RAZPRAVE IV. RAZREDA SAZU	XLV-3	145 - 169	Tab. 4	LJUBLJANA 2004

BACARELLA VIPAVICA N. GEN., N. SP. (ANTHOZOA, SCLERACTINIA) FROM REEFAL BLOCKS IN LOWER EOCENE CARBONATE MEGABEDS IN THE VIPAVA VALLEY (SW SLOVENIA)

BACARELLA VIPAVICA N. GEN., N. SP. (ANTHOZOA, SCLERACTINIA) IZ GREBENSKIH BLOKOV V SPODJEEOCENSKIH KARBONATNIH MEGAPLASTEH V VIPAVSKI DOLINI (JZ SLOVENIJA)

DRAGICA TURNŠEK & ADRIJAN KOŠIR

ABSTRACT UDC: 563.6(118.1)(497.4-16)

***Bacarella vipavica* n. gen., n. sp. (Anthozoa, Scleractinia) from reefal blocks in Lower Eocene carbonate megabeds in the Vipava Valley (SW Slovenia)**

Coral and coral-red algal buildups make a substantial component of Paleocene and Lower Eocene carbonate platform successions in the Kras region (SW Slovenia) and are locally abundant in resedimented carbonates within the succession of Lower Eocene flysch deposits in the Vipava Valley. *Bacarella vipavica* n.gen., n.sp. described in this paper is a peculiar form of small, cateniform scleractinian coral. This coral form has not been encountered in *in-situ* Paleocene and/or Lower Eocene reef facies on the Kras Plateau but occurs abundantly in clasts in carbonate megabeds. The coral-bearing clasts exhibit facies aspects characteristic of mud-mound type buildups.

Key words: Corals, reef buildups, mud mounds, carbonate megabeds, flysch, Paleocene, Eocene.

IZVLEČEK UDK: 563.6(118.1)(497.4-16)

***Bacarella vipavica* n. gen., n. sp. (Anthozoa, Scleractinia) iz grebenskih blokov v spodjeeocenskih karbonatnih megaplasteh v Vipavski dolini (JZ Slovenija)**

Koralne in koralno-algalne grebenske tvorbe so pomembna komponenta zaporedja paleocenskih in spodnjeeocenskih platformnih karbonatov na Krasu, grebenske tvorbe pa najdemo tudi presedimentirane v karbonatnih megaplasteh v spodnjeeocenskem flišu v Vipavski dolini. V razpravi je opisana *Bacarella vipavica* n.gen., n.sp., posebna kateniformna oblika skleraktinijske korale. Doslej nikjer ni bila najdena v *in situ* paleocenskih in/ali spodnjeeocenskih grebenskih faciesih, zelo pogostna pa je v klastih karbonatnih megaplasti. Faciesi klastov s koralami so značilni za tip kopastih muljastih tvorb.

Ključne besede: Korale, grebenske tvorbe, muljaste kope, karbonatne megaplasti, fliš, paleocen, eocen.

Address - Naslov

Dr. Dragica TURNŠEK & Mag. Adrijan KOŠIR
Paleontološki inštitut Ivana Rakovca ZRC SAZU
Novi trg 2
SI-1000 Ljubljana
Slovenia
e-mail: dturnsek@zrc-sazu.si, adrijan@zrc-sazu.si

INTRODUCTION

Facies architecture of the Paleocene and Eocene part of the Adriatic-Dinaric Carbonate Platform in SW Slovenia is generally comparable with other Early Paleogene carbonate platforms of the Mediterranean Tethys (e.g. ARNI 1965, LUTERBACHER 1984, BUXTON & PEDLEY 1989; HOTTINGER 1997), with facies associations characterized by, and described in terms of the prevailing group of foraminifera (e.g. miliolid limestone, alveolina limestone etc.; PAVLOVEC 1963, DROBNE 1977, 1979). However, coral and coral-red algal buildups appear to make a substantial component of Paleocene and Lower Eocene carbonate platform successions in the Kras region (DROBNE et al. 1988, TURNŠEK & DROBNE 1998, KOŠIR et al. 2001, 2003). Moreover, large clasts of coral-dominated limestones are locally abundant in carbonate megabeds and megabreccia deposits within the succession of Lower Eocene flysch in the Vipava Valley.

Bacarella vipavica n.gen., n.sp. described herein is a peculiar form of small, cateniform scleractinian coral. This coral form, which appears to be closely associated with wackestone carbonate facies, has not been encountered in *in-situ* Paleocene and/or Lower Eocene reef facies on the Kras Plateau, but is abundant in clasts of resedimented carbonates in the flysch succession. The coral-bearing clasts exhibit facies aspects characteristic of mud-mound type buildups.

GEOLOGICAL SETTING

The stratigraphy of Upper Cretaceous and Early Paleogene carbonate and siliciclastic successions of the NW Dinarides (Fig. 1) exhibits a typical pattern of underfilled foreland basins (SINCLAIR 1997), comprising three units (Fig. 2A) which were superimposed during basin migration (KOŠIR & OTONIČAR 2001). These units reflect deposition during major tectonic events when the Adriatic-Dinaric Carbonate Platform was subaerially exposed, subsequently re-established, then drowned, and finally buried by prograding deep-water clastics (flysch).

A generalized stratigraphic column of the Upper Cretaceous, Paleocene, and Eocene deposits in the Kras region is shown in Figure 2B. The lower unit (the Kras Group; KOŠIR 2003) overlies the forebulge unconformity and comprises three formations: 1) Liburnian Formation (Upper Maastrichtian to Selandian) characterized by restricted, marginal marine and palustrine carbonates; 2) Trstelj Formation (Thanetian) composed of smaller foraminiferal, coral and algal facies; and 3) Alveolina-Nummulites Limestone (Lower Eocene) dominated by accumulations of larger benthic foraminifera. The total thickness of the Kras Group ranges from several tens of meters to more than 450 m (JURKOVŠEK et al. 1996). The middle unit (Transitional Beds; Lower Eocene) consists of up to 50 m of pelagic and hemipelagic limestones and marls. The upper unit

(Flysch; Lower Eocene) is composed of a succession (>1.000 m thick) of sandstone-dominated turbidites, marls, and resedimented carbonates (debrites and calciturbidites). All three units occur diachronously along the regional profile, corresponding to NE-SW migration of the platform and basin from the Campanian/Maastrichtian to the Middle Eocene (BIGNOT 1972, DROBNE 1977, COUSIN 1981, KOŠIR & OTONIČAR 2001). Age assignments noted above correspond to overall time-spans of the lithostratigraphic units in the Kras region (see DROBNE 1977, JURKOVŠEK et al. 1996, 1997, OGORELEC et al. 2001).

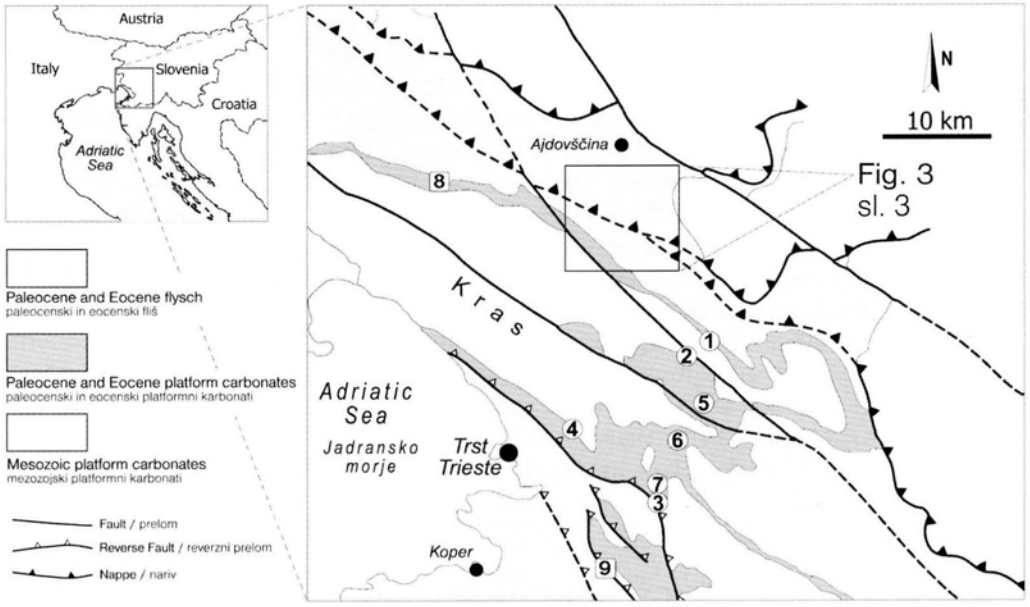


Fig. 1. Geographical position and simplified geological map of SW Slovenia (compiled from PLACER 1981 and DROBNE 1977). Localities of Paleocene and Eocene reef limestones: Paleocene: 1 - Dolenja Vas, 2 - Sopada, 3 - Golež, 4 - Padriče (Padriciano) (TURNŠEK & DROBNE 1998); 5 - 7: motorway road-cuts between Čebulovica and Kozina (KOŠIR et al. 2001, 2003); Eocene: 8 - Trstelj (KOŠIR 1997), 9 - Črni kal (KOLOSVÁRY 1967).
Sl. 1. Geografski položaj in poenostavljena geološka karta JZ Slovenije (sestavljeno po PLACER 1981 in DROBNE 1977). Najdišča paleocenskih in eocenskih grebenskih apnencev: Paleocen: 1 - Dolenja Vas, 2 - Sopada, 3 - Golež, 4 - Padriče (Padriciano) (TURNŠEK & DROBNE 1998); 5 - 7: avtocestni useki med Čebulovico in Kozino (KOŠIR et al. 2001, 2003); Eocen: 8 - Trstelj (KOŠIR 1997), 9 - Črni kal (KOLOSVÁRY 1967).

Relatively consistent NE-SW regional stratigraphic trends (KOŠIR & OTONIČAR 2001) indicate that the platform and basin stratigraphy was largely controlled by the flexural deformation and/or tilting of the foreland. Local variations in stratigraphy, especially of carbonates

onlapping the forbulge unconformity and of platform-to-basin successions, most likely resulted from non-flexural deformations, e.g. reactivation of antecedent pre-orogenic structures. Lithostratigraphic units of Paleocene and Lower Eocene shallow-marine carbonates (Trstelj Formation and Alveolina-Nummulites Limestone) roughly correspond to larger-scale depositional sequences bounded by subaerial exposure surfaces (KOŠIR 2003). Vertical facies successions generally exhibit a retrogradational (backstepping) pattern which reflects a deepening trend and final drowning of the carbonate platform (ramp) by pelagic and hemipelagic deposits (Transitional Beds).

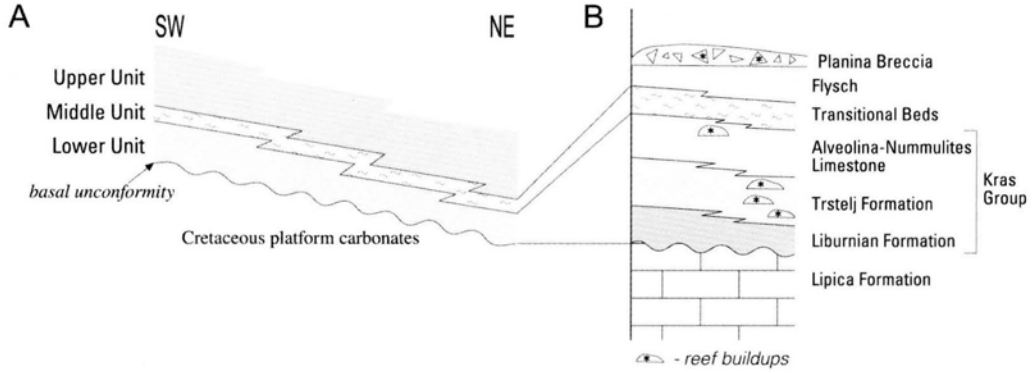


Fig. 2. A) Schematic representation of the NW Dinaric foreland basin stratigraphy. B) Generalized stratigraphic column of the upper Cretaceous - Eocene succession in the northern part of Kras and the Vipava Valley (SW Slovenia) showing major lithostratigraphic units.
Sl. 2. A) Shematski prikaz stratigrafije predorogenega bazena v SZ Dinaridih. B) Posplošen stratigrafski stolpec zgornjekredno-eocenskega zaporedja na področju severnega dela Krasa in Vipavske doline s prikazom glavnih litostratigrafskih enot.

The Flysch succession in the Vipava Valley consists of the alternation of thin to medium-bedded siliciclastic sandstone turbidites, mudstones and marls, and intercalations of thick beds (megabeds) of resedimented carbonates (Fig. 3; ENGEL 1974). Most of the carbonate megabeds (1-30 m thick) consist of bipartite debrite-turbidite beds, composed of lithoclasts of Paleocene and Eocene shallow marine carbonates, and isolated bioclasts (mainly Nummulites). A distinctive, up to 100 m thick megabreccia bed (the Planina Breccia of ENGEL 1970, 1974) occurs in the middle part of the Flysch in the Vipava Valley (Fig. 3).

Although the general paleotransport pattern in resedimented carbonates shows derivation of the carbonate debris from the southern-southwestern margin of the flysch basin (ENGEL 1974), the actual location of the source areas is uncertain. Isolated larger benthic foraminifera and other bioclasts in the megabeds indicate that the material was (partly) derived by resedimentation of a coeval carbonate platform. However, the size and composition of the lithoclastic material and the structure of megabeds suggest that they were emplaced by mass

movements which resulted from failures of steep margins (slopes) of the basin. Steep margins were most probably induced by extensional faults producing unstable fault scarps. Importantly, the presence of Lower Eocene pelagic limestone clasts in the megabeds indicates that supposed extensional faulting and slope failure occurred in a basinal setting and postdated the drowning of the carbonate platform.

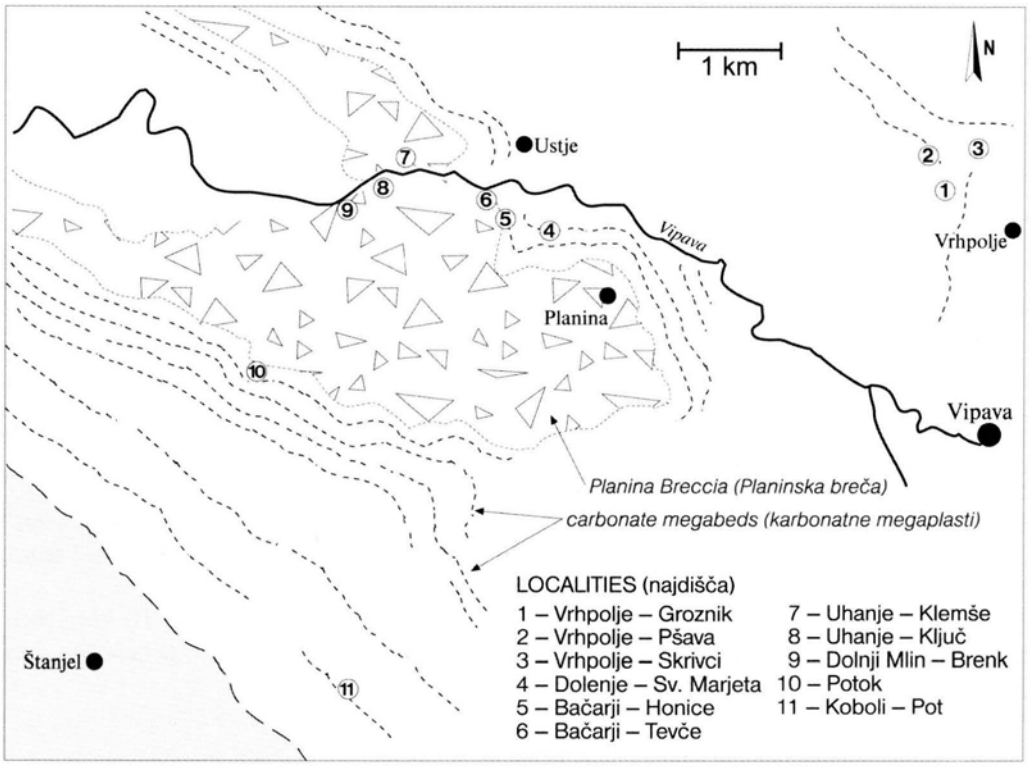


Fig. 3. Geological map of the eastern part of the Vipava Valley (modified from BUSER 1968 and KOSSMAT 1905) showing position of the coral localities.
Sl. 3. Geološka karta vzhodnega dela Vipavske doline (prirejeno po BUSER 1968 in KOSSMAT 1905) z označenimi najdišči koral.

Transitional Beds in the southern part of the Vipava Valley were emplaced within the time span of the NP 12 biozone (Late Ilerdian and Early Cuisian) based on planktic foraminifera and nannoplankton (KOŠIR 1997). Biostratigraphic studies of resedimented nummulite fauna and nannoplankton from marls near the village of Ustje (Fig. 3; DEZANCHE et al. 1967) have placed carbonate megabeds in the middle part of the Flysch succession in the Early to Middle Cuisian age (time span of biozone NP 13).

Tectonically, the Kras Plateau and the southern part of the Vipava Valley correspond to the Komen Thrust Sheet (PLACER 1981). According to the assumed position of thrust faults within the Flysch deposits, shown on a structural map of SW Slovenia of PLACER (1981), resedimented carbonates in the central part of the Vipava Valley belong to the Snežnik Thrust Sheet or to the Hrušica Nappe (Fig. 1; see also PLACER 1981: 41-43). However, in a cross-section through the western part of the Vipava Valley, ENGEL (1974) showed an undisturbed succession of flysch deposits extending from the Kras margin toward the north, with carbonate megabeds and the Planina Breccia forming a core of a large syncline.

STRATIGRAPHIC AND REGIONAL OCCURRENCE OF EARLY PALEOGENE CORAL-BEARING LIMESTONES

TURNŠEK & DROBNE (1998) described coral assemblages from several localities in the Kras region (Fig. 1, localities 1-4). Meter-scale layers of coral-bearing limestones, interpreted as small coral-algal patch reefs (DROBNE et al. 1988, TURNŠEK & DROBNE 1998), occur in different levels of Paleocene carbonates spanning from the Selandian (SBZ 2 zone according to SERRA-KIEL et al. 1998) to the upper part of the Thanetian (SBZ 4). TURNŠEK & DROBNE (1998) determined 22 coral species belonging to 15 genera.

Bodies of massive bindstone-bafflestone facies composed predominantly of scleractinian corals, crustose coralline algae and encrusting foraminifera, and exceeding 20 m in thickness have been found in road-cuts along the motorway between Čebulovica and Kozina (Fig. 1, localities 5-7; JURKOVŠEK et al. 1997, KOŠIR et al. 2001). These "buildups" occur in the middle part of the succession of the Trstelj Formation (= Slivje Limestone in JURKOVŠEK et al. 1997). Coral assemblages of the motorway outcrops have not been determined.

KOŠIR (1997) noted small, 1-2 m thick patches of red algal-coral bindstones within the succession of Lower Eocene (Ilerdian) nummulite packstones and wackestones near Trstelj (Fig1, locality 8). The coral assemblage of the buildups consist of *Coscinarea* sp., *Goniopora* sp., *Astreopora* sp., and *?Rhizangia* sp.

Eocene (?Early Lutetian) corals from the Črni Kal quarry (Fig. 1, locality 9) were described by KOLOSVÁRY (1967). Descriptions of KOLOSVÁRY (1967) are mostly inaccurate and the outcrop was largely destroyed by quarry works (PAVLOVEC & POHAR 1997). However, a succession of coral-coralline algal limestone, more than 10 m thick, has recently been found on a motorway construction site near Črni Kal (Fig. 1, locality 9; KOŠIR et al. 2003).

With the exception of the breccia in the basal part of the flysch succession near Postojna (GOSPODARIČ et al. 1967), coral-bearing limestones have not been described previously from resedimented carbonates in the Paleogene flysch deposits of SW Slovenia.

LOCALITIES AND MATERIAL

Material described in this paper was painstakingly collected by Stanislav Bačar. Samples taken from several dm^3 to m^3 large clasts were colected in six outcrops of the Planina Breccia

around the village of Ustje, about 5 km south of Ajdovščina, in outcrops of megabeds at Dolenje, Potok near Šmarje and Koboli, and on three localities of weathered-out clasts of carbonate megabeds near Vrhpolje (Fig. 3).

Stanislav Bačar made more than 40 polished slabs of the coral-bearing limestone. Thin sections taken from selected slabs were prepared at the Ivan Rakovec Institute of Paleontology ZRC SAZU in Ljubljana. Thin sections were examined and photographed under standard petrographic microscope.

FACIES DESCRIPTION

The coral fauna described below was recovered solely from resedimented material, therefore, no detailed sedimentological analyses have been performed. However, it is important to note some general facies aspects of the coral-bearing clasts. The coral-bearing facies is largely represented by gray to beige wackestones dominated by cateniform colonies of *Bacarella vipavica*, but other corals also occur (see below). Corals are commonly encrusted by coralline algae and foraminifera which also form isolated crusts. The coral colonies and algal-foraminiferal crusts appear to be *in-situ*, but they have not been observed to make a framework. Other skeletal grains include bryozoans, echinoderm fragments and rare smaller benthic foraminifera (miliolids and small rotaliids). The matrix is fine grained (Fig. 4), composed of silt-sized peloids and massive or clotted micrite. The peloidal matrix often exhibits laminar fabric (Figs. 4A-C). Some clasts of the coral wackestone are characterized by the presence of centimeter-scale, irregular cavities (vugs) filled by radiaxial fibrous cements (Fig. 4B) and geopetal sediments. The wackestone facies is associated with patches of packstone to grainstone composed of peloids, miliolids, rotaliids, discocyclinids, orbitolitids, dasycladaceans, red algae, bryozoans and echinoderm fragments. The relationship between facies cannot be established in the studied thin sections.

Mud-dominated and matrix-supported fabric of clasts with *Bacarella* is typical of mud-mound or reef-mound facies (e.g. Reitner et al. 1995, Bosence & Bridges 1995, Tucker & Wright 1990). These buildups might form by trapping and binding of externally supplied mud by corals and other metazoans, however, the peloidal and laminar fabric shows that the fine-grained carbonate was probably largely produced *in-situ*.

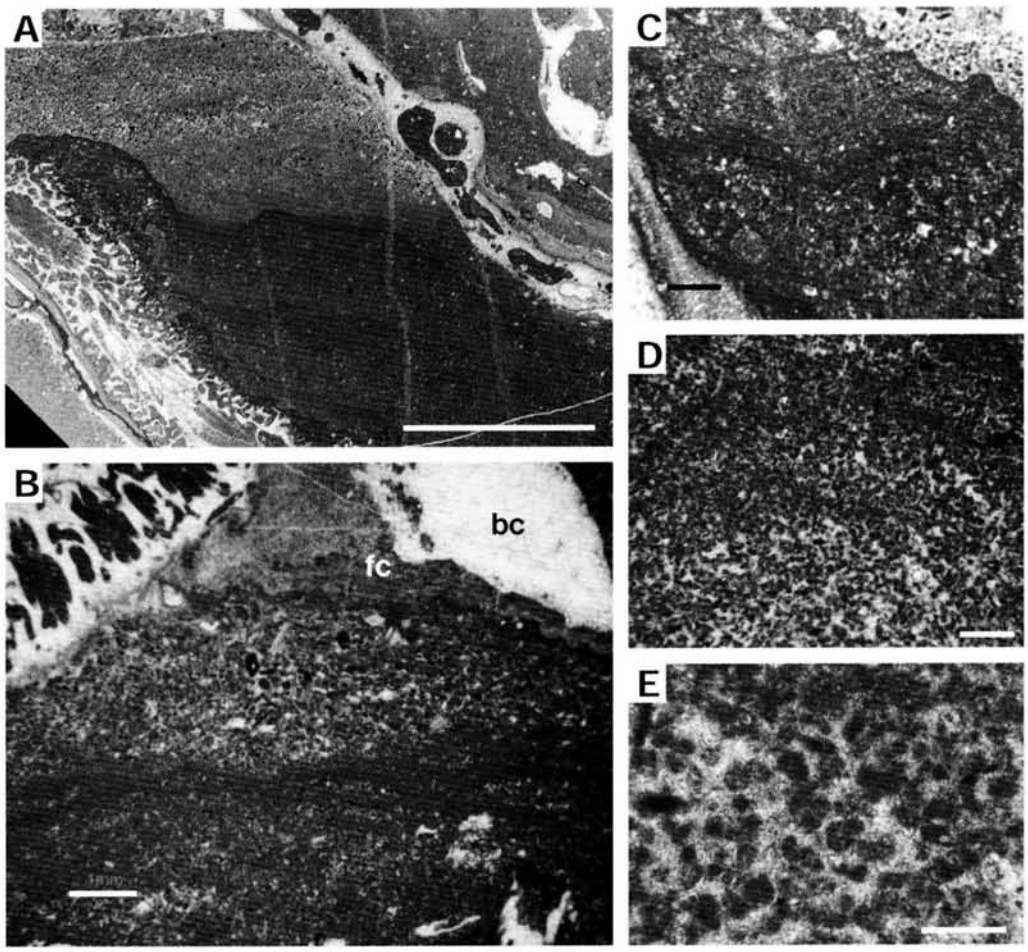


Fig. 4. Thin-section photomicrographs showing facies aspects of the coral-bearing limestone clasts, all in plane-polarized light. A) Coral wackestone/bafflestone, scale bar 5 mm. Sample: Brenk B/b. B) Laminated peloidal and massive micrite. A vug in the upper part is filled with cloudy, brown radiaxial fibrous cement (fc) and clear blocky calcite cement (bc). Scale bar 1 mm. Sample: Uhanje Ključ a3512/1c. C) Wavy laminated peloidal micrite. Scale bar 0.5 mm. Sample: Brenk B/a. D) Peloidal micrite, scale bar 0.5 mm. Sample Uhanje Klemše 3338/A1. E) Detail of D, scale bar 0.2 mm.

Sl. 4. Faciesne značilnosti apnenčevih klastov s koralami. Vse fotografije zbruskov so posnete v polarizirani svetlobi. A) Koralni wackestone/bafflestone, merilo 5 mm. Vzorec: Brenk B/b. B) Laminirani peloidni in masivni mikrit. Votlina v zgornjem delu je zapolnjena z motnim, rjavkastim žarkovitim fibroznim cementom (fc) in prozornim sparitom (bc). Merilo 1 mm. Vzorec: Ključ 3512/1c. C) Valovito laminiran peloidni mikrit. Merilo 0.5 mm. Vzorec: Brenk B/a. D) Peloidni mikrit, merilo 0.5 mm. Vzorec Uhanje Klemše 3338/A1. E) Detajl s slike D, merilo 0.2 mm.

SYSTEMATIC PALEONTOLOGY

Family: Acroporidae Verrill 1902

Genus: *Bacarella* n. gen.

Type species: *Bacarella vipavica* n.gen., n.sp.

Etymology: It is named after Stanislav Bačar who discovered all the localities and collected specimens.

Diagnosis: Cateniform, constantly uniserial rows of corallites with thick septotheca or synapticulotheca and narow subcostate, synapticulate and flaky peritheca (coenosteum). Septa hexameral to octomeral, in 1-2(3) cycles, endotheca lacking or of very scarce thin dissepiments, exotheca of synapticulae, no columella, microstructure is not preserved.

Comparison: According to the relationship between corallites and peritheca, the new genus fits to Acroporidae. It is most similar to *Astraeopora* and *Acropora* from which it differs in consistently uniserial cateniform growth of corallites (compare contemporary description of *Astreopora* by PFISTER 1980, BOSELLINI 1988, BUDD et al. 1992, PRLJ-ŠIMIĆ 1994, BARON-SZABO 2002).

Systematic position of the family Acroporidae: Its higher systematic position is not uniform. It has been attributed to different suborders: to Archaeocoeniina (ALLOITEAU 1952), to Eupsammiina (ELIAŠOVA 1974), to Dendrophylliina (DROBNE et al. 1988, TURNŠEK & DROBNE 1998) to Astrocoeniina (Wells 1956, FROST & LANGENHEIM 1974, PFISTER 1980, BOSELLINI 1988, BUDD et al. 1992, PRLJ-ŠIMIĆ 1994, BARON-SZABO 2002). The very similar genus *Pseudastraeopora* (based on the *Astraeopora hortensis*) has been atributed even to the order Hexanthiniaria (RUSSO 1979: 38). All these clasifications rely either upon septa or wall or peritheca structures or microstructure. The microstructure of our material is completely recrystalized, therefore the classification can not be discussed in present paper.

Remarks: The new genus *Bacarella* is a special uniserial morphotype of Acroporidae which may have developed in specific environments. *Bacarella* is a clearly distinguishable form appearing in many localities, therefore, in our opinion, it can be treated as a new genus.

Bacarella vipavica n. sp.
Fig. 5, Pls. 1-4

Etymology: Named after Vipava Valley where it occurs in a great number.

Holotype: Specimen 3512.

Type locality: Uhanje Ključ. Clast in Lower Eocene resedimented carbonates.

Diagnosis: *Bacarella* with dimensions: d (diameter) of corallites is 0,6-1,2 mm, d of series 1-1,5 mm, s = 6-16(24)(6-8+s2+s3), h (height) of corallites 2-7 mm, length of series up to 80 mm.

Material: 41 specimens, 26 thin sections. Specimens are kept in Stanislav Bačar's collection in the Museum of Ajdovščina (Goriški muzej Ajdovščina). Thin sections are kept at the Ivan Rakovec Institute of Paleontology ZRC SAZU in Ljubljana.

Description: The colony is cateniform, its corallites are low, cylindrical, round in transverse section. They bud extratentacularly, laterally, in uniserial rows or series. It seems that new buds arise in coenosteum. Corallites grow parallel to each other. They join in the entire or partial height (Fig. 5). Series often divide always in rectangular way. Series have straight or wavy or meandroid direction. This feature most likely reflects a constratal growth of the colony. Septa are costate, some of them are short, the others reach the center of the corallum. They are thick at the wall and become thinner toward the centre,where some of them thicken again or bear some kind of auriculae. Septa are developed in 1-2(3) cycles in the irregular hexameral (to octomeral) system. In some corallites we were able to count 6-8 septa of the first cycle, in the others meanwhile, the second (and partly the third) cycle is developed as well, and we can count 12-16(24) septa. Septa have lateral sharp granulae. As a rule, the wall is thick septotheca or synapticulotheca. Endotheca seems to be absent. Exotheca is of synapticulae. There is no columella. In almost all specimens the peritheca or coenosteum is developed. It is subcostate, synapticulothecate, flaky. It appears around the corallites and especially on both sides of series. In places, where series rectangularly divide it becomes wider. Microstructure is completely recrystalized.

Comparison: The same as for the genus. All the specimens of somehow different shapes and variable dimensions are atributed to the same species.

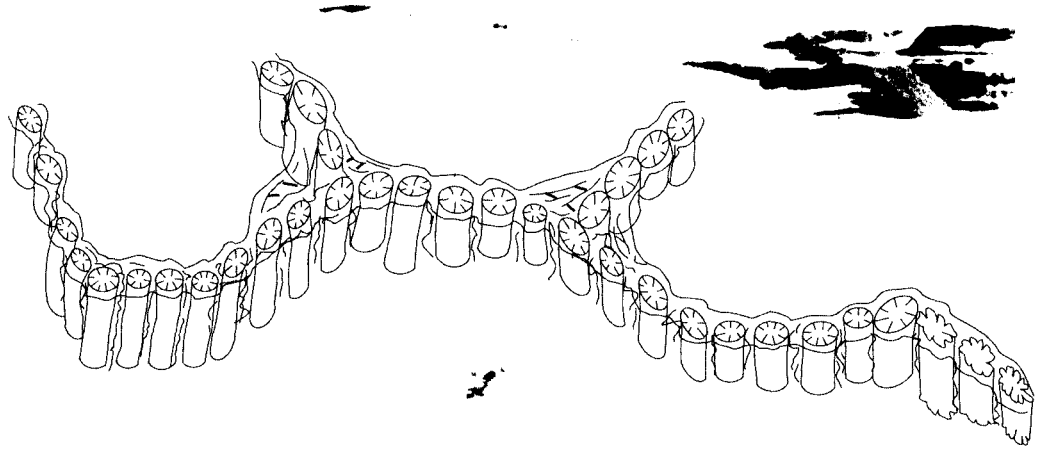


Fig. 5. Reconstruction of the cateniform genus *Bacarella* showing growth of uniserial corallites. Series is straight, wavy to meandroid, rare rounded, in places it divides rectangularly. Neighbouring corallites can be joined along their entire or partial lateral sides by wall or by peritheca. Structural elements on this figure are highly shematized, not in scale and not in perspective.
Sl. 5. Rekonstrukcija členkastega rodu *Bacarella* kaže uniserialno rast koralitov. Serija je lahko ravna, vijugasta, meandrična, redko zaokrožena. Mestoma se serija pravokotno razcepi. Sosednji koraliti so povezani vzdolž celotne ali delne lateralne strani z vmesno steno ali periteko. Strukturni elementi so na sliki močno shematizirani, niso ne v merilu ne v perspektivi.

Localities and material: Uhanje-Ključ (3152, 3433, 3511, 3512=holotype); Uhanje-Klemše (3338, 3339, 6581, 6591, 6595, 6596, 6597, 6623, 6624, 6625, 6627, 6628, 6629, 6630); Dolenje-Sveta Marjeta (3454, 3455); Šmarje-Potok (3530); Dolnji Mlin-Brenk (3751, 3761, 4489, 6673, 6674); Bačarji-Tevče (3827, 3828, 3833); Bačarji-Honice (4434, 4435); Vrhpolje-Groznik (1979, 1988, 2455, 2584, 3717); Vrhpolje-Skrivci (3815); Vrhpolje-Pšava (3759, 6582); Koboli-Pot (3253).

Fossil association: Corals accompanying the new genus are of small dimensions. They belong to the genera *Actinacis, Goniopora, Rhizangia, Astraeopora, Alveopora, Strotogyra, Agatiphyllia, Dendrophyllia, Glyphastraea, Plocophyllia* and others (preliminary determinations after BARTA-CALMUS 1973, KUZMICHEVA 1975, PFISTER 1980, PRLJ-ŠIMIĆ 1996, SCHUSTER 1996, BOSELLINI 1998, BOSELLINI & PAPAZZONI, 2003, and others).

Remarks: No reliable age-diagnostic taxa have been observed in the fossil assemblage with *B. vipavica*. Rare benthic foraminifera in some of the clasts (*Opertorbitolites* sp., larger miliolids, discocyclinids) indicate Late Paleocene or Early Eocene age. However, other clasts, devoid of any diagnostic taxa, may also originate from Lower Paleocene strata.

CONCLUDING REMARKS

Abundant wackestone clasts containing *Bacarella vipavica*, found in resedimented carbonates in the Lower Eocene flysch deposits in the Vipava Valley, provide evidence for Paleocene and/or Lower Eocene carbonate mud-mound type buildups on the Adriatic-Dinaric Carbonate Platform. Such facies has not been reported from *in-situ* Paleogene patch reefs (DROBNE et al. 1988, TURNŠEK & DROBNE 1998, KOŠIR 1997), yet facies characteristics are poorly documented in most previous studies. However, recently discovered buildups along the motorway road-cuts in the Kras region show a lack of skeletal framework and the prevalence of mud-dominated facies (KOŠIR et al. 2003). Therefore, further research should be focused on the reassessment of sedimentology of the Lower Paleogene reef buildups as well as on the re-evaluation of their paleoenvironmental settings.

ACKNOWLEDGMENTS

We are grateful to Stanislav Bačar for generously allowing us to study the fossil material from his collection. We thank Irena Debeljak and Špela Goričan for their constructive criticism of earlier drafts, Kata Cvetko Barić for preparation of thin sections, and Andrej Šmuc for preparation of Fig. 5. Glenn Jacobs is acknowledged for English corrections of the final text. The research was supported by a grant of the Slovenian Academy of Sciences and Arts.

POVZETEK

Paleocensko-eocensko zaporedje Jadransko-dinarske karbonatne platforme v jugozahodni Sloveniji sestavljajo faciesne združbe, v katerih - tako kot drugod na področju Tetide - prevladujejo bentoške foraminifere. Pomemben del zaporedja na Krasu predstavljajo koralne in

koralno-algalne grebenske tvorbe (sl. 1), ki se pojavljajo v različnih nivojih Trsteljske formacije od selandija do zgornjega thanetija (Drobne et al. 1988, Turnšek & Drobne 1998, Jurkovšek et al. 1997, Košir et al. 2001) in v Alveolinsko-numulitnem apnencu (Košir 1997, Košir et al. 2003), klasti paleogenskih grebenskih faciesov pa so pogosti tudi v resedimentiranih karbonatih v zaporedju spodnjeeocenskega fliša v Vipavski dolini (sl. 2).

V razpravi je opisana *Bacarella vipavica* n.gen., n.sp., posebna kateniformna oblika skleraktinijske korale. Doslej nikjer ni bila najdena *in situ*, zelo pogostna pa je v klastih karbonatnih megaplasti. Najdišča teh koral je odkril Stanislav Bačar, ki je tudi zbral večino primerkov. Najdišča se nahajajo v izdankih Planinske breče v okolici Ustja, v megaplastah pri Dolenjem, Potoku in Kobolih ter v preperini resedimentiranih karbonatov v okolici Vrhpolja (sl. 3; gl. tudi Engel 1974). Klasti s koralami se razlikujejo od faciesov *in situ* paleocenskih in spodnjeeocenskih grebenskih tvorb na Krasu, ki jih večinoma sestavljajo koralno-algalni bindstoni in bafflestoni (Drobne et al. 1988, Košir 1997). V klastih s koralami *Bacarella vipavica* namreč prevladuje drobnozrnato karbonatno vezivo, sestavljeno iz masivnega, laminiranega in grudastega mikrita (*clotted micrite*) ter peloidov velikosti melja (sl. 4). Laminirana in peloidna tekstura kaže, da je dobnozrnat karbonatni sediment verjetno (vsaj deloma) nastal *in situ*, kar je značilno za muljaste grebenske kope (*mud mounds* oz. *reef mounds*) (npr. Reitner et al. 1995, Bosence & Bridges 1995, Tucker & Wright 1990).

Bacarella vipavica je nov rod iz družine Acroporidae. Rodovno ime je dobila po zbiratelju Stanislavu Bačarju, ki je odkril nahajališča in zbral večino primerkov, vrstno ime pa je posvečeno Vipavski dolini, kjer je bila najdena. *Bacarella* je majhna kateniformna korala, ki je po svoji členasti rasti edinstvena med skleraktinijami (sl. 5). Premer posameznih koralitov meri komaj 0.6 do 1.2 mm, njihova višina je 2-7 mm, medtem ko so ugotovljene serije dolge do 80 mm. Septa se pojavljajo v heksamernem do oktomernem sistemu, stena je septoteka, endoteke in kolumele ni. Med koraliti je sinaptikularna periteka ali cenostej, kar jo uvršča v omenjeno družino Acroporidae. Vsi primerki so uvrščeni v isto vrsto, ker se nekoliko različne dimenzije in različne oblike rasti pojavljajo že na istem vzorcu in jih štejemo za variacijsko širino vrste (gl. table 1-4). Za raziskave smo imeli na voljo 41 vzorcev, ki so bili najdeni na 11 nahajališčih. Poleg opisane vrste se v kamnini pojavljajo še korale iz rodov *Actinacis, Goniopra, Rhizangia, Astraeopora, Strotogyra, Glyphastraea, Plocophyllia* in druge. Opisana nova vrsta je lahko paleocenske ali spodnjeeocenske starosti.

REFERENCES

Alloiteau, J., 1952: Madréporaires post-paléozoiques. - In: Piveteau, J.(ed.) Traité de Paléontologie (Paris) 1: 539–782.

Arni, P., 1965: L'évolution des Nummulitinae en tant que facteur de modification des dépôts littoraux. - Mém. BRMG (Paris): 32: 7–20.

Baron-Szabo, R. C., 2002: Scleractinian Corals of the Cretaceous. - (Knoxville): 539 pp.

Barta-Calmus, S., 1973: Révision de collections de Madréporaires provenant du Nummulitique du Sud-Est de la France, de l'Italie et de la Yougoslavie septentrionale. – Thesis, Université de Paris: 694 pp.

BIGNOT, G., 1972: Recherches stratigraphiques sur les calcaires du Crétacé supérieur et de l'Éocène d'Istrie et des regions voisines. Éssai de révision du Liburnien. – Trav. Lab. Micropaléont., 2. Univ. Paris VI, Paris, 353 pp.

BOSELLINI, F. R. & C., A. PAPAZZONI, 2003: Palaeoecological significance of coral-encrusting foraminiferan associaltions: A case –study from the Upper Eocene of northern Italy. - Acta Palaeontol. Pol. (Warszawa) 4: 279–292.

BOSELLINI, F. R., 1988: Oligocene Corals from Monte Bastia (Vicentin Lessini Mountains, N. Italy). – Mem. Accad. Naz. Sci. Let. Art. (Modena), ser. 7, 5: 111–157.

BOSELLINI, F. R., 1998: Diversity, Composition and Structure of Late Eocene Shelf-edge Coral Associations (Nago Limestone, Northern Italy). – Facies (Erlangen) 39: 203–226.

BOSENCE, D. W. J. & P. H. BRIDGES, 1995: A review of the origin and evolution of carbonate mud-mounds. In: Monty, C. L. V., Bosence, D. W. J., Bridges, P. H. & Pratt, B. R., (Eds.): Carbonate Mud-Mounds; Their Origin and Evolution. – IAS Spec. Publ. 23, Blackwell, Oxford, 3–9.

BUDD, A. F., T. A. STEMANN & R. H. STEWART, 1992: Eocene Caribbean reef corals: a unique fauna from the Gatuncillo Formation of Panama. – Journal of Paleontology (Lawrence) 66: 570–594.

BUSER, S., 1968: Osnovna geološka karta SFRJ 1:100.000, list Gorica. – Zvezni geološki zavod. Beograd.

BUXTON, M.W.N. & H.M. PEDLEY, 1989: A standardized model for Tethyan Tertiary carbonate ramps. – Journal of the Geological Society (London) 146:746–748.

COUSIN, M., 1981, Les rapports Alpes-Dinarides Les confins de l'Italie et de la Yugoslavie. – Société Géologique du Nord (Villeneuve d'Aseq), Publication no. 5, v.1, 521 p., v. 2 (Annexe), 521 p.

DEZANCHE, V., PAVLOVEC, R. & F. PROTODECIMA, 1967: Mikrofavna in mikrofacies eocenskih flišnih plasti pri Ustju v Vipavski dolini. – Razprave IV. razr. SAZU (Ljubljana) 10: 205–263.

DROBNE, K., 1977, Alvéolines paléogènes de la Slovénie et de l'Istrie: Mémoires Suisses de Paléontologie (Basel) 77: 132 p., 21 pls.

DROBNE, K., 1979: Paleogene and Eocene beds in Slovenia and Istria. – In: Drobne, K., ed.: Geological development in Slovenia and Croatia, Guidebook, 16th European Micropaleontological Colloquium (Ljubljana): 49–64.

DROBNE, K., B. OGORELEC, M. PLENIČAR, M. L. ZUCCHI-STOLFA & D. TURNŠEK, 1988: Maastrichtian, Danian and Thanetian beds in Dolenja vas (NW Dinarides, Yugoslavia). Mikrofacies, foraminifers, rudists and corals. – Razprave IV. razreda SAZU (Ljubljana) 29: 147–224.

ELIAŠOVA, H., 1974: Hexacorallia et Octocorallia du Paleogene des Carpates externes. – Sbornik geol. ved, Paleontologie (Praha) 16: 105–156.

ENGEL, W. 1970: Die Nummuliten-Breccien im Flyschbecken von Ajdovščina in Slowenien als Beispiel karbonatischer Turbidite. – Verhandlungen der geologischen Bundesanstalt (Wien) 1970/4: 570–582.

ENGEL, W., 1974: Sedimentologische Untersuchungen im Flysch des Beckens von Ajdovščina (Slowenien). – Göttinger Arbeiten zur Geologie und Palaeontologie (Göttingen) 16: 65pp.

FROST, S. H. & R. L.. LANGENHEIM JR., 1974: Cenozoic Reef Biofacies. Tertiary Larger Foraminifera and Scleractinian Corals from Chiapas, Mexico. – North Illinois Univ. Press, (De Kalb) 388 pp.

GOSPODARIČ, R., KOLOSVÁRY, G., PAVLOVEC, R. & F. PROTO-DECIMA, 1967: Über Entstehung und Alter der Paläogenschichten im Pivka-Becken bei Postojna (Adelsberg, SW Slowenien, Yugoslawien). – Anzeiger der math.-naturw. Klasse der Österreicischen Akademie der Wissenschaften (Wien) 2: 33–57.

HOTTINGER, L., 1997: Shallow benthic foraminiferal assemblages as signals for depth of their deposition and limitations. Bulletin de la Société Géologique de France (Paris): 168:491–505.

JURKOVŠEK, B., T. KOLAR-JURKOVŠEK & B. OGORELEC, 1997: Geologija avtocestnega odseka Divača – Kozina. – Annales. Anali za istrske in mediteranske študije (Koper), 11, Ser. Hist. Nat. 4: 161–186.

JURKOVŠEK, B., M. TOMAN, B. OGORELEC, L. ŠRIBAR, K. DROBNE, M. POLJAK & LJ. ŠRIBAR, 1996: Formacijska geološka karta južnega dela Tržaško-komenske planote 1:50.000. Kredne in paleogenske karbonatne kamnine, 143 str., Inštitut za geologijo, geotehniko in geofiziko, Ljubljana.

KOLOSVÁRY, G., 1967: Lutetian corals from Črni kal in Yugoslavia. – Geologija (Ljubljana) 10: 189–205.

KOSSMAT, F., 1905: Geologische Spezialkarte der Oesterreichisch-Ungarischen Monarchie 1:75.000, Heidenschaft und Adelsberg. – Geologische Reichanstalt. Wien.

KOŠIR, A., 1997: Eocenski taložni slijed prijelaza karbonatne platforme u bazen na području JZ Slovenije. – Magistarski rad. Sveučilište u Zagrebu. 130 str.

KOŠIR, A., 2003: Litostratigrafska revizija zgornje krede in paleogena v jugozahodni Sloveniji. – Geološki Zbornik (Ljubljana) 17: 92–98.

KOŠIR, A., I. DEBELJAK, B. OTONIČAR & Š. GORIČAN, 2001: Geološko-paleontološki nadzor z vidika varstva naravne dediščine na območju trase avtoceste Kozina – Klanec. – Paleontološki inštitut Ivana Rakovca ZRC SAZU. Ljubljana. (Končno poročilo, 131 str.)

KOŠIR, A. & B. OTONIČAR, 2001, The evolution of Upper Cretaceous and Palaeogene synorogenic carbonate platforms in NW Dinaric foreland basin, *in* Dragičević, I. and Velić, I., eds., Carbonate Platform(s) of the Dinarides: University of Zagreb, Abstracts, p. 62–63.

KOŠIR, A., T. POPIT, I. DEBELJAK, D. TURNŠEK, Š. GORIČAN & A. ŠMUC, 2003: Paleontološka, stratigrafska in sedimentološka spremljava v okviru varstva naravne dediščine na odseku AC Klanec – Srmin: Trasa in objekti od km 11.500 do km 19,500. – Paleontološki inštitut Ivana Rakovca ZRC SAZU. Ljubljana. (Končno poročilo, 101 str.)

KUZMICHEVA, E. I., 1975: Ranne i srednepaleogenovye korally nekotoryh rajonov Evropejskoj chasti SSSR. - Novoe o faune. Akad. nauk SSSR (Moskva): 15–31.

LUTERBACHER, H., 1984 Paleoecology of foraminifera in the Paleogene of the Southern Pyrenees. – Benthos83, 2nd Int. Symp. Benthic Foraminifera (Pau), 389–392.

OGORELEC, B., K. DROBNE, B. JURKOVŠEK, T. DOLENEC & M. TOMAN, 2001: Paleocene beds of the Liburnia Formation in Čebulovica (Slovenia, NW Adriatic-Dinaric platform). – Geologija (Ljubljana) 44: 15–65.

PAVLOVEC, R., 1963: Stratigrafski razvoj starejšega paleogena v južnozahodni Sloveniji. – Razprave IV. razr. SAZU (Ljubljana) 7: 419–556.

PAVLOVEC, R. & V. POHAR, 1997: The Črni Kal Quarry - an example of destroying geotopes. – Geologia Croatica (Zagreb) 50: 181–184.

PFISTER, T. E., 1980: Systematische und palaeoockologische Untersuchungen an oligozaenen Korallen der Umgebung von San Luca (Provinz Vicenza, Norditalien). – Schweiz. Palaeont. Abh., (Basel): 1–121.

PLACER, L., 1981: Geološka zgradba jugozahodne Slovenije. – Geologija (Ljubljana) 24, 27-60.

PRLJ-ŠIMIĆ, N., 1994: Eocenska koraljna fauna Hrvatske. – Sveučilište u Zagrebu, Thesis (Zagreb): 71 str.

REITNER, J., F. NEUWEILER, P. DINGLE, G. FLAJS, P. GAUTRET, C. HENSEN, H. HÜSSNER, B. KAUFMANN, H. KEUPP, R. R. LEINFELDER, D. MEISCHNER, J. PAUL, P. SCHÄFER, M. VIGENER, K. WARNKE & H. WELLER, 1995: Mud mounds: a polygenetic spectrum of fine-grained carbonate buildups. – Facies (Erlangen) 32:1–70.

RUSSO, A., 1979: Studio monographico sui Coralli dell'Eocene di Possagno (Treviso, Italia). – Mem. Accad. Naz. Sci. Lett. Art., (Modena) ser. 21: 1–87.

SCHUSTER, F., 1996: Paleoecology of Paleocene and Eocene corals from the Kharga and Farafra Oases (Western Desert, Egypt) and the Depositional History of the Paleocene Abu Tartur Carbonate Platform, Kharga Oasis. – Tübinger Geowissenschaftliche Arbeiten (Tübingen) A 31: 1–96, 21 pls.

SERRA-KIEL, J., L. HOTTINGER, E. CAUS, K. DROBNE, C. FERRANDEZ, A. K. JAUHRI, G. LESS, R. PAVLOVEC, J. PIGNATTI, J. M. SAMSO, H. SCHAUB, E. SIREL, A. STROUGO, Y. TAMBAREAU, J. TOSQUELLA & E. ZAKREVSKAYA, 1998: Larger foraminiferal biostratigraphy of the Tethyan Paleocene and Eocene. – Bulletin de la Société Géologique de France (Paris) 169: 281–299.

SINCLAIR, H. D., 1997: Tectonostratigraphic model for underfilled peripheral foreland basins: An Alpine perspective. – Geological Society of America Bulletin (Boulder) 109: 324–346.

TUCKER, M. E. & V. P. WRIGHT, 1990: Carbonate sedimentology. Blackwell, Oxford.

TURNŠEK, D. & K. DROBNE, 1998: Paleocene Corals from the Northern Adriatic Platform. – Dela-Opera SAZU (Ljubljana) 4. razr. 34(2): 129–194.

WELLS, J. W., 1956: Scleractinia. – Treatise on Invertebrate Paleontology, Part F. Coelenterata (Lawrence, Kansas), F328–F444.

PLATES - TABLE

PLATE 1 – TABLA 1

PLATE 1

Figs. 1-4: *Bacarella vipavica* n. gen. .n. sp.

1. Polished surface of cateniform colony, showing one row of uniserial corallites in transverse section. Specimen 3152, x 5.
2. Polished surface of cateniform colony showing uniserial corallites in vertical, transverse, and oblique sections. Specimen 3512/1, x 5.
3. Another polished surface of the same specimen showing uniserial corallites in transverse, oblique and longitudinal sections. Corallites are round in oriented transverse sections, and they become oval when section is oblique. Specimen 3512/1, x 5.
4. Transverse section of a series of corallites. Peritheca massive. Thin section, specimen 3512/1b, x 5.

Figures 2, 3 and 4 are of the the holotype.

TABLA 1

Sl. 1-4: *Bacarella vipavica* n. gen. n. sp.

1. Polirana površina členaste kolonije kaže en niz uniserialnih koralitov v prečnem preseku. Vzorec 3152, x 5.
2. Polirana površina členaste kolonije kaže uniserialne koralite v vertikalnem, prečnem in poševnem preseku. Vzorec 3512/1, x 5.
3. Drugi del polirane površine istega vzorca, kaže uniserialne koralite v prečnem, poševnem in podolžnem preseku. Koraliti so okrogli v orientiranem prečnem preseku in postanejo ovalni v poševnem preseku. Vzorec 3512/1, x 5.
4. Serija koralitov v prečnem preseku. Periteka je masivna. Zbrusek, vzorec 3512/1b, x 5.

Slike 2, 3 in 4 so od holotipa.

PLATE 1 – TABLA 1

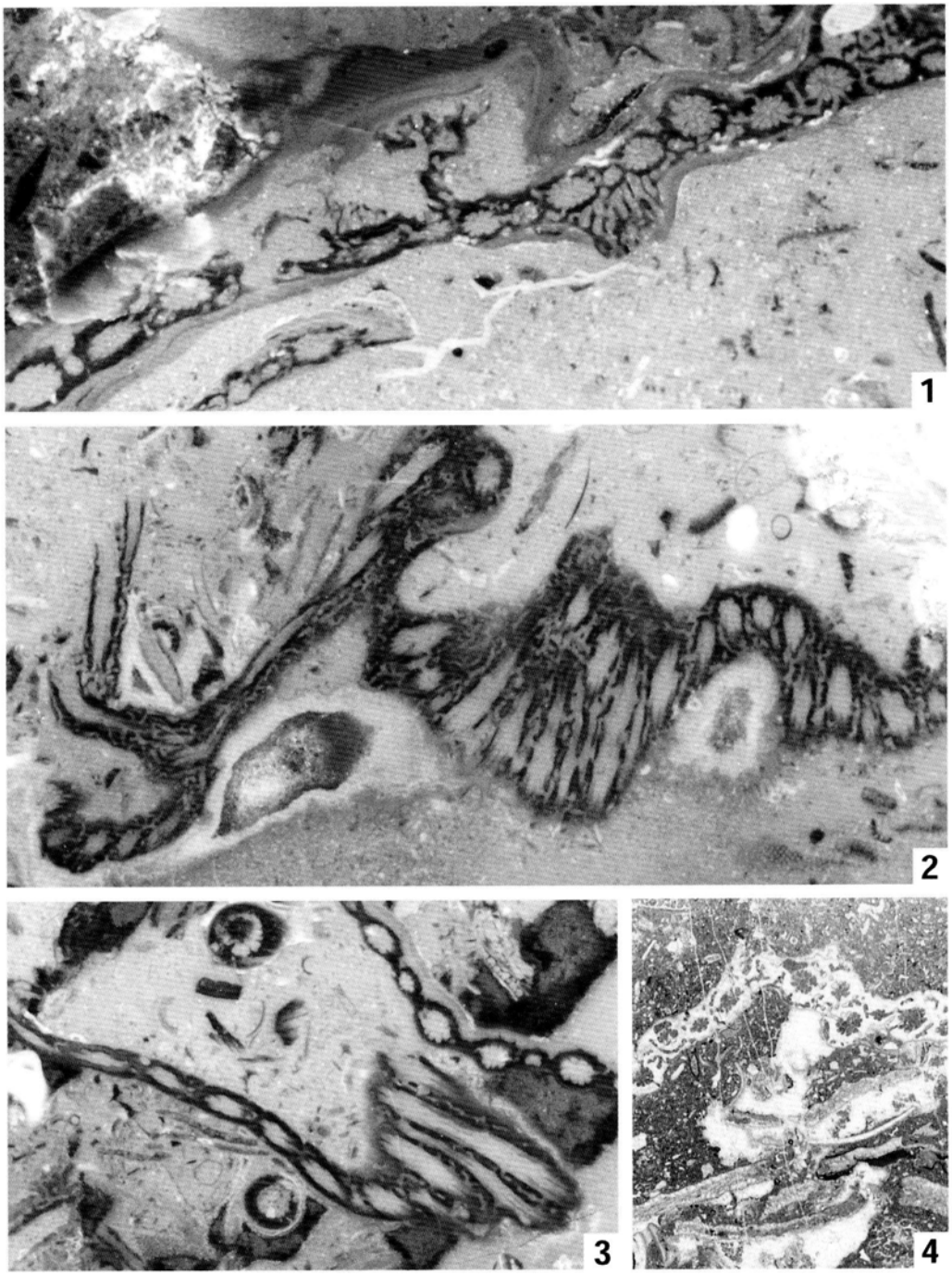


PLATE 2 – TABLA 2

Plate 2

Figs. 1-6. *Bacarella vipavica* n. gen. n. sp.

1. Transverse thin section of four uniserial corallites. The beginning of rectangular division of series is visible. Thin section 3512/1b, x 20.
2. Transverse thin section of four corallites from another series, owergrown by algae. Thin section 3512/1a, x 20.
3. Transverse thin section of another part of of the same series as on Fig. 1. Thin section 3512/1b, x 20.
4. Transverse (slightly oblique) thin section of some corallites of the same series as on Fig. 1. Note thin septa with auriculae and thick peritheca. Thin section 3512/1c, x 20.
5. Vertical section of three corallites along the series. Note septa with lateral sharp granulae and subcostate synapticular peritheca. Thin section 3512/1d, x 20.
6. Vertical section of one corallite in front side of series. Thin section 3512/1b, x 20.

All figures are of the holotype.

Tabla 2

Sl. 1-6. *Bacarella vipavica* n. gen. n. sp.

1. Prečni presek štirih uniserialnih koralitov. Nakazan je začetek pravokotne delitve serije. Zbrusek 3512/1b, x 20.
2. Prečni presek štirih koalitov iz druge serije, ki je preraščen z algami. Zbrusek 3512/1a, x 20.
3. Prečni presek koralitov iz iste serije kot na sl. 1. Zbrusek 3512/1b, x 20.
4. Prečni (rahlo poševni) presek nekaterih koralitov iz iste serije kot na sl. 1. Vidijo se tanka septa in aurikule ter debela periteka. Zbrusek 3512/1c, x 20.
5. Podolžni presek treh koralitov vzdolž uniserialnega niza. Vidijo se septa z lateralnimi ostrimi granulami in subkostatna sinaptikularna periteka. Zbrusek 3512/1d, x 20.
6. Podolžni presek enega koralita s sprednje strani serije. Zbrusek 3512/1b, x 20

Vse slike so od holotipa.

PLATE 2 – TABLA 2

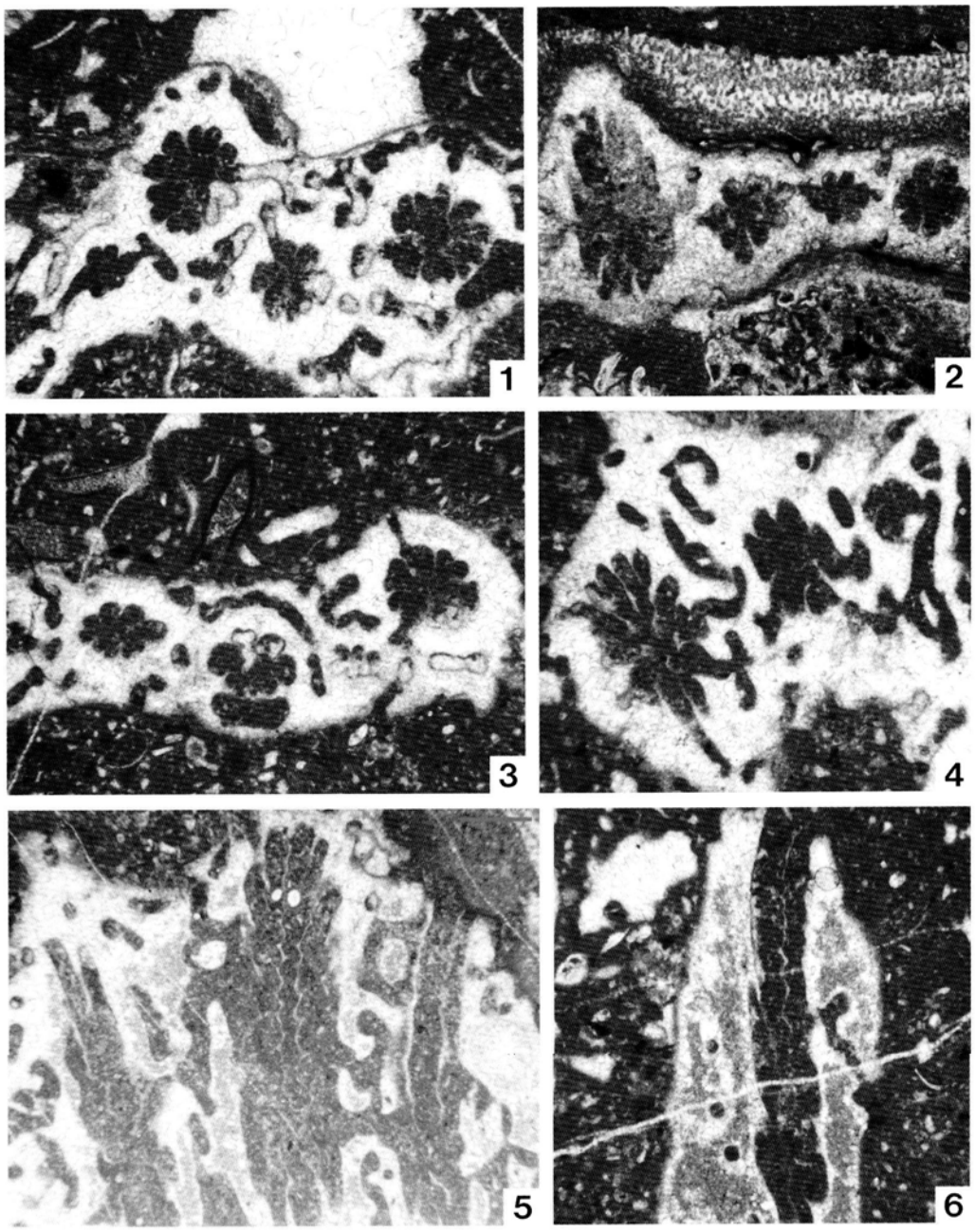


PLATE 3 – TABLA 3

Plate 3

Figs. 1-2. *Bacarella vipavica* n. gen. n. sp.

1. Transverse (slightly oblique) section of two corallites, showing septa with auriculae, wall and peritheca. Microstructure is recrystalized. Thin section 3512/1c, x 50.
2. Longitudinal section of one corallite showing lateral septal granulae and synapticular peritheca. Thin section 3512/1d, x 50.

Both figures are of the holotype.

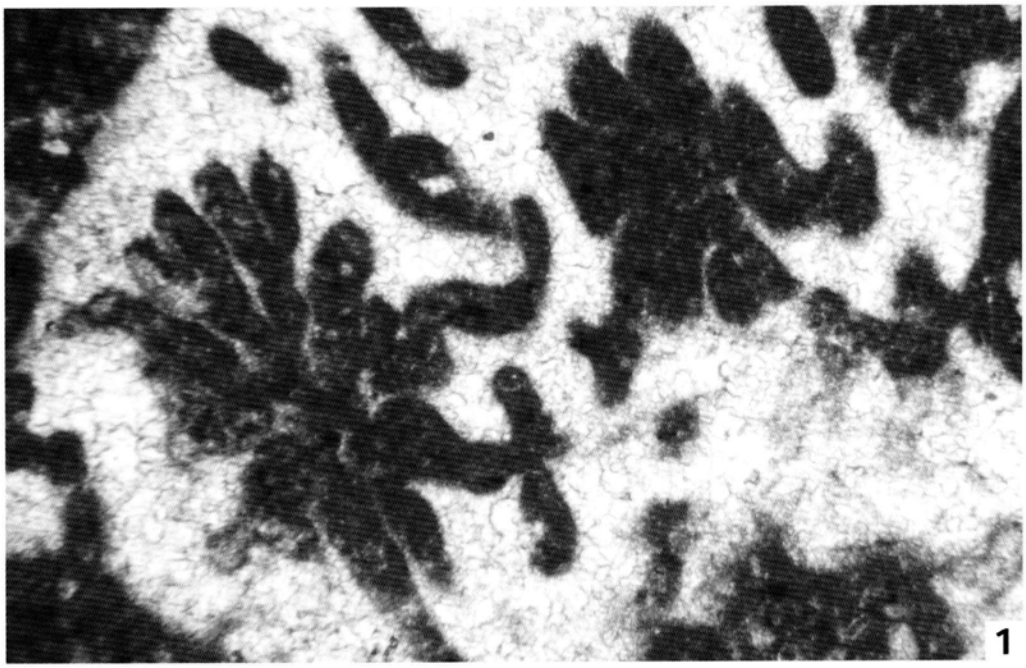
Tabla 3

Sl. 1-2. *Bacarella vipavica* n. gen. n. sp.

1. Prečni (rahlo poševni) presek dveh koralitov iz serije. Vidijo se septa z aurikulami, stena in periteka. Mikrostruktura ni ohranjena. Zbrusek 3512/1c, x 50.
2. Podolžni presek koralita kaže septa z lateralnimi granulami in sinaptikularno periteko. Zbrusek 3512/1d, x 50.

Obe sliki sta od holotipa.

PLATE 3 – TABLA 3



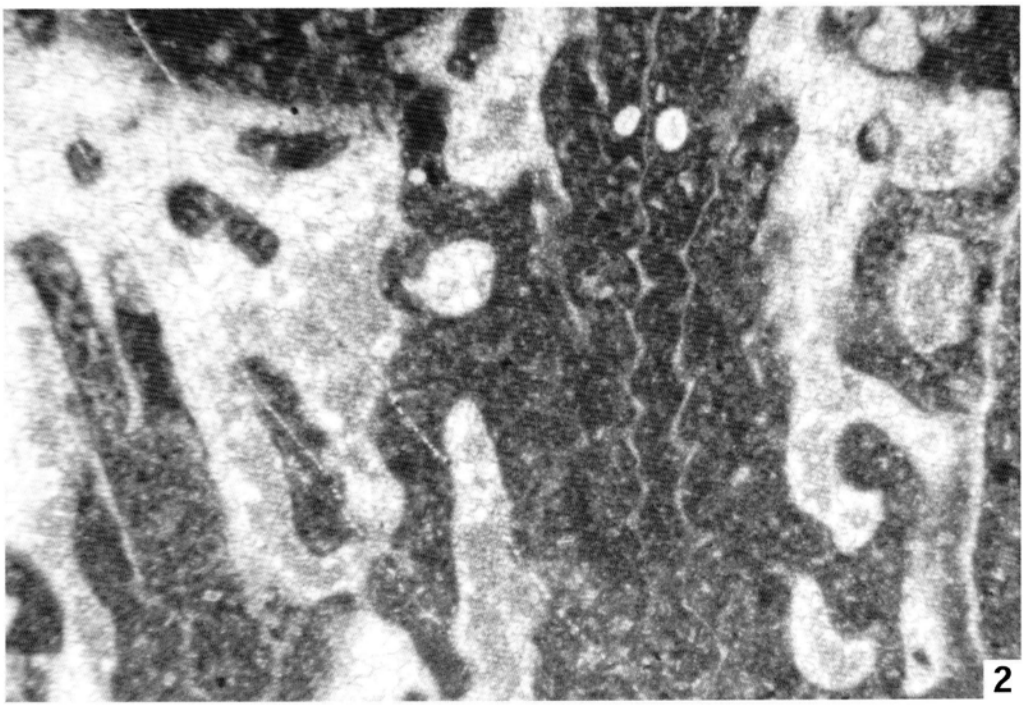


PLATE 4 – TABLA 4

Plate 4

Figs. 1-3. *Bacarella vipavica* n. gen. n. sp.

1. Polished surface showing transverse (and slightly oblique) sections of two straight series of corallites. Specimen 6674, x 5.
2. Polished surface showing transverse section of meandroid and divided series of corallites. Note different dimensions of corallites. Specimen 6673, x 5.
3. Polished surface showing three almost straight series of corallites. In some places the beginnings of rectangular division of series are noticeable. Specimen 3454, x 5.

Tabla 4

Sl. 1-3. *Bacarella vipavica* n. gen. n. sp.

1. Polirana površina kaže prečni (rahlo poševni) presek dveh ravnih serij koralitov. Vzorec 6674, x 5.
2. Polirana površina kaže prečni presek vijugaste in razcepljene serije koralitov. Vidimo različne dimenzije koralitov. Vzorec 6673, x 5.
3. Polirana površina kaže tri skoraj ravne serije koralitov. Na nekaterih mestih vidimo zametke razcepa serij. Vzorec 3454, x 5.

PLATE 4 – TABLA 4