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Middle Miocene Red Algae from the Transylvanian Basin (Romania)

Mittelmiozäne Rotalgen aus dem Transsylvanischen Becken (Rumänien)

by

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BUCUR, I.I. & FILIPESCU, S., 1994. Middle Miocene Red Algae from the Transylvanian Basin (Romania). — Beitr. Paläont., **19**:39–47, 1 Figure, 1 Table, 2 Plates, Wien.

Abstract

Middle Miocene (Badenian) deposits, rich in red algae, outcrop on the western border of the Transylvanian Basin. The paper contains the first algal species inventory among which the specimens of *Lithothamnion, Mesophyllum* and *Lithophyllum* (?) *albanense* are dominant. Considering the assemblage and taking into consideration some characteristics concerning the distribution of algal facies, we draw several conclusions regarding the depositional environment. The presence of *Sporolithon* specimens indicates relative warm waters, while the rhodolith structures and the occurrence of some hemipelagic–pelagic foraminifera are indicators of moderate depth environment.

Zusammenfassung

Am Westrand des Transsylvanischen Beckens sind mittelmiozäne (Badenium) Sedimente aufgeschlossen, die reich an Rotalgen sind. Die vorliegende Arbeit bringt eine erste Bestandsaufnahme der Algen, wobei *Lithothamnion, Mesophyllum* und *Lithophyllum* (?) *albanense* dominieren. Unter Einbeziehung der Assoziationen und der Verteilung der Algenfazies lassen sich verschiedene Schlüsse auf das Ablagerungsmilieu ziehen. Das Auftreten von *Sporolithon* deutet auf relativ warmes Wasser hin, die Strukturen der Rhodolithen und das Vorkommen von hemi-pelagischen Foraminiferen auf mäßig tiefe Ablagerungen.

1. Introduction

Red algae are very abundant in the Miocene deposits on the border of the Transylvanian Basin, being the main constituents of limestones formed in this period. They are known in the Neogene deposits of the whole peri-Mediterranean area, including the Paratethys. In this paper we document, for the first time, an inventory of the red algal assemblage of Middle Miocene deposits from the mentioned area, as well as some considerations concerning the environment.

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2. Geological setting

The Middle Miocene from the western part of the Transylvanian Basin consists of Badenian marine formations.

Lower Badenian deposits are predominantly carbonatic and transgressively overlie the lavas and pyroclastites of the Trascau Mountains ophiolitic complex (ILIE, 1958). The sequence of this interval belongs to the Gârbova de Sus Formation (FILIPESCU & HOSU, in press). The lower part of the formation consists of a 15 m thick sequence with sands alternating with sandstones, microconglomerates and fossiliferous marls. All are overlain by fossiliferous limestones about 30 m thick. These limestones are relatively compact in Podeni section. They can also be well delimited in the middle part of the Moldovenesti section. However, at Lopadea Veche the largest part of this carbonate sequence has a noduliform aspect due to the marly material in which most of the algal crusts are included (Fig. 1).

Besides Rhodophyceae, these limestones also contain larger foraminifera (*Heterostegina costata* d'ORBIGNY, *Amphistegina lessonii* d'ORBIGNY, etc.), bryozoans, brachiopods, bivalves, and echinoids (VADASZ, 1915; GHIURCA, 1964; NICORICI, 1975).

From a biostratigraphic point of view, the sequences investigated at Lopadea Veche and Moldovenesti are characteristic for the "Upper Lagenid Zone" of Badenian. The planktonic species *Orbulina suturalis* BRÖNNIMANN is characteristic for zone N-9 of the Neogene. In both profiles, the limestones are discordantly overlain by sands and marls with typical lower Pannonian s.str. (Serbian) ostracods.

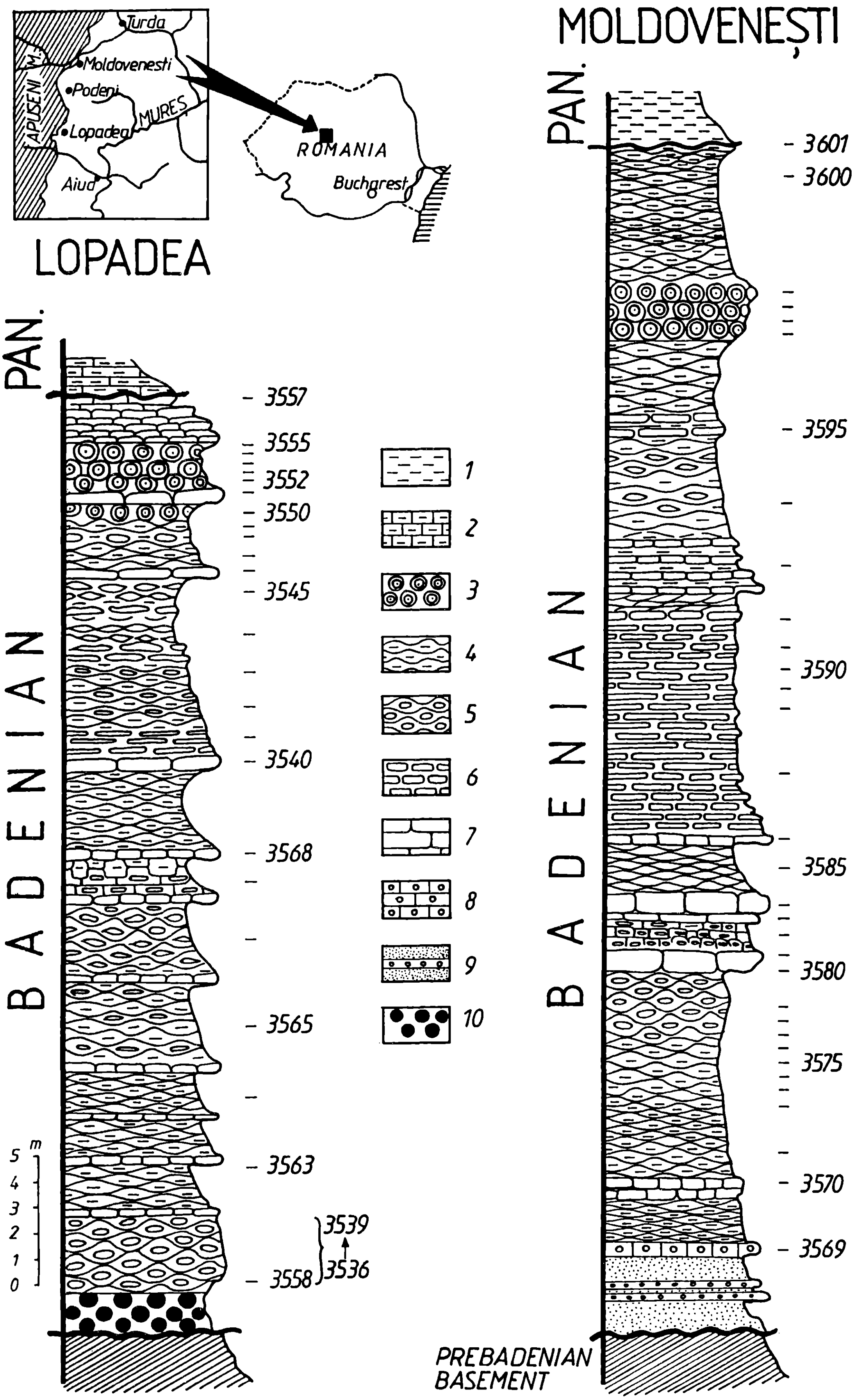

Figure 1: Location of the studied area and the lithological sequences of Lopadea Veche and Moldovenesti. (1: clays, 2: marls, 3: rhodolith bank, 4: nodular marls, 5: nodular limestones with rhodoliths, 6: thin bedded bioclastic limestones, 8: calcareous microconglomerates, 9: sands and sandstones, 10: conglomerates).

Species	Growth form	Hypothallus		Perithallus		Reproductive organs (dimensions in μm)
		Size (mm)	Cells (μm)	Size (mm)	Cells (μm)	
Sporolithon lvovicum MASLOV	mamelonar crusts	0.04–0.12	4/20		10–12 / 6–8	Sporangia: 80–130 / 36–68
Palaeothamnium archaeotypum CONTI	branch fragments			1.0–2.0	16 / 10	Conceptacle: 450 / 100
Lithothamnion cf. *minimum* SEGONZAC	crusts	0.06–0.08	8 / 8–28	1.2–1.4	8–10 / 8–10	
Lithothamnion moretti LEMOINE	crusts, branches	0.07–0.08			8–10 / 12–20	Multiporate conceptacles: 350–465 / 140–155
Lithothamnion praefruticulosum MASLOV	mamelonar crusts	0.10–0.16	12–20 / 46		6–8 / 8–16	Multiporate conceptacles: 300–370 / 120–180
Lithothamnion cf. *gaviense* FAVREGA et al.	branches			0.07–0.12	10–12 / 6–8	Multiporate conceptacles: 230–300 / 110–150
Lithothamnion cf. *lacroixi* LEMOINE	crusts	0.15	12–20 / 6–8		6–8 / 6–8	Multiporate conceptacles: 240–340 / 150–230
Mesophyllum roveretoi CONTI	crusts	0.15–0.31	16–24 / 6–12		6–12 / 4–8	Multiporate conceptacles: 300–430 / 120–240
Mesophyllum cf. *koritzae* LEMOINE	crusts	0.3	10–24 / 8–12		6–8 / 6–8	Multiporate conceptacles: 250–310 / 160–170
Mesophyllum cf. *vaughani* (HOWE)	mamelonar crusts		20–24 / 8–12		4–5 / 4–5	Multiporate conceptacles: 700–780 / 230–300
Lithophyllum (?) *albanense* LEMOINE	crusts, branches	0.24	32–50 / 12–20		16–18 / 16–32	Monoporate conceptacles: 240–380 / 120–230
Lithophyllum ramosissimum (REUSS)	branches				20–24 / 8–12	Monoporate conceptacles: 300–320 / 80–90
Lithophyllum cf. *praelichenoides* LEMOINE	crusts		28–36 / 8–14	0.1	4–6 / 4–6	

Table 1: Red algal assemblage from the Transylvanian basin and main characters of taxa.

3. Material and Methods

The whole succession was investigated on the profiles of Moldovenesti, Podeni, Lopadea Veche, and Gârbova de Sus. 211 samples have been collected from the rich algal levels and from the compact bioclastic limestones. More than 150 thin sections have been made and studied. Our main purpose was to draw the first taxonomic inventory of the red algae. The field observations, as well as those on the microscope, made also possible some paleoecological considerations.

4. Results

Two of the investigated limestone sequences are presented in Fig. 1. Among algae, rhodophyceans are almost exclusive. Some very rare *Halimeda* specimens occur in the Podeni quarry, while Dasycladales are probably absent. The Rhodophyceae form superimposed lamellar or mamellonar crusts. Very often they are embedded in a marly–calcareous or marly matrix, which causes a noduliform aspect, typical for this sequence. In the upper part of the succession there is a distinct level of spherical nodules (rhodoliths).

The identified red algae assemblage is presented in Table 1.

We consider as necessary some remarks on two of the species mentioned in the table: *Palaeothamnium archaeotypum* and *Lithophyllum* (?) *albanense*.

CONTI (1945) described *Palaeothamnium archaeotypum* from the Vienna Basin (Leitha limestone) rendering the ontogenetic evolution of sporangia from the changes in the perithallus cells up to the sporangia individualisation. SEGONZAC (1969) reported a similar evolution, finally resulting in a *Lithothamnion* type structure for *L. camarasae* PFENDER and considered *Palaeothamnium* as a subgenus of *Lithothamnion*. The author also described a new species, *Lithothamnium (Palaeothamnium) badellei* from the French Priabonian. The problem has been recently re-examined by AGUIRRE & BRAGA (1993) who consider that the evolution of the conceptacles cannot be accepted as a generic diagnostic character. Some further data concerning epithallial cells are necessary for an accurate generic assignment of this species.

Concerning *Lithophyllum* (?) *albanense*, the hypothallus structure, as well as the cell setting within the perithallus, differentiates this species from the typical *Lithophyllum* species, to which they resemble only as far as their monoporate conceptacle structure is concerned. The common interpretation of this species corresponds to a Mastophoroid, *Spongites* (BRAGA ,written information of reviewer).

Besides the species mentioned in Table 1, the studied limestones contain *Lithoporella quadratica* ISHIJIMA, *Jania* sp. (Pl. 2, Fig. 1), and specifically undetermined specimens of *Sporolithon, Lithothamnion, Lithophyllum,* and *Mesophyllum.*

5. Discussion

The study of the Badenian limestones between Gârbova de Sus and Moldovenesti emphasised two main facies types.

1. Bioclastic limestones in compact beds, sometimes several metres thick (Gârbova de Sus, Podeni), containing a variable amount of arenitic terrigenous material. They can be mud-supported (biomicrites) or grain supported (biosparites) and contain bryozoans, molluscs, annelids, foraminifera, and red algal fragments (Pl. 1, Figs. 1–2).
2. Algal limestones: We include here lamellar and mamelonar crusts in a calcareous matrix and rhodoliths (spherical bodies, forming a distinct level in the upper part of the sequence). Beside red algae, bryozoans and encrusting foraminifera of *Miniacina* type also contribute to the crust formation.

Branch fragments of coralline algae of variable size, from a few mm to 1 or 2 cm length can be observed in relative abundance within the marly intercalations.
The rhodoliths are considered good paleoenvironmental indicators. In most cases the interpretation has focused on determining the bathymetry of the associated deposits. MONTAGGIONI (1979) defined some characteristics for rhodoliths formed in shallow and/or calm waters, as well as for rhodoliths formed in deep and/or high energy waters. These principles have been followed by BRAGA & MARTIN (1988) in the study of some Miocene rhodoliths from Spain.
Generally rhodoliths have been described both from shallow water deposits (BUGE et al., 1973; BOULANGER & POIGNANT, 1975) and from greater depth deposits (BUCHBINDER, 1977; MINNERY et al., 1985; STUDENCKI, 1988b). ORSZAG-SPERBER et al. (1977) consider that using only rhodoliths as a bathymetric index, without precautions, may lead to uncertain results. It is necessary to have a complex analysis of all paleontological and sedimentological elements supplied by the sequence under study. Such an analysis is not in our purpose for the moment. However, according to the data we already have, we can draw some considerations on the paleoenvironment.
Rhodoliths from the studied sequence consist of crusts developed around a nucleus. Several algal genera and species contribute to their formation, but bryozoans and encrusting foraminifera are also present. These features are, according to MONTAGGIONI (1979), characteristic for deep water rhodoliths. The presence within the matrix of the hemipelagic microfauna indicates that the algal deposits from the western border of the Transylvanian Basin have been formed under moderate depth conditions. For similar deposits, STUDENCKI (1988b) acknowledges a maximum depth of 50 to 80 m, emphasising that the greatest part of the rhodolith pavements and rhodolith algal-bryozoan facies were situated at depths around 30 m.
According to BOSENCE (1985) the rhodolith deposits from the peri-Mediterranean Miocene have their most significant contemporary example in the so-called "corraligène de plateau" These conditions are known in the Mediterranean between 20 and 160 m, the shallow water occurrence (20–50 m) being related with high turbidity coastal areas. The generic composition in which *Mesophyllum, Lithothamnion,* and *Lithophyllum* are predominant, is also similar. These genera occur at relatively shallow depth in cold waters, and at more than 50 m in tropical zones (BOSENCE, 1985). The presence of *Sporolithon* species in the Miocene assemblages points to a relative warm climate.
Considering the aspects mentioned above, we can state that the Miocene algal deposits from the studied area were formed in a relatively warm climate, at about 30–50 m deep.
The algal assemblage identified here includes species from the whole peri-Mediterranean area. There are striking similarities to the assemblages described from Southern Poland (PISERA, 1985: STUDENCKI, 1988a; PISERA & STUDENCKI, 1989), Ukraine (MASLOV, 1956, 1962), and, to a certain extent, from the Vienna Basin (CONTI, 1945; PILLER, unpublished data).

6. Conclusions

Miocene deposits from the western border of the Transylvanian Basin contain typical Badenian fauna and flora. Limestones, with nodular aspect and very rich in red algae, occur in the sequence. The coralline algae form lamellar of superimposed mamelonar crusts, sometimes as spherical aggregates (rhodoliths), which may reach up to 15–20 cm in diameter. The crusts are frequently made up of successive and multiple layers of encrusting bryozoans, foraminifera and algae. Among the algae, the most frequent are species of *Lithothamnion* and *Mesophyllum,* as well as *Lithophyllum* (?) *albanense*. Other Lithophylloideae frequently occur in the bioclastic intercalations. The monostromate encrusting specimens of *Lithoporella* are poorly represented. The presence of *Sporolithon* species suggests an environment with relative warm waters. The algal facies with rhodoliths, as well as the presence of some hemipelagic and pelagic foraminifera in the matrix, indicate moderate depth environment (probably around 30–50 m).
The Middle Miocene algal assemblage from the western border of the Transylvanian Basin resembles those described from Ukraine, Southern Poland, Vienna Basin, as well as the peri-Mediterranean basins.

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PLATE 1

Fig. 1. Bioclastic limestone (biomicrite) bearing foraminifera, bryozoans, bivalves, and echinoderm fragments, as well as red algae. Sample D-14, Podeni; x 7.

Fig. 2. Bioclastic limestone (biosparite) with terrigenous material, bearing foraminifera (*Borelis* sp.), worm tubes, bryozoans, bivalves, echinoderm fragments, and red algae. Sample 3512, Gârbova de Sus; x 6.

Fig. 3. Mamelonar crusts, developing sometimes short branches, built by superimposed red algal thalli (mainly *Lithothamnion*), and bryozoans. Sample 3492c, Gârbova de Sus; x 6.

Fig. 4. Algal rhodolith with *Mesophyllum roveretoi* CONTI. Sample 3550, Lopadea Veche; x 13.

Fig. 5. Superimposed crusts of bryozoans and algae (*Lithothamnion praefruticulosum* MASLOV). Sample 3541, Lopadea Veche; x 6.

Fig. 6. Superimposed crusts of bryozoans, encrusting foraminifera, and algae (*Mesophyllum* cf. *koritzae* LEMOINE). Sample 3502, Gârbova de Sus; x 13.

Fig. 7. Superimposed crusts of bryozoans and algae (*Lithothamnion praefruticulosum* MASLOV and *Lithophyllum* (?) *albanense* LEMOINE). Sample 3548, Lopadea Veche; x 7.

PLATE 1

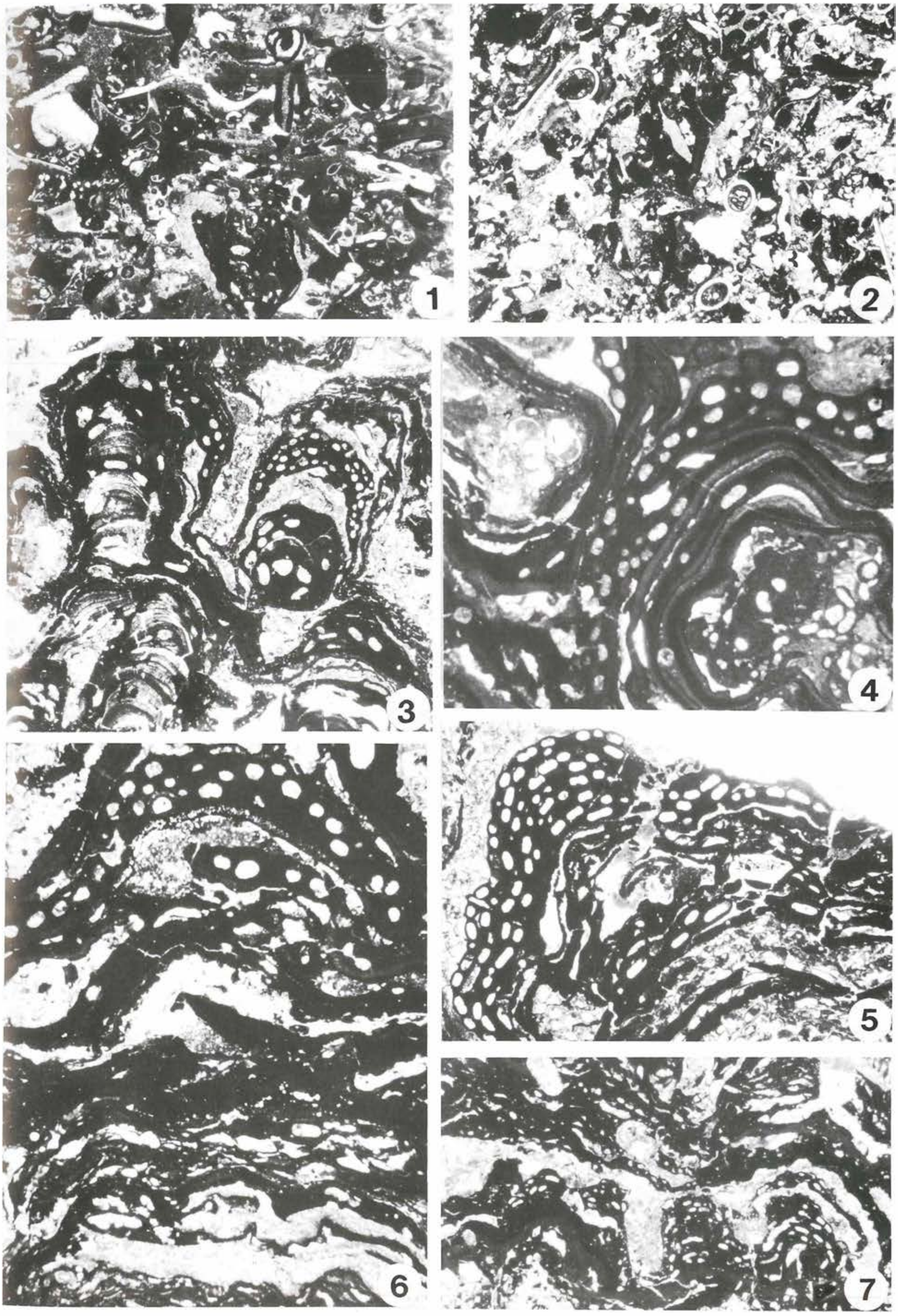

PLATE 2

Fig. 1. *Jania* sp. Sample 3513, Gârbova de Sus; x 80.

Fig. 2. *Sporolithon lvovicum* (MASLOV). Sample D-73b, Podeni; x 70.

Fig. 3. *Palaeothamnium archaeotypum* CONTI. Sample 3512/2, Gârbova de Sus; x 70.

Fig. 4. *Mesophyllum roveretoi* CONTI. Sample D-180, Podeni; x 15.

Fig. 5. *Lithophyllum* sp. Sample 3580, Moldovenesti; x 70.

Fig. 6. *Lithothamnion praefruticulosum* MASLOV. Sample 3515/1, Gârbova de Sus; x 30.

Fig. 7. *Lithophyllum* (?) *albanense* LEMOINE. Sample 3516, Gârbova de Sus; x 45.

PLATE 2