200 to 1000 m depth based on *Propeamussium* bivalves. Zágorsek (1993) suggested 400 m for the bottom beds of bryozoan marl and 1200 m for the topmost bed, comparing the ratio of erect and encrusting bryozoan species with those in modern oceans. Due to a bias caused by fragmentation and disappearance of encrusting species on a muddy bottom, the latter calculation certainly offers a maximum depth only. However, smaller benthic foraminifera show a maximal depth of 150-250 m (lower sublittoral–shallow bathyal zone). Anyhow, the bryozoan marl preserved a record of rapid subsidence of the Buda slope in Priabonian time. Compared to the moderate thickness, it represents a major subsidence. We suggest that in a sequence stratigraphic framework it should be considered a maximum flooding surface (MFS).

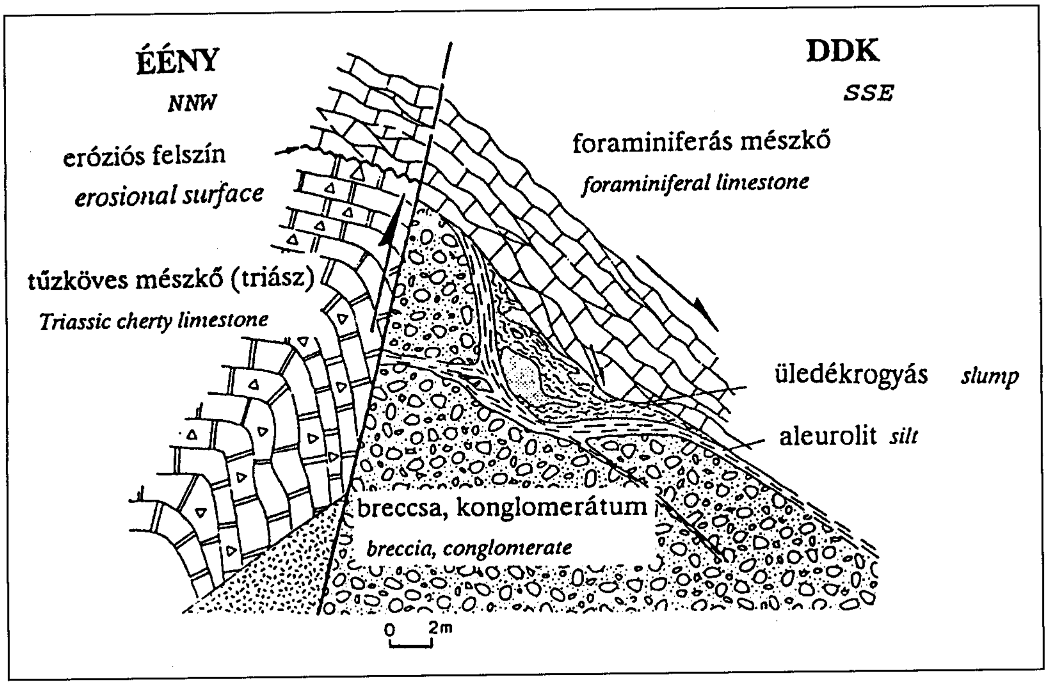

Fig. 15: The synsedimentary talus cone at Mátyás-hegy quarry, northern face (Fodor et al., 1992).

Bükk Mountains

Gy. Less & M. Báldi-Beke

The Bükk Mountains (Fig. 16) lie in NE Hungary, approx. 150 km E-NE of Budapest. Their main body consists of metamorphic and strongly tectonized Carboniferous to Jurassic rocks, covered by a non-metamorphosed Upper Eocene to Upper Miocene sequence. The Paleogene forms a single sedimentary cycle (Báldi, 1986) and contains two horizons very rich in excellently preserved larger foraminifera. In Stops 5 and 6 the lower (Upper Eocene) horizon is visited whereas Stop 7 represents the upper, Upper Chattian horizon.

STRATIGRAPHY
Gy. Less

A simplified stratigraphic column of the Paleogene deposits of the Bükk Mts. is shown in Fig. 17. The Upper Eocene sequence of the Bükk Mts. that is very similar to that of the Buda Hills starts with a 0-100 m thick terrestrial complex (mainly red clays with some debris of Paleo-Mesozoic rocks) called Kosd Formation terminating in some brackish layers containing non-industrial coal-seams. The next complex, called Szépvölgy Limestone (60-80 m thick) lies on these brackish beds but very often it transgresses directly onto the Paleo-Mesozoic basement. In its lower part red algae dominate with *Nummulites fabianii* and with some other subordinate larger foraminifera altogether representing the SBZ 19 zone. Isolated specimens are very rare, however in Stop 5 (Noszvaj, Attila-kút) they are quite frequent. In its upper, 20-30 m thick part the larger foraminiferal composition becomes much richer, different radiate *Nummulites*, *Assilina alpina*, *Spiroclypeus* and different orthophragminids appear. *Nummulites fabianii* is changed by *N. retiatus*. A few marly intercalations with isolated larger foraminifera representing already the SBZ 20 zone have been found in this horizon in the last years (Less, 1999) that are presented in Stop 6 (Kisgyór, Remete-kút). Calcareous nannoplankton represents already the NP 21 zone here. Upsection, the Lower Oligocene pelagic Buda Marl (NP 21-22 zones) follows. This means that the carbonate platform of the Bükk Mts. got drowned later than in the Buda Hills.

From the beginning of the Oligocene the territory

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FIELD TRIP GUIDEBOOK

Shallow water benthic communities at the Middle-Upper Eocene boundary.

Southern and North-Eastern Italy, Slovenia, Croatia, Hungary