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Fauna and flora of the "Älterer Schlier"-marl of Uttendorf in Lower Austria (upper Egerian, Early Miocene)

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2 Text-Figures, 1 Table, 2 Plates

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Blatt 55 Ober-Grafendorf

„Älterer Schlier"
Egerian
planktic foraminifera
calcareous nannofossils
macroalgae

Contents

Fauna und Flora des „Älteren Schliers" von Uttendorf in Niederösterreich (oberes Egerium, frühes Miozän)

Zusammenfassung

Wegen der in ihnen vorkommenden Konservatlagerstätten ziehen die Sedimente des „Älteren Schliers" zunehmende Aufmerksamkeit auf sich. Wir analysierten Foraminiferen-, kalkige Nannofossil- und Tang- (Makroalgen) Assoziationen von Mergeln dieser informellen lithostratigrafischen Einheit aus Uttendorf in Niederösterreich. Basierend auf kalkigen Nannofossilien und planktischen Foraminiferen wurde das Alter der Sedimente als spätes Egerium eingestuft (miozäner Anteil des Egerium, Nannoplanktonzone NN1). Die planktische Foraminiferenassoziation deutet auf warm-gemäßigte Meeresoberflächentemperaturen hin. Sowohl kalkige Nannofossil- als auch benthische Foraminiferenassoziationen weisen auf nährstoffreiche Oberflächenwässer mit hoher Exportproduktion und daraus resultierendem Sauerstoffmangel im Bodenwasser hin. Unsere Ergebnisse bestätigen die weite Verbreitung von reduziertem Sauerstoffgehalt am Meeresboden der westlichen und zentralen Paratethys während des späten Egerium.

Abstract

Sediments of the "Älterer Schlier" attract increasing interest because of its Konservat-Lagerstätten. We analysed foraminifera, calcareous nannofossil, and macroalgae assemblages of marls of this informal lithostratigraphic unit from Uttendorf in Lower Austria. Based on calcareous nannofossils and planktic foraminifera, the sediments were deposited during the Miocene part of the Egerian Stage (nannoplankton zone NN1, late Egerian). The planktic foraminiferal assemblage indicates warm temperate sea surface temperatures. Calcareous nannofossil as well as benthic foraminifera assemblages point to nutrient rich surface waters with high export production and consequent oxygen deficiency at the sea floor. Our results confirm the widespread reduced oxygen content in Western to Central Paratethyan bottom waters during the late Egerian.

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Introduction

The so-called “Älterer Schlier” in Lower Austria consists of dark brownish coloured marls and clays. It is an informal lithostratigraphic unit and experienced rising interest because the unit accommodates well known Konservat-Lagerstätten and yielded spectacular vertebrate and invertebrate fossil assemblages (Gregorova et al., 2009; Grunert et al., 2010). Furthermore, within the scope of the lithostratigraphic formalization and paleoecological interpretations of coeval units in adjacent regions, e.g., the Ebelsberg Formation in Upper Austria (Rupp & Ćorić, 2012), the occurrence described here is of special importance. In particular the stratigraphic position and depositional environments compared to neighbouring occurrences attracts special attention.

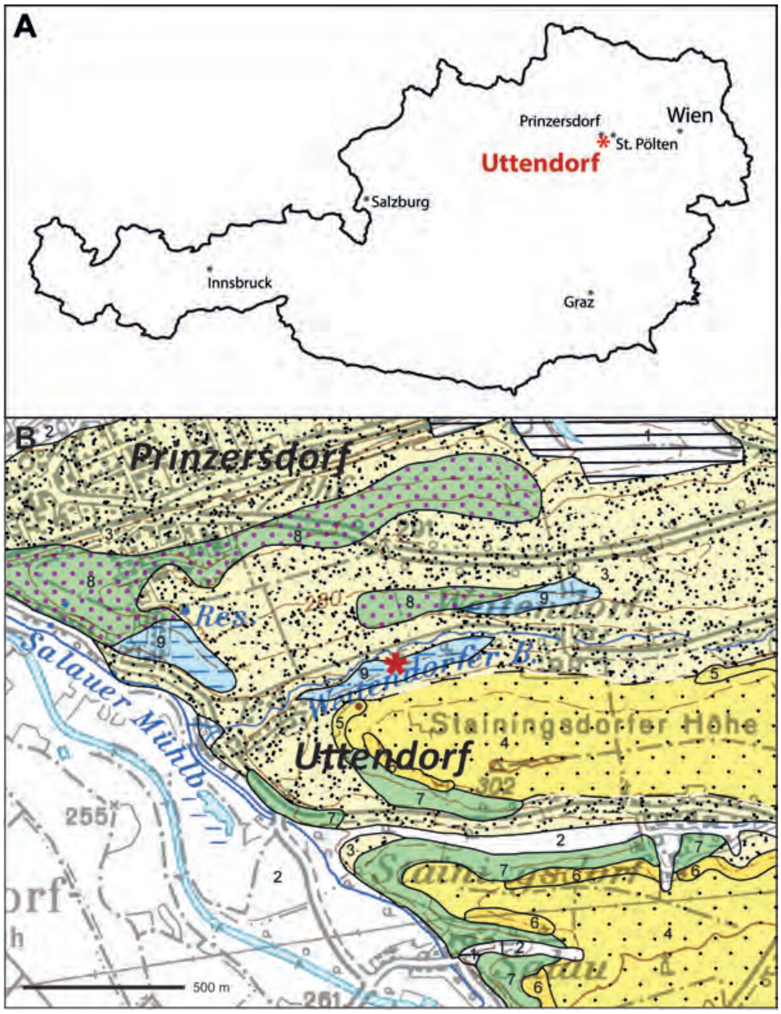
The sampled marl has been gained from a collapsed undercut bank of the Weitendorf stream ENE of Uttendorf (Text-Fig. 1). In this contribution, we document and analyse the major faunal and floral components of a representative sample. This includes planktic and benthic foraminifera, calcareous nannofossils, and macroalgae, which occur in high quantities in the sediments. Also very frequent are fish remains. According to the state of preservation of the sediment, we expect a high potential for occurrences of other fossil groups, in particular such with organic walls.

Methods

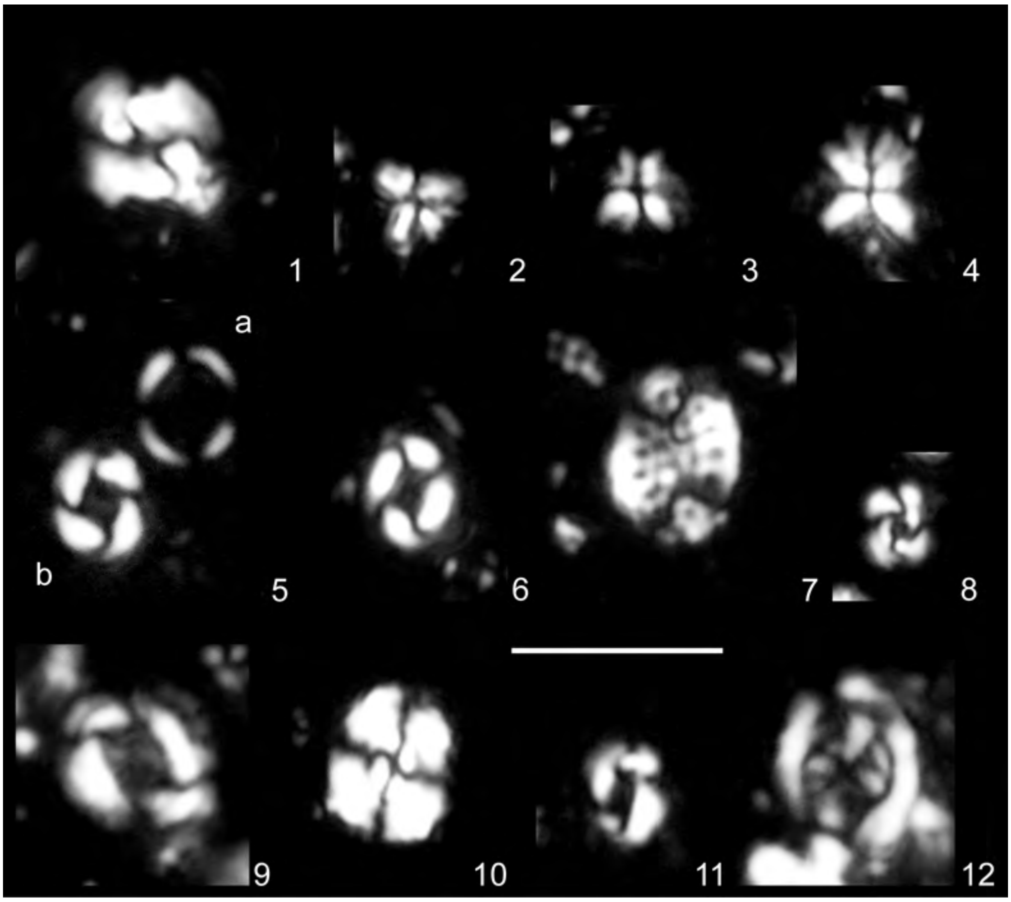
To collect and study smaller benthic and planktic foraminifera (Plate 1) of the sample investigated, 200 g of dry sediment were disintegrated with hydrogen peroxide and washed over a 0.063 mm sieve. The residue was dried and dry sieved into 0.063 to 0.125 and 0.125 to 1 mm fractions in order to prevent coverage by large tests during scanning under light microscope. The sample was split into manageable subsamples (aliquots) and completely picked for foraminifera. Foraminiferal specimens were identified (see Appendix) and counted, numbers for individual fractions were recombined according to the split (Tab. 1). In order to get an overview on the complete foraminiferal assemblage, we picked and identified additional rare representatives of benthic species.

For investigations on calcareous nannoplankton (Text-Fig. 2), smear slides were prepared using standard procedures described by Perch-Nielsen (1985). All samples were examined under light microscope with 1000 x magnification.

Well preserved fragments of macroalgae were selected for photographical documentation (Plate 2). No further preparation has been done before photography.



Text-Fig. 1.
A. Location of outcrop within Austria. B. Geological map of surrounding of sample location southeast of Prinzersdorf (from map sheet 55 Ober-Grafendorf, Schnabel et al., 2012). Explanation of lithologic units: 1 Antropogenic cover, 2 stream and river deposits, 3 solifluction and sheetflow deposits, 4 Loess and Loess loam covering gravel terraces, 5 younger gravel terraces (“Jüngere Deckenschotter”), 6 older gravel terraces (“Ältere Deckenschotter”), 7 “*Robulus*-marl” (lower Ottnangian), 8 Prinzersdorf Formation (lower Ottnangian), 9 “Älterer Schlier” (clay and marl, upper Egerian).



Text-Fig. 2.
Calcareous nannofossils:
1 *Reticulofenestra bisecta*. 2, 3 *Sphenolithus conicus*. 4 *Sphenolithus moriformis*. 5a *Coronocyclus nitescens*. 5b, 11 *Reticulofenestra pseudoumbilica*. 6 *Coccolithus pelagicus*. 7 *Pontosphaera multipora*. 8 *Reticulofenestra gelida*. 9 *Reticulofenestra lockeri*. 10 *Watznaueria barnesae*. 12 *Arkhangelskiella cymbiformis*.
Length of scale bar (for all nannofossils): 10 µm. 10, 12 reworked from Cretaceous rocks.

Species	**Fraction 0.125–1 mm split 1/64 no.**	**total**	**Fraction 0.063–0.125 mm split 1/2048 no.**	**total**	**both fractions**	**proportion (%)**	**planktic or benthic only (%)**
Planktic foraminifera							
Globigerina anguliofficinalis	17	1,088	31	63,488	64,576	12.3	15.8
Globigerina praebulloides	17	1,088	22	45,056	46,144	8.8	11.2
Globigerina ottnangiensis	12	768			768	0.1	0.2
Globigerina cf. *ottnangiensis* (collapsed)	147	9,408			9,408	1.8	2.3
Tenuitella cf. *munda*			46	94,208	94,208	18.0	23.0
Tenuitellinata angustiumbilicata			54	110,592	110,592	21.1	26.0
unclassified planktic foraminifera	418	26,752	28	57,344	84,096	16.0	20.5
total amount of planktic foraminifera					409,792	78.1	
Benthic foraminifera							
Angulogerina angulosa	1	64			64	0.0	0.1
Bolivina trunensis	11	704	2	4,096	4,800	0.9	4.2
Bolivina fastigia	1	64	2	4,096	4,160	0.8	3.6
Cibicidoides spp.			8	16,384	16,384	3.1	14.3
Eponides cf. *pusillus*			1	2,048	2,048	0.4	1.8
Fursenkoina spp.	96	6,144	33	67,584	73,728	14.1	64.1
Caucasina coprolithoides	1	64			64	0.0	0.1
Favolina hexagona	1	64			64	0.0	0.1
Globocassidulina spp.	2	128			128	0.0	0.1
?*Haplophragmoides* sp.	16	1,024	6	12,288	13,312	2.5	11.6
Uvigerina mantaensis	2	128			128	0.0	0.1
Uvigerina steyri	1	64			64	0.0	0.1
total amount of benthic foraminifera					114,944	21.9	

Tab. 1.
Quantitative analysis of planktic and benthic foraminifera found at Uttendorf.

We applied the taxonomic concepts published in standard literature on the region. This includes CICHA et al. (1998) for foraminifera, MARTINI (1971) for calcareous nannofossils (standard nannoplankton zonation), and KOVAR (1982) for macroalgae.

Results

Foraminifera

A large part of the found foraminiferal tests collapsed during diagenesis (Plate 1: Figs. 23, 24). Thus, only a classification on genus level was possible in many cases. This concerns mostly planktic foraminifera. Among benthic taxa, particularly the genus *Fursenkoina* is affected.

Within planktic foraminifera, *Globigerina* is the most frequent genus (29 %), followed by *Tenuitellinata* (27 %), and *Tenuitella* (23 %). These taxa are complemented by *Globoquadrina* and *Globoturborotalita*. About 20 % of the planktic foraminiferal assemblage could not be classified, because of its state of preservation (broken or collapsed). The proportion of planktic foraminifera among the total assemblage is 78 %.

The genus *Fursencoina* dominates the benthic assemblage (64 %). Also frequent are *Cibicidoides* (14 %), *Haplophragmoides* (12 %), and *Bolivina* (8 %). Additional benthic elements with higher numbers are *Angulogerina*, *Eponides*, *Caucasina*, *Favulina*, *Globocassidulina* and *Uvigerina*.

Calcareous nannofossils

The autochtonous calcareous nannofossil assemblage consists of the genera *Coccolithus*, *Coronocyclus*, *Cyclicargolithus*, *Umbilicosphaera*, *Pontosphaera*, *Reticulofenestra*, *Sphenolithus*, and *Zygrhablithus*. *Coccolithus* and *Reticulofenestra* show the highest diversity. In addition to the Lower Miocene assemblage, numerous reworked species of Cretaceous to lower Oligocene origin occur. The calcareous nannoflora is very rich and well preserved.

Macroalgae and fish remains

The found brown algae (Phaeophyceae) consists almost completely of *Cystoseirites altoaustriacus*. The species is well known from the late Oligocene of the Paratethys realm (KOVAR, 1982). Among the fish remains, we found single, mostly broken bones as well as fin rays, and rather large scales (Plate 2: Fig. 4a, b)

Interpretation and discussion

Biostratigraphy

The planktic foraminiferal assemblage indicates a late Egerian age if the concept of CICHA et al. (1998) is applied. *Globoquadrina langhiana* as well as *Globoturborotalita connecta* appear for the first time in the Paratethys during this interval, while *Globigerina officinalis* became extinct at the end of the Egerian. Five-chambered specimens classified as *Globigerina ottnangiensis* (FO base Eggenburgian according to CICHA et al., 1998) were also reported from Egerian deposits of Upper Austria (RUPP & ĆORIĆ, 2012).

The occurrences of *Sphenolithus conicus* and *Zygrhablithus bijugatus*, and the lack of *Helicosphaera recta* and *Discoaster druggii* allows the attribution to nannoplankton Zone NN1 (MARTINI, 1971). This zone can be correlated to the late Egerian (lower Miocene). The investigated sediments contain *Pontosphaera ebelsbergi*, originally described from the Miocene part of Egerian Ebelsberg Formation from Upper Austria (RUPP & ĆORIĆ, 2012). The association with *Cyclicargolithus floridanus, Pontosphaera latelliptica*, *P. multipora*, *Reticulofenestra gelida*, *R. bisecta*, *Reticulofenestra lockeri*, *Reticulofenestra minuta*, *R. pseudoumbilicus*, *Sphenolithus conicus*, *S. moriformis,* and *Umbilicosphaera rotula* confirms the stratigraphic classification.

Paleoecology

The planktic foraminiferal assemblage shows warm-water species (*G. anguliofficinalis*, 16 %), warm temperate species (*T. angustiumbilicata*, 26 %), as well as cool species (*T*. cf. *munda*, 23 %), according to the upper Oligocene and lower Miocene index groups of SPEZZAFERRI (1995). Thus, a warm temperate sea surface temperature during deposition is most probable.

The calcareous nannoplankton association is dominated by *Coccolithus pelagicus* and *Pontopshaera multipora* and points to a shallow marine environment rich in nutrients (e.g. ĆORIĆ & RÖGL, 2004; GEBHARDT et al., 2013). Reworking of Upper Cretaceous (*Arkhangelskiella cymbiformis, Broinsonia parca parca*, *Prediscosphaera cretacea*, *Cribrosphaerella ehrenbergii*) and Eocene/lower Oligocene specimens (*Coccolithus formosus, Reticulofenestra umbilicus*) is evident and indicates erosional processes in the hinterland.

The benthic foraminiferal assemblage is dominated by infaunal and detritivor *Fursenkiona* spp. (64 %). Other frequent taxa are small (< 0.125 mm) *Cibicidoides* spp. (14 %), arenaceous ?*Haplophragmoides* sp. (12 %), and *Bolivina* spp. (8 %). The strong dominance of the flattened, biserial morphogroup (*Fursenkiona, Bolivina*) and arenaceous forms, together with small *Cibicidoides* and the lack of macrobenthos gives a clear evidence for oxygen deficiency, most likely caused by excessive food supply (e.g. BERNHARD, 1986, BERNHARD & SEN GUPTA, 1999, MURRAY, 1991, or GEBHARDT et al., 2013, with further references therein). Also the only occurrence of small sized epifaunal *Cibicidoides*-specimens and the low diversity indicates such conditions for the bottom waters. We suggest increased primary productivity as the main cause for such conditions. VAN DER ZWAAN et al. (1990, 1999) and GOODAY (2003) demonstrated the strong dependence of benthic foraminifera abundances on food availability.

The original habitat of the occurring attached species (*Lobatula, Biapertorbis*) was probably the macroalgae. They become transported into the final depositional area by the floating *Cystoseyrites*-thallus fragments. The dysoxic bottom waters distinctively enhanced the preservation of the macroalgae and the fish remains.

Due to the lack of further shallow water indicators and characteristic sediment structures within sandy layers, as well as the absence of other deep water indicators, we suggest a depositional depth below the wave base but above the bathyal zone (i.e. between c. 50 and 200 m paleo-water depth).

Conclusions

The sampled marls yielded abundant micro- and macrofossils: foraminifera, calcareous nannofossils, macroalgae and fish remains. We analysed the calcareous nannofossil, foraminifera and macroalgae assemblages in detail, the foraminiferal assemblage also quantitatively.

Based on calcareous nannofossils and planktic foraminifera, the sediments were deposited during the Miocene part of the Egerian Stage (nannoplankton zone NN1, late Egerian).

The planktic foraminiferal assemblage indicates warm temperate sea surface temperatures. Calcareous nannofossil as well as benthic foraminifera assemblages point to nutrient rich surface waters with increased primary productivity (high export production) and consequent oxygen deficiency at the sea floor. Our results confirm the widespread reduced oxygen content in Western to Central Paratethyan bottom waters during the late Egerian.

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Plate 1

Planktic and benthic foraminifera:

Figs. 1, 2: *Globigerina anguliofficinalis*.
Fig. 3: *Globigerina* cf. *officinalis*.
Fig. 4: *Globigerina ottnangiensis.*
Fig. 5: *Globigerina praebulloides.*
Fig. 6: *Globoquadrina* cf. *langhiana.*
Fig. 7: *Globoturborotalita connecta.*
Figs. 8, 9: *Tenuitellinata angustiumbilicata.*
Fig. 10: *Tenuitella* cf. *munda*.
Fig. 11: *Angulogerina angulosa.*
Fig. 12: *Biapertorbis* cf. *biaperturatus.*
Fig. 13: *Bolivina aenariensiformis.*
Fig. 14: *Bolivina fastigia.*
Fig. 15: *Bolivina trunensis.*
Fig. 16: *Caucasina coprolithoides.*
Fig. 17: *Caucasina elongata.*
Fig. 18: *Cibicidoides* cf. *tenellus.*
Fig. 19: *Cibicidoides* cf. *praelopjanicus.*
Fig. 20: *Eponides* cf. *pusillus.*
Fig. 21: *Escornebovina orthorapha.*
Fig. 22: *Favulina hexagona.*
Fig. 23: *Fursencoina* cf. *acuta.*
Fig. 24: *Fursencoina* cf. *mustoni.*
Fig. 25: *Globocassidulina oblonga.*
Fig. 26: ?*Haplophragmoides* sp.
Fig. 27: *Lagena semistriata.*
Fig. 28: *Lenticulina* cf. *umbonata.*
Fig. 29: *Semivulvulina deperdita*.
Fig. 30: *Lobatula lobatula.*
Fig. 31: *Reophax* sp.
Fig. 32: *Uvigerina mantaensis.*
Fig. 33: *Uvigerina* cf. *semiornata.*
Fig. 34: *Uvigerina* cf. *steyri.*
Fig. 35: *Valvulineria complanata*.

Length of scale bars: 0.1 mm.

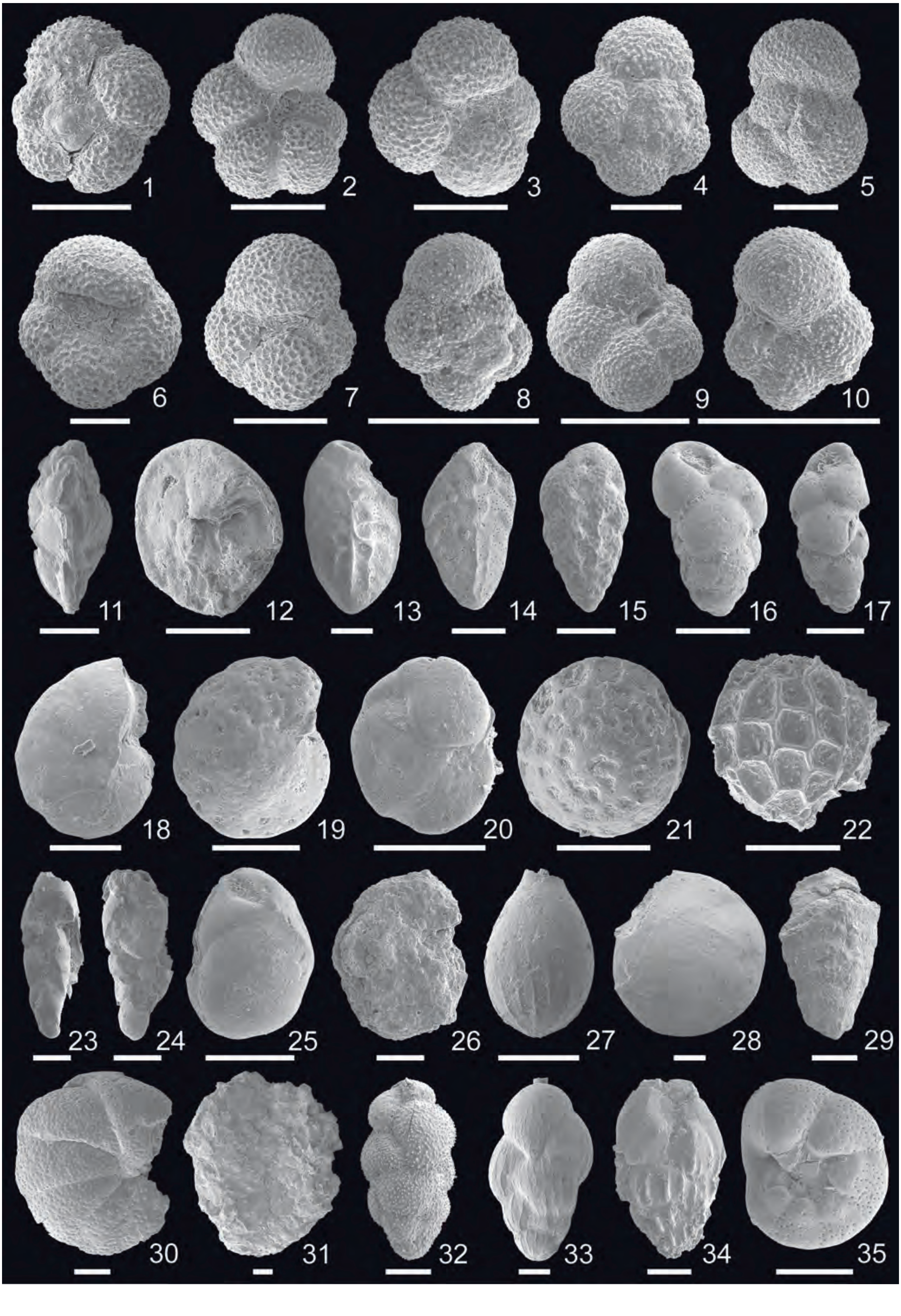
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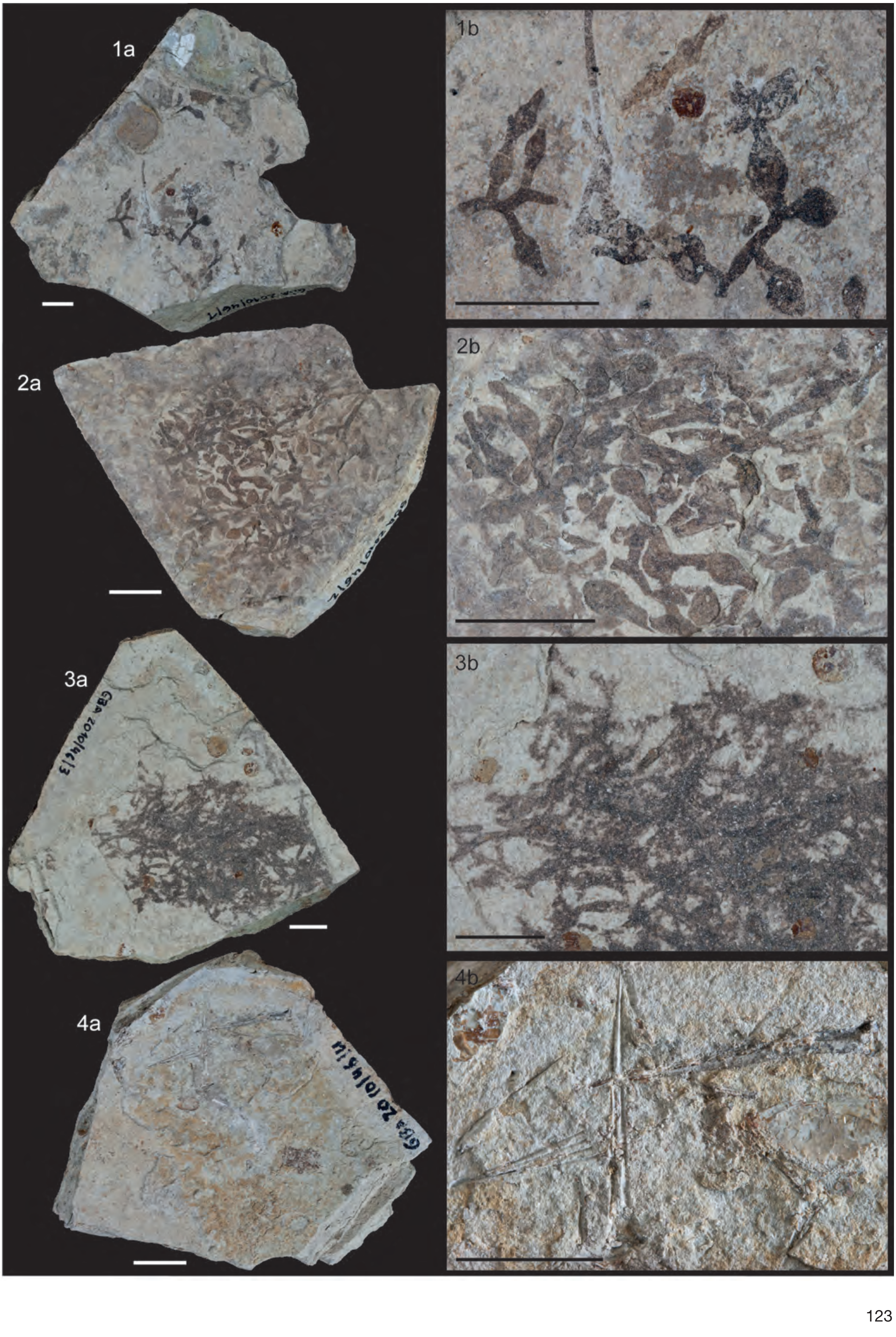
Plate 2

Algal floral elements.

Figs. 1–4: Thallus fragments of *Cystoseyrites altoaustriacus*. Left side (a) overviews, right side (b) details. 1, 3, 4 with fish scales, 4 with fin rays and bones of fish.

Length of scale bars: 1 cm.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Appendix

List of identified species

Planktic foraminifera (Plate 1, Figs. 1–10)

Globigerina anguliofficinalis Blow
Globigerina cf. *officinalis* Subbotina
Globigerina ottnangiensis Rögl
Globigerina praebulloides Blow
Globoquadrina cf. *langhiana* Cita & Gelati
Globoturborotalita connecta (Jenkins)
Tenuitella cf. *munda* (Jenkins)
Tenuitellinata angustiumbilicata (Bolli)

Benthic foraminifera (Plate 1, Figs. 11–35)

Angulogerina angulosa (Williamson)
Biapertorbis cf. *biaperturatus* Pokorny
Bolivina aenariensiformis Myatlyuk
Bolivina cf. *dilatata* Reuss
Bolivina fastigia Cushman
Bolivina trunensis Hofmann
Caucasina coprolithoides (Andreae)
Caucasina elongata (d'Orbigny)
Cibicidoides cf. *tenellus* (Reuss)
Cibicidoides cf. *praelopjanicus* Myatlyuk
Cibicidoides sp.
Elphidium sp.
Eponides cf. *pusillus* Parr
Escornebovina orthorapha (Egger)
Favulina hexagona (Williamson)
Fursencoina cf. *acuta* (d'Orbigny)
Fursencoina cf. *mustoni* (Andreae)
Globocassidulina oblonga (Reuss)
Globocassidulina sp.
?*Haplophragmoides* sp.
Islandiella sp.
Lagena semistriata Williamson
Lenticulina cf. *umbonata* (Reuss)
Lenticulina sp.
Lobatula lobatula (Walker & Jacob)
Reophax sp.
Semivulvulina deperdita (d'Orbigny)
Uvigerina mantaensis Cushman & Edwards
Uvigerina cf. *semiornata* d'Orbigny
Uvigerina cf. *steyri* Papp
Valvulineria complanata (d'Orbigny)

Calcareous nannofossils (Text-Fig. 2)

Coccolithus cachaoi Bown, 2005
Coccolithus pelagicus (Wallich, 1877) Schiller, 1930
Coccolithus sp.
Coronocyclus nitescens (Kamptner, 1963) Bramlette & Wilcoxon, 1967
Cyclicargolithus floridanus (Roth & Hay, in Hay et al., 1967) Bukry, 1971
Umbilicosphaera rotula (Kamptner, 1956) Varol, 1982
Pontosphaera latelliptica (Baldi-Beke & Baldi, 1974) Perch-Nielsen 1984
Pontosphaera multipora (Kamptner, 1948) Roth, 1970
Pontosphaera ebelsbergi Coric, 2013
Reticulofenestra gelida (Geitzenauer, 1972) Backman, 1978
Reticulofenestra bisecta (Hay, Mohler & Wade, 1966) Roth, 1970
Reticulofenestra lockeri Müller, 1970
Reticulofenestra minuta Roth, 1970
Reticulofenestra pseudoumbilica (Gartner, 1967) Gartner, 1969
Reticulofenestra sp.
Sphenolithus conicus Bukry, 1971
Sphenolithus moriformis (Bronnimann & Stradner, 1960) Bramlette & Wilcoxon, 1967
Zygrhablithus bijugatus (Deflandre in Deflandre & Fert, 1954) Deflandre, 1959

Reworked from Eocene/Lower Oligocene rocks:
Chiasmolithus sp.
Coccolithus formosus (Kamptner, 1963) Wise 1973
Reticulofenestra umbilicus (Levin, 1965) Martini & Ritzkowski, 1968

Reworked from Cretaceous rocks:
Arkhangelskiella cymbiformis Vekshina 1959
Broinsonia parca parca (Stradner, 1963) Bukry, 1969
Cribrosphaerella ehrenbergii (Arkhangelsky, 1912) Deflandre in Piveteau, 1952
Eiffellithus gorkae Reinhardt, 1965
Eiffellithus turriseiffelii (Deflandre in Deflandre & Fert, 1954) Reinhardt, 1965
Micula decussata Vekshina, 1959
Prediscosphaera cretacea (Arkhangelsky, 1912) Gartner, 1968
Watznaueria barnesae (Black in Black & Barnes, 1959) Perch-Nielsen, 1968

Macroalgae (Plate 2)

Cystoseyrites altoaustriacus Kovar, 1982

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