SPORES AND POLLEN NEWSLETTER N° 7-8

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Edited by
Marco Vecoli

Commission Internationale de Microflore du Paléozoïque
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Subcommission Spores and Pollen

CONTENTS

Cover picture: permanent tetrad from the Hirnantian (Upper Ordovician) subsurface of the Ghadamis Basin, southern Tunisia (Photo by M. vecoli).

Message from the secretary

Dear colleagues ,

First of all I must apologize for the much delayed distribution of this Newsletter. I was elected secretary for the years 2007 to 2010 of the CIMP Spores and Pollen subcommission, at the CIMP General Meeting in Prague in October 2006. I replace Duncan Mc Lean who acted as secretary and newsletter editor during the previous 4 years. At the same time Zelia Pereira (INETI, Lisbon) replaced Ken Higgs as subcommission President. Coming from the "world" of acritarchs and fossil microphytoplankton, I had to get in contact with all people involved in Palaeozoic spore research, and took time to update the members and distribution list. I sent out calls for news to potentially interested Palaeozoic spore palynologists using the distribution list of the CIMP, and finally I had positive responses from 33 people, 12 of which sent news about their research. Duncan McLean informed me that the Spore and Pollen Newsletter N° 7 (2006) was never produced, so the present issue counts for two: N° 7 and N° 8.

After the General Meeting in Prague, the CIMP Spores/Pollen and Acritarch Subcommission Joint Meeting held in Lisbon and organized by Zelia Pereira and Reed Wicander was an excellent initiative. Unfortunately I could not attend the meeting, and reading through the abstract book (which has been produced with very high editorial standard), I realize that this was a really important event for Palaeozoic palynology. Good reports about this meeting have been published in the Winter 07 CIMP Newsletter.

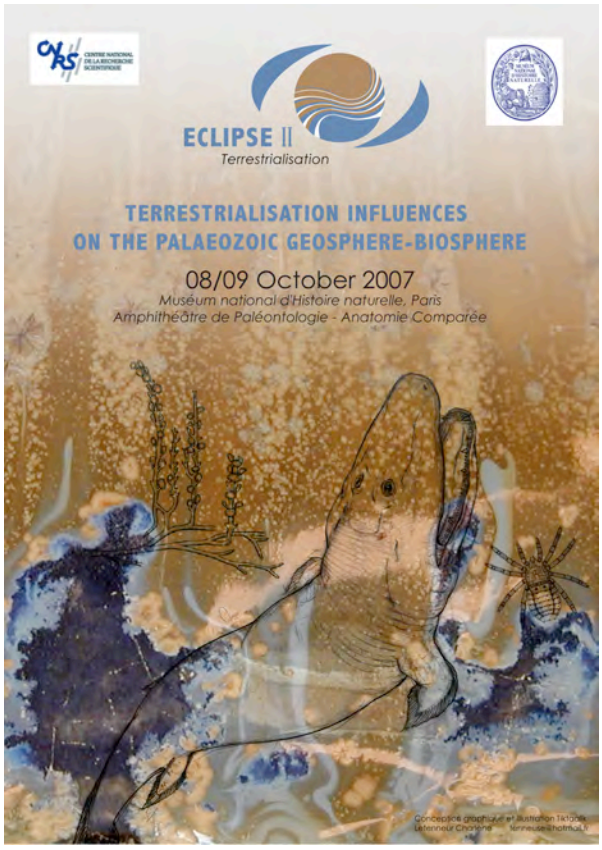
The next important meeting for our community of Palaeozoic Palynologists will be the 12th International Palynological Congress which will be held in Bonn next September. Deadlines are rapidly approaching, and I would like to invite all members to participate to this important international conference.

Finally, I would like to thank all contributors who made possible to produce this Newsletter; please continue to send in your research news, PhD topics, conference announcements, and anything you would like to discuss about.

Marco Vecoli

Conference Report:

Terrestrialization influences on Palaeozoic Biosphere and Geosphere
Paris, 8-9 Octobre, 2007.



Organizers: Marco Vecoli and Gaël Clément

Financial support by CNRS – INSU, programme "ECLIPSE" and by the Muséum National d'Histoire Naturelle, Paris.

This small conference-workshop was on an invitation-only basis and was meant to bring together specialists from different branches of palaeontology (vertebrate palaeontology, palaeobotany, evo-devo, and of course palynology) as well as from various disciplines (sedimentology, geochemistry, biology) to present their most recent results and discuss current ideas about the process of terrestrialization. The terrestrialization (spread of vegetation animal life in non-marine environments) was a complex phenomenon which is perhaps the best example showing the co-evolution of life and its physical environment. The colonization of land by plants prepared the ground for the adaptation of animal life to sub-aerial environments. It was probably a very slow process in the beginning (Cambrian? – Ordovician) then progressively accelerating as vegetation cover rapidly evolved from mosses to real forests (Silurian-Devonian). If we exclude microbial mats, the first colonizers of terrestrial environments were small land plants, the only evidence of them being either biomarkers or primitive spores. The biomarkers investigations in early Palaeozoic sediments are interesting, but presently of difficult interpretation. Consequently, miospores remain the key for understanding the early terrestrialization of plants. A few talks thus focused on spore palynology. Marco Vecoli reported about the current debate about the nature of enigmatic, spore-like palynomorphs from Middle and Upper Cambrian sediments in North America and North Africa, which may represent fossil intermediates between algae and terrestrial plants.
In their talk, Philippe Steemans and Philippe Gerrienne reviewed the different early records and definitions of cryptospores. They suggested that Late Ordovician to early Silurian cryptospores-producing plants were highly tolerant with respect to climatic variation, and that a major change in cryptospore assemblages occurred during a global transgression during Llandovery times. On the other hand, plants producing trilete spores were

probably much more sensible to variations in climatic conditions, hence more useful for palaeogoegraphic reconstructions.

Maurice Streel demonstrated the potential of miospores for high-resolution chronostratigraphy in the Fammennian. Three Famennian miospore assemblages corresponding to climatically controlled evolutionary changes in the land flora were defined, which have a clear chronostratigraphic significance.

Cyrille Prestianni focused on two major steps in the evolution of plants: the appearance of heterospory and the acquisition of seed habit. He showed that major innovations in heterosporous reproductive structures occurred during Givetian times, giving rise to the seed habit. Later, during the Famennian, important diversifications and modifications of seed habit occurred, which are at the origin of the worldwide domination of spermatophytes.

John Marshall illustrated with a series of examples how changes in terrestrial vegetation inferred from palynology can help to achieve both time correlation and an understanding of major climatic perturbations in the Middle to Late Devonian world.

The talks presented at this workshop constitute the basis for the publication of a special volume on the Terrestrialization, which is currently in progress. The conference program with the titles of all contributions is listed below, if interested, you can request a copy of the Abstract Volume to marco.vecoli@univ-lille1.fr

Conference Program (08-09 October, 2007)

Terrestrialization: the early emergence of the concept
Philippe JANVIER

The land plant cover during the Devonian: a reassessment of the evolution of the tree habit and root systems
Brigitte MEYER-BERTHAUD & Anne-Laure DECOMBEIX

Was there a phytoplankton blackout in the Late Palaeozoic?
Thomas SERVAIS, Alexander NÜTZEL & Marco VECOLI

Middle Cambrian, non-marine palynomorphs from the Algerian Sahara: evidence of the earliest phases of the terrestrialization process
Marco VECOLI

Miospores: A key to understanding the early terrestrialisation of plants
Philippe STEEMANS & Philippe GERRIENNE

First record of the lignophyte *Rellimia* Leclercq & Bonamo (Aneurophytales) from Africa
Philippe GERRIENNE, Brigitte MEYER-BERTHAUD, Hubert LARDEUX & Serge RÉGNAULT

Heterospory and seed-habit: Devonian innovations
Cyrille PRESTIANNI & Philippe GERRIENNE

Resolving the biological origin of fossil organic matter; an organic geochemical perspective
Gerard J.M. VERSTEEGH

Land plant evolution and weathering rate changes in the Devonian
Thomas J. ALGEO, Stephen E. SCHECKLER & Patricia G. GENSEL

Under the 'feet' of tetrapods: what terrestrial vegetation tells us about the Devonian Earth System
John MARSHALL

Biomarker analysis of uppermost Ordovician and Silurian sediments in Southern Tunisia (borehole Tt 1) - Preliminary results
Armelle RIBOULLEAU, Marco VECOLI & Gerard J.M. VERSTEEGH

West Gondwanan and Euramerican climate impact on Famennian miospore assemblages
Maurice STREEL

The biostratigraphic and palaeogeographic framework of the earliest diversification of tetrapods (Late Devonian) – a critical review
Alain BLIECK, Gaël CLÉMENT, Henning BLOM, Hervé LELIEVRE, Ervins LUKSEVICS, Maurice STREEL, Jacques THOREZ & Gavin C. YOUNG

NEWS FROM MEMBERS

Oscar Abbink (oscar.abbink@tno.nl)
TNO B&O
Geological Survey of The Netherlands

Research interests and activities:

- Paleozoic spores & pollen.
- Late Paleozoic paleo-ecology of spore/pollen parent plants
- Late Paleozoic paleoclimates and paleo-environments

Projects:

- IGCP Project 469 Late Variscan Terrestrial Biotas and Environments
- Late Carboniferous Sporomorph EcoGroup
- Carboniferous-Permian Biostratigraphic databases

Walter Harald
(Harald.Walter@smul.sachsen.de)
Sächsisches Landesamt für Umwelt und Geologie
Postfach 80 01 32, 01101 Dresden, Germany

In the last year I have been working in collaboration with Christoph Hartkopf-Fröder on a common project (TU Bergakademie Freiberg, Sächsisches Landesamt für Umwelt und Geologie, Geologischer Dienst NRW) about new palynological investigations in the Westfalian of the Vorerzgebirge basin (Saxony).

Sarah Heal (healse@tcd.ie)
Department of Geology, Trinity College Dublin, Dublin 2, Ireland.

I am currently working on my Ph.D., 'Palynological correlation of Mississippian (Carboniferous) stage boundaries in Western Europe and the USA', supervised by Prof. Geoff Clayton. My fieldwork, undertaken during summer 2005 and 2006, has taken me to the classic Mississippian sections along the Mississippi River Valley, Midwest USA. Preliminary results have turned up interesting miospore and acritarch assemblages from the Earliest Carboniferous, and I hope to have a paper published on this later this year.

John Marshall (jeam@noc.soton.ac.uk)
National Oceanography Centre,
University of Southampton

It has been a busy few years in Devonian spore world. In 2006 & 2007 I participated in a joint project with the Nanjiang Institute of Palaeontology and Stratigraphy. The UK end is sponsored by the Royal Society and is led by Chris Berry (Cardiff) with Charlie Wellman (Sheffield). The NIGPAS participants are Wang Yi and Huai Cheng Zhu. The project runs for two years and is an attempt to integrate the Devonian macrofossil plant and spore record from China. There is particular emphasis on *in situ* spores (i.e. in sporangia). Significant effort has been put into comparing Devonian vegetation and spores on the different microplates that make up China. Fieldwork has been in South China (Yunnan) and Xinjiang (northern

China). Huai Cheng Zhu and Wang Yi have visited Southampton and Cardiff.
In July 2006 I visited Syktyvkar and Ukhta in the Timan, Komi Republic, Russia. This is a joint project with Olga Telnova from Syktyvkar, again sponsored by the Royal Society. Fieldwork was carried out on sections in the Frasnian and Famennian on the River Ishzma. Olga Telnova visited Southampton in 2006 & 2007 to study the palynology of the Givetian-Frasnian boundary.
In late July and August 2006 I led an expedition to the Old Red Sandstone in East Greenland to study the Late Devonian to Early Carboniferous interval. Other participating scientists were Chris Berry (Cardiff, macroplants) and Henning Blom (Lund, vertebrates) together with Simon Johnson (Southampton) and Clive Johnson (CASP, Cambridge who organised the logistics). Field transport was by inflatable boats from a forward tundra strip in Strindberg Land. The first locality was the classic *Ichthyostega* section in Paralleldal on Gauss Halvø. We then moved to these coastal sections on Stensïo Bjerg and Nathorst Bjerg. Here we studied the plants and fish in the latest Famennian including the terrestrial D-C boundary section where a detailed collection of spore samples was also made. The group then moved to Celsius Bjerg on Ymer Ø and studied the same interval but in a more proximal section. Importantly the section on Celsius Bjerg was found to continue above the D-C boundary into the earliest Carboniferous.
This fieldtrip was immediately followed by the CIMP meeting in Prague together with the opportunity to visit several classic Barrandian field sections.
In October 2006 I also attended the GSA meeting in Philadelphia and made a presentation at the Beerbower Symposium. (Astin & Marshall, *The age and environment of the East Greenland tetrapods*). I took the opportunity to go on the Catskill fieldtrip led by Ted Daeschler that included the important Red Hill tetrapod site. Many Devonian colleagues were present at the meeting and there was a very interesting and well attended session on Devonian-early Carboniferous glacials.
In the summer of 2006 I attended the Subcommission for Devonian Stratigraphy meeting in Eureka, Nevada followed by the CIMP spore, pollen and acritarch meeting in Lisbon. Finally in the autumn of 2007 I revisited several Devonian field sections in Bolivia with Ian Troth to collect additional spore samples.
In 2006 Ian Troth completed his PhD on the Devonian of Bolivia. He has now joined BG as a geologist.

Paola Pittau (pittaup@unica.it)
Dipartimento di Scienze della Terra,
Università di Cagliari, Italy

My interest is at the moment in the palynology of Late Paleozoic, and I have several papers in press on the Late Carboniferous and late Permian miospore associations of Italy, including biostratigraphy, paleoecology and paleogeography aspects.

My future projects are on Holocene palynology as proxy for paleoclimate and paleovegetation reconstruction of Sardinia. We have commenced to work on and results are very interesting. A multiproxy study (pollen and spores,

forams, diatoms and stable O18 and C14 isotopes) allow a decadal record resolution. I will present the results at the EUG in Wien on next April.

John Richardson
(jb.richardson1@ntlworld.com)
Department of Palaeontology, Natural History
Museum, Cromwell Road, London SW7 5BD;

I continue working on early Land plant evolution and cryptospores – miospores and in situ spores. I am currently preparing a paper on the habitat of Early Land Floras for the Proceedings of the CIMP conference in Prague

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Claudia Rubinstein
(crubinst@lab.cricyt.edu.ar)
Unidad de Paleopalinología IANIGLA – CRICYT, Mendoza, Argentina

I´m currently working on miospores (cryptospores + trilete spores), ranging from the Ordovician up to the Devonian from different basins of Argentina and Brazil.
Particularly, with P. Steemans, we are analyzing rich miospores assemblages from the large Silurian and Devonian deposits of the Precordillera Basin (central-west Argentina) with biostratigraphical, palaeonvironmental and palaeogeographical purposes.
Other projects involve Ordovician and Silurian miospores of the Central Andean Basin, northwestern Argentina.

Philippe Steemans (p.steemans@ulg.ac.be)
Paléobotanique-Paléopalynologie-Micropaléontologie (PPM)
Allée du 6 Août, Bât. B-18.
Université de Liège, Campus du Sart Tilman
B-4000 Liège 1, Belgique

I am currently working on cryptospores and trilete spores from the Silurian and from the Lower Devonian of Argentina in collaboration with C. Rubinstein (Mendoza, Argentina) and in Brazil with C. Rubinstein and H. de Melo (Rio de Janeiro, Brazil); in Paraguay on cryptospores from the Llandovery with P. Mauller-Mendlowicz (Rio de Janeiro, Brazil); on trilete spores in Bolivia with H. de Melo, Y. Grahn , P. Breuer, M. Streel (Liège, Belgium) and A. Le Hérissé for the acritarchs (Brest, France). I am co-director with A. Le Hérissé of the PhD Thesis of M. Perez-Leyton in Bolivia (palynostratigraphy of the Devonian of Bolivia) and co-director with E. Pereira (Rio de Janeiro, Brazil) of the PhD Thesis of P. Mauller-Mendlowicz (Devonian miospores from the Parana Basin). I'm working also on Givetian megaspores from the Ronquières locality (Belgium), well-known since the discovery of the Runcaria proto-seed, with F. de Ville de Goyet and P. Gerrienne (Liège, Belgium). We have also discovered very well preserved Givetian megaspores in Libya on which I am working with P. Breuer and F. de Ville de Goyet. I am director of the PhD Thesis of P. Breuer who is working on Emsian to Givetian trilete spores, cryptospores and megaspores from Saudi Arabia thanks to the collaboration with J. Filatoff and M. Miller of the Aramco petroleum society (Dharhan, Saudi Arabia). I am involved in the CIMP working group on the palynostratigraphy of Saudi Arabia in

collaboration with the spore team - mainly with C. Wellman (Sheffield, UK), K. Higgs (Cork, Ireland) and J. Marshall (Southampton, UK). Recently I have begun to work on Lower and Middle Devonian spores from China, in the Northern area of Urumqi in collaboration with Li Chen-Seng (Beijing, China) and P. Gerrienne for the megaflora. I have also initiated the project of the PalyWeb database on Palaeozoic palynomorphs.

Alfred Traverse (atraverse@earthlink.net)
Huntingdon, PA, U.S.A.

My palynological work during the last few years has been dominated by production of a second edition of my book, **Paleopalynology**, which is now in press with Springer. However, I also have continued research in various palynological projects, for example, palynostratigraphic studies of the non-marine Devonian rocks of Pennsylvania, New York, and vicinity. I am working with Maurice Streel and William Kirchgasser on that project. I also have a project in the Triassic palynostratigraphy of the Petrified Forest National Park in Arizona, in collaboration with S. R. Ash. This work is not Paleozoic, of course, but should be mentioned as the project has consumed much of my time in the last decade. In the past I have also worked on cryptospores of Ordovician and Silurian rocks, in collaboration with former students, Paul Strother and Said Al-Hajri.

Marco Vecoli (marco.vecoli@univ-lille1.fr)
Dept Earth Sciences
University of Lille
Centre National de la Recherche Scientifique UMR 8157
Villeneuve d'Ascq, France

I work on these spore-related pojects:

1) Enigmatic organic-walled sporomorphs from Middle Cambrian through earliest Ordovician of probable non-marine origin from several localities in North Africa.
2) Miospores from Hirnantian, glacial-related deposits in North Africa.
3) A comprehensive palynological analysis on a Siluro-Devonian sequence from a subsurface section in the Ghadamis Basin of North Africa is in progress in collaboration with Dr. Amalia Spina, presently working as postdoc at the University of Lille. We are now analyzing the cryptospores and trilete spores from this sequence, which is essentially marine and thus also contains rich acritarch and chitinozoan assemblages. We will propose an integrated palynological zonation and model of early vegetation evolution based on the study of miospores. The first results will be presented at the next EGU Geneal Assembly in Vienna, at the 33°IGC in Oslo, and at the 13 IPC in Bonn.

News from Argentina

Mercedes di Pasquo (medipa@gl.fcen.uba.ar); Carlos Azcuy (azcuy@ciudad.com.ar); Cecilia R. Amenábar (amenabar@gl.fcen.uba.ar); Sol Noetinger (snoetinger@gl.fcen.uba.ar); - Palynostratigraphy and Paleobotany

Laboratory (PPL) - website: http://palino.gl.fcen.uba.ar

and

Pablo Pazos (pazos@gl.fcen.uba.ar) - Stratigraphy Laboratory

Department of Geology (Facultad de Ciencias Exactas y Naturales (FCEN), Universidad de Buenos Aires (UBA), Argentina.

Some of the most recent contributions have been presented in the 4º European Meeting on Paleontology and Stratigraphy of Latin American, held in Madrid (september 12-14th) and they can be downloaded from the website http://www.igme.es/4empsla.

We invite to visit our website where you can find information about different activities of the staff such as current research projects (in both english and spanish), teaching courses, a gallery of photographs of different events, links of interest including a map with the location of different Argentinean Palynological Groups. A list of contributions, some of them with pdf files (avaliable upon request to contact Mercedes di Pasquo), is included in the section called "TRABAJOS DE INVESTIGACIÓN" and the section called "NEW" updated the information since 2005. Another new section is called "TAXONOMÍA" and includes the illustration of holotype and paratypes of new taxa defined by the members of the group. On the other hand, we want to acknowledge all the colleagues that have sent to us their reprints either by postmail or pdf versions!! We know that the reprint version is better than the pdf file, but it is very difficult for us to send reprints by postmail to everybody (long distances, huge prices and not enough funds for this issue!). Additionally, sometimes we do not have reprints of all contributions. So, this is the best way we find to share our information with all of you and we hope it will be useful as well. We are grateful if everybody can send to us either pdf files or reprints if it is possible of course. We are interested on palynology in general (all Periods and issues) and other paleontological researches are welcome as well.

Ph.D. News

Cecilia R. Amenábar has defended her Ph.D. theses, titled "Palynostratigraphy and palaeoenvironment of the Chigua (Chinguillos Group, Devonian), Malimán and El Ratón (Angualasto Group, Lower Carboniferous) formations, Uspallata-Iglesia Basin. Comparison and correlation with other palynofloras and characterization of the Devonian-Carboniferous boundary in the region", on june 21st at the University of Buenos Aires. She is currently working on the Late Cretaceous microfloras of the Sanctuary Cliff Formation in the Snow Hill Island, James Ross Basin, Antarctica Argentina. This research is carried on the framework of the PICTO (2005) 36166 project and supported by a grant from the National Research Council of Argentina (CONICET), Post-Doctoral position under the supervising of M. di Pasquo and A. Concheyro. A first result was presented in the "9º Congreso Argentino de Paleontología y Bioestratigrafía", held in Córdoba (september 18-22th 2006).

Sol Noetinger, biologist from the University of Buenos Aires (UBA),

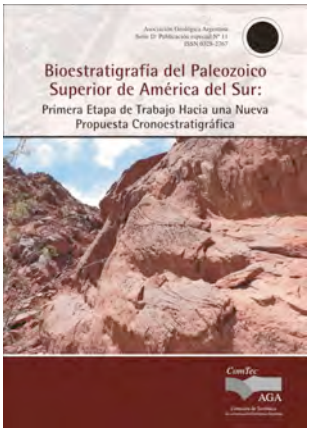
Buenos Aires, Argentina. During her undergraduate studies she collaborated in different areas of botany and time periods like Mesozoic and recent. Her main research interests are Devonian palynology, stratigraphy, palaeobotany, and palaeoecology of the north-western Argentinean basins. The purpose of her current studies is to improve the knowledge of this palaeoecological scenario added to the stratigraphic and chronological information of the Middle Palaeozoic Tarija Basin (north of Argentina and south of Bolivia) and other related areas of Argentina.

She is currently working, since April 2006, in the Geology Department at the Exact and Natural Sciences Faculty from the same university, on her PhD theses: "Studies of the Devonian and Lower Carboniferous microflora from northwestern Argentina and South of Bolivia", supported by a grant from the National Research Council of Argentina (CONICET) under the direction of Dr. M. di Pasquo.

Current projects

Members of the Palynostratigraphy and Paleobotany Laboratory (**PPL**) are involved in several projects dealing with taxonomical issues on palynology and palaeobotany that will allow to improve the comparison and correlation of mega and microfloras occurring from the Devonian to the Permian basins such as Madre de Dios (Bolivia), Tarija (southern Bolivia and northern Argentina), Uspallata/Iglesia, Paganzo, San Rafael (western Argentina) and Paraná (Brazil). Another project involves the palynologic and micropaleontologic studies on the Cretaceous and Tertiary in the James Ross Basin, Antarctica Argentina.

All these researches will contribute to the knowledge on the diastrophic and paleoclimatic events that generated unconformities in those places from western Gondwana. These projects consider the formation of human resources through the accomplishment of doctoral theses, post-doctoral works, final degree works and also, of the production of a scientific work with students.



An important achievement of the **Working Group on Upper Palaeozoic Chronostra-tigraphy of South America** that will be published soon (Azcuy et al., 2007), is the first result of the following meetings: The 1st Meeting of the Upper Palaeozoic Chronostratigraphy Committee of South America, held within the framework of the *XI Reunião de Paleobotânicos e Palinólogos* (Gramado, Brazil, 2004), included researchers from Argentina, Brazil and Uruguay and was coordinated by Carlos Azcuy. The meeting constituted the first step to discuss and establish a regional chronostratigraphic scheme of the Upper Paleozoic of South America. The current scheme established in Western Europe, Russia and North America has been defined using fossil associations that are not common to the region of Gondwana. All of the participants agreed that the best way to establish a regional chronostratigraphy would be by synthesizing all systematical, palaeontological, and radiometrical

works of Upper Palaeozoic basins from South America. It was agreed to divide the task among the participants with Dr. Carlos Azcuy, as Lead Coordinator. The first results of the project were discussed in the framework of the *XIII Simposio Argentino de Paleobotánica y Palinología* (Bahía Blanca, Argentina, 2006). The biostratigraphical units established for the different basins of South America as well as other data (more isolated and new information) are updated and discussed and a correlation chart is supported by a list of selected references.

A summary of this work was presented in the 4º European Meeting on Paleontology and Stratigraphy of Latin American, held in Madrid on September 2007 (Azcuy et al., 2007).

Asociación Geológica Argentina, Serie D: Publicación Especial No. 11: 09-65. (Sent: 12/2006. Accepted: 06/07. Authors in alphabetical order). For more information please contact M. di Pasquo.

A new Book on Palynostratigraphy of South America is under preparation with the collaboration of many palynologists from different countries of South America. It is scheduled to be finished a first version for 2009 to be sent to AASP.

The aim of this book is to be a practical and upgraded biostratigraphic guide with abundant illustrations of palynomorphs characteristic of different basins developed in South America, are arranged by Periods. It will be useful mainly for researching, oil exploration and teaching. In some basins the regional knowledge has allowed the development of biostratigraphic schemes whereas other regions are still under study. For this reason, illustrations of palynomorphss will be able for biostratigraphic purposes but also to recognise what is the level of knowledge in some areas where there is still local or preliminary palynologic studies. Therefore, it will allow to plan the improvement of palynologic investigations and other related aspects in a near future and recognise how is the distribution and quality of the knowledge in South America. Different subjects related to the major palynologic groups will be able to be treated briefly through examples from South America (e.g., their morphologic evolution, botanical affinity, biostratigraphic ranges of different groups, importance of the stratigraphic and geographic distribution of taxa, paleoecologic importance and its application in the interpretation of palaeoenvironments and palaeoclimates, etc.). The treatment per periods of the evolution of the microfloras will be an excellent tool to face new challenges on evolution and paleobiogeography of this region (Mercedes di Pasquo, Coord./General Ed.).

PUBLICATIONS (2006-2007) ON PALAEOZOIC SPORES

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2007

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PHD THESIS

'Devonian miospore palynology in western Gondwana: an application to oil exploration'

By Pierre Breuer

Université de Liège
Belgique

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Abstract - Devonian miospore assemblages from 16 sections in Saudi Arabia and North Africa are studied in order to characterize the palynostratigraphy of the northern margin of western Gondwana which remains poorly known in Saudi Arabia. The preliminary taxonomic work identifies more than 200 miospore species, including a lot of new species endemic to western Gondwana. Numerous species have still to be more precisely circumscribed because of their large morphological variability. Others show continuous intergrading morphological variation. The morphological variability of each taxon is one of the main problems in any palynological study. It is due to phylogenetic evolution, ontogeny (maturation of sporangia) and taphonomic factors.
Although the standard Devonian miospore zonations established in Euramerica (Richardson & McGregor, 1986; Streel et al., 1987) are commonly used in most of the palynological studies, they are not always easily recognizable in western Gondwanan localities because of the endemic nature of the assemblages. Therefore, a new local/regional biozonation based on the characteristics of the miospore assemblages described here was needed for a more accurate correlation. The new established biozonation consists of 9 assemblage zones, 8 interval zones and 2 acme zones, extending from the late Pragian to the late Givetian and possibly the early Frasnian. The new defined biozones are compared to other coeval biozones defined in the literature. Thanks to this new local/regional biozonation, reliable correlations are established between sections. Numerous oilfields occur in the Devonian from western Gondwana. A biozonation based on the first downhole occurrence of species is developed for oil exploration. Thanks to this type of biozonation, only the top of a biozone has to be reached in order to be identified. The use of this biozonation is facilitated by the choice of easily recognizable and common index species. This provisional downward biozonation consists of 8 interval zones. Although it seems relatively reliable by comparison with the previously defined upward biozonation, it needs to be further tested on other drilled sections. The review of the Emsian-Givetian miospore

assemblages from the literature allows to evaluate the provincialism of assemblages on a worldwide scale during this interval.
Coefficient of similarity is calculated between palynofloras from northern Euramerica, southern Euramerica, eastern Gondwana, southwestern Gondwana and northwestern Gondwana. The resulting low values correspond to low to moderate similarity of miospore assemblages between the considered regions in the Emsian-Givetian interval. The provincialism may be explained by a latitudinal climatic gradient as no palaeogeographic barrier is known during this time interval. Indeed, both Euramerican and Gondwanan land masses were very close as soon as the earliest Devonian. Despite a certain degree of provincialism, floristic interchanges existed. Northwestern Gondwana constituted an intermediate warm temperate region with shared taxa mainly from more arid Euramerican localities in the North, and cooler southwestern Gondwanan localities in higher latitudes. However, it seems that a progressive homogenization of the vegetation took place in Middle Devonian as the standard Euramerican biozones are more easily recognized in Givetian than in Eifelian and Emsian. This transition from provincialism to cosmopolitanism during the Devonian is not only shown by palynofloras but also by the palaeogeographic distribution of many other fossil groups. It is likely due to a decrease of the latitudinal climatic gradient in Middle Devonian.

List of Members of the CIMP Spores and Pollen Subcommission

Oscar A. Abbink
TNO B&O
Geological Survey of The Netherlands
www.tno.nl/
T xx-31-(0)30-2564.730/600
oscar.abbink@tno.nl

Cecilia R. Amenábar
CONICET
Facultad de Ciencias Exactas y Naturales
Universidad de Buenos Aires
Área de Paleontología - Dpto. Ciencias Geológicas
Ciudad Universitaria - Pabellón II - piso 1º
C1428EGA Buenos Aires
Argentina
TE: 54-011-4576 3300/09 int. 320
E-mail: amenabar@gl.fcen.uba.ar
cr_amenabar@yahoo.com.ar

Jiri Bek
Department of Palaeobiology and Palaeoecology
Institute of Geology v.v.i
Academy of Science of the Czech Republic
Rozvojova 269, 165 00 Prague 6
Czech Republic
mrbean@gli.cas.cz

Peter Brück
15 Shrewsbury,
Ballinlough,
Cork,
Ireland
pbruck@eircom.net

Anthony Butcher
School of Earth & Environmental Sciences
University of Portsmouth
Burnaby Building, Burnaby Road
Portsmouth PO1 3QL
United kingdom
Tel: (+44) 23 9284 2258
anthony.butcher@port.ac.uk

Ken J. Dorning
58 Robertson Road
Sheffield S6 5DX
England
Phone and Fax 0114 2337 183
International +44 114 2337 183
Email k.j.dorning@sheffield.ac.uk
kjdorning@googlemail.com

José Pedro Fernandes
Dept. Geologia, Fac. Ciencias, Univ. Porto
Rua Campo Alegre 687
4169-007 PORTO (Portugal)
Phone +351 220114539
Fax +351 220114540
jpfernan@fc.up.pt

Mohammad Ghavidel-syooki
Exploration Directorate
National Iranian Oil Company
P.O. Box 11394 Teheran
Iran
M_ghavidelsyooki@yahoo.com

Walter Harald
Sächsisches Landesamt für Umwelt und Geologie
Postanschrift: Postfach 80 01 32 , 01101 Dresden
Besucheranschrift: Halsbrücker Straße 31a, 09599 Freiberg
Tel.: (03731)294170; Fax.: (03731)294115
harald.walter@smul.sachsen.de

Christoph Hartkopf-Froeder
Geologischer Dienst NRW
Postfach 100763
D-47707 Krefeld
Germany
Tel.: ++49-(0)2151-897255
hartkopf-froeder@gd.nrw.de

Hossein Hashemi
Dept. of Geology
Teacher Training University
Moffateh Avenue
Tehran, Iran
hashemi@saba.tmu.ac.ir

Sarah Heal
Department of Geology,
Trinity College Dublin,
Dublin 2,
Ireland.
healse@tcd.ie

Ken Higgs
Dept. of Geology
University College Cork
Cork, Ireland

K.Higgs@ucc.ie

Thomas B. van Hoof
TNO-Geological Survey of the Netherlands
Princetonlaan 6
3584 CB, Utrecht
The Netherlands
Phone: +31 30 2564733
tom.vanhoof@tno.nl

John Marshall
School of Ocean and Earth Science,
University of Southampton,
National Oceanography Centre Southampton,
European Way, Southampton, SO14 3ZH, UK.
phone 023 8059 2015,
jeam@noc.soton.ac.uk

Mercedes di Pasquo
Dpto. Geología
Facultad de Ciencias Exactas y Naturales
University of Buenos Aires
Ciudad Universitaria, Pabellón 2 piso 1º
(C1428EHA) Ciudad Autónoma de Buenos Aires
ARGENTINA
medipa@gl.fcen.uba.ar

Zelia Pereira
NIETI Department of Geology
Rua da Amieira 4465
S. Mamede Infesta, Portugal
zelia.pereira@ineti.pt

Paola Pittau
Dipartimento di Scienze della Terra
Università degli Studi di Cagliari
via Trentino 51; I-09127 Cagliari
ITALIA
Ph.: +39 070 6757742
pittaup@unica.it

John Richardson
Department of Palaeontology, Natural History
Museum, Cromwell Road, London SW7 5BD;
jb.richardson1@ntlworld.com

Jim Riding
British Geological Survey
Keyworth
Nottingham NG12 5GG
tel. +44(0)115 9363447
jbri@bgs.ac.uk

Fatna-Farida Abdesselam-Rouighi
SONATRACH,
Centre de Recherche et de Développement,
1, avenue du 1er-Novembre,
35000 Boumerdès,
Algérie
rouighif@yahoo.fr

Eckart Schrank
Institut fuer Angewandte Geowissenschaften
TU Berlin, Sekr. EB 10
Ernst-Reuter-Platz 1
D-10587 Berlin, Germany
e.schrank@tu-berlin.de

Philippe Steemans
Paléobotanique-Paléopalynologie-
Micropaléontologie (PPM)
Allée du 6 Août, Bât. B-18, parking 40
Université de Liège, Campus du Sart Tilman
B-4000 Liège 1, Belgique
Tél: 00 32 (0)4 366 53 33
p.steemans@ulg.ac.be

Mike Stephenson
British Geological Survey
Keyworth
Nottingham NG12 5GG
UK
mhste@bgs.ac.uk

Maurice Streel
Paléobotanique-Paléopalynologie-
Micropaléontologie (PPM)
Allée du 6 Août, Bât. B-18, parking 40
Université de Liège, Campus du Sart Tilman
B-4000 Liège 1, Belgique
maurice.streel@ulg.ac.be

Paul K. Strother
Palæobotany Laboratory
Weston Observatory of Boston College
Department of Geology & Geophysics
381 Concord Road
Weston, Massachusetts 02493 US
tel 617 552-8395,
strother@bc.edu

Bindra Thusu
Department of Earth Sciences
University College London
Gower Street
London WC1E 6BT
United Kingdom
Tel: +44 (0)20 8205 7787
email: b.thusu@ucl.ac.uk

Alfred Traverse
Alphabet Arboretum
9212 Standing Stone Road
Huntingdon, PA 16652, USA
Ph.: 814-643-1958
atraverse@earthlink.net

Elena Trincianti
ENI S.p.A.
Quinto Palazzo Uffici
Metanopoli, San Donato Milanese
Elena.trincianti@eni.it

Dieter Uhl
Villenstraße 13
67433 Neustadt an der Weinstraße
GERMANY
dieter.uhl@uni-tuebingen.de

Jacques Verniers
Research Unit Palaeontology
Ghent University
Krijgslaan 281 / S 8
9000 Ghent - Belgium
Jacques.Verniers@UGent.be

Charles Wellman
Dept. of Animal and Plant Sciences
University of Sheffield
Sheffield, U.K.
c.wellman@sheffield.ac.uk

Reed Wicander
Department of Geology
Central Michigan University
Mt. Pleasant, MI 48859 USA
Phone: (989) 774-3179
Fax: (989) 774-2142
reed.wicander@cmich.edu