CORRELATION OF THE PROPOSED CONODONT BASED UPPER DEVONIAN SUBSTAGE BOUNDARY LEVELS INTO THE NERITIC AND TERRESTRIAL MIOSPORE ZONATION

(Maurice Streel and Stan Loboziak, Rio SDS meeting, 07/08/2000)

(MARINE-NON MARINE CORRELATION / FRASNIAN AND FAMENNIAN SUBSTAGES WORKING GROUPS)

INTRODUCTION

No miospores are known from the Global Stratotype Sections for the base of the Frasnian Stage and the base of the Famennian Stage in the Montagne noire, in southern France. However, Frasnian miospores occur with conodonts in the Ferques railroad section , in the Boulonnais area, north of France, allowing correlation with the conodont zonation (Streel & Loboziak in Bultynck et al. 1987, Streel et al. 1987, Streel & Loboziak 1996). Famennian miospores occur with conodonts in the Ardenne (Dinant Synclinorium) but adverse conditions in lateral transport and probably poor vegetation cover prevent to use criteria of first occurrence of species for erecting a zonation below the middle Famennian. Furthermore conodonts are rare in the Ardenne during the Late *trachytera* - Early *expansa* interval (Streel 1986, fig. 2).

1. Base of a Middle Frasnian substage defined by first occurrence of *Palmatolepis punctata* (base of MN Zone 5 and base of *punctata* Zone) Becker & House, 1999 SDS Newsletter 15, 17-22.

The conodont zonation was first demonstrated in the Ferques railroad section by Bultynck (in Brice *et al.*, 1979). The first occurrence of *Ancyrodella gigas* was later noted by Coen (in Brice *et al.*, 1981) in the unit P within the Noces Member of the Beaulieu Formation. This first occurrence approximately corresponds to the base of the old middle *asymmetricus* Zone which is now the *punctata* Zone (Ziegler & Sandberg 1990).

Two successive Oppel Zones of miospores, *Samarisporites triangulatus - Chelinospora concinna* (TCo) and *Verrucosisporites bulliferus - Cirratriradites jekhowskyi* (BJ), are present in this section (Loboziak & Streel , 1980 and 1981; Streel *et al.*, 1987). In about the same timespan Richardson & McGregor (1986) defined two Assemblage Zones , the *Contagisporites optivus* var. *optivus - Cristatisporites triangulatus Zone* and the *Archaeoperisaccus ovalis - Verrucosisporites bulliferus* Zone. The limit between these Assemblage Zones corresponds approximately to the base of BJ (Streel *et al.*, 1987, fig. 13).

One biohorizon was selected by Streel & Loboziak (1996) in the same timespan.

The *V. bulliferus* FOB (First Occurence Biohorizon) occurs in sample 05 in unit O (Loboziak & Streel 1981, fig. 1). This Unit is a shale underlying a limestone (unit P) containing the conodont *punctata* Zone. *V. bulliferus* was absent in the five samples which have been studied below, in a 45 m interval above the base of the Beaulieu Formation. The *V. bulliferus* FOB might belong either to the conodont *punctata* Zone or to the conodont *transitans* Zone and might therefore be a good miospore characteristic of the base of a Middle Frasnian Substage as defined above.

2. Base of an Upper Frasnian substage defined near the base of the *rhenana* Zone Ziegler & Sandberg, 1997, SDS Newsletter 14, 11.

Conodonts have not been found in the Briqueterie de Beaulieu section where the late Frasnian Hydrequent Formation contains rich assemblages of miospores and acritarchs (Loboziak & Streel 1981, Loboziak *et al.* 1983). However, in the La Parisienne Quarry, 500 m north of the Briqueterie de Beaulieu, in the upper part of the Ferques Formation which underlines the Hydrequent Formation, *Ancyrognathus coeni (Ancyrognathus triangularis euglypheus in* Brice et al. 1981, p. 163) is present indicating the conodont Late *hassi* or *jamieae* Zones (Ziegler & Sandberg 1990).

On another hand the upper part of the Hydrequent Formation contains acritarchs (Loboziak *et al.* 1983) e.g. the first occurrence of the acritarchs *Visbysphaera (?) occultata* and *Ephelopalla media* which represent good markers for the transitional Late *rhenana-linguiformis* Zones timespan (Martin 1993, Bultynck & Martin 1995).

The Hydrequent Formation of the Briqueterie de Beaulieu section displays three miospore zones: the upper part of the *Verrucosisporites bulliferus - Lophozonotriletes media* (BM) Oppel Zone and the still unformal zones "IV" and "V". Zone "IV" has some similarity, in miospore composition, with the latest Frasnian *Cristatisporites. deliquescens - Verrucosisporites. evlanensis* (DE) Zone of eastern Europe (Avkhimovitch *et al.* 1993, fig. 4). The DE zone, starts with the entry of *Cymbosporites acanthaceus* = *Cymbosporites* sp. *B of* Loboziak & Streel 1981 (Avkhimovitch et al., 1988, p. 563) and corresponds to the Late *rhenana* conodont Zone in eastern Europe (Obukhovskaya *et al.* in press).

The *C. acanthaceus* FOB belongs to the interval Late *hassi* to late *rhenana* conodont Zones and might therefore serve as a provisional miospore characteristic of the base of an Upper Frasnian Substage as defined above.

3. Base of a Middle Famennian substage at the base of the Latest *crepida* Zone.

Sandberg & Ziegler 1999, SDS Newsletter 15, p. 45: "The only other usable position (for the Lower/Middle Famennian limit), easely recognized in conodont faunas is the Latest *crepida* Zone (but this position is too low for approximately equal threefold subdivision of the Famennian)".

Miospores are poorly represented in the early Famennian of western Europe and eastern North America, the tropical southern Euramerica. They are abundant, on the contrary, in eastern Europe and western North America, the equatorial northern Euramerica (Streel *et al.* 1990) where the genus *Cornispora* ,a very distinctive miospore, has its first occurrence in the early-middle Famennian range. In eastern Europe (Pripyat Depression), *Cornispora monocornata* first occurs (Avkhimovitch *et al.* 1993, p. 88) within a *rhomboidea* conodont Zone (Krutchek 1974). In western Canada, *Cornispora monocornata* and *C. varicornata* characterize a very distinctive biozone which, in the Arctic Red River section, yielded an upper *crepida* conodont assemblage, close to the lower boundary of the miospore zone (Braman & Hills 1992, p. 12).

The first occurrence of *Cornispora* in the northern Euramerican belt belongs to the interval late *crepida* to late *rhomboidea* conodont zones and might therefore serve as a provisional miospore characteristic of the base of a Middle Famennian Substage in these regions..

4. Base of a Middle Famennian substage at the base of the Early *marginifera* Zone. Ziegler & Sandberg 1997, SDS Newsletter 14, 11.

As stated by Streel & Loboziak (1999, p. 46), that level is closed to the base of the *Grandispora famenensis* FOB, a distinctive miospore which first appears in the Late *rhomboidea* or the Early *marginifera* (Streel & Loboziak 1996). *G. famenensis* var. *minuta,* a variety with reduced ornamentation, first occurs in the upper part of the Esneux Formation (Condroz Sandstone Group), immediately followed by the first occurrence of the typical variety (*G. f.* var. *famenensis*), a succession also observed at the Eletz/Petrikov limit in Byelorussia (Loboziak *et al.* 1997). Thus the *G. famenensis* FOB appears to be a good marker for long distance correlation within the southern and northern provinces of Euramerica.

5. Base of a Middle Famennian substage (threefold system) or an Upper Famennian substage (fourfold system) at the base of the Latest *marginifera* Zone.

Becker, SDS Newsletter 15, p. 15: "...*Pemoceras* and *Protomoceras* (which) spread slighly below the entry of *Scaphignathus velifer* in conodont terms, the base of the old *velifer* Zone (now Uppermost or Latest *marginifera* Zone) seems an acceptable level."

A very distinctive miospore, *Retispora macroreticulata,* first occurs in the lower part of the Montfort Formation in the Comblain-au-Pont/Bon Mariage section in the Ourthe Valley, Dinant Synclinorium, into a rock sequence containing conodonts of the Latest *marginifera* Zone (Bouckaert *et al.* 1968). *R. macroreticulata* is considered (Streel et al. 1999) as an ancestor of *R. lepidophyta* (See 7.).

6. Base of an Upper Famennian substage (threefold system) at the base of the Early *expansa* Zone. Sandberg & Ziegler 1999, SDS Newsletter 15, p. 45

As stated by Streel & Loboziak (1999, p. 46), that level is poorly known in the Franco-Belgian basins where conodonts are rare at that level. Consequently no miospores can be proposed to characterize that level.

7. Base of an Upper Famennian substage (fourfold system) at the base of the Late *expansa* Zone

Streel *et al.* (1999) have reported that foraminifers, miospores, and to a lesser extent, conodonts and ostracods have been discovered in many localities across the Dinant Synclinorium. However, it is in the eastern part of Belgium, notably in the Ourthe Valley, a classical area for the lithostratigraphy of the middle and late Famennian, that these biostratigraphical data are the most reliable. In ascending order these are : 1) first occurrence of the worldwide distributed and very distinctive miospore *Retispora lepidophyta,* 2) foraminifers of the Df3δ Zone with bilaminated *Eoendothyra (E. communis radiata* and *E. radiata)*, characterized by a radial inner layer, associated with conodonts belonging to the Late *expansa* Zone including *Bispathodus ultimus*, 3) first occurrence of *Quasiendothyra kobeitusana* (Df3ε Zone)

The same sequence of miospores and foraminifers is observed in the type area of the Strunian (Avesnois, northern France), at levels situated more than 100 m below the Etroeungt Limestone, i.e., near the base of the Epinette Shales

If the Df3δ foraminifer Zone obviously belongs to the Late *expansa* Zone; it is still unknown whether the base of the *R. lepidophyta* Zone also belongs to the same conodont Zone, or better to the uppermost part of the Middle *expansa* Zone. The latter zone is found in the nearby Esneux railway section some 55 m below the Late *expansa* Zone.

The *R. lepidophyta* FOB, one the most common biostratigraphical marker used in Palaeozoic palynology, is a very good tool for long distance correlation.

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See Fig. 1

Fig. 1) deleted

CONODONTS			Proposed Substages
OLD ZONATION	STANDARD ZONATION		
S. sulcata	*sulcata*		
L. Protognathodus	*praesulcata*	L	UPPERMOST FAMENNIAN
U. costatus		M	
M. costatus		E	
L. costatus	*expansa*	L	UPPER FAMENNIAN
U. styriacus		M	
M. styriacus	*postera*	E	
L. styriacus		L	
U. velifer	*trachytera*	E	
M. velifer		L	
L. velifer	*marginifera*	E	
U. marginifera		L*	MIDDLE FAMENNIAN
L. marginifera		L	
U. rhomboidea	*rhomboidea*	E	
L. rhomboidea		L	
U. crepida	*crepida*	E	
M. crepida		L*	LOWER FAMENNIAN
L. crepida		L	
U. triangularis	*triangularis*	M	
M. triangularis		E	
L. triangularis		L	
U. gigas*	*linguiformis*	M	
U. gigas	*rhenana*	E	
L. gigas		L	
		E	

Figure 1.Famennian Substages proposed by the Uppermost Famennian Working Subgroup.

NOTE: This figure is to accompany article on Page 12:

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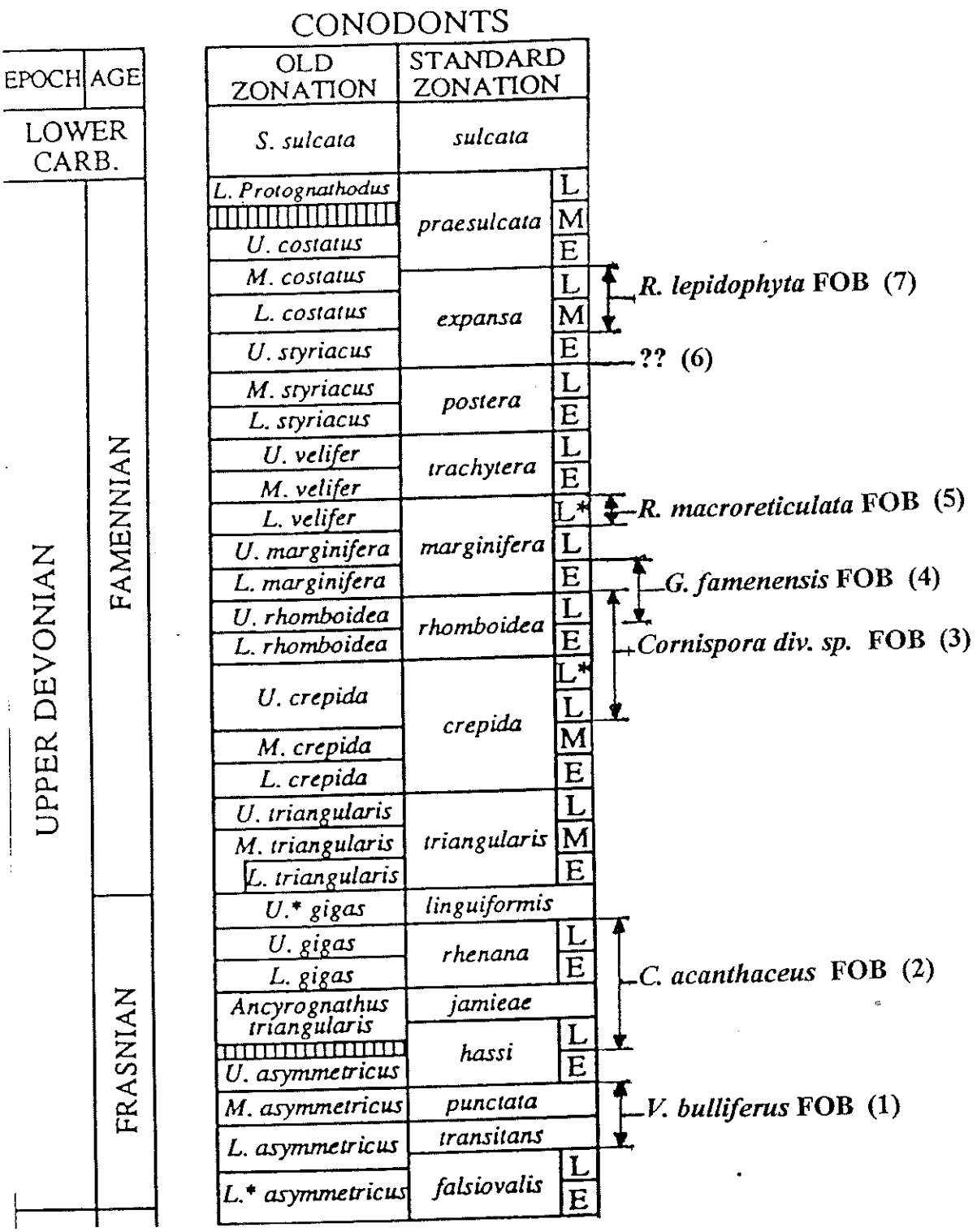

Figure 1.Correlation of proposed conodont based Upper Devonian Substage boundary levels into the neritic and terrestrial miospore zonation.

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