

# Calcareous nannofossil assemblages from the Gschlifgraben near Gmunden (Ultrahelvetic, Austria)

by

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## Abstract

Calcareous nannofossil assemblages are described from samples taken from ammonite specimens of the Gschlifgraben near Gmunden (Upper Austria). Nannofossil marker species indicate a Late Campanian age. Both standard nannofossil subzones CC 22b and CC 22c could be proven. The assemblage shows a mixed Tethyan-Temperate character and indicates low to moderate palaeoproductivities within the Ultrahelvetic zone.

## Zusammenfassung

Nannofossilproben von Ammoniten des Gschlifgrabens (Oberösterreich) belegen ein Obercampan Alter. Die Nannofossil-Subzonen CC 22b und CC 22c können nachgewiesen werden. Die Vergesellschaftung zeigt eine Mischung von Tethyalen und temperaten Arten und weist auf eine niedrige bis mäßige Paläoproductivität in der Ultrahelvetischen Zone hin.

## 1. Introduction

Several smear slide samples for biostratigraphic investigation of calcareous nannofossils were taken from ammonite specimen of the Gschlifgraben collections described by KENNEDY & SUMMEBERGER (1984, 1999). Outcrop samples were not considered during this study because of the diachronous mixture of strata within the Gschlifgraben mudflow (for nannofossil data on the Gschlifgraben outcrops see PREY (1983)). Only 3 samples from ammonite specimen yielded a moderately rich and diversified nannofloral assemblage which could be interpreted in terms of biostratigraphy. The Cretaceous standard zonation of SISSINGH (1977) and PERCH-NIELSEN (1985) could be applied to these assemblages. The nannoflora is relatively well-preserved. Quantitative analysis of the calcareous nannofossil assemblages of two well preserved and biostratigraphi-

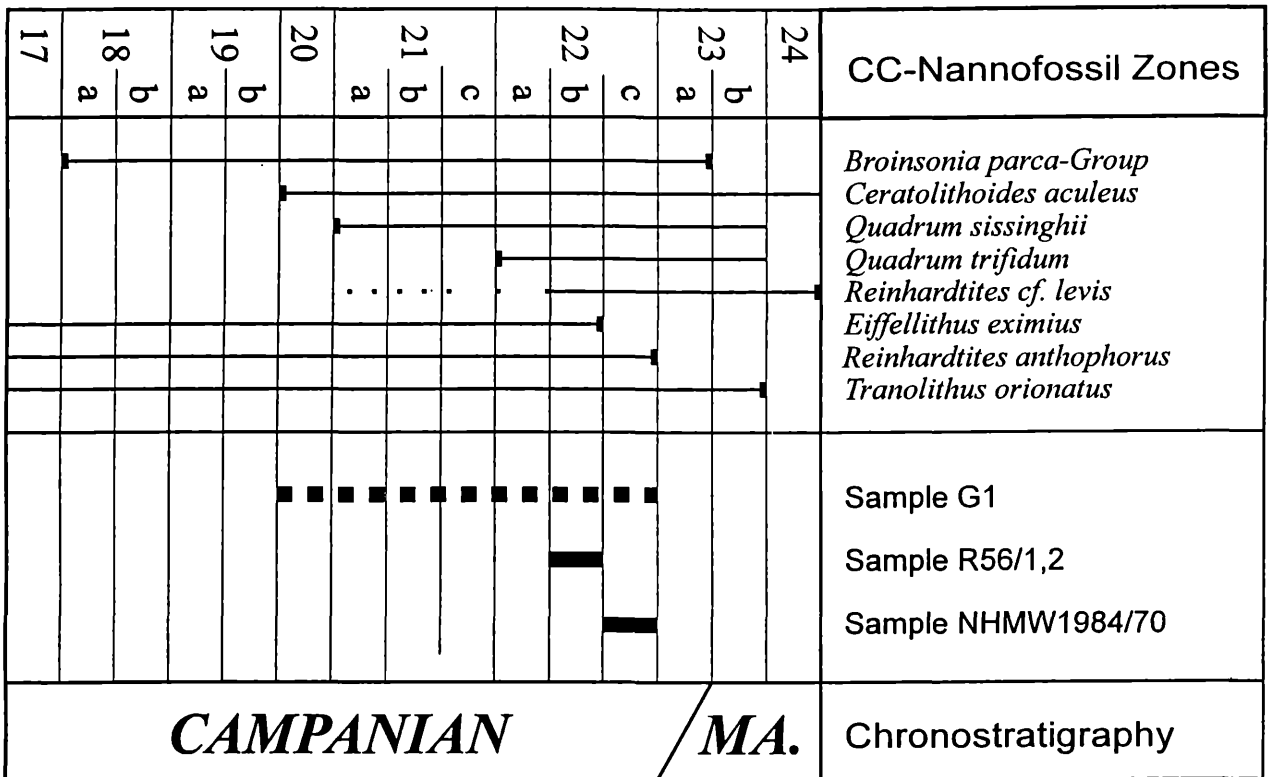
cally well defined samples is based on counting a population of 400 specimen per sample.

## 2. Biostratigraphy

The nannofossil assemblage of sample G1 (see table 1), taken from a specimen of *Trachyscaphites pulcherrimus*, gives evidence for standard nannofossil zones CC 20 to CC 22c after SISSINGH (1977) and PERCH-NIELSEN (1985). The biostratigraphic range is defined by *Ceratolithoides aculeus* (FO defines base of CC 20) and *Reinhardtites cf. anthophorus* (LO defines the top of CC 22c). Additional marker species for the Campanian include *Arkhangelskiella cymbiformis*, *Broinsonia (Aspidolithus) parca parca*, *Broinsonia parca constricta*, *Calculites obscurus*, *Lithraphidites praequadratus*, *Lucianorhabdus cayeuxii*, *Lucianorhabdus maleformis*, *Micula cf. praemurus*, *Quadrum cf. gartneri*, *Quadrum gothicum*, and *Tranolithus orionatus*. Based on recent correlations by SCHÖNFELD & BURNETT (1991) and BURNETT (1996), a late Early Campanian to Late Campanian age is indicated, which is in accordance to the general age assignments by ammonites for the Gschlifgraben fauna (KENNEDY & SUMMESBERGER, 1984; 1999). In a new zonation scheme published by BURNETT (1998), the sample can be assigned to the Tethyan-Intermediate Province Zones UC15b<sup>TP</sup> to UC15e<sup>TP</sup> due to the presence of *Ceratolithoides aculeus* and *Reinhardtites cf. anthophorus*, which was correlated to the upper Lower Campanian to upper Upper Campanian.

The other two samples allow a more precise biostratigraphic dating. Sample R56/1,2 from a *Bostrychoceras polyplacum* specimen can be assigned to the standard nannofossil subzone CC 22b of the *Quadrum trifidum*-Zone, defined by the presence of *Reinhardtites cf. levis* (FO defines the base of CC 22b) and *Eiffelithus eximius* (LO defines the top of CC 22b). This zone is of (late) Late Campanian age (BURNETT, 1996), although the FO of *Reinhardtites cf. levis* may be slightly diachronous in different latitudes. As an additional upper Campanian marker *Prediscosphaera cf. stoveri* is present. Subzone CC 22b can be correlated to the *Globotruncanita calcarata*-Zone which formerly defined the top of the Late Campanian in planktonic foraminiferal zonations

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**Figure 1:** Biostratigraphy of Gschlifgraben nannofossil samples compared to the Cretaceous nannofossil standard zones by PERCH-NIELSEN (1985) with modifications according to SCHÖNFELD & BURNETT (1991) and WAGREICH & KRENMAYR (1993). Ranges of important nannofossil species present in the Gschlifgraben samples and nannofossil events are given at the left.

**Table 1.** Calcareous nanofloral assemblages from ammonite specimen of the Gschlifgraben.

Sample G1 *Trachyscaphites pulcherrimus* (Nannofossil zones CC20-21a – CC22c; UC15b<sup>TP</sup> – UC15e<sup>TP</sup>)

*Acuturris scotus* (RISATTI 1973) WIND & WISE 1977

*Ahmuelierella octoradiata* (GORKA 1957) REINHARDT 1964

*Arkhangelskiella cymbiformis* VEKSHINA 1959

*Biscutum constans* (GORKA 1957) BLACK 1959

*Biscutum* sp.

*Broinsonia parca constricta* HATTNER, WIND & WISE 1980

*Broinsonia parca parca* (STRADNER 1963) BUKRY 1969

*Calculites obscurus* (DEFLANDRE 1959) PRINS & SISSINGH 1977

*Ceratolithoides aculeus* (STRADNER 1961) PRINS & SISSINGH in SISSINGH 1977

*Chiastozygus litterarius* (GORKA 1957) MANIVIT 1971

*Corollithion exiguum* STRADNER 1961

*Cretarhabdus crenulatus* BRAMLETTE & MARTINI 1964

*Cribrosphaerella ehrenbergii* (ARKHANGELSKY 1912) DEFLANDRE 1952

*Eiffellithus turriseiffelii* (DEFLANDRE & FERT 1954) REINHARDT 1965

*Gartnerago obliquum* (STRADNER 1963) NOEL 1970

*Glaukolithus diplogrammus* (DEFLANDRE 1954) REINHARDT 1964

*Glaukolithus spiralis* BRAMLETTE & MARTINI 1964

*Helicolithus trabeculatus* (GORKA 1957) VERBEEK 1977

*Lithraphidites carniolensis* DEFLANDRE 1963

*Lithraphidites praequadratus* ROTH 1978

*Lucianorhabdus cayeuxii* DEFLANDRE 1959

*Lucianorhabdus maleformis* REINHARDT 1966

*Microrhabdulus decoratus* DEFLANDRE 1959

*Micula decussata* VEKSHINA 1959

*Micula cf. praemurus* (BUKRY 1973) STRADNER & STEINMETZ 1984

*Prediscosphaera cretacea* (ARKHANGELSKY 1912) GARTNER 1968

*Quadrum cf. gartneri* PRINS & PERCH-NIELSEN in MANIVIT et al. 1977

*Quadrum gothicum* (DEFLANDRE 1959) PRINS & PERCH-NIELSEN in MANIVIT et al. 1977

*Reinhardtites cf. anthophorus* (DEFLANDRE 1959) PERCH-NIELSEN 1968

*Rhagodiscus splendens* (DEFLANDRE 1953) VERBEEK 1977

*Russellia multiplus* (PERCH-NIELSEN 1973) WIND & WISE 1977

*Rucinolithus* sp.

*Tranolithus orionatus* (REINHARDT 1966) PERCH-NIELSEN 1968

*Vekshinella* sp.

*Watznaueria barnesae* (BLACK 1959) PERCH-NIELSEN 1968

*Zeugrhabdotus embergeri* (NOEL 1959) PERCH-NIELSEN 1984

Sample R56/1,2 *Bostrychoceras polyplocum* (nannofossil zone CC22b; UC15d<sup>TP</sup> – UC15e<sup>TP</sup>)

*Acuturris scotus* (RISATTI 1973) WIND & WISE 1977

*Ahmuelierella octoradiata* (GORKA 1957) REINHARDT 1964

*Arkhangelskiella cymbiformis* VEKSHINA 1959

*Biscutum constans* (GORKA 1957) BLACK 1959

*Biscutum* sp.

*Braarudosphaera bigelowi* (GRAN & BRAARUD 1935) DEFLANDRE 1959

- Broinsonia parca constricta* HATTNER, WIND & WISE 1980  
*Broinsonia parca parca* (STRADNER 1963) BUKRY 1969  
*Calculites obscurus* (DEFLANDRE 1959) PRINS & SISSINGH 1977  
*Calculites ovalis* (STRADNER 1963) PRINS & SISSINGH 1977  
*Ceratolithoides aculeus* (STRADNER 1961) PRINS & SISSINGH in SISSINGH 1977  
*Chiastozygus litterarius* (GORKA 1957) MANIVIT 1971  
*Cretarhabdus crenulatus* BRAMLETTE & MARTINI 1964  
*Cribrosphaerella ehrenbergii* (ARKHANGELSKY 1912) DEFLANDRE 1952  
*Cylindralithus* sp.  
*Eiffellithus eximius* (STOVER 1966) PERCH-NIELSEN 1968  
*Eiffellithus turriseiffelii* (DEFLANDRE & FERT 1954) REINHARDT 1965  
*Gartnerago obliquum* (STRADNER 1963) NOEL 1970  
*Glaukolithus diplogrammus* (DEFLANDRE 1954) REINHARDT 1964  
*Glaukolithus spiralis* BRAMLETTE & MARTINI 1964  
*Haqius circumradiatus* (STOVER 1966) ROTH 1978  
*Helicolithus trabeculatus* (GORKA 1957) VERBEEK 1977  
*Kamptnerius magnificus* DEFLANDRE 1959  
*Lithraphidites carniolensis* DEFLANDRE 1963  
*Lucianorhabdus cayeuxii* DEFLANDRE 1959  
*Lucianorhabdus cayeuxii* DEFLANDRE 1959 ssp. B  
*Lucianorhabdus maleformis* REINHARDT 1966  
*Manivitella pemmatoidea* (DEFLANDRE in MANIVIT 1965) THIERSTEIN 1971  
*Microrhabdulus decoratus* DEFLANDRE 1959  
*Micula decussata* VEKSHINA 1959  
*Prediscosphaera cretacea* (ARKHANGELSKY 1912) GARTNER 1968  
*Prediscosphaera grandis* PERCH-NIELSEN 1979  
*Prediscosphaera spinosa* (BRAMLETTE & MARTINI 1964) GARTNER 1968  
*Prediscosphaera* cf. *stoveri* (PERCH-NIELSEN 1968) SHAFIK & STRADNER 1971  
*Reinhardtites anthophorus* (DEFLANDRE 1959) PERCH-NIELSEN 1968  
*Reinhardtites* cf. *levis* PRINS & SISSINGH in SISSINGH 1977  
*Rhagodiscus angustus* (STRADNER 1963) REINHARDT 1971  
*Rhagodiscus reniformis* PERCH-NIELSEN 1973  
*Rucinolithus* sp.  
*Tranolithus minimus* (BUKRY 1969) PERCH-NIELSEN 1984  
*Tranolithus orionatus* (REINHARDT 1966) PERCH-NIELSEN 1968  
*Vekshinella* sp.  
*Watznaueria barnesae* (BLACK 1959) PERCH-NIELSEN 1968  
*Zeughrabdotus embergeri* (NOEL 1959) PERCH-NIELSEN 1984
- Sample NHMW 1984/70 *Hauericeras fayoli* (nannofossil zone CC22c; UC15d<sup>TP</sup> – UC15e<sup>TP</sup>)
- Ahmuellerella octoradiata* (GORKA 1957) REINHARDT 1964  
*Arkhangelskiella cymbiformis* VEKSHINA 1959  
*Biscutum constans* (GORKA 1957) BLACK 1959  
*Biscutum* sp.  
*Braarudosphaera bigelowi* (GRAN & BRAARUD 1935) DEFLANDRE 1959  
*Broinsonia parca constricta* HATTNER, WIND & WISE 1980  
*Broinsonia parca parca* (STRADNER 1963) BUKRY 1969  
*Calculites obscurus* (DEFLANDRE 1959) PRINS & SISSINGH 1977  
*Calculites ovalis* (STRADNER 1963) PRINS & SISSINGH 1977  
*Ceratolithoides aculeus* (STRADNER 1961) PRINS & SISSINGH in SISSINGH 1977  
*Chiastozygus* sp.  
*Cretarhabdus crenulatus* BRAMLETTE & MARTINI 1964  
*Cribrosphaerella ehrenbergii* (ARKHANGELSKY 1912) DEFLANDRE 1952  
*Cylindralithus* sp.  
*Eiffellithus* cf. *gorkae* REINHARDT 1965  
*Eiffellithus turriseiffelii* (DEFLANDRE & FERT 1954) REINHARDT 1965  
*Gartnerago obliquum* (STRADNER 1963) NOEL 1970  
*Glaukolithus diplogrammus* (DEFLANDRE 1954) REINHARDT 1964  
*Glaukolithus spiralis* BRAMLETTE & MARTINI 1964  
*Haqius circumradiatus* (STOVER 1966) ROTH 1978  
*Helicolithus trabeculatus* (GORKA 1957) VERBEEK 1977  
*Kamptnerius magnificus* DEFLANDRE 1959  
*Lithraphidites carniolensis* DEFLANDRE 1963  
*Lucianorhabdus cayeuxii* DEFLANDRE 1959  
*Lucianorhabdus cayeuxii* DEFLANDRE 1959 ssp. B  
*Manivitella pemmatoidea* (DEFLANDRE in MANIVIT 1965) THIERSTEIN 1971  
*Microrhabdulus decoratus* DEFLANDRE 1959  
*Micula decussata* VEKSHINA 1959  
*Placozygus sigmoides* (BRAMLETTE & SULLIVAN 1961) ROMEIN 1979  
*Prediscosphaera cretacea* (ARKHANGELSKY 1912) GARTNER 1968  
*Prediscosphaera spinosa* (BRAMLETTE & MARTINI 1964) GARTNER 1968  
*Prediscosphaera* cf. *stoveri* (PERCH-NIELSEN 1968) SHAFIK & STRADNER 1971  
*Quadrum* cf. *gartneri* PRINS & PERCH-NIELSEN in MANIVIT et al. 1977  
*Quadrum gothicum* (DEFLANDRE 1959) PRINS & PERCH-NIELSEN in MANIVIT et al. 1977  
*Quadrum sissinghii* PERCH-NIELSEN 1986  
*Reinhardtites anthophorus* (DEFLANDRE 1959) PERCH-NIELSEN 1968  
*Reinhardtites* cf. *levis* PRINS & SISSINGH in SISSINGH 1977  
*Rhagodiscus angustus* (STRADNER 1963) REINHARDT 1971  
*Rhagodiscus reniformis* PERCH-NIELSEN 1973  
*Rhagodiscus splendens* (DEFLANDRE 1953) VERBEEK 1977  
*Rucinolithus* sp.  
*Russellia multiplus* (PERCH-NIELSEN 1973) WIND & WISE 1977  
*Thoracosphaera* cf. *operculata* BRAMLETTE & MARTINI 1964  
*Tranolithus orionatus* (REINHARDT 1966) PERCH-NIELSEN 1968  
*Vekshinella* sp.  
*Watznaueria barnesae* (BLACK 1959) PERCH-NIELSEN 1968

for the Tethyan realm (e.g. CARON, 1985) and is now considered to be of Late Campanian age (e.g. SCHÖNFELD & BURNETT, 1991; BURNETT et al., 1992; WAGREICH & KRENMAYR, 1993). This correlation is in accordance to foraminiferal data given by PREY (1983), who reported the rare occurrence of *G. calcarata* within several samples from the Gschlifgraben area. In the zonations of Burnett (1998), the sample falls into subzones UC15d<sup>TP</sup> to UC15e<sup>TP</sup>. The absence of *Lithastrinus grillii* indicates the upper part of UC15d<sup>TP</sup> to UC15e<sup>TP</sup> or, in the Boreal zonation scheme UC15d<sup>BP</sup>

to UC15e<sup>BP</sup>, due to the presence of *Prediscosphaera* cf. *stoveri*.

The probably youngest assemblage from the Gschliefgraben was found within sample NHMW 1984/70 from a specimen of *Hauericeras fayoli*. The absence of *Eiffellithus eximius* besides the presence of the above mentioned marker species such as *Reinhardtites* cf. *levis* indicates nannofossil subzone CC 22c. Based on results from several European sections this subzone is considered to be of (late) Late Campanian age, below the base of the Maastrichtian defined by the first occurrence of the ammonite *Pachydiscus neubergicus* (e.g. HANCOCK et al., 1993; ODIN, 1996; WAGREICH et al., 1998; KÜCHLER et al., in press), which lies within the nannofossil zone CC 23a. According to the zonations of BURNETT (1998), again the upper part of UC15d<sup>TP</sup> to UC15e<sup>TP</sup> is indicated.

### 3. Palaeobiogeography and Palaeoproductivity

In general the nannofossil assemblages from the Gschliefgraben give evidence of a mixing of Tethyan and mid-latitude taxa. *Watznaueria barnesae*, a typical low-latitude species (e.g. WAGREICH, 1986), comprises about 25 – 30 % of the assemblage, whereas the *Micula*-group, considered as indicative of cooler water masses (e.g. DOEVEN, 1983), counts up to 5 to 7 %. Major constituents of the assemblage are also the genera *Biscutum* (7 – 15 %) and *Prediscosphaera* (about 11 %), which are common both in Tethyan and temperate assemblages of this age (e.g. THIERSTEIN, 1981). Typical low-latitude nannofossils such as *Quadrum sissinghii* or *Ceratolithoides aculeus* (e.g. BURNETT, 1998) are rare to very rare or, as in the case of *Quadrum trifidum*, absent. Mid-latitude to Boreal species like *Prediscosphaera* cf. *stoveri* or *Eiffellithus gorkae* are present but only in very low amounts below 1 %. Compared to coeval assemblages of the deeper-water northern Tethyan margin, e.g. from the Northern Calcareous Alps (WAGREICH & KRENMAYR, 1993; WAGREICH, unpublished) the Gschliefgraben samples show in general remarkable similarities, despite the only sporadic occurrence of *Quadrum* species within the later. The similarity of the assemblages gives evidence for only minor latitudinal differences between these separated palaeogeographic realms at the boundary of the northern Tethys to the Temperate region during the Late Campanian. Only pronounced low latitude species like *Quadrum trifidum* are strongly decreasing northward, testifying to the transitional Tethyan-Temperate character of the assemblage.

The presence of significant amounts of holococcoliths (e.g. *Calculites*, *Lucianorhabdus*, *Russelia*) is in accordance with an outer shelf to upper slope environ-

ment of deposition (PERCH-NIELSEN, 1985) of the Gschliefgraben strata. Estimates of the palaeoproductivity based on the ratio of several Campanian-Maastrichtian productivity-controlled genera (NIP - nannofossil index of productivity after ESHET & ALMOGI-LABIN, 1996) gives low values in the range of -0.1 to -0.5, due to the predominance of low-productivity genera such as *Eiffellithus*, *Prediscosphaera* and *Vekshinella*. These values point to relatively low to intermediate marine productivity levels during the Late Campanian in the Ultrahelvetic zone, which is also indicated by the high species diversity of the nannoflora and the predominance of *Watznaueria barnesae* (ESHET & ALMOGI-LABIN, 1996).

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