PROGRAMME

I - COMMUNICATIONS ORALES ; ORAL COMMUNICATIONS

Mercredi 23 mai

8h30 - 9h30 : Accueil, enregistrement – Reception, registration
Installation des posters – Posters installation.
9h30 - 10h00. Ouverture du colloque, Opening session : Armand de Ricqlès & Jean Broutin

10h00 – 10h30 : " Café de bienvenue" – "Welcoming coffee"

Session 1 : Paléozoïque ; Paleozoic « 1 »
Modératrice - Chair : Brigitte Meyer - Berthaud

10h30 – 11h00 : Conférence introductive - Keynote lecture : *The Early Devonian Rhynie chert, one of the oldest and most complete terrestrial ecosystems*, **Hans Kerp** & Hagen Hass.

11h – 11h20 : *Embryophytes on land: the early steps*, **Philippe Gerrienne**.

11h20 – 11h40 : *Heterospory and seed habit: Devonian innovations*, **Cyrille Prestianni** & Philippe Gerrienne.

11h40 – 12h00 : *Evolution of anatomical diversity in Devonian-Carboniferous arborescent lignophyte,* **Anne-Laure Decombeix**, Brigitte Meyer-Berthaud, Jean Galtier.

12h00 – 12h 15 - discussion et présentations "éclairs" de posters – "flash" presentations of posters

12h15 – 14h00 : déjeuner

Session 2 : Paléoclimatologie – Modélisation ; Paleoclimatology – Modelling
Modérateur – Chair : Thomas Taylor

14h00 - 14h30. Conférence introductive - Keynote lecture *: Palaeobotany in a Changing World: Plant Fossil Contributions to Society and Policymakers*, **Robert A. Spicer**.

14h30 – 14h50 : *Apports du paléomagnétisme à la paléogéographie et aux paléoclimats – Contributions of paleomagnetism to paleogeography and paleoclimates,* **Jean Besse**.

14h50 - 15h10 : *Modélisations climatiques et paléoclimats au Permien – Climate modelling and paleoclimates during the Permian,* **Frédéric Fluteau**.

15h10 – 15h30 **:** *Ecosystem reorganization vs. Ecosystem Replacement in response to changing climates in the late Paleozoic tropics*, **William Dimichele**.

15h30 – 15h50 : *The evolution of Late paleozoic conifers*, **Cynthia V. Looy**.

15h50 – 16h20 : Dicussion ; présentations "éclairs" de posters – "flash" presentations of posters.

16h20 – 16h50 : pause café – posters – démonstrations.

Session 3 : Paléozoïque ; Paleozoic « 2 »
Modérateur – Chair : Jean Galtier

16h50 – 17h10 : *A New Pteridosperm with affinities to Comia from the lower Permian of North-Central Texas, USA,* **Dan Chaney,** William DiMichele, Sergius Mamay, & Hans Kerp.

17h10 – 17h30 : *New insights into the Late paleozoic microbial world : complex microbial and microbe / land plants associations,* **Thomas N. Taylor**, Michael Krings, Hans Kerp, Hagen Hass, Nora Dotzler & Jean Galtier.

17h30 – 17h50 : *Paleozoic conifer reconstruction leading to a better understanding of the conifer concept*, **Genaro Hernandez-Castillo**.

17h50 – 18h20 : discussion - démonstrations

JEUDI 24 MAI

Session 4 : Angiospermes fossiles – Fossil angiosperms
Modérateur - Chair : Margaret Collinson

9h00 – 9h30 : Conférence introductive - Keynote Lecture : *The adaptative significance of sex and closure the angiosperm carpel,* **David Dilcher**.

9h30 –9h50 : *Lauraceae from the Cenomanian of Europe – Les Lauracées du Cénomanien d'Europe*, **Clément Coiffard**, Bernard Gomez, Jiri Kvacek, Mélanie Thiébaut, Didier Néraudeau & Frédéric Thévenard.

9h50 – 10h10 : *Flora of the Latest Eocene insect limestone, Isle of Wight, Soutern England,* **Peta Hayes**, Margaret Collinson & Andrew Ross.

10h10 – 10h30 : *Aquatic radiation predating terrestrial radiation in early angiosperm ecology: insights from Barremian lacustrine macrophytes of Spain,* Carles Martín-Closas, **Bernard Gomez**, Véronique Daviero-Gomez.

10h30 – 10h50 : *New evidence for fossil Piperales: flowers, fruits and in situ pollen from the Middle Eocene Princeton Chert, British Columbia, Canada,* **Selena Y. Smith** & Ruth A. Stockey.

10h50 – 11h20 : pause café

Session 5 : Paléozoïque ; Paleozoic "3" (suite – continuation)
Modérateur – Chair : Jean Galtier

11h20 - 11h50 : *Macralethopteris hallei, a distinctive seed fern from the Early Permian of Middle Sumatra, Indonesia, interpreted in the light of palaeoclimatological changes.* **M. Booi***,* I.M. van Waveren & J.H.A. van Konijnenburg-van Cittert.

11h50 –12h 10: *The Jambi Flora and its geological setting*, **I. M. van Waveren,** M. Crow M. Booi, R. Kars, P. de Boer, & F. Hasibuan, Suyoko.

12h10 – 12h30 : *The Early Permian flora of Valdeviar (Sevilla province, SW Spain): its composition and palaeogeographic significance*, **Robert H. Wagner**.

12h30 – 14h00 : déjeuner

Session 6 : Biogéochimie ; Biogeochemistry
Modératrice–Chair : Thanh Thuy Nguyen Tu

14h00 – 14h30 : Conférence introductive - Keynote Lecture *Chemical and ultastructural preservation of plant fossils : case studies from leaves,* **Margaret Collinson**.

14h30 – 14h50 : *La paléochimiotaxonomie expérimentale : un nouvel outil pour le traçage des changements paléofloristiques et paléoclimatiques. Présentation et application aux conifères fossiles*, **Yann Hautevelle**, Raymond Michels, Bastien Farre, Frédéric Lannuzel et Fabrice Malartre.

14h50 – 15h10 : *Unravelling Climate/Environment interactions and human landuse from pentacyclic triterpenes. Some examples and perspectives from Late Quaternary lacustrine sediments*, **Jérémy Jacob** & Jean-Robert Disnar.

15h10 – 15h30 : *Leaf lipids of Pliocene Fagus leaves from the Upper Valdarno Basin, Italy*, **Florent Zanetti,** Thanh Thuy Nguyen Tu., Adele Bertini Sylvie Derenne.& Jean Broutin.

15h30 – 16h00 : présentations "éclairs" de posters – "flash" presentations of posters – poster session

16h00 – 16h30 : pause café

Session 7 : Palynologie ; Palynology
Modératrice - Chair : Denise Pons

16h30 – 16h50 : *New Evidence of Bryophytes from the Cambrian of Laurentia*, **Paul K. Strother**.

16h50-17h10 : *Palynological data of Utrillas Formation in the Iberian range (Spain),* **Uxue, Villanueva-Amadoz,** Denise Pons, Luis Miguel Sender, José B Diez. & Javier Ferrer.

17h10 – 17h30 : *Palynologie des sédiments à faciès wealdien de l'Ouest du bassin de Mons (Belgique) : corrélation au sein du "Weald stratotypique".* **Jean Dejax**, Freddy Damblon, Jonathan Gueibe, Denise Pons, Paul Spagna & Johan Yans.

17h30 –18h15 : discussion - posters

À partir de 20 heures – from 8 p.m. …. ? jusqu'à l'aube - until sunrise :

Conference Dinner …

… and « free after dinner » (pour les noctambules – for the noctambulantes

VENDREDI 25 MAI

Session 8 : Xylologie – Paléoxylologie ; Xylology – Paleoxylology
Modérateur – Chair : Dario de Franceschi

9h00 – 9h30 : Conférence introductive - Keynote Lecture : *Tree growth at polar latitudes : Permian and Triassic tree rings from Antartica*, **Edith L. Taylor** & R. Patricia Ryberg.

9h30 – 9h50 : *Les bois poreux sont-ils exclusifs des arbres décidus ?,* **Anaïs Boura** & Dario De Franceschi.

9h50- 10h10 : *Dadoxylon type of wood from the Czech part of the Intrasudetic basin (Late Pennsylvanian, NE Bohemia, Czech Republic): a preliminary report*, **Petra Matysová,** Václav Mencl, **Jakub Sakala**.

10h10 – 10h30 : *Preliminary report on wood remains from the Lower Carboniferous of the North Russia (Arkhangelsk region),* **Olga Orlova**.

10h30 – 11h00 pause café

Session 9 : Taphonomie – Paléoenvironments ; Taphonomy – Paleoenvironments
Modérateur – Chair : Robert Spicer

11h00 – 11h20 : *The Autunian flora of Baro (Catalan Pyrennes): Taphonomy and Paleoecology,* **Carles Martín-Closas.**

11h20 – 11h40 : *Marchantiopsid colonization mats from the Aptian of Escucha Formation (Oliete Sub-Basin, Iberian Range, Eastern Spain),* **C. Diéguez**, J. P. Rodríguez-López & N.Meléndez.

11h40 – 12h00 : *A new fossil plants locality from the Callovian of Bebi Barka, Tataouine area, Sout-Eastern Tunisia : Paleaobotany and Taphonomy,* **Georges Barale**, Mohamed Ouaja & Dorra Srarfi.

12h00 – 14h00 : Déjeuner

Session 9 : Taphonomie – Paléoenvironments ; Taphonomy - Paleoenvironments
(suite, continuation). Modérateur – Chair : Robert Spicer

14h00-14h20 **:** *Brackish coastal swamp vegetation from the Upper Cretaceous of Eastern Pyrenees, Catalonia (spain),* **Bernard Gomez**, Carles Martín-Closas, Josep Marmi, Bernat Vila, Frédéric Thévenard.

14h20 – 14h40 : *Mycorrhization of fossil and living plants,* **Christine Strullu-Derrien** & Désiré-Georges Strullu.

14h40 – 15h00 : *Paléoenvironnement et pinèdes méditerranéennes du sud du Massif central au cours des dix derniers millénaires : feux, données isotopiques, conséquences environnementales*. **Jean Louis Vernet**.

Session 10 : Méthodologie ; Methodology
Modératrice – Chair : Isabelle Rouget

15h15 – 15h45 : Conférence introductive - Keynote Lecture : *Three-item analysis: representation and treatment of missing and non-applicable character-states"* **René Zaragüeta Bagils**, Estelle Bourdon.

15h45 – 16h05 : *Minimizing homoplasy is not maximazing homology : a method for choosing among most parcimonius trees (MPTs)*, **Nathanael Cao**, Timothée Le Péchon & René Zaragüeta Bagils.

16h05 – 16h25 : *Information temporelle, registre fossile et phylogénie,* **Hervé Lelièvre**, Isabelle Rouget, René Zaragüeta Bagils.

16h25 – 16h45 : **Diatom phylogeny and classification: fossils, molecules and the extinction of evidence,** *David M.Williams***.**

16h45 – 17h05 : *Base de données et exploration d'une collection de Paléobotanique,* **Régine Vignes Lebbe**, Jean Broutin.

17h05 – 17h20 : discussion

17h20 – 17h50 : pause café

17 h50 – 18h20 : conclusions générales – démonstrations

II - AFFICHES - POSTERS

Session 1

Assessing the earliest seed plant radiation through three dimensional reconstruction techniques, **Zoe Wickens**, Sutton Mark and Hilton Jason.

Session 2

The Early Permian flora of Valdeviar (Sevilla province, SW Spain): its composition and palaeogeographic significance, **Robert H. Wagner**

Macrofloral assemblages (Cathaysian flora) and their evolution and extinction patterns near PTB, Western Guizhou and Eastern Yunnan, South China, **Yu Jianxin**, Jean Broutin, Martine Berthelin, Qisheng Huang.

Les eaux océaniques de surface de l'hémisphere sud pouvaient-elles être plus chaudes que celles de l'hémisphere nord sous climat à effet de serre ? Les provinces biogéographiques des kystes de dinoflagellés de l'Albien terminal utilisées comme proxy, **Edwige Masure** & Bruno Vrielynck

Session 3

Late Permian plant assemblages in the SE Iberian Ranges, Spain: Biodiversity and palaeogeographical significance, **C. Diéguez**, R. De la Horra, J. López-Gómez, M. I. Benito, J. Barrenechea & A.Arche

Session 4

Approche paléobotanique de l'évolution et de la biogéographie des Menispermaceae Palaeobotanic appraoch of the evolution and biogeography of the Menispermaceae, **Frédéric Jacques**

Gymnosperms Middle Albian in age from valle del rio Martin (Teruel, Spain), **Luis Miguel Sender,** José B. Diez, Javier. Ferrer & Uxue Villanueva-Amadoz.

Prolégomènes à la révision des flores foliaires du Crétacé de Pologne, **Adam T. Halamski.**

Session 6

*Les lipides des plantes fossiles dans leurs rapports avec les plantes actuelles***, Thanh Thuy Nguyen Tu,** Sylvie Derenne,Claude Largeau, Denise Pons, Jean Broutin, André Mariotti, Hervé Bocherens.

Session 7

Palynological characterization of organic sediments in Cesantes Beach (San Simon Bay, ria de Vigo, Spain), **José B. Diez,** S. García-Gil, C. Muñoz-Sobrino, J. Iglesias.

Session 8

Taxonomic identification of natural sunken wood samples, **Marie Pailleret,** Nima Saedlou, C Palacios, Magalie Zbinden, Philippe Lebaron, Françoise Gaill & Catherine Privé-Gill.

New questions raised by the studies of ancient wooden made objects: the writing-tablets example, **Nima Saedlou** & Monique Dupéron.

Les caractères anatomiques du bois : de bons marqueurs climatiques ? - Wood anatomical characters: Are they good climatic MARKERS? **Anaïs Boura**.

Étude du bois au sein de l'UMR Paléobiodiversité et Paléoenvironnement, Martine Berthelin, Anaïs Boura, Jean Broutin, Nathanael Cao, Dario De Franceschi, Jean Dupéron, Monique Dupéron, Marie Pailleret, Denise Pons, Catherine Privé-Gill & Nima Saedlou.

Session 9

Contributions to the palaeoenvironmental knowledge of the Escucha Formation in the Lower Cretaceous Oliete Sub-Basin, Teruel, Spain, **D. Peyrot**, J.P., Rodríguez-López, N. Meléndez, L. Lassaletta & E. Barrón.

Enhancing the recognition of the palynologically defined K/T boundary in southwestern North Dakota, USA: Using multiproxy datasets for paleoenvironmental reconstruction to minimize effects of taphonomical biases, **Antoine Bercovici,** Dean Pearson, Douglas Nichols, Jacqueline Wood.

Detailed palaeontologic and taphonomic techniques to reconstruct the earliest Paleocene macroflora: An example from southwestern North Dakota, USA, **Antoine Bercovici,** Jacqueline Wood, Dean Pearson.

The autunian flora of the Martenet site (Blanzy – Montceau les Mines, Burgundy, France): Description, taphonomical study and palaeoenvironmental implications, **Antoine Bercovici,** Jean Broutin.

Verdeña (Spain) : life and death of a Carboniferous forest community, **Robert H. Wagner** & José B. Diez.

Session 10

Nelson 05, a three-item analysis computer program for systematics, biogeography, and palaeontology, **Jacques Ducasse**, Nathanael Cao, René Zaragüeta.

Propositions for a character-state-based phylogenetic nomenclature, **Olivier Béthoux**.

Systématique et évolution – Systematics and evolution.

Timing of diversification and epiphytism evolution in the filmy fern family (Hymenophyllaceae), **S. Hennequin,** E. Schuettpelz, K. M. Pryer, A. Ebihara & J-Y. Dubuisson.

Systematics of Dombeyoideae Beilschm. (Malvaceae) in the Mascarene Archipelago (Indian Ocean) Inferred from Morphology and New Insights on the Evolution of Breeding Systems, **Timothée Le Péchon**.

RÉSUMÉS

DES

COMMUNICATIONS ORALES

ABSTRACTS

OF

THE ORAL COMMUNICATIONS

UN NOUVEAU GISEMENT A PLANTES DU CALLOVIEN DE BENI BARKA, REGION DE TATAOUINE, SUD-EST DE LA TUNISIE: PALEOBOTANIQUE ET TAPHONOMIE.

A NEW FOSSIL PLANTS LOCALITY FROM THE CALLOVIAN OF BENI BARKA, TATAOUINE AREA, SOUTH-EASTERN TUNISIA: PALAEOBOTANY AND TAPHONOMY.

Georges Barale *, Mohamed Ouaja ** & Dorra Srarfi ***
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Paléobotanique, Empreintes, Structures épidermiques, Taphonomie, Callovien, Sud tunisien

Des récoltes paléobotaniques ont été effectuées à Beni Barka, à 4 km au Sud de Tataouine (Sud- tunisien). Le matériel a été récolté dans une formation argileuse juste au dessous de la barre carbonatée qui marque le sommet du Membre Beni Oussid qui fait partie de la Formation des marnes et calcaires de Foum Tataouine. L'âge est Callovien.
La composition floristique est marquée par la présence de Ptéridophytes: *Piazopteris branneri* (White) Lorch et Coniférophytes: *Brachyphyllum trauti* Barale et Contini, *Pagiophyllum* cf. *crassifolium* Schenk, *Araucarites* sp., *Podozamites* sp. Il s'agit d'échantillons fragmentaires d'empreintes dont certaines atteignent une vingtaine de cm de longueur. Pour *Brachyphyllum trauti*, il a été possible d'étudier les structures épidermiques à partir d'un transfert au collodion.
Il s'agit d'une nouvelle flore qui vient compléter nos connaissances paléobotaniques du Sud-tunisien, après les découvertes depuis une dizaine d'années, de flores bathoniennes, oxfordiennes et du Crétacé inférieur.
Cette flore s'est développée sur une plate-forme margino-littorale, située entre le craton africain au Sud et l'océan téthysien au Nord. Cette zone très plate subissait régulièrement les avancées de la mer entraînant l'arrachage et le dépôt de végétaux se développant sur les zones émergées très proches.
Le mélange de divers restes sans tri (axes , empreintes, racines), la présence d'extrémités circinées de fougères, de restes fertiles de conifères, d'axes végétaux traversant verticalement les feuillets sédimentaires, sont des indices d'autochtonie du gisement.
Des comparaisons avec les flores bordant le Nord et le Sud de la Téthys montrent que la flore de Beni Barka est originale par l'absence de Bennettitales. Un climat de type sub-tropical humide devait favoriser le développement d'une forêt de type ripisilve avec en sous-bois des fougères.

Palaeobotany, Imprints, Epidermal structures, Taphonomy, Callovian, South Tunisian

Palaeobotanical material has been collected from Beni Barka, at 4 km at the South of Tataouine (South Tunisia). The fossil plants originate from a limestone formation just below the carbonate bar which delimits the Beni Oussid member which belongs to the marls and limestones of Tataouine Formation. The age is Callovian.
The floristic composition is marked by the presence of Pteridophytes: *Piazopteris branneri* (White) Lorch and Coniferophytes: *Brachyphyllum trauti* Barale et Contini, *Pagiophyllum* cf. *crassifolium* Schenk, *Araucarites* sp., *Podozamites* sp. The material is fragmentary but some imprints have twenty cm in length. Epidermal structure has been studied on *Brachyphyllum trauti* with a collodion peel.
This new flora is interesting after the discovery, since ten years, of Bathonian, Oxfordian and Lower Cretaceous floras from South Tunisia. This flora was present in a margino-littoral platform situated between the African continent at the South and the South-Tethyan ocean. This very flat zone was influenced by the advance of the sea rooting up the plants deposit which were living very near on the emerged part.
The mixture without selection of axes , imprints and roots, young leaves (fiddlehead) of ferns, fertiles parts of conifers, plants axes crossing the sedimentary levels, are the sign of autochtony of the locality.
Comparisons are made with the floras situated at the North and South margins of the Tethys sea. The Beni Barka flora is marked by the lack of Bennettitalean remains. A sub-tropical climate was present favouring the development of a ripisilve flora of conifers with an underwood of ferns.

MACRALETHOPTERIS HALLEI, A DISTINCTIVE SEED FERN FROM THE EARLY PERMIAN OF MIDDLE SUMATRA, INDONESIA, INTERPRETED IN THE LIGHT OF PALAEOCLIMATOLOGICAL CHANGES.

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The Early Permian flora from Jambi, Indonesia, has recently been reinvestigated and reclassified as one primarily composed of Cathaysian elements. New material recently collected in the Jambi province has rendered a large amount of specimens of the robust alethopterid seed fern *Macralethopteris hallei* Jongmans et Gothan. For the first time it is possible to make a reconstruction of the pinna architecture. Originating from different localities, the material also offers an insight in the morphological variation in this species.
The material is found in an assemblage mainly comprised of pteridosperms and primitive gymnosperms, alternating with a lowland floral assemblage. In this respect it is similar to several other floras from this time, primarily from Euramerica. The taphonomy and sedimentological setting give us an opportunity to define the habitat of this seed fern.
Comparing *M. hallei* with related genera from the Permian of Chinese Cathaysia suggests an enlarging trend of the leaves of this pteridosperm lineage through time. We will offer several possible ways to interpret this particular trend.

LES BOIS POREUX SONT-ILS EXCLUSIFS DES ARBRES DECIDUS ?

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D'après le "IAWA committee" (1989) le bois à zone poreuse est défini comme un « bois dans lequel les pores du bois initial sont manifestement plus gros que ceux du bois final de l'année précédente et du même cerne ». Un changement abrupt de taille et densité des vaisseaux permet de distinguer le bois à zone poreuse du bois semi-poreux ou à pores diffus. Cependant, quelques espèces présentent un continuum de ces différents états de porosité, en fonction des conditions environnementales.

Dans les bois à zone poreuse, le bois initial assure l'efficacité de la conduction. L'embolisme, résultant de stress hydrique, induit un blocage des gros vaisseaux de l'année précédente. Le bois final comprenant des plus petits vaisseaux est moins efficace, mais présente une meilleure sécurité hydraulique vis-à-vis du phénomène d'embolisme. La structure bois poreux est donc considérée être une adaptation aux climats saisonniers (Carlquist 2001).

Les jeunes feuilles, à travers la production d'auxine, sont responsables de l'augmentation de l'activité cambiale, de la taille et de la densité des vaisseaux. Ainsi, la formation du bois initial est principalement induite par une poussée de croissance des feuilles. Cela devrait être particulièrement vrai sur les arbres décidus, qui perdent leurs feuilles puis en produisent de nouvelles de manière simultanée, sur l'ensemble de leur couronne. Quelques auteurs ont déjà mentionné cette corrélation entre les structures poreuses et le caractère caducifolié des arbres (Gilbert 1940, Wheeler & Baas 1993, Poole & van Bergen 2006), mais aucun inventaire précis n'a été réalisé jusqu'à présent pour vérifier cette hypothèse.

Nous avons comparé, grâce à Insidewood (2004) et à diverses flores, la porosité de 1503 espèces de pays tempérés et 3419 espèces de pays tropicaux et le caractère décidu de leur feuillage. Les structures à bois poreux sont présentes dans 16 % des espèces étudiées sous climat tempéré et 2 % sous climat tropical. Sur l'échantillonnage d'espèces tempérées, 100 % des espèces à bois poreux sont décidues. Les espèces tropicales à bois poreux le sont aussi principalement.

Comme ces caractères du bois sont fréquemment préservés dans les spécimens fossiles cela pourrait être un intéressant marqueur du type de végétation. Cela pourrait ainsi utilisé pour déduire la saisonnalité des paléoclimats.

Mots clés : bois à zone poreuse, décidu, caducité, feuilles, saisonnalité.

IS POROUS WOOD STRUCTURE EXCLUSIVE OF DECIDUOUS TREES?

According to the IAWA committee (1989) the ring porous wood is defined a "wood in which the vessels in the earlywood are distinctly larger than those in the latewood of the previous and of the same growth ring". An abrupt change of size and density of vessels between early and late wood allows distinguishing, in some extent, species with ring porous wood from species with semi-ring porous or diffuse porous wood. Nevertheless, some species show a continuum between the different states of porosity, depending upon the environmental conditions.

In ring porous structure, the earlywood characteristics offer conductive efficiency. The embolism, result of drought stress, induces the inefficiency of the largest vessels of the previous year. The latewood including smallest vessels is of less efficiency, but offer a better conductive safety regarding the embolism phenomenon. The ring porous structure is thus considered as an adaptation of seasonal climates (Carlquist 2001).

The young leaves are responsible to the increase of cambial activity, size and density of vessels through the production of auxin. Then, the earlywood formation is mainly induced by the leaf growth flushes. This should be particularly true on deciduous trees, which loose leaves and then produce new leaves simultaneously on the whole crown. Some authors have already mentioned this potential correlation between ring porous structure and the deciduousness of the trees (Gilbert 1940, Wheeler & Baas 1993, Poole & van Bergen 2006), but no precise inventory of species have been provided until now to verify this hypothesis.

We compared, with the help of Insidewood (2004) and diverse floras, the wood porosity of 1503 species of temperate countries and 3419 of tropical countries and their foliage characteristics. Porous wood structure occurs in 16 % of the studied species under temperate climate and 2 % in tropical countries. On the temperate species sample, 100 % of ring porous wood species are found deciduous. The tropical species with ring porous wood are also mainly deciduous.

As these wood features are frequently preserved in fossil specimens, this could be an interesting marker of vegetation type. This could be used to infer the seasonality of the paleoclimate.

Key words : ring porous wood, deciduousness, leaves, seasonality

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MINIMIZING HOMOPLASY IS NOT MAXIMIZING HOMOLOGY: A METHOD FOR CHOOSING MPTS

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Parsimony analysis, i.e. searching for the globally shortest tree, is usually justified on the basis that minimizing the total amount of homoplasy instances is equivalent to maximizing the quantity of homology. Homology is a hypothesis that results from the test of a conjecture of similarity, topological correspondence, or as an idea that different things are, finally, the same. It is interpreted as the result of heritage from a common ancestor, or as sameness. Characters that do not pass the test are considered homoplasies, i.e. incorrect homology.

From this statement, it follows that a hypothesis of homology may be accepted as a homology or as a homoplasy, both concepts being strictly complementary. Two main methods of quantifying homology have been proposed in order to choose an optimal tree: compatibility and parsimony. In compatibility analysis, such a tree is the one that results when the highest number of mutually compatible hypotheses of homology is combined. In parsimony analysis, each statement of homoplasy is associated with an extra step. Thus, the optimal tree is the shortest tree.

We propose here a method that introduces the compatibility reasoning into parsimony analysis as a way to chose among most parsimonious trees (MPTs). It is shown that the number of accepted hypotheses of homology may vary greatly through the MPTs. We propose a method that measures the number of corroborated, or accepted, hypotheses of homology (i.e. characters). Our method allows choosing among the MPTs the tree or trees that have the least number of homoplastic characters. The method is applied to a parsimony analysis of *Dombeya* (Malvaceae) species from the Mascarenes allowing a significant reduction of the number of MPTs and improving resolution.

A NEW PTERIDOSPERM WITH AFFINITIES TO COMIA FROM THE LOWER PERMIAN OF NORTH-CENTRAL TEXAS, USA,

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A new genus of possible peltaspermous seed-plant affinity from north central Texas has venation similar to the genus *Comia*. The new material was collected from red clays and silts that indicate growth along the margins of relatively sluggish streams and ponds. The frond is once compound, 40 cm or more in length, with short petiole and pinnae increasing in size distally, usually terminating in two large elongate pinnae. The petiole base is swollen and the leaves appear to have been abscised upon senescence. Pinna venation is three ordered, each higher order being progressively smaller in diameter. The pinna midvein arises from the main rachis and bears secondary veins from which the tertiary veins arise, forming fascicles. Veins of tertiary diameter also arise between fascicles, directly from the midvein. Tertiary veins may dichotomize, anastomose, and terminate in blind endings. Stomata on the rachises are ovoid and lack subsidiary cells or have a pair of paracytic subsidiaries. Stomata on the pinna laminae are amphistomatic with predominantly paracytic stomata though there are rare examples where there are two pairs of lateral subsidiary cells flanking the long axis of the stomata and a pair of smaller subsidiary cells at the top and bottom. The lamina has a uniseriate epidermis, a uniseriate palisade parenchyma, a spongy mesophyll. The venation of is similar to that of *Comia*; all tertiary veins in *Comia*, however, reach the margin of the pinna lamina, without anastomoses or blind endings.

LAURACEAE FROM THE CENOMANIAN OF EUROPE
LES LAURACEAE DU CENOMANIEN D'EUROPE

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Keywords: Lauraceae, systematics, ecology, Cenomanian

Lanceolate leaves showing intramarginate veins were frequently collected from the Cenomanian of Western Europe. They were initially related to the living family Myrtaceae and many were included in the genus *Myrtophyllum* Heer 1869. Such leaves were recently collected in several localities from the Uppermost Albian - Lowermost Cenomanian of Charentes at La Buzinie (Champniers), Font-Benon (Archingeay-Les Nouillers), Puy-Puy (Tonnay-Charente) and Les Renardières (Lussant).

The descriptions and diagnoses of the two main species of the genus *Myrtophyllum*, *M. geinitzii* (the type species) and *M. angustum*, were detailed for the venation and cuticular characters from specimens from the Middle-Upper Cenomanian of Czech Republic (Kva_ek Z. 1983). However, Kva_ek Z. (1992) noted that *Myrtophyllum* is a *nomen illegitimum*, the genus having been used by Turczaninow in 1863 to name a living shrub from South America of the family Flacourtiaceae: *Myrtophyllum chilense* Turczaninow. Moreover, the examination of the specimens of *M. angustum* and *M. geinitzii* from Hloub_tín Hut_, Pecínov, Praha Malá Chuchle and Vy_eho_ovice in collections of the Narodní Muzeum revealed based on the differences in venation patterns and stomatal apparatus that more than two morphotypes, and so likely, more than two taxa exist. Otherviwe, Kva_ek Z. (1983) related *M. geinitzii* and *M. angustum* with *Daphnophyllum crassinervium*, *Grevilleophyllum constans* and *Magnolia amplifolia* under the "group Myrtophyllum" and pointed out that several characteristics are similar to the family Lauraceae. The reproductive organs and the leaves within the group Myrtophyllum show many similarities by their cuticular characters (e.g. *Antocephale chuchlensis* / *M. angustum*, "*Eucalyptus*" *geinitzii* / *M. geinitzii*, *Mauldinia bohemica* / *Grevilleophyllum constans*). The occurrence of more than five leaf types also seems to be supported by the fact that 6 types of reproductive organs of Lauraceae / Laurales were described in the Czech Republic (i.e. *Antocephale chuchlensis*, *Diplostrobus stupeckyanus*, *Stachyura spicata, Mauldinia bohemica* and *Pragocladus lauroides*). From the ecological point of view, the taxa distinguished appear distributed both in floodplains and meanders (Praha Malá Chuchle and Vy_eho_ovice) and in the braided rivers (Hloub_tín Hut_ and Pecínov).

Les feuilles lancéolées à nervures inframarginales sont fréquentes dans le Cénomanien d'Europe occidentale. Elles ont été initialement rapprochées des Myrtaceae actuelles et beaucoup ont été incluses dans le genre *Myrtophyllum* Heer 1869. De telles feuilles ont été récemment collectées dans plusieurs gisements de l'Albien terminal et du Cénomanien basal des Charentes à La Buzinie (Champniers), Font-Benon (Archingeay-Les Nouillers), Puy-Puy (Tonnay-Charente) et Les Renardières (Lussant).

Les descriptions et diagnoses des deux principales espèces du genre *Myrtophyllum*, *M. geinitzii* (espèce-type) et *M. angustum*, ont été précisées pour la nervation et les caractères cuticulaires à partir de spécimens du Cénomanien moyen-supérieur de République Tchèque (Kva_ek Z. 1983). Cependant, Kva_ek Z. (1992) a fait remarqué que le genre *Myrtophyllum* est un *nomen illegitimum*, ce genre ayant été utilisé par Turczaninow en 1863 pour nommer un arbuste actuel d'Amérique du Sud de la famille des Flacourtiaceae : *Myrtophyllum chilense* Turczaninow. De plus, l'examen des spécimens de *M. angustum* et *M. geinitzii* provenant de Hloub_tín Hut_, Pecínov, Praha Malá Chuchle et Vy_eho_ovice dans les collections du Muséum Narodní révèle sur la base de différences dans les nervations et les appareils stomatiques plus de deux morphotypes et donc vraisemblablement plus de deux taxa. D'autre part, Kva_ek Z. (1983) a réuni *M. geinitzii* et *M. angustum* avec *Daphnophyllum crassinervium*, *Grevilleophyllum constans* et *Magnolia amplifolia* sous l'appellation de "groupe Myrtophyllum" et a souligné plusieurs caractéristiques le rapprochant des Lauraceae. Les organes reproducteurs et les feuilles au sein du groupe Myrtophyllum présentent de nombreuses similitudes par leurs caractères cuticulaires (e.g. *Antocephale chuchlensis* / *M. angustum*, "*Eucalyptus*" *geinitzii* / *M. geinitzii*, *Mauldinia bohemica* / *Grevilleophyllum constans*). L'existence de plus de cinq types foliaires semble ainsi également étayé par le fait que les Lauraceae / Laurales soient représentées en République Tchèque par 6, peut-être 7, types d'organes reproducteurs (i.e. *Antocephale chuchlensis*, *Diplostrobus stupeckyanus*, "*Eucalyptus*" *geinitzii*, "inflorescence mâle" de *Myricanthium amentaceum*, *Mauldinia bohemica*, *Pragocladus lauroides*, *Stachyura* sp.). D'un point de vue paléoécologique, les taxa distingués semblent distribués à la fois dans les plaines d'inondation et les méandres (Praha Malá Chuchle et Vy_eho_ovice) et dans les rivières en tresses (Hloub_tín Hut_ et Pecínov).

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ULTRASTRUCTURAL AND CHEMICAL PRESERVATION OF PLANT FOSSILS: CASE STUDIES FROM LEAVES

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This presentation will review recent work in plant molecular taphonomy, focussing on preservational controls linked to presence/absence of resistant organic macromolecules (such as cutan) in living plants versus in situ polymerisation of labile molecules to yield geomacromolecules in fossils (e.g. Gupta et al. 2006). In addition, attention will be drawn to outstanding questions using ongoing and unpublished work on leaves from Clarkia (Miocene, USA) and Geiseltal (Eocene, Germany). Leaves from Clarkia are particulaly interesting as they have been claimed to exhibit 'autumnal colours of red, brown and blackish green' and to preserve labile biomarkers, ancient DNA and organelles. Leaves can be lifted intact from the rock (Smiley 1985, Golenberg 1991, pers. obs.). Inspite of the 'exceptional preservation' at these sites TEM has shown that these leaves exhibit a vast range of anatomical and ultrastructural preservation. Some are mere cuticle envelopes whilst others retain cellular detail and chloroplasts with ultrastructure. Preliminary work suggests that exceptional preservation of leaf tissues, cells and organelles is not linked to exceptional chemical preservation in these fossils. Given that in situ polymerisation is now recognised as an important preservational mechanism future studies should try to address how the controls on this mechanism result in such a vast range of morphological and ultrastructural preservation states.

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EVOLUTION OF ANATOMICAL DIVERSITY IN DEVONIAN-CARBONIFEROUS ARBORESCENT LIGNOPHYTES.

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Ongoing researches on Mississippian (early Carboniferous) lignophytes provide increasing evidence that, soon after the Devonian/Carboniferous boundary, these plants displayed a large diversity of vegetative characters, whether anatomical, morphological, or architectural. This presentation investigates the evolution of a set of anatomical characters from a wide range of Late Devonian to Mississippian lignophyte taxa (progymnosperms and spermatophytes). Data are compiled from the literature or obtained from our own observations of specimens kept in Montpellier or from the collections of Paris, Berlin, London, Edinburgh and Washington. They essentially record euramerican taxa. Observations of new specimens from Mississippian localities of Europe and Australia complete this data set. Qualitative characters are essentially related to stelar architecture. Quantitative characters include measurements of both primary and secondary vascular elements. The distribution of character states is visualized at different periods spanning from the Late Devonian to the Visean, using statistical methods of analyses.

Our analyses are focussed on arborescent taxa and investigate for given groups of characters (1) how they compare with those in non-arborescent taxa (2) how they change between the late Devonian and the end of the Mississippian, and (3) if these changes are linked to environmental or paleogeographical differences. The significance of these anatomical characters, especially those used or voluntarily excluded in previous phylogenetic analyses is discussed.

PALYNOLOGIE DES SEDIMENTS A FACIES WEALDIEN DE L'OUEST DU BASSIN DE MONS (BELGIQUE) : CORRELATION AU SEIN DU "WEALD STRATOTYPIQUE".
PALYNOLOGY OF WEALDEN FACIES SEDIMENTS FROM THE WESTERN PART OF THE MONS BASIN (BELGIUM): CORRELATION WITHIN THE "STRATOTYPIC" WEALDEN.

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Le bassin de Mons forme une aire subsidente d'une quarantaine de kilomètres de long sur une dizaine de kilomètres de large, entre le Nord-Est du Bassin de Paris, le Sud du Parautochtone Brabançon et le Nord de l'Allochtone Ardennais. Au cours du Crétacé inférieur, ce bassin enregistra le dépôt de sables et d'argiles à faciès wealdien.

L'analyse palynologique des sédiments argileux fut entreprise voici plus d'un demi-siècle par Delcourt & Sprumont (1955), dans un article constituant l'un des fondements de la palynologie du Crétacé inférieur. Depuis quelques années, ces sédiments suscitent un regain d'intérêt, notamment grâce à l'étude du matériel conservé à l'Institut Royal des Sciences Naturelles (Bruxelles) : leur analyse est à nouveau abordée, permettant des déductions concernant la stratigraphie du bassin, le paléo-environnement qui régnait lors de la sédimentation et en outre l'observation précise de certains taxons.

Les sédiments extraits de plusieurs sites de l'Ouest du bassin sont analysés :
- le niveau historique des fouilles menées entre 1878 et 1881 dans le puits naturel nommé "cran" de Bernissart [échantillons d'argile (Yans *et al.*, 2004 ; Yans, Dejax *et al.*, 2005 ; Yans *et al.*, 2006 ; Dejax *et al.*, 2007) et coprolithes],
- les carottes remontées lors du forage Ber-3 effectué en 2003 à l'aplomb de ce "cran" (Yans, Spagna *et al.*, 2005),
- l'argile de la carrière de Hautrage, encore en exploitation,
- l'argile provenant de l'ancienne carrière de Baudour (Dejax *et al.*, 2007).

Les associations palynologiques de ces sédiments, assez comparables, révèlent une microflore d'origine continentale déposée dans un environnement lacustre : spores, grains de pollen et "algues" d'eau douce. Les taxons palynologiques inventoriés se partagent essentiellement entre les fougères, les gymnospermes et ces "algues" ; cependant, des grains de pollen d'affinité angiospermienne ont été également observés, dont l'intérêt est majeur :
- ces grains à sculpture crotonoïde témoignent de l'émergence des Angiospermes dans le continent laurasien et de leur diversification précoce ("formes variantes" de Baudour),
- il s'agit de taxons-guides (essentiellement le *biorecord* Superret-*croton*) permettant d'établir une corrélation stratigraphique au sein du "Weald stratotypique", en relation avec les travaux de Hughes *et al.* (notamment 1979) et de Hughes (1994), soit une datation comprise entre le Barrémien moyen et l'Aptien basal.

La datation de ces différents sites étant analogue (selon la résolution temporelle permise par la palynologie d'origine continentale), les mêmes mécanismes de subsidence peuvent être envisagés pour expliquer la formation du "cran" de Bernissart et celle des "poches" d'Hautrage et de Baudour, probablement liés à la dissolution ménagée d'anhydrites viséennes en profondeur.

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MARCHANTIOPSID COLONIZATION MATS FROM THE APTIAN OF ESCUCHA FORMATION (OLIETE SUB-BASIN, IBERIAN RANGES, EASTERN SPAIN)

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At the Oliete Sub-Basin, the Escucha Formation has been divided into three different lithologic intervals from base to top: A (hetherolitic with coal), B (mainly sandstones), and C (claystones). At the upper part of the interval B a grey-silty lithosome has been recognized corresponding to low energy sedimentary environment related to a sandy shoal. In this lithosome marchantiopsid-rich beds extending up to tens of square meters have been preserved. The plant association consists of well-developed mature gametophytes of thallose liverworts with thalli radial, dichotomous branched, rosette forming, prostrate and, in most cases, with gemmae-cups located on their dorsal surface.

The occurrence of scattered individuals forming distinct rosettes that rarely overlap and the loose arrangement of the association, along with sedimentological characteristics allow us to interpret these liverworts-rich beds as monoespecific colonization mats in early stages of colonization in which marchantiopsids played the role of pioneers. In addition, the high proportion of gemmiferous individuals provide significant information on environmental conditions and the effectiveness of colonization by asexual propagules.

Although liverworts colonization mats has been mentioned from the Albian of Antarctica no fossil record of these existed at lower paleolatitudes or in younger geological periods as Aptian. Due to the later, the occurrence of the studied colonization mats becomes of prime importance.

THE ADAPTIVE SIGNIFICANCE OF SEX AND CLOSURE OF THE ANGIOSPERM CARPEL

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The fossil record is necessary to reliably answer several questions regarding the evolution of angiosperms. Fossils add the unique perspective of time to data assembled from extant angiosperms. Totally extinct lineages can be recognized early in the history of this group. Key features of fossil angiosperms lie in the nature of their reproductive organs, the nature of their leaves, their stems and their habit. *Archaefructus*, as an example of early angiosperms, demonstrates several key characters important in understanding the reproductive biology of early flowering plants from seed plant ancestors. The one unique feature of angiosperms is the closed carpel. This single character (closed carpel) definition of angiospermy is important because it is a morphologically based, preservable character that also is uniquely angiosperm. The functional importance of this character in the genetics of flowering plants can never be under estimated. Sex has everything to do with angiosperm evolution. The micropyles of most seed plants contain pollination droplets that consist of fluids often rich in substances that form a biochemical barrier to the successful germination and subsequent fertilization of pollen from the same plant. As the pollen and ovule producing organs were brought into proximity of each other in bisexual reproductive units, this biochemical barrier was very important to prevent self fertilization of pollen from the same plant. When the earliest flowering plants were living in an aquatic environment and their ovules were borne on loosely folded leaves that were susceptible to water washing away the micropylar exudate, mechanical closure of the carpel became important. The mechanical closure of the carpel was the most secure way for early flowering plants to ensure that incompatible biochemical barriers could be maintained. By means of a closed carpel, flowering plants gained an additional advantage over seed plants because of the further genetic control they could maintain over their reproductive biology.

LA SIGNIFICATION ADAPTIVE DU SEXE ET DE LA FERMETURE ANGIOSPERMIENNE DU CARPELLE

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Proposer une réponse fiable aux questions concernant l'évolution des Angiospermes nécessite de passer par le registre fossile. Seuls les fossiles ajoutent une perspective temporelle aux données récoltées sur les Angiospermes actuelles. Des lignées, aujourd'hui éteintes, peuvent être reconnues dans l'histoire précoce de ce groupe. Les caractéristiques clés des Angiospermes fossiles résident dans la nature de leurs organes reproducteurs, de leurs feuilles, de leurs tiges et de leur port. *Archaefructus*, en tant qu'exemple d'Angiospermes précoces, présente plusieurs caractères clés importants pour notre compréhension de la reproduction des premières plantes à fleurs à partir de leurs ancêtres, les plantes à graines. Le seul caractère purement angiospermien est la fermeture du carpelle. La définition de l'angiospermie à partir de ce seul caractère (carpelle fermé) est essentielle car elle est basée sur une caractéristique morphologique, fossilisable et propre aux seules Angiospermes. L'importance fonctionnelle de ce caractère pour la génétique des plantes à fleurs ne pourra jamais être sous-estimée. L'évolution des Angiospermes ne peut se concevoir sans considération liée au sexe. Les micropyles de la majorité des plantes à graines contiennent des sucs de pollinisation, constitués de fluides souvent riches en substances formant une barrière biochimique à la germination et donc à la fécondation par du pollen issu du même plant. Lorsque les organes produisant le pollen et les ovules se sont trouvés à proximité les uns des autres dans des structures reproductrices bisexuées, cette barrière biochimique est devenue très importante pour empêcher l'autofécondation à partir de pollen issu du même plant. Dans l'environnement aquatique où vivaient les premières plantes à fleurs, et où leurs ovules, portés sur des feuilles légèrement pliées, risquaient de voir leurs exsudats micropylaires lavées par l'eau, la fermeture mécanique du carpelle est devenue capitale. Cette fermeture mécanique du carpelle était le moyen le plus sûr pour les premières plantes à fleurs d'assurer le maintien des barrières biochimiques d'incompatibilité. Le carpelle fermé a permis aux plantes à fleurs d'acquérir un avantage supplémentaires sur les plantes à graines, grâce au maintien d'un contrôle génétique sur leur reproduction qui en découle.

ECOSYSTEM REORGANIZATION VS. ECOSYSTEM REPLACEMENT IN RESPONSE TO CHANGING CLIMATES IN THE LATE PALEOZOIC TROPICS

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Plant assemblages in the modern world and, as far as can be ascertained, in the worlds of deep time, strongly reflect local and regional climatic conditions as the primary controlling factor on spatial distribution and taxonomic composition, what might be described as the “biome-scale”. Within these climatic regions, local factors become important in further structuring vegetational composition at what might be considered the “habitat-scale”. Consequently, there is a hierarchy of ecological organization and dynamics that reflects the nature and areal extent of the external controlling factors. In broad terms, plant assemblages then can be viewed as reflecting (1) the primary regional climatic conditions (biomes - it has been suggested by A.M. Ziegler and colleagues [Lethaia, vol. 36, 2003] that patterns of atmospheric circulation and consequent airmass distributions control this distribution), or (2) local habitat conditions, controlled by slope, aspect, soil conditions, etc. that exist within the broader climatic realms. This hierarchy becomes important in understanding the patterns of vegetational change that take place in geological time. In the Paleozoic it is possible to recognize intra-biome patterns of compositional change within and between habitats within a biome (such as between peat-forming and clastic-floodbasin habitats), and to differentiate these patterns from changes in the spatial distribution of biomes on landscapes (such as between the wetland and seasonally dry tropical biomes). The same physical processes, but to different degrees and extents, control spatio-temporal change within and between the broad, mostly distinct species pools that comprise regional biomes. In this presentation, change within the Pennsylvanian and Permian tropical wetlands will be contrasted with the spatial exchange that occurred between wetland and seasonally-dry biomes during the Pennsylvanian-Permian transition in equatorial Pangea.

Key words: Paleoecology, Ecosystem, Climate, Paleozoic, Tropics

MODELISATIONS CLIMATIQUES ET PALEOCLIMATS AU PERMIEN – CLIMATE MODELLING AND PALEOCLIMATES DURING THE PERMIAN

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Le Permien constitue une période charnière de l'histoire de la Terre. D'un point de vue paléogéographique, cette période de collisions continentales se caractérise par l'achèvement de l'édification de la Pangée. D'un point de vue climatique, une transition s'opère entre une époque glaciaire marquée par la glaciation Gondwanienne et une période au cours de laquelle les zones arides se développent et les zones humides diminuent. Les mécanismes responsables de ces changements climatiques et environnementaux ne sont pas toujours élucidés.

La modélisation climatique est un outil puissant, complémentaire des données, qui nous permet de tester la sensibilité du climat et de l'environnement à quelques forçages, en particulier paléogéographiques. Deux exemples illustreront le rôle de la paléogéographie au cours du Permien. Le premier exemple concerne la hauteur de la chaîne Varisque au début du Permien Supérieur. Nous avons forcé le modèle climatique LMDz (modèle de circulation générale atmosphérique développé par le Laboratoire de Météorologie Dynamique, CNRS) par une chaîne Varisque d'altitude croissante associée à une paléogéographie de type Pangée, représentative de la fin du Permien. Les simulations obtenues montrent la forte sensibilité du climat à l'altitude de la chaîne, en particulier au niveau des plaines adjacentes qui recevront de moins en moins d'eaux au fur et à mesure de l'augmentation de la hauteur de la chaîne Varisque.

Ces résultats ont été ensuite confrontés aux données de terrain. Le deuxième exemple concerne le développement d'une flore mixte sur la Péninsule Arabique dont les plus anciens vestiges se situent en Oman. Cette flore mixte est composée d'espèces Cathaysiennes, Gondwaniennes et Euraméricaines, toutes habituellement inféodées à un régime climatique particulier. Quelles sont les raisons de cette mixité ? La modélisation climatique couplée aux données sédimentaires nous permet d'apporter des éléments de réponse. Le climat simulé de la partie sud de la péninsule Arabique est marqué par un climat de type mousson et une alternance entre une courte saison humide et une longue saison sèche. Ce climat est parfaitement adapté à la flore Euraméricaine, mais il est inadapté à la flore Cathaysienne. Or les données sédimentaires indiquent la présence de plaines d'inondations dans lesquelles les plantes Cathaysiennes ont pu s'installer La présence d'une plaine d'inondation humide en permanence dans un climat saisonnièrement aride permet d'expliquer la mixité de la flore.

EMBRYOPHYTES ON LAND: THE EARLY STEPS

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Keywords : Embryophytes, spores, *Cooksonia*, Devonian, Brazil

Embryophytes (land plants) are a monophyletic clade characterised by numerous synapomorphies, including a multicellular embryo, i. e. the young sporophyte still enclosed within the gametophyte generation. Another synapomorphy is the existence of a sporopollenin wall around their unicellular haploid disseminules that are called spores. Evidence from spores (more precisely cryptospores) indicates that ancestral embryophytes, most probably at a bryophyte grade of evolution, already evolved on land surface by Middle Cambrian times, +/- 500 Ma. The earliest body fragments of these plants are parts of sporangia of late Ordovician age (Caradoc, +/- 450 Ma). These fossils are thought to have an affinity with liverworts (bryophytes). The oldest fertile axial land plant fossil is reported from the Middle Silurian (Wenlock, +/- 425 Ma). This plant bears terminal *Cooksonia*-type sporangia. *Cooksonia* was a leafless plant, a few centimeters high, with isotomously branched axes, and terminal sporangia; it has been demonstrated that the axes of some species may include very simple tracheids (water-conducting cells). Accumulating evidence indicates that already by the end of the Silurian and the beginning of the Devonian (+/- 415 Ma), all or nearly all lowland environments on Earth had been densely colonized by early embryophytes. Most of those were very simple and tiny, but is has recently been reported that coeval, larger, morphologically more complex plants could evolve at low latitudes. In this talk, a special focus will be placed on an earliest Devonian flora from Brazil, which is comprised of a large variety of *Cooksonia* and *Cooksonia*-like plants, as well as of more enigmatic specimens.

BRACKISH COASTAL SWAMP VEGETATION FROM THE UPPER CRETACEOUS OF EASTERN PYRENEES, CATALONIA (SPAIN).

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Keywords: *Sabalites*, *Frenelopsis*, angiosperm seeds, mangrove vegetation, brackish coastal swamps, Campanian - Maastrichtian, Pyrenees.

The areas of Fumanya (Berguedà, Barcelona) and Pinyes (Alt Urgell, Lleida) in Catalonia (Eastern Pyrenees) are well known to have yielded during the last decades abundant animal fossils from the Upper Cretaceous of the so-called "Garumian facies", Tremp Formation. Especially the "marly limestones" unit from the Lower Maastrichtian of Fumanya Sud (Figols) and Mina Esquirol (Vallcebre) and the basal limestones and grey marls intercalated with coal seams from the Upper Campanian - Lower Maastrichtian of Coll de Nargó display thousands of titanosaur sauropod footprints and trackways, and dinosaur eggshells and clutches, respectively. Sedimentological studies and the fossil content (brackish charophytes such as *Feistiella* sp. and brackish ostracods such as *Neocyprideis durocortoriensis*) indicate brackish water conditions in coastal swamp environments.

As far as palaeobotany is concerned, large (up to 75 cm long and 40 cm wide laminas and more than half a meter long petioles), oval-lanceolate, costapalmate leaves of *Sabalites* cf. *longirhachis* of the palm family (Arecaceae) co-occur with shortly fragmented axes of *Frenelopsis* of the conifer family Cheirolepidiaceae. *Frenelopsis* shows typical whorls of leaves (probably three), and some axes are simply formed by resin. In addition, three morphotypes of angiosperm seeds, most showing a thick coaly endocarp and two integuments, can be observed after bulk maceration of the sediments from the Mina Esquirol site: (1) droplet-shaped seeds bearing the hilum laterally compared to the rounded part, (2) kayak-shaped seeds bearing a central hilum, and (3) rugby-ball-shaped seeds bearing lateral hilum.

From the taphonomical point of view, the abundance of *Frenelopsis* remains, associated with small rootlets at the base of some coal seams suggests parautochthony in the subsequent development of the coal swamp. In contrast, the presence of clusters of angiosperm seeds in particular horizons appears to be an assemblage selected by floatation. The isolated *Sabalites* leaves probably resulted from a traumatic production, since as a rule, palm leaves remain attached a long time after their senescence. This, along with their large variability in size, probably representing diverse ontogenetic stages (i.e. young and adult leaves) suggests parautochthony. In addition, the presence of an isolated palm-tree base in a closely underlying similar level within the same transitional environment may indicate that the palms were growing within the brackish swamps. As a consequence, the hypothesis of a *Sabalites-Frenelopsis* brackish vegetation is proposed as a working hypothesis, and may be viewed as a transitional stage from Early Cretaceous *Frenelopsis*-dominated mangroves to Palaeogene Arecaceae-dominated (*Nypa*) mangroves in the Pyrenean basin.

LA PALEOCHIMIOTAXONOMIE EXPERIMENTALE: UN NOUVEL OUTIL POUR LE TRAÇAGE DES CHANGEMENTS PALEOFLORISTIQUES ET PALEOCLIMATIQUES. PRESENTATION ET APPLICATION AUX CONIFERES FOSSILES

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Les plantes vasculaires terrestres synthétisent d'importantes quantités de terpénoïdes qui sont des constituants majeurs des résines et des huiles essentielles. Ces terpénoïdes possèdent deux particularités par rapport aux autres composés qui constituent ces végétaux. Premièrement, ce sont des composés de bas poids moléculaire dont le squelette carboné peut être préservé dans les archives sédimentaires pendant des centaines de millions d'années sans modification structurale majeure. Deuxièmement, certains terpénoïdes ont une valeur chimiotaxonomique, ce qui signifie qu'ils sont spécifiques de certains taxons (Otto et Wilde, 2001).

Les bioterpénoïdes sont ensuite transportés jusque dans les bassins sédimentaires où ils sont préservés dans les archives sédimentaires. Au cours de la diagenèse, ils sont transformés en géoterpenoides, c'est-à-dire en biomarqueurs moléculaires qui peuvent être analysés. Ces géoterpénoïdes peuvent conserver, totalement ou partiellement, leur valeur chimiotaxonomique originelle (Otto et Simoneit, 2001). Cette approche paléochimiotaxonomique peut être utilisée en chimiostratigraphie pour tracer l'évolution des paléoflores, et donc des paléoclimats, au cours des temps géologiques. Elle constitue une approche nouvelle et complémentaire de la palynologie et de la paléobotanique (Hautevelle et al., 2006a). Les biomarqueurs moléculaires ont pour avantages d'être plus facilement associables à des taxons végétaux que les spores et les pollens, surtout pour les périodes pré-Cénozoïques et d'être beaucoup plus communs que les macro-fossiles de plantes dans les dépôts sédimentaires. Ces avantages font des biomarqueurs de plantes les traceurs idéaux pour effectuer des reconstitutions paléofloristiques et paléoclimatiques. Malheureusement, les données paléochimiotaxonomiques, qui permettent d'associer des distributions de géoterpénoïdes à des taxons botaniques, font actuellement défaut. C'est pourquoi la paléochimiotaxonomie ne peut pas pour l'instant être utilisée de manière systématique pour caractériser les paléoflores.

Afin de palier à cette lacune, une technique de maturation artificielle de plantes actuelles a récemment été mise au point (Hautevelle et al., 2006b). Son principe est de reproduire en laboratoire l'évolution chimique que la plante aurait subie dans un dépôt sédimentaire au cours des temps géologiques. Cette nouvelle technique permet donc :

1) de déterminer la signature moléculaire de l'équivalent fossile de végétaux actuels ;
2) d'établir des relations entre la composition en géoterpénoïdes et la systématique végétale.

Il devient ainsi possible d'associer chaque ordre, famille et genre botanique à un faciès moléculaire qui lui est spécifique.

L'étude présentée ici porte sur la paléochimiotaxonomie des conifères car ces végétaux sont des composants importants des flores méso- et cénozoïques. Les 7 familles actuelles de conifères (*Araucariaceae*, *Cupressaceae*, *Pinaceae*, *Podocarpaceae*, *Sciadopityaceae*, *Taxaceae* et *Taxodiaceae*) ont été étudiées et les plantes ont été choisies de telle façon que tous les principaux genres, ainsi que ceux ayant un intérêt paléobotanique et/ou paléoclimatique, soient bien représentés. Près de 70 espèces ont ainsi été étudiées et les résultats ont effectivement permis de mettre en évidence les caractéristiques moléculaires propres à chaque famille/genre. Les résultats acquis grâce à cette nouvelle approche permettront prochainement de pouvoir tracer efficacement les changements paléofloristiques et paléoclimatiques via l'étude des biomarqueurs moléculaires.

Mots-clé : paléochimiotaxonomie expérimentale, terpénoïde, biomarqueur moléculaire, conifère, systématique

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FLORA OF THE LATEST EOCENE INSECT LIMESTONE, ISLE OF WIGHT, SOUTHERN ENGLAND

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Fossil plant remains of latest Eocene age occur in pockets within the fine-grained Insect Limestone (Bembridge Marls Member, Solent Group) exposed on the Isle of Wight, southern England. This revision provides new information on the composition of the flora. Study of the collections at the Natural History Museum, London, revealed that some of the previously reported taxa are not preserved within Insect Limestone. The three palm genera, the one taxon representing the Droseraceae, two species of fern, one species of conifer and the charophytes have been excluded from the floral list. New non-destructive techniques have yielded additional taxonomic information and through detailed analysis of the architecture of fragmentary dicotyledonous angiosperm leaves, specimens previously assigned to Ficus and Fagus are now considered incertae sedis. Recent collecting has provided new insights on the relative frequencies of the different types of plant fossils and it has been possible to build up a picture of the local vegetation. Fragments of Typha foliage are the most abundant fossils and, along with other wetland elements such as Acrostichum and Azolla, dominate the flora. The non-wetland plants most frequently represented are trees of the Juglandaceae. Remains of other flowering plant trees and shrubs and conifers are very rare. There are also specimens of possible herbaceous plants and propagules with plumes or awns, which may include an early record of Clematis. Comparison with other fossil occurrences and nearest living relatives suggests that the local wetland vegetation grew in, or close to, a freshwater body, sometimes with a slight brackish influence. Since the plant debris is only preserved in pockets, it is unlikely that there was an extensive, persistent marsh. Trees, shrubs and herbs probably grew in patches a greater distance from the water. The Insect Limestone is famous for its insect fauna, but there is little evidence of plant-insect interaction. However, galls and a possible association between stratiomyid flies and Typha have been discovered.

Keywords: Paleogene, England, Insect Limestone, flora, angiosperms, plant-insect interaction

PALEOZOIC CONIFER RECONSTRUCTIONS LEADING TO A BETTER UNDERSTANDING OF THE CONIFER CONCEPT.

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New whole plant reconstructions of the most ancient conifers in North America (Thucydiaceae and Emporiaceae: Voltziales) have changed our previous understanding of fossil conifers. These new reconstructions suggest that most Upper Paleozoic conifers from Euramerica were small stature trees with lateral plagiotropic branches bearing simple and forked leaves, showing heterophylly, and bearing simple and compound pollen and compound ovulate cones and fertile zones. Stems have an endarch eustele, dense wood and secretory cells in the pith or resin canals. Leaves are often amphistomatic with two adaxial stomatal bands, and two longitudinal abaxial rows of stomata with numerous trichome bases. Pollen cones are simple and have helically arranged microsporophylls and adaxial pollen sacs. However, a single conifer has compound pollen cones, where a cone axis bears series of bract-axillary dwarf shoots with terminal pollen sacs. Thus resembling compound ovulate cones in organization. Prepollen is monolete and monosaccate (*Potonieisporites* Bharadwaj). Ovulate cones are compound with bilaterally symmetrical axillary dwarf shoots that bear numerous sterile scales and 1-4 sporophylls, and occur in the axils of helically arranged bracts with often forked tips. Ovules are inverted, winged and show an internal anatomy similar to that of living conifers. These plants serve as a good example to discuss sets of characters (morphological, cuticular, anatomical, and palynological) derived from the study of growth architecture, leaf variation, pollen and ovulate cones of the most ancient conifers. Thus presenting sets of diagnostic characters that are tested by means of phylogenetic analyses and lead to a discussion on the conifer concept and propose a broader concept that includes both fossil and living conifers.

UNRAVELLING CLIMATE/ENVIRONMENT INTERACTIONS AND HUMAN LANDUSE FROM PENTACYCLIC TRITERPENES. SOME EXAMPLES AND PERSPECTIVES FROM LATE QUATERNARY LACUSTRINE SEDIMENTS.

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Pentacyclic triterpenes are one of the most diversified families of the chemical realm due to the numerous combinations afforded by ring arrangement, methyl group isomerism and to the addition of varying functional groups. Although these molecules are widely distributed in the plant kingdom, some chemotaxonomical relationships can now be established between specific compounds and defined taxa, thanks to the impressive set of data collected by phytochemists. The relative stability of these molecules towards diagenesis, probably due to their anti-microbial/fungal/grazing properties, allows organic geochemists to detect pentacyclic triterpenes produced by once living organisms in sediments and rocks. When a clear relationship can be established between fossil molecules and their source organisms, it is then possible to track the history of vegetation changes from paleoenvironmental archives such as lacustrine sedimentary series. Despite their resistance to early diagenetic processes, pentacyclic triterpenes can suffer several structural alterations depending on the physico-chemical conditions that prevailed within their site of production, during their transportation and deposition. These transformations can lead to isomerisation and/or the loss of (a) functional group(s) and/or even of one or several rings or to their progressive aromatization. Therefore, the precise description of diagenetic derivatives assemblages can reveal useful for deciphering past environmental conditions. Finally, the recent development of compound-specific isotope analyses now also permits the determination of the isotopic composition ($\delta^{13}C$, δD, $\delta^{18}O$ or ^{14}C) of single molecules isolated from complex organic mixtures. The high specificity of some pentacyclic triterpenes makes them outstanding targets for such approaches. Isotopic measurements on selected pentacyclic triterpenes is expected to provide clue information on the coupled evolution of climate and continental environments.

The possibilities afforded by pentacyclic triterpenes for paleoclimatic and paleoenvironmental studies are illustrated by recent work on two sedimentary records in two distinct settings.

Lake Caçó is located in Northern Brazil, almost under the Equator. The sedimentary infill of this lake provided a continuous sedimentary series covering the last 20000 yrs. Our work, engaged with the Institut de Recherche et de Développement, aimed at better understanding the climatic variations that suffered this poorly documented region, as compared to higher latitudes and to decrypt the impacts on such variations on local ecosystems. Onocerane, a pentacyclic triterpene, was detected in some sedimentary levels. This molecule is rather rare in sediments or rocks and its origin was previously attributed to ferns or mosses. On the contrary, the comparison of onocerane variations in abundance with other parameters indicates that onocerane was produced by a plant adapted to dryness, probably related to *Ononis sp*. A series of pentacyclic triterpenes owing a methyl ether group (PTME) was also detected for the first time in these sediments. According to phytochemical studies, these molecules are essentially synthesised by gramineae. Their detection in sediments and rocks should hence help deciphering past grasses dynamics. Abundant diagenetic derivatives of pentacyclic triterpenes also allowed us to propose a scenario for the climatically controlled evolution of the studied watershed.

The second study was realized in the frame of the APHRODYTE project that aims at understanding the climatic evolution in the Alps during the Holocene and its relationships with vegetation successions and the evolution of human societies. A single PTME was detected in the sediment infill of Lake Le Bourget. This compound identified as miliacin can be related to *Panicum miliaceum* (common millet) formerly cultivated in the lake Le Bourget catchment. The first record of this molecule in the sediments is in agreement with the date of introduction of this cereal during the Bronze Age. After an intensive cultivation of millet attested by high concentrations of miliacin during that age, a sudden decrease in abundance during the first Iron Age coincides with a period of climatic deterioration that probably forced population to abandon the surroundings. Then, high concentrations in miliacin attest to a renewal of millet cultivation that stopped around 800 AD, probably due to its replacement by another cereal.

THE EARLY DEVONIAN RHYNIE CHERT, ONE OF THE OLDEST AND MOST COMPLETE TERRESTRIAL ECOSYSTEMS

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The colonization of the land is one of the most important steps in the history of life, and had a large impact on the further evolution of the geo- and atmosphere. The Early Devonian (Pragian) Rhynie cherts represent the oldest and most completely preserved terrestrial ecosystem presently known. These cherts, found near Rhynie (Aberdeenshire, Scotland), have been formed as a result of hot spring activities. Several different facies types are preserved, ranging from fully aquatic to incidently flooded terrestrial communities. A wide variety of organisms (e.g., cyanobacteria, various groups of fungi, green algae, lichens, higher land plants, various groups of arthropods) is known from the Rhynie chert, including the earliest records of several major groups. Of special importance are the oldest completely preserved land plants which show a unique set of anatomical characters, enabling well-founded biological interpretations. Life histories of Rhynie Chert land plants can be reconstructed in great detail, including their reproduction (alternation of generations and gametophyte development, including germinating spores, early cell division stages in young gametophytes, the release of sperm cells from the antheridia), ontogeny, growth strategies and interactions with other organisms. Also the faunal remains often show a remarkable amount of detail, e.g., the presence of booklungs in trigonotarbids, a hexapod with gut contents, genitals and tracheae of opilionids. Recently discovered nematodes are the first soft-bodied animals recorded from the Rhynie chert. Several tissues and various life stages, including young individuals just coming out of the egg, can be documented.

The Rhynie chert is not only unique because of the great amount of detail that is preserved, but also because the plants and animals are often preserved *in situ*. Plants are frequently found in life position and animals may occur among or on plants, within sporangia, and inside (partly decayed) axes of land plants. Individual chert lenses usually represent a number of successive flooding events and show a succession of different facies types with their typical life communities. The Rhynie chert thus provides a unique window on the early history of life on land.

INFORMATION TEMPORELLE, REGISTRE FOSSILE.ET PHYLOGÉNIE.

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Les données fossiles fournissent des informations sur des formes éteintes de vie dont on aurait beaucoup de difficultés à imaginer même l'existence à partir de l'étude des formes de vie actuelle. De plus les fossiles constituent la seule source d'information directe sur l'histoire de la vie sur Terre. Ces constatations mettent en évidence d'une part, l'apport d'une information intrinsèque sur la connaissance de la morphologie des êtres vivants et sur leurs relations de parenté, et d'autre part la nécessité d'améliorer la connaissance d'une succession d'événements dont l'ensemble constitue le registre fossile.

Aucun domaine scientifique ne peut prétendre être fondé sur une information complète, à ce titre le registre fossile est comparable à beaucoup d'autres sources d'information scientifique : il est incomplet. Néanmoins on peut chercher à estimer la qualité des informations portées les fossiles. Ainsi comprendre la relation entre l'information temporelle et les phylogénies nous permet de donner une dimension historique aux classifications.

Dans le cadre de cette problématique trois questions peuvent être formulées :

- Comment apprécier la qualité du registre fossile ?
- Quelle est la signification des indices qui estiment cet accord ou désaccord ?c'est-à-dire, comment peut-on ajuster une phylogénie, qui est une hypothèse hiérarchisée, au temps linéaire ?
- Quelle est la signification d'un accord, ou d'un désaccord, entre la phylogénie et la succession des fossiles dans la stratigraphie ?

La multiplication des réponses apportées notamment sous forme d'indices mesurant l'adéquation entre les phylogénies et le registre fossile rend compte de la difficulté à comparer le temps linéaire et la phylogénie hiérarchique (Siddall, 1998). Récemment une réponse à ce problème méthodologique a été apportée par Zaragueta Bagils *et al.* (2005), mais la question du sens de ce que mesure les indices demeure.

Nous souhaitons faire le point sur cette question de l'ajustement entre stratigraphie et phylogénie, revenir sur la définition des indices proposés et sur l'identification des biais qui y ont été décelés. Enfin tenter de savoir quelle représentation logique de la phylogénie est nécessaire pour permettre de répondre de façon satisfaisante aux questions restées en suspens.

THE EVOLUTION OF LATE PALEOZOIC CONIFERS

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Conifers played a prominent role in the composition of Late Paleozoic plant communities in the equatorial Euramerican province that covered the southern part of the United States and Europe. The earliest, so-called walchian conifers (walchian Voltziales), originated from drier floras, which had co-existed with wetland vegetation for millions of years. Phylogenetic analysis suggests that the Late Permian conifer families Majonicaceae and Ullmanniaceae (voltzian Voltziales) arose from a member of a paraphyletic group of walchian Voltziales. The Majonicaceae and Ullmanniaceae are more derived in that they have fused female reproduction organs, and a reproduction strategy that involves a pollen tube. Until recently, it has not been possible to establish with accuracy when these conifers originated or when they started their rise to dominance over the walchian conifers. Findings from late-Early to early Middle Permian localities in north-central Texas prove that radiation in these conifer lineages occurred significantly earlier than previously thought. It confirms that the Majonicaceae where already well differentiated during Early Permian times, and considerably extends their geographical and temporal range. It proves that that structural evolution and diversification among these conifer taxa took place before late Early Permian. Evolution and migration of conifers in the Late Paleozoic tropical regions seems to have been strongly influenced by the increasingly drier climate.

Conifer; fossil; Majonicaceae, evolution; Permian; Euramerica

THE AUTUNIAN FLORA OF BARO (CATALAN PYRENEES): TAPHONOMY AND PALEOECOLOGY

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Conifer-callipterid floras are generally considered markers of the beginning of the non-marine Permian (Autunian) in Europe. The onset of this flora has been related to global events leading to a generalized arid climate; however the detailed paleoecology of these floras remains obscure. This presentation explores the paleoecology of an Early Permian flora on the basis of taphonomic criteria issued from experiments with extant plants with a similar taphonomic behaviour.

The Autunian flora of Baro (Sort basin, Eastern Pyrenees) is found in lacustrine laminites within a Late Hercynian intramontane basin of the Pyrenees. In the Tertiary, this basin was implicated tectonically in the Alpine compression leading to the uplift of the Pyrenean Range, which makes the paleogeographic reconstruction of the lake difficult. Only preliminary studies were devoted to the flora of Baro up to now. However, from the point of view of regional geology, it was used as a biostratigraphic datum to mark the beginning of the Permian. The plant assemblage of Baro is dominated by conifer remains (*Ernestiodendron* sp., *Walchia piniformis*) which were produced either physiologically (abcission of twigs and cone scales) or traumatically (wind storm breaking of branches or cones) with a later disarticulation of these remains in the leaf litter (separation of conifer acicules from twigs). The diversity of necrobiotic factors leading to the production of these remains suggests a habitat close to the depositional setting, i.e. at the lakeshores. Callipterids (*Lodevia nicklesii*, odontopterid foliage) appear to have the same taphonomic behaviour but their remains were less abundant, as expected from smaller plants growing in the understorey. Other plant remains (*Linopteris* aff. *brogniartii, Gracilopteris* sp., *Taeniopteris* aff. *multinervis, Solernheimia* sp*., Lesleya* sp*., Cordaites* sp.) were extremely scarce. Most of them correspond to coriaceous leaves with evidence of leaf tearing following venation and selection by floatation, which are taphonomic features of transport by running water. A habitat away from the lakeshore appears to be the most probable situation for the producing plants.

In conclusion, the presence of a conifer-callipterid dominated flora in Baro is strongly influenced by taphonomic constraints. The growth of the dominant plants at the shores of the lacustrine depositional setting determined the massive accumulation of their remains, regardless of their abundance or scarcity in other environments. This result suggests that detailed taphonomic analyses are required to know in which extent the plant turnover of the Early Permian affected a large number of paleoenvironments or if plants growing in particular depositional settings, such as wetlands, were more sensitive to the global Permian climatic shift towards aridity.

AQUATIC RADIATION PREDATING TERRESTRIAL RADIATION IN EARLY ANGIOSPERM ECOLOGY: INSIGHTS FROM BARREMIAN LACUSTRINE MACROPHYTES OF SPAIN

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Keywords: charophytes, early angiosperms, aquatic radiation, Barremian, Spain

Early Cretaceous (Barremian) hydrophytes of the Iberian Ranges and Pyrenees (Spain) consisted of charophytes and early angiosperms. Each of these groups of macrophytes is abundant in particular facies and rare or poorly preserved in others, suggesting they grew up in distinct habitats.

Charophytes occur in two types of facies. Calcified fructifications along with calcified portions of thalli of Clavatoraceae, Porocharaceae and early Characeae are extremely abundant in alternating massive limestones and marlstones with occasional hydromorphic profiles. This facies represents heavily vegetated palustrine and shallow lacustrine environments. Otherwise, whole plants are extremely rare in lithographic limestones, indicating that these macroremains were probably transported from the lakeshores to deeper lacustrine areas. All together, charophytes may have inhabited shallow, well illuminated niches affected by oscillating water tables.

Besides the atypical look, *Montsechia vidalii* is by far the most abundant early angiosperm from the non-marine Barremian fossil record of Iberia. The large, branched, leafy axes can be split into two distinct morphologies based on leaf size and phyllotaxy, the most compact bearing *Spermatites*-enclosing carpels still attached. Although the axes are nicely preserved in lithostratigraphic limestones, they look like extremely delicate and fragile, and do not occur in depositional settings formed under higher oxygenation levels or stronger hydrodynamic conditions. In contrast, isolated *Spermatites*-enclosing carpels and/or *Spermatites* seeds are small bodies and lignified enough to be transported and preserved in other lithologies, but have never been found in palustrine marlstones, in spite of intensive sieving in the last twenty years. *Montsechia vidalii* may have grown deeper and/or long-lived lakes where lithographic limestones deposited.

These fossil records are tremendously relevant in the debate about early angiosperm ecology and environment, and may demonstrate that an aquatic radiation predating the terrestrial radiation. Thus, the opportunistic colonization strategy of early angiosperms in terrestrial habitats from the Aptian to Cenomanian is widely accepted, and later competitions in-between plants led to the exclusions of many groups (e.g. cycadophytes and gnetophytes) from lowland open ecosystems. A similar pattern appears to previously settle in aquatic habitats, angiosperms already being abundant in lacustrine environments at least from the Early Barremian onwards. These ecosystems included an initial phase of relegation of early angiosperms to deeper, low-illuminated and low-oxygenated niches in tropical freshwater bodies during the Barremian and subsequent competition face to charophytes and colonization of lakeshores.

DADOXYLON TYPE OF WOOD FROM THE CZECH PART OF THE INTRASUDETIC BASIN (LATE PENNSYLVANIAN, NE BOHEMIA, CZECH REPUBLIC): A PRELIMINARY REPORT

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The Late Pennsylvanian deposits in the region of the Hawk Mountains (*Jest_ebí hory*), situated in the Czech part of the Intrasudetic basin (NE Bohemia, Czech Republic), are famous for abundant occurrence of silicified trunks, the so-called "*araukarity*". The largest specimens are up to several metres in length and about one meter in diameter. They are usually embedded in units of arkosic sediments known as _altman Arkoses of Odolov Formation (compare in Roscher & Schneider 2005), which were created by a rapid and massive fluvial transport of low-weathered material rich in feldspars and biotites during a dramatic tectonic evolution of basins' limnic palaeogeography. This unit is exposed today as the main ridge of Hawk Mts.

The fossils were first described by H. R. Goeppert in 1857 and 1858. He discovered several remarkable localities in the second half of the 19th century, and subsequently determined two species: *Araucarites brandlingii* (= *Dadoxylon brandlingii* which should represent a cordaite wood) and *A. schrollianus* (= *Dadoxylon saxonicum* which should represent a conifer wood). Until now, nobody has studied this permineralized material in more detail. In fact, the main aim of the systematical part of this research is to see if the morphological and anatomical differences between cordaite and conifer wood (e.g., Vozenin-Serra 1985, Noll & Wilde 2002, Noll et al. 2005) can really be recorder on our fossil material.

The second part of the research is focused on geochemistry. Observations of mineral matter preserving trunk bodies is based on a practical application of transmitted light, polarized-light, cathodoluminescence and scanning electron microscopies, EDX and Raman analysis. Besides prevailing SiO2 matter, other mineral phases were qualitatively detected in the trunks, mostly of allochtonous origin. Distinct phases and morphologic types of SiO2 were described within silicified stems that characterize their density, crystallinity and compactness, but also possible conditions of silicification and plant taphonomy. The latter can be excellently proved by imaging using hot cathodoluminescence, which is among others very efficient in distinguishing various generations of SiO2 and other minerals, and thus makes evidence of a multi-phase petrifaction (Matysová 2006). The aim of this part of the study is to find all possible connections between anatomy of the trunks and the ways of their permineralization.

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PRELIMINARY REPORT ON WOOD REMAINS FROM THE LOWER CARBONIFEROUS OF THE NORTH RUSSIA (ARKHANGELSK REGION)

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A lot of wood remains were found recently in the Lower Carboniferous (possibly, Upper Visean) deposits of the Arkhangelsk region (northern Russia). Firstly from the Upper Visean deposits of the Arkhangelsk region (exact address of locality was not indicated) two wood fragments (*Palaeoxylon bourbachensis* Coulon et Lemoigne) were described by S.M. Snigirevsky in 2003 (Antashtchuk, Snigirevsky, 2003). Our collection consists of various wood remains from five different localities (three boreholes, and two outcroppings) and represented at least three different types of wood. The wood remains basically come from yellow and cherry ferruginous sandstones. Above 50 specimens used in this study are kept in the collections of the Department of Paleontology, Geological Faculty, MSU.

Methods: observations were carried out using both “dispersal”, and “in-situ” wood fragments. For the extraction of “dispersal” woods from rocks consists of mechanical splitting of sandstone samples on small fractions. In rare instances these fractions have also been split chemically, i.e. macerated with high-test hydrogen peroxide. Then “dispersal” wood fragments have been selected with a stereomicroscope Olympus SZ-6045, and the well-preserved woods have been studied with a scanning electron microscopy (CAMSCAN). “In-situ” wood fragments have been extracted from the pieces of a very brittle stem (up to 50 mm long and 65 mm wide), which is easy broken during the preparation. Then they have been examined with SEM.

Preliminary results: at least three types of woods can be distinguished now. First type (type “A”) of wood is represented by “dispersal” wood fragments from borehole K276/1 (5,8 m deep). There have been studied radial and oblique sections of the wood. Because of fragmental preservation there is no information on the primary xylem and pith. In radial section the tracheids of secondary xylem are hexagonal, average 22 - 32 _m wide. Tracheid pitting in radial walls is predominantly biseriate (50%) and triseriate (12,5%), rare uniseriate (37,5 %). Alternate (araucaroid type) arrangement of tracheid pitting is observed. The pits are rounded and hexagonal in outline; 5,8 – 11 (average 6 - 8) _m in diameter and display inclined narrow-elliptical apertures. In radial section the tracheids are short (up to 640 _m long). Cross-fields show two-five rounded-tetragonal simple pits. Ray cells are rectangular, 69-72 _m long radially. The rays are rare; each ray consists of three rows of the cells in radial section.

Second type (type “B”) of wood remains under study is “in-situ” wood, coming from yellow sandstones of borehole RPK3/4; 40 - 43 m deep. Wood has been studied in radial and oblique-radial sections. In oblique-radial section metaxylem elements have been observed in three-dimensional view. The tracheids are small (37 - 39 _m in diameter), hexagonal in shape. They have scalariform thickening both in radial and tangential walls. Elements of secondary xylem are well preserved. In radial section the polygonal tracheids are above 800 _m long and 23 - 45 (average 32) _m wide. They have uniseriate (55%) and biseriate (45%) pitting with alternating arrangement of the pits. The rounded-polygonal pits are 7 - 11 (average 8 - 9) _m in diameter, with inclined very narrow (up to 1 _m in wide) apertures. In radial section the rays are high (up to 355 _m) and relatively long – above 530 _m. The distance between neighbouring rays in radial section is 103 - 250 _m. Each ray consists of 12 - 15 rows of rectangular cells. In cross-field areas one-five (average 2 - 3) pits are present; the pits are rounded in shape. They are arranged in two horizontal rows. Most of the pits has elliptical aperture.

Third type (type “C”) of woods found in Arkhangelsk region (locality near Tovskoe Lake) is characterised by following feathers: tracheids are small, commonly 18 _m in diameter in tangential dimension; polygonal in shape. In oblique-tangential section the tracheids of secondary xylem have pitting both in tangential, and radial walls. The tracheids in tangential walls have rare small (average 6 - 7 _m in diameter), rounded pits with rounded pores. The pitting is uni-, biseriate, and arranged alternately. Tracheid pits in radial walls are crowded, rounded-polygonal in shape. Perhaps, the pits are arranged in one-two rows and have oblique apertures. In tangential section the rays are numerous, very low (1 cell in high) and uniseriate. The width of rays is 16 - 24 (average 20,4) _m, with their height 28 – 48 (average 40) _m. The density of ray is 19. per 0.5 mm^2. According to Galtier and Meyer-Berthaud (2006) small diameter of tracheids and small size of rays could be indicated on pycnoxylic wood (as in conifers). Consequently the woods of types “A” and “C” mentioned above from the Lower Carboniferous deposits of the Arkhangelsk region represent most likely pycnoxylic type of the wood.

Key words: fossil wood, Early Carboniferous, araucaroid pitting of tracheids, scalariform tracheid thickening, pycnoxylic wood, Russia, Arkhangelsk region.

HETEROSPORY AND SEED-HABIT: DEVONIAN INNOVATIONS.

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Major evolutionary steps occurred during the Devonian. Within 60 Ma, plants evolved the conducting tissues, the leaf (microphyll or megaphyll), the seed and the tree habit. With the exception of the Angiosperms, all important lineages were established by the end of the period. We will focus here on one of those evolutionary steps: the heteropory and by extension the acquisition of the seed habit.

In 1960, Chaloner emphasized a spore size segregation at the end of the Lower Devonian. This is the first sedimentary record of heterospory. Nevertheless, heterospory remained inconspicuous until the Givetian, when a rapid and geographically widespread rise of innovations in heterosporous reproductive structures occurred. Recent information collected from mid-late Givetian deposits from Belgium and Libya confirm the presence of highly diversified dispersed megaspore assemblages. Moreover, extreme examples of heterospory have been documented, such as the seed megaspores *Spermasporites allenii* and *Granditetrasporites zharkovae*. The existence of such a variety of heterosporous plants has still to be explained, but is obviously linked with seed plant stem-group lineage.

The proto-ovule *Runcaria* from the Givetian of Belgium is the earliest evidence of the seed habit. By the end of the Devonian, 6 different types of seeds (*Moresnetia*, *Condrusia*, *Dorinnotheca*, *Warsteinia*, *Aglosperma* and *Spermolithus)* are known. These plants illustrate major variation in cupule and integument morphologies.

The concommitent rise of several types of heterosporous reproductive strategies in several independent lineages suggests that conditions prevailing during the mid-Givetian have been favorable to it. We suggest that two major events in early seed plant evolution occurred during the Devonian. The first is the advent of the seed habit; it occurred during the Givetian. The second major event is the diversification and modification of the already successful seed habit; it took place during the Famennian. These events in the evolution of plants lead to the worldwide domination of spermatophytes.

NEW EVIDENCE FOR FOSSIL PIPERALES: FLOWERS, FRUITS AND IN SITU POLLEN FROM THE MIDDLE EOCENE PRINCETON CHERT, BRITISH COLUMBIA, CANADA

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Recent study of the Middle Eocene Princeton Chert locality in British Columbia, Canada has focused on the well-preserved remains of an infloresence, flowers and fruits. Plant remains are studied by serial sectioning using the cellulose acetate peel technique modified for hydrofluoric acid. In addition, in situ pollen was studied using scanning and transmission electron microscopy. Minute perianthless flowers, 0.8 mm in diameter, are borne on a racemose infloresence. A flower-bract stalk bears a cupulate bract and pedicellate flower. Five stamens with tetrathecal anthers are adnate to carpel bases. Anthers frequently have in situ pollen. Pollen is minute (<10 µm), monosulcate, boat-shaped-elliptic, with a punctate exine sculpturing. Carpels are basally connate and have a rugose surface. Styles are recurved. A single seed, with marginal placentation, is present per carpel. Flower structure and pollen indicate these fossils are most similar to the genus *Saururus* (Saururaceae, lizard's-tail family; Piperales), which today is found in eastern Asia (*S. chinensis*) and eastern North America (*S. cernuus*). Fossils differ from the living taxa in several characters, including their smaller size, lack of trichomes (found in both species of *Saururus*) and in having five stamens instead of six. In addition, a developmental sequence shows the fossil carpels developing into small schizocarpic, indehiscent fleshy fruits that are nearly indistinguishable from *Saururus* fruits. Previous fossil fruits described as *Saururus bilobatus* (Nikitin) Mai are known from the Late Eocene to Pliocene of Europe and Siberia. The Princeton fossils represent the oldest material of Saururaceae, as well as the first North American fossil Saururaceae, the first fossil flowers and the first pollen record for the group.

Keywords: fossil flowers, Middle Eocene, pollen, Princeton Chert, Saururaceae, *Saurarus*

PALAEOBOTANY IN A CHANGING WORLD: PLANT FOSSIL CONTRIBUTIONS TO SOCIETY AND POLICYMAKERS.

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Global society has never needed palaeobotany more. With the phenomenon of anthropogenic global warming now demonstrated as being "extremely likely" (>90% likely) by the IPCC and accepted by most governments, the debate is moving from establishing the reality of human-induced warming to management and mitigation measures. To date, however, the contribution of palaeobotany to the IPCC, and therefore policymakers, has been far smaller than is desirable both for the subject and for society at large. This is because the IPCC 4th Assessment Working Group 1 has paid scant attention to the past record of climate change over land, particularly in "deep time" (>1 mybp), and thus has ignored the significant climate model inadequacy for simulating past greenhouse conditions and the rate at which past change has taken place even in the absence of the current sustained human assault on the Earth System.

This is particularly concerning because, through palaeobotanical proxies and other geological evidence, the models can be shown to be most conservative in precisely those areas of the globe currently demonstrating the highest rates of warming and where warming is projected to continue most strongly in the future. Moreover these areas are those that are most critical to both the Earth System as a whole and society in particular. They are the polar regions, particularly the Arctic, with implications for rapid loss of ice sheets with concomitant rises in sea level, and in the continental interiors with impacts on agriculture, and in the case of such areas as the Amazon Basin, and the capacity of continental biomass to sequester atmospheric carbon. Overall evidence of past climate change, in part derived from palaeobotanical climate proxies, shows the IPCC document to be conservative and likely to underestimate the rate and magnitude of future change for any given emissions scenario.

Palaeobotanical climate proxies can be quantitatively precise and record annual and seasonal averages in atmospheric temperatures and precipitation as well as almost daily records of growing conditions. Collation of such data from the Jurassic, Cretaceous and Eocene demonstrates the inability of models to simultaneously reproduce past high latitude warming and continental equability. Despite over 30 years of climate model development this remains a paradox that we are still far from understanding. Fossil plant remains have the potential to yield data on atmospheric CO_2 concentrations and provide data crucial to quantifying the carbon cycle as a whole. This is particularly important because evidence is emerging that warming generates a positive feedback loop in the carbon cycle such that again the IPCC 4th assessment is likely to underestimate rises in future atmospheric CO_2 for any given emissions scenario.

Plant fossils also have crucial role in designing efficient ecosystems for atmospheric carbon sequestration, particularly at middle to high latitudes where warming will create new growth opportunities and where terrestrial carbon sequestration appears most effective. The structure, composition and dynamics of ancient polar forests offer blueprints for designing appropriate, managed, high latitude carbon capture systems; the opportunity and need for which will arise at rates that far outpace natural migrationary and evolutionary responses.

Keywords: IPCC, global warming, climate proxies, plant fossils, policy, designer ecosystems, carbon sequestering.

NEW EVIDENCE OF BRYOPHYTES FROM THE CAMBRIAN OF LAURENTIA

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Evidence from microfossil cryptospores and small organic fossils (mesofossils) indicates that land plants (embryophytes) evolved prior to the Middle Cambrian. The earliest records of land plants are small cryptospore tetrads recovered from the Rome Formation in eastern Tennessee, USA. These are complemented by an extensive suite of cryptospore tetrads, dyads, polyads and monads recovered from several Middle to Upper Cambrian sites from both the eastern and western margins of the ancient Laurentian continent. Cryptospore wall ultrastructure varies from homogeneous to laminated, matching that seen in Caradocian (Ordovician) tetrads derived from putative sporangia of liverwort affinity and modern *Riccia*. Clusters of Cambrian cryptospores associated with recalcitrant tissues point toward an embryophytic rather than algal derivation. Small pieces of pseudo-cellular cuticles, similar to that seen in some Silurian preparations, have now been isolated. Recently discovered mesofossils of Upper Cambrian age are composed of a plexus of intertwined organic filaments. The filaments possess oblique cross walls, supporting their interpretation as the resistant protonemata of bryophytic gametophytes. A fair and balanced assessment of these fossils now supports the presence of a persistent subaerial bryophytic flora during most of the Cambrian. These new discoveries support the recognition of a persistent protonematal phase in plant life cycles as an important step in the evolution of plant adaptation to the terrestrial environment.

MYCORRHIZATION OF FOSSIL AND LIVING PLANTS

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Plant-fungal interactions have been known for over a century and the implications of mycorrhizal associations to evolutionary theory and plant ecology are now well documented. The widespread mycorrhization together with the fossil record indicate that plants and fungi have evolved in mycorrhizal relationships since the colonization of land by early plants.
In living plants most mycorrhizal symbiosis are mutualistic associations in which fungus and plant exchange metabolites and nutrients required for their growth and survival. Mycorrhizal symbiosis are restricted to the gametophyte in bryophytes *sensu lato*, involve the gametophyte and the sporophyte in lycophytes and monilophytes (ferns *sensu lato*) whilst symbiotic fungi are present in the sporophyte in spermatophytes.
A new nomenclature is suggested to define two types of mycorrhizae :

- Paramycorrhizae for the colonization of thalli and shoot systems. This case is developed in the gametophyte or/and the sporophyte. The fungal associations are represented by mycothalli and mycorhizomes.
- Eumycorrhizae for the colonization of root systems. In this case, only the sporophyte is concerned.

The aim of this presentation is to discuss the mycorrhizal status in relation with the various clades of embryophytes by considering both fossil and living plants and to develop the implications of mycorrhizal symbiosis in the colonization of land by plants. Symbiotic fungi are known to have played a key role in the ecology of the earliest land plants, which, like modern mosses and liverworts, did not have true root systems. It is suggested that symbiotic fungi were given more suitable habitats when true roots evolved; roots formed eumycorrhizae with fungi and permitted fungi to colonize developed soils. Eumycorrhizae associated with structures such as seeds and later, flowers, could explain the success of spermatophytes in aerial environments.

Keywords : mycorrhizae, nomenclature, embryophytes, colonization of land

TREE GROWTH AT POLAR LATITUDES: PERMIAN AND TRIASSIC TREE RINGS FROM ANTARCTICA

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Tree rings in fossil gymnosperm wood from Late Permian and Middle Triassic sediments and from permineralized peat deposits in the Beardmore Glacier region of Antarctica provide evidence of tree growth at polar paleolatitudes. The Permian plants come from the Buckley Formation (Beacon Supergroup) and the Triassic fossils from the Fremouw Formation, both in the central Transantarctic Mountains. The sites were located at ~75–80° S and ~70–75° S paleolatitude during the Permian and Triassic, respectively. The environment for plant growth in Antarctica during these time periods has no modern analogue, as the trees were growing at higher latitudes than any extant woody plants, and during times of relative global warmth. Tree rings were analyzed in order to understand the paleoclimate and to model the way in which plants responded to a polar light regime, with 24 hours of light in the summer and complete darkness for part of the winter. Standard dendrochronology and wood anatomy techniques were used and it was found that these provided a more accurate description of wood and tree growth in these specimens than methods utilized in some previous fossil tree ring studies.

Permian specimens are all stem wood of *Glossopteris* (*Dadoxylon*) and range from 4.1–17.6 cm in diameter. The wood contains 15–115 or more rings per specimen (x = 47 rings) and ring widths ranged from 0.20–9.9 mm (x = 2.3 mm). Because of the high paleolatitude, each ring is equal to a single year's growth. The Permian wood can be classified as 'sensitive,' based on the calculation of mean sensitivity, which is a measure of the variability of ring width from year to year over the life of the tree. Each ring consists almost entirely of earlywood, with 36–234 earlywood cells per ring (x = 119) and only 1-5 cells of latewood. Francis et al. (1993) found similarly large numbers of cells per ring in Permian wood from the Allan Hills in southern Victoria Land, Antarctica. Triassic wood samples ranged from 2.1–36.0 cm in diameter with 14–136 (x = 65) rings per specimen; ring widths were 0.08–6.83 mm (x = 1.69 mm). Rings displayed the same structure as those from the Permian wood, with a large amount of earlywood (14–104 cells) and only 1–6 cells of latewood. Only half of the Triassic stems would be classified as sensitive. On average there were 45 cells per ring (14–104), less than in the Permian rings.

The Late Permian and Middle Triassic of Gondwana have been reconstructed with very different paleoclimates, based on geological data and physical climate models (e.g., Frakes et al., 1992). Floral diversity in the two Antarctic peat deposits is also very different (Taylor and Taylor, 1990). The Late Permian *Glossopteris* flora is of very low diversity, consisting almost entirely of glossopterid organs, while the Middle Triassic peat includes multiple groups of seed plants, diverse ferns, and equisetophytes. Yet, tree rings from both periods show the same structure. This ring structure reflects a long growing season, with adequate water and favorable temperatures, followed by a very rapid transition to seasonal dormancy. We suggest that the rapid end to the growing season was due to decreasing light levels and that these polar forests were limited, not by water and temperature as in modern boreal forests, but by light.

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Keywords/Mots-clé: tree rings, fossil wood, Antarctica, Permian, Triassic, wood anatomy, paleoclimate

NEW INSIGHTS INTO THE LATE PALEOZOIC MICROBIAL WORLD: COMPLEX MICROBIAL AND MICROBE/LAND PLANT ASSOCIATIONS

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Microorganisms (i.e. bacteria, cyanobacteria, microalgae, and fungi) were critical components of ancient ecosystems, and entered into a wide variety of associations and interactions with other organisms. Only recently, however, have these ancient associations and interactions received increased attention based the fossil record. The Early Devonian Rhynie chert represents one of a few direct sources of information about microbial diversity and interactions in late Paleozoic non-marine paleoecosystems. Although the Rhynie chert has been studied for more than 80 years, documenting the biodiversity and interrelationships between organisms in this ecosystem is still in progress. Here we report on microbial consortia and land plant/microbial interactions from the Rhynie chert that attained a relatively high level of complexity. Newly discovered filamentous-colonial cyanobacteria form aggregates and colonies, as well as microbial mats. Mats are not composed exclusively of cyanobacterial filaments, but also contain several types of fungi. We hypothesize that some of these fungi were biologically associated with the interior of microbial mats. Complex land plant/fungal interactions include three different endophytic fungi that co-occur in the rhizoids and prostrate axes of the land plant *Nothia aphylla*. One of these fungi is a parasite that produced spores in hypodermal cells; the second occurs in the form of large resting spores or zoosporangia in rhizoids and hypodermal cells. The third fungus is endomycorrhizal and produces vesicles and thick-walled spores in the intercellular system of the cortex. The various fossils indicate that some of the elaborate mechanisms causing host responses in extant plants were in place ~400 Ma ago. Cherts that are similarly rich in fossil land plant remains and microorganisms come from the Viséan (Lower Carboniferous) of Combres/Lay and Esnost in France. From these cherts, we report on a microfungal assemblage dominated by various types of chytrids associated within the wood of arborescent lycophytes. The Early Devonian Rhynie chert and the Viséan cherts from France provide a rare oportunity to compare both land plants and fungal endophytes in two non-marine paleoecosystems separated by approximately 80 million years.

PALEOENVIRONNEMENT ET PINEDES MEDITERRANEENNES DU SUD DU MASSIF CENTRAL (FRANCE) AU COURS DES DIX DERNIERS MILLENAIRES : FEUX, DONNEES ISOTOPIQUES, CONSEQUENCES ENVIRONNEMENTALES

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Keywords Charcoal . Fires . Pedoanthracology .Holocene . Mediterranean . Pine forest . Climatic change.

Les pinèdes méditerranéennes du sud du Massif central (Grands Causses et monts de St Guilhem) ont livré de très nombreux charbons de bois, aussi bien dans des sites archéologiques privilégiés mais surtout piégés dans les altérites dolomitiques et les sols superficiels de pelouses.

Ce nouveau matériel géo ou pédo anthracologique n'avait pas été recherché ni exploité à ce jour. Il permet de donner aujourd'hui un éclairage fondamentalement nouveau à l'histoire holocène méditerranéenne et de jeter des jalons pour des études de ce type dans des contextes de dépôts primaires parfaitement identifiés. En effet, la géomorphologie karstique de la région d'étude permet de maîtriser les flux de transport du matériel charbonneux à une aire géographique locale ou sub locale. D'autre part, les recherches montrent que les remplissages sédimentaires, au moins ceux qui ont été étudiés, ont fonctionné de manière hétérochrone, à des vitesses de sédimentation allant de 0,3 à 10 mm/an environ selon les sites. Dans deux cas parmi les plus favorables, un enregistrement sur la quasi-totalité de l'Holocène a même pu être établi.

Il résulte de ces recherches que la zone de moyenne montagne méditerranéenne calcaire que constituent les Grands Causses et les monts de St Guilhem, a joué un grand rôle dans la préservation des écosystèmes steppiques et pré steppiques à *Pinus sylvestris* jusqu'à la mi Holocène. La biodiversité des formations actuelle s'est développée entre 5000 et 3000 BP. Ceci permet mieux d'expliquer la présence d'espèces typiquement alpines et steppiques isolées dans la zone, aujourd'hui. A partir de la mi Holocène, les feux plus fréquents associés au pâturage ont contribué à créer certains paysages dénudés caractéristiques du Parc National des Cévennes. Dans les monts de St Guilhem, l'actuelle forêt de *Pinus nigra* ssp. *Salzmanni.* est dans sa structure actuelle d'origine récente. Elle s'est constituée dès le Moyen âge à partir de peuplements peu à peu anthropisés à partir d'un héritage sans doute fini glaciaire.

Plus de 50 datations C14 AMS viennent à l'appui de ces analyses ; elles ont été complétées par des mesures de C13 appuyées sur un matériel de référence, en vue de mesurer les variations climatiques, particulièrement la sécheresse. Les évènements de feux sont étroitement en rapport avec des périodes de sécheresse accrue au cours de l'Holocène moyen sauf pour la toute période récente où la corrélation n'est pas établie . Ces résultats confirment que la période de la mi –Holocène a bien été le témoin d'une sécheresse accentuée même s'il est difficile d'y voir un changement climatique majeur tel un passage d'un climat océanique à un climat méditerranéen.

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BASE DE DONNÉES ET EXPLORATION D'UNE COLLECTION « SCIENTIFIQUE » DE PALÉOBOTANIQUE.

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On mesure souvent l'importance d'une collection « scientifique » par sa taille c'est-à-dire le nombre de ses échantillons et de ses spécimens-types porte-nom (ou son nombre d'enregistrements ou de Mega octets pour la base de données). Le nombre de prêts, le nombre de publications référençant des objets de la collection et l'incrément régulier du nombre d'échantillons témoignent eux de l'activité scientifique de la communauté des chercheurs pour lesquels la collection est un outil de travail. Mais les potentialités d'une collection de recherche dépendent surtout de la précision de la documentation recueillie pour chaque échantillon sans laquelle toute utilisation scientifique peut devenir impossible. C'est la mise en valeur de l'information **dans toute sa complexité** qui nous a guidé pour l'informatisation de la collection de Paléobotanique de l'Université Pierre et Marie Curie (UPMC), et la conception d'une interrogation de type *exploration* de cette collection de recherche.
Héritière de la « collection Boureau », la collection de l'UPMC est un petit patrimoine scientifique de quelque 15000 échantillons renfermant environ 200 « échantillons types » et de très nombreux « spécimens figurés », fruit de l'activité de recherche des chercheurs et de leurs élèves.
L'informatisation d'une collection de recherche comme celle-ci ne se limite pas à faire autrement et plus rapidement les mêmes actions qu'avec les registres « papier ». Concevoir la base de données (BD) doit conduire à un nouveau regard bi- voire multilatéral, ici Paléobotanique / Informatique, sur la nature des données, et à en proposer de nouveaux modes d'exploration à des fins de recherche. En plus du résultat pratique de stockage et d'accès à la BD, l'informatisation devient en elle-même un apport conceptuel découlant des réflexions communes de modélisation. Le schéma conceptuel de la BD, nécessaire à son informatisation, est l'étape cruciale de la réalisation de toute base de données. Ici cette étape de modélisation **sémantique** a amené à structurer les informations autour de trois notions d'objets de collection : les échantillons tels que collectés sur le terrain, les spécimens « paléontologiques » c'est-à-dire les entités fossiles étudiées, et les objets dérivés (entités physiques stockées dans la collection après études). Des relations multiples unissent ces trois types d'objets. D'autre part les informations attachées à chacun de ces objets peuvent être incomplètes (données manquantes), imprécises (datation ou identification limitée à un rang taxinomique élevé) ou incertaines (doute entre plusieurs valeurs). Chacun de ces cas est pris en compte pour permettre des requêtes adaptées (retrouver par exemple les échantillons d'un étage stratigraphique sans oublier ceux « possibles » qui n'ont été datés qu'avec incertitude).
La BD « Paléobotanique » (encore très incomplète) de l'UPMC est à la fois accessible :
- par le portail international du GBIF (Système mondial d'information sur la biodiversité) selon une interface « classique » où les critères de recherche doivent être tapés dans un champ, le résultat (éventuel) étant affiché sous forme d'une liste de fiches « fermées » de description des objets recherchés ;
- et sur un site web qui lui est propre par une interface originale proposant d'explorer les données de la collection selon un mode de navigation « ouvert » ne privilégiant pas une forme d'interrogation. Dans cette vision exploratoire de la BD, la collection n'est pas considérée comme un stock inerte auquel on veut accéder mais comme un graphe d'informations scientifiques dont les liens qui sont apportés par les objets de la collection peuvent amener, eux-mêmes, à de nouvelles recherches.
Un des développements à attendre de ces recherches info / paléo-biologie est la mise au point de BD « commentées » permettant de conserver l'information sur les étapes du protocole d'étude ayant abouti aux conclusions scientifiques archivées.

PALYNOLOGICAL DATA OF UTRILLAS FORMATION IN THE IBERIAN RANGE (SPAIN)

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In this study we present palynostratigraphical data of two localities (Fuente del Vaso, Puerto de San Just) of the uppermost part of the Utrillas Formation (so called Transitional Marls) located in the Aragonian branch of the Iberian Range.

Utrillas Formation has been interpreted as a meandering fluvial environment evolving to lagoonal facies [1], dated as late Albian/early Cenomanian on the basis of the Lower Albian age of the underlaying formation (Escucha Fm) whilst its top is assigned to the Cenomanian [2].

The palynofloral assemblage includes the following angiosperms pollen grains : *Afropollis jardinus*, *Stellatopollis barghornii*, *Asteropollis* cf. *A. asteroides*, *Retitricolpites virgeus*, *Brenneripollis reticulatus*, *Clavatipollenites* sp., *Tricolpites* sp., *Gnetaceapollenites* sp., *Elaterosporites klaszii*, also conifers, cheirolepidiaceae (*Classopollis* spp.), araucariaceae (*Araucariacites australis*), Taxodiaceae, Pinaceae and pteridophyta such as matoniaceae, schizaeaceae (*Cicatricosisporites*, *Appendicisporites*, *Distaltriangulisporites* and *Klukisporites* type), *Patellasporites* sp., *Exesipollenites* sp., *Camarozonosporites insignis*, *Cycadopites* sp., *Eucommiidites* sp., gleicheniaceae, *Lophotriletes babsae*.

Other palynomorphs that occur in large numbers include the lacustrine freswater taxa such as *Crybelosporites* spp., *Aequitriradites spinulosus*, *Rouseisporites reticulatus*.

The palynological association also yield foraminiferal linings and dinoflagellates : *Oligosphaeridium* sp. indicating a marine influence.

The above palynofloral assemblage indicates an Albian age and it is the first datation of Utrillas Formation on the basis of fossil content.

Moreover, the transgressional sequence is reflected by the great percentage of angiosperms decreasing upwards in importance while the number and diversity of dinoflagellate cysts increase, always subject to freshwater influences.

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THE EARLY PERMIAN FLORA OF VALDEVIAR (SEVILLA PROVINCE, SW SPAIN): ITS COMPOSITION AND PALAEOGEOGRAPHIC SIGNIFICANCE

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The intramontane basin of Valdeviar, a local depression of Early Permian age, came into being after the constituent terranes of the Iberian Massif had been emplaced as a result of Pennsylvanian strike-slip movements of considerable magnitude. Its sedimentary history is closely linked to the vulcanicity which became widespread in the Permian of western and central Europe (from Stephanian C onwards). Red beds are common throughout the c. 300 m thick succession.

Valdeviar is the most southerly occurrence of Lower Permian strata in SW Europe. Its fossil flora, with a little over 40 taxa recognised, consists mainly of sphenopsids, ferns, pteridosperms, cordaites and lycopsids, with rare conifer foliage and only a single find of Autunia conferta among the thousands of specimens collected. The floral composition reflects mainly humid conditions and corresponds to ponded (lacustrine) areas in a basin which was at least 33 km long and only 6 km wide. Although lacustrine conditions were a recurrent theme in the basin history, there is evidence of the ephemeral nature of what must have been rather shallow ponding, and the common obliteration of lacustrine lamination by oxidation producing red beds. Recurrent rainfall reestablished ponded areas and produced flash flood breccias as well as mass flow deposits, several of which uprooted, disarticulated and transported woody trees from a nearby palaeotopography on one of the basin margins.

The floral composition is similar to that of Guadalcanal at c. 30 km distance, but no ginkgophytes have been found as recorded by Broutin from Guadalcanal. In both areas a predominantly humid flora is represented. Although similar in its humid elements, the floras from Guadalajara and Zaragoza provinces in north-central Spain, contain more common callipterid remains. This presumably means drier habitats and even more sporadic rainfall. The rainfall distribution in the palaeoequatorial belt is known to have changed near the end of Pennsylvanian times when glaciation was on the wane and everwet climatic conditions became restricted to certain areas (East Asia, Middle East, Central America) with floras of Cathaysian complexion. Although generally similar to Lower Permian floras in more northerly parts of western Europe, the floral composition of Valdeviar suggests marginally wetter conditions tending towards a transition to everwet floras of the Middle East.

THE JAMBI FLORA AND ITS GEOLOGICAL SETTING

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The age of the Jambi Flora (Sumatra, Indonesia) was initially thought to be Permo-Carboniferous on the basis of the palaeoflora association. It has now been established that the Jambi-Flora sediments and the associated volcaniclastics were deposited during the Asselian and Sakmarian Stages (early Permian) in an unstable continent-margin internal basin subject to volcanicity and to occasional marine incursions.
The plant deposits include large tree stumps, root systems, wood and foliage debris, sometimes associated with coal layers that were buried by sediments, volcanic ashes and mudflows.
Deposition occurred in the (lower) delta plain, and the sedimentary environment was fluviatile with point bars, mouth bars and small deltas. Intercalations of volcanic ashes and occasional mud-flow deposits indicate the proximity of volcanic centres. The analysis of depositional data indicates that the sediments were derived from a south-westerly direction. The fluviatile sediments are composed largely of recycled minerals of volcanic origin. The volcanic centres, which contributed to these sediments and volcaniclastics, included andesitic and dacitic compositions, but the volcanoes themselves have been long since eroded, and their very nature is uncertain. The West Sumatra Permian-Triassic continent-margin volcanic arc was emplaced during a regime of oblique subduction which caused volcanicity and transcurrent fault movements along the continent margin.

Poorly preserved plant deposits occur elsewhere, in the east of the Permian Bangko Basin, associated with coal layers. None have been found to be as extensive or as well preserved as in the fluviatile sediments and volcaniclastics on the western margin of the basin, as exposed along the Merangin and Mengkarang rivers and their tributaries, where xeromorphic and hydrophilic floral assemblages are observed. The hydrophilic assemblage is found in the lower delta-plain deposits. The xeromorphic assemblage is encountered in sediments with a higher energy level, and likely represent a more distal source.
The Permian basin sequence thickens to the east, and contains (abundant) debris derived from subsidiary volcanic centres. Fault movements within the basin may have initiated or contributed to the marine incursions and the deposition of marine limestones.

DIATOM PHYLOGENY AND CLASSIFICATION: FOSSILS, MOLECULES AND THE EXTINCTION OF EVIDENCE

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Diatom classification has remained undeveloped since the advent of the light microscope, little changing during the scanning electron microscope era (1960—2000). Molecular data has now offered a number of new perspectives on diatom phylogeny and classification, including the dismemberment of two major groups. That perspective lacks precise acknowledgement of the role fossils (as organisms) play in the elucidation of relationships. Much diatom systematics relies on the siliceous parts that are preserved in the fossils record. This presentation will outline current diatom classification and indicate precisely the role fossils will play in determining relationships.

LEAF LIPIDS OF PLIOCENE FAGUS LEAVES FROM THE UPPER VALDARNO BASIN, ITALY

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For a few decades, chemical investigations of fossil plants provided many information useful in several disciplines. Using a chemotaxonomical approach by comparing fossils with their extant counterparts and with other fossils can help in precising their taxonomic affinities. Moreover, the chemistry of fossil plants allow a better understanding of the origin and the fate of organic matter in sediments, and may also be used as paleoenvironmental proxies. Lipids are the most commonly used molecules in paleobiology. It is therefore crucial to assess the nature and extent of the changes in lipidic composition associated with diagenesis and fossilization. Furthermore, we still need additional data on the fossil plants chemical composition. Hence, this work aimed at determining the lipidic composition of fossil angiosperm leaves.

This study focuses on fossil leaves very similar to that of extant European beech (Fagus sylvatica L., Fagaceae). They were tentatively attributed to the species Fagus gussonii A. Massal. They were found in grey clays, in a deposit at the Santa Barbara section in the Upper Valdarno Basin (Italy). This deposit contains exceptionally diverse and well preserved leaves. Their black colour indicates that they are organic matter rich.
Studies shew that they deposited in a lacustrine environment three million years ago, during the Middle Fig. One specimen of the organic matter rich Pliocene. [1]

Lipids of the fossil leaves were extracted with organic solvents (dichloromethane and methanol) and were analysed by gas chromatography and mass spectrometry. The molecules identified consist in acyclic fatty lipids (mainly alkanes and alcohols) and polycyclic lipids (mainly triterpenoids, including steroids).

Series of long chain n-alkanes and n-alkanols were identified. They exhibit a marked predominance of respectively odd carbon-numbered homologues and even carbon-numbered homologues, indicating that theses molecules originate mainly from Embryophytes [2]. The distribution of the n-alkanes of the fossil beech shows a maximum at 29 carbons, whereas the extant European beech shows a maximum at 27 carbons. Hence, they may belong to different species. Some fatty aldehydes and fatty cetones were present in small amounts, as well as two fatty acids : hexadecanoic acid and octadecanoic acid. Two monoacylglycerols were also detected. These compounds are rather sensitive to degradation and their presence in fossils is exceptional. As a result, this shows that the excellent morphological preservation of the fossil leaves is associated with a good chemical preservation. In addition, two abundant long chain n-alkyl-diols were identified : triacontan-1,15-diol and dotriacontan-1,15-diol. They may come from Eustigmatophyceae microscopic algae [3]. Their relative abundances are consistent with a freshwater or restricted marine depositional environment [3]. The polycyclic lipids are still under study. They consist mainly in various triterpenoids, including steroids and hopanoids. Some of them include alcoholic forms, confirming a rather good chemical preservation of the fossils. The hopanoids are generally attributed to bacteria. The presence of n-alkyl-diols and hopanoids could be explained by a colonization of the leaves by micro-organisms before and after their burial in the sediments.

The chemical analysis of these fossil beech leaves helped in precising their taxonomy and depositional environment. Assessing the composition of plant fossils can thus contribute to a better understanding of their taxonomy and of the molecular phenomena associated with diagenesis and fossilization.

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THREE-ITEM ANALYSIS: REPRESENTATION OF MISSING AND NON-APPLICABLE DATA

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Question marks are currently used in character-taxon matrices of standard cladistic analyses to represent that a feature is missing, non-applicable or polymorphic. We focus here on the justification for distinguishing the representation of missing and non-applicable homology statements.

Non-applicable data, coded as question marks, are generated when multi-state characters are broken up into separate, binary characters. For instance, the representation and operational treatment of a character describing the red or blue colour of the tail for specimens lacking a tail has been widely discussed in cladistic literature. Similar, botanical cases obviously exist. Non-applicable characters, however, imply a well-supported knowledge of hierarchical dependence among character-states. In the previous example, if an organism lacks a tail, it is obvious that it is *neither red nor blue*.

Question marks representing missing data are strongly linked to palaeontology and the fragmentary nature of fossils. The influence of missing-data in phylogenetic analyses has been extensively discussed, mostly from and operational viewpoint, because question marks may tend to increase the number of most parsimonious trees found, lowering resolution in consensus trees. Missing-data should be treated as missing, because there is nothing to represent. There is no justification to exclude the occurrence of any possible character-state. In the above-cited example, the tail could be *absent* **or** *present* and *red or blue* in a specimen whose posterior axial region is not preserved.

The various meanings of question marks should lead to different treatments in parsimony programs. However, these programs do not manage to make such a semantic distinction: they apply the same treatment in order to minimise steps, no matter what the source of a question mark is. This problem is related to the way of representing homology statements. In taxon-character matrices, the hierarchical nature of homology assessments, including paralogous nodes, cannot be represented. We demonstrate that hierarchical representation of homology statements used in three-item analysis, as implemented in NELSON05 computer program, correctly represents and treats either missing or non-applicable data. As opposed to recent criticisms, we show that transformation of character-taxon matrices into three-taxon statement matrices do not generate missing-data.
Keywords: missing data, non-applicable data, question marks, cladistics, three-item analysis, hierarchical homology statements

RÉSUMÉS DES AFFICHES

ABSTRACTS OF THE POSTERS

THE AUTUNIAN FLORA OF THE MARTENET SITE (BLANZY – MONTCEAU LES MINES, BURGUNDY, FRANCE): DESCRIPTION, TAPHONOMIC STUDY AND PALAEOENVIRONMENTAL IMPLICATIONS

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Keywords: Autunian, Early Permian, Paleoenvironment, Taphonomy, *Walchia*

This work presents the first description of the autunian flora of the Martenet fossil site in the Blanzy – Montceau les Mines basin. The study was undertaken on the specimens catalogued at the paleobotanical collection of the Université Pierre et Marie Curie - Paris VI. They were collected 35 years ago near the shore of the Martenet pond, in a grass covered area with little rock exposure. This collection is important because these outcrops are not easily accessible nowadays, making the specimens from the paleobotany collection one of the few available for study.

The megaflora consists of well preserved organic compressions and imprints on fine laminated mudstone and siltstone. Description of the megaflora revealed a common « Autunian » flora of which 90% is dominated by voltziales (*Culmitzschia frondosa* and *Walchia piniformis* being the dominant species). Also present in the assemblage are conifer seeds and cones, frond fragments from seed ferns, and sphenopsids.

The taphonomical and sedimentological prospective has made it possible to evaluate the transportation and preservation of plant fragments and to have an idea of the palaeoenvironment surrounding the Martenet fossil site, even if no stratigraphic exposure was available for current study. Sedimentological facies, consisting of laminated mudstones and siltsones, some with coarser sandstone lamination, as well as surfaces with mud cracks, indicate a frequently immersed environment with fluctuating fluvial influence (playa lake).

Fragmentation is present on most plant remains, suggesting that a fair amount of transport has occured prior to final deposition at the fossil site. This is obvious when observing voltziales sterile shoots, where mechanical action separated second order ramifications from main ramifications, and with increasing mechanical stress and maceration, single leaves are also being separated from second order ramifications. All states of fragmentation are visible, as a particular degradation stages in one laminae, or sometime as multiple degradation stages in the same laminae. This implies the Martenet fossil site is the result of an accumulation of plant material sampled from a broad area, and transported with variable distance for each fragments. A constantly changing hydrodynamism in the playa lake is responsible for different lithologies as well as for the different fragmentation stages observed in each laminae.

Using a modern environment analogy suggesting that conifers are likely to grow some distance from constantly flooded soils imply the process begins with wind transport. Once plant particles are brought in the sedimentation cycle, wind transport can still take place, but the ratio of wind transport versus water transport is difficult to discern. As previously suggested, wind can also take a major role by controlling the amount of plant material incorporated in the sedimentation cycles by breaking off voltziales shoots and branches during period of high wind.

Palynological extraction from the matrix has produced only poorly preserved palynomorphs. Strong reducing conditions in the playa lake favored the precipitation of pyrite in the sediment which damaged the exine on all specimens. However, even if identification is difficult at the species level, it is possible to recognize the assemblage is dominated by monosaccate pollen grains. This is consistent with what is seen with the megaflora, as voltziales are the producers of this type of pollen grain. Comparisons with other « Autunian » flora from french Permian basins show the numerical abundance of each morphological group is very similar among sites presenting the same lithologies. However, the abundance of striated pollen grains is more important in facies dominated by fine sandstones, corresponding to stream environments. This suggests that either a taphonomical bias is preventing striated pollen to have access to the playa lake environment for fossilization, and/or that the plants producing striated pollen had a preference for open land continental conditions, and are growing further away from the playa lake. This show that palynological assemblage are displaying local ecological control and can be used, with some restrictions because of the possible broad dissemination of palynomorphs, for the local scale, for paleoenvironment reconstitution.

Comparisons done with previous palaeobotanical studies in other french Permian basins show that even if all assemblages are conifer dominated, the dominant species is not always the same. This suggests that within similar sedimentological context, environmental and/or palaeogeographical preferences can be observed within autunian conifers.

ENHANCING THE RECOGNITION OF THE PALYNOLOGICALLY DEFINED K/T BOUNDARY IN SOUTHWESTERN NORTH DAKOTA, USA: USING MULTIPROXY DATASETS FOR PALEOENVIRONMENTAL RECONSTRUCTION TO MINIMIZE EFFECTS OF TAPHONOMIC BIASES

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Keywords: Cretaceous/Tertiary boundary, Extinction, Fort Union Formation, Microvertebrates, Paleoenvironment, Palynology, Taphonomy

In the vicinity of the Cretaceous/Tertiary boundary in southwestern North Dakota, USA, a microscopic analysis of the rocks was undertaken to determine changes in local environments associated with the disappearance of Mesozoic faunas and floras and the arrival of Cenozoic forms.

A detailed study was carried out at four localities to compare trends between datasets. At one locality, V02017, a trench was excavated and twenty-six different lithologic units were identified. This stratigraphic section extends from the coal at the Hell Creek/Fort Union formational contact, which is an identifiable field datum used for the entire study area. A stratigraphically controlled collection was recovered in the basal twenty units (up to 286 cm above the formation contact) with a sampling precision of 5–10 cm. This collection includes microvertebrates, plant material, palynomorphs, and samples for heavy mineral analysis.

Mammal specimens identified from the Puercan 1 Land Mammal Age and Fort Union megafloras were identified and both placed into stratigraphic position as First Appearance Data (FAD), 133 cm above the basal coal. Microvertebrates retreived from 5405 kg of screenwashed matrix (through a 380 µm screen) revealed 5341 specimens, all of which either survived or appeared after the end Maastrictian extinction event.

Palynomorphs identified from previous studies at V02017 revealed the presence of Maastrichtian species (K-taxa) throughout the basal 365 cm of the Fort Union, suggesting the Cretaceous/Tertiary boundary should be placed above that level, which is above the FAD for the Paleocene mammal and megafloral components.

The Last Appearance Data (LAD) was plotted for all Maastrichtian microvertebrates collected from the surface and through screenwashing of nine additional sites within the uppermost 30 meters of the Hell Creek Formation in the study area. The microvertebrate remains along with the megafloral component were plotted relative to the coal and Paleocene components. The LAD for the Maastrichtian vertebrate component occurs at 114 cm below the base of the formation contact coal and the LAD for the Maastrichtian megafloral component is at 87 cm below this same datum, coincident with the onset of lacustrine environmental deposition.

Sediments within this transition zone indicate a palynofacies change from a terrestrial freshwater river environment to freshwater lacustrine mudstones. This occurs during the transition from the Hell Creek Formation to the Fort Union Formation, through the formation contact coal. This switch from terrestrial to aquatic is supported by freshwater algal cysts and pollen of aquatic plants becoming dominant, indicating a change in sedimentary processes limiting terrestrial deposition and accounting for the lack of terrestrial specimens within this interval. However, Cretaceous palynomorphs continue to be present as remnants from the previous environment.

Near the end of this transition zone, dinoflagellates become numerous and even dominate some assemblages, providing a first glimpse of a Maastrichtian dinoflagellate component mixed with reworked specimens of Albian age. These first appear as siltier deposition begins anew and corresponds to a change in paleocurrent direction. This event may be responsible for bringing in the dinoflagellates and also for ushering in the new fluvial environment occuring above the lacustrine mudstone.

Quantitative data show that even if the Cretaceous palynological component is present at +365 cm above the coal, the component percentage decreases to a negligable amount of 2.6% within the first 23 cm above the top of the coal, and to 0.3% at 28 cm above the coal. The low abundance of K-taxa above the basal coal of the Fort Union Formation suggests they are not indicative of Maastrichtian age, as when found in the Hell Creek Formation. Moreover, the Cretaceous palynomorphs found in the Fort Union Formation are often not as well preserved as the ones found in the Hell Creek Formation, which supports reworking of these specimens. If these taxa are no longer regarded as biostratigraphically indicative, the K/T Boundary must be crossed at the level where their relative abundance decreased 23 cm above the coal. Additional ongoing studies will determine if reworking is a major factor in the occurrence of K-taxa up section. However, the vertebrate collection from this site does not contain any taxa restricted only to the Cretaceous. At that time this finding does not support the hypothesis of reworking in this interval.

DETAILED PALAEONTOLOGIC AND TAPHONOMIC TECHNIQUES TO RECONSTRUCT THE EARLIEST PALEOCENE MACROFLORA: AN EXAMPLE FROM SOUTHWESTERN NORTH DAKOTA, USA

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Keywords: Cretaceous/Tertiary boundary, Fort Union Formation, Hell Creek Formation, Macroflora, Paleoenvironment, Palynology, Taphonomy

Abstract: Multiple stratigraphical sections in the basal Fort Union Formation were used to analyze environmental recovery following the terminal Cretaceous extinction event. At one of these sites (V02017), a well documented fossil record has made it possible to reconstruct the local environment using vertebrates, palynology and macrofloras. This report will focus only on the macroflora from this site, located just above the Cretaceous-Tertiary (K/T) Boundary, where the first appearance data for Paleocene floral recovery can be observed. The macroflora consist of leaf mats deposited in a near-stream paleoenvironment associated with short-term flood events. Detailed information was gathered by cutting a stratigraphic column from the Hell Creek/Fort Union formational contact up through the basal four meters of the Fort Union Formation. The stratigraphic column was made wide enough to expose a surface of at least one square meter and to a depth of a meter to get beyond the weathered sediments.

The lithology immediately above the formation contact coal consists of a 112 cm thick mudstone and silty mudstone representing lacustrine environments. Above the lacustrine deposits is a 21 cm thick siltstone and sandstone deposit where reworking is identified by the presence of both Maastrichtian and Albian marine dinoflagellates, acting as a transition zone between the lacustrine environment below and the terrestrial deposits above. The lithologic unit that contains the leaf mat analyzed in this study lies in a 15 cm thick silty mudstone superimposed upon this transitional zone which preserves the first terrestrial component following the K/T boundary, placed in the mudstone below by using a new palynological criteria determined by relative abundance.

A 0,5 m^2 surface by 35 cm thick block of matrix including the leaf mat was plaster-jacketed and taken to the museum laboratory in Bowman, N.D. for analysis under controlled conditions. Work consisted of removing sediments at a millimeter scale and recording placement and orientation of all fossil materials for three-dimentional drawings. The observations showed that the leaf mat consists of tightly stacked leaves preserved as carbon imprints, usually seperated by thin mud laminations. Using this technique, a description and census of more than 300 leaf specimens was possible. These specimens represent a low-diversity Fort Union flora composed exclusively of dicots not seen in the Hell Creek Formation. Major changes in taxa abundances correlated with different lithologies were revealed, three main zones can be identified:

1) From the base of the leaf mat, also corresponding at the base of lithological unit #9, the first 5 cm thick mudstone layer is composed of fragmented reeds, *Platanus raynoldsii* and *Cornophyllum newberryi* leaves and *Cercidiphyllum* seeds.

2) A 4 cm interval is present in the center of the leaf mat which consists of a siltier component at the top of lithologic unit #9. This zone is dominated by a leaf species previousely described in the Paleocene of the Denver Basin, but is reported here for the first time in the study area.

3) The top zone from the base of lithologic unit #10 is represented by a mudstone with a very dense mat of large *Platanus raynoldsi*. The leaf density gradually decreases as the lithology changes from mudstone to silt.

On a taphonomical perspective, most of the leaves shows signs of maceration, whereas few present cracks and fragmentation. This can be explained by a short residence time of the leaves on the open ground. Chances are that most of the leaves were rapidly transported by wind to be collected by slow moving water. They are deposited in areas of lowest hydrodynamism, represented by all three identified zones in the stratigraphic section. The assemblage described here represents a collection from a fairly broad area of the local floodplain dominated by streams.

Palynological analysis shows that lithologic units #9 and #10 contains a numerical abundance of 99.8% specimens known to cross the boundary, whereas the macroflora described here is composed of 100% new Paleocene forms. These findings suggest the plants composing this Fort Union macroflora are not the same as the ones that have produced the pollen found in lithologic units #9 and #10.

THÉMATIQUES LIÉES À LA DESCRIPTION ANATOMIQUE DU BOIS AU SEIN DE l'UMR 5143

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La Xylologie (science de la morphologie et de l'anatomie des bois) fait l'objet d'une activité de recherche scientifique soutenue au sein de l'UMR 5143. Elle consiste en la description du bois au niveau macroscopique, mais surtout microscopique par l'observation des types cellulaires constitutifs de ce « matériau » biologique. En plus de son intérêt scientifique, le bois est un matériau très utilisé dans nos sociétés et il a depuis longtemps une grande importance économique. Il constitue donc à la fois une source d'information pour l'expertise, l'écologie et la systématique et fait l'objet de recherches fondamentales et appliquées tout à fait complémentaires.
Dans le domaine de l'expertise, l'intérêt du bois porte essentiellement sur l'identification des taxons. Ainsi, lors de la rénovation d'une œuvre d'art est-il indispensable d'utiliser rigoureusement les mêmes essences de bois pour conserver la meilleure ressemblance avec l'objet original. D'autre part, certaines constructions doivent utiliser un bois possédant des propriétés physiques particulières : résistance à l'usure, dureté, couleur, etc. Enfin, pour réguler le commerce du bois les douaniers doivent pouvoir identifier les essences pour contrôler s'il n'existe pas de restrictions concernant l'exploitation d'un taxon donné.
L'archéobotanique utilise aussi le bois dont les identifications permettent d'étudier les activités humaines passées : on peut, par exemple, découvrir des taxons importés et / ou exportés et mettre en évidence les voies de leur commercialisation.
Grâce au bois, les arbres sont de véritables « livres d'histoire » permettant des études écologiques. Ils enregistrent les conditions du milieu dans lequel ils vivent (climat, attaques d'insectes, feux, chablis, coupes d'éclaircie en forêt). L'étude des corrélations entre particularités anatomiques et facteurs environnementaux sur les bois actuels permettent, par une (ou des) fonctions de transfert, de mieux comprendre les paléoenvironnements à partir de l'étude des bois fossiles. Il existe en effet de nombreux bois fossiles dont la préservation est de très bonne qualité, depuis l'apparition des plantes arborescentes « à cambium » dès le Dévonien.
Une fois la plante morte, le bois peut encore jouer un grand rôle dans les écosystèmes. L'un des rôles le plus original est la constitution d'écosystèmes marins sur un « biotope d'origine biologique » constitué par l'accumulation de bois coulés. Arbres entiers et branches de toutes dimensions peuvent être charriés par les fleuves jusqu'à l'océan. Dérivant au gré des courants, ils se gorgent progressivement d'eau et finissent par couler et se déposer sur le fond. On a découvert récemment que dans les grandes fosses abyssales une faune abondante et diversifiée, pouvant être proche de celles rencontrées autour des sources hydrothermales, des fluides froids et des carcasses de baleines, s'installe sur ces « bois coulés ». Ces communautés se rassemblent autour ou au sein même des débris ligneux pour s'en nourrir et / ou s'y réfugier. Les bois coulés restent encore, à l'heure actuelle, peu étudiés.
Dans le domaine de la systématique, l'étude du bois contribue à préciser et à accroître la connaissance de la phylogénie des plantes. Les structures anatomiques du bois se sont modifiées au cours des temps géologiques et permettent de proposer de nombreux caractères permettant des comparaisons multiples et aisées entre taxons actuels et fossiles. Le systématicien dispose maintenant de puissantes méthodes pour identifier les homologies et reconstruire l'histoire des plantes ligneuses.
Ces différentes problématiques sont abordées par l'équipe Paléodiversité, Systématique et Évolution des Embryophytes au sein de l'UMR 5143 afin de contribuer à une meilleure connaissance du bois.

Anatomie du bois, xylologie, expertise, écologie, phylogénie.

PROPOSITIONS FOR A CHARACTER-STATE-BASED PHYLOGENETIC NOMENCLATURE

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A procedure for defining taxon names upon a single character state is developed. It is centred on the designation of two specimens, belonging to two distinct species, exhibiting the same given character state, as type material, and referred to as ‘cladotypes’. A taxon name designates a monophyletic group until one of the following assumptions is falsified: (1) the character state typified by cladotypes is homologous in individuals that are designated as cladotypes, and (2) cohesion mechanisms isolated individuals exhibiting the type-character-state from those that do not. A taxon name defined by a character state that is found to be a combination of several character states is to be redefined upon the character state shared by its cladotypes. If several character states are available, the character state that makes the taxon the least inclusive taxon including the species to which belong the cladotypes is to be preferred. Taxon names designate obsolete phylogenetic hypotheses if the first assumption is falsified (such names are to be kept for this purpose, *i.e.* they are not to be recycled in another definition). Main cases of taxon names synonymy involve name definitions based on different pairs of cladotypes but referring to the same type-character-state, and name definitions based on the same character-state initially hypothesized as acquired by convergence in cladotypic species pairs, but later demonstrated as originating from a unique ancestor. Taxon names could be synonyms if a permanent splitting event did not segregate individuals exhibiting a new character state, qualified as type-character-state, from individuals already assigned to an earlier taxon. This procedure accommodates potentially any species concept, but is not tied to any; it is an extension of the composite species concept. Species are treated in a different way than other taxa: they are defined as individuals belonging to the same evolving (segments of) metapopulation lineages as a holotype specimen.

LES CARACTERES ANATOMIQUES DU BOIS : DE BONS MARQUEURS CLIMATIQUES ?

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Il est admis depuis longtemps, que le climat à un impact sur les caractéristiques anatomiques du bois. Ainsi, certains défauts du bois, la lunure, la gélivure, la roulure surviennent après des hivers très froids. En outre, il n'est pas rare de voir sur un même bois, deux cernes consécutifs de tailles très variable. Il existe donc pour l'arbre des "bonnes années" lors desquelles la production de bois est importante et des "mauvaises années", lors desquelles, au contraire, cette production chute. Ce sont en général, ces caractères liés à la productivité qui sont pris en compte dans les études bois/climat.

La fonction principale du bois est la conduction de la sève brute. L'eau est un facteur limitant dans de nombreux milieux (milieux froids et sec), et un manque d'eau peut conduire à des embolies gazeuses du système hydraulique de l'arbre. Ce travail est une synthèse bibliographique présentant les adaptations anatomiques du bois, liés aux caractères des vaisseaux (disposition, taille, type de perforation, type de ponctuation, présence d'épaississements spiralés) et des fibres (types), à des contraintes climatiques menaçant l'efficacité hydraulique de l'arbre.

Aux vues des résultats obtenus, il apparaît judicieux de considérer le bois comme un excellent marqueur climatique. L'utilisation de bois fossiles pour la reconstruction des paléoclimats, comme cela est fait depuis longtemps, est pour les mêmes raisons très pertinente. Des études sont en cours afin d'affiner ces résultats, dans le but de trouver marqueurs climatiques intra et interspécifiques.

Mots clés : Marqueurs climatiques, conduction, embolisme, xylem, caractères anatomiques du bois, vaisseau

WOOD ANATOMICAL CHARACTERS: ARE THEY GOOD CLIMATIC MARKERS?

Since a long time, it has been admitted that climate has an effect on wood anatomical characteristics. Some wood blemishes happen after a very cold winter. What is more, it is not rare to see on a wood sample, two consecutives tree-rings with very different sizes. It then exists, for one tree, "good years", during which wood production is very important and "bad years" in which, on the contrary, this production drop. These characteristics regarding wood production are usually used in studies dealing with wood and climate.

The main function of wood is sap conduction. Water is a limiting factor in several habitats (cold and dry areas), and a lack of water can lead to a gaseous embolism of the hydraulic system of the tree. This work is a bibliographic summary, which presents wood anatomical adaptation of characters related to vessels (arrangement, size, perforation type, appearance of spiral thickening) and to fibres (types) to climatic constraints threatening the tree hydraulic efficiency.

Looking at the obtained results, it is judicious to consider wood as an excellent climatic marker. The use of fossil wood in the reconstruction of palaeoclimate, as it has been done since a long time, is for the same reasons very relevant. Studies are now being conducted in order to refine these results and to find new climatic intra and inter-specific markers.

Key words: Climatic markers, conduction, embolism, xylem, wood anatomical character, vessel,

LATE PERMIAN PLANT ASSEMBLAGES IN THE SE IBERIAN RANGES, SPAIN: BIODIVERSITY AND PALAEOGEOGRAPHICAL SIGNIFICANCE.

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The end-Permian extinction is the largest of all time. An estimated 57% of all the families and 95% of all species of marine animals became extinct. Different recent researches suggest a relatively sudden, possible catastrophic event, perhaps of 50,000 years duration or less.

Plant extinctions elsewhere in the world were less striking, but nevertheless more notable than earlier or later in the Permian and Triassic. The regional and diachronous character was an important factor of this extinction. A replacement of palaeophytic with mesophytic floras (Knoll, 1984) was considered for this interval, and although a prolonged nature is thought for this changeover, the palynostratigraphic record has long hinted at more dramatic changes.

The Upper Permian sedimentary succession in the Iberian Ranges, SE of Spain, shows a very interesting plant and palynostratigraphic record. This succession is represented in this area by the Boniches and the Alcotas Formations, from base to top, respectively. The present study is focused on the paleogeographical significance of the flora and microflora record of the Alcotas Formation.

The Alcotas Formation, lying conformably on the Boniches Formation, is unconformably overlain by the Valdemeca or Cañizar Formations, both of probably early Anisian age (Bourquin et al., 2007). It consists of siltstones and sandstones with minor presence of conglomerate lenses. Its thickness ranges from 82 to 180 m. Its age is well compelled through several Thuringian (Upper Permian) pollen and spore assemblages, and has been recently (López-Gómez et al., 2005) constrained to the upper Tatarian/lower Lopingian (zone 29 of Gorsky et al., 2003). This unit is subdivided in three parts. The lower part is interpreted as the evolution of sandy and gravely braided fluvial systems with huge floodplains where carbonates paleosoils were developed. The middle part represents an abrupt change to meandering fluvial systems and, in the upper part, a new change to a sandy braided fluvial systems evolution is developed.

Five successive plant assemblages have been recovered from the lower and middle part of the Alcotas Fm. The oldest assemblage comprise impressions of leafy shoots and caules of gymnosperms. The poor preservation of megaremains hinder their classification.

A significant increase in diversity and population density is evident in the following and younger association, which shows reproductive structures and remains of leaves, trunks and indeterminate caules of sphenopsids, cordaitales and conifers. An almost lack of plant and trunk remains fossils is the main characteristics of the upper part of the Alcotas Fm.

Next assemblage is dominated by conifers. The specimens collected mainly corresponds to silicified trunk fragments highly carbonized. Finally the youngest assemblage shows a slight increase in diversity again being equisetales accompanied by remains of trunks and cones of conifers.

The occurrence of these fossil floras is significant due to the paucity of fossil record of megafloras of identical or similar geological age. This latter fact have difficulted in a great extent the knowledge on development of flora and vegetation in the Upper Permian of Europe.

The evolution in biodiversity of the megafloras fits well, in some extent, with that described on the basis of palynological assemblages (Dieguez and Barrón, 2005) in the same area and allows us to infer paleovegetational and paleoecological changes for a time interval close to the end Guadalupian biotic crisis.

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NELSON05, A THREE-ITEM ANALYSIS COMPUTER PROGRAM FOR SYSTEMATICS, BIOGEOGRAPHY, AND PALAEONTOLOGY

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We present Nelson05, a new computer program for three-item analysis (3ia). 3ia is a cladistic method of classification of taxa, for phylogeny, and of endemic areas, for historical biogeography. Nelson05 is a cladistic analysis program that does not use the principle of parsimony.
Nelson05 is a modular program. The modules are accessed via a command line window or via a graphic user interface. The modules that compose the program are written in C language, whereas the interface is developed in python. Nelson05 runs on Windows and Linux platforms.
Nelson05 uses a hierarchical coding of the hypotheses of homology. Characters are entered as an enriched matrix *sensu* Cao *et al.*, or using the interface to directly draw a rooted tree or a hierarchy. The program decomposes the characters into a series of three-item statements (3is) and computes the fractional weighting for each of them. The optimal trees are searched in order to maximize the subset of 3is compatible with the general cladogram, taking into account their fractional weights. Nelson05 is original because it implements the principle of compatibility in a new way: measuring the compatibility of 3is.
If more than one optimal tree is found, Nelson05 computes a tree that resumes the information common to all these equally optimal trees, called the *intersection tree*. The intersection tree is a new method of building a summary tree that keeps what is common to the optimal trees, and only what is common, that takes into account the information present in the characters and that provides an unambiguous interpretation of the results. The intersection tree is not equivalent to a consensus tree.
Nelson05 is the first 3ia program to compute the status of the hypotheses of primary homology, as secondary homologies, and associates them to a node of the cladogram or the intersection tree, or as homoplasies, which are also plotted into the cladogram as additional information.
Nelson05 can also manage biogeographic hypotheses. The biogeographer must enter the source cladograms of taxa, define the endemic areas and associate terminal taxa from the cladograms to the defined endemic areas. Nelson05 is the first program to implement both the transparent method, i.e. the solution to MASTs (Multiple Areas in a Single Terminal), and paralogy-free sub-tree analysis. Nelson05 extracts the hierarchical information from the non-hierarchical, tree-like, structures generates in the first stages of area cladistics. Nelson05 thus, implements the Assumption 2 of Nelson and Platnick.
Nelson05 implements the computation of the Hirarchical Fit index (HiFi) of Zaragüeta *et al.* The HiFi measures the adjustment of a phylogenetic hypothesis to stratigraphy, following the hierarchical representation of time of Zaragüeta *et al.* Nelson05 detects temporal paralogy instances and measures the adjustment for orthologous nodes only.

Keywords: biodiversity informatics, systematics, cladistics, three-item analysis, area cladistics, biogeography.

PROLEGOMENES A LA REVISION DES FLORES FOLIAIRES DU CRETACE DE LA POLOGNE

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Plusieurs flores crétacées (principalement néocrétacées) ont été décrites du territoire de la Pologne ; toutefois, pour la majorité de ces travaux il s'agit soit de descriptions datant de la première période de la paléobotanique, soit de contributions provisoires. On n'a jamais réalisé de synthèse ; les macroflores sont absentes du volume consacré au Crétacé de l'ouvrage standard *Géologie de la Pologne*. L'auteur se propose donc de réviser ces flores foliaires.

Les flores néocrétacées sont connues avant tout dans deux régions : le Roztocze (Plateau de Lublin, Pologne orientale) et la Basse-Silésie (y compris les Monts de Sudètes). Selon Kohlman-Adamska (1975), la flore du Roztocze (la collection se trouve au Musée de la Terre de l'Académie polonaise des Sciences à Varsovie) se compose de dix-neuf taxa, dont dix angiospermes (ex. *Dryophyllum*, *Dewalquea*, *Eulirion*) et neuf gymnospermes (ex. *Geinitzia*, *Cunninghamia*). La flore silésienne (la collection se trouve au Musée Géologique de l'Université de Wroc_aw) inclut, entre autres, les angiospermes *Credneria*, *Flabellaria* et *Dewalquea* (Goeppert, 1842). Quelques spécimens proviennent également de la bordure secondaire des Monts Sainte-Croix et de la vallée moyenne de la Vistule (deux régions de la Pologne centrale).

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Mots-clés : gymnospermes, angiospermes, macroflores foliaires, taxonomie, Crétacé.

PROLEGOMENA TO A REVISION OF CRETACEOUS LEAF FLORAS FROM POLAND

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Several Cretaceous (mainly Upper Cretaceous) floras have been described from Poland. However, the majority of these reports either belongs to the first period of palaeobotany or to provisional contributions. No synthesis has ever been realised; macrofloras are absent from the Cretaceous volume of the standard work *Geology of Poland*. A revision of these leaf floras is therefore being attempted by the present author.

Upper Cretaceous floras are mainly known from two regions: Roztocze (Lublin Upland, eastern Poland) and Lower Silesia (including the Sudeten Mts.). According to Kohlman-Adamska (1975), the Roztocze flora (collection housed in the Museum of the Earth, Polish Academy of Sciences, Warsaw) consists of nineteen taxa, ten angiosperms (e.g., *Dryophyllum*, *Dewalquea*, *Eulirion*) and nine gymnosperms (e.g., *Geinitzia*, *Cunninghamia*). The Silesian flora (collection housed in the Geological Museum of Wroc_aw University) includes (among others) angiosperms *Credneria*, *Flabellaria*, and *Dewalquea* (Goeppert, 1842). Additional rare specimens have been found in the Mesozoic border of the Holy Cross Mts. and in the middle part of the Vistula valley (both central Poland).

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Kohlman-Adamska, A., 1975. From the paleobotanical collections of Muzeum Ziemi PAN. *Pr. Muz. Ziemi*, **24**: 163–167, pls 1–2. Warszawa.

Keywords: gymnosperms, angiosperms, leaf macroflora, taxonomy, Cretaceous.

TIMING OF DIVERSIFICATION AND EPIPHYTISM EVOLUTION IN THE FILMY FERN FAMILY (HYMENOPHYLLACEAE)

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The Hymenophyllaceae, or filmy ferns, are a family of leptosporangiate ferns well characterized by distinctive marginal sori consisting of a sporangium-bearing receptacle protected by an indusium, and extremely thin leaves (usually a single cell thick). With ca. 600 species, they are the largest family among basal fern families, but also the most diverse in terms of morphology and ecology. The Hymenophyllaceae were traditionally divided in two genera: *Hymenophyllum* and *Trichomanes*. Although equally rich in species number, these genera are quite different in terms of ecological and morphological diversity. In *Trichomanes,* 40 % of the species are terrestrial, 45 % epiphytic, and the remaining species are hemi-epiphytic or lianescent, this latter being a quite rare habitat in ferns. Furthermore, different morphotypes are associated to these habitats (Dubuisson et al., 2003). Contrastingly, *Hymenophyllum* is exclusively epiphytic and the species share a similar morphology. Another difference between the two genera is the striking difference in the rate of molecular evolution, as showed by Schuettpelz and Pryer (2006) for *rbcL*. Further analyses showed that *Hymenophyllum* was experiencing a significant rate deceleration compared to *Trichomanes* and other fern lineages. However, this deceleration could not be explained by any of the factors known to influence evolutionary rates.

With a view to improving our knowledge of filmy ferns evolutionary history, we carried out a detailed ecological study of the family, taking time into account. To this end, we estimated divergence times in the family through analyses of two data sets: 1) a two-gene (*rbcL, rps4*) data set including 50 Hymenophyllaceae and 58 outgroups; 2) a taxonomically expanded single-gene (*rbcL*) data set including 146 Hymenophyllaceae and 58 outgroups. We then reconstructed the evolution of selected morphological characters and of the various habitats in the family and dated their occurrence using the newly acquired divergence time estimates. We show that although initial divergence within the Hymenophyllaceae is estimated at the end of the Triassic, initial divergence within *Hymenophyllum* occurred only during the Cretaceous, while initial divergence within *Trichomanes* is estimated in the middle Jurassic. Colonial epiphytism is showed to be a derived habitat in the family and to have independently appeared in the Hymenophyllaceae at least four times during the Cretaceous. Therefore, as in other groups of seed-free plants, the Hymenophyllaceae seem to have diversified as epiphytes when angiosperms forests were already well established.

Keywords: Hymenophyllaceae, divergence times, epiphytism, ecology

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APPROCHE PALEOBOTANIQUE DE L'EVOLUTION ET DE LA BIOGEOGRAPHIE DES MENISPERMACEAE

PALAEOBOTANIC APPRAOCH OF THE EVOLUTION AND BIOGEOGRAPHY OF THE MENISPERMACEAE

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La famille des Menispermaceae, faisant partie des Ranunculales (Eudicotylédones basales), regroupe plus de 500 espèces actuelles. Elle est majoritairement composée de lianes, et se répartit aujourd'hui dans l'ensemble des zones tropicales et subtropicales des Amériques, de l'Asie et de l'Afrique. Ces endocarpes présentent souvent une forme très reconnaissable et sont assez facilement identifiés dans les registres fossiles. De nombreux fossiles de feuilles sont aussi mentionnés, mais leur identification souvent ancienne demande d'être révisée. Dès le paléocène, et surtout à l'Eocène, cette famille est très présente en Europe (London Clay, Bassin parisien, Messel) et en Amérique du Nord (Clarno Beds), sous forme d'endocarpes ou de moulages d'endocarpe. Les espèces de cette époque montre déjà une importante diversification morphologique, rendant compte de la diversité actuelle de la famille. Quelques rares occurrences feraient même remonter cette famille d'Angiospermes au Crétacé.

Les fossiles postérieurs à l'Eocène sont plus rares, même si quelques gisements (comme *Rusinga* au Kenya, datant du Miocène) sont assez riches.

L'expansion maximale des Menispermaceae à la limite Paléocène/Eocène correspond vraisemblablement à l'optimum thermique et à l'expansion des flores tropicales et subtropicales. La richesse relative de l'Eocène en Menispermaceae serait donc une conséquence d'un échantillonnage plus intense en Europe et en Amérique du Nord.

The Menispermaceae family, part of the Ranunculales (basal Eudicots), groups more than 500 extant species. Climbers represent the majority of this family, now distributed in all the tropical and subtropical regions of Americas, Asia and Africa. Its endocarps often show a characteristic shape, easily identified in the fossil floras. Numerous leave fossils are also mentioned in the literature, but their often ancient identification needs revision.

As soon as the Palaeocene, and particularly during the Eocene, this family is present in Europe (London Clay, Paris Basin, Messel) and in North America (Clarno Beds), as either endocarps or endocarp locule-cast. The species of this age already shows an important morphological diversification, corresponding to the extant diversity of the family. A few scarce specimens from the Cretaceous could be part of this Angiosperm family.

Fossils after the Eocene are more scarce, even if a few outcrops (like Rusinga in Kenya, dating of Miocene), are relatively rich.

The maximal expansion of Menispermaceae, during the Palaeocene/Eocene limit, corresponds probably to the thermal optimum and to the maximal expansion of tropical and subtropical floras. The relative richness of Eocene in Menispermaceae could be a consequence of a more intense sampling in Europe and North America.

SYSTEMATICS OF DOMBEYOIDEAE BEILSCHM. (MALVACEAE) IN THE MASCARENE ARCHIPELAGO (INDIAN OCEAN) INFERRED FROM MORPHOLOGY AND NEW INSIGHTS ON THE EVOLUTION OF BREEDING SYSTEMS.

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The Mascarene Archipelago is characterized by an exceptional fauna and flora, especially because of its high rate of endemism. Among the Angiosperms, the Dombeyoideae Beilschm. is one of the most diversified group with 22 species, among which 21 are endemic - including three endemic genera - and 1 is indigenous. This first study deals with the evolutionary relationships between the Dombeyoideae using morphology.

The morphological matrix included 32 representative species and 40 characters. These data were analyzed with the Three-item Analysis (3ia). The Dombeyoideae from Mascarene Archipelago are paraphyletic and distributed into 8 clades.

The provided phylogeny is then used for inferring evolution of important functional features such as breeding systems. This genus is indeed described as hermaphroditic in Madagascar, whereas in the Mascarenes, all the endemic species are described as dioecious. The paraphyly of the Mascarenian Dombeyoideae clearly suggests that in the Mascarene archipelago, the dioecy might have been acquired several times in independent clades. This independent acquisition could be an evolutionary convergence and could illustrate responses under insular constraints.

LES EAUX OCEANIQUES DE SURFACE DE L'HEMISPHERE SUD POUVAIENT-ELLES ETRE PLUS CHAUDES QUE CELLES DE L'HEMISPHERE NORD SOUS CLIMAT A EFFET DE SERRE ?

LES PROVINCES BIOGEOGRAPHIQUES DES KYSTES DE DINOFLAGELLES DE L'ALBIEN TERMINAL UTILISEES COMME PROXY

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Mots clés : Dinoflagellés, Crétacé, Albien, climat, biogéographie, paléocéanographie

Sous climat interglaciaire, les eaux océaniques de surface de l'hémisphère sud sont plus froides que celle de l'hémisphère nord. Le front polaire qui correspond de nos jours à l'isotherme 3° C se place à 65°N et 55°S. Les kystes des dinoflagellés planctoniques des eaux chaudes ont une répartition vers les hautes latitudes plus importante dans l'hémisphère nord (60-70°N) que dans l'hémisphère sud (45-55°S). En raison des glaces polaires et des hautes pressions atmosphériques qu'elles induisent, le système des vents qui entraine les gires océaniques est stable et les convergences subtropicales où se mélangent les masses d'eaux froides et chaudes et leurs espèces sont placées symétriquement à 40-45°N et 40-45°S.

Sous climat à effet de serre, la disparition des calottes glaciaires entrainerait une déstabilisation du système des vents et les gires océaniques seraient remplacées par des tourbillons d'échelle moyenne (Hay et al. 2005). Cette structure océanique expliquerait les évènements anoxiques ainsi que les discrètes provinces biogéographiques de certains groupes du plancton marin.

Afin de vérifier si les dinoflagellés en matière organique ont le même comportement, une synthèse paléogéographique des données de 50 ans de littérature a été entreprise pour la période de l'Albien terminal. Les dinokystes, dégagés des sédiments de 150 coupes et forages profonds ODP et DSDP, et étudiés dans les 67 publications analysées se répartissent entre 10° et 80° de latitude sur les deux hémisphères. Les données intégrées dans une base ont été gérées par le système d'information géographique « ArcGis ESRI software ». La présence des 35 espèces sélectionnées a été reportée sur un fond de carte qui figure la position des océans et des continents à 100 Ma.

La répartition géographique des espèces délimite 4 provinces dans l'hémisphère nord et trois dans l'hémisphère sud. Du Nord au Sud les provinces latitudinales ci nommées sont reconnues: la province arctique à *Wigginsiella*, dont la limite sud se place à 60°N, la province tempérée à *Natans* et *Vesperopsis* entre 60°N et 40/45°N, la province téthysienne subtropicale à *Campanulata*, 40/45°N-25/30°N, la province intertropicale à *Chleuh*, 30/25°N-40°S, la province subtropicale à *Campanulata,* 40S°-70°S, et la province tempérée à *Natans* au Sud de 50°S. Les espèces bipolaires inféodées aux eaux chaudes se cantonnaient au Sud de 45° dans l'hémisphère nord et atteignaient 70° dans l'hémisphère sud. La zone de convergence où se mélangeaient les espèces des masses d'eaux chaudes et froides s'étendaient sur 5°de latitude (40-45°N) dans l'hémisphère nord et sur 20° (50-70°S) dans l'hémisphère sud. A l'Albien terminal, cette zone de mélange se situait dans l'hémisphère nord à la même latitude que de nos jours et était déplacée de 20° vers le pole sud dans l'hémisphère sud.

La conquête des hautes latitudes de l'hémisphère sud par les espèces albiennes contraintes aux masses d'eaux chaudes révèle que la température des eaux océaniques de surface était plus chaude dans l'hémisphère sud que dans l'hémisphère nord. La stabilité apparente de la zone de mélange dans l'hémisphère nord peut s'expliquer par la position latitudinale des masses continentales qui freinaient les échanges entre l'océan Téthys et l'océan Arctique. Par contre dans l'hémisphère sud, la position longitudinale des masses continentales gênaient moins la progression des masses d'eaux subtropicales. L'étendu sur 20° de latitude de la zone de mélange de l'hémisphère sud indique que les directions des courants tropicaux et circum antarctiques étaient instables. Cette observation renforcerait l'hypothèse d'une circulation océanique tourbillonnaire (Hay et al., 2005).

En conclusion, le concept d'un climat à effet de serre uniforme est à réviser en raison d'un gradient de température plus marqué dans l'hémisphère nord que dans l'hémisphère sud et de l'instabilité du système des courants initiés par celui des vents, déstabilisés vraisemblablement par l'absence des calottes glaciaires.

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LES LIPIDES DES PLANTES FOSSILES DANS LEURS RAPPORTS AVEC LES PLANTES ACTUELLES

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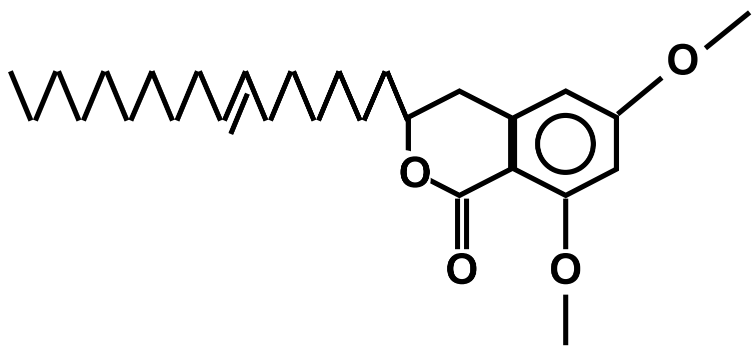
Des analyses comparatives des lipides de plantes fossiles cénomaniennes et de leur plus proche parent actuel ont été entreprises dans le but de tester l'intérêt taxinomique des lipides en paléobotanique. La comparaison des lipides d'une Ginkgoacée fossile, *Eretmophyllum andegavense*, avec ceux de son plus proche parent actuel, *Ginkgo biloba*, a révélé la présence chez ces deux plantes, de molécules originales, les diméthoxyalkylcoumarines (Figure), qui ont confirmé, sur des bases chimiques, la parenté de ces deux plantes. Des différences de distribution des *n*-alcanes des Ginkgoacées fossiles *E. andegavense* et *E. obtusum* ont par ailleurs confirmé que ces deux Ginkgoacées, pourtant très proches morphologiquement n'appartenaient pas à la même espèce. Par ailleurs, l'analyse des lipides d'une Cheirolepidiacée fossile, *Frenelopsis alata*, en parallèle avec ceux de son plus proche parent actuel, la Cupressacée *Tetraclinis articulata*, a révélé quelques similitudes dans la composition de ces deux plantes pourtant assez éloignées, notamment la présence de terpénoïdes abondants et variés. Enfin l'analyse comparative d'échantillons sains de *F. alata* et d'autres envahis par des champignons fossiles, a montré que ces micro-organismes pouvaient avoir une influence importante sur la composition des macrorestes végétaux. En conclusion, si ils ne suffisent pas à eux seuls pour déterminer le genre ou l'espèce à laquelle appartient une plante fossile donnée, les lipides peuvent permettre de préciser la taxinomie de certains spécimens qui ont déjà été étudiés d'un point de vue paléobotanique.



TAXONOMIC IDENTIFICATION OF NATURAL SUNKEN WOOD SAMPLES

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Sunken woods are debris that comes from terrestrial woody plants. They are abundant in deep oceanic environments and have been known for a long time; they house a huge faunal diversity. In the 1960's, studies on that substrate firstly focused on the associated organisms, but since a few years, botanical identification of wood is a further aim. The purpose is to appreciate its preservation state, diversity, geographical origin, immersion and degradation processes and to identify specific associations between colonizing organisms and substrate.
First determinations were made on natural sunken woods from Taiwan/Philippines, Vanuatu archipelago and Mediterranean Sea: these samples were identified based on histological studies. Different methods were used, depending on the preservation state of wood samples. Detailed descriptions were made and microphotographs of the cell types were taken, using the three classical sections (cross, tangential and radial). Botanical features were compared first to the native flora of the closer islands, then also to the introduced species.
Most of the wood samples were well preserved. Thus, the identification was possible; we encountered a large diversity of species, seemingly originating from local floras. *In situ* experiments on known wood species will give us a likely answer to the evaluation of degradation and colonization degree, as various woods were placed at the same depth, in the same conditions and for the same duration (20 months) near the New-Caledonia.

Keywords : sunken wood, deep sea, taxonomic identification

CONTRIBUTIONS TO THE PALAEOENVIRONMENTAL KNOWLEDGE OF THE ESCUCHA FORMATION IN THE LOWER CRETACEOUS OLIETE SUB-BASIN, TERUEL, SPAIN

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The Aptian-Albian interval is characterized by very notable palaeoenvironmental conditions and is generally considered as a key period in the evolution of modern ecosystem and, particularly, the establishment of a modern vegetation integrated by Angiosperms. Only few palynological investigations have been conducted on Spanish material corresponding to this period and the present study represents a preliminary attempt to reconstruct the palaeovegetation at this time in a well defined lithostratigraphical context. The study area is situated in the link zone between the Iberian and the Costero-Catalana Ranges (Spain). The studied material proceed of the Escucha Formation, located in the Oliete sub-basin (Teruel Province). This sub-basin was controlled by striking basement faults defining several blocks with different subsiding patterns activated by listric faults. Four detailed sections (with an accumulated thickness of more than 260 m) have been studied in order to establish the necessary stratigraphical framework to perform the palynological study.

The most relevant palynomorphs from the Oliete sub-basin succession are pollen grains attributed to the Taxodiaceae/Cupressaceae (*Inaperturopollenites dubius*), Araucariaceae (*Araucariacites*) and the extinct conifer family Cheirolepidiaceae (*Classopollis* spp.). The most significant contribution of vascular cryptogams to the palynological associations observed in Oliete is brought out by psilate trilete spores of the genus *Deltoidospora* (Cyatheaceae/Dicksoniaceae), and schizaeaceous taeniate spores of the genus *Cicatricosisporites*. The pollen of primitive angiosperms are also well-represented by monosulcate grains related to the genera *Clavatipollenites* and *Stellatopollis* sp. as well as to the group *Retimonocolpites*/*Brenneripollis*. A very scarce number of more complex forms including tricolpate grains have been observed from the highest levels. The quantitative analysis performed upon the supplied palynological data supports the hypothesis of palaeoenvironments controlled by non-uniform conditions during this period. The lowermost studied level of the succession presented chorate and proximate dinoflagellate cysts which indicate marine influence for the lower part of the succession.

NEW QUESTIONS RAISED BY THE STUDIES OF ANCIENT WOODEN MADE OBJECTS: THE WRITING-TABLETS EXAMPLE

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The systematic typological and traceological (observation of tools traces) analysis already made on the ancient wooden objects can be supplemented by anatomical identifications of wood. Indeed, each species belongs to a tree which grows in a characteristic geographical and ecological area. This data must be associated with other paleoenvironmental studies in order to understand the existing vegetation near the excavations. The artefacts manufactured with local wood shall be separated from those made of exotic wood.

The aim of these studies is to understand the commercial itinerary of the wood in the ancient period. We'll also try to discover some handicraft production centres for some objects such as writing-tablets which are found everywhere in the ancient world.

GYMNOSPERMS MIDDLE ALBIAN IN AGE FROM VALLE DEL RÍO MARTÍN (TERUEL, SPAIN)

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The fossil-rich site within the Albian Escucha Formation in the Oliete Sub-basin is located in the northeast of Spain, in the central part of the Aragonian branch of the Iberian Range The succession consists of 130 m of sandstones and shales, with coal seams and some interbedded calcarenites. This formation represents a regressive megasequence that accumulated by progradation of a ''deltaic / estuarine system'', and comprises three members which are distinguished on lithological criteria. It overlies unconformably the Oliete Formation (Aptian), which was deposited in a shallow marine environment, and has an erosive contact with the Utrillas Formation above, which is of fluvial origin and dated as late Albian / early Cenomanian. The gymnosperm remains are fairly abundant in the upper member, constituted by sediments deposited in fluvial and paludal environments without marine influence.

A great abundance of different types of gymnosperms has been found, corresponding to remains fossilized as impressions which have preserved both morphology and venation, but lacking of cuticles. This flora includes remains of leaves, cones and seeds corresponding to Coniferales (*Sphenolepis kurriana, Sphenolepis seftenbergiana Geinitzia sp*., and representatives of morphogenus *Brachyphyllum and Pagiophyllum*), leaves of Caytoniales (*Sagenopteris cf S. elliptica*), leaves of Ginkgoales (genus *Ginkgoites* and genus *Sphenobaiera*), Bennettitales (with leaves of genus *Ptilophyllum* and several species of genus *Zamites*), Cycadales (leaves of genus *Nilssonia* and genus *Ctenozamites* with entire and denticulate pinnae margins), Czekanowskiales, and reproductive structures of Gnetales.

Gymnosperms from Valle del Río Martín are distributed in several stratigraphic levels which are distinguished by their composition and by the quantity and variety of the assemblages within. The different associations of gymnosperms indicate a subtropical climate and a wide variety of environments in the Middle Albian from Spain.

Some of the refered taxa also have been found and described by several authors in different outcrops from northeast USA, Canada and from central Asia, all of them Aptian to Albian in age. This fact could indicate a probable geographical connection between these areas and the Iberian plate during Albian times.

Keywords. Gymnosperms, Midle Albian, Escucha Formation, Spain

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VERDEÑA (SPAIN): LIFE AND DEATH OF A CARBONIFEROUS FOREST COMMUNITY

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The remains of a forest of 305 million years ago allow reconstructing its history of colonisation of a coastal sand bar and its eventual destruction by marine flooding due to faulting in a high destructive deltaic setting. Sigillarian trees snapped off just above the rooting bases, whereas woody trees (*Cordaites*?) were uprooted by the unidirectional current, which oriented the fallen logs. This record puts a new perspective on reconstructions of Carboniferous forest mires.

Small scale opencasting for coal in steeply dipping strata of early Stephanian (Cantabrian) age near the village of Verdeña in northern Palencia, Cantabrian Mountains, NW Spain, has exposed a wall of 180 m long and 5 to 12 m high on which the imprints of lycopsid rooting bases and fallen logs allow reconstructing the history of a coastal forest of some 305 Ma ago. This is the top surface of a rootlet bed underlying the coal which was taken away by mining. The locality is preserved by order of the Environmental Council of the Autonomous Government of Castilla-León, and the site is signposted with a full explanation of the significance of the imprints and the position that the fossil forest occupies with regard to the sedimentary sequence represented. This is linked to the history of a high-destructive delta with a high rate of sedimentation, perhaps as much as 2,000 m per Ma, as a result of tectonic mobility which has left its stamp on the sedimentary succession. Indeed, the imprints of rooting bases and fallen logs have been seen on several top surfaces of deltaic sequences in different parts of the succession, all of which represent a similar history. Only the surface near Verdeña has been preserved. It is a perfect example. The tectono-sedimentary environment being rather different to that usually represented in reconstructions of Pennsylvanian coal-measure forests, the fossil forest of the Verdeña site constitutes a unique record. Its analysis has allowed a degree of precision which partly confirms and partly corrects the classical reconstructions as found in the literature.

Detailed stratigraphic sections established throughout the succession of lower Cantabrian strata of the San Salvador Formation in the vicinity of Verdeña have shown the repetition of coarsening upwards deltaic sequences which commonly, though not invariably, terminate with sandstone representing a coastal sand plate or bar. This is the only non-marine part of the sequence, allowing its colonisation by land plants. Shallowly rooted lycopsid trees identifiable in one instance as a cannelate *Sigillaria* provided cover together with occasional woody trees which almost certainly correspond to *Cordaites*. It is noted that two clearly separated generations of lycopsid rooting bases have left their imprint. The first generation consists of large rooting bases, with a basal stem diameter of 40 to 60 cm. These are fairly regularly spaced at intervals of 2,5 to 3 m, which are controlled by the size of the rather extensive Stigmarian rooting systems. Partial overlap of the rooting systems exists, probably to the extent allowed by competition for nutrients in the soil. *Sigillaria* is either unforked or once forked near the top of the tree, so these trees must have appeared well spaced out. The second generation, with stem bases of 10 to 20 cm in diameter, is much less evenly spaced, and its distribution shows that the sporelings which managed to become permanently established, had to utilise spaces in between the rooting systems of the first generation trees. The difference in size between the first and second generation lycopsid rooting bases and stem diameter almost certainly means that sporelings managed to grow into trees only when they were not in competition with the first generation, i.e. when the large trees of the pioneer generation had completed their full life span and were no longer alive. This conclusion is supported by the fact that no fallen logs are found that correspond in size to the large rooting bases of the first generation of lycopsid trees. These must have rotted away *in situ*.

Indeed, all the imprints of fallen logs correspond to the second generation of lycopsid trees. This refers to shallow imprints which are just a little wider than the diameter of the stem bases of second generation lycopsid rooting systems. The shallowness of the imprints is explained by the fact that lycopsid trees possessed little wood and a large cortical area which will have decayed rapidly so as to make the log collapse on itself. This would produce a flattening effect with a slight increase in stem width. It is noted that the bases of the fallen logs do not have the thickening that is normally associated with lycopsid stem bases. They also look slightly frazzled. All this suggests that the tree trunks snapped off just above the stem bases, leaving the rooting systems and stem bases firmly anchored to the ground. The extensive rooting systems were an effective anchoring device, whilst the thin wood cylinder and large cortical area did not provide the strength to keep the stem in connection with the stem bases and rooting apparatus. In order words, the lycopsid trees would not uproot but have the stem snap off. This observation calls into question the common practice of reconstructing Carboniferous coal-measure forests with some of the lycopsid trees shown uprooted, with the Stigmarian rooting systems up in the air. Another common mistake is to show fallen lycopsid logs with circular cross sections whereas these logs would in fact collapse rapidly as the cortical tissue decayed, and be almost entirely flattened as they rested on the soil.

Woody trees reacted differently. A large wood cylinder would impart strength to the stem and provide cohesion between the stem and its rooting system. Woody trees, as known at present, do tend to uproot when a tree is toppled. Woody logs do not flatten as lycopsid tree stems tended to do but retained their cylindrical shape. Some of the imprints of stems on the sandstone surface at the Verdeña site are not shallow but rather deep, so deep in fact that the coal miners scratched out the coal contained in these hollows. One of these deep imprints of fallen logs widens out into a rooting base. This was clearly an uprooted tree with a substantial wood cylinder. In the context of a coastal forest of Pennsylvanian times a woody tree can only mean a *Cordaites*.
The imprints of fallen logs on the sandstone surface are practically all aligned the same way, and where base and top of a log can be determined, the orientation proves to be the same as well. Whatever agency toppled the trees did so unidirectionally. In the context of a coastal forest, and having regard to the high rate of sedimentation, it appears likely that syn-sedimentary faulting altered the shoreline catastrophically, and that the forest with second generation lycopsid trees was destroyed by sudden marine flooding. The current being unidirectional, a tsunami was not involved. The alternative of hurricane force winds toppling the trees is less likely, since this would not lead to permanent destruction of the forest. It is also noted that small vegetable debris is apparently absent. Only a water current would sweep small debris off the site. Small patches of sandstone surface show a dense arrangement of markings which are interpreted as rooting marks of sporelings.
The site was not recolonised after the catastrophic event, and the overlying dirty coal seam probably corresponds to lagoonal conditions (brackish or even marine?) with vegetable matter being swept in from a nearby forested area on the landward side of the fault. This closes the history of the site of a late Carboniferous coastal forest with two separate generations of lycopsid (*Sigillaria*) trees mixed in with probable *Cordaites*, a forest which was eventually destroyed by catastrophic marine flooding. Geological conditions determined the establishment and demise of this forest, the analysis of which has allowed a better understanding of the processes involved.

ASSESSING THE EARLIEST SEED PLANT RADIATION THROUGH THREE-DIMENSIONAL RECONSTRUCTION TECHNIQUES

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Seed plants appear in the fossil record during the Upper Devonian, but in many Devonian and Early Carboniferous floral assemblages they are only unequivocally represented by isolated seeds. The study of seed-fossils is hence of critical importance to studies of the radiation of the clade itself, but previous investigations have been hampered by the three-dimensional nature of the material. New methods of critically examining fossil seeds through computerised three-dimensional reconstruction are being explored, in order to re-evaluate anatomically preserved seeds from the serial-peel collection of Albert Long, which represent the most complete dataset on early seed-plant radiation.

A number of taxa including *Genomosperma latens* and *Genomosperma kidstoni* are being restudied, using both existing serial-peel datasets and new high-resolution serial-section datasets. Reconstructions have been prepared using a custom computer software suite (*SPIERS*). Study of these ‘virtual fossils’ will better constrain the morphology of these early seeds, allowing rigorous testing of existing hypothesis on their development and function. Reconstructions will also provide a basis for quantitative analyses, using computerised aerodynamic modelling, which can be expected to provide further insight into the functional morphology of the earliest seed plants.

Key Words: seed, radiation, Devonian, Carboniferous, Genomosperma.

MACROFLORA ASSEMBLAGES (CATHAYSIAN FLORA) AND THEIR EVOLUTION AND EXTINCTION PATTERNS NEAR PTB, WESTERN GUIZHOU AND EASTERN YUNNAN, SOUTH CHINA

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Both marine and non-marine continuous PTB strata are well developed in Western Guizhou and Eastern Yunnan, South China, making an ideal place to undertake research considering the terrestrial - ecological system evolution across the Permian -Triassic Boundary (PTB). These boundary sections can be used as one of the high-resolution methods for the subdivision and correlation of the PTB from marine to land.

Plant fossils are abundant mainly in the Xuanwei Formation (Upper Permian to Lowermost Triassic), with very few species found in the Kayitou Formation (Lowest Triassic). The PTB in nonmarine strata marks decrease of plants and the compositional change of plants from the dominance of Paleozoic ferns and pteridosperms to the dominance of Mesozoic gymnosperms. Three plant assemblages have been recognized from this area, which can be regionally correlated in South China. The first assemblage (late Late Permian, upper part of the Xuanwei Formation) is named *Gigantopteris nicotianaefolia-Lobatannularia multifolium-Schizoneura manchuriensis* flora. The second (in the PTB clayrocks of the uppermost Xuanwei Formation) is named *Gigantonoclea guizhouensis-Ullmannia* cf. *bronnii-Annularia pingloensis* flora. The third (Early Triassic Indian Stage, Kayitou Formation) is named *Annalepis-Ullmannia* flora.

The extinction pattern within the flora derived from macroplant data declined suddenly at the PTB after a long-term, gradual evolution, followed by a lesser extinction during the earliest Triassic. The first extinction happened in the sediments when the Cathaysian flora decreased sharply and the so-called fungi appeared abundantly. In the meantime, there are abundant woody root fossils (e.g. *Stigmaria*) in this suite of sediments, indicating the deterioration of environments during that time. The transitional flora in the PTB strata disappeared gradually and isochronously throughout the whole area. The second extinction in the earliest Triassic totally exterminated the Cathaysian *Gigantopteris* flora.

The Permian coal-forming period ranged from late Early to Late Permian in South China. It happened earlier in southeastern areas, and gradually shifted toward west in Late Permian. The coal measures were created by tropical plant of the *Gigantopteris* flora. In the late Late Permian, the coal measures mainly formed in a limited area of the Yangtze Platform. Peat swamps of the *Gigantopteris* Flora gradually migrated westward and meanwhile horizon of the coal-bearing strata of South China transcended from east to west, where the last of the *Gigantopteris* Flora survived into the earliest Triassic.

The study of plant fossils, combining clay minerals, inorganic geochemistry and sedimentary facies in this area, enable us to interpret the events occurring at that time. Our conclusions are that the mass extinction across the PTB in Western Guizhou and Eastern Yunnan was probably caused by the Siberian basaltic eruption episode and the siliceous volcanism in South China. These lithospheric events represented by volcanisms heralded a series of climatic and environmental events, giving rise to a catastrophe for the biosphere.

Keywords: Plant fossils, Evolution and extinction patterns, Permian-Triassic Boundary, Southwest China.