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Bivalves from a Middle Jurassic submarine high (Bajocian, Som Hill, Bakony Mts, Hungary)

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(with 2 figures and Plate 6)

Abstract

Marine bivalves from a fissure filling of Upper Bajocian (Middle Jurassic) age are briefly described and figured. Palaeoecological analysis of the Som Hill assemblage as well as the similarity of its taxonomic composition to those of other, coeval faunas preserved in fissure-fillings suggest that a distinct bivalve assemblage populated fissures of some Mediterranean seamounts during the Middle Jurassic. Both in diversity and density, bivalves are subordinate to gastropods in the Som Hill fauna. The bivalve fauna is dominated by the epibyssal forms and consists of representatives of extinct genera except *Limopsis* and *Cuspidaria* s. l., which latter two are frequent in Recent deep-sea bivalve assemblages.

Key words: Middle Jurassic, Bajocian, Bivalvia, Bakony, Hungary, paleoecology

Introduction

Except some opportunistic and probably pseudoplanktonic forms such as *Bositra* (= "*Posidonia*" auctt.) and thin-shelled inoceramids, bivalves are not frequent elements in invertebrate faunas of the deeper-water Jurassic of the peri-Mediterranean region, where the macro-benthic asseblages are usually dominated by brachiopods. Bivalves other than those mentioned above have been especially rarely recorded from higher Middle Jurassic (Bajocian to Callovian) deposits, which represent times when considerably large areas provided hostile environmental conditions for benthic life. In most segments of the peri-Mediterranean region *Bositra*-bearing deep-water limestones, marls and radiolarites, – sediments probably deposited at the greatest water depth reached during the period –, represent these stages (see BAUMGARTNER 1986).

In contrast to the paucity in benthic molluscs of fossil assemblages in most of the typical Mediterranean Middle Jurassic environments, fillings of submarine fissures penetrated into submarine highs ("seamounts" or "guyots") yielded surprisingly rich bivalve and gastropod faunas (e. g. CONTI & FISCHER 1981, 1984; WENDT 1971). Such type of sediments have been known from the Jurassic of the Bakony Mts as well (e. g. VÖRÖS 1993). The most fossiliferous fissure-filling rocks of Middle Jurassic age are known from the Som Hill, from where the bivalves described below were collected.

Geological setting of the locality and previous studies on the fauna

Jurassic sediments of the Bakony Mts were deposited on a passive continental margin, overlying segments of the drowned Upper Triassic carbonate platform (GALÁCZ et. al. 1985). Stratigraphical and facies analyses suggest a very marked bottom topography during most of Jurassic times. Submarine highs, their slopes, and inter-seamount basins were the main depositional environments, each of them characterized by distinct lithologies, stratigraphical features and fossil assemblages.

The Som Hill is an approx. 650 m high forest-covered hill near the village Bakonybél, west of the town Zirc, in the heart of the Bakonyerwald (Fig. 1). On the top of the hill an E-W striking trench and some natural outcrops expose the Jurassic rocks, which have been known since the last century (see KONDA 1970 and GALÁCZ 1976 for review). The exposure was made during the sixties, and was first sampled and studied by József KONDA, then Director of the Hungarian Geological Institute. Later János SZABÓ from the Hungarian Museum of Natural History enlarged the section, recognized the relationships between the rock bodies observable and made extensive bed-by-bed collections.

SZABÓ (1990) distinguished six beds of red, manganiferous, usually micritic limestone, in max. 2m cumulative thickness, below the uppermost two beds of the light yellow, oolithic Kardosrét Limestone (Lower Jurassic, most probably Hettangian) (Fig. 2). This latter rock forms the base of the section as well. The red limestones sandwiched between beds of much older rocks can be interpreted as infilling of a "horizontal" fissure ("S-Spalte") (WENDT 1971). The lower and upper three beds represents parts of the Bajocian Humphriesianum and Niortense Zones, respectively (GALÁCZ 1985). Both Lower and Middle Jurassic rocks are penetrated by near vertical dykes ("Q-Spalten") of various ages. At the eastern end of the trench, above the uppermost two oolithic limestone banks, nodular "ammonitico rosso" limestone beds, representing the upper part of the Bajocian Humphriesianum Zone and lower part of the Parkinsoni Zone appear, in 160 cm thickness (GALÁCZ 1985). The latter-mentioned Middle Jurassic rocks are conformably overlain by pink nodular limestones of Kimmeridgian (Upper Jurassic) age.

The lack of several stages (Sinemurian to Aalenian, Bathonian to Oxfordian) and especially that of radiolarite, which latter occurs in most of the Jurassic sections of the Bakony Mts, as well as reduced thicknesses and peculiar facies of the rocks indicate that the Som Hill was a submarine high during at least some periods of the Jurassic.

The fissure-infilling Bajocian rocks contain a well preserved and diverse mollusc fauna, characteristic of this type of environments (WENDT 1971). Fossils are usually coated with a thin layer of Fe-Mn-oxides and their cavities are filled with sparry calcite, which makes them rather fragile. The fossil assemblage is highly dominated by gastropods, which were described in a series of papers by SZABÓ (1979, 1980, 1981, 1982, 1983) and CONTI & SZABÓ (1987). Stratigraphic evaluation of the abundant ammonites was given by GALÁCZ (1976, 1985). MONOSTORI (1995) described the ostracods. Foraminifers, annelids, solitary corals, scaphopods and echinoids also occur, but they have not been studied until now.

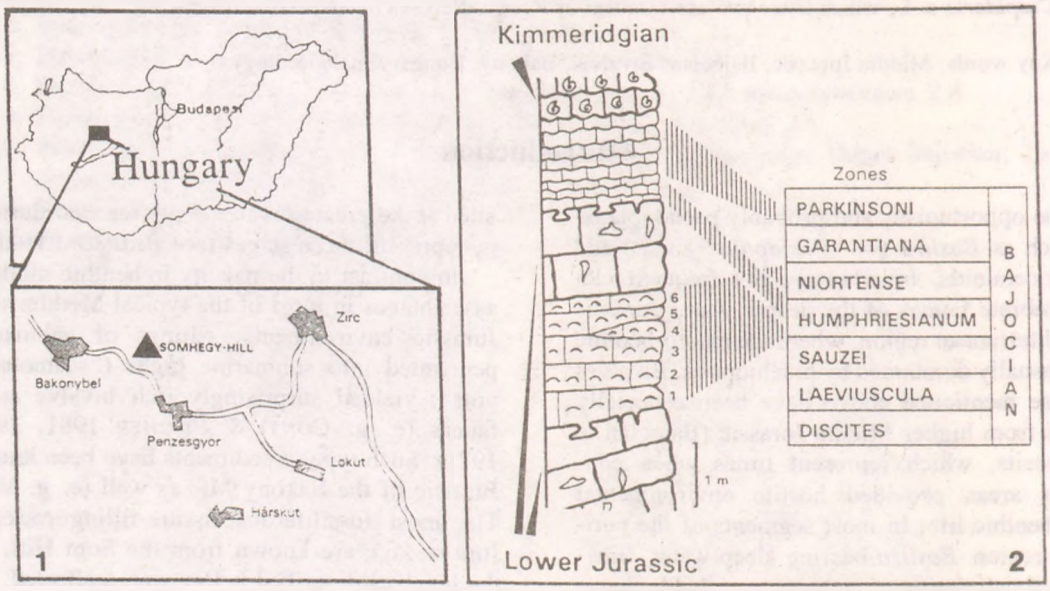

Fig. 1. Locality of the studied bivalves.
Fig. 2. The stratigraphical sequence on the top of the Som Hill.

Bajocian bivalves of the Som Hill: an annotated list

More than 80 bivalve specimens are available. The vast majority of the material has been collected by KONDA and SZABÓ from the fissure-filling. As it can be judged from the collection of SZABÓ, the lower three beds corresponding to the Humphriesianum Zone proved to be much more rich in bivalves than the upper three. Exact localities and stratigraphic positions of the specimens collected by KONDA have remained unfortunately unknown.

Except two articulated *Palaeonucula* specimens, the material consists of single valves. Their internal characteristics, due to the host rock usually harder than the recrystallized shell material, could be studied only exceptionaly.

Palaeonucula sp.
Pl. 6, figs 1–2.

Material: Two articulated specimens and three valves.

Remarks: The specimens are most probably juvenile ones. No attempt has been made to identify them at species level.

Isoarca subtransversa UHLIG, 1881
Pl. 6, figs 3, 4, 8.

Material: 29 valves.
Description: Medium-sized, inflated, strongly inaequilateral valves. Umbones placed at about the anterior one-fourth of the length. Dorsal margin straight. Anterior, ventral and posterior margins rounded. Outer surface ornamented with comarginal striae and radial riblets resulting in a fine granulate pattern. Hinge can not be studied in detail on the available specimens, only traces of taxodont teeth can be observed.
Remarks: *I. subtransversa* differs from *I. plutonis* (DUMORTIER, 1874), a similar species widespread in the Aalenian (DUMORTIER, 1874, p. 299. pl. 59, figs 1–3; VACEK, 1886, p. 112. pl. 19, fig. 13) mainly by its more oblique form and more rounded ventral margin. Occurence of *Isoarca* in the Bajocian of the Bakony Mts was first recorded by VÖRÖS (1984).

Arcoid bivalvia, gen. et sp. indet.
(not figured)

Material: One incomplete right valve.
Remarks: The specimen surely belongs to Arcoida, but its poor preservation does not allow a more precise identification.

Catella? caterinae (PARONA, 1894)
Pl. 6, fig. 5.

*1894 *Arca (?Macrodon) caterinae* sp. n. – PARONA: 293, pl. 1, fig. 43.
1983 *Parallelodon caterinae* (PARONA). – CONTI & FISCHER: 518, text-fig. 20 [cop. PARONA, 1894], pl. 3, figs 21–23.
1986 *Parallelodon caterinae* (PARONA). – CONTI & MONARI: 181, pl. 1, figs 10–11.

Material: Five left and four right valves.
Description: Small, inaequilateral, oblique pteriform valves with expanded posterior region. Dorsal margin straight, umbones at about the first fourth of the length. The ornamentation consists of fine growth striae, radial riblets and small tubercles at the intersection of radial and comarginal elements. Internal features can not be studied.
Remarks: Shape and ornamentation of the Bakony specimens correspond well to the description and figures given by CONTI & FISCHER (1983) and CONTI & MONARI (1986). MONARI's careful studies of Italian specimens (MONARI, in press) suggest that *"Arca" caterinae* can be assigned most probably to *Catella* HEALEY, 1908. *Arca (Eonavicula)* cf. *minuta* (SOWERBY), recorded by WENDT (1971, p. 159) from an Upper Bajocian fissure-filling of Rocca Busambra (Sicily) may probably represent *C.? caterinae.*

Limopsis teresitae (PARONA, 1894)
Pl. 6, fig. 6.

*1894 *Arca teresitae* sp. n. – PARONA: 392, pl. 1, fig. 41–42.
1971 *Isoarca* aff. *teresitae* (PARONA) – WENDT: 156–159.
1983 *Limopsis teresitae* (PARONA) – CONTI & FISCHER: 519, text-fig. 21 [cop. PARONA 1894], pl. 3, figs 24–25.

Material: two right valves.
Description: Small, subaequilateral valves. Length exceeds height. Dorsal margin straight. Umbones slightly in front of the mid-length. Outer surface covered by very fine comarginal and radial striae. Internal features can not be observed on the available specimens.
Remarks: Dimensions and shape of the Bakony specimens agree well with those of the specimen figured by CONTI & FISCHER (1983). The rare comarginal rugae are, however, less marked than those shown by the Italian specimen. This difference may be of ecophenotypical nature. *Limopsis minima* (J. de C. SOWERBY, 1824), a widespread species in the Bathonian to Oxfordian of Europe (HALLAM 1976) differs from *L. teresitae* by its more triangular valves (see e. g. FISCHER 1969).

Inoceramus fuscus QUENSTEDT, 1858
Pl. 6, fig. 7.

Material: Two juvenile valves and an adult one.
Remarks: *I. fuscus* is the most common and usually the only bivalve in Aalenian-Bajocian red, nodular, ammonite-rich limestones of the Bakony Mts. A fine specimen was figured by PRINZ (1904, pl. 1, figs 1a–b) from the Aalenian of the Tűzköves Ravine of Bakonycsernye.

Parainoceramus sp.
Pl. 6, figs 9–10

Material: Three valves.
Remarks: Small to medium sized, inflated species of the genus *Parainoceramus* are frequent in some Jurassic deposits of the Bakony Mts and are currently studied by the present author.

Plagiostoma rupicola (UHLIG, 1881)
Pl. 6, fig. 11.

Material: One right valve from the Humphriesianum Zone.
Remarks: The near-orbicular outline, very short lunule and numerous fine radial striae, all are characteristics of *P. rupicola* as described and figured by UHLIG (1881, p. 410, pl. 9, fig. 4.) from the Callovian of the Pieniny Klippen Belt and by SIMIONESCU (1899, pl.1, fig. 14) from the Callovian of the Getic Unit of the Southern Carpathians.

Entolium (E).? sp.
(not figured)

Material: Two fragmentary valves.
Remarks: The available specimens are smooth, incomplete orbicular valves without any trace of ornamentation.

Camptonectes auritus (SCHLOTHEIM, 1813)
Pl. 6, fig. 12.

Material: Two fragmentary valves from the Humphriesianum Zone.
Description: Sub-orbicular disc ornamented with fine antimarginal (= divaricate) striae on all parts of the surface.
Remarks: Although the Som Hill specimens are incomplete, their observable features agree well with those given by JOHNSON (1984) as specific characteristics of *C. auritus*.

Camptonectes sp. B.
Pl. 6, fig. 13.

Material: about 10 valves.
Description: More or less fragmentary valves with byssal notch below the anterior auricle of the right valve. Outer surface ornamented with very fine comarginal nd antimarginal striae.
Remarks: Shape and ornamentation of the specimens slightly resemble those of *Entolium (E.)* (see below). According to JOHNSON (1984), however, *E. (E.) lunare* (ROEMER, 1839), the only Jurassic *Entolium* species with byssal notch is confined to the Early Jurassic.

Camptonectes? sp.
Pl. 6, fig. 14.

Material: A single left valve, most probably from the non-fissure-filling Parkinsoni Zone.
Description: Sub-ovate (H>L) disc ornamented with prominent comarginal lamellae and fine antimarginal striae.
Remarks: The projecting comarginal lamellae shown b the specimen are unusual in *Camptonectes*, and stron ly resemble to the ornamentation of *Camptochlamy* ARKELL, 1930, elevated to genus rank by WALLER MARINCOVICH (1992). Radial striae, characteristic *Camptochlamys* can not, however, be observable. A JOHNSON (1984) pointed out, one of the shell layers *Entolium* is composed of antimarginal calcite fibre which can be visible when the outer layer is eroded The Som Hill specimen, however, does not show an sign of erosion.

Limea? (Pseudolimea?) sp.
(not figured)

Material: A single right valve.
Remarks: The specimen is too poorly preserved to b identified with certainty even at generic level. Th oblique form and strong radial riblets ornamenting th surface recall *Limea (Pseudolimea)*.

Bositra buchii (ROEMER, 1836)
Pl. 6, fig. 15.

Material: 8 valves.
Remarks: Questions concerning the systematics of *Bositra* species were recently discussed by ABERHAN (1994) CONTI & MONARI (1992) and SZENTE (1995). The Som Hill specimens belong to the more orbicular *"ornati"* morphotype, but the H/L ratio of the valves seems to be considerably increasing during ontogeny, which indicates a more elongated, *"buchii"* shape i juvenile.

Cuspidaria s.l. sp.
Pl. 6, figs 16–18.

Material: 5 valves.
Description: Small-sized, well inflated, postero-dorsally rostrated valves ornamented with fine growth striae. Internal features can not be studied.
Remarks: According to KEEN (1969b) *Cuspidaria* NARDO, 1840 (= *"Neaera* GRIFFITH, 1834") appeared in the Late Cretaceous. YIN & FÜRSICH (1991) presumed that some of the Jurassic *"Neaera"* species in fact belong to Corbulidae. This statement can be surely held for specimens described from nearshore, marginal marine, or even brackish water settings. Data hitherto accumulated by the present author suggest, however, that *"Neaera"* species, which are usually the only macrobenthic organisms associated to the abundant pygopid brachiopods in Upper Jurassic pelagic sediments of the peri-Mediterranean region, really represent *Cuspidaria* s.l. There is no reason to doubt that some Middle Jurassic forms can be also assigned to Cuspidariidae DALL, 1886.

Palaeoecology of the Som Hill bivalve fauna

As it was mentioned above, gastropods are highly dominating elements in the Som Hill fauna: more than 50 species represented by some 440 specimens were recorded by SZABÓ (1990). Ammonites are also more frequent than bivalves: some 300 specimens were collected from the fissure-infilling Bajocian beds (A. GALÁCZ, personal communication, 1995). A sound palaeoecological and biofacies analysis should be therefore based on the study of the fore-mentioned groups. Keeping in mind, however, the uncertainties concerning (palaeo)autecology of ammonites and gastropods, and the fact that bivalves are probably the best known group of marine macro-invertebrates in this respect, some remarks on their palaeoecology are worth to be given here.

Considering the specific sedimentary environment of the deposits yielding the fauna, questions can arise about the autochtonous vs. allochtonous nature of the fossil assemblage. The specimens, although most of them are single valves, do not show traces of significant transport and they can be interpreted as para-autochtonous remains of the former communities. The striking similarities between the compositions of bivalve faunas preserved in fissure fillings also suggest that these characteristic assemblages really populated submarine cavities.

A comparison with coeval non fissure-dweller faunas settled on submarine highs is, however, rather difficult, because "normal" faunas are much poorly documented in the fossil record.

The richest peri-Mediterranean Middle Jurassic benthic molluscan faunas, which supposedly populated submarine highs are mostly of Aalenian age (e. g. BOTTO-MICCA, 1893; GRECO 1898) and many of them are related to the South Alpine San Vigilio oolite and its equivalents (e. g. DE GREGORIO 1886; VACEK 1886; CONTI & SZABÓ 1989; DAL PIAZ 1912, see STURANI 1971). Bivalves are extremely rare in Bajocian and younger Middle Jurassic "normal" benthic assemblages, which are dominated by brachiopods (WENDT 1971). Studies of bivalve faunas from Lower Jurassic and Tithonian "Hierlatzkalk"-type rocks, thought to represent seamount slopes (VÖRÖS 1991) suggest that small, inflated *Parainoceramus* species were more frequent in the seamount-dweller faunas than it was found in the Som Hill assemblage (FŐZY et al. 1994; SZENTE in prep.).

Isoarca subtransversa UHLIG, 1881 is the most frequent species in the Som Hill bivalve fauna (about 34%). Systematic position of the peculiar genus *Isoarca* MÜNSTER, 1842 is rather uncertain. The problem was discussed by several authors in the past (see NICOL 1947) and seems to have been unsolved until now. According to KEEN (1969a) the genus belongs to Nuculanacea H. ADAM & A. ADAM, 1958. HALLAM (1976), however, assigned *Isoarca* to the Arcoida.

Autecology of *Isoarca* is also doubtful. The genus is widespread in Late Jurassic reef- or peri-reefal faunas of South and Central Europe (see e. g. BOEHM 1881, 1883; YAMANI 1975) and HALLAM (1976) interpreted it as a probable nestler within the crevices of coral reefs. HEINZE (1991), however, considered *I. texata* (MÜNSTER), an Upper Jurassic species, as an infaunal suspension filter. From the Middle Jurassic, abundant occurrence of *I. plutonis* was reported by VACEK (1886) from the San Vigilio oolite, where the bivalve fauna is highly dominated by epifaunal forms, especially by *Eopecten*. These examples suggest that *I. subtransversa* were probably an epibyssate bivalve.

Only a limited number of guilds are represented in the bivalve fauna. Epibyssate suspension-feeders are the dominant group. Infaunal deposit-feeders *(Palaeonucula* and questionably *Limopsis)* and carnivores *(Cuspidaria)* are subordinate. Cemented and sessile infaunal forms as well as semi-infaunal and free-lying ones are lacking. WENDT (1971) also documented the rarity of burrowing bivalves in the Sicilian fissure-dweller faunas. The dominance of epibyssate forms indicates that considerable areas of hard substrate were available for attachment.

Occurrence of *Limopsis* and *Cuspidaria*, as the only taxa possessing living relatives, may bear some palaeoenvironmental significance. Recent species of these genera live in cold or deep waters (e. g. KNUDSEN 1967, 1970).

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Plate 6

(all specimens coated with ammonium-chloride)

Figs. 1–2. *Palaeonucula* sp.
1. Niortense Zone, 2×
2. Humphriesianum Zone?, 5×

Figs. 3–4, 8. *Isoarca subtransversa* UHLIG 1881
3. Humphriesianum Zone, 1.5×
4. Humphriesianum Zone?, 1.7×
8. Humphriesianum Zone?, 2×

Fig. 5. *Catella*? *caterinae* (PARONA 1894). Humphriesianum Zone, 4×
Fig. 6. *Limopsis teresitae* (PARONA 1894) Humphriesianum Zone, 2×
Fig. 7. *Inoceramus fuscus* (QUENSTEDT 1858) Humphriesianum Zone, 1.6×
Figs. 9, 10. *Parainoceramus* sp. Humphriesianum Zone?, 1.5×.
Fig. 11. *Plagiostoma rupicola* (UHLIG) Humphriesianum Zone, 1.9×
Fig. 12. *Camptonectes auritus* (SCHLOTHEIM 1813) Humphriesianum Zone, 1.65×
Fig. 13. *Camptonectes* sp. Humphriesianum Zone, 1.5×
Fig. 14. *Camptonectes?* sp. Parkinsoni Zone?, 1.8×
Fig. 15. *Bositra buchii* (ROEMER 1836) Parkinsoni Zone?, 2×
Figs. 16–18. *Cuspidaria* sp.
16. Humphriesianum Zone, 1.6×
17. Humphriesianum Zone, 1.7×
18. Humphriesianum Zone, 2.0×