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## Proposal of boundaries for subdivision of the Famennian Stage: miospore implications

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If subdivision of the Famennian Stage is to be based on the first occurrence of conodont zones that can be widely recognized not only by their zonal indicators, but also by their accompanying faunas (Ziegler & Sandberg, 1997), they should also calibrate with the floral zonations, particularly the miospore zonation, the unique tool for correlating the continental and marine realms in the Famennian.

Ziegler & Sandberg (1997) proposed the base of the Early expansa Zone as the lower boundary of an Upper Famennian Substage. However the base of this zone occurs stratigraphically well below one of the most useful biohorizons suggested for the base of the Strunian (Conil & Lys, 1980) i.e. that of the miospore *Retispora lepidophyta* which starts somewhere in the Middle or Late expansa Zones, most probably close to the base of the Late expansa Zone (Dreesen et al., 1993; Streel & Loboziak, 1996). In the Franco-Belgian basins, the Early expansa Zone is poorly known and the eustatic rise, if any, really begins higher, at the base of that Strunian i.e. the base of the Epinette Shales or the Comblain-au-Pont Beds (The base of the Fa2d sensu Bouckaert et al. 1969). *R. lepidophyta* probably derived from the older *R. macroreticulata*, noted for the first time from the Montfort Formation in a section which contains also the Latest marginifera Zone. *R. lepidophyta* is a very distinctive miospore, present worldwide, from subpolar to equatorial regions, and is certainly one of the most common biostratigraphical marker used in Palaeozoic palynology.

The base of the Early marginifera Zone, proposed by Ziegler & Sandberg (1997) as the lower boundary of a Middle Famennian Substage, is near the base of *Grandispora famenensis*, another distinctive miospore which first appears somewhere in the Late rhomboidea or in the Early marginifera Zones (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.*

*famenensis*), a succession also observed at the Eletz / Petrikov limit in Byelorussia (Loboziak et al., 1997). Thus the first occurrence of *G. famenensis* appears to be a good marker for long distance correlation within the southern and northern provinces of Euramerica.

Significantly, the four Substages of the Famennian as proposed by Streel et al. in press, can also be characterized by the first occurrence of miospores as shown here on Fig. 1 which also indicates the range of uncertainty in the correlation of conodonts and miospores.

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Proposed Substages	CONODONTS				MIOSPORES
	OLD ZONATION	STANDARD ZONATION			
LOWER CARB.	<i>S. sulcata</i>	<i>sulcata</i>			
UPPERMOST FAMENNIAN	<i>L. Protognathodus</i>	<i>praesulcata</i>	L		--- <i>R. lepidophyta</i> LOB
	<i>U. costatus</i>		M		
	<i>M. costatus</i>	<i>expansa</i>	L		--- <i>R. lepidophyta</i> FOB
<i>L. costatus</i>	M				
UPPER FAMENNIAN	<i>U. styriacus</i>	<i>postera</i>	L		
	<i>M. styriacus</i>		E		
	<i>L. styriacus</i>	<i>trachytera</i>	L		
	<i>U. velifer</i>		E		
	<i>M. velifer</i>		L*		
MIDDLE FAMENNIAN	<i>U. marginifera</i>	<i>marginifera</i>	L		--- <i>G. famenensis</i> FOB
	<i>L. marginifera</i>		E		
	<i>U. rhomboidea</i>	<i>rhomboidea</i>	L		
	<i>L. rhomboidea</i>		E		
LOWER FAMENNIAN	<i>U. crepida</i>	<i>crepida</i>	L*		
	<i>M. crepida</i>		L		
	<i>L. crepida</i>		M		
	<i>U. triangularis</i>	<i>triangularis</i>	L		--- <i>K. dedaleus</i> FOB
	<i>M. triangularis</i>		M		
<i>L. triangularis</i>	E				
FRASNIAN	<i>U.* gigas</i>	<i>linguiformis</i>			
	<i>U. gigas</i>				
	<i>L. gigas</i>	<i>rhenana</i>	L		

Fig. 1-Proposal for Famennian Substages after Streeel et al., in press, their correlation with current and old conodont zones and the occurrence of a few selected miospores (FOB = well defined first occurrence biohorizon, LOB = well defined last occurrence biohorizon).

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## Proposal for a Strunian Substage and a subdivision of the Famennian Stage into four Substages

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### Strunian Substage

1. The Strunian is based upon the Etroeungt Limestone ("Calcaire d'Etroeungt") and was introduced by de Lapparent (1900, p. 860) and later considered as a Stage by Barrois (1913, p. 16) and Maillieux & Demanet (1929). This limestone was studied by Gosselet (1857) in the Parcq Quarry at Etroeungt near Avesnes (Department of the North, France) and has been

updated by Sartenaer & Mamet (1964). The Strunian has been widely used, following Gosselet's guide-line, for beds containing a transitional fauna between the late Devonian and the early Carboniferous (as understood before the latest modification of the Devonian/Carboniferous boundary). The Strunian has been mentioned and investigated in almost one hundred sedimentary basins on most continents. Its faunas and floras have been studied by various authors and, in some regions,