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PRESENCE OF BIG SIZE AMMONITES IN THE JURASSIC OLISTOLITHS OF TRANSYLVANIAN NAPPE(S) FROM RARĂU SYNCLINE (EASTERN CARPATHIANS, ROMANIA)

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Abstract: Rarău Syncline is known through various ammonite faunas, from Triassic to Early Cretaceous, but only two specimen of large ammonites were quoted until now, respectively from Sinemurian (Bodia Hill) and Aalenian (Moldova slope). The paper added a new fossiliferous point with big size ammonites (Praşca Peak, Sinemurian: *Zetoceras bonarelli, Coroniceras (Coroniceras) cf. lyra, C. (Paracoroniceras) sp.* etc) and remembered the first two records.
Key-words: Big size ammonites, Sinemurian, Aalenian, Rarău Syncline, Transylvanian nappes.

1. General data on big size ammonites

Three empirical size categories of ammonites have been proposed (Stevens, 1985, 1988): small (with diameter up to 170 mm), medium/big (with diameter between 170 mm and 435 mm) and large (with diameter beyond 435 mm and very rarely greater than 1 meter. Medium (more frequently) and large ammonites (more rarely) have been collected in many parts of the world from the Late Devonian to Late Cretaceous, but the reasons of their presence in certain beds and biozones are not obvious. The general rarity of large ammonites may be due to preservational factors (the ammonite shells are very thick), life cycle characteristics, environmental features etc. Stevens (1988) also showed relationships between the presence of large ammonites and eustatic see level fluctuations: the main stratigraphical intervals with such ammonites have coincided with sea-level changes: Hettangian-Early Sinemurian, Bajocian, Kimmeridgian-Tithonian, Late Aptian, Cenomanian-Turonian and Early Campanian, less frecquent being in Late Pliensbachian, Early and Middle Oxfordian and Late Campanian. The author accepts the hypothesis that transgressions favor the appearance of large ammonites through relatively low reproduction rate, late maturation, greater longevity, large body and trophic specialization (Calder, 1984 – fide Stevens, 1988).

The presence of large ammonites also emphasizes as much on local fossilization conditions and paleoenvironment. Big versus small ammonites might be controlled by post-mortem sorting and transport or several specimens could be only nuclei of originally bigger ammonites. On the other hand, they might be immature individuals which died by different causes before reaching full size.

The biological reasons are not still clearly explained:

- there are families of ammonites which preserved only small specimens; echioceratids were the most widespread in the *Echioceras raricostatum* Taxon-range Zone (Late Sinemurian) and they were always small; other families (e. g. *Arititidae)* has both large and normal size exemplaires;

- several taxa could be usually encountered by large adult specimens in some biozones/subbiozones; *Paracoroniceras* or *Coroniceras (Paracoroniceras)* is often recorded through big size shells in *Coroniceras (Coroniceras) lyra* Subzone;

- in the same biozones and paleonvironments there are prevalent large shells of several taxa and only small ones for another; e.g. in the *C.(C.) lyra* Subzone, with large specimens of *C. (Paracoroniceras),* the *Arnioceras* were only small individuals.

In conclusion, the relevance of large ammonites for the global and local events isn't yet clearly deduced.

The Paleontology-Stratigraphy collection of the Geology Department, University "Alexandru Ioan Cuza" of Iaşi holds several specimens of large ammonites: from the Triassic, Hagighiol-Dobrogea - *Trachyceras (Trachyceras) curionii* MOJSISOVICS, *Gymnites bosniensis* (HAUER) – Simionescu (1913); from the Jurassic: *Subsaynella suesii* (SIMIONESCU) - Dâmbovicioara Basin, Simionescu 1898; *Procerites moorei* (OPPEL) - Bucegi Mountains, Simionescu, 1905; *Perisphinctes (Arisphinctes) cotovui* SIMIONESCU*, P. (A.) pseudobreviceps* SIMIONESCU*, P. (Orthosphinctes) suevicus planus* SIMIONESCU, *P. (Dichotomosphinctes) dobrogensis* SIMONESCU, *P. (Kranaosphinctes) promiscuus* BUKOWSKI, *P. (Perisphinctes) multifidus* (SIMIONESCU), *P. (Discosphinctes) gerontoides* SIEMIRADZI, *Decipia ernesti paucicosta* (SIMIONESCU) – Hârşova, Dobrogea Simionescu, 1907; and from the Cretaceous - *Pachydiscus* sp. (*P.* cf. *levyi* GROSS = *Nowakites macoveii* SZASZ) – Macovei, 1906, and a few fragments of large ammonites from the Dâmbovicioara Basin - *Crioceratites kilianii, Crioceratites (? =Hoplocrioceras)* sp., Simionescu (1898).

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There are also undocumented ammonites with large dimensions in other Romanian collections.

2. Setting of the Jurassic olistoliths (Transylvanian Nappes)

Field researches made in the last years in the Jurassic deposits of the Rarău Syncline has provided new information concerning the presence of large ammonites in the Transylvanian Nappes rocks (the first being reported by Turculeț, 1966).

The Transylvanian Nappes occur only as olistoliths and hieratic blocks in the Cretaceous wildflish. It was outlined by Uhlig (1907), who distinguished and named in the Rarău Syncline two kinds of nappes: the autochthonous Bucovinian Nappe and the allochthounousTransylvanian Nappe; the last name suggests the original area of its deposits. Uhlig identified Triassic and Jurassic sedimentary rocks mixed with oceanic igneous rock in the Transylvanian Nappe.

Until the middle of the eightieth decade, subsequent researchers accepted the Transylvanian Nappe (although with different interpretations) and its presence was also highlighted in Hăghimaş and the Perşani mountains (Popescu-Voiteşti, 1936; Preda, 1940; Patrulius, Popescu, 1964; Mutihac, 1968; Săndulescu, 1973, 1976; Patrulius et al., 1971, 1979; Rădulescu et al., 1976; Săndulescu et Visarion, 1978; Rădulescu et Săndulescu, 1973; after Săndulescu, 1984).

The deposits of the Transylvanian Nappes were formed on an oceanic spreading floor, and represent different ages on a different ophiolitic basement. Using this evolutionary model, Săndulescu (1984) proposed three heterochronous Transylvanian Nappes:

- the oldest one – Perşani Nappe **–** *sensu stricto* with Triassic deposits and without ofiolitic rocks;
- the Olt Nappe, separated in the Perşani Mountains by Patrulius et al., 1979 including ultrabasic rocks, pillow-lava and Traissic – Middle Jurassic deposits;
- and the last one, Hăghimaş Nappe, delimited in the mountains with the same name by Săndulescu (1976), this representing the Tithonian – Early Cretaceous time interval.

In the Rarău Syncline, the Jurassic of the Transylvanian Nappes is marked until now by Sinemurian (Praşca Peak, Bodia Hill, Izvorul Malului), Pliensbachian (Valea Pojorâtei stream), Toarcian, Toarcian - Aalenian (Izvorul Malului stream, Măgura hill – Moldova valley between Sadova and Pojorâta), Bajocian (Valea Pojorâtei stream), Bathonian (Valea Seacă) - Turculeț, 2004; and Early Callovian deposits (Izvorul Malului, Izvorul Alb, Moldova valley) – Turculeț, 1979.

The affiliation of olistoliths and, especially, exotic blocks to one of the three Transylvanian Nappes is difficult and needs comparative studies between their presence in Rarău, Hăghimaş and Perşani mountains.

The rocks of the Transylvanian Nappes are the most fossiliferous in the Rarău Syncline, the fauna including algae, foraminifers ammonites, bivalves, gastropods, belemnites, brachiopods, crinoids, echinoids etc.

3. Large Jurassic ammonites in Rarău Syncline

Two specimens of large sized ammonites have so far been collected from the Rarău Syncline deposits: the first was found in Aalenian deposits – Moldova river slope (Turculeț, 1966) and the second from a hieratic Sinemurian block – Bodia hill (Țibuleac, 2002). A few other fragments of large ammonites testify to their presence in another fossiliferous outcrop (Praşca Peak).

3.1 Sinemurian olistolith from Praşca Peak

The most important olistolith of Liassic age from the Eastern Carpathians occurs in the Praşca Peak, almost in the middle of the syncline, several kilometers south-west of Câmpulung Moldovenesc, Suceava County (Fig. 1). It was discovered by Uhlig (1900), and has subsequently been studied and reported by Trauth (1906), Popescu & Patrulius (1964), Turculeț (1965, 1968, 1971), Popa and Patrulius (1996), Turculeț and Țibuleac (2001) and Țibuleac (2005). Uhlig considered the olistolith to be a development of the “Adnet facies” because of the similarity of lithology (red nodular limestones and marls) and the similarity of the ages of ammonites represented.

A rich fauna of ammonites and a few taxa of algae, foraminifera, bivalves, gastropods, crinoids and brachiopods have been recorded. Specimens have been collected in recent years both *in situ* and from the soil which buried the olistolith.

An upside-down inclination of the olistolith in the Cretaceous wildflish can be demonstrated by the relative position of *in situ* fossiliferous beds. For example, beds yielding ammonites from the *Arnioceras semicostatum* T.-r. Zone occur up-slope from beds yielding ammonites of the *Echioceras raricostatum* T.-r. Zone. The presence of other ammonites Zones between these and of earlier and later

has also been proved by recent diggings made in the area of Praşca Peak.

These field researches have also yielded some fragments of large ammonites. We could identify several taxa from these fragmentary fossils: *Zetoceras pseudo-oenotrium* (KOVÁCS, 1942), *Z.* cf. *oenotrium* (FUCINI, 1901), *(Coroniceras (Coroniceras)* cf. *lyra* HYATT, 1867, *Coroniceras (Paracoroniceras)* sp. cf. ? *C. (P.) charlesi* DONOVAN, 1955), Coroniceras (*Paracoroniceras)* sp., a taxon from the *Eoderocetacaee* family, *Gleviceras sp.,* and *Lytoceras* sp.

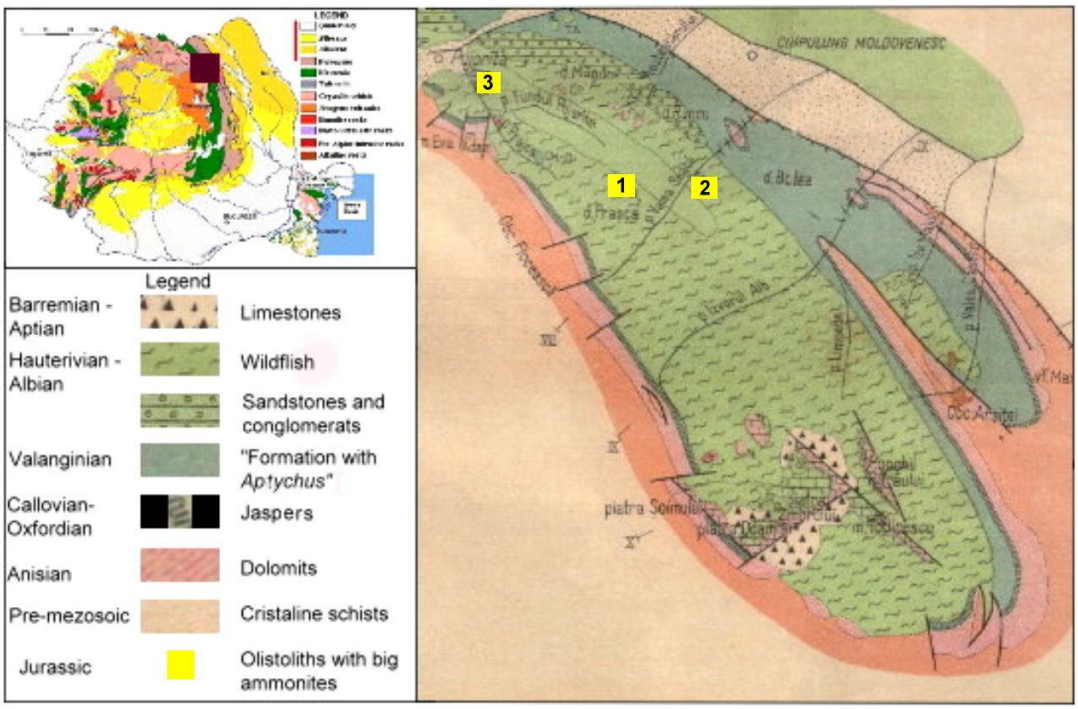

Figure 1 Geological settings of the olistoliths with big ammonites (Rarău Syncline, Eastern Carpathians): 1- Praşca Peak, 2 – Bodia Hill, 3 – Right slope of Moldova river between Sadova and Pojorâta (after Turculeț, 1971).

Two big specimens of *Zetoceras* were encountered during recent digging: a *Z. pseudo-oenotrium (*or *Z. zetes* sensu Meister and B Böhm, 1993) was collected *ex situ* in the area of outcrop of the *Arnioceras semicostatum* Zone; it is a specimen of around 185 mm diameter, other exemples of *Zetoceras* (50-80 mm diameter) have been cited previously (Turculeț and Țibuleac 2001) The large specimen has a crinoid dorsal cup attached (Pl. I, fig. 1a).

The species is identified through several characteristic features: the complex suture line shows a short ventral lobe and a broad lateral lobe with two accessory saddles (the external more high then the internal one) and the first two saddles (E/L, L/U) are tetraphyllic; the umbilicus is moderate open, with an abrupt wall and the whorl section is subtrapezoidal/ subelliptical, with the maximum width near to the umbilicus. (W/h =0,39).

The second specimen was collected *in situ* in the same zone; throughout the more open umbilicus and the general outline of whorl section it could be a *Z. oenotrium (*or *Z. zetes* sensu Meister and B Böhm, 1993) of the closed dimensions as the first one.

Zetoceras was proposed as a genus by Kovács (1939 – fide Fantini-Sestini, 1969) in a revision of Jurassic phylloceratids, but a few years later, Wiedmann (1963 – fide Fantini-Sestini, 1969) considered *Zetoceras* KOVÁCS (and also *Geyeroceras* HYATT 1900) as a subgenus of *Phylloceras* SUESS 1865.

Subsecvent researchers have adopted one or other point of view. For example, Meister and Böhm (1993) considered *Zetoceras* as a subgenus of *Phylloceras* and grouped *Phylloceras (Zetoceras) zetes* (d'ORBIGNY 1850), *P. (Z.) oenotrium* (FUCINI 1901), *P. (Z.) bonarelli* (BETTONI, 1900) and *P. (Z.) lavizarii* (HAUER, 1854) in a single species - *P. (Zetoceras) zetes.* Few years later, Alkaya and

Meister (1995) maintain *Zetoceras* as distinctive genus adding *Phylloceras (Zetoceras) pseudo-zetes* FUCINI 1908 to the synonymy of *Z. zetes*; but they regarded *Zetoceras lavizarii* as a distinctive species characterized by the shape of section whorl and several particularities of suture line: the lateral lobe is more asymmetric in comparison with noted species, "its branch extending laterally to the middle of the venter".

During the Sinemurian – Pliensbachian - ? Early Toarcian interval, *Zetoceras* was a common tetraphyllic phylloceratid in the Tethyan realm being also reported occasionally from the Euroboreal region (Great Britain, Germany – Donovan, 1967; Géczy and Meister, 1998; Meister and Friebe, 2003). However, few specimens of large size have been recorded in Sinemurian (after the available references): from Enzesfeld Quarry (Adnet – Austria), one cited by Hauer (fide Meneghini, 1867-1881) is 150 mm diameter, another held in the collection of the Natural History Museum Vienna) is about 190 mm diameter; and a specimen recorded from Çalik (Turkey) figured by Alkaya and Meister (1995) is around 170-180 mm diameter.

Joly (2000) quoted several specimen over 200 mm diameter (maximum 275 mm – *Zetoceras lavizzarii* (HAUER, 1854) in the Late Pliensbachian of France.

In Romania, specimens of *Zetoceras* were also found at Pietrele Albe (Perşani Mountains (Popa, Patrulius, 1996).

Coroniceras sp. is represented by a few fragments, collected *in situ* (*Arnioceras semicostatum* Zone) and *ex situ*.

Guérin-Franiatte (1966) distinguished three subgenera of *Coroniceras* HYATT, 1867: *Coroniceras s.s., Paracoroniceras* SPATH, 1922*, Metophioceras* SPATH 1924, but Arkell et al., (1968) considered them as distinctive genera within the subfamily Arietitinae. The arguments in favour of this separation concern the morphology of the whorl section, sculptural aspects, and several details of the suture line etc. Subsequent reserchears have been divided between these two points of view. Regarding the new samples from Praşca Peak, one fragment represents a partial phramocone and partial body chamber, the others only phragmocones of large individuals. It is difficult to identify the species because the specimens are fragmentary shell casts and the ontogenetic evolution of whorl sections, sculpture, involution etc. cannot be determined. We still supose the presence of few species.

Coroniceras (Coroniceras) cf. *lyra* – sensu Guérin-Franiatte is represented by a fragment collected *in situ* (*Arnioceras semicostatum* Zone) with a subquadratic whorl (generally, *C. (C.) lyra* proves a very varaible whorl section), a relative flat venter which keeps the main keel and weak sulci. It has distant, slowly provers ribs, with vestigial tubercles, the approximation of suture lines suggest a mature specimen (Pl. I, fig 4). The l/h report is 0,81, which is close to that given by Guérin-Franiatte (1966) on 152 specimens of *C. (C.) lyra* (the index varing between 0,70 and 1,25).

The suture line shows several features of the pattern typical of this genus/subgenus: it shows four lobes: a straight, deep ventral lobe, a broad, divided lateral lobe (with one high accesory saddle), an U_1 and the internal lobe; the first and lateral saddles are the most important, last one a little high and the sadddle U/I more deccupated than the first two saddles.

Coroniceras (C.) lyra was also recorded through other olistolith specimens collected *in* and *ex situ* in the Perşani Mountains.

The most complete fragment (Pl. II, fig. 1) shows an evolute shell with distant ribs and a whorl section that resembles *Coroniceras (Paracoroniceras) charlesi*. It was found *ex situ* and there is no previous data about its presence in the olistolith. Corna et al. (1997) considered it as a boreal species showing the influences of north–west seas in the Daulphinoise zone of the French Alps (Écrins Massif).

Coroniceras (Coroniceras) and *C. (Paracoroniceras)* appear in the both Euboreal and Tethyan areas.

Gleviceras is known from the first mention of the olistolith: Uhlig (1900) noted an exemplary of *Oxynoticeras guibali* d'ORBIGNY, 1844 (=*Gleviceras aff. subguibalianum* PIA, 1914 – after Popa and Patrulius' revision, 1996). It has a widespread distribution - North-West Europe, Tethys, Pacific areas, being encountered in the Late Sinemurian (*Echioceras raricostatum* Zone). Our fragments is a phragmocon part, with flat and smooth flancs, compressed venter and weakly risen keel (Pl. II, fig.3). It isn't a true large ammonite (we have only a fragment) since the specimen has bigger size than the ussualy ones found in the olistolith: *Gleviceras boucaultianum* (DUMORTIER,) sensu PIA, 1914, *G. doris* (REYNES, 1879) sensu Pia, 1914.

A big size ammonite of the the Superfamily *Eoderoceratoidea* SPATH, 1929 is represented by a fragment that shows a suture

line with a bifid lateral lobe and the tendency of the lateral saddle to be bifid. The inner whorls are more densly ribbed than the following ones and the ventral part seems to lose the sulci (eoderoceratoids rarely have sulci). The whorl sections are modified (Pl. II, Fig. 4 a, c), but we suposse the essential change are due by erosional cause.

Several specimens of large *Lytoceras*, and also several aulacocerids with big dimensions were found. A few other fragments are indeterminables.

3.2 Sinemurian blocks from Bodia hill

A few years ago, a specimen of *C. (Paracoroniceras*) with an approximated diameter of 32 cm was found on a dried torrent of Bodia hill, near to the western slope base (Ţibuleac, 2002). It is known that (*C.) Paracoroniceras* changes markedly through ontogeny being trigonal in large mature whorls, this specimen differing from other known *C. (Paracoroniceras)* species by its elliptical whorl section (Pl. III, fig 1).

3.3 *Aalenian blocks from the right slope of the Moldova river*

Turculeţ (1966) described an Aalenian fauna in an exotic material from the right slope of the Moldova river (between Sadova and Pojorâta). These rocks consisted of strata of grey-yellowish marls between 8 - 10 m thicknesses with elliptical structures composed of adulterated grey-bluish marls; these *ellipsoids* were fossiliferous, yielding *Leioceras opalinum, L. comptum, L. gotzendorfensis, Leioceras* sp. (large specimen) *Costileioceras, Hudlestonia, Dumortieria* sp*., Pleydellia aalensis***,** *Ludwigia* sp*., Rhabdobellus exilis, Belemnopsis subblainvillei.* Few years later, Turculeţ (1982) named the large *Leioceras – L. carpathicus* and he estimated the reconstructed shell at 42.1 cm diameter (Pl. III, fig 2). The fragment of large ammonite represents only a part of body chamber and it is difficult to determine it preciously.

4. Conclusions

Comparing the interval with large ammonites quoted by Stevens (1988) during the Mesozoic we find two of these intervals in the Rarău Syncline – Sinemurian and Aalenian.

The new data come from the Praşca olistolith; the ammonite fragments were found in soil and in the excavation made into a transversal section in the olistolith (*Arnioceras semicostatum* T.-r. Zone and under this Zone). The possibility of finding large ammonites was restricted by the dimensions of the excavation (1.0 – 1.5 m width and until 1 m depth), hence can suppose a more substantial presence of such specimens.

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Captions of plates

Plate I

Fig. 1 – *Zetoceras pseudo-oenotrium* (KOVÁCS, 1942), *ex situ* in the area of *Arnioceras semicostatum* Taxon-range Zone, Sinemurian, Praşca Peak (Rarău Syncline, Eastern Carpathians).

Fig. 2 – *Zetoceras* cf. *oenotrium* (FUCINI, 1901), *in situ, Arnioceras semicostatum* T.-r. Zone, idem.

Fig. 3 – *Zetoceras zetes* (d'ORBIGNY, 1850), *in situ, Arnioceras semicostatum* T.-r. Zone, idem.

FIG. 4 – *Coroniceras (Paracoroniceras)* sp., *ex situ,* in the area of *Arnioceras semicostatum* T.-r. Zone, idem.

Fig. 5 – *Coroniceras (Coroniceras)* cf. *lyra* HYATT, 1867, *in situ, Arnioceras semicostatum* T.-r. Zone, idem.

Plate II

Fig. 1 – *Coroniceras (Paracoroniceras)* sp., (*cf. ? C. (P.) charlesi* (DONOVAN, 1955) *ex situ,* in the area of *Arnioceras semicostatum* T.-r. Zone Sinemurian, Praşca Peak (Rarău Syncline, Eastern Carpathians).

Fig. 2 – *Lytoceras* sp., *ex situ*.

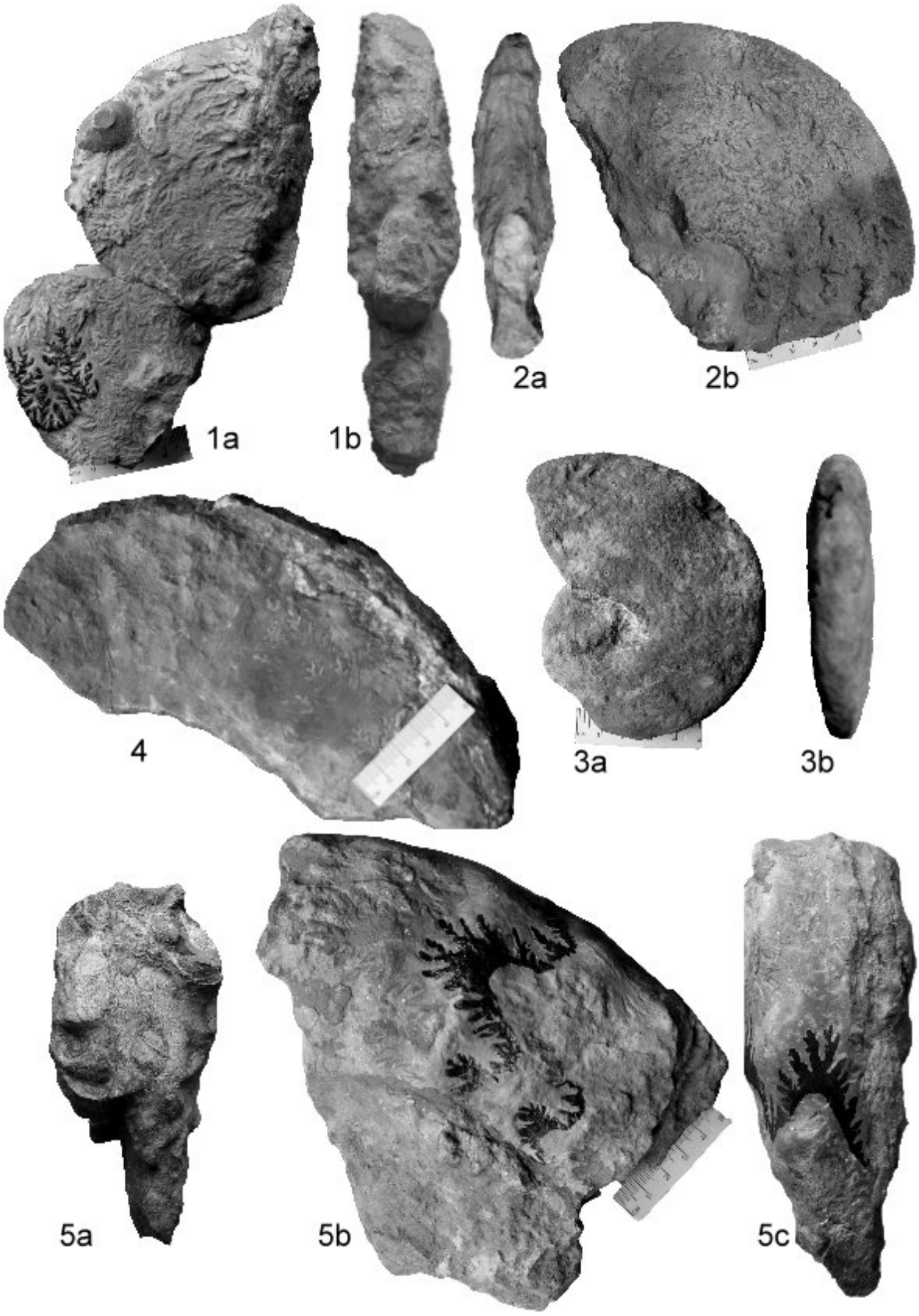
Fig. 3 – *Gleviceras* sp., in the area of *Echioceras raricostatum* T.-r. Zone, idem.

Fig. 4 – *Eoderocetacaee* family, *ex situ*.

Plate III

Fig. 1 – *Paracoroniceras* sp., exotic block, Sinemurian, Bodia Hill (Rarău Syncline Eastern Carpathians)

Fig. 2 – *Leioceras carpathicus* TURCULEȚ (2a from Turculeț, 1982; 2b from Paleontology-Stratigraphy collection) exotic blocks, Aalenian, right slope of Moldova river (between Sadova and Pojorâta).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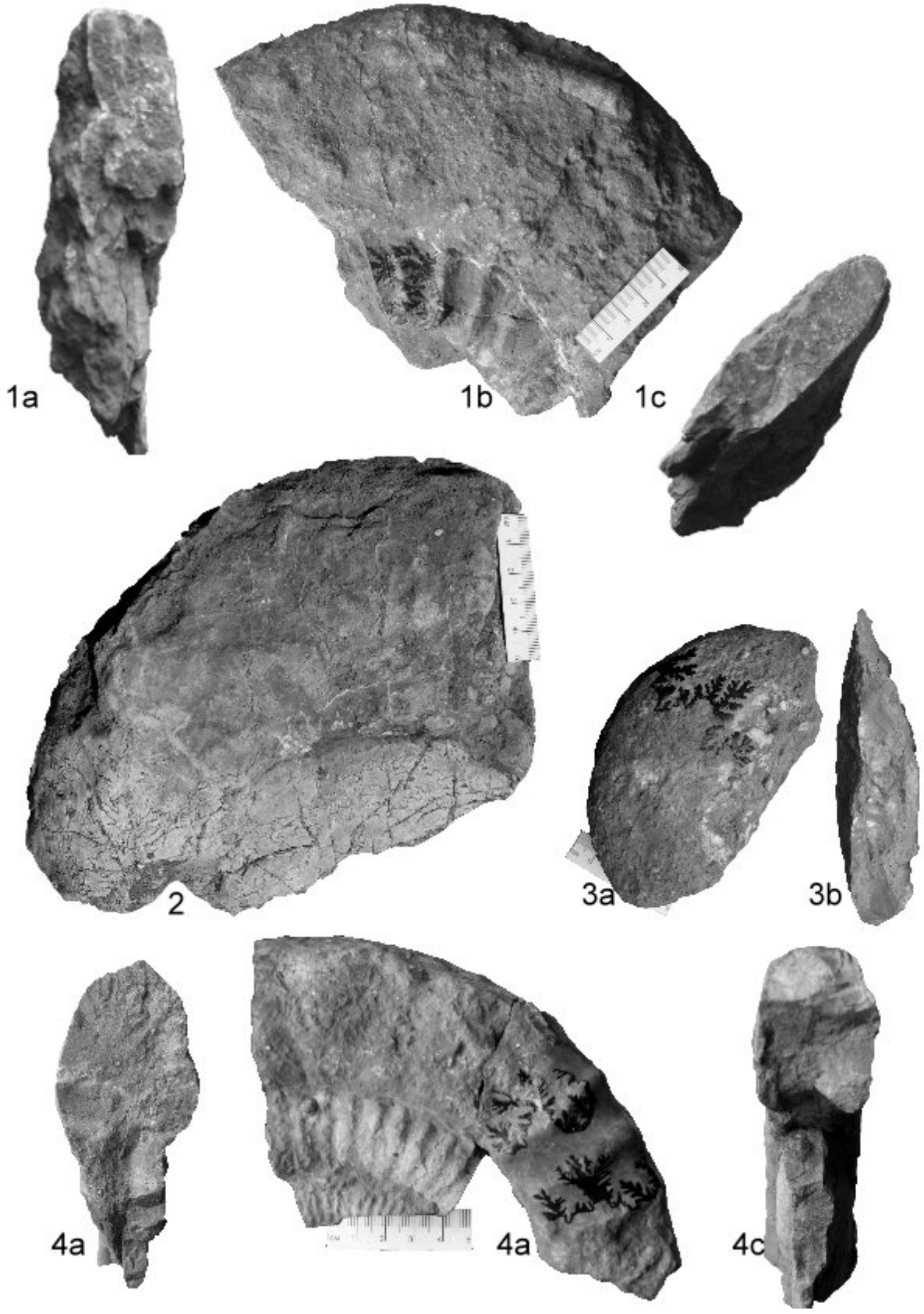
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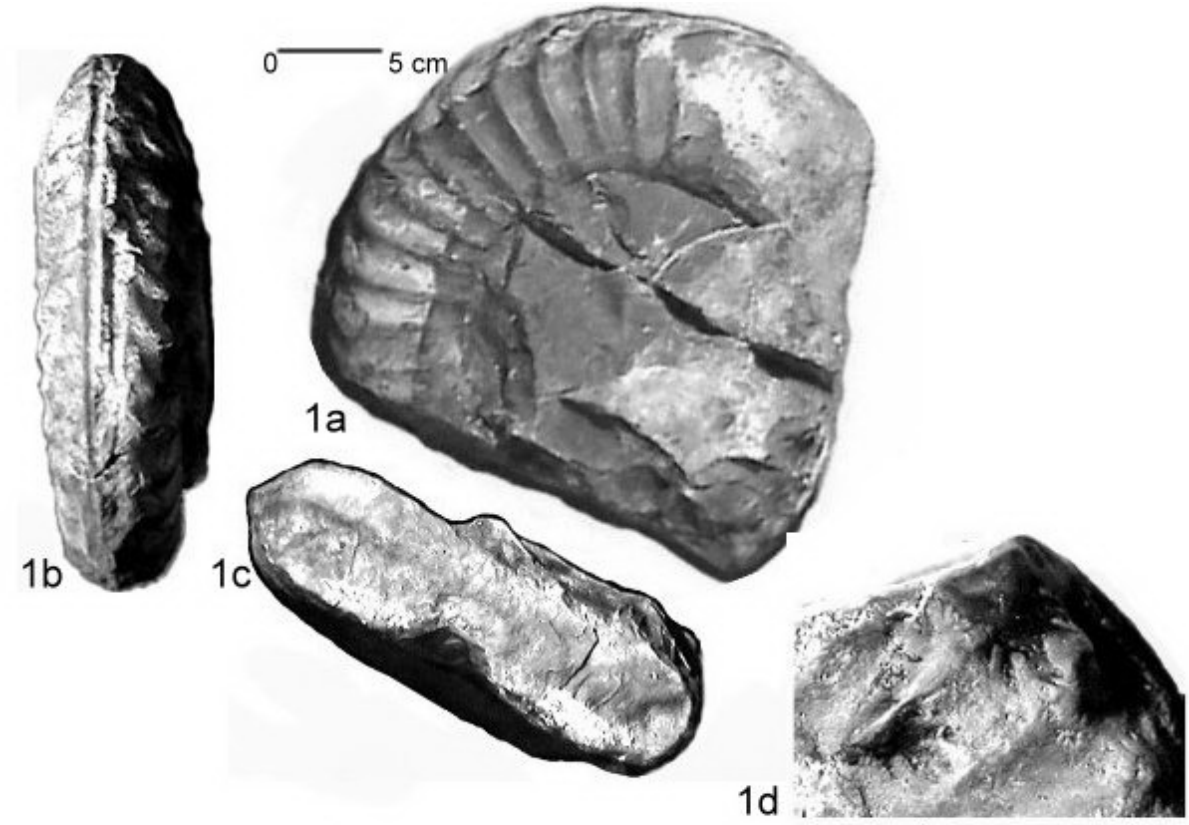
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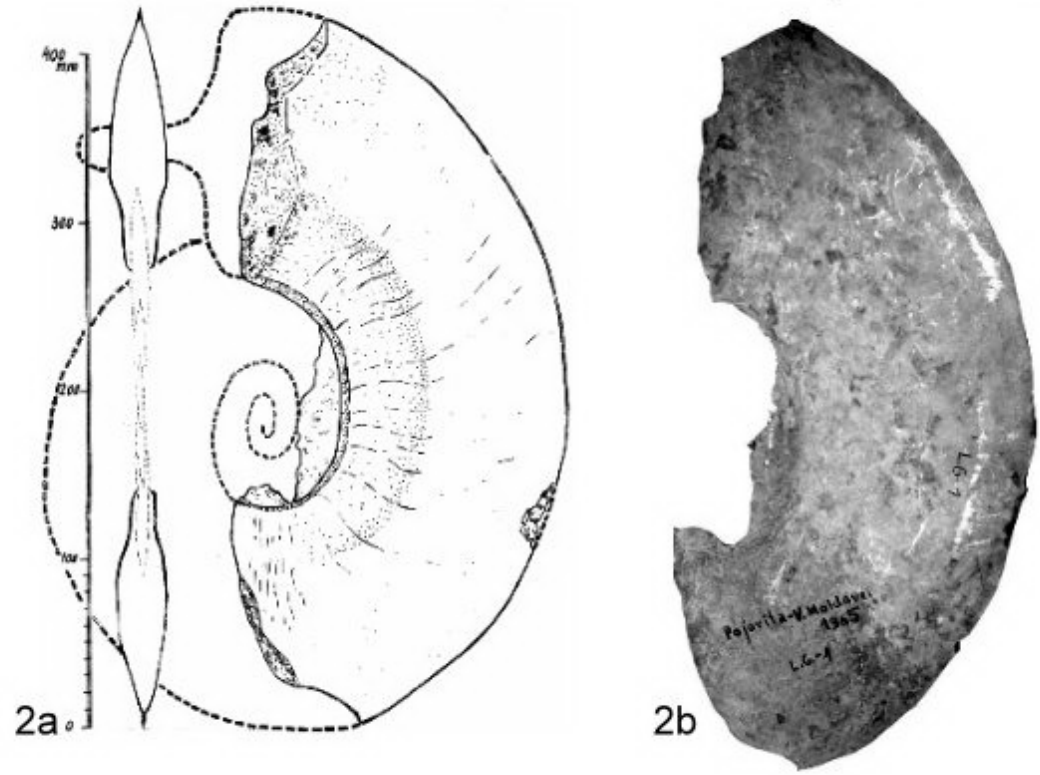
2a
2b