

MICROBIAL STRUCTURES AND MICROENCRUSTERS IN THE UPPER JURASSIC-LOWER CRETACEOUS DEPOSITS FROM BUILA-VÂNTURARIȚA MASSIF (SOUTH CARPATHIANS)

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ABSTRACT. The Upper Jurassic – Lower Cretaceous limestones from Buila-Vânturarița massif consisting of reef build-ups, are characterised by an important component of microbial organisms. This paper describes and illustrates some of the most important structures interpreted as having a microbial nature: “*Tubiphytes*” and *Bacinella*-type structures, cyanobacterial structures, micritic crusts, and peloidal structures. Most of these structures are related to different shallow-water environments, from intertidal, high-energy environment, to protected low energy subtidal environment.

Keywords: microbial structures, microencrusters, Upper Jurassic-Lower Cretaceous, Buila-Vânturarița, Romania.

INTRODUCTION, GEOLOGICAL FRAMEWORK

Buila-Vânturarița massif which represents a secondary ridge of the Căpățâni Mountains (Fig.1), and building up a NE-SW extended carbonate bulwark, is remarkable due to individual peaks sometimes reaching more than 1800 meters.

There are relatively few geological studies on this massif (Ștefănescu, 1884; Murgoci, 1898; Boldor et al., 1968; Todiriță-Mihăilescu, 1969). Dragastan (1980) provided the most recent data and has identified the following succession in the Valea Bistriței-Valea Costești sector:

1) The Malm, almost completely outcropping here, being represented by the Oxfordian-Tithonian interval. Callovian-Oxfordian deposits are transgressively overlying the crystalline schists, and represented by clayey sandstones, laterally grading into bioherms with *Cladophyllia dichotoma* and *Thecosmilia* sp. The Kimmeridgian consists of micrites and pelmicrosparites with protoglobigerinids, trocholinas and *Saccocoma*. The Tithonian includes the *Salpingoporella pygmaea*, *Campbelliella striata* and *Clypeina jurassica* (= *C. sulcata*) zones;

2) The Neocomian is only partly exposed and consists of oosparites, pelsparites, and intrapelsparites, laterally and successively grading into biomicrites. This interval contains two distinctive associations: a lower one, consisting of foraminifers (*Trocholina alpina*-*T. elongata*) and algae (*Kopetdagaria iailensis*, *Macroporella praturtoni*, *Salpingoporella anulata* and *Actinoporella podolica*), and an upper one, consisting of *Pseudotextulariella salevensis*, *Melathokerion* sp., *Cayeuxia moldavica* and *C. atanasii*.

3) The Urgonian is transgressively and unconformably overlying the Neocomian formations; three zones were separated: *Pfenderina globosa*, *Salpingoporella muehlbergii*, and *Paleodictyoconus* zones.

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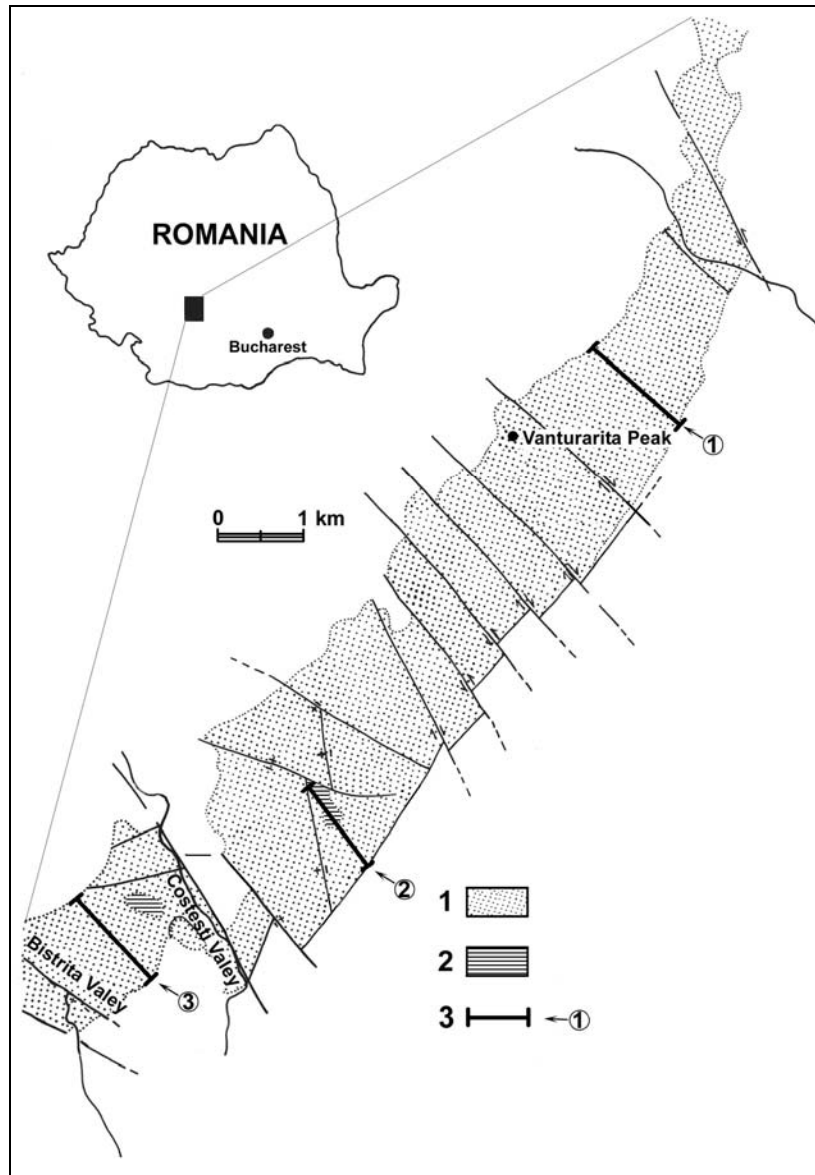


Fig.1 – Location of the studied area (After Lupu et al., 1978 – geological map of Romania, 1:50.000, sheet 126a Vânturarița-Olănești). 1: Upper Jurassic-?Neocomian limestones; 2: Lower Cretaceous (urgonian-type facies) limestones; 3: location of the sampled profiles.

This paper describes and briefly discusses some structure types considered as being the result of microbial activity. The study is based on the evaluation of 150 thin sections on samples collected from three profiles from Costești-Cheile Bistriței area, and east from Vânturarița peak respectively (Fig.1).

BIOSTRATIGRAPHICAL REMARKS

The Stramberk-type limestones of Kimmeridgian-Tithonian age which make up most of the Vânturarița ridge, are mainly represented by peloidal-bioclastic grainstones, fenestrated grainstones and mudstones, partly dolomitized mudstones, and coral-microbial boundstones. Wackestones and packstones are subordinated in the samples studied. The identified micropaleontological association is basically similar to that mentioned by Dragastan (1980): *Clypeina sulcata* (ALTH) (Pl.I, fig.7), *Salpingoporella pygmaea* (GUEMBEL) (Pl.I, fig.6), *Salpingoporella annulata* CAROZZI, *Salpingoporella johnsoni* (DRAGASTAN), *Anisoporella(?) jurassica* (ENDO), *Suppiluliumaella* sp. (Pl.I, fig.5), *Mohlerina basiliensis* (MOHLER) (Pl.I, fig.3), *Andersenolina alpina* (LEUPOLD) (Pl.I, fig.2), *Protopeneroplis ultragranulata* (GORBACHIK) (Pl.I, fig.1).

The Neocomian (Berriasian-Valanginian, identified by Dragastan, 1980 in Costești-Valea Bistritei area) could not be separated based on the micropaleontological association. We assume its presence in the Stramberk-type limestone succession taking into account the association indicated by Dragastan (1980), and the identification of the species *P. ultragranulata* within the studied association.

Finally, limestones with rudists in an urgonian-type facies outcrop in small areas in the Costești sector. The identified micropaleontological association consists of *Vercorsella hensoni* (DALBIEZ) (Pl.I, fig.10), *Vercorsella cf. camposaurii* (SARTONI & CRESCENTI), *Charentia* sp., *Everticyclammina* sp., *Falsolikanella danilovae* (RADOIČIĆ) (Pl.I, fig.8). Additional to the microfauna indicated by Dragastan (1980), this association confirms a Barremian-Aptian age.

MICROBIAL STRUCTURES AND MICROENCrustERS

Recent studies performed on Upper Jurassic limestones, known for a long time as reef limestones (or Stramberk-type facies), have proven that an important role in their genesis was played by microbial organisms and microencrusters (Leinfelder et al., 1993; Schmid, 1996). Thus, Schmid (1996) and Leinfelder et al. (2002) have separated the „microbialite-dominated reefs” among the reef types occurring in the Upper Jurassic, which are frequently dominant within the Stramberk-type limestones. The microbial organisms generated various types of structures, from simple crusts or void fillings (Riding, 2001) to significant bioconstructions of stromatolite or thrombolite type (Leinfelder et al., 1993; Schmid, 1996). Microencrusters are frequently associated. We assume that some of the identified structures in the Stramberk-type limestones from Vânturarița massif have been also generated via similar mechanisms.

Types of structures and their significance

„Tubiphytes” morronensis-type structures

These structures were noticed in all the microfacies types identified in the studied area. „Tubiphytes” *morronensis* consists of a “core”/“nucleus” represented by a nubeculariid foraminifer (showing a central, or subcentral arrangement of the chambers) surrounded by a micritic envelope. The nature of this structure type has been long time under debate (e.g. Bernier, 1984); one of the most recent interpretations (Schmid, 1995) considers the whole structure as representing a doubled-layered foraminifer. In the samples from Vânturarița, the detailed structure of the micritic envelope

shows a peloidal aspect (Pl. 4, fig. 1, 2), the peloids probably being of microbial origin. If this layer belonged to the same organism that had generated the central area, we may consider that the microcrystalline carbonate was the result of a symbiosis between a foraminifer and microbes located in the external cytoplasm. The dominant morphological type of "*Tubiphytes*" *morronei* in the studied area is ellipsoidal-nubecularioid. Some of the structures occur as complex nodules (Pl. 4, fig. 4), of a "*Labes atramentosa*"-type *sensu* Eliášova (1986)

According to Leinfelder et al. (2002), "*Tubiphytes*" *morronei* is an euribathic species, which can be still used as a depth indicator due to the fact that the thickness of its external wall varies with the available amount of light.

Bacinella irregularis

In the succession from Vânturarița massif, beds mainly consisting of *Bacinella irregularis* RADOIČIĆ (Pl.2, fig. 4-5), 1.5-2 meters thick, occur. The structure is characterised by the presence of crusts or nodules consisting of an irregular net, sometimes including subdermal structures of a *Lithocodium aggregatum* ELLIOTT-type which is under intense debate (Radoičić, 1959, Segonzac & Marin, 1972, Banner et al., 1990, Schmid & Leinfelder, 1995). Schäffer & Senowbari-Daryan (1983), Maurin et al. (1985) and Camoin & Maurin (1988) argued the possible microbial nature; a microbial interpretation is adopted in this study.

According to Leinfelder et al. (2002), *Bacinella irregularis*, as well as *Lithocodium aggregatum* and "*Tubiphytes*" may contribute to the reef binding and construction, being restricted to shallow settings.

Cyanobacteria

Rivulariacean-type cyanobacteria are abundant in the studied limestones, within the shallow facies. Similar structures are sometimes associated to *Bacinella irregularis* (Pl.II, fig.5).

Koskinobulina

Koskinobulina socialis CHERCHI & SCHROEDER (Pl.IV, fig.3) is an encrusting micro-organism, being considered by various authors as either an *incertae sedis* (Leinfelder et al., 1993), an acervulinid foraminifer (Gisiger, 1967), or an alga (Cherchi & Schroeder, 1979). Similar Palaeozoic structures (*Wetheredella*) were compared by Kazmierczak & Kempe (1992) to modern cyanobacteria.

Radiomura

Radiomura cautica SENOWBARY-DARYAN & SCHAFFER has an uncertain systematic affiliation; it is abundant within crusts of a dominantly microbial nature in reef limestones (Radoičić, 1992).

Iberopora

Iberopora bodeuri, illustrated by Eliáš and Eliášva (1984, 1986) and by Granier (1987), and formally described by Granier & Berthou (2002) from Berriasian formations, was assigned to "*incertae sedis*", with a possible algal or foraminiferal affinity. The encrusting habit and the cellular feature do not exclude the assignment of a microbial origin. In the studied material, *Iberopora* is present as successive crusts with a cellular structure (Pl.III, fig.4), that are embedded in micrite of possible microbial origin.

Micritic crusts and void fillings

The grumelous stromatolitic-thrombolitic structures were frequently noticed in Costești sector. They are associated with „*Tubiphytes*” *moronensis*, *Koskinobulina socialis* and *Radiomura cautica* encrustations, sometimes accompanied by worm tubes, encrusting foraminifera and bryozoans. Often occurring in the same sector are fenestrate mudstones with rivulariaceae and „*Tubiphytes*” (Pl.II, figs. 1-3), formed instead of microbial mats.

Some of the corals within the coral biolithites underwent microbial micritization of septa, the solution voids between (or within) the septa being partly filled with micrite of presumed microbial nature (Pl.III, fig. 1-3). Some of these void fillings might represent veneers *sensu* Riding (2002).

Peloidal structures

Frequently the Stramberk-type reef limestones contain structures consisting of relatively small micritic peloids (Pl.V, fig.1-4). They are sometimes associated with micritic-laminated structures (Pl. IV, fig. 5) within some stromatolitic-thrombolitic levels. It is generally accepted that most of the peloids of this type are a product of cyanobacterial-induced calcification (Chaefer, 1986).

CONCLUSIONS

Microbialites, including the microencruster associations are important elements in paleoceanographic and paleobathymetric reconstructions. They occur abundantly in hiatuses or condensation levels (Leinfelder et al., 2002).

A large range of microbial structures and microencrusters were noticed in the studied deposits (*Bacinella irregularis*, „*Tubiphytes*” *morronensis*, algal-mat type structures, thrombolitic and peloidal structures, micritic crusts, with *Koskinobulina*, *Radiomura* and *Iberopora*). The coral bioconstructions were intensely encrusted by microbial, algal and foraminiferal structures.

Most of these structures are related to shallow-water reef environments with variable hydrodynamic regimes (from intertidal, high-energy environment, to protected low energy subtidal environment).

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PLATES

Plate I

- Fig. 1. *Protopeneroplis ultragranulata* GORBACHIK, sample V51, X 75
Fig. 2. *Andersenolina alpina* (LEUPOLD), sample V46, X 35
Fig. 3. *Mohlerina basiliensis* (MOHLER), sample V10, X 85
Fig. 4. *Neoteutloporella socialis* (PRATURLON), sample V90, X 85
Fig. 5. *Suppiluliumaella* sp., sample V46A, X 25
Fig. 6. *Salpingoporella pygmaea* (GÜMBEL), sample V60, X 80
Fig. 7. *Clypeina sulcata* (ALTH), sample V28, X 15
Fig. 8. *Falsolikanella danilovae* (RADOIČIĆ), sample V104, X 55
Fig. 9. *Rajkaella* sp., sample V76, X 75
Fig. 10. *Vercorsella hensoni* (DALBIEZ), sample V94, X 70

Plate II

- Fig. 1-3. Fenestrate microbial structures. Irregular micritic patches surrounding fenestrae may be of microbial origin. Fig.1, sample V70, X 20; fig.2, V70, X25; fig.3, V37, X 85.
Fig. 4. *Bacinella irregularis* RADOIČIĆ, sample V16, X 25
Fig. 5. *Bacinella irregularis* together with cyanobacterial threads in an intimate assemblage. Sample V16, X 30
Fig. 6. Rivulariacean-like cyanobacteria. Sample V51, X 80

Plate III

- Fig. 1-3. Dissolved coral septae. The space between septa was partially filled with micrite of probable microbial origin (generated by biofilms?). Fig.1, V32', X 25; fig.2, V32', X 100, fig.3, V 32', X 60.
Fig. 4. Successive crusts of *Iberopora bodeuri* GRANIER (an incertae sedis) and micrite, both of possible microbial origin. Sample V128, X 100
Fig. 5. Micritic-cellular structure generated very probably by microbial activity. Sample V26, X 100

Plate IV

- Fig. 1. "*Tubiphytes*" *morroneis* CRESCENTI. Sample V52, X 85
Fig. 2. Detailed structure of a "*Tubiphytes*" *morroneis* showing the peloidal aspect of the micrite composing the successive coatings. Peloids may be of microbial origin. Sample V52, X 85
Fig. 3. *Koskinobulina socialis* CHERCHI & SCHROEDER. Sample V118, X 75
Fig. 4. "*Tubiphytes*" like structure, described as *Labes atramentosa* by Eliášova (1986). Sample V50, X 55
Fig. 5. Microbial crust covering a peloidal sediment, followed by a grainstone with "*Tubiphytes*" *morroneis*. Sample V56, X 75
Fig. 6. Microbial crusts around an annelid worm tube. Sample V52, X 40

Plate V

- Fig. 1-4. Different types of peloidal structures which may be generated by microbial activity. 1, 2-sample V62, X 50; 3-sample V59, X 33; 4-sample V59, X 25

Plate I

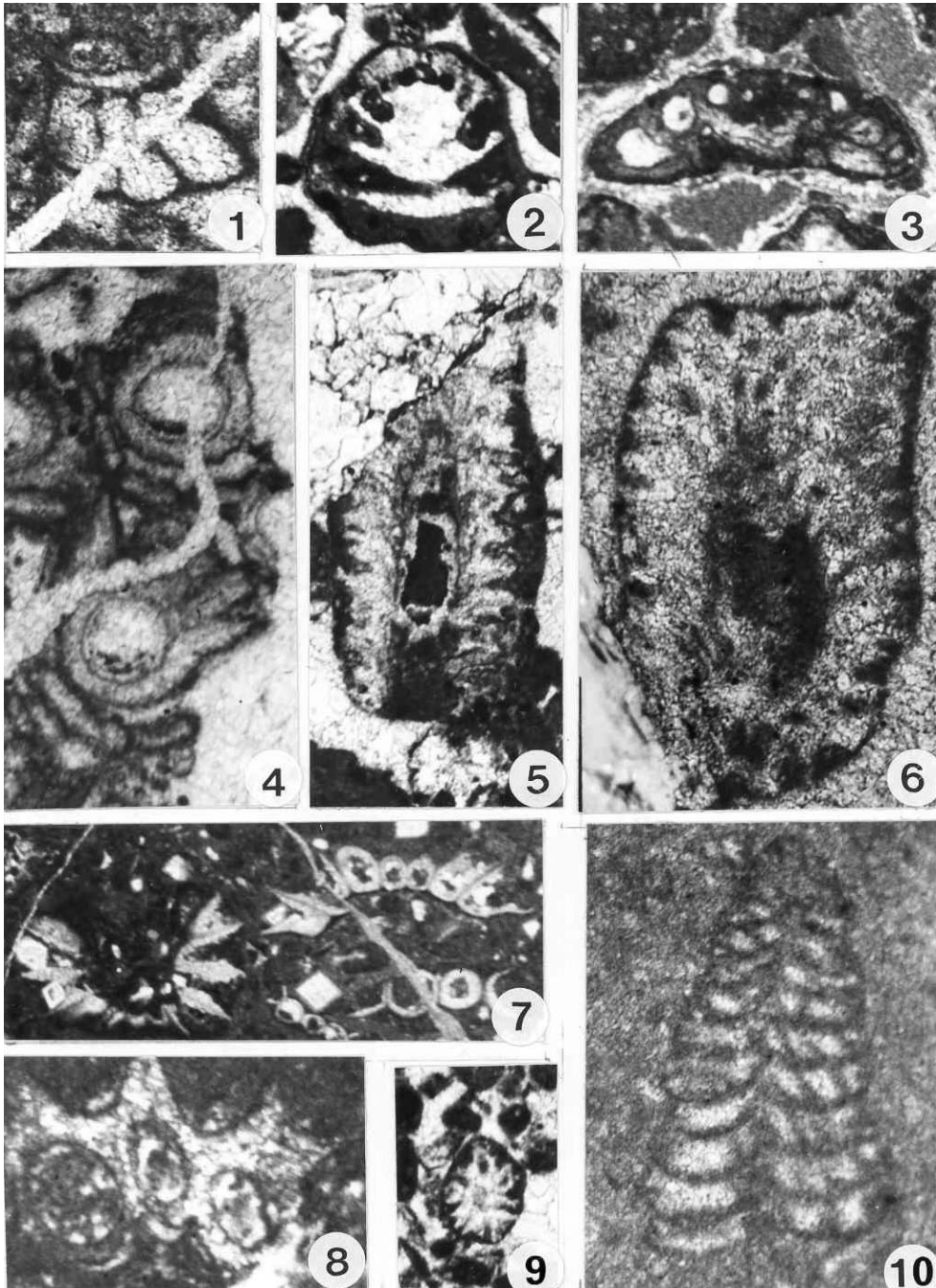


Plate II

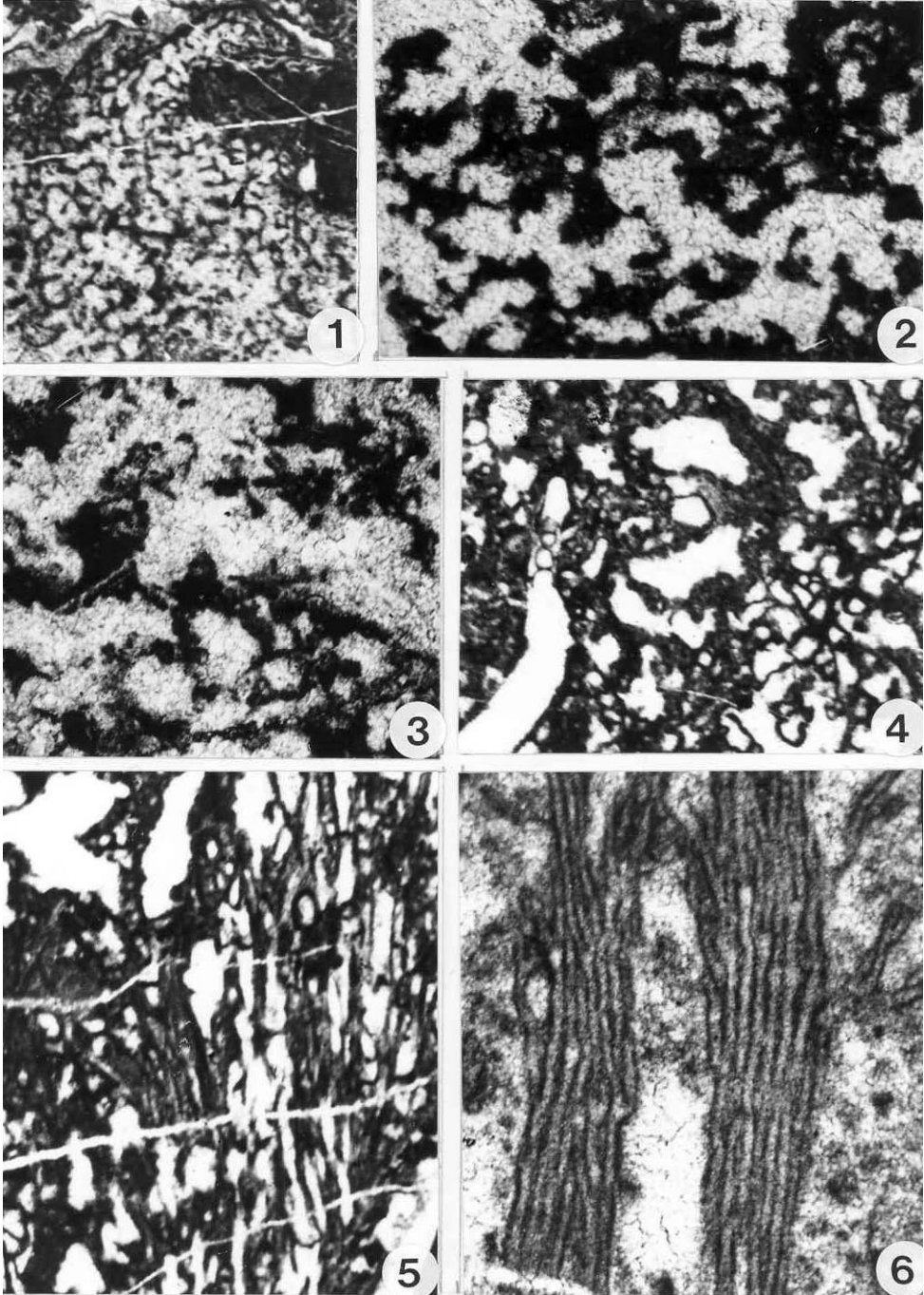


Plate III

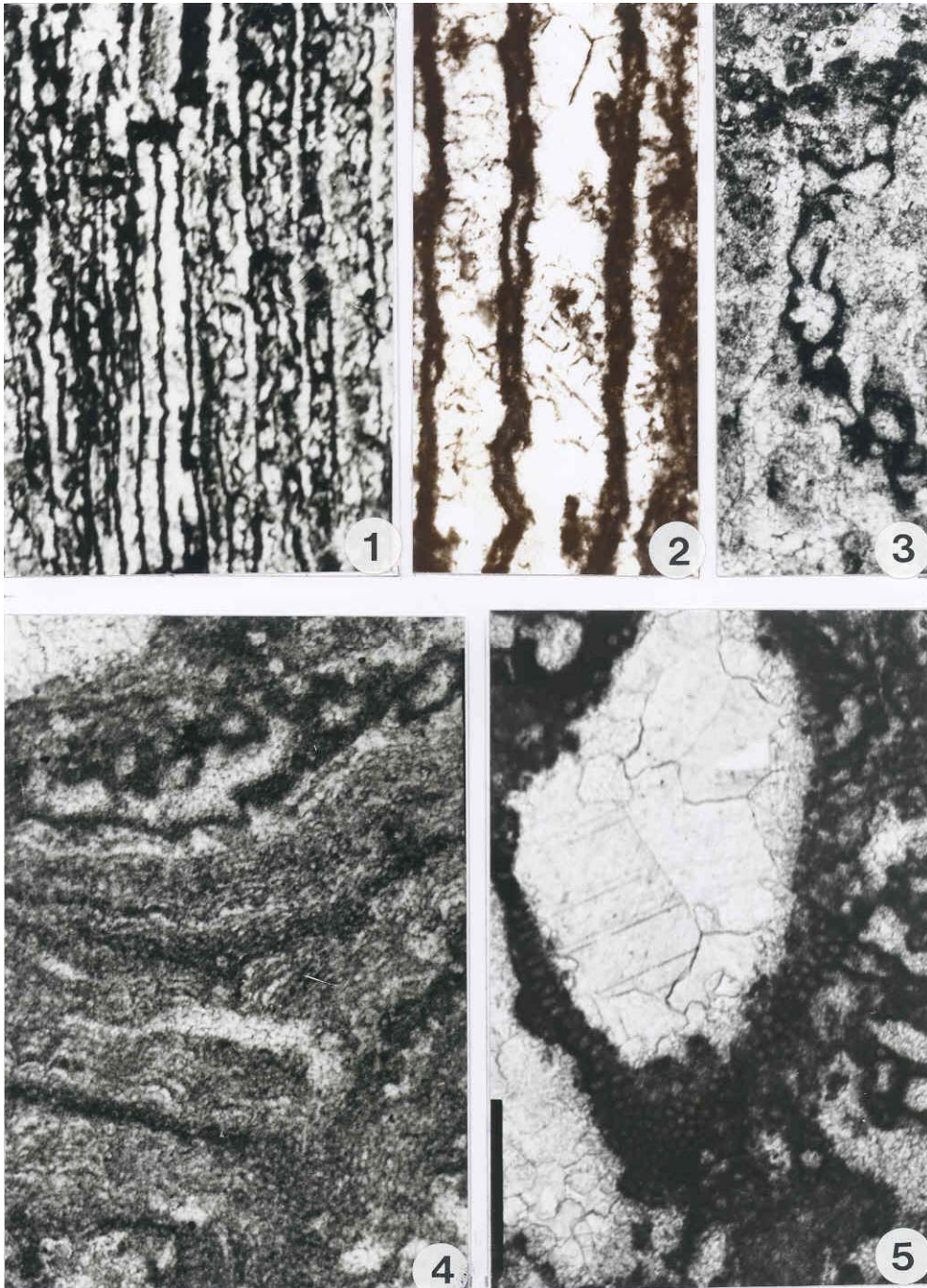


Plate IV

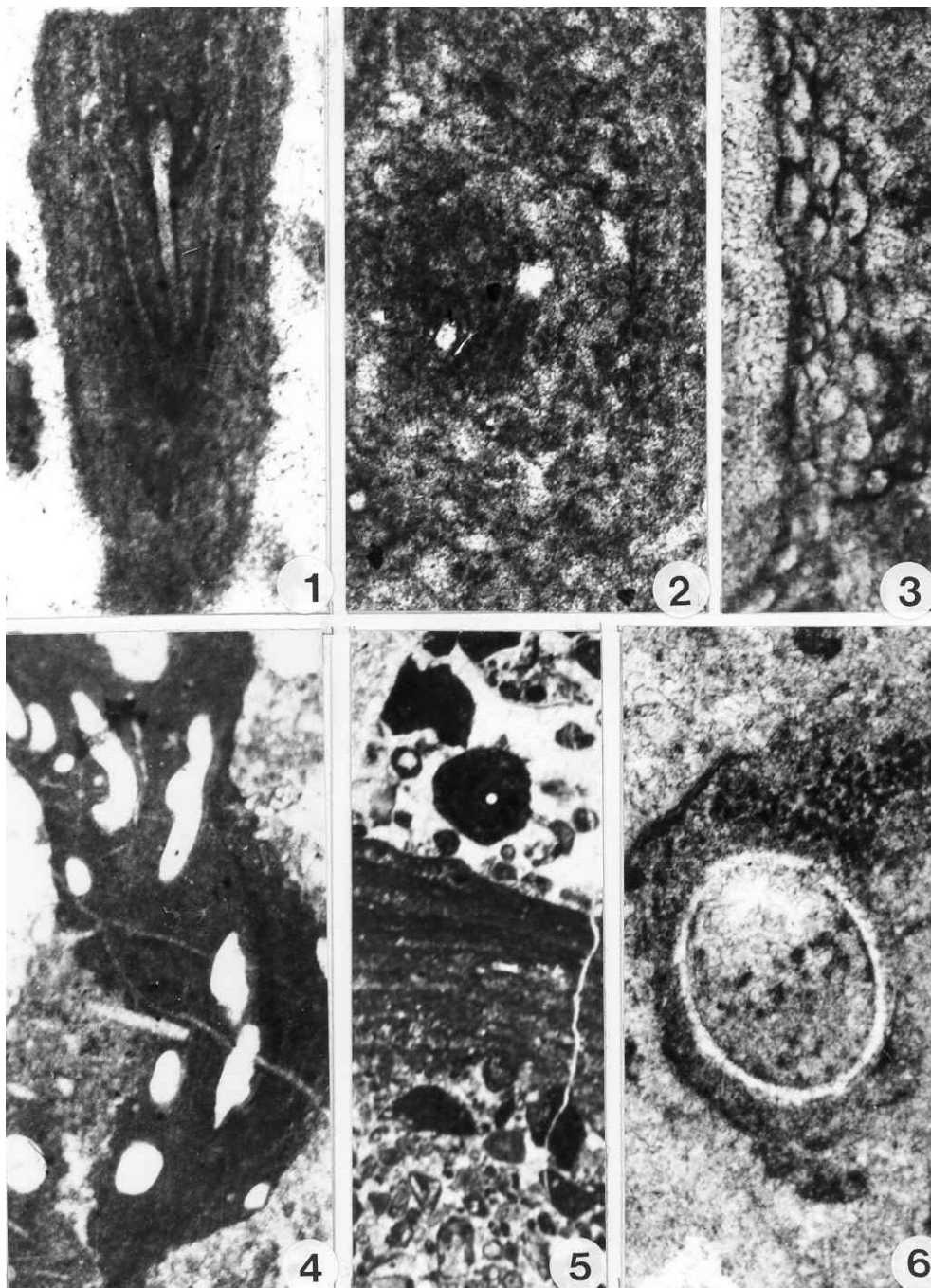


Plate V

