

**ANNALES**  
**UNIVERSITATIS SCIENTIARUM**  
**BUDAPESTINENSIS**  
**DE ROLANDO EÖTVÖS NOMINATAE**

**SEPARATUM**

**SECTIO GEOLOGICA**

**TOMUS XXVIII.**



**BUDAPEST**  
**1988**

# LOWER CRETACEOUS FACIES ZONES IN THE BAKONY UNIT OF HUNGARY

by

M. KÁZMÉR

Department of Palaeontology, Eötvös University, H-1083 Budapest,

Kun Béla tér 2, Hungary

(Received: 30th May, 1987)

## Abstract

Contrasting lithology, highly varied sediment thickness and differences in the timing of pelagic sedimentation provide a tripartite division of the Bakony unit in the Neocomian. A deep basin in the Zala region, containing thick Biancone limestone and pelagic, dark marl, corresponds to the Lombardian basin of the Southern Alps. An elevated ridge (below the photic zone) with condensed sedimentation corresponds to the Trento plateau, and a contemporaneous flysch basin in the Gerecse to the Belluno trough.

## Introduction

The Bakony unit is situated in the NW part of the Pannonian basin. It is bordered by the Rába and Balaton strike-slip faults, which are parts of the Periadriatic lineament system (KÁZMÉR, 1986) (Fig. 1.). It has been displaced from the Alps to its actual position by an Oligocene continental escape (KÁZMÉR and KOVÁCS, 1985). Its Lower Cretaceous formations, among others, are closely similar to those of the Southern and Eastern Alps (FÜLÖP, 1964). The marked differentiation of the Southern Alps into distinct facies zones: the Friuli platform, the Belluno trough, the Trento plateau, and the Lombardian basin with several internal swells and troughs (AUBOUIN, 1963; BOSELLINI, 1973), made us to look for similar features in the Bakony unit. This paper summarizes the results for the Lower Cretaceous (Neocomian).

Twelve published Neocomian surface and subsurface profiles, ranging from the Zala region in the west to the Gerecse region in the east are correlated with each other, emphasizing lithology and sediment thickness (Fig. 2). Their interpretation is given in the framework of a basin and ridge submarine topography.

## Stratigraphy (Fig. 2)

Up to now the most important works on the Neocomian of the Bakony unit were prepared by FÜLÖP (1958, 1964), more than two decades ago. His data are still reliable and form the basis for the present paper. Further refe-

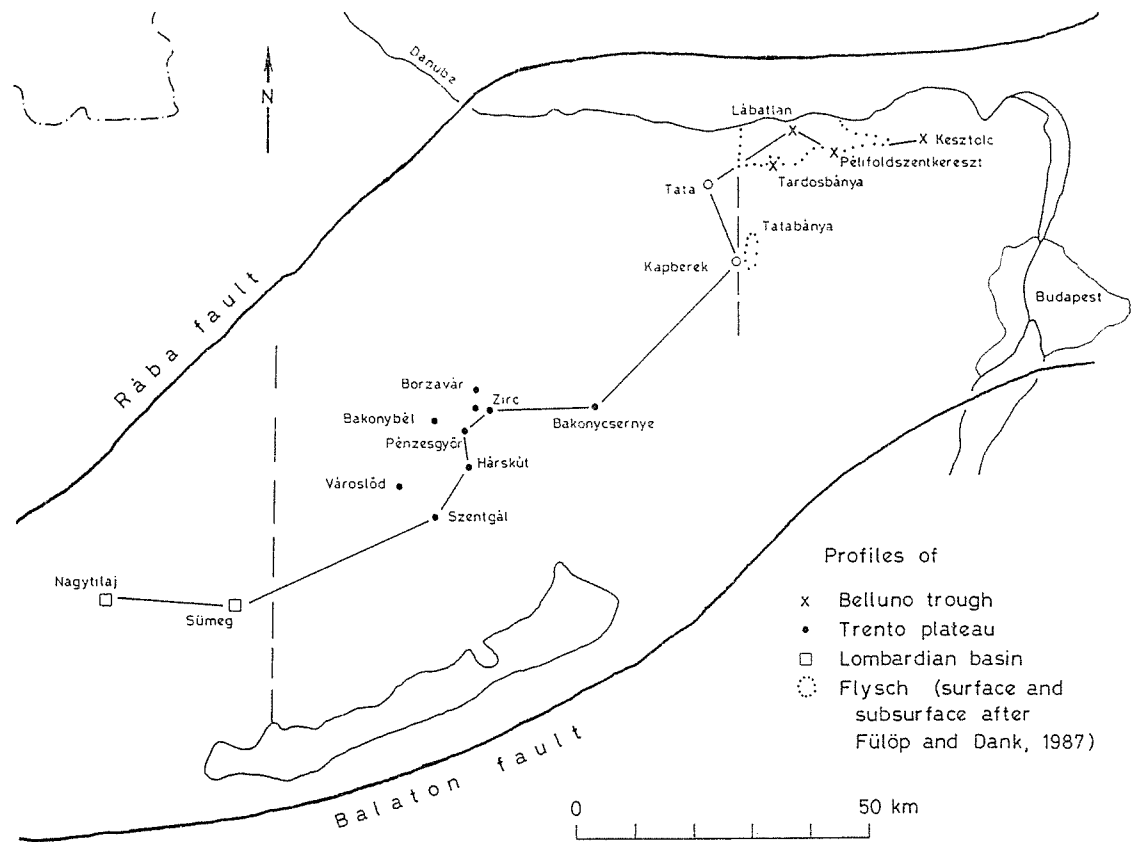


Fig. 1. Location of Lower Cretaceous profiles in the Bakony unit of Hungary. The dashed lines indicate the approximate position of basin-plateau boundaries.

rences on the lithology, biostratigraphy and sedimentology of the formations are provided by KÁZMÉR (1986).

#### *Biancone* (Tithonian – Lower Hauterivian)

(= Mogyorósdomb Limestone Formation). White, thin-bedded limestone with dark chert nodules and beds. The Berriasian – Lower Hauterivian section is about 250 m thick in a surface profile, but isoclinal folding makes this number imprecise. Its stratigraphy is based on calpionellids (TARDI – FILÁ CZ, 1986), ammonoids (VÍGH in HAAS et al., 1985), and magnetostratigraphy (MÁRTON, 1986). The Tithonian – Berriasian boundary is localized in the Mogyorósdomb surface profile at Sümeg, but the other occurrence in Nagytilaj – 2 borehole is poorly dated.

#### *Grey marl* (Hauterivian – Aptian)

(= Sümeg Marl Formation). Light grey, poorly bedded marl and siltstone, without sandstone layers (FÜLÖP, 1964, HAAS et al., 1985). Thickness: 250 m in Süt – 17 borehole (no tilt correction). The rich nannoflora and planktonic foraminifer fauna and ammonite shells indicate deposition in a

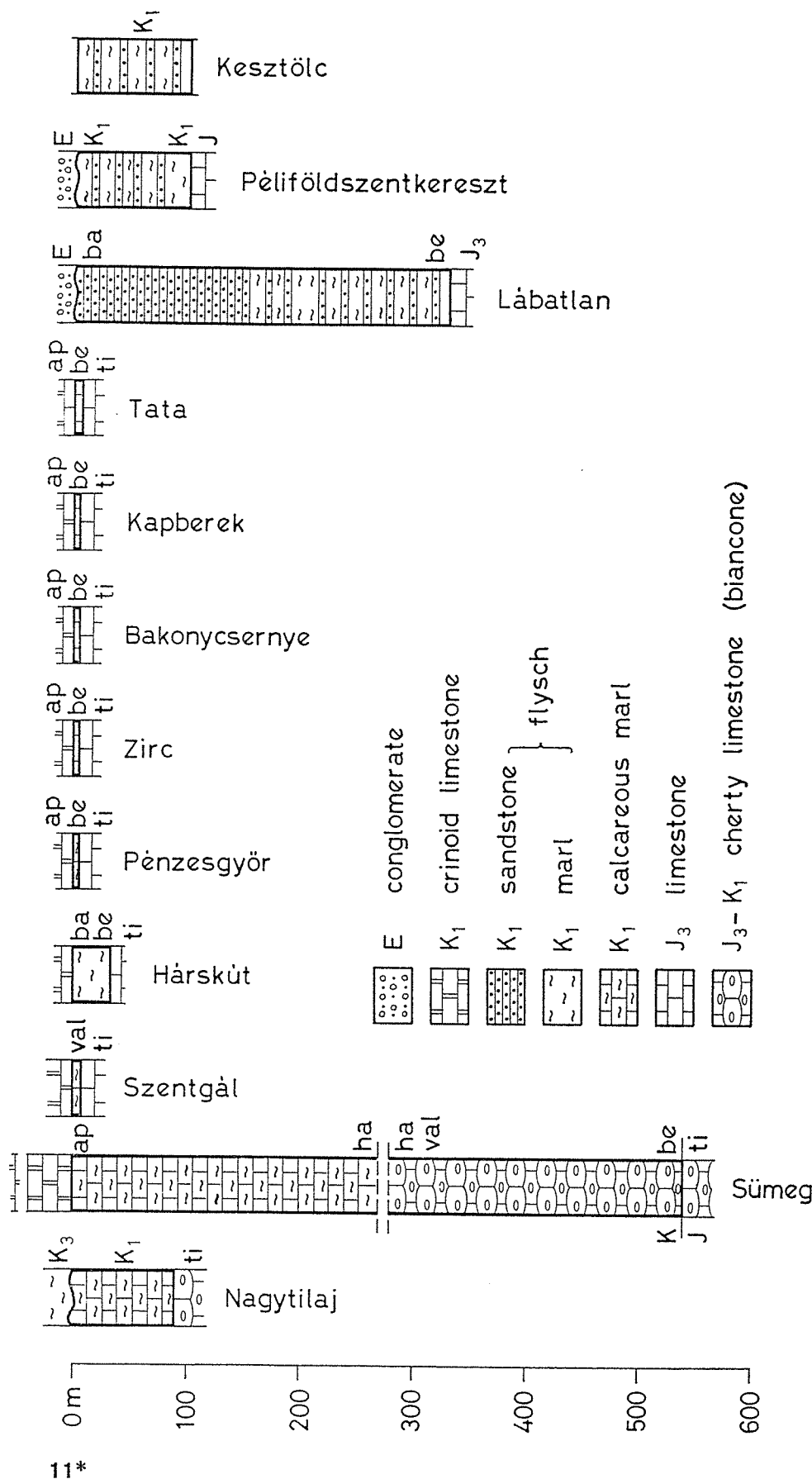


Fig. 2. Stratigraphic columns of Lower Cretaceous profiles in the Bakony unit. Thick Biancone (white cherty limestone) and dark marl sequence characterizes the Zala basin, highly condensed limestone and marl sequences occur on the Bakony plateau (including a minor trough at Hárskút). The Gerece basin displays thick shaly and sandy flysch.

Sources: Nagytilaj - 2 borehole: Kőrössy (1987); Sümeq: Biancone (Mogyorósdomb Hill): HAAS et al. (1985), marl: Süt - 17 borehole: HAAS et al. (1985); Szentgál - 1 borehole: FÜLÖP (1964); Hárskút, Közöskút ravine (FÜLÖP (1964); Pénzesgyőr, Somhegy: FÜLÖP (1964); Zirc, Bocskorhegy: FÜLÖP (1964); Bakonycsérnye, Tűzköves ravine FÜLÖP (1964); Vértessomló, Kapberek - 43/K - I. borehole: FÜLÖP et al. (1965); Tata, TVG - 59 borehole: FÜLÖP (1976); Lábatlan, MÁK - II borehole: FÜLÖP (1958); Péliföldszentkereszt (drawn from a section): GYDAI (1985); Kesztölc, Esztengom - 91 borehole: NAGY (1968), RÁKOSI (1971).

pelagic environment above aragonite compensation depth. Its subsurface exposures are known in the Sümeg region only.

A ca. 90 m thick profile in Nagytílaj – 2 borehole (1048 – 1140 m) exposes “unbedded, calcareous marl, brownish red with green spots, hard rock of conchoidal fracture. SZEPESHÁZY and DUBAY considered it Valanginian” (KŐRÖSSY, 1987, p. 116); however, lithological correlation with the Hauterivian – Aptian Sümeg Marl is more probable. Unfortunately, biostratigraphical data are not available. The marl is underlain by Biancone limestone.

*Calpionellid limestone* (Tithonian – Berriasian)

(= Szentivánhegy Limestone Formation). Red, compact, pelagic limestone with rich fauna: *Calpionella alpina*, *Globochaete* (FÜLÖP, 1976) and ammonoids (VÍGH, 1984). Thin beds: thickness range from 0,2 to 2,0 m in the Berriasian. Frequent hardgrounds and dissolved ammonites occur (VÍGH, 1984). Localities: Zirc, Bakonycsérnye, Kapberek and Tata.

*Condensed limestone beds* (Berriasian to Barremian)

(Mogyorósdomb Formation and Borzavár Formation). Thin (0,3 to 2 m) limestone beds with rich ammonite fauna, and phosphate oncoids (FÜLÖP, 1964; MISZLIVÉCZ and POLGÁRI, 1987). Age is mostly Berriasian, rarely Valanginian and Barremian. Locally encrinite occur with well-preserved calyxes (SZÖRÉNYI, 1959).

*Flysch* (Berriasian to Barremian)

(Bersek Marl and Lábatlan Sandstone Formations). Upper Tithonian calpionellid limestones, covered by limonitic hardgrounds, are overlain by thin Berriasian sandstone and calcareous breccia (FÜLÖP, 1958; VÍGH, 1984). Valanginian – Lower Hauterivian grey and red marls, with graded sandstone layers follow. The upper part is Upper Hauterivian – Barremian sandstone with interbedded marls, displaying graded bedding, flute casts, trace fossils etc. The sequence is capped by Barremian chert breccia and conglomerate (FÜLÖP, 1958; CSÁSZÁR in CSÁSZÁR and HAAS, 1984). The more than 300 m thick Neocomian sequence is a prograding submarine fan: distal turbidites (Bersek Marl), proximal turbidites (Lábatlan Sandstone) and a fan channel sequence (breccia and conglomerate) (KÁZMÉR, 1987a). Rare molds of ammonites and frequent aptychi indicate deposition between aragonite and calcite compensation depths.

*Crinoid limestone* (Aptian)

(Tata Limestone)

Grey crinoid limestone with rare chert nodules, siliceous sponge spicules and sandy intercalations. Mostly biosparite, less biomicrite. Contains glauconite. Brachiopod and ammonite faunulas occur at the bottom, and benthic and

planktonic foraminifers above. Besides crinoid ossicles it contains much carbonate extraclasts (LELKES, 1985). It has been deposited below the photic zone, in a deep neritic to shallow bathyal environment. References: FÜLÖP (1964, 1976); HAAS et al., (1985).

### Facies zones

Lithological and thickness variations (Fig. 2) make possible to recognize three facies zones in the Bakony unit of Hungary. Similar positions of Lower Liassic facies zones based on South Alpine analogues (KÁZMÉR and KOVÁCS, 1985; KÁZMÉR, 1987b) provided considerable help.

#### *Zala basin*

It covers the present-day geographic region of the North Zala hydrocarbon basin, and the westernmost part of Bakony Mts. around Sümeg. This palaeogeographic unit is based on two localities, the Nagytillaj – 2 borehole, and two boreholes (Süt – 17, Sp – 1) and a single outcrop at Sümeg.

However, the similar sequence: Upper Jurassic (to Hauterivian) biancone (more than 250 m thick), covered by more than 280 m grey, pelagic marl indicate a deep marine depositional environment above aragonite compensation depth. Conspicuous isoclinal folding (unknown elsewhere in the Bakony unit) (HAAS et al., 1985) and a surplus number of magnetostratigraphic zones (MÁRTON, 1986) in the Biancone may be due to slumps and slump folds in the sequence, indicating bathyal, slope environment. This basin shows close relationships to the Lombardian basin of the Southern Alps (KÁZMÉR and KOVÁCS, 1985).

The Sümeg locality has belonged to the neritic Bakony (=Trento) plateau in Hettangian time (KÁZMÉR, 1987b). Its shift to a basin environment before Neocomian indicate the eastward “prograding” of the Zala basin. A detailed investigation in terms of the Lombardian basin – Trento plateau border zone in the Southern Alps (CASTELLARIN, 1972) will provide more details.

#### *Bakony plateau*

Instead of the more than 500 m thick Neocomian sequence at Sümeg in the Zala basin, the Bakony plateau – extending from Szentgál to Tata – displays sequences usually less than a metre thick (but never exceeding 27 m). These beds are Biancone-like marls at the three western localities: Szentgál, Hárskút and Pénzesgyőr, and micritic limestones and encrinurites in all other places. Absence of organisms which need light indicate deposition below the photic zone. Small thickness, condensation, frequent stratigraphic gaps, hardgrounds and phosphatic nodules indicate currents sweeping the plateau, preventing deposition of sediments.

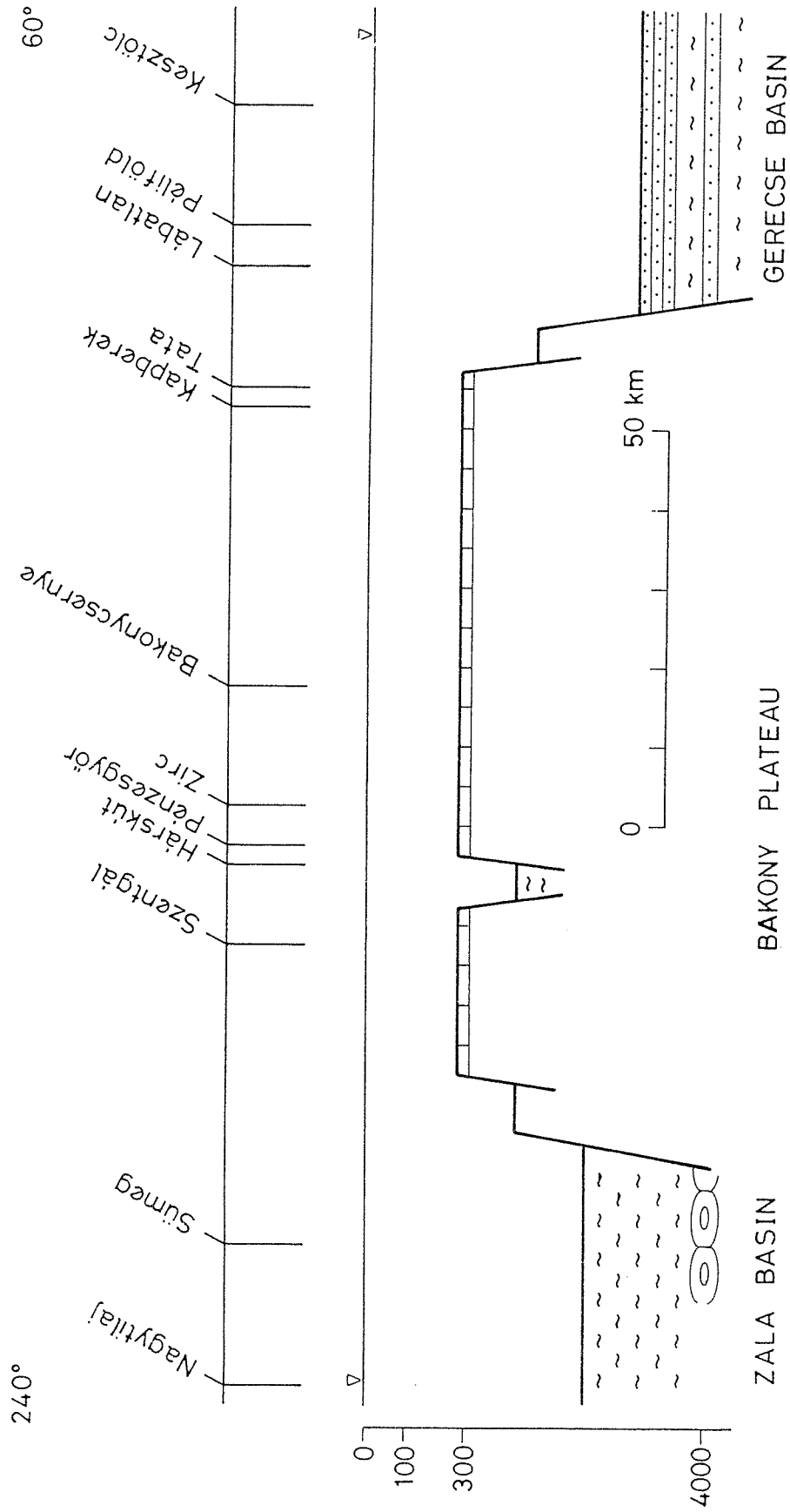


Fig. 3. Schematic palaeogeographic section of Bakony unit in Early Cretaceous (Berriasian - Barremian) time. The depth scale on the left indicates intervals only: 100 to 300 m: deep neritic; 300 to 4000 m: bathyal environment. The Zala basin contains a thick Biancacone and dark marl sequence deposited above ACD. The Bakony plateau displays a highly condensed, sometimes less than 1 m thick limestone and marl sequence, with frequent gaps. The Gerecse basin is filled by a thick turbidite sequence, deposited between ACD and CCD. (Localities of Neocomian profiles are projected on a 240° - 60° line, representing the long axis of the Bakony unit.)

*Gerecse flysch trough*

It extends from the immediate eastern neighbourhood of Tata (CSÁSZÁR and HAAS, 1979) to at least Kesztlőc in the east. Following the detailed description of FÜLÖP (1958), the flysch character of the Gerecse Neocomian was recognized by CSÁSZÁR and HAAS (1979). The sediments of a prograding submarine fan (KÁZMÉR, 1987a) have been deposited in a relatively quickly subsiding basin (330 m flysch at Lábatlan vs. 0,3 m limestone at Kapberek and 6,3 m crinoid limestone at Tata (TVG-59 borehole). The western margin was a fault, as shown by the immediate neighbourhood of the reduced Kapberek sequence and the Tatabánya flysch (data for the latter locality are available only from the pre-Cenozoic map of FÜLÖP and DANK, 1987).

Close similarities between the Gerecse flysch and the Rossfeld beds in the Northern Calcareous Alps have been known for a long time (FÜLÖP, 1958). Their relationship can be understood in the palinspastic framework of KÁZMÉR and KOVÁCS (1985), which placed the Bakony tectonic unit to the south of the Northern Calcareous Alps.

A possible palaeogeographic section emphasizing topographic differences during Neocomian time is shown in Fig. 3. The boundaries between the basins and the plateau are considered as faults, since no transition between them has been observed.

The pelagic feed-up model of pre-Neocomian basins as described by GALÁCZ et al. (1985) is valid for the Bakony plateau itself; the Zala and especially the Gerecse basins show an increase in differential subsidence.

### Conclusions

The Bakony unit contains three facies zones in Hungary: the Zala basin in the west filled by 550 m carbonate and pelitic sediments; the Gerecse basin in the east with more than 330 m flysch and the Bakony ridge between them with condensed carbonate sedimentation. Their similarity with the Southern Alpine Lombardian basin, Belluno (equals to North Alpine Rossfeld) basin and Trento plateau, respectively, provides further support for the Mesozoic position of the Bakony unit within the Alps.

### REFERENCES

- AUBOUIN, J. (1963): Essai sur la paléogéographie post-triasique et l'évolution secondaire et tertiaire du versant sud des Alpes orientales (Alpes méridionales; Lombardie et Vénétie, Italie; Slovénie occidentale, Yougoslavie). — Bull. Soc. Géol. France (7) 5, 730–766, Paris
- BOSELLINI, A. (1973): Modello geodinamico a paleotettonico delle Alpi meridionali durante il Giurassico–Cretacico. Sue possibili applicazioni agli Apennini. — Accademia Nazionale dei Lincei, Quaderno 183, 163–205, Roma
- CASTELLARIN, A. (1972): Evoluzione paleotettonica sinsedimentaria del limite tra “piattaforma veneta” e “bacino lombardo” a nord di Riva del Garda. — Giornale di Geologia 38/1, 11–212, Bologna



- CSÁSZÁR, G., HAAS, J. (1979): Review of facies and paleogeography of the Cretaceous in Hungary. — In: Wiedmann, J. (ed.): *Aspekte der Kreide Europas*, IUGS Ser. A 6, 413–424, Schweizertbart, Stuttgart
- CSÁSZÁR, G., HAAS, J. (1984): Hungary. 27th Int. Geol. Congr., Excursion 104: Mesozoic formations in Hungary, Guidebook, 92 p. Vízdok, Budapest
- FÜLÖP, J. (1958): Die kretazeischen Bildungen des Gerecse-Gebirges. — *Geologica Hungarica*, ser. Geol. 11, 124 p., Budapest
- FÜLÖP, J. (1964): Unterkreide-Bildungen (Berrias-Apt) des Bakonygebirges. — *Geologica Hungarica*, ser. Geol. 13, 194 p., Budapest
- FÜLÖP, J. (1976): The Mesozoic basement horst blocks of Tata. — *Geologica Hungarica*, ser. Geol. 16, 229 p., Budapest
- FÜLÖP, J., DANK, V. (eds.) (1987): Magyarország földtani térképe a kainozoikum elhagyásával. (Geological map of Hungary without Cenozoic cover.) Magyar Állami Földtani Intézet, Budapest, 1:500 000
- FÜLÖP, J., KNAUER, J., VÍGH, G. (1965): Ein Juraprofil im Vértesgebirge. — *Földtani Közlöny* 95/1, 54–61, Budapest (in Hungarian with German abstract)
- GALÁCZ, A., HORVÁTH, F., VÖRÖS, A. (1985): Sedimentary and structural evolution of the Bakony Mountains (Transdanubian Central Range, Hungary): Paleogeographic implications. — *Acta Geologica Hungarica* 28/1–2, 85–100, Budapest
- GIDAI, L. (1985): Conditions stratigraphiques de l'Oligocène dans la partie ouest du Bassin de Dorog (Hongrie). — *Földtani Közlöny* 115/4, 369–384, Budapest
- HAAS, J., J-EDELENYI, E., GIDAI, L., KAISER, M., KRETZOI, M., ORAVECZ, J. (1985): Geology of the Sümeg area. — *Geologica Hungarica*, ser. Geol. 20, 365 p., Budapest
- KÁZMÉR, M. (1986): Tectonic units of Hungary: Their boundaries and stratigraphy (A bibliographic guide). — *Annales Univ. Sci. Budapest, Sect. Geol.* 26, 45–120, Budapest
- KÁZMÉR, M. (1987a): A Lower Cretaceous submarine fan sequence in the Gerecse Mts., Hungary. — *Annales Univ. Sci. Budapest., Sect. Geol.* 27, 101–116
- KÁZMÉR, M. (1987b): Lower liassic facies zones in the Bakony unit of Hungary. — *Annales Univ. Sci. Budapest., Sect. Geol.* 27, 89–100
- KÁZMÉR, M., KOVÁCS, S. (1985): Permian–Paleogene paleogeography along the eastern part of the Insubric–Periadriatic lineament system: Evidence for continental escape of the Bakony–Drauzug unit. — *Acta Geologica Hungarica* 28/1–2, 71–84, Budapest
- KŐRÖSSY, L. (1987): Hydrocarbon geology of the Little Plain in Hungary. — *Általános Földtani Szemle* 22, 99–174, Budapest (Hungarian with English abstract)
- LÉLKE, Gy. (1985): Quantitative petrography and depositional environment of the Tata Limestone Formation (Aptian) in the northern Bakony Mountains (Transdanubia). — *Annual Report Hung. Geol. Inst. for 1983*, 303–319, Budapest
- MÁRTON, E. (1986): The problems of correlation between magnetostratigraphic zones in Late Jurassic–Early Cretaceous section. — *Acta Geologica Hungarica* 29/1–2, 125–131, Budapest
- MISZLIVÉCZ, E., POLGÁRI, M. (1987): Fe–P bearing calcareous concretions from Zirc “Marble quarry” (Transdanubian Central Range, Hungary). — *Annales Univ. Sci. Budapest., Sect. Geol.* 27, 121–134
- NAGY, G. (1968): Magyarázó a Dorogi-medence földtani térképéhez, 10.000-es sorozat, Kesz-tölc. (Explanations to the 1:10.000 geological map of the Dorog basin, Sheet Kesz-tölc.) Magyar Állami Földtani Intézet, Budapest, 50 p.
- RÁKOSI, L. (1971): Palynologische Untersuchung des Neokom-Untergrundes des Doroger Braunkohlenbeckes. — *Annual Report Hung. Geol. Inst. for 1968*, 267–292, Budapest (Hungarian with German abstract)
- SZÖRÉNYI, E. (1959): Les Torynocrinus (Crinoïdes) du Crétacé inférieur de la Hongrie. — *Acta Geologica Acad. Sci. Hung.* 6, 231–271, Budapest
- TARDI-FILÁCZ, E. (1986): Investigation of Calpionellidea remnants from the Tithonian-Berriasian basic profiles of Tata and Sümeg. — *Acta Geologica Hungarica* 29/1–2, 37–44, Budapest
- VÍGH, G. (1984): Die biostratigraphische Auswertung einiger Ammoniten-Faunen aus dem Tithon des Bakony-Gebirges sowie aus dem Tithon-Berrias des Gerecsegebirges. — *Annales Inst. Geol. Publ. Hung.* 67, 210 p., Budapest