

PLANTS AT THE DEVONIAN/CARBONIFEROUS  
BOUNDARY, A SHORT REVIEW

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Miospores

Plant miospores are very useful and important fossils for the recognition of the Devonian/Carboniferous boundary. Miospores at this stratigraphic level have a global distribution being found on all the continents, with the exception of Antarctica. They are also significantly preserved in both non-marine (continental) and marine rocks. They occur abundantly, and the presence of distinctive and rapidly evolving forms has resulted in the establishment of a detailed miospore succession at this interval.

The most complete and continuous miospore record at the Devonian-Carboniferous boundary has been found in the enormously thick marine clastic sequences in southern Ireland. HIGGS *et al* (1988) have described a miospore zonation scheme comprising eight biozones (fig.1) which are defined essentially on the first appearances of selected and distinctive taxa. The only exception to this is at the LN/VI Biozone boundary where the base of the VI Biozone is defined at the disappearance of the well known and highly distinctive *Retispora lepidophyta* complex and associated species (fig.1). This extinction event has been recorded worldwide and is considered to be an isochronous event, resulting from a major change in climatic conditions at this time. However, no significant time gap is envisaged at the LN/VI boundary because many other species survive this event and continue through into the succeeding VI Biozone including members of a number of morphological and possible phylogenetic lineages eg. *Vallatisporites* complex (see STREEL and TRAVERSE, 1978) also the *Umbonatisporites* and *Sphaerotriletes* complexes.

CLAYTON and HIGGS (1979) have demonstrated both the stratigraphical application of this miospore zonation scheme and its independence of sedimentary facies. They have conclusively shown that the marine and non-marine rocks at this stratigraphic interval can be successively correlated using miospores and that the top of the continental facies in southern Ireland is strongly diachronous. The lack of diagnostic conodont and ammonoid faunas in the Irish sequences has ruled them out as possible boundary stratotypes.

The miospore zonation scheme described from Ireland has been successively correlated with the well dated marine sequences in the classic area of the North Rhenish Slate Mountains of Germany (HIGGS and STREEL, 1984).

The most continuous spore succession here is found in the Hasselbachtal Section, where the LN/VI Biozone boundary occurs near the top of the Hangenberg Shales only 14 cms below the bed 84 containing *Siphonodella sulcata*.

A palynological study of the more recent Hasselbachtal Borehole has confirmed the presence of the LN/VI boundary just below the *sulcata* level equivalent bed and it has also extended the LN Biozone well down into the Hangenberg Shales. Also the base of the Hangenberg Shales in this section is much younger than those at Oberrödinghausen where they are of LL Biozone age.

Recent collaborative work between Soviet and western palynologists, has allowed detailed palynological correlation between the respective miospore schemes in Russia and western Europe, (AVCHIMOVICH *et al*, 1988) - see fig.2 - where the LN/VI boundary correlates with the base of the PMI in the central and eastern parts of the Russian Platform and the base of the M Zone in the Pripjat Depression and Nugodzhary. Palynological correlation of the Devonian-Carboniferous boundary beds in China is much more difficult due to absence of suitable clastic lithologies at this interval.

The rather poorly preserved and limited assemblage recorded from the Gedongguan Bed shale between limestone beds 21 and 22 (JI QIANG, 1987) in the Muhua section in Guizhou Province in southern China is tentatively correlated with the VI Biozone.

This illustrates one of the unfortunate problems in palynology, that is the absence of well preserved and identifiable spores in carbonate lithologies. Hence, no miospores have yet been recovered from the carbonate sequences of the Devonian-Carboniferous boundary beds at Nanbiancun in China, from Grune Schneid in Austria, and from La Serre in the Montagne Noire, France. In conclusion, it is considered that the LN/VI miospore biozone boundary is a very distinctive, widespread and readily recognisable biohorizon. It occurs very close to the base of the *Sphenodontia sulcata* conodont zone and so is an excellent biostratigraphical marker for the recognition of the Devonian-Carboniferous boundary. This is particularly important due to the fact that miospores have the unique attribute of allowing correlations to be made between marine and continental rocks at the Devonian-Carboniferous boundary.

#### Macroflora

The stratigraphic distribution of plants at the Devonian-Carboniferous boundary has recently been reviewed by FAIRON-DEMARET (1986). Figure 3 illustrates the ranges of the more important genera, and a few general comments are given here. The most important elements of the late Devonian flora belong to the genera *Archaeopteris*, *Rhacophyton* and *Cyclostigma* only (*Rhacophyton* sp. (not yet studied specimens fully).) is known to range into rocks of proved early Carboniferous age (Avon Gorge). *Archaeopteris* is characteristic of the Upper Devonian (although first appearing in the late Givetian), this genus ranges into the Strunian then disappears close to the Devonian/Carboniferous boundary. *Cyclostigma* has been much less extensively recorded but the few records indicate it may be restricted to the Strunian interval.

There is no continuous and uninterrupted plant record through the Devonian-Carboniferous boundary. However, it appears that a different plant flora comprising forms such as *Adiantites* and *Aneimites* appears in the early Carboniferous rocks.

The biostratigraphical value of plant fossils in the recognition of the Devonian-Carboniferous boundary is obviously limited, due to their restriction to mainly continental facies and to their general lack of abundance. Nevertheless, in broad terms two separate macrofloras are clearly recognisable either side of the systemic boundary.

REFERENCES

- AVCHIMOVITCH V.I., BYVSHEVA T.V., HIGGS K.T., STREEL M. and UMNOVA V.T., (1988) - Miospore systematics and stratigraphic correlation of the Devonian-Carboniferous Boundary deposits of the European part of the USSR and western Europe. Cour. Forsch. Senckenberg 100 : 169-191.
- CLAYTON G. and HIGGS K., (1979) - The Tournaisian marine transgression in Ireland. J. Earth. Sci. Dubl. Soc. 2, 1-10.
- FAIRON-DEMARET M., (1986) - Some Uppermost Devonian Megaflores: a stratigraphical review. Special Aachen volume. Ann. Soc. G  ol. de Belg. 109 : 43-48.
- HIGGS K., CLAYTON G., and KEEGAN J.B., (1988) - The Stratigraphic and Systematic palynology of the Tournaisian rocks of Ireland. Geol. Surv. Ire. Sp. Pap. N   7, pp. 110.
- HIGGS K., and STREEL M., (1984) - Spore stratigraphy at the Devonian-Carboniferous boundary in the Northern "Rhenisches Schieferberge" Germany. Cour. Forsch. Senckenberg 67 : 157-179.
- JI QIANG, (1987) - New results from Devonian-Carboniferous boundary beds in South China. Newsl. Stratigr. 17(3) : 155-167.
- STREEL M. and TRAVERSE A., (1978) - Spores from the Devonian/Mississippian Transition near the Horseshoe Curve Section, Altoona, Pennsylvania U.S.A. Rev. Palaeobot. Palynol. 25 : 21-39.

STRATIGRAPHY		SPORE BIOZONES	SELECTED SPECIES APPEARING IN THE BIOZONE	SELECTED SPECIES DISAPPEARING IN THE BIOZONE
CARBONIFEROUS	CHADMAN	Pu	<i>Lycopora pusilla</i>	
	COURCEYAN	VISEAN Via		
TOURNAISIAN Tn3		CM	<i>Convolvospora circumvallata</i> <i>Schopffites claviger</i>	<i>H. explanatus</i> <i>C. cristifer</i> <i>L. malekensis</i> <i>L. triangularis</i>
Tn3a		PC	<i>Crasispora trychera</i> <i>Anaplanisporites beccatus</i> <i>Prolycospora rugulosa</i>	
DEVONIAN	STRUNIAN	Tn2 b/c	<i>Catalisporites decorus</i>	
		TOURNAISIAN Tn2	<i>Spebeotriletes pretiosus</i> <i>Rasirickia clavata</i> <i>R. condylota</i> <i>Kraeuselisporites mirabilis</i> <i>Granulohisporites microgranulata</i>	<i>S. obtusus</i> <i>S. reticulatus</i>
	Tn2a	HD	<i>Vallatisporites vallatus</i> <i>Spebeotriletes balteatus</i>	
	Tn1b	VI	<i>Neorasirickia cymosa</i>	
DEVONIAN	STRUNIAN	TOURNAISIAN Tn1	<i>Umbonatisporites distinctus</i> <i>Kraeuselisporites habermicus</i>	
		Tn1b	<i>Crasispora maculosa</i> <i>Spebeotriletes obtusus</i> <i>Cyrtospora cristifer</i>	<i>R. lepidophyta</i> <i>V. pusillifolius</i> <i>Rugospora flexuosa</i> <i>Diducites verobilis</i> <i>Crasispora catherina</i> <i>Ancyclospora spp.</i>
		Tn1c	<i>Umbonatisporites abstrusus</i>	<i>Relispora casticula</i> <i>Aurotriospora tarquata</i>
		LL	<i>Verrucosiporites nitidus</i> <i>Vallatisporites verrucosus</i> <i>Lophozonitriletes malekensis</i> <i>Hymenozonitriletes explanatus</i>	
			<i>Relispora lepidophyta</i> <i>Vallatisporites pusillifolius</i>	

Fig.1

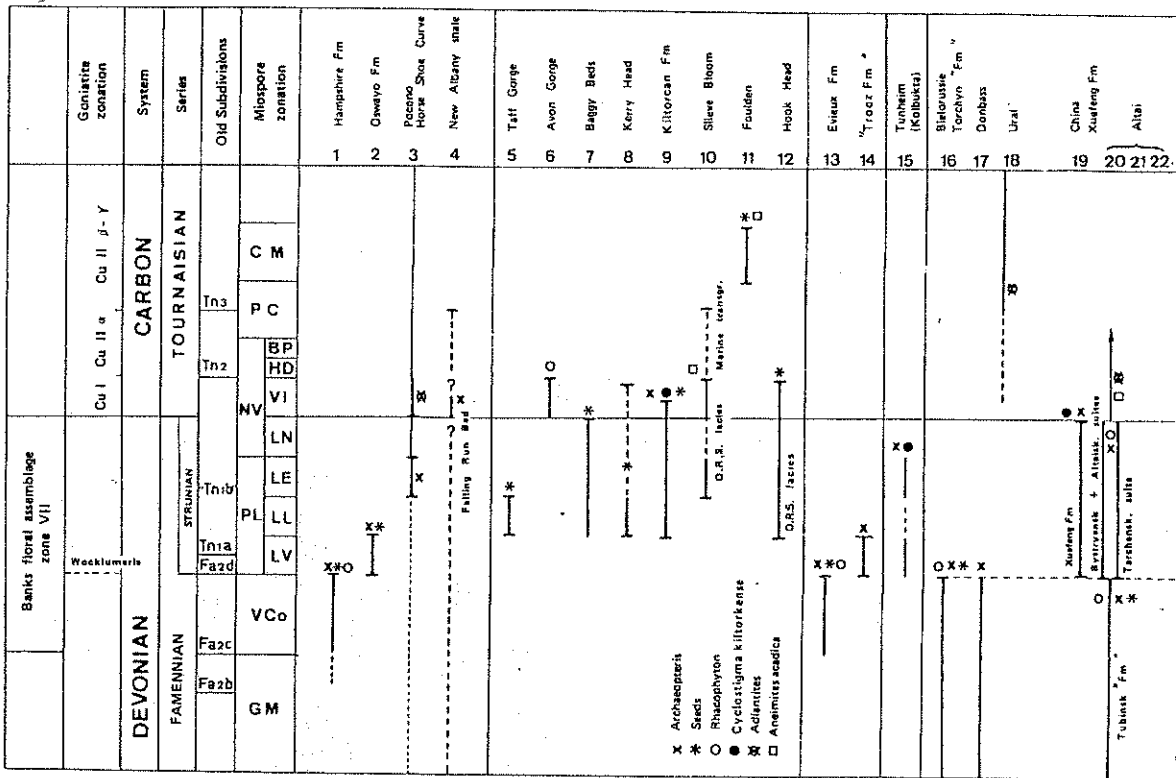
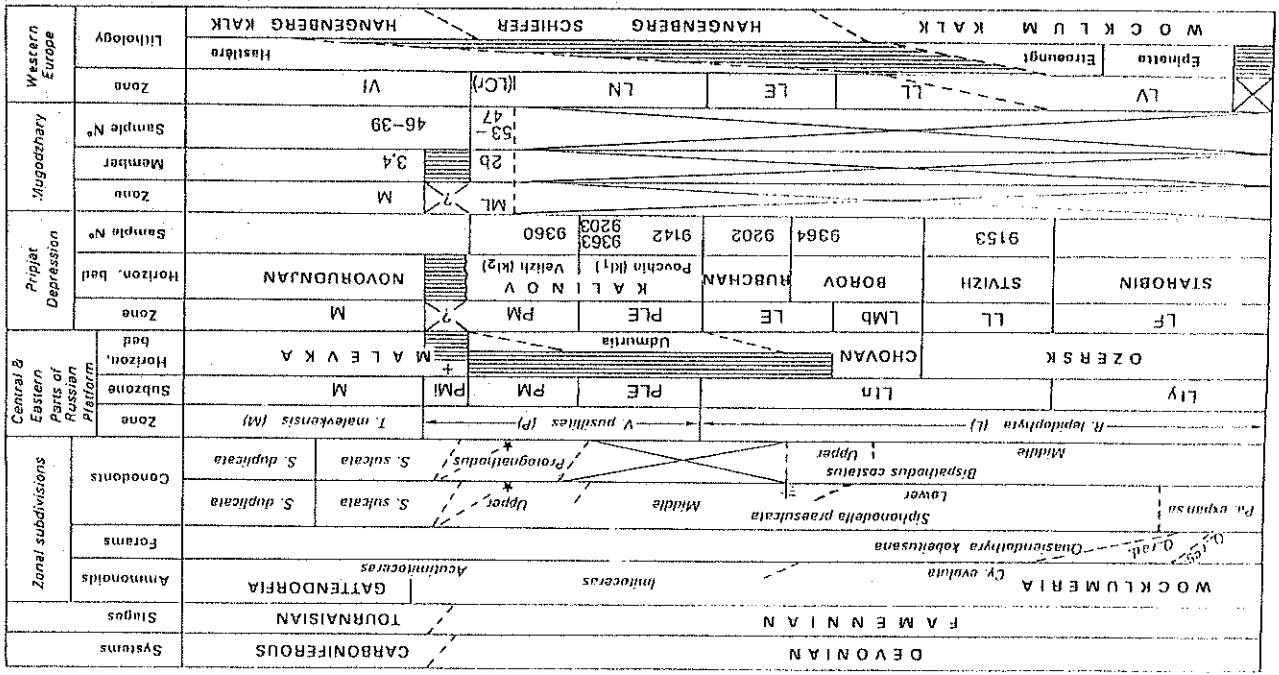


Fig. 2



\* base of *P. Fustaria* in BARKOV et al. 1984  
+ Kupavin beds