Permophiles

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International Union of Geological Sciences

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Permian Stratigraphy
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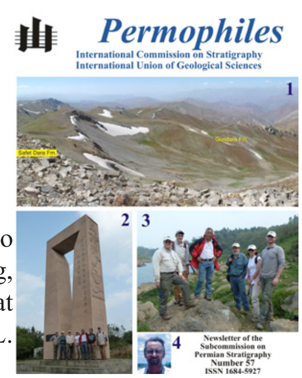
Contents



1, Watershed between the Gundara and Charymdara Valleys in N Pamir; 2), the monument erected to celebrate the Lopingian base GSSP on the Panglai Islet. From left to right: S.D. Burgess, S.A. Bowring, C.M. Henderson, L. Angiolini, S.Z. Shen, S.D. Shoepfner. 3), Discussion on the Lopingian base GSSP at Penglaitan, Laibin, China. From left to right: C.M. Henderson, S.D. Shoepfer, S.Z. Shen, S.A. Bowring, L. Angiolini, S.D. Burgess; 4, Brian Glenister

EXECUTIVE NOTES

Notes from the SPS Secretary

Lucia Angiolini

Introduction and thanks

While I write these notes the sun is shining on a cold late winter day on the ancient roof of the beautiful historical building of the Academy of Sciences of Nanjing, the institute of the new chair of the Subcommission on Permian Stratigraphy, Shuzhong Shen. The past chair, Charles Henderson, is also here, deeply absorbed by the study of Permian conodonts from the Cisuralian of China. In this foreword, I would like to thank very much Shuzhong Shen who has invited Charles Henderson and myself here in Nanjing to edit this issue of *Permophiles*, which is the first of the new executive committee of Subcommission on Permian Stratigraphy.

I would like to thank him also for the excellent organization of the field trip on the Penglaitan section (Laibin) that he led a few days ago (February 25-28, 2013). This trip benefitted from the presence of Sam Bowring, Shane Schoepfer, Seth Burgess, Yue Wang, Wei Wang, Dong-xun Yuan, Jun Chen, Yi Ding, Mei-nan Shi, and Quan-feng Zheng as well as a warm sun shining on a very beautiful river landscape. The Penglaitan section, continuously outcropping along the Hongshu River west of the GSSP of the Guadalupian-Lopingian boundary, records an amazingly long interval of time in the late Permian: more than 600 metres of succession for the Lopingian Series. It not only provides a very detailed window to study the events, which preceded the end-Paleozoic mass extinctions, but it also records the P/T boundary beds that crop out sharply along the shore of the river, carefully looked after by a group of Chinese workers who pump water away from the site and remove the clay soil, which cover it northwestward; such a care to look after geological sites I have seen only in China.

Nothing is missing along this part of the section: Permian fossils including fusulinids, brachiopods and ammonoids (besides conodonts of course!) range up to a few centimetres below the boundary, ash beds are frequently interbedded below, at and above the boundary, sedimentary structures are well exposed, paleosols and coals occasionally interrupt limestone deposition and a consistent part of the section is made by marine siliciclastics, sequence boundaries and maximum flooding surfaces are easily identifiable. A multidisciplinary group of scientists from Nanjing and from other parts of the world are studying the section from multiple perspectives under the efficient supervision of Shuzhong Shen, investigating not only the different branches of paleontology, but also sedimentology, organic and inorganic geochemistry and geochronology.

In conclusion, Penglaitan seems to be THE PERFECT SECTION, discovered in the nineties when looking for coals. It is an exceptional section; therefore a producer for HHMI, NOVA/PBS and Holt Productions from the USA came to film Shuzhong Shen and Sam Bowring describing the boundary beds while we were there.

I will never forget the fruitful discussions we had on the section, as well as the packed lunches brought to us by small boats adventurously crossing the strong river current and the visit to the monument to the Guadalupian-Lopingian boundary, built in front of the GSSP on a luxuriant island.

Back from the field, Charles, Shuzhong and I met here in Nanjing to edit this issue based on a few contributions we received from our Permian colleagues. The new chair has tried to stimulate some discussion among the voting members on the Kungurian base GSSP candidates from the Mechetlino section in southern Ural and Rockland section in Pequop Mountains, Nevada, which were included in the previous issue (*Permophiles* #56).

Your comments are very important to move Permian studies forward and to improve correlation and the resolution of the Permian Timescale. In the same way, your contributions will be important to keep going for future issues of *Permophiles*.

I would like to thank M. Bahrammanesh, C.M. Henderson, G. Muttoni, M. Stephenson and Miodrag Jovanović for their contributions to this issue.

Previous and forthcoming SPS Meetings

A previous SPS meeting was held between 19:00 and 20:30 pm on the 7th of August during the 34th International Geological Congress. Charles Henderson chaired the meeting. We only had a few attendees including Shu-zhong Shen, Guang R. Shi, Olga Kossovaya, Zhong-qiang Chen, Barry Richards, Svetlana Nikolaeva, Onaerj Barek, Markus Aretz at the meeting. During the business meeting, Charles reported a workshop held in Wells Nevada and the recent progress on the Cisuralian GSSPs. He also introduced the new SPS executive and voting members and the plan to move the GSSP work forward.

Two forthcoming SPS meetings are scheduled. One will be held during the International meeting on Carboniferous and Permian Transition, which is hosted by the New Mexico Museum of Natural History and Science, Albuquerque, New Mexico, USA May 20-22, 2013.

The second one will take place during STRATI 2013 1st International Congress on Stratigraphy in Lisbon, at the Gulbenkian Conference and Exhibition Centre, July 1-7 2013.

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This issue contains the following reports:

A memorial for our distinguished colleague Brain Glenister is provided by Claude Spinosa in this issue.

A short report on the correlation of Tethyan stages in the Pamirs by L. Angiolini and C.M. Henderson.

M. Bahrammanesh presents a report in which she describes the fossiliferous succession of Guadalupian to Early Triassic age cropping out in the Shahreza-Esfeh area of Central Iran.

G. Muttoni discusses the uncertainty that still remains on the precise configuration of Pangea during the Late Paleozoic-Early Mesozoic comparing the two general models of 1) a Pangea A-type configuration or 2) a supercontinent, which evolved from a Pangea B-type to a Pangea A-type configuration over this interval.

M. Stephenson provides a report on the diachronous onset of deposition of the Khuff Formation along the northern Gondwanan margin across the Arabian Peninsula, based on palynological evidence from the clastic facies that conformably underlies the Khuff Formation.

Miodrag Jovanović reported marks of tetrapod vertebrate tracks from a specimen (small plate) of Permian reddish-brown siltstone from vicinity of Donji Milanovac.

Future issues of Permophiles

The next issue of *Permophiles* will be the 58th issue.

I kindly invite our colleagues in the Permian community to contribute papers, reports, comments and communications.

REMEMBER, your contributions are very important to move Permian studies forward. Do not miss this opportunity!

The deadline for submission to Issue 58 is August 30, 2013. Manuscripts and figures can be submitted via email address (lucia.angiolini@unimi.it) as attachments. Please follow the format on page 3 of Issue 44 of *Permophiles*.

Finally, I remember that Shu-zhong Shen has provided a new SPS webpage at http://permian.stratigraphy.org/. We welcome your contributions and advice to improve the webpage as we move forward.

Notes from the past SPS Secretary

Shu-zhong Shen

These notes represent my last communication as secretary of the Subcommission on Permian Stratigraphy. I have enjoyed working with the past SPS chair Charles Henderson over the last eight years and I would express my gratitude to Charles for his leadership and valuable contributions to Permian issues and *Permophiles*. The Permian Period was an extremely important time interval. It witnessed the process from an icehouse-dominated to a greenhouse-dominated world, the largest global sea-level fall at the end-Guadalupian and the largest biologic mass extinction at the last moment of the Permian. As I think back over the last eight years, several things come to my mind. First, SPS established the uppermost two GSSPs (base-Wuchiapingian and base-Changhsingian) in 2005, which provide the important calibration of the whole Lopingian (Late Permian). This is critical to understanding the largest mass extinction. Second, SPS obtained significant progress on the Cisuralian GSSP candidates. I would thank Boris Chuvashov and the past SPS Vice-Chair Vladimir Davydov for their organization of a field excursion in southern Urals to investigate all of the Cisuralian GSSP candidates. This excursion provided a lot of advances for SPS to make some new decisions on the candidates of the Cisuralian GSSPs. I would also thank Charles Henderson who organized another field excursion on the Rockland section in Nevada, USA, where a new base-Kungurian GSSP candidate was proposed. Third, the Permian timescale has been greatly refined and a high-resolution Permian timescale is available. I would like to acknowledge Sam Bowring's and Mark Schmitz's groups who made significant progress to the ID-TIMS high-precision U-Pb dating for the ash beds from the Lopingian and Permian-Triassic boundary interval in South China and from the Cisuralian in southern Urals (see timescale in this issue).

This issue has been edited by the new SPS secretary Lucia Angiolini, the past chair Charles Henderson and me while in Nanjing. Both Lucia and Charles came to China on the 25th of February, 2013 and we went to visit the Penglaitan section with the Lopingian-base GSSP in Laibin, Guangxi Province. A beautiful 10 m high monument was built on the Penglai Islet last year. After the field excursion, we all came to Nanjing to edit *Permophiles* #57 and eat Sichuan food.

Notes from the New SPS Chair

Shu-zhong Shen

This note represents my first communication as the new SPS chair. I would like to acknowledge the valuable contributions made by the past-Chair, Charles Henderson and the past vice-Chair Vladimir Davydov. Under Charles' leadership SPS has made considerable progress. Two GSSPs in the Lopingian were ratified in 2005 by ICS. Significant progress has been made for the Cisuralian GSSP candidates. The Permian timescale has been greatly refined based on new biostratigraphic, geochemical and geochronologic data.

I would like to introduce our new SPS Secretary and new Vice-Chair. Lucia Angiolini from the University of Milano, Italy will be the Secretary. She has mainly focused on Permian brachiopods and stratigraphy, in particular from the regions of Oman, Iran, Karakorum, and Pamir. Jörg W. Schneider from the Institute of Geology of Freiberg University will serve as the new Vice-Chair. Jörg mainly focused on the Permian and Carboniferous terrestrial fossil groups and stratigraphy. I welcome them to be executive members and look forward to working with them over the next several years. The SPS will have the following priorities for the next few years:

1) Establishing the three remaining GSSPs. This is the first priority for SPS to push forward. Two proposals for the base-Kungurian GSSP have been published in the last issue of *Permophiles* and we are looking forward to receive comments from all voting members and from the Permian community. We hope to move this GSSP forward to a vote by the Subcommission on Permian Stratigraphy very soon. The base-Sakmarian GSSP candidate has been moved to the Usolka section and the base-Artinskian GSSP candidate is at the Dalny Tulkas section. We currently do not have any other candidate for these two stage boundaries. Proposals will appear in next *Permophiles* to be followed by votes.

2) The SPS will organize an International Working Group led by Jörg W. Schneider to intensify the studies of the correlation between the terrestrial and marine Permian sequences.

3) Further supplementary studies on the Guadalupian GSSPs. The three GSSPs in the Guadalupian were ratified more than 10 years ago. However, the papers on these GSSPs have not been published yet, and geochemistry and magnetostratigraphy around the boundaries are not yet available. Conodonts defining the GSSPs have not been formally figured yet.

4) Refining the Permian timescale.

With the cooperation of our new SPS executive and voting members, I am confident our Permian agenda over the next four years will be active and successful. So I hope you will join the SPS and help to provide a strong and powerful voice for the Permian community.

Notes from the New SPS Vice-Chair

Joerg W. Schneider (Jogi)

The international Permian timescale has been significantly improved during the past five years. The GSSPs of the three series Cisuralian, Guadalupian and Lopingian and of six of the nine stages are ratified since 1996. Much progress has been made to improve the global Permian time scale in detail, especially with respect to numerical ages as demonstrated by the "Latest Permian Timescale" of 2012 (http://permian.stratigraphy.org/). But the Late Carboniferous and the Permian was a time of exceptionally low sea level in Earth's history, comparable only to the Pleistocene and post-Pleistocene modern world. Of the two largest components of the Paleozoic supercontinent Pangea, Gondwana covered an area of about 73 million km^2, but was only about 15% covered by epi-continental seas, while Laurasia covered an area of about 65 million km^2, but was only about 25% covered by epi-continental seas. That means that most of the preserved deposits of this time with many economically interesting resources, mainly of natural gas, salt and other minerals are stored in continental deposits. Looking at our actual time scale, we could see the really significant progress in the determination of marine stage boundaries, but very little about the correlation of these boundaries into the vast continental deposits on the Permian Earth. That means, besides the ratification of the still missing three stage boundaries, the future focus of SPS has to be strictly set on marine – non-marine correlation.

For that we need:

the strong cooperation of marine and terrestrial biostratigraphers,

much more reliable isotopic ages from marine and terrestrial deposits,

to use any and all correlative age-relevant proxies from marine and non-marine deposits,

to focus marine – non-marine correlation research on the most promising areas with well developed mixed marine/terrestrial profiles, as e.g.

for the Cisuralian and Guadalupian mainly on mixed marine-terrestrial deposits on the East European platform and in the North American Midcontinent basins,

for the Lopingian on mixed marine-terrestrial deposits in North China and the East European platform.

I ask all marine workers to use their knowledge to determine regions with mixed marine/terrestrial deposits for promising future common research projects within the framework of SPS. I ask all workers in their own continental basins to get in touch with SPS to promote detailed local to regional knowledge toward our global aims. I ask all colleagues in the Northern dominated SPS to get in closer contact with colleagues studying the terrestrial Gondwana. And I ask the colleagues from Gondwana to get in closer contact with their Northern colleagues.

I have tried for some time now to establish a non-marine – marine correlation working group inside the SPS with no real success. Now, since the situation has changed and most work on the establishment of the marine scale has been completed, I expect much more interest and cooperation. Together with the chairman of the SPS, Shu-zhong Shen, I will try to develop an internet-platform on the SPS homepage for exchange of ideas and information on marine – non-marine correlation. This should be the starting point for future promising collaborative research within SPS.

Notes from the SPS Past Chair

Charles M. Henderson

This issue is the 22nd issue of *Permophiles* in which I have been directly involved in editing and publishing and it seems like time to move on. My role began in October 2000 at Claude Spinosa's cottage on Pend d'Oreille in northern Idaho when I assisted Claude, Bruce Wardlaw and the late Brian Glenister on *Permophiles* #36 (June 2000) and ends at the Nanjing Institute of Geology and Palaeontology during early March 2013 (*Permophiles* #57; December 2012) with Shu-zhong Shen and Lucia Angiolini. I now look forward to providing articles to future issues of *Permophiles* as a contributing member while my research program continues to develop.

This experience has been very rewarding for me because I have learned much during the process and have made many good friends. Bruce Wardlaw and I made a great team and I wish to thank him for the many discussions, some of which became fueled by significant amounts of scotch. Both of us should also thank our wives Jean and Elizabeth for their "patience" during our respective visits, Bruce sensibly coming to Calgary in the summer and I to Reston, Virginia during the winter. Elizabeth was also a gracious host when Shu-zhong visited our home as SPS Secretary. Shu-zhong Shen and I have become very good friends and conduct considerable collaborative research that will undoubtedly continue for many years yet. It was with great pleasure that I turned over the reins to Shu-zhong Shen at the IGC meeting in August 2012 in Brisbane, Australia. I am certain that SPS will be well served by his leadership. I am pleased that another close friend, Lucia Angiolini, has become the SPS Secretary and I wish every success to Shuzhong and Lucia and Joerg Schneider as they continue the progress of *Permophiles*.

Shu-zhong Shen also leads a tremendous team at the State Key Laboratory of Palaeobiology and Stratigraphy, which is affiliated with the Nanjing Institute of Geology and Palaeontology. The laboratory and institute include many top-tier researchers and are known worldwide for outstanding international cooperative research. One group, the Late Paleozoic Eastern Tethys Research Group, involves excellent international research aimed at advancing evolutionary patterns and processes that occurred during the Late Paleozoic and P-T transition. My continuing involvement with these groups is truly a highlight for me.

It is sad to announce in this issue the passing of Brian Glenister. I was able to work with him late in his career and saw his determination to move the GSSP process forward. I remember his strong, but diplomatic voice in Perm, Russia during a heated debate about whether the Permian should comprise three series or two. If you look at the cover of *Permophiles* 44 (lower left) there is a picture of Brian, with me behind listening to the conversation during a fieldtrip as part of the 1991 International Permian Meeting. That was an eye-opening and very influential meeting and really set my career on the Permian into motion.

Another particularly influential meeting for me was the Carboniferous-Permian Congress in Beijing during 1987. At the time the Chinese had a different definition for the base of the Permian, but this meeting truly opened the door to international cooperation on these issues. I enjoyed my first involvement with the Permian-Triassic boundary when I was invited into a working group by Yin Hong-fu and visited Meishan for the first time well before it became a GeoPark. I was also introduced to the fine food and culture of China and I have kept coming back nearly every year since the 1996 IGC in Beijing. I have had the opportunity to work with many excellent Chinese researchers both young and not so young including Chang-qun Cao, Yue Wang, Shi-long Mei and Jun Chen and others. I would be remiss to not mention one last individual who also significantly influenced my research career and that is the late Jin Yu-gan. He welcomed me to China many times, but especially during a 2003 visit when I spent four months in Nanjing on sabbatical. I learned many things from Lao Jin, but probably the most important is the value to keep smiling throughout the many trials and tribulations of life; navigating the politics of the Permian is but one of those trials.

As I look back there has been considerable progress. The base and top of the Permian are internationally recognized and many of the stages of the three series are defined. I regret that we are not quite finished, but I will contribute to the completion of the Permian in the next two *Permophiles* issues.

REPORTS

Subcommission on Permian Stratigraphy: Annual Report 2012

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Permian Stratigraphy (SPS)

Submitted by:
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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Subcommission Objectives: The Subcommission's primary objective is to define the series and stages of the Permian, by means of internationally agreed GSSP's, 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 GSSP's where appropriate and related to a hierarchy of units to maximize relative time resolution within the Permian System; and 2. Establishment of framework and systems to encourage international collaboration in understanding the evolution of the Earth during the Permian Period.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2012

Progress was made on the three remaining Lower Permian (Cisuralian) stage GSSPs including base-Sakmarian, base-Artinskian, and base-Kungurian, but none has been voted yet. An SPS business meeting on the candidates of the Kungurian-base GSSP was held on the 8th of June, 2012 at Wells, Nevada, USA under the support of ICS. All of the executive and five voting members attended the workshop. Seven attendees gave talks on the progress of the Kungurian GSSP candidates including the new Mechetlino section in southern Urals, Russia and the Rockland section in the Pequop Mountains in Nevada, USA. After an extensive discussion, SPS decided to complete a proposal including both the Mechetlino section in Urals and Rockland section in Nevada in near future and now one proposal for the Kungurian-base GSSP has been received.

3b. LIST OF MAJOR PUBLICATIONS OF SUBCOMMISSION WORK (BOOKS, SPECIAL VOLUMES, KEY SCIENTIFIC PAPER)

There was one *Permophiles* published in 2012. We received fewer contributions from our Permian colleagues recently. However, we have planned to publish one issue of *Permophiles* before the end of November, 2012 if we can get the Kungurian-base GSSP proposal shortly. There are two key recent scientific papers which are very useful to refine the Permian timescale. One is published on Science by Shen et al. (2011), among which 29 high-precision geochronologic ages in the Permian-Triassic transition with high-resolution biostratigraphy were reported. According to this paper, the Permian-Triassic boundary is dated as 252.17 Ma and the Wuchiapingian/Changhsingian boundary is 252.14 Ma. Another important paper is published on GSA Bulletin by Schmitz and Davydov (2012). High-precision geochronologic ages for the Cisuralian in southern Urals were published. The Carboniferous/Permian boundary is dated as 298.9 Ma, the Sakmarian-base is 295 Ma, the Artinskian-base is 290.1 Ma and the Kungurian-base is 282 Ma. All those ages are from the candidate of the Sakmarian-base GSSP section (Usolka) and the candidate of the Artinskian-base GSSP section (Dalny Tulkas) in southern Urals.

3c. PROBLEMS ENCOUNTERED, IF APPROPRIATE

There were no major problems in 2012, but progress on remaining GSSP proposals is slow. A new potential problem is that the Lopingian-base GSSP established in 2005 at the Penglaitan section on the bank of the Hongshui River in Guangxi Province, South China is in danger to be flooded because the Chinese government has planned to establish a dam for electricity at a place about 150 km downstream to Penglaitan. However, the situation regarding how high the water level in the reservoir will become is still not very clear yet. SPS may seek ICS document support to ask a solution to protect the GSSP. We will send a report about this problem to the Chinese government.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2013)

The primary objectives are to complete the GSSP's for the last three GSSP's (Sakmarian, Artinskian, and Kungurian stages). We will produce one or two issues of *Permophiles* in 2013 depending on how many contributions we will receive. We anticipate the following schedule:

1. Complete both proposals and vote on base-Artinskian and base-Kungurian GSSPs in 2013.
2. Anticipate a proposal for base-Sakmarian GSSP candidate, voting is anticipated in 2013.
3. Two business meetings respectively at Albuquerque, New Mexico, USA in May 20-22, 2013 during the symposium on Carboniferous-Permian Transition and at Lisbon in early July, 2013 during the International Congress on Stratigraphy.

4b. SPECIFIC GSSP FOCUS FOR 2013

The priority of 2013 for GSSP is voting for the Kungurian-base GSSP. The Artinskian-base and Sakmarian-base GSSPs will be followed for voting in 2013. In addition, we will organize an international group to do a joint field excursion on the Guadalupian Series in West Texas. The purpose of this field excursion is to work on the conodonts, high-resolution geochemistry and to collect ash beds and possible magnetostratigraphic samples. The three GSSPs of the Guadalupian Series were established more than 10 years ago. No GSSP paper has been published yet and the defined FAD conodonts have never been formally figured and there are no markers established at the GSSPs. Chemostratigraphy is basically not available. In order to meet the basic requirement of GSSP in the current sense, the planned work is essential for the GSSP paper.

5. SUMMARY OF EXPENDITURES IN 2012

The Kungurian Workshop was held following the plan last year. More than 10 international colleagues attended the meeting. The fund from ICS has been spent on paying airfare for a few colleagues from Russia and the United States, subsidizing 2 night's accommodation and meals of all participants in Wells and vehicle rentals for field work in Nevada to see candidate of the Kungurian-base GSSP. ICS provided $7500 (US$) to SPS in 2012 to cover costs of Kungurian Workshop and partial costs for the Brisbane IGC meeting. Total costs for Kungurian Workshop were $6900.17 (Can$; currently on par with US$). Remaining funds subsidized accommodation of Shen and Henderson in Brisbane.

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2013

1) Establishing a new SPS webpage: US$1270. This is already completed (see links at ICS webpage).
2) Supporting Lucia Angiolini (new SPS secretary) to Nanjing in February, 2013 for *Permophiles*: US$1500.0
3) A part of travel cost to Lisbon for International Congress on Stratigraphy, US$1500.0
In total: US$4270.00

APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2008-2012)

1) A new executive committee of SPS has been elected and nominated. Shu-zhong Shen was elected as the new chair, Joerg Schneider was elected as the new vice-chair and Lucia Angiolini was nominated as the new secretary of SPS. Four voting members have been replaced by new members.
2) A high-resolution timescale of the Permian system is significantly refined by two recent papers (see SPS webpage Permian Timescale).
3) SPS decided to search new GSSP candidate for the Kungurian Stage after an investigation on the previous candidate. Now two candidates for the Kungurian-base GSSP are available.
4) Significant progress on the Sakmarian-base and Artinskian-base GSSP candidates has been made. Proposals for voting will be prepared soon.
5) A monument and a protected area is established at Penglaitan, Laibin, Guangxi Province, China for the Wuchiapingian-base GSSP.
6) 5 formal issues and two supplementary issues of *Permophiles* were published since 2008.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2013-2017)

1) Establishing the three GSSPs for the Cisuralian.
2) Establishing a working group on the Guadalupian and global correlation for chemostratigraphy and geochronologic calibration.
3) Developing a large working group on the correlation between marine and continental sequences. This has already been initiated.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

See new officers and voting members since August, 2012 in this issue.

9b List of Working (Task) Groups and their officers

1) Kungurian-base GSSP Working Group; Chair-Bruce Wardlaw.
2) Sakmarian-base and Artinskian-base GSSPs Working Group; Chairs-Valery Chernykh and Boris Chuvashov respectively.
3) Guadalupian Series and global correlation; Chair-Charles Henderson.
4) Correlation between marine and continental Permian System; Chair-Joerg Schneider.
5) Neotethys, Paleotethys, and South China correlations; Chaired by Lucia Angiolini and Yue Wang.

9c Interfaces with other international project

SPS interacts with many international projects on formal and informal levels. SPS has taken an active role on the development of a project on the correlation between marine and continental Permian sequences bilaterally supported under the foundation of the Sino-German Centre for Research Promotion (SGCRP) by NSFC and DFG. SPS is also involved in a NSFC supported key study of major biological events in the Palaeozoic. Shu-zhong Shen and Yue Wang are concentrating on establishing a section-based Permian database in Geobiodiversity Database.

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The Permian-Triassic Boundary in Central Iran (Shahreza–Esfeh)

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Introduction

The greatest biological catastrophe in Earth's history occurred at the end of the Permian just over 252 million years before present. The biodiversity of life during the latest Permian and the turnover of invertebrate faunas at the beginning of the Early Triassic, make continuous boundary intervals very important to understand this time interval.

Iran is well known to host several Permian-Triassic (P-T) boundary successions: Djulfa in NW Iran (Stepanov et al., 1969; Golshani et al., 1984; Partozar, 2002), Elikah-Nesen in N Iran (Gaetani et al., 2009; Angiolini et al. 2010), Abadeh in Central Iran (first described by Taraz, 1971 and more exhaustively by the Iranian-Japanese Working Group, 1981), and Kuh-e-Surmeh and Kuh-e-Dena in the Zagros (Insalaco et al. 2006).

A very fossiliferous succession of Guadalupian to Early Triassic age crops out in the Shahreza-Esfeh area and it is here briefly described. The section, named Shahzadeh Ali Akbar, is located 16 km NE of Shahreza and 5 km N of Esfeh village (32˚07'30''N; 51°57'00''E) (Figs. 1-2). It comprises three formations: Surmagh Formation, Abadeh Formation and Hambast Formation (Fig. 3).
The Shahreza section has been studied by Partoazar (1995) and Mohtat Aghaii and Vachard (2005).

Surmagh Formation

This formation crops out in tectonic contact with the Lower Cretaceous *Orbitolina* Limestone. It has been divided into 3 units. Unit 1 consists of grey limestone with calcite veins and grey chert in its middle part; the age is Murgabian.

Unit 2 is 300 metres thick and it comprises mostly cherty limestone with foraminifers (*Cribrogenerina* sp., *Verbeekina verbeeki, Langella* sp., *Globivalvulina* sp.); the age is middle to late Murgabian.

Unit 3 is 120 metres thick, cliff-forming and comprising grey to light brown cherty limestone. It includes: *Verbeekina verbeeki* (Geinitz), *Staffella* sp., algae (*Vermiporella* sp., and Dasycladacean algae), gastropods, brachiopods and bivalves.

Abadeh Formation

This formation has been divided into units 4a, 4b and 5.
Unit 4a begins with marly limestone in the lower part becoming more calcareous upward. It mainly contains gastropods and bivalves. Unit 4b is transitional from unit 4a with thick grey to dark grey limestone with intercalations of marly limestone; the thickness of unit 4 is 20 metres and its age is early Dzhulfian.

Unit 5 is 38 metres thick and consists of dark grey cherty limestone with calcite veins; the age is early Dzhulfian.

Hambast Formation

This formation has been divided into units 6 and 7 (Fig. 4).
Unit 6 is 25 metres thick and comprises grey marly limestone that is very rich in brachiopods. These include the following taxa: *Spinomarginifera* sp. indet., *Spinomarginifera ciliata* (Arthaber), *Spinomarginifera helica* (Abich), *Araxilevis intermedius* (Abich), *Araxathyris felina* (Arthaber), *Araxathyris protea* (Abich), *Araxathyris* sp. indet., *Araxathyris* cf. *kandevani* Fantini Sestini, *Linoproductus lineatus* (Waagen), *Leptodus* sp. indet., *Leptodus nobilis* (Waagen), *Orthotichia* sp. indet. (Fig. 5). This brachiopod association can be correlated to the *Araxilevis* bed in Djulfa, NW Iran. The age of the unit is late Djulfian.

Unit 7 begins with red shale for about 0.5 metres and then continues with dolomitic limestone with bivalves and ammonoids (*Araxoceras* sp., *Cyclolobus* sp., *Domatoceras* cf. *atypicum* Shimansky, *Metacoceras* cf. *dorashamense* Shimansky, *Vescoceras acutum* (Rhuzhensev), *Vescoceras* cf. *parappelum* (Ruzhentsev). Small foraminifers include *Baisalina pulchra* Reitlinger, *Paraglobivalvulina* sp., *Discospirella* sp., suggesting a Djulfian to latest Permian age.

The Hambast Formation is overlain by a few centimetres of green and pinkish claystone succeeded by *Claraia*-bearing microbial limestones of Early Triassic age (Fig. 6).

Conclusions

The Shahzadeh Ali Akbar section in the Shareza-Esfeh area is a

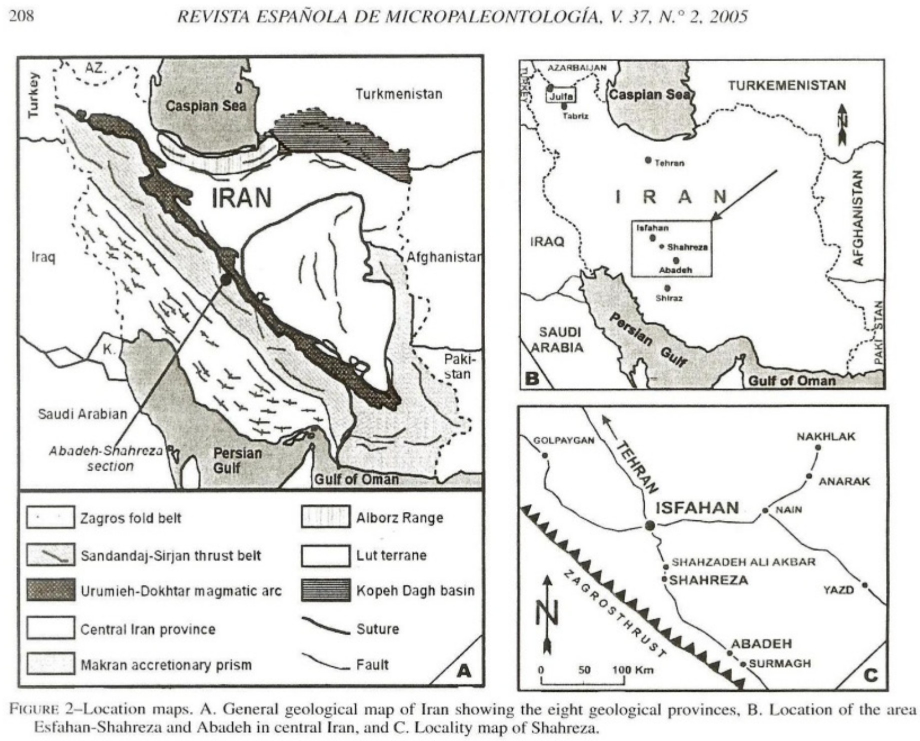


Fig. 1. Location maps. A. General geological map of Iran. B. Location of the Esfeh-Shahreza area and Abadeh in Central Iran. C. Detail showing the position of Shahreza.

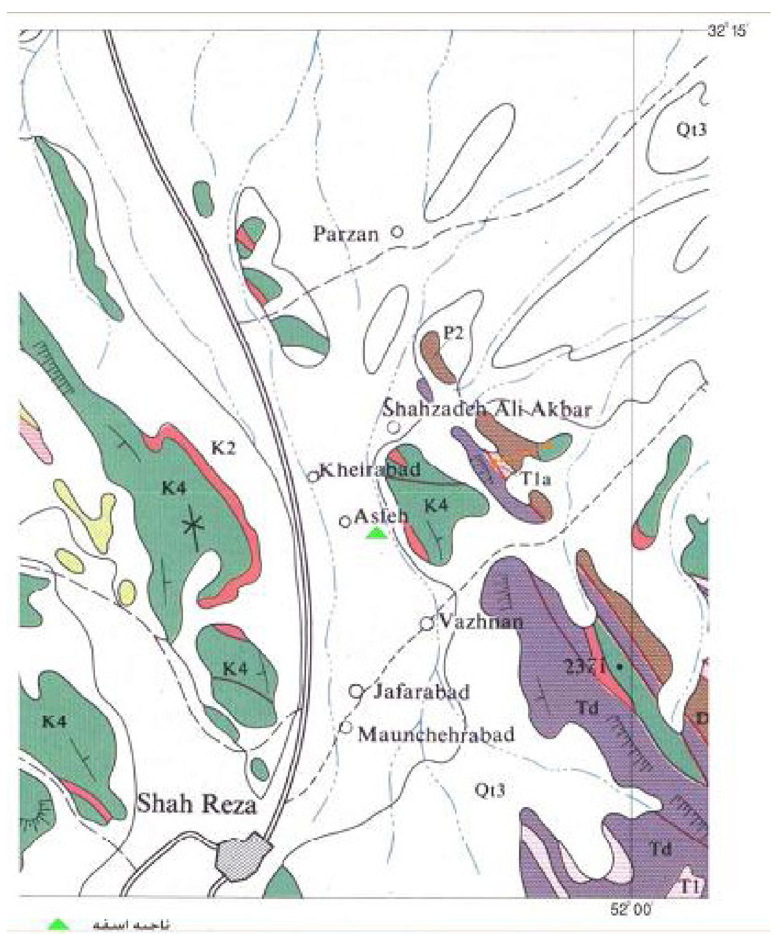


Fig. 2. Geological sketch map of the Esfeh-Shahreza area, showing the location of the Shahzadeh Ali Akbar section.

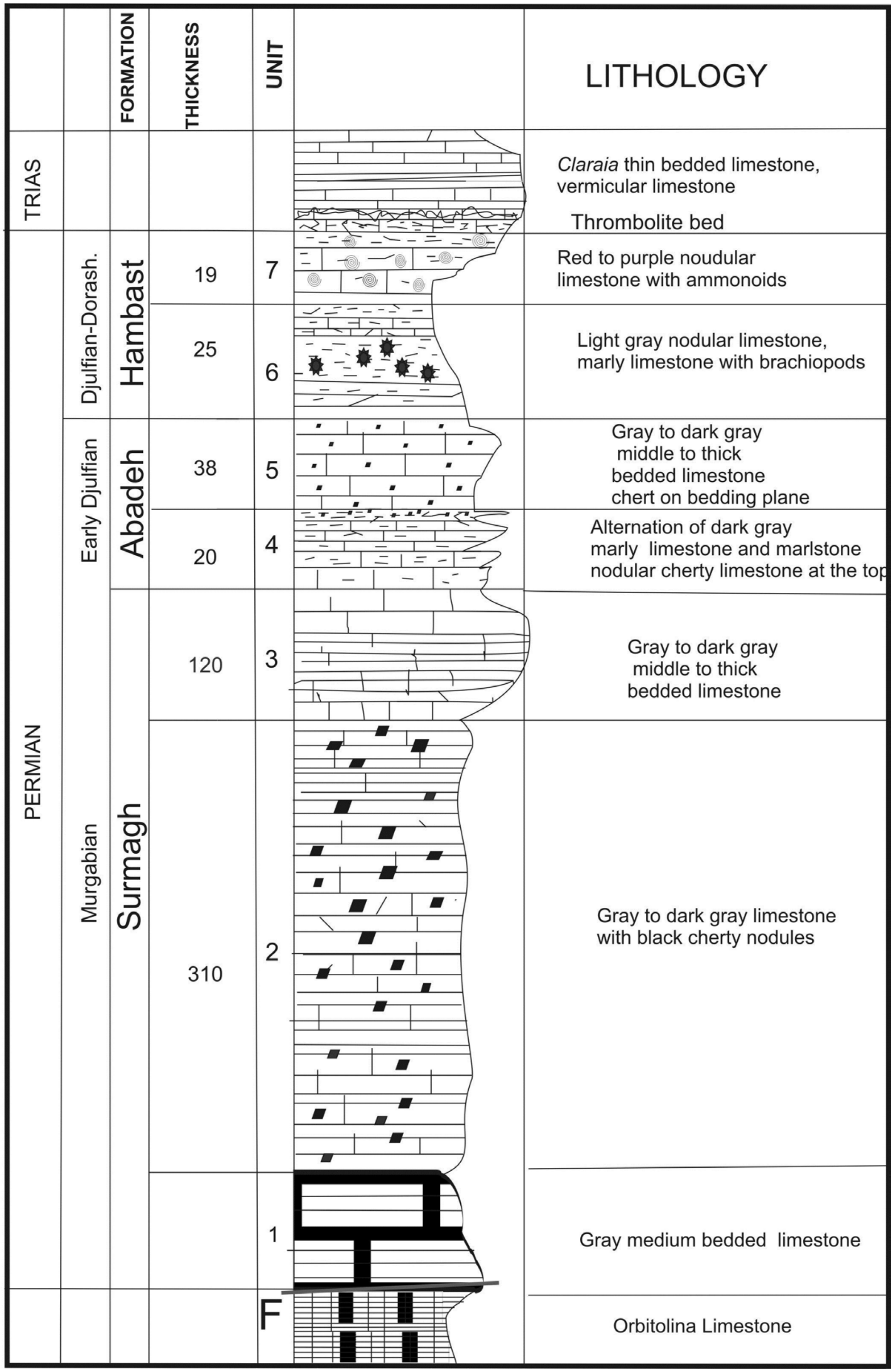


Fig. 3 Stratigraphic log of the Shahzadeh Ali Akbar section.

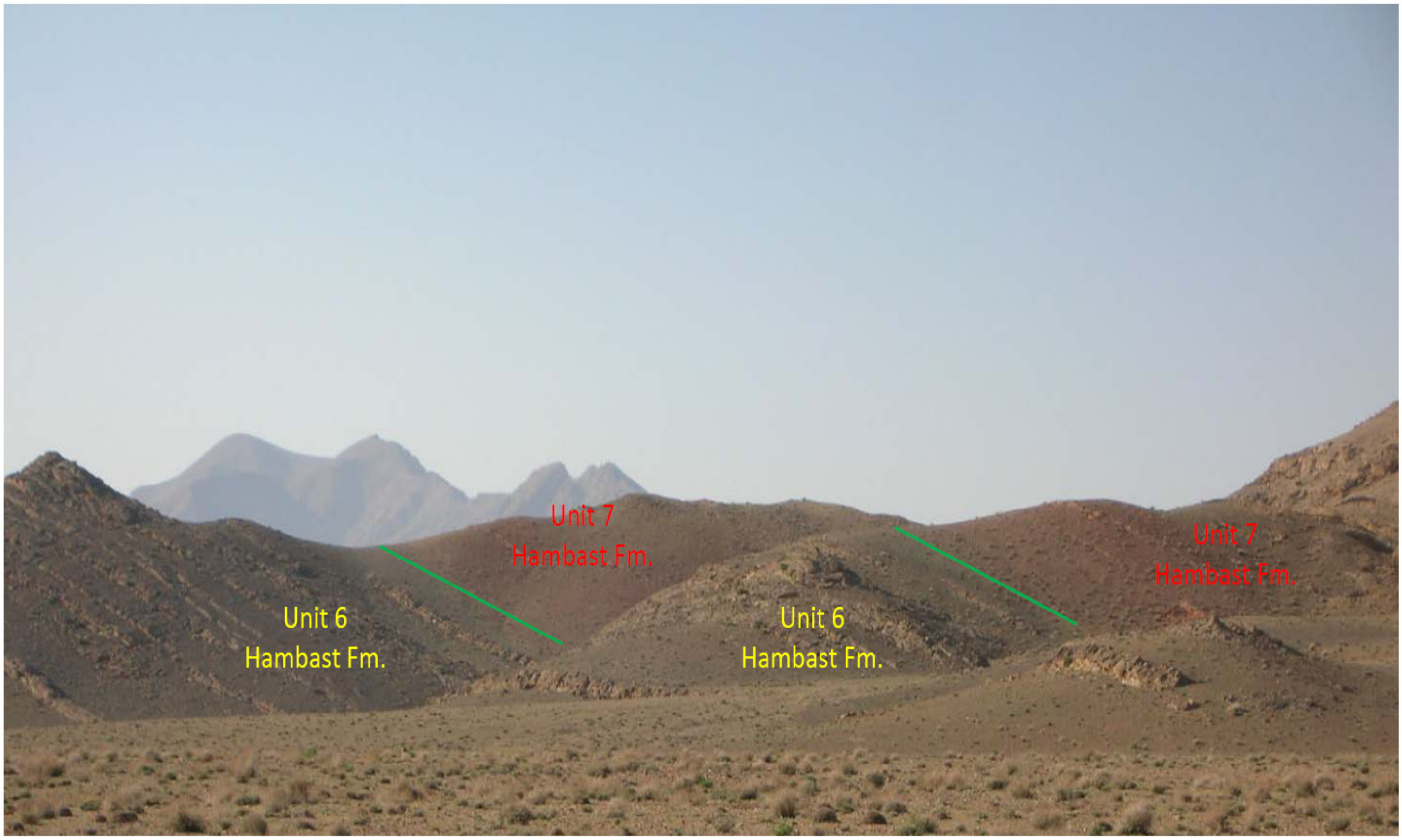
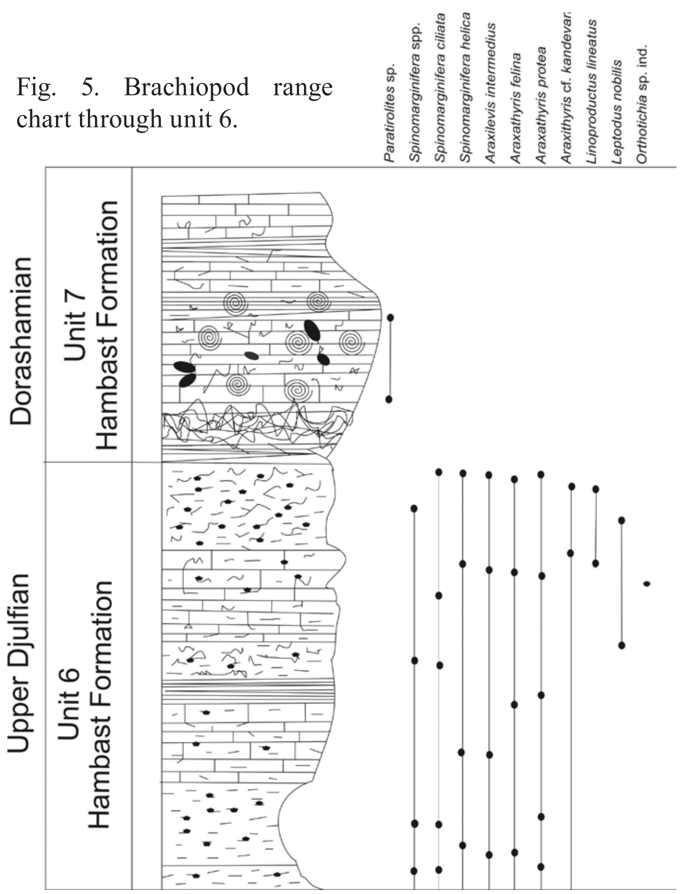


Fig. 4. Panorama of the section showing the Hambast Formation with its units 6 and 7.

Fig. 5. Brachiopod range chart through unit 6.



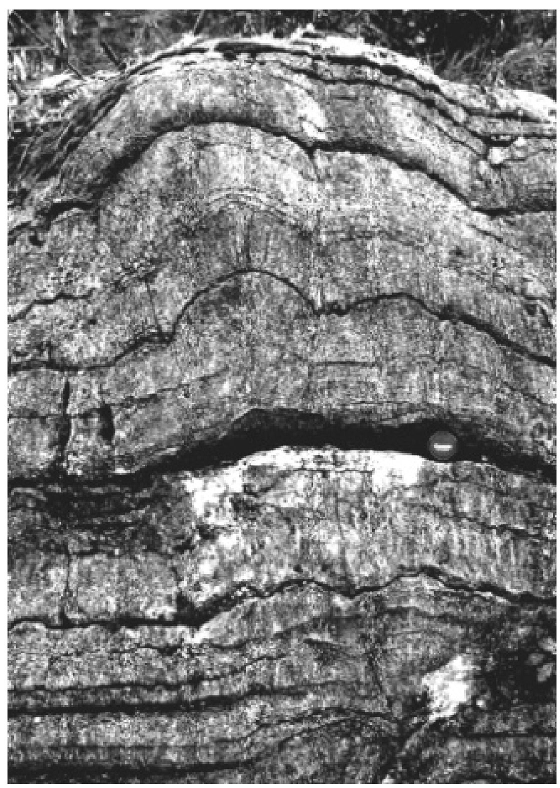


Fig. 6. Thrombolite at the base of the Lower Triassic succession.

very promising section for a detailed study of Permian-Triassic events. It is easily accessible, rich in fossils especially brachiopods and ammonoids and it is continuous through the Permian-Triassic boundary. Not only are the Permian –Triassic beds well exposed, but this section also records a good exposure of the Guadalupian-Lopingian boundary and a remarkable thickness for the Middle Permian.

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Paleomagnetism and Pangea

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Introduction

Paleomagnetism provides critical constraints independent of paleoclimatology on the latitudinal distribution of land masses. Descriptions of the methodology and assumptions of the subject are discussed extensively elsewhere, for example, see Butler (1992) and Tauxe (2010) for a general treatment. A central assumption of paleomagnetism is that when averaged over some thousands of years, the Earth’s magnetic field will be closely approximated by that of a geocentric axial dipole (GAD). This means that an observed mean inclination (I) can be related to geographic latitude (L) according to the dipole formula (tan I = 2 tan L). This assumption has been tested with paleomagnetic observations for the past few million years, whereas for earlier times, evidence for the general validity of the GAD hypothesis comes from the substantial congruence with the inferred latitudinal dependence of various climate indicators (see discussion and references in Kent and Muttoni, 2003).

A temporal sequence of paleomagnetic poles – called apparent polar wander path (APWP) – is a convenient way to represent the motion of a continent with respect to the rotation axis. The axial symmetry of the dipole model of the field (GAD) means that a paleomagnetic pole can be used to determine the position of a tectonic plate only with respect to lines of paleolatitude, leaving paleolongitude indeterminate (Kent and Muttoni, 2003). For the late Mesozoic and younger time, marine magnetic anomalies and other signatures of sea floor spreading provide a precise measure of relative paleolongitudes for most tectonic plates. For the early Mesozoic and earlier time, the matching of geologic or biogeographic features or provinces must be relied upon to provide some constraints on the relative longitudinal distribution of tectonic plates (Kent and Muttoni, 2003). Finally, it should be remembered that paleomagnetic data – like any other type of data – are not uniform in quality or abundance, and therefore, there is considerable variability in the definition and reliability of APW paths for different continents or time intervals. Accordingly, paleogeographic reconstructions are not uniformly constrained and may change as better data become available (Kent and Muttoni, 2003).

Pangea configurations in the Carboniferous–Permian

Although the existence of Pangea during the Late Paleozoic and Early Mesozoic has been decisively demonstrated by a variety of data, uncertainty remains on its precise configuration. A first-order problem is the position of the southern continental assembly of Gondwana with respect to the northern continental assembly of Laurasia. Two general models have been proposed over the years: 1) a supercontinent that maintained a more or less static Pangea A-type configuration over the Late Paleozoic and Early Mesozoic (*e.g.*, Van der Voo, 1993), or 2) a supercontinent that experienced appreciable internal deformation and evolved from a Pangea B-type to a Pangea A-type configuration over this interval (*e.g.*, Irving, 1997; Muttoni et al., 2003).

A Pangea A-type model is the traditional Wegenerian configuration whose salient feature is the placement of northwestern Africa adjacent to eastern North America. The Pangea B reconstruction – first proposed by Irving (1977) and Morel and Irving (1981) – is characterized by northwestern South America placed against eastern North America whereas northwestern Africa is positioned south of Europe. The existence of Pangea B would require about 3000–3500 km of right-lateral relative motion between Gondwana and the northern continents because the Atlantic Ocean opened

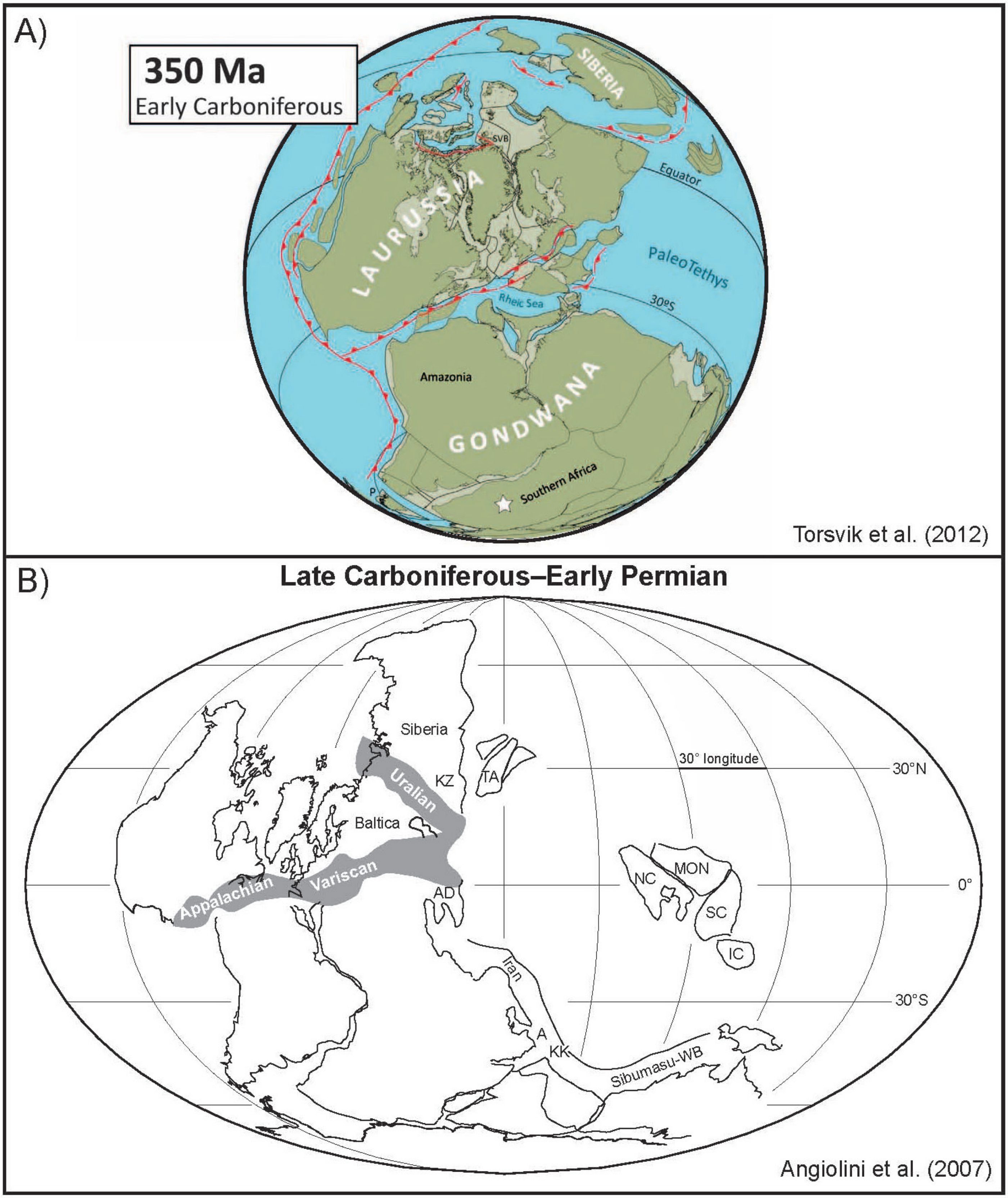

Fig. 1. (A) Paleogeographic reconstruction of Pangea during the Early Carboniferous according to Torsvik et al. (2012). This Pangea bears much resemblance to Pangea B of Irving (1977). (B) Pangea B during the Carboniferous–Permian boundary interval (Angiolini et al., 2007); KZ—Kazhakstan, TA—Tarim, NC—north China, MON—Mongolia, SC—south China, IC—Indochina, WB—west Burma, KK—Karakoram, A—central Afghanistan, AD—Adria.

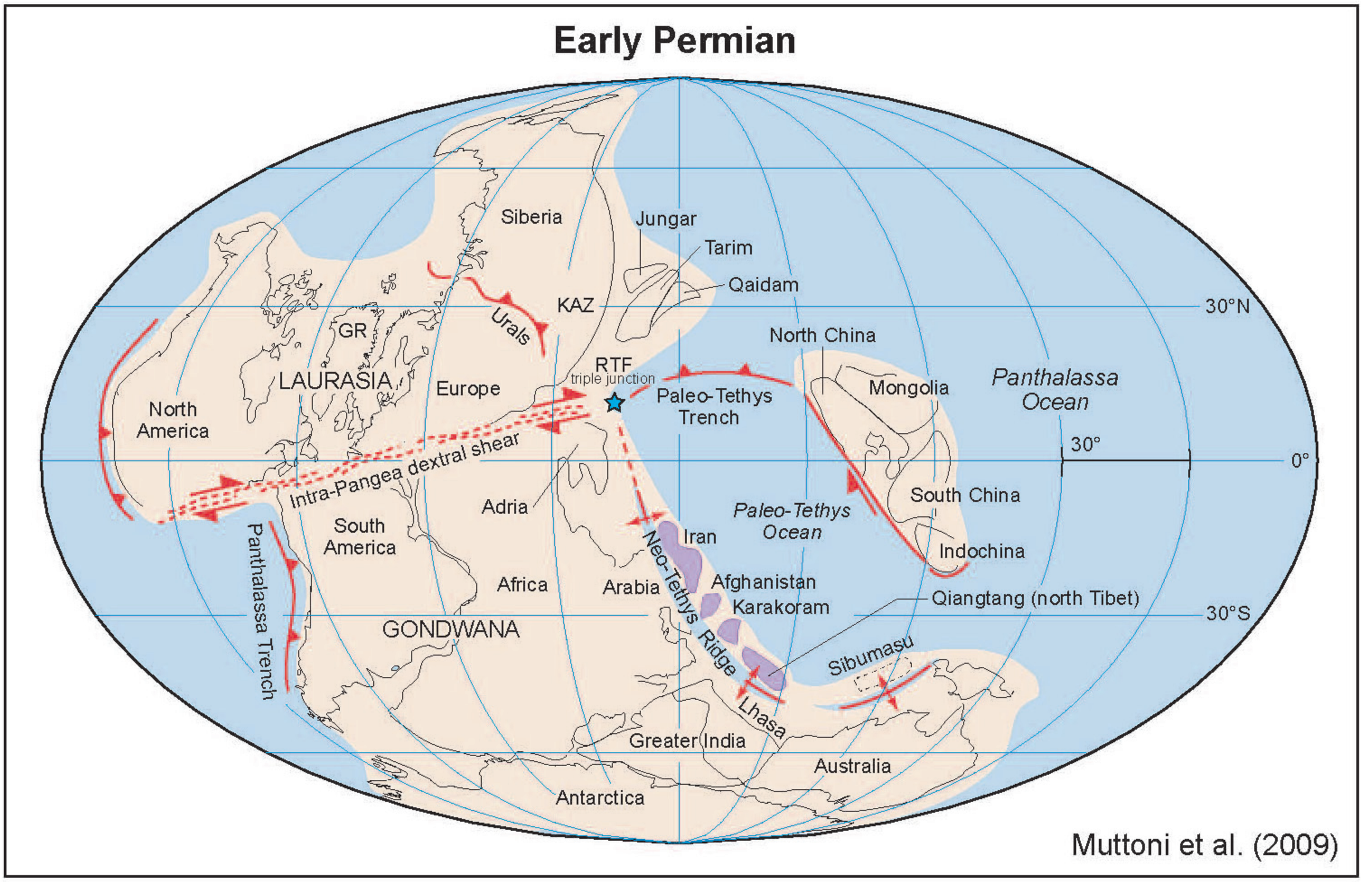

Figure 2. Paleogeographic reconstruction of Pangea B for the Early Permian based on paleomagnetic poles from Muttoni et al. (2009). The star to the northeast of AD–Adria indicates the hypothetical location of a ridge-trench-fault (RTF) triple junction adjoining the Gondwana, Laurasia, and Paleo-Tethys plates. Plate boundaries discussed in the text are, from west to the east, the Panthalassa trench, the intra-Pangea dextral shear system, the Neo-Tethys ridge, and the Paleo-Tethys trench. Trenches are indicated by solid triangles, ridges by small diverging arrows, while half arrows indicate transcurrent plate motion. A–central Afghanistan, AD–Adria, AR–Arabia, IC–Indochina, IR– northern and central Iran, JU–Junggar, KAZ–Kazhakstan, KK–Karakoram, LH–Lhasa, MON–Mongolia, NC–north China, QA–Qaidam, QT–Qiangtang (north Tibet), SC–south China, SIB–Siberia, Sibumasu–Myanmar-Thailand-Baoshan-Malaysia, TA–Tarim. Terranes of uncertain position are represented by dashed lines (i.e., A–central Afghanistan, LH–Lhasa, Sibumasu).

from a Pangea A configuration (Muttoni et al., 2003; 2009). The reality of Pangea B has thus been much debated on the basis of geologic and paleomagnetic data (see Domeier et al., 2011 versus Aubele et al., 2012 for an update on the Pangea controversy).

Early Carboniferous paleomagnetic data from Gondwana and Laurussia support a paleogeographic reconstruction of Pangea very similar to Pangea B (Torsvik et al., 2012) (Fig. 1a). At this time, the Variscan Orogeny is waning and crustal shortening decreasing with the amalgamation of Laurussia and Gondwana. By then, the bulk of Pangea was formed, centred on the equator, and stretching from pole-to-pole (Torsvik et al., 2012).The available paleomagnetic data from Gondwana and Laurasia (Africa and Europe) support Pangea B also in the Late Carboniferous–Early Permian (~315 –285 Ma; mean of ~300 Ma) according to the analysis of Angiolini et al. (2007; Fig. 1b), but see an alternative view by Torsvik et al., 2012. The APWP of Gondwana for the reminder of the Permian and the Triassic is instead generally poorly documented, contributing to the uncertainty in Pangea configurations. To augment the definition of the Gondwana APW in this interval, Muttoni et al. (1996; 2003; 2009) included paleomagnetic data from Adria, the African promontory (Channell, 1996; Muttoni et al., 2003; Muttoni et al., 2013), as a proxy for Gondwana, and by integrating these data with data from Laurasia, generated a tectonic model for the evolution of Pangea from the Early Permian (~284–276 Ma) to the Early Jurassic (~200–190 Ma). According to this model, the reconstruction that satisfies Early Permian paleopoles is virtually the same as Pangea B, as illustrated in Figure 2 (from Muttoni et al., 2009), but see an alternative view by Torsvik et al., 2012. According to Muttoni et al. (2009), the transformation from Pangea B to a Pangea A configuration occurred during the Middle Permian (Fig. 3). Tectonic evidence for this major transformation seems to be preserved in the complex pattern of vertical-axis rotations of crustal blocks in the Mediterranean region (Aubele et al., 2012). By the Late Permian–Early Triassic and into the Middle–Late Triassic, the Gondwana-proxy data from Adria allow a reconstruction resembling a Pangea A model (Fig. 4).

The Permian reconstructions (Figs. 2–4) depict an internally consistent Gondwana–Laurasia–Paleo-Tethys plate circuit. In short,

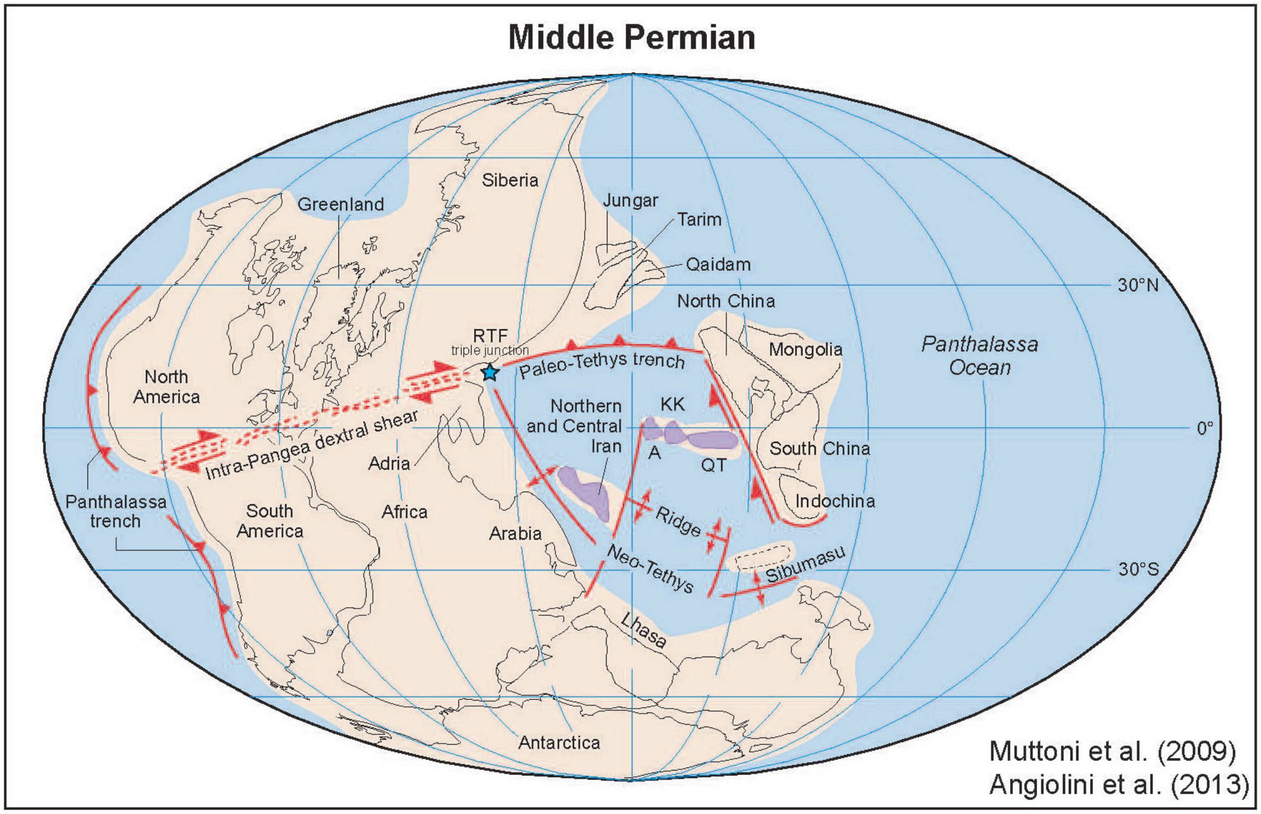

Figure 3. Paleogeographic reconstruction of Pangea undergoing transformation from Pangea B to Pangea A during the Middle Permian; reconstruction based on paleomagnetic poles from Muttoni et al. (2009). Symbols, acronyms, and notes as in Figure 2.

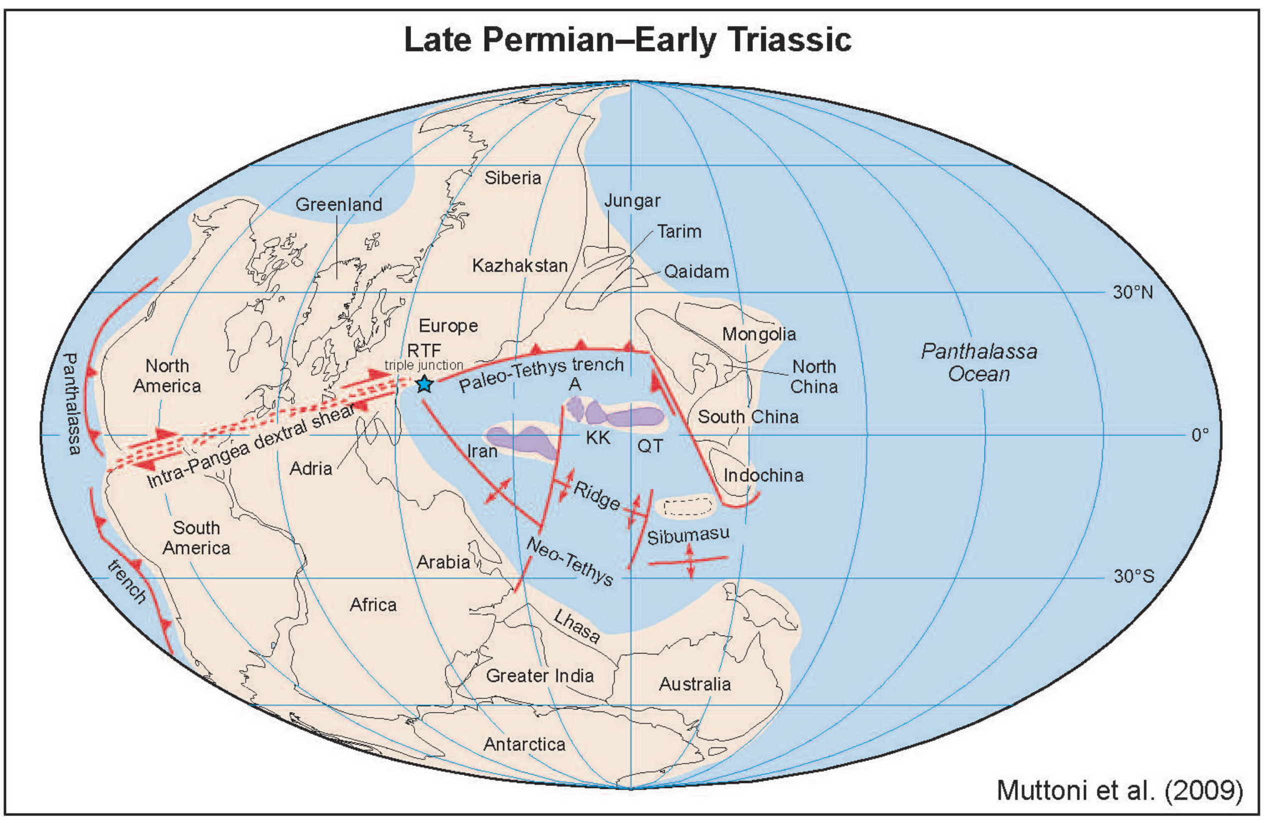

Figure 4. Paleogeographic reconstruction of Pangea A for the Late Permian–Early Triassic based on paleomagnetic poles from Muttoni et al. (2009). Symbols, acronyms, and notes as in Figure 2.

new oceanic lithosphere emplaced at the Neo-Tethyan ridge was in part accommodated by the synchronous subduction of old Paleo-Tethys oceanic lithosphere at the Paleo-Tethyan trench, which was active during most of the Permian–Triassic. The remainder of the Neo-Tethyan oceanic lithosphere was accommodated by the dextral transcurrent motion of Laurasia relative to Gondwana along the intra-Pangea shear system. The motion of Laurasia relative to Gondwana was in turn accommodated by the subduction of Panthalassan oceanic lithosphere along the west side of the Americas (Figs. 2–4). The RTF triple junction where the Gondwana, Laurasia, and Paleo-Tethys plates joined (star in Figs. 2–4) remained presumably stable over the Middle Permian because the intra-Pangean dextral shear system and the Panthalassan trench were broadly aligned along the same great circle transect (see Muttoni et al., 2009 for further information).
The difference between Pangea B and Pangea A is mainly in the relative paleolongitudes of Laurasia versus Gondwana, hence the latitudinal distribution of land areas is not very different in the two alternative reconstructions. However, Pangea B is characterized by a narrow Tethys Ocean, an open ocean to the south of North America, and an orogenic belt (Alleghanian–Variscan) along the equatorial zone (Fig. 1b). In contrast, the Pangea A-type reconstruction has a wide Tethys Ocean and lacks a large ocean to the south of North America (Fig. 4). These and other features of a mobile Pangea have been shown to bear important and largely underestimated implications for Late Paleozoic and Early Mesozoic paleobiogeography (*e.g.,* Angiolini et al., 2007; 2013) and paleoclimate (*e.g.*, Godderis et al., 2008). Paleomagnetic-based paleogeographic reconstructions should be implemented in all modern versions of paleobiogeographic and paleoclimatic models.

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Palynological evidence for diachroneity in the basal Khuff Formation clastics, Middle East

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Introduction

The Guadalupian Khuff Formation represents a major transgressive-regressive cycle deposited along the northern Gondwanan margin across the Arabian Peninsula, Iran (where it is known as the Dalan Formation), and Iraq (Chia Zairi Formation). The Khuff Formation is significant for hydrocarbons, as it is a major regional seal in places such as in the Oman Salt Basin, as well as being one of the largest non-associated gas reservoirs in the world containing amongst others the supergiant North Dome – South Pars Field in the Arabian Gulf. The onset of deposition of the Khuff Formation has been considered by some to be diachronous, younging to the north through the Arabian Plate (e.g.Hughes, 2005).

Palynomorphs are rarely recovered from the Khuff Formation itself, due to inimical preservation conditions in limestone, and modern desert weathering of outcrops. However, the clastic facies, which conformably underlies the Khuff Formation, yields palynomorphs from both the subsurface and exposures. The purpose of this article is to survey the palynological character of these 'basal Khuff clastics' and assess the direct palynological evidence for diachronism.

Locations

Palynology samples were collected in locations across the region illustrated in Fig. 1. The locations include: the Umm Irna Formation of Jordan; the central Saudia Arabia basal Khuff clastics in the-Dilam-1, Nuayyim-2 and Haradh-51 wells; and the basal Khuff clastics of the interior Oman, Huqf area outcrops and Barik-36 well. Details of the palynological assemblages of these locations are described in the following papers: Jordan (Stephenson and Powell, 2013), Saudi Arabia (Stephenson and Filatoff, 2000); and Oman (Stephenson, 2006, 2008, 2011).

Biostratigraphy

The sections discussed are all broadly correlateable within the standard Permian palynological biozonation, known as the Oman-Saudi Arabia Palynological Scheme (OSPZ), which was erected for Arabia in 2003 (Stephenson et al., 2003). The biozonation consists of a framework of eight biozones for the uppermost Carboniferous to Middle Permian rocks in the region. The lower five biozones (OSPZ 1, 2, 3a to 3c) were established in the palyniferous uppermost Carboniferous to Lower Permian sequence in Oman, and to some extent these are recognizable in sequences of central and southern Saudi Arabia, Yemen and Pakistan (Jan and Stephenson, 2011; Stephenson et al., 2013; Stephenson and Al-Mashaikie, 2011).

OSPZ4 and the succeeding two biozones were established in the sporadically palyniferous Middle and Upper Permian sequences of Oman and Saudi Arabia. The base of OSPZ5 is defined by the first appearances of *Hamiapollenites dettmannae* Segroves 1969, *Distriatites insolitus* Bharadwaj and Salujah 1964, *Indotriradites ater* Stephenson 2008, *Playfordiaspora cancellosa* (Playford and Dettmann) Maheshwari and Banerji 1975 and *Thymospora opaqua* Singh 1964. The base of OSPZ6 is defined by the first appearance of *Florinites*? *balmei* Stephenson and Filatoff 2000. This is a very well established datum in Oman having been recorded in numerous subsurface well sections (confidential PDO reports). OSPZ6 has also been widely recognized throughout the Arabian Peninsula and in Iraq (Nader et al., 1994), Kuwait (Tanoli et al., 2008), Turkey (Stolle et al., 2010) and Pakistan (Jan et al., 2009).OSPZ5 is recognizable in Oman and in the subsurface of

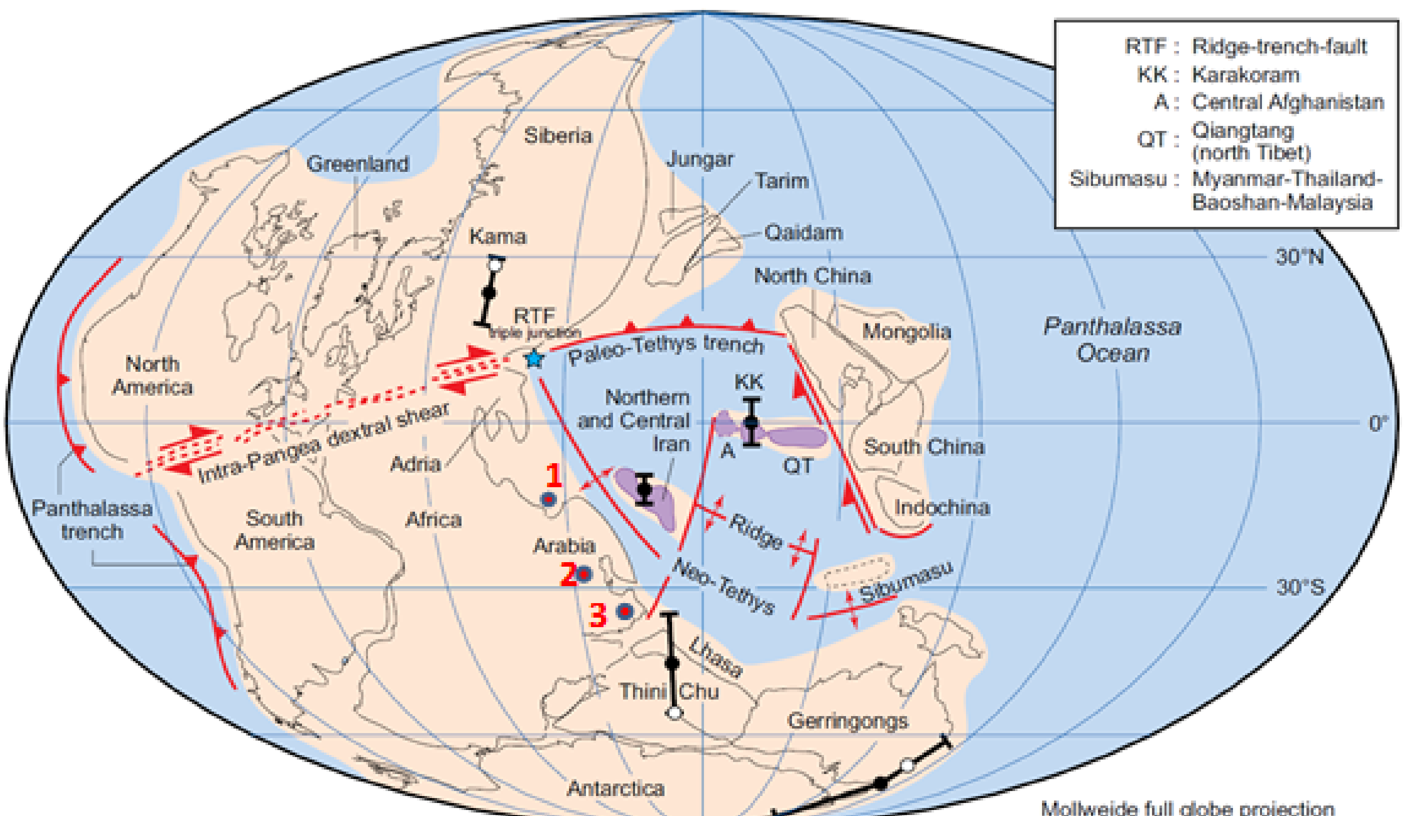

Fig. 1. Middle Permian continental configuration. 1 = Dead Sea Umm Irna Formation ; 2 = central Saudia Arabia Dilam-1, Nuayyim-2 and Haradh-51 wells; 3 = interior Oman, Huqf area outcrops and Barik-36 well (paleogeographic map modified after Muttoni et al., 2009).

the far southeast of Saudi Arabia (Stephenson, 2006).

Palynological assemblages

Assemblages of the Upper Gharif Member in Oman are dominated by bisaccate pollen including distally taeniate bisaccate pollen (mainly *Distriatites insolitus* and *Hamiapollenites dettmannae*; see Stephenson, 2006, 2008, 2011). Spores such as *Indotriradites ater* and *Playfordiaspora cancellosa* also occur, as well as distinctive colpate pollen such as *Kendosporites robustus* Stephenson 2008. Close to the base of the Khuff Formation the assemblages continue to be dominated by bisaccate pollen, but cingulizonate spores become more common. *Florinites*? *balmei* appears and becomes common a few metres below the first carbonates of the Khuff Formation (see Stephenson, 2006, 2008, 2011).

The palynology of the basal Khuff clastics in Saudi Arabia was described by Stephenson and Filatoff (2000) from the Dilam-1, Nuayyim-2 and Haradh-51 wells from central Saudi Arabia. Non-taeniatebisaccate pollen is the most common form in all the sections, and *Alisporites nuthallensis* Clarke 1965, *Lueckisporites virkkiae* Potonié and Klaus emend. Clarke 1965, *Distriatites insolitus, Playfordiaspora cancellosa, Thymospora opaqua* and *Reduviasporonites chalastus* (Foster) Elsik 1999 occur in Dilam-1 and Nuayyim-2 (Stephenson and Filatoff, 2000). Haradh-51 contains all but *Playfordiaspora cancellosa* and *Thymospora opaqua*. Elsewhere in the subsurface of central Saudi Arabia the basal Khuff clastics contain *Pretricolpipollenites bharadwaji* Balme 1970 and *Cedripites priscus* Balme 1970 (Stephenson unpublished PhD thesis).

A number of taxa present in Saudi Arabia are absent from the very numerous Oman sections examined. These include *Camptotriletes warchianus* Balme 1970, *Pyramidosporites cyathodes* Segroves 1967, *Pretricolpipollenites bharadwaji, Cedripites priscus* and *Protohaploxypinus uttingii*. The most distinctive form is *Protohaploxypinus uttingii* which has a characteristically shrunken intexinal body and is one of the smallest multi-taeniate bisaccate pollen known (see Plate 1). It is sometimes very common in the central Saudi Arabian Dilam-1, Nuayyim-2 and Haradh-51 wells (Stephenson and Filatoff, 2000). Extensive subsurface studies in Saudi Arabia have established the upper limit of the range of *Protohaploxypinus uttingii* as immediately above the Middle Khuff Anhydrite unit (Khuff D Anhydrite) (see Stephenson and Powell, 2013), which suggests an age range for Protohaploxypinus uttingii of Wordian-Capitanian to early Wuchiapingian (Middle to early Late Permian).

As discussed above *Protohaploxypinus uttingii* is however entirely absent from the many Gharif Formation and basal Khuff clastics sections examined in Oman. It is known to occur (sometimes commonly) in the overlying Khuff Formation in Oman as it often occurs in the caved components of assemblages derived from cuttings samples from wells that have penetrated the Khuff Formation (confidential Petroleum Development Oman reports). This evidence suggests that *Protohaploxypinus uttingii* has a first occurrence somewhat above the first appearance of *Florinites*? *balmei* (*i.e.* the base of OSPZ6). Its presence in the basal Khuff clastics in central Saudi Arabia therefore suggests that the basal Khuff clastics are younger there than in Oman. Recent work in the Umm Irna Formation of Jordan appears to support the proposition of a basal Khuff clastics sequence younging to the north and west. The Umm Irna Formation is exposed along the eastern Dead Sea shore and is overlain by the carbonate Ma'in Formation, which in part is considered Early Triassic in age (Stephenson and Powell, 2013).

The Umm Irna Formation assemblages are dominated by non-taeniate bisaccate pollen including *Alisporites nuthallensis, A. indarraensis* Segroves 1969 and *Falcisporites stabilis* Balme 1970; also present are *Cedripites priscus, Distriatites insolitus, Playfordiaspora cancellosa, Pretricolpipollenites bharadwaji, Reduviasporonites chalastus*, and *Thymospora opaqua*. These assemblages are very similar to those of the central Saudi Arabia basal Khuff clastics, although the Jordanian assemblages do not contain *Florinites*? *balmei*. *Protohaploxypinus uttingii* is common in the Umm Irna Formation. The Umm Irna Formation also has similar fluvial and paralic depositional environments to those described for the basal Khuff clastics in the subsurface in Oman and the basal clastics of the Khuff Formation at outcrop and in the subsurface in central Saudi Arabia.

A significant difference in the Umm Irna Formation assemblages is the commoness of the non-taeniate bisaccate pollen *Falcisporites stabilis*. This taxon is the most common identifiable palynomorph in the Umm Irna Formation assemblages, and is considered by Kerp et al. (2006) to have been produced by the corystosperm plant *Dicroidium*. Kerp et al. (2006) considered the *Dicroidium* flora to be more typical of the Triassic of Gondwana, but conceded that dating evidence indicates a Permian age (Kerp et al., 2006) in Jordan. The presence of common *Falcisporites stabilis* might indicate that the Umm Irna Formation is even younger than the basal Khuff clastics in Saudi Arabia and therefore that the trend of diachronism present between Oman and Saudi Arabia extends to the north and west to Jordan. Further work is being undertaken to date the lower beds of the Ma'in Formation to test this hypothesis.

Conclusions

The basal Khuff clastics show systematic palynological variation between Oman and central Saudi Arabia in the Middle Permian OSPZ6 Biozone. The distinctive multi-taeniate bisaccate pollen *Protohaploxypinus uttingii*, known to occur in the Khuff Formation of Oman is completely absent in the basal Khuff clastics there. *Protohaploxypinus uttingii* is however common in the basal Khuff clastics of central Saudi Arabia. This pattern of occurrence and the presence of a number of other taxa in central Saudi Arabia that are absent from Oman (including *Pretricolpipollenites bharadwaji, Cedripites priscus, Camptotriletes warchianus* and *Pyramidosporites cyathodes*) provides some palynological evidence for diachroneity in the basal Khuff clastics from southeast to northwest across the Arabian Plate. Limited palynological evidence from the Umm Irna Formation in Jordan may indicate continued diachronism further to the northwest.

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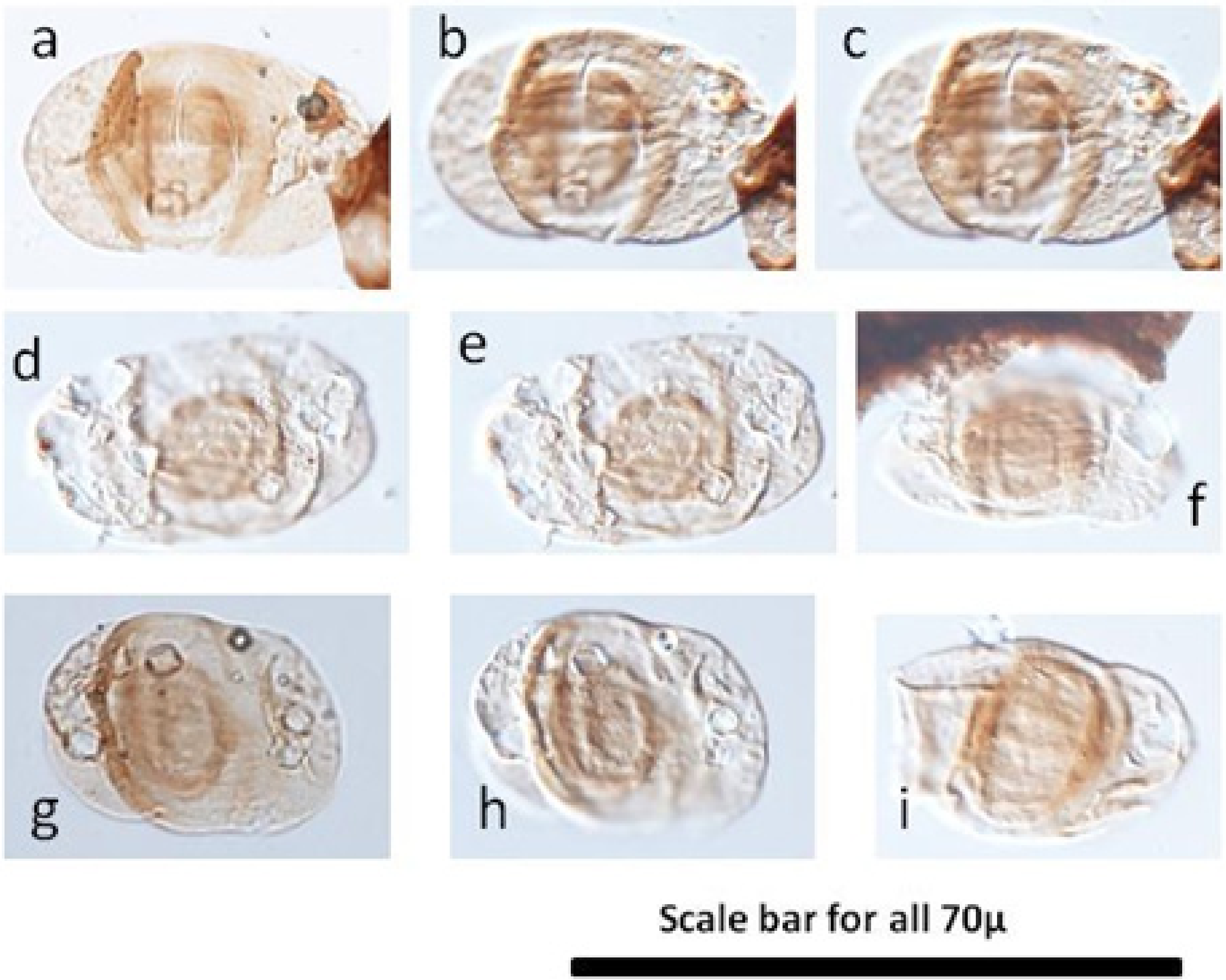

Plate 1. *Protohaploxypinus uttingii* from the Umm Irna Formation, Jordan. Slides are held in the collection of the British Geological Survey, Keyworth, Nottingham, NG12 5GG, UK. Specimen locations are given by England Finder code: a, b, c D53/3, 62253; d, e, F51/4, 62253; f, F46/4, 62253; g, h O52, 62253; i N44/3, 62253.

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The once and future quest: looking for mid-Permian correlation between the Tethyan and the International Time Scales

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During the last three years a group of people, including Lucia Angiolini and Andrea Zanchi of the Universities of Milano (Italy), carried out fieldwork in Tajikistan in order to investigate the geologic setting, stratigraphy and paleontology of the Permian successions. This activity was funded by the DARIUS Programme.

The Permian succession of Tajikistan is very important as it contains the stratotypes of the Tethyan scale established by Leven (1980). The stratotypes of the Kubergandian and Murgabian stages are located in the Gorno-Badakhshan Autonomous Region in SE Pamir, whereas that of the Bolorian stage is located in Darvaz, N Pamir (Fig. 1). It is worth noting the different paleogeographic settings in which the successions have been deposited. The SE Pamir succession was deposited along the Cimmerian blocks on

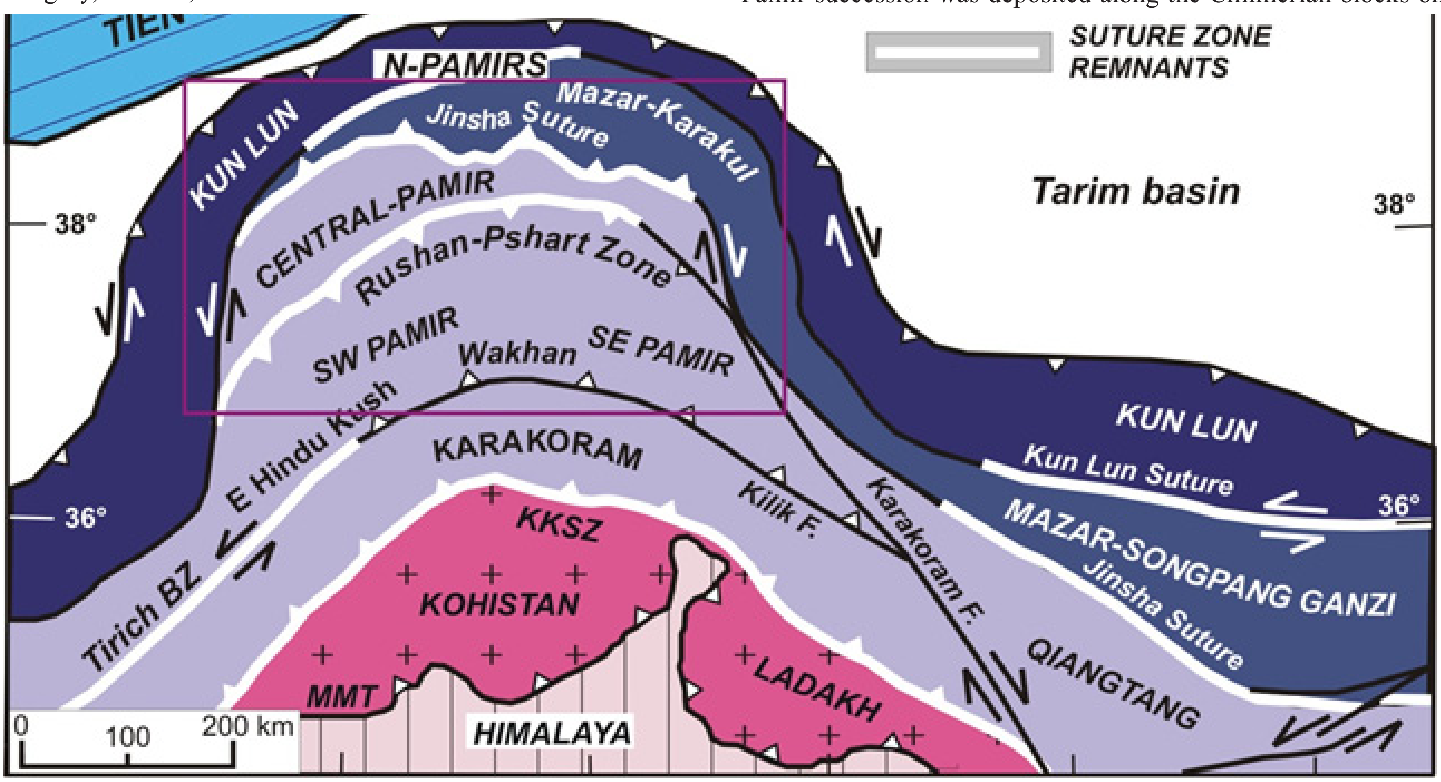

Fig. 1. Present tectonic setting of SE Pamir, a Cimmerian block sandwiched between North Pamir, which represents the Eurasian plate margin to the north and Karakorum, Kohistan/Ladakh and the Indian plate to the south. The North Pamir section is indicated by a yellow star; the SE Pamir sections have been measured in the area outlined by the red square (from Angiolini et al. in press).

Fig. 2. Preliminary results showing possible correlation of the Middle Permian Tethyan stages with the ISC stages.

the southern shore of the Paleotethys Ocean, whereas the N Pamir succession was deposited on the Eurasian margin of the northern shore of the Paleotethys (Angiolini et al. in press).

Studies are still in progress on samples collected along the Pamir stratotypes by a number of scientists including L. Angiolini, F. Berra, C. Henderson, N. Malaspina, A. Nicora, R. Rettori, D. Vachard, G. Vezzoli, I. Vuolo, S. Zanchetta, and A. Zanchi. Preliminary results suggest that the correlation of the Tethyan stratotypes with the International Scale is not an easy task (Angiolini et al. in progress). For instance the concomitant occurrence of conodonts and fusulinaceans seems to support a correlation of the late Kubergandian-early Murgabian to the Roadian as previously suggested by Leven and Bogoslovskaya (2006), but a more problematic correlation for the late Murgabian-Midian (Fig. 2), contradicts previous results (see reference in Angiolini et al., 2008, 2010).

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Amphibia and Reptilia of Permian red sandstones (red-beds) from Glavica hill near Donji Milanovac (Eastern Serbia)

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Abstract. The geological collection of Natural History Museum includes a specimen (small plate) of Permian reddish-brown siltstone from vicinity of Donji Milanovac. Both sides (bottom and top) show marks of tetrapod vertebrate tracks. The concave track on the top side (epichnial undertracks) was already described (Jovanović, 2012). This paper will show convex imprints of tracks on the bottom side of this specimen (hypichnial undertracks).

Keywords
Ichnofossil, cf. *Batrachichnus* isp., cf. *Dromopus* isp., aff. *Charachichnos* isp., Permian, Donji Milanovac, Eastern Serbia.

Description and Comparisons

Sample of red Permian sandstone plate (red-beds). The thin layers forming the top and bottom surface of the plate with tracks and imprints are composed of reddish-brown siltstone, with smooth surface and silky gloss. Their thickness varies from about 0.1 mm to 0.3 mm. The middle layer between the siltstone layers is composed of poorly developed layers of fine-grained to medium-grained sandstone, reddish-brown with numerous tiny, shiny flakes, probably of muscovite and feldspar. There is a single insert of medium-grained sandstone of lighter brown colouring toward the upper surface of the sample (Jovanović, 2012). In addition to tracks and imprints, both the upper and the lower surface also contain shorter, irregular, broken narrow lines, remains of former fractures.

Discussion: The described plate is part of the bottom of a water basin formed during a sedimentation cycle. It started with deposition of silt in still-water environment. Due to some smaller tectonic changes, water in the basin started to flow slowly and deposit fine-grained sand over the silty layer. Additional tectonic

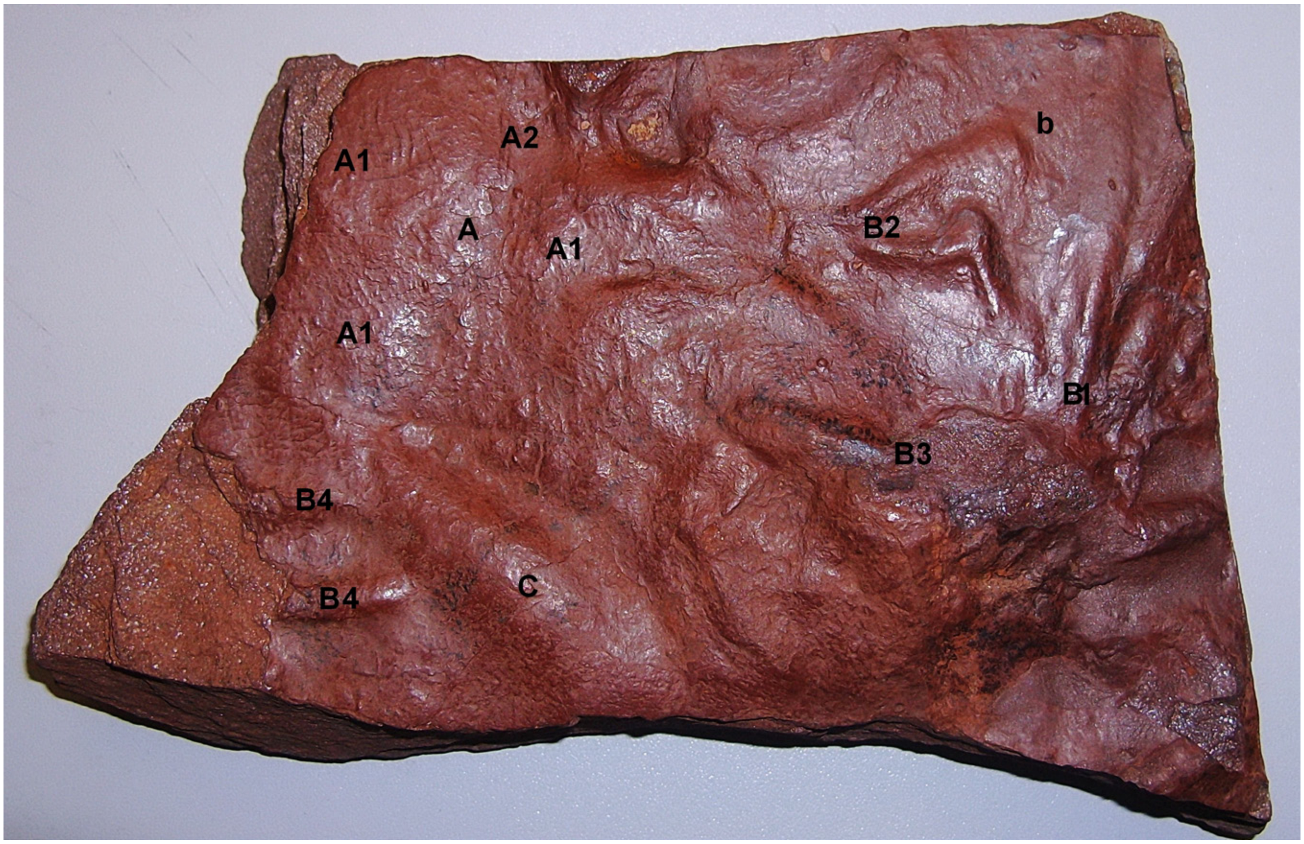

Figure 1. A – Track imprint, ichnogenus cf. *Batrachichnus* isp.; B - Track imprint, ichnogenus cf. *Dromopus* isp. b – Imprint of a claw mark; C - Track imprint, ichnogenus aff. *Charachichnos*.

changes have stopped the water flow so another layer of silt was formed on top. This sedimentation cycle was finished by draining of the water basin. During the course of time silt changed to siltstone while the fine-grained sand turned to fine-grained sandstone.

Description of track imprint:

At the bottom side of the plate there are track imprints (convex, hyporelief). They are presented in Fig. 1 and labeled as A, B and C.

Track imprints A (cf. *Batrachichnus* isp). In the part of plate labeled as A, there are two types of tracks visible in several places, but most probably made by the same organism.

A1 – small tracks made by “scraping”, in the form of three narrow grooves. The scrape tracks are about 5 mm long and about 3 mm wide.

A2 – imprint of track formed by three claws grabbing the substrate. There are two other places in the part of plate labeled with A that show imprints of a single claw mark.

Discussion: Imprints of tracks A resemble ichnogenus *Batrachichnus* with their shape and size (Avanzini et al., 2008; Avanzini et al., 2011; Cassinis, Santi, 2005; Lucas et al., 2005; Lucas, Spielmann, 2009; Lucas et al., 2009; Lucas et al., 2011a; Lucas et al., 2011b; Stimson et al., 2012; Voigt, 2004; Voigt et al., 2011a). Tracks are very well-preserved. During the Permian Period, ichnogenus *Batrachichnus* inhabited Europe and America (ibid).

Track imprints B (cf. *Dromopus* isp).

B1 – This is the most complete imprint of left (?) palm with toes. There are imprints of four toes. The length of first toe imprint is 16 mm and width is 7 mm. It was not possible to measure other toes with any accuracy.

B2 – Imprints of two toes, 17 and 25 mm long and about 4 mm wide. The top of the longer toe shows an imprint of a claw (b).

B3 – Imprint of one toe, about 25 mm long and about 6 mm wide.

B4 – Imprint of two toes, 18 and 16 mm long and 5 mm wide.

Discussion. Track imprints B resemble the shape of ichnogenus *Dromopus* (Avanzini et al., 2011, Cassinis, Santi, 2005, Lucas, Spielmann, 2009., Lucas et al., 2009, Voigt et al., 2011,a,b, 2012). Dimensions of B tracks are greater than those usually cited for ichnospecies *Dromopus lacertoides* (ibid.). They may have belonged either to a large individual of *D. lacertoides* or to a new ichnospecies. During the Permian Period, ichnogenus *Dromopus* inhabited Europe and America, and it was also recorded in the northern Caucasus (Lucas et al., 1999.).

Track imprint C (aff. *Charachichnos*).

There is only one visible toe imprint, about 50 mm long, about 15 mm wide and about 3-4 mm high. The top of the toe is pointed so the mark was possibly left by a claw.

Discussion. Imprint of the toe is matching the spur on the upper side of plate by both shape and size (Jovanović, 2012). According to opinion of Spencer Lucas (pers. comm.), it resembles the ichnogenus *Charachichnos* that used to inhabit USA from the lower part of Middle Triassic to Upper Triassic (Hunt and Lucas, 2007). The more precise determination of imprints C will be possible only when new imprints are found.

Age of the plate with tetrapod tracks

According to track imprints A (cf. *Batrachichnus*) and B (cf. *Dromopus*), it may be assumed that some of the red sandstone of Eastern Serbia are of Lower Permian age (Hunt and Lucas, 2006, Voigt, 2004, Voigt et al. 2011a) matching the results from Romania (Cassinis et al., 2000). The imprint C (aff. *Charachichnos*) supports the hypothesis that large Paleozoic tetrapods used to live in this part of Europe during the Lower Permian.

Paleoecology

Remains of tracks made by ichnogenera cf. *Batrachichnus*, cf. *Dromopus* and aff. *Charachichnos* on the bottom side of a plate of red Permian sandstone and imprint of tracks by ichnogenus aff. *Charachichnos* on the top side of the same plate indicate paleoecological changes within a freshwater lake (perhaps with a river tributary) and at the bottom side of the plate into a still shallow-water environment (top side of the plate).

Conclusion

The collections of Natural History Museum include a sample of Permian red sandstone plate that on the bottom side bears imprints of tracks resembling ichnogenera *Batrachichnus*, *Dromopus* and *Charachichnos*, while the top side bears only imprints of tracks resembling the ichnogenus *Charachichnos*. Presence of this plate supports the hypothesis that in the dry warm desert of Lower Permian, including large parts of late Paleozoic of Eastern Serbia, larger freshwater basins have periodically appeared together with accompanying paleoherpetofauna.

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Editors Note: The paper used the terms alevrolite and alevrite. Google showed that aleurolites (sp?) were rocks of silt-sized particles (according to Great Soviet Encyclopedia). I have substituted the terms silt and “siltstone”. CMH

IN MEMORIAL

Brian Frederick Glenister (1928-2012)

Brian F. Glenister, passed away on 7 June 2012 in Phoenix, Arizona at the age of 83. Brian was a member of the International Stratigraphic Commission and several of its subcommissions. During the last ten years of his life, Brian was especially a guiding member of the Subcommission on Permian Stratigraphy.

Brian was born in Albany, Western Australia on September 28, 1928. He attended the University of Western Australia in Perth where he received a BSc in Physics in 1948. Later, in 1950, he enrolled in the MSc program in geology at the University of Melbourne, receiving an MSc (Geology) in 1952 and in1953, Brian became Lecturer in Geology at the University of Melbourne. In 1956, Brian received a PhD from the University of Iowa, and married Anne Marie Treloar, who preceded him in death in 2010. He returned to the University of Iowa, as a faculty member in 1959 and served as Chair of the Department from 1968 to 1974 and as A. K. Miller Professor of Geology from 1974 until his retirement in 1997.

Brian F. Glenister led a team of researchers, including W. M. Furnish, Zhou Zu-ren and J. Kullmann, in the publication of the Treatise on Invertebrate Paleontology, revised section of Paleozoic ammonoids, published in 2009.

Brian served as titular (voting) member for the Subcommission on Permian Stratigraphy from 1978. He served as chair from 1980 to 1984, during which time, through his personality, commitment, and tenacity he marshaled Permian workers from all corners of the globe into abandoning long-held views and embracing the basics of the International Stratigraphic Code. In this effort, he was instrumental in the establishment of a tri-partite nomenclatural scheme for the Permian System. Especially convincing, following the Permian Congress in Perm, Russia (1991), was Brian's work in the Ural Mountains, in the Guadalupe Mountains of West Texas, and in South China. In these three regions he demonstrated to enthusiastic and reluctant colleagues alike, that these regions offered the best stratigraphic representations for the Lower, Middle, and Upper Permian; the Cisuralian, Guadalupian, and Lopingian series, respectively, and their component stages.

Brian held membership in many geological and scientific societies, including the Geological Society of America and the Paleontological Society; for the latter he served as president in 1988-1989. He was the recipient of the Gilbert Harris Award of the Paleontological Research Institution in 2000. At the 2004 Sixth International Symposium, Cephalopods Present and Past, he received a Lifetime Achievement Award.

Brian's outgoing and forthright personality was an inspiration to many students at the University of Iowa, where, during his tenure of over forty years, he guided and served as mentor to more than fifty MS and PhD students.

In recognition of the high regard held by the Permian community, issue 44 (2004) of *Permophiles* was dedicated to the immeasurable and continuing contributions of Brian Glenister. They no longer continue, but those contributions are lasting and his fingerprint is there in our Permian Time Scale (see new version in this issue). The next time you hear "Waltzing Matilda" give a thought to Brian.

Submitted by Claude Spinosa; edits and minor additions by Charles Henderson

ANNOUNCEMENTS

The Carboniferous-Permian Transition

An international meeting devoted to all aspects of Carboniferous-Permian geology with special emphasis on the Carboniferous-Permian transition.

May 20-22, 2013
Hosted by the New Mexico Museum of Natural History and Science, Albuquerque, New Mexico, USA
Organizing Committee: Spencer G. Lucas (Albuquerque), James E. Barrick (Lubbock), Vladimir Davydov (Boise), William DiMichele (Washington, D. C.), Karl Krainer (Innsbruck), John Nelson (Champaign) and Joerg W. Schneider (Freiberg)

Schedule:
19 May: Pre-meeting fieldtrip to the Carboniferous-Permian transition section at Carrizo Arroyo, central New Mexico (limited to 25 participants)
20-22 May: Talks and posters.
21 May: Afternoon fieldtrip to Late Pennsylvanian Kinney Brick quarry
23-25 May: Post-meeting fieldtrip to Pennsylvanian-Permian rocks exposed in Joyita Hills-Cerros de Amado east of Socorro, New Mexico

Fieldtrips:

Trip 1: Carrizo Arroyo is one of the most paleontologically diverse localities across the Carboniferous-Permian boundary. It exposes mixed marine and nonmarine strata of the Bursum Formation that yield everything from plants and insects to fusulinids and brachiopods. This section plays a key role in global marine/non-marine correlations because of the co-occurrence of conodonts and insect-zone species. Access is difficult, by 4-wheel-drive vehicle over difficult roads, so the number of participants is limited to 25 persons.

Trip 2: The Kinney Brick quarry is a world class Late Pennsylvanian Lagerstätte, located just east of Albuquerque. It is also important for marine/non-marine correlations due to the occurrence of conodonts, fusulinid, branchiosaur and insect zone species. All participants will take an afternoon excursion to the quarry as a break in the meeting technical program

Trip 3: East of Socorro, marine and nonmarine sedimentary rocks of Middle Pennsylvanian-Early Permian age are exposed along the eastern margin of the Rio Grande rift. This is one of the best exposed and most studied Pennsylvanian-Permian sections in New Mexico, and recent work has brought forth diverse paleofloras, detailed conodont biostratigraphy, extensive ichnofossil assemblages, and much more. The three-day trip, headquartered in Socorro, will work through this entire section, focusing on issues of stratigraphy, sedimentation and paleontology.

Symposium proceedings:

Proceedings of the symposium and a field guide will be published by the New Mexico Museum of Natural History and Science. Contributions on all aspects of Carboniferous and Permian geology are appropriate for the proceedings. Contributions to the proceedings can range from abstracts to full length articles. Also, you do not need to attend the meeting to contribute to the proceedings volume.

Editors of the symposium proceedings are the meeting organizers, so please contact one of the organizers for further information.

Deadline for publishable contributions in the proceedings volume will be January 1, 2013.

To register for the Carboniferous-Permian transition meeting next May in Albuquerque, please go to this link:
http://www.brownpapertickets.com/e/297322

For further information contact:

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1st International Congress on Stratigraphy, Lisbon, 1-7 July, 2013

It is with pleasure that the Organizing Committee announces the 1st International Congress on Stratigraphy (STRATI 2013), to be held in Lisbon, 1–7 July 2013.

This congress follows the decision to internationalize the conferences previously organized by the French Committee of Stratigraphy (STRATI), the last one of which was held in Paris in 2010. Thus, the congress possesses both the momentum gained from an established conference event and the excitement of being the first International Congress on Stratigraphy. It is being held under the auspices of the International Commission on Stratigraphy (IUGS), and it is envisaged that this first congress will lead to others being held in the future.

Stratigraphy is a geoscience specialism that involves numerous researchers and practitioners worldwide and has many applications, with growing importance in scientific, technological, economic, and environmental fields. The Organizing Committee welcomes all interested parties to this event and intends to hold a congress of high scientific quality in a friendly and professional environment.

Deatiled information see: **http://www.strati2013.org/**

XVIII INTERNATIONAL CONGRESS ON CARBONIFEROUS AND PERMIAN

KAZAN, RUSSIA, August 7-15, 2015

Dear colleagues:

It is the honor and our pleasure to invite you to the XVIII International Congress on Carboniferous and Permian to be held in the Kazan Federal University, city of Kazan, Russia, in August 2015.

Venue

The city of Kazan is one of the ancient cities in Russia . The population is 1,2 million people. It is cultural and industrial center included in UNESCO World Heritage list. The combination of the Muslims and Christian monuments create the unique atmosphere and scenery. The city of Kazan is easy available from Europe through Frankfurt, Moscow and Saint-Petersburg. The location of

Kazan in the center of the European Russia allows to propose the observation of the variety of sections and outcrops located in the several districts of Russia.

Host and Conference Language
The XVIII ICCP will be held in the Kazan Federal University on August 7-15, 2015. The official congress language will be English.

Congress topics
Carboniferous and Permian high resolution stratigraphy
Carboniferous and Permian stage boundaries and worldwide correlation - progress and perspectives
Climatic and biotic changes during Late Paleozoic glaciation
Permian continental biota- approach to a new geochronological scale
Non-marine Late Paleozoic world - paleogeography, migration, fauna and flora
Sedimentary sequences and depositional environments during Carboniferous and Permian
Carboniferous and Permian marine biota

Geological excursions:
Pre-congress excursions:
1a. Lower Carboniferous of the Saint-Petersburg region (northwestern Russia).
1b.Moscow basin. Stratotypes of the Serpukhovian, Moscovian, Kasimovian and Gzhelian stages.
1c. Southern Urals. Deep water successions of the Carboniferous and Permian.
1d. Middle Permian – Lower Triassic continental sequences in Vologda and Arkhangelsk regions (North of the European Russia) and localities of flora, tetrapods, non-marine fishes and invertebrates.
Post-congress excursions
2a. Volga and Kama Region. Middle and Upper Permian.
2b. Central Urals. Carboniferous-Permian marine succession.
2c. Carboniferous reference sections, Southern Urals.
2d. Permian of Omolon massif, North-Eastern Russia
Mid-congress excursion:
3. Permian deposits along the Volga River.
Accommodations. A large variety of hotels is available in the city of Kazan.
Organizing committee
A.S.Alekseev, I.V.Budnikov, A.S.Byakov, B.I.Chuvashov, I.R.Gafurov, V.G.Golubev, N.V.Goreva, O.L.Kossovaya, G.V.Kotlyar, E.I.Kulagina, D.K.Nourgaliev, S.V.Nikolaeva, V.V.Silantiev
For further information, please contact: iccp2015@ksu.ru
The information will be also available through web site: www.iccp2015.ksu.ru
Organizers: Russian Academy of Sciences, Interdepartmental Stratigraphical Committee of Russia, Carboniferous and Permian Subcommissions of Russia, Kazan Federal University, Moscow State University, All-Russian Research Geological Institute,
International Subcommission on Carboniferous Stratigraphy
International Subcommission on Permian Stratigraphy

SUBMISSION GUIDELINES FOR ISSUE 58

It is best to submit manuscripts as attachments to E-mail messages. Please send messages and manuscripts to Lucia Angiolini's E-mail address. Hard copies by regular mail do not need to be sent unless requested. Please refer to Issue #46 of *Permophiles* (*e.g.* Nurgalieva *et al.*) for reference style, format, *etc.* Please provide your E-mail addresess in your affiliation. All manuscripts will be edited for consistent use of English only.

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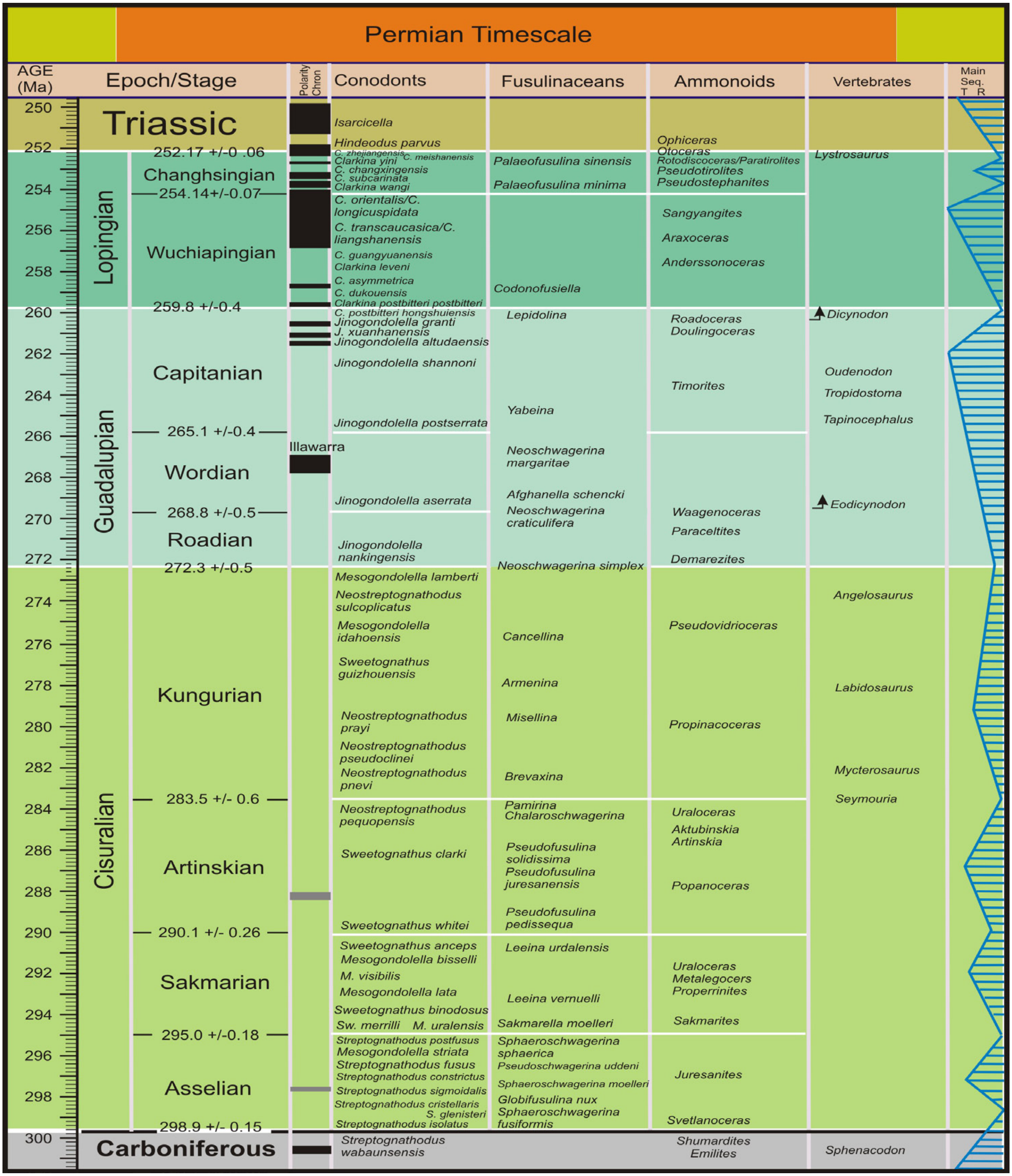
Submission Deadline for Issue 58 is
August 30, 2013



Note: This is the latest version of the Permian timescale which SPS recommend. We welcome any comments to improve it. All the information will be updated from time to time here. Geochronologic ages are combined from Shen et al., 2011 (Science) for the Lopingian; Schmitz and Davydov, 2012 (GSA Bulletin) for the Cisuralian, Henderson et al. (2012, *Permophiles*) for the base of Kungurian and the current ICS International Chronostratigraphic Chart for the Guadalupian. Tetrapod biochronology is after Lucas (2006, Geological Society, London, Special Publications, Vol. 265, p. 65-93).