Newsletter Winter 2008 No. 74

A scenic view of Bonn Botanic Gardens taken while attending the International Palynological Congress

Photo: Jenny Brittain

Commission Internationale de Microflore du Paléozoïque
President: John Marshall
Past President: Florentin Paris
Secretary General & Newsletter Editor: Gary Mullins
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CIMP homepage:
http://www.cimp.ulg.ac.be

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MESSAGE FROM THE PRESIDENT

Firstly a Happy New Year from the CIMP President and welcome to the first newsletter of 2009.

This was an important year for CIMP as we had a series of sessions at the Bonn IPC. I think everyone agreed that this was an excellent meeting with a good number of Palaeozoic presentations. I certainly met some Mesozoic workers who were very much of the view that we were both a well organized and very effective group. I interpret as meaning that they had fewer interesting talks to attend. For those of you who were not able to attend there are several reports of the Bonn meeting in this newsletter together with the Palaeozoic abstracts. These reports have been written by the students who had their attendance at the meeting sponsored by CIMP. This was the decision that the CIMP officers made to promote Palaeozoic palynology by encouraging student attendance. We also sponsored a local reception hosted by local CIMP member Rainer Brocke. More about this below. The CIMP also held three sub-commission meetings together with a General Assembly. In the absence of the outgoing secretary it falls to me to provide a report of this meeting.

John Marshall, jeam@noc.soton.ac.uk

MESSAGE FROM THE GENERAL SECRETARY

I feel that my first job is to say a big thank you to Mike Stephenson for doing such a good job over the past several years.

This CIMP newsletter could rightly be described as a "bumper" edition. Given the number of pages, it certainly seems to have been a busy year for the CIMP and its members. The International Palynological Congress at Bonn was certainly a highlight of the year. The CIMP had three sessions at this meeting covering the topics of palynostratigraphy, oceanic and climate change, and the palynology of the Arabian plate. In addition, numerous talks and posters were presented in other symposia that had a Palaeozoic palynological theme. The abstracts from this meeting are reproduced here. In 2008, the CIMP awarded a number of travel grants so that researchers at the start of their careers could attend the IPC. Each awardee has written an article for the newsletter recounting their experiences or describing the science presented. Let me pass on my thanks to each for their contributions. Likewise, thank you to all of you who answered my requests for news and views. **Finally – it is 2009, please pay your subscriptions.**

Gary Mullins, gary.mullins@fugro-robertson.com

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PetroStrat Limited, a fast growing, dynamic biostratigraphic consultancy based in Conwy, North Wales, U.K, has a career opening for a Palynologist with Palaeozoic experience (particularly Gondwanan Palaeozoic sporomorphs, acritarchs and chitinozoa), to join our expanding team of scientists. Applicants should ideally have 3 years or more industry

experience working the Palaeozoic, but candidates with a suitable academic background will also be considered.

We can offer varied and interesting career opportunities; we are currently active in many overseas areas including North Africa and The Middle East. Applicants should, preferably, be willing to conduct occasional wellsite work both onshore and offshore; full training for offshore work (including an offshore safety training course) will be provided. It is anticipated that these posts will involve a healthy mix of office-based analytical work and wellsite work.

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To apply for this position please email your CV and covering letter to directors@petrostrat.com or by post to The HR Director, PetroStrat Ltd, Tan-y- Graig, Parc Caer Seion, Conwy, North Wales, LL32 8FA. For more Information please visit our website at www.petrostrat.com.

FUTURE MEETINGS AND CONFERENCES

42ND ANNUAL MEETING OF THE AASP-THE PALYNOLOGICAL SOCIETY

Meadowview Convention Center, Kingsport TN
Natural History Museum, Gray Fossil Site, ETSU

The 42nd Annual Meeting of the AASP-The Palynological Society is being held in the Appalachian Mountains of east Tennessee, bordering Virginia, and North Carolina. **Start making plans to attend now!** Plans for a pre-conference workshop and post conference field trips are being made. In addition, thematic sessions on forensic palynology and in honor of Ronald Kapp are underway. Three general lectures are planned, featuring David Pocknall: *Palynology and Petroleum: Supplying Americas Energy Needs*, Vaughn Bryant: *Pollen, Much More than a Sneeze*, and Owen Davis: *Climate Change in Arid Regions*, and will be open to the public.

I also want to remind every member and non-member, whether attending the meeting or not, that you are welcome to submit your best artistic photographs that depict any aspect of palynology (including industry, organic petrology, ultra-structure, etc.) for a display that will be presented at the Natural History Museum and Gray Fossil Site. The exhibit opens on the night of the ice breaker September 27, 2009 and will run about 2 months. We will also take suggestions for the name of the exhibit. Send an electronic version of the photograph(s) or a high quality photograph on paper to Michael S. Zavada, Department of Biological Sciences, Box 70703, Johnson City, TN 37614 or electronically to zavadam@etsu.edu . The museum will mount and label the photographs, and will be returned at the end of the public display. Immediately following the meeting is the International Storytelling Festival in nearby Jonesborough, TN. This festival annually attracts tens of thousands for down-home fun, and includes crafts, music, and showcases the rich folklore and oral traditions of the Appalachian and international peoples.

The 42nd Annual Meeting will be held at Meadowview Resort (http://www.bookmarriott.com/329/index.html) at the foot of Bay's Mountain, in the Tri Cities (Bristol-Kingsport-Johnson City), which offers a stunning setting with

swimming, golf (18 holes only $45 with cart) and local tourist attractions (including Barter Theatre, and all that Ashville, N.C., Pigeon Forge and Gatlinburg have to offer less than 90 minutes away). It is especially fun for children. The airport is located just a few miles from the resort (http://www.triflight.com/). In addition, the cost of the meeting is all inclusive. This means the prices include the entire meeting package, i.e., meeting registration, resort hotel accommodations, food (outstanding Breakfast, Lunch & Dinner buffets), Icebreaker with music by *The Bearded* (http://www.thebearded.org/mnuHome.htm) , Tuesday Evening Banquet with music by the ETSU Music Department Jazz Ensemble, transportation to and from events, the Wednesday business luncheon, and workshop (if applicable). Field trip or attendance at the International Story Telling Festival is separate. **The costs are very reasonable for students and for international attendees.**

MEETING SCHEDULE

Friday 25th: Check-in if attending workshop

Saturday 26th: Workshop "Understanding Pollen and its Application to Forensic Palynology"

Sunday 27th: Check-in & Meeting Registration, Icebreaker at Museum of Natural History and Gray Fossil Site

Monday 27th: Sessions, Public Lecture

Tuesday 29th: Sessions, Public Lecture, Evening Banquet

Wednesday 30th: Sessions, Business Luncheon, Public Lecture

Thursday 1st: Field trip

Friday 2nd: Field trip, Storytelling Festival

Saturday 3rd: Field trips return to Meadowview, International Storytelling Festival

Sunday 4th: Check-out, Last day of Storytelling Festival

REGISTRATION

In January a website will go active for registration and submission of your abstract. **A non-refundable deposit of $250 is required at registration** although you can submit the entire amount at the time of registration. Abstracts are due by **August 10, 2009**. **The prices below are *all inclusive.***

All prices are "per person" rates

MEETING ONLY

Option 1 – Sunday Check-in to Wednesday Check-out
Single: $875, Double: $775
Triple: $650, Quad: $625

Option 2 – Saturday Check-in to Wednesday Check-out
Single: $1000, Double: $825
Triple: $775, Quad: $725

Option 3 - Sunday Check-in to Thursday Check-out
Single: $1000, Double: $825
Triple: $775, Quad: $725

Option 4 – Saturday Check-in to Thursday Check-out
Single: $1125, Double: $950
Triple: $900, Quad: $850

WORKSHOP + MEETING

Includes cost of the workshop (Transportation will be provided to and from Meadowview and ETSU)

Option 1 – Friday Check-in to Wednesday Check-out
Single: $1150, Double: $1025
Triple: $925, Quad: $875

Option 2 – Friday Check-in to Thursday Check-out
Single: $1275, Double: $1100
Triple: $1050, Quad: $1000

MEETING + FIELD TRIP

Add the approximate cost of the field trip or event to Options 3 or 4 for "Meeting Only"

Appalachian Habitats: Flora, Bears, and Birds, Organizer: Fred Alsop (add approximately $450). Includes food, transportation, accommodation, guides, and materials. *Minimum10 participants*

Tennessee Ball Clays, **Collecting the Clairborne**, Organizers: Liu and Zavada (add approximately $450). Includes transportation, accommodation, light breakfast, a visit to the Courthouse and Museum in Dayton, TN, the site of the Scopes Monkey Trial (http://www.law.umkc.edu/faculty/projects/FTrials/scopes/scopes.htm or http://www.bryan.edu/1990.html), and fossil collecting near Paris, TN. Does Not include lunch and dinner Thursday-Saturday. *Minimum 10 participants*

International Storytelling Festival, Jonesborough, TN ($120 each additional night at Meadowview (all inclusive) + the cost of the ISF Tickets see http://www.storytellingcenter.net/festival/about-fest.htm). Meeting participants can continue their stay at Meadowview for this international event that begins on Friday October 2 and ends Sunday October 4 in the oldest town in Tennessee, Jonesborough. Attend one, two, or all three days of the festival.

WORKSHOP + MEETING + FIELD TRIP

For the best value, add the approximate cost of your chosen field trip to the following choices if you want to participate in the Workshop and attend the entire meeting. Those attending the ISF should add $120 for each additional night at Meadowview and the cost of the ISF tickets. **NOTE: During the International Story Telling Festival local Motels double their prices and most are booked well in advance.**

Friday Check-in to Thursday Check-Out

Single: $1275, Double: $1100

Triple: $1050, Quad: $1000

Looking forward to seeing you at the meeting!

Michael Zavada, East Tennessee State University, Department of Biological Sciences, Box 70703, Johnson City, TN 37614 USA, zavadam@etsu.edu

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EUROPEAN UNION OF GEOSCIENCE GENERAL ASSEMBLY 2009

http://meetings.copernicus.org/egu2009/

Call for papers Session SSP5: The Terrestrialization process: timing, mechanisms, and impact on the Earth System (co-sponsored by IAS).

http://meetingorganizer.copernicus.org/EGU2009/session/926

We would like to cordially invite you to this session focusing on the terrestrialization process during the Palaeozoic.The colonization of continental and subaerial environments by plants and animals constitutes one of the most important events in the history of life, and correlates in time with periods of major palaeoenvironmental perturbations, including the major drop in atmospheric CO_2 in Phanerozoic history, a transition from greenhouse to icehouse climatic state, and a global reorganization of sedimentary dynamics. It thus represents one of the best examples of co-evolution of life and its environment. This session is intended to gather together all specialists of the various aspects of the terrestrialization process and to discuss the latest developments in this field of research. Some of the topics that will be addressed are: - Origin and evolution of land plants: the palynological record from Cambrian to Devonian- Origin and evolution of land plants: the macrofossil record- The terrestrialization of animals: palaeobiology and

palaeoecology of the first tetrapods- The palaeoenvironments of early terrestrial ecosystems- The fossil record of insects and the coevolution of insects and land plants- The impact of vegetation cover and soil development on processes of erosion and sediment transport- Global changes associated with the "greening of the planet": palaeoclimate, biogeochemical cycles- Response of marine communities to varying nutrient inputs in the oceans The EGU General Assembly is the major geoscience meeting in Europe; The EGU General Assembly 2009 will bring together geoscientists from all over Europe and the rest of the world into one meeting covering all disciplines of the Earth, Planetary and Space Sciences. Especially for young scientists the EGU appeals to provide a forum to present their work and discuss their ideas with experts in all fields of geosciences. The EGU is looking forward to cordially welcome you in Vienna!

Conveners:

Marco Vecoli, University of Lille 1, France, marco.vecoli@univ-lille1.fr

Gaël Clement, Natural History Museum, Paris, France, clement@mnhn.rf

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CIMP Faro'09
II Joint Meeting of Spores/Pollen and Acritarch Subcommissions

CIMP FARO'09. II JOINT MEETING OF SPORES/POLLEN AND ACRITARCH SUBCOMMISSIONS

MEETING

Devonian to Carboniferous Palynology: Contributions to Palaeogeography, Palaeoceanography, and Geotectonics of the Euramerica – Gondwana Collision **Venue**: University of the Algarve, Faro, Portugal.

Date: 20 to 24 September 2009.

The Spore/Pollen and Acritarch Subcommissions of the CIMP warmly invite you to attend the CIMP Faro 09 meeting on Devonian to Carboniferous Palynology: Contributions to Palaeo-geography, Palaeoceanography, and Geo-tectonics of the Euramerica – Gondwana Collision.

This reunion builds on the general CIMP meeting held in 2007 in Lisbon and will bring together palynologists and other geoscientists with the aim of stimulating discussion regarding the utility of palynomorphs in the reconstruction of the Euramerica – Gondwana collision. We are seeking presentations in which palynomorphs contribute significantly to palaeogeographic, palaeoceanographic, and geotectonic models. Studies that integrate palynology with stratigraphy, sedimentology or other disciplines, are also welcome.

A two-day technical session will be followed by a two-day fieldtrip to the key outcrops of the Upper Devonian to Carboniferous Southwest Sector of the South Portuguese Zone. Due to difficulties relating to safe access of the outcrops, the fieldtrip will be limited to the first 25 participants. However, the technical sessions will not have any restrictions as to the number of participants.

We will very soon be including on the CIMP web page a link with all the information regarding this meeting.

Hope to see you all in Faro.

The organising committee,

Paulo Fernandes, Zélia Pereira, Tomás Oliveira, Geoff Clayton, and Reed Wicander

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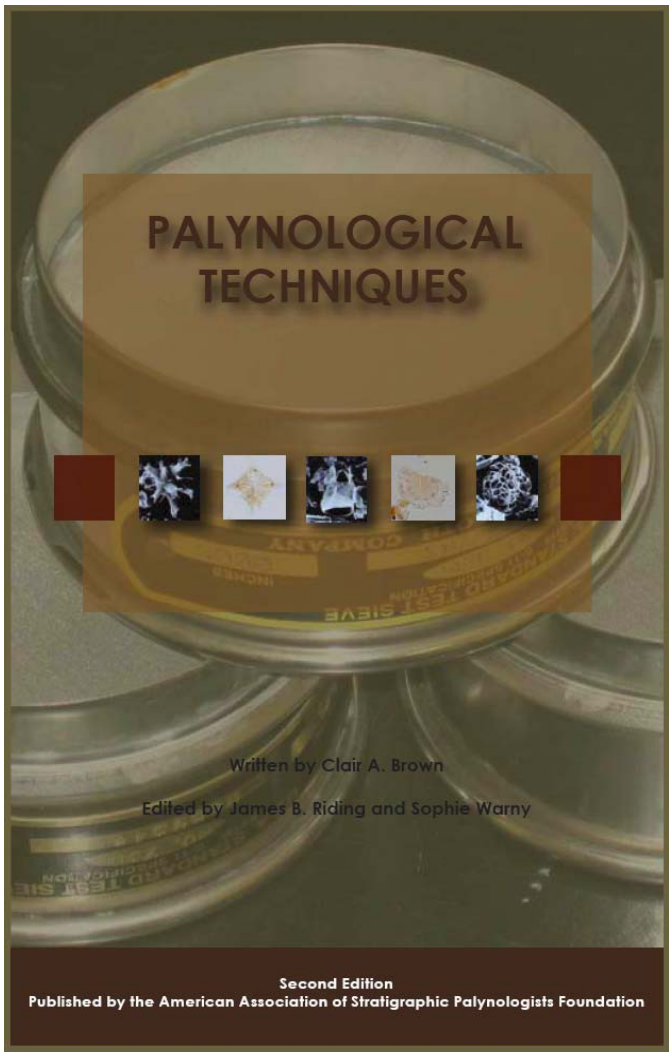
FRENCH PALYNOLOGICAL SOCIETY (APLF)

The 21st meeting of this society takes place in Lille on June 2-5 together with the French palaeontologists.

Thomas Servais, Thomas.Servais@univ-lille1.fr

NEW BOOKS



POLLEN AND SPORES . APPLICATIONS WITH SPECIAL EMPHASIS ON AEROBIOLOGY AND ALLERGY

By Shripad N. Agashe, Professor Emeritus in Botany, Bangalore Univeristy, Bangalore, India & Eric Caulton, Director, Scottish Centre of Pollen Studies, Napier University, Edinburgh, Scotland. Ca.400 pages, hc; US $109.00 / British Pounds 61.00 / Euros 88.80. Book published and released in January 2009 by Science Publishers, P.O.Box 699, 234, May Street, Enfield, New Hampshire 03748, USA, sales@scipub.net. UK & European Distributor: NBN International, Estover Road, Plymouth PL67PY, UK.

orders@nbninternational.com

PALYNOLOGICAL TECHNIQUES, 2nd EDITION

By Clair A. Brown. Edited by James Riding and Sophie Warny. Published by the American Association of Stratigraphic Palynologists Foundation. 146 pages 0.5 x 8.5 inches, laminated soft cover, ISBN 978-0-931871-07-8, LCCN: 2008932132.2008. ($ 15). (weight 0.75 lbs.). Weblink: https://payment.palynology.org/index.php?main_page=product_info&cPath=73&products_id=322

CHITINOZOAN DATABASES (O. & F. Paris)

The SEM photos made by myself and by my students since 1972 have been digitalized and are being stored in a huge database ("CHITINOSEM") including close to 20.000 digital pictures with the related geographical, stratigraphical, systematic data (Fig. 1).

This database is connected with a system of "help for identification" based on the selection of morphological criteria among a large set of characters. It allows a rapid multi-criteria sorting of the material and comparison of new individuals with previously illustrated specimens.

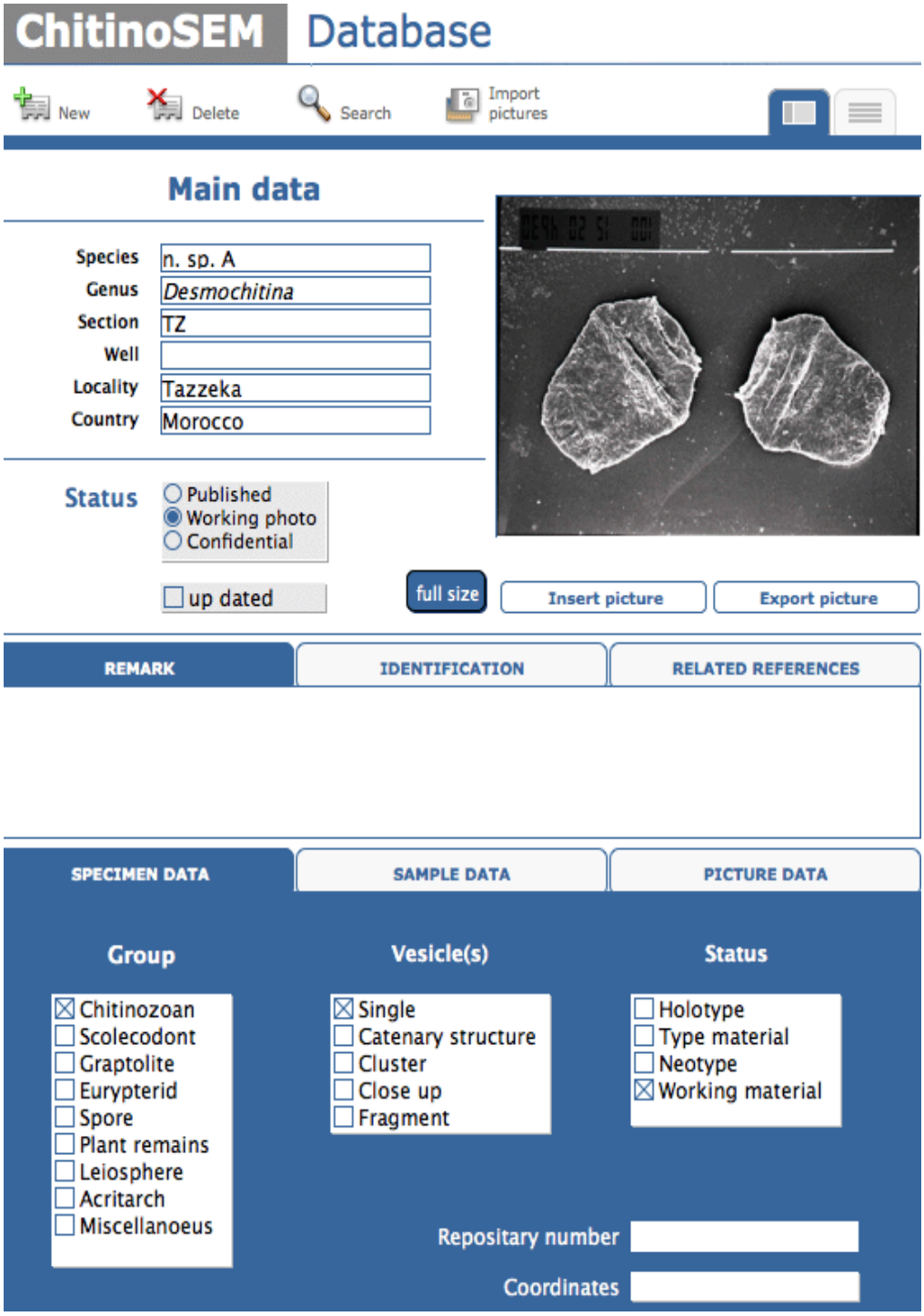


Fig. 1

Another database ("CHITINOVOSP"), initiated some 15 years ago (Paris, F. & Bernard. D, 1994, Abstract of the Sheffield CIMP Symposium) has been completed and updated. It includes the 1210 chitinozoan species described up to December 2008. The main palaeontological and stratigraphical information concerning the recorded species are provided (Fig. 2). A system of "help for identification" is incorporated to this database. For an new specimen, and through a few clicks, it allows a rapid selection of the closest related species.

For more information on these databases, please contact me: florentin.paris@univ-rennes1.fr

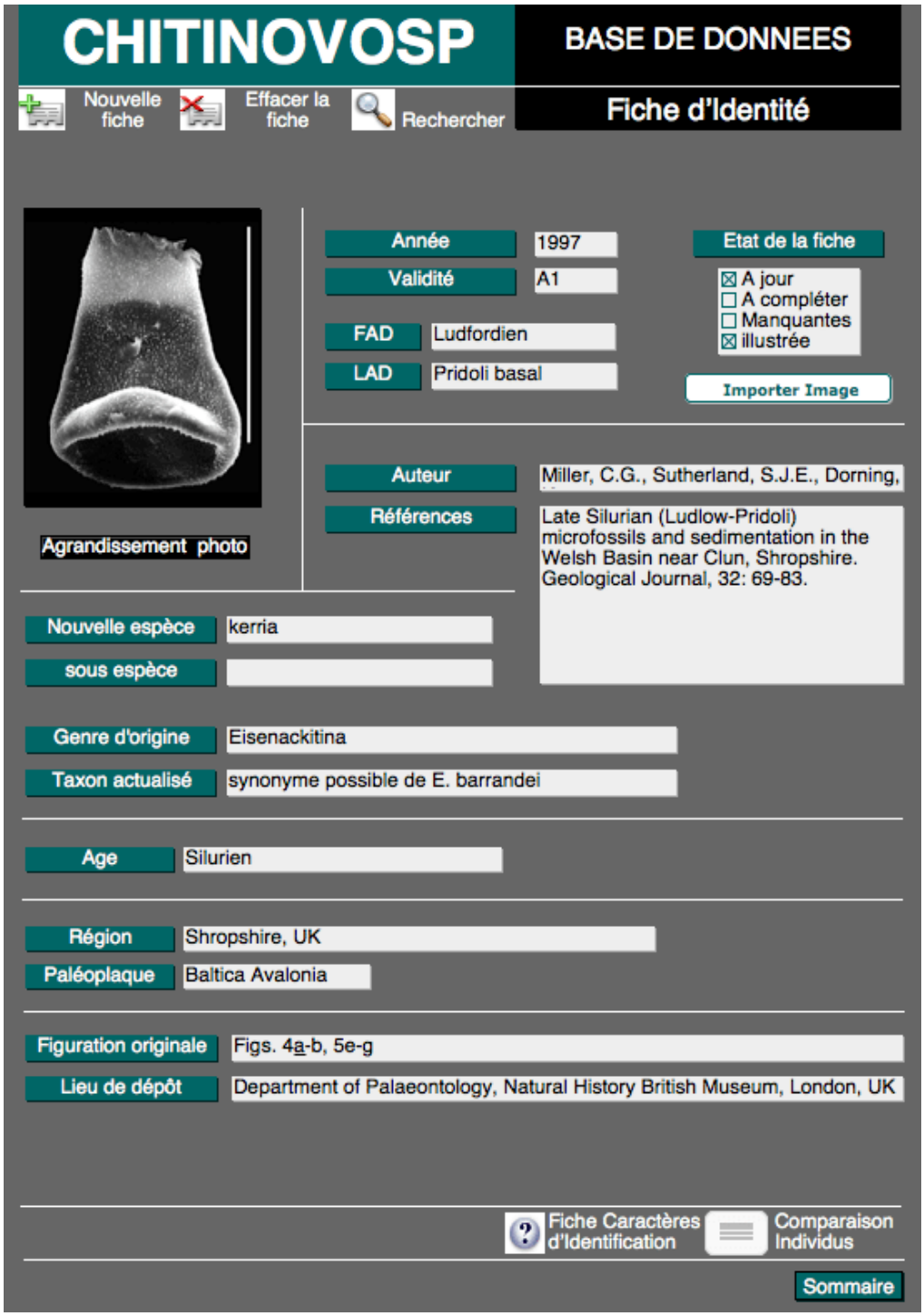

CHITINOVOSP
BASE DE DONNEES
Nouvelle fiche
Effacer la fiche
Rechercher
Fiche d'Identité
Agrandissement photo
Année
1997
Validité
A1
FAD
Ludfordien
LAD
Pridoli basal
Etat de la fiche
A jour
A compléter
Manquantes
illustrée
Importer Image
Auteur
Miller, C.G., Sutherland, S.J.E., Dorning,
Références
Late Silurian (Ludlow-Pridoli) microfossils and sedimentation in the Welsh Basin near Clun, Shropshire. Geological Journal, 32: 69-83.
Nouvelle espèce
kerria
sous espèce
Genre d'origine
Eisenackitina
Taxon actualisé
synonyme possible de E. barrandei
Age
Silurien
Région
Shropshire, UK
Paléoplaque
Baltica Avalonia
Figuration originale
Figs. 4a-b, 5e-g
Lieu de dépôt
Department of Palaeontology, Natural History British Museum, London, UK
Fiche Caractères d'Identification
Comparaison Individus
Sommaire

Fig. 2

Group Photo at the 50th CIMP Dinner, photo: John Marshall

INTERNATIONAL PALYNOLOGICAL CONGRESS, BONN 2008 AUGUST 30TH-SEPTEMBER 5TH, 2008

The following pages document the discussions and decisions at the CIMP General Assembly and the meetings of the various Subcommissions.

CIMP GENERAL ASSEMBLY, Thursday 4th September, Horsaal 10, University Main Building, Bonn

The meeting opened at 18:30, some 40 members and guests were in attendance. Following a few introductory remarks the President introduced the discussion on a new category of sustaining membership. This had been introduced in advance of the meeting in an email (*Important News from CIMP*, 4th April, 2008) to CIMP members. The idea is that this will be companies and other organisations who wish to support the activities of CIMP can choose to do so at a higher annual subscription rate. There would be no increase in subscription rate for normal CIMP members and sustaining members would enjoy no additional membership rights. The advantage of a sustaining member category is that supporting organisations will commit to paying an annual subscription that will give CIMP a regular and predictable income. This is significantly more advantageous than having irregular sponsorship from a few companies. The sustaining member subscription rate will be at least €200, i.e 10x the normal member subscription. After some debate

the following change to the CIMP constitution was tabled

5b. *The category of sustaining members. This will be for companies and other organisations that wish to support CIMP. Staff in these organisations with interests in palynology can be nominated for sustaining CIMP membership and will normally have the same rights and responsibilities as CIMP members. Sustaining members will have their contribution listed in the CIMP Newsletter.*

This addition/change to the CIMP constitution was proposed by Ken Dorning and seconded by Reed Wicander. It was passed by the majority (near unanimous) of CIMP members present..

The President then introduced a general discussion on *CIMP and the future*. This didn't really generate a lot of discussion but was generally positive. Philippe Steemans suggested that we should make more use of the CIMP website and use it as a place to upload pdf's of our palynological publications. There was then a general discussion as to the attitude of publishers if we did this. There was also a discussion about open access publications.

ELECTION OF THE NEW SECRETARY-GENERAL

It was reported that Mike Stephenson was standing down as CIMP Secretary-General on taking up the palaeo-palynology editorship of *Review Palaeobotany and Palynology*. He had done an excellent job as secretary and was thanked in his absence by the CIMP members present. As already announced by email the new CIMP Secretary-General will be Gary Mullins from Fugro-Robertson. Gary was nominated by the CIMP officers and the membership had been canvassed for other candidates. There were none, so Gary was elected unopposed and will take over the role of Secretary-General from the Bonn General Assembly.

FINANCIAL REPORT

The Treasurer Philippe Steemans then presented the CIMP accounts. These are given in this newsletter. Philippe came equipped with a Powerpoint presentation to discover that the laptop computer had been removed.

FUTURE MEETINGS

Warsaw 2010

Marzena Oliwkiewicz-Miklasińska then gave a short but informative invitation for CIMP to meet in Warsaw in 2010. This meeting would be for 2 or 3 days duration and be a general meeting. It would be followed by a 2 day fieldtrip to the Holy Cross Mountains. The date would be either the first or second week of September. The first circular would be available at about the end of 2008. The CIMP members present were very supportive of the proposed meeting in Warsaw, Poland.

ANY OTHER BUSINESS

Marco Vecoli suggested that CIMP should propose a session for the EUG meeting in Strasbourg in 2009. He also reminded members that contributions were needed for the 2008 Spore and Pollen Sub-Commission Newsletter.

The President then closed the meeting by reminding members that his term of office would be completed at the Warsaw CIMP meeting. It was time to start thinking about a replacement.

The meeting then closed and the party walked to the Rietbrocks Weinhaus where Rainer Brocke hosted the CIMP 50th Anniversary dinner. At the suggestion of Catherine Duggan (Acritarch Sub-Commission Secretary) a cake was arranged. Pictures from the dinner are given elsewhere in this Newsletter. Unfortunately the cake proved to be both

too edible and sticky to be able to send a slice to Catherine.

John Marshall

CIMP President, January 2009

Impromptu Speech by CIMP past president Bernard Owens at the 50th Dinner to celebrate 50 years of the CIMP, photo: John Marshall

ACRITARCH SUBCOMMISSION

Greetings Fellow Acritarch Workers:

For those of you who attended IPC XII, you know that we had a very successful meeting with many excellent talks and good attendance at the three CIMP-sponsored symposia. In addition, we had a short Acritarch Subcommission meeting at 6:30 pm on Monday, September 1, 2008 in which 32 members attended. For those of you who were unable to attend, here is a brief synopsis of what was covered at the meeting.

- A brief review of the joint Spores and Pollen/Acritarch Subcommission conference that was held last September in Lisbon, Portugal.
- A short discussion of the necessity of electing a new chairman and secretary at the next CIMP meeting in Warsaw, Poland in 2010. Reed will have served the constitutionally-allowed two terms and cannot stand for a third term. It is time for someone else to be chairman, so think about running for this office. If we do not elect a new chairman and secretary at the next CIMP meeting, we will cease to exist as a subcommission. Catherine's career is taking a turn away from acritarch research, and she will no longer be able to serve as our secretary. This is an excellent position for one of our younger members, and an excellent opportunity to be involved, not only with our subcommission, but the other subcommissions, as well as CIMP. Please consider running for this position, or the chairmanship.
- The fiftieth anniversary of CIMP was noted as well as recognition of the many international professional relationships and friendships that have developed over the years through this organization.
- Members were encouraged to submit updates to the forthcoming Acritarch Newsletter. Submissions need only be a line or two, consisting of contact details and a summary of one's recent research and future plans. Supervisors are strongly encouraged to inform their students, particularly new students, about the newsletter so that they may introduce themselves and their project to other workers.
- There was a brief discussion about the possibility of coming up with some guidelines about how to go about describing acritarchs. There will be more on this in the upcoming Newsletter.
- The Marco Tongiorgi volume in Revue de Micropaléontologie (2008), vol. 51 is now available and contains many acritarch articles.
- Another volume of interest to acritarch workers is vol. 148 (2008) of Review of Paleobotany and Palynology which has a section of five papers devoted

to "Palaeozoic organic-walled microfossils: aspects of their palaeoenvironmental and biostratigrahical significance."

You will soon be receiving a notice to send in what you've been doing for the past year as Catherine starts to put together the next issue of the Acritarch Newsletter. This is your chance to let the world know what research you've been doing or anything else related to the world of acritarchs. We hope to hear from many more of you than we did last year, so start putting your research and publications together to send to Catherine.

And lastly, think about running for either the office of chairman or secretary of our subcommission. The campaign doesn't have to be as long or arduous as the United States Presidential campaign, and there won't be any debates to engage in. Just let either Reed or Catherine know you are interested in one of these positions. Remember, if we don't fill these positions in 2010, there won't be an Acritarch Subcommission, and that would be a real pity!

Best regards,

Reed Wicander – Chairman

Catherine Duggan – Secretary

CHITINOZOAN SUBCOMMISSION

We also convened for a short semi-formal meeting with all the subcommission members present at the conference, where we mainly discussed our next meeting. After having explored the possibility of organising on-line gatherings, we agreed not to have a dedicated chitinozoan subcommission meeting in 2009, due the density of conferences and meeting that already exist. Our next meeting will be at the next general CIMP meeting, normally to be held in Poland in 2010. Ken Dorning suggested that he could look into possibilities of organising a chitinozoan workshop, mainly on taxonomical issues, for people attending the general CIMP meeting. Florentin Paris raised the point that is difficult to organise such a workshop with normal optical microscopes as the detail necessary to discuss most of the taxonomic issues can only be obtained using SEM – magnifications. One way around this may be to bring high-quality digital pictures to such a workshop, allowing to zoom into specimens and details of interest. If you have any comments on this, or special requests, please let Ken or me know.

Ken Dorning – Chairman

Thijs Vandenbroucke - Secretary

SPORES AND POLLEN SUBCOMMISSION

Another year in finishing, with a great number of activities. For those of you who attended IPC XII, you know that we had a very successful meeting with excellent talks and a good attendance at the three CIMP-sponsored symposia.

We had also a short Spore and Pollen Subcommission business meeting, were the following items were discussed:

- A short report on the 2007 meetings and conferences was made;

- A brief review of the joint Spores and Pollen/Acritarch Subcommission conference that was held in Lisbon, in September 2007, Portugal;

- The fiftieth anniversary of CIMP was noted and a few propositions to celebrate the date were made.

- A short discussion of the necessity of electing a new chairman and secretary at the next general CIMP meeting in Warsaw, Poland in 2010. Please consider running for these positions.

- Members were encouraged to submit updates and news to the next Spore and Pollen Newsletter.

- Future meetings were proposed and discussed.

Concerning next year, another Spore/Pollen and Acritarch Subcommissions meeting is coming out (yes, another!), this time with a more field character and under the subject matter: Contributions to Palaeogeography, Palaeoceanography, and Geotectonics of the Euramerica-Gondwana Collision. The venue is at University of Faro (Algarve) in South Portugal. A two-day technical session will be followed by a two-day fieldtrip to the key outcrops of the Upper Devonian to Carboniferous Southwest Sector of the South Portuguese Zone is being planned. See more information in the CIMP Web page.

Zélia Pereira and Marco Vecoli

REPORTS FROM THE INTERNATIONAL PALYNOLOGICAL CONGRESS, BONN 2008

In 2008 the CIMP made several travel awards to help researchers at the beginning of their careers attend the IPC meeting in Bonn. In the following pages they have described some of the science presented and/or their own experiences of attending. I hope that they give those of you who couldn't attend the congress an idea of what research was presented. Enjoy!

THE 12TH IPC, BONN: A POINT OF VIEW OF A YOUNG ACRITARCH WORKER

by Aurélien Delabroye, Université Lille 1, France, aurelien.delabroye@etudiant.univ-lille1.fr

Thanks to the financial support of the CIMP and its members, I was lucky to participate in the 12th International Palynological Congress and the 8th International Organisation of Palaeobotany Conference which took place in Bonn (Germany) from the 30th of August to the 5th of September 2008. Among the fifty organised symposia, three clearly dealt with Palaeozoic palynology (Symposium 37 (CIMP symp. 1): Palaeozoic palynostratigraphy, J. Marshall & M. Vecoli; Symposium 53: Palaeozoic oceanic and climate change, K. Dorning & R. Wicander; Symposium 40 (CIMP symp. 2): Palaeozoic plate of Arabian Plate, M. Miller, P. Steemans & C. Wellman). They concerned a large variety of scientific topics (biostratigraphy, ecostratigraphy, palaeobiogeography, taxonomy, climate change and crisis, carbon cycle and productivity…). I am working on acritarchs for my PhD, I focused more on marine palynomorph communications (acritarchs, chitinozoans, scolecodonts) during the congress.

It has appeared to me that several areas in the world have not been yet investigated in detail, and still remain a lot of work to be done in order to obtain more and more data to compare (e.g. Australia, Wicander & Foster, p. 306, abstract 766). Our vision of the Palaeozoic plankton, its behaviour as regards to palaeoenvironmental pressures of selection, its palaeobiogeography and its disparities (e.g. Hints et al., p. 115-116, abstracts 284), need always new investigations, material descriptions and comparisons. This could help in the development of a powerful alternative biostratigraphic tool which could emphasize weaknesses in major biostratigraphic tools such as the graptolites (Verniers & Nielsen, p. 297, abstract 742; Servais et al., p. 254, abstract 631).

However, a comprehensive synthesis of available data might be helpful for a better efficient Palaeozoic palynology. This is the case of the sometimes confusing acritarch

taxonomy. This question was raised during the meeting of the CIMP subcommission on acritarchs. The Acritarch Working Group is thinking on a global methodology and glossary to use for accurate and efficient acritarch taxonomy. A major revision is needed in order to propose a clearer classification scheme of the group. This would facilitate the comprehending of the acritarch group for future young PhD students and a better harmonisation for comparative studies.

For a long time, this taxonomy has been time consuming when applied because of the extreme high morphological variability and diversity of the group. Now, acritarchs among others Palaeozoic palynomorphs are observed as fossil organisms that lived and evolved according to their environment and its associated changes. Ecophenotypism is then much more taken into account during the material observation (Fatka, p. 76-77, abstract 182). Like for dinoflagellates, acritarchs are very sensitive to environmental perturbations (light, salinity, oxygen) and react by morphological changes because of an important plasticity. If comprehended, ecophenotypism observations could develop alternative solutions to a not always adapted biostratigraphy (e.g. ecostratigraphy). Ecostratigraphy could turn out to be useful to correlate sections of a given basin with high resolution.

The development of our knowledge of the palynomorph's biology and consequently their taxonomy has also been approached by means of new technical investigations. Dutta et al. (p. 71-72, abstract 169) exposed interesting results on the biogeochemistry of prasinophytes, megaspores, scolecodonts and chitinozoans. It appears that each group of palynomorphs shows a different biogeochemical signature. Whatever the group considered and the morphology of the individuals constituting the group, the signature is stable. Neither the acid treatment nor the type of sedimentary rock dissolved has an impact on it. The biogeochemical signature of a given palynomorph group only changes according to the geological period investigated. According to the authors, these biogeochemical investigations cannot lead to the establishment of a chemotaxonomy but are useful for hydrocarbon source rock evaluations. Nowadays, in the future, such techniques could be oriented on the acritarchs. Although globally considered as representing palaeophytoplanktonic micro-organisms, the acritarchs are in fact much more heterogeneous that we think (zooplankton vs phytoplankton, heterotrophic vs autotrophic …). In this way, biogeochemical analyses could help to better understand the biological affinities of the group. The size of acritarchs is the only real obstacle as picking method is necessary before to process to pyrolysis, gas-chromatography and mass spectrometry.

New scientific approaches using Palaeozoic palynology could then be developed. It is the case for Vandenbroucke et al. (p. 294, abstract 734). Like for the studies of Cenozoic and Mesozoic plankton distribution, the authors used different statistical analyses on chitinozoans and graptolites of a biostratigraphically well constrained and well documented time slice (*Normalograptus gracilis* Zone, lower Sandbian, base of the Upper Ordovician) in order to discriminate the main factors controlling the plankton distribution and produce maps of surface currents with latitudinal temperature/climate belts and gradients.

I would like to express my sincere thanks to the CIMP for providing me financial support to attend to this meeting. I could not have been present without this help. It was important for me to be there. I had a thousand of questions for several senior researchers that I could ask and discuss in

details there. This was important for the evolution of my running PhD thesis.

Reference

Terra Nostra, 2008/2, 12th International Palynological Congress (IPC-XII) and 8th International Organisation of Palaeobotany (IOPC-VIII), August 30 – September 5, 2008, Bonn, Germany, Abstract Volume, GeoUnion Alfred-Wegener-Stifgung, Berlin, 337 pp.

CARBONIFEROUS AND PERMIAN PALYNOLOGY AT THE 12TH IPC, BONN

by Niall W. Paterson, Trinity College Dublin, Ireland, paterson@tcd.ie

I hope that everyone who attended the recent meeting enjoyed their stay in the beautiful city of Bonn and found the meeting as productive and rewarding as I did. Since several parallel sessions were scheduled and so many exciting talks were on offer, people were often faced with a tough decision when choosing which presentations to attend. In this article I hope to provide those of you unable to attend all of the Carboniferous and Permian talks scheduled during the week with a 'flavour' of what they may have missed.

Proceedings began with an early start on Sunday morning - Symposium 37: Paleozoic palynostratigraphy; Lower Paleozoic and Upper Paleozoic (CIMP Symposium I). Despite some technical problems with the projector which would persist throughout the session, all of the day's speakers gave excellent presentations. The session commenced with a keynote talk delivered by Clayton *et al*. focusing upon the revision of the Western European Miospore Zonation for the Carboniferous. This fascinating presentation touched upon various important issues such as the standardisation of zonal nomenclature, the basal definition of the zones, and the integration of new data gathered from regions including the Baltic coast of Germany and southern Portugal.

During the course of the morning we heard several accounts of the exciting research currently taking place in regions such as the Czech Republic (Trzepierczyńska *et al*.), Bolivia (di Pasquo), the USA (Heal *et al*.; Paterson *et al*.) and offshore Ireland (Haddow & Clayton). In a well delivered talk, Trzepierczyńska *et al*. presented results from the first palynological investigation of the upper Moravice Formation from the Moravia region, Czech Republic. Despite encountering problems relating to the relatively high thermal maturity of the sample material, the authors were able to assign miospore assemblages to the VF and NC miospore zones.

Later in the morning di Pasquo *et al*. presented a report on the first palynological study of the Pando X-1 Borehole from northern Bolivia. The authors reported that well preserved assemblages of miospores, pollen, microplankton and scolecodonts were recovered from the core samples, and provided a detailed description of the three 'palynoassemblages' recognised during the course of the investigation.

Concluding the first half of the morning session, Sarah Heal together with co-authors Geoff Clayton and Cortland Eble, presented some interesting results from her PhD research in the USA. Focusing upon 'Visean' spore assemblages recovered from the Mississippi Valley Stratotypes in the Midwest USA, the authors discussed the various problems associated with the palynological correlation of Mississippian stage boundaries between the USA and Western Europe. The apparent late first appearance of important zonal taxa such as *Lycospora pusilla* in the 'type' Mississippian region was highlighted and the necessity for a separate miospore zonation for the region discussed. The theme of Mississippian palynostratigraphy in the USA was also a topic discussed in

this authors own presentation later in the morning.

Following a short coffee break, Haddow & Clayton presented the results of a case study in which the revised Carboniferous Miospore Zonation was applied to a well drilled in the Slyne Basin, offshore Western Ireland. The authors reported that application of the revised zonal scheme allowed for greater resolution in the palynostratigraphic interpretations made when compared with previous palynological studies of the well; four biozones and two subzones were identified confirming the inferred Bolsovian – Langsettian age of the section studied and allowing the repositioning of the top Duckmantian (Westphalian B) and Langsettian substage boundaries .

The morning's proceedings were concluded with a couple of fascinating presentations focusing upon Pennsylvanian and Permian palynostratigraphy. Firstly, Souza *et al*. discussed the palynological succession in Pennsylvanian and Permian strata of the Paraná and Chacoparaná Basins in South America. Feng *et al*. then provided a well presented and wonderfully illustrated talk focussing upon megaspores recovered from the Pennsylvanian and Permian succession of northern China.

Palynostratigraphy of Permo-Carboniferous strata was a theme which would continue over the following days. On Monday afternoon (Symposium 53: CIMP Symposium II) Michael Stephenson presented an informative talk concerning the age of the Carboniferous-Permian *Converrucosisporites confluens* Oppel Biozone. This topic resumed on Wednesday afternoon in a special symposium focusing on the Palaeozoic palynology of the Arabian Plate and adjacent areas (Symposium 40: CIMP Symposium III). In this session a series of inter-related talks were presented detailing some of the current research taking place on the Permo- Carboniferous palynology of regions including Saudi Arabia (Hooker *et al*.; Clayton *et al*.), south-eastern Turkey (Stolle) and Oman (Al-Barram; Stephenson). These presentations touched upon on various topics including the character of the Cm Biozone in the region and the difficulties associated with its recognition and interpretation due to reworking (Clayton *et al*.) and a palynologically 'hostile' palaeoclimate and depositional environment (Hooker *et al*.).

As a postgraduate student in the final year of my PhD research it is reassuring to see that the field of Palaeozoic Palynology is currently experiencing somewhat of a revival, a fact which is surely demonstrated by the sheer volume and breadth of the research presented at the conference. I wish to express my gratitude to the CIMP for the generous travel award which allowed me to attend the IPC/IOPC meeting and of course to all of the speakers for presenting such fascinating talks. I very much look forward to seeing everyone again at future meetings and I hope that everyone's research proves to be both productive and enjoyable in the meantime.

SILURIAN AND DEVONIAN TALKS AT THE 12TH IPC, BONN

by Sarah Heal, Trinity College Dublin, Ireland, healse@tcd.ie

Silurian and Devonian palynology was well represented at the 12th International Palynological Congress in Bonn. Thirteen talks were spread over 3 CIMP and 2 open sessions. I managed to attend most of the talks - apologies for any I missed, but I'm sure most would agree that there was a great deal to see and only limited time to see it.

Paleozoic palynology kicked off first thing on the Sunday with Session 37 – handily entitled Paleozoic Palynostratigraphy. After a morning of Carboniferous and Permian talks, the afternoon had plenty of Silurian and Devonian on offer. The first speaker of the afternoon was Marco Vecoli, who gave an account of the

Silurian and Devonian of the Ghadamis Basin, North Africa. Four cryptospore-miospore assemblages were described and the Silurian/Devonian Boundary recognised. The authors illustrated how the closure of the Rheic Ocean and migration of floras from Gondwana to Avalonia are recognised in the palynomorph assemblages. Following this, John Marshall gave an account of palynological assemblages from the Falkland Islands. Assemblages were correlated with those previously described from Brazil and Bolivia. The uppermost Dunbar Creek is recognised as late Famennian (pre-*lepidophyta*) and correlates with Bolivia and South Africa.

Valentina Mantsurova led the way for Russian research with a talk on the Semiluky-Petin Boundary (Frasnian) of Russia. The lower Semiluky corresponds to the *Geminospora semilucensa* – *Perotriletes donensis* zone, the upper part contains the *Spelaeotriletes bellus* and *Cymbosporites vetlasjanicus* subzones of the *ovalis-grumosus* zone. In all sections the characteristics of the zones stay the same but the quantative proportions of taxa change. The final talk of the symposium was given by Zelia Pereira on the late Famennian Cercal Anticline from the Portuguese pyrite belt. Shales from the Cercal Anticline yielded a diverse, well-preserved assemblage dominated by tetrads. This places the assemblage within the VH Biozone and allows correlation with other regions of the pyrite belt. Tucked away in Symposium 34c – Devonian plants and floras, Gil Machado gave a talk on organic-walled microplankton from the Upper Devonian of western Portugal. Although many of the sediments are heavily deformed and metamorphosed, moderately preserved microplankton suggest a Frasnian age. Assemblages resemble those found in the Euramerican late Devonian realm.

Symposium 37 continued on Monday afternoon as Jacques Verniers gave a very interesting talk describing chitinozoans from the Ordovician-Silurian transition in southern Sweden. The authors highlighted the adjustment required for the GSSP section in Dob's Linn, and the use of chitinozoan assemblages for correlating the boundary to non-carbonate sequences. At Röstanga a rich chitinozoan assemblage was obtained, illustrating the essential role that palynology plays in global correlation. In the following session - CIMP Symposium 53 - Paleozoic oceanic and climate change, Marco Vecoli gave an account of organic carbon burial and isotope excursion in the Silurian of North Africa. The earliest Wenlock excursion is linked to a period of massive black shale deposition and an excursion in the late Ludlow is associated with a major turnover in acritarch assemblages. The importance of integrating the two fields of study is highlighted.

Tuesday was our well-earned day of rest and an opportunity to see some of Germany's geological attractions, or cultural wonders, depending on your priorities. Wednesday brought an entire day and CIMP session devoted to the Paleozoic palynology of the Arabian Plate. Sa'id Al-Hajri introduced the session by providing a summary of the collaboration between Saudi Aramco and CIMP since it's inception in 1990 and recognised the work of the contributing scientists. He also gave a very informative overview of the Paleozoic stratigraphy of the Arabian Plate, setting the scene for the following talks. After a morning of Ordovician talks, the coffee break was followed by a second talk from Sa'id, who presented a rich palynological assemblage from the mid-Pridoli of northwestern Saudi Arabia comprising miospores, cryptospores, chitinozoans and acritarchs. This assemblage is likely the result of a brief marine transgression across North Gondwana and contributes towards the formation of a new SO biozone.

This was followed by two talks on the Devonian of Oman. The first was given by Mohammad Ghavidel-Syooki who described 4 acritarch assemblages from the Padeha and Bahram formations ranging from Frasnian to late Famennian, and correlated them to those from North Africa, Western Australia and Saudi Arabia. The second, given by Hossein Hashemi, described marine and terrestrially derived palynofloras from the Geirud Formation, Northern Iran and correlated upper Devonian assemblages with the independent biostratigraphy from the region. Two miospore assemblages were introduced and similarities in the microplankton of Northern and Central Iran were observed as indicating migration routes in the late Devonian.

After lunch, and after some very interesting new data regarding the earliest vascular plants (Wellman *et al.*), we moved back into the Devonian. Pierre Breuer presented a new provincial miospore and megaspore zonation for the Devonian of Western Gondwana. The authors applied a statistical analysis to determine the similarity of Western Gondwanan palynofloras to those from other parts of the world, and recognised a mid Devonian shift from provincial to cosmopolitan floras. Merrell Miller presented an assemblage from the Mid-Devonian Jauf Formation comprising a few acritarchs, a single chitinozoan species and freshwater Chlorococcales. These provide important evidence for freshwater influence in paleoenvironments and are useful in recognizing estuarine and freshwater environments in the Jauf Formation. The session was wrapped up by some very interesting Permian talks, after which we all dashed back to put on our party frocks for the very impressive conference dinner on the Rhine.

The amount and variety of talks showed the enormous amount of Paleozoic palynology research currently going on worldwide, and the large numbers in attendance (especially at the CIMP sessions) demonstrated the great support and interest in the subject within both academia and industry. I'm incredibly grateful to CIMP for their generous assistance which allowed me to attend the conference. I gained a lot out of it, as I'm sure everyone else did, both socially and academically, and made some good friends. It's great to be part of such a friendly and welcoming group of people, and a very useful opportunity to pick fellow scientists brains every year! I look forward to the next meeting.

NON-CIMP PALAEOZOIC RESEARCH AT THE 12TH IPC, BONN

by Jenny Brittain, University College, Cork, Ireland, jen_brittain81@hotmail.com

I had the pleasure, during a very productive and enjoyable week in Bonn at the IPC/IOPC congress, to hear numerous interesting talks on the subject of ongoing Palaeozoic research which were not featured in CIMP sponsored symposia. Fortunately for those of us finishing our PhDs, the conference demonstrated that Palaeozoic research is very much alive and kicking. Unfortunately, this meant that there were so many talks scheduled - especially early in the week – that it was impossible to see them all. Here is, I hope, a flavour of some of those talks for those of you who, like me, were torn between attending CIMP symposia and the many other symposia of interest that were scheduled throughout the week.

Sunday August 31st was chock-full of Palaeozoic research including Paul Strother's Cambrian spores and plant fragments (Symposium 34b, Open topics), which focussed on early plant evolution evidence. The Upper Palaeozoic dominated the schedule however, and ranged from Devonian to late Permian research. This included a symposium on Late Palaeozoic plants as a proxy for

climate(Symposium 44), which, apart from Pfefferkorn *et al.*'s study of climatic signals during a Carboniferous icehouse interval in two Polish coal basins, focused on Indian and Chinese Permian floras (Stevens *et al.*, Banerjee *et al.*, D'Rozario *et al.*, and Yu *et al.*). This was followed by a short symposium on Permian plants and floras (Symposium 34a) in which North American pond palaeofloras (Chaney *et al.*) and Italian gymposperm floras (Fischer *et al.*) were highlights. On Sunday afternoon there was a Devonian plants and floras symposium (34c) convened by Hans Kerp. It focussed on three amazingly well preserved floras from Germany (Schultka, Gossman *et al.*, and Giesen (Giesen's enigmatic field assistant providing great entertainment!)). Many examples of these floras could be seen at the Goldfuss Museum, ten minutes walk from the Conference centre. Also of note in this symposium was the use of the PAST freeware software in analysing the palaeobiogeographical implications of Upper Devonian organic-walled microplankton in Portugal, described by Machado *et al.*.

Another feature of Sunday's very busy programme was the morning sessions on the application of palaeopalynology in palaeoenvironmental analysis, sequence stratigraphy and biostratigraphy (Symposium 28, convened by Christoph Hardkopf-Fröder and Duncan McLean). These were dominated by Devonian and Carboniferous research topics which demonstrated the importance of palynology in multidisciplinary palaeoenvironmental reconstruction projects. The work of Kai Jasper is a good example of this with his multidisciplinary approach to high-resolution reconstruction of Duckmantian paleoenvironments in the Ruhr Basin in Germany. Also of interest in this symposium was the introduction of an innovative new method for dating Dutch Rotliegend 'Barren Red Beds' using biogenic silica particles (Abbink *et al.*).

Monday September 1st provided a hectic schedule, beginning with an interesting discussion by Seyfullah *et al.* on reconstructed Palaeozoic pteridosperms and their bearing on seed plant relationships (Symposium 41). This was followed by many late Paleozoic talks in Symposium 4 convened by Josef Pšenička and Jiři Bek on the reproductive organs of fossil plants and their *in situ* spores and pollen. Current research in the Czech Republic was a feature of this symposium, beginning with an interesting report on the origin of *Calamospora* (Bek) and including a description of well preserved *in situ* spores from Pennsylvanian ferns (Pšenička *et al.*) as well as an informative review of monolete-producing Carboniferous to Permian sphenophylls by Milan Libertin. A new species of lycopsid *Polysporia lugardonii* sp. nov., from the Upper Devonian of Cleveland, Ohio, USA (Chitaley *et al.*) was also presented in this session, as well as Permian pollen and pollen sacs from the central Transantarctic Mountains (Ryberg *et al.*). Finally, on Monday afternoon, Micheal Krings described endophytic microfungi and fungi-like microorganisms preserved within Late Visean land plants from central France (Symposium 35) which, in his own words, offered 'a rare view of the diversity, biology and ecology of microorganisms in a Carboniferous terrestrial palaeoecosystem'.

Tuesday was field-trip day at the conference and many people took advantage of the diversity of field excursions offered to nearby places of geological and historical interest. Wednesday, on the other hand, was dominated, for most CIMP members, by the remarkable quantity of work on the Palaeozoic palynology of the Arabian Plate and adjacent areas (Symposium 40; CIMP Symposium III; convened by Merrell Miller, Philippe Steemans and Charles Wellman). There were several topics in other symposia that day that were of interest, however, such as those presented

in Symposium 9 (convened by Chaloner, Kvaček, and Denk) on the problems naming fossil plants and spores. New approaches to naming were presented by Travese, on the typification of fossil palynomorph names, and by Kvaček, who discussed the problems of naming 'whole plants' or assemblages of fossil plant parts normally found in the fossil record as separate entities, known as morphotaxa, of which palynomorphs form a major part.

Key events in the evolution of early plants using multiple sources of data were the subject of Symposium 20 (convened by Gensel and Berry), also held on Wednesday. Some Lower Paleozoic research was presented here including Taylor's description of Cambrian dyads from North America, two discussions on *Cooksonia* physiology by Boyce and Gonez *et al.,* and a unique discussion by Jennifer Morris on the parent plants of Silurian Cryptospores, based on discoveries of coalified mesofossils from Upper Silurian to Lower Devonian strata of the Anglo Welsh Basin, UK, which either contained *in situ* spores or occurred as spore masses. Charles Wellman also discussed the integration of plant megafossil and dispersed spore fossil records in examining the adaptive radiation of Late Silurian-Early Devonian vascular plants. A discussion of Early Devonian plants from the Armorican Massif in France was presented by Strullu-Derrien *et al.* in this symposium. Several informative presentations on Middle to Upper Devonian plant and palynomorph assemblages from China (Xue *et al.*, Berry *et al.*, and Xu *et al.*) brought an end to another eventful day of debate and discussion, which continued on into the superb conference banquet Cruise on the Rhine.

There was an excellent symposium on past vegetation of Australasia (Symposium 38, convened by McLoughlin and Meyer-Berthaud) on Thursday September 4th, half of which was dominated by Upper Palaeozoic research topics ranging from a comparison of Devonian plants from China and Australia by Wang *et al.* to the keynote lecture of Decombeix *et al.,* on the Mississippian permineralised plants of Queensland, Australia. Finally, from the very upper reaches of the Palaeozoic (!), Keith Holmes compared the vegetation of eastern Gondwana prior to the end-Permian extinction event with its middle Triassic recovery, based on Australian floras.

Several presentations given on Friday 6th of September, the final day of IPC/IOPC, demonstrated the application of scientific data in the reconstruction of Palaeozoic paleoenvironments. These included the work of Mary Parrish on the reconstruction of a Pennsylvanian forest, and an entertaining presentation on the reconstruction of Palaeozoic ecosystems for children, given by Hannah Bonner. Also on Friday was the enigmatic melanosclerite microfossil research presented by Claudia Trampisch, in which she described the wall ultrastructure of these unusual microfossils using new TEM images and differentiated the melanosclerites into genera and species based on this new research.

As demonstrated by the presentations described above, the sheer number and variety of research topics from the Palaeozoic at the concurrent International Palynological Congress and International Organisation of Palaeobotany Conference demonstrate that the field of Palaeozoic research is alive and well in the scientific community, contradicting the concern that more recent geological time (Mesozoic to Holocene) has come to dominate world palynological research. The talks prove that Palaeozoic research is a wide ranging field and covers many ages, in many parts of the world. It is interesting to note the pre-eminence of the Upper Palaeozoic in current global research, however- it seems the Ordovician did not get a look in at the conference! It was beneficial to see the

scope of ongoing work, not just in palynology and palaeobotany as pure sciences, but their application and importance in the wider scientific community. I gratefully acknowledge the generous Travel sponsorship provided by CIMP which allowed me to benefit from attending the IPC/IOPC in Bonn, an experience that proved to be both highly educational and enjoyable.

THE EXPERIENCE OF ATTENDING THE IPC

by Sol Noetinger, UBA/CONICET, Argentina, snoetinger@gl.fcen.uba.ar

The idea that the International Palynological Congress and the International Organisation of Palaeobotany Conference were held together was overwhelming but exciting. The possibilities on planning to attend the event were something different. Coming from the farthest south of the world was not an easy task to achieve. Fortunately I was awarded with two financial grants, one from this association and one from the AASP, which helped me made the jump over the pond.

After a really long and exhausting flight, I arrived to Germany, a train later, I was finally in Bonn… running to get to the open ceremony, trying not to get distracted by the beautiful buildings and general landscape.

The end of the summer was being kind to us allowing the Icebreaker Party to be held outside, in the Botanical Garden, what a treat! The building, the flowers… as soon as the national beer started to run, you could hear the first attempts of the recently arrived ones to socialize in different languages. I was lucky to meet up with colleagues who were abroad for different reasons and I was introduced to several new ones, as well. But I did have not much time to be social, I had to go through the Programme, marking up pages and painting with colours the lectures that I wanted to be present at… what a difficult thing! I desperately wished to be able to split myself in two, in order to go to all the presentations I would have liked to.

The next morning the sessions started on time. Hung my poster and went over to the Lecture Room 1, the "Palaeozoic palynostratigraphy" symposium was my first choice. It is not the purpose of this contribution to give you a detail review about the different talks. The general level of the presentations was good. I may say that there were talks that I enjoyed more than others, not only for the topics but also for how beautifully they were presented. As one of the inexperienced participants, it is soothing to see that we are not the only ones to get nervous during a presentation even though the years of practice.

Located in the centre of the available infrastructure for the meeting, the main auditorium, where the posters sessions were being held became the place where you could meet with the other colleagues-friends that were attending different sessions. This room was an open window to get into different palynological and palaeobotanical worlds, having enough time to read and to analyse the diverse proposals. To me it was an opportunity to wait for some authors that I was willing to meet and greet.

Another highlight of the meeting were the crowded corridors during the well-designed schedule of the coffee breaks, which allowed you getting in time, most of the times, into another rooms.

Tuesday was chosen to be the day off and the day assigned for the Field Trips. Unfortunately I was not able to join any of them, even though, they seemed very interesting. Although we arrange an informal tour to the City of Cologne with recently met friends and we shared a delightful day of architecture and regional food exchanging our assorted backgrounds. Getting off from the train, and running into that tremendous cathedral

was an experience on its own. Spectral, nevertheless well grounded… inspiring respect.

The days passed, there were not as many but the various experiences gave the impression, fortunately, that we were there for a longer period of time.

I did not have the opportunity to go to the Congress dinner on the Rhine River, but I have heard that it was magical.

50th Anniversary cake but by the oldest and youngest CIMP members. To clarify for Bernard, the definition of oldest is the member present with the longest CIMP membership. Kristina Mehlqvist from Lund, Sweden, is the 'youngest' CIMP member, photo: John Marhsall

The meeting was getting to an end. Thursday night was the time for the CIMP General Assembly, a good opportunity to check out the faces that constitute this association. After the institutional updates and new proposals, I guess published in this same number, we walked our way out to the reception and dinner held at the Rietbrocks Weinhaus, a traditional place where politicians were supposed to have had good times as well as the locals. In a very warm ambiance, the reunion invited to mingle and enjoy. Again, great food and general good mood!. The coronation of the night was with a cake that was cut by the longest affiliated to the association, Bernard Owens, and the newest one, Kristina Mehlqvist, and then a big cheeeeeeeese smile for a group picture.

I should confess that I did not participate in the closing ceremony. I was already beginning my long way back home. During my train, train, airport one, flight, airport two and flight I started to settle down the whole Bonn experience, as I decided to call it. The balance: a modest sum of poster prints, papers and magazines; names associated with faces; new contacts; new techniques to practice (thank you Pierre for your patience); an updated review of the subjects our colleagues are working on, a refreshing interaction with people from different parts of the world; and a couple of extra kilos (thanks to the great local food!).

I cannot thank you enough for making this opportunity possible. Thank you, I will be forever grateful.

ABSTRACTS OF FROM THE INTERNATIONAL PALYNOLOGICAL CONGRESS, BONN 2008

The following pages list the abstracts for the talks and posters presented at the IPC in Bonn, reproduced here with the kind permission of the organizing committee. The abstracts are arranged under the headings of the three CIMP symposia given at the congress. In addition, abstracts presented in other symposia that have a Palaeozoic palynological theme are also listed.

SYMPOSIUM 37: PALEOZOIC PALYNOSTRATIGRAPHY: LOWER PALEOZOIC AND UPPER PALEOZOIC (CIMP SYMPOSIUM I)

Conveners: John Marshall and Marco Vecoli

CARBONIFEROUS MIOSPORE BIOSTRATIGRAPHY IN WESTERN EUROPE

Geoffrey Clayton[1], Ken Higgs[2], Duncan McLean[3], Bernard Owens[4]

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A revised scheme of miospore biozones for the whole of the Mississippian Subsystem and much of the Pennsylvanian in Western Europe was presented in outline at the 15th International Congress on Carboniferous and Permian Stratigraphy at Utrecht in 2003. At this time, the ranges of all of the stratigraphically-significant miospore taxa used in the original 1977 scheme were critically reviewed and several of the original index species were replaced by more appropriate taxa. A standardised system of basal definition and nomenclature was also introduced for each of the zones in order to eliminate ambiguities caused by the use of dual index species in parts of the 1977 zonation. Recent developments in Carboniferous palynostratigraphy are now reviewed and their bearing on the establishment of a comprehensive zonal scheme assessed. Publication of miospore assemblages from parts of Europe that were previously poorly known, such as southern Portugal and the Baltic coast of Germany, has enabled extension of the geographical applicability of the scheme. However, these studies have also drawn attention to significant differences in both the stratigraphic ranges of some taxa and the typical quantitative composition of assemblages at several stratigraphic levels. Recent revision of the chronostratigraphic classification of the Carboniferous System has also raised new questions concerning the age and correlation of some of the twentysix miospore biozones in the current zonal scheme, notably in relation to the base of the Pennsylvanian Subsystem and the base of the Viséan Series.

NEW LATEST HIRNANTIAN ACRITARCH AND CHITINOZOAN ASSEMBLAGES OF BALTICA (TOPMOST PORKUNI STAGE, VALGA10 DRILL CORE, SOUTHERN ESTONIA): BIOSTRATIGRAPHICAL INTEREST

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The latest Ordovician is characterised by global environmental perturbations (e.g., Hirnantian glaciation) which had a major impact on the biosphere (Late Ordovician mass extinction). Improvement of the chronostratigraphic resolution of the Hirnantian biozonations is critical for a better understanding of the chronology and cause-effect relationships among geological and biological events. We focus here on palynomorph assemblages from a key-section crossing the Ordovician-Silurian boundary in the carbonaceous sequence of southern Estonia (Valga-10 borehole). Fourteen samples have been

analysed, encompassing the Pirgu (upper Katian), Porkuni (Hirnantian) and Juuru (Rhuddanian) regional stages. Two samples from the Porkuni Stage (Ēdole Member of the Kuldiga Formation and Brocēni Member of the Saldus Formation) yielded a very diversified and extremely well preserved assemblage comprising acritarchs, prasynophytes and cryptospores, showing no evidence of reworking. This assemblage has a clear late Ordovician affinity and is clearly distinct from the stratigraphically lower assemblage recognized in the Pirgu Stage of the same borehole. In addition to typical late Katian species such as *Orthosphaeridium rectangulare*, *O. insculptum* and others, more than ten new species have been recognized in this assemblage (i.e., *Evittia* n. sp., *Ordovicidium* n. spp. A and B, *Goniosphaeridium* n. sp., *Oppilatala* n. sp., *Baltisphaeridium* n. spp., *Orthosphaeridium* n. sp., and *Peteinosphaeridium* n. sp.). The same interval yielded a peculiar chitinozoan assemblage composed of six morphotypes: *Rhabdochitina*? sp., *Belonechitina* sp., *Conochitina* sp. A, *Ancyrochitina* sp., *Spinachitina* sp., and *Conochitina* sp. B. These taxa have never been previously recorded in the Porkuni Stage of Baltica. This assemblage clearly differs from the two preceding chitinozoan Zones of Hirnantian age which have been also identified, and are well known in Baltica: the *S. taugourdeaui* and *C. scabra* Zones. Carbon isotopic data indicate that these new palynomorph assemblages stratigraphically correlate with the descending leg (post-*S. scabra* Zone) of the well known Hirnantian Isotopic Curve Excursion, corroborating a latest Hirnantian age. The new chitinozoan assemblage is proposed here as a potential new, post-*S. scabra* uppermost Hirnantian Zone in Baltoscandia. The absence of this zone in other parts of Baltoscandia might prove the existence of hiatuses in many previously investigated Ordovician-Silurian boundary sections.

MORPHOLOGICAL VARIABILITY OF THE ACRITARCH GENERA ADARA FOMBELLA 1977 AND ELIASUM FOMBELLA 1977 IN CAMBRIAN OF THE BARRANDIAN AREA (CZECH REPUBLIC)

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Five species have been assigned to the Cambrian genus *Adara* Fombella 1977 (type species *Adara matutina* Fombella 1977), while *Eliasum* Fombella 1977 (type species *Eliasum llaniscum* Fombella 1977) includes eight species ranging from the early Cambrian to early Silurian. One or two species of *Adara* have been established in samples of Cambrian age in Europe, Africa and Newfoundland, while one to three species of *Eliasum* have been usually determined in papers dealing with acritarch assemblages from Africa, South and North America, Europe and Asia. However, detailed evaluation of morphological variability within separate populations has been never published for these two genera. Presence of *Eliasum* llaniscum Fombella 1977, *E. jennessii* Martin in Martin and Dean 1984, *E. pisciforme* Fombella 1977 and *E. asturicum* Fombella 1977 was documented in Cambrian to Ordovician sediments of the Barrandian area and *Adara alea* Martin in Martin and Dean 1981 and *A. longispinosa* Fatka 1989 were established in Cambrian sediments in this area. Good preservation and common occurrence of acritarchs in the richly fossiliferous Jince Formation at the Vinice Hill locality near Jince furnished material used for detailed morphometrical study of eight populations of *Adara* and *Eliasum*. The separate populations originating from eight palynological samples taken from a continuous section provided the possibility

to observe trends in morphological changes. Within the studied interval trends in morphological changes observed in *Eliasum* and *Adara* show comparable patterns. The Czech Science Foundation supported the contribution through the Project No 205/06/0395.

GONDWANA MONOSACCATE POLLEN GRAINS: PALYNOTAXONOMICAL AND STRATIGRAPHIC APPROACH BASED ON SELECTED GENERA OF BRAZILIAN INTRACRATONIC BASINS

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The Subturma Monosaccites Chitaley emend. Potonié & Kremp includes a significant number of species of monosaccate pollen grains well represented in the Late Palaeozoic Gondwanan palynofloras related to the Cordaitales, Pteridospermales and Coniferales. In the last decades, some taxononomical revisions were published based on South America materials, especially from Argentinian and Brazilian basins. Pennsylvanian and Permian deposits in Brazil yielded abundant records of these pollen grains enough to promote a re-examination mainly of several species of genera here assigned to the Infraturma Monopolsacciti (e.g., *Costatascyclus* Felix & Burbridge emend. Urban) and Dipolsacciti (e.g., *Cannanoropollis* Potonié & Sah, *Plicatipollenites* Lele, *Potonieisporites* (Bhardwaj) Bharadwaj, *Circumplicatipollis* Ottone & Azcuy, *Caheniasaccites* Bose & Kar, *Crucisaccites* Lele & Maithy, *Stellapollenites* Lele and *Divarisaccus* Venkatachala & Kar). New palynofloras obtained from the Upper Palaeozoic deposits of Brazilian intracratonic basins allow the updating of synonymy lists of many species recorded in other basins of Uruguay and Argentina also. Their main diagnostic features are emphasized and schematic drawings areprovided to make comparisons easier. Moreover, these palynofloras have recently been well constrained by radiometric data, so they are used to refine the stratigraphic distribution of this group, which is more abundant in the Pennsylvanian and Lower Permian deposits, and is scarce or absent from the Middle to the Upper Permian in this part of Gondwana.

PALYNOSTRATIGRAPHY OF THE UPPERMOST CARBONIFEROUS AND LOWERMOST PERMIAN SEDIMENTS IN THE SUDETES (SW POLAND)

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Palynostratigraphical studies were focused on the lacustrine sediments occurring among red-brownish rocks of the uppermost Carboniferous and lowermost Permian in the Intra- and Northsudetic Basins, SW Poland. In the Intrasudetic Basin samples were taken from so called *Antracosia* shales, which are considered as forming two separated stratigraphical levels, and the *Walchia* shales. Previous palynostratigraphical studies of these sediments have not solved problem of the Carboniferous/Permian (C/P) boundary in this section, although this boundary have been usually located below the lower level of the *Antracosia* shales. In the Northsudetic Basin the *Antracosia* shales were sampled and they have not been biostratigraphically dated earlier. Rich and diverse miospore assemblages were recognized in the studied rocks. The stratigraphical interpretation of the palynological data based on various percentage of the main groups of

miospores and occurrence of some stratigraphically important taxa. The *Antracosia* shales from the Intrasudetic Basin belong to three Upper Pennsylvanian miospore Biozones: *A. spendidus-L. trileta* (ST), *P. novicus-bharadwaji-C. major* (NBM) and *V. costabilis* (VC). It suggests that they do not occur as two stratigraphical levels, but rather the episodes of the lacustrine sedimentation took place in different parts of this basin during the time interval, corresponding to the ST-VC Biozones. The *Antracosia* shales in the Northsudetic Basin accumulated at the end of this time interval as they belong to the VC Biozone. The *Walchia* shales contain miospore assemblages with numerous *Vittatina* specimens and were assigned to the *D. striatiti* (DS) Biozone, known from the stratotype of the C/P boundary in Kazakhstan. It indicates that the C/P boundary in the Intrasudetic Basin should be located in the *Walchia* shales, which earlier had been considered as the upper Autunian. This research was supported by the Ministry of Science and Higher Education (project 2- PO4D-078-28 'The organic matter petrology of the Late Palaeozoic lacustrine black shales from the Sudetes, Poland').

A REVISED CARBONIFEROUS PALYNOSTRATIGRAPHY FOR WELL 27/5-1, SLYNE BASIN, OFFSHORE WESTERN IRELAND

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A revised Carboniferous palynostratigraphy for the Enterprise 27/5-1 well, located in the Slyne Basin, offshore Western Ireland is presented. Drilled in 1996, the well encountered a Pennsylvanian (Upper Carboniferous) section. Previous palynostratigraphic interpretations, utilising an industry-based miospore zonal scheme, identified a 269 metre succession of Bolsovian (Westphalian C) to Langsettian (Westphalian A) age rocks, although the top Langsettian substage boundary proved difficult to position. Revised palynostratigraphic interpretations use the recently revised Carboniferous miospore zonal scheme of Western Europe and incorporate recent modifications to the North Sea Carboniferous miospore biozonation. Palynological data from the previous analysis in addition to data from thirty new cuttings samples are interpreted in terms of the revised zonal scheme. Due to the potential for caved miospores occurring within the cuttings samples, biozones are primarily defined on stratigraphic range tops (first downhole appearances) of key miospore species. However, as reworked miospores are present throughout the well section, the range bases of biozone defining species are also considered. Using the revised zonal scheme enables higher resolution palynostratigraphic interpretations; four biozones and two sub-biozones are identified, confirming the presence of Bolsovianto Langsettianage rocks and facilitating the repositioning of the top Duckmantian (Westphalian B) and Langsettian substage boundaries. The revised interpretations also enable correlation of the 27/5-1 well palynostratigraphy with other recently reinterpreted Carboniferous well sections in the adjacent PorcupineBasin.

PALYNOLOGICAL CORRELATION OF MISSISSIPPIAN (CARBONIFEROUS) STAGE BOUNDARIES IN THE MIDWEST USA AND EUROPE

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The introduction of the Mississippian and Pennsylvanian as subsystems of the Carboniferous has highlighted difficulties in the correlation of their constituent stages and stage boundaries. A miospore zonal scheme for Western Europe has existed for a considerable time but no comparable zonation has been established for the USA. This study focuses on marine sections from Kentucky and the MississippiValley. Latest Devonian/Early Carboniferous miospore assemblages from north eastern Kentucky have yielded assemblages representative of the LN, VI, BP and PC European miospore biozones. Kinderhookian, Osagean and Meramecian miospore assemblages from the Mississippi Valley differ in comparison to their Eastern USA and European equivalents, with many key European taxa absent or occurring later in the Mississippi Valley. The first appearance of the miospore *Lycospora pusilla* slightly below the Tournaisian/Viséan boundary is widely recognised as a significant event in Mississippian plant evolution. However, *Lycospora pusilla* is absent in Osagean/Meramecian assemblages from Geode Glen and Cragwold Road in the Mississippi Valley, and does not appear until the Chesterian (late Viséan) at Coles Mill. Here, it appears alongside spore assemblages typical of the European TC Miospore Biozone. This later occurrence of *Lycospora pusilla* in the MississippiValley is most likely due to environmental or palaeogeographical factors, and illustrates the need for a separate miospore biozonation for the Mississippian in this region.

PALYNOLOGY OF THE UPPERMOST SILURIAN TO MIDDLE DEVONIAN FROM TWO WELLS IN SOUTHERN ALGERIA

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A palynological study was carried out in uppermost Silurian to middle Devonian strata of two wells in southern Algeria. Well 1 is located in the Hoggar block, in a very proximal basin margin position. Well 2 is placed 70 km to the west. In general well 2 is in a more distal position at the outer shelf, dominated by pelitic rocks and the proportion of sandstones is significantly lower compared to well 1. Massive sandstone packets typical for the lower to middle Devonian in well 1 are missing completely in well 2. Therefore lithostratigraphic correlation of both sections is very limited. Palynomorphs are present in all samples, mainly miospores, less common Acritarchs and Prasinophytes Chitinozoa are very rare, partially missing. Compared to frequencies in well 1 the proportion of miospores in well 2 is cut by half, whereas acritarchs are increased by 30%. Prasinophytes and Chitinozoa show no differences. Based on miospores a continuous palynostratigraphic framework could be established for the Pridolian to Givetian interval of both wells, leading to a detailed palynostratigraphic correlation. In opposite to well 1 continuous deposition took place from the Pridolian to the Givetian in well 2, but lower sedimentation rates are observed. A clear change from mudstone domianted to a sandstone rich succession at the Silurian/Devonian boundary is observed in both wells. In well 2 a gradual shift from uppermost Pridolian to lower Lochkovian is observed, whereas in well 1 an abrupt change is seen directly at the boundary. This change is observed in organofacies also, especially in terrestrial:marine indices. Ternary plots used for palaeoenvironmental interpretation of organofacies show no clear change between uppermost Silurian and lower Devonian samples. But terrestrial:marine ratios show a significant change from marine to terrestrial dominated organofacies at the Silurian/Devonian boundary. Similar to

lithology a more abrupt change of organofacies is observed in well 1, whereas well 2 shows a gradual shift from the Pridolian into the Lochkovian. Four transgressive intervals (high amounts of marin OM) are observed in palynofacies, two are supported by a lithological change to calcareous deposits. Similar to palynofacies changes at the Silurian/Devonian boundary, transgressional and regressional events are less clearly observed in well 2, especially in the terrestrial:marine ratio of total OM. Again this fits to the more distal position of well 2, where transgressional/regressional changes are observed less sharp than in the more proximal position of well 1.

Giant liliy pads at Bonn, photo: Jenny Brittain

TAXONOMY AND BIOSTRATIGRAPHY OF THE LATE CARBONIFEROUS-PERMIAN MEGASPORES FROM SHANXI, NORTH CHINA

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Megaspores from the Penchi Formation (Moscovian), Taiyuan Formation (Kasimovian-Sakmarian), Shansi Formation (Artinskian-early Kungurian) and Shihhotse Formation (Middle-Late Permian) in Shanxi Province, N. China, are described and illustrated by scanning electron micrographs and transimitted light microscopy. These include eight index species: *Lagenicula horrida* Zerndt, 1934, *Spencerisporites radiatus* (Ibrahim) Felix et Parks 1959 (mainly appearing in Penchi Formation and the lower part of Taiyuan Formation); *Zonalesporites superbus* (Bartlett 1928) Karczewska, 1967, *Gulisporites* sp., *Laevigatisporites glaberatus* (Zerndt) Potonié et Kremp, 1955 (mainly appearing in the upper part of Taiyuan Formation to the lower part of Shihhotse Formation); *Aneuletes spongiosus* Yang and Sun , 1986, *Trileites levis* Fuglewicz, 1980, *Triangulatisporites jimsarensis* Yang and Sun , 1986 (mainly appearing in the upper part of Shihhotse Formation); Other eight species that were previously recorded in N. China are also described based on specimens found in the new localities. The present megaspore taxa are partially comparable to those from other palaeofloristic regions, especially the Euramerican Province, but there are a large number of endemic elements which can be comparable with those from in situ megaspores of N. China. In the Late Permian, the assemblage of megaspore is obviously different from that in Late Carboniferous to Early Permian. But it is somewhat similar to the assemblage recovered in the Guodikengzu Formation and Jiucaiyuan Formation in late Late Permian-Triassic in Xinjiang Province. The botanical affinities of the megaspores with heterosporous lycopsids and ferns suggest that a warm and humid climate prevailed during the Late Carboniferous to Early Permian in N. China. Even though, when time was up to Late Permian, aridity was widespread around the Cathysian Province, wet niches still appeared in short time interval.

THE SEMILUKY-PETIN BOUNDARY (FRASNIAN) IN THE SOUTH-EAST OF RUSSIAN PLATE BY PALYNOLOGICAL DATA

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The boundary between Semiluky and Petin horizons on Russian Plate is connected with a regional break in sedimentation. In Volgograd region on this boundary redeposition of fossils is fixed, therefore in shallow-sea layered sections carrying out border between these horizons is problem. This boundary is well enough characterized by core as Semiluky chalkstones and Petin sandstones are objects for searches of oil pool in them. Semiluky Horizon (0-216m) is represented by shallow-sea layered or bioherm deposits. Depression type section is represented by domanic facieses. Semiluky horizon is subdivided on Lower and Upper Subhorizons. Lower Semiluky deposits corresponds to *Geminospora semilucensa-Perotrilites donensis* zone, established on Russian Plate (Avkhimovich et al.,1993). Miospore assemblage is characterized by prevalence *G. rugosa*, *G. semilucensa*, *G. micromanifesta*, *Archaeozonotriletes variabilis*, *Spelaeotriletes krestovnikovii* and presence *P. donensis*, *Hymenozonotriletes argutus*, *Archaeozonotriletes timanicus*, *V. grumosus*. *Archaeoperisaccus* from individual samples up to 3% in top part is marked. Upper Semiluky Subhorizon corresponds to *Spelaeotriletes bellus* subzone of *ovalis-grumosus* zone. Miospore assemblage is characterized by numerous species: *V. grumosus*, *V. concessus*, *G. rugosa*,

G. semilucensa, *S. krestovnikovii*, *S. bellus*, *Ancyrospora laciniosa*, *Archaeoperisaccus ovalis*, *A. mirus*, *A. completus*, *A. menneri*. Upper Semiluky miospore assemblage contain *Archaeoperisaccus* in amount 3-21%. In earlier published palynological characteristic of Semiluky Horizon (Nasarenko, 1983) they were always marked in amount.

HIGH PALAEOLATITUDE DEVONIAN PALYNOLOGICAL ASSEMBLAGES FROM THE FALKLAND ISLANDS, SOUTH AMERICA

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During the Devonian the Falkland Islands were part of the Cape Basin of South Africa and located close to the palaeo South Pole. The palynological assemblages from the Falkland Islands are very low in diversity and dominated by simple spores together with chitinozoans whilst acritarchs are extremely rare. There are now a significant number of studies on the Devonian palynology of South America and North Africa that enable a more informed interpretation of the palynological assemblages from the Falkland Islands. These palynological assemblages are from a section at Port North in West Falkland which, uniquely for the CapeBasin, has a low level of thermal maturity. The South Harbour Member (Port Stephens Fm) contains rare verrucate and sculptured trilete spores, lacks emphanoid spores and is regarded as early Lochkovian in age. Up section there are more diverse assemblages in the Fish Creek Member which contain the *Dictyotriletes emsiensis* morphon, simple zonate spores and Knoxisporites ?riondiae. They are attributed to the NsZ of Brazil and are of mid/late Lochkovian age. The best correlative datum is from the transgressive black shales of the Fox Bay Formation where the palynological assemblage includes inceptions of *Hoegisphaera* cf. *glabra*, *Ancyrochitina olliverae*, followed by *Ramochitina* '*devonica*' and *R. magnifica* accompanied by *Estiastra barbata*. This assemblage is well known in South America and is now

dated as latest Lochkovian to Pragian with the main transgressive level probably early Pragian. In the upper part of the Fox Bay Formation there is an assemblage with the first specimens of *Emphanisporites annulatus*, *Acinosporites lindlarensis* and *Grandispora* spp which comparisons with Bolivia suggests an early Eifelian age. At the base of the Port Philomel Formation there is a thick black shale with a very sparse palynological assemblage but including leiospheres. Facies and stratigraphic position suggests that this could be the late Eifelian *Evittia sommeri* transgression. Above this level there is the inception of *Geminospora lemurata* and the base of the Givetian. There is then the >500m thick interval of Port Stanley Formation sandstones that generally lacks palyniferous lithologies. But at the top there is a thin interval that contain a late (but not latest) Famennian assemblage dominated by *Verrucosisporites famenensis* together with the *Auroraspora*/*Diducites* morphon, multifurcate tipped spores and *Knoxisporites concentricus*. The acritarchs include *Horologinella horologia*, *Umbellasphaeridium saharicum* and *Maranhites*.

PALYNOSTRATIGRAPHY OF THE PANDO X-1 BOREHOLE BETWEEN 1038 M AND 729 M DEPTH, NORTHERN BOLIVIA

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The palynostratigraphic analysis of thirteen core samples obtained from the 1038 m to 729 m depth of the Pando X1 Borehole (11°36'07'' S, 67°56'45'' W), northern Bolivia, is documented for the first time. Broadly, the three assemblages defined, are composed of abundant and diverse spores and/or pollen grains and microplankton species, fairly well preserved, light yellow to light brown in colour. Pyritization is also recognized in many samples. The palynoassemblage 1 (P1), composed of t hree samples between 1035-1038 m to 972-975 m, yielded several diagnostic species of the Mag Zone (Late Viséan) Melo and Loboziak (2003). Among them, *Schopfipollenites ellipsoides* appears in the upper BAFC-Pl 1522 level while *Foveosporites pellucidus* *Cordylosporites magnidictyus* and many species of *Verrucosisporites*, *Cristatisporites* *Vallatisporites*, *Punctatisporites* and *Leiotriletes* are recorded from the lowest one BAFC-Pl 1524. Palynoassemblages 2 and 3 (P2, P3) are obtained from ten samples between 867-729 m depth. They yielded 48 species of which six are spores and among the pollen grains, 21 are monosaccate and 19 bisaccate (11 striate species) and scarce scolecodonts and microforams are also present. The P2 (867 m to 756 m depth) is dominated by amorphous organic matter and few monosaccate pollen grains and spores. The P 3 (741 m to 729 m depth) is recognized on the basis of the appearance of diverse striate pollen grains; tracheids and brown and charcoal phytoclasts are dominant while spores, scolecodonts and microforams are less frequent. Many of the species recognized are known from Pennsylvanian and Permian palynofloras elsewhere in Gondwana and Euramerica. Nevertheless, exclusive species of the Pennsylvanian microfloras from South America are *Cristatisporites spinosus*, *Apiculiretusispora alonsoi*, *Apiculatasporites parviapiculatus*, *Costatacyclus crenatus*, *Limitisporites scitulus*, *Lunatisporites onerosus* and *Lahirites segmentatus* (e.g., Playford and Dino, 2000 a, b; Césari and Gutierrez, 2001; di Pasquo, 2003). A close comparison with the Amazon Basin supports a Bashkirian-Moscovian age for this assemblage (see Playford and Dino, 2000 b), which is more or less in agreement with the Bashkirian age attributed to this interval by Mamet and Isaacson (1997) based on calcareous

microfossils. The Permian range of *Florinites eremus*, *Cannanoropollis singrauliensis*, *Striatopodocarpites solitus*, *S. antiquus*, *S. gondwanensis* and *Protohaploxypinus bharadwajii* registered in the P3 are here extended to the Pennsylvanian.

MIDDLE-UPPER DEVONIAN MICROFLORA FROM A BOREHOLE IN NORTHWESTERN ARGENTINA

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Devonian deposits extend over the subsurface between Bolivia, Paraguay and Argentina, represented by shale and sandstone facies deposited mainly in a shallow marine environment. This study presents a survey of the microflora recovered from six core samples of the Tonono x-1 well (c.a. 63º 38', 22º 17') located in northwestern Argentina. The considered stratigraphic section ranges from the Late Eifelian to Early Frasnian. The total microflora is composed of 87 species, represented by diverse palynological groups such as trilete spores (46 species), cryptospores, palaeomicroplankton including several Prasinophycean, Chlorophycean and acritarch taxa (31 species), chitinozoans (10 species) and scolecodonts. Among them there is new taxa yet to be described. The stratigraphic distribution of the species allowed distinguishing three associations. The palynoassemblage **P1** (3946.5-3638.5 m), where the general preservation of the organic matter is very poor with relatively high level of thermal maturity, which leads to a small concentration of palynomorphs. Nevertheless, some stratigraphically important species are recognized such as the spores *Grandispora douglastownense*, *Dibolisporites eifeliensis*, *Verrucosisporites* sp cf. *V. loboziakii* and *Acinosporites* sp. cf. *A. macrospinosus*, and the chitinozoans *Alpenachitina matogrossensis*, *Ancyrochitina simplex*, *Alpenachitina* sp. cf. *A. eisenacki* that suggest a middle to late Eifelian age for this assemblage. The palynoassemblage **P2** (3367.35-3285 m) presents a better preservation than the level below. Regarding on the presence of *Geminospora lemurata*, *Aneurospora greggsii*, *Biharisporites parviornatus*, *Raistrickia aratra* and *Leiotriletes balapucencis*, and on the age of the assemblage P1 (300 m below), an early-middle Givetian age is proposed. The palynoassemblage **P3** (3073.2- 3137.5 m) comprises predominantly marine elements (90%). There is a high proportion of AOM and the preservation of the palynomorphs is fairly good. Only few key species are recognized such as *Acinosporites* sp. cf. *A. eumammillatus* together with the chitinozoans *Angochitina katzeri* and *Angochitina mourai* that support an early Frasnian age for this assemblage, reinforced by the notably increase of marine elements and AOM between the P2 and P3, which would have occurred as a response to a maximum flooding event during the Frasnian, probably related to major global eustatic changes.

LOWER MISSISSIPPIAN MIOSPORES FROM THE UPPER ROCKWELL FORMATION AND BURGOON SANDSTONE OF PENNSYLVANIA, USA

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The results of a palynostratigraphic investigation of the Burgoon Sandstone (Kinderhookian -Osagean), of Pennsylvania, USA are presented. This study, the first to be attempted at this stratigraphic level within the state of Pennsylvania, was undertaken to determine

the age of the unit and to provide a means by which it may be correlated with similar lithostratigraphic units in adjacent states. Eighteen samples were collected from two roadcut localities near Altoona, Blair Co., and Cramer, Indiana Co., and from an outcrop section in the Warrior's Path State Park, Bedford Co. Sampling focussed primarily upon shaley and silty layers within the Burgoon Sandstone; additional samples were collected from the uppermost beds of the underlying Rockwell Formation. Samples yielded moderately well preserved miospore assemblages, typically of low diversity. Assemblages recovered from both the Rockwell Formation and Burgoon Sandstone are dominated numerically by *Spelaeotriletes balteatus* and *S. pretiosus*. Additional taxa encountered include *Aratrisporites saharaensis*, *Crassispora maculosa* and *Neoraistrickia logani*. The composition of miospore assemblages appear similar to that of the middle Tournaisian *S. pretiosus – R. clavata* (PC) Biozone of Western European. Significant numbers of taxa characteristic of latest Devonian miospore biozones are also present in the assemblages and are considered to be reworked. The palynological evidence is consistent with the results of previous studies of the 'Big Injun' sandstone of West Virginia and the Black Hand Sandstone of Central Ohio. The results of this investigation shed light on the position of the Kinderhookian – Osagean boundary within the Eastern United States.

NEW DATA ON THE LATE FAMENNIAN MIOSPORE ASSEMBLAGE OF THE CERCAL ANTICLINE (WESTERNMOST IBERIAN PYRITE BELT AREA), PORTUGAL

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The Cercal Anticline (CA) is located in the westernmost region of the Iberian Pyrite Belt (IPB). The exposed stratigraphic sequence includes, in ascending order, the Volcano-Sedimentary Complex (VSC) followed by the Xistos das Abertas Fm, which passes gradually to the flysch sequence of the Mira Formation (Carvalho, 1976). The VSC is composed from base to top by: Felsic Volcanics (Vα), that comprehends lavas, pumice and volcaniclastic beccias with intercalations of volcanogenic shales; diabases and intermediate/basic subvolcanics (Vβ); jaspers and the S. Luís Formation (SL), a unit composed of shales, phyllites, siliceous shales and volcanogenic sediments. About 500m NW of São Luís village, at the base of this last unit, brachiopods ascribed to the late Strunian were found (Quiring, 1936). This determination led Carvalho (1976) to assume that the volcanics of the VSC are older than the Strunian, meaning so that this volcanism is the oldest in the Portuguese IPB. The stratigraphic succession of the CA is still poorly constrained, in terms of lithostratigraphy and age. In fact, three boreholes carried out in the hinge zone of the anticline by the Elf Aquitane company, about 1km NW of São Luis village, showed that below the felsic volcanics a thick (>250m) succession of dark shales and siltstones occur. These shales yielded very well preserved specimens of *Grandispora echinata* together with *Ancyrospora* spp., *Apiculiretusispora* sp., *Auroraspora macra*, *Cristicavatispora dispersa*, *Diducites poljessicus*, *D. mucronatus*, *D. versabilis*, *Emphanisporites annulatus*, *Grandispora cornuta*, *Punctatisporites* spp., *Retispora* cf. *macroreticulata*, *Retusotriletes phillipsii*, *R. planus*, *R. triangulatus*, *R. rugulatus*, *Rugospora explicata* and *R. radiata*. This assemblage indicates the VH Biozone of late

Famennian age. It is similar to those found in shales interbedded in felsic volcanics in several regions of the Portuguese Pyrite Belt (Neves Corvo Mine, Albernoa Anticline, São Domingos Mine). Palynostratigraphic research in the CA is currently still in progress. However, these preliminary results show that the age of the CA felsic volcanics is similar to that obtained in the northeastern branches of the Portuguese Pyrite Belt and no prove that the volcanism migrated in time to the NW, as suggested by Carvalho (1976), could be detected.

NEW PALYNOLOGICAL RECORD OF THE ORDOVICIAN/SILURIAN BOUNDARY IN THE ARGENTINE CORDILLERA ORIENTAL, CENTRAL ANDEAN BASIN

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The characterization of the Ordovician/Silurian transition represents a challenge for palynologists because of relevant changes in marine microplankton related to a major climatic event recorded by the Hirmantian glaciation that exerted a strong influence on sea level and a profound effect on life, creating extensive hiatuses and fossil rework. Ordovician/Silurian successions from the Central Andean Basin contain marine palynomorphs as acritarchs and chitinozoans, and subordinated terrestrial components as cryptospores and probable fresh-water algae as *Proteolobus*. In the Caspalá section, surveyed within the Cordillera Oriental, NW Argentina, five productive levels come from the base of a glacial horizon. Important soft-sediment deformation would indicate strong reworking of previous sedimentary record. Samples coming from layered diamictites show mixed faunal assemblages. Chitinozoans are poorly preserved, hence the specific determination is difficult to carry out. These include typical elements of the Darriwilian, Sandbian, and Katian Global Stagesas *Belonechitina* cf. *micracantha* and *B.* cf. *robusta*. Acritarchs from the same levels are relatively diverse, with scarce Late Ordovician (Katian) diagnostic species and high participation of Early and Mid Ordovician taxa. Acritarch assemblage contains *Neoveryhachium* sp. A in Molyneux, 1988, *Orthosphaeridium* cf. *rectangulare*, *Stellechinatum* cf. *brachyscolum*, *Tylotopalla* sp., *Vilosacapsula setosapellicula*. *Arkonia* sp., *Ferromia pellita* and *Stelliferidium striatulum* are among the reworked species. Hirnantian index-palynomorph taxa have not been found in the studied levels. The overlying Lipeón Formation, regarded as Silurian, represents the transgression after glacial waining. The lower productive level of this unit yielded chitinozoans such as *Linochitina penequadrata* and *Cingulochitina dreyensis* and a diverse acritarch assemblage containing *Dactylofusa marahensis*, *Domasia amphora*, *D. trispinosa*. *Duvernysphaera aranaides*, *Tunisphaeridium tentaculiferum* and *Tylotopalla caelamenicutis* among others. The upper level records a distinct chitinozoan assemblage composed by *Angochitina* cf. *hansonica*, *A. longicollis*, *Lambdachitina bipedata* and *L.* cf. *synaphacantha*. Both groups would indicate an age no older than Telychian. First palynological work in this new section allows bracketing glaciation to Hirnantianearliest Silurian. However,

given the fluvial facies association related to the glacial record in this region, it is possible that it was emergent during some time previous to being onlapped by the Silurian Series.

ACRITARCH BIOSTRATIGRAPHY OF THE LOWER-MIDDLE ORDOVICIAN BOUNDARY: ADVANCES AND PROBLEMS

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The Lower to Middle Ordovician Dawan Formation has been palynologically investigated at Huanghuachang (Global Stratotype Section and Point, GSSP, of the basis of the Dapingian, first Global Stage of the Middle Ordovician Series) with the aim to discuss the biostratigraphical potential of acritarch assemblages for the recognition of the Lower-Middle Ordovician boundary, that has recently been defined by the first appearance of the conodont *Baltoniodus*? *triangularis*. For comparison the nearby Daping section has also been sampled. The new results have been compared with those from previous investigations from the same sections. Correlation problems occur because the different teams of acritarch biostratigraphers use different graptolite and/or conodont biozonations. Here, we present a new biostratigraphical succession of acritarchs, correlated with the most recently established graptolite and condodont biozonations. Based on their First Appearance Data (FAD) some of the taxa recorded in the sections might potentially be used to determine the Lower-Middle Ordovician boundary. While the genera Barakella and Liliosphaeridium appear to be indicators of the base of the Dapingian, appearing just above the GSSP, the genus *Stelomorpha* appears to be a diagnostic genus present in the boundary interval, because some species of this genus are present below the GSSP, while other just occur above it.Other diagnostic taxa useful for international correlation, including *Orthosphaeridium* and *Dicrodiacrodium*, first appear in the Dapingian, higher in the succession. Several of the stratigraphically significant taxa are typical of the peri-Gondwanan palaeobioprovince, while others also occur outside of the Gondwana palaeocontinent. *Barakella* allows a correlation of the Lower-Middle Ordovician boundary with sections from peri-Gondwanan Europe and North Africa, while *Liliosphaeridium* allows correlation with Baltica. In addition to the Tremadocian/Floian boundary (Molyneux et al. 2007), acritarchs are therefore also useful for the identification of the Lower-Middle Ordovician (Floian/Dapingian) boundary in sections where conodonts, graptolites or other fossils are absent.

PENNSYLVANIANN AND PERMIAN PALYNOLOGICAL SUCCESSION OF THE CENTRAL-EASTERN PORTION OF SOUTH AMERICA (PARANÁ/CHACOPARANÁ BASINS): INTEGRATIVE APPROACH AND RELATIONS WITH THE OCCIDENTAL GONDWANA EVOLUTION

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Pennsylvanian and Permian palyniferous sedimentary beds of the Paraná/Chacoparaná Basin are known from Argentina, Brazil, Paraguay and Uruguay. Distinct biostratigraphical zonal schemes have been proposed to these deposits. Pennsylvanian palynozones are recognized in the northeastern portion of the BrazilianParanáBasin (*Ahrensisporites*

cristatus and *Crucisaccites monoletus* zones) and within the Chacoparaná Basin in Argentina (*Potonieisporites-Lundbladispora* Zone). Pteridophytic spores and monosaccate pollen grains related to the Cordaitales and Coniferales are dominant in these palynozones. The Permian *Vittatina costabilis* and *Lueckisporites virkkiae* zones of the Paraná Basin are adequately correlated with the *Cristatisporites* and *Striatites* zones in Argentina, as well as with the *Cristatisporites inconstans-Vittatina subsaccata* and the *Striatoabieites anaverrucosus-Staurosaccites cordubensis* zones of the Paraná Basin in Uruguay (zonation from Uruguay is preliminary), respectively, although few differences be found. A greater palynological diversity characterizes the older Permian zones (*Vittatina costabilis*, *Cristatisporites* and *Cristatisporites inconstans-Vittatina subsaccata*), marked by the presence of several taeniate pollen grains related to the incoming of the Glossopterids, as well as by a variety of pollen groups. Among the spores of the Permian zones, cingulizonate species are very common and the appearance of *Converrucosisporites* confluens seems to be a significant marker for biochronocorrelation along the Gondwana. The younger Permian zones show similarities on the frequency of palynologic groups, such as dominance of taeniate pollen grains, which reach up to 80% of certain assemblages, and the lower frequency of spores, which are rare or scarce within certain levels. These main palynological characteristics are discussed herein, as well as their potential for correlation in the Occidental Gondwana context.

CHRONOSTRATIGRAPHY AND PATTERNS OF VEGETATIONAL CHANGES INFERRED FROM PALYNOMORPHS IN THE SILURO-DEVONIAN OF THE GHADAMIS BASIN, NORTH AFRICA (PERI-GONDWANA)

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Because of excellent preservation and high abundance and diversity of palynological yields, early Palaeozoic sedimentary successions in the subsurface of North Africa are excellently suited for the study of the early phases of the terrestrialization process. In this perspective, we analyzed the palynology of the Silurian-earliest Devonian section of borehole MG1, situated in the Ghadamis Basin (Southern Tunisia) cutting through, in ascending stratigraphic order, the Tanezzuft, Akakus, Tadrart and Ouan Kasa formations. The obtained microfloristic assemblages comprise very well preserved and diversified crypto- and trilete spores, acritarchs and prasinophytes. Four cryptospore-miospore Assemblage Zones have been established and they have been respectively attributed to Gorstian, Gorstian-Lufordian, Pridoli and Lockovian. The lithostratigraphical boundary between the Acacus and the Tradart fms corresponds to the Silurian-Devonian boundary. In this time span, the Ghadamis basin was the site of an extensive regression. Comparison with coeval miospore assemblages described in the literature showed that some species of trilete spores (e.g. *Synorisporites papillensis*), characteristic of the Lochkovian in Europe, occurred in the Pridoli on the Gondwana continent. These early occurrences are probably due to the separation of Avalonia, Laurentia and Baltica from the Gondwana by the Rheic ocean during the Silurian. The microfloristic homogenisation which followed during Devonian times, probably reflects the closure of the Rheic Ocean and the migration of the flora from Gondwana to Avalonia. Trilete spore taxa are much more abundant and diversified than

cryptospores in almost all the studied levels. This is probably due to the predominance of marine conditions throughout the succession, well indicated by the constant presence of chitinozoans and acritarchs from the Gorstian up to the Pridoli-Lockovian transition and might also reflect the so-called "Wellman effect" according to which cryptospores tend to be dominant in continental to shallow marine environments. The recovery of many species of sculptured miospores from Ludlow to Pridoli supports the hypothesis that megaplants diversified greatly during this time interval, undergoing rapid evolution.

PALYNOSTRATIGRAPHY OF THE UPPER PART OF THE LOWER CARBONIFEROUS FLYSCH SUCCESSION IN THE THE EASTERN PART OF THE MORAVIAN-SILESIAN ZONE (NIZKY JESENIK MTS.; CZECH REPUBLIK)

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The Lower Carboniferous flysch deposits (Culm) of the eastern part of the Moravian-Silesian zone exposed in the Nizky Jesenik Mts. of the Moravia region in the territory of Czech were studied. The deposits represent the uppermost part of the Andelska Hora Fm of early-middle Visean to the Hradec-Kyjovice Fm of late Visean-early Serpukhovian. The stratigraphy of the flysch succession in the entire Moravia region (the Nizky Jesenik Mts., the Drahany Upland, the Odra Mts.) was based principally on lithological correlations. The Early Carboniferous age was confirmed locally by conodonts and especially by goniatites. Index species of goniatites document the early/middle Visean to early Serpukhovian. Palynology had never been applied before to determine stratigraphy of the Culm in the Moravia region. However, successful results of miospore studies of the Kyjovice Fm, the uppermost part of the analogous flysch deposits at the western margin of the Upper Silesia Coal Basin (Poland) demonstrate that it could be another efficient method of biostratigraphy of the Culm in the entire Moravian-Silesian zone. Suggestion for the palynostratigraphy of the Upper Moravice and the Hradec-Kyjovice Fm in the Moravia region are presented here . Shales with plant detritus from natural outcrops south-west of the Ostrava-Karvina Coal basin yielded miospores. Stratigraphically significant and other characteristic taxa were determined. The abundance of *Schulzospora*, *Tripartites* and common presence of *T.vetustus*, indicative species of the standard VF spore zone document the age of the associations not older than late Visean. They were distinguished in the Upper Moravice Fm and in the Hradec Mb of the Hradec-Kyjovice Fm that corresponds to their general stratigraphic range based on goniatites between Goα 2-3 and E1a zones. *Bellispores nitidus*, indicative species of the standard NC zone and *Crassispora kosankei* suggest an early Serpukhovian age of the associations recorded in the Hradec-Kyjovice Fm. This also corresponds to its general stratigraphic range between Goβ spi and E1a zones. *Mooreisporites trigallerus*, indicative species of the new standard TK zone may suggest late Serpukhovian age of this association, much younger than ever thought.

CHITINOZOANS FROM THE ORDOVICIAN-SILURIAN TRANSITION IN THE RÖSTANGA BOREHOLE (SCANIA, SWEDEN)

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Chitinozoans have been extracted from samples of the Röstanga borehole in Scania (southern Sweden), drilled by one of the authors (A.N.). The graptolites have been determined by T. Koren and a detailed and well documented graptolite biozonation around the Ordovician-Silurian boundary was published by Koren, Ahlberg & Nielsen (2003). They recognised a new latest Ordovician (Hirnantian) post-*persculptus* and pre-*ascensus* subzone. The interval under interest in the Röstanga borehole is between 46.75 and 56.14 m depth, with the Ordovician-Silurian boundary at -52.70 m. It comprises the *acuminatus* zone (46.75-50.40 m), *ascensus* zone (50.51-52.70 m), *avitus s.s.* zone (lacking the guide fossil *P. persculptus*) (52.80-55.90 m), and the *persculptus s.s.* zone (56.16-56.14 m). The chitinozoans from 41 samples in these interval are rather well preserved (light to dark brown). The assemblages are dominated by *Ancyrochitininae* with often broken appendices and rich in *Cyathochitina*. The rare *Spinachitina* allow correlation with other sections. The chitinozoan biozonation in this newly studied borehole will be compared with the biozonation in Scania (a.o. Lönstorp borehole), Laurentia (the GSSP section in Dob's Linn see Verniers et al. 2003), and with the biozonation in Avalonia (a.o. Deerlijk borehole in Belgium), Bohemia and northern Gondwana.

SYMPOSIUM 53: PALEOZOIC OCEANIC AND CLIMATE CHANGE: EVIDENCE FROM THE PALYNOLOGICAL RECORD (CIMP SUMPOSIUM II)

Conveners: Reed Wicander and Ken Dorning

NEW RECORDS IN OLD MATERIAL: PRELIMINARY DATA ON FLOIAN ACRITARCHS – A SURPRISING NEW WORLD IN THE NERY DELGADO COLLECTION AT THE GEOLOGICAL MUSEUM, PORTUGAL

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Nery Delgado (1835-1908) was one of the pioneers of Portuguese geology. In 1857, the Geological Survey of Portugal (GSP) was created as a section of the Geodesic Service of the Public Works Ministry. N. Delgado was involved since the beginning; he worked as an adjunct and during the year 1882 was nominated head of the survey. Due to his scientific contributions, N. Delgado participated in the major developments of nineteenthcentury geology. The lithological and palaeontological samples collected by N. Delgado are placed at the Geological Museum, integrating the N. Delgado collection, belonging to the LNEG-LGM, the institution which inherited the legacy of more than 150 years of geological research carried out by the GSP. Following the program that commemorates the 100 years after the death of N. Delgado, preliminary palynostratigraphic research was established in several samples from the N. Delgado collection, that allowed the discovery of a surprising new world in the old material of the Geological Museum. Investigated samples are from the *Xistos com Phyllodocites* Formation from the Mestre André quarry (Barrancos village). This rock unit crops out in the Estremoz-Barrancos sector of the Ossa Morena Zone (Southeast of Portugal) and consists of dark, green and reddish micaceous shales and siltstones. The upper part also contains

psammites with abundant ichnofossil genera, such as *Phyllodocites*, *Nereites*, *Dictyodora*, *Palaeophycus* and *Gordia* genera. These uppermost levels yielded the graptolites *Expansograptus sparsus* and *E. hirundo* that indicates a late Floian age. The trace fossil assemblage and the graptolites indicate an offshore shelf depositional environment. The first determination on acritarchs in the upper levels of the *Xistos com Phyllodocites* Fm are from 1988, when Cunha & Vanguestaine recovered in two samples, from an outcrop along the road Sto Aleixo-Barrancos (Km 94,2), a moderated preserved assemblage assigned to the Floian-Dapingian boundary. The preliminary age determinations based on acritarchs, from the Mestre André quarry, are here presented. The acritarch assemblages are abundant and very well preserved and contain *Acanthodiacrodium costatum*, *Acanthodiacrodium uniforme*, *Arbusculidium filamentosum*, *Coryphidium bohemicum*, *Polygonium* sp., *Steeliferidium stelligerum*, *Striatotheca principalis parva*, *S. rugosa*, *Veryhachium lairdii* and *V. trispinosum* suggesting a mid late Floian age, that confirms the preceding dating.

CHITINOZOANS AND SILURIAN GLACIATIONS IN THE AMAZON BASIN

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The dynamic of environmental patterns during the Silurian in the Amazon Basin were been studying in this work using the chitinozoan forms. The temperature and salinity are the major environmental variables relevant to the course of the distribution and evolution the planktonic organisms like chitinozoans in the geological record. In the case of these forms, we are convinced that the occurrence of parasitism associated with some extinction was been caused by the inputs of the frost of the polar ice cap. This is related before in the literature. During the Silurian occurred glacial episodes in the sedimentary basins over world. Specially in Amazon Basin (the Nhamundá and Pitinga Formations), the temperatures declined dramatically in three short-lived, during the early Aeronian (glaciation **I**), between the latest Aeronian and the early Telychian (glaciation **II**), and at least between the latest Telychian and the earliest Wenlock (glaciation **III**). Each one of the glaciations here described were the turning point to the first three Local Chitinozoans Assemblages (I, II and III) identified in the Nhamundá and Pitinga Formations. During the glaciation **I** two species have been disappeared: *Euconochitina iklaensis* and *Spinachitina maennili*, and eight species have been appeared like *Pogonochitina djalma* and *Bursachitina wilhelmi* (endemic species). During the glaciation **II** twenty five species have been appeared like *Euconochitina cruzi, E. patula, E. sulcata* and *P. inornata* (endemic species) and *Conochitina* cf. *C. acuminata*, *Cingulochitina convexa* and *Margachitina margaritana* (cosmopolitan species). During the glaciation **III** have been disappeared twenty six species like *Cyathochitina caputoi, Pogonochitina djalma, Bursachitina wilhelmi, Euconochitina cruzi, E. patula, E. sulcata, Cingulochitina convexa, Margachitina margaritana.* The parasitism could be seeing in species like *Cyathochitina caputoi*, *Conochitina* cf. *C. acuminata*, Pogonochitina *djalmai* and *P. inornata*.

PALAEOZOIC PALYNOMORPH ABUNDANCE AND DIVERSITY: AN OVERVIEW OF THE EVIDENCE FROM CHITINOZOANS AND PHYTOPLANKTON OF PAST ENVIRONMENTS AND GLOBAL CLIMATE CHANGES

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The marine phytoplankton record is documented throughout the Palaeozoic through the record of acritarchs and prasinophytes from the Cambrian to Permian. The chitinozoans are regularly recorded in marine sediments from the Ordovician, Silurian and Devonian. The abundance as well as the diversity of the marine phytoplankton in samples gives two separate environmental indicators, which may be broadly linked to palaeolatitudes as well as overall changes of climate in the past. The benthonic chitinozoan record is more difficult to interpret, as the overall composition of assemblages may also be influenced by sediment type. Cambrian palynological assemblages are of characterised by low to moderate abundance and low to moderate diversity acritarchs with processes, together with variable numbers of sphaeromorph acritarchs. Non marine acritarchs and small 'cryptospores' are rare in marine sequences. During the latest Cambrian to early Ordovician there is a marked increase in phytoplankton provincialism, leading to a significant increase in overall total acritarch diversity. Palynological assemblages from shelf areas in the early Ordovician Arenig to late Ordovician Ashgill interval often contain diverse acritarch assemblages as well as chitinozoans. Cryptospores are regularly recoderded in marginal marine sediments. Distinct moderate diversity acritarch assemblages are associated with the early Hirnantian glacial events. The late Hirnantian to early Llandovery cool interval is marked by low diversity acritarch assemblages in shelf areas, as well as widespread intervals with sphaeromorphs associated with the deposition of black hot shales in deeper areas, linked to anoxic bottom waters and to oceanic stratification. There is a notable increase in acritarch and chitinozoan diversity in the late Llandovery, followed by a gradual punctuated decline in acritarch diversity through the Wenlock and Ludlow into the early Devonian. At the same time, spore diversity increases noticeably in nearshore marine shelf areas worldwide. Shelf successions in the Devonian contain low to moderate diversity acritarch and prasinophyte assemblages, with some chitinozoans. Prasinophytes with flanges are notably more diverse than is typical for the Silurian. Within depositional basins in the Palaeozoic there are relatively short intervals that have an abundance of a single acritarch species, which are very useful for stratigraphical correlation. These horizons may also be linked to significant climate events.

ORGANOFACIES OF NEOPROTEROZOIC CAP CARBONATES FROM NAMIBIA – NEW DATA ON NEOPROTEROZOIC EXTREME CLIMATES

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The Neoproterozoic climatic paradox of glacial deposits (diamictites) at low palaeolatitudes led to the idea of at least 2 global glaciations, known as the Snowball Earth model. A key point of the model are the Cap Carbonates, associated with negative -δ13C excursions, representing the synglacial collapse in organic productivity in the ocean, caused by the isolation of the global ocean from the atmosphere due to the global thick ice cover. Therefore Cap Carbonates are interpreted as synglacial, totally anorganic sediments and until now no organic life was recorded in it. A palynological study is done on samples from Cap Carbonates of the late Neoproterozoic Ghaub Fm glaciation in NE-Namibia, to test the two

crucial preconditions of the Snowball Earth model: 1. the collapse of the organic productivity in the ocean and 2. the continuous major transgression in this interval. (1) For the first time a continuous record of life is found in the Cap Carbonate, dominated by cyanobacteria with few prasinophytes and acritarchs. In one section organic life was proved from the breccias below, throughout the Cap Carbonate and into the dark micritic limestones above. The decrease of organic matter in the Cap Carbonate (TOC > %) not related to less organic productivity in the ocean, but to facies changes to extremely shallow marginal marine conditions of a proximal carbonate platform. The continuous biogenic productivity proved by palynology contradicts a crucial requirement of the Snowball Earth model. It gives clear evidence, that there were areas of open ocean during this glacial interval. (2) Palynofacies analysis gives clear evidence for sea-level fluctuations within the Cap Carbonate. Variations in relative sea-level are recorded by changing proportions of prasinophytes and acritarchs within the generally very shallow, marginal marine environment dominated by microbial mats (cyanobacteria). This indicates continued climatic variability during Cap Carbonate deposition and contradicts the Snowball Earth model, which interprets Cap Carbonates as purely anorganic precipitates deposited during one single major marine trangression at the end of the global glaciation. The continuous record of biogenic productivity and fluctuations in relative sea-level coeval with dropstones, proving the coexistence of regions of open oceans and low latitude glaciations during the deposition of the Cap Carbonate. This strongly supports the Ice Patch Earth model merging widespread glaciations with open oceans in between. The study of the Ghaub Fm Cap Carbonate in Namibia shows, what essential role palynology can play in analysing palaeoenvironmental evolution of the earth, not only in modern times, but also in the very early evolution of the earth.

THE SILURIAN OF NORTHEASTERN AVALONIA: A SHELF-SLOPE TESTCASE FOR PALAEOBASIN ANALYSIS AND PALAEOCLIMATOLOGY, PRELIMINARY RESULTS

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Northeastern Avalonia comprises during the Silurian a basin with many different palaeodepths and allows to test hypotheses for the explanation of global phenomena like the worldwide recognized oxic-anoxic alternations. The case-study area is the Condroz Inlier that will be examined lithostratigraphically and biostratigraphically mostly with chitinozoans but also with macrofossils like graptolites, brachiopods, trilobites. A comparison of the sediments of the Brabant Massif (deposited on a continental slope) with these of the Condroz Inlier (deposited on a shelf) will allow us to characterize the shelf-continental slope of northeastern Avalonia. Preliminary results of our study will be presented.

THE AGE OF THE CARBONIFEROUS-PERMIAN *CONVERRUCOSISPORITES CONFLUENS* OPPEL BIOZONE OF THE GANIGOBIS SHALE MEMBER, DWYKA GROUP, NAMIBIA, AND IMPLICATIONS FOR THE TIMING OF GONDWANAN DEGLACIATION

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The establishment of the *Converrucosisporites confluens* Oppel Zone in the Canning Basin, Australia in cored intervals from the Calytrix No. 1

Borehole was considered an advance in Gondwana Carboniferous-Permian palynostratigraphy because the zone was associated with a marine fauna that suggested a correlation with the standard Russian Lower Permian stages and because the eponymous species has a wide occurrence in Gondwana outside Australia, e.g. India, Argentina, Brasil, Uruguay, Antarctica, Oman and Saudi Arabia. The recognition of *Converrucosisporites confluens* in a well-preserved, diverse assemblage within a radiometrically-dated sequence in Namibia has shown that the taxon may range lower than previously thought (Carboniferous, Gzhelian or possibly earliest Permian, Asselian); similarly, preliminary study of its range top in Argentina and Uruguay suggests that it ranges higher there than in Western Australia. The *C. confluens* Oppel Zone is well known to straddle glacigene and postglacial facies, for example in Western Australia, Peninsular India and Arabia and is widely considered to be a biostratigraphic marker for final Gondwana deglaciation. The original late Asselian to early Sakmarian age suggested for the *C. confluens* Oppel Zone has had a strong influence on views as to the timing of deglaciation in Gondwana. This study has shown that some deglaciation sequences, dated only by the *Converrucosporites confluens* Oppel Zone, may be older than previously thought and that further rigorous testing is required of palynological biozones against radiometric and independent palaeontological dating.

GROUND TRUTHING ORDOVICIAN CLIMATE MODELS USING SPATIAL ANALYSES OF CHITINOZOANS AND GRAPTOLITES

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Global cooling during the Late Ordovician culminated in one of the major icehouse intervals of the Phanerozoic. The causal mechanisms and duration of the latter remain contentious and to date workers have largely relied on region-specific studies. Few climate simulation models for this time interval have been produced and General Circulation Models (GCMs) have yet to be ground truthed with geological data. Here we examine the potential for using planktonic chitinozoans and graptolites as water mass indicators to ground truth Ordovician climate model predictions of ocean and climate state. We are following the techniques applied to Cenozoic and Mesozoic planktonic foraminifer and calcareous nannoplankton distributions, which are used to track ocean surface and deep watermasses in deep time. At the core of our research strategy is the compilation of a high stratigraphical resolution, biogeographical database of species occurrences, palaeoenvironmental and ocean-climate proxy data. This is used to compile surface water (and where possible depth assemblage) palaeobiogeographic maps of chitinozoan and graptolite distributions. Species assemblages are produced using multivariate analytical techniques such as correspondence analysis, R-mode, Q-mode and Twinspan clustering, allowing discrimination of the main factors controlling the plankton distribution. The maps produced can be retro-tested against

GCM maps of surface currents and used to identify latitudinal temperature/climate belts and gradients. Preliminary results are presented for the key time slices that characterise the critical climate transitions namely the *N. gracilis* graptolite Biozone (greenhouse climate mode), and the Hirnantian (glacial maximum-icehouse climate).

ORGANIC CARBON BURIAL AND ISOTOPE EXCURSIONS IN THE SILURIAN OF NORTH AFRICA (PERI-GONDWANA): A COUPLED PALYNOLOGICAL – GEOCHEMICAL APPROACH

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Several distinct carbon isotopic excursions are known to occur globally during Silurian times but have so far mainly recorded from low to middle palaeolatitude localities. Although the ultimate causes and palaeoenvironmental significance of these excursions are still a matter of debate, changes in the rates of organic carbon burial certainly play an essential role. We present herein a first carbon isotopic curve (d^{13}Corg) for the Silurian of high-palaeolatitude Gondwana (North Africa), coupled to detailed palynological analyses (acritarchs, chitinozoans, miospores, palynofacies) and organic geochemistry data. The two major early Sheinwoodian (earliest Wenlock) and Ludfordian (late Ludlow) carbon isotopic excursions are well represented in high-latitude Gondwana. These excursions are associated, and probably causally linked to, changes in lithology, palynofacies, organic geochemistry parameters, as well as in changes in palynological composition. The earliest Wenlock strong positive isotopic shift is undoubtedly associated to a protracted period (Rhuddanian to early Wenlock) of massive black shale deposition ("hot shales"), and thus of organic carbon burial, on continental platforms located in high-latitude settings. Although "hot shale" AOM is very well preserved, acritarch assemblages are not only poorly diversified but also badly preserved, showing evidence of corrosion (bacterial attack?). Significant black shale deposition is not obviously associated with the Ludfordian excursion, and levels of primary productivity seem to have remained essentially unchanged before and during the event (oligotrophic conditions as suggested by palynofacies evidence). Significant compositional changes in the acritarch assemblages across the Ludfordian show a major turnover but do not evidence significant extinction events. An quantitatively important input of organic matter of terrestrial derivation into the marine sedimentary record (miospores of early land plants) correlate exactly with the maximum values of organic carbon isotopic fractionation. This study suggest that previously proposed palaeoenvironmental models do not fully explain the observed relationships among isotopic development, facies changes, and fluctuation in biodiversity, and they cannot be readily applied in the more general case, and particularly in the case of high-palaeolatitude localities. Further detailed investigations from several Gondwanan localities are in progress in order to improve knowledge of the Silurian global carbon isotopic signal.

AN EARLY ORDOVICIAN (TREMADOC-EARLY ARENIG) ACRITARCH ASSEMBLAGE FROM THE NAMBEET FORMATION, CANNING BASIN, WESTERN AUSTRALIA, AND ITS PALEOGEOGRAPHIC AND CLIMATIC SIGNIFICANCE

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A well-preserved and somewhat diverse acritarch assemblage consisting of representatives of *Aryballomorpha*, *Athabascaella*, *Gorgonisphaeridium*, Lua, and *Rhopaliophora*, among others, was recovered from the subsurface Nambeet Formation, Canning Basin, Western Australia. To date, few Early Ordovician acritarch assemblages have been recovered from Australia, namely from the Canning and Georgina Basins, and these are younger than the assemblage reported herein. The organic-walled phytoplankton dataset for the Early and Middle Ordovician is well documented and permits subdivision into cold-water (high latitude) and warm-water (low latitude) assemblages, as well as recognizing taxa that are found at all latitudes. Presently, *Lua* has been reported only from low latitudes, and *Aryballomorpha* and *Athabascaella* are most common in low latitudes, but also occur in some middle latitude assemblages. These three co-occurring genera are considered to represent a low latitude assemblage, extending from approximately 20 degrees north to 30 degrees south latitude. The *Aryballomorpha*, *Athabascaella*, *Lua* assemblage has thus far been reported from Early Ordovician assemblages in North China, Australia, and Laurentia. Comparison is made to other Early Ordovician organic-walled phytoplankton assemblages in terms of overall diversity changes both regionally and globally during this time interval. Based on results from the phytoPal Project, Paleozoic phytoplankton increased through the Cambrian to a peak in the Darriwilian Stage, before declining towards the end of the Ordovician.

SYMPOSIUM 40: PALEOZOIC PALYNOLOGY OF THE ARABIAN PLATE AND ADJACENT AREAS (CIMP SYMPOSIUM III)

Conveners: Merrel Miller, Philippe Steemans and Charles H. Wellman

PALYNOSTRATIGRAPHY AND PALYNOFACIES OF THE LATE CARBONIFEROUS-EARLY PERMIAN AL KHLATA FORMATION, OMAN

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The Al Khlata Formation consists of a thick sequence of continental deposits that accumulated during the Late Carboniferous-Early Permian in an extensive basin extending from central to southern parts of Oman. During the Late Carboniferous-Early Permian Oman formed part of Gondwana and was located at southern high latitudes. It was influenced by the Late Carboniferous-Early Permian Gondwanan glaciation (3rd Arabian's Plate glaciation), probably lying just north of the southern ice sheet, although it has been suggested that the ice sheet may have covered these parts at least some of the time. The deposits of the Al Khlata Formation are complex. They consist entirely of terrestrial deposits and include a diversity of glacial to periglacial deposits. Rich assemblages of well preserved palynomorphs have been recovered from throughout the Al Khlata Formation. They contain only non-marine forms (a vast diversity of spores and pollen and phytodebris) and lack any evidence for marine influence. They show similar palynomorph trends described from coeval strata from other parts of Gondwana; Australia, South America, South Africa, India, and Antarctica. The general palynological trend recovered from the Al Khlata Formation shows three major episodes. From oldest to youngest these are: an episode dominated by simple trilete spores and monosaccate pollen; an episode dominated by zonate/cavate spores and

pollen; an episode dominated by bisaccate pollen. The lack of biostratigraphically useful marine fauna and dateable volcanic ash within the Arabian Peninsula makes correlating and dating of the Al Khlata Formation difficult. Palynology is proving useful in that it allows correlation with coeval sequences in Australia. Here pollen and spore assemblages have been recovered from strata containing marine fauna that has been correlated to the ICS (International Commission of Stratigraphy) stratotype. The occurrence of the spore *Converrucosisporites confluens* within the Al Khlata Formation enables correlation with the Australian *C. confluens* Oppel-Zone indicating an Early Permian age. Palynofacies analysis is revealing distinct spore/pollen assemblages associated with the varied facies present in the Al Khlata Formation. This is being used to reconstruct the different palaeoenvironments and correlate the complex glacial-periglacial facies.

PALYNOLOGY OF THE PALEOZOIC IN SAUDI ARABIA: A PROGRESS REPORT ON THE 75TH ANNIVERSARY OF SAUDI ARAMCO

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The first paper addressing the Paleozoic palynology of Saudi Arabia was published in 1965, and presented by arwin Hemer at the 5th Arab Petroleum Conference in Cairo. A few scattered papers followed in the seventies and eighties, until Saudi Aramco began discovering major hydrocarbon reserves in the Paleozoic succession during the nineties. These significant discoveries mandated an improved understanding of the stratigraphy of Saudi Aarabian Paleozoic sediments, and their geological and paleogeographical relationships to successions in neighboring countries and on adjacent plates. This need resulted in the initiation of a joint palynostratigraphic project between Saudi Aramco and the Commission Internationale de Microflore du Paleozoique (CIMP) in 1990. The long-term collaboration between Saudi Aramco and CIMP has thus far resulted in considerable informal technology transfer and three significant publications, marking the successful completion of three distinct phases of the project. These publications have not only elucidated the palynology of the Paleozoic of Saudi Arabia, but have also established a robust, utilitarian biostratigraphic zonation of Ordovician to Permian strata, and formally described numerous important palynological taxa. Results from the early phases of the project were presented at the 8th International Palynological Congress in 1992, the 1998 CIMP workshop in Pisa, the International Conference on the Ordovician System in Prague in 1999, and at the 11th International Palynological Congress in Granada in 2004. This paper will review the above-mentioned results together with those from the current phase of the project that are now including sedimentology, and will demonstrate the significant impact of palynological studies in resolving local and regional stratigraphic problems. This paper will also illustrate the benefits and advantages of collaborations such as the one between CIMP and the petroleum industry.

A DISTINCTIVE MARGINAL MARINE PALYNOLOGICAL ASSEMBLAGE FROM THE PRIDOLI OF NORTHWESTERN SAUDI ARABIA

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This paper describes a rare occurrence of a rich and diverse palynological assemblage from a controversial stratigraphic unit in well EW8 in northwestern Saudi Arabia. The composition of this assemblage strongly suggests a Pridoli age and therefore it is referred here to the Tawil Formation. The assemblage encountered contains very characteristic chitinozoans, acritarchs, tasmanities, scolecodontsm, eurypterid cuticle and common land-derived miospores and hilate cryptospores. Chitinozoans such as *Margachitina elegans*, *Ancyrochitina fragilis brevis*, *Ancyrochitina fragilis*, *Sphaerochitina sphaerocephala*, *Urnochitina urna*, *Pseudochlathrochitina carmenchui* and *Lagenochitina brevicollis* confer the Pridoli age assignment. This assemblage of chitinozoans correlates very well with Assemblage D from the Alternances Gréso-Argileuses Formation of the A1-61 well in northwestern Libya. Among the acritarchs present are: *Cymbosphaeridium pilar*, *Leoniella carminae*, *Diexallophasis* spp., *Tunisphaeridium* cf *caudatum*, *Leiofusa estrecha* and *Eupoikilofusa striatifera*. Furthermore, the join occurrence of *U. urna*, *P. carmenchui* and *M. elegans* is clearly indicative of the middle part of the Pridoli as in the Libyan well A1-61, and in many wells in Algeria. This corresponds to what is considered to be a transgressive mid Pridoli event in the Algerian Sahara, with non marine intervals bracketing this brief marine sea level rise. This event is likely to have extended into all of north Gondwana including Arabia.

CHARACTER OF THE SAUDI ARABIAN CM PALYNOZONE

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Moderately well preserved palynomorphs have been recovered from 17 core samples from the Unayzah in a development well on the east flank of the Ghawar structure in Eastern Saudi Arabia. The lithology of the short (*ca*. 35 ft) core is described as dominantly sandy mudstone representing deposition in a glacial lake setting. It has the characteristics of the Stratified Diamictite depositional facies that occurs in the Unayzah B stratal unit. Stratigraphic interpretation of the palynomorph assemblage is extremely complex since at least seven individual components can be recognized, ranging in age from early Silurian to late Carboniferous. Six of these components are clearly reworked while the seventh may be indigenous. This youngest association of taxa, which includes the saccate pollen genera *Cannanoropollis, Florinites, Plicatipollenites* and *Potonieisporites*, is assigned to the Cm Biozone of Saudi Arabia, which is correlated with the MJ Biozone of Libya. These biostratigraphic units are very poorly constrained in terms of chronostratigraphy. In Libya, the base of the MJ Zone is considered to be early Pennsylvanian (Serpukhovian), whereas the age of its top is constrained by the latest Pennsylvanian/earliest Permian age of the base of the succeeding IG Biozone. Although the Cm Biozone has been recognized in several wells in Saudi Arabia, its chronostratigraphic significance remains incompletely understood.

PALYNOSTRATIGRAPHY AND PALEOGEOGRAPHY OF DEVONIAN STRATA IN KERMAN PROVINCE, CENTRAL IRAN

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Some four acritarch assemblages were established within the Padeha and Bahram formations as listed below: (1) Acritarch assemblage zone I, associated with foraminifers, they are present in 90m of the Padeha Formation suggesting the Late Devonian (Frasnian). (2) Acritarch assemblage zone II occurs 15m in the Padeha Formation and 60m of the Bahram Formation. Based on acritarch taxa and associated foraminifers, late Frasnian-early Famennian age is suggested. (3) Acritarch assemblage zone III appears in 15m of Bahram Formation which contains diagnostic acritarchs and foraminifers, suggesting the Famennian. (4) Acritarch assemblage zone IV occurs in 120m of the Bahram Formation which contains acritarch and foraminiferal taxa, indicating the late Famennian. Comparison was made between the encountered palynomorph taxa of the Padeha and Bahram formations with those from other parts of the world and Iran. Results show broad similarities between the palynomorph taxa of southern and northern Iran with those of Libya, Algeria, and Morocco, Saudi Arabia, Western Australia. This similarity suggests that the Iranian Plateau, North Africa, Western Australia and Saudi Arabia were occupied with the same Palaeolatitude during the Late Devonian. Moreover, based on the relative frequency of continental elements (Miospore) to the marine elements (acritarchs, scolecodonts, chitinozoan and foraminifers), it can be asserted that shallow marine environments with tropical condition prevailed in the northwestern parts of Kerman Province during the Late Devonian.

PALYNOLOGY OF THE GEIRUD FORMATION, NORTHEAST OF TEHRAN, IRAN

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The Geirud Formation represents Upper Devonian strata in the central Alborz Mountains, northern Iran. At the study section, northeast of Tehran, it is composed of alternating sandstone and shale with few intercalations of fossiliferous limestone. Diverse and reasonably well preserved palynofloras of both marine and terrestrial derivation occur in the material studied. Presence of palynomorphs with well known stratigraphic distribution, namely, *Daillydium pentaster*, *Papulogabata annulata*, *Cymatiosphaera perimembrana*, *Chomotriletes vedugensis, Deltotosoma intonsum, Crassiangulina tesselita, Unellium lunatum*, *U. piriforme*, *Geminospora lemurata*, *Diducites mucronatus* suggests a Late Devonian age; thus corroborating the previous palaeozoologicalbased (Goniatites and Fish) dating. Co-occurrence of marine microphytoplankton cyst remains (acritarchs and prasinophyte phycomata) with abundant land-derived palynomorphs (spores) implies a shallow, nearshore marine depositional setting. In the palynofloras investigated, presence of *Geminospora lemurata* associated with various representatives of *Verrucosisporites* and *Ancyrospora* indicates that progymnosperms and fern allies were among major components of plant community existing around the Geirud Formation depositional environment. In addition, the presence of spores widely assigned to Rhyniopsida, Zosterophyllopsida, Equisetopsida, Lycopsida, Filicopsida, and Barinophytopsida refers to the probable source of dispersed spores. Based on the vertical distribution of spores, two Assemblages (Assemblage zone I and II) are introduced. Eponymous index species of the *lemurata-magnificus, optivus-triangulatues, ovalisbulliferus, torquata-gracilis, pusillites-lepidophyta* Assemblage Zones are identifiable in the Geirud Formation's palynofloras. Microphytoplankton-dominated palynofloras also known to occur in Upper Devonian strata of the Central Iran Basin. Despite notable lithofacies variation between Devonian sequences of north and central Iran, they appear to share large numbers of microphytoplankton species. Such similarities might indicate migration

routes existing between the two areas during the Late Devonian. Shared miospore taxa, however, are comparatively less frequent.

Bonn Botanic Gardens, photo: Jenny Brittain

DISCOVERY OF LATE ORDOVICIAN SCOLECODONTS FROM THE QUSAIBA-1 CORE HOLE, ARABIAN PENINSULA, AND ITS PALAEOBIOGEOGRAPHICAL IMPLICATIONS

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Scolecodonts, the jaws of eunicidan polychaetes, constitute one of the most common groups of acidresistant microfossils in the Ordovician and Silurian deposits. They are rather well known from Baltica and Laurentia, but only few data are available from other palaeocontinents. The global picture of palaeobiogeography of scolecodonts is therefore biased and all new accounts from the hitherto poorly known regions deserve full attention. In the course of the chitinozoan study of the Qusaiba-1 core, central Saudi Arabia, a rich assemblage of scolecodonts was recovered from the Late Ordovician Qasim Formation. This interval belongs to the *Armoricochitina nigerica* chitinozoan zone, which is correlated with the upper part of the Katian Global Stage. The bulk of material was obtained by repacking the sample residues but specimens scattered in the chitinozoan slides were also studied. The entire collection contains more than 150 well-preserved scolecodonts, including some fused jaws and a compound jaw apparatus. In a sample from 497.8 ft 76 posterior maxillae were counted from a 10 g crushed sample making this is one of the richest samples ever studied for scolecodonts. Taxonomically the assemblage is not particularly diverse ontaining two species of *Oenonites*, two species of "*Atraktoprion*", *Kettnerites* sp., possibly *Kalloprion*, an unidentified placognath and a new genus that cannot be confidently attributed to any known family. The latter taxon bears mixed characters of polychaetaspids, kalloprionids and ramphoprionids and accounts for the majority of the specimens in the collection. Similar forms have been reported from the Late Ordovician of North American Mid-continent region, but are unknown from Baltica so far. The low percentage of placognaths is also noteworthy and possibly indicates biogeographical relationships with Laurentia rather than Baltica. Moreover, *Kettnerites*, being also recorded in Bohemia, is a characteristic component of the Late Ordovician polychaete faunas of Laurentia. In Baltica, paulinitids are very rare in the Ordovician, though more

common in the Silurian. The consequence of this discovery of scolecodonts from the Arabian plate allows, for the first time, to assess biogeographical links of Ordovician jawed polychaetes of Gondwana. It shows that Gondwanan polychaetes were related to Laurentian rather than Baltic faunas. The high abundance of scolecodonts indicates also their potential in stratigraphy and biofacies analysis; however, more data are needed for that.

PALYNOLOGY OF THE PERMO-CARBONIFEROUS SUBSURFACE UNAYZAH, CENTRAL SAUDI ARABIA

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The formations of the Permo-Carboniferous Unayzah form an important hydrocarbon play in Central Saudi Arabia, accounting for approximately 30 producing or potential oil and gas fields in the Kingdom. Palynology continues to be vital in the development of our understanding of the stratigraphy of the Unayzah, in spite of the challenges TERRA NOSTRA 2008/2 IPC-XII/IOPC-VIII Bonn, Germany 2008 Abstract Volume 121 presented by palynologically "hostile" paleoclimatological and depositional environments, factors prevalent during the Late Carboniferous and Early Permian in this region. Palynology provides the only chronostratigraphic framework currently available, and also significant paleoenvironmental and paleoclimatological input to the sedimentological models. Both of these contributions enhance rock unit correlations and prediction of reservoir facies distribution. The Unayzah comprises Late Carboniferous (Serpukhovian-Ghzelian) to earliest Permian (Asselian-early Sakmarian) glacial and periglacial sediments of the Unayzah C (Ghazal) and Unayzah B (Jawb), followed by Early Permian (mid Sakmarian-Kungurian) post-glacial sediments of the Unayzah A (Nuayyim), including the "un-named middle Unayzah member" (Wudayhi) in its lower part. The Unayzah C represents a glaciogenic phase dominated by thick braidplain fluvial outwash sediments exhibiting large scale glacially induced deformation, and palynology indicates either low diversity cold-climate spores and pollen or reworked assemblages. This is overlain by the Unayzah B, reflecting a terminal phase of deglaciation, and represented by highly variable sedimentary facies ranging from minor push moraines, showing small scale glacially induced deformation, to proglacial lake deposits including shoreline and turbiditic facies. Palynofloras in this unit display increasing diversity of spores, pollen and fresh water algae, in response to climatic amelioration and ice melt. The post-glacial Unayzah A, characterized by ephemeral fluvial, playa lake and aeolian sediments, is marked by a sharp palynological change, as spore dominated palynofloras are replaced by striate saccate and colpate pollen, in response to increased climatic aridity. Fresh water algae are locally abundant in the lower part (particularly in the "unnamed middle Unayzah member") and may be a non-marine equivalent of the P10 mfs expressed by the presence of saline acritarchs in the lower Gharif of Oman.

LATE ORDOVICIAN ORGANIC-WALLED PROTISTS FROM THE QUSAIBA-1 SHALLOW CORE (NW SAUDI ARABIA)

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Diverse and well-preserved microfloras of organic-walled protists (acritarchs, prasinophycean phycomata and other microalgal remains) are documented from 40 core samples from the Sarah and upper Qasim formations in QUSAIBA-1 shallow core hole, NW Saudi Arabia. The samples also yielded spores (Steemans et al., IPC, Bonn, 2008) and chitinozoa (Paris et al., IPC, Bonn, 2008). The youngest three samples, including organic-rich shale from the Qalibah Formation, contain abundant amorphous organic matter, and only dispersed small acanthomorphic acritarchs and leiospheres. Populations of microfossils are quite different from the associations found below in the syn-glacial strata of the Sarah Formation. A major characteristic of the glacio-marine samples, are stratigraphically admixed assemblages. This is consistent with Hirnantian glacial deposits recognized elsewhere along the north Gondwanan margin. Erosion and redeposition from glacial advance and retreat, and incision of glacial valleys is likely to have incorporated material from older strata into younger. Reworked elements are from the Darriwilian, Sandbian, and Katian, e.g., *Baltisphaeridium ternatum* and other baltisphaerids, *Cymatiogalea* spp., diacrodians, *Dicrodiacrodium ancoriforme*, *Frankea* spp. *Virgatosporites rudii*, etc. Hirnantian acritarch assemblages are dominated by veryhachids, netromorphs and leiospheres. The assemblages are considered to indicate glacio/lacustrine to marginal-marine depositional environments and variations of marine palynomorph composition are attributed to climatic and environmental changes. The basal Sarah Formation also includes a small number of stratigraphically significant species, such as *Safirotheca safira,* a component of the diamictites of the Late Ordovician Kosov Formation in Bohemia, and *Oppilatala* cf. *frondis*, only found above the major glacial erosion surface, in the synglacial unit 2 of the polyphased glaciation in Morocco. Underlying these glacial strata, the assemblages of the upper part of the Qasim Formation have good representation of *Veryhachium* and netromorph specimens, but are also more diverse. In-situ marine palynomorph assemblages contains new species but are also typical upper Sandbian and Katian associations of baltisphaerids, *Actinotodissus crassus, Anomaloplaisium lumariacuspis* (rare), *Cheleutochroa gymnobrachiata, Leprotolypa evexa, Navifusa* sp., *Neoveryhachium carminae, Nexosarium parvum, Orthosphaeridium* spp., *Striatotheca* sp. A of Molyneux (1988), *Tunisphaeridium* sp., *Veryhachium subglobosum* and *Villosacapsula* spp.

MARINE AND FRESH WATER PALYNOMORPHS FROM THE JAUF FORMATION, NORTHWEST SAUDI ARABIA

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In Northwest Saudi Arabia the Jauf Formation consists of five members, in ascending stratigraphic order these are: Sha'iba, Qasr, Subbat, Hammamiyat and Murayr. The age of the Jauf in this area ranges from Pragian? to Emsian. Depositionally it consists of fluvial, estuarine and marine lithofacies. Within the clastics of this succession there are carbonate and shale beds that yield marine body and trace fossils. The acritarchs and spores were recovered from shallow stratigraphic core holes that provided

unoxidized palynology samples for study. The marine palynomorphs include veryhachids, *Micrhystridium* spp., *Multiplicisphaeridium* spp., various sphaeromorphic acritarchs, *Winwaloeusia* sp., *Oppilatala* spp. and *Polydryxium* sp. The assemblages are not particularly diverse and indicate near-shore and/or shallow water depositional conditions. A single chitinozoan species of the genus *Angochitina* also occurs in the Hammamiyat Member and represents a distinct, correlative flooding event. In addition to the marine components noted above, fresh water representatives of the Chlorococcales, Family Hydrodictyaceae, including *Bijugum*, *Musivum* and *Tapetisphaerites*, are present. All of these forms are thinwalled, planar coenobia and have a regular, geometric cell addition. This distinct morphology allows easy identification. They have been found in spore dominated palynomorph assemblages and indicate the presence of fresh water. They also occur as allochthonous components in the marine assemblages. Representatives of the Hydrodictyaceae are important indicators for recognition of estuarine and fresh water depositional environments in the Jauf succession. In combination with marine acritarchs, non-marine Paleozoic Hydrodictyaceae are proven to provide added paleoecological for identifying fresh water influence.

AERONIAN AND TELYCHIAN CHITINOZOANS FROM CENTRAL SAUDI ARABIA

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A total of 58 core samples from three shallow core holes (Qusaiba-1, Baq'a-3 and Baq'a-4) penetrating the Qalibah Formation in Central Saudi Arabia have been investigated. The core samples are grey-greenish hemipelagic shale or silty-shale and yield very well-preserved and abundant Early Silurian chitinozoans. Most of the recorded chitinozoan assemblages are highly diverse and include several new taxa coexisting with well-known species. Five chitinozoan biozones ranging from the Aeronian to the Telychian, and considered of regional value at the scale of Northern Gondwana regions, are identified. From the oldest to the youngest they are the: *Conochitina alargada*, *Angochitina hemeri*, *Angochitina maclurei*, *Tanuchitina obtusa* and *Euconochitina silurica* biozones. The three older regional biozones have been already reported in Saudi Arabia (Paris et al. 1995) whereas the two youngest ones are documented for the first time in the Arabian Peninsula. Their eponymous index species were described from the subsurface of the Algerian Sahara. Several subbiozones of at least local application are also defined. The fairly closely spaced and regular sampling permits the total range of several highly diagnostic forms to be better constrained and thus the interval of uncertainty between biozones is reduced. Beside abundant chitinozoans and acritarchs, sporadic occurrences of scolecodonts and of eurypterid cuticle fragments are also noted in the organic residues. The presence of eurypterids suggests a shallowing trend in the sedimentary record, which is consistent with the distribution of the graptolites sicula and/or rhabdosomes. Indeed, the graptolites are frequent through the Qusaiba Member, except in the youngest examined samples where shallower environments like those in the Sharawra Member begin. Recently, Zalasiewicz et al. (2007) studied in detail the range of the graptolites in the three shallow cores. These graptolite data provide independent chronostratigraphical

control refining previous age assignments. The *alargada* and the *hemeri* chitinozoan biozones correspond to the mid-Aeronian *convolutus* graptolite biozone whereas the *maclurei* chitinozoan biozone extends through the early Telychian *guerichi* and *turriculatus* graptolite biozones. The *obtusa* and the *silurica* chitinozoan biozones occur in an interval devoid of graptolites are referred to the mid-late Telychian as they do not contain yet typical Sheinwoodian species.

BIOSTRATIGRAPHY OF LATE ORDOVICIAN CHITINOZOANS FROM NORTHWEST SAUDI ARABIA

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The QUSAIBA-1 shallow core drilled in NW Saudi Arabia penetrated the Qalibah, Sarah and Qasim formations. The Silurian graptolites and chitinozoans from the Qusaiba Member of the Qalibah Formation have been investigated previously. The present study focuses on the Upper Ordovician part of the core hole. A total of 39 core samples from the glacio-marine Sarah Formation and from the upper part of the Qasim Formation were processed for chitinozoans. Part of the sample set yielded abundant and well-preserved specimens associated with graptolite remains, scolecodonts, acritarchs and cryptospores. Other samples from glacially related sediments contained only a few fragmented chitinozoan vesicles of early Late Ordovician species suggesting reworking. Four different chitinozoan assemblages are identified. The youngest one is restricted to two samples located very close to the gamma ray peak and to the highest evidence of glacial sediments. This assemblage is dominated by *Cyathochitina* species including *C. caputoi*, associated with subordinate numbers of *Ancyrochitina, Euconochitina* and *Belonechitina* species. This assemblage does not contain the classical Late Ordovician chitinozoan taxa and an early Rhuddanian age is considered possible. The underlying interval is less productive and sometimes virtually barren. This interval yields a second assemblage mainly composed of broken specimens of *Tanuchitina, Cyathochitina,* and *Euconochitina*. Most of these forms seem reworked, probably through glacial erosion. The composition changes drastically in the older core samples where abundant *Armoricochitina nigerica* and *Ancyrochitina* species are associated with e.g., *Euconochitina lepta*, *Calpichitina lenticularis*, *Acanthochitina barbata* and *Desmochitina minor*. This constitutes the third recovered chitinozoan assemblage. In addition to the classical components, new species have been observed. This assemblage occurs in pre-glacial strata and is assigned to the late Katian (Ashgill). The oldest processed sample contains *Belonechitina, Hercochitina, Conochitina* and *Euconochitina* species. This fourth assemblage, however, lacks *A. nigerica* and suggests an older age assignment (e.g., late Caradoc of the British chronostratigraphy).

AN ORDOVICIAN CRYPTOSPORE AND TRILETE SPORE ASSEMBLAGE FROM SAUDI ARABIA

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The QSAIBA shallow core hole in NW Saudi Arabia penetrates a sequence of Ordovician-Silurian rocks. This study concentrates on the Sarah and Qasim Formations, below the Qalibah Formation (Qusaiba Member) that is Llandovery (Aeronian) in age. A detailed palynological analysis of these formations has been undertaken including spores (this study), chitinozoans (Paris *et al*., IPC, Bonn 2008) and acritarchs (Le Hérissé *et al*., IPC, Bonn 2008). Four assemblages of chitinozoans have been distinguished, dating the oldest samples as late Caradoc or earliest Ashgill and the youngest as Rhuddanian in age. Acritarchs suggest similar ages. The forty studied samples all produced rich assemblages of well-preserved palynomorphs of low thermal maturity (yellow to orange in color). They are dominated by marine elements, but most of them also contain spores. The spore assemblages contain the classical assemblages of cryptospores wellknown in many coeval localities on the Gondwana and Euramerican plates. Envelope-enclosed cryptospores are abundant (e.g., *Segestrespora* spp., V*elatitetras* spp.). Naked monads are less frequent (e.g., *Gneudnaspora* spp.). Of interest is the occurrence of a new genus of quadrahedral tetrads. It is similar to the ?alga *Quadrisporites*, but has a thicker wall, is sometimes enclosed within an envelope, and never has an operculum similar to that seen in several species of *Quadrisporites*. Identical specimens of this new genus have also been observed in the Llandovery from Paraguay. The most interesting aspect of this study is the discovery of laevigate and ornamented trilete spores that occur in most of the samples. The assemblage of trilete spores is composed of specimens of laevigate *Ambitisporites*, *Synorisporites* ornamented either with low verrucae or convolute muri and a ?*Synorisporites* or *Aneurospora* ornamented with grana or small verrucae. These are the oldest trilete spores known. Hitherto, the earliest accepted record of trilete spores was of extremely rare small *Ambitisporites* from the Hirnantian of Turkey. In general, rare *Ambitisporites* have been reported in the Rhuddanian and lower part of the Aeronian, becoming more abundant in the upper Aeronian. *Archaeozonotriletes* makes its appearance in the Telychian and the earliest ornamented trilete spores (*Synorisporites* spp.) are reported from Homerian layers from the UK. Some specimens observed in Saudi Arabia seem to be similar to the UK ones. This discovery suggests that our conception of the primitive vegetation and its terrestrialization has to be re-evaluated (Wellman *et al.*, IPC, Bonn 2008).

DEVONIAN MIO- AND MEGASPORES IN WESTERN GONDWANA

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Devonian miospore assemblages from 16 localities in Saudi Arabia and North Africa have been studied in order to characterize the palynostratigraphy of the northern margin of Western Gondwana. More than 200 miospore species, including many new species endemic to Western Gondwana, have been identified. Although the standard Devonian miospore zonations established in Euramerica are commonly used in most palynological studies, they are not always easily applicable to Western Gondwanan localities because of the endemic nature of the assemblages. Therefore, a new local/regional biozonation based on Gondwanan miospore species has been established. It consists of nine assemblage zones, eight interval zones and two acme zones, from

the late Pragian to the late Givetian and possibly the early Frasnian. A biozonation based on the first downhole occurrence of species is also 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. This provisional downward biozonation consists of eight interval zones. Although it seems relatively reliable by comparison with the previously defined upward biozonation, it needs to be further tested. The review of the Emsian-Givetian miospore assemblages from the literature allows evaluation the provincialism of assemblages on a worldwide scale. Coefficient of similarity is calculated between palynofloras from northern and southern Euramerica and eastern, Southwestern and Northwestern Gondwana. The resulting low values correspond to low to moderate similarity of miospore assemblages. The provincialism may be explained by a latitudinal climatic gradient as no significant palaeogeographic barrier is known during this time. 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. 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.

SPORE AND POLLEN ASSEMBLAGES FROM THE MIDDLE AND UPPER GHARIF MEMBERS (PERMIAN, OMAN) AND CORRELATION WITH THE AMAZONAS BASIN, BRAZIL

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The late Early Permian to Mid Permian palynological biozones OSPZ5 and 6, defined recently for the Arabian Peninsula, sometimes contain well-preserved and diverse assemblages which are described here for the first time, concentrating on taxa used in recognition of biozones. Some of these taxa were previously assigned informal names. The recognition of taxa such as *Hamiapollenites karrooensis* and *H. dettmannae* is notable because they are important in biozonation and correlation in the Amazonas Basin in northern Brazil. Thus a tentative correlation of the base of the Upper Gharif Member with the base of the Andirá Formation in Amazonas can be suggested and equivalence of the Amazonas upper *Vittatina costabilis* and *Tornopollenites toreutos* biozones with at least part of OSPZ5 and 6 is also implied. The lithological character of the Andirá Formation is similar to that of the Upper Gharif Member in that it is dominated by continental siltstones, fine sandstones and shales and is in places appreciably red in colour. Palaeogeographical reconstructions of the Wordian indicate that Oman and Amazonas had similar palaeolatitudes, and it may be that some of the similar character of the palynology and lithology is derived from a similar palaeoclimate in the area at the time.

PERMIAN PALYNOLOGICAL ASSEMBLAGES FROM THE ASSELIANEARLY SAKMARIAN DORUD GROUP AND WUCHIAPINGIAN-CHANGHSINGIAN NESEN FORMATION OF THE ALBORZ MOUNTAINS, IRAN: COMPARISONS WITH ARABIAN ASSEMBLAGES

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Palynological samples from the Asselian-early Sakmarian lower and middle units of the Dorud Group, Alborz, Iran yielded poorly preserved assemblages dominated by monosaccate and bisaccate pollen (mainly *Potonieisporites* spp.), with very few spores and acritarchs. Taxa recorded include *Plicatipollenites*, *Cannanoropollis*, *Barakarites* sp., ?*Kingiacolpites subcircularis* and *Corisaccites alutas*. The assemblages are similar to those of the upper parts of the late Sakmarian Lower Gharif Member and Artinskian Middle Gharif Member in Oman and to the OSPZ3 or 4 biozones of Arabia. Overall, the Dorud Group assemblages are quite unlike those typical of the Asselian – early Sakmarian of geographically close areas of the Arabian Peninsula and other Gondwana areas in Australia, India, South America and Antarctica, which are characterised by the *Converrucosisporites confluens* Oppel Zone. Thus it is interesting that the late Sakmarian – Artinskian terrestrial plant palaeoecology of Arabia may have already been established earlier, further north in Iran along the Neotethys shore, and then subsequently migrated southward. Samples from the the Wuchiapingian-Changhsingian Bear Gully and Mangol Quarry sections of the lower part of the Nesen Formation yielded common *Densoisporites*/*Lundbladispora* spp., *Distriatites insolitus*, *Triquitrites proratus* and ?*Florinites balmei* suggesting similarities with the highest part of the Changshingian Chhidru Formation of the Salt Range, Pakistan (the 'White Sandstone Unit'). ?*Florinites balmei* has also been recorded recently from the Mid-Permian in Iraq and is known to be present at similar levels in other Gulf states. The first uphole appearance of this taxon, which is widely present in Arabia, defines the base of the Arabian OSPZ6 Biozone and closely relates to the lowest beds of the Khuff Formation carbonates. The lower limit of its range in Alborz is not certain in the episodically palyniferous Upper Permian sequence. However its ubiquity may ultimately prove useful in general Middle Eastern stratigraphic palynological studies.

CORRELATION OF THE KAŞ FORMATION (PERMIAN, SE TURKEY) WITH THE GA'ARA FORMATION (NORTH IRAQ) – A CONTRIBUTION TO ARABIAN PLATE STRATIGRAPHY

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The approximately 50 m thick upper part of the Permian Ga'ara Formation is exposed mainly as sandstones at the type locality in the Ga'ara Depression in western Iraq. From the subsurface of the same area, intercalations of sand- and claystones have been reported. The equivalent of the Ga'ara Formation, according to previous studies of Arabian Plate stratigraphy, is missing in southeastern Turkey, c. 450 km northward from the Ga'ara Depression. In this study, however, relatively contemporaneous strata are now recognized in the Kaş Formation. The Kaş Formation in southeastern Turkey consists of grey to black organic-rich claystones and yellow sandstones. The palynological assemblages from the lowermost beds of these dark, fine-grained clastics can be correlated palynologically with assemblages previously reported from claystones of the upper Ga'ara Formation at a depth of 55 m-60 m in the B.H.100/B/85 well. Biostratigraphically significant taxa for the correlation of the lowermost Kaş Formation with the fossiliferous interval in the B.H.100/B/85 well include among others *Verrucosisporites* sp. cf. *V. planiverrucatus* Imgrund 1960 (*sensu* Balme 1970), *Diaphanospora rutbaensis* Nader, Khalaf and Yousif 1993 and

?*Florinites balmei* Stephenson and Filatoff 2000 (in Iraq as *F. millotti*). The Kaş Formation is assigned to the middle to late Wordian, based on foraminiferal age control. Recent studies of the stratigraphy of Iraq consider the Ga'ara Formation to be Late Carboniferous to Middle Permian, as young as middle Wordian. According to these age assignments, *V.* sp. cf. *V. planiverrucatus* and *D. rutbaensis* have, in southeastern Turkey and Iraq, their last occurrences in strata of middle Wordian age. No major unconformities nor evidence for other stratigraphic gaps have been recognized during palynological investigations of both, the outcrop and subsurface sections of the Kaş and overlying Gomaniibrik formations (middle Wordian to Changhsingian), from various southeastern Turkey localities. Comparison of the palynological assemblages from southeastern Turkey with those from the Ga'ara Formation and the overlying Chia Zairi Formation show a similar, relatively continuous succession of Permian strata of Iraq. This is contrary to some previous studies, which interpreted the presence of a major unconformity between the Ga'ara and the Chia Zairi formations.

TRILETE SPORES FROM THE ORDOVICIAN OF SAUDI ARABIA: EARLIEST EVIDENCE FOR VASCULAR PLANTS AND THEIR IMMEDIATE PREDECESSORS (“PROTRACHEOPHYTES”)

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The invasion of the land by plants (embryophytes) is considered to have occurred in a step-wise fashion. The earliest noncontroversial fossil evidence for land plants is from the Middle Ordovician and consists of dispersed spores. These spores are termed cryptospores because they occur in unusual configurations, although they do bear similarities to the spores of certain extant bryophytes. They are considered to represent a flora of stem group embryophytes that possessed bryophyte-like anatomy and physiology. Cryptospore assemblages are palaeogeographically widespread and exhibit stasis for approximately 40 million years, showing remarkably little temporal and spatial variation. The bryophyte-like stem group embryophytes were probably generalists that could tolerate a wide variety of climates. A major change in dispersed spore assemblages is documented in the Late Ordovician (Ashgill)-Early Silurian (Llandovery) when trilete spores appear. Early occurrences are sparse with simple trilete spores forming a very minor component of dispersed spore assemblages. However, in the late Llandovery trilete spores diversify in terms of abundance, diversity and disparity concomitant to a dramatic decline in cryptospore abundance. Trilete spores are characteristic of primitive vascular plants (fossil and extant) and their extinct immediate precursors (“protracheophytes”). The change in spore assemblages is interpreted as representing the origin of this group of plants that initially were rare and diversified little (slow fuse) but then underwent a dramatic and rapid diversification in terms of abundance, diversity and disparity (adaptive radiation). During this radiation they outcompeted the bryophyte-like stem group embryophytes, although this group of plants probably gave rise to the extant bryophyte groups (but always as a minor component of the land flora subsidiary to the better adapted vascular plants). Here we report on an important new trilete spore occurrence from Mid-Late Ordovician rocks from Gondwana. This is the earliest to date and is surprisingly diverse (4-5? taxa) including laevigate and ornamented

species. It suggests that the origin and diversification of vascular plants exhibited a slightly different pattern than previously envisaged. It seems likely that vascular plants appeared earlier on Gondwana before spreading to other continents. Based on the position of Gondwana at this time, these findings hint at the intriguing possibility that vascular plants may have evolved at high southern latitudes before migrating northwards and eventually diversifying.

ABSTRACTS FROM NON-CIMP SYMPOSIA

BIOGENIC SILICA PARTICLES IN "BARREN RED BEDS": A NEW STRATIGRAPHIC TOOL FOR ROTLIEGEND SEDIMENTS OF THE NETHERLANDS

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The presence of natural gas in the Southern North Sea subsurface is of significant economic and strategic importance. The most important gas reservoirs occur in the Upper Permian Rotliegend sediments, deposited in an arid environment. Terrestrial Permian biostratigraphy is usually based on organic-walled microfossils (sporomorphs). In Rotliegend sediments, these fossils are, generally, not preserved, due to strong oxidizing conditions during deposition. Hydrocarbon exploration and production is hampered by the lack of an independent stratigraphic control. In 2005, TNO started a study supported by industry to resolve this issue by using biogenic silica particles originating from higher land plants and from other (aquatic) organisms as stratigraphic markers in the Dutch Rotliegend. Little is known about the stratigraphic significance of plant biogenic silica (i.e. phytoliths) in Permian continental deposits. However, major plant groups like gymnosperms, lycopods and ferns, existed by the end of the Devonian and these early land plants may have formed phytoliths within their tissue. Depending on the diagenetic conditions, the phytoliths may preserve in the fossil record following the decomposition of the organic matter. Similarly, silica bodies from other (aquatic) organisms (i.e. algal bodies, sponge spicules) may also preserve. A preparation technique was developed to separate the biogenic silica particles from the mineral particles and to concentrate the biogenic silica. A total of 153 samples from the Rotliegend sections of 5 Dutch wells has been analyzed using detailed light and scanning electron microscopy together with energy dispersive X-ray spectrometry. In addition, the biogenic silica residues have been analyzed with ICP-MS for their Rare Earth Element (REE) content. Preliminary interpretation of the microscope analyses shows the occurrence of 22 biogenic silica morphotypes in four main categories. Based on the qualitative and quantitative distribution patterns, selected morphotypes appear to have potentially stratigraphic significance. A tentative correlation scheme allows a correlation of the 5 studied wells and a proto-zonation scheme can be established. The data from the REE analyses on the biogenic silica residues provide additional stratigraphic signals. The results of this study may form a breakthrough in biostratigraphy in traditionally "Barren Red Bed" sediments.

RECENT ADVANCES ON THE MISSISSIPPIAN PALYNOSTRATIGRAPHY OF THE MALIMÁN FORMATION, NORTHWESTERN ARGENTINA

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A palynozonal scheme for the Mississippian deposits of the Malimán Formation cropping out in northwestern Argentina is established based on extensive palynological studieson three localities. The unit was accumulated in marine, littoral and fluvial-deltaic environments. Samples yielded regular to well-preserved palynomorphs composed of 114 spore species and scarce microplankton. Recycled Devonian taxa are quite common in the samples, and they mainly derived from the underlying Chigua Formation. Three assemblage zones were established from oldest to youngest: Palynozone 1. Characterized by the first occurrence of *Convolutispora insulosa*, *C. varicosa, C.* sp. cf. *C. usitata, Crassispora invicta*, *C. trychera, Dibolisporites* sp. cf. *D. setigerus, Emphanisporites hibernicus, Grandispora debilis, G. notensis, G. spiculifera* and *Verrucosisporites oppressus*, among others. All of them, exclusive from this zone, disappeared in the upper limit with the subsequent zone. Quantitatively this assemblage is distinguished by a high content of specimens of a new species of *Crassispora*. This zone is recognized in the lowermost part of the unit. Palynozone 2. The lower limit is defined by the appearance of two key species, *Schopfites claviger* and *Colatisportes decorus* and most of the species of *Verrucosisporites* (*V. congestus, V. morulatus, V. papulosus* and *V. baccatus*) are also recorded in this zone.*Apiculatisporis castanea* and *A. variocorneous* are exclusive of this zone and species of *Crassispora* and *Cristatiporites* are present in a low proportion. This zone is mainly represented in the middle part of the Malimán Formation. Palynozone 3. The lower limit is marked by the dominance of species of *Cristatisporites* (e.g. *C. indolatus, C. inordinatus*) and *Densosporites* is also a common genera. The upper limit is defined by the uppermost palyniferous sample located at the beginning of the deltaic deposits of the upper part of the unit while the rest of this section is barren due to its predominantly coarse-grained lithology. Based on thestratigraphic ranges of the species identified, the limit between the first and second palynozones is likely latest Tournaisian-earliest Viséan and the third one is early Viséan. A correlation of these palynozones is proposed with the Viséan *Anapiculatisporites largus* of Australia, the late Tournaisian-early Viséan CM and Pu Zones of Euramerica and the early Viséan assemblage of the Itacua Formation of Bolivia.

THE APPLICATION OF PALYNOLOGY IN THE CORRELATION AND PALAEOENVIRONMENTAL INTERPETATION OF UNUSUAL TEMPESTITE FACIES SEQUENCES (STORM EVENT HORIZONS) FROM THE TOURNAISIAN OF SOUTHERN IRELAND AND SOUTH WALES

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Synsedimentary deformation structures discovered in Tournaisian (Mississippian) rocks at Hook Head in southeast Ireland are interpreted as part of an atypical tempestite facies sequence (storm event horizon). Similar tempestite facies sequences of Tournaisian age have been found at three other localities in southern Ireland and at two localities in South Wales. The sedimentology and structure of these tempestite sequences are indicative of an event, or series of events, of intense storm activity followed by the disturbance of the background sedimentation, possibly triggered by the severity of the storminess. High resolution palynological analysis has proved vital in accurately determining whether the tempestite facies sequences

represented either a major regional synchronous event or a series of events during the Tournaisian. Ninety palynological samples were analysed from the six sections studied. The data has lead to the refinement of the early Mississippian BP and PC miospore biozones (Brittain & Higgs, in press, Communicações Geológicas, Proceedings of the CIMP, Lisbon, 2007). The dating and correlation of the tempestite facies sequences, their regional palaeoenvironmental significance and basinwide proximal-distal relationships are presented and discussed.

PALYNOLOGY AND FACIES OF THE EIFELIAN-GIVETIAN TRANSITION IN ITS TYPE AREA (EIFEL HILLS, GERMANY)

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Well exposed cyclic limestones and mudstones from several quarries in the Hillesheim Syncline (Rhenish Massif, Germany) have been analyzed palynologically and sedimentologically. Comprising the Junkerberg, Freilingen, Ahbach, Loogh and Cürten formations, the respective sequences cover the Eifelian-Givetian boundary and include the late Eifelian Kacak bioevent. This critical time interval is characterized by stable conditions in general, but shows evidence of episodic physical and biotic changes. Detailed palynological sampling provided rich and well to moderately preserved assemblages of terrestrial and marine organic walled microfossils (OWM) allowing for a bed-by-bed palynofacies study. Overall, within the palynological assemblages, land derived miospores and phytoclasts, especially cuticles and tissue fragments, dominate with up to 90 % of microfossils in some samples, whereas higher amounts of marine elements, e.g., acritarchs, prasinophytes, chitinozoans, scolecodonts and other zooclasts are confined to some distinct levels. Temporal distribution of specific palynological groups, including amorphous organic matter, and the terrestrial/marine index, clearly indicates paleoenvironmental changes. In some of the samples, prasinophytes like *Leiosphaeridia* are prevalent, while the abundance and diversity of miospores, phytoclasts and acritarchs is comparatively low. This may reflect changes in specific environmental or depositional parameters, possibly related to fluctuations in oceanographic conditions (e.g., sea level changes) or climate, as has been documented from in other areas during the Middle Devonian. In some distinct beds, thick-walled miospores (e.g., *Retusotriletes*) dominate over other miospore taxa. This may suggest differences in the hydrodynamic system and/or in the climatically controlled terrestrial environment. Thus, judging from the distribution of the different associations of palynomorphs and from sedimentology, the paleoenvironment in general can be interpreted as a shallow marine depositional system, rarely bordering on marginal marine conditions. However, the proportion of terrestrial input to the palynofacies spectrum is high, while marine constituents (e.g., acritarchs and chitinozoan) are surprisingly rare. In addition, the miospores contribute to local and regional biostratigraphic correlation, especially in comparison to other index fossils (e.g., conodonts).

PALYNOSTRATIGRAPHICAL CORRELATION OF UPPER PERMIAN TO MIDDLE TRIASSIC FACIES FROM THE IBERIAN RANGES (SPAIN)

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In the Iberian Ranges, lithological formations spanning the Upper Permian to Middle Triassic are presenting two main facies types: siliciclastic redbeds formerly attributed to the "Buntsandstein", and calcareous facies attributed to the "Muschelkalk". Historically, the stratigraphy working group of the University of Madrid conducted a series of studies in this area to describe these sections. As a result, an abundant series of detailed works (monographs, theses and publications) with the generation of a very diverse nomenclature system was proposed. This multiplication of names is in most cases justified because of the fragmentary nature of the studied outcrops, mainly resulting of very intense tectonic activity. The Iberian ranges are subdivided in three domains: 1) the Aragonian or Oriental Branch (where four formations were described), 2) the Castilian or Occidental range spanning three subdomains (North with dix formations, central with seven formations and southeastern with eight formations), and 3) the Balearic Islands (six formations). This work is presenting a compilation of all published palynological data as well as an addition of others unpublished results to propose a unified palynological biozonation for the entire study area. This biostratigraphical scale is allowing for more precise correlation of the lithostratigraphical sections, and can yield to terminological simplification as well as better definition of sedimentary cycles for this period of time, in the Iberian Ranges.

PALYNOLOGICAL EVIDENCE FOR PENNSYLVANIAN EXTRA-BASINAL VEGETATION IN ATLANTIC CANADA

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Pollen preserved in latest Westphalian and early Stephanian clastic deposits of the Sydney Coalfield suggest that there was a concentric set of vegetational habitats surrounding the wetlands where the coal-forming peat was formed. On the margins of the wetlands was a narrow band with large cordaitanthacean trees. This was surrounded by 'occasionally-dry' habitats supporting *Schuetzia*-plants, ruflorioid-plants and *Aethophyllum*-like herbaceous conifers. Around this were mesic or seasonally-dry habitats, dominated by walchian conifers, cycads and disaccates-producing peltasperms. These in turn were surrounded by xeric or seasonally-wet habitats, dominated by ullmanniacean conifers, cycads and monsaccates-producing peltasperms. During latest Westphalian and early Stephanian times, the mesic and xeric habitats encroached nearer to the wetlands, although the vegetation of the wetlands themselves remained essentially unaffected. This vegetation change was not a response to climate change, but probably to changing drainage patterns and topography in the surrounding hinterland. The *Florinites*-producing cordaitanthaceans appear not to have been upland trees, as previously suggested, but occupied mainly coastal habitats, or riparian habitats on the margins of the wetlands.

BIOGEOCHEMISTRY OF PRASINOPHYCEAN ALGAE, MEGASPORES AND CHITINOZOANS AS REVEALED BY PYROLYSIS-GAS CHROMATOGRAPHY-MASS SPECTROMETRY

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Palynology has developed into a multifaceted discipline with new applications. Molecular palynology is one of those new subjects that appeal the researchers from both academia and industries. Here we report outcomes of an ongoing study in which the molecular compositions of extraordinarily well preserved prasinophytes, megaspores, and chitinozoans are investigated. We focused on palynomorphs of low thermal maturity. Samples were collected from the Silurian-Permian and Cretaceous- Tertiary of Germany, Turkey, Australia and USA. The overall chemical compositions of *Tasmanites* and *Leiosphaeridia* are similar. The pyrolysates are dominated by a series of C6−22 *n*-alkene/*n*-alkane doublets. Tricyclic terpenoids, present in the pyrolysates of *Tasmanites* from Tasmania, were not detected by analytical pyrolysis of the *Tasmanites* from Turkey and USA. Interestingly, the pyrolysates of *Leiosphaeridia* show the presence of several unsaturated and aromatic tricyclic terpenoids. Thus, an inherent source-biomarker relationship between the *Tasmanites* and tricyclic terpenoids may not always exist. Alkylbenzenes and alkylphenols are the major aromatic pyrolysis product of all megaspores. A homologous series of *n*-alkene/*n*-alkane doublets was detected in all fossil sporopollenin. Oxygenated aromatic compounds like benzaldehyde, acetophenone and 4- vinylphenol were found in the pyrolysates of all megaspores of Lower Cretaceous and Paleogene age. However, they are absent in the pyrolysates of Pennsylvanian megaspores. Within the realm of our present investigation, it is suggested that all megaspore walls had the same chemical composition prior to fossilization. The subsequent differences in chemical composition of fossil sporopollenin are likely due to the influence of different diagenetic processes and thermal history. The major pyrolysates of chitinozoans are aromatic hydrocarbons such as akylbenzenes, alkylnapthalenes, alkylphenantherenes and alkylphenols. A homologous series of *n*-alkene/alkane doublets also indicated the presence of a significant aliphatic moiety. No pyrolysis products diagnostic of chitin were detected and it is unlikely that the original biomacromolecules of chitinozoans prior to fossilization were made of chitin. In total, our data reveal that pyrolysis of marine derived kerogen can yield phenols and aromatic compounds; hence they are not always diagnostic of kerogen derived from terrestrial higher plants. This has implications in hydrocarbon source rock evaluations which will be discussed in this presentation.

PALYNOLOGICAL AND COAL PETROGRAPHICAL STUDIES IN THE DUCKMANTIAN OF THE RUHR BASIN/GERMANY: IMPLICATIONS FOR HIGH RESOLUTION PALAEOENVIRONMENTAL RECONSTRUCTION

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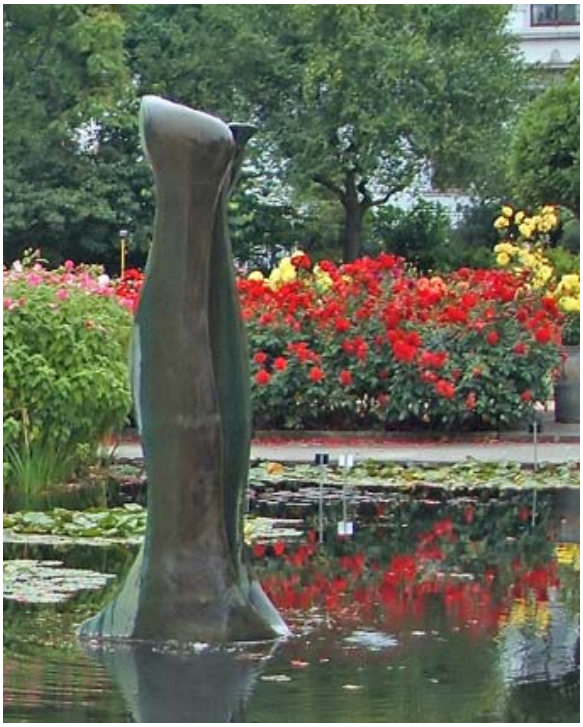
This study concentrates on the plant evolution in the paralic Ruhr Basin during the Duckmantian using palynology and coal petrography. In this Variscan foreland basin over hundred coal seams were deposited from the Yeadonian (Namurian C) until the Bolsovian (Westphalian C). Thickness of Westphalian sediments reaches up to 3000 m. The studied sequence covers 525 m. For coal petrography over 400 samples were collected from six seams and from the under- and overlying organic rich mudstones and fine grained sandstones. 160 samples were analysed for palynology. All samples originate from the Prosper-Haniel coal mine. Following organic petrographical analyses and Rock-Eval pyrolyses, coals are dominated by vitrinite with typically high Hydrogen and low Oxygen Indexes. Clastic rocks show mostly more vitrinite than inertinite. Based on Rock-Eval pyrolyses, coals are type II to type III kerogen, whereas clastic rocks are typically type III kerogen. Vitrinite reflectance is between 0.7% and 1.1% VRr indicating low thermal maturity. Overall, coal swamp and clastic wetland floras were dominated by arborescent lycopsids. Especially in clastic wetland sediments, *Lycospora* sometimes reaches up to 90% as it is usual in Westphalian coal bearing sequences. *Granasporites* and *Crassispora* are also common. In coals, miospore diversity is higher than in clastics, which may be due to the rather poor preservation in the mudstones. Miospores of plants like subarborescent or herbaceous lycopsids, ferns, cordaites, sphenophylls as well as calamites occur regularly, while those of tree ferns are rare. Short time changes in mire conditions resulted in ombrotrophic swamps with a miospore association dominated by densospores. Environmental changes are clearly reflected by variations in the miospore associations and by coal petrographic data. Hence, palynology and coal petrography contribute to a better understanding of small scale depositional fluctuations and changes in vegetational composition.



Bonn Botanic Gardens, photo: Jenny Brittain

REVIEW OF MONOLETE-PRODUCING CARBONIFEROUS-PERMIAN SPHENOPHYLLS

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Fructifications of the genus *Sphenophyllum* was erected by Binney in 1871 as an organ-genus *Bowmanites*. *Bowmanites* cones yielded several different types of spores and can be divided into several groups. One of thses groups is represented by sphenophyllalean cones produced thin walled, laevigate monolete spores of intermediate and large diameter (i.e. more than 35 microns). Cones of this group are characterized by sporophylls indistinguishable from sterile leaves, sporangia borne in clusters of four on sporangiophore. Spores of the *Laevigatosporites* – *Latosporites*-type were macerated from species *B.*

myriophyllus, B. majus, B. laciniatum, B. bifurcatus, B. nindelii, B. simonii, B. zwickaviense, B. ketnerii, B. priveticense and from related taxa *Leeites oblongifolius, Tetraphyllostrobus broganensis*, *T ristachya* (*Lilpopia*) *crockensis* and *Ptychocarpus hexastichus*. *In situ* spores from all these plants are indistinghuishable each other the morphology/anatomy of their producers is the only criterion for their determination and classification. Roughly similar type of monolete spores but with sculptured outer exine layer (*Columinisporites*-type) was macerated from petrified sphenophyllalean specimens of *Sentisporites glorii* and *Peltastrobus reedae*. This research is supported by GAAV A300130503.

ORGANIC-WALLED MICROPLANKTON FROM THE UPPER DEVONIAN OF THE ALBERGARIA-A-VELHA BLACK SHALES (W PORTUGAL) AND ITS PALEOBIOGEOGRAPHICAL IMPLICATIONS: PRELIMINARY RESULTS

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The Albergaria-a-Velha Unit is composed by several dispersed outcrops along the Porto-Coimbra-Tomar shear zone (W Portugal). It constitutes one of the several tectonostratigraphic out-of-sequence units of a metamorphic belt along this shear zone. It is composed entirely by pelitic sediments. The older (Upper Devonian) part is composed solely of black and dark grey shales while the younger sediments (Lower Carboniferous) have shales, siltstones and rare fine sandstones. Most of the sedimentary information is obliterated by the intense deformation and metamorphism, but the rare preserved sections indicate that the original facies was probably turbiditic. The paleogeography of this area during the Devonian and Lower Carboniferous is poorly known. Reconstructions are restricted to local environments based mostly on geological mapping, tectonostratigraphy and clay mineralogy/geochemistry evidences. The relative position to other terranes is unknown due the complex geotectonic framework. The palynological content of the unit was studied originally by Chaminé *et al.,* 2003 (and references there in) focusing mostly on the spore stratigraphy. The determined age was Late Givetian-Lower Frasnian but the possibility of a younger age was not excluded. The organic-walled microplankton obtained from the analyzed samples of this unit is diversified and moderately preserved. The assemblages point to a Frasnian age. The presence of *Cymatiosphaera perimembrana, Villosacapsula* cf. *ceratoides* and *Winwaloeusia* cf. *ranulaeforma* and other genera and species suggest a closer proximity to a Euramerica late Devonian realm. So far no species of *Umbellasphaerdium, Crassiangulina, Horologinella and Schizocystia* species were found (common Gondwanan genera). Further analysis of the samples and quantified comparison with other assemblages is needed to properly evaluate the paleobiogeographical meaning of this microplankton assemblage.

ELUCIDATING THE PARENT PLANTS OF SILURIAN CRYPTOSPORES

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Despite the absence of megafossils prior to the Llandovery (Early Silurian), evidence for the earliest embryophytes can be inferred from phytodebris and the dispersed spore record as far back as the mid-Ordovician. Trilete spores (evidence for tracheophytes) did not appear until the Llandovery, prior to which sporomorph assemblages were dominated by cryptospores (non-trilete sporomorphs of elusive affinity). During this period, laevigate cryptospores were particularly common, and were naked or enveloped, fused or unfused, in tetrad, dyad, or monad arrangement (e.g. *Tetrahedraletes*, *Dyadospora* and *Laevolancis* respectively). Unlike the trilete-producing vascular plants, little is known about the affinity of the cryptospore-producers, due to their poor preservation. However, the discovery of fragmentary yet well-preserved coalified mesofossils (less than 1mm in width), do give clues to the nature of cryptospore-producers. Mesofossils from the Upper Silurian (Přídolí) to Lower Devonian (Lochkovian) strata from the Anglo-Welsh Basin are either minute branching or unbranching axes with terminal sporangia, or fragmentary sporangia, both of which contain *in situ* spores, or occur as spore masses. Both in situ cryptospores and triletes have been reported. Here we report a number of fragmentary, coalified mesofossils and spore masses from the Upper Silurian (from the Lower Přídolí Downton Castle Formation, Shropshire, UK). Material is semi-compressed and well preserved, and broken open to reveal *in situ* spores. Spore masses occur as tightly adhered clusters, or are encased in tissue interpreted as remnants of the inner sporangial wall. Gross mesofossil and spore mass morphology are compared to known mesofossils from the Přídolí and Lower Lochkovian (Lower Devonian) and *in situ* spores are compared with dispersed spore taxa, with particular attention to spore arrangement. A number of different groups have been recognised. Firstly, flattened, circular sporangial discs with thick marginal rims, contain *Laevolancis*. Secondly, horseshoe-shaped spore masses similar to *Hollandophyton* containing an unpublished spore taxa with a distinctive shagrinate-reticulate distal sculpture. Thirdly, semi-hemispherical sporangial fragments contain thin-walled laevigate cryptospores, either in monad, dyad or tetrad form. Finally, two examples of elongate axial fragments are completely surrounded by sporomorphs (*Laevolancis* and verrucaesculptured, non-permanent tetrads respectively) and appear to show spores with various developmental phases.

UPPER PALAEOZOIC CARBONATE COMPLEX IN THE BASEMENT OF THE OUTER CARPATHIANS – AGE AND HYDROCARBON POTENTIAL ON THE BASE OF PALYNOLOGICAL STUDIES

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Upper Palaeozoic carbonate rocks occur in the basement of the Outer Carpathians on two blocks: Upper Silesia and Małopolska. On the Upper Silesia Block carbonate platform exist in the Middle and Upper Devonian. Tournisian-Visean carbonate sediments are lithologically very similar and seems to be the continuation of the carbonate platform's sedimentation. On the Małopolska Block Devonian-Carboniferous carbonate deposits occur only in the western part. Carbonate complex were recognized in numerous boreholes in the area Busko- Rzeszów-Tarnów-Kraków, and on the west in the area Kraków-Cieszyn. The carbonate Devonian-Carboniferous rocks were divided into 6 lithostratigraphical complexes, based on correlations of the geophysics data and lithological descriptions of cores. The aim of the palynological studies was age

determination of these complexes and estimation of hydrocarbon potential based on the palynofacial record and TAI determination. Also under-and overlying clastic deposits and terrigenous intercalations were examined, because the samples from carbonate rocks contain very small amount or lack the organic matter. Palynostratigraphy of the Devonian-Carboniferous deposits was established according to spore zonation of Devonian (Richardson & McGregor, 1986; Streel at al., 1987; Avkhimovitch et al., 1993) and Carboniferous (Clayton et al., 1977, Higgs et al., 1988). Mudstones underlying the carbonate complex represent assemblage zones annulatus-sextantii (Late Emsian) or douglastownense-eurypterota (Emsian/Eifelian). Terrigenous sediments overlying the carbonates represent palynozones vetustus-fracta VF (Asbian/Brigantian) or nitidus-carnosus NC (Brigantian/Pendleian). Inside the carbonate complex the following zones were recognised: velatus-langii (Eifelian), devonicus-naumovi (Eifelian/ Givetian), optivus-triangulatus (Late Givetian/ Frasnian), pusillites-lepidophyta (Famennian), pretiosus-clavata (Hastarian/ Ivorian), claviger-macra (Ivorian/ Chadian), pusilla (Chadian/ Arundian), tesselatuscampyloptera (Early Asbian), nigra-marginata (Middle Asbian). Hydrocarbon potential of the carbonate complex is more perspective on the Upper Silesia Block, where thermal maturation is not so high as on the Małopolska Block. Lachowice-Stryszawa oil and gas field is the best example of the good hydrocarbon potential of Devonian- Lower Carboniferous carbonates on the Upper Silesia Block, while on the Małopolska Block the best conditions for the hydrocarbon accumulation occur in the vicinity of Rzeszów (Trzebownisko field).

IN SITU SPORES FROM PENNSYLVANIAN FERNS FROM UPPER SILESIAN BASIN (CZECH REPUBLIC, POLAND)

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Ferns are very abundant fossils during all geological ages. Several fern taxa belong to eusporangiate and leptosporangiate group were described from the Pennsylvanian deposits of the Upper Silesian Basin. The knowledge about their morphology and partly anatomy are relatively god, but the knowledge about their spores (*in situ*) is poor in comparison with number of known species described based on sterile specimens. Another way we still do not now plant affinity of several dispersed spore taxa. We know in situ spores of only about 10 per cent of ferns. Based on this fact we presented some specimens of fertile ferns from the Upper Silesian Basin where is possible to identify their spores preserved in attached reproductive organs and we radiate the database of ferns and their spores. This research is supported by GAAV A301110701 and GACR 205/07/1059.

A REVIEW OF PALYNOLOGICAL PREPARATION AND THE DEVELOPMENT OF ACID-FREE TECHNIQUES

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Palynological preparation techniques aim to extract the indigenous palynomorphs from sediments and sedimentary rocks and to isolate, concentrate, and present fully representative assemblages for study in perfect condition. The science of palynology was revolutionised by two key breakthroughs. The first was the invention of the microscope. The second was the development of chemical preparation

techniques for palynomorphs during the middle of the 19th century. The first uses of hydrochloric and hydrofluoric acids to isolate palynomorphs were in 1848 and 1924 respectively. Another large step forward was the use of Schulze's solution to macerate coals in 1855. Acid-based methods in palynology developed rapidly during the modern era in the 20th century as the entire subject expanded. Between the 1950s and the 1970s, a standard procedure of preparing pre-Quaternary samples evolved. In summary this is: (1) cleaning/crushing; (2) demineralization using mineral acids; (3) density separation; (4) oxidation/alkali treatment; (5) staining; (6) sieving; and (7) slide production. There is an extensive literature on palynological preparation which includes both generic works, and accounts on specific aspects. The use of mineral acids is hazardous. If effective alternatives to this procedure can be developed, processing will be made significantly safer. Two methods of palynomorph extraction without using mineral acids have recently been developed. The first of these uses sodium hexametaphosphate [(NaPO3)6], which is a disaggregating/deflocculating agent. The sample is softened using a detergent, before treatment with (NaPO3)6. The deflocculated clay (<10 µm) is then sieved away and the residue centrifuged to remove mineral grains. Another non-acid technique developed uses hydrogen peroxide (H2O2). The sample is briefly heated, treated with 15-30% H2O2 for 10 minutes, and flooded with water. Disaggregated material tends to float, and can be decanted. If any undisaggregated sample remains, the procedure may be repeated. This stepwise technique minimises exposure to the hot H2O2, which is an oxidising agent. Both these methods have been successfully tested on material of Carboniferous to Quaternary age.

PALYNOSTRATIGRAPHY AND ENVIRONMENT OF "STRUNIAN" AND VISEAN DIAMICTITES FROM SOUTH AMERICA (WESTERN GONDWANA)

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Diamictites and other associated sediments from the "Strunian" Cabeças Formation and from the Visean Poti Formation in the Parnaiba Basin (Brazil), from the "Strunian" to Visean Toregua Formation in the Madre de Dios Basin (Bolivia) and from the "Strunian" to Visean Itacua (Saipuru) Formation of the Tarija Basin (Bolivia) contain very abundant and well preserved palynomorphs, most being reworked from older sediments. The Western European miospore stratigraphy linked to the conodont stratigraphy allows dating these diamictites. The acritarch stratigraphy being almost always based on assemblage definition is not suitable for comparison with the conodont scale. Only the youngest recorded miospores in the diamictites allow their dating. The delay between the glacial deposition and the melting process accumulating diamictites is investigated. The comparison with miospores from varved sediments and from sediments laterally associated with the diamictites provides evidence for their almost contemporaneousness. Quick changing and alternating climatic conditions are established in Western Europe at the end of the Famennian and in the late part of the Visean. They allow explaining, for instance, the delusive simultaneity of Late Visean warm climate based on macroplants (The Paraca Flora, Iannuzzi & Pfefferkorn, Palaios 17, 2002) and Late Visean cold climate dated by miospores in diamictites. The polycyclic character of the diamictites examined in Bolivia explains also the divergence of age given to the Itacua (Saipuru) Formation (latest Devonian according to Wicander *et al.,* CIMP Symposium Prague 2006,

Visean according to di Pasquo, Rev. geol. Chile 94, 2007). The absence of Tournaisian diamictites and sometimes absence of Tournaisian sediments in Bolivia are confirmed, Tournaisian diamictites being restricted to the Solimões Basin in Brazil. Interruptions in the Mississippian miospore versus sediment record in South America is tentatively explained by cold and dry period with poor vegetation cover and poor soil development alternating with less cold but wetter period allowing richer vegetation cover and ice sheet reaching sometimes coastal marine environments. Largely reworked acritarchs into the Mississippian sediments cast some doubt on the reality of the recent assertion (Mullins & Servais, Rev. P. P., 149, 2008) that the obvious Carboniferous decrease in acritarch diversity should be searched for near the end of the Tournaisian rather than at the end of the Famennian (Riegel, Rev. P. P.,148, 2008).

SPORES AND PLANT FRAGMENTS FROM CAMBRIAN ROCKS

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Palynological macerations of Cambrian rocks of nearshore facies from Laurentia yield spores and small tissue fragments. Three classes of remains possess characters previously known only from subaerial plants: *i*) sporemasses attached to cuticles, *ii*) membranous sacs (sporangia) with and without enclosed spores, and, *iii*) wefts of filaments with oblique cross walls. Combined lm, sem and tem examination of Cambrian spore-like palynomorphs clearly demonstrates closer affinities with younger cryptospores and liverworts, than with either extant or fossil algae. W. A. Taylor has shown that multilaminated walls occur in some Cambrian cryptospores, supporting Blackmore & Barnes who earlier proposed this as the primitive sporoderm type in land plants. But neither the plant fragments nor the spores can prove the existence of embryophytes *sensu strictoat* 500 Ma. Plant axes do not appear until the Silurian, and definitive embryophyte structures such as archegonia, antheridia and multicellular embryos have low fossilization potential. If those defining features evolved near the end of a series of terrestrial adaptations, it would be consistent with the known fossil record. Thus, the embryophytes may have evolved from ancestral species already in possession of sporopolleninous meiospores and cuticles, characters that today are associated primarily with land plants rather than algae. The progressive acquisition of terrestrial adaptations is consistent with green plant phylogeny, but it requires re-defining the land plants to include both the embryophytes and their immediate ancestors.

CAMBRIAN DYADS FROM NORTH AMERICA

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There is little doubt that the first adaptation of preterrestrial organisms in the lower Paleozoic was the resistant-walled spore. Various dispersed monads, dyads, and tetrads - linked to larger sporangial fragments – are the most widely recognized evidence of the oldest land plants. These are as old as the Middle Ordovician (Llanvirn). The fossil record of resistant-walled spores extends deeper into the lower Paleozoic, however, the systematic affinities of Cambrian resistant-walled sporelike bodies are controversial. Equally uncertain, at least from an actualistic perspective, is the affinity of the younger spore dyads. No extant plants produce dyads as a normal course of their development. There is a well recognized phylogenetic sequence of spore dyads giving rise to monads by gradual

dissociation throughout the Silurian. The question remains, however: Where did these dyads come from? In the course of an ongoing detailed ultrastructural analysis of packets of Cambrian spores, it was discovered that each packet consists of either two or four units, and that the smallest member of each unit is, in fact, a dyad. Based on this, I am proposing that, in at least one lineage of resistant-walled spore producing organisms, the primitive unit of dispersal was the dyad. The Cambrian dyads consist of an outer homogeneous wall that encloses both dyad members, while each dyad member has its own wall that consists of little more than one 20nm thick lamina, that is fused to the outer wall (synoecosporal wall or "envelope") where they are in contact. Younger dyads (e.g., *Dyadospora murusdensa*) that have an outer homogeneous wall and an inner poly-laminate wall may have arisen from these older dyads by increasing the number of laminae around the individual dyad members.

WESTPHALIAN CLIMATE AND ENVIRONMENTAL RECONSTRUCTIONS BASED ON QUANTITATIVE PALYNOLOGY FROM DUTCH ON- AND OFFSHORE WELLS AS A NEW TOOL IN PALYNOSTRATIGRAPHY

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Recently, renewed interest in the hydrocarbon reservoir potential of middle Silesian (Westphalian) strata of the North Sea basin led to an increasing demand for a high resolution and solid stratigraphical framework for the Westphalian. At the moment the main biostratigraphical tool to provide chronostratigraphical information for exploration wells in NW European Westphalian strata is classic palynostratigraphy based on first and last occurrences of sporomorph. The application of the classic palynostratigraphical approach is hampered by the observed spatial variation in distribution of sporomorph taxa and the often poor preservation of marker taxa. A new approach in palynostratigraphy is based on the socalled sporomorph ecogroup model concept (SEG), which was developed for Jurasic deposits in the North Sea basin (. With this methodology sporomorphs are linked to the motherplant, which makes a detailed palaeo-ecological interpretation of the quantitative palynological signal possible. The by this way detected changes in environment and/or climate can be used to enhance the stratigraphical correlation of wells. In this study a SEG model is developed for the Westphalian and applied to the Dutch onshore well Kemperkoul-1 (Westphalian B/C) and several wells in the Dutch offshore (D-E blocks). A comparison between the detailed palaeoenvironmental and climate reconstructions based on the SEG model and the sedimentological and paleontological analysis in well Kemperkoul-1 is made to test the outcome of the SEG model results. Furthermore, the SEG model approach enabled the detection of regional changes in facies distribution in the offshore D-E area during the Westphalian. Based on this study it can be concluded that combined application of classical palynostratigraphy with a SEG model approach enhances the stratigraphical resolution and accuracy of Westphalian chronostratigraphical interpretations based on biostratigraphy. Furthermore, the detection of changes in the regional facies distribution by the SEG approach provides a new tool for reservoir characterization during the Westphalian.

THE LATE SILURIAN-EARLY DEVONIAN ADAPTIVE RADIATION OF VASCULAR PLANTS: INTEGRATING THE PLANT MEGAFOSSIL AND DISPERSED SPORE FOSSIL RECORDS

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The fossil record suggests that plants invaded the land at least 40 million years before the first vascular plants appeared in the Early Silurian. The earliest vegetation consisted of stem group embryophytes believed to have been at a bryophytic grade of organization. These plants were widespread and probably generalists that tolerated a wide range of environments. The dispersed spore record during this period exhibits stasis suggesting that they evolved little over a long period of time. The emergence of polysporangiophytes (vascular plants and their immediate predecessors) probably coincided with the shift from gametophyte to sporophyte dominance. This unleashed evolutionary potential in that the sporophyte is diploid and ultimately evolved lignified tracheids. In particular the evolution of a rigid and efficient conducting system allowed plants to increase in height and begin to explore a whole new domain of morphospace. This sparked an adaptive radiation of vascular plants with the stem group embryophytes (bryophyte-like plants) outcompeted. They were cast out into the nooks-andcrannies where their relatives, the extant bryophytes, remain to this day. The adaptive radiation of polysporangiophytes is seen in the plant megafossil record and the dispersed spore record. The former is notoriously incomplete and biased, arguably relying on a few temporally/spatially scattered assemblages (although we are fortunate that some of these are exceptionally preserved: the charcoalified plants of the Anglo-Welsh basin and the silicified plants of the Rhynie chert). On the other hand the dispersed spore fossil record is more complete, and exhibits clear patterns of diversification in terms of changing biodiversity, disparity, and palaeophytogeography. Studies of *in situ* spores integrate evidence from the plant megafossil and dispersed spore fossil records. Here we explore recent advances in combining the two fossil records that are shedding light on the adaptive radiation of polysporangiophytes in the Late Silurian-Early Devonian. This includes: (i) development of a spore disparity index; (ii) new data on *in situ* spores; (iii) new analyses of spore wall ultrastructure that are providing evidence for the affinities of previously unassigned spore groups (e.g. *Emphanisporites*-type spores).

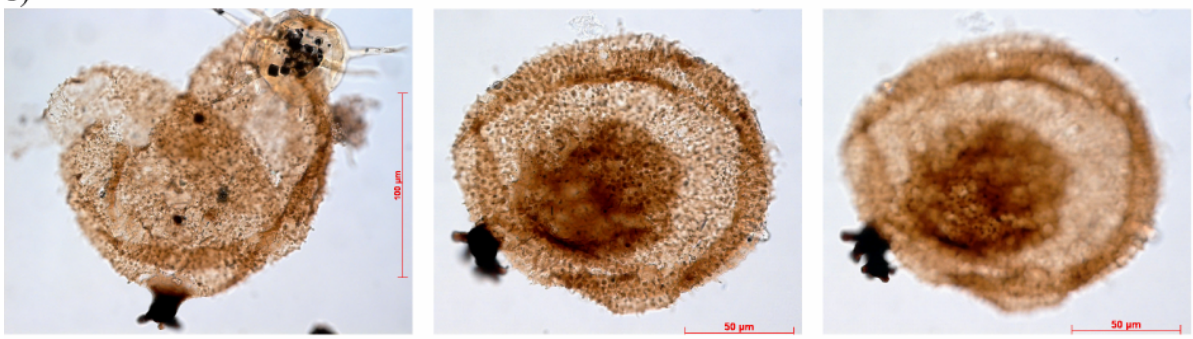
ENIGMATIC PALYNOMORPHS FROM CANADA

Aurélien Delabroye - PhD student, Université de Lille 1, France

I am continuing my PhD thesis at Lille (France) on acritarch dynamics across the Ordovician-Silurian boundary under the supervision of Marco Vecoli and Thomas Servais. After studying acritarchs of the O/S boundary at Anticosti, I focused this year on assemblages of the same stratigraphic interval from Baltica with Olle Hints and Jaak Nõvak (Valga 10-drill core, south Estonia) but also from western Gondwana with Claudia Rubinstein (La Caspala, Argentina). Taxonomic descriptions, palaeobiogeographic analyses and biostratigraphic utility are in progress. In this context, bibliographic investigations incite me to focus also on the problematical Hirnantian event stratigraphy at a worldwide scale. During the observation of my palynological slides, I encountered some weird palynomorphs. They all come from the Ellis Bay and Becsie Formations of Anticosti Island. If somebody has already seen such

morphologies or has an idea, please contact me by e-mail. Thank you in advance for your help. aurelien.delabroye@etudiant.univ-lille1.fr.

1)



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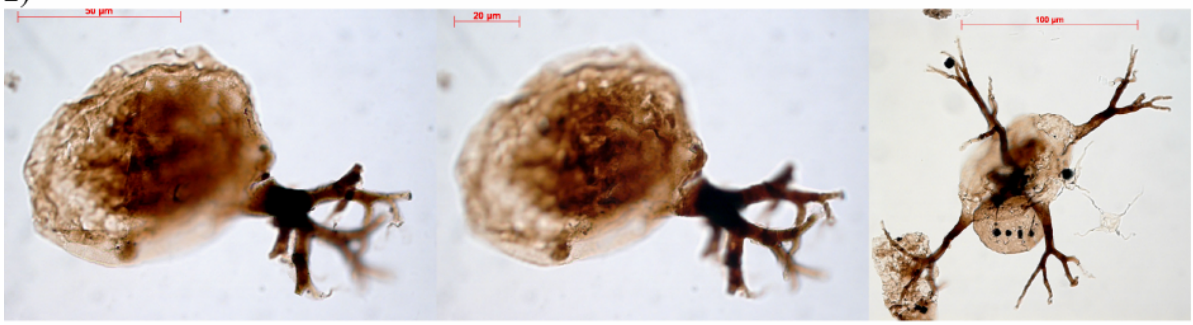

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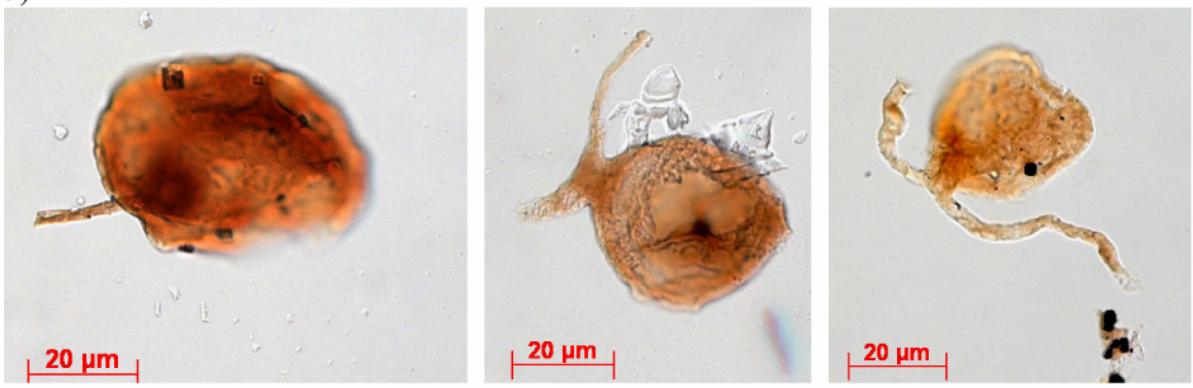

TRESURERS STATEMENT

CIMP Treasurer's statement: 2006-2008 (Euros)

Expenses:

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  - Software (Developers4web) creation of forms: 23.99
  - Software (Developers4web) internet security: 15.99
  - IFPS fees (½ 2004 - 2005-2008): 339
- 2008
  - IFPS fees (2009-2010): 177
  - Charges for the IFPS payment: 9.68
  - Bonn CIMP grants: 1500
  - Bonn CIMP reception: 800 (estimate)

- Incomes:
  - 2006 (since the Prague CIMP meeting)
    - Fees (collected during the Prague CIMP meeting): 680
    - Fees paid on accounts: 30
    - Interests: 41.57
  - 2007
    - Balance (from previous treasurer): 110.69
    - Fees (collected during the Lisbon CIMP meeting): 80
    - Fees paid on accounts: 699.56
    - Interests: 56.84
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  - -2865.66 + 1848.29 = **-1017.37**

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