

- Schulz, H.-P. & C.G. Maples (1992). Comparison of the Late Pennsylvanian faunal assemblage of Kinney Brick-Company Quarry, New Mexico, with other Late Pennsylvanian Lagerstätten. In : Zidek, J. (ed.), *Geology and paleontology of the Kinney Brick Quarry, Late Pennsylvanian, central New Mexico. New Mexico Bur. Mines & Miner. Res. Bull.*, 138 : 231-242.
- Schulz, H.-P., C.G. Maples & C.R. Cunningham (1994). The Hamilton Konservat-Lagerstätte : Stephanian terrestrial biota in a marginal-marine setting. In : Rolfé, W.D.I., E.N.K. Clarkson & A.L. Parthen (eds), *Volcanism and early terrestrial biotas. Tr. Roy. Soc. Edinburgh : Earth Sci.*, 84 [1993] : 443-451.
- Sorokin, V.S. (1978). Eapay razvitiya severo-zapada Russkoy platformy vo Franskom veke [Stages of development of the north-western part of the Russian platform in the Frasnian]. *Zinane publ.*, Riga, 282 p. [In Russian.]
- Streef, M., K. Higgs, S. Loboziak, W. Riegel & P. Steemans (1987). Spore stratigraphy and correlation with faunas and floras in the type marine Devonian of the Ardennes-Rhenish regions. *Rev. Palaeobot. Palynol.*, 50 : 211-229.
- Streef, M. & S. Loboziak (2000). Correlation of the proposed conodont based Upper Devonian substage boundary levels into the neritic and terrestrial miospore zonation. *Subcomm. Devon. Stratigr. Newsletter*, 17 : 12-14.
- Thorez, J., M. Streef, J. Bouckaert & M.J.M. Bress (1977). Stratigraphie et paléogéographie de la partie orientale du synclinorium de Dinant (Belgique) au Famennien supérieur : un modèle de bassin sédimentaire reconstitué par analyse pluridisciplinaire sédimentologique et micropaléontologique. *Mémoires de la Société Royale de Géologie de Belgique*, 28 (2) : 17-28.
- Traverse, A. (2003). Dating the earliest tetrapods: A Catskill palynological problem in Pennsylvania. In: Wilde, V. (ed.), *Studies on fossil and extant plants and floras. Dedicated to Friedemann Schaarschmidt on the occasion of his 65<sup>th</sup> birthday. Cour. Forsch.-Inst. Senckenberg*, 241 : 19-49.
- Trewin, N.H. ed. (2002). *The Geology of Scotland* (4<sup>th</sup> edition). The Geological Society, London, 576 p.
- Vorobyeva, E.I. (1977). Morfologija i osobennosti evolyutsii kislepernykh ryb [Morphology and peculiarities of the evolution of the crosspterygian fishes]. *Akademika Nauk SSSR, Trudy Paleontologicheskogo Instituta*, 163 : 1-239. Nauka publ., Moskva [In Russian].
- Williams, E.A., P.F. Friend & B.P.J. Williams (2000). A review of Devonian time scales: databases, construction and new data. In: Friend, P.F. & B.P.J. Williams (eds), *New Perspectives on the Old Red Sandstone. Geol. Soc. London Spec. Publ.*, 180: 1-21.
- Young, G.C. (1993). Middle Palaeozoic macrovertebrate biostratigraphy of eastern Gondwana. In: Long, J.A. (ed.), *Palaeozoic vertebrate biostratigraphy and biogeography*. Belhaven Press, London, chap. 9: 208-251.
- Young, G.C. (1996). Devonian (Chart 4). In: Young, G.C. & J.R. Laurie (eds), *An Australian Phanerozoic Timescale*. AGSO / Oxford University Press, Melbourne, p. 96-109
- Young, G.C. (1999). Preliminary report on the biostratigraphy of new placoderm discoveries in the Hervey Group (Upper Devonian) of central New South Wales. In: Baynes, A. & J.A. Long (eds), *Papers in vertebrate palaeontology. Rec. W. Austral. Mus., Suppl.*, 57: 139-150.
- Young, G.C., J. Long & C. Burrow (2000a). Vertebrata. Pp. 209-219 and 250, in: Talent, J.A., R. Mawson *et al.*, *Devonian palaeobiogeography of Australia and adjoining regions*. Pp. 167-257, in: Wright, A.J., G.C. Young, J.A. Talent & J.R. Laurie (eds), *Palaeobiogeography of Australasian faunas and floras. Assoc. Australas. Palaeontol., Mem.* 23; Canberra.
- Young G.C., L. Sherwin & O.J. Raymond (2000b). Late Devonian. Hervey Group. In: Lyons, P., O.L. Raymond & M.B. Duggan (eds.), *Explanatory Notes - Forbes 1:250,000 Geological Sheet S155-7, 2<sup>nd</sup> edition. AGSO Record 2000/20 : 125-149 ; Canberra.*
- Zhu, M. (2000). Catalogue of Devonian vertebrates in China, with notes on bio-events. In: Blicek A. & S. Turner (eds), *Palaeozoic Vertebrate Biochronology and Global Marine/Non-Marine Correlation – Final Report of IGCP 328 (1991-1996). Cour. Forsch.-Inst. Senckenberg*, 223: 373-390.
- Zhu, M., P.E. Ahlberg, W. Zhao & L. Jia (2002). First Devonian tetrapod from Asia. *Nature*, 420: 760-761.
- Zhu, M., N.-z. Wang & J.-q. Wang (2000). Devonian macro- and microvertebrate assemblages of China. In: Blicek A. & S. Turner (eds), *Palaeozoic Vertebrate Biochronology and Global Marine/Non-Marine Correlation – Final Report of IGCP 328 (1991-1996). Cour. Forsch.-Inst. Senckenberg*, 223: 361-372.

## SUBDIVISION OF THE FAMENNIAN STAGE INTO FOUR SUBSTAGES AND CORRELATION WITH THE NERITIC AND CONTINENTAL MIOSPORE ZONATION

(SDS Business Meeting Florence, August 23, 2004)

M. Streef

University of Liège, Geology Department, Sart-Tilman Campus, B18, LIÈGE, Belgium

e-mail : Maurice.Streef@ulg.ac.be

The present report was partly submitted at the IGC Rio de Janeiro SDS Meeting in August 2000 (Streef & Loboziak, 2001) based on proposals made during the Bologna SDS Meeting in June 1998 (Streef et al. 1999, Streef & Loboziak 1999). The subdivision of the Famennian suggested then and proposed again now, is shown on fig. 1. These four subdivisions of the Famennian Stage correspond to respectively 6, 5, 7 and 4 conodont zones.

### 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), easily 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 tropical northern Euramerica (Strel *et al.* 1990) where the genus *Corrispora* a very distinctive miospore, has its first occurrence in the early-middle Famennian range. In eastern Europe (Pripyat Depression), *Corrispora monocrornata* first occurs (Avkhimovich *et al.* 1993, p. 88) within a *rhomboida* conodont Zone (Krutchek 1974). In western Canada, *Corrispora monocrornata* 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 *Corrispora* in the northern Euramerican belt belongs to the interval late *crepida* to late *rhomboida* conodont zones and might therefore serve as a miospore guide for the base of a Middle Famennian Substage in these regions.

### Base of an Upper Famennian Substage at the base of the Latest *marginifera* Zone.

Becker, SDS Newsletter 15, p. 15: "...*Pemocreras* and *Protomocreras* (which) spread slightly below the entry of *Scophignathus 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 Marriage 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 (Strel *et al.* 1999) as an ancestor of *R. lepidophylla*.

### Base of an Uppermost Famennian Substage at the base of the Late *expansa* Zone

The relation of the neritic microfaunas and continental microfloras with the conodont and other pelagic faunas within the latest part of the Famennian is demonstrated by Strel *et al.*, in press (SDS Newsletter 20) at the SDS Annual meeting Rabat, March 2004 and again during the Florence IGC (August 2004) (See Strel *et al.*, in preparation). The base of the Late *expansa* Zone is the nearest level to the original definition of the Etroeuingt (Strunian) in the type region, a division of the Famennian used by many authors in huge regions around the world.

This level corresponds to a distinct level within the biometric range of *Retispora lepidophylla*, a very abundant miospore with a worldwide distribution (The quantitative change from *Retispora lepidophylla lepidophylla* to *Retispora lepidophylla minor* in Maziane *et al.* 2002).

### References

- Avkhimovich, V.I., Tshibrkova, E.V., Obukhovskaya, T.G., Nazarenko A.M., Umnova, V.T., Raskanova, L.G., Manturova, V.N., Loboziak, S., Strel, M., 1993. Middle and Upper Devonian miospore zonation of eastern Europe. Bull. Cent. Rech. Expl. Prod. Elf Aquitaine 17 (1): 79-147.
- Becker, R.T., 1999. Prospects for an international substage subdivision of the Famennian. SDS Newsletter 15 (1998): 14-17.
- Bouckaert, J., Strel, M., Thoretz, J., 1968 : Schéma biostratigraphique et coupes de référence du Famennien belge. Note préliminaire. Ann. Soc. géol. Belg. 91: 317-336.
- Braman, D.R., Hills, L.V., 1992. Upper Devonian and Lower Carboniferous miospores, western District of Mackenzie and Yukon Territory, Canada. Paleontographica Canadiana 8: 1-97.
- Krutchek, S.A., 1974. On the Middle Devonian conodonts in Belorussia. In: Problems of regional geology in Belorussia. Minsk Bel-NIGRI: 118-126 (In russian).
- Maziane, N., Higgs, K.T., Strel, M., 2002. Biometry and paleoenvironment of *Retispora lepidophylla* (Kedo) Playford 1976 and associated miospores in the latest Famennian nearshore marine facies, eastern Ardennne (Belgium) - Review of Palaeobotany and Palynology, 118, 211-226.
- Sandberg, C.A., Ziegler, W., 1999. Comments on Proposed Frasnian and Famennian Subdivisions. SDS Newsletter 15 (1998): 43-46.
- Strel, M., Loboziak, S. 1999. Proposal of boundaries for subdivision of the Famennian Stage: miospore implications. SDS Newsletter 15 (1998): 46-47.
- Strel, M., Loboziak, S. 2001, Correlation of the proposed conodont based Upper Devonian Substage boundary levels into the neritic and terrestrial miospore zonation. SDS Newsletter 17, 12-14.
- Strel, M., Faron-Demaret, M., Loboziak, S., 1990. Givetian-Frasnian phylogeography of Euramerica and western Gondwana based

on miospore distribution. In: McKerrow, W.S., Scotese, C.R., (eds.), *Palaeozioc Paleogeography and Biogeography*. Geol. Soc. Mem. 12, 291-296.

Streel, M., Brice, D., Degardin, J.-M., Derycke, C., Dreesen, R., Groessens, E., Hance, L., Legrand-Blain, M., Lethiers, F., Loboziak, S., Maziane, N., Milhau, B., Mistaen, B., Poty, E., Rohart, J.-C., Sartenaer, P., Thorez, J., Vachard, D., Blicek, A., 1999. Proposal for a Strunian Substage and a subdivision of the Famennian Stage into four Substages. IUGS Subcommission on Devonian Stratigraphy, Newsletter 15 (1998): 47-52.

Streel, M., Belka, Z., Dreesen, R., Durkina, A.V. Groos-Uffenorde, Hance, L., Harkopf-Fröder, C., Haydukiewicz, J., Korn, D., Perri, M.C., Piecha, M., Spalletta, C., in press. Relation of the neritic microfaunas and continental microforas with the conodont and other pelagic faunas within the latest part of the Famennian. SDS Annual Meeting Rabat, March 1 and 2, 2004, SDS Newsletter 20

Streel, M., Belka, Z., Dreesen, R., Durkina, A.V. Groos-Uffenorde, Hance, L., Harkopf-Fröder, C., Haydukiewicz, J., Korn, D., Perri, M.C., Piecha, M., Spalletta, C., Relation of the neritic microfaunas and continental microforas 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 Business Meeting, Florence, August 23, 2004, in preparation

SDS Business Meeting Florence, August 23, 2004

CONODONTS		STANDARD ZONATION	Proposed Substages			
OLD ZONATION						
<i>S. sulcata</i>	<i>sulcata</i>					
<i>L. Prolognathodus</i>	<i>praesulcata</i>	L	UPPERMOST FAMENNIAN			
		M				
<i>U. costaius</i>	E	UPPER FAMENNIAN				
<i>M. costaius</i>	L					
<i>L. costaius</i>	<i>expansa</i>	M		MIDDLE FAMENNIAN		
<i>U. syriacus</i>		E				
<i>M. syriacus</i>		L				
<i>L. syriacus</i>	<i>posera</i>	E			UPPER FAMENNIAN	
<i>U. velifer</i>		L				
<i>M. velifer</i>	<i>trachyera</i>	E				UPPER FAMENNIAN
<i>L. velifer</i>		L*				
<i>U. marginifera</i>	<i>marginifera</i>	L	MIDDLE FAMENNIAN			
<i>L. marginifera</i>		E				
<i>U. rhomboida</i>		L				
<i>L. rhomboida</i>	<i>rhomboida</i>	E		MIDDLE FAMENNIAN		
<i>U. crepida</i>		L*				
<i>M. crepida</i>	<i>crepida</i>	L				
<i>L. crepida</i>		M				
<i>U. triangularis</i>		E				
<i>M. triangularis</i>	<i>triangularis</i>	L			LOWER FAMENNIAN	
<i>L. triangularis</i>		M				
<i>U.* gigas</i>	<i>linguiformis</i>	E	LOWER FAMENNIAN			
<i>U. gigas</i>		L				
<i>L. gigas</i>		E				