Palynologists and
Plant Micropalaeontologists of Belgium (PPMB)

Miscellanea palaeontologica

Program and abstracts
Edited by P. Gerrienne, E. Pétus & P. Steemans

A meeting of the NFSR Working Group:
"Micropaléontologie végétale et Palynologie (MVP)"

Palaeobotany, Palaeopalynology and Micropalaeontology
University of Liège
December 04, 2009

Université de Liège

Paléobotanique
Paléopalynologie
Micropaléontologie

Program

Schedule	First authors	Titles
10h-10h20	**Prestianni**	The flora from Dechra-Aït-Abdallah (Morocco): a Lower to Middle Devonian transitional assemblage.
10h20-10h40	**Damblon**	Charcoal and wood remains from East Carpathian and Siberian loess.
10h40-11h00	**Roche**	Phytostratigraphie et aperçu environnemental du Néogène continental de l'Entre-Sambre-et-Meuse et du Condroz (Belgique).
11h00-11h15	**Café**	
11h15-11h30	**Romero**	Identification of land plant biomarkers from Carboniferous (Visean) coal deposits at Dunbar (East Lothian, Scotland).
11h30-11h50	**Lepot**	Mineral artefacts mimicking microfossils in Archean rocks.
11h50-12h00	**Pouille**	The Paleodiversity and paleoenvironments of siliceous biomineralization at the Neoproterozoic-Phanerozoic transitional interval.
12h00-14h00	**Lunch and discussions**	
14h00-14h20	**Delabroye**	Acritarchs and prasynophytes from the Ordovician-Silurian boundary at Anticosti Island, Québec, Canada: their stratigraphic implications.
14h20-14h35	**Mortier**	The ravine 700m east section of Neuville-sous-Huy (Upper Llandovery to Middle Wenlock), preliminary result.
14h35-14h55	**Mehlqvist**	Palynological evidence for early land plants in upper Silurian strata, Skåne, Sweden.
14h55-15h10	**Bignon**	Quantification of ontogenetic modifications within the genus *Dechenella* from the Middle Devonian of the Ardenne Massif (France).
15h10-15h25	**Pinte**	Givetian tabulate corals from southern Ardennes : relations with environmental conditions.
15h25-15h45	**Café**	
15h45-16h00	**Denayer**	Lower Carboniferous corals from the Zonguldak Area (Black Sea, Northwestern Turkey).
16h00 -16h20	**Van Boxlaer**	Illuminating the black box of punctuated equilibrium evolution: evolutionary punctuations in *Bellamya* gastropods from Lake Malawi.
16h20-16h35	**Verhoven**	Dinoflagellate cysts and pollen from the Tjörnes/Breidavik section, northern Iceland.
16h35-16h50	**Goubel**	Quantification of intra-specific and inter-specific morphological variability in European Pleistocene large bovids.
16h50-17-10	**Fischer**	Diversity and extinction of Cretaceous ichthyosaurs.

The abstract books 2008 and 2009 are available online:

(2008) - http://orbi.ulg.ac.be/handle/2268/13202?locale=en
(2009) - http://orbi.ulg.ac.be/handle/2268/30260?locale=en

Example of reference:
Denayer, J., 2009. Lower Carboniferous corals from the Zonguldak Area (Black Sea, Northwestern Turkey). *in* Gerrienne, P. & Steemans, P. (Eds). *Miscelanea palaeontologica*. Paléobotanique, paléopalynologie, Micropaléontologie, Université de Liège, Liège, Décembre 4, 2009: 8.
http://orbi.ulg.ac.be/handle/2268/30260?locale=en

Vegetation dynamics of atlantic mountainous Central Africa since 17 ,000 years BP. Preliminary analysis of pollen records from lake Bambili, Northwestern Cameroon.

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The study concerns the preliminary results of pollen analyses carried out on a 13.5m long core taken from the shore of the crater lake of Bambili, Cameroon (05°56 '11''N; 10°14 ' 31''E; 2273m alt.). This allows to reconstruct the history of montane forest ecosystems from Atlantic Central Africa since 17 000 years BP. Well diversified microflora, show several changes. At the base of the pollen sequence, the vegetation is dominated by herbaceous plant populations such as Poaceae, associated with "dry" plant types from Amaranthaceae-Chenopodiaceae families and tree and shrub plant types from savannas and open forest formations types such as *Gnidia, Lannea,* Combretaceae, *Cussonia*… The montane forest expansion started from 14 080cal BP with the appearance of the pioneer taxon *Myrica*. This taxon is followed by *Schefflera*, *Podocarpus*, *Olea*, *Syzygium…* which widely expanded in the immediate surroundings of the lake from 12 310 to 4 590 cal BP. After this date, the montane forest was strongly reduced. However a short phase of forest regrowth is recorded around 2000 BP during which *Schefflera* dominated the forest assemblage.

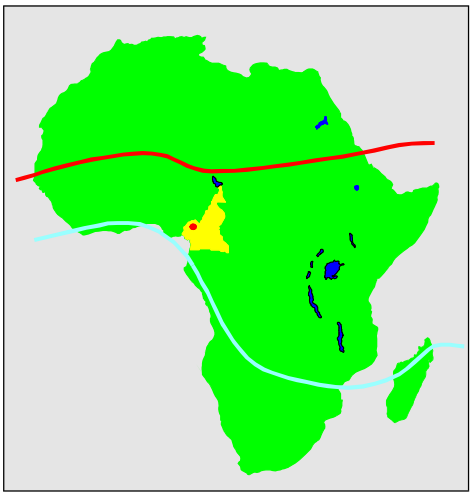

Figure 1 : Localisation du site de Bambili au Cameroun

Figure 2 : Le lac du cratère de Bambili et l'endroit du sondage

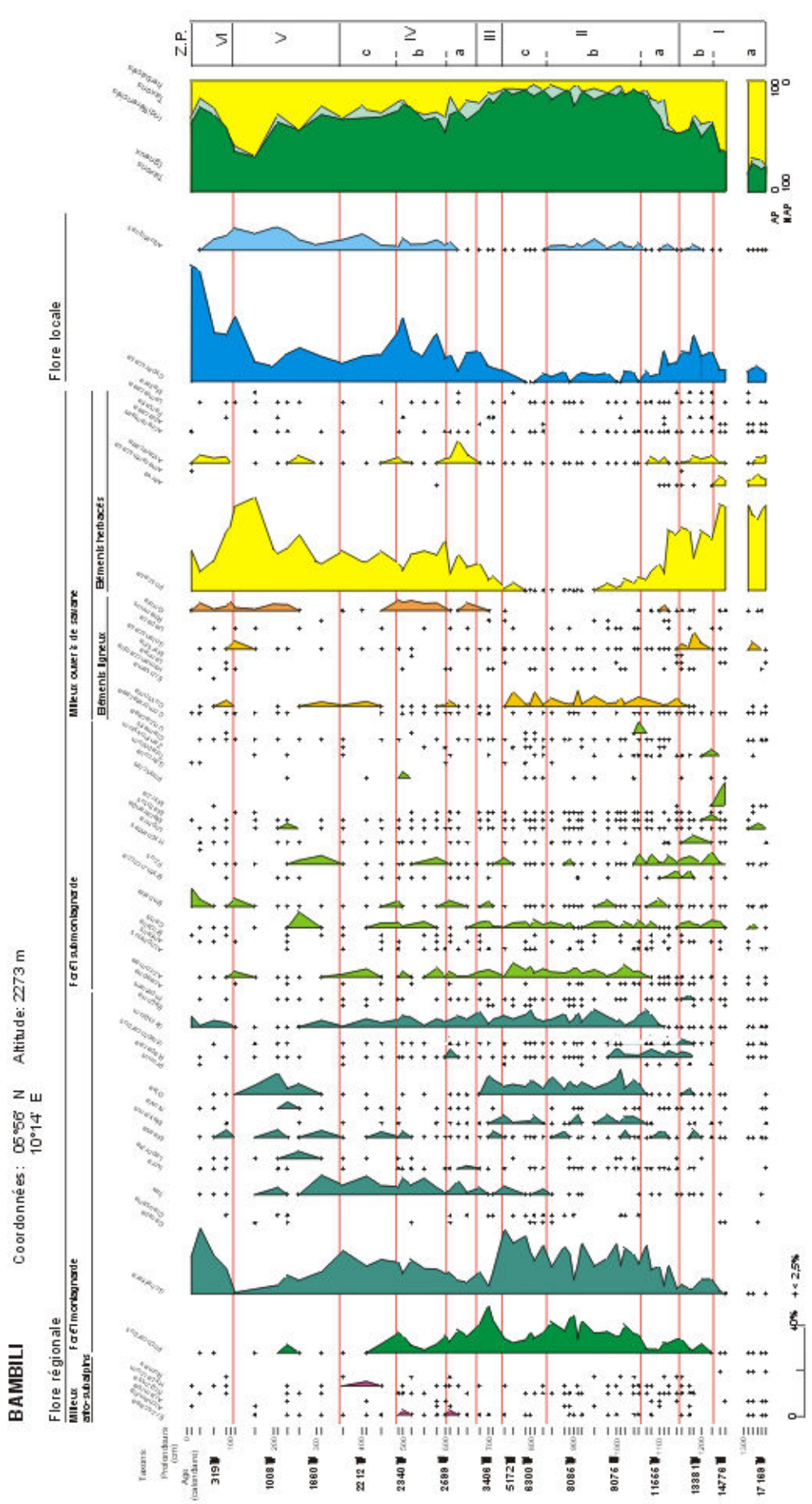

Figure 3: Diagramme pollinique simplifié des principaux taxons de la séquence du Lac Bambili.

Cette figure montre, de gauche à droite, en fonction de la profondeur, les pourcentages des taxons de l'étage afro-subalpin, de la forêt de montagne, de l'étage submontagnard, des milieux ouverts de savane et de la flore locale. A la fin du diagramme, une dernière colonne fait la synthèse en représentant les pourcentages du total des arbres (AP) à gauche et des plantes herbacées (NAP), à droite. A l'extrémité droite du diagramme figurent les différentes subdivisions polliniques; la délimitation des zones principales a été basée sur le dendrogramme réalisé à l'aide du logiciel *CONISS*(GRIMM, E., 1991). Les pourcentages des taxons terrestres sont calculés sur la somme des grains déterminés à l'exclusion des Cyperaceae, des plantes aquatiques et des fougères. Les pourcentages de ces trois derniers groupes sont calculés sur le total de tous les grains comptés.

Quantification of ontogenetic modifications within the genus *Dechenella* from the Middle Devonian of the Ardenne Massif (France).

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The Mont d'Haurs section (Givetian), in the south of the Ardenne Massif, has yielded an important number of trilobites attributed to three different species of the genus *Dechenella* (Proetidae). A morphometric analysis based on the landmark method has been performed independently on the cranidia and the pygidia.

The objectives of this work are: 1) to identify ontogenetic stages from the establishment of different size clusters, 2) to characterise the inter-specific morphological changes, 3) to describe size and shape changes occurring during ontogeny in each species, and 4) to identify the different modes of evolutionary changes of ontogeny in the three dechenellid species (Webster and Zelditch, 2005).

The quantitative analysis performed on the cephala has permitted to differentiate clearly two *Dechenella* species. Their cephalic ontogenetic trajectories are also distinct and an allometric repatterning expresses these differences.

Conversely, the pygidial shape of these species could not be differentiated quantitatively and their ontogenies are similar. However, the modification rates of the pygidial shape during the ontogeny between these two species are different.

The last species, only known from its pygidia, is quantitatively different from the other two. Moreover, its pygidial ontogenetic trajectory is also singular, only an allometric reparttening can explain the relationships between the ontogeny of this species and those of the other two.

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Charcoal and wood remains from East Carpathian and Siberian loess. Their contribution to the history of climate during the last 45,000 years.

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The aim of the present work is setting up a chronological frame of the climatic events recorded in central European and Siberian loess deposits within the period between 45 and 10 ka BP. Some palaeo-environmental information may also be taken from charcoal and wood assemblages in loess.

Combined pedostratigraphic investigations were achieved in Central Europe on long loess sequences with multiple Upper Palaeolithic occupations rich in charcoal and in Central Siberia on natural loess-loam sequences with numerous wood accumulation layers. Special attention was paid to the strategy of sampling in safe accordance with stratigraphy, to the preparation process in the laboratory for extraction, cleaning, identification and selection of the best charcoal or wood fragments to date.

The palaeobotanical data point to diverse combinations of conifers, mainly spruce, larch and pine, locally associated with birch, alder, willow or poplar, which appeared linked to valley bottom and slopes. No mesophilous taxon was found in the pleniglacial deposits in the investigated area between the Carpathians and the Yenisei Basin.

The ^{14}C results were compared to previous dates after careful critical screening of the former published data and the present dates. By combining radiocarbon dates and detailed stratigraphy, it was possible to propose correlations between the different loess sequences on the ground of the sequential analysis of pedosedimentary and climatic signatures. In this way, the study of the loess sequence has led to setting up long semi-continuous climatic and chronological sequences for the period between 42.5 ka and ca 13 ka BP by integrating some 20 interstadial episodes with a resolution degree of centuries. By another way, the conjunction of the climatic signals in loess and the associated radiocarbon dates on charcoal and wood allowed to build up a correlative scheme with the Greenland ice isotope sequence and to precisely position the long series of atmospheric radiocarbon dates from loess with regard to the climatic signatures in the ice record.

Acritarchs and prasynophytes from the Ordovician-Silurian boundary at Anticosti Island, Québec, Canada: their stratigraphic implications.

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The outcropping sedimentary strata on Anticosti Island (Québec, Canada) represent among the key sections spanning the Ordovician-Silurian boundary (time of important palaeoenvironmental perturbations and biological related crisis).

The upper Vauréal Formation (late Katian), the Ellis Bay Formation (late Katian? to Hirnantian) and the lower Becscie Formation (late Hirnantian-early Rhuddanian) *sensu* Petryk (1981) have been sampled for palynological investigations in western Anticosti whereas in eastern Anticosti, only the upper Ellis Bay Formation and the lower Becscie *sensu* Long & Copper (1987) have been sampled. These two extremities of the island have long been difficult to correlate in the past because of eastern strata more influenced by siliciclastic inputs than western ones.

Acritarch analyses of a total of 144 samples from the two extremities of the island allowed to propose a new east to west correlative scheme based on the definition of seven acritarch local biozones, confirming recent correlations based on chitinozoans (Achab et al. in press) that questioned the commonly used correlative scheme based on brachiopods (Copper 2001). In summary, the lower half of the Ellis Bay Formation in eastern Anticosti correlates with the upper Vauréal Formation in western Anticosti.

In conclusion, these recent findings permit to propose a completely new stratigraphic framework for the Late Ordovician-Early Silurian anticostan strata.

The proposed east-west acritarch-based correlations rely on a detailed systematic analysis of palynological assemblages from the upper Vauréal, Ellis Bay and lower Becscie formations. Among the encountered palynomorphs, four prasynophyte species, 79 acritarch species, and three problematica have been detailed systematically.

These new data show that acritarch assemblages from the Ellis Bay Formation, that records the two major Late Ordovician glacially driven sea-level drops well recorded in North-Gondwana (Desrochers et al. in press), are characterized by relatively high rates of speciation and morphological innovations, contrary to what previously assumed (Duffield & Legault 1981).

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Lower Carboniferous corals from the Zonguldak Area (Black Sea, Northwestern Turkey).

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Palaeozoic rocks crop out along the Black Sea coast between Istanbul and Bartin, in the northwestern part of Turkey. The Carboniferous, especially the Mississippian is well exposed south of the coal basin of Zonguldak, where it forms a thin limestone belt rich in corals. This area has been explored during the 1920's by F. Charles who discribed the macrofauna (Charles, 1933). A primary description of foraminiferal association has been done by Dîl (1975). He has recognized the major west-european formainiferal biozones ("Fa2", "Tn1a-b", "Tn2a-b-c", "V1a", "V2a-b" and "V3b", so an age varying from Famennian (Upper Devonian) to Upper Viséan.

Four sections have sampled in the Zonguldak Municipality for the tetracorals: Gökgöl section, Kokaksu, Ulutam and Kisla section, showing more or less continuously the succession from the Upper Devonian to the base of the Namurian. The Tournaisian beds are very poor in macrofauna in every section, contrarily to the Viséan, very rich in corals. The majors coral taxa found are: Aulophyllum, Caninia, Caninophyllum, Clisiophyllum, Corwenia, Dorlodotia, Haplolasma, Kwangsiphyllum, Lithostrotion, Nemistium, Palastrea, Paleosmilia, Pseudozaphrentoides, Siphonodendron and Siphonophyllia. The rugose corals biozones of Poty et al. (2006) RC4 to RC8 (Moliniacian to Warnantian substages) have been recognized trought the sections.

The Kokaksu section is the more intersting for corals because the Livian beds contain numerous and diversified Dorlodotia and Siphonodendron fauna. The first are composed of "european" taxa as D. briarti and endemic (?) taxa as D. euxini sp. nov. and unknown cerioid form half way between Dorlodotia and Petalaxis. This taxa is probably the root of the Middle-Upper Carboniferous Petalaxis-group corals, still enigmatic today. "European" Siphonodendron species have been found in Turkey: S. ondulosum, S. martini, S. irregulare and S. pauciradiale. Moreover, "endemic" species have been found in the same assemblages: S. sp., intermediate between S. martini and S. intermedium and S. cf. irregulare, close to S. junceum but showing dissepiments. These new taxa argument the heterochronic lineage of Siphonodendron described by Poty (1993).

Palaeobiogeographic reconstructions of the Zonguladak area during the Carboniferous, based on formaniferal distribution, have been proposed by Kalvoda (2001). After this author, the Zonguldak Terrane was close to the Ukrainian Donetz Basin. On the other hand, the corals from Zonguldak have very few affinities

with those from the Lower Carboniferous corals from Donetz. Indeed the Zonguldak Terrane should have been closer to Western Europe Basin than Donetz, in the northern realm of Palaeotethys.

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Diversity and extinction of Cretaceous ichthyosaurs.

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Considered as the last members of dying group, Cretaceous ichthyosaurs have traditionally been referred to the genus *Platypterygius*, whose diagnosis and phylogenetic position are clearly inappropriate. This systematic bias strongly hampers our understanding of the biodiversity evolution of Cretaceous ichthyosaurs. However, new material from the Lower Cretaceous of Russia and SE France exhibits a high taxonomical and ecological diversity, equal or even greater to that of the very well known Lower Jurassic forms. New specimens also indicate that most of the Late Jurassic ichthyosaurs actually cross the Jurassic-Cretaceous boundary. Furthermore, these new data contradicts the 2 hypotheses explaining the ichthyosaur extinction at the end of Cenomanian. A new explanation, involving a series of causes, including non-biological drivers is proposed.

On some specimens of the putative early lignophyte *Crossia* (Stenokoleales) from Ronquières (Middle Devonian, Belgium).

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The Middle Devonian is a period of important taxonomic turnover for early terrestrial plants, which showed high origination rates. This pattern coincides with the evolution of phenotypic novelties (tree habit, megaphyllous leaves with increasing laminate surfaces, proto-ovules) that potentially increased the range of growth, reproductive, and dispersal strategies of the plants, modified interactions between organisms, and have initiated a profound modification of terrestrial landscapes.

Based on current evidence, the lignophytes (plants that possess a bifacial vascular cambium, producing secondary phloem -inner bark- outwards, and secondary xylem -wood - inwards) evolved during Middle Devonian times. Plant deposits of Middle Devonian age are numerous and widely distributed over the Palaeozoic palaeocontinents; yet the richest and most diverse in terms of lignophytes and related taxa occur in Laurussia, a distribution also observed in the Late Devonian.

The genus *Crossia* has been originally reported from an Eifelian locality from Virginia (Beck and Stein, 1993). The authors described a narrow peripheral zone of radially aligned tracheids from a single specimen, and interpreted it as a small amount of secondary xylem. On this basis, the genus has been presented as the earliest lignophyte (Kenrick and Crane, 1997), even though the presence of a bifacial vascular cambium has still to be demonstrated.

In this presentation, we focus on the occurrence of permineralized remains of *Crossia* from a middle to late Givetian (TA spore Zone) locality in the Ronquières area (Belgium). The locality is contemporaneous and geographically close to the locality that provided the proto-ovule *Runcaria* (Gerrienne et al., 2004) which is no longer accessible.

Seven permineralized axes have been collected. All are similar to the single fragment interpreted as a first-order axis by Beck & Stein (1993). They show a large three-ribbed protostele containing a central protoxylem stand and up to 20 protoxylem strands arranged along the mid-planes of the primary xylem.

Lateral appendages are produced alternately and in pairs, each member of a pair containing two separate strands of unequal size proximally.

We demonstrate that a ring of secondary xylem with radially aligned tracheids and narrow rays is present in several specimens from Ronquières (Fig. 1). Pitting is continuous over the radial and tangential walls of tracheids. Rays are 1-3 seriate and up to 45 cells high. Until now, we failed to demonstrate the presence/absence of a bifacial vascular cambium and of secondary phloem.

The primary body of *Crossia* is compared to coeval or slightly younger woody plants and early spermatophytes. The phylogenetic position of *Crossia* is discussed.

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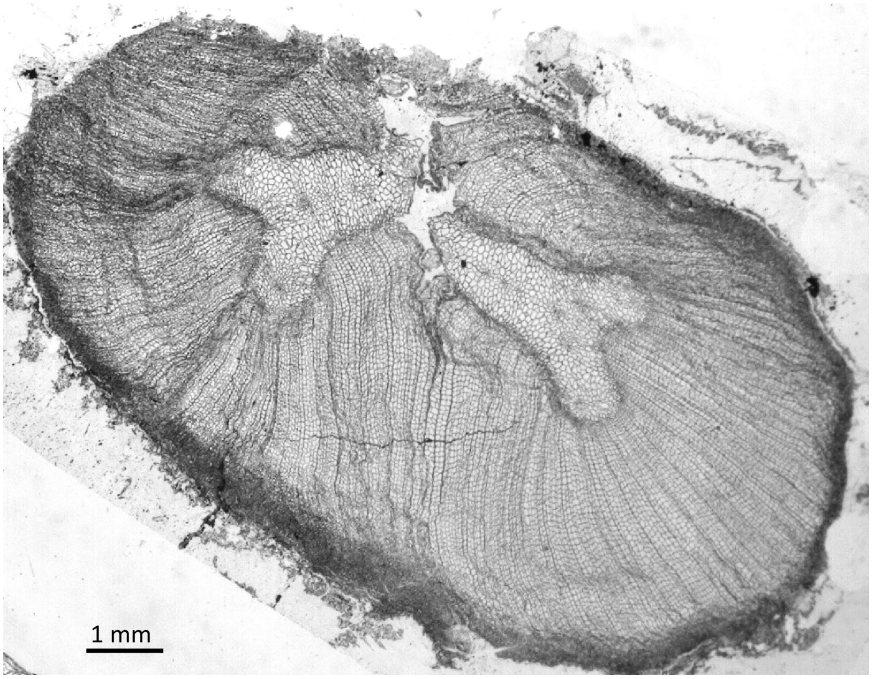

Figure 1 : *Crossia* sp. Transverse section of an axis with a ring of secondary xylem.

Quantification of intra-specific and inter-specific morphological variability in European Pleistocene large bovids.

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During Upper and Middle Pleistocene (~ from 1 Ma to 12.000 y. BP) in Europe, large bovids are mainly represented by *Bos* and *Bison* genus. Because of the strong climatic changes that affected this period and the anatomical and diet adaptations within these two groups, each taxon is identified from different ecological contexts. Thus, generic and specific determinations are necessary in order to establish geographical and chronological faunistic dynamics (especially large mammalian turnovers) and accurate palaeoenvironment of pleistocene ecosystems.

Nevertheless, the distinction between *Bison* and *Bos* is often difficult to do through classical methods, such as morphometric measurements. Indeed, anatomical and dental elements of large bovids show a wide morphological plasticity. Cheek teeth (premolars and molars) are often used to distinguish *Bos* and *Bison*, especially for aurochs (*Bos primigenius*), living under temperate climate and forest context, and for steppe bison (*Bison priscus*), adapted to cold and steppe context.

In order to quantify bovid intra-specific and inter-specific morphological variability in large bovids, outline analyses *via* elliptic Fourier transform are performed on first lower, third upper and third lower molars. Because they are hypsodont, both shape and size of occlusal surface are directly linked to wear. Thus, outline analyses are only performed on the basal (inferior) part of the teeth. In order to assess shape plasticity within a single aurochs population, Biache-Saint-Vaast aurochs accumulations (Pas-de-Calais, France) have been chosen as reference population for both richness and quality.

Pleistocene aurochs populations from contrasted climates and palaeoenvironments were then integrated. The observed disparity has been confronted with extrinsic parameters such as climate and ecological modifications. Several steppe bison specimens have been also included in order to assess inter-specific morphological variability.

Mineral artefacts mimicking microfossils in Archean rocks.

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Because prokaryotes populating the early Earth were structurally and morphologically very simple, it is difficult to obtain taxonomic information from microfossils, and even more problematic, to distinguish true fossils from abiotic objects. For example, many self-assembly processes associated with the precipitation of nanoscale minerals in the presence of organic compounds generate cell-like structures. Based on high resolution microscopy observations on natural samples, we describe three types of features common to Archean rocks and suggest that they represent microfossil-like artefacts.

Using Scanning Electron Microscopy we have observed carbon-free silica inclusions in carbonate sediments that are very similar in size and shape (rods and spheres) to microorganisms. The common distribution of organic carbon at grain boundaries in those rocks indicate that such cell-like minerals, when coated by secondarily-migrated carbonaceous mater, could easily be mistaken for microfossils.

The organisation and the micro- to nano-structure of bacteriomorphs might be even more confusing. We have observed chains of spheres that match in size and arrangement with some coccoid bacteria such as streptococci. Transmission Electron Microscopy (TEM) observation of Focused Ion Beam (FIB) sections cut through these spheres shows that they are composed of TiO_2 nanocrystallites partly rimmed or linked by nanoscale chlorite films. This assemblage creates smooth cell-like structures at the micron-scale. However, the absence of organic carbon in those structures as well as the observation of many similar TiO_2 chains of spheres dispersed in volcanic glass shards argue against a biologic origin.

Ambient inclusions trails also generate filamentous structures that can be mistaken for microfossils. (Knoll and Barghoorn, 1974) suggested that such pseudofossils could have formed by the displacement of a crystal (e.g. pyrite) in its mineral matrix owing to pressure solution processes linked to gas evolution of associated organic material. We have found (Ca, Fe)-garnet filaments within the Maddina Formation (2.7Ga) basalt that have a morphology similar to that of 1) certain modern iron-mineralized filamentous bacteria, 2) some ancient filamentous structures interpreted as microfossils and also 3) tubular structures produced by microbial boring activity. TEM analysis of FIB sections cut trough these filaments and Raman mappings of

carbonaceous matter confirm the role of organic matter displacement in the formation of those microfossil-like structures.

Thus, the existence of such organo-mineral features shows the importance of correlating microbial morphologies with the texture and distribution of organic matter within (to support an indigenous origin) or around (to identify migrations) cell-like micro to nano-structures.

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Palynological evidence for early land plants in upper Silurian strata, Skåne, Sweden.

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Spore assemblages produced by early land plants have been studied in drill core samples (drillcore Klinta 1) from the Upper Silurian Öved-Ramsåsa Group, Skåne, Sweden. The sediments are dominated by siliciclastic deposits with minor carbonate units. The palaeoenvironmental setting has been previously interpreted as a near shore marine ecosystem (Wigforss-Lange 2007), offering a prime target for palynological analysis. The terrestrial record is, in this marine setting, represented by rich spore assemblages and the high percentage of spores at some levels signifies a near-shore, intertidal environment. However, an interval characterized by a total lack of spores is interpreted to be a high-tidal to supra-tidal environment where organic materials were oxidized. Apart from spores, wood remains and marine palynomorphs (such as acritarchs) are present in the palynological assemblages.

A total of 14 spore species belonging to 11 genera were identified and additionally three taxa were identified to genus level. The interval has stratigraphically been identified as most probably belonging to the *libycus-poecilomorphus* spore zone (Richardson & McGregor 1986) based on the presence of following spore species: *Emphanisporites neglectus* and *Hispanaediscus verrucatus* indicating that the studied sediments would be of Ludlowian (Ludfordian) age (420 Ma). The spore zonation has subsequently been correlated with the existing biostratigraphical scheme based on conodonts, graptolites and tentaculitids.

An interesting trend, consisting in an increase in the relative abundance of trilete spores in younger strata, has been observed. In the older part of the investigated cores, cryptospores dominate. This is interpreted as a result of the evolution towards more modern spores produced by vascular plants in the top of the section and a decrease of spores produced by more primitive plants.

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The ravine 700m east section of Neuville-sous-Huy (Upper Llandovery to Middle Wenlock), preliminary result.

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It is known since the studies by Michot (1932, 1934) that in the central Condroz Inlier, in Neuville-sous-Huy (Belgium), three long parallel sections occur through Silurian sediments: the Parc de la Neuville section, the ravine 700m east (of the Parc de la Neuville) and the ravine 1200 m east. In between graptolitic shale four volcanic beds were described with intercalated red mudstone levels. Each section has its own characteristics distinguishing them from the other sections.

A restudy of the three sections by Maes *et al* (1978) with graptolites sampling and a new study by Rickards (Cambridge, UK) showed that the three sections together form a nearly continuous composite section covering the Telychian, Sheinwoodian, and parts of the Homerian and Gorstian.

The ravine 700m east (of the Parc de la Neuville) has now been studied lithostratigraphically in detail. In the sequence with a thickness of more than 170 meter we can now distinguish 6 units: (from top to base):
Unit 6: Grey shales to fine siltstones.

Unit 5: Dark grey, finely laminated shales with some calcareous levels, a similar facies as unit 3.
Unit 4: Alternation of red, fine siltstones and olive green, greenish grey to dark grey, sometimes laminated, fine siltstones. Higher up the red, fine siltstones disappear and passes into green to greyish green, fine shales.
Unit 3: Dark grey, finely laminated shales with some calcareous levels.

Unit 2: Olive green, greenish grey to grey and dark grey, fine siltstones intercalated with grey, medium-grained to coarse siltstones. Red, fine siltstones occur only in the finer parts of the section.
Unit 1: Grey, greenish grey to olive green, compact fine siltstones alternating with dark grey and greenish grey, laminated, fine siltstones. Higher up red, fine siltstones appear.

Units 1 and 2 occur in a continuous section showing a stratigraphic sequence more than 108 m thick. In between the sedimentary rocks 11 volcanic to volcano-sedimentary layers occurs. Ten of these eleven layers occurs in units 1 and 2. The units 3, 4, 5 and 6, representing the upper part of the sequence, and also situated in the upper part of the ravine 700 m east, occur in discontinuous outcrops where the exact contacts and relations to the other units is mostly not observable.

The section contains graptolites ranging from the *crispus* Biozone up to the *linnarsoni* Biozone following Rickards in Maes *et al.* (1978). A preliminary study by Verniers (unpublished data) on the chitinozoans shows the presence of the globally recognizable chitinozoan biozones *Eisenackitina dolioliformis*, *Angochitina longicollis* and *Margachitina margaritana* refining the ages given previously to the units and marker beds.

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Givetian tabulate corals from southern Ardennes: relations with environmental conditions.

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The Givetian (Middle Devonian) of the southern Ardennes is divided into six formations (from the Hanonet Formation p. p. to the Nismes Formation p. p.). The Mont d'Haurs and the "Cul d'Houille" section located in the southern part of the Ardennes (Givet, France) expose almost this entire stratigraphic interval.

Tabulate corals were sampled bed by bed in these two sections. They are studied into relation with the various Givetian environments. The analysis of biodiversity and abundance indicates a decrease of biodiversity at Mont d'Haurs/Fromelennes transition. In Fromelennes Formation, tabulates corals are very abundant but they are almost reduced to scolioporids. The morphologic variability is less important too, with only small and branching tabulate corals.

The study also shows very different relations between stromatoporids and tabulate corals according to environment. For instance, in a patch reef at the top of the Hanonet Formation, these organisms alternate themselves more or less. This alternation could result from seasonal variations. While in the Fromelennes Formation, the phenomena of competition between these two groups seem to be privileged.

The Paleodiversity and paleoenvironments of siliceous biomineralization at the Neoproterozoic-Phanerozoic transitional interval.

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The Neoproterozoic-Lower Paleozoic transition is characterized by profound changes in the structure of marine communities. It concerns the continuous increase of marine biodiversity stretching from Ediacarian times to the Late Ordovician mass extinction. Our understanding of the origin, establishment and biodiversity dynamics of modern marine ecosystems during this transitional interval is very fragmentary. More particularly, data are rare and incomplete regarding Radiolarians, a major component of the heterotrophic plankton since the Cambrian time.

Recent molecular studies suggest that polycystine Radiolaria are part of the most basal branch of Rhizaria, a monophyletic protist supergroup that also includes Formaninifera and Cercozoa (Burki & Pawlowski, 2006). Consequently, the fossil record of the oldest polycystine radiolarians is of primary importance to understand the evolutionary history of Rhizarian lineages and their history of biomineralisation. Besides, the introduction of silica-secreting Radiolarians must have had a major impact on the oceanic silica cycle. Therefore, knowing the timing and modality of this radiolarian invasion is of major interest.

In addition, comparison of the biotic changes reflected on Radiolarian biodiversity with the changes recorded by coeval phytoplankton (Acritarchs) can give a good perspective of the changes and productivity recorded through the pelagic trophic chain. This implies the need of a much more detailed taxonomy which would also include the study of the internal morphological characters of the siliceous skeleton. Indeed, important morphological groups are in need of a profound taxonomic revision (Danelian & Popov, 2003). The long term objective is to understand the origin and spatiotemporal development of radiolarian diversity in marine environments.

For this reason, we plan to collect marine sedimentary sequences extending from the Vendian (Late Proterozoic) to the Upper Ordovician. Some promising sequences have been discovered in Kazakhstan (Altai Mountains, Lake Balkhash), in Kyrgyzstan (Sarydzaz) and in Canada (western Newfoundland). Cherts from Kazakhstan are the only known continuous sequence of abyssal deposits across the Cambrian-Ordovician boundary and it contains the oldest known radiolarian ooze (Tolmacheva *et al*, 2001).

Collaborations established with local colleagues will allow us to collect this material and to study it in a well constrained stratigraphical framework. There is a real need for further information and each new added

material can significantly improve our knowledge on the biodiversity and evolutionary innovations of polycystine Radiolaria.

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The flora from Dechra-Aït-Abdallah (Morocco): a Lower to Middle Devonian transitional assemblage.

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The Devonian Period is of major importance in the understanding of the evolution of plants as well as of the whole environment. The terrestrialisation process induced deep changes in the geobiosphere that lead to the establishment of modern environments. The transition from Lower Devonian to Middle Devonian is particularly rich in innovations. The Devonian plant record from Gondwana is however scarce, and our knowledge on those crucial times is mainly based on information collected from the Old Red Sandstone continent.

The plant assemblage from Dechra-Aït-Abdallah (central Morocco) presented here was first reported by Termier & Termier (1947, 1950) who emphasized its abundance and diversity. They assigned it an Eifelian age on the basis of associated Tentaculita and Phacopidae. They described a various flora including *Asteroxylon elberfeldense* Kraüsel & Weyland, *Psilophyton princeps* Dawson, *Hyenia* cf. *elegans* Kraüsel & Weyland, *Aneurophyton maroccanum* Termier & Termier, *Scougouphyton abdallahense* Termier & Termier, *Cordaianthus devonicus* Dawson, "*Archaeopteris*" *rotundifolia* Termier & Termier and incertae sedis specimens. The diversity of this assemblage and the obvious need for its taxonomic revision prompted us to review the flora.

The Termier's original collection is not available anymore. We collected new specimens at Dechra-Aït-Abdallah during two successive field sessions in 2000 and 2007. The locality is situated in the southeastern Meseta (east-central Morocco). It is part of a Lower to Late Devonian age allochtonous sedimentary nape. The succession is dominated by marine carbonates deposited in a shallow environment dominated by algal sedimentation. Plants are allochtonous and information on their original environment is unavailable. Dating of the poorly diversified sediments is problematic. A late Emsian age has been proposed based on badly preserved Tentaculita (Gerrienne et al., in press), but other studies indicate an early Eifelian age (Grobe, 1993).

The assemblage is moderately diverse and includes representatives of both Early Devonian and Middle Devonian floras. It is dominated by *Aneurophyton maroccanum* Termier and Termier (1950). This generic attribution has been questioned (Fairon-Demaret & Regnault, 1986). We here describe and illustrate the plant,

and we discuss its affinities. The progymnosperm *Rellimia* has also been collected (Gerrienne et al., in press). The Protolepidondedrales (Lycophytes) *Leclercqia* and *Haskinsia* are present. A large axis with possible lycophyte affinities has also been discovered. Zosterophylls are putatively represented by a spiny axis that recalls *Sawdonia.* Several vegetative axes tentatively assigned to *Psilophyton* have been found. This assemblage represents the only occurrence of early Eifelian plants on Gondwana. Its palaeographical and evolutionary implications will be assessed.

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Phytostratigraphie et aperçu environnemental du Néogène continental de l'Entre-Sambre-et-Meuse et du Condroz (Belgique).

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Le réexamen des données palynologiques et paléobotaniques du matériel organique présent dans une partie importante du remplissage des poches karstiques du Condroz et de l'Entre-Sambre-et-Meuse a permis d'établir une chronologie des dépôts et de reconstruire les paléoenvironnements qui leur ont donné naissance.

La biostratigraphie des dix sites sélectionnés peut s'établir sur base de la disparition et de l'apparition d'une quarantaine de taxons en marge d'un ensemble de genres à caractère mésophile formant le fond commun de la végétation relevée dans les différents dépôts. Ainsi, dans les plus récents, mio-pliocènes, apparaissent ds éléments plutôt tempérés-froids (*Abies, Picea, Tsuga, Betula, Carpinus, Fagus*) annonciateurs du Pré-Tiglien alors que les dépôts les plus anciens, d'âge Miocène inférieur, se caractérisent par des assemblages à taxons thermophiles (Cyatheaceae, Schizeaceae, Cyrillaceae, Palmae, Sapotaceae, *Engelhardia*, *Mastixia, Ostrya, Reevesia, Symplocos*) disparaissant progressivement au cours du temps.

Les phases majeures de remplissage en matière organique des cryptokarsts se sont déroulées au Néogène comme l'atteste la composition palynologique des différents gisements, corrélés avec ceux des principaux bassins sédimentaires régionaux d'Europe. En prenant comme référence le site de Champseau (Andenne) qui, sur base de travaux antérieurs avait donné lieu à débat sur l'âge du remplissage de la poche (Miocène ou Oligocène), on a constaté en réétudiant l'archivage palynologique que ce dernier diffère fondamentalement de ceux reconnus pour l'Olgocène de Belgique. Non seulement les marqueurs-types oligocènes font défaut dans le spectre pollinique,mais la flore révélée par l'analyse se différencie par ses spécificités écologiques des flores oligocènes, plus riches en taxons mégathermes.

Contrairement aux idées reçues, les remplissages des poches karstiques ne sont pas échelonnés de façon aléatoire au cours du Néogène. Il semblerait plutôt que les principales phases de piégeage de la matière organique correspondent à des périodes particulières de karstification majeure. On pourrait ainsi distinguer deux phases principales, datées par la palynologie, l'une se situant au Miocène inférieur (Florennes, Andenne-Champseau, Oret, Sosoye), l'autre au passage Miocène moyen-Miocène supérieur (Onhaye, Bioul). Une capture plus inégale de matière organique se poursuivrait ensuite, au Pliocène, dans un contexte de karstification nettement ralenti.

Par ailleurs, les qualités du matériel piégé ne seraient pas uniformes; elles seraient fonction de l'environnement régional et des conditions climatiques au moment de son enfouissement. Ainsi, la matière organique xyloïde bien conservée des gisements de Florennes et de Champseau correspondrait à une fossilisation lente, en milieu anaérobie sous climat subtropical, dans un environnement de forêts inondées et de grands marécages tributaires de la susidence de la basse vallées rhénane alors que le moins bon état des débris ligneux des dépôts de Onhaye et de Bioul serait dû à un environnement lacustre-palustre perturbé par un ruissellement local et des apports fluviatiles irrréguliers sous un climat tempéré chaud à saisons contrastées.

Au Pliocène, la flore comporte encore des éléments "chauds" mais, en fin de période, ils n'apparaissent pratiquement plus qu'à l'état de reliques dans un ensemble à forte connotation tempérée.

Référence

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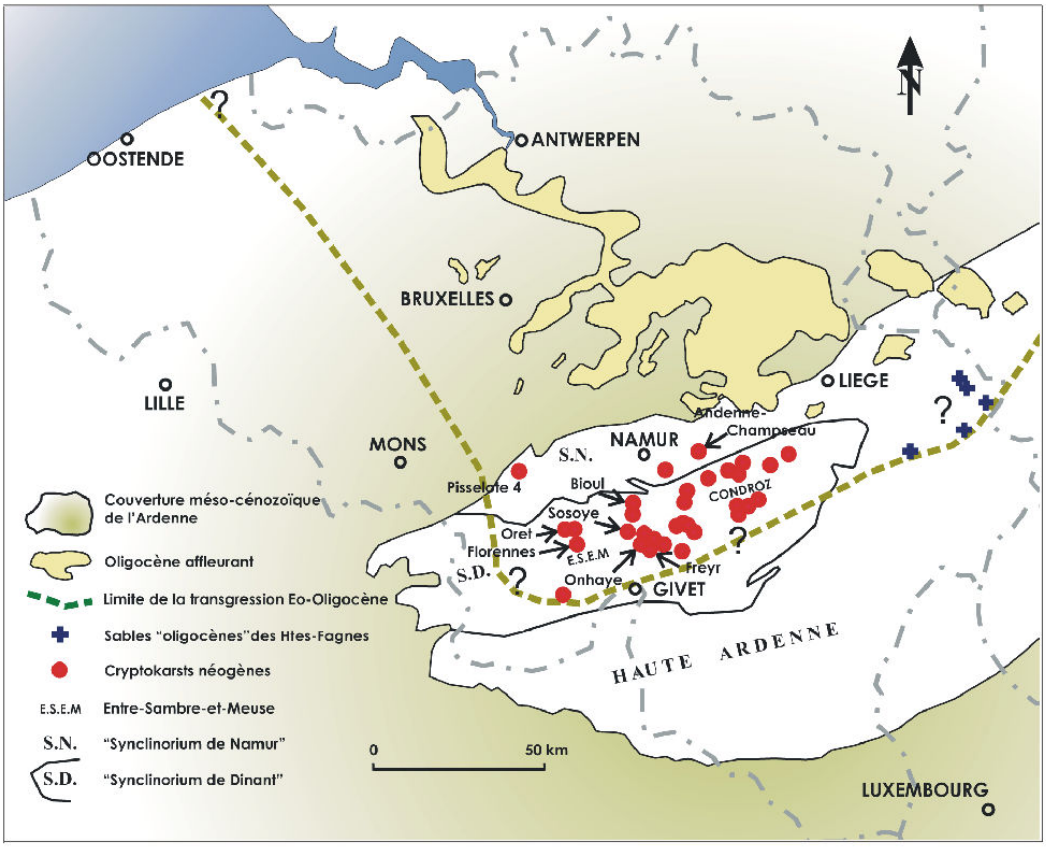

Localisation des cryptokarsts de l'Entre-Sambre-et-Meuse et du Condroz

Identification of land plant biomarkers from Carboniferous (Visean) coal deposits at Dunbar (East Lothian, Scotland).

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The terrestrial terpenoids phyllocladane, norabietane, 4β(H)-eudesmane and norpimarane have been identified in the aliphatic fractions of Early Carboniferous coals from Dunbar, East Lothian – Scotland. Additionally, the aromatic biomarkers retene, cadalene, simonellite, tetrahydroretene, totarane, sempervirane, isohexylalkylnaphthalene and 2-methylretene were also detected in these Scotland coals. The presence of diterpenoids precursors based on the norabietane and phyllocladane skeletons is clearly correlated with the relative proportion of retene and 2-methylretene. While 4β(H)-eudesmane has been proposed as typical sedimentary marker for some of the more evolved land plants such as some angiosperms and gymnosperms (Noble et al., 1986), retene has been also considered as a conifer biomarker (van Aarssen et al., 2000). In contrast, the occurrence of 2-methylretene is unexpected because this biomarker has been only observed in samples of Permian to Tertiary age (Bastow et al., 2001). The presence of retene and 2-methylretene in our coals may be associated to some families of conifer resins. However, retene could also derive from the diagenesis of compounds with a kaurane-type skeleton (Romero-Sarmiento et al., in press), which were abundantly produced by the early Palaeozoic land plants. In general, these coal samples contain abundant and well-preserved miospores and megaspores assemblages (Spinner, 1969). These terrestrial palynofacies could be associated to a flora in which large arborescent lycopods (e.g., Wellman et al., 2009) with long leaves and some more diminutive forms developed on land during the Early Carboniferous. Accordingly, the identified biomarkers can be related at least partly to a lycophyte arborescent flora.

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Illuminating the black box of punctuated equilibrium evolution: evolutionary punctuations in *Bellamya* gastropods from Lake Malawi.

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Punctuated equilibrium evolution (Eldredge & Gould, 1972; Gould & Eldredge, 1977) claims that phenotypic evolution is concentrated in punctuations separated by long-lasting morphological stasis. The theory can be regarded as a black box speciation model since the punctuations occur faster than is observable in the fossil record. Here we study an evolutionary punctuation in four endemic *Bellamya* gastropod species, recently derived from a common ancestor preserved in Holocene, radiocarbon-dated lacustrine deposits in the Malawi Basin to illuminate the black box. Morphometric comparison of extant and fossil morphs with semi-landmark analysis and traditional parameters documented a 3.6-5.1 times morphospace expansion since the middle Holocene. Modelling according to displaced optima (Estes & Arnold, 2007) indicates that adaptive shifts towards new optima and hence the morphospace expansion were completed within 500 years for each cladogenetic event. Associated Lynch Delta rates (Lynch, 1990; Hunt, 2006) of morphological evolution fall within or above the neutral expectancy of genetic drift, but are slower or equal to rates commonly observed in selection experiments, suggesting that punctuated speciation such as that of *Bellamya* in Lake Malawi can entirely be explained by natural selection on generational timescales. Morphological conservatism in African *Bellamya* species, geographically isolated in rivers of separated drainage basins, lead to the construction of pseudo-stationary lineages, whereas disparity increased by morphological adaptation to lacustrine environments.

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Dinoflagellate cysts and pollen from the Tjörnes/Breidavik section, northern Iceland.

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Although the geology of Iceland is dominated by magmatic rocks, the sedimentary Tjörnes section is well developed and holds a relatively well preserved biological assemblage. Thanks to subsidence during the Pliocene and the Early Pleistocene in the Tjörnes fracture zone on the north east coast of Iceland, shallow marine to coastal deposits could develop. The 500m thick Pliocene Tjörnes section consists of organic swamp deposits, lignite layers, and mud- and sandstones. Because of the presence of mainly lava flows and glacial deposits, the overlying Breidavik sequence does not provide a continuously sequence.

Sixty eight samples from the sedimentary succession of Tjörnes and 20 samples from the overlying Breidavik Group were palynologicaly investigated for pollen and dinoflagelate cysts. Of the 14 sedimentary cycles (ice free and ice cover conditions), recorded within the Breidavik Group, 4 were suited for palynological research (3, 4, 5, 7). Despite the fact that 2/3 of the samples were barren or very low (<10 dinocysts/g) in dinoflagellate cysts, the retrieved assemblages allowed us to retrieve as well ecological as biostratigraphical information. However, the focus in this talk goes to the biostratigraphical implications of the dinoflagallate study.

The dinoflagellate assemblage from the Tjörnes section reflects a clear Pliocene flora. Typical Miocene species that disappear on the Miocene/Pliocene border (5Ma) as *Selenopemphix armageddonensis* and others are not observed. The nearly continue occurrence of species as *Batiacasphaera minuta* (H.O. 3.4/3.8Ma) and *Operculodinium tegillatum* (H.O. 3.7Ma) in the upper part of the Tjörnes section (Serripes mollusc zone) gives a minimum age of 3.7Ma on the top of this zone. Because of this, The sediments of the Tjörnes section shows a faster sedimentation rate and a general older age than thought based on the K/Ar dates of the overlying basalt flow. (Albertsson 1975) In the Serripes zone, the find of a new species *"Selenopepmhix islandica"* is done.

Observations of fragile heterotrophic cysts as *Barssidinium pliocenicum* (H.O. 2.6Ma), *Echinidinium euaxum* (H.O. 2.6Ma), *Selenopemphix dionaeacysta* (H.O. 2.2/2.6Ma) and *Trinovantedinium glorianum* (H.O. 2.2/2.6Ma) in the Hörgi member give a minimum age of 2.6Ma on this third glacial/interglacial cycle. In accordance to the Tjörnes section, this member has to be older than thought in the present age model of the outcrop. (Símonarson and Eiríksson, 2008)

The biostratigraphical analysis indicates an upper Piacenzian age (Upper-Middle Pliocene) for the

Hörgi Formation, instead of the previous Gelasian (Basis Pleistocene) age. The K/Ar dates of the Höskuldsvik lavas seem to be too young. This is probably caused by Ar loss through alteration or hydrothermal activity. The magnetic polarity record is incomplete and difficult to interpret without correct radiometric ages.

The dinoflagellate cyst analysis shows a problem in the radiometric dates and the need for a better correlation with the paleomagnetic polarity scale.

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