UPPER CRETACEOUS RUDIST-BEARING DEPOSITS FROM THE EASTERN BORDER OF THE GILĂU MOUNTAINS (CORNİ SECTION, HĂȘDATE): PALAEOECOLOGICAL REMARKS

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ABSTRACT. Along the eastern border of the Gilău Mountains crop out carbonate deposits which were formed during the Late Cretaceous (Santonian-Campanian). These deposits are characterized by a significant presence of rudists and were formed on the border of a narrow marine shelf. The typical feature is represented by the dominance of the coral-rudist associations. The paleontological study of these deposits revealed the presence of four evolutionary stages when corals, rudists and red calcareous algae stabilised and colonised the sediment depending on the relative sea level evolution. All the evolutionary stages have been included into an idealised ecological sequence.

Keywords: palaeoecology, Upper Cretaceous, Gilău massif, Apuseni Mountains.

INTRODUCTION

The Upper Cretaceous limestones from Corni quarry are characterized by the dominance of the coral-rudist associations (Moisescu, 1960; Lupu, 1960; Bucur & Urian 1989; Bucur et al., 1991). Besides, red algae, cyanobacteria, foraminifers, annelid worms, bryozoans and less frequent green algae fragments are present. These limestones have been traditionally mined and used as ornamental rocks. The Upper Cretaceous deposits from the eastern border of Gilău Mountains occur only on isolated areas, thus the outcrop provided by the quarry is relatively small-sized (Fig. 1). However, it still offers sufficient data for a paleoenvironmental interpretation and reconstruction.

The present paper provides supplementary data to the sedimentological study on the same area (Săsăran & Săsăran, 2003), bringing new data on the palaeoecology of the biotic communities.

II. PALAEOECOLOGICAL CONSIDERATIONS

The rudist-bearing deposits in Corni quarry were formed within a narrow shelf border during the Late Cretaceous (Santonian-Early Campanian). The identified rudists were assigned to two families: Hippuritidae Gray 1848 (*Vaccinites* div. sp.), and Plagiptychidae MacGillavry 1937 (*Plagiptychus* sp.). From the Upper Cretaceous limestones outcropping in the north-eastern border of the Gilău Massif, the following rudist species have been mentioned: *Vaccinites oppeli* DOUVILLÉ – at the junction of the two Someș rivers (Lupu, 1976); *V. sulcatus* DEFRANCE, *V. inaequicostatus*

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MÜNSTER, *V. gosaviensis* DOUVILLÉ, *V. oppeli* DOUVILLÉ – the latter being collected from the Creasta Pietricelei Hill, located north from Corni quarry (Moisescu, 1960; Tătărâm, 1963). Our results complete the previous record on the rudist fauna outcropping on the north-eastern border of the Gilău Mountains with the species *V. vredenburgi* KÜHN, and *Plagioptychus* sp.

Fig. 1 – Location of the study area

The rudists are quantitatively subordinate to the corals. They occur in-between corals, as isolated specimens or as small clusters (*Vaccinites*) showing the lower cylindrical or conical attached valve of diameters ranging from 3 cm - *V. sulcatus*, up to 8-10 cm – *V. inaequicostatus*. The *Plagioptychus* sp. are small-sized, solitary specimens with a conical or coiled, or slightly coiled, lower valve.

Five facies associations have been separated in the carbonate succession from Corni quarry: 1) marls and limestones with terrigenous clasts; 2) limestone with tabular corals and rudists; 3) bioaccumulations with branching/platy corals; 4) bioclastic rudstone/grainstone; 5) bioclastic floatstone/packstone. The facies associations show an independent but concomitant evolution, as a reply to the relative sea level changes. The limits between the carbonate facies associations may be sharp or transitional, due to the local (terrigenous siliciclastic input, uplift tectonics, subsidence), or global (eustatic) control factors (Săsăran & Săsăran, 2003).

The ecological sequence identified within the carbonate succession is associated with a rhythmic distribution of the identified facies associations; it represents an answer to the relative sea level changes. Within an idealised ecological sequence, four stages may be defined (Fig. 2, 3).

Stage 1 – characterized by branching coral concentrations, accompanied by subordinate sheet-like colonies (Pl. I, fig. 1). Corals are intensely encrusted by red algae that sometimes form nodular or dendritic concentrations.

Within this stage, the clinger rudists (*Plagioptychus* sp.) are dominant, showing a coiled and slightly coiled lower valve. They are characterized by a low elevation index and play an important role in the initial stabilisation (pioneer palaeocommunities). The elevator rudists are less frequent and are represented by small-sized, elongated-cylindrical forms (*V. sulcatus*). For starting their growth, these forms needed reduced sedimentation, even non-depositional episodes in quiet, shallow waters, only occasionally or periodically exposed to disturbances (Gili et al, 1995; Skelton & Gili, 2002).

The matrix sediment of these bioaccumulations, with a mudstone/wackestone texture as well as the algal encrustations and the perforations produced by various organisms are arguments in the favour of an environment with a low- to moderate energy and low sedimentation rates. This type of sub-environment is frequently associated with the lateral sides of bioconstructions/ coarse shoals.

Stage 2 – represented by very diverse fauna, dominated by tabular coral and elevator rudists (Pl. I, fig. 2). *Plagioptychus* occur only sporadically. The corals and rudists, besides the red algae may form small-sized mounds and locally distinctive bioaccumulated levels (Săsăran & Săsăran, 2003).

Within these facies the elevator rudists (*Vaccinites* sp.) present an elongated-cylindrical or a wide cylindrical attached valve, and are partly buried in the sediment accumulated in their neighbourhood (constratal growth). The specimens occur isolated or in small groups of individuals representing several successive generations of young individuals attached by lateral cementation of the shell walls (Pl. II, fig. 3).

The bioclastic substrate generated during stage 1 had provided optimal conditions for the fixation and development of the elevator rudists. The material resulted from the biotic fragments (rudists, corals) due to the intense bioerosion that took part at the end of stage 1 consisted the base for the larvae attachment and tabular corals fixation on the sea bottom. During this stage, the corals and rudists record an explosive increase of their number.

Stage 3 – it was separated based on the dominance of the tabular corals contained by coarse sediment. Rudists are scarce and usually they stand in a reverse position.

The development of the coral colonies and rudists, accompanied by the accumulation of bioclastic deposits resulted from the in situ alteration of shells lead to a decrease of the relative sea level.

In spite of the fact that the environment was favourable for the istalation of the rudists (stages 1 and 2), corals registered their optimal ecological conditions, probably by inhibiting the rudist larvae development (Pl. III, fig. 2) (Sanders & Pons, 1999).

Stage 4 – represented by well- to moderate-sorted bioclastic bodies that may include isolated tabular corals (Pl. I, fig. 3). This stage was reached when the coral-generated bioaccumulations had been covered by bioclastic deposits resulted from the in situ shells' alteration, sometimes mixed with allochthonous sediments from the neighbouring areas. The relative decrease of the sea level lead to the formation of these bioclastic shoals.

Fig. 2 – Idealized ecological sequence from the Corni quarry.

III. BIOTIC ASSEMBLAGES AND ENCRUSTING ORGANISMS

Besides corals and rudists, the third main biotic component of these deposits is represented by red algae. Red algae encrust both the coral and the rudist fragments (Pl. III), and sometimes form nodular concentrations (Pl. V). The following species have been identified: *Polysrta alba* (PFENDER), *Sporolithon* sp. (forming crusts on the surface of the rudists), *Paraphyllum amphiroaeforme* (ROTHPLETZ), *Paraphyllum* sp., *?Lithothamnion* sp., *Parachaetetes asvapatii* PIA. Other encrusting organisms are also present, such as agglutinated foraminifers (*Coscinophragma-Acruliammina* type), bryozoans, annelid worms (Pl. III) and cyanobacteria (*?Pycnoporidium* sp.) (Pl. IV). Perforations by lithofagous bivalves are frequently noticed within the coral colonies and on the rudist shells (Pl. III, fig. 3, 4). It is worth to mention that these perforations are absent in the case of canal-bearing rudists (*Plagioptychus* sp.). Extremely rare are the fragments of green algae *Neomeris* cf. *plagnensis* DELOFFRE (Pl. IV, figs. 1,2,3), and *Terquemella* sp. (Pl. IV, fig. 4), this being the first mention of dasyclads in the Upper Cretaceous limestones from Hășdate.

CONCLUSIONS

The rudists identified in Corni quarry belong to the “elevator” morphotype, solitary or grouped (*Vaccinites*), or „clingers” morphotype (*Plagioptychus* sp.). The “elevator” specimens present an elongated-cylindrical, or largely-cylindrical attached valve, partly buried in the surrounding sediment. The “clingers” presenting a coiled and slight coiled lower valve show a low elevation index and play an important role during the initial stabilisation (pioneer paleocommunities). The clingers overlay the isolated or grouped (into clusters) „elevator” rudists. For being initialised, these forms required episodes of reduced or even lack of sedimentation in shallow, quiet waters only occasionally or periodically exposed to disturbances (Gili et al, 1995; Skelton & Gili, 2002).

The corals and rudists might have co-existed within the same area forming closed associations, but in this case either the rudists, or the corals were very close to their ecological tolerance limit (Götz, 2003). Taking into account the coral domination in the facies from Corni quarry we can state that the area on the shelf margin was characterized by a reduced sedimentation rate, and a moderate energy of the environment.

In a similar way, the formation of successive generations of crusts involving various types of organisms (foraminifers, bryozoans, annelid worms, cyanobacteria and especially rhodophytes), as well as the intensive perforation of the small coral colonies, of some rudists or rhodophyta nodules by lithofagous bivalves have been favoured by a reduced sedimentation rate.

The siliciclastic facies interlayered with the carbonate deposits in the base of the profile represents terrigenous input stages that might have constituted stressing factors for some biota. The energy increase of the environment - indicated by the coarse facies interlayers in the stage 4 - led to the inhibition and destruction of the newly-formed bioaccumulations.

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Fig. 3 – Corni quarry section. 1 – 4 – characteristic composition of the 4 stages; 5 – marls and limestone with terrigenous clast; 6 – shallowing-upward depositional cycles; 7 – dipping-upward depositional cycles.

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PLATES

Plate I

- Fig. 1 – Branching coral concentrations, accompanied by subordinate sheet-like colonies (arrows).
- Fig. 2 – Tabular corals and elevator rudists, identified in the stage 2.
- Fig. 3 – Isolated tabular corals in bioclastic shoals.

Plate II

- Transverse sections of the right valve of different rudist specimens.
- Fig. 1 – *Vaccinites inaequicostatus* MÜNSTER.
- Fig. 2 – *Vaccinites sulcatus* DEFRANCE.
- Fig. 3 – *Vaccinites inaequicostatus* MÜNSTER in the right position and *Vaccinites gosaviensis* DOUVILLÉ in the left (marked with arrows).

- Fig. 4 – *Plagioptychus* sp. (both valves).
Fig. 5 – *Vaccinites vredenburgi* KÜHN.
Fig. 6 – *Plagioptychus* sp. (both valves).
For all figures scale bar is 1 cm.

Plate III

- Fig. 1 – Thin section of a caprinid shell.
Fig. 2 – Longitudinal section of a juvenile rudist with both valves, fixed on a coral colony.
Fig. 3, 4 – Perforations by lithofagous bivalves are frequently noticed within the coral colonies (fig. 4) and on the rudist shells (fig. 3).
Fig. 5 – Annelid tubs covered by thin rhodophytic crusts.
Fig. 6 – Small annelid “colonies” encrusting a coral fragment.
Fig. 7 – Agglutinated foraminifers (*Coscinophragma-Acruliammina* type).
Fig. 8 – Complex crusts of bryozoans and rhodophytes.
For all figures scale bar is 1 mm.

Plate IV

- Fig. 1-4 – Dasyclad fragments: 1, 2, 3 – *Neomeris* cf. *plagnensis* DELOFFRE; 4 – *Terquemella* sp.
Fig. 5 – *Parachaetetes asvapatii* PIA.
Fig. 6 – Hemispherical crusts of the solenoporaceae algae (*Parachaetetes* sp. or *Solenopora* sp.). It essentially differs from *Parachaetetes asvapatii* by the much more larger diameter of the filaments.
Fig. 7, 8 – Cyanobacteria – like structures with filaments containing rare vertical walls (as in *Pycnoporidium*). The large amount of micritic material between filaments indicate rather a microbial affinity.
Fig. 9 – Coral colonies surrounded by thin rhodophytic crusts.
Scale bar is 1 mm for figs. 1, 2, 5-9, and 0.5 mm for figs. 3-4.

Plate V

- Fig. 1-3 – Morphologic types of rhodoids made up of *Sporolithon* sp.. 1-2 – mamelonar crusts; 3 – branching thalli with anastomosed branches.
Fig. 4 – Encrusting foraminifer associated with red algae.
Fig. 5, 6, 7 – *Sporaolithon* sp.
Fig. 8, 9 – Wackestone/packstone with *Paraphyllum amphiroaeforme* and *Sporolithon* sp., foraminifers, bivalve and coral fragments.
Scale bar is 1 mm for figs. 1-7, and 0.5 mm for figs. 8-9.

UPPER CRETACEOUS RUDIST- BEARING DEPOSITS FROM THE GILĂU MOUNTAINS

Plate I

Plate II

Plate III

Plate IV

UPPER CRETACEOUS RUDIST-BEARING DEPOSITS FROM THE GILĂU MOUNTAINS

Plate V