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RELATION OF THE NERITIC MICROFAUNAS AND CONTINENTAL MICROFLORAS WITH THE CONODONT AND OTHER PELAGIC FAUNAS WITHIN THE LATEST PART OF THE FAMENNIAN WITH A FEW, NEW ADDITIONAL DATA AND A SYNTHETIC CORRELATION CHART

(SDS Annual Meeting Rabat, March 1st and 2nd, 2004)

(new data given below in Courier New)

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The existence of a transitional Devonian-Carboniferous fauna was mentioned by Gosselet as early as 1857 in the Etroeungt area (Avesnois, northern France). The base of the Etroeungt Formation (Bultynck & Dejonghe 2001), in the recent Bochut Quarry for instance, corresponds approximately to the transition between the foraminifers *Quasiendothyra communis* and *Q. kobeitusana* (Mamet & Prét 2003). A chronostratigraphic unit (Latest Famennian) has now to be recognized which would make an end to the long standing uncertainties regarding the definition of the so widely and internationally used terms Strunian or Etroeungt (Sartenaer 1997, Becker 1998).

Some of the formerly proposed bases for this unit (Tn1a base in Conil et al. 1964 and following papers) are found in the railway section of Avesnelles (now partly walled), starting at the Epinette transgressive level which corresponds approximately to the base of the *Eoendothyra communis radiata* (DF3δ) foraminifer Zone and to the base of the *Retispora lepidophyta - Knoxisporites literatus* (LL) miospore Zone. The next *Quasiendothyra kobeitusana kobeitusana* (DF3ε) foraminifer Zone starts higher but well below the Etroeungt Limestone (Fig. 1). Foraminifer *Q. kobeitusana* and miospore *R. lepidophyta* have a wide distribution around the world (Streel et al. 1998, fig. 3).

The calibration of these biostratigraphic markers with the conodont standard zonation needs moving to central and eastern Belgium and western Germany.

In the Anseremme section (Meuse valley, central Belgium, Dreesen & Thorez, 1994 and C.A. Sandberg in Casier et al. 2004) the succession Middle/Late *expansa* is found near but slightly above the base of *Quasiendothyra kobeitusana kobeitusana*.

In the Chanxhe section (Ourthe valley, eastern Belgium) the Late *expansa* conodont Zone is present between DF3δ and DF3ε foraminifer Zones. Above the DF3ε foraminifer Zone occurs the next *Retispora lepidophyta-Indotriradites explanatus* (LE) miospore Zone (Streel et al. 2003, fig. 1). Until very recently the base of the Late *expansa* Zone was unknown in the area but new data from the Refrath 1 borehole (Bergisches Land, western Germany) allow now to fill this gap in our knowledge. The lower part of the LL miospore Zone (with presumed ancestor *Retispora macroreticulata* and large specimens of *R. lepidophyta*) corresponds to the Middle *expansa* conodont Zone and to the early *hemisphaerica-dichotoma* ontomozocean Zone (Groos-Uffenorde, in press; Hartkopf-Fröder, in press; Piecha, in press) (Fig. 2). The conclusion is that the base of the Late *expansa* conodont Zone and the base of the *Q. kob. kobeitusana* (DF3ε) foraminifer Zone are obviously much closer than believed so far. The continental to neritic facies scheme shows now (Fig. 5) three steps of potential biostratigraphic markers to help defining a Latest Famennian.

This scheme can be applied to huge regions in Eurasia particularly in Belarus and Timan-Pechora (Durkina, Dreesen & Streel in Streel 2001, tab. 2) and, partly by miospores (Filipiak 2004), in the Kowala trench (Holy Cross Mountains, Poland).

The transition from the neritic to the pelagic facies is stratigraphically progressive in Poland near the Variscan Front. On the Holy Cross Mountains side, at a level higher than the lower LL Zone known in the Kowala trench, the Kowala I

borehole shows (Nehring-Lefeld 1990) Late *expansa* to Early *praesulcata* conodont faunas with *Bispathodus ultimus* and *Pseudopolygnathus marburgensis trigonicus* in succession. However the neritic / pelagic transition is sharper in the Dzikowiec Quarry on the Sudetes Mountains side. The contact of both facies is between the highest part of the neritic Main Limestone with foraminifers Df3δ and Df3ε, below and the pelagic Clymeniid Limestone with ammonoids of the *Wocklumeria* Zone, above (Streel et al. 2003, fig. 3). In both facies conodont data were known after Freyer (1968) as belonging to the *expansa* to *praesulcata* Zones but more detailed data are now available, although still unpublished, provided by Belka (unedited) and Haydukiewicz (unedited). After these authors, the Clymeniid Limestone belongs to the Late *expansa* – Early *praesulcata* Zones with *Bispathodus ultimus*, *Palmatolepis gracilis gonioclymeniae* and *Pseudopolygnathus marburgensis trigonicus*, *B. ultimus* occurring slightly above the two other species after Dupieralska & Belka (in press). From a manuscript document provided by J. Haydukiewicz and new data provided by Dupieralska & Belka (in press) the lowest specimen of *Siphonodella praesulcata* occurs about 1 m above the neritic/pelagic contact, i.e., according to new ammonoid data by Korn (unedited) near, but below, the *sublaevis/parundulata* limit (Fig. 3). A sample located 50 cm below the top of the neritic facies provided conodonts indicative of the interval from the Early *expansa* to the lower part of the Middle *expansa* Zone but, approximately 30 cm higher, still in the Main Limestone, there is a breccia horizon and the top of this unit is erosional in character. Thus there is at least a small stratigraphic gap between the neritic and the pelagic facies. Consequently, the contemporaneity of the base of the *Q. kob. kobeltusana* foraminifer Zone and the base of the Late *expansa* conodont Zone is not invalidated by these observations.

Many authors have collected material from this famous quarry but rarely using exactly the same log or collecting for different fossil groups using the same bed numbers. As the available thickness of the Clymeniid Limestone is quite variable along the walls of the quarry, this situation does not help defining accurate limits.

Defining the base of the Late *expansa* conodont Zone in pelagic facies is questionable. It was defined by Ziegler & Sandberg (1984) on the entry of *Bispathodus ultimus*, with *Palmatolepis gracilis gonioclymeniae*, *Pseudopolygnathus marburgensis trigonicus* and *Branmehla suprema* having their first occurrence within the zone. However, *Bispathodus ultimus* being unknown in the Great Basin and Rocky Mountain regions of North America, the lower boundary of the Late *expansa* Zone was defined, there, by the lowest occurrence of *Pseudopolygnathus marburgensis trigonicus*, *Polygnathus vogesi*, or *Protognathodus meischneri* (Sandberg 1979, p.97).

The base of the Late *expansa* Zone has been intensively investigated in the Carnic Alps by Perri & Spalletta (1998 and new unpublished data). Four sections are concerned: Rio Boreado (RB), Casera collinetta di Sotto A (CSA), Malpasso (ML) and Sentiro Storico A (SSA). In all four sections, *B. ultimus*, *Ps. marb. trigonicus* and *Pa. grac. gonioclymeniae* occur at the same level, not in succession. Resampling of the Malpasso section did not provide better results than before. Three new samples (8d, 8a, 7c) were taken in a one meter interval below the first Late *expansa* fauna (ML9) (Fig. 4) but no *Pa* element of *B. ultimus* appeared. Transitional forms between *Branmehla fissilis* and *Br. suprema* were recognized in ML7e and ML8a. In ML8d (few cm below ML9) one specimen of *B. suprema* have been identified, a species which is reported in literature from the lower half of the Late *expansa* Zone.

The Malpasso section in the Carnic Alps was also investigated by Korn (1998) allowing a direct correlation between ammonoid and conodont zonations (Fig. 4). However the base of the *sublaevis* Zone being not reached, the correlation not more accurate than in the Dzikowiec Quarry in Poland. Therefore it is not known so far if the "Wocklum German Stufe" base has to be correlated with the latest Middle, the base or the earlier Late *expansa* Zone.

The *Bispathodus ultimus* base is shown in relation with the foraminifer *Quasiendothyra kobeltusana kobeltusana* base and the pelagic conodonts *Palmatolepis gracilis gonioclymeniae* and *Pseudopolygnathus marburgensis trigonicus*, from the Dinant Basin (Belgium) to the Carnic Alps (Italy) (Fig.5)

In conclusion, a continental to pelagic facies scheme can now (Fig.6) be completed, showing three steps of potential biostratigraphic markers to help defining a Latest Famennian. They group into three levels (3-4, 5-6, 7-8) the former 3 to 8 biostratigraphic levels recognized in Streel (2001, tab. 1). The middle level (5-6) is the nearest to the original definition of the Etroeungt in the type region. Well above the Epinette transgressive level it corresponds to a rather high sea-level reached just before the inception of the Gondwanan end-Famennian glaciation (Miospore Zones LE and LN) which culminated in a deep regression immediately after the Hangenberg Event. More locally, the Variscan orogeny, i.e. at Dzikowiec (Poland), or the Antler orogeny in the western United States (C.A. Sandberg personal communication), may interfere with this global glacio-eustatism.

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Fig. 1: The Avesnelles-St-Hilaire section in the Etroeungt area (northern France): Litho- and biostratigraphic data.

Fig. 2: The Chanxhe section in eastern Belgium and the Refrath 1 Borehole in western Germany: biostratigraphic data. (Groos-Uffenorde, in press ; Hartkopf-Fr der, in press ; Maziane et al. 2002 ; Piecha, in press)

Fig. 3: The Dzikowice Quarry in the Sudetes Mts (Poland) : biostratigraphic data.

Fig. 4: The Malpasso section in the Carnic Alps (Italy): biostratigraphic data.

Fig. 5: Uppermost Famennian synthetic correlation chart

Fig. 6: Biostratigraphic correlation from continental to neritic and pelagic facies in the latest part of the Famennian. (3-4, 5-6, 7-8 see Street, 2001, tab. 1)

Working Groups

THE GIVETIAN WORKING GROUP

PROPOSAL FOR A THREEFOLD SUBDIVISION OF THE GIVETIAN

Aboussalam & Becker (2002) proposed the base of the *hermanni* conodont Zone as the base of an Upper Givetian Substage emphasizing that it represents an important conodont and ammonoid event corresponding to a significant eustatic sea-level rise. The base of the *hermanni* Zone is characterized by several marker conodonts that are widely distributed. The consequence of a definition of an Upper Givetian Substage at this level is that in most Givetian successions, pelagic and neritic, a Lower Givetian Substage will represent a much longer-lasting period than the Upper Givetian. For this reason a more time-balanced threefold subdivision is proposed. The base of the *rhenanus/ varcus* Zone (Bultynck 1987) = upper part of the Lower *varcus* Subzone of Ziegler, Klapper & Johnson 1976 is recommended as the base of a Middle Givetian Substage. The basic criteria for a threefold subdivision of the Givetian are summarized in Fig. 1.

DEFINITION OF THE BASE OF A MIDDLE GIVETIAN SUBSTAGE

Preliminary comments concerning the validity of *Polygnathus rhenanus* and the *varcus* Zone and Subzones

The holotype of *P. rhenanus* is from a level just below the lower *pumilio* bed at Syring quarry near Oderhausen, Germany (Klapper et al. 1970). According to Lottmann (1990, p.91) this level is about 0.60 m below the first occurrence of *P. ansatus* in that section (note that in the figure p.91 the base of the Middle *varcus* Subzone is drawn too low according to its definition by Ziegler et al. 1976). These authors also regarded *P. timorensis* as a senior synonym of *P. rhenanus* "because the latter seems to have been based on a juvenile specimen of *P. timorensis*". I agree that the holotype of *P. rhenanus* is not a fully adult specimen but Bultynck 1987 (pl.7, figs.13-15) figures adult specimens of *P. rhenanus* that can be easily separated from adult specimens of *P. timorensis* (ibidem pl.7, fig. 9) by the very long free blade and the short, clearly asymmetrical platform, due to the prominent outward bowing of the outer anterior trough margin. Klapper (1980, 1981) introduced a form of *P. timorensis*, specifying that it corresponds to *P. rhenanus*. The latter species is recognized and figured by Sparling 1999, including synonym list, Garcia-Lopez & Sanz-Lopez 2002 and Kaufmann 1998. So *P. rhenanus* is regarded here as a valid species.

In Fig.1 the *timorensis*, *rhenanus/ varcus*, *arsatus* and *semialternans/ latifossatus* Zones are used instead of the Lower, Middle and Upper *varcus* "standard" subzones. Although the use of the Lower, Middle and Upper *varcus* Subzones is deep-seated in conodont literature, *P. varcus* itself is not the critical species for recognizing the base of these subzones according to their definition by Ziegler et al. 1976. Moreover, figured specimens that conform to the revised diagnosis of *P. varcus* by Klapper et al. 1970 are rare. Ziegler et al. 1976 redefining the *varcus* Zone do not figure any *P. varcus*. From the distribution tables in the same paper it appears that *P. varcus* first occurs well above the base of the zone and that in the studied North American sections it occurs only in a few samples. Huddle 1981 did not recognize it in the Givetian of New York. Rodgers 1998 who among others studied Middle *varcus* Subzone conodonts from Iowa only mention "*P. varcus* group". In the Middle *varcus* Subzone of north-central Ohio Sparling 1999 recognized *P. rhenanus* and *P. arsatus*, both figured, but not *P. varcus*, etc. In my opinion the name *P. varcus* Zone does not reflect the most important changes in the conodont succession of that part of the Givetian and should not be retained only in the interest of nomenclatural stability.

The base of the Middle Givetian in the Moroccan Anti Atlas

The base of the *rhenanus/ varcus* Zone is best documented in the Bou Tchratine Section a hemipelagic succession in the northern Tafilalet (Bultynck 1987) and in the hemipelagic-neritic succession Ou Driss in the Maider (Bultynck 1989; Belka et al. 1997 and Kaufmann 1998).

In the Bou Tchratine section (Bultynck 1987, fig. 4) the Givetian is about 14 m thick and conodonts and goniatites are abundant, for the latter see Becker & House (1994, 2000). *P. rhenanus* and *P. varcus* appear in sample 23; the goniatite *Wedekindella* aff. *Psittacina* first occurs at the same level. Sample 23 is at the top of a sequence with nodular limestones

Bases of the Strunian in the Etroeungt area (Northern France)

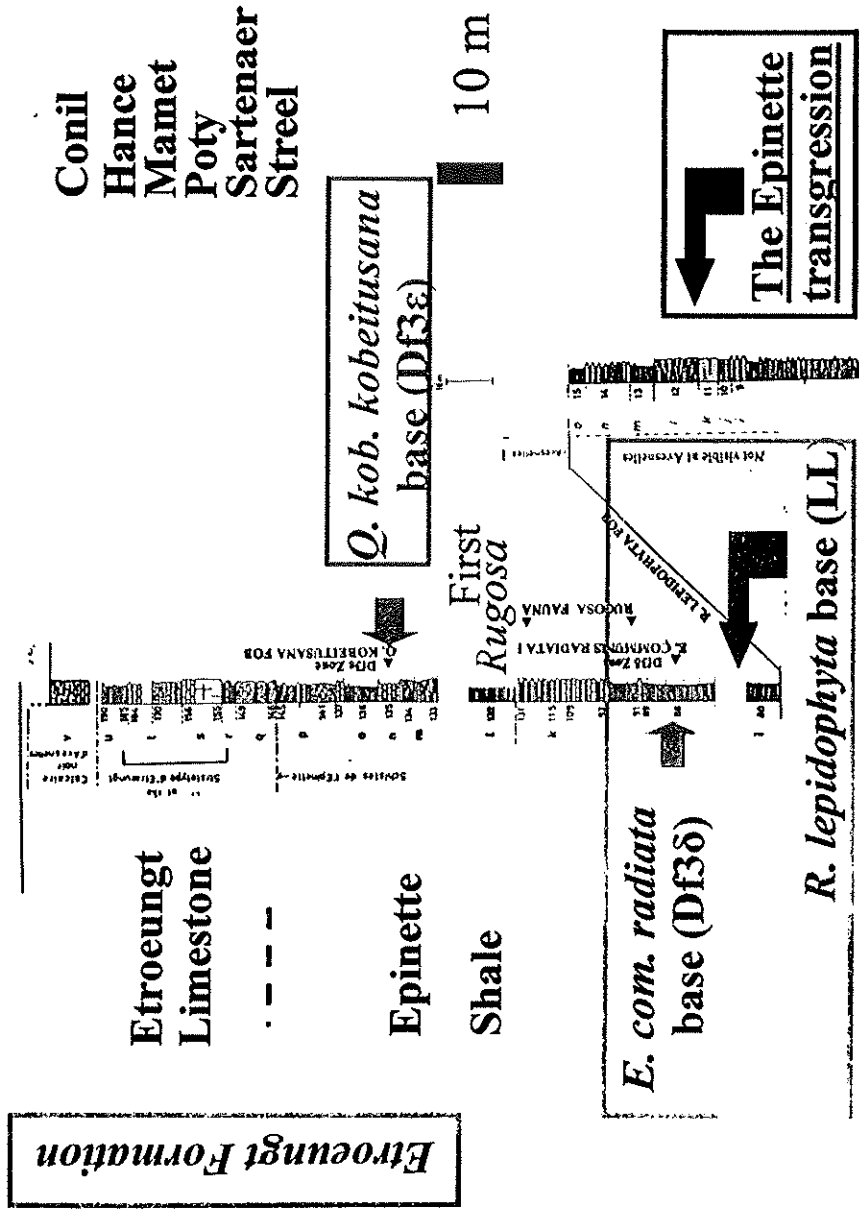


Fig. 1: The Avesnelles-St-Hilaire section in the Etroeungt area (northern France): Litho- and biostratigraphic data.

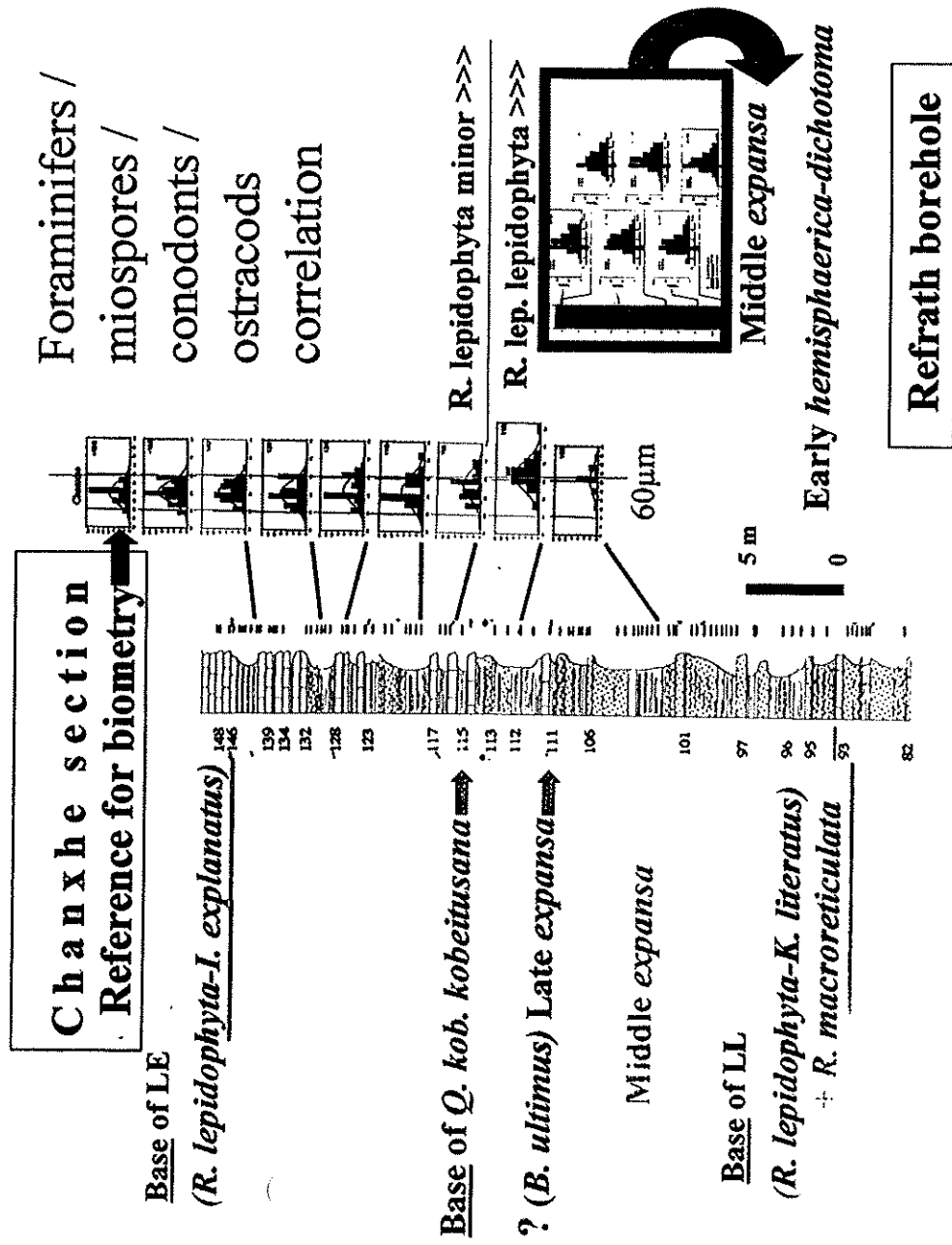


Fig. 2: The Chanxhe section in eastern Belgium and the Refrath 1 Borehole in western Germany: biostratigraphic data. (Groos-Uffenorde, in press ; Hartkoph-Fröder, in press ; Maziane et al. 2002 ; Piecha, in press)

Dzikowiec Quarry: logs and faunas by different authors

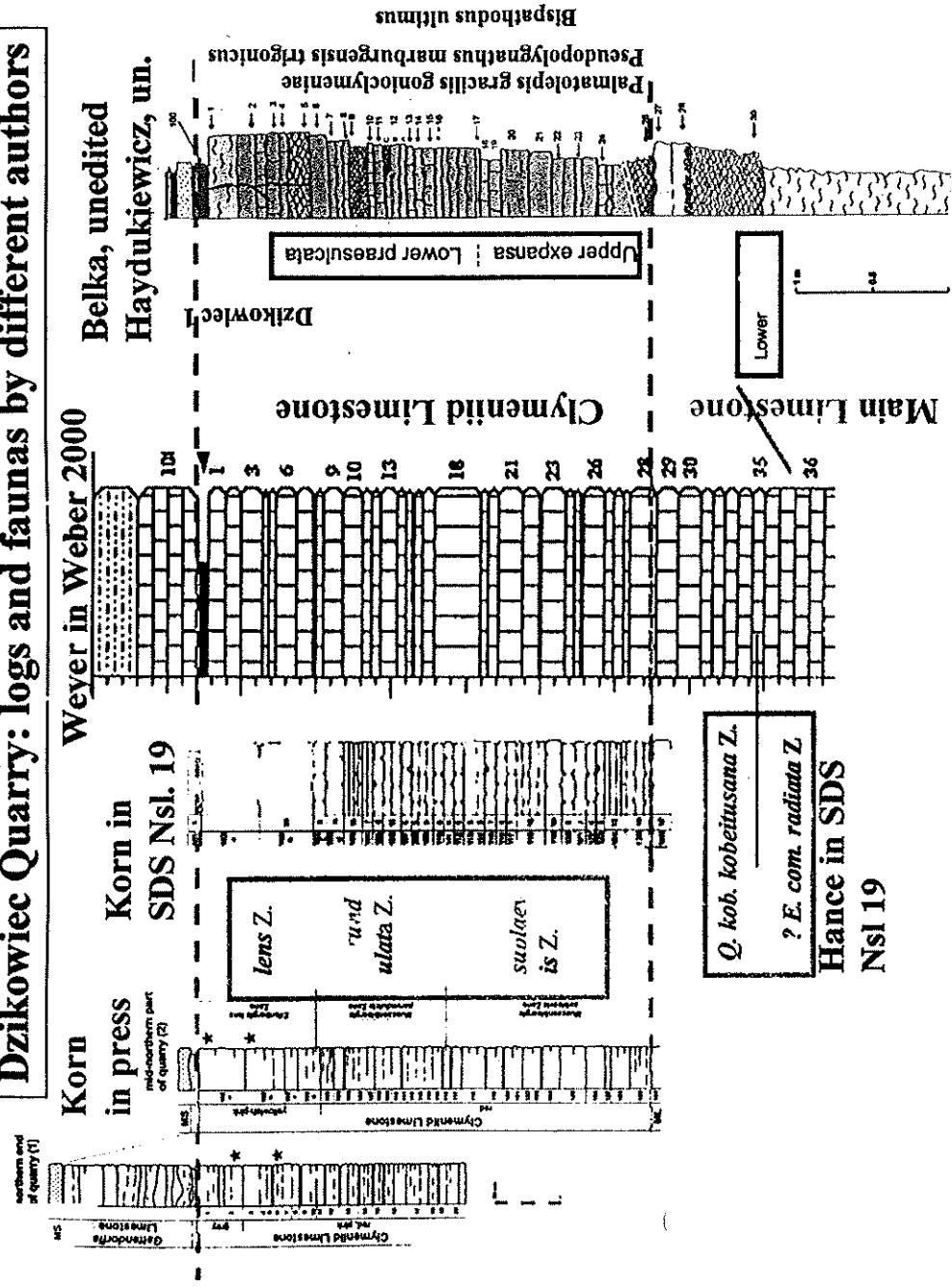


Fig. 3: The Dzikowiec Quarry in the Sudetes Mts (Poland) : biostratigraphic data.

Malpasso (ML)

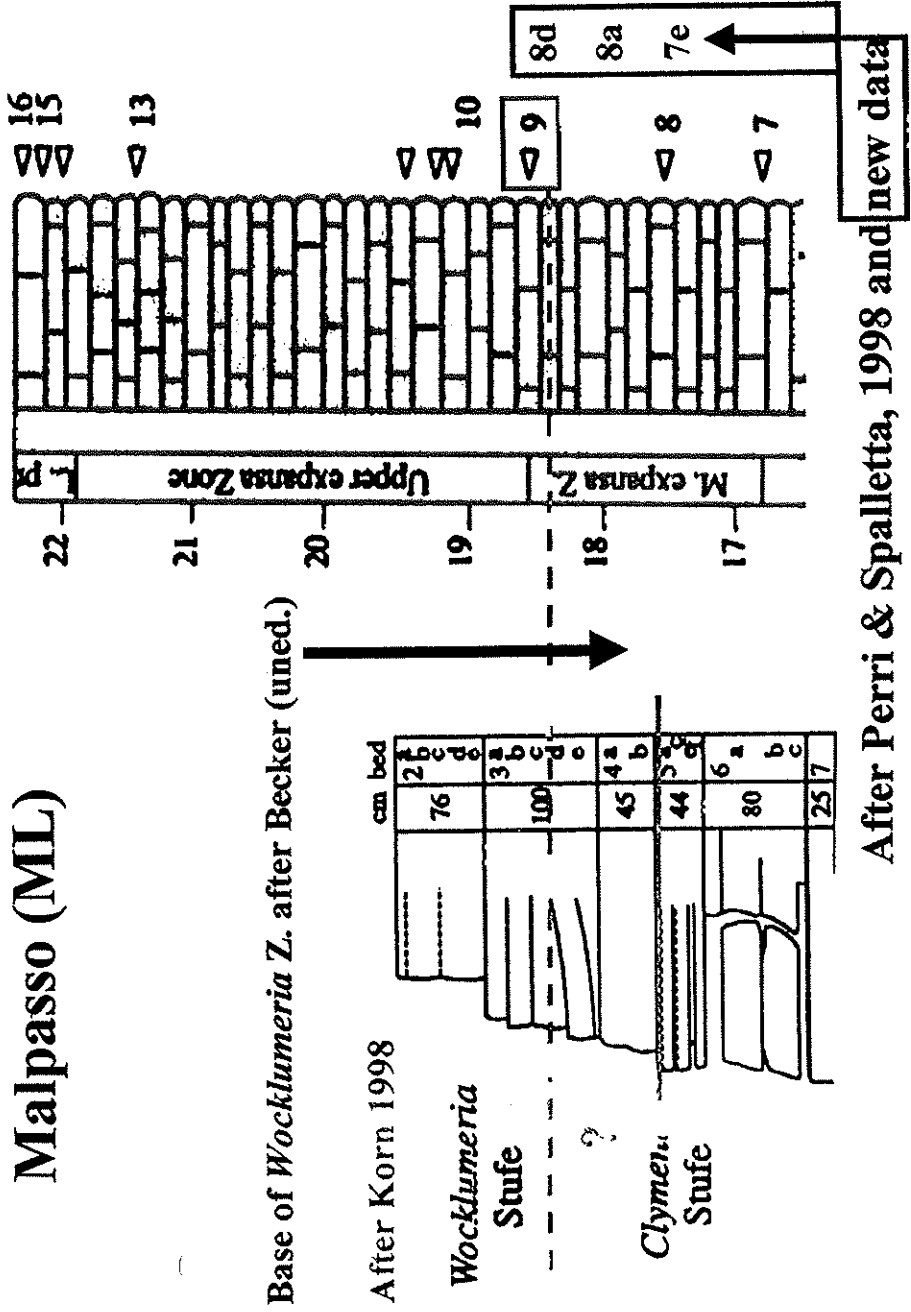


Fig. 4: The Malpasso section in the Carnic Alps (Italy): biostratigraphic data.

The *Bispathodus ultimus* base from the Dinant Basin to the Carnic Alps

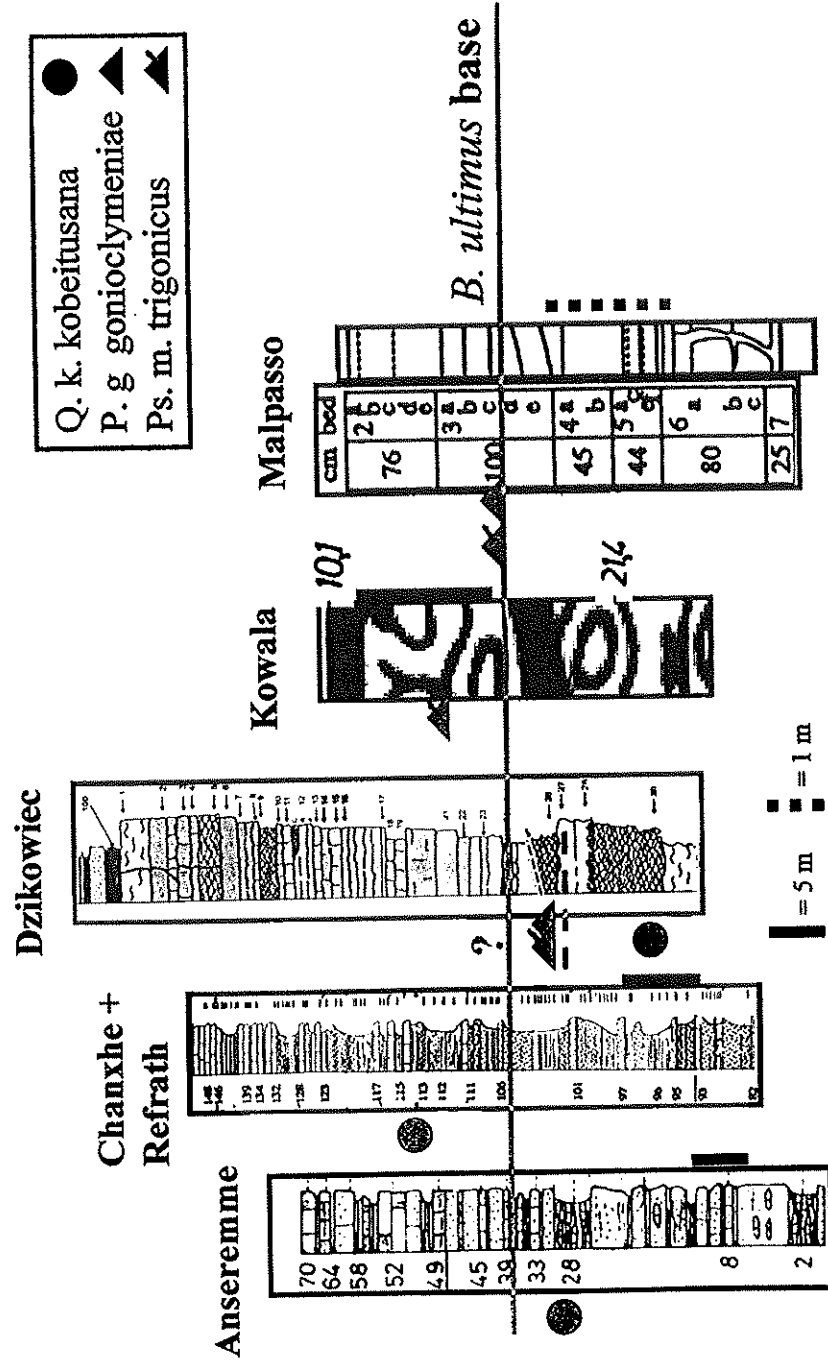


Fig. 5. Uppermost Famennian synthetic correlation chart

CONTINENTAL to NERITIC

R. lepidoph. – *I. explan.* (LE) base

7-8

Early *praesulcata*

PELAGIC

5-6

Late *expansa* *B. ultimus* + *Pa. g. gonioclymeniae*

Q. kob. kobeitusana (Df3ε) base

+ *Ps. marb. trigonicus* base

R. lepidophyta minor >>>

sublaevis base?

3-4

Middle *expansa*

Early *hemisphaerica* – *dichotoma*

E. com. radiata (Df3δ) base

R. lepidophyta – *K. literatus* (LL) base

Fig. 6: Biostratigraphic correlation from continental to neritic and pelagic facies in the latest part of the Famennian. (3-4, 5-6, 7-8 see Streef, 2001, tab. 1)