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PROCEEDINGS

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New biostratigraphic ammonite data from the Jurassic/Cretaceous boundary at Nutzhof (Gresten Klippenbelt, Lower Austria)

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(With 3 plates and 4 figures)

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Abstract

Upper Jurassic to Lower Cretaceous ammonites were collected at the Nutzhof locality in the eastern part of the Gresten Klippenbelt in Lower Austria. The cephalopod fauna from the Blassenstein Formation, correlated with micro- and nannofossil data from the marly unit and the limestone unit, indicates Early Tithonian to Middle Berriasian age (*Hybonoticeras hybonotum* Zone up to the *Subthurmannia occitanica* Zone). According to the correlation of the fossil and magnetostratigraphic data, the entire succession of the Nutzhof section embraces a duration of approx. 7 million years (approx. 150–143 Ma). The deposition of the limestones, marly limestones and marls in this interval occurred during depositionally (e.g. tectonics) unstable conditions.

The ammonite fauna comprises 6 different genera, each apparently represented by a single species. The occurrence at the Nutzhof section is dominated by ammonites of the perisphinctid-type. Ammonitina are the most frequent component (60 %; *Subplanites* and *Haploceras*), followed by the Phylloceratina (25 %; *Ptychophylloceras* and *Phylloceras*), and the Lytoceratina (15 %; represented by *Lytoceras* and *Leptotetragonites*). The ammonite fauna consists solely of Mediterranean elements.

Keywords: Ammonites, Jurassic/Cretaceous boundary, Gresten Klippenbelt, Lower Austria

Zusammenfassung

Ober-Jurassische und Unter-Kretazische Ammoniten der Lokalität Nutzhof im östlichen Teil der Grestener Klippenzone Niederösterreichs wurden untersucht. Die Cephalopoden Fauna der Blassenstein Formation zeigt unteres Tithonium bis mittleres Berriasium an (*Hybonoticeras hybonotum*-Zone bis *Subthurmannia occitanica*-Zone). Der Korrelation von Fossilien und magnetostratigraphischen Daten zufolge umfasst das gesamte Profil Nutzhof eine Dauer von an die 7 Millionen Jahre (ca. 150–143 Mio. J.). Die Kalke, mergeligen Kalke und Mergel dieses Abschnitts lagerten sich während instabiler (tektonisch) Ablagerungsbedingungen ab. Die Ammoniten Fauna zeigt 6 unterschiedliche Gattungen, von welchen jede durch nur eine Art vertreten ist. Das Vorkommen am Nutzhof wird durch Ammoniten vom Typ *Perisphinctidae* dominiert. Die Ammonitina stellen das häufigste Faunenelement dar (60 %; *Subplanites* und *Haploceras*), gefolgt von

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der Gruppe der Phylloceratina (25 %; *Ptychophylloceras und Phylloceras*) und den Lytoceratina (15 %; *Lytoceras* und *Leptotetragonites*). Die Ammoniten Fauna setzt sich ausschließlich aus mediterranen Elementen zusammen.

Schlüsselworte: Ammoniten, Jura/Kreide-Grenze, Grestener Klippenzone, Niederösterreich

1. Introduction

Jurassic and Lower Cretaceous pelagic sediments are well known to form a major element of the northernmost tectonic units of the Gresten Klippenbelt. In this Klippenbelt, Tithonian to Berriasian cephalopod-bearing deposits are recorded in 2 different facies, the Stollberger Schichten (KÜPPER 1962; GOTTSCHLING 1965) and the Blassenstein Formation (KÜHN 1962; DECKER 1990; DECKER & RÖGL 1988; PILLER et al. 2004). Upper Jurassic (Tithonian) sediments of the lower part of the Blassenstein Formation comprise marls, marly limestones and limestones (intercalated), whereas the upper part of the Blassenstein Formation at Nutzhof (Tithonian to Valanginian) is composed of very pure limestones (up to 97 % $CaCo_3$). The stratigraphy of the Lower Cretaceous sediments around the investigated area is mainly based on microfossils. The first study of the lithology and stratigraphy of this area was provided by CŽJŽEK (1852), followed a century later by KÜPPER (1962). The presented cephalopod fauna was collected in limestones and marly sediments of the Blassenstein Formation of the Gresten Klippenbelt.

Biostratigraphic data on the Stollberger Schichten of the Gresten Klippenbelt (Lower Austria) are remarkably scarce (CŽJŽEK 1852; KÜPPER 1962). This reflects the rare occurrence of identifiable ammonoid fauna as well as the absence or bad preservation of relevant microfossils. The discussed lithological (marls versus limestones) and biostratigraphic (Jurassic versus Cretaceous) boundary, however, is extraordinarily important for reconstructing pieninic geodynamics. They mark the initial siliciclastic input into the basin, reflecting the phase of the Penninic Ocean opening. The newly discovered outcrop at Nutzhof (fig. 1) in the heart of Lower Austria now fills the above gap. That section revealed, for the first time, the critical interval in an environment comprising extraordinarily rich accumulations of radiolaria, calpionellids, saccocomids, nannofossils and, in parts of the log, ammonites.

1.1 The history of the opening Penninic Ocean

The Penninic Ocean was initiated in the Late Triassic by rifting and disjunction of the Austroalpine microcontinent from the southern European Plate margin (SCOTESE 2001; STAMPFLI & MOSAR 1999). It was the eastern prolongation of the North Atlantic Rift-System, which effected the final disintegration of the Permotriassic Pangea Supercontinent (e.g. FAUPL 2003). The formation of the oceanic crust and the sea floor spreading lasted from the Middle Jurassic to the Early Cretaceous, terminating with the introduction of its southward-directed subduction beneath the northern Austroalpine plate margin (FAUPL & WAGREICH 2000; MANDIC & LUKENEDER). This tectonic mega-event is reflected by the lithological change in the middle part at the Nutzhof section. An increasing deepening, detected by the formation of different sediments (e.g. allodapic limestones and microturbidites), of the succession at Nutzhof marks the beginning of the opening of the Penninic Ocean. The pelagic carbonate sedimentation, which already started in the Late Jurassic, therefore changes within several meters of the section from a siliciclastic into pure limestone-dominated sedimentation. The history of the Penninic Ocean persisted from the Upper Jurassic through almost the whole Lower Cretaceous.

1.2. Depositional and tectonic setting

The studied section at Nutzhof includes the distal slope succession of the Gresten Klippenbelt, representing an independent and scarcely known part of the southern Rhenodanubian Flysch system. The Gresten Klippenbelt is tectonically intercalated within the

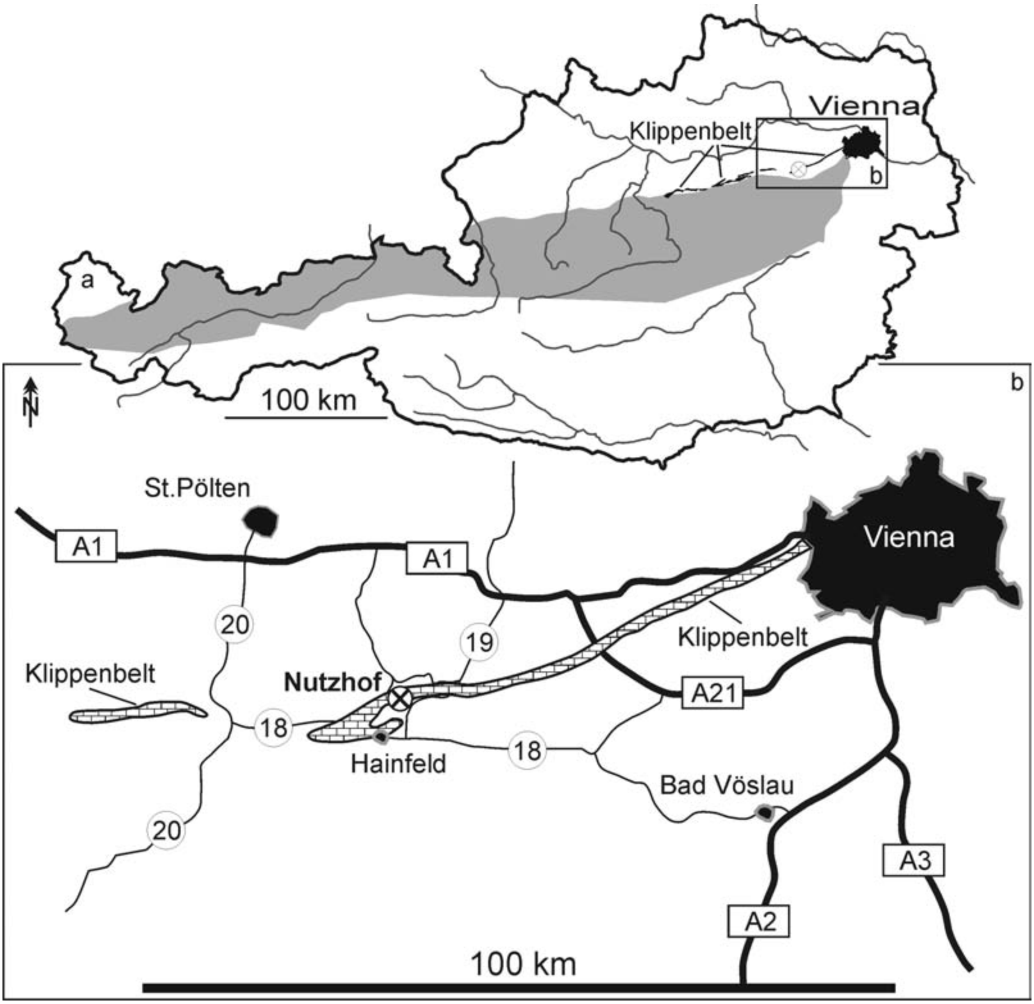

Fig. 1a: Locality map of Austria with indicated position of the Gresten Klippenbelt in Lower Austria. 1b: Detailed map of the area around Nutzhof showing the outcrop of Upper Jurassic – Lower Cretaceous sediments from the Gresten Klippenbelt (brick-structure).

latter zone as a thin, long, east-west striking marly and calcareous succession. The Upper Jurassic to Lower Cretaceous pelagic sediments of the Gresten Klippenbelt at Nutzhof represent a major sedimentation cycle. The significant depositional change from the siliciclastic to the carbonate depositional system is reflected in the boundary between the lower marly part and the upper calcareous part. Accordingly, the older (Tithonian) marly part features typically dark, laminated pelagic marls and marly limestones with intercalated limestone beds whose formation was triggered by erosion and intensive redeposition (e.g. allodapic limestones and microturbidites). This is comparable to the formation of the younger (Aptian) siliciclastic and marly Tannheim Formation (WAGREICH 2003). The younger part (limestones), on the other hand, represents the phase of autochthonous pelagic sedimentation with the light-colored, chert- and aptychi-bearing nannoconid limestones. The macro-invertebrate fauna of the Berriasian limestone succession is very sparse, comprising rare ammonites, aptychi, belemnites and brachiopods. The macro-invertebrate fauna of the Tithonian marl-limestone succession is rich in saccocomids accompanied by rare bivalves (inoceramids) and, in parts, abundant ammonites. The microfauna is in contrast abundant, with dominating calpionellids and radiolarians in the limestone succession and saccocomid blooms within the marl-limestone succession.

2. Geographical setting

The outcrop is situated in the Gresten Klippenbelt in Lower Austria. The exact position is about 20 km south of Böheimkirchen and 5 km north of Hainfeld (600 m, ÖK 1:50000, sheet 56 St. Pölten; fig. 1a). The outcrop is located in an abandoned quarry in the southeastern-most part of the northeast-southwest Gresten Klippenbelt, running between the Kasberg (785 m) to the east and the vicinity of the Nutzhof (550 m) to the west. The surrounding area is called Kleindurlas and the locality itself Nutzhof, nearby the farming house Nutzhof.

The dark and light grey succession, comprising the ammonite-bearing beds, is located on the northern side of the Kasberg ridge (approx. 785-500 m). The ammonite-occurrence is exposed on the left side (eastern) of the quarry. The exact position of the ammonite-occurrence as determined by GPS (global positioning system) is N 48°04’49’’ and E 15°47’36’’ (fig. 1).

3. Material, preservation and methods

During the course of this study, 46 ammonite specimens (NHMW 2008z0264/0001-0021) and 238 lamellaptychi were examined. Four brachiopods and 3 inoceramids as well as a single belemnite specimen were collected. Ammonites are preserved as steinkerns and most are moderately well preserved. No shell is present. The phragmocones are mostly flattened, whereas the body chambers are better preserved because of early sediment infilling. The fragmentation is due to preburial-transport, sediment compaction and considerable tectonic deformation, which influences the precise determination of most cephalopods with chambered hard-parts (e.g. ammonites and belemnites).

Calcium carbonate contents ($CaCO_3$) were determined using the carbonate bomb technique. Total carbon content was determined using a LECO WR-12 analyser. Total organic carbon (TOC) contents were calculated as the difference between total carbon and carbonate carbon, assuming that all carbonate is pure calcite. All the chemical analyses were carried out in the laboratories of the Department of Forest Ecology at the University of Vienna.

4. Geological setting and biostratigraphy

Setting. The Gresten Klippenbelt is in this area a small band of Upper Jurassic to Lower Cretaceous sediments from 200-500 m width. It is surrounded by thick sediments of the Rhenodanubian Flysch Zone. Tectonically, the outcrop is situated only 5 km north of the main border of the Rhenodanubian Flysch Zone to the more southern Northern Calcareous Alps. The section at Nutzhof contains 18 m of inverse, cm to dm beds showing the Jurassic-Cretaceous boundary at meter 7 (Nu 7.0).

The succession at Nutzhof was deposited in an unstable slope setting to the north of the Penninic Ocean characterized by thick stratigraphic units that reflect transgressive histories punctuated by tectonic events (shown by the deposition of allodapic limestones).

The entire section at Nutzhof is inversely bedded, and the beds dip 45-60° to the southeast. At this outcrop the lower part comprises a series called Blassenstein Formation with dark marls and intercalated limestone beds; the upper part consist solely of limestones with sometimes cherty areas (Nu 5.0-7.0).

Lithology. The Nutzhof section apparently consists of two different parts (fig. 2). The lower part (Tithonian, 18.0-10.0 m) with dark-grey marls with rhythmically intercalated

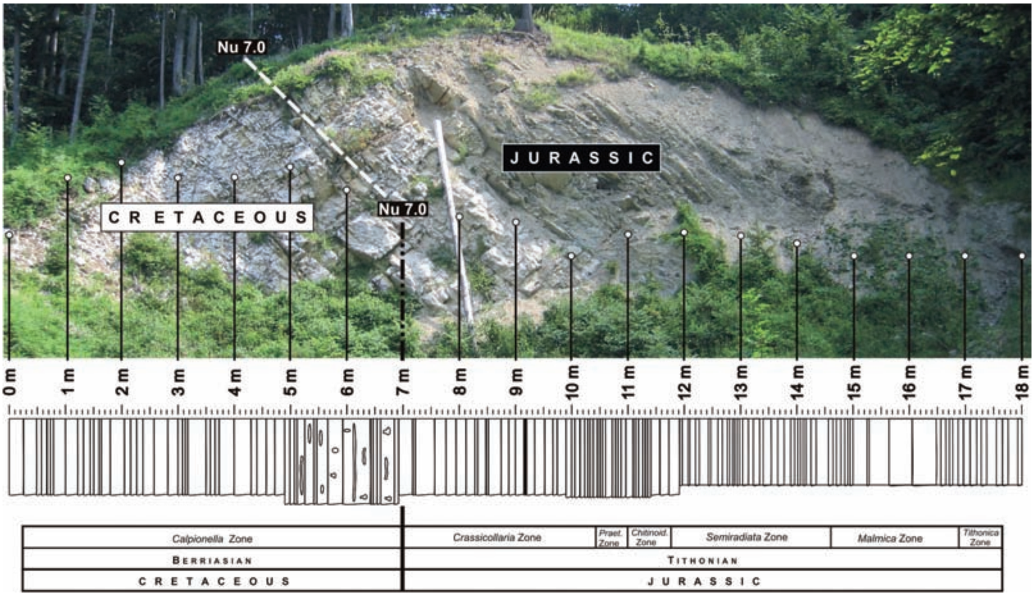

Fig. 2: Exposure of the investigated detailed log with indicated position of the outcrop at the Nutzhof section (Gresten Klippenbelt) and Jurassic-Cretaceous boundary, located at meter 7.0.

limestone beds, and the upper part (Berriasian, 10.0-0.0 m) with light-grey limestones. The strong lithological change at Nu 10.0 does not coincide with the Jurassic/Cretaceous boundary at bed Nu. 7.0. Sediments occur as wacke-, pack- or mudstones.

The $CaCO_3$ (calcium carbonate contents, equivalents calculated from total inorganic carbon) vary in the lower and upper part of the log. The lower part shows variations from 89.03 % (Nu 12.0) to 40.72 % (Nu 13.4), whereas the more constant upper part displays values ranging from 86.16 (Nu. 9.6) up to the maximum log value of 97.4 % (Nu 3.6).

The total sulphur content is positively correlated to the $CaCO_3$ values. The maximum sulphur amount (0.59 %) in the lower part corresponds to bed Nu 12.0 and the minimum value in this part, as for $CaCO_{3,}$ is at Nu 13.4 with 0.30 %. In the upper part the maximum value is at bed Nu 9.0 (0.58 %) and the minimum (0.5 %) corresponds to bed Nu 0.0.

The weight % TOC values (total organic carbon) show no positive correlation, either to S or to $CaCO_3$. TOC values oscillate throughout the log. They vary from 0.91 % (Nu 11.2) to 0.001 % (numerous beds) in the lower part and from 1.07 % (Nu 3.4) to 0.001 % (numerous beds).

Fauna. The invertebrate fauna consists of ammonites, aptychi (*Lamellaptychus*), rhyncholites, belemnites (*Hibolithes* gr. *semisculcatus*), serpulids, echinoderms (*Phyllocrinus*), bivalves (*Inoceramus*), brachiopods (*Triangope*), ophiurids, crinoids (*Saccocoma*), benthic and planktonic foraminifera and radiolarians (fig. 3; see also REHAKOVA et al. 2009; this volume). The only benthic macrofossils observed in the ammonite beds are bivalves and brachiopods. The rare but generally well-preserved cephalopods are dominated by members of the Perisphinctidae. The fairly fossiliferous part of the section is at Nu 14.0-Nu 18.0 m.

Biostratigraphy. According to microfossil (calcareous dinoflagellates, calpionellids) and palaeomagnetic data (more details in PRUNER et al. 2009; this volume), the association indicates that the cephalopod-bearing beds of the Nutzhof section belong to the *Carpistomiosphaera tithonica*-Zone of the Early Tithonian up to the *Calpionella* Zone of the Middle Berriasian (figs 2 & 3). This interval corresponds to the ammonite zones from the Early Tithonian *Hybonoticeras hybonotum*-Zone up to the Middle Berriasian *Subthurmannia occitanica*-Zone.

The biostratigraphically indicative cephalopods are: *Subplanites fasciculatiformis* sp. nov., *Ptychophylloceras ptychoicumm*, *Leptotetragonites honnoratianus*, *Haploceras elimatum*, *Hibolithes* (gr.) *semisulcatus* and some lamellaptychi.

Although zonal index ammonites are missing, the typical ammonite association, in correlation with the micro- and nannofossil data, allows a precise evaluation of the age. The stratigraphic investigation of the micro- and nannofauna revealed that the Nutzhof section comprises sedimentary sequence of Early Tithonian to Middle Berriasian age. Microfossils from the *Tithonica*-Zone up to the *Calpionella*-Zone were detected. The nannofossil zonation shows the *Conusphaera mexicana mexicana* Zone up to the *Nannoconus steinmannii steinmannii* Zone (for more details see REHAKOVA et al. 2009; this volume).

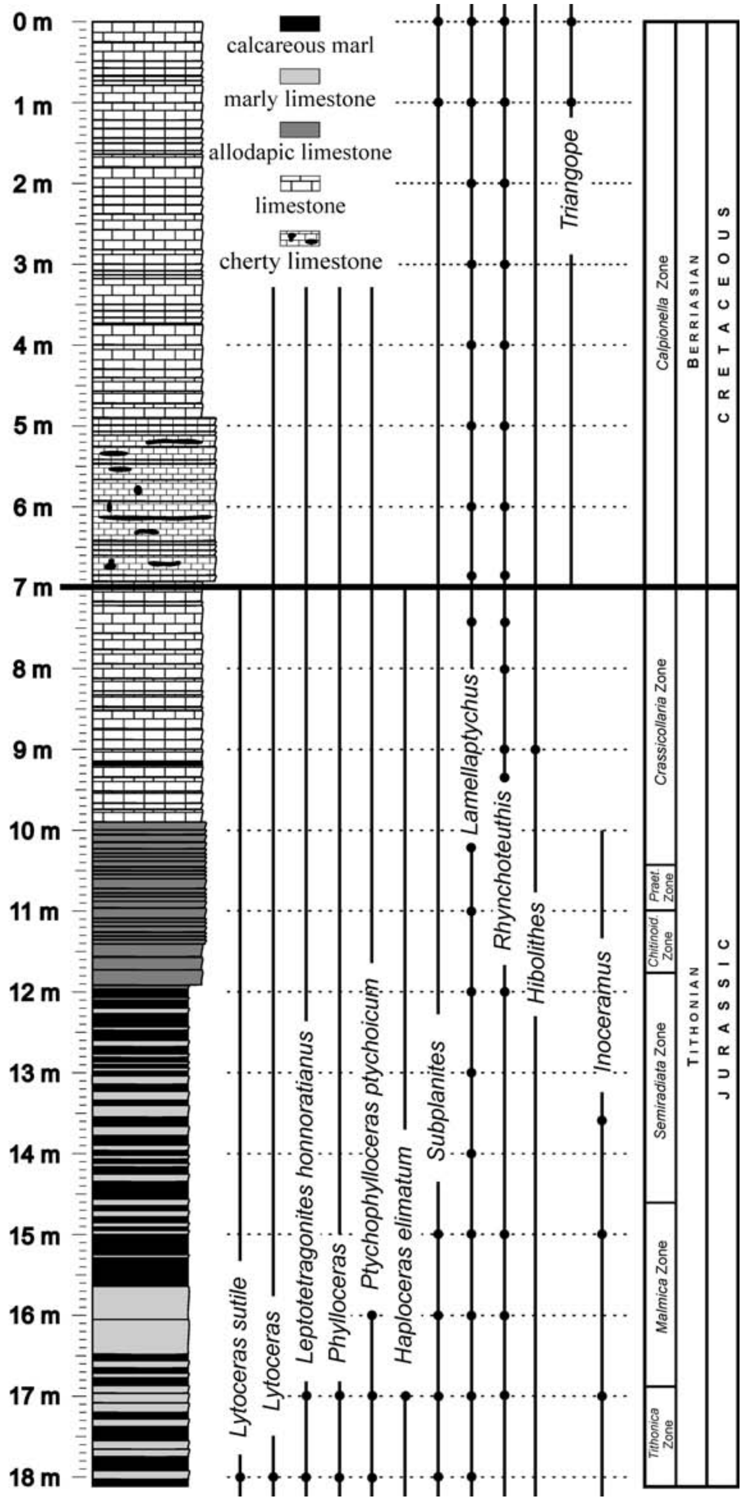

Fig. 3: Lithological log with macrofossil occurrence and range from the Nutzhof locality.

5. Palaeontology – The macrofauna

Conventions. The material examined is stored in the palaeontological collection of the Natural History Museum (NHMW), Vienna, Austria (Burgring 7, 1010 Vienna). All specimens in Plate 1, 2 and 3 were coated with ammonium chloride before photographing.

Ammonites

Lytoceras sutile Oppel, 1865, *Lytoceras* sp., *Leptotergaonites honnoratianus* (d'Orbigny, 1841), *Phylloceras* sp., *Ptychophylloceras ptychoicum* (Quenstedt, 1845), *Haploceras* (*Haploceras*) *elimatum* (Oppel, 1865), *Subplanites fasciculatiformis* sp. nov. (fig. 4). The similar, but only Berriasian species *Pseudosubplanites fasciculatus* was recently introduced by Bogdanova & Arkadiev (2005).

The ammonite fauna comprises 6 different genera. The occurrence at the Nutzhof section is dominated by ammonites of the perisphinctid-type (*Subplanites*). Accordingly, Ammonitina present the most frequent component (60 %; *Subplanites* and *Haploceras*), followed by the Phylloceratina (25 %; *Ptychophylloceras* and *Phylloceras*), and the Lytoceratina (15 %; represented by *Lytoceras* and *Leptotetragonites*) (fig. 4). Only Mediterranean cephalopod elements are present at Nutzhof.

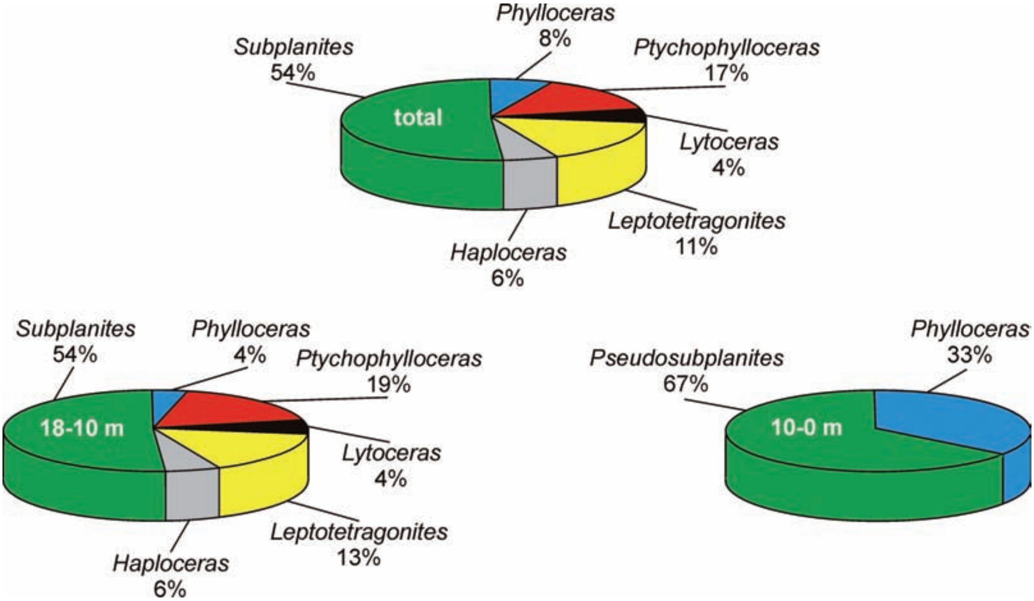

Fig. 4: Ammonite spectra from Nutzhof. On top, overall (total log) spectrum with indicated genera. Note the dominance of the perisphinctids and their abundant genus *Subplanites*. Below, splitted ammonite spectra of log ranges from 18-10 m (left) and 10-0 m (right).

Cephalopod beaks

Lamellaptychus sp.

Belemnites

Hibolithes (gr.) *semisulcatus* (MÜNSTER, 1830)

Brachiopods

Triangope sp.

Bivalves

Inoceramus sp.

Echinoderms

Phyllocrinus sp.**,** *Saccocoma* sp.

6. Discussion

Interpretation of the section

The biostratigraphic analysis (macro-, micro-, and nannofossils; see also KROH & LUKENEDER 2009; PRUNER et al. 2009; REHAKOVA et al. 2009; all this volume) proved that the lower part of the section, including the investigated lithostratigraphic boundary between the marly-limestone succession (18.0-10.00) and limestone succession (10.0-0.0), is continuous. No distinct stratigraphic discontinuity can be detected at the lithostratigraphic boundary at meter 10.0. Moreover, the biostratigraphy clearly demonstrates that the outcrop comprises a tectonically inverted block of about 18 m thickness.

The cephalopod assemblage from Nutzhof shows a typical Late Jurassic (Tithonian) to Early Cretaceous (Berriasian) composition. Additional findings of typical brachiopods (*Triangope*) fit into the picture of the Jurassic/Cretaceous boundary. The fauna is comparable to other Tithonian-Berriasian sections from the Waschbergzone (Ernstbrunner Kalk; ZEISS 2001), the Stramberger Schichten (Štramberk; BLASCHKE 1911) and similar assemblages from the Northern Calcareous Alps of Austria (Oberalmer Schichten; BOOROVÁ et al. 1999). Tithonian persiphinctid- and saccocomid-dominated successions pass into deeper aptychi- and calpionellid-dominated.Berriasian limestones.

The presented data (see also KROH & LUKENEDER 2009; PRUNER et al. 2009; REHAKOVA et al. 2009; all this volume) allow a more precise reconstruction of the paleogeographic setting of the studied section (LUKENEDER et al. in prep). Accordingly, the described specimens were deposited in habitats of the outer shelf situated on the southern edge of the European mainland at the Late Jurassic to Early Cretaceous.

7. Conclusions

The presented results are based on new macrofossil findings from the Gresten Klippenbelt at Nutzhof.

The macrofauna, as already stated, is represented especially by ammonites, belemnoids, aptychi and bivalves. The whole section yielded about 46 ammonite individuals. The sparse and selective occurrence of the ammonites within the section at Nutzhof and the lithologic character of the sediments makes the sampling difficult.

The stratigraphic investigation of the cephalopod, micro- and nanno-fauna revealed that the Nutzhof section comprises Tithonian to Berriassian sediments. The ammonoid fauna contains solely representatives of the Mediterranean Province. The described specimens of *Subplanites* are the first evidence of these ammonites within the Gresten Klippenbelt.

The new ammonite findings from the Lower Austrian locality of Nutzhof show the importance of correlating macrofaunas with the accompanying micro- and nannofossils. Restricting the stratigraphic evaluation to the Nutzhof ammonites would have indicated a time span and age from Tithonian to Early Berriasian.

The presented fauna is also a step forward in our understanding of ammonite faunas from a crucial area at and around the Jurassic/Cretaceous boundary: the Gresten Klippenbelt and the neighbouring Waschberg Zone. Both were located at the northern margin of the Penninic Ocean at this time.

Further investigations on magnetostratigraphy, geochemistry and isotopes will shed light on the environmental history of this little-known area at the Jurassic (Tithonian) – Cretaceous (Berriasian) transitional phase.

Sediment deposition at Nutzhof took place during conditions of relatively stable water masses and during relatively low sedimentation rates but unstable sedimentological conditions (allodapic limestones and microturbidites). This is shown by the change in lithology and the occurrence of numerous event layers with redeposited faunal elements (e.g. saccocomids etc.) from more shallow areas from the north. The depositional area was situated on the passive northern margin of the Penninic Ocean influenced and closely connected by the opening of this Ocean during the Upper Jurassic to Lower Cretaceous. The log shows a significant deepening at the late Tithonian (at 10.0 m) marked by a major lithological change from marly sediments to almost pure limestones.

The ammonites were apparently not redeposited from shallower shelf regions into a deeper shelf environment. The ammonite fauna of the Nutzhof section is interpreted as an assemblage comprising only "autochthonous" and parautochthonous pelagic elements from the open sea. The ammonite shells found their final resting place on the deeper shelf or upper slope of the European side of the Penninic Ocean.

Although the section is not very long, the presence of the Jurassic/Cretaceous boundary and the occurrence of a lithologic change make the section at Nutzhof suitable for the present investigation. Finally, different methods of biostratigraphic correlation based on macro-, micro- and nannofossils proved, also in the Gresten Klippenbelt, to be a powerful tool for stratigraphic dating of Late Jurassic – Early Cretaceous deep-water successions.

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Plate 1

Fig. A: *Leptotetragonites honnoratianus* (D'ORBIGNY, 1841), Nutzhof section, 17.0 – x 1, NHMW 2008z0264/0001.

Fig. B: *Leptotetragonites honnoratianus* (D'ORBIGNY, 1841), Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0002.

Fig. C: *Haploceras elimatum* (OPPEL, 1865), Nutzhof section, 13.0 – x 1, NHMW 2008z0264/0003.

Fig. D: *Lytoceras* sp., Nutzhof section, 180 – x 1, NHMW 2008z0264/0004.

Fig. E: *Lytoceras* sp., Nutzhof section, 17.0 – x 1, NHMW 2008z0264/0005.

Fig. F: *Ptychophylloceras ptychoicum* (QUENSTEDT, 1845), Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0006.

Fig. G: *Ptychophylloceras ptychoicum* (QUENSTEDT, 1845), Nutzhof section, 17.0 – x 1, NHMW 2008z0264/0007.

Fig. H: *Ptychophylloceras ptychoicum* (QUENSTEDT, 1845), Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0008.

Fig. I: *Leptotetragonites honnoratianus* (D'ORBIGNY, 1841), Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0009.

Fig. J: *Haploceras elimatum* (OPPEL, 1865), Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0010.

Fig. K: *Lytoceras sutile* OPPEL 1865, Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0011

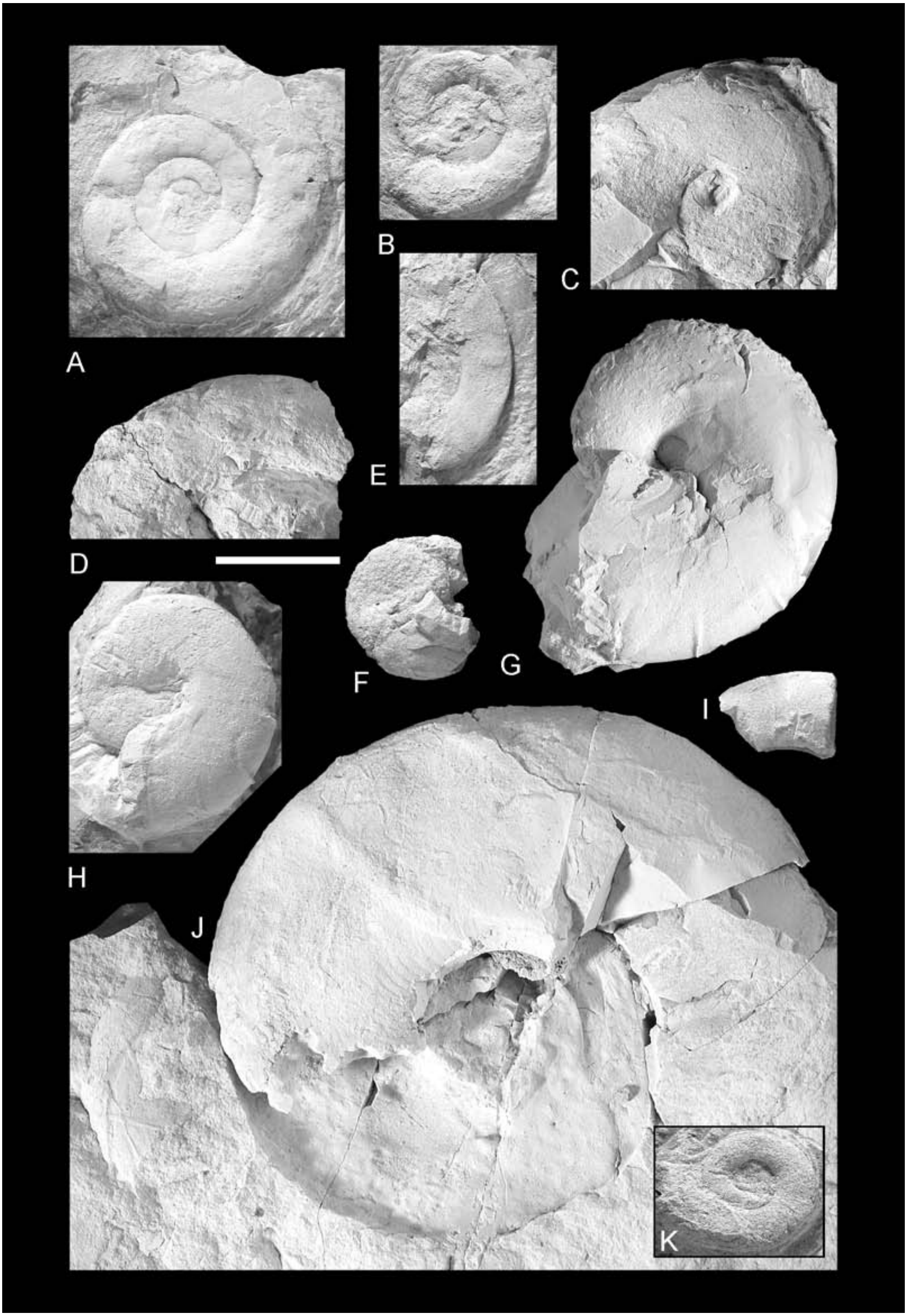
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Plate 2

Fig. A: *Subplanites fasciculatiformis* sp. nov., Nutzhof section, 17.0 – x 1, NHMW 2008z0264/0012.

Fig. B: *Subplanites fasciculatiformis* sp. nov., Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0013.

Fig. C: *Subplanites fasciculatiformis* sp. nov., Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0014.

Fig. D: *Subplanites fasciculatiformis* sp. nov., Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0015.

Fig. E: *Subplanites* sp., Nutzhof section, 0.0 – x 1, NHMW 2008z0264/0016.

Fig. F: *Subplanites* sp., Nutzhof section, 17.0 – x 0.75, NHMW 2008z0264/0017.

Fig. G: *Subplanites* sp., Nutzhof section, 17.0 – x 0.75, NHMW 2008z0264/0018.

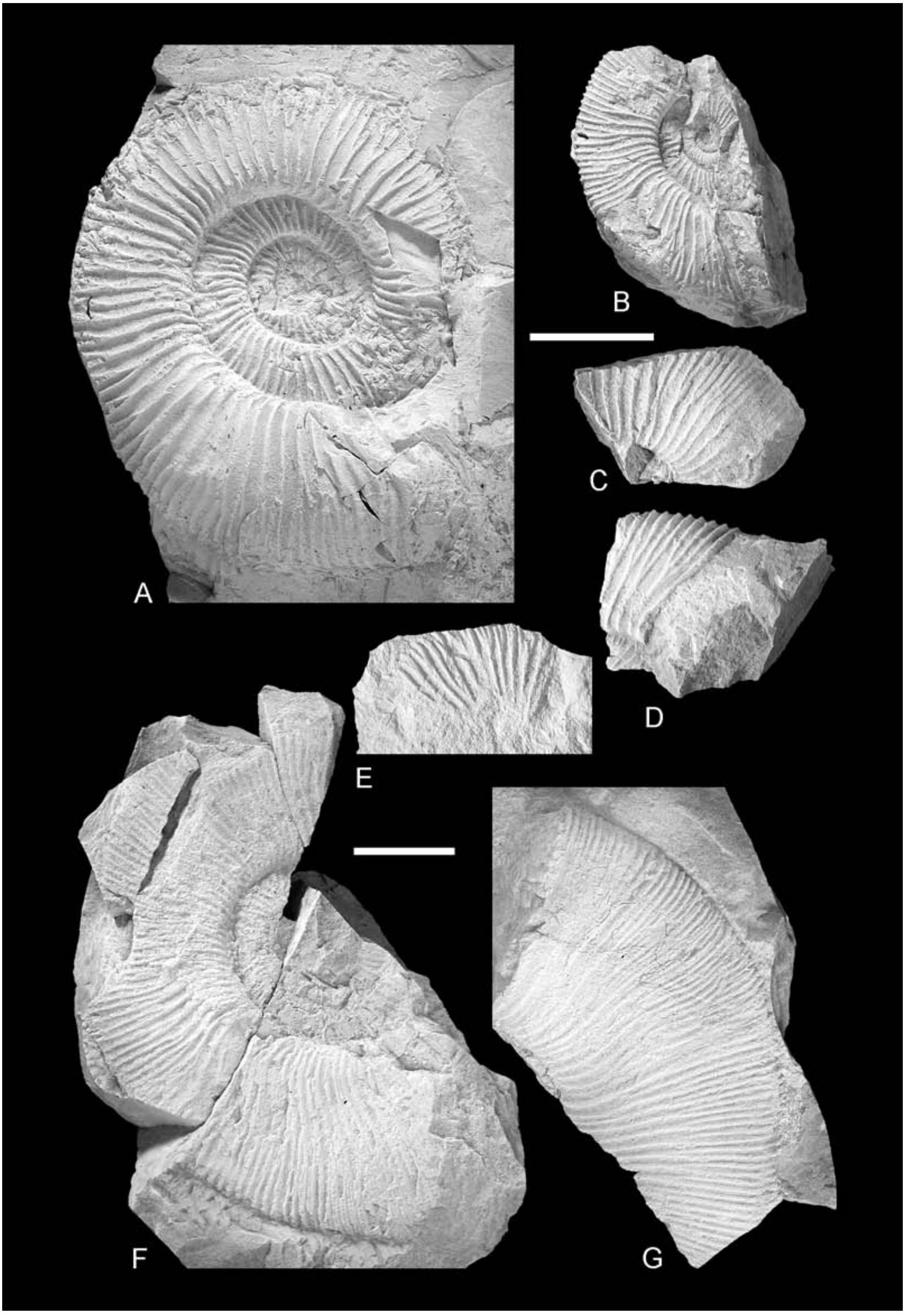
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Plate 3

Fig. A: *Subplanites fasciculatiformis* sp. nov., Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0019.

Fig. B: *Subplanites fasciculatiformis* sp. nov., Nutzhof section, 17.0 – x 0.5, NHMW 2008z0264/0020.

Fig. C: *Subplanites* sp., Nutzhof section, 17.0 – x 1, NHMW 2008z0264/0021.

Fig. D: *Lamellaptychus* sp., Nutzhof section, 13.8 – x 0.5, NHMW 2008z0264/0022.

Fig. E: *Lamellaptychus* sp., Nutzhof section, 13.9 – x 1, NHMW 2008z0264/0023.

Fig. F: *Lamellaptychus* sp., Nutzhof section, 18.0 – x 1, NHMW 2008z0264/0024.

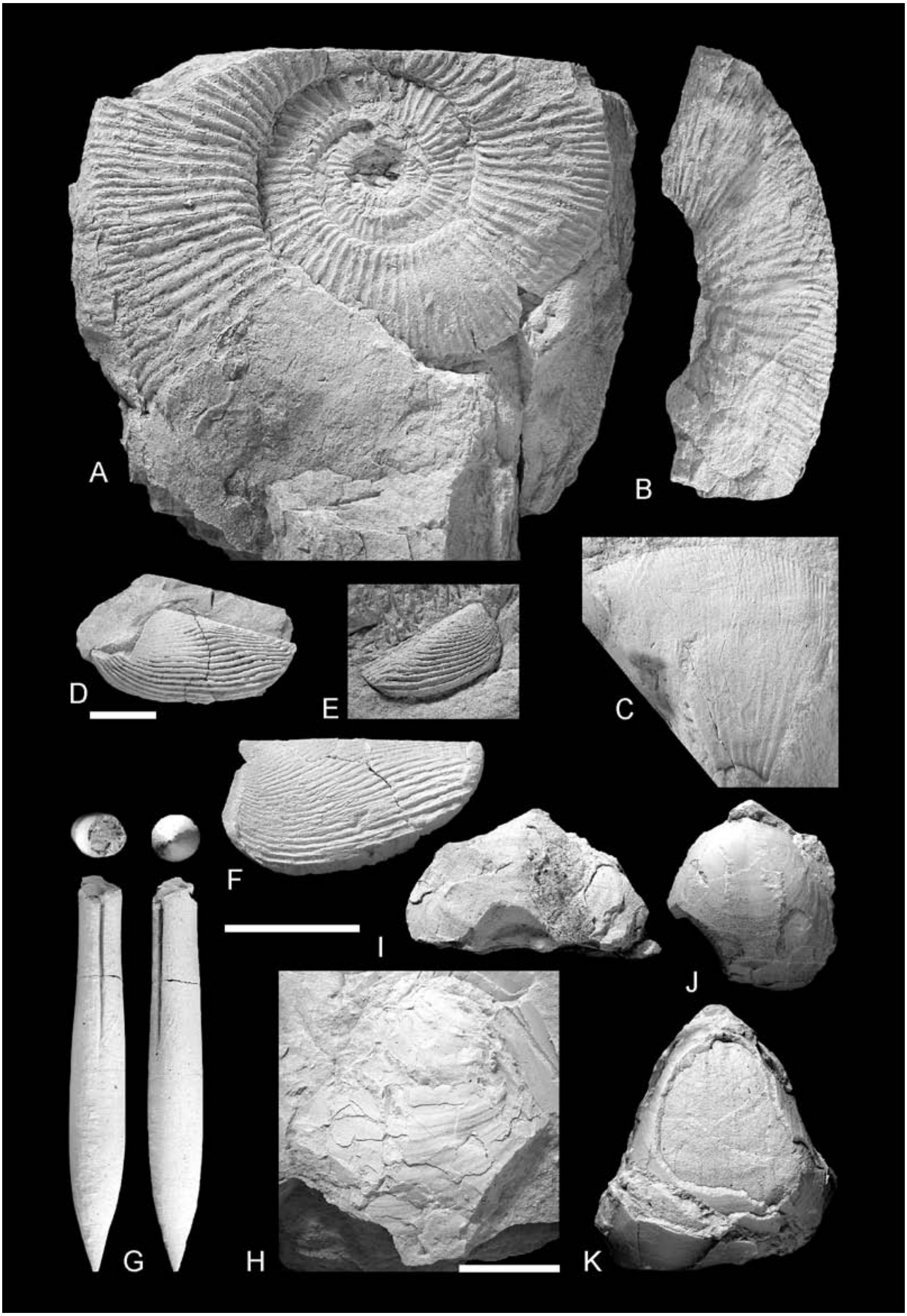
Fig. G: *Hibolithes* (gr.) *semisulcatus* (Münster, 1830), Nutzhof section, 14.3 – x 1, NHMW 2008z0264/0025.

Fig. H: *Inoceramus* sp., Nutzhof section, 14.0 – x 0.75, NHMW 2008z0264/0026.

Fig. I: Brachiopod, front view, Nutzhof section, 2.0 – x 1, NHMW 2008z0264/0027.

Fig. J: Brachiopod, upper view, Nutzhof section, 2.0 – x 1, NHMW 2008z0264/0027.

Fig. K: *Triangope* sp., Nutzhof section, 1.0 – x 1, NHMW 2008z0264/0028.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Appendix

Order Ammonoidea ZITTEL, 1884

Family Perisphinctidae STEINMANN, 1890

Subfamily Virgatosphinctinae SPATH, 1923

Genus *Subplanites* SPATH, 1925

Type species: *Virgatosphinctes* (*Perisphinctes*) *reisi* SCHNEID, 1914; Reisbergschichten, Unterstall bei Neuburg an der Donau, Kimmeridgian.

Diagnosis: Rather evolute shell with subquadrate whorl section. Steep umbilical wall, rounded in adults. Sharp, slightly prorsiradiate and straight, bifurcated ribbing on early whorls. Later intercalated with fasciculate ribbing on same whorl. Ribs start at bottom of umbilical wall and cross round venter at all stages. Ribbing rather distinct.

Subplanites fasciculatiformis LUKENEDER sp. nov.

Plate 2, Figs. A-D; Pl. 3, Figs. A-B

Derivation of name: After the morphology of its intercalated fasciculate ribbing (Latin, *fasciculatus* = bundle like).

Holotype: Natural History Museum, Vienna, NHMW 2008z0264/0012, steinkern, diameter 81 mm, whorl height 27 mm, whorl width 22 mm, umbilical width 32 mm, ribs per whorl 59 (Pl. 2, fig. A).

Paratypes: NHMW2008z0264/0013 (Pl. 2, Fig. B), NHMW2008z0264/0019 (Pl. 3, Fig. A).

Material: 24 specimens preserved as steinkerns, no shell is preserved, preservation in limestone, most of specimens are fragments, suture line is not visible.

Type locality and horizon: Nutzhof, Lower Austria, Gresten Klippenbelt, limestones of the Blassenstein Formation, log NU at N 48° 04’ 49’’ and E 15° 47’ 36’’, beds 13-18, Early-Middle Tithonian.

Description: Medium-sized, strongly ribbed steinkerns and negatives. Additional material as reproduced casts of the latter. Rather evolute and subrectangular, compressed whorls. Umbilicus wide and shallow. Flanks rather straight in early whorls and slightly convex in adults. Bifurcating ribs passing onto subrounded venter. Slightly prorsiradiate ribbing strong and prominent throughout. Ribs projected by approx. 5°-10° to aperture. Ribs straight, not curved. Bifurcated ribs start in the middle of lateral wall, whereas fasciculate ribbing starts on the inner half of whorl height. 59 primary ribs are counted per whorl on umbilical edge.

Remarks: As noted by BOGDANOVA & ARKADIEV (2005) similarities can be observed in *Subplanites* and *Pseudosubplanites*. The vertical umbilical wall, the straight ribbing and more compressed whorls distinguish *Subplanites* from *Pseudosubplanites*. *Pseudosubplanites* is noted by the latter authors to be only a Berriasian genus. Most morphological similarities are observed between the herein erected *Subplanites fasciculatiformis* sp. nov. and the Crimean Berriasian species *Pseudosubplanites fasciculatus* BOGDANOVA & ARKADIEV (2005). The main difference is the higher number (59) of umbilical ribs in *S. fasciculatiformis* sp. nov. (compared at same sizes) in addition to straighter ribbing. Both possess the typical fasciculated ribs. As noted by BOGDANOVA & ARKADIEV (2005) such forms are morphologically closely related to the genus *Fauriella* due to their fasciculate ribbing, but differ in absence of umbilical tubercles. All other species in *Subplanites* and *Pseudosubplanites* differ in the absence of the characteristic fasciculate ribbing.

Occurrence: The genus *Subplanites* is known all over Europe and additionally from Jurassic beds of Borneo, ?Greenland, India, Mexico, Russia and Somalia. The herein erected species *S. fasciculatiformis* sp. nov. occurs in section Nutzhof from beds 13-18 (Early-Middle Tithonian).