A REFERENCE SECTION FOR NERITIC FACIES AT THE TRANSITION LATE TO LATEST FAMENNIAN

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The international Subcommission on Devonian Stratigraphy (SDS) has decided to subdivide the Famennian Stage into four substages, which do not require GSSP definitions, but need reference sections in continental, neritic and pelagic facies. We present here a candidate section for a base of the Latest Famennian in neritic facies.

In addition to several macrofossils (algae, brachiopods, crinoids, corals, stromatoporoids, etc), the faunal and floral microfossils at Chanxhe (eastern Belgium) are represented by miospores, acritarchs, conodonts; foraminifers, and ostracods, which allow accurate correlation with other well known sections from western to eastern Europe. The base of the Latest Famennian (Strunian in neritic facies) has already been proposed at the base of the conodont Upper expansa Zone (Streel 2005, Streel et al. 2005) and is used here (see also Thorez et al. 2006) as a chronological limit at the base of bed 111..

The biostratigraphic context of the Chanxhe section is summarized on fig. 1. The miospore zonation has been reviewed by Maziane et al. (1999) and the biometric zonation based on R. lepidophyta diameter sizes, by Maziane et al. (2002). A quantitative analysis of miospores and acritarchs in 111 shaly samples is given on figs. 2 and 3.

Three major limits QC1, QC2, QC3 (QC for Quantitative Change) subdivide the concentration records (amount of miospores or acritarchs per gram of sediment) from the base to the top of the section. QC1 corresponds exactly to the base of the LL Zone and QC3 to the base of the LE Zone. LL and LE Zones start with rather small amounts of palynomorphs (about or less than one thousand per gram). However the LL Zone starts in a marine influenced environment where acritarchs are almost as abundant as miospores. On the contrary the LE Zone starts in an environment where acritarchs are less and less present.(see also fig. 3).

The QC2 limit underlines the first occurrence of Tumulispora rarituberculatus, a miospore species often used in the literature to subdivide the LL Zone. QC2 also corresponds to a quantitative change in the biometry of Retispora lepidophyta as well as in the ratio R. lepidophyta versus miospores originating from "coal" swamp environment as explained in Maziane et al. (2002). Below QC2 limit, the diameter sizes of R. lepidophyta are obviously linked to some sedimentary sorting and the miospores originating from "coal" swamp, more abundant than above, a probable consequence of a high fresh water level on the continent. These limits might well correspond to some minor gaps (hiatus) in the sediment record.

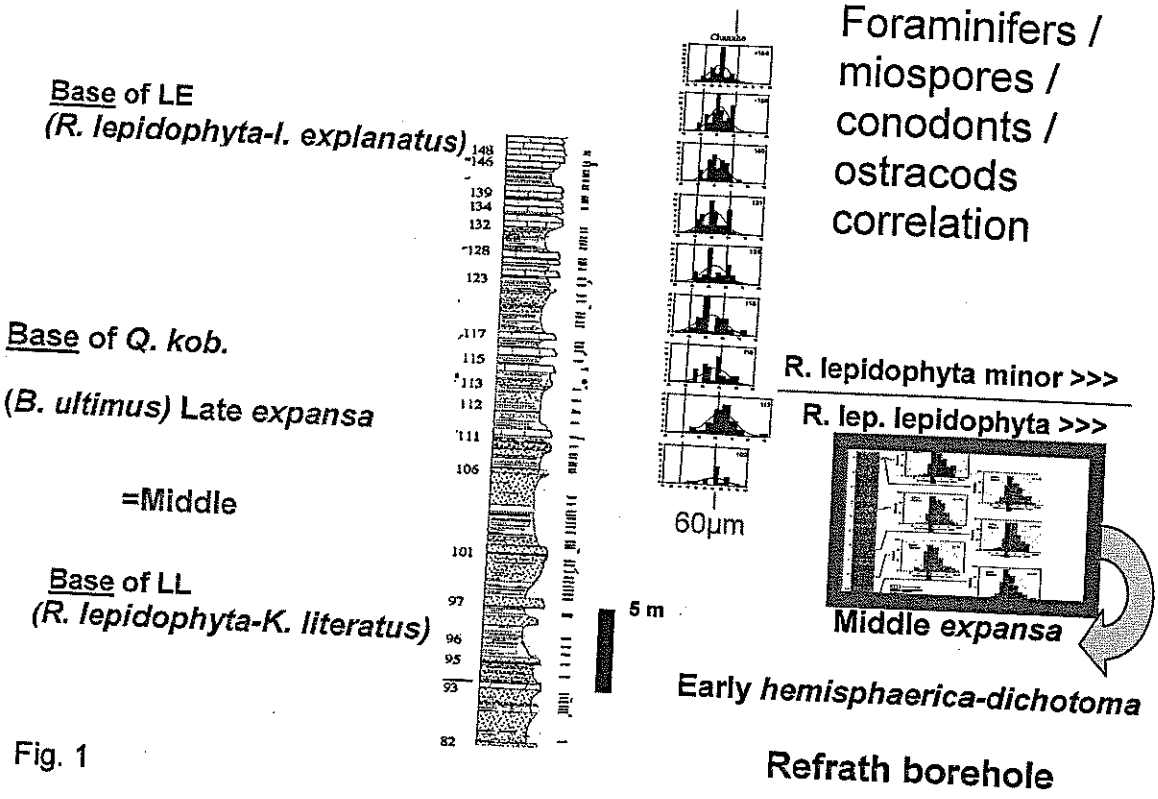

Fig. 1

Fig. 1: Part of the Chanxhe section (below LE Zone occurring between limestones 146 and148 of Conil 1964). *Q. kob. kobeitusana* first occurs in limestone 115, *Bispathodus ultimus* occurs in limestone 111. The base of the LL miospore Zone is in shale on the top of bed 87. Short lines on the right side of the section are very numerous sample locations for palynology. (Maziane 1999). Histograms are diameter distribution of *R. lepidophyta,* ranging from a majority of large specimens of *R. l. lepidophyta* (sample 112 and below) to a majority of small specimens of *R. l. minor* (sample 116 and above). Critical size limit is 60 µm. The Refrath borehole (western Germany, about 100 km east of Chanxhe) has Middle *expansa* conodont Zone and Early *hemisphaerica-dichotoma* ostracode Zone with large specimens of *R. l. lepidophyta* allowing a correlation with the interval 101 to 112 of the Chanxhe section (Streel & Hartkopf-Fröder 2006).

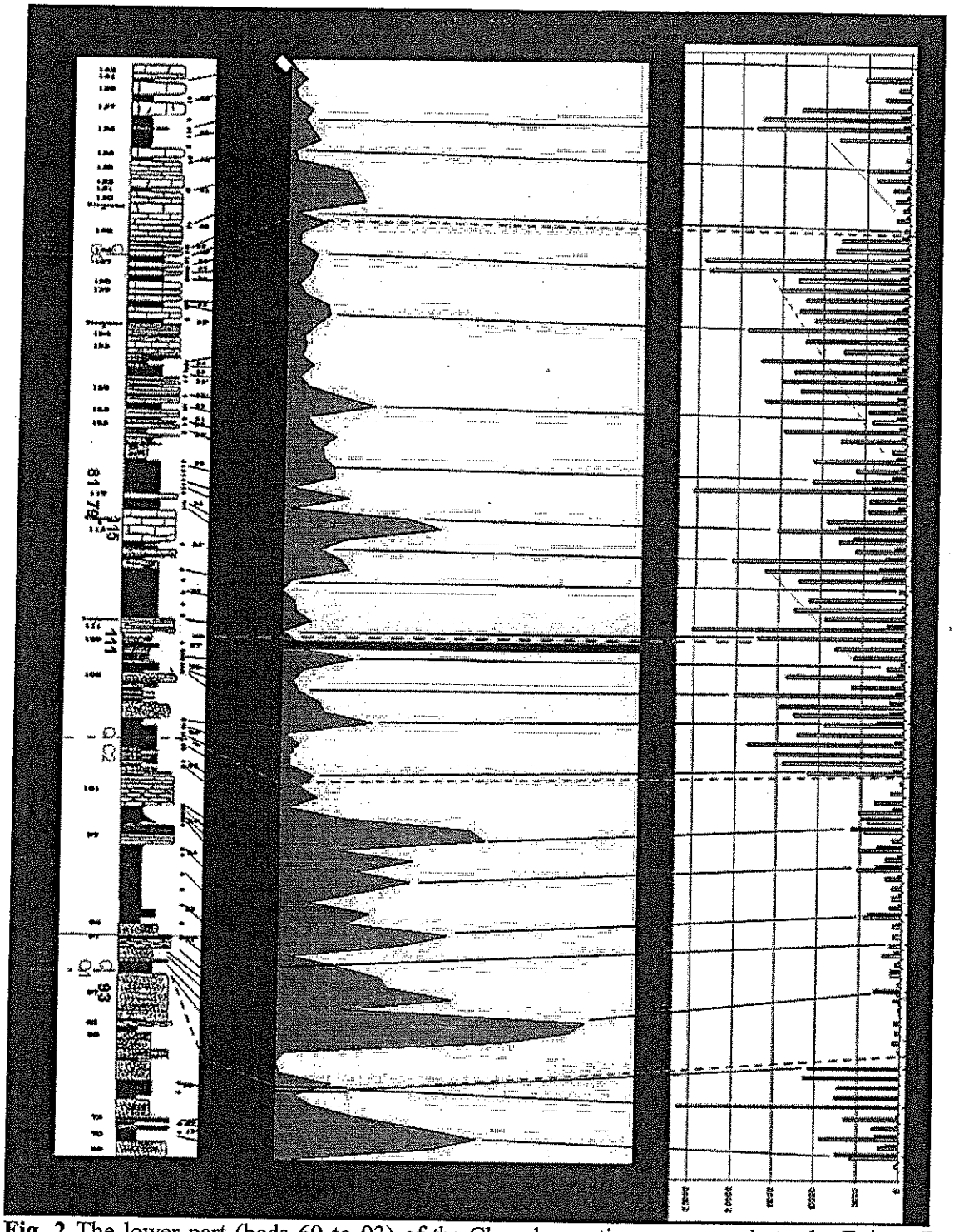

Fig. 2 The lower part (beds 69 to 93) of the Chanxhe section corresponds to the Evieux Formation. The higher part of the sequence (beds 94 to 163) corresponds to the Comblain-au- Pont Formation. At the top of the section a fault prevents to observe the transition to the Tournaisian beds. On the left of the lithological log are Conil (1964) bed numbers. On the right are Maziane (1999) sample numbers for palynomorph studies. Data are distributed in two columns. The left column is a one hundred percents diagram where the dark area represents the percentage of acritarchs / total of acritarchs + miospores and the light area the percentage of miospores / total of acritarchs + miospores. The right column shows histograms of amounts of miospores (light bars) and acritarchs (dark bars) in one gram of sediment. Scale ranges from 0 to 25.000. Cyclic increasing occurrences of miospores in the shaly sediments are suggested in the Strunian part of the sequence. The Strunian base is delineated at the base of bed 111.

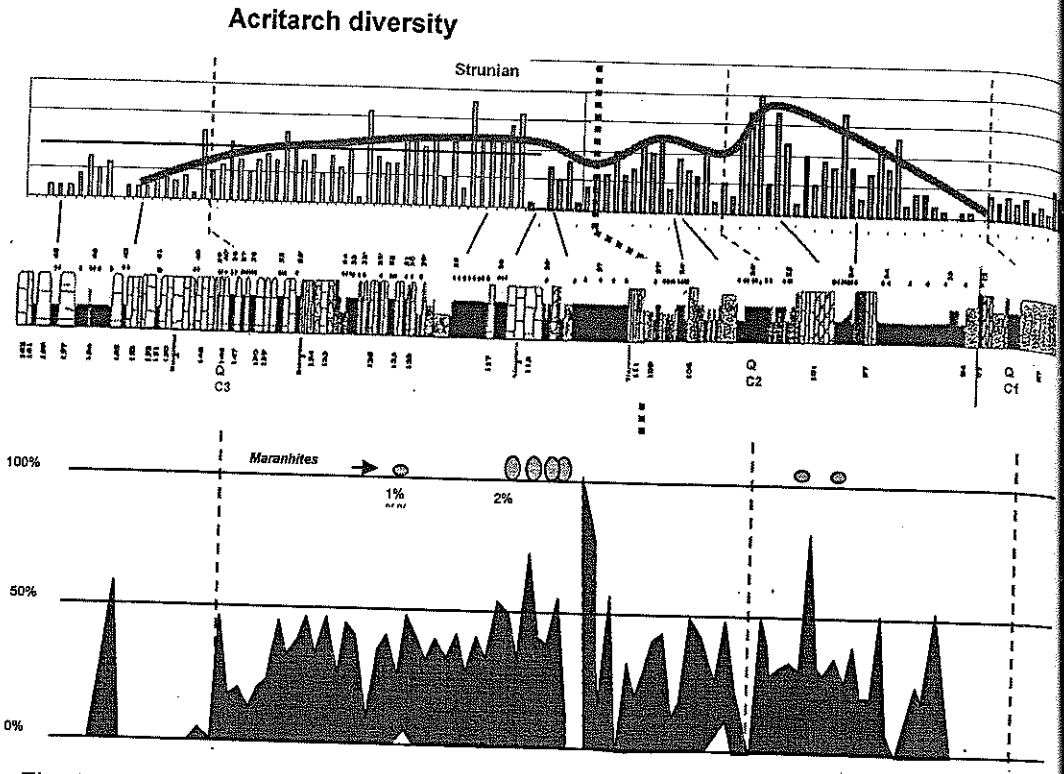

Fig. 3

Fig. 3: Acritarch species number ranges from 0 to 20. The chart below "Acritarch diversity"allows to compare the relative abundance of Prasinophytes specimens (white area) and otheracritarch specimens (dark area). The Prasinophytes show more than 50% to 100% of the total Prasinophytes + other acritarchs. A few percentages of *Maranhites* (1 to 2 %) correspond to the minima of Prasinophytes.

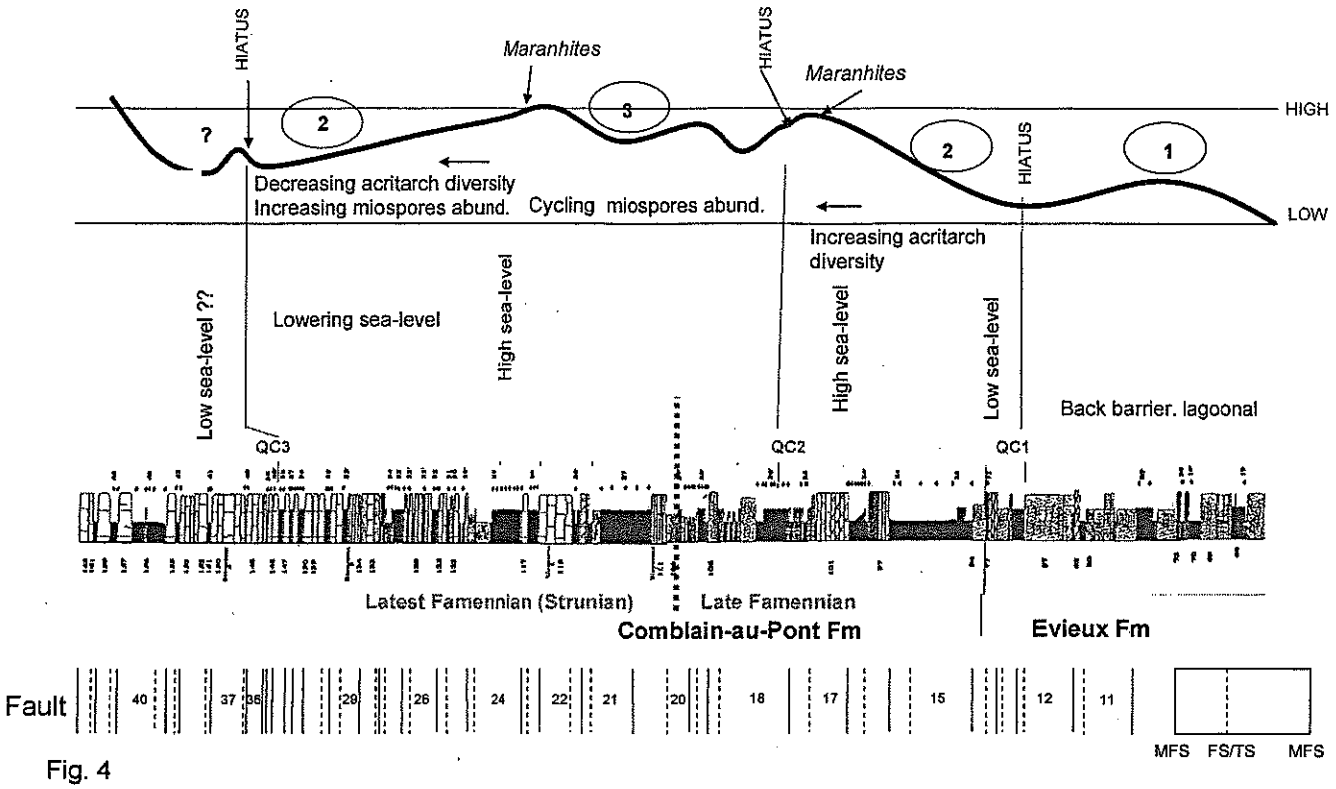

Fig. 4

Fig. 4: suggested bathymetry in the Chanxhe section. Facies 1 corresponds to a low sea-level,facies 2 to the Epinette transgression. Strunian starts in a high sea-level facies (facies 3) andthen returns to a low sea-level (facies 2). Shallow water Ostracod species (Casier et al. 2005)increase in quantity and diversity from bed 123 to bed 152 across the QC3 limit. At the base of the figure are metric to plurimetric sequences: MFS = maximum flooding surface, FS/TS = Flooding or transgressive surface.

0
5
1
1
2
2

The acritarch species number (ranging from 0 to 20 on fig. 3) has a maximum below the QC2limit b slowly decreases in the Strunian part of the section. The Prasinophytes show more than 50% to 100% of th total acritarch assemblage. They mostly belong (Tyson 1995) to small *Leiosphaeridia*, small and larg *Gorgonisphaeridium*, *Synsphaeridium*, *Cymatiosphaera* and *Pterospermella*. *Maranhites* occu significantly (2 %) above the Strunian base. Suggesting that the highest sea-level is reached in that part of the section (Streel et al. 2000b). Othe acritarchs are *Micrhystridium*, *Solisphaeridium*, *Stellinium* and *Verhyachium*. The Prasinophytes ar characteristic of both lagoonal and offshore facies (Montenari & Leppig 2003) but with the increasin miospore abundance observed in the higher part (beds 133 to 147) of the section immediately below th QC3 limit the latter environment (Woods 1955 in Tyson 1995) is exclude. Shallowing trend is corroborate by the increase in quantity and diversity from bed 123 to bed 152 of shallow water Ostracod specie belonging to the genera *Platycopina* and *Paraparchiticopina* (Casier et al. 2005).

The Prasinophytes have also affinity with cold water and dysoxic-anoxic facies (Tyson 1995, p. 301). This is in line with the general cooling and glaciation on Western Gondwana in the LE and LN miospore Zones (Streel et al. 2000a).

Metric to plurimetric sequences can be defined as the smallest cycles of variations of the depositional conditions, related to minor sea-level cyclic fluctuations developed within shallow water and shallowing upward conditions. Each sequence is limited by two maximum flooding surface (MFS). Flooding or transgressive surface (FS/TS) separates the progradation part (below) from the retrogradation part (above) of the sequence. When considering (Fig. 4) the characteristics of the sequences (11 to 42), one may note that most of them (11 to 27) do show a typical distortion pattern, the "rise period" (Above FS/TS) being generally reduced in importance or thickness. Indeed thickness of sequences are plurimetric up to 27 and metric or less higher. This is partly due to synsedimentary tectonics i.e. contemporaneously listric fault activity that affected in particular the tilted block which include the Chanxhe section (Maziane et al 2002). The tectonic activity is also materialized by the occurrence of three ball-and-pillow levels in the upper part of the Comblain-au-Pont Formation.

Taking into account the sedimentology, the sequential pattern as well as the palynomorph distribution, one can attribute the basal part of the Comblain-au Pont Formation in the Chanxhe section to a general transgressive trend (global TST) which regroups the sequences 11 to 21, up to just above the chronostratigraphic boundary marking the base of the Strunian, The remaining upper part of the formation (22 to 42) better fits with a global highstand (HST) developed as a typical aggradation during the building of the corresponding sequence sets that incorporated cyclically only fine-grained siliciclastics and limestones with several biostromes.

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