31 BIOSTRATIGRAPHICAL STUDY (CALCAREOUS NANNOFOSSILS AND MOLLUSCS) OF THE BADENIAN DEPOSITS OF LIVADA (CLUJ COUNTY)

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Abstract. The Badenian deposits of the Livada Basin are situated near Turda, in the northern extremity of the Trascău Mountains. This basin is an extension of the Miocene Petreşti Sea. These deposits crop out in the Livada area in the Sigău (= Livada) Valley and its right tributaries: the Mare Brook, the Rogoaza Brook and the Argeluşa Brook, as well as north of Livada, in the place called Gruiul Zapodii. They belong to the Copăceni-Tureni Formation (conglomerates and Leitha-type limestones) and the Dej Formation (the "Dej Tuff Complex") represented by tuffs, tuffites, clays and marls. These deposits transgressively overlay the metamorphic formations of the Baia de Arieş Lithogroup (in the Eastern and Southern area) and of the Eocene formations (Priabonian: the Cluj Limestone, in the North and West).

In this region, the Lower Badenian is documented by the presence of Biozone NN5 - with *Sphenolithus heteromorphus* Deflandre and the Biozone with *Neopycnodonte navicularis* (Brocchi). A new species of *Helicosphaera* and a new species belonging to the *Limidae* Family, *Acesta livada n. sp.*, are also present. From bivalves, *Pecten sp.* is also present. The nannoplankton assemblage is rich. It contains 27 species.

Key Words: Badenian, Calcareous nannofossils, Mollusca: Bivalvia, New taxa, Transylvanian Basin: Livada (County of Cluj)

The Livada Basin is situated in the northern extremity of the Trascău Mountains crystalline unit, near Turda. It was investigated by Niţulescu (1936), Gabos (1974), Chira (1996).

The Miocene Livada Basin is an extension of the Miocene Petreşti Sea, stretching as a channel in the direction NNE-SSW and linking to the Petreşti Basin, through the Deleni area in the NE.

Miocene deposits, respectively of Badenian age, outcrop in the Livada channel, on the Sigău Valley and its right tributaries: the Mare Brook, the Rogoaza Brook and the Argeluşa Brook, as well as north of the village of Livada and in the left side of the road to Petreştii de Jos, in the place called Gruiul Zapodii (Fig. 1).

In the eastern and southern part of the region, on the tributaries mentioned above and at the origin of the Livada Valley, the Miocene deposits are located in three small gulfs and transgressively overlay the metamorphic formations of the Baia de Arieş Lithogroup. The crystalline unit occurs between the Livada Valley and the Mare Valley and extends up to the Hasdate Valley in the north. In the northern and western part of the region, the Miocene transgressively covers the Eocene formations belonging to the Cluj Limestone (Priabonian).

The Miocene deposits are of Badenian age, namely the Lower Badenian.

The sedimentation begins with conglomerates and Leitha-type limestones, which belong to the Copăceni-Tureni Formation (Lubenescu et al., 1978). This formation is represented in the investigated area only by blocks in the Mare Brook. In these blocks also *Pecten* sp. (fragments and casts) was found (Fig. 2).

The Copăceni-Tureni Formation was described as "Copăceni-Tureni Beds" by Lubenescu et al. (1978) in the localities in the neighbourhood of the studied region.

The conglomerates and Leitha-type limestones of the Tureni-Copăceni-Cheia-Petreşti-Borzeşti-Livada region represent an equivalent north of the Arieş Valley of Buha Limestone (Popescu et al.,1995) (= Podeni Limestone, Meszaros,1991) or, more recently, the Gârbova de Sus Formation (Filipescu & Garbacea, in Filipescu,1996), defined south of the Arieş Valley.

Lubenescu et al (1978) proved the existence of the *Neopycnodonte navicularis* Biozone within the "Copăceni-Tureni Beds", in the area surrounding the localities named. This biozone marked the presence of the Lower Badenian, also after Moisescu & Popescu (1980).

In the Livada Basin, west of the Livada crystalline unit, the detrital, coarse-grained basal level was noticed (Gabos, 1974). East of the village of Livada, in the Mare Brook (Blaja Hill) a bank of sandstone was mentioned, which sometimes develops a thickness of 6-7 m, consisting only of elements of the crystalline basement. The thickness of the breccia level reduces following the westward dip of the strata and gradually passes into polymictic conglomerates. These lithological features indicate a rapid accumulation of the sediments. From these conglomerates a scarce planktonic microfauna was described which is very characteristic of the Lower Badenian.

The same level but with a significantly reduced thickness was also mentioned in the Rogoaza Brook. In the Mare Brook, at Livada, blocks of polymictic conglomerates were found, relatively close to the confluence of the Sigău Valley . We can thus presume the presence of this level in this area also, which marks the Badenian transgression. Two *Pecten* sp. with a diameter of 4-5 cm were identified in this area. These forms are not very well preserved being rounded during their transport.

In the tributaries of the Mare Brook, overlaying the biotitic schists, which here dominate the crystalline formations, a conglomerate with elements of biotitic and quartz-biotitic schists occurs. Marls containing the same fragments of schists follow in the succession (Fig. 2).

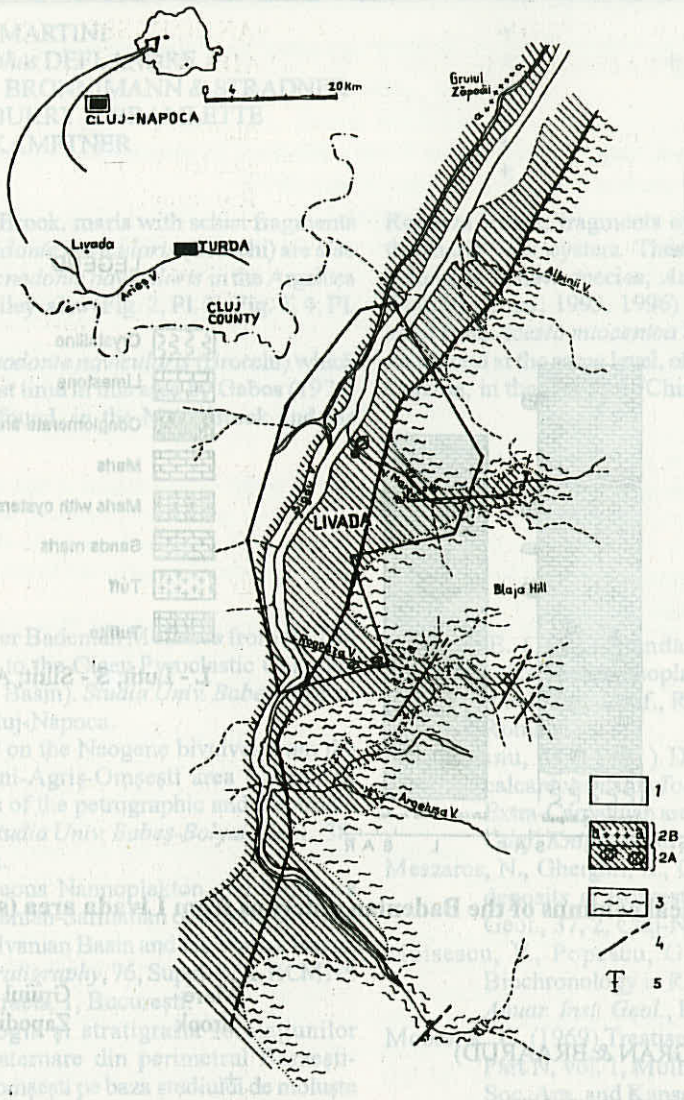


Fig. 1 Geological Map of the Livada area (scale 1:20000) 1. Quaternary; 2A, 2B. Lower Badenian deposits: 2A. Copăceni-Tureni Formation, 2B. Dej Formation; 3. Crystalline unit - Baia de Arieş Lithogroup; 4 Faults; 5. Fossils (Neopycnod oute navicularis Biozone)

In the Rogoaza Brook, a right tributary of the Sigău Valley, above the biotitic schists and micaschists, marls with fragments of schists and oysters crop out (Fig.2).

The Dej Formation (Popescu, 1970), represented by the formerly defined "Dej Tuff Complex", consists of tuffs, tuffites, clays and marls. Tuffs and tuffites are present in the Livada area. In the Livada Basin this "complex" was identified in the Mare Brook, the Rogoaza Brook and in the place called Gruiul Zapodii.

The mineralogical composition of the tuff in the Mare Brook (Blaja Hill) is similar to that of the tuff in the Deleni-Petreşti area (Gabos, 1974). The tuff level was also identified on the Rogoaza Brook and the Livada Valley (Chira, 1996).

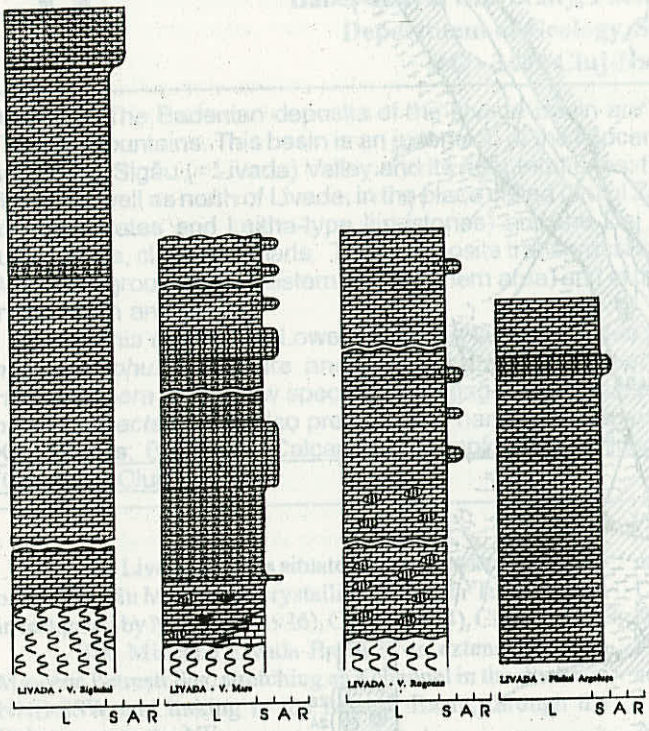
In the Mare Brook, a right tributary of the Sigău Valley, the Dej Formation is represented by a coarse-grained tuff and tuffite with interbedded marls containing *Neopycnodonte navicularis* (Brocchi). The thickness of these deposits is about 150 m. These marls are also very rich in globigerinids and other foraminifers. The marls are also interlayered with sandy levels (Fig. 2).

The tuff in the Mare Brook is vitroclastic, has a medium-grained texture and originated in a submarine eruption. This tuff level was parallel to the upper part of the "Dej Tuff Complex".

Above this tuff a tuffitic marl (tuffite) develops.

The nannoplankton is richly represented in the Lower Badenian deposits in the Mare Brook, especially, in the neighbourhood of the locality of Livada. The nannoplankton assemblages can be assigned to Biozone NN5 with *Sphenolithus heteromorphus* (Pl. I).

Below, the calcareous nannofossil assemblages of the two areas: the Mare Brook and Gruiul Zapodii (Livada region) are presented:



LEGEND

- Crystalline
- Limestone
- Conglomerate and Leitha - type limestone
- Marls
- Marls with oysters
- Sands marls
- Tuff
- Tuffite

L - Lutit; S - Siltit; A - Arenit; R - Rudit.

Fig. 2 Lithological columns of the Badenian outcrops from Livada area (scale 1:500)

	Mare Brook	Gruiul Zapodii
Braarudosphaera bigelowii (GRAN & BRAARUD) DEFLANDRE	+	
Coccolithus pelagicus (WALLICH)SCHILLER	+	+
Coccolithus miopelagicus BUKRY	+	+
Calcidiscus leptoporus (MURRAY & BLACKMANN) LOEBLICH &TAPPAN	+	+
Cyclococcolithus rotula (KAMPTNER) KAMPTNER	+	
Discoaster variabilis MARTINI & BRAMLETE	+	+
Discoaster exilis MARTINI & BRAMLETTE	+	
Discoaster musicus STRADNER	+	
Helicosphaera carteri (WALLICH) KAMPTNER	+	+
Helicosphaera walbersdorfensis MULLER	+	+
Helicosphaera waltrans THEODORIDIS	+	
Helicosphaera stalis THEODORIDIS	+	
Helicosphaera cf. sellii (BUKRY & BRAMLETTE) JAFAR & MARTINI	+	+
Helicosphaera vedderi BUKRY	+	
Helicosphaera orientalis BLACK	+	
Helicosphaera sp. n.?	+	
Pontosphaera multipora KAMPTNER	+	+
Reticulofenestra pseudoumbilicus (GARTNER)	+	+
Cyclicargolithus floridanus (ROTH & HAY) BUKRY	+	+
Cyclicargolithus abisectus (MULLER)	+	
Rhabdosphaera sicca (STRADNER) FUCHS & STRADNER	+	

Rhabdosphaera procera MARTINI	+	
Sphenolithus heteromorphus DEFLANDRE	+	+
Sphenolithus moriformis BRONNIMANN & STRADNER	+	
Sphenolithus neoabies BUKRY & BRAMLETTE	+	
Syracosphaera histrica KAMPTNER	+	
Thoracosphaera sp.	+	

On the Rogoaza Brook, marls with schist fragments and marls with *Neopycnodonte navicularis* (Brocchi) are also present. We found *Neopycnodonte navicularis* in the Argeluşa Brook and the Livada Valley also (Fig. 2, Pl. II, Fig. 3, 4; Pl. III, Fig. 1-13).

Besides *Neopycnodonte navicularis* (Brocchi) which was mentioned for the first time in this area by Gabos (1974) in the Mare Brook, we found, in the Mare Brook and the Rogoaza Brook, fragments of large-size and thin valves, in the marls with oysters. These fragments are considered to belong to a new species, *Acesta livada n. sp.?* (*Limidae* Family) (Chira, 1993, 1996) (Pl. II, Figs. 1,2). It is a form apart from *Acesta miocenica* Sismonda (Sacco, 1898) which was found at the same level, of the Lower Badenian, at Ciceu-Corabia, in the Dej Tuff (Chira, 1992).

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Captions of Plates

Plate 31. I

Fig. 1. *Sphenolithus heteromorphus* Deflandre (N+) (x 2000)
Fig. 2. *Sphenolithus neoabies* Bukry & Bramlette (N+) (x 2000)
Fig. 3. *Syracosphaera histrica* Kamptner (N+) (x 2000)
Fig 4. *Discoaster musicus* Stradner, *Helicosphaera ampliaperta* (Wallich)Kamptner (1N) (x 2500)
Fig. 5. *Discoaster musicus* Stradner (1N) (x 2500)
Fig. 6, 7. *Cyclicargolithus floridanus* (Roth & Hay) Bukry, *Helicosphaera carteri* (Wallich) Kamptner, *Coccolithus pelagicus* (Wallich) Schiller (1N, N+) (x 3000)
Fig. 8. *Pontosphaera multipora* (Kamptner) Roth , *Coccolithus miopelagicus* Bukry (N+) (x 1100).

Plate 31. II

Fig. 1, 2. *Acesta livada n. sp. ?* - right valve (x 1)
Fig. 3, 4. *Neopycnodonte navicularis* (Brocchi) - left valve (x 1,1)

Plate 31. III

Neopycnodonte navicularis (Brocchi)
Fig. 1, 2, 3, 6, 7, 10 - right valves (x 1,2)
Fig. 4, 5, 8, 9, 11, 12, 13 - left valves (4, 5, 11, 12, 13) (x 1,2), (8, 9) (x 1)