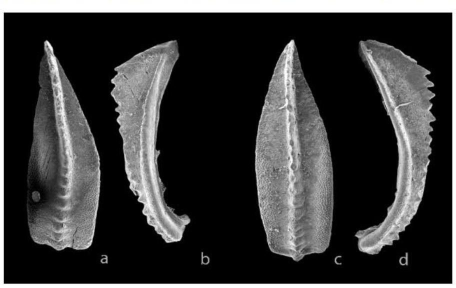
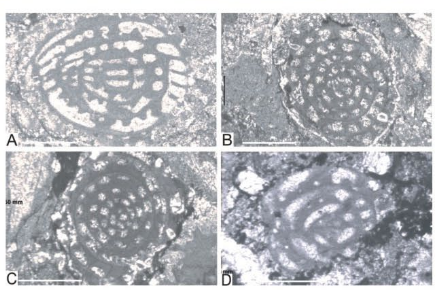
Permophiles

International Commission on Stratigraphy





Newsletter of the
Subcommission on
Permian Stratigraphy
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Lucia Angiolini

Introduction and thanks

During this unusually warm winter, but, as usual, very busy time, Shuzhong Shen and I prepared this issue of Permophiles 62, via email, as we had not the opportunity to meet *de visu*.

In this foreword, I would like to let the Permian community know about the great honour received by our chair, Dr. Shuzhong Shen, who was appointed as a new Academician of the Chinese Academy of Sciences in 2015. We congratulate our chair for this very important achievement which sheds light also on the Permian Subcommission and Permian scientific community.

Unfortunately, we did not receive many contributions from our Permian colleagues for this issue, but those received (some at the very last minute!) keep the discussion very active and promote good science, making this issue interesting to read. So I want to thank Joerg Schneider and Shuzhong Shen, Gerhard Bachmann, Lucas Spencer, Mike Stephenson, Claudio Garbelli, Abdalla Abu Hamad and coauthors and Balini and coauthors for their interesting contributions.

Also, I would like to thank Claudio Garbelli for his assistance in editing this and previous issues of Permophiles.

Finally, I would like to keep drawing your attention to the new SPS webpage that Shuzhong Shen has provided at http://www.stratigraphy.org/permian/, where you can find information about Permophiles, what's going on in the Permian Subcommission, an updated version of the list with addresses of the SPS corresponding members and, very important, the updated Permian timescale.

Previous and forthcoming SPS Meetings

The last business meeting was held during the XVIII International Congress on the Carboniferous and Permian at the Kazan Federal University (Volga region), about which Schneider & Shen report in this issue (p. 5).

A forthcoming SPS meeting is scheduled during the 35th International Geological congress which will be held at Cap Town, South Africa at the Cape Town International Convention Centre from 27 August to 4 September 2016.

Permophiles 62

This issue starts with the report by Schneider and Shen on the XVIII International Congress on the Carboniferous and Permian 2015 held in Kazan, Federal Republic of Tatarstan, Russia, on August 11-15, 2015. During this important meeting some decisions were made, among which was the approval of the Usolka section as a candidate for the GSSP of the Sakmarian Stage, and the necessity to better excavate and further study the Mechetlino and the Dalniy Tyulkas sections.

A second report, written by Gerhard Bachmann, concerns the12th International Workshop on the Permian-Triassic / Boreal Triassic II Conference, held in Longyearbyen/Svalbard, Norway, August 28–September 1, 2015. During the workshop new data on the Permian-Triassic succession of the region were presented and the spectacular outcrops of the fossiliferous Permian succession were visited, as nicely described and illustrated by Gerhard Bachmann.

The next report is by Spencer Lucas, who vividly recounts the history of the Permian at the dawn of its recognition by Murchison in 1841. As originally understood, the base of the Permian was younger than as meant today, but subsequent studies and correlation with the European succession allowed the downward extension of its base. Also, Spencer Lucas explains why, notwithstanding its early recognition, the Permian was universally accepted only by the Second World War.

Lucia Angiolini and Daniel Vachard present a summary of the main results achieved during their study of the Permian successions of South and North Pamir which is, in part, already published. While underscoring the difficulties correlating the Tethyan stages and the International Stratigraphic Scale due to provincialism, endemism, and diachroneity, the authors nevertheless suggest a possible correlation of the Bolorian, Kubergandian and Murgabian with the Kungurian to Wordian stages.

Mike Stephenson critically discusses the biostratigraphical value of the widespread and distinctive bisaccate pollen *Lueckisporites virkkiae,* which has long been considered useful for correlation in the Permian phytogeographical province of Euramerica. Integration of radiometric dates with palynological biozones in South America seems to cast doubt on its isochronous first occurrence, but Mike Stephenson concludes that its biostratigraphic value as a marker for the Guadalupian might be maintained if the original concept of *Lueckisporites virkkiae* Potonié & Klaus 1954 is followed.

The contribution by Claudio Garbelli comments in general on the exponentially increasing number of research papers on the end Permian mass extinction, seeking clarity over the trigger and killing mechanisms and calling for a more holistic approach which also considers biotic factors in interpreting timing and causes of exctinction.

Abdalla Abu Hamad and coauthors describe the poorly known non-marine faunal content of the transitional continental-marine Upper Palaeozoic/Lower Mesozoic sequence of the eastern Dead Sea region in Jordan, which is otherwise well known for hosting one the most remarkable Permian floras of the Near East. The authors report conchostracans from the Himara and Nimra members of the Ma'in Formation. Those from the Nimra Member belong to species of *Rossolimnadiopsis*, which, accoding to the authors, is a promising biostratigraphic tool for the Permian/Triassic boundary in continental successions.

The last contribution is by Marco Balini and coauthors, who describe Upper Pennsylvanian ammonoids and Lower Permian conodonts from the Bagh-e-Vang area of Central Iran. These findings have important implications for the dating of the top of the

Sardar Formation which seems to postdate the Gzhelian in this area, and for the calibration of the conodont based age with the fusulinid based age of the basal Bagh-e-Vang Member.

Future issues of Permophiles

The next issue of Permophiles will be the 63th issue.

Contributions from Permian workers are very important to move Permian studies forward and to improve correlation and the resolution of the Permian Timescale, so I kindly invite our colleagues in the Permian community to contribute papers, reports, comments and communications.

The deadline for submission to **Issue 63** is **1st June, 2016**. Manuscripts and figures can be submitted via email address (lucia.angiolini@unimi.it) as attachments.

To format the manuscripts, please follow the TEMPLATE that you can find on the new SPS webpage at http://permian.stratigraphy.org/ under Publications.

We welcome your contributions and advices to improve the webpage as we move forward.

Notes from the SPS Chair

Shuzhong Shen

Time is flying and the year 2016 comes to us quickly. This is a time when all worries and sorrows are left behind and the only rule is to be merry and celebrate. On behalf of the Permian Subcommission on Stratigraphy, I would thank our Vice-Chair Joerg Schneider and Secretary Lucia Angiolini for their very hard work during the last four years; thanks are also given to other 14 voting members and all other colleagues in the Permian community for their support and contributions to the Permian studies and Permophiles. So far, we have published more than 62 issues. The term of the current SPS executive committee will end in middle August, 2016 when the International Geological Congress held in Cape Town, South Africa. A ballot prepared by SPS former chair Charles Henderson was sent to the 14 SPS voting members (Joerg Schneider, Lucia Angiolini and myself are not included) and 5 honorary members asking whether they supported a second term for the current executive committee. The results indicate that the SPS executive has been elected to a second term. I would thank Charles Henderson for organizing such an important procedure. According to the ICS rule, some of our voting members will be replaced too, please let us know if you have candidates who are actively involved in the Permian community.

We are slow to finish the remaining Cisuralian GSSPs in the Permian System. During the XVIII International Congress on the Carboniferous and Permian Stratigraphy held in 2015 in Kazan, Russia and the pre-congress field excursion in southern Urals, I presented to all participants the main pitfalls of the potential GSSP candidate sections in southern Urals, Russia. I agree that the Sakmarian-base candidate at Usolka is good because it has excellent exposure, and contains abundant conodonts, some fusulinids and ash beds which were precisely dated by Ramezani Jahan, Mark Schmitz and Vladimir Davydov. Chemostratigraphy is also available at the Usolka section. However, the candidates for the Artinskian-base at Dalny Tulkas and the Kungurian-base at Mechetlino Quarry and Mechetlino sections are heavily covered by weathered deposits, and the outcrops are not thick enough to serve as as GSSPs. I am very glad to see that our Russian colleagues immediately organized a meeting during the ICCP 2015 to discuss how to solve the natural pitfalls of the sections. I hope that the excavation of the Mechetlino Quarry section and the Dalny Tulkas section will be completed soon, so international colleagues can go to those sections to investigate more about the conodont biostratigraphy and chemostratigraphy in the near future. I also hope we can move forward to the voting for the Sakmarian-base GSSP candidate at Usolka shortly, after Valery Chernyk provides me more conodont data from the Usolka section. We need more data preparation for the proposal of the Sakmarian-base GSSP candidate before we can send out for voting.

I would like to thank Jonena Hearst and Lance Lambert for their guidance and support for the field work on the Guadalupian Series in the Guadalupe National Park in West Texas, and Bruce Wardlaw for his very useful discussion on the conodonts from the sections. As a part of the GSSP work, we have organized two trips to collect samples from the GSSP sections. So far, the official papers on the three Guadalupian GSSPs, which are usually published on Episodes, have not been published yet.

I would also thank Joerg Schneider for his great efforts to organize the joint working group of the Carboniferous-Permian marine and non-marine correlation around the Carboniferous-Permian transition. I hope more and more colleagues will be interested to join in this working group.

In addition, Spencer Lucas and I have organized a Special Publication of the Geological Society of London on "The Permian Timescale." This special volume will brings together state-of-the-art reviews of the non-biostratigraphical and biostratigraphical data that are used to define and correlate Permian time intervals, present comprehensive analyses of Permian radio-isotopic ages, magnetostratigraphy, isotope-based stratigraphy and timescale-relevant marine and non-marine biostratigraphy. We expect this publication before the end of 2016.

Finally, I wish all colleagues a happy, healthy and prosperous 2016!

SUBCOMMISSION ON PERMIAN STRATIGRAPHY
ANNUAL REPORT 2015

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Permian Stratigraphy (SPS)

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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 2014

The proposals of the Sakmarian-base and Artinskian-base GSSPs have been published in Permophiles (Issue 58). After the proposals were published, we received a couple of comments and discussions on the conodont taxonomy for the index species and quality of the sections from the working group members, which have also been published in the subsequent Permophiles 59. Since discrepancies on the taxonomy of conodonts and selection of the conodont index species for the definition of the two GSSPs are present in the working group, a special workshop on these issues were discussed in a business meeting during the ICCP 2015 in Kazan. The Russian Stratigraphic Committee agreed to excavate the sections and organize another joint field excursion during 2016.

In addition, we organized an international group to do the second joint field excursion on the Guadalupian Series in West Texas in April, 2015. During this field excursion more than 800 kg samples were collected for conodont and high-resolution geochemical analyses. Seven ash bed samples were collected.

3b List of major publications of subcommission work (books, special volumes, key scientific paper)

Three issues of Permophiles (Issues 60, 61 and 61 suppl.) have been published since June, 2014.

An updated Permian timescale has been published in the proceeding volume of STRATI 2013 by Shen and Henderson (2014). A special issue titled "The Permian Timescale" has been organized by Spencer Lucas and Shuzhong Shen. This will be published on Geological Society of London, Special Publications in 2016.

3c. Problems encountered, if appropriate

We have encountered problems that discrepancies in conodont taxonomy and selection of the index species of the two proposals for Sakmarian-base and Artinskian-base GSSPs are present. The section for the Kungurian-base GSSP in southern Urals is still too short as a GSSP section. The Russian Stratigraphic Committee promised to excavate the section as soon as possible.

We also met a problem for the Lopingian-base GSSP which will be flooded after a dam established in 5 years for electronic power in the downstream of the Hongshui River in Guangxi, South China. We have extensively discussed with the local government and a detailed plan for searching the replacement of the GSSP section nearby the GSSP has been made. Field work to search replacement section in South China was carried out too during 2015.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015)

The primary objectives are to complete the last three GSSPs (Sakmarian, Artinskian, and Kungurian stages). The Russian Stratigraphic Committee has made a plan to excavate the section, then SPS will organize an international joint field excursion to collect various samples. In addition, the chair of the Sakmarian-base GSSP Working Group, Valery Chernyk, has agreed during the ICCP 2015 in Kazan to provide the detailed taxonomic data for the section to complete the GSSP proposal for voting soon.

4b. Specific GSSP Focus for 2015

The priority of 2015 for GSSP is to send the Sakmarian-base GSSP proposal for voting in the Working Group and SPS.

5. SUMMARY OF EXPENDITURES IN 2015

1) As planed in the Annual Report 2014, a field excursion on the three potential GSSP sections in southern Urals was organized by Valery Chernyk (18th ICCP) partly under the support of SPS. We invited all voting members to attend the field excursion, six voting members finally attended the excursion, four of them are supported by SPS (1980 US$). In addition, we also supported the vice-chair for his field trip to the terrestrial PTB sections in Kazan (440 US$)
2) A session and an SPS business meeting on the Permian GSSPs were organized during the 18th ICCP meeting (580.54US$).
3) Supporting a part of Lucia Angiolini's stay in Nanjing in May, 2015 and editing Permophiles (US$1000).
4) A second field excursion for the three GSSPs of the Guadalupian Series in the Guadalupe National Park was organized in April. This costed a lot of money which is mostly covered by Shuzhong Shen's project, approximately 1000US$ was used for the field trip.

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2016

1. Shuzhong Shen will organize a session in the 35th IGC which will be held at Cap Town, South Africa and attend the ICS business meeting during the 35th IGC. This will cost more than US$2000. It depends upon how much ICS will support to cover his trip to Cap Town.
2. SPS secretary Lucia Angiolini will be invited to Nanjing to edit the next Permophiles and work on the proposal for the three Cisuralian GSSP proposals (1000US$).
3. A working group led by Valery Chernykh will excavate the Kungurian-base and Artinskian-base GSSP sections in southern Urals. The Working Group will invite SPS voting members to work on those sections. SPS will partly support this important activity with a total amount (US$2000).
4. A workshop organized by the Marine and non-marine Working Group (Joerg Schneider) will be held in the late 2016. SPS will try to support this workshop for 1000US$ depending upon how much ICS will support SPS.

In total: **US$6000**

APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2010-2015)

1) A new SPS website has been established.
2) Three GSSP bronze markers have been placed on the GSSPs in the Guadalupe National Park in USA.
3) A high-resolution timescale of the Permian system has been significantly refined (see SPS webpage Permian Timescale).
4) SPS decided to search new GSSP candidate for the Kungurian Stage after an investigation on the previous candidates. Now two candidates for the Kungurian-base GSSP are available, but further work is necessary before a voting process is conducted.
5) Significant progress on the Sakmarian-base and Artinskian-base GSSP candidates has been made. Proposals for voting have been published and extensively discussed.
6) Two monuments have been built and a protected area has been established at Penglaitan, Laibin, Guangxi Province, China for the Wuchiapingian-base GSSP.
7) Seven formal issues and three supplementary issues of Permophiles have been published since 2010.
8) A Working Group on the Carboniferous-Permian transition between marine and non-marine sequences has been organized in 2015.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015-2019)

1) Publishing the revised version of the proposals, organizing the field excursions and establishing the three (at least two) GSSPs for the Cisuralian.
2) Continue to work on the Guadalupian and global correlation for chemostratigraphy and geochronologic calibration. Publish the official papers for the three Guadalupian GSSPs.
3) Searching the replacement of the Lopingian-base GSSP nearby the stratotype section at Penglaitan, Guangxi, South China because the original will be flooded in 5-10 years by a dam for electronic power.
4) Developing a large working group on the correlation between marine and continental sequences. This has already been organized.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

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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; Chair-Valery Chernykh.
3) Guadalupian Series and global correlation; Chair-Charles Henderson.
4) Correlation between marine and continental Carboniferous-Permian Transition; Chair-Joerg Schneider.
5) Neotethys, Paleotethys, and South China correlations; Chairs 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 in 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. In 2014, SPS chair Shuzhong Shen organized an international cooperative project on the correlation of the Guadalupian Series between South China and Mt. Guadalupe in Texas, USA, which has been approved by NSFC.

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REPORTS

Report on the XVIII INTERNATIONAL CONGRESS ON THE CARBONIFEROUS AND PERMIAN 2015 held in Kazan, Federal Republic of Tatarstan, Russia

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Fig. 1. Group photo of the attendants after the opening session of the ICCP 2015 in front of the main building of the Kazan University.

The XVIII International Congress on the Carboniferous and Permian was held at the famous Kazan (Volga region) Federal University, the second oldest university in Russia, in the marvelous capital of Tatarstan with its 1,000 years of history (Fig. 1). It was a congress that was worth the trip in every aspect: a well-organized scientific meeting in a very friendly atmosphere with very hearty, typically-Russian organizers; these included Danis Nurgaliev (Chairman of the Organizing Committee), Vladimir V. Silantiev, (Congress General Secretary), and Milyausha N. Urazaeva (Assistant Secretary). The Organizing Committee did a really great job (Fig. 2).

The congress was an efficient platform for business and formal and informal scientific communication of scientists from various countries, and facilitated discussion of further joint research and multidisciplinary studies on various problems of Carboniferous and Permian geology. 415 scientists were represented (165 attending in person) from 33 countries (Australia, Austria, Armenia, Belgium, Brazil, Canada, China, Croatia, Czech Republic, France, Germany, India, Indonesia, Iran, Israel, Italy, Japan, Kazakhstan, Kyrgyzstan, Malaysia, Morocco, Netherlands, Norway, Russia, Slovenia, South Africa, Spain, Switzerland, Thailand, Turkey, United Kingdom, Ukraine, and USA). During the four days of the congress, 18 sessions were held and 106 presentations were given.

The congress demonstrated considerable progress in the studies of GSSP candidate sections of Carboniferous and Lower Permian stages, which have not yet obtained complete formal status in the International Stratigraphic Scale. 17 reports were devoted to this issue. These concern, among others, the Serpukhovian Stage sections (Verkhnyaya Kardailovka section in Russia and the Naqing section in China). New data were also presented for the base Gzhelian GSSP (Usolka section in Russia and Naqing section in China). For the Early Permian, the Usolka section was approved as a candidate for the GSSP stratotype of the Sakmarian Stage. It was shown that the Mechetlino section (Kungurian) and

Fig. 2. Thanks during the closing session of the ICCP in Kazan to Vladimir V. Silantiev, the Congress General Secretary (second from right), Milyausha N. Urazaeva, Assistant Secretary (first from right), and their enthusiastic powerful team.

Fig. 3. Pre-congress excursion to the type and reference sections of continental Permian-Triassic deposits in the north of European Russia, river Sukhona, outcrops of Severodvinian (Capitanian) stage.

Fig. 4. Pre-congress excursion to the type and reference sections of continental Permian-Triassic deposits in the north of European Russia, Klinovo section, Vyatkian (Wuchiapingian) stage; crossing the Sukhona river by hovercraft.

the Dalniy Tyulkas section (Artinskian) require additional study and excavation of presently covered intervals. These studies were considered particularly urgent.

Important new data were presented on the stratigraphy, paleontology, paleoecology, tectonics, paleogeography, and paleoclimatology of the Carboniferous and Permian periods. In particular, in the framework of IGCP 592 'Continental Construction in Central Asia', the congress considered and approved the proposed model of the stratigraphy of the oceanic plate emphasizing its important role in deciphering the evolution of the Paleo-Asian Ocean and development of the Central-Asian Fold belt.

A main focus was set on projects such as "Late Paleozoic continental biota: systematics, ecosystems, and paleobiogeography" and "End-Permian mass extinction and Early Triassic recovery" including new data of the IGCP 630 on the ecosystem changes at the Permian-Triassic boundary and the recovery of life and ecosystems in the Early Triassic.

During the congress evenings, business meetings were held by the Subcommission on Carboniferous Stratigraphy (chaired by SCS Chairman Barry C. Richards), and the Subcommission on Permian Stratigraphy(chaired by SPS Chairman Shuzhong Shen). In both meetings, reports were given and future tasks of the non-marine – marine Late Carboniferous–Permian–Early Triassic Working Group led by Joerg W. Schneider, were discussed. During the SPS business meeting, 6 voting members (Joerg W. Schneider, Ausonio Ronchi, Katsumi Ueno, Galina Kotlyar, Alexander Biakov, and Xiangdong Wang) attended the meeting. SPS Chair Shuzhong Shen gave an oral presentation to show all the participants the progress and problems of all remaining GSSPs and the new problems of some ratified GSSPs of the Permian System. In particular, the current problems which block the further advance of the Cisuralian GSSPs in the southern Urals were clearly explained. After the business meeting, the Russian team organized a meeting to discuss the problems presented by Shuzhong Shen and a plan to excavate the sections was initiated by the Russian team led by Dr. Galina Kotlyar.

Besides these, a meeting of the ICCP Standing Committee and an IGCP 630 business meeting took place. Four workshops were delivered by the Company 'SocTradeLLC', a Swedish-Russian company which is amongst others specialized in supplying laboratory equipment for quality control in the oil and gas industry.

Highlights of the congress were the pre-, mid- and post-congress excursions. The excursions demonstrated the impressive progress made by Russian geoscientists in the last decade, stimulating interesting discussions between the participants, and, last-but-not-least, providing unique impressions of landscapes and historical sites in different regions of Russia. Despite the often long distances between single outcrops in the vast landscape of Russia, the excursions were absolutely punctual. An impressive array of modes of transport were also provided: river boats, hovercraft, and rubber boats organized by the excursion guides especially to the marvelous outcrops on the banks of the rivers in the Vologda and Arkhangelsk regions in the north of European Russia as well as in the Volga and Kama Region of southeastern Tatarstan (Figs 3-6).

Further information can be found on the congress homepage http://kpfu.ru/iccp2015; the abstract volume and the excellent excursion guides are available for download, and these contain many otherwise unpublished data. For the participants of the congress – please use the offer to publish your contributions in one of the Proceedings Volumes (see the homepage link above and the information reported below).

The ICCP Standing Committee accepted the friendly offer of the University of Cologne, represented by Hans-Georg Herbig, chairman of the German Subcommission of Carboniferous Stratigraphy, **to hold the XIX ICCP congress in Cologne, Germany, in 2019.**

Fig. 5. Mid-congress excursion on the Volga River into the type area of the Kazanian stage and to the marvelous historical town Pechischi. The excursion guide was Vladimir V. Silantiev, the Congress General Secretary

The programme of the XVIII ICCP in Kazan included the following sessions:

S1 Carboniferous stage boundaries, stratotype sections, and GSSPs

S2 Permian stage boundaries, stratotype sections, and GSSPs

S3 Carboniferous and Permian high-resolution stratigraphy (multi-proxy correlations)

S4 Late Paleozoic glaciations and interglacials: impact on ecosystems and sedimentation

S5 Carboniferous and Permian plate tectonics and orogenies

S6 Late Paleozoic marine macrofossils: systematics, biostratigraphy, and paleobiogeography

S7 Late Paleozoic continental biota: systematics, ecosystems, and paleobiogeography

S8 Micropaleontology: systematics, phylogeny and biostratigraphy

S9 The terrestrial late Paleozoic world: paleosols, lithofacies, and environments

S10 Sequence stratigraphy and cycles

S11 Late Paleozoic reefs, biostromes, and carbonate mounds

S12-14 Upper Paleozoic oceans and land: climate, evolution, extinctions and recoveries

S15 End-Permian mass extinction and Early Triassic recovery

S16 Carboniferous and Permian coal and mineral deposits

S17 Eurasian conventional and unconventional hydrocarbon systems

S18 Marine-Non-marine Carboniferous and Permian Correlation

One hundred and six presentations were delivered at the Congress (session 1 – 11 reports, session 2 – 6 reports, session 3 – 5 reports, session 4 – 5 reports, session 5 – 6 reports, session 6 – 8 reports, session 7 – 16 reports, session 8 – 10 reports, session 9 – 3 reports, session 10 – 3 reports, session 11 – 3 reports, sessions 12–14 – 3 reports, session 15 – 13 reports, session 16 – 6 reports, session 17 – 3 reports, session 18 – 5 reports).

Proceedings Volumes

All registered participants were invited to prepare the Congress papers for publication in special issues of the journals "Stratigraphy and Geological Correlation", "Paleontological Journal" and "Uchenye zapiski Kazanskogo Universiteta."

The **"Stratigraphy and Geological Correlation"** and **"Paleontological Journal"** are two peer-reviewed scientific journals of MAIK "Nauka/Interperiodica" Publishing House (http://www.maik.rssi.ru/).

Stratigraphy and Geological Correlation (Stratigrafiya, Geologicheskaya Korrelyatsiya) covers fundamental and applied aspects of stratigraphy and the correlation of geological events and processes in time and space. Scientific Guest-Editor of the Stratigraphy and Geological Correlation is Alexander S. Alekseev. Please, send your manuscripts to aaleks@geol.msu.ru

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Fig. 6. Post-congress excursion to the type and reference sections of the Middle and Late Permian of the Volga and Kama region in Tatarstan; the field crew in front of the luxurious river boat of the TATNEFT oil-company of Tatarstan.

Paleontological Journal (Paleontologicheskii Zhurnal) publishes on anatomy, morphology, and taxonomy of fossil organisms, as well as their distribution, ecology, and origin. It also publishes studies on the evolution of organisms, ecosystems, and the biosphere and provides information on global biostratigraphy. Scientific Guest-Editor of the Paleontological Journal is Tatiana B. Leonova.

Please, send your manuscripts to tleon@paleo.ru

Guidelines http://www.maik.ru/cgi-perl/journal.pl?lang=eng&name=strteng&page=guid

The materials of the Congress will also be published in Uchenye Zapiski Kazanskogo Universiteta, Seriya Estestvennye Nauki (Proceedings of the Kazan University. Natural Sciences Series) which offers comprehensive coverage of the fundamental and applied aspects of chemistry, biology, geophysics, geology and geography. The journal is particularly pleased to encourage interdisciplinary papers on various natural sciences. Guidelines for submission of papers are provided on the journal website (http://kpfu.ru/uz-eng/ns). The manuscripts can be prepared in Russian or in English.

Scientific Guest-Editor of the Uchenye Zapiski Kazanskogo Universiteta is Vladimir V. Silantiev. Please, send your manuscripts to vsilant@gmail.com

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Please note that the deadline for contributions to the proceedings volumes is scheduled for January, 2016.

THE SPONSORS OF THE XVIII INTERNATIONAL CONGRESS ON THE CARBONIFEROUS AND PERMIAN

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12th International Workshop on the Permian-Triassic / Boreal Triassic II Conference, Longyearbyen/Svalbard, Norway, August 28–September 1, 2015

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The 12th International Workshop, combined with the Boreal Triassic II Conference, was held in Longyearbyen/Svalbard at 78° 13' North. Indeed, there is no other place where you can get so close to the North Pole without joining an expedition. Thus, the workshop was a unique occasion to visit excellent Permian-Triassic outcrops in a unique Arctic environment. The workshop was organised by Atle Mørk, NTNU & SINTEF, Trondheim, Hans Arne Nakrem, Oslo University, and Gunn Mangerud, Bergen University. Their invitation was accepted by around 60 international participants. Longyearbyen is reached from Oslo by a 3 hour direct flight. The town of 2000 inhabitants owes its origin to the mining of high-grade Tertiary hard coals. In recent years there has been an increasing contribution from tourism and from the Svalbard University UNIS to the local economy.

The Svalbard archipelago is a prominent uplifted part of the Barents Sea and of particular importance for the exploration of oil and natural gas. Therefore, the first two days of the workshop were devoted to lectures and posters presenting new results on the Permian-Triassic of the area (Nakrem & Mørk, eds., 2015, Abstr. Proc. Geol. Soc. Norway, 4, 1–48). A social highlight was certainly the conference dinner at the Radisson Hotel during the first evening, whose large hall provided a magnificent panoramic view of the late evening sunset at Isfjorden and its distant glaciers. More rustically on the second evening at "Camp Barents" east of Longyearbyen, by the light of crackling fire, a reindeer soup was served and participants were informed about polar bears, of which over 3000 live in the archipelago.

The weather was initially arctic cold and windy with rain and snow, but improved during the next two excursion days. With the research vessel MS Stalbas we went to the famous Festningen coastal section, about 60 km west of Longyearbyen, close to the Russian mining settlement of Barentsburg (Fig. 1). Participants were dropped ashore in small groups with Zodiac boats (Fig. 2). The spectacular outcrop is approx. 3 km long and exposes steeply dipping, predominantly fine-grained clastic sedimentary strata of the Upper Permian, Triassic, Jurassic and Cretaceous. The sequence stratigraphic units of Festningen often correspond to those in Central Europe. Because of the latent danger of polar

Fig. 1. Festningen section, Svalbard, Kapp Starostin Formation, Permian (Photo: Ute Gebhardt).

Fig. 2. Landing of a group near the Upper Triassic coastal profile Deltaneset/Spitsbergen.

Fig. 3. Vindodden section, Svalbard, Gipshuken and Kapp Starostin formations, Permian (Photo: Ute Gebhardt).

Fig. 4. Deltaneset section, Svalbard, De Geerdalen Formation, Nordic testimony of the “Mid-Carnian Wet Intermezzo”.

bears, the group, as required by law, was always accompanied by several watchful rifle-bearing students - but fortunately not a bear were sighted. On the second day of the excursion, in bright sunshine, the excursion went to the east end of the Isfjorden, past towering mountains. At the Vindodden coastal section, fossil-rich Permian rocks were visited (Fig. 3). Further east the Tunabreen glacier flows into the fjord and exhibits a spectacular 20-meter-high cliff of greenish-blue ice. The final landfall was made at the Deltaneset coastal section, where Upper Triassic strata resemble the German Schilfsandstein, a Nordic testimony to the “Mid-Carnian Wet Intermezzo” (Fig. 4). A dinner on board the Stalbas with sufficient Aquavit and cordial words of thanks to the organizers closed this very successful workshop.

The next Triassic workshop will take place from August 1 to 6th, 2016 in Xingyi, Guizhou, Southern China, organized by Da-Yong JIANG and Zuoyu ZU of Peking University. The main topics will be the well-known Triassic vertebrate fossil lagerstätten of Panxian, Luoping, Xingyi and Guanling, situated in spectacular limestone landscapes. For contact: djiang@pku.edu.cn.

The difficult early history of the Permian

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Introduction

Today, we students of the Permian timescale, the “Permophiles,” take it for granted that the Permian is a geological time period recognized globally. It so appears on all current geological timescales. However, this was not always so. Recognition and broad acceptance of the Permian as a geological system/period had a somewhat difficult history until about the time of the Second World War. Here, I recount some of that history.

Murchison’s Permian

All students of the Permian should recall that legendary British geologist Roderick Murchison (1792-1871) named the Permian as a result of fieldwork he undertook in Russia. This fieldwork, in 1840 and 1841, is well known, based on Murchison's own publications (especially Murchison et al., 1845), his principal narrative biography (Geike, 1875), and Collie and Diener (2004), who recently published an edited and annotated version of Murchison's previously unpublished narrative description of his work in Russia.

To summarize, while in Paris in 1840, Murchison became aware of an extensive, flat-lying (little deformed) and fossiliferous Paleozoic section in the Baltic region of European Russia. That summer he went to Russia with French paleontologist Édouard de Verneuil (1805-1873), and they were accompanied by the Russian government official Baron Alexander von Meyendorff (1798-1865) and Russian geologist Count Alexander von Keyserling (1815-1891). Their goal was to examine the older Paleozoic strata and to confirm their succession and, in particular, to further establish the validity of the Devonian System. The 1840 excursion visited the shores of the White Sea, then travelled southwest along the Dvina River and finally proceeded to the west and south via the Volga River to Moscow.

The same team returned to Russia the next summer, for five months in 1841, but this time with the financial support of the Russian Czar, ostensibly to evaluate coal resources. They travelled from Moscow east across the Russian platform via Perm to the Ural Mountains, then south along the Urals, southwest to the Sea of Azov and north back to Moscow. The second trip fulfilled Murchison's original purpose, which was to recognize Silurian, Devonian and Carboniferous rocks in Russia based on their fossil content.

An incidental byproduct of the second trip was the naming of the Permian, first proposed in a letter Murchison wrote to the Academy of Science in Moscow in the Fall of 1841. Later, in 1841, Murchison published an article (essentially a translation of the letter) in the Philosophical Magazine establishing the Permian Period for a succession of marls, limestones, sandstones and conglomerates on the western flank of the Urals. He thus wrote:

The Carboniferous System is surmounted, to the east of the Volga, by a vast series of beds of marls, schists, limestones, sandstones and conglomerates, to which I propose to give the name of "Permian System," because, although this series represents as a whole, the lower new red sandstone (Rothe-todte liegende [sic]) and the Magnesian Limestone or Zechstein, yet it cannot be classified exactly…with either of the German or British subdivisions of this age…. To this "Permian System" we refer the chief deposits of gypsum of Arzamas, of Kazan, and of the rivers Piana, Kama and Oufa, and of the environs of Orenbourg; we also place in it the saline sources of Solikamsk and Sergiefsk, and the rock salt of Iletsk and other localities in the government of Orenbourg, as well as all the copper mines and the large accumulations of plants and petrified wood, of which you have given a list in the "Bulletin" of your Society (anno 1840) (Murchison, 1841, p. 419).

Murchison et al. (1845, p. 7*) went on to affirm the significance of their "establishing under the name of "Permian" a copious series of deposits which form the true termination of the long Palaeozoic periods" (Fig. 1)

According to Murchison, in Russia the Permian System overlies Carboniferous rocks (including, the "Grits of Artinsk") that he correlated to the British Millstone grit. However, Murchison judged fossil fishes and amphibians from the Russian Permian similar to those of the German Zechstein, which indicated correlation of the Russian Permian to the British Magnesian limestone. Murchison also considered the Permian fossil plants to be intermediate between those of Carboniferous and Triassic ages. He thus equated part of the Permian to the "lower New Red Sandstone," which supported correlation to the German Rotliegend.

It has always been clear that Murchison's type Permian is not the entirety of the Permian of most later usage. Thus, the strata in Russia that Murchison identified as Permian are now assigned to the regional Kungurian, Ufimian, Kazanian and Tatarian stages, and thus encompass the latest Early Permian (Cisuralian), Middle Permian (Guadalupian), Late Permian (Lopingian), and even a part of the earliest Triassic in current usage (Fig. 1). Murchison regarded as Carboniferous the underlying strata of what are now

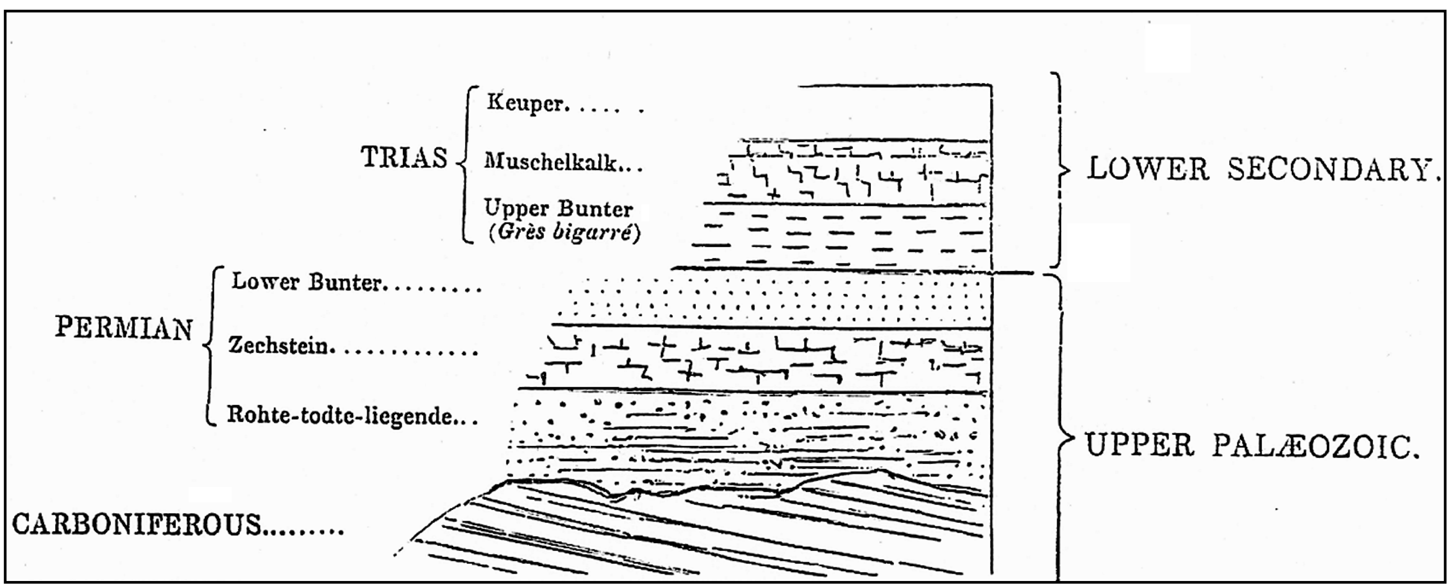

Fig. 1. Woodcut diagram showing the European equivalents of the Russian type Permian (from Murchison et al., 1845, p. 204).

considered the majority of the lower Permian (Cisuralian) Series. This means that the original base of the Permian sensu Murchison was much younger than the current base of the Permian.

Extension of that base downward took place in two ways. First, inclusion of the central European Rotliegend in the Permian, a mis-correlation first advocated by Murchison, immediately brought strata older than the "type" Permian into the system. Second, subsequent studies of ammonoids by Russian paleontologist Alexander Karpinsky (see especially Karpinsky's, 1889 monograph) included the Russian Artinskian strata (the "grits of Artinsk," considered Carboniferous by Murchison) and its much later recognized, older subdivisions, the Asselian and Sakmarian, in the Permian.

An important point, easily overlooked, is that continental European geologists had long united the German Rotliegend and Zechstein into one "group" or "system." These were a portion of the "Flötz" rocks of the 18th Century German miners and geologists, an economically important stratigraphic interval (Flöz means lode or seam, Zeche means mine). Thus, Permian rocks were some of the first rocks studied stratigraphically, notably in the late 1700s by the first German stratigraphic geologists, Johann Gottlieb Lehman (1719-1767) and Georg Christian Füchsel (1722-1773). Indeed, they were a part of Abraham Werner's (1749-1817) "Flotzformations" of the 1780s because they included important sources of copper from the famed copper slates (Kupferschiefer of the Zechstein). The underlying rocks without metal ores were the Rotliegend, literally the "red underlayer" of the old German miners. Thus, inclusion of the Rotliegend and Zechstein in a single system found long precedence in German geological research and without doubt facilitated acceptance of the Permian System.

Alternatives

Murchison's (1841) Permian soon gained wide acceptance. Thus, in 1858 Permian rocks and fossils were recognized in North America (Foster, 1989). Blanford et al. (1856) identified them in India, Bain (1856) in South Africa and Richthofen (1877-1912) in China. Indeed, the idea of "Gondwána-land" published by Austrian geologist Eduard Suess (1831-1914) in his classic book Das Antlitz der Erde (1885) was based in part on his recognition of Permian rocks in Australia, India and Africa.

Despite the acceptance of Permian by many, alternative names for the system were proposed throughout the 1800s. Prior to Murchison's 1841 name Permian, Belgian geologist Jean Baptiste Julien d'Omalius d'Halloy (1783-1875), in his 1834 book Elemente der Geologie, had proposed the name "Terrain Penéen" to refer to the Rotliegend plus Zechstein strata. According to d'Omalius d'Halloy, the term "penéen" referred to the poor fossil record of these rocks. In 1859, Swiss geologist and paleontologist Marcou (1824-1898) proposed the term Dyas ("two parts") as a supposedly more appropriate term than Permian (Marcou, 1862; Murchison, 1862).

For those unable or unwilling to separate the Carboniferous and Permian, German geologist and paleontologist Wilhelm Waagen (1841-1900) combined them into one system that he named Anthracolithic, because of the "intimate connection between the two systems" (Waagen, 1891, p. 294). In 1896, American stratigrapher Charles Rollin Keyes (1864-1942) proposed the term Oklahoman as a North American term to replace Permian. Of these alternative terms, only Dyas and Anthracolithic achieved limited use—Penéen and Oklahoman were quickly forgotten.

Acceptance

Acceptance of the Permian as a separate system seems to have been most difficult among North American stratigraphers, who generally combined it with the Carboniferous till about the time of the Second World War. Thus, the U. S. Geological Survey long recognized a Carboniferous System divided into three series—Mississippian, Pennsylvanian and Permian (Wilmarth, 1925). And, some American workers used Anthracolithic well into the 1900s (e.g., Prosser, 1910; Wheeler, 1934). As an aside, and perhaps most unusual, was British stratigrapher R. L. Sherlock (1928, 1947), who advocated combining most of the Permian and most of the Triassic into one system he called Epiric, but this gained no followers.

Acceptance of the Permian as a separate system seems to have been universal by the Second World War. In the USA, during the late 1930s, the American Association of Petroleum Geologists formed a committee devoted to Permian stratigraphy. That committee (Adams et al., 1939; Tomlinson et al., 1940) recognized Permian as a separate system/period and proposed a North American standard for Permian time that remains the basis for the provincial series/stages still in use (Henderson et al., 2012). With that late recognition by American geologists, the Permian came into universal use as a distinct system/period of the geological timescale.

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The Permian sedimentary successions of the Pamir mountains, Tajikistan

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The high peaks and plateaux of South and North Pamir in Tajikistan are remote and logistically difficult to access, but are characterized by spectacularly outcropping Permian sedimentary successions, which represent the stratotypes of certain regional stages of the Tethyan Scale (Leven, 1980). Studied by Russian authors mainly in the seventies-eighties (e.g. Dutkevich, 1937; Grunt and Dmitriev, 1973; Novikov, 1976, 1979; Chediya and Davydov, 1980; Leven, 1958, 1967, 1981; Leven and Shcherbovich, 1978, 1981; Leven et al., 1983, 1992; Chediya et al., 1986), they have been recently revised to understand the correlation of the regional Tethyan Scale to the International Stratigraphic Scale (Angiolini et al., 2013, 2015, submitted).

The tectonic setting of the Pamirs is very complex and comprises several tectonic blocks, namely South Pamir, Central Pamir and North Pamir (Angiolini et al., 2015). The southern block is South Pamir, which is separated southward from Karakoram by the Tirich Boundary Zone (TBZ) (Zanchi and Gaetani, 2011). North of South Pamir is Central Pamir, the two being separated by the Rushan-Pshart zone (e.g. Leven, 1995; Robinson et al., 2012; Angiolini et al., 2013, 2015). Central Pamir is separated northward from North Pamir by the the Jinsha suture (e.g. Schwab et al., 2004). The blocks have a distinct ancestry: the Central Pamir and South Pamir were part of Perigondwana in the Early Permian and of the Cimmerian belt during the Middle-Late Permian and the Triassic, whereas the North Pamir represents the former Eurasian margin, separated from the southern blocks by the Palaeotethys Ocean (Fig. 1B).

The research performed by Russian authors in the 1970s and 1980s led to the establishment of some of the stratotypes of the Tethyan Scale in the two separate palaeogeographic domains of North Pamir (Eurasia, yellow star in Fig. 1B) and South Pamir (Cimmeria, green star in Fig. 1B). In particular, the Yakhtashian and the Bolorian (Leven, 1979, 1980, 1981; Leven et al., 1983) were selected in the sedimentary successions of the Darvaz region in North Pamir, whereas the stratigraphically higher stages of the Kubergandian (Leven, 1963, 1981) and Murgabian (Miklukho-Maklay, 1958; Leven, 1967, 1981) were selected in the sedimentary successions of the eastern part of South Pamir.

In our recent studies (Angiolini et al., 2015, and submitted), we have revised the Bolorian, Kubergandian and Murgabian stratotypes providing information for correlating the Tethyan regional chronostratigraphic scale with the International Stratigraphic Scale.

The two lower stages of the Tethyan scale, the Asselian and the Sakmarian were derived from the Urals scale (Ruzhentsev, 1954; Leven and Shcherbovich, 1978, 1980; Leven et al., 1992; Leven, 1975, 2001), and should be thus correlatable to the International Stratigraphic Scale *per definitionem*. However, in a recent publication, Davydov et al. (2013) questioned a direct correlation between these stages. Our data from southeast Pamir are scant, but seem to agree on the original correlation (Leven, 1975; Leven and Shcherbovich, 1978) for the Sakmarian.

The overlying stage is the Yakhtashian, whose correlation to the Artinskian of the International Time Scale was thoroughly discussed by Leven (2001); however, also in this case, Davydov et al. (2013) disagreed. In particular, the authors introduced a new stage, the Hermagorian (with type-locality in the Carnic Alps), for the Sakmarian and lower Artinskian, and correlated the Yakhtashian with the upper Artinskian and the lower Kungurian. Though we have a small amount of data from the Yakhtashian, such conclusion needs further comparative revision of the stages Sakmarian, Yakhtashian and Artinskian.

Our investigation of the foraminifers and conodonts from the stratotype sections of the Bolorian, Kubergandian and Murgabian suggest that:

the Bolorian comprises a single biozone, the *Brevaxina* Zone,

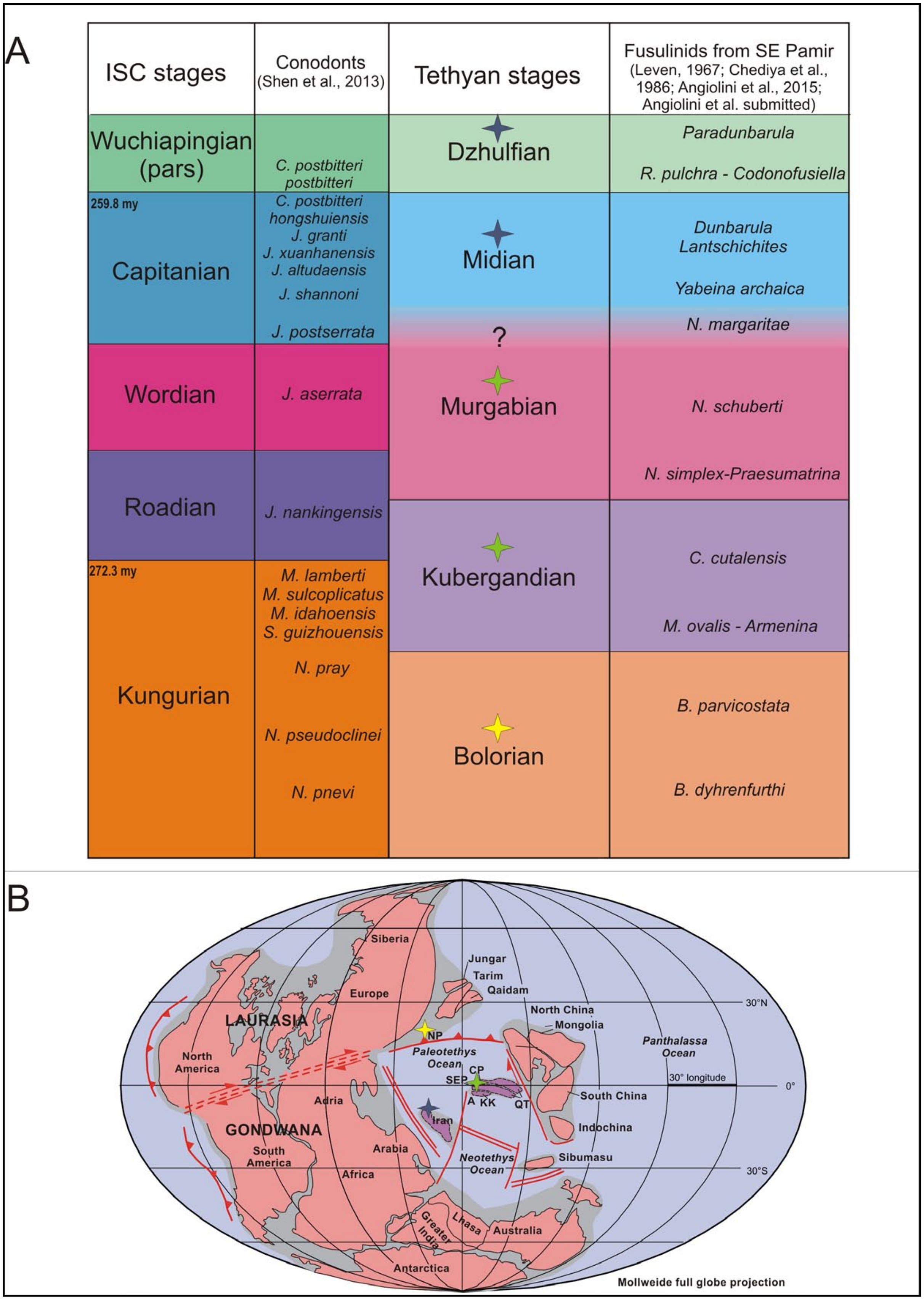

Fig. 1. A. Suggested correlation of the Bolorian to Midian Tethyan stages with the ISC stages (modified from Angiolini et al., 2015; Angiolini et al. submitted). B. Palaeogeographic map showing North Pamir (yellow star), South Pamir (green star) and Transcaucasus (blue star) (modified from Angiolini et al., 2013).

and the subsequent *Misellina* Zone with *M. aliciae*, *M. claudiae* and *M. termieri* (≈ *Misellina ovalis-Armenina* Zone) corresponds to the lower Kubergandian. Therefore Bolorian and the lower part of the Kubergandian correlate to the Kungurian (Fig. 1A);

the upper Kubergandian (*Cancellina cutalensis* Biozone) and the lower Murgabian (*Neoschwagerina simplex- Presumatrina neoschwagerinoides* Biozone) correlate to the Roadian;

the mid Murgabian (formerly *N. craticulifera* Biozone in Leven (1967); then, *Afghanella tereshkovae-Neoschwagerina deprati* Biozone in Leven (1992)) correlates to the Wordian;

the upper Murgabian (formerly *N. margaritae* biozone; then *Afghanella schencki-Neoschwagerina haydeni* biozone (Leven, 1967, 1992)) and the lower Midian *Yabeina archaica* biozone correlate to the lower Capitanian (Fig. 1A).

It should be noted that the final three stages, Midian, Dzhulfian and Dorashamian (Leven, 1980), have stratotypes in Azerbaijan (blue star in Fig. 1B) and have not been investigated in our revision.

In conclusion, the Bolorian and Kubergandian stratotypes show a good fusulinid record and – only the Kubergandian - a good conodont coverage allowing correlation to the Kungurian and to part of the Roadian, as suggested in Fig. 1A. The Murgabian lectostratotype is tectonically deformed and it has a poor fusulinid record (Angiolini et al., 2015), so the correlation of the interval between the LAD of *Neoschwagerina simplex* and the FAD of *Yabeina archaica* remains problematic and must be further tested. A redefinition of this biozone in northern Afghanistan (Hindu Kush), where the markers (*A. schencki* and *N. haydeni*) suggested by Leven in 1992 were defined, would be probably most relevant.

As a general conclusion, provincialism, endemism, diachroneity and lack of previous detailed study are the main factors that hamper Permian correlation, in particular for the Guadalupian.

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On the age of the first appearance of the bitaeniate bisaccate pollen *Lueckisporites virkkiae* Potonié & Klaus 1954 in Gondwana

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The bitaeniate bisaccate pollen *Lueckisporites virkkiae* has long been considered useful for correlation in the Permian phytogeographical province of Euramerica (now represented by the areas west of the Ural Mountains, Europe, parts of North Africa, and North America). This is because it is widespread in the province (Warrington, 1996; Clarke, 1965; Visscher, 1971; Wilson, 1962; Clapham, 1970), and because the taxon is very distinctive with a diploxylonoid outline, a thin corpus intexine and a prominent cappa formed chiefly by two reniform exoexinal taeniae (see Klaus 1963; fig. 27).

The biostratigraphic value of *Lueckisporites virkkiae* also stems from its well-established first occurrence in the lower part of the Kazanian (Roadian) in its type area in the Russian Platform (e.g. Utting et al., 1997; Warrington, 1996), and therefore was useful for correlating to the then international scale of the Upper Permian before the Guadalupian Epoch was established in the United States.

Early confirmation of a Guadalupian first occurrence for *Lueckisporites virkkiae* in the Gondwana phytogeographic province came from radioisotopic dating of the Argentinian Striatites Biozone (Archangelsky and Vergel, 1996), at the base of which that taxon makes its first appearance. Melchor (2000) reported a radioisotopic date of 266.3 ± 0.8 Ma (Wordian) for the base of the Striatites Biozone.

Since 2007 much work has been done in attempting to integrate radiometric dates with palynological biozones in South America. Amongst the most important of these studies are those of Césari (2007), Guerra-Sommer et al. (2008), Mori et al. (2012), and di Pasquo et al. (2015).

Fig. 1. *Lueckisporites virkkiae* Potonié and Klaus 1954, from the basal Khuff clastics of Saudi Arabia (?Wordian). The specimens are about 50 microns across

In the first of the studies, Césari (2007) noted radiometric dates in the San Rafael Basin in central western Argentina and in the Paraná Basin in southern Brazil that suggested absolute ages for biozones established by Césari and Gutiérrez (2000) and Souza and Marques-Toigo (2003) in those basins respectively. Thus the *Lueckisporites* – Weylandites Assemblage Biozone of Césari and Gutiérrez (2000) (of which *Lueckisporites virkkiae* is a component), in the San Rafael Basin contains a horizon dated at 266.3 ± 0.8 Ma (Wordian), while the *Lueckisporites virkkiae* Interval Zone of Souza and Marques-Toigo (2003) in the Paraná Basin contains a dated horizon of 278.4 ± 2.2 Ma suggesting a considerably earlier date of mid Kungurian. Mori et al. (2012) noted an even earlier date of 281 ± 3.4 Ma (early Kungurian) for another horizon within the *Lueckisporites virkkiae* Interval Zone of the Paraná Basin in the Candiota coal mine.

di Pasquo et al. (2015) gave radiometric dates from five volcanic ash beds within the Early Permian Copacabana Formation in central Bolivia (Tarija Basin). The dates appear to come from a study by Henderson et al. (2009) and were regarded by di Pasquo et al. (2015) as preliminary. The dates given by di Pasquo et al. (2015, fig. 4) are 298 Ma, 295.1 – 295.4 Ma, 293 Ma (for two ash layers approximately 25m apart stratigraphically), and 291.3 – 292.1 Ma. According to di Pasquo et al. (2015), these dates suggest an Asselian – Sakmarian age for an assemblage containing *Lueckisporites virkkiae*.

Clearly the accuracy of radiometric dates is important for discussion of the stratigraphic occurrence of *Lueckisporites virkkiae*, and inaccuracies inherent in radiometric dating may be the cause of apparent discrepancy in its first appearance, otherwise we have to consider that *Lueckisporites virkkiae* has a diachronous first occurrence strongly reducing its value as a possible Euramerica - Gondwana ‘bridging taxon’. However it may also be that *Lueckisporites virkkiae* is being misidentified or that the conception of the taxon being used by taxonomists is too wide. It may also be possible that species of *Corisaccites* Venkatachala and Kar 1966 are being identified as *Lueckisporites virkkiae*.

The original concept of *Lueckisporites virkkiae* Potonié and Klaus, 1954 was of a diploxylonoid bisaccate pollen grain with wide separation of sacci (see, for example, Potonié and Klaus, 1954; text-fig. 5, plate 10, fig. 3; Klaus 1963, fig. 27). Clarke (1965) allowed more haploxylonoid specimens within *Lueckisporites virkkiae* in his emendation of the species, referring to these as 'variant B'. di Pasquo et al. (2015) do not illustrate the specimens that they attribute to *Lueckisporites virkkiae*, but the specimen illustrated by Mori et al. (2012; fig. 3, j) is strongly haploxylonoid and lacks evidence of a prominent cappa or exoexinal taeniae. It appears closer to *Corisaccites alutas*. Haploxylonoid specimens of *Lueckisporites virkkiae* (using the conception of Clarke, 1965) are difficult to separate from *Corisaccites alutas*, though Venkatachala and Kar (1966) regarded *Corisaccites alutas* as 'subsaccate', and subsequent authors have described *Corisaccites alutas* as having poorly inflated, 'leathery' sacci whose exoexine is structurally indistinguishable from that of the corpus (see Stephenson, 2008).

To maintain the value of *Lueckisporites virkkiae* as a biostratigraphical marker may mean rejecting the emendation of Clarke (1965) and retaining the original concept of *Lueckisporites virkkiae* Potonié & Klaus 1954 as a diploxylonoid bisaccate pollen grain with wide separation of sacci. It may also be valuable to start comparative studies between South American Gondwanan and Euramerican localities focusing on the genera *Lueckisporites* and *Corisaccites*.

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Insights about the biodiversity decline at the end of the Permian.

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In the last twenty years, the number of scientific publications related to the end Permian and the associated mass extinction event grew exponentially (see fig. 1). The reasons for this trend may be

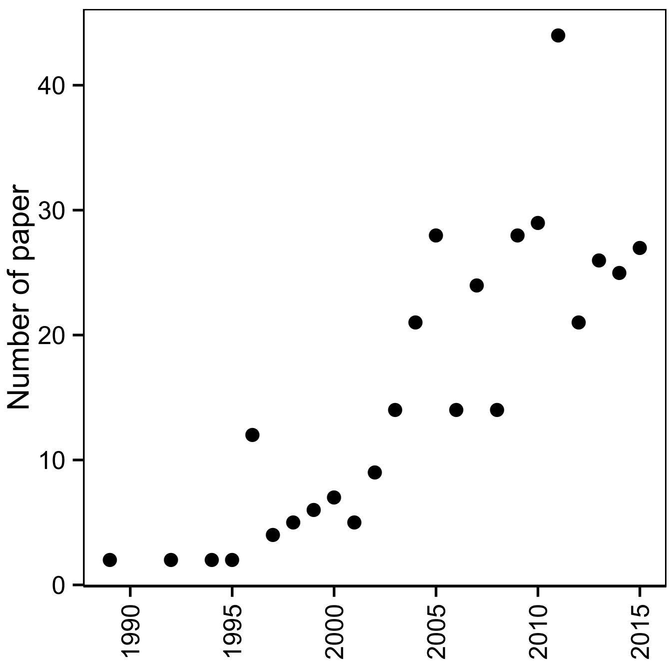

Fig. 1. Number of publications/year containing both the word “Permian” and “Extinction” in the title (source: Web of Science).

various and complex (e.g. the increased number of researchers interested in this topic, the general greater rate of publications, the necessity of the authors of reaching a higher impact factor, the interest of the public). The essential thing, for a researcher interested in this topic, is the increased number of information available to understand the complex dynamics of the biosphere during the Permian - Triassic transition. This fact, coupled with the improvement of analytical techniques, gives the researchers the opportunity to test the veracity of their hypotheses or to formulate new ones.

One of the most difficult issue is to provide clear evidences of the interplay between trigger and killing mechanism causing the loss of biodiversity. A plethora of processes have been proposed (see Knoll et al. 2007). A kill mechanism is a disruptive process causing the death of organisms. The trigger mechanism is the event which brings the kill mechanisms into play. It is clear that several trigger mechanisms could work in a synergistic way and that a kill mechanism may be fueled by more triggers. Moreover, a massive death of organisms may be the trigger for other killing mechanisms through ecosystem reorganization. For instance, a killing mechanism could be hypercapnia caused by excess of carbon dioxide in the ecosystem; one associated trigger could be the volcanism (i.e. the Siberian Traps events in this case). Since effects of hypercapnia are more disruptive in early stages of life, the population structure of some organisms can be modified, possibly creating cascading effects which alter the trophic structure of the ecosystem. As consequence, the synergistic way on which the factors works returns a very complex scenario to be deciphered and proved.

For example, Schobben et al. (2014, 2015a, b) recently proposed a convincing scenario, supported by solid data. They investigated the carbonate associate sulfate (CAS) sulfur and CAS oxygen isotopes across the Permian – Triassic transition to reconstruct the sulfur cycle and to assess the impact on biodiversity. The data were collected in the sections of Kuh-e-Ali Bashi and Zal in NW Iran, where the Permian-Triassic sedimentary succession is represented by the Ali Bashi Formation and the overlying Elika Formation. The upper part of the Ali Bashi Fm. comprises the *Paratirolites* Limestone, which is overlapped by the older unit of the Elika Formaion, the Boundary Clay, which is latest Changhsingian in age. The boundary between these two units is considered the extinction horizon following Ghaderi et al. 2014, and Schobben et al. (2015) found a divergence in the curves of CAS sulfur and oxygen isotopes, which starts at the base of the Boundary Clay. They supposed that this pattern may be related to the mass extinction event and hypothesized a convincing scenario, which has the potential to be extendable to all the continental shelf successions. In their hypothesis, the authors supposed that the global warming produced an intensification of the hydrological cycle and the consequent processes caused a “large-scale eutrophication on the continental shelf, which, in turn, expands oxygen minimum

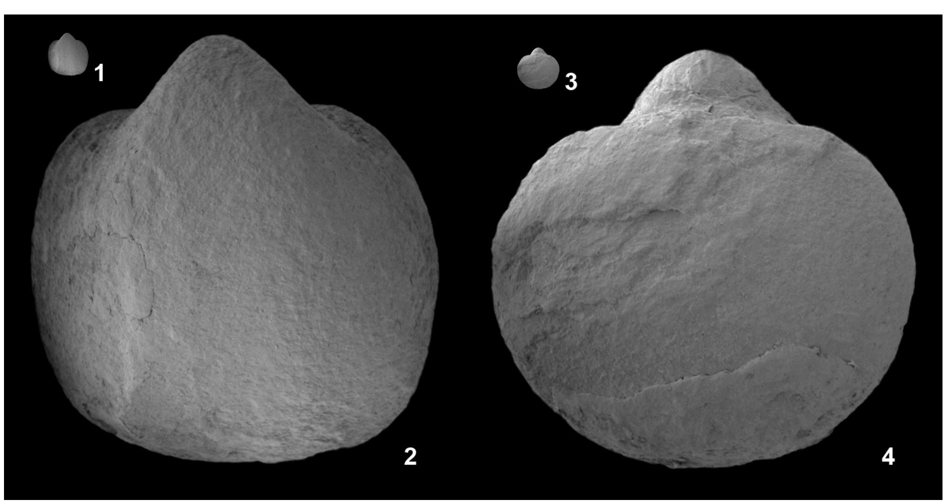

Fig.2.*Paracrurithyris pygmaea* (Liao 1980); 1-2, MPUM 11299 (JU148-4), ventral view of an articulated specimen, x1 and x10 respectively; 3-4, MPUM11298 (JU148-1), dorsal view of an articulated specimen, x1 and x10 respectively; from Garbelli et al. (2014).

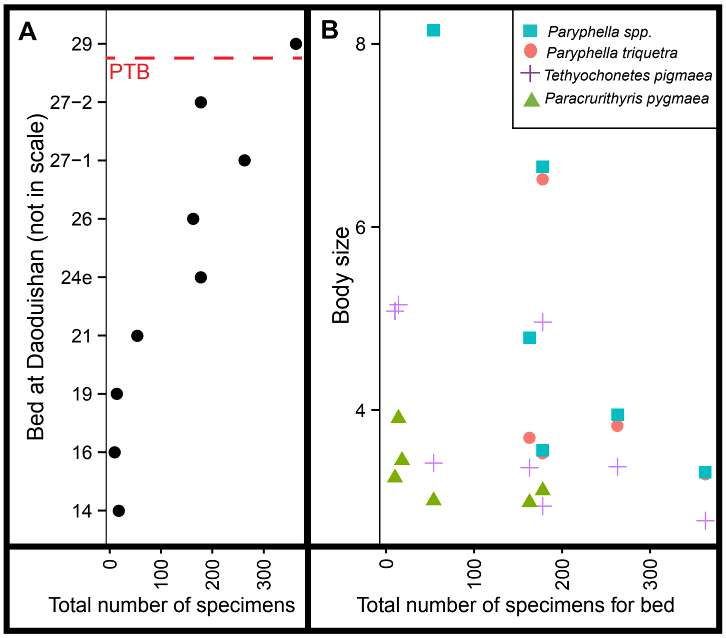

Fig.3. A - Total number of brachiopods specimens sampled in an area equal to 0.5/0.6 m^2 along the Daoduishan section; from He et al. (2015b). B - plot of size against the overall number of specimens for every bed in the Daoduishan section. This looks very similar to the relationship between body size and population abundance found in modern organisms. The plots are built based on the data published by He et al (2015b, table 1); PTB = Permian - Triassic boundary

zones by increased respiration, which can turn to a sulfidic state by increased microbial-sulfate reduction due to increased availability of organic matter" (Shobben et al, 2015b - abstract) . They suggested that sulfidic toxicity (?the killing mechanism) drove the marine biodiversity loss at the EPME. This scenario may be credible, but it tells more about "how" the conditions were during this time than about the killing mechanism. In fact, the situation is much more complex and, as Schobben et al (2015b) recognized, the sulfidic toxicity can be coupled to other effects related to a sudden increase of atmospheric CO2 (i.e. ocean acidification and thermal stress on the organisms).

The recent recovery of "disaster taxa", such as species of the brachiopod genus *Paracrurithyris*, in the *Paratirolites* Limestone and in the Boundary Clay (Fig. 2; Garbelli et al., 2014), coupled with the fact that the topmost 4–5 cm of the *Paratirolites* Limestone shows a conspicuous accumulation of sponge remains (Leda et al., 2013) and that there is a decrease in diversity in ammonoids in the upper part of *Paratirolites* Limestone (Korn et al., 2015), shows that there is the biotic turnover which started before the "sulfidic toxicity interval". These facts, coupled with the increasing evidences that changes in population dynamics and community structure could significantly affect chemico-physical conditions of the oceans (e.g. Kakani and Dabiri, 2009; Wilson et al., 2009), stress the importance to study the palaeoecology and evolutionary trends in fossil communities which became extinct during the late Changhsingian.

Moreover, since the mass extinction lasted, at least, several thousands of years (Burgess et al., 2014) and since it happened at the Permian - Triassic transition, which marks the change between the Paleozoic and Mesozoic faunas (Leighton and Schenider, 2008), it is plausible that the seeds of the crisis have been already present in the upper Changhsingian fossil communities. In this perspective it is essential to detect the elements, which stressed organisms, promoted the suppression of biodiversity in this time interval.

Some authors grasped the potential of studying fossils as once living organisms to dectect factors affecting survivorship in the late Changhsingian and to assess mechanisms which suppressed biodiversity. A growing, even if debated, attention has been given to the study of body size in several organisms (Twitchett, 2007), (e.g. Chu et al. 2015a, b; Forel and Crasquin, 2015). For example, He et al (2010, 2015a, b) examined this feature in Permian and Triassic brachiopods, at specific and generic level. A distinction has to be done between the miniaturization of brachiopod species occurring before the P/T boundary and the one that occurred in the aftermath of the mass extinction (He et al. 2007). The analysis of the first one may offer insights to understand the late Changhsingian events, which probably paved the way to the mass extinction. The main, and also in this case, oversimplified idea, is that the decreasing size of taxa is related to the environmental changes which caused the extinction. In a recent paper, He et al. (2015b) showed that the turnover in brachiopod assemblages and their biological features are indicative of the existence of stressful conditions during the end Permian mass extinction. They pointed out that brachiopod species decreased in size in response to depleted food and oxygen in the environment (He et al. 2015a). This assumption is generally accepted as true and leads to the hypothesis that anoxic/dysoxic conditions were fatal for the majority of organisms, which underwent the extinction. However, this interpretation suffers of some weaknesses, because the body size of brachiopods seems to be inversely correlated to population size, which increases up to the P/T boundary (Fig. 2). This is a common population dynamics observed in modern organisms by ecologists (see for instance Brown et al 2004, even if relationship between body size, metabolism, population dynamic and resources availability are not easy to decode), and it cannot be directly ascribed to changing environmental conditions, which would cause the extinction. So not only the abiotic parameters, but also the biotic factors should be considered when interpreting change in distributional patterns and potential stresses for organisms.

In conclusion, we have to improve our "multiple disciplinary" approach to have a more holistic perspective of the end Permian extinction.

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First occurrence of the Permian-Triassic enigmatic conchostracan *Rossolimnadiopsis* Novozhilov, 1958 from the Dead Sea, Jordan – preliminary report

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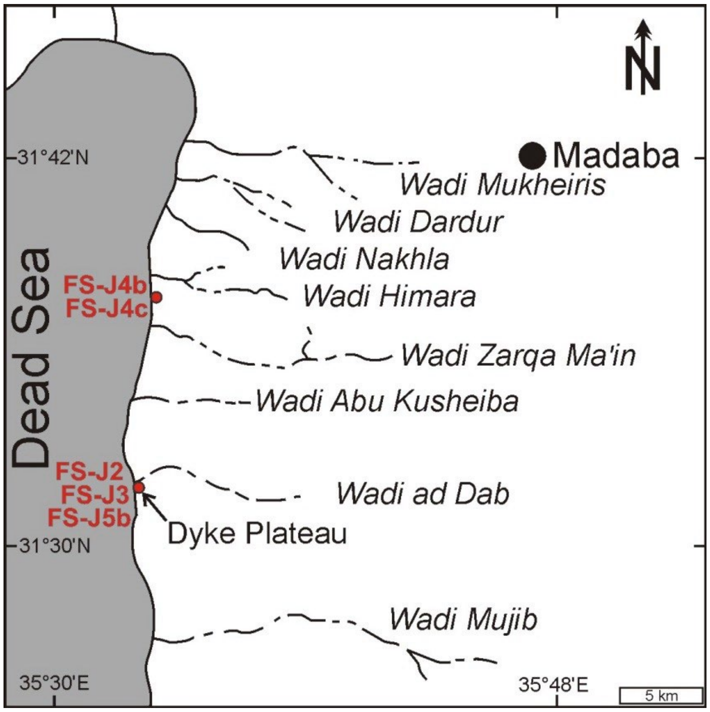

Fig. 1. Geographic map of the study area between Wadi Mukheiris and Wadi Mujib at the NE coast of the Dead Sea, Jordan (modified from Bandel and Abu Hamad, 2013), and position of conchostracan localities (FS-J2 to FS-J5b).

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The transitional continental-marine Upper Palaeozoic/Lower Mesozoic sequence of the eastern Dead Sea region in Jordan yields one of the most remarkable Permian floras of the Near East (Abu Hamad et al., 2008; Kerp et al., 2015). By comparison, the non-marine faunal content of the sequence has experienced much less attention considering that just conchostracans ("*Estheria*") and some invertebrate trace fossils are hitherto mentioned from the study area (Bandel and Salameh, 2013: 59). Reports on both the Permian flora and Triassic conchostracans, stimulated fieldwork in relevant deposits along the eastern Dead Sea between Wadi Mukheiris and Wadi Mujib in 2011 and 2015 (Fig. 1). Apart from excellent macrofloral fossils (Kerp et al., 2015), the about 65 m thick Permian Umm Irna Formation yielded only two faunal remains, a *Palaeoxyris* shark egg capsule (Abu Hamad et al., in press) and a blattoid insect forewing. A huge assemblage of conchostracans, however, were collected from five localities of the up to 45 m thick Triassic Ma´in Formation.

The Permian Umm Irna Formation and the Triassic Ma´in Formation are bounded by an erosional unconformity (Dill et al., 2010; Bandel and Abu Hamad, 2013; Stephenson et al., 2014) raising the question on the duration of the related stratigraphic gap. A mid-Wordian to mid-Wuchiapingian age has recently been proposed for the Umm Irna Formation based on fossil palynomorphs (Stephenson and Powell, 2014; Stephenson, 2015). This is confirmed by an approximately 261 Ma late Capitanian age that refers to radiometric dating of zircons from a volcanic ash bed about 5 m above the base of the Umm Irna Formation at its Wadi Himara stratotype section (Kerp et al., 2015). About 10 m above the unconformity, low diversity palynomorph assemblages comparable to the *Endosporites papillatus* - *Veryhachium* spp. zone suggest an Early Triassic, probably Olenekian, age for the lower part (= Himara Member) of the Ma´in Formation (Abu Hamad, 2004; Kerp et al., 2006). A preliminary study of conodonts and foraminifers from the upper part (= Nimra Member) of the Ma´in Formation suggests a late Induan to early Olenekian age for the sampled strata (Stephenson et al., 2014). The overlaying Dardun Formation is considered to be of Scythian to early Anisian age based on conodonts and palynomorphs (Bandel and Abu Hamad, 2013). In 2015, some pyroclastic beds were discovered just a few meters below the unconformity. Thus radiometric ages may soon give new input on the issue if Changhsingian or lowermost Induan strata are missing in the Permian/Triassic sequence of the eastern Dead Sea.

We collected conchostracans at five new localities in the Himara and Nimra members of the Ma'in Formation. The about 26 m thick Himara Member consists of thinly interbedded, reddish-purplish sand-, silt- and carbonatic claystones (Bandel and Khoury, 1981). Horizontal bedded red sandstones at the base of the Himara Member are characterized by shallow water ripples, desiccation cracks, and abundant invertebrate traces including *Cruziana*, *Rusophycus*, *Fuersichichnus*, and *Diplopodichnus* (Fig. 2). The presence of lingulid brachiopods in the upper Himara Member has been ascribed to marine influence (Stephenson and Powell, 2013). We found conchostracans starting about 5 m above the basal unconformity. Unfortunately, taxonomic assignation of the material is limited by the low number of specimens and its poor preservation due to relatively coarse grained sediments.

The up to 25 m thick Nimra Member consists of flaser-bedded,

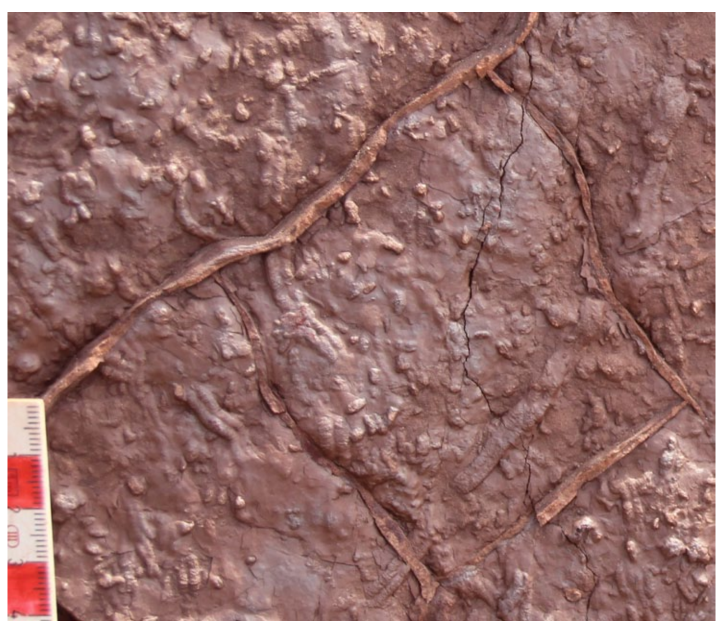

Fig. 2. *Cruziana* and *Rusophycus* at the lower surface of red sandstone from the base of the Himara Member, Ma´in Formation (Early Triassic, locality FS-J4b (31°37'33.30" N, 35°34'51.70" E). Scale equals 4 cm.

Fig. 3. Fossil locality FS-J3 at the 2015 shoreline of the Dead Sea (31°32’23.1’’ N, 035°33’20.5’’ E), bearing mass occurrences of the conchostracan *Rossolimnadiopsis*. Strata are referred to the Nimra Member, Ma'in Formation, Early Triassic.

red and green silt- and claystone in its lower part, and cross-bedded, white and fine-grained sandstone above (Bandel and Khoury, 1981). Carbonate intercalations in the upper part of the member contain marine bivalves, lingulid brachiopods, conodonts, and foraminifers referred to a tidally-influenced marginal marine palaeoenvironment (Bandel and Khoury, 1981). A conchostracan mass occurrence, supposed to be part of the Himara Member, was discovered about 500 m south of Wadi ad Dab within an area known as the ‘Dyke Plateau’ (Stephenson and Powell, 2013). Quaternary debris obscures the relationship of this exposure to the surrounding Permian-Triassic rocks (Fig. 3). As the fossil-bearing beds are greyish to green coloured fine-grained siliciclastics very similar to the Nimra Member we correlate them with the upper part of the Ma’in Formation. Small grain size and lamination of the beds indicate deposition in a low-energy environment; single lingulid shells in fine-grained sandy layers suggest occasional marine influence. Supposedly, brachiopods were transported by storm waves from the sea into nearshore coastal freshwater ponds or lakes.

The conchostracan mass occurrences from the ‘Dyke Plateau’

Fig. 4. About 6 mm long valve of *Rossolimnadiopsis* from locality FS-J3, Nimra Member, Ma’in Formation, Early Triassic.

area are mainly formed by large, up to 8 mm long valves (Fig. 4). According to the round shape and its characteristic concave dorsal margin, we assign them to *Rossolimnadiopsis* Novozhilov, 1958. This peculiar kind of conchostracans was hitherto only known by a few specimens from two sites of the East European platform in Russia. The holotype of *Rossolimnadiopsis marlierei* Novozhilov, 1958 comes from the Obnora Formation in the Vladimir region, Moscow syncline, which is referred to the uppermost Upper Vyatkian in the Russian regional scale and most possibly correlates with the Late Permian Changhsingian. Other specimens, described as *Rossolimnadiopsis* sp. (Scholze et al., 2015), were found in the same region of the Moscow syncline but in the basal Vokhma Formation of the Vokhmian Regional Stage correlating with the Early Triassic of the Russian scale. Closely related forms may occur in the Lower Triassic Panchet Formation of India (Ghosh et al., 1987: pl. 2, fig. 8) and in the upper part of the Fulda Formation, Zechstein Group, transitional Late Permian (latest Changhsingian) to Early Triassic (earliest Induan) in Thuringia, Germany (Scholze et al., 2015: Fig. 14D).

Rossolimnadiopsis from Jordan represents a well-defined new species. Genus and species have potential to become a biostratigraphic marker for the Permian/Triassic boundary in continental sequences and thus deserve further investigation.

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First report of Upper Pennsylvanian ammonoids and Lower Permian conodonts from Bagh-e-Vang area (Central Iran)

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In Central Iran, the area southeast of Shirgesht, about 65 km north of Tabas, in the surroundings of Kuh-e-Bagh-e-Vang and Kuh-e-Shesh Angosht, is well known for the beautiful outcrops of Devonian to Permian successions belonging to the Shishtu, Sardar and Jamal formations. Since the the early work of Ruttner et al. (1968), the area has been visited several times by paleontologists and stratigraphers, who were especially interested in the rich fossil record of the Jamal Formation (Flügel, 1972; Leven and Vaziri Mohaddam, 2004; Senowbari-Daryan et al., 2005; Ernst et al., 2006; Leven et al., 2007; Senowbari-Daryan and Rashidi, 2010, 2011; Leven and Gorgij, 2011; Partoazar et al., 2014).

Despite of the rich literature, lithological description of the formations and facies analysis have not been improved, especially as regard the unconformity of the lower part of the Jamal Formation (Bagh-e-Vang Member) with the underlying Sardar Formation. The detailed stratigraphic study of this interval in the Bagh-e-Vang area is of crucial importance for the reconstruction of the stratigraphic evolution of Central Iran, and it was one of the aims of a three-year project funded in the 2010-2013 by the Darius Programme.

Nine stratigraphic sections encompassing the Sardar/Bagh-e-Vang boundary were described in the Kuh-e-Shesh Angosht and two sections were measured at Kuh-e-Bagh-e-Vang. The sections were sampled for conodonts and macrofossils.

Two ammonoids have been collected from the upper part of the Sardar Formation, mostly consisting of very fine grained greenish siltstones. One *Agathiceras* was collected from one of the Shesh Angosht sections. This genus is reported from the first time from Central Iran, but it is not age-diagnostic. More important is the finding of *Marathonites* at Bagh-e-Vang, which is also a new discovery for Central Iran. This genus is limited to the Gzhelian and the Bagh-e-Vang specimen documents the Gzhelian age of the top of the Sardar Formation.

Conodont faunas have been recovered from the lowermost part of the Bagh-e-Vang Member at both Shesh Angosht and Bagh-e-Vang sections. These faunas are new for Central Iran, and suggest an age assignment older than the Yakhtashan/Bolorian/early Murgabian age reported in literature for the Bagh-e-Vang Member on the basis of fusulinids (Leven and Vaziri Mohaddam, 2004; Leven et al., 2007; Leven and Gorgij, 2011, Partoazar et al., 2014).

The lowermost conodont assemblages from Bagh-e-Vang consists of *Mesogondolella manifesta* Chernykh, 2005, *Mesogondolella monstra* Chernykh, 2005, *Streptognathodus* aff. *lanceatus, Streptognathodus postconstrictus* Chernykh, 2006, *Streptognathodus postfusus* Chernykh and Reshetkova, 1987 and *Sweetognathus* aff. *binodosus.* According to Boardman II et al. (2009), Chernykh (2005, 2006), Chernykh and Reshetkova (1987), Mei et al. (2002), Shen et al. (2012) , this conodont fauna points to an early Sakmarian age (Vuolo et al., 2014).

The age of the basal Bagh-e-Vang Member is younger at Shesh Angosht sections than at Bagh-e-Vang. The lowermost bed of the Bagh-e-Vang Member at the Shesh Angosht yielded small brachiopods assigned to the genus *Costispinifera* and a conodont fauna including *Sweetognathus guizhouensis* Bando et al., 1982 and transitional forms *Sweetognathus whitei* (Rhodes, 1987) to *S. guizhouensis*. The brachiopods suggest an Early Permian age, and the conodonts point to an Artinskian-Kungurian age (Wang et al., 1987; Mei et al., 2002; Shen et al., 2012).

The new ammonoid and conodont data lead to post-date the top of the Sardar Formation to the Gzhelian in the study area. This is an unexpected result, because in other sites of Central Iran (e.g. Zaladou and Anarak: Leven and Gorgij, 2006a,b; Leven et al., 2006) the unconformity at the top of the Sardar Formation is pre-Gzhelian, and Gzhelian fusulinids are recorded within the Zaladou Formation, the unit unconformably overlying the Sardar Formation.

The discrepancy between the early Sakmarian conodont based age of the basal Bagh-e-Vang Member and the Yakhtashan/Bolorian/early Murgabian fusulinid age still requires further investigations. The new conodont faunas were found from beds underlying the first reported occurrence of fusulinids, but this difference in stratigraphic position probably is not enough to justify the age discrepancy. In order to verify the calibration of conodont and fusulinids, some newly collected fusulinid samples are going to be processed.

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SUBMISSION GUIDELINES FOR ISSUE 63

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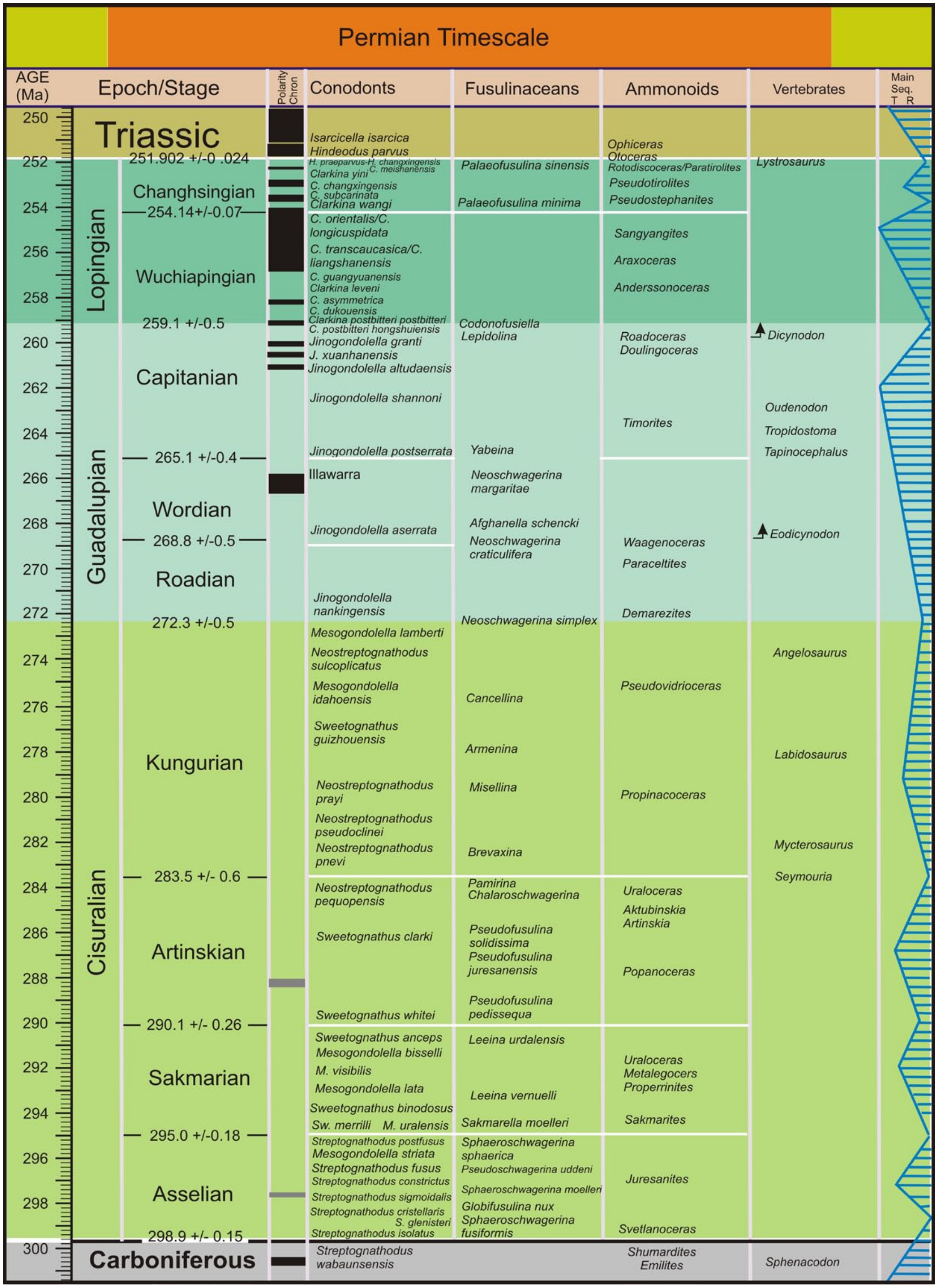

Note: This is the latest version of the Permian timescale which SPS recommends (Shen et al., 2013, New Mexico Museum of Natural History and Science, Bulletin 60, p. 411-416). We welcome any comments to improve it. All the information will be updated from time to time here. Geochronologic ages are combined from Burgess et al. (2014, PNAS 111, 9, p. 3316–3321); Shen et al. (2011, Science 334, p. 1367-1372) for the Lopingian; Zhong et al. (Lithos, in press) for the Guadalupian-Lopingian boundary; Schmitz and Davydov, (2012, GSA Bulletin 124, p. 549-577.) for the Cisuralian, Henderson et al. (2012, The Geologic Time Scale 2012 (vol. 2), p. 653-679) for the base of Kungurian and the Guadalupian. Tetrapod biochronology is after Lucas (2006, Geological Society London Special Publications 265, p. 65-93).