Miospore ranges near the D/C Boundary and extinction events.

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What means "extinction events" in plant kingdom when seen through the miospore record ?

The most spectacular extinction event amongst land plants is obviously at mid-Permian time when most major groups had to evolve in new groups (like Pteridosperms) or collapse (like Lepidodendropsids). How sudden was this extinction event is poorly known but it is exemplative of the kinds of stress which affected land plants according to the environment where they were living. Those reproducing with spores dispersion were largely dependent of wet environments and therefore often controlled by the sea level fluctuations. They almost disappeared when the parallic swamps collapsed. Those reproducing by seeds, being able therefore to spread upland, had first of all to adapt themselves to changing climatic conditions.

Coincidence in time of important sea level fluctuations and climatic changes may indeed lead to major events in plant kingdom.

The miospore record of such events will depend of the distance between the production sites (where mother-plants were living) and the sedimentation sites (where miospores were burried). Marine sediments are preferred for investigation because they offer more chance for the record of direct coastal influxes as well as upland influxes through the fluvial discharge into the sea. Quantitative analysis of miospores allows to separate theses influxes as far as the mother-plants (and their ecological connotation) are known but the sedimentological context sometimes allows also to identify the source-area.

Paleogeographical and ecological controls on Devonian miospores.

A latitudinal zonation of the vegetation is obvious since the Upper Devonian at least (Streel et al. 1990), reflecting climatic latitudinal gradients. Rather cosmopolitan at Givetian and early Frasnian the vegetation displayed some equatorial realm in the middle and late Frasnian. Cooling of part of the Gondwana during the early and middle Famennian leads to a climatically highly segregated world reinforced by cold phases on western Gondwana during the late Famennian and the early Carboniferous.

Coastal versus upland vegetations were probably differentiated since the Middle Devonian (Streel 1964, Richardson 1965) and the first peat swamps of some importance are known since the beginning of the late Famennian (trachytera or postera Zones) (Streel & Schlecker 1990).

During the late Famennian, the miospore records suggest that a cosmopolitan vegetation, allowing correlations throughout the world, is mainly of coastal origin and therefore was affected by the sea level changes. This was particularly true near the D/C boundary.

Late Famennian coastal vegetations and their collapse near the D/C Boundary.

Streel & Schlecker (1990) have compared miospore assemblages (VCo Zone) from continental sediments of the Hampshire Formation of Virginia and West Virginia, U.S.A. with those from the nearly coeval marine facies (Fa2c) of the Ourthe Valley, Belgium. Onshore autochthonous and allochthonous beds generally show correspondence between the recovered plant megafossils and the miospore assemblages. These assemblages enable to distinguish between deposits resulting from short-term flooding episodes, those of autochthonous upland backswamps and deltaic marshes. One can distinguish upstream from downstream environments in the continental samples (Table 1).

The Retispora lepidophyta assemblages from the marine nearshore facies (Fa2d, "Tn1a") of the Ourthe Valley, Belgium (expansa - praesulcata Zones) are very similar in species composition to the Fa2c assemblages except for the new occurence and the abundance of R. lepidophyta which, by comparison, seems to belong, together with V. hystricosus, to a downstream swamp margin environment (Jarvis 1992, unpublished thesis and Streel in Dreesen et al. 1993).

The relative proportion of R. lepidophyta, V. hystricosus, A. asperella and Diducites plicabilis might reflect different coastal swamp environments in various proportion depending, for instance, on different distances to the water table. This is corroborated by the sequence of quantitative events of these miospores as seen in a very detailed sampled section like Stockum trench II immediately below the D/C boundary (Higgs et al. 1993). (Fig. 1). The almost complete extinction of these species near that boundary level, well known around the world (Streel 1986, Loboziak et al. 1993), appears to occur step by step in this trench. It is marked first by the disappearance of "coal" swamps with D. plicabilis and is followed by a strong reduction of the proportion of R. lepidophy-

Table 1: Miospores dominating a specific environment

Well drained alluvial plains:
Aneurospora greggsii (probably Archaeopteris microspores)

"Coal" swamps:
Diducites plicabilis-Auroraspora varia Complex (Rhacophyton miospores)

Downstream swamp margins:
Vallatisporites hystricosus, or Auroraspora asperella (A. macra auctorem)

Upstream swamp margins:
Grandispora gracilis, or Retusotriletes cf. coniferus

ta (from 30 % to 1 or 2 %) suggesting the progressive reduction of the related swamp margin environment which seems to completely disappear soon after, together with the V. hystricosus and A. asperella (=A. macra) swamp margin environments. It might even be of some significance that Retusotriletes coniferus, which characterizes an upstream swamp margin environment, probably less dependant of the coastal water table, was amongst the few species surviving the sharp exctinction limit.

These miospore events immediately succeeded a sedimentary cycle constituted by a transgression (the Hangenberg Black Shale event) and a deep regression (the Hangenberg Sandstone event) (Bless et al. 1993). The regression was part of the major regression event IIf of Johnston et al. (1985) and can be correlated by miospores with the glacial episode known in Brazil. Becker (in press) estimates the cycle to correspond to some 400.000 years but the events duration might as well have been much shorter, the deposits of the Hangenberg Sandstone for instance being possibly discontinuous.

It is unrealistic however to imagine that coastal plant communities were not able to follow the water table because the changes were rather quick. Alternatively, we might think that additional events have interferred with the sedimentary cycle like drastic short living cold spells bringing cold water far into the intertropical belt as suggested by Copper (1977) explaining the unability of the coastal vegetation to take over the new Carboniferous transgressive conditions.

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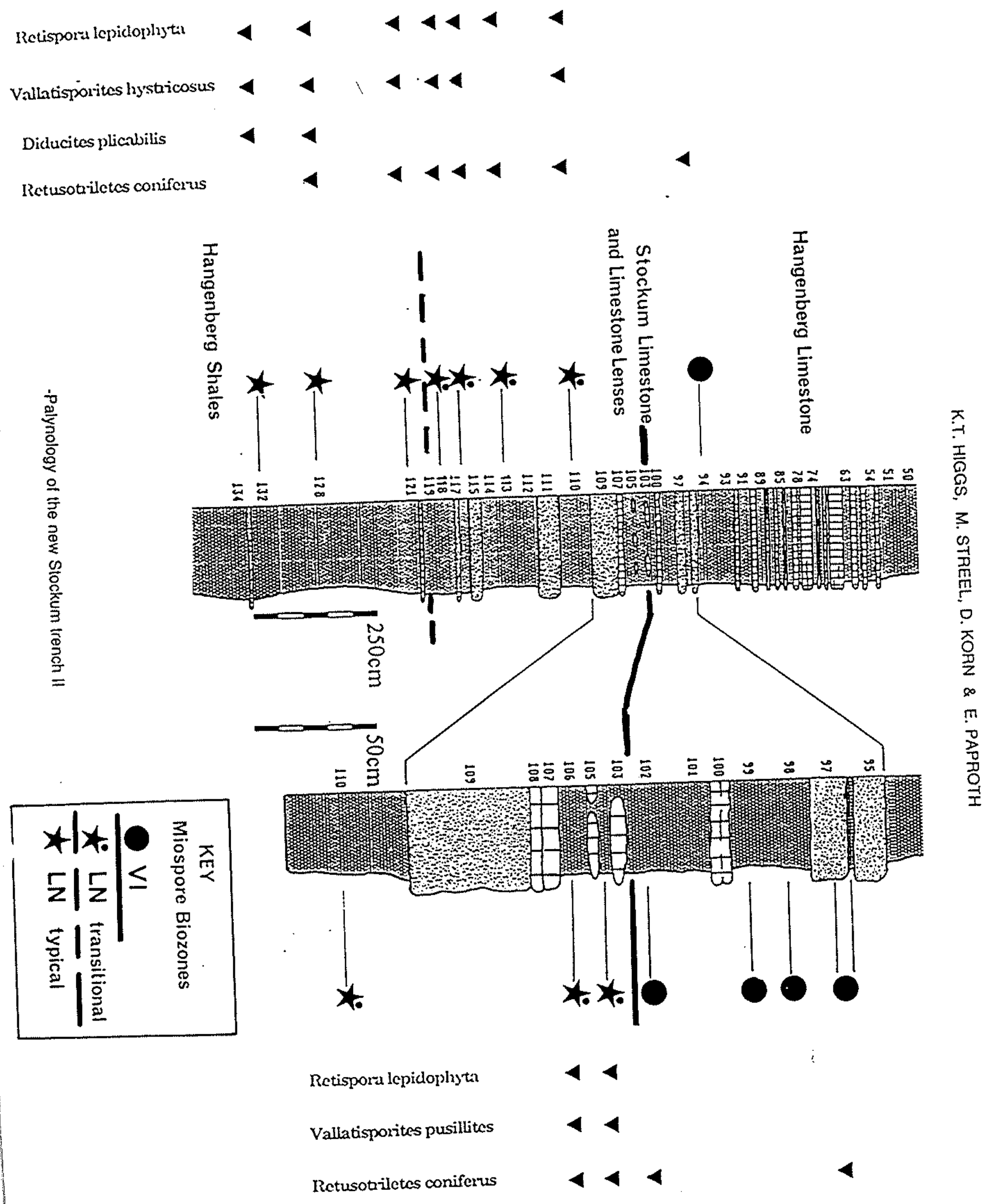

-Palynology of the new Stockum trench II