STRATIGRAPHY OF A MIDDLE JURASSIC – LOWER CRETACEOUS SEQUENCE N OF ZOBÁKPUSZTA, MECSEK MTS., HUNGARY

by

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Abstract

Results of the mapping in a scale of 1:10 000 of an area lying 4 km east to Komló, in Mecsek Mts., Southern Hungary are presented. The following formations are described: Aalenian-Bajocian grey mottled marl (Fleckenmergel), Bathonian red, nodular calcareous marl, Callovian greenish-grey cherty limestone, Oxfordian light grey cherty limestone, Kimmeridgian red, nodular, cherty limestone, Tithonian white, cherty limestone with intraclasts, Lower Cretaceous alkaline basalt and Recent calcareous tufa. Palaeontological, petrographical, microfacies, sedimentological, heavy mineral, X-ray and DTA investigations indicate open marine sedimentation during Middle and Late Jurassic. The sea deepended from the Aalenian-Bajocian onwards, reaching its maximum depth during Callovian-Oxfordian time. Decrease of depth followed later.

A Lower-Middle Bathonian profile with an abundant ammonite fauna is described for the first time, The substages could be recognized by the presence of *Morphoceras*, *Parkinsonia* and *Bullatimorphites*. *Cererithyris* sp. aff. *intermedia*, a brachiopod previously known to occur from Late Bathonian onwards, is described from Hungary for the first time.

Introduction

We have mapped the area between Hidasi and Takanyó valleys, N of Zobákpuszta, in the Eastern Mecsek Mts. in the scale of 1:10 000 *(Fig. 1)*. This area is very near to the classical Jurassic localities of Síngödör and Márévár valleys, the latter also exposing Lower Cretaceous volcanic rocks. Short notices concerning the mapped area were published by BÖCKH (1880 – 81), listing the fauna collected by HOFMANN in Hidasi valley, and about fifty years later VADÁSZ (1935) mentioned the Hidasi valley and its tributaries as good exposures of the Bathonian stage. KOVÁCS (1953) published a list of fossils collected from the Bathonian rocks near the "Csurgó" calcareous tufa locality. Unfortunately, all of these authors published a mixed list of fossils, indicating that collections were made indifferently from the different beds.

Recent works of BILIK (1966), SIDÓ (1966), NAGY I. (1966, 1967), HETÉNYI (1969), PATAKY et al. (1982) and FŐZY et al. (1985) published data on the lithostratigraphical subdivision, microfacies and foraminifer investigations and on the relationships between sedimentary and volcanic rocks.

The area is characterized by a ca. 20° N or NE dip of strata.

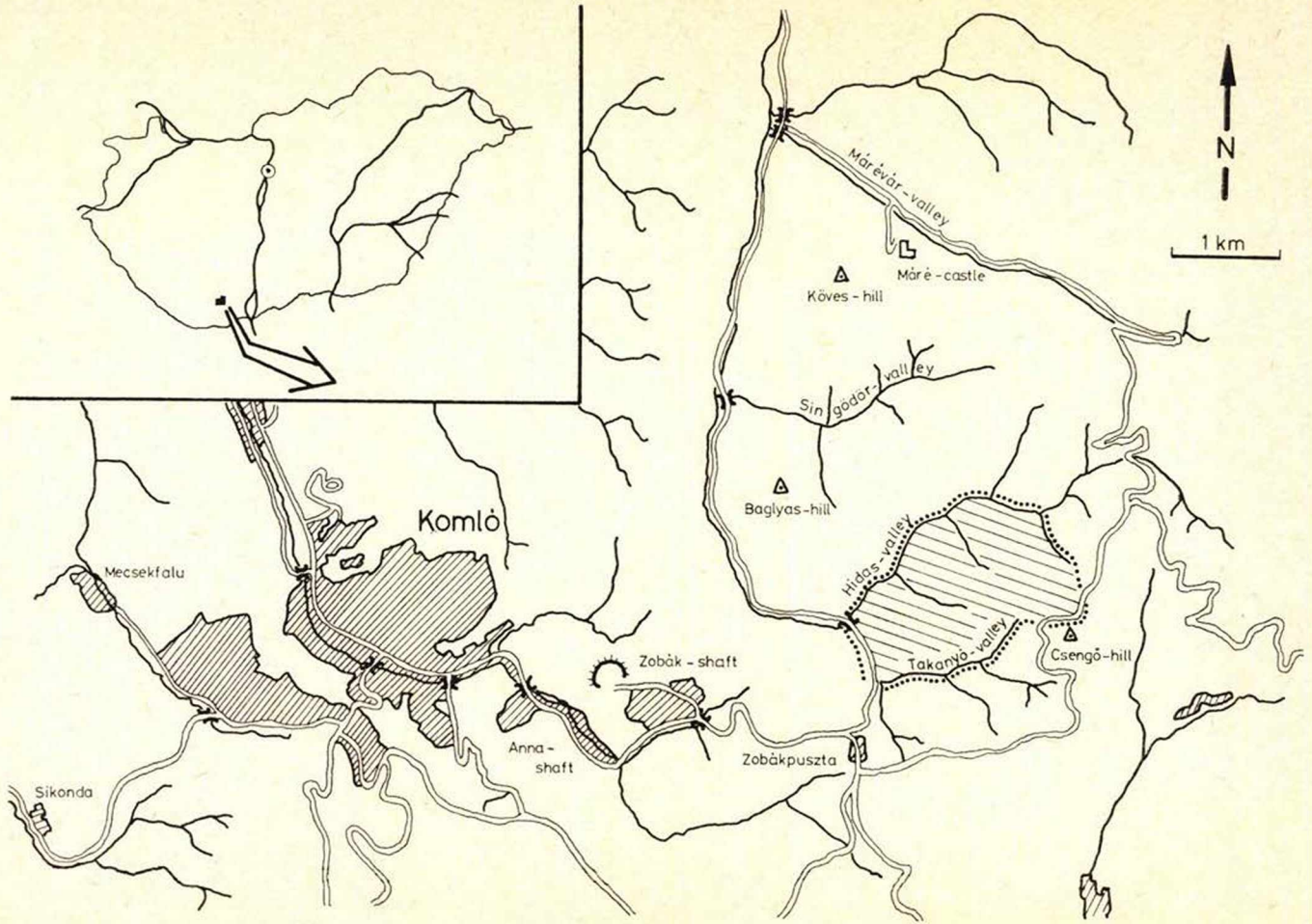

Fig. 1. Location of the investigated area in the eastern Mecsek Mts.

Description of the rocks

The geological map is shown on *Fig. 2*, completed by a stratigraphical column on *Fig. 3*.

Grey mottled marl (Fleckenmergel)

Dark grey rock with light grey spots, rarely with yellow ones. Bituminous. Lower part is silty clayey marl forming 1–1.5 cm thick laminae, separated by a slightly undulating clay film. Thin, 15–20 cm thick calcareous marl beds are intercalated in the lower part, thickening upwards to 0.5–1 m. Their number decreases upwards. The colour is lighter in the upper part and rare chert nodules appear at the top. The fossils are yellowish brown with a limonitic coating. Ammonites, *Bositra*, Belemnites rostra and plant fragments were found.

Thin section features: strongly clayey mudstone-wackestone with radiolarians, *Bositra* and other mollusc fragments and sponge spicules. Rare darker bands are interpreted as traces of bioturbation.

The heavy minerals are much limonite, less garnet, muscovite, pyrite, magnetite and pyroxene. After acid etching some radiolarians were found.

Neither mega-, nor microfossils were suitable for precise age determination. Lithological comparisons indicate Aalenian-Bajocian stages, but its Upper Toarcian age is possible at the SW part of the area (Vadász, 1935; Főzy et al., 1985).

The rock is part of the Komló Calcareous Marl Formation; its thickness exceeds 200 m.

Red nodular calcareous marl

Red calcareous marl, light yellow green, where weathered; alternating clayey and calcareous strata. The latter contain limestone nodules, 1 to 10 cm in diameter. The nodules are mostly oval; rarely these are ammonites. This marl shows a continuous transition downwards to the clayey gray Fleckenmergel. The red marl has been chosen as a guide bed for the mapping, due to its apparent colour, which made recognition easy.

The rich fossil fauna contains ammonites, Bositra, brachiopods, belemnites and echinozoans. Thin sections revealed a *Bositra*-wackestone microfacies, with plenty of mollusc fragments and some traces of bioturbation.

The 0.1–0.2 mm grain size fraction contains heavy minerals: abundant muscovite, limonite, magnetite and pyrite.

This formation belongs to the Bathonian stage, indicated by the ammonites Morphoceras and Bullatimorphites (*Plates* I and II). Its name is Óbánya Limestone Formation. This formation can be observed in a 13 m thick sequence, unique in the Mecsek Mts., which is described at the end of this paper.

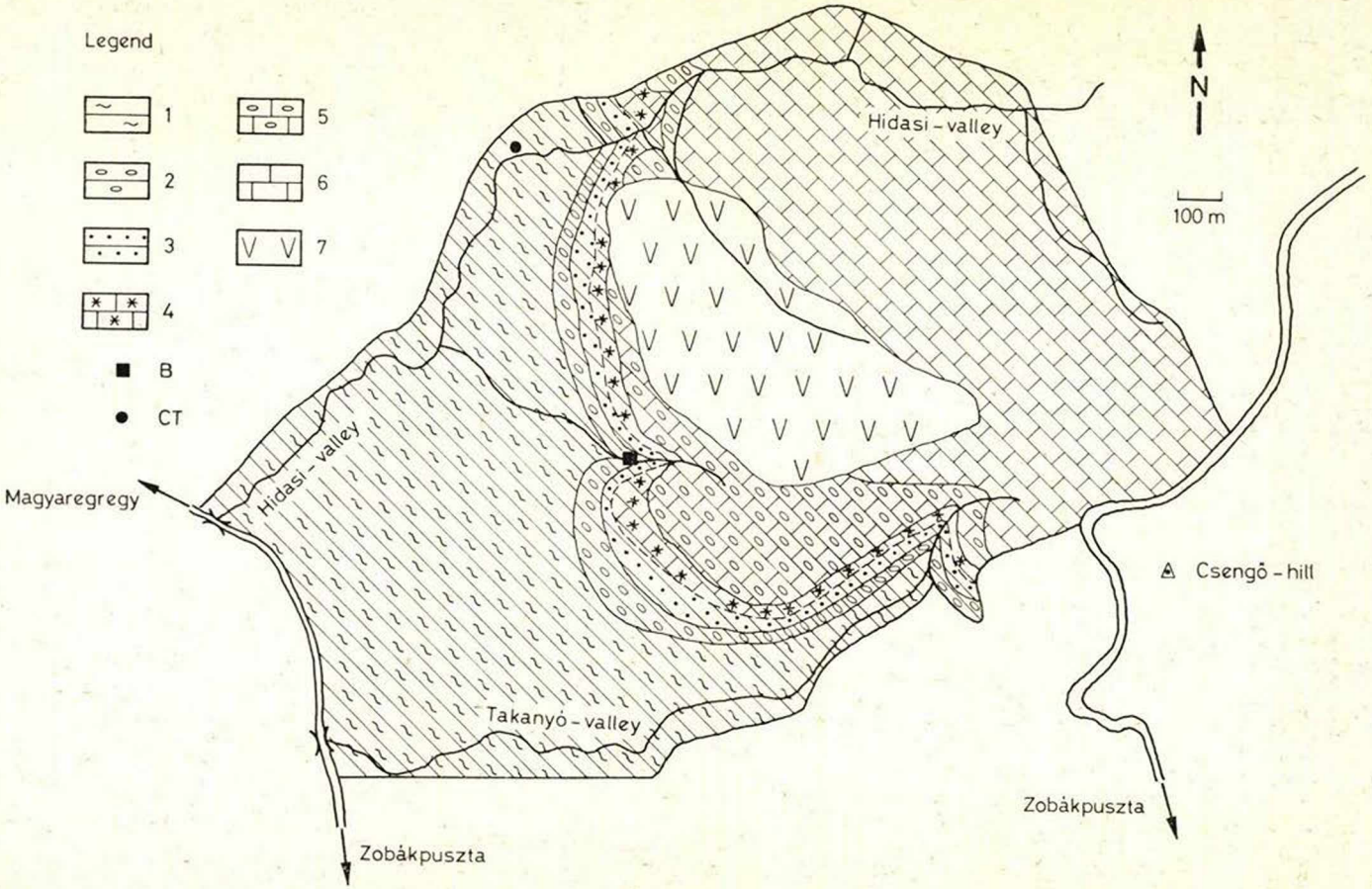

Fig. 2. Geological map. 1: Aalenian-Bajocian grey Fleckenmergel (Komló Calcareous Marl Formation). 2: Bathonian rend, nodular, calcareous marl (Óbánya Limestone Formation. 3: Callovian greenish grey cherty limestone (Dorogó Calcareous Marl Formation). 4: Oxfordian light grey cherty, Mn-dendritic limestone (Fonyászó Limestone Formation). 5: Kimmeridgian red, nodular, cherty limestone (Kisújbánya Limestone Formation). 6: Tithonian white cherty, intraclastic limestone (Mánvár Limestone Formation). 7: Loess. Contour

Greenish-grey cherty limestone – light grey cherty limestone with Mn-dendrites

This greenish grey, coarse-grained limestone is characteristically banded at the upper part of the sequence. The bands are red and yellow, with rare ochre intercalations. It is well-bedded, with wavy bedding surfaces. Thicker (50–60 cm) and thinner (20–30 cm) beds alternate. Thin, cm-sized clay intercalations occur in its lower part, disappearing upwards. The chert forms lenses or bands, displaying mostly brownish grey, rarely yellow and grey colour. There seems to be no continuous transition between the red nodular limestone and the greensih grey, cherty limestone.

The rock contains rare megafossils: a few aptychi have been found.

Thin section investigations revealed the rock to be wackestone-packstone, with abundant radiolarians; besides mollusc fragments and rare echinoderm fragments occur. The banding is visible in thin sections, too. The

thickness (m)	Lithology	Lithostratigraphy	Chronostratigraphy
	calcareous basalt		Recent
?	alcalic basalt	Mecsekjános Basalt F.	Lower Cretaceous
80	white, cherty, intraclastic limestone	Márévár Limestone F.	Tithonian
~20	red, nodular cherty limestone	Kisújbánya Limestone F.	Kimmeridgian
~20	light grey, cherty Mn-dendritic limestone	Fonyászó Limestone F.	Oxfordian
~20	greenish-grey cherty limestone	Dorogó Calcareous marl F.	Callovian
13	red, nodular calcareous marl	Óbánya Limestone F.	Bathonian
200	grey, spotted marl	Komló Calcareous marl F.	Bajocian Aalenian

Fig. 3. Stratigraphical column. Legend: see at the map, Fig. 2.
(Corr.: calcareous basalt read calcareous tufa)

radiolarians are ordered along limonitic bands. Rare intraclasts occur in the rock.

Heavy mineral examinations revealed some pyrite, limonitized ore minerals and amphiboles.

Neither mega-, nor microfossils allowed precise age determination and biostratigraphical separation of the subsequent cherty limestone with Mn-dendrites.

The former rock gradually changes into light grey, cherty, frequently Mn-dentritic limestone, bearing a greyish weathered surface. This is a finely grained limestone; its bedding surfaces are not nodular. It contains aptychi only.

A considerable enrichment of heavy minerals was shown in this rock: limonite, hematite, apatite, magnetite, tourmaline, muscovite, pyroxene, ilmenite, pyrite, garnet, staurolite and amphibole occur.

The microfacies is wackestone with frequent radiolarians and rare aptychi.

Its separation from the former formation is problematic; the two form the Callovian-Oxfordian stage together. These belong to the Dorogó Calcareous Marl and/or to the Fonyászó Limestone formation. Thickness is 20–20 m.

Red nodular cherty limestone

It shows a gradual transition to the underlying light grey, Mn-dendritic, cherty limestone. Texture is compact. In the lower part the red color dominates, turning into mottled upwards, being red, beige and green. Clay content also grows upwards. Megafossils are a few poorly preserved ammonites in the red part and aptychi in the upper part.

Thin section examination reveals a packstone-wackestone texture. The components are mostly echinoderm fragments with syntaxially overgrown calcite. A similar observation has been described by NAGY (1966). Upwards the fossil content changes into radiolarian- and sponge-rich wackestone.

Heavy mineral content mostly resembles to that of the Tithonian limestones: magnetite, limonite, tourmaline, muscovite, apatite and haematite.

The etched samples yielded a large quantity of sponge spicules, displaying tetraxon and Y-forms. Some linear forms also occur, with limonite coating. The amount of radiolarians is insignificant compared to the sponge spicules.

The transition to the overlying white, cherty, intraclastic limestone is not exposed in the mapped area. The age is Kimmeridgian, concluding its stratigraphic position below the Tithonian limestone. Its name is Kisújbánya Limestone Formation. Thickness: 20 m.

White, cherty, intraclastic limestone

White, micritic limestone of conchoidal fracture; it is rarely cherty. Its weathered surface is of yellowish tint, fresh fracture shows beige colour.

Frequently intraclasts occur. Their size ranges from a few millimetres to a few centimetres. The clasts are angular, with sharp edges. Chert occurs in thin, a few mm thick bands or lenses. The light red lower part of the formation, mentioned by VADÁSZ (1935) has not been found; probably the transition section is not exposed. Many small aptychi have been found.

Microfacies examinations: thin sections provided accurate data for the age determination. The rock is a Tithonian mudstone with calpionellids and radiolarians; the latter are nassellarians and spumellarians with easily observable pores. Calcisphaeres also occur, besides mollusc fragments. Narrow calcite veins transect the rock.

Heavy mineral content is relatively high, but similar to that of the underlying formation: limonite, magnetite, hematite, tournaline, muscovite and apatite.

Its name is Márévár Limestone Formation. Its thickness exceeds 80 m.

Alkaline basalt

The second side valley of Hidasi valley to the southeast exposes this formation *(Figs. 1, 2)*. It overlies the underlying formation without any observable contact phenomena. Its weathered surface is greenish brown. The fragmented surface is dark grey, locally black. No minerals could be identified by the naked eye. Rarely the rock shows columnar jointing and a very fresh surface.

Thin section texture is porphyric microholocrystalline. Mineral component are plagioclase, augite, magnetite and other opaque minerals. A conspicuous, red vein was found visible by the naked eye, but which could not be traced in the field. Its thin section characters are markedly different from those of the country rock. It shows equigranular texture with rare crystallites. Mineral components are plagioclase, augite, opaque minerals (more than in the country rock) and chlorite. Grain size is also larger than in the country rock.

Its age is Lower Cretaceous. Concerning its name and age we refer to the papers of BÖCKH (1876), VADÁSZ (1935), BILIK (1966) and NAGY I. (1967). It belongs to the Mecsekjánosi Basalt Formation. Thickness is unknown. Its relationships to other formations are not clear.

Calcareous tufa

Even VADÁSZ (1935) mentioned the "Csurgó" cliff made of calcareous tufa *(Fig. 2.)*. The cliff is about 5 m high and 5 m wide. The rock can be crushed by the fingers. It is travertino of yellowish colour. The process of the encrusting of plants by carbonates can be well observed here. The thin moss sheet growing on the rock surface is covered by a thin calcareous coating. Other calcarous tufa occurrences are in the Takanyó and Hidasi-valleys. These can be recognized easily by the occurrence of flat, slightly emerging terraces.

Lithology and microfacies of the most fossil-rich exposure of the Bathonian red nodular calcareous marl

The location of the exposure is marked by a black square on *Fig. 2.*, *Fig. 4* displays the profile idicating the ammonite and brachiopod content of the strata.

The profile exposes the Bathonian red, nodular, calcareous marl in 13 m thickness. We have made a bed-by-bed collecting. A clayey and the calcareous bed above it have got one number; altogether 55 units have been sampled.

Lithology: the lower 3 metres are characterized by alternating thin (5 cm) calcareous and somewhat thicker (6 – 7 cm) beds. In the following 3 metres the thickness of the calcareous beds attain 8 – 10 cm. In the upper part of the sequence both type of beds strongly thin, while total bed thickness shows considerable variation. In this thinly bedded section the group of beds were distinguished by the occurrence of thicker (8 – 10 cm) calcareous beds *(Fig. 4)*.

Microfacies: the whole profile is uniform *Bositra*-wackestone. In the lower part there are some echinoderm fragments together with a few foraminifers. The *Bositra* fragments are smaller that at the top of the profile. The beds are bioturbated; some burrowing traces are concentrically surrounded by *Bositra* shells. The amount of *Bositra* shells grows upwards, while the ratio of other bioclasts decreases. At the upper part of the exposure, where the red nodular calcareous marl turns into greenish grey compact limestone the microfacies characters also change. Plenty of intraclasts contain tiny ammonite shells, radiolarians and mollusc shell fragments. The coarse-grained matrix contains echinoderm fragments and *Bositra* shells.

Fauna and biostratigraphy of the Bathonian red nodular calcareous marl

Faunistic description of the exposure: The study of the collected material made possible to recognize substages in the sequence. Further collections from a larger surface are needed for the recognition of ammonite zones and subzones. The Phylloceratina are dominant element in the fauna (70,62%), while there are relatively few Lytoceratina (13,56%) and Ammonitina (15,82%). The Phylloceratina are represented by the following genera: *Phylloceras*, *Calliphylloceras*, *Holcophylloceras* and *Ptychophylloceras*. The Lytoceratina are represented by *Lytoceras* and *Nannolytoceras*. These genera and *Bositra*, Bivalvia, Spongia and Echinozoa are not figured on *Fig. 4*. A few ammonitines are figured on Pl. II – III.

The lower part of the profile (until bed 111) yielded a large amount of *Nannolytoceras* (partly *N. tripartitum*), which is frequent in the Lower Bathonian. This substage is also characterized by *Morphoceras* (bed 74; Pl. I, Fig. 5.) and *Parkinsonia* (bed 103). The appearance of *Bullatimorphites* in bed 118 indicates a stratigraphic level close to the base of the Middle Bathonian (Pl. II, fig. 1). The boundary of the Lower and Middle Bathonian substages possibly is at beds 119 – 120. Bed 122 yielded a *Cererithyris* sp.

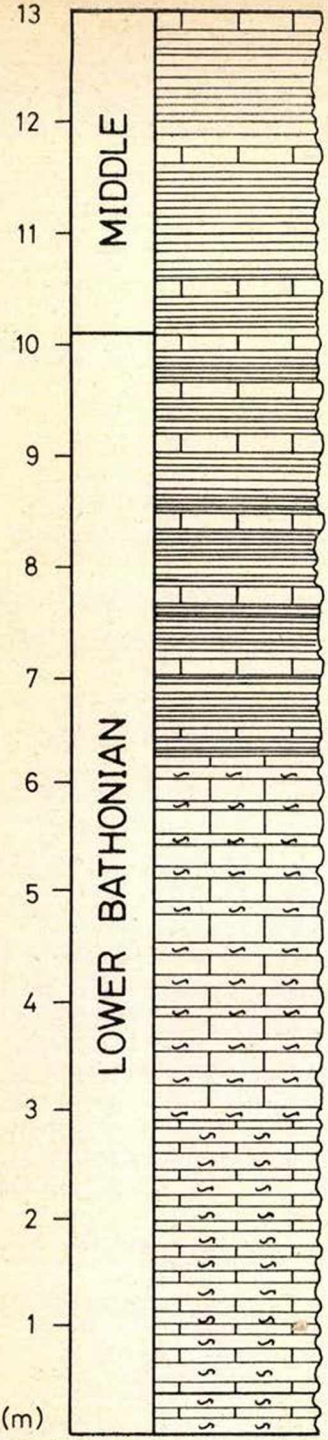

Fig. 4. Measured profile of the Bathonian section. Ammonitina genera and the occurrence of *Cererithyris* sp. aff. intermedia are indicated.

aff. *intermedia* (SOWERBY, 1812), (Pl. II, fig. 2, 3, 4) specimen; further three fragments were collected from the scree. This is the first occurrence of this genus in Hungary. It is characteristic for the NW-European ammonite province and is frequent in the Upper Bathonian substage. This genus appears earlier in the Mecsek Mts. of Submediterranean character, in the Middle Bathonian. The scree yielded also a brachiopod: *Caucasella* ? and the bivalve *Anisocardia* cf. *tenera* (SOWERBY, 1821), Belemnites rostra, echinozoans and most ammonite genera occurring in the profile. We have found plenty of ammonite specimens bearing the traces of worms in the siphonal canal.

Sedimentation environment

X-ray, DTA examinations and sedimentological and palaeontological observations were applied for the reconstruction of the Jurassic sedimentation environments.

The mottled marl (Fleckenmergel) contains relatively high percentage of silica and clay minerals: mostly montmorillonite illite. The red nodular calcareous marl beds contain the highest percentage of clay minerals. Above these beds the illite is dominant with a little associated montmorillonite. The ratio of silica decreases also. In the following greenish grey cherty limestone and light grey cherty limestone the amount of silica reaches its maximum, while the decrease of clay content begins. Its minimum is reached in the Tithonian strata. Towards the Tithonian the amount of silica strongly decreases *(Fig. 5)*.

The appearance of illite instead of montmorillonite indicates a deepening of the sea, supported by the increase of silica content. Palaeontological and sedimentological observations also support this statement.

Either benthonic or planktonic forms occur in the grey Fleckenmergel beds. Bioturbation was not intensive enough to totally mix the sediment. The high amount of terrigenous material indicates a nearshore, but not shallow marine environment. The grey colour indicates a reductive environment. The mottled appearance of the rock may be due to bioturbation.

The Bathonian red nodular calcareous marl is dominated by pelagic fauna: ammonites, *Bositra*, Belemnites and by a few inbenthonic and epibenthonic forms: Echinozoa, Crinoidea, Brachiopoda. Its red colour indicates deposition in an oxydative environment. It is also characterized by a high clay content.

The greenish grey, cherty limestone and the light grey, cherty, Mn-dendritic limestone is dominated by radiolarians, which, however, appear in older rocks also. The lack of ammonites may be due to their easily soluble aragonitic shell. This absence and the increasing percentage of cherts indicates deposition in a growing depth. Percentage of terrigenous material also decreases. Probably this was the maximum depth of the sea.

The red nodular chertly limestone also indicates deep sea, but the appearence of poorly preserved ammonites indicates a slight decrease of water depth. The most frequent fossils of these beds are aptychi.

High carbonate content and terrigenous material percentage of the white cherty intraclastic limestone also indicated deposition in an open marine environment. This is proven by calpionellids, calcisphaeres, radiolarians and aptychi.

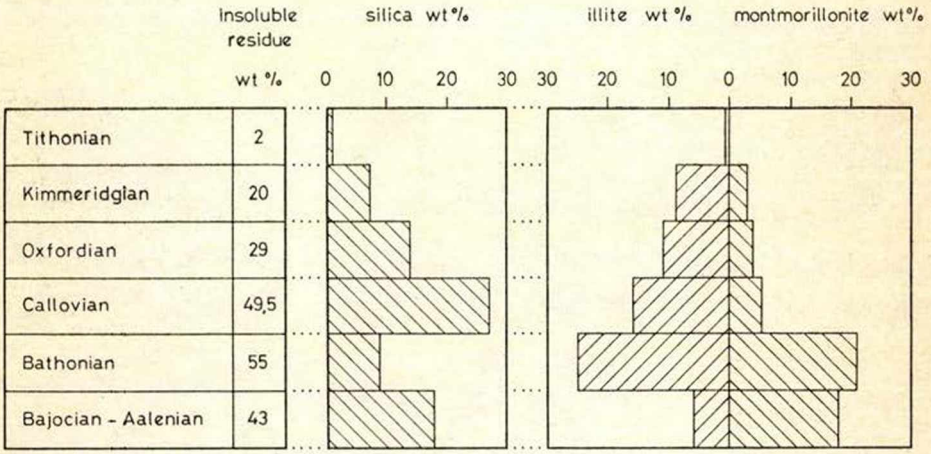

Fig. 5. Insoluble residue, silica and clay mineral (illite, montmorillonite) content in wt%.

Conclusions

A 1:10 000 geological map was made on the investigated area, joining the map of Főzy et al. (1985). Differentiation of the rocks can be made mostly on lithological grounds. Microfacies studies indicate the Tithonian age of the white intraclastic cherty limestone. Ammonite studies indicate the age of the Bathonian red nodular calcareous marl only.

The investigated profile exposes the thickest Bathonian sequence in the eastern Mecsek Mts. The ammonite fauna (*Morphoceras*, *Bullatimorphites*) indicates the presence of most of the Lower Bathonian and the lower part of the Middle Bathonian. Probably the upper parts of the Bathonian are missing due to subsolution or non-deposition.

Its fauna is dominated by Phylloceratina and Lytoceratina. The relatively high amount of the Ammonitina indicate a transition between the Mediterranean and the NW European ammonite provinces (Géczy, 1973, 1984). The brachiopod *Cererithyris* sp. aff. *intermedia* indicates the same position, since this species occurs later, in Late Bathonian time in the NW European province. Further collections may provide more evidences on the Submediterranean character on the Mecsek Jurassic.

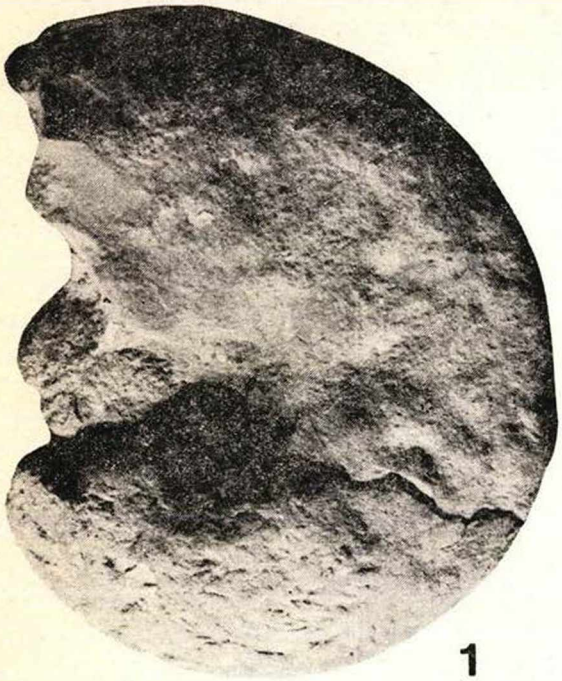

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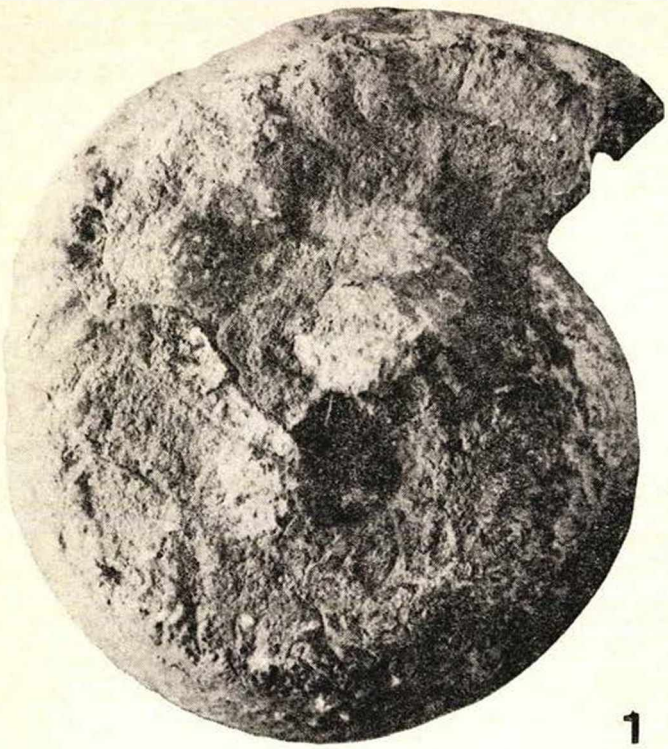
PLATE I.

Fig. 1. Lissoceras sp. (natural size)
Fig. 2. Procerites sp. (natural size)
Fig. 3. Oxycerites sp. (natural size)
Fig. 4. Oxycerites sp. Lateral view of the specimen of Fig. 3.
Fig. 5. Morphoceras sp. (natural size)



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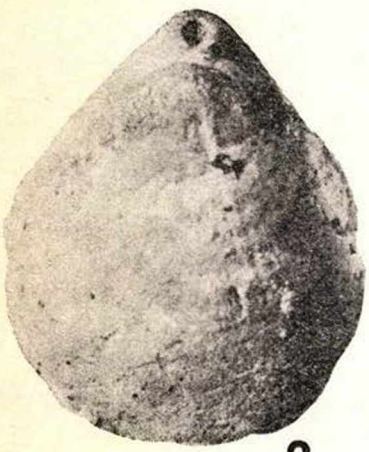

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PLATE II.

Fig. 1. Bullatimorphites sp. (natural size)
Fig. 2. Cererithyris sp. aff. *intermedia* (SOWERBY, 1812) (2x)
Fig. 3. Lateral view of Fig. 2.
Fig. 4. Cererithyris sp. aff. *intermedia* (SOWERBY, 1812) (2x)

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