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WEST GONDWANAN AND EURAMERICAN CLIMATE IMPACT ON FAMENNIAN MIOSPORE ASSEMBLAGES

Maurice STREEL
Paleobotany, Paleopalynology, Micropaleontology Unit , Department of Geology, University of Liège, Belgium

Accurate Upper Devonian biostratigraphy is based on conodonts, marine microfossils. Dating non-marine or marine deposits which do not contain conodonts, often depends on miospores, which are produced in huge quantities by terrestrial plants and are abundantly dispersed in contemporaneous marine sediments. Most of the correlation between conodont and miospore stratigraphies has been established in Western Europe, notably in the Ardennes-Rhine area. Because same Frasnian and Famennian miospore zones (the *Cymbosporites* Realm in Streel & Marshall 2006) occur in both Southern Euramerica and Western Gondwana (implying close proximity of these continents) they allow transfer of Southern Euramerica conodont stratigraphy to Western Gondwana. When reconciling the Famennian conodont and miospore zones with the new, now widely accepted chronostratigraphy (Kaufmann 2006) and using the substage nomenclature proposed by Streel *et al.* 2000 and Streel 2005 (**Fig. 1**), three steps are recorded which might be climatically controlled

1) In Southern Euramerica, the Lower-Middle Famennian vegetation crisis (6 Myr) corresponds to very poorly diversified miospore zones (Raymond & Metz 1995, Streel *et al.* 2000). This crisis seems to extend stratigraphically to the Upper Famennian in cold temperate to sub-polar Western Gondwana and may be therefore climatically control.

2) The Upper Famennian miospore zones are based on a succession of species of the genus *Grandispora* occurring in the same stratigraphic order in Western and Eastern Europe (Higgs *et al.* 2000). The bases of the Upper Famennian VCo and VH miospore Zones in USA (Richardson & Ahmed 1988) are poorly controlled by marine fossils which often occur as single specimens at long distance from rich miospore assemblages (Streel & Loboziak 1994). Correlation is then based on lithostratigraphy despite its diachronous character. Maybe, alternatively, a belated arrival of VCo and VH characteristic miospores in the Upper Famennian of Belgium could have been controlled by the arid climate (Streel & Marshall 2006) if rain-bearing winds were deflected into Gondwana as proposed in the Tournaisian by Wright (1990). This alternative is called here the Upper Famennian climatic versus correlation challenge (6 Myr). During the Upper and Uppermost Famennian characteristic conodont taxa (Kaiser 2005) show shorter stratigraphic ranges and are more numerous than characteristic miospores. Both microfossils mark an obvious turnover near the Upper / Uppermost Famennian limit.

3) Glacial and interglacial cycles, during a period called here the Uppermost Famennian quick changing climate (3 Myr), are quite evident after the sharp climate change occurring during the late Upper Famennian within the Middle *expansa* Zone and introducing a new, almost cosmopolitan vegetation belt characterized by the miospore *Retispora lepidophyta*. But the best documented part is obviously the Uppermost Famennian age, when glacial deposits containing the LE-LN Zones reached the sea-level in Western Gondwana. Based on miospore (and locally on acritarch) quantitative data, cycles are very obvious in arid equatorial (Greenland) as well as in tropical (Ardennes-Rhine) regions (Streel & Marshall 2006). They allow also very detailed correlation of the Hangenberg Crisis (Streel 1999, Kaiser *et al.* 2006), in the Middle to Upper *praesulcata* Zone, with new geochemical data from tropical (Western Europe) and subtropical (Southern France and Morocco) regions and detailed correlation with warm temperate subtropical Pocono Fm (Pennsylvania) and the glacial events in Western Gondwana (South America).
In Western Gondwana, cold and dry climates with rather poor vegetation (Holocene Barren Grounds climate type) seem to alternate with

less cold but wetter climates with glacier extensions and richer vegetation.

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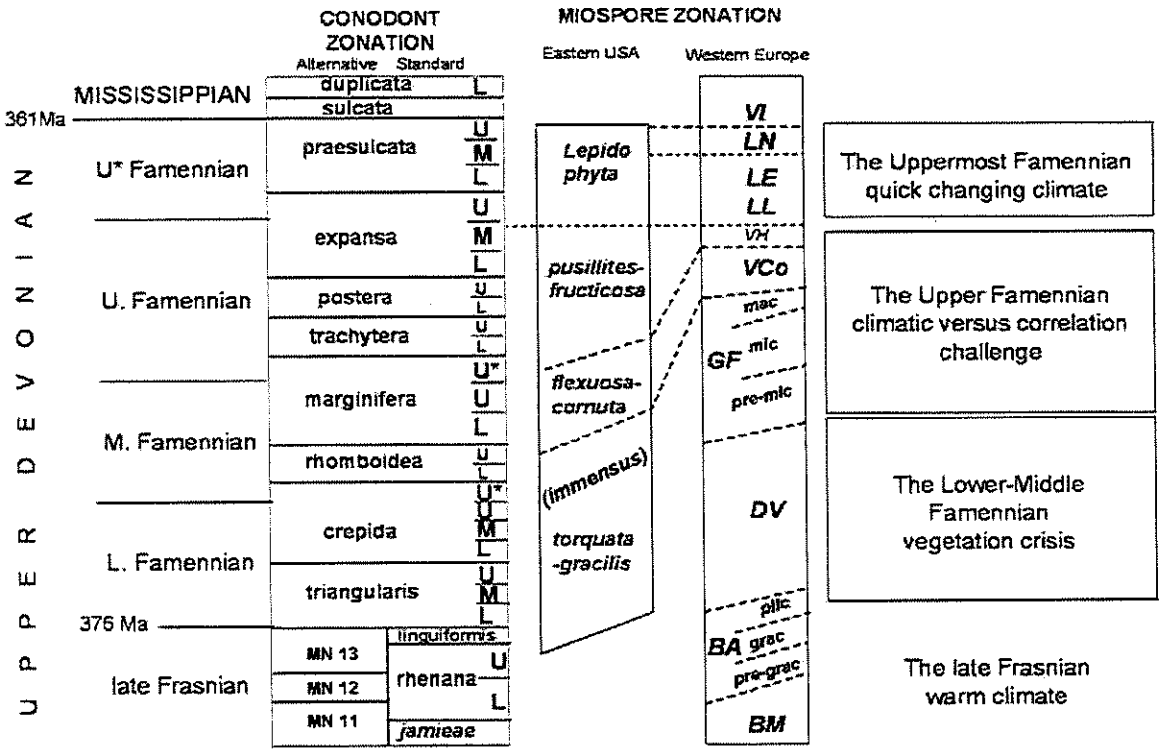

Fig. 1
Correlation of conodont and miospore stratigraphies
Relation between chronostratigraphy and conodont stratigraphy after Kaufmann 2006.
Famennian substages as proposed by Streel et al. 2000 and Streel 2005.
Miospore / conodont correlation in Eastern USA based on Richardson & Ahmed 1988, lithologic correlation after Kirchgasser 2000. Miospore correlation between Eastern USA and Western Europe mainly based on Richardson & Ahmed 1988.
The type Belgian lithostratigraphic data (Thorez et al. 2006) suggest that, in Kaufmann 2006, the Uppermost marginifera conodont Zone duration is probably too long and the Middle expansa conodont Zone, probably too short. Consequently, they have been here slightly modified.
The new names for late Frasnian- Lower Famennian miospore zones in Western Europe are defined in Streel 2008