The Chitinozoans in the upper Ordovician to lowermost Devonian succession of the Cellon-Section. – A preliminary report.

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Introduction.

The investigations of the chitinozoans from the Cellon section [Caradoc- Lochkovian] were part of a project with the goal of examining the geographic and stratigraphic distribution of the main palynomorph groups (acritarchs, chitinozoans, spores) within the different environments of the upper Ordovician to lower Devonian series in the Carnic Alps.

In the Silurian, the period mainly concerned by this research, these environments are: the "Plöcken Fazies", a shallow water environment with predominantly calcareous deposits; the "Bischofalm Fazies", a siliciclastic basinal environment, and the transitional "Findenig Fazies", mediating between the former two [the nearshore environment ("Wolayer Fazies") with strongly condensed sediments of very shallow water has not yet been studied].

In none of these facies *spores* could be observed. The *acritarchs* turned out to be highly influenced by the local environments. Their only remarkable occurrence is in the Lower Silurian of the Cellon section which belongs to the calcareous shallow water facies [PRIEWALDER, 1987].

The *chitinozoans* however, proved to be the geographically and stratigraphically widest distributed group of the palynomorphs.

From the siliciclastic and the transitional facies altogether 79 samples have been examined so far by spot checks to estimate the appearance of the chitinozoans: 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 of them [= 51%] yielded chitinozoans.

As the chitinozoans were opaque to transmitting light the investigations had to be carried out 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 on gross determinations only. Detailed morphological studies have yet to be done and will result in more diverse chitinozoan associations at many horizons of the Cellon section.

In the studied section, the chitinozoans appear in the following sequences [Fig.1]:

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

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to the lower-most Rauchkofel Limestone [Ludlow/Pridoli boundary - lowermost Lochkovian].

The Chitinozoans of the upper Ordovician.

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

Stratigraphically the chitinozoans make their debut in sample ***126*** at the base of the Plöcken Formation with a few insignificant specimens of the genera *Conochitina EISENACK 1931* and *?Tanuchitina JANSONIUS 1964*. Further, numerous melanosklerits with a strong resemblance to chitinozoans can be observed, as well as chitinozoan-like graphitic particles.

At the top of this formation 3 assemblages [samples ***128***, ***129***, ***45***] contain representatives of the genera *Conochitina*, *Desmochitina EISENACK 1931 [e.g., Desmochitina minor EISENACK 1931]*, *?Rhabdochitina EISENACK 1931*, *Spinachitina SCHALLREUTER 1963* and of the Ancyrochitininae, but most of all two taxa which are diagnostic for the Ashgill: *Armoricochitina nigerica (BOUCHÉ 1965)* and *Tanuchitina elongata (BOUCHÉ 1965)* thus indicating the Hirnantian ***Tanuchitina elongata*** - **Biozone** (PARIS 1990).

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

The Chitinozoans of the upper Llandovery.

Between the Ordovician Plöcken Formation and the overlying Silurian Kok Formation there is a large stratigraphical gap comprising the entire Rhuddanian and also the Aeronian.

The lowermost part of the Kok Formation [samples ***46A***, ***47***, ***130***, ***131***] yielded chitinozoan faunas with a great number of undeterminable specimens of the Lagenochitinidae and the Ancyrochitininae and taxa such as *Ancyrochitina* gr. *ancyrea (EISENACK 1931)*, *Cyathochitina caputoi DA COSTA 1971*, many specimens of *Bursachitina TAUGOURDEAU 1966* and *Conochitina* [e.g., *C.sp. cf. emmastensis NESTOR 1982]*, as well as *Eisenackitina dolioliformis UMNOVA 1976* which is a very characteristic Cellon-species and the index species of the upper Aeronian-lower Telychian ***Eisenackitina dolioliformis*** - **Biozone** [VERNIERS et al.1995].

Also the upper Telychian part of the Kok Formation [samples ***49***, ***50***, ***132***, ***133***] is rich in chitinozoans. Less important taxa are representatives of *Cyathochitina EISENACK 1955*, *Eisenackitina JANSONIUS 1964*, *Lagenochitina EISENACK 1931 and Sphaerochitina EISENACK 1955*. However, here also occurs one *Conochitina*-species [besides several others] which is similar to the important upper Telychian to lower Sheinwoodian *C.proboscifera EISENACK 1937*, and an *Angochitina*-species which closely resembles *A.longicollis EISENACK 1931, suggesting* the ***Angochitina longicollis*** - **Biozone** [VERNIERS et al.1995] of upper Telychian age.

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.

The Chitinozoans of the Wenlock - lower Ludlow.

Throughout the Wenlockian sequence of the Cellon section, the strata of which attain a thickness of only 5 meters thus indicating an extreme condensation [SCHÖNLAUB 1997], and also in the lower Ludlow , that means, in the middle and upper part of the Kok Formation, associations of determinable chitinozoans are missing. Only sporadic and badly preserved fossils are present [samples ***135, 54, 136, 56***].

The 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.

The assemblages are dominated by *Angochitina-* [e.g., *A. echinata EISENACK 1931*], *Sphaerochitina-* [e.g., *S.sp.* cf. *impia LAUFELD 1974*], *Belonechitina-* and *Conochitina* - species [*e.g., B.sp.* cf. *latifrons (EISENACK 1964), B.sp. cf. lauensis (LAUFELD 1974)* and *C.sp.* cf. *tuba EISENACK 1932*].

Furthermore, some representatives of the genera *Ancyrochitina EISENACK 1955, Bursachitina TAUGOURDEAU 1966, Cingulochitina PARIS 1981, Eisenackitina JANSONIUS 1964* and *Linochitina EISENACK 1968* appear.

At the base of this sequence however, an *Angochitina*-fragment resembling *A.elongata EISENACK 1931* was found, consequently referring the Cardiola Formation to the upper Gorstian-lower Ludfordian ***Angochitina elongata*** - **Biozone** [VERNIERS et al.1995].

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

From the base of the Alticola Limestone up to the end of the Ludlow, the examined samples did not yield chitinozoans.

The Chitinozoans of the uppermost Ludlow to the lower Lochkovian

From the Ludlow/Pridoli boundary beds within the Alticola Limestone up to the end of the examined section in the lower part of the Rauchkofel Limestone of lower Lochkovian age, numerous diverse chitinozoan assemblages occur.

At the base of this succession [sample ***73*** = uppermost Ludfordian; samples ***74***, ***75*** =

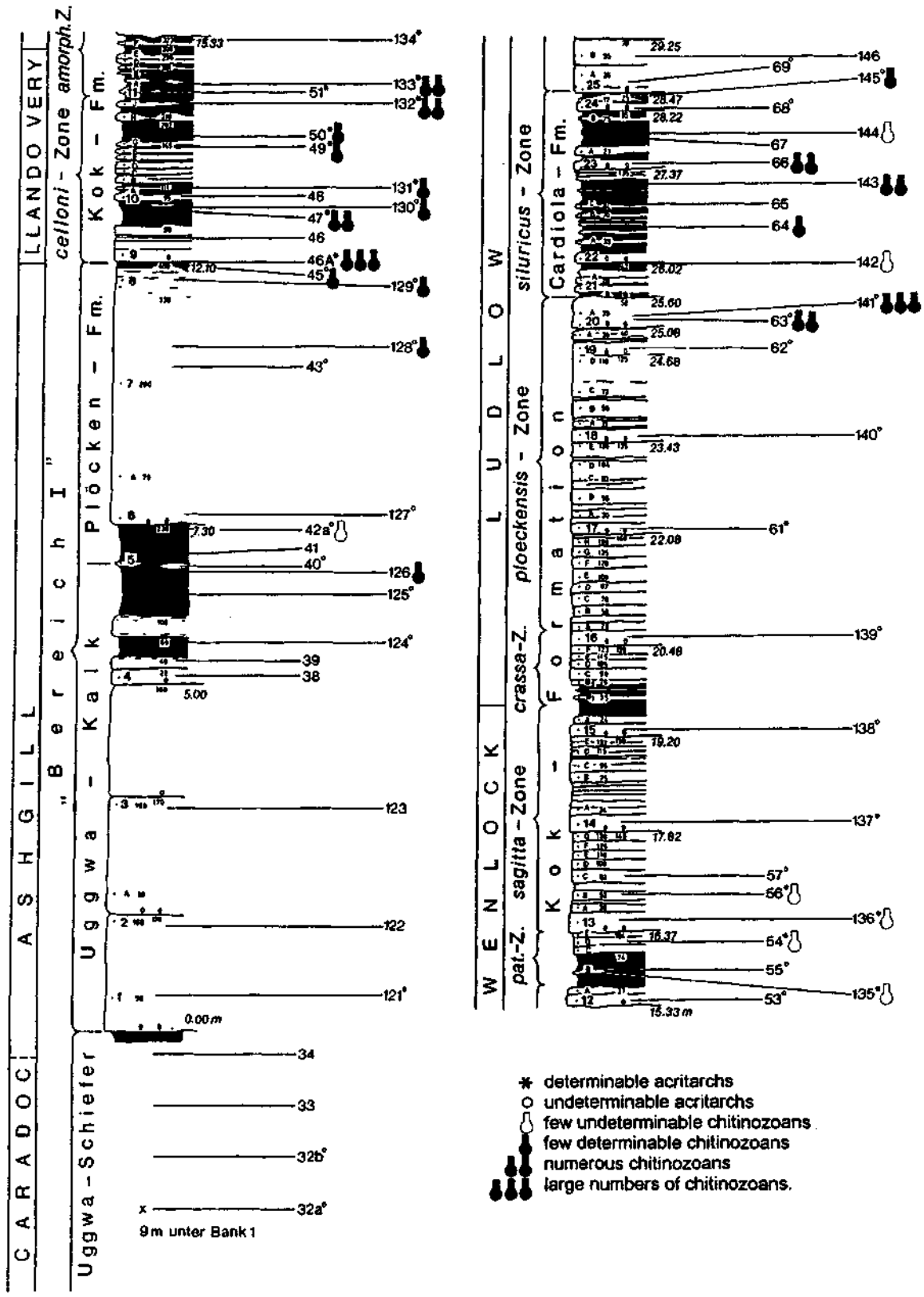
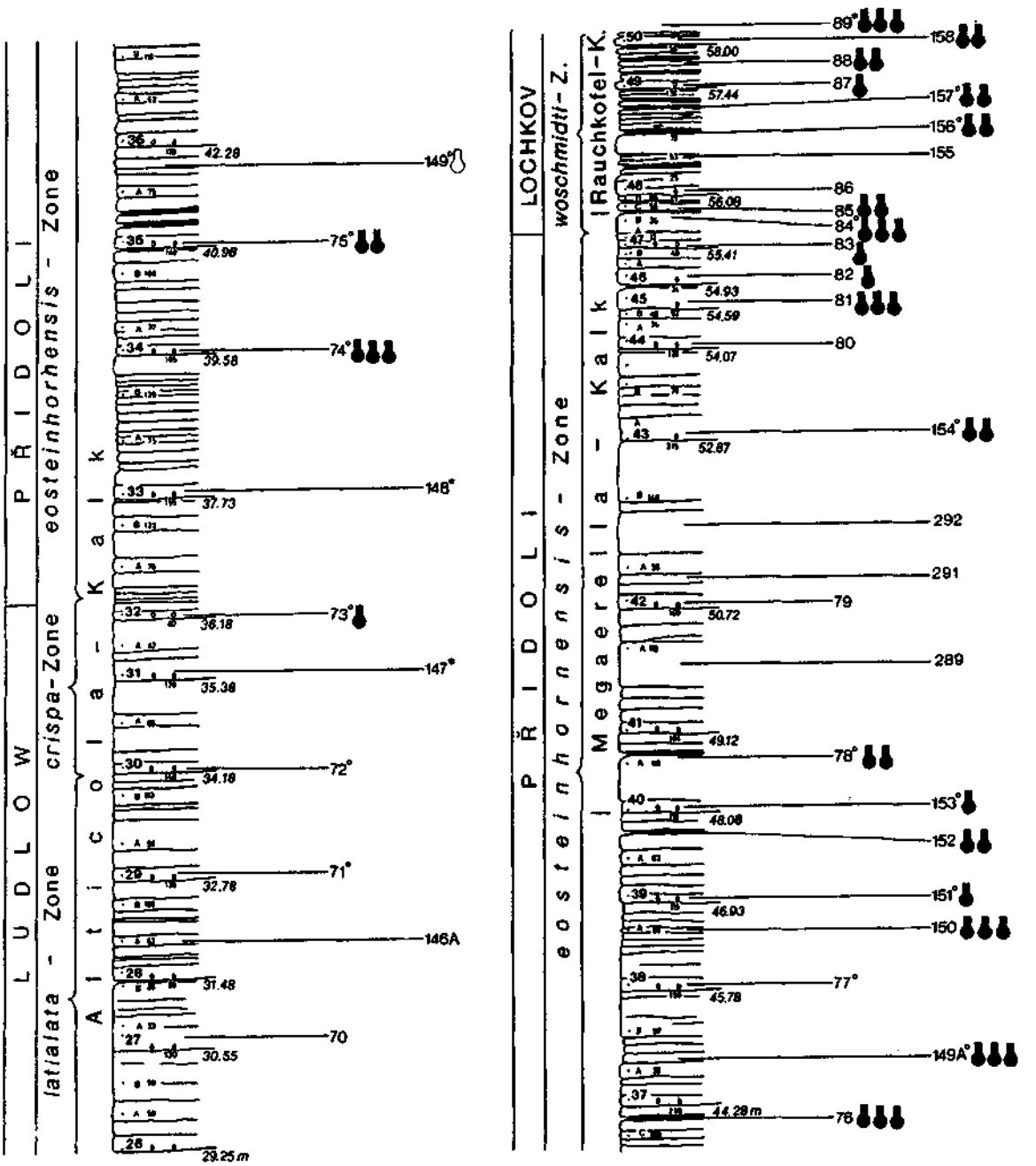


Fig.1: The location of the samples in the Cellon-section (drawing of the section after SCHÖNLAUB 1985).


LUDLOW
PŘÍDOLI
latialata - Zone
crispa-Zone
eosteinhorhensis - Zone
Litiscolaia - Kalk
PŘÍDOLI
LOCHKOV
eosteinhornensis - Zone
woschmidti-Z.
Megaerella - Kalk
Rauchkofel-K.
42.28
40.98
39.58
37.73
36.18
35.36
34.18
32.78
31.48
30.55
29.25 m
58.00
57.44
56.09
55.41
54.93
54.59
54.07
52.87
50.72
49.12
48.08
46.93
45.78
44.28 m
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

lower Pridoli] *Ancyrochitina* gr. *ancyrea (EISENACK 1931), Eisenackitina granulata (CRAMER 1964), E. intermedia (EISENACK 1955), Sphaerochitina* cf. *sphaerocephala (EISENACK 1932), some Angochitina EISENACK 1931, Bursachitina TAUGOURDEAU 1966 , Gotlandochitina LAUFELD 1974* and the stratigraphically most important taxa *E. barrandei PARIS & KRIZ 1984* and *Urnochitina urna (EISENACK 1934),* the latter in an atypical version, are present.

E.barrandei is the index species of the uppermost Ludfordian ***Eisenackitina barrandei* - (total range) - Biozone** of VERNIERS et al. 1995, while the total range of *U.urna* defines the entire Pridoli.

At the global stratotype section of the Ludlow/Pridoli-boundary at Pozáry Quarry (Prague Basin, Bohemia), the two species occur together within a very short intervall in the Ludfordian/Pridoli – boundary-beds. Compared to the ranges of *E. barrandei* and the atypical *Urnochitina urna* in the Cellon section, some discrepances are obvious which have to be settled by further studies.

The assemblages of the upper part of the Alticola Limestone and the lowermost Megaerella Limestone [samples ***149, 76, 149A, 150, 151, 152, 153, 78, 154***] are generally dominated by typical *U.urna*. Further important species are *E. granulata* and *Bursachitina krizi (PARIS & LAUFELD 1980),* the latter makes its debut in sample ***149A*** with large quantities of individuals and then after a sudden and drastic reduction in the number of specimens disappears in the upper Megaerella Limestone. Some insignificant specimens of *Ancyrochitina, Angochitina, Linochitina* and *Sphaerochitina* are co-occurring.

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

Above this level the chitinozoan fauna starts to rearrange: *U.urna* loses its numerical dominance, while representatives of other genera like *Angochitina EISENACK 1931, Cingulochitina PARIS 1981, Gotlandochitina LAUFELD 1974, Linochitina EISENACK 1968, Sphaerochitina EISENACK 1955* and especially *Ancyrochitina EISENACK 1955* become more and more frequent.

The uppermost Pridolian samples [***81, 82, 83***] of which the lower one yielded an enormous amount of chitinozoans are represented -among others - by *Linochitina klonkensis PARIS & LAUFELD 1980, Calpichitina corinnae JAGLIN 1986, Sphaerochitina* cf. *sphaerocephala (EISENACK 1932),* very few specimens of *U. urna (EISENACK 1934)* and a distinctiv *Ancyrochitina*-species provided with simple processes with very broad bases.

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 which are the ***Fungochitina kosovensis* -,** the ***Margachitina elegans* –** and the ***Anthochitina superba* – Biozones** of VERNIERS et al.1995, could not be identified at Cellon.

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

The chitinozoan assemblage of sample ***85*** contains a few *Angochitina* and *Cingulochitina* and also several well preserved *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].

The remaining samples in the Cellon section [***156***, ***157*** , ***87*** , ***88*** , ***158*** and ***89***, the latter with a large number of chitinozoans] are dominated by numerous *Ancyrochitina* [at least 5 different species]. Moreover, there occure different taxa 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 specimens; thinner-walled individuals are often more or less strongly collapsed.

Conclusions.

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

In several samples [***46A***, ***141***, ***74***, ***76***, ***149A***, ***150***, ***81***, ***84***, ***89***] the chitinozoans occur with large numbers of individuals and generally great diversity.

2.) The chitinozoan assemblages of the Ashgillian and the upper Llandoverian strata of the Cellon section, which rest conformably one upon the other but are seperated by a large stratigraphical gap are unequivocally different and in each case typical for their ages.

The Llandovery/Wenlock-boundary and the Wenlock/Ludlow-boundary, respectively, cannot be established by the aid of chitinozoans because these fossils are missing throughout the Wenlock and also in the lower Ludlow.

As for the chitinozoans, the position of the Ludlow/Pridoli- boundary in the Cellon section is not yet clear and needs further inverstigations.

Finally, the base of the Lochkovian is well documented by diagnostic chitinozoan assemblages.

Almost all of the chitinozoan bearing sequences of the Cellon section can be assigned to the existing global chitinozoan biozones. These are:

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.

3.) Obviously, environmental conditions were more favourable for the chitinozoans in the upper than in the lower part of the section: Starting with the topmost layer of the Kok Formation [upper Ludlow] up to the lower Lochkovian Rauchkofel Limestone, the assemblages show greater diversities, larger numbers of individuals and also better preservation than in the upper Llandoverian to lower Ludlowian Kok Formation. This is in

good accordance with the results of recent studies concerning the environmental development of the Cellon section, suggesting more stable pelagic conditions from the Alticola Limestone onward [HISTON & SCHÖNLAUB, 1999 (in press)].

However, presently the reasons for the occurence 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.

4.) 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.

Most probably because of the palaeogeographic vicinity of the two depositional areas, the Silurian and lower Devonian chitinozoans of the studied section are very similar to those from Bohemia (so far, only very few and insignificant chitinozoan associations have been observed in the Ashgillian of the Barrandean region) [DUFKA, 1992; DUFKA & FATKA, 1993; 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 succession did not yield determinable 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 in the sedimentary environment of the Cellon section, like a high hydrodynamic regime in a very shallow sea - at least temporary, non-deposition of protecting sediment, oxidation.

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