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## BORING ANIMALS ACTIVITY IN EGGENBURGIAN LITTORAL ENVIRONMENTS (SW PART OF THE WESTERN CARPATHIANS)

(Pls. 4)



**Abstract:** Littoral environment of Eggenburgian clastic sediments formation in the SW part of the Western Carpathians is indicated by characteristic textural and structural features. Life activity traces of boring marine animals belong to such structural features. Their occurrence and mode of preservation depend on sea shore and floor palaeomorphology.

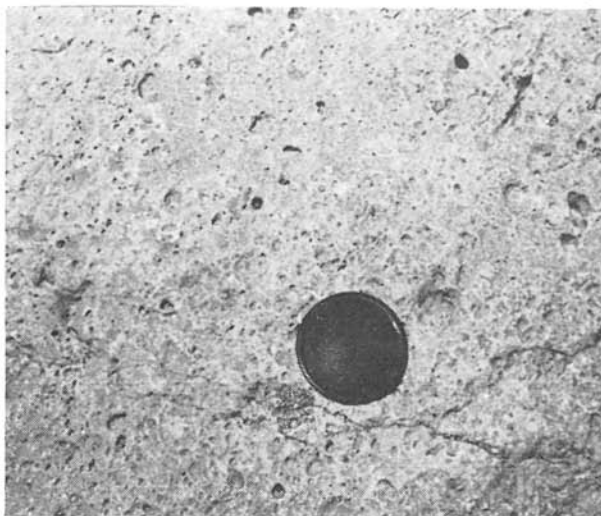
**Резюме:** Литоральные условия образования кластических осадков эгенбургского возраста в ЮЗ части Западных Карпат определены характеристическими структурно-текстурными признаками. К текстурным признакам относятся также следы после буровой деятельности морских организмов. Их появление и способ сохранения зависит от палеоморфологии морского берега и дна.

The Eggenburgian conglomerates and sandstones from the SW part of the Western Carpathians represent denudation remnants of sediments deposited in littoral part of the sea (macro- and microfauna findings support this fact; Cícha, 1956; Čtyroký, 1959, 1960). They outcrop to the surface in a belt stretching from the NE margin of the Vienna basin and the Malé Karpaty Mts. through the Brezovské and Čachtické Karpaty Mts. to the region of the eastern slopes of the Biele Karpaty Mts.

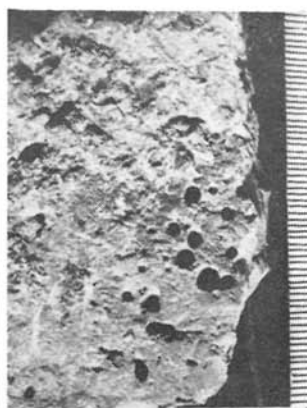
Sedimentary environment is characterized in addition to the sedimentary structures and textures, also by frequent borings of marine organisms. Several types of environments with suitable conditions for their preservation may be characterized in the studied region.

Locality Hradište pod Vrátnom (quarry NE of the village) is a good example of sedimentation in the region of sea shore cliff and adjacent rocky medio- and infralittoral. The Eggenburgian coarse-clastic sediments are overlying the Triassic dolomites of the pre-Neogene basement with angular discordance. Conglomerates are composed of pebbles, cobbles and boulders (max. diameter 235 cm). The coarsest material is concentrated to the sequence basement. Several cycles are recurring upwards, grain size is gradually decreasing in them. The cycles are mostly graded. Rounding of pebble material is of various degree — from angular and subangular to well-rounded pebbles. Beds have horizontal, ripple, diagonal and cross bedding. Pebble material of the basal part is unsorted without more distinct imbrication. Upwards, lenticular beds of well imbricated conglomerates appear. Lenticles have an erosive contact with the underlying beds. They partly represent filling of channels in which the pebble material was transported towards the basin. In this part of the sequence there are beds of thin-bedded sandstones with diagonal bedding. They are overlain

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by thick beds of unbedded sandstones to fine-grained conglomerates which were deposited during rapid sedimentation on slope of basin margin.

Borings of lithophags were found on surface of dolomites forming the basement of the Eggenburgian sediments (Pl. I, Figs. 1, 3, 4). During sedimentation they represented a strongly abraded cliff. Boulders of original cliff-boulder mass are bored too. In addition to the sequence basement, borings of marine organisms are found also in coarse-clastic material (boulders with diameter of 80 cm) in the beginning of individual cycles. Besides subangular fragments of local material also well-rounded pebbles with two generations of boring organisms are present there. The latter were transported by waving and littoral currents from the sea shore towards the basin. Borings are not found in unbedded sandstones and conglomerates with badly or chaotically arranged pebble material. Their absence was caused by rapid deposition and overlapping of the sediments.

The following boring organisms were observed: sponges (*Cliona celata* GRANT 1826 (Pl. II, Fig. 1), *Cliona vastifica* HANCOCK 1949 (Pl. II, Fig. 3), *Cliothesa* sp. (Pl. II, Fig. 4)), polychaetes (*Polydora ciliata* (JOHNSTON) (Pl. I, Fig. 2, Pl. II, Fig. 5)) and bivalves which cannot be determined in more detail owing to the fact that their valves were not preserved (*Lithophaga* sp. (Pl. I, Fig. 1, Pl. III, Fig. 4), *Gastrochaena* sp. (Pl. III, Figs. 1, 2, 5)).

Localities in the environs of Podbranj (Pl. III, Fig. 7) refer to sedimentation in the region of sea shore cliff and its boulder mass. Sediments from the localities in the environs of Čachtice were formed in shallow littoral environment. Locality Čachtice Castle (quarry 500 m S of the castle) forms an exception. It is analogous to occurrence of unbedded sandstones and conglomerates from the locality Hradište pod Vrátnom. It bears the features of rapid sedimentation which prevents the lithophags activity.

Clasts of the locality Sverepec (sand pit on the NW margin of the village) were deposited in sandy gravel strand environment. Quarry wall is composed mostly of yellow-grey fine- to medium-grained carbonate sandstones. They have different lithification, they form crumbling to strongly lithified loaf-shaped bodies of several metres in size with recrystallized cement. Bedding is stressed by conglomerates beds of 5—150 cm in thickness. Conglomerates beds and lenticles display frequent diagonal and cross bedding. Size of pebbles varies from 1 to 3 cm, rarely even 25—30 cm. They have distinctly imbricate structure and graded bedding. Besides conglomerates beds, pebble lines are present in sandy matrix. Their origin is connected probably with scour of surrounding sediment by the currents. Pebble material is represented by Triassic limestones and dolomites, Jurassic and Cretaceous limestones, Cretaceous

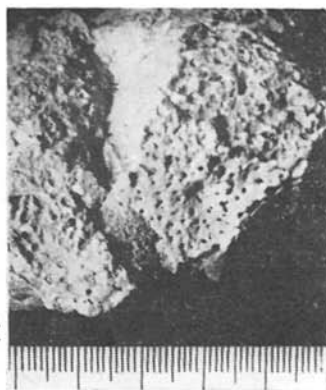
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#### Plate I

Fig. 1 — Borings of *Lithophaga* sp. on dolomites of rocky basement of the Eggenburgian sediments, Hradište pod Vrátnom. Fig. 2 — Borings of *Polydora ciliata* (JOHNSTON) on dolomites of rocky basement of the Eggenburgian sediments, Hradište pod Vrátnom. Figs. 3—4 — Abundant borings on surface of dolomite blocks forming rocky basement of the Eggenburgian sediments, Hradište pod Vrátnom. The black circle (5 cm in diameter) for scale.



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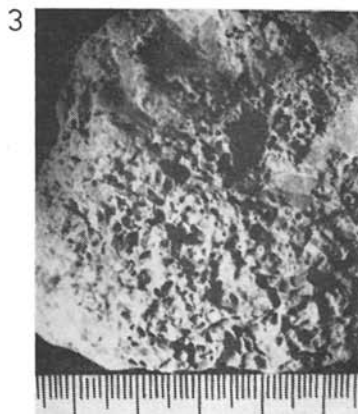
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conglomerates and sandstones which may be derived not only from local but also from remote source areas (in contrast to the former localities).

Borings are found sporadically in the pebble material which was longer transported. It was formed by destruction of cliff-boulder mass.

The following boring organisms (lithophags) were observed: sponges (*Cliona celata* GRANT 1826) and bivalves (*Lithophaga* sp.).

About 15 cm thick bed rich in very badly preserved macrofauna fragments lies in the lower part of exposure. Owing to sporadic pebbles and wood fragment findings it can be considered as a product of sudden flood from the sea shore. Wood finding was strongly bored by bivalve from the genus *Teredo*, similarly as in the locality Krajné.

Textural and structural features of the sediments from the locality Krajné refer to deeper littoral environment. Sand pit wall on the S margin of the village is formed by massive crumbling sandstones of grey-yellow colour (Pl. IV, Fig. 4). Bedding, except 10—15 cm thick conglomerates beds, is stressed by diagenetically lithified sandstones beds. Conglomerate beds contain pebbles of 5—10 cm in size, sporadically rounded boulders of max. 75 cm in size. Pebble material is formed mostly by Triassic dolomites and limestones. Lithophags borings occur in the pebbles with a diameter of over 30 cm.

The following boring organisms were observed: sponges (*Cliona celata* GRANT 1826 (Pl. II, Fig. 2)), polychaetes (*Polydora ciliata* (JOHNSTON) (Pl. II, Fig. 7)), and small undeterminable polychaetes (Pl. II, Fig. 6) and bivalves (*Lithophaga* sp., *Aspidopholas* sp. (Pl. III, Figs. 3, 6)).

Conglomerate beds showing a sharp contact with underlying beds, imbricate structure of pebbles and graded bedding refer to sporadic transport of coarse-clastic material from highly dynamic sea shore environment (medio- and infralittoral) to deposition area (circalittoral).

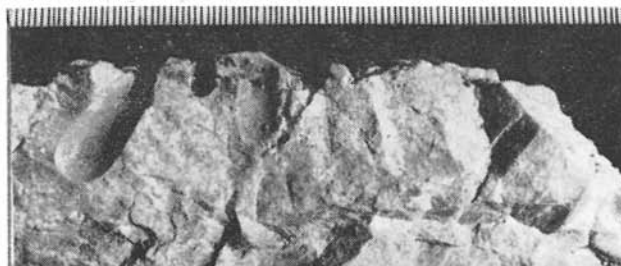
Frequent findings of plant detritus and wood fragments (part of stem) support proximity of the sea shore. Plant detritus and wood fragments are coalificated and strongly limonitized. Wood is bored with tubes of boring organisms probably from the genus *Teredo* (Pl. IV, Fig. 1). Preserved valves of the animals were not found, only fillings of borings were found. Filling is composed of fine fraction of the surrounding sandstone. Borings originally followed direction of fibres in wood. They are somewhat thicker than those given in literature (Čtyrský, 1959; Miner, 1950; Tauber, 1953; Trunkó, 1976). Their thickness vary from 20 to 30 mm and length from 100 to 200 mm. Individual borings of oval diameter are not crossed, nor branched, some-

## Plate II

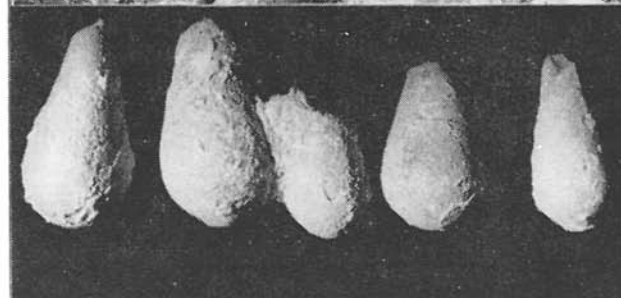
Figs. 1—2 — Borings of *Cliona celata* GRANT, dolomite pebbles from the Eggenburgian conglomerates, Hradište pod Vrátnom. Fig. 3 — Borings of *Cliona vastifica* HANCOCK, pebble from the Eggenburgian conglomerates, Hradište pod Vrátnom. Fig. 4 — Borings of *Cliothisa* sp., dolomite pebble from the Eggenburgian conglomerates, Hradište pod Vrátnom. Fig. 5 — Borings of *Polydora ciliata* (JOHNSTON), pebble from the Eggenburgian conglomerates, Hradište pod Vrátnom. Fig. 6 — Borings of small undeterminable polychaetes, pebble from the Eggenburgian conglomerates, Krajné, natural size. Fig. 7 — Borings of *Polydora ciliata* (JOHNSTON), pebble from the Eggenburgian conglomerates, Krajné, natural size.



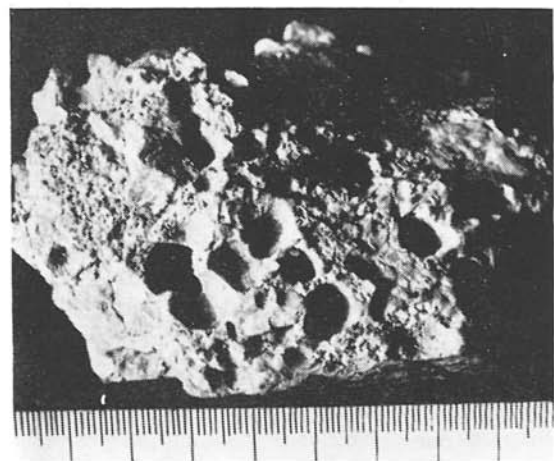
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where they suddenly change their direction adjusting the surrounding borings. In addition to the large forms, also smaller ones of 5—7 mm in thickness and 50—100 mm in length occur. They replace almost the whole original mass of wood. Similar findings from this locality and from the region of Vaňovce are presented by Čtyrský (1959) as *Teredo* sp. (Pl. IV, Figs. 1, 2, 3).

The upper part of the quarry is composed of crumbling sandstones with higher clay content in matrix. Badly preserved (decalcified) marine macrofauna occurs there. In addition to the species described by Čtyrský (1959), casts of *Turitella* sp. and fillings of crabs burrows (*Ophiomorpha*) 15—25 thick of oval section and 80—150 mm long are present in sandstones. Casts are filled with fine fraction of the surrounding sandstone. Similar forms occur in the locality Šípkové, N of Vrbové. Origin of burrows is determined on the basis of similarity to the findings in the Upper Badenian sediments from the Devínska Kobyla region (Mišík et al., 1974).

### *Characteristics of the lithophags from described localities*

*Sponges*: Borings of sponges represent relatively frequent fossil finding. Study of collected material and its comparison with borings in the Upper Badenian near-cliff sediments from the environs of Bratislava (Radwański, 1968) and from Poland (Radwański, 1964, 1965) and with the recent material enable us to determine two species from the genus *Cliona* GRANT 1826: *Cliona celata* GRANT 1826 (occurrence: Hradište pod Vrátnom, Podbranč, Krajné, Sverepec), *Cliona vastifica* HANCOCK 1949 (occurrence: Hradište pod Vrátnom, Podbranč), *Cliothosa* sp. (occurrence: Hradište pod Vrátnom).

*Polychaetes*: Borings of worms represent another quite frequent fossil finding in the localities of Eggenburgian transgression in the SW part of the Western Carpathians. Comparison of our findings with the Miocene findings from Poland and the Vienna basin region (Radwański, 1964, 1965, 1968) enable us to determine the polychaetes borings as follows:

*Polydora ciliata* (JOHNSTON) (occurrence: Hradište pod Vrátnom, Podbranč, Krajné), small undeterminable polychaetes similar to the recent findings occur in the localities: Hradište pod Vrátnom, Podbranč, Krajné.

*Bivalves*: Borings of bivalves are known mainly from the sea shore sediments where they represent quite frequent fossil findings. Preserved valves were not found. Borings were compared with literature (Konopka, 1974; Radwański, 1964, 1965, 1968) and determined as follows:

### Plate III

Figs. 1, 2, 5 — Borings of *Gastrochaena* sp. in dolomite cobbles from the Eggenburgian conglomerates, Hradište pod Vrátnom. Figs. 3, 6 — Sediment-filled borings and empty borings of *Aspidopholas* sp., Krajné, natural size. Fig. 4 — Borings of *Lithophaga* sp. (abraded) and *Cliona vastifica* HANCOCK, pebble from the Eggenburgian conglomerates, Hradište pod Vrátnom. Fig. 7 — Borings of *Lithophaga* sp. secondarily filled with calcareous cement, pebble of Cretaceous limestone from the Eggenburgian conglomerates, Podbranč, natural size.



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*Lithophaga* sp. (occurrence: Hradište pod Vrátnom, Podbranč, Krajné, Sve-repec), *Gastrochaena* sp. (occurrence: Hradište pod Vrátnom, Podbranč), *Aspidopholas* sp. (occurrence: Krajné).

Traces of boring organisms found almost in each locality of the Eggenburgian sediments occurrence in the SW part of the Western Carpathians determine reliably marine environment of their origin. (Marine fauna is preserved only in some localities remote from each other). Evaluation of structural and textural features of the localities refers to various conditions of sedimentation in supra-, medio-, infra and circalittoral zones. These conditions depended on sea shore and floor palaeomorphology. Rapid accumulation of clastic material on slopes of basin margin and overlapping of older sediments by younger ones enable good preservation of borings in the rocky basement and basal conglomerates.

Translated by O. Mišániová

#### REFERENCES

- CÍCHA, I., 1956: Stratigrafické zhodnocení neogenních mikrofaun v SV části Dolnomoravského úvalu a v neogénu Pováží. Zpr. geol. výzk. v roce 1955 (Praha), pp. 10—12.
- ČTYROKÝ, P., 1959: Fauna mořských měkkýšů spodního burdigalu v Pováží. Geol. Práce (Bratislava), 51, pp. 55—140.
- ČTYROKÝ, P., 1960: Fauna litorálních sedimentů spodního burdigalu z okolí Povážské Bystrice. Geol. Práce Zpr. (Bratislava), 18, pp. 141—152.
- KONOPKA, H. P., 1974: Zur Ökologie bohrender Meerestiere. Natur und Museum (Frankfurt a. M.), 104, pp. 229—237.
- MINER, R. W., 1950: Field Book of Seashore Life. (New York), pp. 607—608.
- MISÍK, M. — GULIČKA, J. — URVICHIAROVÁ, E., 1974: Devínska Kobyla, Geologické pomery, kvetena a fauna. Obzor (Bratislava), 22 pp.
- RADWAŃSKI, A., 1964: Boring Animals in Miocene Littoral Environments of Southern Poland. Bull. Acad. pol. Sci., Sér. Sci. géol. géogr. (Varsovie), 12, 1, pp. 57—62.
- RADWAŃSKI, A., 1965: Additional Notes on Miocene Littoral Structures of Southern Poland. Bull. Acad. pol. Sci., Sér. Sci. géol. géogr. (Varsovie), 13, 2, pp. 167—173.
- RADWAŃSKI, A., 1968: Tortonian Cliff. Deposits at Zahorska Bystrica near Bratislava (Southern Slovakia). Bull. Acad. pol. Sci., Sér. Sci. géol. géogr. (Varsovie), 16, 2, pp. 97—102.
- TAUBER, A. F., 1953: Die Fossilen Terediniden der Burgenländischen und Niederösterreichischen Tertiärablagerungen. Wiss. Arbeiten aus Burgenland, Landesmuseum (Eisenstadt), Heft 3, pp. 5—41.
- TRUNKO, L., 1976: Spuren von Bohrorganismen in fossilen Treibholz des mitteloligozänen Meeressandes von Steinhardt bei Bad Kreuznach. Beitr. naturk. Forsch. Südw. Dtl. (Karlsruhe), 35, pp. 169—179.

Manuscript received October 16, 1987.

#### Plate IV

Fig. 1 — Wood fragment (70 cm long) with all its mass replaced by casts of *Teredo* sp., Krajné. Figs. 2—3 — Sediment-filled casts of *Teredo* sp., Krajné. Fig. 4 — Locality Krajné, general view.