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PROPOSAL FOR THE TERMINOLOGY OF FOSSIL MARINE BENTHIC SHELF ECOSYSTEMS

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Abstract: Authors point out the importance of more detailed facial studies in geology, based above all on the method of actualism. At the same time they point to the absence of in geology applicable biofacial terminology. They suggest the introduction of index marking of shelf facies by letters and numbers; the indices have been proposed by one of the authors on the basis of his studies of recent marine facies in the last twenty years, according to the occurrences of benthic organisms in the Mediterranean, Carribean and Pacific regions. The proposed terminology takes into consideration mutual relationships of litho- and biofacies. In the presented paper there are numerous examples of the possibilities of application of fossil, especially marine facies to recent environments and their ecosystems.

Key words: fossil, marine, shelf, ecosystems, terminology.

The application of the actualistic principle is today still the most effective method for the reconstruction of fossil marine facies. However, this "actuofacial" specialization has until now lacked a generally accepted terminology and definitions, especially for variable shelf environments.

Perès and Picard (1964) introduced a new terminology for recent environments based on the occurrence of benthic organisms. The substance of their inovation was of course not in a few new terms (in the past, expressions like "eulittoral", "sublittoral", "tidal zones", shallow and deep "neritic", "laminar zone" etc. were already in use in geological interpretations), but the fact that the newly established units (denominated "Étage"), instead of the imprecise bathymetric indication of the old ones, refer rather to the spatial and topographic relationships of the environment to the coast, to the lithology of substrate, light conditions and dynamics of the environment. The basic biological characteristics of the facies (litho- or bio-) dinstinguished within the individual "Étages" are applicable world-wide, almost without regard to climate zones (the species, of course, being different in each bioprovince).

This has been undoubtedly confirmed also by some of our observations in recent shelf regions. In an almost identical succession of the infralittoral, e.g. mass occurrences of *Glycymeris glycymeris* have been found in the Adriatic region and *Glycymeris undatus* in the region of the Carribean Sea as well as in the Florida Strait. Rhodophyt incrustations on hard littoral substrate and "Coralligene de plateau" on mobile circalittoral substrate occupied the same position in the Mediterranean, the Carribean and the Pacific. The distribution of extensive sea-grass meadows is almost the same in all recent seas.

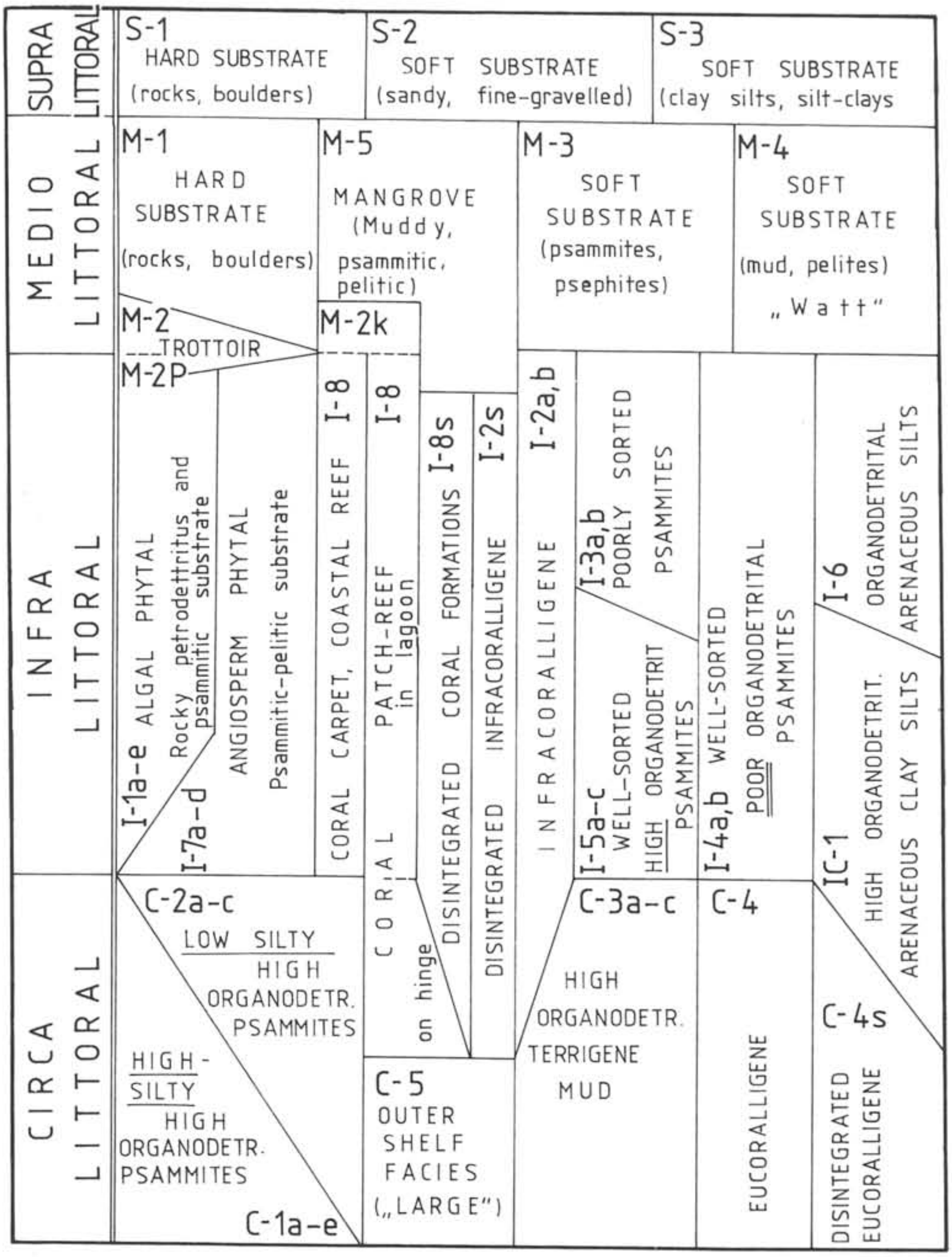
Thus, we could use this modern terminology of Perès and Picard also in geology, for the evaluation of fossil biofacies.

Nevertheless, we should bear in mind the necessity of modification of this terminology due to the presence of fossil thanatocenoses and taphocenoses. (Under the term "thanatocenosis" we understand in this case communities of simultaneous age origin, formed by supply from neighboring biotops of the same age). A predominant part of macrophytal is not fossilizable, and thus it is possible to distinguish their presence in fossil facies only on the basis of mass occurrence of herbivorous gastropods or small bryozoans, which originally lived on the plants. This "biocenose" is nevertheless in fossil state usually enriched by sessile as well as vagile benthos which lived on, or was characteristic of macroflora substrate.

Thanatocenoses formed by this process can still be considered autochthonous (AUT), since their aphytal (mostly carnivorous and detritus-feeding) elements do not come from a foreign biotop. Different thanatocenoses can occur on mobile, by denser phytal not bound substrate, especially near hard, rocky ground covered by rhodophyts and bryozoans (Infracoralligene), or within the range of biologically eroded circalittoral rhodophyt bioherms (Eucoralligene). Since these thanatocenoses consist of elements from two or more biotops, we considered them allochthonous (ALT). A similar situation occurs in coral environments of the tropical zone.

We woud like to point out the necessity of a modification of the terms "Phytal" and "Aphytal" when applying them to fossil facies. From the viewpoint of distinguishing the position of fossil shelf sediments, we can hardly apply in geology the for recent conditions generally undoubtedly valid principle of Pères and Picard (that the whole shelf is "Phytal"), since only

Table 1. Relationship between fossil litho- and biofacies of shelf areas.



macrophytal of brown and green algae and of angiosperms is constantly topographically related to fossilizable benthos. This benthos frequently provides marked distinguishing features of the paleoenvironment. Because of this, for the purpose of evaluation of fossil facies, we denote by the term "Phytal" only growths containing evidence of fossilizable organisms. All other shelf environments are from the paleofacial viewpoint considered "Aphytal". (However, we have distinguished "Trottoirs" formed by calcareous rhodophyts, further "Infra-" and "Eucoralligene" as well as tropical "Coral Facies" with rhodophyts. We consider all other soft and mobile sediments with sporadic occurrences of marine macroflora to be "Aphytal").

We consider the use of a combination of alphabetic and numeric symbols to be most convenient for the interpretation of fossil facies (since new symbols can be freely created for hitherto unregistered paleoenvironments).

We should bear in mind that Perès & Picard's term "Étage" (in English "Stage") cannot be used in geology since this expression is preoccupied in chronostratigraphic terminology. Our facial units, distinguishable on the basis of their biological and physical-chemical properties, are therefore denoted "Horizon" and in the symbols we use their principal letter S, M, I, C.

Each of these horizons can be characterized by ecologically different ecosystems of organisms. They are undoubtedly individual "microecosystems" (in our symbols denoted by arabic numbers, e. g. *I-1, I-3, C-2* etc.).

These numbers are followed by small letters expressing the litho- or biofacies within the microecosystem, noted for a special biocenose or thanatocenosis (e.g. in the Adriatic Shelf region, within the ecosystem of infralittoral well-sorted organodetrital sand *"I-5"* we have distinguished: *I-5a* = facies with *Pecten jacobaeus*, *I-5b* = facies with *Cladocora cespitosa*, *I-5c* = facies with *Lithophyllum racemus*).

We would like to stress that ecosystems (facies) are often globally distributed. Their representatives (species) are of course in various bioprovinces different, but the characteristics of genera are usually common. Experience shows that these common features are applicable also to fossil, especially Tertiary facies.

Since we have already published (Seneš, 1988, 1989) the symbols of a majority of the ecosystems and facies, we present in this contribution only their brief summary. The description includes *several examples of the application of recent thanatocenoses to fossil ones*, which are familiar to us mostly from the autopsy of the Central European Neogene.

Supralittoral

S-1-*Hard substrate (rocks, boulders)*. Sessile benthos poor in genera. AUT. (From medio- and infralittoral transported benthos is always ALT). Fossil:?

S-2-*Soft substrate (sandy, fine-gravelled)*. Often sorted thanatocenoses, possibility of admixture of terrigene elements. ALT. Fossil – Miocene: Burgschleinitz (A) (Steininger, 1971): Malá n/Hronom (CS) (Seneš, 1949); Rapovce-Demečer (CS) (Hano and Seneš, 1953; Seneš, 1971; Ondrejíčková, 1972); Lipovany, Loc. 515 (CS) (Ondrejíčková, 1972; Kalonda, Loc. 309 (CS) (Ondrejíčková, 1972).

S-3-*Soft substrate (clayei silts, silty clays);* possibility of sorted thanatocenoses, as well as of terrigene elements. ALT. Fossil:?

Mediolittoral

M-1-*Hard substrate (rocky, bouldery)*. Sessile and vagile benthos. AUT. Fossil – Miocene: Devín-Sandberg (CS) (Švagrovský, 1978).

M-2-*Trottoir (formed exclusively by calcareous rhodophyts, sessile benthos)*. AUT. Fossil:?

M-2p-*Pseudo-trottoir* (a cover of sessile benthos on subhorizontal, into littoral protruding rocks). AUT. Fossil:?

M-2k-*The near-shore part of the "Coral Carpet"* and sometimes also the uppermost part of the "Coastal Reef" (*tropical* zone). AUT. Fossil – Pleistocene: Bougenville-Salomon Isl. (PNG), Rincon de Guanabo, Cayo Largo (CU) (Seneš, 1966).

M-3-*Soft substrate (psammites, psephites,* unsorted thanatocenoses, mostly washed from the infralittoral). ALT. Fossil – Miocene: Burgschleinitz (A) (Steininger, 1971); Bretka partim (CS) (Vaňová, 1959, 1975); Lipovany, Loc. 237, 239, 240 (CS) (Ondrejíčková, 1972).

M-4-*Soft substrate (mud, pelites, clayei silts and silty clays* of the "Watt" environment, the infauna can be AUT, unsorted thanatocenoses are usually ALT). Fossil:?

M-5-*Mangrove type – muddy, psammitic, pelitic* (tropical-subtropical zones). Sessile and vagile benthos, deeper roots in the top of the infralittoral. ALT. Fossil – Oligocene: borehole RK-2, 406.8–406.9 *m* (CS) (Ondrejíčková, 1989).

Infralittoral

Phytal environment (Macrophytal):

I-1-*Hard substrate (rocky, petrodetrital)*. Betwen boulders there are frequent psammitic islets.

I-1a-Partly fossilizable colonies of green algae (e.g. *Acetabularia, Halimeda*). Poor sessile and vagile benthos. ALT.

I-1b-Partly fossilizable brown algae (e.g. *Padina*). Poor sessile and vagile benthos, ALT.

I-1c, d-Dense growth of infossilizable brown algae (e.g. *Cystoseira, Sargassum*). Fossilizable epifauna prevails. On large areas AUT. Fossil – Miocene: Fels am Wagram (A) (Steininger, 1963, 1971); Malá n/Hronom (CS) (Seneš, 1952), borehole Soľ-1, 260–261 m (CS) (Seneš, 1955); Kamenica n/Hronom, partim (CS) (Kováč, 1978); Kosihovce, partim (CS) (Kováč, 1978); Frumusita – borehole (R) (Stancu and Tăutu, 1973).

I-1e-Colonies of fossilizable flora on hard substrate (e.g. *Lihothamnium + Halimeda + Amphiroa*). Poor sessile and vagile benthos. AUT-ALT. Fossil – Miocene: Veľ. Čausa, Hor. 1 (CS) (Seneš, 1959, 1971).

I-7-*Psammitic-pelitic organodetrital immobile substrate bound by sea-grass growth.* (*Angiosperma* from the genera *Zostera, Cymodocea, Posidonia, Thalassia* etc.). According to light conditions the stems can be settled by small gastropods and bryozonas. Lower infralittoral horizons (−30, −40 m) contain almost no organisms washed from other biotops. AUT. Fossil – Oligocene: Mužla, borehole M-3 (CS) (Ondrejíčková and Seneš, 1965); Obid, horehole 0-15 (CS) (Ondrejíčková and Seneš, 1965). Miocene: Dol. Plachtince (CS) (Seneš, 1950); borehole Soľ-1, 30–40 m (CS) (Seneš, 1955); Varhaňovce (CS) (Seneš, 1955); borehole ŠO, 7–125 m (CS) (Ondrejíčková, 1978); borehole K-5, 389–423 m (CS) (Ondrejíčková, 1980); Korytnica (*Turbella-Loripes* comm.) (PL) (Hoffman, 1977).

Aphytal environment:

I-2-*"Infracoralligene"*. It forms a cover consisting mostly of rhodophyts, bryozoans and anthozoans, on a hard substrate.

I-2a-Photophillic sessile benthos (vagile representatives are preserved usually only in the environment *I-2s*). AUT.

I-2b-Sciaphillic sessile benthos in greater depths (to −100 m). AUT. Fossil – Miocene: Devín-Sandberg (CS) (Schaleková, 1969; Švagrovský, 1978); Jurkowice (PL) (Radwański, 1973).

I-2s-Disintegrated organogenic material from the biocenoses I-2a and I-2b, distributed usually on psammitic substrate ("Lithothamnion" sand – AUT, ALT). Fossil – Miocene: Achberg (A) (Steininger, 1971); Devín-Sandberg (CS) (Schaleková, 1969; Švagrovský, 1978); Nawozdice (PL) (Radwański, 1973).

I-3-*Poorly sorted fine-grained or coarse psammites* of the shallower infralittoral.

I-3a-It occurs near the shore. Phytal only sporadical. Prevailing fossilizable organisms are Mollusca. Thanatocenoses are usualy ALT. Fossil – Miocene: borehole Soľ-1, 40–50 m (CS) (Seneš, 1955); Veľ. Čausa, Hor. 2 (CS) (Seneš, 1959, 1971); Radzovce, Loc. 441 (?) (CS) (Ondrejíčková, 1972).

I-3b-Psammites in wide lagoon areas or in protected bays with extensive dasycladacean carpets. AUT. Fossil – Miocene: Soceni, Politioana (R) (Stancu and Tăutu, 1973).

I-4-*Well-sorted psammitic sediments.* The organodetrital component is poor. Owing to the greater depth the sediments are not as mobile as in the facies I-3.

I-4a-From fossilizable organisms, characteristic are above all molluscs, endobiotic forms being prevalent. AUT. Fossil – Oligocene: Novaj and Nyárjas (H) (Báldi, 1973; Báldi and Beke, 1973). Miocene: Gauderndorf (Sandgrube) (A) (Steininger, 1971); Hor. Plachtince (CS) (Čechovič and Seneš, 1950); Starata Češma (BG) (Koyumdgieva, 1976); Opatovská Nová Ves (CS) (Seneš, 1952); Prešov (CS) (Švagrovský, 1952); Veľ. Čausa, Hor. 3 (CS) (Seneš, 1959, 1971); Hor. Motešice, Kostolné Mitice, Krásna Ves (CS) (Ondrejičková, 1979).

I-4b-Dominant is usually the genus *Glycymeris* (in the Mediterranean *Glycymeris glycymeris*, in the Carribean region *Glycymeris undata*, in the South American region of the Atlantic Shelf *Glycymeris longior* etc.). Usually AUT.

Fossil – Oligocene: Eger-Wind (clay and sandst. Hor.) (H) (Báldi, 1966, 1975). Miocene: Kováčov, Hor. E (CS) (Seneš, 1958, 1975); Kaltenbachgraben, Hor. 4 (D) (Hölzl, 1973).

I-5-*Well sorted organodetrital fine-grained psammites* of the deeper infralittoral.

I-5a-Almost in all latitudes mostly the occurrence of large pectinids (e.g. in the Mediterranean *Pecten jacobaeus*, in the Northern Pacific and in the Aleutian-Kamchatka bioprovince the genera *Patinopecten*, *Swiftopecten*, in the south–eastern Pacific *Chlamys patagonica*, on the South American Atlantic Shelf *Chlamys tehuelcha*, etc.). In different latitudes this facies occurs in different depths, however, as a rule in the deeper infralittoral. AUT. Fossil – Oligocene: Eger-Wind (glauconit sdst. Hor.) (H) (Báldi, 1966, 1975). Miocene: Loibersdorf (A) (Steininger, 1971); Brunnstubengraben (Upp. Hor.) (A) (Steininger, 1971); Paleoogasta (BG) (Koyumdgieva, 1976); Hámor ps. partim (CS) (Čechovič and Seneš, 1950); Vaďovce (CS) (Čtyroký, 1959, 1971); Trenč--Strážna Hora (CS) (Kováč, 1978); borehole PKŠ, 902–945 m (CS) (Ondrejíčková, 1980), Budafok, Pacsirta Hill (H) (Báldi, 1959, 1971); Várpalota, Hor. 4 (H) (Kókay, 1973).

I-5b-Extensive bioherms of non-tropical colonial corals (e.g. *Cladocora*) on predominantly organodetrital psammitic substrate of the deeper infralittoral. The bioherms themselves represent an autochthonous biocenose, the surrounding soft substrate can however contain thanatocenoses of ALT character, with components from the facies I-5a, C-1a, C-1c. Fossil – Miocene: Gross Höflein, partim (A) (Steininger and Papp, 1978).

I-5c-The facies is noted for abundant occurrence of solitary lump-like calcareous rhodophyts *(Lithophyllum racemus)*, almost always in environments with strong current dynamics. The thanatocenoses are ALT, but the facies can be very well distinguished due to mass occurrence of firm lumps of this solitary rhodophyt. Fossil – Miocene: Grabow Nowy (PL) (Radwański, 1973) (possibly also C-2a??).

I-6-*Organodetrital psammitic-pelitic substrate* (arenaceous silt) *of the deeper infralittoral*, with prevalent *Veneridae* and *Tellinidae*, rather small in size. AUT. Fossil – Miocene: Kamenica n/Hronom (CS) (Seneš, 1949); Slov. Ďarmoty (CS) (Seneš, 1952); Čakanovce, Loc. 88 (CS) (Ondrejíčková, 1972); Neporadza (CS) (Ondrejíčková, 1979); Korytnica (*Corbula* comm.) (PL) (Hoffman, 1977).

I-7-See *"Phytal environment"*.

I-8-*Coral formations of the tropical zone* with abundant calcareous rhodophyts.

I-8a-There are numerous variants of the topographic position of morphologic development of the formations, which are however in fossil state difficult to indentify. This ecosystem includes deeper, to a depth of −30 m lying "coral carpet", two varieties of "coral patch reef", futher "coastal reef" in which living coral specimens usually do not reach deeper than −40 m. Fossilizable specimens are always AUT. Fossil – Pleistocene: Rincon de Guanabo (CU) (Seneš, 1966).

I-8s-Destructed and disintegrated I-8a in the form of "coral lithothamnion sand" in lagoons and sometimes on coastal hinge. The character of thanatocenoses is usually ALT. Fossil – Pleistocene?: Cayo Largo, Cayos de los Ballenatos (CU) (Seneš, 1966).

IC-1-*High-organodetrital, fine-grained psammitic and pelitic substrate* (organodetrital arenaceous clayi silts) on the boundary of infra- and circalittoral. It usually covers large horizontal or subhorizontal shelf areas. In the majority of bioprovinces this facies is characterized by the presence of various smaller representatives of mollusc infauna, but above all by mass occurrences of the genus *Aporrhais* as well as *Scaphopoda*. If the facies occurs on large areas, the thanatocenoses are always AUT. Fossil – Miocene: Str. Plachtince (CS) (Čechovič and Seneš, 1950); Prš. dolina (CS)

(Čechovič and Seneš, 1950; Kováč, 1978); Lontov, borehole ŽI-2 (CS) (Brestenská, 1978); Borač (CS) (Brzobohatý and Cicha, 1978); borehole K-5, 16−307 m (CS) (Ondrejíčková, 1980); Korytnica (*Corbula* − spatangoid comm.) (PL) (Hoffman, 1977); Vallée du Runcu (R) (Rusu, 1975).

Circalittoral

C-1-*Fine-grained, high-organodetrital psammites*, mostly on horizontal plains of open shelf regions, especially fine-arenaceous bryozoan sediments.

C-1a, b, c-The facies are exceptionally rich in bryozoans enriched by benthic foraminifers, ostracods, molluscs and echinoderms. In the Mediterranean, *Hippodiplosia foliacea* prevails in the thanatocenoses of the facies "a", *Scrupocellaria, Porella, Hornera* (on more pelitic substrate) in the facies "b" and the facies "c" contains besides *Hippodiplosia* also mass occurrence of *Arca noae* and some other large lamellibranchs. Due to the depth and wide space distribution of these facies, their thanatocenoses are AUT.

C-1d-The substrate is occupied by colonial occurrences of *Polychaeta*. It has been found on the North Adriatic Shelf. It is very similar to the substantially more extensive occurrences of large *Sabellaria* colonies in the facies *C-2c*. AUT. Fossil − Oligocene: Šandor ps. (CS) (Seneš, 1953). Miocene: Rainbach (?) (A) (Schultz, 1973); Mula (CS) (Seneš and Čechovič, 1950); Hor. Plachtince, partim (CS) (Kováč, 1978).

C-1e-The thanatocenosis is distributed on large plains of open shelves. In the Mediterranean region it is characterized above all by mass occurrences of *Ophiotrix quinquemaculata* and *Chlamys opercularis*. Always AUT, contains representatives of all epi- and endobenthic animal classes. Fossil − Miocene: Bajtava (CS) (Seneš, 1949); Dol. Strháre (CS) (Čechovič and Seneš, 1950); Luboriečka (CS) (Čechovič and Seneš, 1950); Záhorce (CS) (Seneš, 1953); Hlinné (CS) (Seneš, 1955); Veľ. Čausa, borehole ČČ-3, Hor. 3, 4 (CS) (Seneš, 1959, 1971); borehole ŠO-1, 125−144 m (CS) (Ondrejíčková, 1978).

C-2-The ecosystem is restricted to *high-organodetrital low-silty and well-sorted psammites* of the circalitorral in deeper, near-shore regions.

C-2a-The facies is characterized by mass occurrence of solitary calcareous rhodophyt lumps (in the Mediterranean *Lithothamnium fruticulosum*), without large pectinids. AUT. Fossil − Miocene: C-2a could be represented in the Neogene by mass occurrences of solitary lithothamnion lumps, on the localities of Wiazovnica and Nawodnica in the Badenian of Poland (Radwański, 1973), we however do not exclude the possibility of these localities belonging to the facies I-5c.

C-2b-The composition is similar to C-2a, however without solitary rhodophyts. The environment is less dynamic. Large molluscs are predominant. AUT. Fossil − Miocene: Kosihovce, partim (CS) (Hano, 1950; Kováč, 1978).

C-2c-Dense fields of representatives of *Sabellaria* (other *Sabellaria: Sabellaria vulgaris?* − are known to occur in the form of allochthonous thanatocenoses e.g. in the Carribean (Seneš, 1966), however, predominantly in shallower environment, in lagoons protected by coastal reefs). AUT. Fossil: No convincing evidence of this facies has been found in younger sediments. However, we would like to submit for consideration the possibility that an equivalent of this facies are mass occurrences of tubes classified as "*Ophimorpha nodosa*" in the Badenian of Poland (Radwański, 1973), futher *Tigillites (Scolithus)* in the Ordovician of the Bohemian Massif, in "Drabov quartzites" (Špinar et al., 1965), or the tube-like traces in Ordovician sandstones from the region of Tassilia, North Africa (Mišík, pers. comm.). See also the contribution Bodeur, Gruet, Varchard and Vovelle (1989).

C-3-*Pelitic, high-organodetrital terrigene mud*, occurring above all in protected bay regions. On the basis of molluscs it is possible to distinguish:

C-3a-facies with prevalent *Turritella tricarinata* communis, besides *Aloidis gibba* and *Cardium paucicostatum*,

C-3b-another facies with prevalent *Turritella tricarinata* communis as well as with considerable number of *Myrtea spinifera* and

C-3c-third type of facies noted especially for the presence of thin-walled tellinids and ledids.

All three facies are AUT and, evidently regardless of population explosions of various species, they are also overlapping. Fossil − Oligocene: Eger Wind (A) (Molluscan-Clay) (H) (Báldi, 1966, 1975); Krapina-Radoboj (YU) (Muldini and Mamuzić, 1975); Dilja 5410, Hor. 14 (R) (Moisescu, 1975). Miocene: Brunnstubengraben (Basalsch.) (A) (Steininger, 1971); Baden-Soos (A) (Papp and Steininger, 1978); Oponec, Božurica, Staropatica, Lipen (BG) (Koyumdgieva, 1976); Kalonda (CS) (Seneš, 1951); Nenince (CS) (Seneš, 1953); Kováčov, Hor. H (CS) (Seneš, 1958, 1975); Sverepec (CS) (Seneš, 1960, 1971); Bántapusztan Hor. 8 (H) (Kókay, 1973); Várpalota, Hor. 8 (H) (Kókay, 1973); Chlaba, borehole ŠO-1 (CS) (Ondrejíčková, 1978); Židlochovice (CS) (Cicha, 1978); Plášťovce (CS) (Kováč, 1978); borehole ŠV-8, 427−444 m (CS) (Ondrejíčková, 1980); borehole FV-1, 226−365 m (CS) (Ondrejíčková, 1988); Korytnica (*Turtellid* comm.) (PL) (Hoffman, 1977).

C-4-One of the most important ecosystems, by the authors denominated "*Eucoralligene*" (= "Sekundäre Hartboden", "coralligene de plateau", "Algal patch reef").

C-4a-Hard calcareous red algal formations. Its soft substrate is the principal feature distinguishing this facies from "*Infracoralligene*" (*I-2* representing only the growth or cover on a hard fossil substrate). AUT. Fossil − Miocene: Achberg (A) (Steininger, 1971); Brunnstubengraben (A) (Steininger, 1971); Gross-Höflein, partim (A) (Steininger and Papp, 1978); Trenč (CS) (Čechovič and Seneš, 1950); Kosihovce, partim (CS) (Hano, 1950; Kováč, 1978); Hámor ps. − Končistý (CS) (Čechovič and Seneš, 1950; Kováč, 1978); Devín-Sandberg, Hor. 5 (CS) (Schaleková, 1969; Švagrovský, 1978); Chanz (PL) (Radwański, 1973).

C-4s-Hard eucoralligene is in the time of its growth affected by continuous biological erosion caused by sessile as well as other, vagile elements. Due to this processes, a thick carpet of rhodophytal sand (in the fossil form known as "lithothamnion sand") is formed. Its composition is similar to the facies I-2s, however, owing to allochthonous elements from neighbouring circalittoral facies it can be sometimes distinguished from decomposed infracoralligene. Sands of this facies almost always contain benthic communities, in various, especially infra- and circalittoral sandy facies belonging above all to the ecosystems *I-2, I-5, C-2*. ALT (AUT). Fossil – Oligocene: Budikovany (CS) (Vaňová, 1959, 1975); Orlek (YU) (Pleničar and Rijavec, 1975). Miocene: Goss-Höflein, partim (A) (Steininger and Papp, 1978); Hámor ps., partim (CS) (Čechovič and Seneš, 1953); Veľ. Zlievce (CS) (Seneš, 1953); Bretka, partim (CS) (Vaňová, 1959, 1975); Devín-Sandberg (CS) (Schaleková, 1969; Švagrovský, 1978); Oslavany (CS) (Cicha, 1978); Trifonovo, Tarnere (BG) (Koyumdgieva, 1976); Várpalota, Hor. 7 (H) (Kókay, 1973); Piotrkowice (PL) (Radwański, 1969).

C-5-This facies of open shelves occurring in greater depths is characterized above all by *psammitic-pelitic organodetrital sediments*. Perès and Picard (1964) named this ecosystem-facies "Détritique du Large". A considerable number of eurybathic benthic species is common with the rest of the circalittoral, but according to the substrate benthos is variable, represented by thin-walled *Lamellibranchiata, Dentalia*, brachyopods, some solitary corals and some typical *Echinodermata*. Another difference in comparison with the rest of circalittoral is the significant mass occurrence of planktonic foraminifers. We have retained for this environment the fitting term "Large" and we assume that its thanatocenologic composition is essentially AUT.

Fossil – Oligocene: Pouzdřany, borehole VB-103 (CS) (Cicha, 1975); borehole FV-1, 572–920 m (CS) (Ondrejíčková, 1988). Miocene: Ottnang (?) (A) (Rögl, 1973); Trifonovo, Zamfirovo (BG) (Koyumdgieva, 1976); Pôtor (CS) (Seneš, 1951); borehole DB-17 (CS) (Ondrejíčková, 1975); Devínska Nová Ves-Brickyard (CS) (Švagrovský, 1978); Alber Sch. – Kaltenbachgraben (D) (Hölzl, 1973); Bajtava (CS) (Seneš, 1949, Lehotayová and Ondrejíčková, 1966).

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