The Distribution of the Chitinozoans in the Cellon Section (Hirnantian - Lower Lochkovian). - A Preliminary Report.

by

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with 1 figure

Introduction

The investigations of the chitinozoans from the Cellon section [Ashgill - Lochkovian] were part of a project with the goal of examining the geographic and stratigraphic distribution of the palynomorphs within the different facies of the Upper Ordovician to Lower Devonian strata in the Carnic Alps.

These are: the shallow water facies with mainly calcareous deposits, the siliciclastic basin facies and the transitional facies mediating between the former two.

In none of these facies *spores* could be observed. The *acritarchs* turned out to be strongly influenced by the local environments. Their only remarkable occurrence was in the Lower Silurian of the Cellon section which belongs to the calcareous facies [PRIEWALDER, 1987]. However, the *chitinozoans* proved to be the geographically and stratigraphically widest distributed group of the palynomorphs.

Concerning the chitinozoans, 79 samples from the siliciclastic and transitional facies have been examined so far by spot checks: 60% of them were found to be fossiliferous.

From the Upper Ordovician to Lower Devonian sequence in the Cellon section 95 samples have been prepared. 48 [= 51%] yielded chitinozoans.

As the chitinozoans were opaque to transmitting light the investigations had to be done mainly under SEM. About 4.300 micropalaeontological objects [chitinozoans as well as chitinozoan-like and/or problematic particles] have been examined in this way.

It has to be pointed out that the names of the chitinozoans in this report are provisional because they are based only on gross determinations. Detailed studies have yet to be carried out and will result in more diverse chitinozoan associations at many horizons of the section.

In the Cellon section, the chitinozoans are restricted to four formations [fig.1]:

- the *Plöcken Formation* [***upper Ashgill***];
- the lower part of the *Kok Formation* [***upper Llandovery***];
- the sequence from the uppermost *Kok Formation* to the top of the *Cardiola Formation* [***upper Ludlow***];

- the sequence from the upper part of the Alticola *Limestone* to the lowermost *Rauchkofel Limestone* [***Ludlow/Pridoli boundary - lowermost Lochkovian***].

Chitinozoans of the Upper Ordovician

In the Uggwa Shale and Uggwa Limestone chitinozoans are lacking. Instead, black and glossy particles with chitinozoan-like contours, probably consisting of graphite, are frequently present. In the light-microscope they can be confused with badly preserved chitinozoans.

Stratigraphically the chitinozoans occur for the first time at the base of the Plöcken Formation [sample ***126***] with a few representatives of *Conochitina EISENACK 1931* and probably also *Tanuchitina JANSONIUS 1964*. Further numerous melanosklerits with a strong resemblance to chitinozoans can be observed, as well as chitinozoan-like graphitic particles.

In the uppermost part of the Plöcken Formation a few samples [***128*** , ***129*** , ***45***] contain taxa which are diagnostic for the Ashgill: *Armoricochitina nigerica (BOUCHÉ 1965)* and *Tanuchitina elongata (BOUCHÉ 1965)*. Furthermore *Desmochitina minor EISENACK 1931*, which does not range across the Ordovician/Silurian boundary, and representatives of *Conochitina*, *Rhabdochitina (?) EISENACK 1931*, *Spinachitina SCHALLREUTER 1963* and the first specimen of the *Ancyrochitininae* with broken processes have been extracted.

The chitinozoan assemblages of this succession suggest the Hirnantian ***Tanuchitina elongata*** - **Biozone** (PARIS 1990).

The Ashgillian samples yield very few chitinozoans in a rather bad state of preservation: most specimens are three-dimensionally preserved , but broken.

Chitinozoans of the upper Llandovery

Sample ***46A*** at the very base of the Kok Formation [= upper Llandovery], which unconformably overlies the Plöcken Formation, yields a completely different chitinozoan fauna with a great number of individuals: numerous representatives of *Lagenochitinidae* and *Ancyrochitininae*, which cannot be determined exactly; *Ancyrochitina* gr. *ancyrea (EISENACK 1931)*, *A.* cf. *diabolo (EISENACK 1937)*, *Cyathochitina caputoi DA COSTA 1971* and *Eisenackitina dolioliformis UMNOVA 1976* which is very characteristic of this sample.

Samples ***47*** , ***130*** and ***131*** contain many specimens of *Bursachitina TAUGOURDEAU 1966* and *Conochitina* [e.g. *C.sp. cf. emmastensis NESTOR 1982*], further *E. dolioliformis*, as well as *A. cf. nigerica* and *Laufeldochitina ? sp.*, which are reworked taxa of upper Ordovician age.

This part of the sequence may be assigned to the upper Aeronian - lower Telychian ***Eisenackitina dolioliformis*** - **Biozone** [VERNIERS et al. 1995].

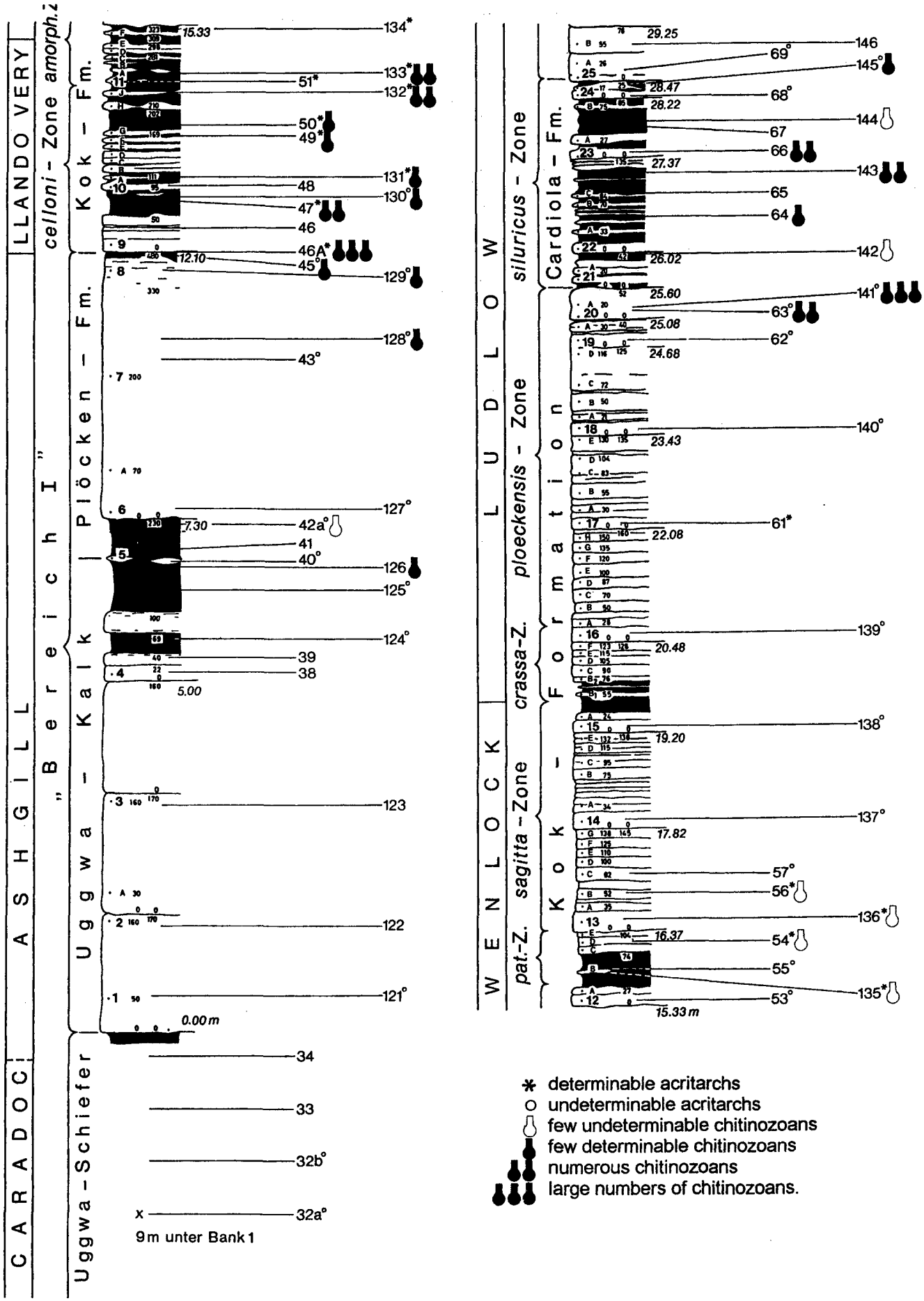
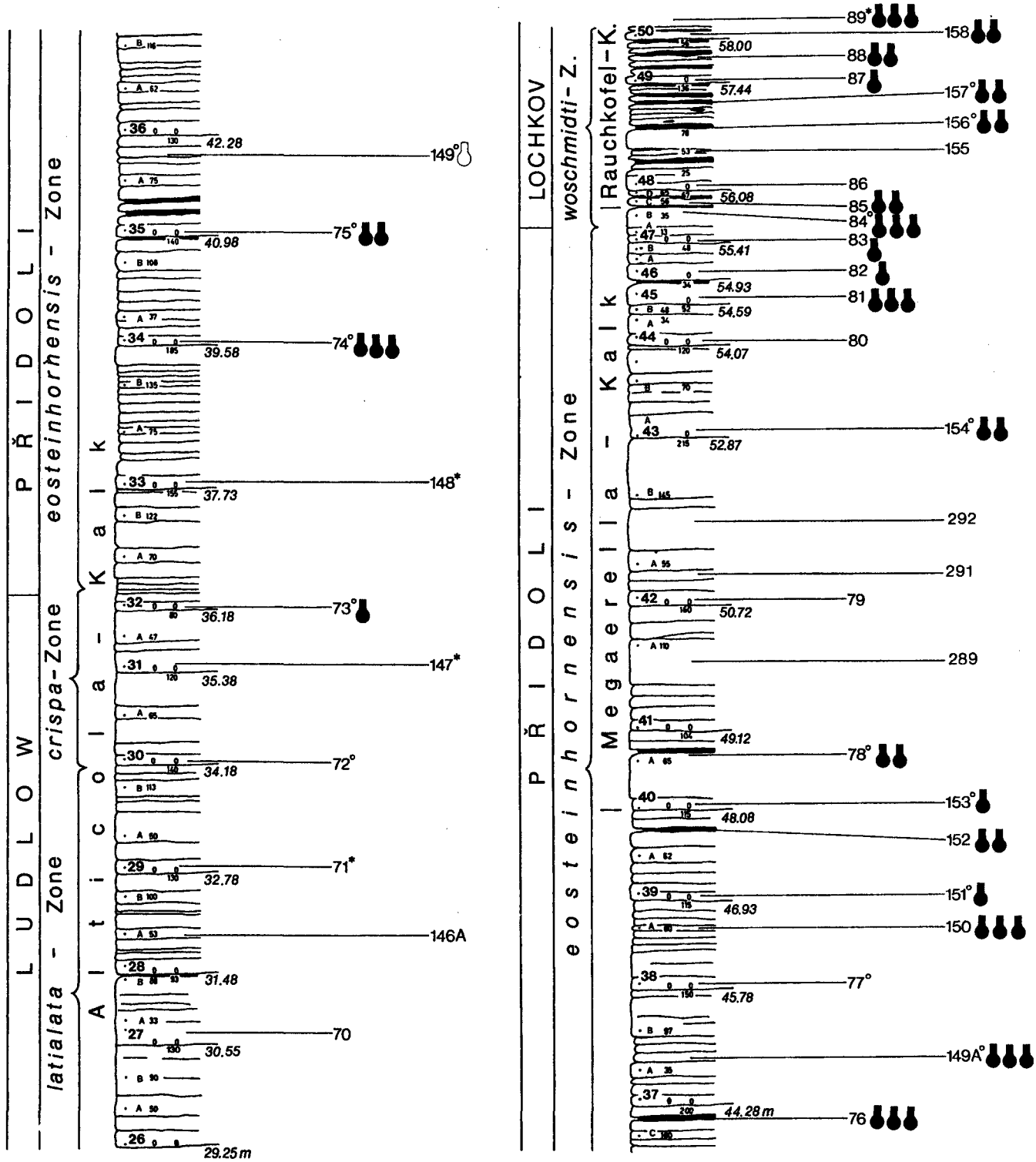


Fig.1: The location of the samples in the Cellon-section (drawing of the section after SCHÖNLAUB 1985).


LUDLOW
PŘÍDOLI
latialata - Zone
crispa-Zone
eosteinhorhensis - Zone
Alticola - Kalk
PŘÍDOLI
LOCHKOV
eosteinhornensis - Zone
woschmidti - Z.
Megaaerella - Kalk
Rauchkofel-K.
42.28
40.98
39.58
37.73
36.18
35.38
34.18
32.78
31.48
30.55
29.25m
58.00
57.44
56.08
55.41
54.93
54.59
54.07
52.87
50.72
49.12
48.08
46.93
45.78
44.28m
149°
75°
74°
148*
73°
147*
72°
71*
146A
70
89*
158
88
87
157°
156°
155
86
85
84°
83
82
81
80
154°
292
291
79
289
78°
153°
152
151°
150
77°
149A°
76

In sample ***49,*** an *Angochitina* species appears which is similar to *A. longicolla EISENACK 1931*, the index species of the following ***Angochitina longicollis* - Biozone** [VERNIERS et al.1995] of upper Telychian age.

The upper part of the Llandoverian strata of the Kok Formation [samples ***50, 132***] is characterized by chitinozoans which closely resemble *Conochitina proboscifera EISENACK 1937*, a typical species of the upper Telychian/lower Sheinwoodian period; *Conochitina* spp. [e.g. *C.* sp. cf. *C. armillata TAUGOURDEAU & DE JEKHOWSKI 1960, C.* sp. cf. *C.edjelensis elongata TAUGOURDEAU 1963*], *Eisenackitina sp.* and *Lagenochitina sp.* occur less frequently.

The uppermost Llandovery sample [***133***] yields only badly preserved individuals resembling *Angochitina longicolla*, as well as *Conochitina* sp., *Cyathochitina* sp., *Eisenackitina* sp. and *Sphaerochitina* sp..

The chitinozoans from this part of the section are entirely or partly flattened and frequently folded. In cases of intense folding or variable flattening of the vesicles [e.g. thinner-walled necks are more, thicker-walled body chambers less strongly deformed] their contours may be altered to an extent that the original taxon is difficult to recognize.

Chitinozoans of the Wenlock - lower Ludlow

hroughout the Wenlock, the strata of which attain a thickness of only 5 meters indicating extreme condensation [SCHÖNLAUB 1994], and also in the lower Ludlow, associations of determinable chitinozoans are missing. Only sporadic and badly preserved fossils are present: Sample ***135***: one fragment of *Belonechitina* sp.; sample ***54***: the internal moulds of *Conochitinidae* indet.; sample ***136***: fragments of *Conochitinidae* indet. and *Lagenochitinidae* indet., sample ***56***: *Bursachitina* sp., *Lagenochitinidae* indet., *Conochitinidae* indet..

Chitinozoans of the upper Ludlow

From the uppermost bed of the Kok Formation [sample ***63***] to the top of the Cardiola Formation [sample ***145***] a great variety of chitinozoans occurs.

At the base of this sequence [samples ***63***, ***141***] abundant and diverse *Angochitina EISENACK 1931* [e.g. *A. echinata EISENACK 1931* and a fragment similar to *A. elongata EISENACK 1931*], *Sphaerochitina EISENACK 1955* [e.g. *S.*sp. cf. *impia LAUFELD 1974*], *Conochitina EISENACK 1931* and a few *Bursachitina* sp. and *Eisenackitina* sp., as well as some *Ancyrochitina* sp. appear.

Above this level a fragment of *Linochitina EISENACK 1968* [sample ***142***] is found.

Some *Cingulochitina* cf. *convexa (LAUFELD 1974), Sphaerochitina* spp. and *Angochitina* spp. [like in samples ***63*** , ***141***] and a few *Ancyrochitininae* indet. are found in sample ***64***.

The middle part is dominated by numerous *Conochitina and Belonechitina JANSONIUS 1964. C.*sp. cf. *tuba EISENACK 1932* occurs in sample ***143***. Sample ***66*** yields *Belonechitina* sp. cf. *latifrons (EISENACK 1964)* and *B.*sp. cf. *lauensis (LAUFELD 1974)* and rare *Sphaerochitina* sp..

Finally, in the last sample of this succession [***145***] a few *Cingulochitina* sp. and *Ancyrochitininae* indet. are present.

The chitinozoans of this sequence seem thus to be referred to the upper Gorstian - lower Ludfordian ***Angochitina elongata*** - **Biozone** [VERNIERS et al. 1995].

Here an other - unusual - state of preservation can be observed: the vesicles of thin-walled taxa from limestones had collapsed three-dimensionally similar to a deflated rubber ball. This feature probably had been developed at an early stage of diagenesis when the internal cavities of the chitinozoans became dehydrated before mineral fillings occurred. These fillings are common in chitinozoans from limestones and they are responsible for their three-dimensional preservation.

From the base of the Alticola Limestone up to the end of the Ludlow the examined samples yield no chitinozoans.

Chitinozoans of the uppermost Ludlow to the lower Lochkovian

A rich development of chitinozoans is documented from sample ***73*** of the Ludlow/Pridoli boundary beds and persists through the Pridoli up to the end of the section in the lower Lochkovian [sample ***89***]. It comprises the upper part of the Alticola Limestone, the Megaerella Limestone and the lowermost part of the Rauchkofel Limestone.

Three samples at the base of this succession [***73*** = uppermost Ludfordian sample; ***74***, ***75*** = lower Pridolian samples] contain numerous *Eisenackitina barrandei PARIS & KRIZ 1984, E. granulata (CRAMER 1964), E. intermedia (EISENACK 1955), Urnochitina* gr. *urna (EISENACK 1934)*, and some *Sphaerochitina* cf. *sphaerocephala (EISENACK 1932), Ancyrochitina* gr. *ancyrea (EISENACK 1931), Angochitina* sp., *Bursachitina* sp. and *Gotlandochitina* sp..

E. barrandei is the index-fossil of the ***Eisenackitina barrandei*** - **(total range) - Biozone** [VERNIERS et al.1995] which is restricted to the uppermost Ludfordian. At the global stratotype section of the Ludlow/Pridoli-boundary at Pozáry Quarry of the Prague Basin, Bohemia, *E. barrandei* ranges a few decimeters into the Pridoli, where it coexists within a very short distance with atypical representatives of *Urnochitina* gr. *urna* [typical specimens are present in the higher parts of the Pridoli]. The latter is an index species of the Pridoli appearing in the Prague Basin within an interval of a few centimeters below to a few centimeters above the Ludlow/Pridoli-boundary [PARIS in KRIZ et al.1986].

Compared to the ranges in the Cellon section an obvious difference exists: here *E. barrandei* ranges relatively high up into the Pridoli [almost 5 meters]; moreover, in this interval it coexists with atypical *U.* gr. *urna*. Detailed studies will have to settle this discrepancy.

The next sample [***149***] reveals a very low fossil content consisting of only some *Eisenackitina* sp., *Angochitina* sp. and *Ancyrochitina* ? sp..

The development of typical *Urnochitina urna* starts suddenly and with a great number of specimens in sample ***76***. As already described in the literature the fauna here too is of almost monospecific composition with the exception of only rare representatives *of Desmochitinidae* indet..

The following sample [***149A***] displays a special feature: *U. urna* becomes numerically unimportant, whereas large quantities of *Bursachitina krizi (PARIS & LAUFELD 1980)* are present. The residue consists almost entirely of representatives of the latter species.

Sample ***150*** is dominated by *U. urna; in addition*, only very few individuals of *B. krizi* and *Desmochitinidae* indet. occur.

The next three samples [***151***, ***152***, ***153***] yield insignificant associations with various *Lagenochitinidae* indet., a fragment of *B.krizi* [?], some *Angochitina* similar to *A. chlupaci (PARIS & LAUFELD 1980)* and *Sphaerochitina* sp..

The only taxon in the following sample ***78*** is *E. granulata* with a few well preserved individuals. It is still present in sample ***154***, but there accompanied by rare *B. krizi*, *Linochitina klonkensis PARIS & LAUFELD 1980* and *Ancyrochitina* sp..

The strata between the samples ***78*** and ***154*** in the lower part of the Megaerella Limestone proved to be barren of chitinozoans.

At about this level of the section the chitinozoan fauna starts to rearrange: *U. urna* occurs with more and more decreasing numbers of individuals, while *Angochitina EISENACK 1931*, *Cingulochitina PARIS 1981*, *Gotlandochitina LAUFELD 1974*, *Linochitina EISENACK 1968*, *Sphaerochitina EISENACK 1955* and especially *Ancyrochitina EISENACK 1955* occur more frequently.

The most abundant species in sample ***81***, from which large quantities of chitinozoans could be extracted, represents *Ancyrochitina* sp. A, provided with simple processes with very broad basis. Other taxa are *L. klonkensis*, *Calpichitina corinnae JAGLIN 1986*, *Sphaerochitina* cf. *sphaerocephala (EISENACK 1932)*, *Gotlandochitina* ? sp. and *U. urna* with very few specimens.

Samples ***82*** and ***83,*** the uppermost Pridolian samples, contain only poor associations: very few *U. urna*, *Ancyrochitina* sp. A and *S.* cf. *sphaerocephala*.

The Pridoli is defined by the total range of *Urnochitina urna*, which at the global stratotype section for the Silurian/Devonian-boundary at Klonk, Prague Basin, disappears exactly at the boundary, while in the Karlstejn section it ranges a few decimeters above the base of the Lochkovian [PARIS, LAUFELD & CHLUPÁC 1981].

Due to the lack of the index-fossils, the chitinozoan biozones of the Pridoli [***Fungochitina kosovensis* -, *Margachitina elegans* -** and ***Anthochitina superba* - Biozones**, VERNIERS et al.1995] could not be identified at Cellon.

Sample ***84*** from the lowermost Lochkovian bed yields a rich fauna: comparatively numerous *U. urna,* which is the last documented occurrence in the section; in addition, many well preserved and diverse representatives of *Angochitina*, *Gotlandochitina*, *Sphaerochitina* [e.g. *S. sphaerocephala*] and a few *Ancyrochitina* with unusual processes are found.

The chitinozoan assemblage of sample ***85***, in which the number of individuals is rather low, is dominated by *Eisenackitina bohemica (EISENACK 1934)*, a species typical of the Lochkovian, which in the Prague Basin appears a few decimeters above the base of the Devonian, i.e. in bed 21 at the Klonk section [PARIS 1981]. Co-occurring taxa are a few *Angochitina* aff. *chlupaci*, *Cingulochitina* sp., *Desmochitinidae* indet. and *Lagenochitinidae* indet..

In sample ***156*** *A. chlupaci* is present with several unequivocal individuals together with a few *Angochitina* sp. and *Desmochitinidae* indet..

The remaining samples in the section [***157***, ***87***, ***88***, ***158*** and ***89*** with a large quantity of chitinozoans] are dominated by numerous *Ancyrochitina* [at least 5 species]. Moreover they yield numerous diverse representatives of *Angochitina*, *Sphaerochitina*, *Gotlandochitina*, *Linochitina* and *Cingulochitina* [e.g. *C. ervensis (PARIS 1979)*] .

The chitinozoans of the Pridoli/Lochkovian sequence are generally three-dimensionally preserved, especially thicker-walled taxa; thinner-walled individuals are often more or less strongly collapsed.

Conclusions.

- In contrast to the acritarchs which are mainly restricted to the upper Llandovery to lower Wenlock sequence, the chitinozoans are present in almost all series of the Upper Ordovician to Lower Devonian succession of the Cellon section.

  In several samples (46A, 141, 74, 76, 149A, 150, 81, 84, 89) they occur with large numbers of individuals and usually great diversity.

- The chitinozoan assemblages of the upper Ashgill and upper Llandovery strata separated by a gap of two stages are easily to distinguish.

  The boundaries between the Llandovery and Wenlock, and the Wenlock and Ludlow, respectively, cannot be established by the aid of chitinozoans as these fossils are missing throughout the Wenlock and also in the lower Ludlow.

  With regard to the chitinozoans, the position of the base of the Pridoli in the Cellon section is not yet clear and needs further investigations.

  However, the base of the Lochkovian is well documented by diagnostic chitinozoan associations.

  Several chitinozoan biozones can be identified:
  - the Hirnantian *Tanuchitina elongata* - Biozone;
  - the upper Aeronian - lower Telychian *Eisenackitina dolioliformis* - Biozone;

- the upper Telychian *Angochitina longicollis* - Biozone;
- the upper Gorstian - lower Ludfordian *Angochitina elongata* - Biozone;
- the uppermost Ludfordian *Eisenackitina barrandei* - Biozone;
- the Pridolian *Urnochitina urna* - Biozone;
- the lower Lochkovian *Eisenackitina bohemica* - Biozone.

◆ Obviously, environmental conditions were more favourable for the chitinozoans in the upper part of the section than in the lower. Starting with the topmost layer of the Kok Formation [upper Ludlow] up to the lower Lochkovian they show greater diversities and larger numbers of individuals and also better preservation than in the lower part.

Presently, the reasons for the occurrence of at least some chitinozoans in the unfavourable high energy environment of the Plöcken Formation and their absence in the off-shore low-energy facies of the Uggwa Limestone and the Uggwa Shale are difficult to explain.

◆ The Hirnantian-age chitinozoans of the Cellon section show a pronounced relationship with assemblages of the Northern Gondwana cold-water realm, while in the Silurian and Lower Devonian their affinities to representatives of the warm-water environments of Baltica/ Avalonia are obvious.

Because of the palaeogeographic vicinity of the two depositional areas, the Silurian-Lower Devonian chitinozoans of the studied section are very similar to those from Bohemia which is especially true for the upper Ludlow to lower Lochkovian sequence [DUFKA, 1992; KRIZ, 1992; KRIZ et al. 1986; PARIS & KRIZ, 1984; PARIS et al., 1981].

On the other hand in the Cellon section samples from the base of the Wenlock to the lower Ludlow yield no chitinozoans whereas in Bohemia diverse faunas can be obtained from coeval strata [KRIZ, 1992; KRIZ et al., 1993]. This phenomenon might be caused by unfavorable conditions for the chitinozoans' preservation [e.g. high hydrodynamic regime in a shallow sea, at least temporary; oxidation] in the sedimentary environment of the Cellon section.

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