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**Explanation of Cover:**  
1. This issue is dedicated to the memory of Neil Archbold (1950-2005) and to his lasting contributions to Permian paleontology and stratigraphy. Photo taken in 2003.  
3. With Guang Shi, Claude Spinosa (former SPS Secretary), his wife Jean, and T. Leonova.  
5. At Bold Hill, Bacchus Marsh, Victoria 1998 including Clinton Foster (former SPS Vice-Chair).  
6. Unveiling Ceremony of the base-Changhsingian GSSP on June 14, 2006 including participants of the IPC pre-conference fieldtrip A3 to Meishan and Chaohu. Meishan, Changxing County, Zhejiang Province, China.
Notes from the SPS Secretary

Introduction and thanks

I want to thank Profs. John A. Talent, Guang R. Shi, Giuseppe Cassinis, and Bruce Waterhouse, as well as Dr. Monica Campi who contributed articles, reports or notes for inclusion in this 47th issue of Permophiles. I also thank Charles Henderson for coming to Nanjing; we did all of the editorial work for this issue during 7 days from June 8th to 14th. We thank individuals for financial contributions to the Permophiles publication fund in support of this issue and remind our readers that despite the fact that we have gone mostly electronic there are still costs involved in printing and mailing a limited number of copies. Permophiles is recognized by the ICS as an exceptional newsletter and the continuing support of our readers is necessary to maintain that quality. All of the previous issues of Permophiles can be freely downloaded at http://www.nigpas.ac.cn/permian/web/index.asp. All members are welcome to visit our website, download Permophiles and join in the PermoForum to discuss Permain issues.

Previous SPS Meeting and Minutes

A ceremony to celebrate the formal ratification of the Lopingian-base and the Changhsingian-base GSSP by IUGS in conjunction with the field excursion A3 of the International Palaeontological Conference 2006 (IPC2006) was held at the Meishan Geopark on the 14th of June. The Lopingian-base GSSP has been ratified at the Penglaitan section in Laibin County, Guangxi Province and the Changhsingian-base GSSP has been ratified at the Meishan Section D in Changxing County, Zhejiang Province, China. Local government officers from Changxing County and media attended the ceremony. I chaired the ceremony and Professor Sha Jingeng, Director of Nanjing Institute of Geology and Palaeontology gave a brief introduction for the working process for those two GSSPs. SPS Chairman Charles Henderson, Doug Erwin, the officers from Changxing government all gave short speeches to congratulate the establishment of GSSPs in South China. After the ratification of the Changhsingian-base GSSP, the Meishan Section D has become a unique section with two GSSPs at the same section thereby establishing the body stratotype of the Changhsingian. Unfortunately, Prof. Jin Yugen, the chair of both the Lopingian-base and Changhsingian-base Working Groups could not attend the ceremony. After the short ceremony, the participants of the pre-conference field excursion of IPC 2006, Cao Changqun, Charles M. Henderson, John A. Talent, Roger Summons, Doug Erwin, Matthew E. Clapham, Zhong-Qiang Chen, Yasuo Kondo, Enzo Farabegoli, M. Cristina Perri, Shanan Peters, Aleksander Klets, Roger Pierson and I, visited all Permain-Triassic sections in the Meishan Geopark.

Future SPS Meeting and IPC2006

1) An SPS meeting will be held on June 20, 2006 during the second International Palaeontological Conference at Beijing China. IPC2006 will be held just after editing this issue. More than 850 participants from 50 different countries will join in the conference. There are a few sessions related to Permain, including integrated stratigraphy (S1 convened by Charles Henderson and Shen Shuzhong), Late Paleozoic: the end-Permian extinction following a 100 m.y. long stability (T8 convened by Doug Erwin and Wang Xiangdong), Past and present global changes and biotic saltations (S6 convened by Yin Hongfu), Palaeoecology, palaeobiogeography, palaeogeography and palaeoclimate (G7 convened by John Talent and Guang R. Shi) and Geo-biodiversity: taxa, morphology and ecology (S2 convened by Arnie Miller) etc. Selected abstracts related to the Permain are provided in this issue.

2) An SPS meeting will be held in Siena, Italy, in conjunction with the Field Conference on the Stratigraphy and Palaeogeography of late- and post-Hercynian basins in the Southern Alps, Tuscany and Sardinia, and comparisons with other Western Mediterranean areas and geodynamic hypotheses, between September 18-23, 2006. This field excursion is sponsored by the Italian Geological Society. The Field Conference will consist of an initial excursion (September 18-21) followed by two day meeting (September 22-23) in Siena. The field excursion will focus on the Permain and Triassic continental sequences in the southern Provence, western Liguria and northwestern Tuscany. Oral or poster contributions are welcome; abstract deadline is July 30, 2006. Additional information is available from Prof. G. Cassinis, Dipartimento di Scienze della Terra, Università degli Studi, Via Ferrata No. 1, 27100 Pavia, Italy. Tel: 39 0382 985834. Fax: 39 0382 985890. E-mail: cassinis@unipv.it. The first circular has been sent out and is available at http://manhattan.unipv.it/sem_conf_new.htm (this information is provided by Prof. Giuseppe Cassinis).

3) Another SPS business meeting will be held in conjunction with the XVI International Congress on Carboniferous and Permain that will be held at Nanjing between June 21-24, 2007 (see detailed first circular in this issue). This conference is sponsored by Chinese Academy of Sciences, National Natural Science Foundation of China, Ministry of Science and Technology, China, Chinese Academy of Geological Sciences, The International Subcommission on Carboniferous Stratigraphy and The International Subcommission on Permain Stratigraphy. Prof. Wang Xiangdong and I will co-chair the Organizing Committee of the conference. We warmly welcome our colleagues all over the world to Nanjing to participate in this conference.

This issue of Permophiles

This issue of Permophiles is dedicated to the memory of Prof. Neil Archbold. We are deeply saddened by the news of Neil’s departure. He was my teacher, colleague and friend. It was Neil Archbold who established the detailed Permain biostratigraphical framework in Western Australia which is very useful for the correlation of the Permain System in the peri-Gondwanan region. Neil was particularly popular with brachiopod researchers. We will remember a special scientist and colleague who was passionate about brachiopods and brought his infectious sense of fun to all
who worked with him. We will all miss him.

Future issues of Permophiles

The next issue of *Permophiles* (Issue 48) is scheduled for late October 2006 after GSA, which will be prepared by Charles Henderson and me in Calgary. Everyone is encouraged to submit manuscripts, announcements or communications by Monday October 16. Manuscripts and figures in the appropriate format can be submitted via my email address (szshen@nigpas.ac.cn; or shen_shuzhong@yahoo.com) as attachments or by our SPS website (http://www.nigpas.ac.cn/permian/web/index.asp). Hard copies by regular mail do not need to be sent unless requested. However, large electronic files such as plates in Photoshop or TIF format may be sent to me on discs or hard copies of good quality under my mailing address below. Alternatively, large files can also be transferred via the submitting system on our SPS website. Please follow the format on Page 3 of issue 44 of *Permophiles*.

Cancellation of the Cisuralian Workshop

A field workshop on the Cisuralian GSSPs was planned last year in order to complete the GSSP proposals in a timely fashion for voting during 2007. This workshop was tentatively set for July 24 – August 4, 2006 in the southern Urals. It’s greatly regretful that Boris Chuvashov could not undertake the workshop because of some significant budget cuts and changes in the Russian Academy of Sciences at the last stage. A new plan for the Cisuralian GSSPs will be discussed shortly among the SPS.

SPS Website is online

Our SPS website has been available for one year now and it provides information on activities of the SPS, events and meetings, the organization of SPS, the progress of GSSPs related to the Permian stages and various working groups as well as all issues of Permophiles. It also provides links to useful partner organizations such as IUGS, ICS, the Permian Research Institute at Boise State University, and the Late Palaeozoic Research Group at Nanjing Institute of Geology and Palaeontology. We have also designed a PermoForum on the website, with the goal to stimulate on-line discussions by members of the Permian community to share ideas and thoughts. The username and password to enter this PermoForum are respectively *SPS (username)* and *wangi (password)*. In addition, you can download all of the previously published Permophiles issues. All members or people who are interested in the Permian issues are encouraged to visit our website, download Permophiles, and submit your comments.

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Notes from the SPS Chair

Charles M. Henderson

Shuzhong Shen and I completed this issue during seven warm days at the Nanjing Institute of Geology and Palaeontology where I enjoyed some fantastic Chinese hospitality. This 47th issue of *Permophiles* went online on June 15th and now our readers can download not only this issue, but every previous issue from the same website (http://www.nigpas.ac.cn/permian/web/index.asp). The content of these issues has centred on providing timely information on the Permian and increasing communication between researchers on the Permian. As a result *Permophiles* is widely cited in the scientific literature and this testifies to the value of the efforts of previous executives to continue to produce and help evolve this volume.

In the last issue of Permophiles I indicated that there would be a Cisuralian field excursion to the southern Urals to visit the three potential GSSPs for the base-Sakmarian, base-Artinskian, and base-Kungurian. A considerable amount of work has been completed and we have informal definitions for each as discussed in *Permophiles* #41. However, there is still work needed, in particular on geochemistry, geochronology, access and reproducibility; Mark Schmitz and Vladimir Davydov are working on the completion of the geochronology of the many ash layers found near the selected Cisuralian GSSP sections. It is important that full and free access to these locations be demonstrated by the Russian geologic community such that geochemical and paleontologic samples can be collected and shipped in a timely fashion for analysis. Unfortunately and sadly, this field excursion was cancelled at a very late date. This is a significant blow to our attempts to complete the Permian timescale by 2008 as mandated by IUGS. It also calls into question one of the most fundamental requirements for a GSSP – namely ACCESS. The field excursion has been delayed to the summer of 2007 – any delay beyond this point may necessitate SPS to consider other potential GSSPs for the Cisuralian stages.

In contrast, I had the welcome opportunity to represent the SPS at the ceremony to honour the Upper Permian or Lopingian Series GSSPs on June 14th. We were there to celebrate two decisions – decisions between geologists and paleontologists from several countries – an international collaboration that was not easily struck, but wholly satisfying once completed as now we have a means to calibrate and correlate the Upper Permian. The ceremony was held at Meishan, the site of the base-Changhsingian GSSP in Changxing County, Zhejiang Province. Government representatives were present from Changxing County, Zhejiang Province, which is the site for the base-Wuchiapingian GSSP. I thank those representatives for their interest and support to make these sites freely available for future geoscientists as well as maintain the sites for the general public, especially the Geopark at Meishan (see cover, p. 5 and p.24 for more). My only regret is that Prof. Jin Yugan was unable to attend. Professor Jin was the Chair of the working groups for both boundaries. Lao Jin’s inspiration has been an important element of my career development and I sincerely hope that he feels better soon.

There have been no business meetings since the last issue of Permophiles, but a meeting is scheduled for June 20 in association with the second International Palaeontological Conference in
Beijing. A second meeting in 2006 is scheduled for September 22 in Siena, Italy in association with a European continental Permian meeting organized by Prof. Cassinis (see announcement in this issue). This meeting follows a very successful non-marine meeting in Albuquerque last October. It is great to see so much work being done on these successions as this is an important task for SPS following establishment of the marine GSSPs – that is to correlate marine rocks into continental successions. I hope that we can see more reports in future issues of Permophiles from those groups working on continental successions. These workers as well as all those working on marine rocks of Carboniferous and Permian age should be seriously considering their attendance at the XVI International Congress on the Carboniferous and Permian (ICCP) to be held June 21-24, 2007 in Nanjing China (see announcement in this issue).

This issue honours a few individuals that have made significant contributions to Permian geology and paleontology during their careers. The geological community and especially the Permian community is saddened by their deaths. I want to thank John Talent for his excellent words on Neil Archbold. I only met Neil Archbold once, but after reading John’s obituary I regret this and wished I had known Neil better. It is an inspirational story. Bruce Waterhouse was inspired to also write about Neil and included in his obituary accounts of the lives of Norman Newell and Mac Dickens. Mac was honoured in Permophiles 46. I have talked briefly in the past with Norman Newell at a number of major geological meetings and knew him to be a fine gentleman and avid reader and supporter of Permophiles. We can learn a lot from the lives of these individuals and I thank Bruce for sharing his experiences with these fine geological gentlemen. These accounts remind us of the short time we have to make our contributions and point to a passing of the torch so to speak, but they also remind of the importance of renewal. Those of us working in geology and paleontology must continue to encourage today’s youth to take up the challenge of the profession. Judging from the lives of Archbold, Dickens, and Newell as told to us by Talent and Archbold once, but after reading John’s obituary I regret this and wished I had known Neil better. It is an inspirational story. Bruce Waterhouse was inspired to also write about Neil and included in his obituary accounts of the lives of Norman Newell and Mac Dickens. Mac was honoured in Permophiles 46. I have talked briefly in the past with Norman Newell at a number of major geological meetings and knew him to be a fine gentleman and avid reader and supporter of Permophiles. We can learn a lot from the lives of these individuals and I thank Bruce for sharing his experiences with these fine geological gentlemen. These accounts remind us of the short time we have to make our contributions and point to a passing of the torch so to speak, but they also remind of the importance of renewal. Those of us working in geology and paleontology must continue to encourage today’s youth to take up the challenge of the profession. Judging from the lives of Archbold, Dickens, and Newell as told to us by Talent and Waterhouse, there is excitement, travel and discovery ahead for those that do.

Finally, I submitted the SPS annual report to ICS in December and this report is appended below. This report can also be downloaded from our website (http://www.nigpas.ca.cn/permian/web/index.asp) and from the ICS website (http://www.stratigraphy.org/). I wish to encourage Permophiles readers and those interested in stratigraphy to take a look at these websites as they contain considerable valuable information.

International Commission on Stratigraphy
Subcommission on Permian Stratigraphy
ANNUAL REPORT 2005

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY
The Subcommission’s primary objective is to define the series and stages of the Permian, by means of internationally agreed GSSPs, and to provide the international forum for scientific discussion and interchange on all aspects of the Permian, but specifically on refined regional correlations.

Fit within IUGS Science Policy: The objectives of the Subcommission involve two main aspects of IUGS policy:
1. The development of an internationally agreed chronostratigraphic scale with units defined by GSSPs where appropriate and related to a hierarchy of units to maximize relative time resolution within the Permian System; and
2. Establishment of frameworks and systems to encourage international collaboration in understanding the evolution of the Earth during the Permian Period.

3. ORGANIZATION
The Subcommission has an Executive consisting of a Chairman, a Vice-Chairman, and a Secretary; all three are Voting Members of the Subcommission. These three executive positions are new as of the IGC meeting in Florence in August 2004. There are sixteen total Voting Members representing most regions of the world where Permian rocks are exposed. The objectives of the Subcommission are pursued by both stratigraphic and thematic Working Groups that are disbanded upon completion of their directed task. For example, the Working Groups on the Carboniferous-Permian Boundary, on the Guadalupian stages (Middle Permian), on the base-Lopingian boundary (base-Wuchiapingian Stage), and on base-Changhsingian have been disbanded on the successful establishment of their defining GSSP’s and ratification by IUGS. The current working groups include:
1. Cisuralian stages
2. Continental Permian
3. Transitional biotas as gateways for global correlation
4. Neothysts, Palaeothysts, and S. China intraplatform basin correlation

The Subcommission also supports a special project titled “The Permian: from glaciation to global warming and mass extinction”.

Officers for 2004-2008:
Chair: Professor Charles M. Henderson, University of Calgary
Vice-Chair: Dr. Vladimir Davydov, Boise State University
Secretary: Dr. Shuzhong Shen, Nanjing Institute of Geology and Palaeontology
Website: http://www.nigpas.ac.cn/permian/web/index.asp. This site includes all back issues of Permophiles in downloadable PDF format (#1 in 1978 to #46 Dec. 2005). Links to Permophiles/Permian research have also been established at http://pri.boisestate.edu/ and http://www.geo.ucalgary.ca/asrg.

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS
SPS interacts with many international projects on formal and informal levels. SPS is taking an active role in the development of integrated chronostratigraphic databases by participating with CHRONOS and PALEOSTRAT, which are NSF funded initiatives. Bruce Wardlaw and Vladimir Davydov are concentrating on the
Permian-Triassic Time Slice Project and the development of improved taxonomic dictionaries, database sharing and manipulation with PALEOSTRAT. SPS is also involved in core study from a drilling project of the Permian-Triassic boundary at Meishan, China; this project is an international collaboration investigating the signature and causes of the P-T extinction.

SPS co-sponsored meetings on *Triassic Chronostratigraphy and Biotic Recovery* in Chaohu, China in May 2005 and on the *Nonmarine Permian* in Albuquerque, New Mexico in October 2005 and will meet at the 2nd International Palaeontology Congress in Beijing, China in June 2006.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2005

**GSSP's**: The proposal for the base-Changhsingian was voted and ratified by ICS/IUGS in 2005.

**Publications**: The June 2005 issue of *Permophiles* (#45) was produced at Nanjing during June 2005 and distributed to a mailing list of 280. The December 2005 issue of *Permophiles* (#46) was produced at the University of Calgary during November 2005 and distributed as a pdf on our website. In addition the remaining back issues of *Permophiles* were scanned and added to our website providing a complete series of communications by Permophiles since 1978.

**Meetings**: The SPS conducted two business meetings in 2005 including at the Triassic Chronostratigraphy and Biotic Recovery meeting in Chaohu, China on May 23, 2005 with 27 in attendance and at the Non-marine Permian Conference at Albuquerque New Mexico on Oct. 23, 2005 with 28 in attendance. This latter conference was organized by Spencer Lucas and was very successful with 68 people in attendance from 12 countries.

**Membership**: Significant changes were made to our voting membership in 2004, but only one change in voting membership occurred in 2005. Professor Giuseppe Cassinis of Italy retired as a voting member and Dr. Marc Durand of Universite de Nancy, France was voted by the executive as a replacement. The SPS executive created a new membership category in 2004, Honourary Members, to reflect the significant past and continuing contributions of some retiring voting members. Professor Cassinis was added to that list in 2005. Honourary Members will receive GSSP proposals and be invited to comment on the merits of the proposal, but they will not vote on the proposal. The revisions suggested by Honourary Members will be included in subsequent versions of the proposal.

6. CHIEF PROBLEMS ENCOUNTERED IN 2005

There were no major problems in 2005.

7. SUMMARY OF EXPENDITURES IN 2005 (ANTICIPATED THROUGH MARCH 2006):

**INCOME**

- Donations: $ 600
- University of Calgary support (1): $4,500
- NIGPAS (2): $1,000
- ICS (3): $900

**TOTAL: $7,000 (quoted in US$ using 0.84 as the conversion from Canadian$)**

(1) University of Calgary support from NSERC grant to Charles Henderson.

(2) NIGPAS (Nanjing Institute of Geology and Palaeontology) support from NSF-C grant to Shuzhong Shen.

(3) University account includes revenue from ICS and donations minus printing and postage. Current balance is a deficit of $245.49 CAN ($207US).

**EXPENDITURES**:

- Printing and Mailing of *Permophiles* (1): $1,707.00
- Travel support for *Permophiles* Production (2): $1,000.00
- Support for travel for SPS sponsored international meetings and fieldwork (3): $4,500.00

**TOTAL: $7,207.00** (quoted in US$ using .84 as the conversion from Canadian$)

**BALANCE: -$207.00**

(1) paid by donations and ICS support
(2) Shen to Calgary
(3) Henderson to Chaohu and Nanjing China and Albuquerque NM

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2006):

2. Analysis of samples collected by working group in #1.
3. Preparation of proposal by Cisuralian Working Group on base-Sakmarian GSSP.
4. Production of *Permophiles* #47 in Nanjing during June 2006.
5. Business meeting to be held during IPC in Beijing June 2006.
6. Production of *Permophiles* #48 in Calgary during November 2006.

9. BUDGET AND ICS COMPONENT FOR 2006

**Cisuralian Working Group Field Excursion (1) $34,000**

**Annual Business Meeting, Beijing, IPC (2) $2,500**

**Permophiles and GSSP printing and postage $ 1,900**

**Permophiles travel (3) $ 1,000**

**TOTAL 2006 BUDGET $40,000**

Support from University of Calgary (Henderson; NSERC) $ 5,000
Support from NIGPAS (Shen; NSF-C) $ 3,000
Fieldtrip Participants to form Cisuralian Working Group $30,000
Anticipated donations for *Permophiles* $ 600

**TOTAL BUDGET REQUEST (ICS) $1,400**

(1) Based on $800.00/participant internal costs in Russia for 20 participants (includes Russians) and average airfare of $1,200 times 15 international participants.

(2) Cost of travel to IPC meeting for Executive

(3) Cost of Shen travel to Calgary in November

10. REVIEW CHIEF ACCOMPLISHMENTS OVER PAST 5 YEARS (2001-2005)

The SPS has approved the general divisions of the Permian and has now had 6 GSSP’s ratified by ICS and IUGS (Asselian, Roadian, Wordian, Capitanian, Wuchiapingian, Changhsingian). Support for documentation (fieldwork and publications) of the various chronostratigraphic methods for the establishment of the GSSP’s has been the most...
outstanding and differentiating character of this Subcommission. *Permophiles* has become an internationally respected newsletter and bears an ISSN designation (1684-5927) and is deposited in the National Library of Canada; nine issues were published during the five-year period. See Accomplishments in 2005 (above) for additional details.

11. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2005-2008)

The primary objective is to complete the GSSP process by 2008. We currently anticipate that the last three GSSP’s (Sakmarian, Artinskian, and Kungurian) should be ratified by 2007. In order to achieve this, the SPS executive is preparing an International Workshop for July 24-August 4, 2006 at the probable Cisuralian GSSP sites along the west flank of the Urals. This field workshop will be limited to twenty researchers and they will be charged with completing analysis of new samples and producing first drafts of GSSP proposals by early to mid-2007. New samples will document geochemical signatures and augment extensive geochronologic work, and conodont samples will highlight the accessibility of the sections and reproducibility of the chosen potential points. The trip will end at Aidaralash, Kazakhstan to celebrate the production of a permanent display for the base-Permian GSSP. We anticipate the following schedule:

1. A vote by SPS on the Sakmarian proposal may be conducted during early 2007.
2. A vote by SPS on the Artinskian is anticipated during late 2007.
3. A vote by SPS on the Kungurian is anticipated during late 2007.

Once this process is completed SPS will shift focus toward three directions:

1. Correlations into Continental deposits,
2. Correlations across provincial boundaries and within the Tethys region,
3. Detailed documentation of the geologic evolution of the Earth during the Permian with respect to the established chronostratigraphic framework.

**List of Working Groups and their officers**

1. Cisuralian stages; Chairman is Boris Chuvashov
2. base-Changhsingian Stage; Chairman is Yugan Jin
3. Continental Permian Correlations; Chairman is Joerg Schneider
4. Transitional biotas as gateways for global correlation; Chairman is Guang Shi
5. Neotethys, Palaeotethys, and S. China intraplatform basin correlation; Co-Chairmen are Vladimir Davydov and Heinz Kozur.

On the following page, the Permian time scale is repeated in this issue from *Permophiles* #46 for the information of SPS members. I have noticed that many workers seem to prefer their local scales in publications; this practice is acceptable if these scales are calibrated with the International Scale.

Recent references to the development and correlation of the time scale were provided by Manfred Menning and copied below:


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<thead>
<tr>
<th>Stage</th>
<th>Mag.</th>
<th>Conodonts</th>
<th>Fusulinaceans</th>
<th>Ammonoids</th>
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<tr>
<td>Triassic</td>
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<td>Changhsingian</td>
<td>252</td>
<td>C. meishanensis</td>
<td>Palaeofusulina spp.</td>
<td>Otoceras</td>
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<td>C. yini</td>
<td>Colaniella spp.</td>
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FOR ISSUE 48

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Submission Deadline for Issue 48
is Monday, October 16

REPORTS

Beware of your FO and be aware of the FAD

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Someone reading this title and understanding the subtleties of the English language might think that I was talking about Heinz Kozur, but actually Heinz and I do communicate on a regular basis. In the fashion world fads come and go with time, but in the geological world, GSSP (Global Stratotype Section and Point) FADS are generally unchanging.

One of the tasks that many of us perform on a regular basis is to review manuscripts for publication. In some recent manuscripts that I have reviewed there seemed to be a lack of appreciation for the correlation of GSSP definitions and in the interest of communication and generating comment I provide this brief note.

Quoting from the abridged version of the Stratigraphic Code on the ICS website (1) “Chronostratigraphic units are bodies of rocks, layered or unlayered, that were formed during a specified interval of geologic time. The stage has been called the basic working unit of chronostratigraphy…and it is defined by its boundary stratotype, sections that contain a designated point in a stratigraphic sequence of essentially continuous deposition, preferably marine, chosen for its correlation potential. The boundaries of chronostratigraphic units are synchronous horizons by definition. In practice, the boundaries are synchronous only so far as the resolving power of existing methods of time correlation can prove them to be so.”

For example, the GSSP for the base of the Triassic (the PTB or Permian-Triassic Boundary or actually the base of the Induan Stage) is defined by the FAD (First Appearance Datum) of Hindeodus parvus at the base of bed 27c at Meishan Section D in south China. This is the only location where this definition is directly applicable. In many Paleozoic GSSPs the evolutionary event of a conodont species has been chosen to define the stage boundary because the widespread nature of these species indicates high correlation potential. If chosen carefully, the FAD of a species at the GSSP should be the earliest occurrence of that species anywhere in the world and thus represent the true evolutionary appearance. This is impossible to prove, but by using various other means of chrono-correlation a reasonable level of confidence can be achieved. The first occurrence of this species at any other section is theoretically either correlative or younger than that at the GSSP. To recognize the lowermost Triassic elsewhere we must correlate that point by using all physical means possible. As a result, the local FO (First Occurrence) of Hindeodus parvus in any other section, whether it is in Shangsi China (Nicol et al., 2002) or Opal Creek in Western Canada (Henderson, 1997) does not necessarily define the base of the Triassic in that section. It merely indicates that you are within the range or biozone of Hindeodus parvus and thus within the Lower Triassic; the FO may indeed coincide with the FAD at Meishan, but it does not follow that it must. To correlate the PTB as defined at Meishan is to be aware of the FAD as well as involving the use of all physical means of correlation including other fossils (brachiopods, ammonoids, or other species of
conodonts, for example, *H. eurypyge*, *H. changxingensis*, and *Clarkina tayloriae* may be useful), major extinction events (like that occurring at the top of bed 24e at Meishan just below the FAD of *H. parvus*), marker beds like ashes (beds 25 and 28 at Meishan have yielded geochronologic ages of about 252 million years), geochemical means (carbon isotopes; for example at Meishan, a major negative shift in carbon isotopic values occurs just below the FAD of *H. parvus* in bed 26), sequence stratigraphy (a Sequence Boundary is defined at the top of bed 24d at Meishan), magnetostratigraphy (the PTB occurs within a normal polarity zone), and any other available technique. Many of these occurrences or values can be cross-calibrated using graphic correlation techniques including Pete Sadler’s CONOP program. By employing such techniques it becomes apparent that the FO of *Hindeodus parvus* at Shangsi (Nicol et al., 2002) does not correlate with the PTB, but rather occurs about 4.5 metres above the PTB. Beware of that FO; its higher occurrence may result from any number of reasons (biostratigraphic pitfalls) including biofacies restriction.

References


The following section contains selected abstracts presented at the Second International Palaeontological Congress held June 17-21, 2006 at Beijing, China. These abstracts are published in an abstract volume of IPC 2006 and are repeated here for the convenience of the SPS members. All the references and figures in the abstracts have been deleted to save space for this issue.

Lower Permian brachiopods and palynomorphs of the Alborz Mountains (North Iran) and their palaeobiogeographic affinity

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2 British Geological Survey, Nottingham, UK

North Iran has always been considered of Gondwanan affinity for several reasons: its pre-Palaeozoic basement is thought to be related to the Baikalian orogenetic cycle, its Cambrian sedimentary rocks are similar to those occurring south of the Zagros suture. Similarly the region lacks Variscan deformation and is located south of the supposed position of the Palaeotethys suture. Palaeontological evidence has also been used to suggest Gondwanan affinity because north and central Iranian Devonian stromatoporoids, rugose corals and brachiopods were considered to be similar to those of Armenia, Afghanistan and Karakorum. But in fact the Devonian fauna has a cosmopolitan character and shares affinities with northern regions also (Western Europe and Russian platform).

This study of the Lower Permian Dorud Formation of the Alborz Mountains (north Iran) illustrates how fossil groups can be used to infer the palaeobiogeographic affinities of continental blocks. Brachiopods of the Dorud Formation comprise a Derbyiidae gen. et sp. ind., *Neochonetes* (N.) sp. ind., *Costispinifera* sp. ind., *R. uralica*, *Calliprotia* sp. ind., *J. dorudensis*, *L. dorotheevii*, *Cancrinella cancriniformis*, *Linoproductica* gen. et sp. ind., *A. aff. juresanensis* and *Larispirifer* sp. They show strong affinities with the Asselian-lower Sakmarian faunas of the Urals and of the Russian Platform to the north, and to a lesser extent to the Trogkofel Limestone (Carnic Alps) in the west. The palynomorph assemblage, which is dominated by monosaccate pollen, with very few spores, is most unlike those recorded from the Asselian-Sakmarian *Granulatisporites confluens* Biozone which is ubiquitous in the Gondwana region.

The assemblages of Asselian-early Sakmarian brachiopods and palynomorphs from Dorud are also consistent with the southern provinces of the Boreal Realm and of the W Tethys province, and are dramatically different from coeval faunas and microflora of the Gondwanan peripheral regions from Western Australia, India, Karakorum, Central Afghanistan and Oman. It is difficult to explain the boreal affinity of the Dorud brachiopods and palynomorphs if north Iran is considered part of the Peri-Gondwana fringe during the Asselian-early Sakmarian. A more northerly position for this block at this time is thus more likely.

Abnormalities of organic carbon isotope in non-marine Permian-Triassic boundary sequences of Dalongkou and Taoshuyuan, Xinjiang, China

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To investigate the organic carbon isotope excursions in the non-marine Permian-Triassic boundary sequences and correlate this with that in the marine sequences, 126 samples were determined for the carbon ratios δ13Corg of kerogen samples spanning 102 metres from the Guodikeng Formation to the Lower Triassic Jiucaiyuan Formation in the southern limb of Dalongkou Antcline (SDA) and Taoshuyuan sections of Xinjiang, China. Associated fossil assemblages suggested the P-T boundary is in the middle part of Guodikeng formation (proposed P-T boundary
at A, B or C in figure below), and provided significantly biostratigraphic overlaps during the Permian-Triassic transition.

Two negative $\delta^{13}C_{org}$ spikes were detected in the middle part of Guodikeng Formation. The later Permian $\delta^{13}C_{org}$ values oscillate between -26‰ and -21‰ in the lower part of Guodikeng Formation. First negative $\delta^{13}C_{org}$ spike occurred rapidly with minimum values less than -29‰ at the base of bed 55. Followed temporary recovery with values up to -24‰, the $\delta^{13}C_{org}$ values drop rapidly to around -30‰ and coincide with the occurrence of Lower Triassic fossil of vertebrate *Lystrosaurus* at the base of bed 64. In the uppermost interval of Guodikeng Formation, it recovers to averaging value of -24‰, and then oscillates largely with maximum excursions up to 14‰ in the Lower Triassic Jiucaiyuan Formation. Similar $\delta^{13}C_{org}$ excursion pattern occurred also apparently within 116 samples in the Guodikeng Formation of Taoshuyuan section, and could be identified in that of marine P-T boundary sequence of Meishan, southern China. The negative abnormality zones near the P-T boundary both in marine and terrestrial sequences characterised significantly by the underlying stability stage in Later Permian and the overlying larger oscillation stage in the Lower Triassic stratigraphic intervals. Therefore, the first negative $\delta^{13}C_{org}$ in non-marine sequences could be correlated to that occurred from bed 23 to bed 24d in the marine section of Meishan. In turn, the second negative spike might be corresponded to that occurred in the “Black shale” of bed 26 in Meishan, and may suggested as a marker for the non-marine P-T boundary definition.

Recently most studies suggested a complex feedback mechanism on the global ecosystem collapse rather than a single and sudden catastrophic event such as the rapid outpouring of Siberian flood basalts and meteorite impact during the end-Permian extinction. Multiple negative $\delta^{13}$C spikes both in marine and terrestrial P-T sequences recorded in the uppermost Permian or in the lowermost Triassic stratigraphic intervals. Moreover, relatively rapid $\delta^{13}$C excursions are often superimposed on a gradual Upper Permian decline. Sustained environmental degradation associated with the atmospheric hypoxia plus climate warming has been proposed recently for the end-Permian catastrophic event. Both in marine and terrestrial P-T sequences, the first occurrences of negative $\delta^{13}$C excursions should reflect environmental stress which might be the result of a later Permian sea-level drop. However, because the occurrence of a temporary recovery in $\delta^{13}$C with values similar with that in the Late Permian period, the occurrence of second negative spike could not be discarded the effect on the global carbon cycle from some sudden and sharp events such as the meteorite impact.

The rise of the modern evolutionary fauna: decoupled taxonomic and ecological response during the end-Guadalupian extinction

Matthew E. Clapham and David J. Bottjer

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The replacement of Palaeozoic rhynchonelliform brachiopod-dominated marine benthic communities by post-Palaeozoic assemblages dominated by the molluscan Modern evolutionary fauna was one of the most significant ecological transitions in the Phanerozoic, completely restructuring the ecosystem and paving the way for modern marine communities. The timing of the abrupt diversity switch has been tightly constrained, occurring during the catastrophic mass extinction at the Permian-Triassic boundary. In contrast, the shift in ecological dominance, as measured by relative abundance in marine communities, has only been assumed to be synchronous with the taxonomic change. However, this assumption ignores potential effects of the earlier end-Guadalupian extinction, at the end of the Middle Permian. In order to test whether the ecological transition was contemporaneous with the end-Permian taxonomic shift, we quantified Permian community change in fossil assemblages from offshore tropical carbonate environments collected from the western United States, Greece, and China. Early and Middle Permian fossil communities were overwhelmingly dominated by brachiopods, which comprised an average of 98.9% of an assemblage. Bivalves only accounted for 0.7% and were strongly dominated by epifaunal forms (>90% of the bivalve population). Although bivalves were rare, it appears that they were smaller than co-existing brachiopods. In contrast, Late Permian assemblages contained a mixture of brachiopods and molluscs: brachiopods only comprised 34.6%, with bivalves accounting for 17.9% and gastropods the most abundant group at 47.5%. Bivalve life habits were also more evenly distributed, with 52% epifaunal suspension feeders and 42% infaunal suspension feeders. In addition, bivalves were more comparable in size to co-existing brachiopods; their median size was approximately 80% that of brachiopods from the same sample. These results demonstrate that a substantial portion of the ecological transition from brachiopods to bivalves, in terms of relative abundance, ecological dominance of infaunal forms, and size distributions, had occurred prior to the end-Permian biotic crisis and was apparently synchronous with the end-Guadalupian extinction. However, a new compilation of Middle and Late Permian global diversity reveals that the end-Guadalupian crisis was only a minor event, with slightly elevated extinction intensity of 33.9% at the genus level, relative to 27.7% extinction in the preceding Wordian and 32.1% in the succeeding Wuchiapingian. Only 34.3% of rhynchonelliform brachiopod genera and 31% of bivalve genera were eliminated during the Capitanian stage. This low overall intensity and weak selectivity contrasts markedly with the end-Permian mass extinction (77.9% overall; 96.1% for brachiopods and 62.9% for bivalves) and implies extreme decoupling of taxonomic and ecological responses during the end-Guadalupian extinction. The cause of the decoupled behaviour is unknown, but may have been influenced by environmental changes during the Guadalupian-Lopingian transition or the end-Guadalupian extinction mechanism itself. It therefore appears that mass extinctions and catastrophic taxonomic change are not necessarily required to trigger major ecosystem restructuring such as the rise of the Modern evolutionary fauna.

Patterns of faunal change through the Permian: a section based study of brachiopod originations and extinctions from Sichuan, China

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The study of extinction and origination patterns in the Permian is of interest as the largest mass extinction in Earth’s history occurred at the end of this period, with a second major mass extinction approximately 8 Ma earlier, at the Guadalupian-Lopingian boundary (Jin et al., 1994; Shen and Shi, 2002). This study examined brachiopod diversities and patterns of faunal change at the relatively complete Chuanmu section, Sichuan. This section extends from the Late Artinskian (Cisuralian) to the Triassic, allowing us to develop a clear picture of Permian brachiopod diversity in this area. A total of 131 brachiopod species from 70 genera and 33 families were identified from this section. The patterns of brachiopod diversity through the Permian at this section were analyzed using proportionate origination and extinction rates, which indicated five origination and two extinction events at this section. The origination events were: 1) the top of Liangshan Formation; 2) during the Chihsia Formation; 3) at the beginning of the Maokou Formation; 4) the end of the Longtan and beginning of the Changhsing Formations, and 5) the middle of the Changhsing Formation. The first extinction event, in the lower part of the Changhsing Formation, was relatively minor, while the second extinction event (at the end of the Permian) corresponds to the global end-Permian mass extinction, resulted in the disappearance of Permian-type brachiopods from this section. The end-Guadalupian mass extinction is not clearly recognized at the Chuanmu section due to a depositional hiatus during the late Maokouan and very early Lopingian at this section.

Permian fusulinids fauna of the Daguanshan Formation, Xiahe and Tongren County, western Qinling, China

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The Permian Daguan Shan Formation outcrops in Xiahe County, Gansu Province and Tongren County, Qinghai Province. The Daguan Shan Formation is composed of reef limestone. Based on a study of the fusulinid fauna, we assigned the Daguan Shan reef limestone to the Middle to Late Permian. There are abundant reef-building organisms in the Daguan Shan reef limestone, such as fibrous sponges, calcisponges, bryozoans, calcareous algae and colonial corals. The attached-reef organisms include the fusulinids, the non-fusulinid foraminifers, brachiopods, bivalves, gastropods, echinoderms and corals.

In this study 16 species belonging to 12 genera were recognized from the Daguan Shan Formation. Three fusulinid zones – based on genera - can be identified in ascending order as follows: Parafusulina zone, Neoschwagerina zone, and Codonofusiciella zone. (1) Parafusulina zone: This zone represents the lower parts of Maokouan Stage. The base of zone is undefined, and the top of the zone is defined by the LAD of the genus Parafusulina. Associated taxa include; Parafusulina shaksgamensis, Pseudofusulina postkraffti, Parafusulina cf. gigantea, Pseudofusulina sp., Pseudofusulina fusiformis, Neoschwagerina sp., Scubertella sp., Schwagerina bicornis, Codonofusiciella sp., and Schubertella sp. This zone is present in many sections of the Maokouan in the Middle Permian of south China, including Fujian, Zhejiang, Jiangsu, Guizhou, and Hubei Provinces. (2) Neoschwagerina zone: This zone, of late Maokouan age, begins with the LAD of the genus Parafusulina and ends with the LAD of the genus Neoschwagerina. Common species are Neoschwagrina sp., Verbeekina sp., Kahlerina sp., and Vityamaia sp. The genera Yabeina and Staffella are absent from the study area, however they commonly occur in other areas of south China where the Neoschwagerina zone is present. This zone is widely distributed across south China. (3) Codonofusiciella zone: The zone represents the Wuchiapingian Stage. The lower limit is defined by the LAD of Neoschwagerina, and the upper limit is not clear. Common elements are Codonofusiciella sp., Schwagerina sp., Pseudofusulina sp., Afghanesella sp., and Sphaerulina sp. The Zone is extensively developed in the Wuchiapingian strata in the provinces of Sichuan, Guizhou, Anhui, Hubei, and Guangdong across south China. The three fusulinid zones indicate that the age of Daguan Shan Formation in the study area is Maokouan, Middle Permian, to Wuchiapingian, Late Permian in age.

Late palaeozoic biogeography and palaeogeography of central Asian terranes in NW China: an integration of faunal and tectonostratigraphic constraints

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New and previous fossil data from Central Asian terranes (Afghanistan, Uzbekistan, Karakorum-Kunlun Mts, Tarim Basin, Qaidam Basin, Tienshan Mts, Junggar Basin, Altaiads, Kazakhstan, and Mongolia) indicate a significant degree of latitudinal variation in biogeographic patterns during the Late Palaeozoic through the marginal seas along northern Gondwana, the Palaeo-Tethys Ocean and the seas along the southern margin of the Siberian continent. Semi-quantitative and quantitative analysis of the distribution patterns of brachiopods, corals and fusulinids across this region, together with critical analysis of their tectonostratigraphic settings combined with current palaeogeographical data, provide more accurate, more sophisticated models of the dynamics of the Late Palaeozoic–Central Asian marine systems. This study focuses on the Late Devonian to Permian intervals with primary emphasis on the terranes of NW China. These blocks were juxtaposed against major collisional orogenic belts; their depositional histories have been controlled by the assembly and displacement of these tectonic units. The biogeographic affinity and tectonostratigraphic information derived from the NW China blocks indicate significant amounts of palaeolatitudinal variation triggered by displacement of the terranes during the Late Palaeozoic. The palaeogeographic positions of the NW Chinese blocks relative to other tectonic blocks during the Late Palaeozoic
are elucidated by using the evolving provincialism of marine faunas and non-marine floras. The Tarim Basin was a mobile plate in the Palaeo-Tethys. It belonged to the same biogeographic province as South China; they were located in close proximity to each other during the latest Devonian to Early Carboniferous. During the Late Carboniferous the faunas of the Tarim Block developed clear links with Europe and the Urals, but decreasingly with South China; this is consistent with westwards movement of the block. Throughout the Permian the Tarim Basin underwent continuous movement towards the Europe-Asian continent, but did not become united with the supercontinent until the end of the Permian. Other NW Chinese blocks such as central and northern Tienshan Mts, Junggar Basin, and Qaidam Basin were parts of/or accreted to the Kazakhstan palaeoplate during the Devonian–Carboniferous. The Chinese Altai region was part of the Siberian plate during Devonian–Carboniferous. Subsequently both the accreted Kazakhstan and Siberian plates docked with the Europe–Asian supercontinent during the Late Carboniferous to Permian.

Environmental and biotic changes across the Permian–Triassic boundary in western Tethys: the Bulla parastratotype, Italy

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The sedimentary and biotic evolution of a 190m interval of shallow marine and lagoonal facies in the Bellerophon and Werfen formations in the Southern Alps has allowed comparison of western with eastern Tethys: Meishan D section (southern China), Salt Range (Pakistan) and Abadeh (Iran). The results are as follows:

1) The upper part of the Bellerophon Fm. (Changhsingian changxingensis-deflecta Zone) shows only modest biotic variation connected with tectonically-driven local variation and perhaps to more general climatic variation. The δ13C decrease starting in the uppermost 30m of the Bellerophon Fm. is correlated with decrease in global organic productivity starting about 1m below the PTB in Chinese sequences and 20m below in the Abadeh section. This interval culminated in a regression truncated by an unconformity–paraconformity (Unconformity 1).

2) The uppermost Bellerophon Fm. is a ca 1m transgressive-regressive sedimentary cycle, the informally named Bulla mbr (Changhsingian: Early praeparvus Zone). The maximum flooding interval of this unit possibly had a slight increase in biodiversity, mainly in foraminifers, algae and brachiopods. The high increase in biodiversity previously reported may, in part, reflect abundance of biota and organic matter reworked into transgressive and regressive intervals. We suggest partial correlation of the basal unconformity of the Bulla mbr (Unconformity 1) with the regressive uppermost Bed 24e of the Meishan D section marking the disappearance of foraminifers and algae in the eastern Tethys. We also suggest diachronous disappearance of benthic taxa in the Tethys, with the Southern Alps acting like a refugium.

3) The main extinction (first extinction phase, mainly regarding foraminifers) in the Southern Alps occurred in a thin ca 25cm interval including the uppermost regressive Bulla mbr, Unconformity 2, and possibly, the basal transgressive bed of the Tesero Mbr of the Werfen Fm. This interval is correlated in part with regressive Bed 26 of Meishan D section. The main decrease in abundance and biodiversity in the Southern Alps coincides with appearance of small oolites with crystalline outer cortex near the basal transgressive tract of the lower Tesero Mbr, a ca 220cm sedimentary cycle, which is followed by extension of microbialitic layers alternating with veritable biostromes with brachiopods and byssate bivalves as salient components among the algae. Vacated niches favoured evolution of conodonts. Hindeodid conodont biodiversity increased with species developing characteristics of Isarcicella. This interval has been referred to the Changhsingian Late praeparvus Zone and correlated with Bed 27a–b of Meishan D section. The PTB has been identified in the Bulla section at 1.30m from the base of the Werfen Fm.—with the first appearance of Hindeodus parvus defining the base of the parvus Zone—in a microbialitic layer correlated with Bed 27c of Meishan D section. Around the PTB the major part of the remaining Permian biota disappeared. Gymnocodiacean algae were the last group to undergo extinction within the Triassic layers.

4) Biodiversity dropped severely in the succeeding bioturbated microbialitic interval from which conodonts are absent. More humid climate is reflected in a more sandy marine substrate inhabited by Lingula, Unionites and Claraia. Conodonts recurred in the schizohaline upper part. The succeeding entry of the biozonal markers Isarcicella lobata, I. staeschei and I. isarcica allow discrimination of three conodont biozones. The layer with entry of I. staeschei has been aligned with Bed 28 of Meishan D section. The main extinction phase in the western Tethys seems to correspond to a gradual but swift transition from acid-bath to alkaline-bath. The Bulla section with abundant data on biotic and depositional variation is here considered as the PTB parastratotype for the shallow marine western Tethys.

Cyclic morphology and population approaches toward high-resolution biostratigraphy of Late Permian and earliest Triassic gondolellid taxa

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Late Permian and Early Triassic gondolellid taxa are largely discriminated by changes in the configuration of carinal denticles. The presence of discrete denticles typical of only juvenile Jinogondolella granti, in adults of the descendant Clarkina postbitteri suggests a paedomorphic evolutionary process. This evolutionary event is associated with a major sequence boundary and extinction (Middle-Upper Permian boundary) and involved the evolution of a new gondolellid genus, Clarkina, defined by the lack of serration, high anterior blade-like denticles, and major change in platform outline. The discrete denticulation may be related to a deepening event during the Early Wuchiapiingian. Depositional shallowing is subsequently associated with younger
Wuchiapingian taxa that typically show increasingly closely spaced denticles, culminating in the wall-like carina of *C. wangi* at the Wuchiapingian-Changhsingian boundary. While it is true that the smallest juveniles of *Clarkina* species appear to be very similar, some hint of the evolutionary process is revealed by comparing juveniles of *C. longicuspidata* and *C. wangi*. Juvenile *C. longicuspidata* have relatively discrete denticles compared to the increasingly fused denticles of intermediate and larger mature forms. In contrast, denticles of juvenile *C. wangi* are already partially fused, and in adults closing the anterior gap adjacent to the cusp, forming the high wall-like carina, completes this fusion. This implies a heterochronous process involving acceleration of development or peramorphosis. This small-scale evolutionary event within an anagenetic series of *Clarkina* species is associated with a series of relatively minor flooding surfaces. Younger Changhsingian taxa show a breakup of the wall-like carinal development, but they remain typically characterized by closely spaced denticles that decrease in height posteriorly. Discrete carinal denticles within *Clarkina* species are however again associated with the major flooding and extinction event near the Permian-Triassic boundary. Detailed geochronologic work for Upper Permian and lowermost Triassic rocks in South China may allow some quantification of these evolutionary rates. The high anterior (or ventral) blade in *Clarkina* may have served a similar function to the long anterior blade of other ozarkodinid conodonts like *Streptognathodus* that constrains element motion to the transverse plane and apparently maximised food-processing efficiency. This may provide a palaeobiologic basis for relating the morphologic variation used in Upper Permian and Lower Triassic biostatigraphy. The importance of the carinal shape in these taxa may be related to the parallel evolution or extinction of taxa representing potential food sources or to the availability of food sources along some environmental gradient. The cyclic nature of the carinal morphology and the ontogenetic changes that occur within species indicates that a sample population approach is needed. The sample population approach typically views the entire collection within a given sample collected over a thin interval in the rock record as a population and recognizes the most consistent and stable characters within that sample population for identification. Rare morphotypes within sample-populations that resemble related taxa are not recognized as separate taxa unless a distinct growth series can be demonstrated. This approach will allow the discrimination of the closely similar taxa necessary to define a precise high-resolution biostatigraphic zonation.

Middle Permian fusulinids from the Xainza area of the Lhasa block, Tibet

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Fusulinids hitherto reported from the Xiala Formation in the Xainza area of the Lhasa Block consist of 69 (15 genera). Of these, 26 species (4 genera) are identified from the authors’ collections and the remainder from previous studies (Chu, 1982; Wang et al., 1986). The presence of *Neoschwagerina* sp., *Verbeekina* verbee and absence of *Yabeina* indicate a probable Maokouan age, approximately late Roadian to Wordian (Jin, 2002). Our fauna differs markedly from contemporaneous fusulinid faunas from Cathaysian South China, especially in regards to dominant taxa. At generic level, the Maokouan fusulinids from South China are characterised by a flourishing of *Neoschwagerinidae* and *Verbeekinidae*—26% and 37% of the total genera respectively—but in the Xiala Formation, *Neoschwagerinidae* is relatively impoverished, restricted to only one genus: *Neoschwagerina*. Moreover, the Xiala Formation fusulinids lack 60% of the genera occurring commonly in coeval fusulinid faunas from South China (e.g. *Praesumatrina, Sumatrina, Metadoliolin*, and *Yangchienia*). At species-level, *Neoschwagerinidae*, *Verbeekinidae* and *Schwagerinidae* were most diverse in South China during the Maokouan with a dominance of *Neoschwagerina, Parafusulina, Schwagerina* (each with 16 species) and *Verbeekina* (with 9 species). In the Xainza area, however, species of *Neoschwagerinidae* and *Verbeekinidae* account merely for 1% and 3% of the total species respectively, and the *Schwagerinidae* have the highest species diversity (54%) in the Xiala Formation. The dominant genera are *Chusenella* (25 species) and *Nankinella* (17 species) with only one species in each of *Neoschwagerina, Parafusulina* and *Verbeekina*. The fusulinids from the Xiala Formation of the Xainza area, with 32% endemics, are thus regionally distinctive.

Late middle Permian Kamura event and the Guadalupian-Lopingian boundary mass extinction: a high productivity-cooling event in mid-panthalassa

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A secular change in stable carbon isotope ratio of carbonate carbon (δ¹³Ccarb) was analyzed in the Middle to Upper Permian shallow marine carbonates in Kamura, Japan, in order to document the oceanographic change in the superocean Panthalassa with respect to the mass extinction across the Guadalupian-Lopingian boundary (G-LB). The Permian carbonates were derived from a palaeo-atoll complex developed on an ancient seamount in mid-Panthalassa. The Capitanian (Upper Guadalupian) Iwato Formation (19 m-thick dark grey limestone) and the conformably overlying Wuchiapingian (Lower Lopingian) Mitai Formation (17 m-thick light grey dolomitic limestone) are composed of bioclastic limestone of subtidal facies, yielding abundant fusulines. The Iwato Formation is characterized mostly by unusually high positive δ¹³Ccarb values of +4.9 to +6.2‰, whereas the Mitai Formation is characterized by low positive values from +1.9 to +3.5‰. The negative excursion occurred in three steps around the G-LB and the total amount of the negative shifts reached over 4‰. A remarkably sharp drop in δ¹³Ccarb values, for 2.4‰ from 5.3 down to 2.9‰, occurs in a 2 m-thick interval of the topmost Iwato Formation, after which all the large-shelled fusulines and bivalves
disappeared abruptly. Such a prominent high positive $\delta^{13}$C values across the G-LB was detected for the first time, and this trend in the mid-superoceanic sequence is correlated chemostratigraphically in part with the GSSP (Global Stratotype Section and Point) candidate for the G-LB in South China. The present results prove that the end-Guadalupian event occurred doubtlessly on a global scale, affecting the circum-Pangean basins, Tethys and Panthalassa oceans. The end-Guadalupian interval of a high positive plateau in $\delta^{13}$C values over +5% is particularly noteworthy because it recorded an unusually high bio-productivity period that has not been known in the Permain. This end-Guadalupian high productivity event, newly named the Kamura event, suggests burial of a huge amount of organic carbon, draw-down of atmospheric CO$_2$, and resultant global cooling at the end of Guadalupian, considerably after the Gondwana glaciation. The low temperatures during the Kamura event may have caused the end-Guadalupian extinction of large-shelled Tethyan fusulines and bivalves adapted to warm climate. On the other hand, the following event of ca. 4% negative shift in $\delta^{13}$C values across the G-LB indicates a global warming in the early Lopingian. This may have allowed radiation of the new Wuchiapingian fauna, and this trend appears to have continued into the Mesozoic. These observations are in good agreement with the global sea-level curve in the Middle-Late Permian. The smooth and gradual pattern of the negative shift suggests that the causal mechanism was not of a catastrophic nature (e.g. bolide impact, sudden melting of methane hydrate) but was long and continuous.

Records of marine reptiles from the Panxian and Guanling faunas, Guizhou Province, southwestern China: markers of the Triassic biotic recovery after the end-Permian mass extinction

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After the end-Permian extinction, the biosphere started to recover slowly during the Early Triassic while the environment was unstable. During the late Early Triassic, the earliest records of the marine reptiles (e.g. ichthyosaur and sauropod) appeared in south China, Japan, Spitsbergen, and British Columbia, Canada, but they were rare and fragmentary. The marine ecosystem began to stabilise and the organisms radiated rapidly in the Middle Triassic, during which time the Panxian fauna occurred in the ancient Guizhou sea. The Panxian fauna was discovered in the Upper Member of the Guanling Formation (conodont *Nicoraella kockeli* Zone, Pelsonian of Middle Anisian), Xinmin, Panxian County, Guizhou Province, southwestern China. Marine reptiles of the Panxian Fauna known so far include: three ichthyosaurs (a new species of *Mixosaurus*, *Phalarodon* cf. *P. fraasi*, and a new taxon of basal ichthyopterygian); one protorosaur (*Dinocephalosaurus orientalis* Li, 2003); two nothosaurid sauropodians (a new species of *Nothosaurus*, and a new species of *Lariosaurus*); and possible placodont and pachypleurosaurid sauropodians. The new species of *Nothosaurus* is the second representative of this genus from southwestern China and outside the western Tethyan fauna province; the new species of *Lariosaurus* is the oldest definite record of this genus known so far. The nothosaurs from the Panxian fauna further strengthen the palaeobiogeographic affinities between Middle Triassic marine reptiles from South China and the western Tethyan, and are of important significance to study the early history of this family. In the early late Triassic, the global diversity reached its highest of the Triassic. The Guanling fauna from the Wayao Member (conodont *Paragondolella polygnathiformis* Zone, Carnian), Falang Formation, Xinp, Guanling County, Guizhou Province corresponds to this peak phase, that marks a full recovery of marine organism diversity from the end-Permian extinction. Reptiles became the top predators in the marine realm just as dinosaurs emerged on land. The fossil marine reptiles from the Guanling Fauna provide an important link between the Triassic Pacific and Tethyan, and between Triassic basal forms and the Jurassic-Cretaceous marine top predators. The most remarkable fossils are the large completely articulated ichthyosaur skeletons up to and more than 10 m, and the first recorded thalattosaurs and placodonts in China. Following our review, of the 17 named reptilian taxa, eight are considered to be valid: three ichthyosaurs (*Qianichthyosaurus zhouti* Li, 1999; *Guizhouichthyosaurus tangae* Cao and Luo in Yin et al., 2000; *Guanlingsaurus liangae* Yin in Yin et al., 2000); three thalattosaurs (*Anshunsaurus huangguoshuensis* Liu, 1999; *Xinpusaurus suni* Yin in Yin et al., 2000; *Xinpusaurus kohi* Jiang et al., 2004); and two placodonts (*Sinocyamodus xinpensis* Li, 2000; *Psephochelys polyosteoderma* Li and Rieppel, 2002). The Panxian and Guanling Faunas are of high diversity, containing well preserved and completely articulated skeletons of marine reptiles associated with fish and invertebrates, and are two of the best examples of marine reptile records in life history, and markers in the process of Triassic biotic recovery.

Upper Paleozoic brachiopods of marginal seas of the Angarida: events and stages in development

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During the Late Paleozoic, Angarida was surrounded by marginal seas extending over a continental shelf. The Late Tournaissian Stage is the time of maximum Early Carboniferous transgression, and a time directly before the collision of the Angarida continent and the Kazakhstan continent. The Seheglovian event is the beginning of the closing of the Palaeoasian Ocean. It is expressed in a drastic decrease in taxonomic diversity of different faunal groups as well as in the change of lithology. The best sections of the marine Carboniferous and Permian deposits around the Angarida continent are known from the Verkhoyanye-Okhotian region. This area is characterized by a coastal zonation from continental facies – on the west, to basin facies – on the east. Sequences of Carboniferous and Permian of Verkhoyanye-Okhotian region are characterized by cyclical
successions. Regional units correspond to transgressive-regressive cycles of the highest order. Their biostratigraphy and stratigraphic correlations are based mainly on brachiopod studies. Twelve regional horizons and twenty-three biozones have been established for this area in the Carboniferous and Permian. The main events influencing the history of continental development and recorded in the sediments of the marginal seas are located at the base of the Bazovian and Solonchakan horizons, the Carboniferous-Permian boundary and the base of the Tumarian, Delenzhan and Dulgalkan horizon. Six bioevents were recognized: 1 – Scheglovian event, 2 – Tylakhan event, 3 – Setlandian event, 4 – Tumarian, 5 – Delenzhan event and 6 – Dulgalkan event. The Angarida continent determined the synchronisation of geological processes occurring not only on the land, but also along its periphery – within shelf sedimentary basins. Alignments of the Carboniferous and Permian stratigraphic charts of the different regions along the periphery of the Angarida Continent were made on the basis of: (1) detailed biostratigraphic chart for the Verkhoyany-Okhotian area; (2) established global events boundaries within the studied region; (3) reference correlative intervals. The latter corresponds to the maximum transgression. The assemblages of brachiopods that characterize the local stratigraphic units have been of prime importance for interregional correlation. The names of these units are used for referencing interregional correlative intervals that include Krapivian, Magarian, Natalian, Early-Solonchakan, Late-Kyrgyztassian, Khorokytian, Early-Tumarian, Early-Delenzhan and Early-Dulgalkan intervals.

**Statistical correlation between fusulinacean fauna and sea-level changes through the Early and Middle Permian in southern Guizhou, China**

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Sea-level changes from the end of the Loudianian to the Lengwan in the study area include seven 3rd-order cycles, each with two stages, i.e. an early rise, and a late rise to fall. The first three cycles belong to the first phase, the last four cycles to the second phase. The second phase is characterized by faster early-rise rates in cycles compared with the first phase. Statistical results on numbers of species, first appearance of species (FAS), and last appearance of species (LAS) of fusulinacean faunas during sea-level changes have the following features for correlation between faunas and simultaneous sea-level changes.

1) Percentages of number of FAS in a stage to total number of FAS, three maximum values of about 36% of all FAS occurred wholly in the first phase with percentages obviously higher than the average value of FAS per stage. Moreover, the total number of FAS and the evenness number of FAS per assigned thickness-interval of strata in the first phase were 1.5 and 2.2 times as much as in the second phase.

2) However, the percentages of the number of LAS in a stage to total number of LAS, four maximal values including about 43% of all LAS occurred in the second phase with total number of LAS about 1.8 times as much as in the first phase. The total number of LAS in the first phase, in which the number of LAS in any stage was not higher than the evenness number of LAS per stage, was more or less evenly distributed in six stages, but about 69% of LAS in the second phase was concentrated on four early-rise stages.

3) The number of species in each stage persistently increased within the first phase, reached a climax at the end of the first phase, and then definitively decreased during the second phase except for a brief increase in one stage.

The features above demonstrate that sea-level changes with slower early-rise rates favoured increase in species diversity in the fusulinacean fauna due to the higher rate of speciation and the lower rate of disappearance. Conversely, the sea-level changes with faster early-rise rate could have been seriously detrimental to the fauna because the very high rate of disappearance and the lower rate of speciation led to a great decrease in species diversity. Therefore, it could be deduced that the 3rd-order changes of sea level were an important environmental background, and the early-rise rate of sea-level changes might be one of the key factors related to the evolutionary pattern of “Maokouan” fusulinaceans discriminated from fossil data from the same area.

**The correlations of biomarker data of Late Permian in Meishan section**

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With the data of four biomarker parameters, C31 2α-methylhopane index (2α-MHI), C31 3β-methylhopane index (3β-MHI), regular steranes/17α-hopanes and C35 homohopane index (C35-HHI), which were attained from Meishan Core-1, some probable interpretations of the end-Permian anoxia event are given. By analyzing these data it was noticed that there are many obvious correlations between them, and additional comparisons with the data of sea-level changes and inorganic carbon isotope shift can be made. According to the biomarker parameters, the end-Permian anoxia might have already begun at the early Changhsingian Stage, and it progressed with a quick transgression. Such a long period of extensive anoxia affected the organisms in the shallow water. In the early Triassic, the marine environment was almost oxic and the reconstruction of the ecosystem was led by prokaryotic organisms.

The Permian/Triassic transition was divided into five stages, A-E (see the figure). In stage E, the high 3β-MHI indicates a high activity of methanotrophic bacteria in a sulfate depleted environment (Brocks et al. 2005), and the low C35 homohopane index shows an oxic sedimentary environment (Peters and Moldowan 1991). In stage D, with a very high C35-HHI, both 3β-MHI and 2α-MHI dropped dramatically. These reveal an anoxic shallow sea with low cyanobacteria and methanotrophic bacteria activity. And, low ratio of regular steranes/17α-hopanes means prominent prokaryotic input to buried organic matter (Moldowan...
In stages B and C the C35-HHI is still high, but decreased a little. Together with relatively high 3β-MHI and 2α-MHI it could be presumed that the shallow water column was possibly dysoxic. And, the high ratio of regular steranes/17α-hopanes indicates the organic matter input mainly came from algae and higher plants. So an enhanced terrestrial weathering during this long term regression might have brought a large amount of nutrition and organic matter to the ocean and then been buried, thus resulting in the slight enhancement of organic matter input mainly came from algae and higher plants. So an enhanced terrestrial weathering during this long term regression

Biodiversity dynamics of the superorder fusulinoida (foraminifera) during its evolutionary path

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Superorder Fusulinoida Fursenko, 1958 is one of the main groups among marine invertebrate organisms, used for dating and correlation of the Late Palaeozoic deposits. In superorder Fusulinoida 6 orders, 29 families and 187 genera are distinguished. Fusulinoida have appeared in Early Carboniferous (Viséan age) and have existed for almost 95 million years up to the end of Permian epoch. In order to assess the Fusulinoida’s biodiversity dynamics over time, a graph illustrating the change in the number of genera in each order of the superorder Fusulinoida was constructed (Fig.1). Similar charts have been published by E.Ya. Leven (2003). However, our interpretation differs from the last a little. The schedule for superorder Fusulinoida as a whole is represented by a curved line with three precise peaks, approximately equal, but varied in qualitative content. The first peak, which is caused by burst of genera formation in order Fusulinida, falls at the Moscovian age. The second peak of generic diversity in superorder Fusulinoida is marked from Asselian up to Artian ages and is defined by primary prevalence of genera number in order Schubertellida. The character of a variety curve of Schubertellida is qualitatively similar to the schedule on Fusulinida. In both orders we notice a fast increase in their generic variety at the initial stage and, after rather a short period of the maximal peaks of a variety on the schedule. But the main difference is that the third peak qualitatively differs from first two since there is no domination by any one order. Neoschwagerinida determined the aspect of middle Permian Fusulinoida fauna, but they never achieved such generic variety, as Fusulinida in Middle Carboniferous or Schubertellida in Early Permian. In relation to their rather low level of a generic variety, Neoschwagerinida have been comparable to other orders existing at that time, Schubertellida and Staffellida. At the end of Middle Permian, set against a background of proceeding reduction of the shallow shelf seas and an increasingly arid climatic, the Schwagerinida and Neoschwagerinida became extinct. In Late Permian the generic variety of Fusulinoida sharply reduced, they are replaced by a few genera of Staffellida. Ozawainellida and a little more variation in the Schubertellida genera. By the end of the Permian epoch the final phase of Fusulinoida has come to an end.

The greatest end-Permian catastrophic events: progress and perspectives from China

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The end-Permian mass extinction has been unanimously ranked as the greatest mass extinction during the Phanerozoic, eliminating about 95% of all the species in the world’s ocean and also heavily affected terrestrial ecosystems (e.g. Erwin, 2006). Although it has been extensively studied, its causes remain a mystery. In China, intensive investigations have taken place in high-resolution biostratigraphy (Zhao et al., 1981; Sheng et al., 1984; Yin et al., 1996; Shen et al., 2006), analytic palaeobiology and computer modeling (Jin et al., 2000), microstratigraphy and sedimentology (Cao and Shang, 1998), geochemistry (Cao et al., 2002) and geochronology (Bowring et al., 1998; Mundil et al., 2004). These investigations have occurred in different facies and different palaeogeographical settings including southeast China, southwest China, Tibet and northwest China.

Careful analyses show that the widely perceived end-Permian mass extinction (in the sense of Sepkoski, 1981) actually consisted of two phases, one at the end-Guadalupian which is either called the pre-Lopingian crisis or the end-Guadalupian mass extinction (Jin, 1993; Jin et al., 1994; Stanley and Yang, 1994; Shen and Shi, 1996, 2002; Shi et al., 1999; Wang and Sugiyama, 2000; Yang et al., 2004) and another at the close of the Changhsingian (Jin et al., 2000). Relatively little is known about the first phase in comparison to the second. What has been recognized however, is that the pre-Lopingian crisis is much less pronounced than the second
extinction event (Shen and Shi, 2002), and it is taxonomically selective and possibly palaeobiogeographically different in severity (Wang and Sugiyama, 2000; Shen and Shi, 2002; Yang et al., 2004). Corals and fusulinids experienced significant decline, brachiopods, foraminifera, bivalves and gastropods, however, did not show distinctive changes (Jin et al., 1994; Shen and Shi, 2002).

The crisis was associated with $^{13}$C depletion was recognized at the major global regression. A dramatic Guadalupian-Lopingian boundary (Wang et al., 2004; Kaiho et al., 2005). Although the pre-Lopingian crisis may be consistent in timing with the Emeishan igneous province in South China (Zhou et al., 2002), the cause-effect links between them remain unclear.

Detailed statistical analyses based on high-resolution biostratigraphy and geochronology suggest that the effects of the end-Changhsingian mass extinction were rather rapid or even catastrophic, and probably lasted less than a couple of hundred thousand years or possibly even less than tens of thousands of years (Bowring et al., 1998; Jin et al., 2000; Kaiho et al., 2001; Shen and Shi, 2002; Xie et al., 2005). The sudden disappearance of fossil groups happened in various depositional environments from terrestrial to marine, from littoral, carbonate platform, reef, slope to basin facies. It is also comparable in timing and pattern to the extinction event in the peri-Gondwanan region of southern high palaeolatitudes (Shen et al., 2006). A rapid climatic warming event is indicated by the southward invasion of various warm-water faunas in the peri-Gondwanan region. Rugose corals, brachiopods, fusulinids, ammonoids, etc. all turned out to be the victims of this bioevent. Recent investigations into the terrestrial alluvial, marine/nonmarine transitional and littoral Permian-Triassic boundary (PTB) sequences in southwest China also reveal a rapid climatic drought and deforestation of the tropical Gigantopteris megaflora which is synchronous with the mass extinction of marine organisms. The end-Changhsingian event was associated with a sharp negative drop of both $^{13}$Corg, which occurs slightly below the PTB in both marine and $^{13}$Carb and terrestrial sequences. A rapid transgression also began in the latest Changhsingian, frequent volcanic activities indicated by multiple ash beds occur near the Permian-Triassic boundary, and widespread anoxic conditions prevailed during the extinction and its aftermath intervals (Wignall and Twitchett, 1996; Grice et al., 2005; Xie et al., 2005).

The temporal coincidence between the extinction event and the flood basalt in Siberia (Renne et al., 1995), and evidence of climatic warming (greenhouse effect) possibly derived from carbon dioxide released from frequent volcanic eruptions suggest that volcanism is probably the most plausible causal links between the eruptions and the mass extinction. This scenario is also supported by widespread multiple ash beds or tuffs near the PTB in South China. However, the China ash beds are from pyroclastic volcanism, probably from northern Vietnam or southern China, rather than from the Siberian flood basalts based on the presence of bi-pyramidal quartz, which is associated with subduction-related volcanism. Therefore, to establish a close cause-effect link between volcanism and mass extinction remains a task for future multidisciplinary research (Erwin et al., 2002). The geochronological and statistical evidence of a catastrophic extinction at the close of the Changhsingian continues to activate the discussed scenario of an extraterrestrial impact as the cause of the extinction. The most suggestive evidence of this scenario is the presence of helium and argon trapped in a variety of fullerenes (Becker et al., 2001; Li et al., 2005). However, experimental results of Becker et al. (2001) were not validated by the subsequent study (Farley and Mukhopadhyay, 2001). Microspherules possibly related to volcanism or impact have been widely reported from the PTB sections in south China (He, 1985; Gao, 1987; Yang et al., 1991). However, sources of the PTB microspherules remain unclear in terms of their chemical composition and abundance. Sedimentological evidence of anoxia advanced by Wignall and Hallam (1992, 1993) and Itozaki (1997) has been widely recognized in South China based on the lithologic and community shift, frequent occurrences of framboidal pyrite and a biomarker of Chlorobioaceae across the PTB (Wignall and Hallam, 1993; Cao and Shang, 1998; Grice et al., 2005; Xie et al., 2005). However, the evidence for anoxia could reflect extinction rather than anoxia (Erwin et al., 2002).

In order to unravel the cause(s) of the end-Permian mass extinction, a detailed working plan was made recently. Two wells were drilled in 2004 at a quarry near the PTB GSSP section in Changxing, Zhejiang Province, SE China. A total thickness about 340 m of the cores was collected. In addition, large quantities of very fresh samples from the quarry at Meishan have been accomplished by blasting quarry facies. Research programs including an integrated succession for the Lopingian Series, timing of the end-Permian event, a blind test for the suggested extraterrestrial event, organic geochemical evidences and co-evolution in the Permian-Triassic terrestrial and marine ecosystems are suggested.

The marine Permian of east and northeast Asia: an overview of biostratigraphy, palaeobiogeography and palaeogeographical implications

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The marine Permian is extensively distributed in east and northeast Asia, but their mutual correlations and alignments with the international Permian chronostratigraphic timescale remains a major challenge due to profound marine provincialism during the Permian. In this paper, an attempt is made to synthesise the Permian biostratigraphy, faunal successions and mutual correlations (where possible) throughout east and northeast Asia, region by region, based on both published literature and the author’s field observations in specific parts of this vast region. Correlation of the Permian marine successions of NE Asia with the Permian international timescale and, in particular, with the Gondwanan Permian marine sequences, is aided by employing biogeographically mixed faunas from east Asia (SE Mongolia, NE China, South Primorye of Far East Russia and the South Kitakami Terrane of Japan) as “biostratigraphic gateways”, coupled with some bipolarly and bi-temperately shared Permian marine taxa and faunas. With this new “biostratigraphic gateway method”, it has been possible to correlate, with reasonable confidence, some of the high-palaeolatitude Permian marine rock units and faunas of NE Asia with those of the Tethyan region and Gondwana. Palaeobiogeographically, the Permian marine faunas of E and NE
Asia are assigned to four major provinces: Verkolyman, Sino-Mongolian-Japanese, Cathaysian, and Panthalassan provinces, on the basis of their palaeogeographic distribution patterns and characteristics of faunal assemblages. Of these, the Sino-Mongolian-Japanese Province has considerable significance for regional palaeogeographic, plate tectonic and palaeoceanographic reconstructions during the Middle Permian because of its conspicuously mixed cool- and warm-water marine biota. The origin of this biogeographically mixed marine biota is interpreted to have resulted from a combination of factors including the increased tectonic convergence between the Bureya-Jiamusi Terrane and the Sino-Korean Platform during the Permian and intermingling of both warm- and cold-water ocean currents off the eastern coastal areas of the Bureya-Jiamusi Terrane and the Sino-Korean Platform during the Middle Permian.

Permian fusulinaceans from the Tengchong block, western Yunnan, China

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The Tengchong Block, a tectonostratigraphic unit of western Yunnan, southwest China, has Permo-Carboniferous sequences with biota of strong Gondwana-affinity. Many authors have therefore suggested the block is of Gondwanan provenance (e.g. Wang, 1983; Jin, 1994, 2002; Wopfner, 1996), but the arduous terrain has long restricted field work and accumulating data necessary for analysing the palaeogeographic development of this block. Fusulinacean fossils reported here came from two horizons in the Permian Dadongchang Formation north of Tengchong township, specifically near Kongshuhe and Shanmutang villages. The fauna from the lower part of the Dadongchang Formation in the Kongshuhe section consists of Eoparafusulina tschernyschevi (Schellwien, 1909), E. malayensis Igo, Rajah and Kobayashi, 1979, Parafusulina sp., Monodiexodina wanneri (Schubert, 1915), and may be Artinskian in age. The fauna from the middle part of the Dadongchang Formation in the Kongshuhe section consists of Eoparafusulina tschernyschevi (Schellwien, 1909), E. malayensis Igo, Rajah and Kobayashi, 1979, Parafusulina sp., Monodiexodina wanneri (Schubert, 1915), and may be Artinskian in age. The fauna from the middle part of the Dadongchang Formation in the Shanmutang section consists of Chusenella mingguangensis sp. nov. C. sp. indet., Parafusulina sp., Pseudofusulina sp., Monodiexodina gigas sp. nov., and is probably of Wordian to Capitanian age. The low generic and specific diversities and absence of Cathaysia-indicating pseudoschwagerinids, verbeekinids, and neoschwagerinids are remarkable features of the fusulinacean faunas of the Tengchong, Baoshan and Sibumasu blocks. However, the species-composition of the fauna from the Tengchong Block is different from those of the other two blocks, emphasizing a regional character of the fauna of the Tengchong Block.

Distribution of small foraminifers in the Permian-Triassic boundary strata at Meishan section, Zhejiang, China

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Sixty-three species in 21 genera of non-fusulinid small foraminifers are identified from the middle and upper Changhsingian Stage and the Permian-Triassic boundary strata at the Meishan Section in Changxing County, Zhejiang Province, where the named Changxing Limestone and the GSSPs (Global Stratotype Section and Point) for both base and top of the Changhsingian Stage are located, based upon a high-resolution samples at the section. The uppermost Changhsingian and the Permian-Triassic boundary strata are sampled and thin-sectioned at intervals of 2-4 cm. The overall distribution of the small foraminifers at the section shows an apparent sharp drop at the near top of the Changxing Formation with only nine species of five genera extending over the main event bed, Bed 25, among which Nodosaria netschajewi and N. sp. are observed in Bed 29 as well. However, a closer view on the distribution of the small foraminifers in the topmost part of the Changhsingian indicates a significant gradual decrease towards the end of the Changhsingian. The real distribution is a smooth decline though a statistical analysis might show a stepwise extinction. These data would be of importance for a better understanding of the extinction pattern at the end of the Permian as well as the nature of the events.

Relating the fossil record to deglaciation in the Early Permian of Gondwana: development of a Gondwana-wide biotic deglaciation model

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Deglaciation sequences of Early Permian age in Gondwana have until now been distinguished mainly on lithological criteria by reference to climate-sensitive lithologies such as diamicite, limestone, glacial shales (with dropstones and varves) and associated geochemistry, whereas identification on biotic criteria such as vegetational or faunal change has not been employed. Data shows that the maximum rate of deglaciation probably occurred around the Granulatisporites confinis palynological Biozone, at least in Australia, Antarctica, East Africa, India and Arabia, in late Asselian – early Sakmarian times.

Present palaeontological data, which are admittedly widely-scattered geographically, and of different stratigraphic scales and resolutions clearly show diversity increase from glacial conditions to post glacial conditions. Amongst the marine fauna, a cold water fauna consisting of bivalves such as Eurydesma and Deltopecten, and brachiopods such as Lyonia and Trigonotreta, were established in the earliest post glacial marine transgressions that did not affect all of Gondwana. Above this is a more diverse,
increasingly warmer, temperate fauna, including brachiopods, bryozoans, bivalves, cephalopods, gastropods, conularids, fusulinids, small foraminifers, astrozoans, blastoids and crinoids like that of the Saiwan Formation/Haushi limestone of Oman.

The palynomorph succession shows some consistency across Gondwana in Asselian-Sakmarian rocks. Very broadly a change from monosaccate pollen assemblages, associated with fern spores to more diverse assemblages with common non-taeniate bisaccate pollen occurs through the deglaciation period. In Oman, where this has been studied in greatest detail, the upland saw changes from a glacial monosaccate pollen-producing flora to a warmer climate bisaccate pollen-producing flora; while in the terrestrial lowlands, a parallel change occurred from a glacial fern flora to a warmer climate colpate pollen-producing and lycopod lowland flora. The sedimentary organic matter of the clastic rocks of the Oman sequence records a corresponding δ13C trend (from approximately -21 to -24‰) believed to reflect palaeoatmospheric change due to postglacial global warming.

The advantages of developing a deglaciation model would be in understanding in detail the response of life to increasing temperatures and other climate changes, and might be useful in the study of modern biotic change during global warming. However, to achieve such a model more detailed bed by bed interdisciplinary palaeontological studies of measured sections demonstrably related to climate-forced deglaciation must be carried out. For these studies to be comparable across Gondwana, sections must be precisely correlateable so that like can be compared with like. Therefore a Gondwana-wide palynostratigraphy, uniting the four or five schemes presently in existence for the former continents of Gondwana, needs to be established.

Molecular evidence for radical changes in ocean chemistry, globally, across the Permian Triassic boundary

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The Late Permian mass extinction was most extensive in Earth’s history, resulting in around 90% of marine animal species, and many terrestrial taxa, becoming extinct. Shallow and deep water anoxia, euxinia, global warming, Siberian Trap volcanism, collapse and oxidation of methane hydrates, sea level change and bolide impact are among the proposed causes of the extinction event.

Samples from outcrop, and from a new core drilled through the Permian-Triassic (P-Tr) Boundary at the type marine section at Meishan, have been examined for biomarker and isotopic evidence of environmental and associated biotic change. Late Permian sediments from Meishan Beds 22-30 are characterized by indicators of anoxia including low Pr/Ph ratios and abundant aryl isoprenoids and isorenieratane derived from the precursor carotenoid isorenieratene. These latter biomarkers, derived from brown species of green sulfur bacteria (Chlorobiaceae), are considered reliable indicators of euxinic water columns where hydrogen sulfide extends into the photic zone. Highest abundances of Chlorobiaceae biomarkers occur through Beds 24 to 27 and so bracket the major extinction horizon evident in ash Bed 25. Additional sub-maxima of Chlorobiaceae biomarker abundances, at Beds 30, 35 and 37 in the Early Triassic and coincident with monotonous bivalve debris suggestive of mass extinction, indicate that pulses of photic zone euxinia occurred well after the Permian and may have caused the biodiversity recovery to be protracted.

The prevalence of aryl isoprenoids and isorenieratane is also recorded in a recently cored borehole, Hovea-3, of the Perth Basin, Western Australia (Grice et al., 2005). Other, well-established, boundary sections in Tibet and at the Great Bank of Guizhou, had similar biomarker patterns as did two sections outside the Tethys realm, in Western Canada and at Kap Stosch in East Greenland. In fact, the presence of biomarkers for Chlorobiaceae at six separate locations, worldwide, indicates that water column euxinia was pervasive during and after the extinction event and suggest that sulfide may have been a key toxic agent, as is supported by the photochemical modeling studies of Kump et al. (2005). Widespread outcropping of anoxic sulfidic waters onto continental shelves compromised aerobic habitats and might ultimately have allowed a hydrogen sulfide plume to influence continental regions and compromise terrestrial organisms (Kump et al., 2005). Further evidence for widespread euxinia comes from δ34S isotope studies on sulfate and sulfide minerals at P-Tr sections from numerous locations worldwide (e.g. Nielsen and Shen, 2004).

At Meishan, a pronounced negative C-isotopic excursion of around 4 per mil for kerogen is evident reaching a maximum near the top of bed 26 (black shale layer). This, and roughly parallel shifts in carbonate δ13C, have been observed in other P-Tr sections worldwide. The carbon isotopic excursions, and accompanying anomalies in nitrogen and sulfur isotopes, indicate there was a major reorganization of the global carbon cycle over the P-Tr Boundary. Biomarker and isotopic anomalies found for Meishan have much in common with those observed in black shales deposited during the early Aptian, late Cenomanian and late Frasnian oceanic anoxic events. This suggests globally pervasive euxinia is not a rare phenomenon and may explain many of Earth’s major mass extinctions.

Palaeoecology of the Permian alatoconchid bivalves from north-central Thailand

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Alatoconchid bivalves are found extensively in Permian limestones along the mountain belt west of the Khorat Plateau in north-central Thailand. More than 30 localities with alatoconchid beds have been studied stratigraphically and sedimentologically. The bivalves were observed mainly in bedded, dark to light grey wackstones and packstones. Limestones with alatoconchids occur in beds are few centimetres thick to very thick-bedded of the Saraburi Group. They range in age from Murghabian to Midian based on fusulinid biostratigraphy (Wielchosky and Young, 1985). Dolomitic limestones occur interbedded with limestones. Collapsed limestone breccias with red matrix and fragments of alatoconchids, corals and other shelf organisms are interpreted as palaeocave deposits. The sequence stratigraphy reveals fluctuations in sea level. Alatoconchids are alate, equilibrated bivalves with vertical plane of commissure and wing-like flanges with dorsal ridge. The largest adult shells are up to one metre width whereas the smallest juvenile shells are less than one centimetre. Dark grey micritic limestones with both adult and juvenile shells in living or growth position imply a soft substrate with high content of organic matter. Burrows with micritic infillings in alatoconchid shells were probably caused by cyanobacteria and indicate depositional environments below the photic zone. Associated fossils consist of fusulinids, brachiopods, massive corals, solitary corals, bellerophontid gastropods, algae, sponges and crinoids; these suggest relatively shallow, clear water. Storm events, discriminated from tempestites, occurred occasionally. These are mainly composed of calcirudite and calcarenite shell beds. Dislocated massive corals, upside-down coral heads and fusuline storm sheets indicate occasional turbulent water as well.

Ca.-100-m.y.-long foraminiferal faunal record before the end-Permian extinction in a mid-ocean setting: perspective from Paleo-Tethyan oceanic carbonate buildsups in the Changning-Menglian belt, SW China

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The Changning-Menglian Belt in West Yunnan, SW China, is regarded as a displaced ophiolite belt between the Cathaysian Lincang Massif (Permian-Triassic volcanic arc developed along the continental margin of “Cathaysialand”) and the Cimmerian Baoshan Block (Gondwana-derived continental sliver), representing one of closed remnants of the Paleo-Tethys Ocean in East Asia. The belt contains huge, Carboniferous-Permian carbonate bodies of mid-ocean origin, formed by the carbonate factory upon OIB edifices (oceanic islands and/or plateaus) in the Paleo-Tethys Ocean. These oceanic carbonates involve continuous records of approximately 100-m.y.-long, biotic and environmental changes in an open-ocean setting within the Paleo-Tethys before the end-Permian mass extinction. In this paper, we review the foraminiferal faunal succession from two sections of these oceanic carbonates in the Changning-Menglian Belt; they are the Yutangzhai section and the Shifondong section. These two sections cover almost the whole of the Changning-Menglian oceanic carbonate succession, and thus are optimal for understanding the general overview of stratigraphy and biotic succession in a Paleo-Tethyan open-ocean condition. The Yutangzhai section, about 1100 m thick, starts from weathered basalt, followed by thick piles of pure carbonates that are from the influx of terrestrial siliciclastic materials. They are composed essentially of shallow-marine limestone, and are dominated by whackstone, packstone, and fine grainstone with a minor amount of peritidal dolo-mudstone, except markedly observed cementstone in the lowermost part. Large-scale, reef-related sediments consisting of skeletal metazoan frameworks are absent. These facies associations suggest that the carbonates in the Yutangzhai section are mostly of back-reef sediments in a seamount depositional system. We recognized seventeen, essentially continuous fusuline faunas ranging from the Serpukhovian (late Mississippian/late Early Carboniferous) to the Midian/Capitanian (late Guadalupian/late Middle Permian) in this section. No significant faunal break can be recognized in this section. Because some of corals from the basal part of the carbonate succession presumably indicate a Visean age, the pedestal basalt is of Visean or slightly older. The generic and some specific compositions of the Yutangzhai fusuline assemblages indicate that the faunal succession is essentially similar to what we can see in the Tethyan and Panthalassan areas and is of typical tropical Tethyan type although their generic diversity is definitely lower than those of Paleo-Tethyan shelves (such as South China, Indochina, and Central Asia).

The Shifondong section, about 100 m thick, represents the topmost part of the Changning-Menglian, Paleo-Tethyan oceanic carbonate succession. This section is rich in foraminiferal remains and has been assigned to the Changhsingian (late Lopingian/late Late Permian) in previous studies by the occurrence of Palaeofusulina sinensis. Our biostratigraphic study demonstrated that it is subdivided into the Codonofusiella cf. kwangsiana Zone (Wuciaptingian), Palaeofusulina minima Zone (early Changhsingian), and Palaeofusulina sinensis Zone (late Changhsingian) in ascending order. The fusuline and smaller foraminiferal associations in the Shifondong section show a high taxonomic diversity and have a close affinity with coeval faunas found in South China. Moreover, our recent, preliminary isotopic analysis detected a level with a strong negative shift of $\delta^{13}$C value (from 4.1‰ to -0.6‰; comparable with carbon isotopic data from the P-T boundary section in Meishan, South China) within a microbe-dominated interval just overlying the very latest Permian Palaeofusulina sinensis Zone in the upper part of the section.
This may suggest a possibility that the section is across the P-T boundary. If this interpretation is available, the Shifodong section is also unique to comprehend an end-Permian, oceanic environment and shallow-marine biotic demise in a far distal area from the “Shallow Tethys” (Pangean shelves) as well as the nature of P-T boundary event in a mid-ocean setting in the Paleo-Tethys.

An abrupt shift in S-isotopic composition: evidence for H₂S input as a trigger of the end-Permian marine biotic crisis and environmental mutagenesis

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Many mechanisms have been proposed to explain the end-Permian extinctions, one of them being the massive release of hydrogen sulfide to the ocean and atmosphere (Nielsen and Shen, 2004; Kump et al., 2005). However, more evidence needs to be investigated. In this paper, we will focus on an interpretation of the S-isotopic excursion pattern around the main extinction interval in Meishan section, China, the Global Stratotype Section and Point (GSSP) for the Permian-Triassic boundary. The abrupt and strong negative shifts in δ³⁴S^rock, δ³⁴S^sulfate and δ³⁴S^pyrite synchronously occur with the negative shift in δ¹³C^carb from Bed 24e to Bed 26 (Fig. 1), strongly indicating a common trigger for the change of CO₂ and H₂S source in the ocean. The 34S-depletion character for the intervals above Bed 24 is similar to that in the East Greenland Basin (Nielsen and Shen, 2004). What is more important is that a strong positive shift in δ³⁴S^pyrite (δ³⁴S^rock) occurs in Bed 24e (the last-appearance interval of a wide variety of Late Permian faunal species, according to Jin et al., 2000). This S-isotope shift pattern is very similar to that of δ³⁴S^pyrite in the Tenjinmaru and Sasayama sections from Japan (Kajiwara, 1994). The possible mechanism for such a S-isotope shift pattern is suggested as follows: massive H₂S was abruptly input (released) into the bottom water, accompanying the deposition of Bed 25 (illite-montmorillonite claystone of volcanic origin), it then diffused downwards into Bed 24e and scavenger Fe²⁺ formed semi-euhedral or euhedral pyrite, thus leading to δ³⁴S^pyrite enrichment in Bed 24e and probably iron depletion in the sea. While above Bed 25, the very low sedimentary rate, and decreased Fe supply, caused extensive sulphide reoxidation and sulphate reduction, leading to strong ³⁴S^pyrite depletion. Thus, the strong positive shift in δ³⁴S^pyrite in Bed 24e is considered to be important evidence for the massive H₂S input into the ocean. The source or genesis of H₂S is discussed in detail.

Radiation of the fusulinoideans between the two phases of the end-Permian mass extinction, South China

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The end-Permian mass extinction is one of the largest bioevents in geological history. The benthic groups such as fusulinids, corals and bryozoans, nevertheless, suffered most severely at the end of the Guadalupian, which was regarded as the first phase of the event. As a consequence of the pre-Lopingian global regression, the large-scale carbonate platforms that used to be the habitats for the endemic benthos fauna disappeared in the peri-Pangean region, and the relic shelves in the Palaeotethys also disappeared. The changes in the ecosystem turned out to be a disaster for the benthos living in the carbonate environments. Among them, the fusulinoideans suffered a generic extinction rate of 76% globally, and 87% in South China. Those capable of living in the sandy or wider environments other than carbonate platform survived and became the dominant figures of the Wuchiapingian. For example, the genera Codonofusiella and Reichelina were so abundant in Wuchiapingian that they formed the Codonofusiella fossil zone in South China. The explosion of new genera in the Late Permian did not start until the Changhsingian Stage when Palaeofusulina minima first appeared as a pioneer in the lower Changhsingian and P. sinensis appeared as an advanced form in the upper Changhsingian. Thus, the genus Palaeofusulina was regarded as an index fossil for the Changhsingian Stage.

However, recent studies on the Capitanian-Wuchiapingian boundary led to the discovery of the Wuchiapingian Palaeofusulina fauna in Penglaitan, Laibin County, Guangxi Province. The fauna is composed mainly of large-sized and long-fusiform forms as well as a few small fusiform figures. The increasing data of the genus made it necessary to re-evaluate its evolution pattern because there exists an evolutionary vacuum between the supposed ancestor Dunbarula and the Changhsingian Palaeofusulina. In this cladistic analysis, ten species were selected, including the six subgroups of Palaeofusulina, the type species of Nanlingella and Parananlingella, and the newly discovered species of Palaeofusulina and Gallowayinella in Penglaitan, with Dunbarula mathieui as an outgroup. The result shows that the two morphologic types of Palaeofusulina in the early Wuchiapingian stand for two evolutionary lineages. One is the long-fusiform form, including Gallowayiella sp. A. and Palaeofusulina sp. A., which diversified in the early Wuchiapingian, but became less diverse during the Changhsingian. The other is represented by the small and fusiform species, which formed the dominant lineage of P. minima-P. sinensis-P. ellipsoidalis and P. priscus in Changhsingian.

Of the fusulinoidean genera that appeared in the Upper Permian, nearly 70% of the genera developed in a short period of time soon after the Pre-Lopingian crisis. A comparison between the evolutionary change of Late Permian fusulinids and the palaeogeographic shift indicates that rebound and final extinction of fusulinids during their survival phase coincided closely with the appearance and elimination of small-scaled isolated carbonate platforms in southwest China.
Global and provincial correlations of the Guadalupian (Middle Permian) Broughton Formation, southern Sydney Basin, eastern Australia

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The first detailed taxonomic study of the brachiopod and molluscan faunas from the Broughton Formation, in the southern Sydney Basin, eastern Australia has recently been conducted. The results of the study assisted in determining a Wordian (Guadalupian or Middle Permian) age for the formation and have been utilized with additional paleomagnetic and small foraminifera data to aid in regional and global correlation. The correlation of Guadalupian faunas and sedimentary successions between basins in eastern Australia, and other basins and provinces around the world, is an ongoing problem. Many of the faunas found in the Sydney Basin at that time are endemic at a species level to the basin or at a generic level to the Austrazean Province. A few taxonomic elements illustrate antitropical distribution and provide some correlation to the Boreal Realm, and some other elements represent faunas of Gondwana affinities in East Asia. These faunas are significant tools for correlation because they provide useful links to the international time scale at other localities. This is particularly important because the subdivision of the time scale is an ongoing problem. Many of the faunas found in the Sydney Basin at that time are endemic at a species level to the basin or at a generic level to the Austrazean Province. A few taxonomic elements illustrate antitropical distribution and provide some correlation to the Boreal Realm, and some other elements represent faunas of Gondwana affinities in East Asia. These faunas are significant tools for correlation because they provide useful links to the international time scale at other localities. This is particularly important because the subdivision of the time scale is ascendant stratigraphic order. Additionally, four coeval radiolarian zones were identified, consisting of a Follicucullus fals–Foremanhelena triangula Zone, an Albaillalla yamakita Zone, an A. levis Zone and a Nealbailalla ornithiformis Zone (also in ascending order). The basal Lopingian GSSP at Penglaitan, South China, has identified six conodont zones, including a granti-crofti Zone, a hongshuensis Zone, a postbitteri Zone, a dukouensis Zone, an asymmetrica Zone and a guangyuensis Zone in ascending stratigraphic order. Although the GSSP is in a section of limestones and cherts, no radiolarian guide species have been recovered there, and identification of the G–L boundary in terms of radiolarian zonation has been debatable (Ishiga 1990; Blome and Reed 1992; Kozur 1993; Wang et al. 1994; De Wever et al. 2002). The establishment of an adequate reference section for the G–L boundary in a section of radiolarian-bearing pelagic cherts would be useful for biostratigraphic correlation in the G–P boundary interval between continent marginal and oceanic basins. High-resolution microbiostratigraphic work from the Guadalupian–Lopingian transitional interval of a Middle–Upper Permian section of pelagic ribbon cherts at Dachongling, near Qinzhou city in Guangxi, South China, has identified six conodont zones, including a granti-crofti Zone, a hongshuensis Zone, a postbitteri Zone, a dukouensis Zone, an asymmetrica Zone and a guangyuensis Zone in ascending stratigraphic order. Additionally, four coeval radiolarian zones were identified, consisting of a Follicucullus fals–Foremanhelena triangula Zone, an Albaillalla yamakita Zone, an A. levis Zone and a Nealbailalla ornithiformis Zone (also in ascending order). The basal Lopingian GSSP at Penglaitan, South China, is correlated with the base of bed Dch 45-21 at Dachongling on the basis of the first occurrence of the conodont C. postbitteri postbitteri Mei and Wardlaw. The first appearances of the radiolarians Albaillalla yamakita Kuwahara and A. cavita Kuwahara at the same level indicate that both FADs can be used for identifying the G–L boundary in radiolarian-bearing pelagic cherty facies. The appearance of both radiolarian species in the sections at Sasayama, Gujo-Hachima in Southwest Japan, and in the Quinn River Formation of north-central Nevada, indicates that both boundary-index radiolarian fossils can be traced worldwide. Many works have revealed that both the conodont and radiolarian biozones exhibited prominent provincialism during this time, so it is therefore important to establish a transnational section containing both well-developed conodont and radiolarian biozones.

The protracted Permo-Triassic crisis and the multi-act mass extinction around the Permian-Triassic boundary

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The Permo-Triassic crisis constituted a great turning period in the geological history. The Paleozoic biota remarkably declined since the end-Guadalupian phase of extinction and experienced a long-term decline during Late Permian, which eventually led to their final decimation at the PTB. This general trend coincided with the greatest Phanerozoic regression. Thus the two phases of mass extinction, the end-Guadalupian and the PTB are related, and the recovery lasted for the entire Early Triassic. \cite{Carb}perturbations also ranged from Late Wuchiapingian to the end of Early Triassic and were multi-phase. Therefore, the Permo-Triassic crisis was a protracted one spanning Late Permian-Early Triassic. The PTB mass extinction took place in three episodes, the prelude, the main act and the epilogue. This paper provides evidence to show that the prelude commenced prior to the event beds (beds 25-26) at Meishan and coincided with the eeb of end-Permian regression. The epilogue happened at late Greisbachian and coincided with the second volcanogenic layer at Meishan. The temporal distribution of the multi-act extinction constrains interpretation of mechanisms of this greatest mass extinction, especially the role of a postulated bolide impact happened about 50,000 after the prelude. The prolonged and multi-phase pattern of the Permo-Triassic crisis favours mechanisms of Earth’s intrinsic evolution. The integration of Pangea may have linked with the greatest Phaenerozoic regression, the PTMS paleomagnetic disturbance, the widespread extensive volcanism and other mechanisms through common geosphere interactions in the earth’s depth. These remote causes put together could be responsible for the profound changes in marine, terrestrial and atmospheric environments that evoked the P/T mass extinction. A bolide impact is possible, but not necessary and adequate to explain these changes.

Micro and macroflora assemblages and their evolutionary patterns near PTB, western Guizhou and eastern Yunnan, South China

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Both marine and non-marine continuous PTB strata are well developed in western Guizhou and eastern Yunnan, South China, making it an ideal place to undertake research considering the terrestrial - ecological system evolution across the Permain - Triassic Boundary (PTB).

These boundary sections can be used as one of the high-resolution methods for the subdivision and correlation of the PTB from marine to land. Three clear palynological assemblages are recognised across the PTBST at some terrestrial PTB sections in western Guizhou and eastern Yunnan, South China. Assemblage 1 (Xuanwei Formation) is dominated by a Late Permian palynological assemblage of ferns and pteridosperms, with a few gymnosperms. Most of them are Palaeozoic types with the appearance of some typical Late Permian pollen such as \textit{Lueckisporites}. Assemblage 2 (PTBST) is marked by an abrupt drop of palynomorphs and the appearance of fungal spores, though it is still dominated by a palynological assemblage of ferns and pteridosperms, with a few gymnosperms. A mixed flora containing both Late Permian and Early Triassic elements occur in this assemblage. Most palynomorphs are still typical of the Late Permian types as found in Assemblage 1; however, some palynomorphs of Early Triassic age (such as \textit{Lundbladispora} and \textit{Taeniaesporites}) appear. In Assemblage 3 (the top Xuanwei Formation and Kayitou Formation), the proportion of gymnosperm pollen increases rapidly and exceeds ferns and pteridosperms for the first time in western Guizhou and eastern Yunnan, although the content of palynomorphs was still very sparse. Some special palynomorphs of Early Triassic age (such as \textit{Lundbladispora}, \textit{Aratriporites} and \textit{Taeniaesporites}) were present in greater abundance in this assemblage.

Plant fossils are abundant mainly in the Xuanwei Formation, with very few species found in the Kayitou Formation. The PTB in nonmarine strata marks a decrease of plants and the compositional change of plants from the dominance of Palaeozoic ferns and pteridosperms to the dominance of Mesozoic gymnosperms. Three plant assemblages have been recognized from this area, which can be regionally correlated in South China. The first assemblage (Late Permian, upper part of the Xuanwei Formation) is named \textit{Gigantopteris nicotinnaefolia-Lobatanannularia multifolium-Schizonteura manchurienesis} flora. The second (in the PTB clayrocks of the uppermost Xuanwei Formation) is named \textit{Gigantoconolec guizhouensis-Ullmannia cf. bronnia-Annularia pingoensis} flora. The third (Early Triassic Indian Stage, Kayitou Formation) is named \textit{Annalepis-Ullmannia} flora.

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

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

Permian palaeogeographic implications of the Lhasa block based on new lithologic and faunal data from the Mujiuco area, Xainza, Tibet

Yichun Zhang \textsuperscript{1}, Liren Cheng \textsuperscript{2} and Shuzhong Shen \textsuperscript{1}
Ceremony for the base-Changhsingian and base-Wuchiapingian GSSPs: June 14, 2006 at Meishan, Changxing County, Zhejiang Province. Below is the speech given by SPS Chair Charles Henderson.

We are celebrating two different kinds of decisions. The first is by geologists and palaeontologists involved in a truly international effort. It took a long time to get to this agreement as is typical in the geological profession, but it is very satisfying to reach the point where we can now officially register the base of the Changhsingian Stage on the International Time Scale. We now have a common language and method for calibrating and correlating an interval of time representing the last 2 million years of the Permian, culminating in the Permian-Triassic Boundary that was also officially honoured at this same location 5 years ago.

We are also celebrating a geological decision for the base of the Wuchiapingian Stage. This Global Stratotype Section and Point is located near Laibin along the Hongshui River of Guangxi Province. All of this work was conducted over the past two decades with a very concentrated effort during the past five years—an effort that was led by the strong leadership of Academician Professor Jin Yugan of the Nanjing Institute of Geology and Palaeontology and I especially wish to thank him. Others that were instrumental in this work included Shen Shuzhong, Wang Yue, Wang Xiangdong, Cao Changqun, Mei Shilong, Chen Lide, Brian Glenister and Bruce Wardlaw.

Finally, we are celebrating a second type of decision. This decision was made by the government officials of Changxing County in this beautiful Zhejiang Province to honour these international geological decisions with this extremely impressive GeoPark. I know that the county has spent a great deal of money to prepare these fantastic grounds and the panels that display the history of life. I sincerely thank them for their efforts in preserving these natural sites and believing in the value of science. I am especially gratified when I see the general public and travelers come to this site as they can learn something of what earth scientists do. As SPS Chair I extend my thanks for this ceremony and hospitality—Xie Xie.
IN MEMORIAL

Professor of Palaeontology, Deakin University

Wisdom begins in wonder.
– Socrates (469–399 BC).
My country is the world, and my religion is to do good.
– Thomas Paine (1737–1809)

Neil Wilfred Archbold, born 14 August 1950 in Ringwood, Victoria, was the younger son of Dorothy Alice Archbold (née Fletcher) and the late Stuart James Archbold. The Archbold family was closely associated with the gold-mining town of Chewton in central Victoria where Archbold’s Gold Treatment Works had been operated by the Archbold family for over 100 years, commencing with Jeremiah Archbold (1846-1917) and ending with Harry Archbold (1929-1988), a cousin of Neil’s father, Stuart. For Neil, sensitive to history, Chewton was an ever-surprising place, breathing with the collective toil of his ancestors. Archbold’s was purchased in 1997 by Heritage Council Victoria, renovated by them, and launched on 17 May 2003 as a major heritage feature, coinciding with an Archbold family reunion.

Neil and wife Linda were there for the unveiling. Much as Archbold’s was renowned for being able to extract gold from rocks that appeared utterly non-auriferous, Neil proved to be capable of extracting valuable scientific information from the most intractable materials.

Neil and brother Jim were brought up in Mitcham, one of Melbourne’s eastern suburbs. As a child Neil was seriously ill, but numerous major operations from when he was eight until he was twelve, undertaken by the renowned surgeon Sir Albert Ernest Coates (1895–1977), saved his life. Sir Albert had put Neil’s chances of survival at 2%. In the three years 1958–1961 there had, in fact, been 14 major bouts of surgery. He had been chubby before the operations, but, after that multitude of operations, he resembled a broom-stick and remained that way for the rest of his life.

Neil survived several subsequent operations and was always quick to give credit to his mother’s unrelenting attention to him—without her, he insisted, he would never have survived. His mother has commented that every month, every day that Neil lived beyond age 12 was a bonus. And Neil, revelling in being alive, was grateful each morning he awoke, having survived another night. For him—perhaps more conscious of his being as a consequence of the traumas he had been through—every moment seemed imbued with heightened significance. It seemed there was never a moment that he felt life owed him anything.

Neil early displayed a passion for all aspects of natural history, but he had a special love of Lepidoptera and arachnids. As a boy he and brother Jim delighted in rearing Emperor Gum Moths (Opodiphthera eucalypti) from their enormous green caterpillars found in eucalypt and peppercorn trees. His passion for natural history and especially Lepidoptera was maintained throughout his life. The Archbold garden in Doncaster in eastern suburban Melbourne featured plants with a long history through time (“living fossils”) including Ginkgo biloba, Nothofagus cunninghamii (myrtle beech), and araucarias. Among Neil’s prized living fossils was a King Billy Pine (Athrotaxis selaginoides) that he had carried as a seedling from Tasmania.

In order to attract butterflies, the Archbolds, as Neil and brother Jim had done as children, grew an array of stinging nettles, milkweed and other plants that dedicated gardeners would have swiftly uprooted from their gardens. They monitored the swift spread of the introduced European Wasp (Vespula germanica) and the corresponding rapid decline to near extinction by the late 1970s of the Emperor Gum Moth in the vicinity of Melbourne.

Because leaf-chewing was viewed as a symptom of a healthy garden, the Archbolds avoided use of garden chemicals. There were no great swathes of butterfly-attracting plants in the Archbold garden: a small clump here, one or two there, mostly like weeds. On one occasion when I visited their home, easily overlooked inhabitants of the Archbold garden included Lesser Wanderers around the milkweed (Asclepias fruticosa), Australian Admirals lurking among the stinging nettles (Urtica spp.), Painted Ladies checking out everlasting (Helichrysum spp.), a Swallowtail or two lured by lemon trees, Imperial Blues and Fiery Jewels attracted by Acacia spp. and, inevitably, Cabbage White butterflies looking for cabbages… They exemplified the elemental and meaningful simplicity of the Archbolds’ life-style. Neil, as Liz Weldon tells me, even had a special penchant for cream-filled butterfly cakes…

Neil had a passion for collecting stamps and coins. As an ailing boy he developed an unusual pastime of making vast numbers of 30-centimetre-diameter cardboard replicas of coins in his collection. These he would spin into treetops until they lodged among the branches, and would subsequently collect them when dislodged by wind, and again spin them aloft.

Neil relished the music of Stravinsky and the grand classics of Wagner and Mahler, but also had a soft spot for Prokofiev, Shostakovich and Khatchaturian, all of whom had lived under the menacing shadow of Stalin’s murderous megalomania. His love of music broadened as he grew older, but never extended to jazz, country and western, heavy metal, rock, reggae, rap or techno.

Neil had little time for contemporary art, but had a deep love of paintings and etchings by the great naturalist artists who had painstakingly and with extreme accuracy depicted flowers, birds,
in most of those faunas. The pleasure he derived from working
Australia, especially the brachiopods, the most prominent element
a passion for Carboniferous and Permian brachiopods, especially
to undertake a PhD on Permian brachiopods. He was fortunate to
of Melbourne Postgraduate Scholarship (1976–1979) enabling him
and then a PhD, completed in 1983. In 1973 he was awarded the C.
of BA, funded by a Commonwealth University Scholarship, MSc
contact with his old school, making regular visits, sometimes as
several years of studying Chinese; this was of enormous help
immediate appeal for Neil and wife Linda. They were early
that such an initiative, focused on restoration ecology, had
endangered Australian plants and animals. It is not surprising
of land, particularly with remnant native vegetation, fencing them
understandable that among Neil’s favourite spots where he
windswept Warrnambool–Port Campbell coast. Other inspirational sites
Australia has almost half the endangered mammal species of
World War II, Neil’s father, Stuart, had been an ace
fighter pilot. He was one of the first pilots to use rockets, and at
one stage ran a dive-bombing school at Mildura. Subsequently,
as a commercial pilot, he flew Douglas DC3s, DC4s and DC6s for
Australian National Airways and then was one of Air Ceylon’s
(now Sri Lankan Airlines) initial pilots. He then joined Qantas,
lying Super Constellations (which he loved), Electras and Boeing
707s until his retirement in 1975. Stuart was killed at Bacchus Marsh
on 12 May 1980 when a glider in which he was the passenger and
the towing plane, still linked, suddenly plummeted to earth from
an altitude of about 300 ft (about 160 m). Neil and brother Jim
coped well with the despair resulting from loss of their legendary
father—so tragically, in such a public way.

Australia has almost half the endangered mammal species of
the globe. Earth Sanctuaries Ltd, founded by Dr John Wamsley in
South Australia in 1985, set about purchasing substantial blocks of
land, particularly with remnant native vegetation, fencing them
to keep out feral animals and plants, and introducing rare and
endangered Australian plants and animals. It is not surprising
that such an initiative, focused on restoration ecology, had
immediate appeal for Neil and wife Linda. They were early
supporters, enthusiastically buying shares in the organization to
help purchase additional blocks of land in various habitats—
scattered across Australia—to be used as refuges for native
Australian flora and fauna. For Neil, causing the death of birds or
other animals, large or small, especially for sport, was beyond
comprehension.

Neil’s secondary school education at Camberwell Grammar
School in Canterbury, Melbourne, completed in 1969, included
several years of studying Chinese; this was of enormous help
when he embarked subsequently on studies of palaeobiogeography of the Asia–Australia region. He maintained
contact with his old school, making regular visits, sometimes as
an invited speaker. At Melbourne University he undertook degrees
of BA, funded by a Commonwealth University Scholarship, MSc
and then a PhD, completed in 1983. In 1973 he was awarded the C.
M. Tattam Scholarship in Geology and was awarded a University
of Melbourne Postgraduate Scholarship (1976–1979) enabling him
to undertake a PhD on Permian brachiopods. He was fortunate to
have had as postgraduate supervisor the late George Thomas, a
genial, fatherly soul of exceptionally broad interests who also had
a passion for Carboniferous and Permian brachiopods, especially
of Western Australia. Not surprisingly, because of this, Neil’s
research focused on the spectacular Permian faunas of Western
Australia, especially the brachiopods, the most prominent element
in most of those faunas. The pleasure he derived from working
with these faunas and the associated stratigraphies continued
throughout his life, and it was from them that his interests spread
so fruitfully into questions of Late Palaeozoic biogeography and
intercontinental stratigraphic alignments.

While doing his postgraduate degrees, Neil was employed
as a part-time tutor (1973–1980) and then full-time tutor (1980–
1982) in the Geology Department of the University of Melbourne.
He also tutored for the Council of Adult Education in Melbourne
for 17 years (1973–1989) until full-time employment as Lecturer in
Earth Sciences at the Rusden campus of Victoria College
(incorporated into Deakin University, 1992) finally necessitated
relinquishing some of the stimulus he derived from teaching mature-
age students. He nevertheless continued to give talks, faced with
gentle wit, to amateur groups such as the Field Naturalists Club of
Victoria, of which he was a member. For many years (1983–1988)
he continued his association with Melbourne University as a
Research Associate in its School of Earth Sciences but his new
roles at Deakin made continued association with and frequent
travel to his alma mater increasingly difficult. He had taught Higher
School Certificate evening classes at University High School for
three years (1977–1980), had temporary employment as a Scientific
Services Officer in the Division of Geomechanics with the
Commonwealth Scientific and Industrial Research Organization
in Melbourne (1983–1986), and had stints as a contract lecturer in
the Department of Earth Sciences at Monash University (1984–
1988), in the Department of Geology at Melbourne University
(1986) and with the Department of Geography and Earth Sciences
Neil was a charismatic tutor and lecturer, loved by all for his
kindness and the gentle joie de vivre that was characteristic of
his lectures; they were never obscure or unintelligible.
Nevertheless, a truly permanent academic position somehow
seemed to elude him.

The patchwork of short-term teaching commitments came to
an end when he was appointed Senior Tutor in Earth Sciences at
Victoria College (1989). It was the start of a new and even more
dynamic era in which his diverse talents were given free range; a
meteoric rise to academic prominence ensued. Within a year he
was promoted to Lecturer (1990–1992), then Senior Lecturer
(1993–1995) and finally Professor (personal chair) in Earth
Sciences (1995–). During that period, Victoria College
metamorphosed into a campus of the rapidly expanding Deakin
University (1992). Neil became head of the Earth Sciences sector

Neil could never refuse appointment to committees where he
felt he might be able to facilitate laudable results. At Melbourne
University he was a member of the University Council (1978–
1979) and a member of its Committees on Research and Graduate
Studies (1978–79), the Library (1978), and the Faculties of Arts
and Science (both in 1979). At Victoria College he was a member
of Faculty of Applied Science Higher Degrees Committee (1991–
1992) and the Faculty of Applied Science Research Committee
(1991–1992). At Deakin University, Neil served on a dozen or
more committees. This notwithstanding, he continued to pour
out research papers at an incredible rate. He was a member of
Deakin’s Research Committee (1993–1997), its Research
Committee’s Higher Degree Regulations Working Group (1993),
its Faculty of Science and Technology Promotions Committee
(1993–1994), its School of Aquatic Science and Natural Resources
Neil was a reservoir of vast knowledge, a master of the sage perspective. He enjoyed challenging students to think critically. To first-year students he showed films such as Armageddon and Deep Impact, requiring them to succinctly critique Hollywood’s versions of science. His excursions were always congenial, punctuated by counter lunches at interesting hotels, interludes of sampling products of favourite bakeries, and intense, freewheeling, intellectually bracing—one might say symbiotic—discussions, occasionally punctuated by dry humour. He had the capacity to fill even emptiness with penetrating explanations. There was never a hint of supercilious professorial detachment. The students tended to flock around him like seagulls around a tuna boat. He found such interludes to be a tonic. As he said to me on numerous occasions: “I enjoy nothing more than interacting with my students!”

Neil received several awards for teaching excellence. He supervised numerous Honours and postgraduate students at Deakin as well as at Melbourne University. There were no half measures with his supervision of his research students. Zhong Qiang Chen, one of his former PhD students, has stressed the enormous amount of time Neil would devote to polishing their English, and then, face to face, go through their text, sentence by sentence, to make sure the clearest possible interpretations were being presented. For them he was not only a mentor, but a role model of scientific and personal integrity—amusing, discerning, always optimistic, always supportive (he was never one to throw rotten tomatoes from the sideline). Neil was a reservoir of vast knowledge, a master of the sage perspective.

Neil was disappointed that the keystone of traditional teaching, the benign guru–disciple relationship, of which he was a natural exponent, seemed to be waning rapidly in proportion to the increase—pervading all levels of academia—of a managerial class characterized by few if any scholarly credentials, and not having a clue about nation building. For him, ambitious martinets-cum-exponent, seemed to be waning rapidly in proportion to the benign guru–disciple relationship, of which he was a natural exponent.

Neil believed that time spent in anger or bitterness was intolerable but, nevertheless, was profoundly disappointed when his research associateship of the School of Earth Sciences at Melbourne University was terminated at the end of 1998 by the then head of geology, doubtless responding to a dictate from senior...
management to reduce the large number of research associates having a formal connection with the school. This was particularly disappointing for one who had given so much to his alma mater. Neil was also profoundly disappointed when a proposal that he spearheaded from Australian brachiopod workers for running the 5th International Brachiopod Congress in Australia was rejected at the 4th IBC in London (in 2000), mainly by European colleagues reluctant to travel to the Antipodes. Though no alternative venue was tabled, Neil did not take it personally. A similar bid, again spearheaded by Neil, to run the 6th IBC in Australia met with approval from delegates at the 5th IBC meeting in Copenhagen.

From 1985 until his death, Neil had received 15 research grants from the Australian Research Council, and for many years was a diligent assessor of ARC research grant submissions. Initially his ARC grants were concerned with plate tectonic relationships within Australia and between it and its neighbours during Permian times, and with time control on the Permian of the Bowen and Sydney Basins, but soon spread to probing patterns of provinciality and their implications worldwide with principal foci being on India, South-east Asia, the Tibet–Yunnan region of China and, eventually, the Late Palaeozoic of South America. Some of the grants were solo, some, especially on palaeobiogeography, being in association with Guang R. Shi, also of Deakin University. Neil’s research association with Guang proved especially fruitful.

At the time of his death Neil had produced 205 scientific papers (31 of these as abstracts; 94 as sole author), but with others still coming through “the mill”. Evidence of the ease with which he established fruitful communication with colleagues globally is indicated by the 40 or more significant co-authors from at least 20 institutions, scattered globally, involved in 87 of his publications. From his initial core area of research on the taxonomy of Permian brachiopods from Western Australia, he spread into considerations of other taxonomic groups (especially bivalves and trilobites), palaeogeography and palaeobiogeography, palaeoclimatology and palaeoecology, oceanic circulation patterns, and global stratigraphic alignments for the Permian and, later, Carboniferous systems. His numerous publications in these areas, especially on palaeobiogeography, contained many commendable exercises in quantitative palaeobiogeography with Guang R. Shi. These were based on a monumental, six-part critical listing of all Permian brachiopod taxa from the Western Pacific Region, compiled mostly by Guang and himself—though with collaboration from Shuzhong Shen for the last two parts—and published by the School of Applied Science and Natural Resources Management, Deakin University (1993–1997). These compilations were major items within a constant stream of taxonomic papers on Late Palaeozoic brachiopods from around the world: the Northern Territory, Timor, Irian Jaya, Thailand, China (Xinjiang, South China, Tibet and West Yunnan), Argentina, India, Russia and Serbia that included a series of papers (numbered 1 to 14, 1980–1997) on the taxonomy of Permian brachiopods from Western Australia, published in the Proceedings of the Royal Society of Victoria. Neil’s taxonomic output included documentation of more than 150 new species, nearly 40 new genera and subgenera, five new subfamilies and one new family of brachiopods as well a new species of trilobite and one of bivalves. The brachiopod world has included several workaholics whose published output was gargantuan: James Hall, G. Arthur Cooper, Vladimir Havlièek and a great contemporary, Art Boucot. Neil was very much one of the same ilk, producing six, seven or more significant publications a year.

During the 1980s, when concerned with Permian faunas from various localities in Timor, Irian Jaya and Papua New Guinea, Neil came across the work of Richard Archbold (1907–1976), an heir to early fortunes of the Standard Oil Company. Richard, an American who had led and provided most of the funding for four major biological-cum-anthropological expeditions (1929–1939)—the first to Madagascar and the subsequent three to inland New Guinea—became one of Neil’s heroes. The question of whether or not Richard was a far distant relative of the Australian Archbolds was never resolved.

Neil derived much pleasure from documenting the palaeontology of the marine incursion into the Permian glacially-derived sequences of the Bacchus Marsh district in Victoria; this incursion had escaped more than 150 years of intermittent investigations by many workers. Neil was knowledgeable on the Cenozoic stratigraphy of southeastern Australia, publishing a modicum of work on Cenozoic brachiopods, echinoids and marsupials. One of his major achievements was a pivotal role in publication (1995) during the height of the Yugoslav wars of a comprehensive volume in Serbian and English on the Carboniferous of northwest Serbia by six authors, with himself and Smiljana Stojanovic-Kuzenko contributing the large and copiously illustrated chapter on brachiopods.

Neil, the idealist, was amazed by the long and hideous history of colonialism, its savagery, megalomania, and terrible sagas of rule by coercion. He was appalled by the forces of chaos and brutality that continue to overtake the lives of individuals and nations, as had occurred in India during partition and in recent years in Rwanda, Afghanistan, Chechnya and the former Yugoslavia. He was dumbfounded by the ideological extremism, rampant greed and perilous shortsightedness of the contemporary western world. He was astonished by political extremism born out of foreign occupation, and the more recent saga of the absurd: warrior intellectuals hunting desperately beneath Iraqi prayer rugs for post hoc justification of a frivolous war. Neil took heart, however, that in Moorish Spain, Norman Sicily and in Sarajevo (before the Bosnian War, 1992–1995) it had been possible for profoundly differing cultures and religions to live together for a long time in comparative harmony.

Neil believed there was no need for religion and science to be in conflict, to be invariable antagonists. He was convinced that the loud, irrational, fundamentalist voices, with their potential for engendering violence—and presently demanding a choice be made—are not representative of the mainstream Judeo–Christian–Muslim religious communities, nor for that matter of any other sizeable religious group. Neil was tolerant of the entire spectrum of religious persuasions. He had come from a liberal Presbyterian background, but this connection had waned with time. He was a scientist to the core, the immensity of time and the vast panorama of organic evolution, from primitive prokaryote to modern man, ecosystems, and ultimately to the biosphere itself, never ceasing to fascinate him; the swift revival of doctrinaire creationism and its latest expression, intelligent-design theory—as largely the same old stuff: William Paley dressed up with a more sophisticated set of feathers.

Neil had a passion for history, global as well as Australian, and could discourse profoundly on seemingly unrelated topics.
ranging from the history of the Austro-Hungarian Empire, the
Soviet Union, and the Australian gold-rush era—and the
architectural artefacts of the last of these. With such interests it
was inevitable that he would become a Life Member of the National
Trust of Australia (Victoria). He had a passion for old books and
antique maps, especially ancient scientific monographs, not just
tomes connected with his research, but icons of publishing
elegance. Neil had an aversion to the published word being turned
back into pulp—apart from newspapers, dumbed-down journalism,
and breathless discoveries of the obvious. His immense
professional library, including a vast number of reprints and
photocopies, has been gifted to the Royal Society of Victoria. The
Society has agreed to it being housed under lock-and-key as a
special collection in the Deakin University library.

Throughout his career Neil had probed the early history of
the earth sciences in Australia, publishing papers on the debate
over the age of the black coals, the history of vertebrate
palaeontology in Australia, the 1874 and 2004 transits of Venus,
and on Sir Frederick M’Coy, J. E. Tennison Woods, Joseph Jukes
and the remarkable brachiopod worker, Georgiy Nikolaevich
Frederiks, a gentle apolitical palaeontologist-stratigrapher-
tectonicist executed during the Great Terror in Stalinist Russia
early in 1939. Neil’s research in the history of the earth sciences
became enriched during his later years from association with Doug
McCann. Neil had planned, with Doug, to generate an account of
the emergence of the theory of continental drift and its
transmutation into plate tectonic theory. As Doug has reminded
me, Neil particularly revelled in his investigations into the “coal
debate”, discovering that the history, as presented until now,
had, curiously, been completely biased—skewed well away from
what was the true story. Neil sought better understanding of why
various events in the history of the earth sciences in Australia
had been pitched in particular ways, and how their depiction had been
coloured by underlying human motivations.

Neil was thoroughly steeped in the history of the geological
surveys of Australia during the 1800s, especially those of Western
Australia and Victoria and, early in his career, had published on
the history of the former. The geologists of Alfred Selwyn’s
Geological Survey of Victorian (1852–1868) and subsequent
Victorian geological survey groups during the later 1800s were
Neil’s heroes. Of particular interest was James Stirling (1852–
1909), a notably benign person, a self-taught geologist, botanist,
and elegant draftsman who, _inter alia_, published significant
accounts of the alpine flora of Victoria. He had been, briefly, a
monumental mason, an architectural draftsman and, subsequently,
the Lands Department surveyor at Omeo. James was loved by the
mining communities of northeastern Victoria, so much so that the
gold miners of the Haunted Stream goldfield (which he had done
much to develop) insisted their principal village be named Stirling
in his honour. James had remarkably modern views on education
and equality of the sexes, had enthusiastically accepted the then
new theory of organic evolution, and relished giving “adult
education” lectures on science and technology. His was a family
fascinated by the natural world—birds, insects, flowers and
geology—as well as anthropology. Neil believed that Stirling, who
became Government Geologist (1897-1900) under Alfred W. Howitt,
Secretary for Mines, had been undervalued, especially for his
vigorouos and pivotal role in the quest for black coals in the south
Gippsland Early Cretaceous rock sequences (at that time believed
to be Jurassic), and for pioneer investigations of the Latrobe
Valley brown coals.

Howitt (1830–1908), earnest, elitist, was an efficient
administrator, explorer and remarkable pioneer anthropologist and,
like Stirling, was also an amateur geologist and botanist of note.
This may have been the root of what seems to have been Howitt’s
distaste for Stirling, but he may have been irked by Stirling’s
remarkably liberal views for the late 1800s. Howitt, at least in old
age, was not good in personal relationships, was given to sourly
dissimive comment (perhaps heightened from long and bitter
denigration by armchair anthropologist Andrew Lang), and was
reluctant to accept new data calling for modification of his earlier
geological opinions. He seems to have been detested by his
geologist underlings, among them William Baragwanath Jr. (pers.
comm., 1964) and Ernest Lidgley. Neil, more a kindred spirit of the
genial James than the crusty Alfred, had hoped that he and Doug
McCann might produce something substantial—liberally
illustrated by examples of Stirling’s elegant drafting—to help
“set the record straight”. Doug has informed me that Neil would
have loved also to have helped rehabilitate other neglected,
maligned and misunderstood Victorian geologists and
palaeontologists, among them J. W. Gregory and Sir Frederick
McCoy. He wanted to devote more time to bringing them back to
life, to reclaiming the truth.

Neil inherited and greatly enjoyed driving a 1962 Humber
Vogue car that had been his grandmother’s. Reluctantly he had to
part with it when upkeep and difficulties in obtaining spare
parts became too great. He was a member of the Olive Club, a
light-hearted intellectual group of scientists, judges, architects,
librarians and engineers which has three-monthly meetings over
dinner to discuss matters of general interest, some of moment,
some inconsequential. He was also a member of the Skeptics, the
Field Naturalists Club of Victoria, a literary coterie known as the
Boobooks Club, and the venerable Wallaby Club (founded 1894),
an organization conducting day walks and, like the Olive Club,
focused on serious, but lively discussion.

Neil’s marriage to Linda Botham in 1984 was pivotal for his
career. She made their home in Doncaster not only a base, but a
haven. Her unflagging support enabled him to focus to great
effect on his increasingly vast spectrum of interests. Despite frail
health, he travelled overseas to participate in conferences in
Argentina, Australia, Canada, Denmark, England, New Zealand,
the Netherlands, Oman, South Africa and the former USSR
(Tartaria) where he was delighted to find our joint paper (with
Viktor Z. Machlin) on the ill-fated G. N. Frederiks, executed with
other noteworthy earth scientists by order of Stalin, displayed
prominently in an exhibition mounted at Frederiks’s alma mater,
the University of Kazan”—in czarist times one of the elite Imperial
Universities.

The University of Kazan’ mounted a memorable meeting of
the Subcommission on Permian Stratigraphy in 1998. The entire
meeting took place by boat. The participants, committed to
geniality, presented papers and gourmandized their way—sturgeon,
caviar and marvellous fruit that was not only delicious, but
eminently photogenic—down the Volga from Kazan’ to historic
Permian localities including ones at the centre of Frederiks’s
earlier works. Among them was Simbirsk (later Ul’yanovsk; now
Simbirsk again), former home of the Ul’yansovs, a polite middle-
class family with a high sense of social responsibility whose six
children included Aleksandr, a brilliant zoology student, and Vladimir (later to become V. I. Lenin). Aleksandr, among 15 confederates, nearly all students, arrested and accused of plotting to assassinate Czar Aleksandr III, refused to recant his reformist beliefs and was callously hung at age 21 with four other conspirators by a government committed to meeting terrorism and savagery with even greater barbarism. His execution on 5 May 1887 transformed the surviving children and especially Vladimir into committed revolutionaries. Neil was disappointed that presentation of the Ul’yanov home in 1998, though interesting, had yet to rise above Soviet-era politics and mythology.

In late 1997 (30 November–3 December) Neil was joint-organiser of the Strzelecki International Symposium on “The Permian of Eastern Tethys” in Melbourne, and was one of the three editors of the large volume derived from that meeting and published a year later by his beloved Royal Society of Victoria.

Neil still had a large palette of interesting and ambitious research to be done, but he was looking forward to early retirement at the end of 2005, to a life with fewer deadlines, fewer life-and-death appointments, less forward-planning, and with more peace of mind, but his frailty was increasing. Colleagues on the Gotland excursion of the Fifth International Brachiopod Congress (4–8 July 2005) had noted how Neil, cheerful as ever, but perhaps more wraithlike in appearance, was unable to walk far without stopping to regain breath.

In later years Neil travelled to Argentina three times and established very warm research and personal linkages with colleagues in Argentina, four of whom visited Australia and became firm family friends: Tristan Simanauskas, Gabriela Cisterna, Arturo Taboada and Alejandra Pagani. Neil was much attracted by Argentina, a land of religion, culture and strong family ties with a tumultuous history, chameleon-like politics, and a determination to make a new future after the military dictatorship of the 1970s. Neil fell ill following participation in Gondwana 12, the Twelfth International Gondwana Congress (6–11 November 2005), in Mendoza, Argentina, at which he made a conference presentation. Argentinean colleagues rushed to Mendoza to help in every possible way but, after two weeks in hospital, on 28 November at the Clinica de Cuyo in Mendoza, with wife Linda at his bedside, he passed away. A large community of friends—about 300 of them—participated in a memorial service at Wantirna, an outer suburb of Melbourne, on 14 December 2005.

The connecting thread through Neil’s odyssey had been pragmatism, a journey that nevertheless found beauty in virtually every corner. He nevertheless was saddened by the consumer culture gone wild—rich in goods, but poor in everything that gives breadth and depth to a community—and our increasingly free-floating and more and more dangerous world. Neil was inspirational because he was a people-person, always concerned with the people-side of things. He would discourse equally kindly with anyone: shy or confrontational, couth or uncouth, brilliant or belligerently dumb, as well as the genial slacker, the ambitious worker, a long-time friend of mine, the late J. G. (‘Jess’) Johnson of the State University of Oregon, Corvallis. Jess produced voluminously and perceptively throughout most of a professional career attached to artificial diaphragms. Such people are role models for all of us, even the physically able-bodied.

Neil’s all-too-brief career is thus a lesson on the capacity of an individual to quietly bring about change. Those who knew Neil were always amazed by his buoyancy, despite his manifest frailty. His ingrained empathy for the human condition and his profound sense of social responsibility seemed to become more resilient as time went on. There were surely moments of despair but, if so, he kept these to himself. Neil was unique—inimitable, irreplaceable.

It was appropriate that Neil’s ashes should be scattered in Chewton, locus of so much Archbold history. Among the numerous historic features in and near Chewton is the immense Garfield waterwheel about a kilometre north of the town, reputedly the largest waterwheel in the Southern Hemisphere. It was there that Neil’s ashes were scattered by his brother Jim.

Compilation of this obituary has been facilitated by information supplied by Neil’s wife Linda, his brother and sister-in-law Jim and Sue, Monica Campi, Doug McCann and Guang Shi, supplemented by illuminating reminiscences from Zhong Qiang Chen, Bernie Joyce, Fons VandenBerg and Liz Weldon. All helped balance my perspective.

John A. Talent
Macquarie University

Obituaries for N. D. Newell, J. M. Dickins, and N. W. Archbold

Bruce Waterhouse

25 Avon Street, Oamaru, New Zealand

The year 2005 saw the death of three international paleontologists who amongst other fields of research, concerned themselves with Permian stratigraphy, fossils and correlations on a world scale.

Norman Newell spent most of his career at the American Museum of Natural History, New York, where he taught paleontology to generations, of whom many became distinguished paleontologists and geologists. Nils Eldredge, who succeeded Norman at the museum, recorded in a New York Times obituary how Norman, contrary to at least some expectations, hammered the theme of extinctions rather than evolution: eventually Nils
bivalves, being convinced (like me) that they contained the
Symposium organization for many years. He also delighted in
spent considerable time using bivalves to characterize Permian
on west Australian molluscs, a still outstanding work, and later
self-deprecating smile. Mac came out with his finest study in 1963
perhaps iconoclastic or even idiosyncratic approach, and delightful
remains memorable about Mac was his quiet manner, shrewd if
we seemed to find more immediate concerns to talk about. What
that Mac was politically unsound. Whether so, I have no idea, as
the New Zealand Geological Survey, warning me in horrified tones
village we stormed, dust and stones and rifle shots. The Chhidruans
mounted camels and brandished rifles, and through the bad guy
successful day, we recruited the Chhidruans to act as guard: they
our way to Chhidru in a shower of stones. On our way back after a
Society newsletter, published about 1965. We had to pass through
the adventures we shared are relayed in an early N. Z. Geological
We three then teamed up to go to the Salt Range in Pakistan, and
instead of turning to an easier and less demanding life style.
There have been few who can match such a record, and we can
salute the mental alertness, the drive, the discipline in going on,
What is most extraordinary about Norman’s contributions is the
sheer number of years devoted to research. After early days
interpreting aerial photographs, he launched into two still highly
regarded and seminal studies on “Pectinacea” and “Mytilacea”
mostly from US Carboniferous, the first published in 1937. In 1995
he published with Donald Boyd a study on chiefly Permian Pectinida, daring in its innovations in classification, when in his
mid-eighties. The last paper sent to me is dated 2002. So there
have been more than 65 years of new and intriguing discoveries.
There have been few who can match such a record, and we can
salute the mental alertness, the drive, the discipline in going on,
Norman and I first met in 1964, in Calcutta, India, where we
were examining the great collections of Permian fossils kept at the
Geological Survey of India. There we joined by Mac Dickins from
the Bureau of Mineral Resources, Geology and Geophysics, Canberra. Mac and I had known each other since the mid-fifties.
We three then teamed up to go to the Salt Range in Pakistan, and
the adventures we shared are relayed in an early N. Z. Geological
Society newsletter, published about 1965. We had to pass through
a village hostile to foreigners – or geologists, and we escaped on
our way to Chhidru in a shower of stones. On our way back after a
successful day, we recruited the Chhidruans to act as guard: they
mounted camels and brandished rifles, and through the bad guy
village we stormed, dust and stones and rifle shots. The Chhidruans
were notorious in the district, hadn’t paid taxes for years, and no
doubt they recognized fellow ruffians in us geologists. Mac was
another bivalve specialist. I still recall Charles Fleming, my boss in the New Zealand Geological Survey, warning me in horrified tones that Mac was politically unsound. Whether so, I have no idea, as we seemed to find more immediate concerns to talk about. What remains memorable about Mac was his quiet manner, shrewd if perhaps iconoclastic or even idiosyncratic approach, and delightful self-deprecating smile. Mac came out with his finest study in 1963 on west Australian molluscs, a still outstanding work, and later spent considerable time using bivalves to characterize Permian stratigraphy in east Australia. He assumed an important role in Gondwana geology, serving as President of the Gondwana Symposium organization for many years. He also delighted in poring over nineteenth century collections of British Carboniferous bivalves, being convinced (like me) that they contained the
forebears of Australian Permian bivalves. He further paid scrupulous attention to Soviet studies (ah ha??) and combined in an excellent study in 1992 with Noel Morris and Kira Astafieva-Urbaitis on the evolution of anomalodesmatan bivalves world-wide.

Neil Archbold was much younger than the other two; he died during a Gondwana field-trip in Argentina, and really was not well during the conference meetings. Neil had had to struggle against ill-health all his working life, even in the early seventies when I first met him as a student of George Thomas at Melbourne University. Despite these difficulties, Neil was courteous, good-humoured, and insightful, with a wide range of interests, as displayed by his historical researches and the important role he played in the Royal Society of Victoria. In paleontology, Neil shaped an outstanding career, on mostly Permian brachiopods. First he delivered an impressive array of papers on brachiopods (especially Productida and Spiriferida) from Western Australia, and later he extended his research first into Timor and Indonesia, then into South America and into southeast Asia, mostly Thailand and Tibet. Becoming a Professor in a college of Deakin University, Melbourne, he set up a dynamic group of excellent staff, and brought in advanced and brilliant students especially from China and South America, as well as Australia. He named more than forty new genera, the agreed mark of a significant contribution in paleontology according to R. E. Grant (1980, The human face of the brachiopod, Presidential Address for the Paleontological Society, Journal of Paleontology 54: 499-507), as well as new species and family group categories. There was more to Neil in his record of service. It was he who helped fund from his resources an important publication by David Briggs on east Australian brachiopods as a memoir for the Association of Australasian Palaeontologists. He also showed considerable courage and integrity, for he was not always well treated by his peers. Shamefully, papers were rejected or severely refereed because he refused to join the witch-hunt that ludicrously sought to remove the controversial V. J. Gupta from the scientific record. With his growing knowledge of Himalayan brachiopods, Neil was aware that Gupta, whatever his faults (and they were surely many), had been involved in publishing valid taxa from the Himalayas, and such taxa, no matter who authored them, should not be ignored.

As a mark of the esteem in which he was held, he was asked at the last brachiopod conference (in 2005) to host and organize the next conference at Deakin. All at the meetings were thrilled that Neil should be so chosen. Alas, too late.

Publication list by Neil W. Archbold


1982e. Quinquenella magnifica sp. nov. (Chonetidina, Brachiopoda) from the Permian of Irian Jaya, Indonesia: a study of the ontogeny of a chonetid brachiopod. Geological Research and Development Centre, Paleontology Series, 2, p. 27-34.


1984c. Western Australian occurrences of the Permian brachiopod genus Retimarginifera. Alcheringa, 8(2), p. 113-122.


1988g. Studies on Western Australian Permian brachiopods. 8. The Late Permian brachiopod fauna of the Kirkby Range Member, Canning Basin. Proceedings of the Royal Society of Victoria, 100, p. 21-32.


1990b. Studies on Western Australian Permian brachiopods. 9. The Sterlitamakian brachiopod fauna of the Cuncudgerie


—. 1994a. Gondwana and the Complex of Asia during the Permian: The Importance of Palaeobiogeographical Studies. 9th International Gondwana Symposium (Hyderabad, India), Key Paper, p. 29 p.


—. 1994d. Permian palaeontology of Western Australia. Permophiles, 24, p. 11-12.


—. 2000d. Palaeobiogeography of the Australasian Permian. Memoir of the Association of Australasian Palaeontologists


—. 2003c. The Permian of Gondwana and correlation with the global stratigraphic scale. Permophiles, 42, p. 4-6.


—. 1985c. Western Australian Permian Brachiopoda: Their biogeography and biostratigraphy. New Zealand Geological Survey Record, 9, p. 8-10.
—. 2001a. A Lopingian (Late Permian) brachiopod fauna from the Qubuerga Formation at Shengmi in the Mount Qomolangma region of southern Xizang (Tibet), China. Journal of Palaeontology, 75(2), p. 274-283.
—. 2000b. Permian brachiopods from the Selong Xishan section,
Permophiles Issue #47 June 2006

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**New taxa and combinations of N. W. Archbold**
*Compiled by Monica Campi, 2006*

<table>
<thead>
<tr>
<th>Bivalve species</th>
<th>Reference</th>
<th>Location</th>
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<tbody>
<tr>
<td><em>Pseudomonotis (Trematoniccha) carnavonensis</em></td>
<td>Archbold &amp; Skwarko, 1988</td>
<td>Western Australia</td>
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<tr>
<th>Trilobite taxa</th>
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<tr>
<td><em>Narinia</em></td>
<td>Archbold, 1997c [ex <em>Iriania</em> Archbold, 1982c]</td>
<td>Irian Jaya</td>
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**Taxa named in honour of Neil Archbold**

*Archboldina* Waterhouse, 2001

Type species *Pustula micrancantha* Hosking, 1933

Permian (Sakmarian) productellid brachiopod from Western Australia


**Brachiopoda**

<table>
<thead>
<tr>
<th>Family</th>
<th>Reference</th>
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<tbody>
<tr>
<td>Subfamilies (5)</td>
<td>Reference</td>
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<td>----------------</td>
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<tr>
<td>Caenanopliinae</td>
<td>Archbold, 1980b</td>
<td>Caenanoplia Carter, 1968</td>
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<td>Notospirifer, Harrington, 1955</td>
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<td>Archbold, 1981d</td>
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<td>Svalbardinae</td>
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<td>Echinalosia (Notolosia)</td>
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<td>N. dickinsi Archbold, 1986c</td>
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<td>Heteralosia (Etherilosia)</td>
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<td>Strophalosia etheridgei Perdergast, 1943</td>
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<td>Shen &amp; Archbold, 2002</td>
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<td>Neochonetes (Sommnerella)</td>
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<td>Neospirifer plicatus Archbold &amp; Thomas, 1986a</td>
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<td>Argentiella</td>
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<td>Argentiella stappenbecki Archbold, Cisterna &amp; Sterren, 2006</td>
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<td>Taeniothaeus minutienis Coleman, 1957</td>
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<td>Archbold &amp; Thomas, 1985a</td>
<td>Spirifer rostallinus Hosking, 1931</td>
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<td>Archbold &amp; Thomas, 1985a</td>
<td>Cratispirifer nuraensis Archbold &amp; Thomas, 1985a</td>
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<td>Strophalosia inexpectans Cooper &amp; Grant, 1975</td>
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</tr>
<tr>
<td><em>Cariya coolkiliensis</em> (Coleman)</td>
<td>Archbold, 2001h</td>
<td><em>Taeniothaerus coolkiliensis</em> Coleman, 1957</td>
</tr>
<tr>
<td><em>Cariya minilienisi</em> (Coleman)</td>
<td>Archbold, 2001h</td>
<td><em>Taeniothaerus minilienisi</em> Coleman, 1957</td>
</tr>
<tr>
<td><em>Cariya roberti</em> (Archbold)</td>
<td>Archbold, 2001h</td>
<td><em>Taeniothaerus roberti</em> Archbold, 1996d</td>
</tr>
<tr>
<td><em>Cariya tetcherti</em> (Coleman)</td>
<td>Archbold, 2001h</td>
<td><em>Taeniothaerus tetcherti</em> Coleman, 1957</td>
</tr>
<tr>
<td><em>Cimmeriella foordi</em> (Etheridge)</td>
<td>Archbold &amp; Hogeboom, 2000</td>
<td><em>Productus teniuistratus de Verneuil? var. foordi</em> Etheridge, 1903</td>
</tr>
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<td>(Etheridge)</td>
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<tr>
<td><em>Cooltitella bella</em> (Etheridge)</td>
<td>Archbold, 1993b</td>
<td><em>Productus bellus</em> Etheridge, 1918</td>
</tr>
<tr>
<td>(Waterhouse)</td>
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<tr>
<td>(Waterhouse)</td>
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<tr>
<td><em>Costatumulus polliciformis</em></td>
<td>Shen, Shi &amp; Archbold, 2003a</td>
<td><em>Cancrinella polliciformis</em> Waterhouse, 1978</td>
</tr>
<tr>
<td>(Waterhouse)</td>
<td></td>
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<tr>
<td><em>Costiferina wadei</em> (Prendergast)</td>
<td>Archbold, 1985b</td>
<td><em>Dictyoaclostus callyharrensis</em> var. wadei Prendergast, 1943</td>
</tr>
<tr>
<td>(Prendergast)</td>
<td></td>
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<tr>
<td><em>Crantisus skeatzi</em> (Allan)</td>
<td>Archbold, 1991d</td>
<td><em>Ancistrocrania skeatzi</em> Allan, 1940</td>
</tr>
<tr>
<td>(Hosking)</td>
<td></td>
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<tr>
<td><em>Crassispirifer rostralinus</em></td>
<td>Archbold &amp; Thomas, 1985a</td>
<td><em>Spirifer rostralinus</em> Hosking, 1933</td>
</tr>
<tr>
<td>(Hosking)</td>
<td></td>
<td></td>
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<tr>
<td><em>Crassispirifer? kimberleyensis</em></td>
<td>Archbold &amp; Thomas, 1985a</td>
<td><em>Spiriferas kimberleyensis</em> Foord, 1890</td>
</tr>
<tr>
<td>(Foord)</td>
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<tr>
<td><em>Cyrolexis superstes</em> (de Verneuil)</td>
<td>Shen, Shi &amp; Archbold, 2003a</td>
<td><em>Terebratula superstes</em> de Verneuil, 1845</td>
</tr>
<tr>
<td>(Hosking)</td>
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<tr>
<td><em>Dyschrestia micracantha</em> (Hosking)</td>
<td>Archbold, 1984b</td>
<td><em>Pustula micracantha</em> Hosking, 1933</td>
</tr>
<tr>
<td>(Hosking)</td>
<td></td>
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</tr>
<tr>
<td><em>Echinalosia (Echinalosia) prideri</em> (Coleman)</td>
<td>Archbold, 1986c</td>
<td><em>Strophalosia prideri</em> Coleman, 1957</td>
</tr>
<tr>
<td>(Coleman)</td>
<td></td>
<td></td>
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<tr>
<td><em>Etherilosia prendergastae</em> (Coleman)</td>
<td>Archbold, 1993b</td>
<td><em>Heteralosia (Etherilosia) prendergastae</em> in Archbold, 1993a originally <em>Strophalosia prendergastae</em> Coleman, 1957</td>
</tr>
<tr>
<td>Name</td>
<td>Authors and Year</td>
<td>Synonyms</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td><em>Fusispirifer byroensis</em> (Glauert)</td>
<td>Archbold &amp; Thomas, 1987</td>
<td><em>Spirifer byroensis</em> Glauert, 1912</td>
</tr>
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<td><em>Gjelispirofera decipiens</em> (Hosking)</td>
<td>Archbold, Thomas &amp; Skwarko, 1993</td>
<td><em>Spiriferina cristata var. decipiens</em> Hosking, 1933</td>
</tr>
<tr>
<td><em>Globiella foordi</em> (Etheridge)</td>
<td>Archbold, 1983e</td>
<td><em>Productus tenuistriatus var. foordi</em> Etheridge, 1903 [later referred to <em>Cimmeriella</em> by Archbold &amp; Hogeboom, 2000]</td>
</tr>
<tr>
<td><em>Heteralosia complectens</em> (Etheridge)</td>
<td>Archbold, 1986c</td>
<td><em>Strophalosia complectens</em> Etheridge, 1918</td>
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<td><em>Lyonia lyoni</em> (Prendergast)</td>
<td>Archbold, 1983e</td>
<td><em>Linoprocessus cancriformis var. lyoni</em> Prendergast, 1943</td>
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<td><em>Megasteges fairbridgei</em> (Coleman)</td>
<td>Archbold, Thomas &amp; Skwarko, 1993</td>
<td><em>Aulosteges fairbridgei</em> Coleman, 1957</td>
</tr>
<tr>
<td><em>Megasteges septentrionalis</em> (Etheridge)</td>
<td>Archbold, 1986c</td>
<td><em>Aulosteges baracooodensis var. septentrionalis</em> Etheridge, 1907</td>
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<td><em>Neospirifer hardmani</em> (Foord)</td>
<td>Archbold &amp; Thomas, 1986a</td>
<td><em>Spirifer hardmani</em> Foord, 1890</td>
</tr>
<tr>
<td><em>Punctocyrtella australis</em> (Thomas)</td>
<td>Archbold, Thomas &amp; Skwarko, 1993</td>
<td><em>Cyrtella nagmargensis australis</em> Thomas, 1971</td>
</tr>
<tr>
<td><em>Stibtozoster senticosus</em> (Hosking)</td>
<td>Archbold, 1984b</td>
<td><em>Pustula senticosas</em> Hosking, 1933</td>
</tr>
<tr>
<td><em>Streptorhynchos plata</em> (Waterhouse)</td>
<td>Shen, Shi &amp; Archbold, 2003a</td>
<td><em>Arctitretas plata</em> Waterhouse, 1978</td>
</tr>
<tr>
<td><em>Tethyochonetes wongiana</em></td>
<td>Chen, Shi, Shen &amp; Archbold, 2000</td>
<td><em>Chonetes wongiana</em> Chao, 1928</td>
</tr>
<tr>
<td><em>Tivertonia falchensis</em> (Amos)</td>
<td>Cisterna et al., 2002c</td>
<td><em>Lissochonetes falchensis</em> Amos, 1961</td>
</tr>
<tr>
<td><em>Transennatia timorensis</em> (Hamlet)</td>
<td>Archbold &amp; Bird, 1989</td>
<td><em>Productus graciosus var. timorensis</em> Hamlet, 1928</td>
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<td><em>Trigonotreta pericoensis</em> (Leanza)</td>
<td>Cisterna et al., 2002c</td>
<td><em>Spirifer</em> (<em>Spirifer pericoensis</em> Leanza, 1945)</td>
</tr>
<tr>
<td><em>Waagenoconcha waagenti</em> (Rothpletz)</td>
<td>Archbold &amp; Bird, 1989</td>
<td><em>Productus waageni</em> Rothpletz, 1892</td>
</tr>
<tr>
<td><em>Wooramella senticosata</em> (Hosking)</td>
<td>Archbold in Hogeboom &amp; Archbold, 1999</td>
<td><em>Pustula senticosata</em> Hosking, 1933</td>
</tr>
<tr>
<td><em>Wyndhamia multispinifera</em> (Prendergast)</td>
<td>Archbold, 1987b</td>
<td><em>Sphalosia multispinifera</em> Prendergast, 1943</td>
</tr>
<tr>
<td><em>Wyndhamia multispinifera</em> (Prendergast)</td>
<td>Archbold, Thomas &amp; Skwarko, 1993</td>
<td><em>Sphalosia multispinifera</em> Prendergast, 1943</td>
</tr>
</tbody>
</table>
ANNOUNCEMENTS

Future SPS meetings

Continental Permian Meeting in Italy

A SPS meeting will be held in Siena, Italy, in conjunction with the Field Conference on the “Stratigraphy and Palaeogeography of late- and post-Hercynian basins in the Southern Alps, Tuscany and Sardinia, and comparisons with other Western Mediterranean areas and geodynamic hypotheses”, September 18-23, sponsored by the Italian Geological Society. The Field Conference will consist of an initial excursion (September 18-21) followed by two day meeting (September 22-23) in Siena. The field excursion will focus on the Permian and Triassic continental sequences in the southern Provence, western Liguria and northwestern Tuscany. Oral or poster contributions are welcome; abstract deadline is July 30, 2006. Additional information is available from Prof. G. Cassinis, Dipartimento di Scienze della Terra, Università degli Studi, Via Ferrata No. 1, 27100 Pavia, Italy. Tel: 39 0382 985834. Fax: 39 0382 985890. E-mail: cassinis@unipv.it. The first circular has been sent out and is available at http://manhattan.unipv.it/sem_conf_new.htm.

Neil W. Archbold Memorial Symposium

Invitation for Expressions of Interest

The Royal Society of Victoria and the Faculty of Science and Technology at Deakin University propose to hold a NEIL W. ARCHBOLD MEMORIAL SYMPOSIUM. The symposium will be held in honour of the late Neil Archbold, Professor of Palaeontology, Deakin University, and immediate past president of the Royal Society of Victoria. Professor Archbold (14th August 1950 – 28th November 2005) was an eminent Australian palaeontologist who specialized in Permian brachiopods. He died in Mendoza, Argentina, following his participation in Gondwana 12 – the Twelfth International Gondwana Congress.

This Memorial Symposium will provide an opportunity for colleagues and friends to honour and celebrate Professor Neil Archbold’s life and work by attending the Symposium and/or contributing Symposium papers which will be published as a special issue of the Proceedings of the Royal Society of Victoria (a peer reviewed and internationally circulated journal). Details of the planned Symposium are included below:

NEIL W. ARCHBOLD MEMORIAL SYMPOSIUM
Friday 24th November 2006
to be held at
The Royal Society of Victoria’s Hall
9 Victoria Street, Melbourne, Victoria 3000, Australia

The organisers welcome expressions of interest from anyone who wishes to (please tick):
? attend the Symposium
? attend the Symposium and present a paper
? offer a paper for the Proceedings but are unable to attend the Symposium

First Circular
XVI International Congress on the Carboniferous and Permian

Invitation

Geologists from around the world interested in Carboniferous and Permian rocks are invited to meet at Nanjing, People’s Republic of China, June 21 - June 24, 2007. The Carboniferous and Permian in China are characterized by excellent outcrops, a wide spectrum of depositional types, characteristic fauna and flora, and above all, fully developed successions. During recent years, research
on the Carboniferous and Permian in China has experienced exciting developments and has achieved great success in four areas. 1) Locating exposures for candidates as stratotypes of series and stage boundaries to establish detailed integrated stratigraphic sequences, especially in the Mississippian and Late Permian (Lopingian). 2) Exploring the Carboniferous and Permian in South China, North China and Northwest China for coal-bearing beds, and sources of oil and gas. 3) Detailed geological and palaeontological survey of the Peri-Gondwana Carboniferous and Permian in Tibet and West Yunnan, which has led to significant progress in understanding the evolution of the Paleo-Tethys, the dispersion of Gondwana, and Asian accretion. 4) Studies of Carboniferous and Permian geological events and processes using bio-diversity, isotope geochemistry, and other stratigraphic data, which have resulted in a more comprehensive understanding of the end-Permian mass extinction as well as other events.

We believe that we can offer our colleagues a vibrant academic environment for discussions on the Carboniferous and Permian world, as well as opportunities to see the amazing geological record of Carboniferous and Permian biotic and physical processes.

Sponsors

Chinese Academy of Sciences
National Natural Science Foundation of China
Ministry of Science and Technology, China
Chinese Academy of Geological Sciences
The International Subcommission on Carboniferous Stratigraphy
The International Subcommission on Permian Stratigraphy

Congress Organizers

Nanjing Institute of Geology and Palaeontology, CAS
State Key Laboratory of Palaeoecology and Stratigraphy
Institute of Geology and Mineral Resources, CAGS
China University of Geosciences
Nanjing University

Organizing Committee

Honorary Chair: Yu-gan JIN

Co-Chairs: Xiang-dong WANG; Shu-zhong SHEN

Technical Program Committee:


Secretary General: Xiao-juan WANG

Venue and Schedule

The venue for the XVI ICCP will be in the International Conference Hotel of Nanjing (http://www.nic-hotel.com), a garden-style grand hotel very close to the Sun Yatsen Mausoleum and the Ming Emperor’s Tomb, within the Purple Mountain Scenic Area at eastern Nanjing, Jiangsu Province, East China.

Natural Setting and cultural resources: Nanjing is an economic and cultural centre in East China, having a total population of about 6 million and boasts a long history and rich cultural heritage. Archeological relics indicate that some 6,000 years ago humans lived here in primitive communities. Furthermore, ancient human and hominid fossils found in Nanjing have proven that this area was inhabited by ancient humans over 300,000 years ago. Since 220AD ten dynasties or regimes have made their respective capitals in Nanjing one after another. With its elegant natural setting and rich cultural resources, Nanjing is well known as a tourist attraction. Among hundreds of scenic spots the most outstanding historic relics for tourism are: the Sun Yatsen Mausoleum, the Ming Emperor’s Tomb, the approximately 1,400 years old Jiming Temple, the relics of the Taiping Heavenly Kingdom, the majestic ancient city walls, the stone carvings of the Southern Dynasty, and the pagoda for Buddhist relics. The top natural scenic spots are the East Suburbs Scenic zone, the Qixia Temple and hills, Xuanwu Lake, Mochou Lake, and the Qinhuai River Scenic zone. Two-thirds of the Ancient City Wall of Nanjing is intact, the longest and best-preserved city wall in China. Nanjing is one of China’s four key cities in scientific research and education. In total, Nanjing has 48 institutions of higher learning, including the following geological organizations: Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences; Department of Earth Sciences, Nanjing University; Nanjing Institute of Geology and Mineral Resources; Nanjing Institute of Geophysics in Petroleum Exploration; Nanjing Petrological and Mineralogical Test Center; Nanjing Geological Museum; and the newly established Nanjing Palaeontological Museum.

Schedule:

June 14-June 19: Pre-congress field excursions
June 20- Arrive Nanjing, Registration and welcome reception
June 21-June 24 Talk and poster sessions, workshops
June 22- Congress banquet
June 25-Depart Nanjing
June 25- June 30: Post-Congress field excursions

Travel

- By air to Nanjing transferring at Beijing, Guangzhou, Xi’an, Hong Kong, Macau or other large cities within China; or from Incheon (Seoul), Osaka, or Singapore. Delegates may take the Nanjing airport taxi to the International Conference Hotel in Eastern Suburb Scenic Park (cost approx. 15 USD). (Strongly recommended)
- By train or shuttle via Shanghai to Nanjing: Delegates who fly into Shanghai Pudong International Airport may either take the airport bus/taxi to Shanghai railway station and then the train (3 hours) to Nanjing or chose the airport shuttle directly to Nanjing (4 hours) using the express highway. (Not recommended because of inconvenient transfer at Shanghai Railway Station for non-Chinese speaking delegates)
Obtaining a visa to visit China: Please check to see if your visit to China will require a visa. Delegates with a valid passport from Japan and Korea in the visa waiver program may enter China for two weeks stay without a visa. Delegates from countries not included in the visa waiver program are required to obtain a visiting or travel visa. The process involves contacting the nearest Chinese embassy or consulate in the country where your passport will be issued. We will send an official invitation letter issued by Chinese Academy of Sciences to delegates who need to apply for a visiting visa.

Scientific Programs

Meeting Format: The meeting will consist of concurrent sessions of talks, each of 20 minutes (including questions and transition). Talks will be grouped based on broad themes. There will be one poster session, which will include afternoon refreshments. Speakers will normally be limited to one presentation (talk) at the meeting. Individuals may participate as a non-presenting coauthor on additional talks. Individuals may participate in as many posters presentations as they wish. Details will follow in the Second Circular.

Proposed sessions:
1. Carboniferous and Permian Palaeobotany and Microflora
2. Carboniferous and Permian Macro- and microfossils
3. Devonian F-F Mass Extinction and Mississippian Recovery
4. Biotic Turnovers during the mid-Carboniferous boundary and Early Permian
5. Carboniferous and Permian Reef, Biofacies, and Basin Analysis
6. Evolutionary Palaeogeography and Palaeoclimatology
7. Integrative Stratigraphy and High Resolution Biostratigraphy
8. Isotopic Geochemistry and Geobiology in the Permo-Carboniferous
9. Gondwana and Peri-Gondwana Faunas, Stratigraphy, and Geology
10. Bio-Diversity Patterns and Quantitative Analysis of Biotic Databases
11. Stratotypes, Boundaries, and Global Correlations
12. End-Permian Biotic Mass Extinction and Early-Triassic Recovery
13. Pangea formation and breakup
14. Cyclotheic Stratigraphy and Sequence Stratigraphy
15. Carboniferous and Permian Coal, Petroleum, and Economic Geology
16. Computerized Palaeontology
17. Palaeontological Education for the Public

Call for Abstracts: Abstracts for the meeting are due April 1, 2007. A request for abstracts will be announced in the Second Circular, which will also have instructions for electronic submission of abstracts. The Abstract volume for the meeting will be edited by Yue Wang and Ronald R. West and distributed to registered delegates at the meeting.

Proceedings Volume: A volume of congress proceedings is planned for publication in Palaeoworld, an Elsevier peer-reviewed quarterly journal dedicated to studies of palaeontology and stratigraphy centred in China and the neighbouring regions. Original works on fossils and strata, comparative studies worldwide, and interdisciplinary approaches with related disciplines are encouraged. Palaeoworld is oriented toward a broad spectrum of geoscience researchers as well as experts and students in evolutionary biology who are interested in historical geology and biotic evolution.

Manuscripts for the proceedings volume are encouraged, and should be prepared following the Guide for Authors of Palaeoworld. This guide can be downloaded from the Palaeoworld website of Elsevier (http://ees.elsevier.com/palwor/). Contributed papers relating to the topics of ICCP are invited from registered participants. Please note that the deadline for contributions to the proceedings volume is scheduled for December 31, 2007.

Workshops: Several free workshops will be scheduled and are mainly designed for subcommissions on the Carboniferous and Permian stratigraphy. A workshop on the Meishan drilling project that aims at resolving the timing and geochemistry of Permian-Triassic Events (PTEs), South China will also be planned. Any colleagues or working groups wishing to hold a special symposium or workshop are advised to contact the organizers with their ideas no later than December 31, 2006.

Language: The official language for the scientific program and all business of the meeting is English.

Proposed Field excursions
A. Pre-Congress excursions:
A2. Carboniferous and Permian carbonate sequences in Northwest Tarim, Xinjiang.
A3. Pennsylvanian to Lower Triassic continental sequences in Hancheng, South Sha’anxi.
A4. Pennsylvanian to Permian continental sequences in Shanxi and Hebei.

C. Post-Congress excursions:
C1. Gondwana and Peri-Gondwana Carboniferous and Permian sequences in Xizang (Tibet).
C2. Peri-Gondwana Carboniferous to Permian sequences in West Yunnan.
C5. Devonian-Carboniferous marine sequences including the Hongguleleng F-F refuge faunas and geological records of the end-Permian mass extinction in the continental sequence, North Xinjiang.
Social Programs

Welcome Reception: After on-site registration, delegates can share a buffet style reception with beer, wine, and juice in the dining hall of the hotel. Full vegetarian fare will also be provided.

Banquet Dinner: A formal Chinese style banquet dinner will be held at the evening of June 22.

Guest Program: No formal guest program is planned at this time. However, the congress organizers can help coordinate local excursions to suit most interests. Feel free to request information, provide suggestions or just share potential interests.

Accommodations and Food

Hotel:
International Conference Hotel of Nanjing (www.nic-hotel.com): 6 km from the Nanjing Institute of Geology and Palaeontology: single room (in No.6 building, with bathroom, TV, telephone, air conditioner and refrigerator, current price: RMB 400 per night); two-bed room A (in No.6 building, with bathroom, TV, telephone, air conditioner and refrigerator, current price: RMB 400 per night); two-bed room B (in No.1 building, with bathroom, TV, telephone, air conditioner and refrigerator, current price: RMB 500 per night); suite A (in No.1, No.2, No.3 buildings, with one king-size bed, a bathroom, TV, telephone, refrigerator, current price: RMB 600); suite B (in No.1, No.2, No.3 buildings, with additional sitting room, one king-size bed, a bathroom, TV, telephone, refrigerator, current price: RMB 800 per night).

Restaurants and Daily Meals:
Daily meals are in the hotel and are in buffet style with an exception of the banquet dinner.

Type of clothing and weather conditions:
Daytime highs in Nanjing for the meeting dates historically average 35 °C with lows of 24 °C; summer clothing is appropriate. All hotel rooms and conference halls are air-conditioned. Those who participate in excursions to Tibet and Xinjiang will need a jacket.

Registration

- Registration fees*:
Before April 1, 2007:
Regular participant: 400 US$, includes meeting resources and support, abstract volume, proceedings volume, refreshments at session breaks, and all meals including breakfast, lunch, and supper from June 21 to June 24, as well as reception and banquet dinners.
Student: 200 US$, as above: individual must provide a student identification card from current institution at time of on-site registration.
Accompany: 150 US$, as above: with the exception of abstract and proceedings volumes.

After April 1, 2007:
Regular participant: 450 US$, student: 250 US$, and accompany: 200 US$ (* Registrations fees are subject to modification depending on the current rate of exchange between the Chinese Yuan RMB and USD. The rate of exchange on March 10, 2006 was 100 US$ = 804.7 RMB Yuan.)

Payment: A down payment for the meeting and field trips will be requested in the Second Circular. The balance will be due at the time of the meeting, payable in $USD.

- Registration form: A pre-registration and reply form is attached and the first circular can be downloaded from the Congress website: www.ICCP2007.cn as of April 15, 2006.

Important Dates

April 15, 2006: First Circular available on line
May 1, 2006: Distribution of the printed copy of the First Circular
December 31, 2006: Deadline for returning the Reply Form from the 1st Circular
February 1, 2007: Second Circular available online and distribution
April 1, 2007: Deadline for pre-registration and abstract submission
May 1, 2007: Third Circular available online
December 31, 2007: Deadline for manuscript submission of the proceedings volume

(This animal is Bixie (in Chinese pronunciation) that is one of the symbols of Nanjing City and means ‘ward off evil’, originally intended to provide powerful spiritual protection.)
Thank you for your *Permophiles* Subscription Donation!

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