Newsletter on Carboniferous Stratigraphy

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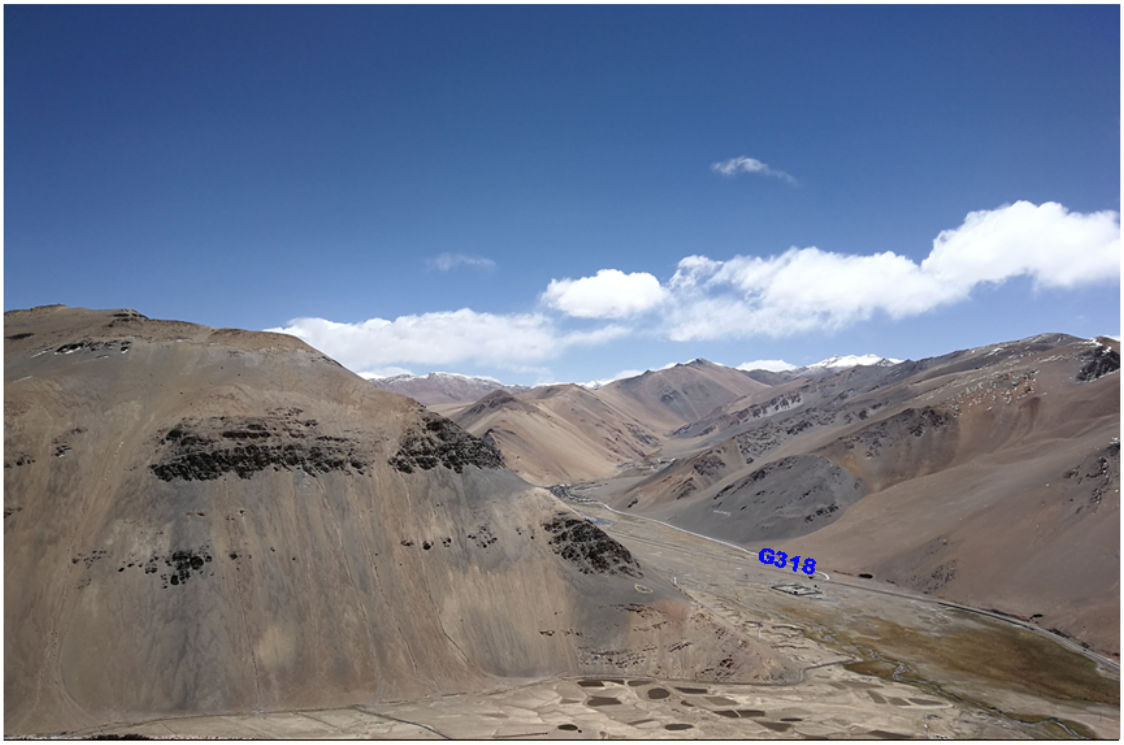

International Union of Geological Sciences
International Commission on Stratigraphy

Subcommission on Carboniferous Stratigraphy

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Newsletter edited by Dr. Wenkun Qie

Thanks to all colleagues who contribute to this newsletter!

Cover illustration:

The cover shows the national road G318, cutting through the uppermost Devonian to Carboniferous Yali Formation and Naxing group in Tibet, which is 500 meters to the north of the Yalai Village, Nielamu County. *(photo taken in June, 2018, by the courtesy of Wenkun Qie)*

EXECUTIVE'S COLUMN

Dear Fellow Carboniferous Researchers,

Welcome to the SCCS newsletter 2018, and the goal of the yearly compilation is to introduce some of the important events, reports, accounts of past conferences, notice of upcoming meetings, activities and issues that concern the subcommission. This newsletter mainly includes SCCS annual report to ICS for 2017-2018, the progresses on redefining the DCB GSSP, establishing GSSP for the Bashkirian-Moscovian boundary, and Carboniferous magnetostratigraphy provided by the task group leaders and members, detailed reports on the International Conferences ("Uppermost Devonian and Carboniferous carbonate buildups and boundary stratotypes") held in Kazakhstan during 2017, and the conference/field-workshop schedule for 2019 along with themes and anticipated results.

In middle and late year of 2018, we learnt of the sad news about the losses of Emeritus Professor John Roberts and Professor Jürgen Kullmann. John Roberts was an eminent expert on Australian and global Carboniferous and Permian stratigraphy, timescales and biostratigraphy. He was a long-term SCCS voting and corresponding member of both the SCCS and SPS, and served as Chairman of the SCCS from 1997 to 2000 and was a member of the Permanent Committee for the International Congress on the Carboniferous and Permian (ICCP) held every four years. Jürgen Kullmann had a distinguished academic career primarily based at the University of Tübingen. His research on Carboniferous ammonoids, corals and biostratigraphy is widely and internationally recognized. We have obituaries for John and Jürgen in this Newsletter.

In late November 2018, SCCS Chairman Xiangdong Wang submitted the official annual report of Subcommission on Carboniferous Stratigraphy for 2017-2018 to the International Commission of Stratigraphy (ICS). The income of SCCS in this fiscal year includes the funds carried forward from 2016-2017 ($350) and the grant from ICS ($ 3000), and the total number is $3,350. The main expenditures in 2018 include the support for the 5th International Palaeontology Congress held in Paris and the Newsletter's editing and printing, with a total amount of $ 2380. As for the budget in 2018-2019, the executive committee plan to apply for $6,980 from ICS to support SCCS voting members, executives, and CMs to participating in the 19th ICCP in Cologne during July 29th and August 2nd and the Strati 2019 held in Milan, and to edit the SCCS Newsletter 2019.

There were several geological conferences, field meetings and workshops that were of substantial importance and interest for SCCS members in 2018. The most important one was the IPC5 (the 5th International Palaeontological Congress), held on the July 9th-13th in Paris, France. Many SCCS members attended this meeting and reported on: the Carboniferous conodont and coral fauna around the world, study progress on the candidate GSSP for the Visean—Serpukhovian boundary and Mid-Carboniferous conodonts and their evolution in South China. Results of recent work and their abstracts were published in the conference abstract volume. Following the SDS meeting in Paris, Dr. Markus Aretz and Carlo Corradini, the leaders of the task group for the redefinition of the base of the Carboniferous , held a group meeting concerning the current knowledge on the new DCB criteria and the upcoming special volume in Palaeobiodiversity and Palaeoenvironments in 2019. The submission process for the volume 'Global review of the Devonian-Carboniferous boundary' will start by February 1st of 2019, and according to Markus, 'the formal meeting of the task group for the redefinition of the Devonian-Carboniferous Boundary will be held at the Carboniferous-Permian Congress in Cologne (29.7-2.8.2019) and a session on "the base of the Carboniferous Period" will be organised. During this meeting the task group will vote on the suitability of the criteria discussed during the workshop in Montpellier, and this will hopefully start the ratification process of the boundary criterion and the search for suitable sections. The results presented in the P2 volume are one very important contribution to the discussion'.

Next important Carboniferous meetings:

- *The 19th International Congress on the Carboniferous and Permian, Cologne, German, 2019*

  In the summer of 2019, the XIX International Congress on the Carboniferous and Permian (ICCP) will be held during July 29th and August 2nd in Cologne, Germany at the Institute of Geology and Mineralogy, University of Cologne. It will include four days of scientific sessions and a mid-congress field trip. Pre-congress and post-congress field trips are planned to visit Carboniferous and Permian strata in Germany and adjacent countries, giving a splendid opportunity to explore some of the most classical regions of the Carboniferous in central Europe. For more information, please see the official congress

Website http://iccp2019-cologne.uni-koeln.de. Please contact Hans-Georg Herbig from Universität Köln (herbig.paleont@uni-koeln.de), if you have any questions or suggestions about this important upcoming meeting.

- *The 3rd International Congress on Stratigraphy, Milano, Italy 2019*

  Following the first edition of this congress, held in Lisbon (Portugal) in 2013 and the second edition organized in Graz (Austria) in 2015, the third edition of STRATI has been assigned by the International Commission on Stratigraphy (ICS) to Italy, a country with a long historical tradition in Stratigraphy since the 17th century. The topics of the congress will range from the Precambrian to the Holocene and will include all the stratigraphic techniques. The congress will provide the opportunity to discuss the recent developments in the study of the stratigraphy of the volcanic areas, Antarctic and Artic sedimentary successions and ice caps, as well as of crystalline rocks. As in previous editions, the congress will also host meetings of the ICS and of its subcommissions to debate topics and problems in updating and improving the geological time scale. For more information, please see the Congress website: http://www.strati2019.it.

- *The 11th North American Paleontological Convention (NAPC) , Riverside, CA, U.S.A. 2019*

  The 11th North American Paleontological Convention (NAPC) will be held at the University of California, Riverside, during June 23–27, 2019. NAPC is an international conference that meets every 4-5 years, bringing together all branches of paleontology (vertebrate, invertebrate, paleobotany, micropaleontology, paleo-related organic and inorganic geochemistry, paleoecology, paleoclimatology, and astrobiology) for a joint meeting typically hosted on a campus.

  The meeting attracts professional scientists, graduate and undergraduate students, serious amateur paleontologists, and interested members of the public. The purpose is to exchange research findings, define future directions, and be a forum for extended and relaxed interactions between professionals and early career scientists, most particularly graduate and undergraduate students. NAPC meetings are generally less formal than annual association meetings, and allow time for more extended and relaxed interactions. They also serve a major role in public outreach through public lectures and other activities. For more information, please see the Congress website: https://napc2019.ucr.edu/

Unfinished Businesses:

- *Dissolution of task groups and their reestablishment*

  In the past years, our previous Secretary Markus Aretz suggested that the subcommission is not being properly run because we are violating several of the ICS statutes or permanent rules regarding the administering of our task groups. According to the 2002 version of the ICS statues, Rule 7.1-Task points out "Task Groups have a four (4) year term that may be extended for a single additional four (4) year term, depending on sufficient progress with the entrusted task." As recorded in the minutes of SCCS business meeting held at the 18th ICCP in Kazan in 2015, most of the task groups have been around for 12 years or more. However, little progress has been made by most task groups. There is a preliminary discussion about the need to dissolve most of the current SCCS task groups and establish new task groups led by new chairs. We might need to proceed on this item in the next few years.

- *SCCS website update*

  Chair Xiangdong Wang planned to strengthen and vivify the Carboniferous website, making it a genuine platform to bring Carboniferous specialists together for collaboration and exchange of new ideas and results. In the early 2018, we are going to add a new "Reference" section, showing the newest information of publications concerning the Carboniferous palaeontology and stratigraphy, and to integrate the Carboniferous database from the entire world, combing the Geobiodiversity Database (GBDB, the official Database for the ICS, IPA) at Nanjing Institute of Geology and Palaeontology, the Paleobiology Database at the University of Wisconsin-Madison, and other major databases.

- *Proposal for the GSSP defining the base of the Gzhelian Stage*

  The base of the Gzhelian has been widely accepted to be the FAD of the index fossil conodont *Idiognathodus simulator*. The task group should move forward and select a suitable section for the GSSP in the near future.

OBITUARY

Vale: Emeritus **Professor John Roberts**

(6th April 1938 – 6th May 2018)

Emeritus Professor John Roberts, an eminent expert on Australian and global Carboniferous and Permian stratigraphy, biostratigraphy and timescales died in May 2018 aged 80 years. John was a long-time Voting and Corresponding Member of both the Subcommission on Carboniferous Stratigraphy (SCCS) and Subcommission on Permian Stratigraphy (SPS). He served as Chairman of SCCS from 1997 to 2000 and was a member of the Permanent Committee for the International Congress on the Carboniferous and Permian (ICCP) held every four years.

John Roberts in the Northern Territory, Australia, 2004

John was born in Armidale, NSW, Australia and attended Armidale High School and then the newly formed University of New England (UNE) in Armidale graduating with a First Class B.Sc. (Hons) in Geology in 1959. Speaking of John as a student, his former lecturer and mentor at UNE, Emeritus Professor Richard Stanton commented "he was a fine fellow and one of our great early students". After his graduation in 1959 John gained a Commonwealth Post-Graduate Fellowship at the University of New England to pursue a PhD studying Carboniferous marine faunas. After moving to Perth in 1961 to take up a position as Senior Demonstrator in the Department of Geology, University of Western Australia, John transferred his PhD studies to UWA and was awarded his Doctorate by UWA in 1963. Soon after gaining his PhD John joined the Bureau of Mineral Resources (BMR) in Canberra in 1963 where he undertook significant field mapping and biostratigraphical projects in particular relating to the Carboniferous of the Hunter Valley of NSW. It was during this time that he honed his excellent field mapping skills that he later passed on to students in his later academic career. I remember well when dining out with John on a number of occasions that he was obviously a connoisseur of red wine, no doubt developed during long periods of fieldwork in the Hunter Valley wine region! In 1971 John moved from the BMR to join the University of New South Wales (UNSW) as Lecturer in Geology. John then spent the rest of his academic career at UNSW in the School of Applied Geology. He was appointed to a Personal Chair in 1986 and served as Head of Department in 1988-89. John retired in 1998 but continued his association with UNSW as Emeritus Professor and remained extremely active and productive.

John Roberts was an outstanding scholar and intellectual who excelled in his teaching, research, editorial and administrative activities. He was always keen to share his knowledge and provide support and advice to both students and colleagues. He was a plain-speaking person with strong opinions who was not afraid to be frank in discussions but he would always listen and could be persuaded by well-presented arguments. John's outstanding publication record began with his first paper published in 1961 in the Journal and Proceedings of the Royal Society of NSW on Carboniferous faunas. He subsequently published more than eighty high-quality scholarly articles. John's work on Carboniferous brachiopods was substantial and has contributed greatly to knowledge of brachiopod taxonomy, phylogeny and palaeobiogeography. He was the main author and coordinator for the chapter on Australia in the SCCS/IUGS publication The Carboniferous of the World Volume II.

In the 1990s John took an initiative to globally calibrate the largely endemic Carboniferous and Permian biostratigraphic schemes of Australia by U-Pb isotopic dating of zircons in air-fall tuffs and ignimbrites in those sequences using the Australian-developed Sensitive High Resolution Ion Microprobe (SHRIMP) in collaboration with Mark Fanning (ANU) and Jon Claoué-Long (BMR). He also realised that better calibration of Carboniferous and Permian sequences in Australia could provide vital constraints on the age and age-durations of both regional and global geological processes including basin development, orogenesis (in particular the New England Orogen), Late Palaeozoic glaciations, magnetostratigraphy (in particular the important Kiaman reversal) and global climate change. This for me is probably the greatest lasting legacy of John's international contributions for it was this innovative move that has led to immense strides forward in both regional and global timescales and correlation both in Australia and globally. Several important and influential papers resulted from this work and its

significance was acknowledged by being awarded the F.L. Stillwell Award for the best paper of the year in the Australian Journal of Earth Sciences for his 1996 paper with Jon Claoué-Long & Clinton B. Foster on SHRIMP zircon dating of the Permian System of eastern Australia. Recognition of problems with the SL13 standard used for SHRIMP dating by John and colleagues threw the reliability of their many dates into question and this undoubtedly caused John quite a bit of discomfort. Limitations of the accuracy and precision of SHRIMP dating in the Phanerozoic have now been largely addressed with new standards and instrument development but recent times have seen a move to using the much more precise and accurate CA -TIMS method the development and early application of which I had the privilege of being involved with initially in China and then Australia.

John energetically engaged in the wider earth science community both nationally and internationally and served on the Australian Research Council (the peak national competitive research granting body in Australia} in various capacities including Member and Chair of the Earth Sciences Advisory Sub-Panel, Deputy Chair of the Engineering, Earth and Applied Science Panel, and member of the Research Grants Committee. He also acted as the ARC representative on the working party for Towards 2005: A Prospectus for Research and Teaching and Research Training in Australian Earth Sciences (1991 – 1992). I also had the privilege of working with John in the early 1990s on Australia's involvement in the International Ocean Drilling Program (ODP), John being the Chairman of the Australian ODP Council when Richard Arculus (Director) and myself (Science Coordinator) took on the Australian ODP Secretariat at UNE. John was a corresponding and voting member of the SCCS from 1974 to 2000 and Chairman of the SCCS from 1997 to 2000 during a traumatic period for the SCCS with voting members split down the middle regarding the two major subdivisions of the Carboniferous, their rank and naming. In Australia John was extremely active in the Geological Society of Australia (GSA) and served as Editor for the society's publications Alcheringa (1978-82) and Australian Journal of Earth Sciences (1986-1990). He was President of the Association of Australasian Palaeontologists from 1988 to 1990, Secretary of the Australasian Palaeontological Group, Chairman of the NSW division of GSA in 1974 and Secretary of the WA division 1961-1962.

John Roberts was the recipient of many distinctions and awards including a Norman McKie undergraduate scholarship, the Archibald D. Olle prize (1965) and the Clarke Medal (1989) of the Royal Society of New South Wales, a Harkness Fellowship of the Commonwealth Fund of New York (1967 – 1969) to study Palaeobiology at the Smithsonian Institution and University of Illinois, a Commonwealth Bursary of the Royal Society, London (1977) and UNE Distinguished Alumni Award (2009). In addition John received many significant grants from the Australian Research Council to support his research activities.

John is survived by his wife Yvonne and daughter Karen but sadly his son Antony predeceased him by some decades.

Emeritus Professor John Roberts was a scholar and a gentleman of immense intellect who has left an enduring legacy for the Earth Sciences both in Australia and globally. He will be sorely missed.

By Ian Metcalfe
Adjunct Professor,
University of New England, Australia
3 August 2018
(with input from John Pickett, Dick Glen, Al Dunlop, Peter Flood, Richard Stanton and Paul Lennox)

Representative Publications:

ROBERTS, J. (2013): Carboniferous Faunas: Their Role in the Recognition of Tectonostratigraphic Terranes in the Tasman Belt, Eastern Australia. *Terrane Accretion and Orogenic Belts*.

ROBERTS, J. (2010): Control mechanisms of carboniferous brachiopod zones in eastern australia. *Lethaia*, 14(2), 123-134.

ROBERTS, J., & OVERSBY, B. (2008): The early carboniferous palaeogeography of the southern new england belt, new south wales. *Journal of the Geological Society of Australia*, 20(2), 161-173.

ROBERTS, J. (2007): Lower carboniferous brachiopods from greenhills, new south wales. *Journal of the Geological Society of Australia*, 11(2), 173-194.

ROBERTS, J., CLAOUÉ-LONG, J.C. & JONES, P.J. (1995): Australian Early Carboniferous time. *Geochronology Time Scales and Global Stratigraphy Correltion, EPM Special Publication*.

ROBERTS, J. (1981): Control mechanisms of Carboniferous brachiopod zones in eastern Australia. *Lethaia*, 14, 123-134.

ROBERTS, J. (1975): Early carboniferous brachiopod zones of eastern australia. *Journal of the Geological Society of Australia*, 22(1), 1-31.

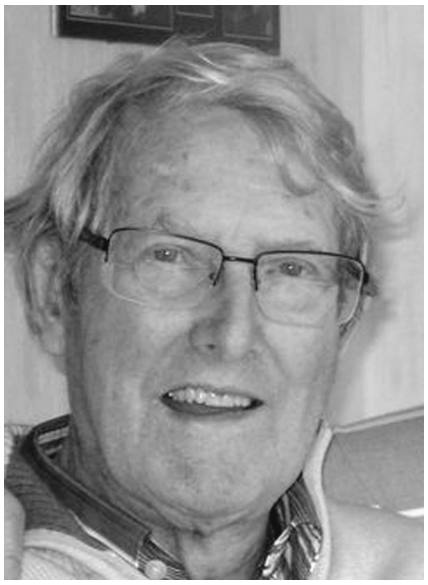
ROBERTS, J. (1971): Devonian and Carboniferous brachiopods from the Bonaparte gulf basin, northwestern Australia. *Bureau of Mineral Resources, Geology and Geophysics*.

OBITUARY

Jürgen Kullmann

(May 23, 1931–August 21, 2018)

Jürgen Kullmann, who passed away on August 21, 2018, had a distinguished academic career primarily based at the University of Tübingen. He described many new and stratigraphically important species of ammonoids and corals from Carboniferous localities in Europe, and participated in programs of the German Research Foundation and international projects related to the Devonian and Carboniferous stratigraphy. His research on Carboniferous ammonoids, corals and biostratigraphy is widely and internationally recognized.



Jürgen Kullmann was born in Berlin on the 23rd May, 1931, and went to school in Spandau, Berlin throughout the war years, where he kept a diary of his childhood observations and experiences, published much later as a book. He graduated in 1950 (Abitur), and began the study of biology, geology and paleontology at the Freie Universität Berlin. Shortly afterwards, he moved to Tübingen to continue working with his teacher, Professor Otto Heinrich Schindewolf. He obtained his doctoral degree in 1960, for a thesis on the Devonian and Carboniferous goniatites of the Cantabrian Mountains of northern Spain. It was published in four parts in 1960 to 1963. In 1964, Jürgen Kullmann completed his habilitation with a thesis “Rugose Korallen der Cephalopodenfazies und ihre Verbreitung im Devon des südöstlichen Kantabrischen Gebirges (Nordspanien)” (Rugose corals of the cephalopod facies and their distribution in the Devonian of the southeastern Cantabrian Mountains (Northern Spain)). In 1965 he received the "Privatdozent" position at Tübingen University, and in 1966/1967 he worked on a research fellowship in the University of Iowa, USA. In 1971, he was awarded the title of "extraordinary professor" at Tübingen, followed in 1978 by his appointment to a full professor. Throughout his research years he pursued the study of two fossils groups: Rugosa corals and ammonoids. Jürgen Kullmann’s research on Devonian and Carboniferous ammonoids and deeper-water (“Cyanthaxonia Facies”) corals is highly respected internationally and it very important in the light of the detailed study of deep-water uninterrupted successions that have recently attracted particular attention as potential sites of GSSPs of geological boundaries. He was interested in a broad range of topics related to morphology, taxonomy, and biostratigraphic significance of Paleozoic ammonoids across Europe and published on the evolution of ammonoid faunas in space and time. His ongoing interest in various aspects of ammonoid evolutionary history allowed him to venture into innovative and pioneering projects, and his diligence and methodical approach helped to effectively organize and substantiate the results. Jürgen Kullmann’s research interests included the quantitative study of ammonoid diversity at the major geochronological boundaries, including the Mid-Carboniferous boundary evolution of the ontogeny of ammonoid shells. Together with J. Wiedmann, he organized the 2nd International Cephalopod Symposium in 1985 in Tübingen (“Cephalopods – Present and Past), which was dedicated to his teacher O.H. Schindewolf. One of his major contributions was a project of a comprehensive database of Paleozoic ammonoids (e.g. Kullmann et al. 1993; Kullmann 2007, currently: GONIAT Online), which included nearly all known ammonoid records, their localities, literature sources and synonymy lists. Jürgen Kullmann hosted many international postdoctoral students who became his coauthors and often personal friends. He generated many ideas of possible applications of ammonoid-related studies and generously shared his scientific knowledge.

Jürgen Kullmann retired from teaching in 1995, but continued as a researcher for many subsequent years. In 2009, the revised Treatise on Carboniferous and Permian ammonoids was eventually published after many years of preparation. The volume is authored by Bill Furnish, Brian Glenister, Jürgen Kullmann, and Zhou Zuren. For the Carboniferous part of the Treatise, Jürgen Kullmann patiently and methodically collected the data and photographs and figures from a broad range of international sources, and many of us remember receiving requests for images of a particular rare species.

In total, Jürgen Kullmann (co-) authored ca. **150** publications, of which only the Carboniferous ones are compiled here.

He recognized the importance of information exchange between scientists, and for many years sent regular donations to the Carboniferous Newsletter.

Jürgen Kullmann was a gentle and devoted family man. He leaves behind his wife Hilde and five children (Eva, Angela, Peter, Klaus and Demsas Ghebreab), the last two were adopted, and ten grandchildren. Jürgen Kullmann was a warm-hearted and humorous man, and always eager to help others. He will be very much missed. (*Provided by Svetlana Nikolaeva*)

Representative Publications:

SCHINDEWOLF, O.H. & KULLMANN, J. (1958): Goniatites devónicos y carboníferos de la Cordillera Cantábrica. *Estudios Geológicos*, 14 (37): 45–53.

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SCCS REPORTS

Annual report to ICS for 2017-2018

SCCS Chairman Xiangdong Wang

1. This version of the 2017-2018 SCCS Annual Report is abbreviated from the document submitted by our chairman to the International Commission of Stratigraphy in late November, 2018. The full version of the Annual Report has been posted on our website at http://carboniferous.stratigraphy.org/

2. OVERALL OBJECTIVES AND FIT WITHIN IUGS SCIENCE POLICY

Objective

The SCCS promotes and coordinates international cooperation among various geologic specialists for the purpose of defining standard global chronostratigraphic boundaries within the Carboniferous System and promoting regional and intercontinental stratigraphic correlation of Carboniferous. The principal SCCS goals are:

(a) to establish a standard global stratigraphic time scale and to select the best stage boundaries within the two Carboniferous subsystems;

(b) to redefine the Carboniferous-Devonian boundary GSSP;

(c) to facilitate global and regional correlation within the system.

Fit within IUGS Science Policy

The current objectives of SCCS relate to main aspects of IUGS policy:

(a) Establishment of a standard global stratigraphic time scale, defined by Global Stratotype Sections and Points (GSSPs);

(b) Development of an internationally acknowledged chronostratigraphic units/or boundary;

(c) Promotion of international cooperation in geological research.

3. CHIEF ACCOMPLISHMENTS IN 2017-2018

3.1. The base of the Carboniferous:

The members of the joined SDS/SCCS Task group continued to gather new data in the critical time interval. As in the last years these data are often based on multi-disciplinary approaches, which combine palaeontological, sedimentological, geochemical and petrophysical methods and data. The focus of the activities of the task group members are to test the proposal combining several criteria for the redefinition of the Devonian-Carboniferous boundary agreed on at the Montpellier workshop and to write regional syntheses for the DCB interval, which will be published in special volume of Palaeobiodiversity and Palaeoenvironments. In the future some kind of calendar of palaeontological and geological events should be taken into consideration when determining the boundary.

The phase of testing should come to an end next summer with a formal decision of the task group at a meeting to be held during the 19th International Congress on the Carboniferous and Permian, followed by a formal vote on the new criterion by SCCS. Assuming that this process can be concluded in 2019, the look for a suitable section for the GSSP will start in 2020. It is the aim to present a detailed proposal for the GSSP defining the base of the Tournaisian Stage, and hence the base of the Carboniferous Period latest at the STRATI meeting in 2023, with the clear objective to finalize the ratification process before or at the International Geological Congress in 2024.

3.2 Carboniferous Magnetostratigraphy:

In the past years, the focus of the projects group has been to find suitable sections which work for Carboniferous magnetostratigraphy, which fill the data gaps in the Tournasian to late Visean and early Bashkirian (Chokerian to Yeadonian European regional substages). Mark Hounslow, along with Andy Biggin, Courtney Sprain, Annique Van der Boon, Jerzy Nawrocki and Krystian Wójcik have identified a number of potential targets in Northern England, Scotland and southern Poland which had potential in terms of their low thermal maturity (CAI <=2). Numerous samples have been collected from these successions and detailed analysis is currently underway to fully assess magnetostratigraphic data.

3.3 Carboniferous Stronium isotopic stratigraphy

The residence time of Sr in the ocean (~10^6a) is far longer than the ocean mixing time (~10^3a), the world's oceans are considered homogeneous with respect to seawater $^{87}Sr/^{86}Sr$, which has long been used as a tool for precise stratigraphic correlation and dating. Chen et al. (2018) present a high-temporal-resolution and high-fidelity record of Carboniferous-early Permian seawater $^{87}Sr/^{86}Sr$ based on conodont bioapatite from the Naqing section in South China, in combination with high-resolution carbon isotopic stratigraphy and conodont biostratigraphy, providing an integrated stratigraphic framework and timescale of Carboniferous.

3.4 Carboniferous cyclostratigraphy

Cyclostratigraphy is a powerful tool in high-resolution stratigraphic subdivision and correlation. As for the Paleozoic strata, astronomically calibrated floating time scales with time resolution of 400 kyr could be provided by the interpretation of cyclic variations in the sedimentary records, and in

combination of radiometric age, enable us to improve the accuracy and resolution of geologic time scale. High-resolution cyclostratigraphy based on magnetic susceptibility, covering the Serpukhovian to late Moscovian icehouse climate, has been investigated in the Luokun section of South China by Fang et al. (2018). They assigned the basal Serpukhovian in Luokun with the numerical ages from GTS 2012 to construct floating time scales ranging from 331.55±0.5 Ma to 323.2±0.5 Ma, and indicate that the Serpukhovian Stage has a duration of 7.68±0.15 Myr.

4. SUMMARY OF INCOME IN 2018
Prepared by Prof. Xiangdong Wang, Chair of SCCS (Accounts maintained in U.S dollar)

Funds carried forward from 2017	$350
ICS Grant	**$3,000**
TOTAL INCOME	$3,350

5. SUMMARY OF EXPENDITURE IN 2017-2018:
Prepared by Prof. Xiangdong Wang, Chair of SCCS (Accounts maintained in U.S dollar)

Post-conference fieldtrip registration (IPC5 in Paris) support for SCCS secretary	$430
Travel/conference registration/ accomodation (IPC5 in Paris) support for voting members	$1,500
SCCS Newsletter 2018 editing, printing, and mailing	$450
TOTAL EXPENDITURE	$2,380

6. BUDGET FROM ICS IN 2019
Prepared by Prof. Xiangdong Wang, Chair of SCCS (Accounts maintained in U.S dollar)

In 2019, the 19th International Congress on the Carboniferous and Permian (ICCP) and the 3rd International Congress on Stratigraphy (Strati 2019), will be held at the University of Cologne, Germany on July 29 to August 2 and in Milano, Italy on July 2 to July 5, respectively. At the 19th ICCP, there will be a special session devoted to the undecided and revised Carboniferous GSSPs, with emphasis on 1) the discussion of redefinition of the Devonian-Carboniferous boundary (DCB), 2) votes on an index fossil for the base of the Serpukhovian boundary by the task group and 3) a proposal for the GSSP defining the base of the Gzhelian Stage. In addition, more discussion on new criterion for the DCB and upcoming special issue about the global DCB review as well as other Carboniferous GSSPs will be given at the Strati 2019, which is crucial for the precise subdivision and correlation of Carboniferous. The attendance of several VMs and CMs at these two important conferences is going to be sponsored by the Subcommission. We anticipate 4 members need financial supports for the 19th ICCP and 2 members for the Strati 2019, which are equivalent to the full waiver of $1250 covering registration, transportation and hotel fees for 6 participants (total amount $7500). Thus, we are in request $ 6,980 from the ICS NSF grant to support members of SCCS's attendance at ICCP and Strati 2019.

PROJECTED EXPENSES	
Support for voting members and/or students to participate in the 19th ICCP in Germany (Registration €330 + Transportation €276 +Hotel €100*5day) *4persons	$5,000
Support for voting members and/or students to participate in the Strati 2019 (Registration €470+Transportation €240 +Hotel €100*4day)*2persons	$2,500
SCCS Newsletter 2019 editing, printing, and mailing	$450
TOTAL PROJECTED EXPENSES	$7,950
INCOME	
Carryover (from CREDIT balance of 2017 fiscal year)	$970
Estimated donations	$00.00
TOTAL PROJECTED INCOME	$970
BALANCE	
Estimated (deficit) /credit from above	-$6,980
BUDGET REQUEST FROM ICS for 2017-2018	$6,980

7. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR:

- A special volume entitled as 'Global review of the Devonian-Carboniferous boundary' will be published in Palaeobiodiversity and Palaeoenviroments in early 2019.
- In 2019, most VMs and CMs will meet in Cologne at the 19th ICCP in July, 29th-August, 2nd, we will have a Carboniferous GSSPs session, and a proposal for the GSSP defining the base of the Gzhelian Stage will be probably submitted to the SCCS.
- A task group meeting for the Devonian-Carboniferous Boundary GSSP reappraisal will be held in the 19th ICCP, and a formal vote on the new criterion will be held by the SCCS before the end of 2019.
- An index for the Viséan-Serpukhovian boundary needs to be voted on by the task group and SCCS in the next year.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2016-2020)

- Within the next 4 years, it will be possible to select the defining events for all of the stage boundaries and progress toward selecting candidate sections for the GSSPs. We intend to use high-resolution biostratigraphy and combine it with a multi-discipline approach (use of sedimentology, geochemistry, and geological events) to establish as many of the remaining GSSPs as possible. The realistic objective is to have two GSSPs ratified in the next four years.
- We will encourage and pay more attention to finding volcanic ash beds for radiometric dating, in order to establish a more precise Carboniferous time scale and facilitate the correlation of important Carboniferous events at global scale.
- Using multi-discipline methods including palynological studies, U-Pb dating and stable isotope studies, we will further promote marine and non-marine correlation.
- We are going to organize at least one academic activity each year, either a workshop (maybe combined with conferences) or joint workshop/ field excursion.
- To establish working groups on dividing the Tournaisian and Viséan stages because both of them represent too much time.
- To strengthen and to vivify the SCCS website, with membership lists revised, tasks and newsletters updated in time, making it a genuine platform to bring Carboniferous specialists together for collaboration and exchange of new ideas and results.
- Integrate the Carboniferous databases from the entire world, combining the Geobiodiversity Database (GBDB, a large compilation of data about sections) at Nanjing Institute of Geology and Palaeontology, the Paleobiology Database (a large compilation of data about fossils) at the University of Wisconsin-Madison, and other major databases, to facilitate the studies on Carboniferous biota and stratigraphy.

9. ORGANISATION - interface with other international projects/groups

9.1 SCCS Officers for 2016-2020:

Chair: Xiangdong Wang (China)
Vice-Chair: Svetlana Nikolaeva (UK)
Secretary: Wenkun Qie (China)

9.2 Voting members (VM) and corresponding members (CM):

The Carboniferous subcommission of ICS together have 19 voting members (including 3 officers) representing 10 countries: Belgium (2), Cezch Republic (1), China (4), France (1), German (1), Japan (1), Russia (4), Spain (1), UK (1), USA (3). A full list of current voting members (with address, telephones and emails) is at the end of this newsletter. There are approximately 280 corresponding members at present, please check the latest issue of Newsletter on Carboniferous Stratigraphy for contact information.

9.3 SCCS maintain an official website, and the URL is as following:

http://carboniferous.stratigraphy.org

9.4 Interface with other international projects/ groups

The SCCS works closely with the subcommissions on Devonian (SDS) and Permian Stratigraphy (SPS) to establish the common boundaries with the Carboniferous. The SCCS expects to cooperate with the NSF-sponsored Chronos initiative, which has a website at www.chronos.org, and with the NSF-sponsored PaleoStrat community digital information system for sedimentary, paleontologic, stratigraphic, geochemical, geochronologic, and related data, hosted at Boise State University, and with a website at www.paleostrat.org. It also has established a more close relationship with the Geobiodiversity Database (GBDB, a large compilation of data about sections and fossil occurrences) hosted at Nanjing Institute of Geology and Palaeontology, CAS.

TASK GROUP REPORTS FOR 2017-2018 AND WORK PLANS FOR 2019 FISCAL YEAR

Due to short notice, only one short task group report for redefining the DCB from Markus Aretz, task group report to establish a GSSP close to the existing Bashkirian-Moscovian boundary from Alexander Alekseev and report of the project group on Carboniferous magnetostratigraphy from Mark Hounslow were received and present in this newsletter.

REPORT OF THE JOINT DEVONIAN-CARBONIFEORUS BOUNDARY GSSP REAPPRAISAL TASK GROUP

Markus Aretz[1] and Task Group
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Introduction and general progress

The members of the joined SDS/SCCS Task group continued to gather new data in the critical time interval. As in the last years these data are often based on multi-disciplinary approaches, which combine palaeontological, sedimentological, geochemical and petrophysical methods and data. The focus of the activities of the task group members are to test the proposal combining several criteria for the redefinition of the Devonian-Carboniferous boundary agreed on at the Montpellier workshop and to write regional syntheses for the DCB interval, which will be published in special volume of Palaeobiodiversity and Palaeoenvironments. These syntheses and other detailed work should form a solid base for the decision whether the Montpellier Criteria can be used for the new boundary decision and especially the global correlation of the critical time interval.

It should be reminded here that although the working group works on the timeline for the future boundary, other solid timelines are developed and established in the latest Famennian and earliest Carboniferous to foster the stratigraphic frame in which the boundary will be placed. In the future some kind of calendar of palaeontological and geological events should be taken into consideration when determining the boundary.

The phase of testing should come to an end next summer with a formal decision of the task group at a meeting to be held during the 19th International Congress on the Carboniferous and Permian, followed by a formal vote on the new criterion by SCCS. Assuming that this process can be concluded in 2019, the look for a suitable section for the GSSP will start in 2020. It is the aim to present a detailed proposal for the GSSP defining the base of the Tournaisian Stage, and hence the base of the Carboniferous Period latest at the STRATI meeting in 2023, with the clear objective to finalize the ratification process before or at the International Geological Congress in 2024.

REPORT OF THE TASK GROUP TO ESTABLISH A GSSP CLOSE TO THE EXISTING BASHKIRIAN-MOSCOVIAN BOUNDARY (2018)

Alexander S. Alekseev[1] and Task Group
[1]Department of Paleontology, Geology Faculty, Moscow State University, 119991 Moscow GSP-1, Russia; e-mail: aaleks[at]geol.msu.ru

In 2018 members of the Task Group received several important results which show essential progress in the final selection of marker and section for the Bashkirian-Moscovian (B-M) GSSP.

Northern Spain (Elisa Villa)

In the Asturian Coalfield the Levinco package seems to correlate with the K interval and the lower part of the L interval of the Donets Basin (Villa et al., 2018). In the Levinco strata one of the most striking aspects is the presence of Bashkirian microfauna (abundant archaediscids and fusulines such as *Aljutovella* cf. *porrecta* Dzhenchuraeva), occurring along with large *Aljutovella* with intensive plication of septa (*Aljutovella asturiensis* Villa, *Aljutovella* aff. *postaljutovica* Safonova, etc.) resembling typical Moscovian forms. The upper part of the Levinco stratal package yielded a species (*Eofusulina* aff. *triangular* (Rauser-Chernousova and Beljaev) of early Moscovian age.

The eofusulinin genera *Verella* and *Eofusulina* formed an important lineage among fusulines to define the B-M transitional interval in the Pennsylvanian (Upper Carboniferous). The morphologies of *Verella transiens* Ginkel and Villa, a highly evolved form in the genus, and the first *Eofusulina* species from the Los Tornos section in the Cantabrian Zone of northern Spain, were studied to understand the discriminating diagnosis of these two genera (Ueno and Villa, 2018). *Eofusulina* is distinguishable from *Verella* in having stronger septal fluting, lesser development of secondary deposits, generally larger proloculus, absence of early tightly coiled volutions, and with some lesser extent slightly larger diameter of shell and absence of polar torsion. No single morphological character provides a reliable criterion to distinguish the two genera, but rather only a combination of all these morphological criteria enables reliable generic discrimination. In regional biostratigraphic aspects, was proposed a minor modification on the FAD of *Eofusulina* in the Los Tornos section, and lower it about 5 m stratigraphically. A comprehensive taxonomic review of *Verella* and *Eofusulina* is also very important for B -M boundary interval correlation.

Zircons from tonstein (altered volcanic ash) in the Asturian Coalfield from transition B-M interval, *Profusulinella* Zone III (early Vereian), show radiometric age 314.4±1.3 Ma (LA-ICP-MS U-Pb dating) (Merino-Tome et al., 2017), that is very close to 314.40±0.06 Ma from k4 coal seem in the Dontes Basin (Davydov et al., 2010).

Donets Basin (Tamara I. Nemyrovska and K. Hu)

Ten sections spanning the B-M boundary interval were studied in the Donets Basin. Six of them contain most representative conodont and foraminifer associations. We focused on three the most complete sections that include stratigraphically important conodont species, which belong to the genera

Declinognathodus, *Idiognathoides*, *Idiognathodus*, *Neognathodus*, "*Streptognathodus*", *Mesogondolella* and *Diplognathodus*. The majority of those species are widely distributed, which makes the correlation to other areas reliable. Two conodont lineages established here are considered as potential markers for the definition of the lower boundary of the Global Moscovian Stage: *D. marginodosus – D. donetzianus* and *Id. sulcatus sulcatus – Id. postsulcatus*. The conodonts *D. donetzianus* and *Id. postsulcatus*, both proposed before as potential markers for the definition of the GSSP at the B-M boundary, are described and compared to those from the other areas. The entry of *D. donetzianus* is updated and confirmed to the top of the limestone K1 in both sections, the Zolota Valley and the Malo-Mykolaivka sections. Three conodont zones characterize the B-M boundary interval: *Id. tuberculatus – Id. fossatus* Zone and *D. marginodosus* Zone from the upper Bashkirian, and *D. donetzianus* Zone from the lower Moscovian (Nemyrovska and Hu, 2018).

South Urals (Alexander S. Alekseev et al.)

Relatively numerous elements of *Diplognathodus*, altogether around 50 in number, were found in the Bed 4 of the Basu 1. Of these, over 30 specimens are well- and relatively well-preserved. They come from the upper part of Bed 4, which represents an algal *Donezella* biostrome, samples 16-10A and 16-10B. This algal biostrome, 0.8 m thick, suggests a brief shallowing episode, indicated by the presence in sample 16-10A of several specimens of the genus *Adetognathus*. The more extend description is published in this volume (Alekseev et al., 2018).

Three morphotypes can be recognized among diplognathodids. The first morphotype is identified as *D.* aff. *orphanus* (Merrill), and it is a single specimen found in sample 16-10A. The carina is separated from the blade by a very small notch of one lower denticle. Most specimens of the second morphotype come from samples 16-10A and 16-10B were identified as *D.* aff. *ellesmerensis* Bender. They are very similar to the morphotype named as *D. orphanus* from the Naqing section (South China) (Qi et al., 2016, fig. 7: D, E), which was proposed as a member of the lineage that eventually evolved into *D. ellesmerensis*. The third morphotype with a lower carina relative to the height of the blade is considered to be an earlier form of *D. ellesmerensis*, more primitive than the specimens of this species at 176.9 m in the Naqing section (Qi et al., 2016, fig. 7: A, B). FAD of *D. donetzianus* occurs at the base of Bed 5 (Sample 11), just above of *D. ellesmerensis* entrance.

A single specimen of *D.* aff. *ellesmerensis* is present in sample 17-14Bu from Bed 8 also. These finds confirm that elements of *Diplognathodus* are more common in the Basu 1 section than we thought previously. Much more specimens of *Diplognathodus* are needed to clarify their morphologic and taxonomic relationships. Joint occurrence of marker conodonts *D. donetzianus* and *D. ellesmerensis* in the Basu 1 section increase its value for correlation American, European and South China B-M interval.

The new sedimentological analysis of Basu 1 section shows that succession is dominate by relatively deep-water mid- and outer ramp limestones with chert nodules and bands (Gorozhanina et al., 2018). Also calcareous algae were studied (Ivanova and Kulagina, 2018).

Because old profile in the Basu section (named as Basu 1 now) was partly destroyed Elena Kulagina, Guzel Sungatullina, Raphael Sungatullin sampled new one (Basu 2) closer to the highway, 12.5 meters to the south only, in October, 2017. In total 20 samples were collected for conodont extraction (total weight more than 100 kg) and several for fusulinids (interval of sampling is 0.5–1 m). These samples processed in the Department of Paleontology, Lomonosov Moscow State University, and conodonts picked up from most of them. Alexander Alekseev and Elena Kulagina collected more conodont and foraminiferal samples from Basu 1 and Basu 2 sections in September, 2018, to elucidate conodont ranges in this important B-M succession.

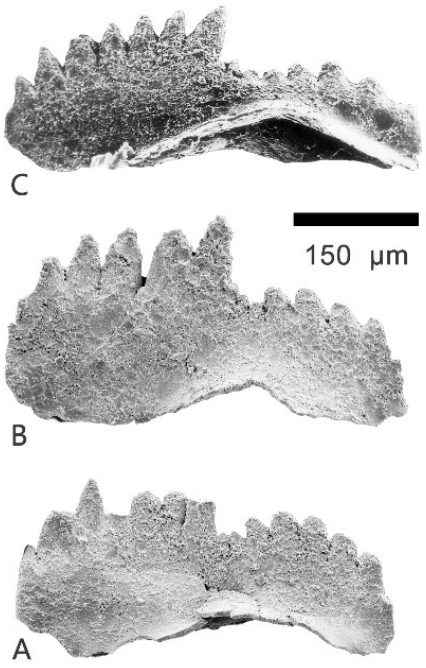

Figure 1. Morphological variation of "*D. benderi*" (A, LD174.3), *D. ellesmerensis* primitive form (B, NQC175.9) and *D. ellesmerensis* (C, NSC176.9). All specimens from the Naqing section, Guizhou, South China.

South China (Yuping Qi et al.)

In 2018, Chinese colleagues collaborated with Nicholas Hogancamp, Alexander Alekseev and Lance Lambert working on the lineage of *Diplognathodus ellesmerensis* Bender. They analyzed the morphological variation of different *Diplognathodus* morphotypes from B-M interval in the Naqing section, South China, through a landmark-based morphometric analyses. The result helps to recognize a lineage from "*D. benderi* n. sp." to *D. ellesmerensis* through increasing relative relief between carina and blade (lowering carina and elevating blade) and other minor changes (Fig. 1). The study is ongoing by Keyi Hu, Yuping Qi and Nicholas Hogancamp.

North America (Lance L. Lambert)

Three Pennsylvanian stratigraphic units in southwestern Missouri that have long been recognized as preceding the Cherokee Group (and as pre-Desmoinesian Stage) are compared on the basis of their conodont faunas: the Riverton Shale, the Ladden Branch Limestone Member of the Riverton Shale, and the type Burgner Formation from the subsurface. Shale at the base of the Rivertonwas produced a conodont fauna that is mostly similar to that of the Ladden Branch Limestone Member, which occurs at the base of the Riverton Shale at other localities. Both units produced biostratigraphically important *Neognathodus* bothrops and *N. colombiensis* s.l. A difference is that the Ladden Branch Limestone Member commonly produced specimens of *Idiognathoides*, whereas none were recovered from the basal Riverton shales. Both are assigned to the upper Atokan *Neognathodus colombiensis* Zone, and most likely are age-equivalent facies. Strata at the Republic coal pit, previously considered correlative with the type Burgner Formation, are now correlated with the Riverton Shale based on its *N. colombiensis* Zone conodonts and overall similarity to the basal Riverton. The core that represents the type Burgner Formation produced a conodont fauna somewhat different from the other sections, including specimens of an advanced morphotype of *Neognathodus nataliae*. The type Burgner Formation is, therefore, assigned to the upper part of the lower Atokan *N. nataliae* Zone. In spite of more younger age of these formations than B-M boundary because they are equivalents of the Kashirian Regional Substage in the Moscow Basin (Russia), the conodont faunas are interesting and several specimens identified as *Diplognathodus orphanus* (Merrill), possible pare-ancestor of *D. ellesmerensis*, are illustrated.

Plan for 2018

The Russian Team hopes to complete study of conodonts and foraminifers from the South Urals Basu 1 and Basu 2 B-M sections and present results at Cologne Carboniferous and Permian Congress (Germany) in 2019.

The Kurielga section, 6 km southeast of the Basu 1 and 2 sections (a road cut along the Ufa – Beloretsk highway), is another South Urals prospective section for the study of the B-M boundary interval which is planned to be studied in 2019.

In the 2018, Chinese collegues will continue working on conodonts from the B-M boundary interval in the Naqing section (South China) together with our foreign colleagues including Nicholas Hogancamp, Alexander Alekseev, Lance Lambert and Tamara Nemyrovska. The correlation study of conodonts with fusulinids from the B-M boundary interval in the Naqing section will be continued by Yue Wang and Katsumi Ueno.

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REPORT OF THE PROJECT GROUP ON CARBONIFEROUS MAGNETOSTRATIGRAPHY

Mark W. Hounslow[1] and Project Group Members

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The rationale of the project group has been to build on the existing magnetostratigraphy through the late Visean to Serpukovian (early Namurian) generated by the work of Opdyke, Giles & Utting (2014). For age control this study primarily utilized the spore zonation of eastern Canada linked to the European regional substages (Brigantian to early Arnsburgian for their data). Their magnetostratigraphic data has now been calibrated to U/Pb radiometric ages (Hounslow, 2016) and the base of the Kiaman Superchron dated to ~318.8 Ma (Fig. 1).

The focus of the projects group has been to find suitable sections which work for magnetostratigraphy, which fill the data gaps in the Tournasian to late Visean and early Bashkirian (Chokerian to Yeadonian European regional substages). Mark Hounslow, along with Andy Biggin, Courtney Sprain, Annique Van der Boon, Jerzy Nawrocki and Krystian Wójcik have identified a number of potential targets in Northern England, Scotland and southern Poland which had potential in terms of their low thermal maturity (CAI <=2).

Tournasian sections (which also cover the Devonian-Carboniferous boundary) were tested at Czatkowice Quarry and Racklawka Valley in southern Poland (Poty et al. 2003), the Burnmouth section in SE Scotland (Kearsley et al. 2016), and the Pease Bay section in SE Scotland (Andrews & Nabi, 1994). Of these the Czatkowice Quarry section appears the most promising for magnetostratigraphy, and currently Annique van der Boon, Andy Biggin, Krystian Wójcik and Mariusz Paszkowski are undertaking a full sampling of this section to try and determine a magnetostratigraphy from the late Famennian through most of the Tournasian.

Visean age sections tested for magnetostratigraphy were the Pease Bay section in SE Scotland (Andrews & Nabi, 1994), and various sections in northern England, including the Holkerian and Asbian stratotypes (Riley, 1993). Of these the most promising appears to be the Chadian to Asbian age successions in south Cumbria (including Holkerian stratotype) and North Lancashire described for coral-brachiopod biostratigraphy in the classic works of Garwood (1912, 1916). A mosaic of sections allows a composite stratigraphic section to be constructed through most of the Chadian-Arundian-Holkerian-Asbian substages. Detailed analysis and sampling on these sections is currently underway by Hounslow and Tereza Kameníková to fully assess magnetostratigraphic and cyclostratigraphic data through the Chadian and Asbian at a sub-meter-resolution.

Late Namurian (early Baskirian) age sections tested magnetostratigraphy were the Joppa shore section in Scotland, sections near Howick Burn in NE England, and the Mousegill section in Northern England. Currently the Mousegill section and associated sections nearby may provide the best possibility to recover a magnetostratigraphy through the Arnsbergian to Yeadonian.

Volcanic ash intervals in the Visean and Tournasian sections (some currently un-described) may provide radiometric constraints in the longer term (work being coordinated by C. Sprain). We would welcome anybody who would like to join our group to help us better define the biostratigraphy, cyclostratigraphy, sequence stratigraphy or magnetostratigraphy of our selected sections.

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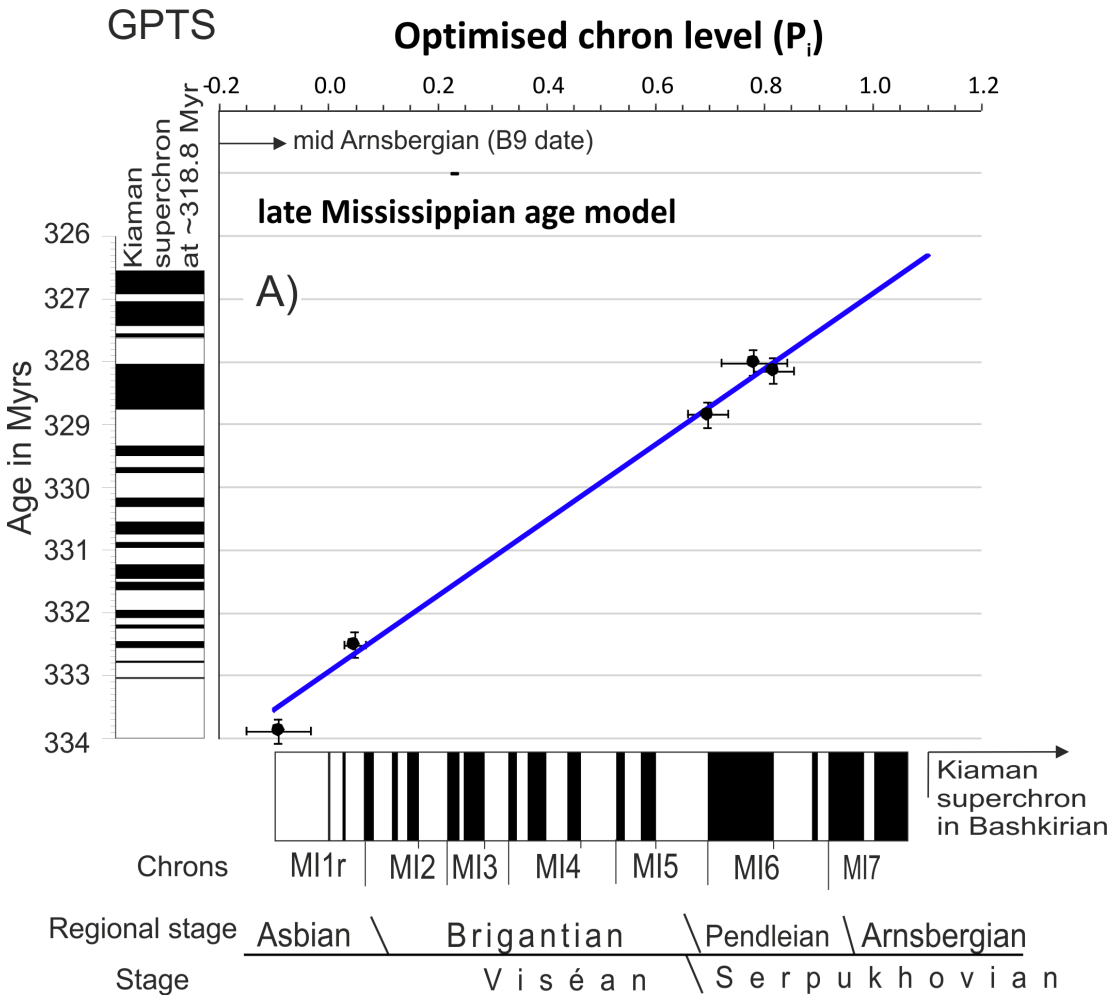

Fig. 1. Radiometric calibrated magnetostratigraphy of Opdyke et al. (2014). Bottom magnetostratigraphy is section -scaled composite, left is age-scaled magnetostratigraphy, blue line is best fit linear using uncertainties in both x and y (black=normal polarity). See Hounslow (2016) for details.

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SCCS DOCUMENTS

REPORT ON THE INTERNATIONAL CONFERENCE AND FIELD TRIP TO THE UPPER DEVONIAN-CARBONIFEROUS REEF BUILDUPS OF THE BOLSHOI KARATAU MOUNTAINS (SOUTH KARATAU) AUGUST 15–22, 2017

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1. Introduction and overview

From August 15-22, 2017, members of the Subcommission on Carboniferous Stratigraphy (SCCS) attended a meeting in southern Kazakhstan hosted by the Lithology and Engineering Geology Group of the K.I. Satpayev Institute of Geological Sciences. The meeting was multifaceted but had two main components: a one-day conference titled - International conference “uppermost Devonian and Carboniferous carbonate buildups and boundary stratotypes” and a subsequent field meeting - Field trip to the Upper Devonian and Carboniferous reef buildups of the Bolshoi Karatau Mountains (South Karatau). The conference was held in the ancient city of Turkestan in the Institute of Geological Sciences at the K.I. Satpayev University and the field meeting in the Bolshoi Karatau Mountains (Fig. 1).

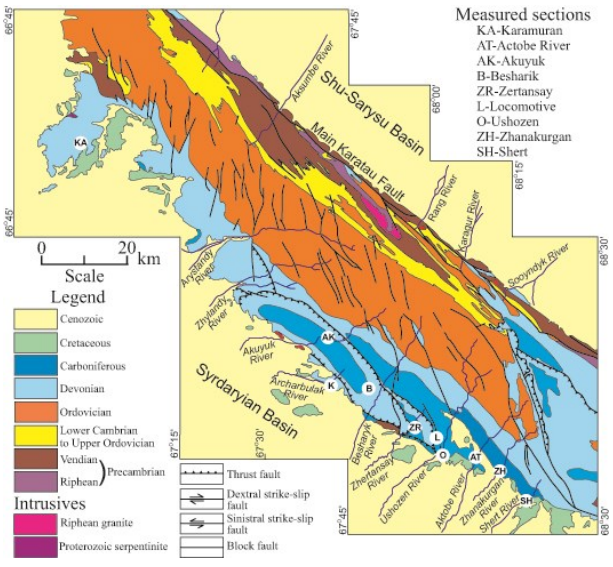

Figure 1. Index map and simplified geological map of the Bolshoi Karatau Mountains in southern Kazakhstan showing locations of Upper Devonian and Carboniferous stratigraphic sections visited on the SCCS field trip in August 2017 (modified from Cook et al., 2002).

The conference was well organized, and the field meeting geologically exciting, particularly for SCCS members who are interested in Famennian to Bashkirian reefs, carbonate mud mounds, and foraminifers. For the field meeting, Zhaimina et al. (2017) prepared an excellent field guide containing a wealth of foraminiferal-based biostratigraphic data and reef photographs. The field guide, titled Upper Devonian and Carboniferous reef buildups of the Bolshoi Karatau Mountains (south Kazakhstan), was edited by V.Ya. Zhaimina and S.V. Nikolaeva and published in Russian and English. The abstract volume (available on our SCCS website), International conference “uppermost Devonian and Carboniferous carbonate buildups and boundary stratotypes”, was edited by Zholtaev, G.Zh., Zhaimina, V.Ya., Fazylov, E.M., Nikolaeva, S.V. and Musina, E.S and published in Russian and English. In the city of Turkestan, accommodation and most meals were at the Hotel Khanaka (Fig 2).

The hotel was situated next to the spectacular and well-preserved 14th century historical Khanaka (mausoleum) of Khodzha Akhmed Yasawi (Figs. 3a, b). On the morning of August 16, we toured the mausoleum and associated buildings. From August 16th to 21st, the participants examined Upper Devonian and Carboniferous stratigraphy and reefs in the Bolshoi Karatau. On the afternoon of August 19, we visited the ancient walled city of Sauran. Unfortunately, several participants including myself had to leave the team for Almaty on August 20th to catch flights and deal with immigration issues.

In this review of the conference and associated field trip, I have included some of the information presented in the information circulars for the meeting. I have provided the basic itinerary (updated from the circulars) and illustrations of most reefs we visited along with a summary of the geological highlights for each day of the field trip. For a comprehensive analysis of the stratigraphy and reefs of the Bolshoi Karatau, I direct you to the published field guide by Zhaimina et al. (2017) and the paper by Cook et al. (2002). Approximately 17 foreign guests along with about 13 geologists and support personnel (drivers, translators, and photographers) from Kazakhstan attended the meeting (Fig. 2).

We had an excellent turnout for the conference but I would have liked to have seen more registrants from North America (represented by two Canadians) and Western Europe. Most of the foreign guests were from the Peoples Republic of China and the Russian Federation. The field lunches were feasts that included lamb and goat cooked in the field using traditional Kazakhstanian methods. The weather was almost perfect with abundant sun and no rain but it was hot for northerners (in mid 30s or higher most days).

Figure 2. Field conference participants in front of the Hotel Khanaka in the city of Turkestan, south Kazakhstan. (Photo taken by Dr. L.V. Shabalina.)

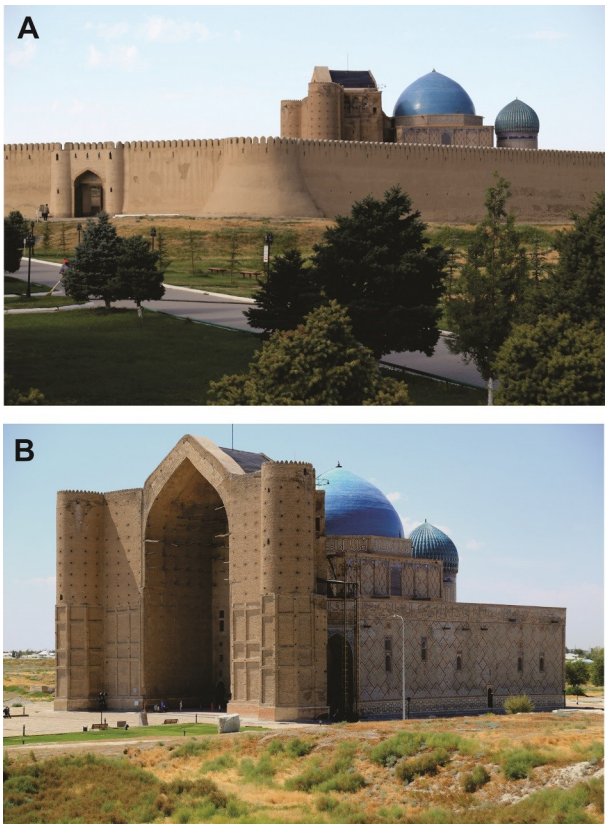

Figure 3. A) Walls enclosing the Khanaka (mausoleum) of Khodzha Akhmed Yasavi with its 18 m wide blue dome built in late 14th century, AD. Situated in ancient city of Turkestan, in southern Kazakhstan. Walled enclose contains several other smaller mausoleums, mosques, a bathhouse, and other ancient buildings. **B)** The Khanaka (mausoleum) of Khodzha Akhmed Yasavi.

2. Organizers and Sponsors

Many people helped prepare the meeting but the principal organizers were Elmira S. Musina and Valentina Ya. Zhaimina. The institutional organizers were the SCCS and K.I. Satpayev Institute of Geological Sciences. Svetlana Nikolaeva was the chief editor for the English versions of the circulars, program, field guidebook, and abstract volume. Valentina Ya. Zhaimina was the chief editor of the Russian version of the documents. On behalf of the meeting participants, I wish to thank all of the organizers, editors and field-trip leaders for their work and for the completion of a very successful and enjoyable field meeting.

2.1 Institutional Organizers and sponsors

Institutional organizers were the Subcommission on Carboniferous Stratigraphy (SCCS) of the International Commission on Stratigraphy (an IUGS commission); K.I. Satpayev Institute of Geological Sciences; Committee of Geology and Subsoil Use of the Ministry for Investment and Development of the Republic of Kazakhstan; and Khoja Akhmet Yasawi International Kazakh-Turkish University. The major sponsors for the meeting were the SCCS and Khoja Akhmet Yasawi International Kazakh-Turkish University.

2.2 Organizing Committee:

Prof. Xiangdong Wang: Chairman of Subcommission on Carboniferous Stratigraphy; School of Earth Sciences and Engineering, Nanjing University .

Dr. S.V. Nikolaeva: Vice-Chairman of Subcommission on Carboniferous Stratigraphy; Paleontological Institute, Russian Academy of Sciences, Russia and Natural History Museum, London, United Kingdom.
Dr. B.C. Richards: Former Chairman of the Subcommission on Carboniferous Stratigraphy; Natural Resources Canada, Geological Survey of Canada-Calgary.
Prof. A.S. Alekseev: Head of a Working Group for the Subcommission on Carboniferous Stratigraphy; Moscow State University, Russia.
Prof. G.Zh. Zholtaev: Academician of the National Academy of Sciences of the Republic of Kazakhstan; Director of the K.I. Satpayev Institute of Geological Sciences.
B.K. Nurabaev: Chairman of the Committee of Geology and Subsoil Use of the Ministry for Investment and Development of the Republic of Kazakhstan.
Prof. U.S. Abdibekov: Principal Dean of the Khoja Akhmet Yasawi International Kazakh-Turkish University.
Dr. V.Ya. Zhaimina: Senior Researcher at K.I. Satpayev, Institute of Geological Sciences.

2. 3 Organizing group:
Dr. E.M. Fazylov: Head of the Department of Regional Geology, Head of the Lithology and Engineering geology group of the K.I. Satpayev Institute of Geological Sciences.
V.M. Buvtyshkin: Director of the Izdenis Ltd. Association of geological enterprises. Mapping expedition.
A.E. Zorin: Chief Geologist of the Izdenis Ltd. Association of geological enterprises. Mapping expedition.
Dr. S.K. Kurbaniyazov: Khoja Akhmet Yasawi International Kazakh-Turkish University.
Dr. S. Mustapaeva: Lecturer at the National K.I. Satpayev University Institute of Geological Sciences.
E.S. Musina: Engineer at the Lithology and Engineering Geology Group of the K.I. Satpayev University Institute of Geological Sciences.

3. Main destinations of the Kazakhstan trip (modified from second circular)

Almaty is the largest and greenest city in Kazakhstan, with a population over 1,421,800 (in 2010). It was the capital city of the country, until 1997 when Astana became the capital. Almaty takes pride in being the cultural centre of the republic. It has 270 cultural sites including theatres, concert halls, museums, art galleries, libraries, historical and architectural monuments, and churches of all denominations. The busy international airport receives flights from many destinations. Almaty has an international character with a variety of European and Asian restaurants. It has a beautiful location at the foot of the spectacular snow-caped Zailiysky Alatau Mountains (up to 16,335 feet [5,076 m] at Pik Talgar Peak), which form the northernmost part of the Tien Shan Mountains and contain fabulous alpine scenery and ski resorts. Numerous well-maintained and beautiful modern and historic buildings occur in the city. The large deciduous trees and historic buildings give the city a green European appearance. The Almaty region is in marked contrast to the extremely flat, grass-covered plains (steppe) that occupies most of Kazakhstan. Most foreign participants arrived in Almaty on August 15th and students greeted them at the airport. Our stay in Almaty was brief. Guests stayed at the Tien Shan Hotel and other hotels in Almaty.

Turkestan is one of the oldest cities in Kazakhstan (archaeological record dates back to 4th century AD) and lies on the northeastern margin of the steppe within the Syrdaryian Basin. The city is a remote industrial, educational and cultural centre, of moderate size (population of 227,098 in 2009, Wikipedia) and a popular tourist destination. Known as the second Mecca of the east, Turkestan is an important Islamic pilgrim site. Its sightseeing attractions include the 15th century Khanaka (mausoleum) of Khodzha Akhmed Yasawi. The city is famous for its oriental vegetable and fruit markets. Some residents still use camels for transportation and they are common in the outlying fields and villages. The climate is semiarid (desert-like) and strongly continental. Summers are very hot, with mean August temperatures of 33-35 °C (day), and 25-27°C (night). In summer, daily temperature fluctuations of 15-20 °C are common. Culturally, Turkestan is Islamic and food is mainly of traditional aspect with lamb and goat being common. The Turkestan railway station (1905) is beautiful and has the status of an architectural monument.

On the morning of August 16th, most participants arrived in Turkestan by bus after a grueling 12 hour all night drive from Almaty. In Turkestan, our accommodation and most breakfasts and dinners were at the Hotel Khanaka (Fig. 2).

The hotel had recently opened and was a bargain. The meals at the hotel were of traditional Kazakhstan aspect and provided great value for the money. The hotel was near the spectacular and well-preserved 15th century historical mausoleum of Khodzha Akhmed Yasawi (Figs. 3a, b) and we had numerous opportunities to walk over there. Starting on the morning of August 17, our group made day trips by four-wheel-drive sports utility vehicles and small buses from Turkestan to the nearby Bolshoi Karatau Mountains to examine the Upper Devonian to Carboniferous stratigraphy and reefs.

4. Conference: International conference "uppermost Devonian and Carboniferous carbonate buildups and boundary stratotypes"

We held our conference on August 16th from 11:00 to about 17:40 at the K.I. Satpayev Institute of Geological Sciences. Participants presented an exciting array of oral presentations and posters. Topics ranged from the selection and definition of GSSPs (particularly the Viséan/Serpukhovian and Kasimovian Gzhelian boundaries), stratigraphic utility of bryozoans, economic potential (ore deposits and hydrocarbon potential) of south Kazakhstan, and Devonian to Middle Pennsylvanian reefs and carbonate mounds of Kazakhstan, Urals of Russia, Western Europe and North Africa,. The program is outlined below and the content of the abstract volume is on our SCCS website.

16 August 11:00

Introduction and greetings by: ZHOLTAEV G.Zh. - Prof., Dr. Academician of Kazakh Academy of Sciences, Director of K.I. Satpayev Institute of Geological Sciences; NADYRBAEV A.A. - Chairman of the Committee of Geology and Subsoil Use of the Ministry for Investment and Development of the Republic of Kazakhstan; and RAIMBERDIEV T.P. - Vice President for Science and Innovation of the Khoja Akhmet Yassawi International Kazakh-Turkish University.

PRESENTATIONS

Morning session

Chairman: ZHOLTAEV G. Zh.

11:30-12:00 ZHAIMINA V.YA.

A Late Devonian-Carboniferous formation of reefs in Kazakhstan

12:00-12:20 ZHEMCHUZHNIKOV V.G.

Brief review geological formation of the Big Karatau Mountains

12:20-14:00. Lunch break

Afternoon sessions

Chairpersons: NADYRBAEV A.A., and FAZYLOV E.M.

14:00-14:20 YAO, LE, ARETZ M., WEBB GE., CHEN JT., WANG XD. Earliest Carboniferous stromatolites from lower Qianheishan Formation

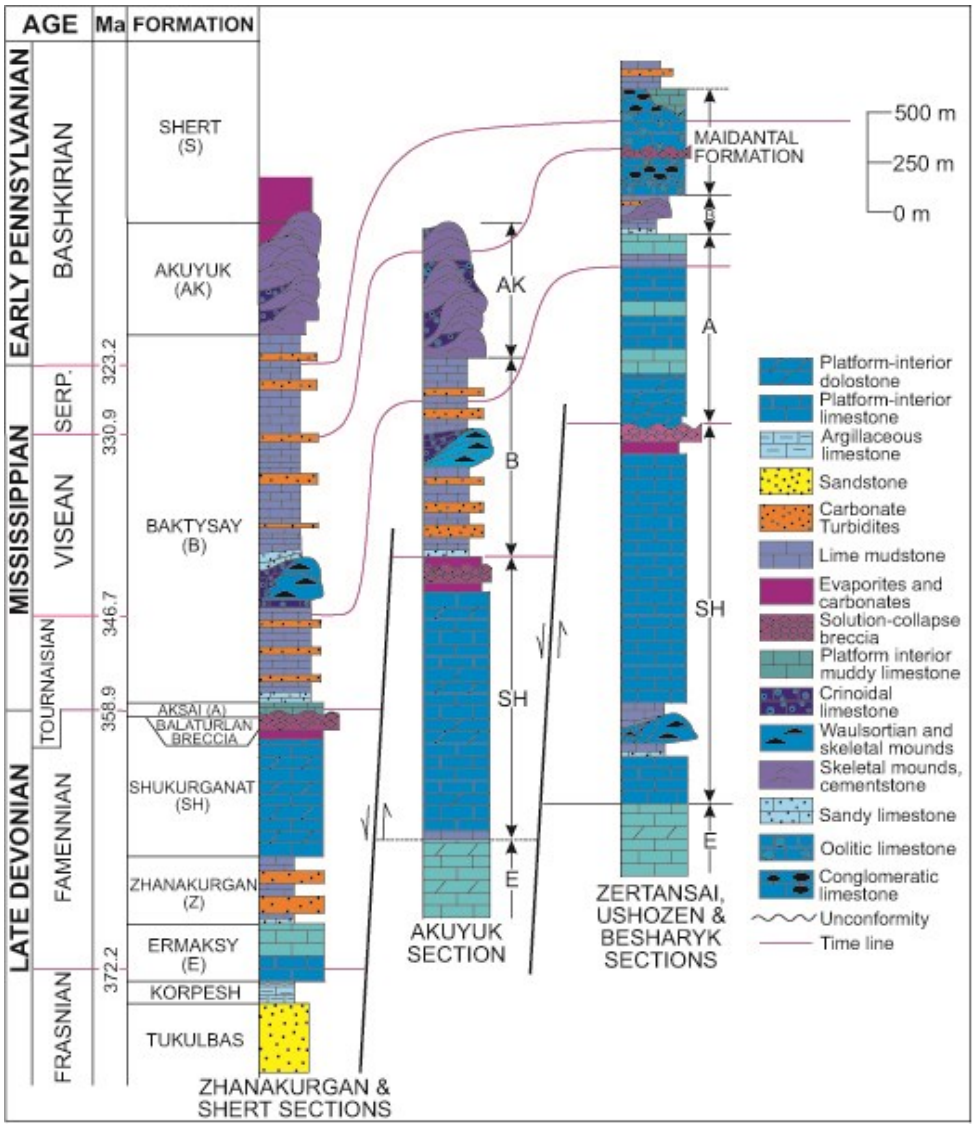

Figure 4.

Correlation chart showing relationship of formations in the Bolshoi Karatau to Devonian and Carboniferous stages (modified from Cook et al., 2002).

(tnb1), northwestern China: implication for microbial carbonate proliferation after the end-Devonian mass extinction
14:20-14:40 RICHARDS B.C., NIKOLAEVA S.V., KULAGINA E.I., ALEKSEEV A.S., GOROZHANINA E.N., GOROZHANIN V.M., KONOVALOVA V.A., GOREVA N.V., JOAHIMSKI M.M., GATOVSKY Y.A. A Candidate for the global stratotype section and point at the base of the Serpukhovian in the South Urals, Russia
14:40-15:00 HERBIG H.-G., BÄTZ, S, RESAG, K. A potential conodont-based Viséan-Serpukhovian boundary – data from the Rhenish mountains, Germany
15:00-15:20 ARETZ M. Famennian and Mississippian reefs and mounds in Europe and North Africa

15:20-16:00 Coffee break
16:00-16:20 NIKOLAEVA S.V., ALEKSEEV A.S., KULAGINA E.I.
Potential biostratigraphic markers for the base of the global Serpukhovian stage
16:20-16:40 KULAGINA E.I., STEPANOVA T.I., NIKOLAEVA S.V. Serpukhovian and Bashkirian bioherm facies on the eastern slope of the South Urals
16:40-17:00 SUNGATULLINA G.M. Kasimov conodonts of the section Usolka, Southern Urals
17:00-17:20 TOLOKONNIKOVA Z.A. Stratigraphical significance of the Famennian-Tournaisian bryozoans from the southern and central regions of Russia
17:20-17:40 FAZYLOV Ye.M., ZHAIMINA V.Ya., MUSINA E.S. Lithological characteristics of carbon-bearing rock masses of South Kazakhstan and their ore -bearing, and oil and gas content prospects

5. Excursion program

The five days of geological field trips that followed the conference provided an opportunity to see the Upper Devonian to Early Pennsylvanian carbonate mounds, reefs, and associated limestone-dominated succession that Cook et al. (2002) document in their important paper. Foraminifers are common and well preserved at many levels in the succession. Along with the associated conodonts, they provide a biostratigraphic framework (Zhaimina et al. 2017). Deposition of the succession occurred on the passive to extensional western side of Kazakhstan continental block along the eastern side of the Uralian Ocean (Cook et al, 2002). Carbonate platform construction started in the Late Devonian (Frasnian) and continued into the Bashkirian. Early stages of the Uralian Orogeny terminated platform development during the Moscovian. The platforms and associated bioherms/ carbonate mounds in the Bolshoi Karatau are similar to those in the Tenzig Oil Field of the North Caspian Basin and provide a nice exposed analogue for those deposits. The focus of the day trips were the Upper Devonian to Bashkirian reefs and carbonate mounds of the Bolshoi Karatau and we examined many of the occurrences that Cook et al. (2002) illustrated and described. Other objectives of the excursions were to see the general characteristics of the Upper Devonian to Bashkirian stratigraphic successions and discuss the sequence stratigraphy, depositional environments, stage boundaries, and fossils. The stratigraphic sections we visited lay northeast of the city of Turkestan along ephemeral to spring-fed streams draining southwest into the steppe (Syrdariyan Basin) occupied by Syrdariyan River. The Bolshoi Karatau, part of the Tien Shan Mountain trend, lie southwest of Main Karatau Fault. I have outlined and illustrated below some geological and historical highlights from the five days of field trips.

On the excursions, we had several leaders and translators. Our principal geological leaders were Dr. Viacheslav G. Zhemchuzhnikov (chief geologist of LLP "Aman Munai") and Dr. Valentina Ya. Zhaimina (senior researcher at K.I. Satpayev, Institute of Geological Sciences). Other leaders included A.E. Zorin (Chief Geologist of Izdenis Ltd. Association of Geological Enterprises) and Dr. E.M. Fazlov (Head of Department of Regional Geology, Head of the Lithology and Engineering geology group of the K.I. Satpayev Institute of Geological Sciences). Our principal translators were Elmira A. Shakirova and K.T. Kubaseva (engineer at the Lithology and Engineering Geology Group of the K.I. Satpayev University Institute of Geological Sciences). Dr. L.V. Shabalina (Lithology and Engineering Geology Group of the K.I. Satpaev University Institute of Geological Sciences) was our official photographer.

August 17

On the morning of August 17th, we visited the Khanaka of Khodzha Akhmed Yasavi, the well-known sufi (Islamic mystic) and poet (Figs. 3a, b). Khodzha Akhmed Yasavi was the first great Turkic Muslim holy man. A high 18 m wide blue-tiled dome caps the main chamber of the mausoleum, which contains a huge 2,000 kg metal Kazan (cauldron) containing holy water. Timur built the monument in the late 14th century AD but the structure was never finished (much of monument lacks external tiles and ancient scaffolding remains).Within the extensive walled enclosure containing the Khanaka, the “Azret Sultan” memorial complex houses the burials of the great Kazakh kings Esim-Khan, Ablai-Khan, Abulhir-Khan and others. There is also a memorial to Kazybek Bi - one of the authors of the “Zhety Zhargy”, the first set of Kazakh laws, and other important contributors to the Kazakh State. The famous underground mosque (Khyluet) and the bathhouse of Turkestan (“Vostochnye Bani”) (1600-1700s) are in the enclosure north of the Khanaka of Khodzha Akhmed Yasavi.

After lunch at the Hotel Khanka in Turkestan, we toured an Upper Devonian (Frasnian and Famennian) and Mississippian (Tournaisian to Serpukhovian) stratigraphic section along the Zhanakurgan River (Fig. 1, loc. ZH). At the start of the tour, Dr. Viacheslav G. Zhemchuzhnikov showed us the Upper Devonian succession starting with hummocky cross-stratified sandstone of the Frasnian Tkulbas Formation

Figure 5. A) Carbonate submarine debris-flow breccia in slope succession of Famennian Zhanakurgan Formation, Zhanakurgan River section on August 17th. Deposits overlie peritidal carbonates of Ermaksy Formation and resulted from a regional drowning event. **B)** Looking toward the southeast and up section from debris-flow breccia in Zhanakurgan Formation to Famennian cliff-forming succession on Zhanakurgan River. Cliff section shows mounds and clinoforms and represents an early stage in the development of the regions Famennian to Bashkirian carbonate platform. **C)** Viséan Waulsortian carbonate mound in Baktysay Formation of Tournaisian to early Bashkirian age on Zhanakurgan River. Flanking facies crop out on right-hand side of mound above automobile. View is toward northwest. **D)** *Stromatactis* fabric in core facies of Waulsortian carbonate mound on Zhanakurgan River in Baktysay Formation; diameter of lens cap is 7.8 cm. **E)** Karst sinkhole (at centre and right) developed in Bashkirian Akuyuk reef complex in Shert section.

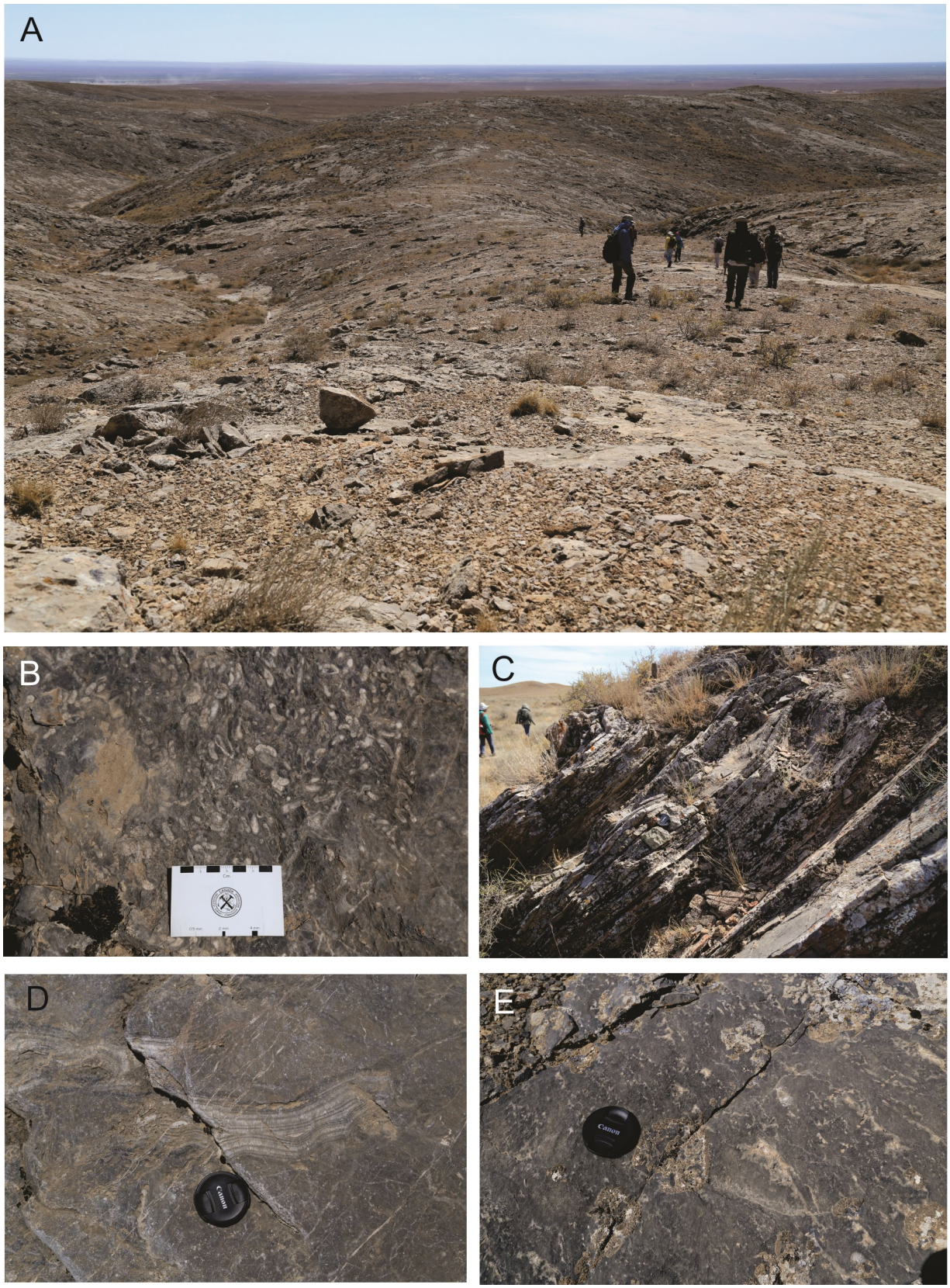

Figure 6. A) On crest of Famennian Karamuran shelf-margin reef complex looking toward the adjacent slope and basin succession represented by the Shalkinsky Formation (in distance below horizon) at locality KA on Figure 1. **B)** Ammonoid-rich bed at boundary between Karamuran reef complex and flanking facies along reef-slope transition. Divisions on card are one centimetre. **C)** Cherty limestone slope deposits of Shalkinsky Formation basinward of the Karamuran reef complex showing turbidites and convoluted slump deposits (upper left). **D)** Isopachous bladed to fibrous submarine calcite cement in cavities in core facies of Karamuran reef complex. Diameter of lens cap is 7.8 cm. **E)** *Stromatactis* fabric (irregular areas of white cement) in core facies of Karamuran reef complex.

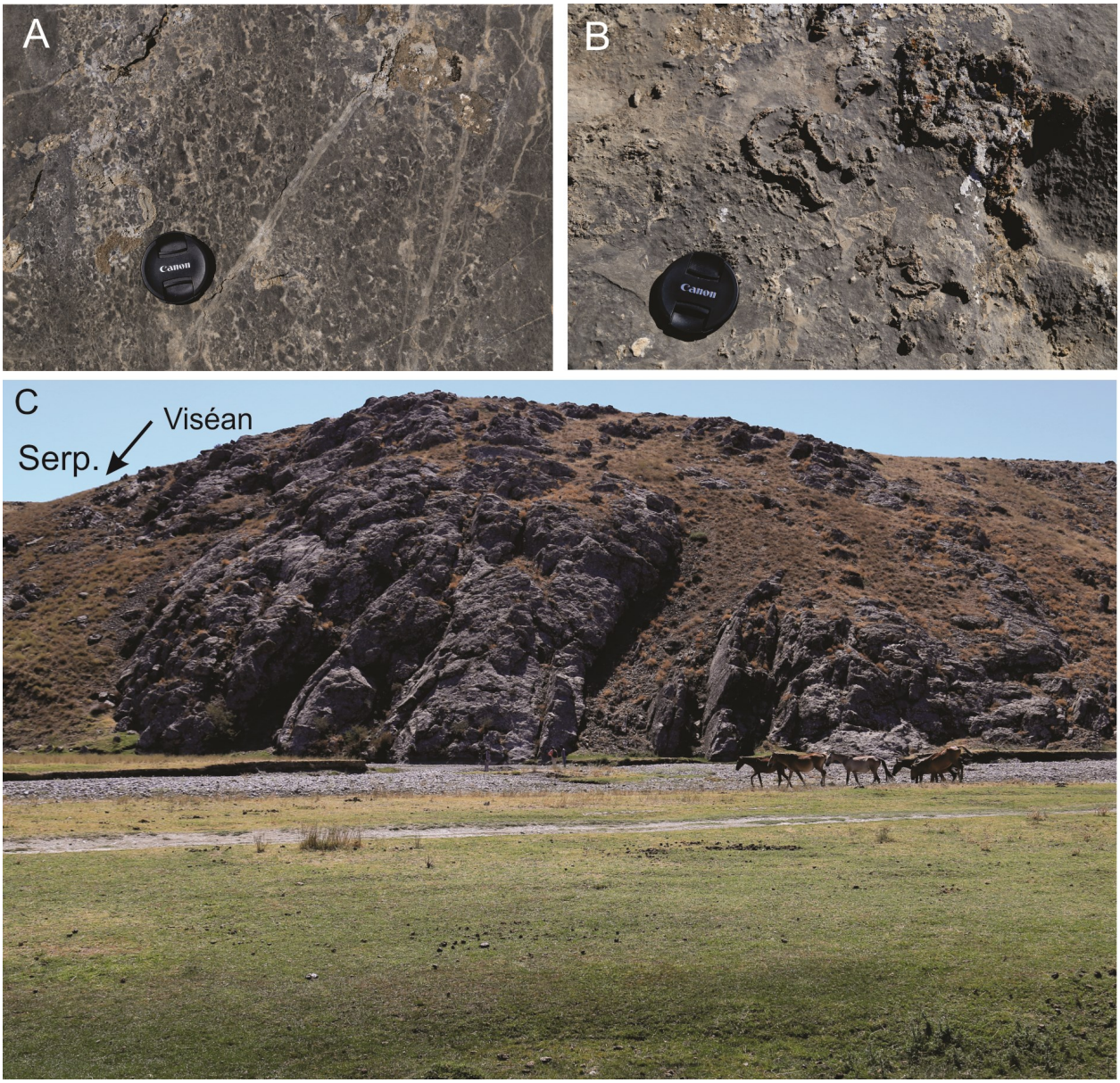

Figure 7. **A)** Core lithofacies of Famennian Karamuran reef complex at locality KA showing typical fabric comprising masses of Renalcis algae encased in sparry calcite cement. Diameter of lens cap is 7.8 cm. **B)** Core lithofacies of Viséan bioherm in Akuyuk reef complex in Actobe River section showing sponges (Fig. 1, loc. AK); diameter of lens cap is 7.8 cm. **C)** Mound-shaped bioherm in Akuyuk reef complex in Actobe River section. Arrow indicates approximate location of the Viséan-Serpukhovian boundary; top of bioherm is to the left. Bioherm developed in a carbonate-slope setting. It overlies turbidites and debris-flow limestone breccias of Kazanbuzar Formation and underlies shallow-neritic to peritidal carbonates of the Maidantal Formation. View is toward southeast.

(Fig. 4). Higher in the section, we saw peritidal carbonates of the Frasnian to Famennian Ermaksy Formation representing early developmental stages of the regions Famennian to Bashkirian carbonate platform. Overlying deposits of the Famennian Zhanakurgan Formation, contained carbonate turbidites and debris-flow breccias (Fig. 5a). Toward the southeast of the breccias we were examining, the Upper Devonian carbonates formed impressive cliffs displaying mound- and clinoform-like features (Fig. 5b).

Downstream (toward southwest) from the Famennian deposits, we examined one of the Viséan Waulsortian mounds in the Baktysay Formation (Tournaisian to lower Bashkirian).The Zhanakurgan River cut through the southeast side of the mound revealing its internal structure and that of the flanking lithofacies (Fig.5c). Numerous other mounds occur at the same stratigraphic level, cropping out along strike for about 10 km and offering potential for future detailed studies. The Waulsortian mound transected by the river was spectacular because it was well preserved and widely exposed yet readily accessible. We climbed up through the mound from the river then walked across its top examining the lithofacies and sedimentary structures. The core of the mound

displayed well-developed *Stromatactis*-like structures (Fig. 6d), Neptunian dykes, and extensional fissures lined with several generations of calcite marine cement.

In the late afternoon, we visited the Akuyuk reef complex (Akuyuk Formation) of Bashkirian age in the Shert section (Fig. 1, loc. SH). The reef complex occurs near an important Islamic holy site – an enclosed well containing holy water. This reef complex was readily accessible, exposed along the sides of a broad shallow canyon. Unlike the Waulsortian mound on the Zhanakurgan River, it does not form a well-defined buildup and its relationships with flanking and capping facies are not clear. The complex appears to consist of amalgamated mounds. According to Zhamina et al. (2017), algae and sponges are the main skeletal constituents. Walls of the canyon locally expose spectacular cementstone within the complex. Karstic deposits of uncertain age fill sinkholes penetrating the top of the complex (Fig. 5e).

August 18: On August 18th, we visited an extensive, readily accessible, Famennian shelf-margin reef complex and related carbonate-slope lithofacies at the Karamurun section in the northwestern part of the Bolshoi Karatau (Fig. 1, loc. KA). The reef complex and slope succession lie within the Karamurun Syncline and were discovered during regional 1:200,000 scale geological mapping. According to Cook et al. (2002) the reef trend is about 200 m thick but at the locality we visited it is up to 417 m thick (Zhaimina et al., 2017). We explored an extensive portion of the reef complex by hiking along ridge-top reef exposures and on boundstone in shallow canyons (Fig. 6a). The exposures we examined looked like a complex of amalgamated mounds but in the Karamurun region, the Zhanakurgan also contains isolated bioherms up to 10 m high. The Famennian to Tournaisian Shalkyinsky Formation conformably overlies the Karamurun reef complex and extends out into the adjacent basin (Cook et al., 2002; Zhaimina et al., 2017). Exposures in Karamurun section provide an excellent opportunity to study a reef crest to basin transition. Spectacular ammonoid-rich beds (Fig. 6b) occur locally at the transition between the reef and flanking facies and we were able to sample one of them. The Shalkyinsky includes debris-flow beds containing platform-derived blocks, cherty slope turbidites, and slump deposits showing convoluted bedding (Fig. 6c).

Most of the reef and mound deposits are of massive aspect lacking obvious bedding, evidence for growth stages, and other megascopic features except Neptunian dykes and reef cavities filled with marine cements (Fig. 6d). However, the microfacies are commonly well displayed. Abundant Stromatactis-like structures with white sparry calcite cement are well displayed (Fig. 6e). However, lime boundstone consisting of *Renalcis* algae, bryozoans, and sponges encased in marine cements (Fig. 7a) constitute most of the reef (Cook et al., 2002; Zhaimina et al., 2017).

Figure 8. Ruins of the ancient (inhabited 13th to 18th centuries) fortified town of Sauran near city of Turkestan situated on the historic Silk Road in southern Kazakhstan. Ridge-like features in background are remains of the town walls and watch towers.

August 19

In the morning of August 19th, we visited the Actobe River section and one of the upper-slope mound-shaped bioherms in the Akuyuk reef complex (Fig. 1, loc. AK). The mound we examined (Fig. 7c) was about 90 m thick and lies within a belt of bioherms extending about 10 to 12 km along strike. The mounds overlie the carbonate slope carbonates of the Kazanbuzar Formation and are overlain by shallow -water, Serpukhovian carbonates of the Maidantal Formation that include breccias and oolitic beds (Zhaimina et al., 2017). Below the Viséan Akuyuk reef complex on the Actobe River, we examined Tournaisian and Viséan carbonates including turbidites and debris-flow beds then examined the reef lithofacies. Below the mound, Qi Yuping and his colleagues systematically sampled an interval spanning the Tournaisian/Viséan boundary for conodonts. The southeast side of the Actobe River had eroded into the mound we examined, thereby, revealing large-scale features including bedding and growth stages. Carbonate lithofacies within the mound were well displayed and easy to examine. Lime boundstone within the mound consists of algae (*Donezella*), *Tubiphytes,* sponges (Fig. 7b), and marine cement. A carbonate breccia containing lime boundstone rock fragments occurs near the top of the mound, thereby, indicating the top of mound extended above wave base. Higher in the section, peritidal deposits including limestone with fenestral fabric are exposed in the Maidantal Formation above the mound. The Actobe River bioherm developed in slope settings along the shelf-margin belt of a carbonate platform.

In the afternoon after a fabulous traditional field lunch cooked on the banks of the Actobe River, we visited ruins of the ancient fortress city of Sauran (Figs. 8, 9). The walled city, inhabited from the 13th to 18th centuries, was constructed of adobe bricks. In recent years, several archaeological teams investigated the site and portions of it are currently being excavated and restored. Sauran was an extensive complex surrounded by a moat and included seven defensive towers. The ruins extend from north to south for 850 m and east to west for 660 m.

Figure 9. Group photograph of geoscientists attending August 15-22, 2017 SCCS conference on "Uppermost Devonian and Carboniferous carbonate buildups and boundary stratotypes" at entrance to ancient fortified town of Sauran. Photo taken by Dr. L.V. Shabalina.

August 20

In the morning of August 20th, the excursion through the Akuyuk River section (Fig. 1, loc. AK) started with the examination of slope to peritidal limestone and breccia in the Famennian Shukurganat Formation. One of the most interesting deposits in the lower part of the section was the Balaturlan Breccia (Fig. 10a) near the Famennian/Tournaisian boundary in the upper Shukurganat Formation. Shallow-water carbonate rock fragments encased in brown-weathering siltstone constitute the breccia, which is up to several metres thick and extends for about 70 km. The breccia overlies peritidal carbonates. In contrast, the overlying Tournaisian strata in the Baktysay Formation are of deep-water aspect. Cook et al. (2002) interpreted the breccia to be a karstic deposit of evaporite-solution-collapse origin.

Higher in Akuyuk River section, we saw an

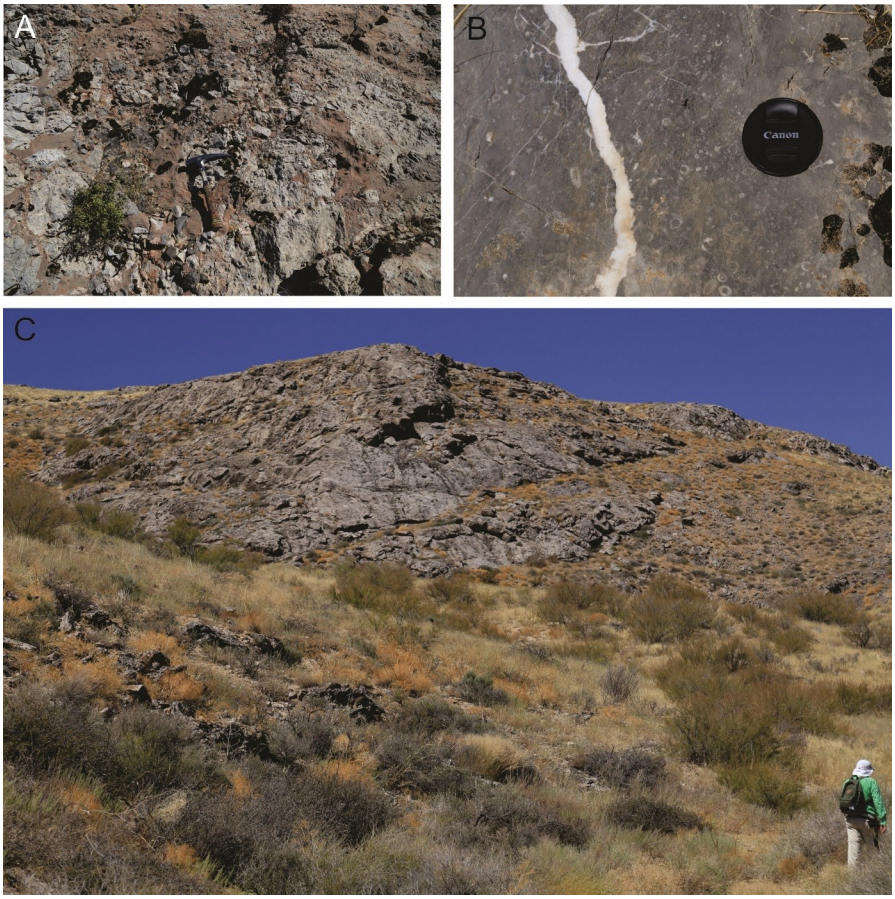

Figure 10. A) Balaturlan Breccia (50 to 10 m thick) near DCB at the top of the Shukurganat Formation. Geological hammer near centre of photograph indicates scale. **B)** Crinoid lime packstone from flanking facies that intertongue with the core facies of the Tournaisian carbonate mound shown in Figure 10c. Akuyuk River section; diameter of lens cap is 7.8 cm. **C)** Isolated Tournaisian carbonate mud mound developed in slope deposits of Baktysay Formation in Akuyuk River section. Mound is of Waulsortian aspect and its core comprises limestone mudstone containing scattered crinoid debris, bryozoans, and rugose corals. Core facies intertongue with crinoid lime packstone like that shown in Figure 10b.

isolated lower Tournaisian mound in the slope deposits of the Baktysay Formation (Figa.10a, b). The well-exposed and readily accessible bioherm is about 100 m thick, 200 m across, and has four main growth stages (Cook et al., 2002). Carbonate slope deposits, which include turbidites, encase the bioherm. The foundation, core, and flanking facies are readily accessible. Most of the core appeared to consist of growth layers with abundant *Stromatactis* fabric developed in lime mud containing scattered crinoidal debris. In the lower part of the mound, crinoid lime packstone from the flanking deposits (Fig. 10b) interfingered with the core facies. Cook et al. (2002) interpreted this to be a skeletal mound comprising lime mud with crinoids, bryozoans, and rugose corals.

The highlight of the Akuyuk section was a large mound-shaped bioherm developed in the middle Viséan to Bashkirian Akuyuk reef complex (Fig. 11). It was the most spectacular bioherm we examined during the five days of field trips. The Akuyuk reef complex, preserved within the Akuyuk Formation, extends for about 70 km and is approximately 600 m thick. The complex developed on a foundation of carbonate slope deposits during an extended period of sea level rise (Cook et al., 2002). The mound lies above the southeast side of the Akuyuk River valley and is largely a vertical cliff-face exposure requiring technical climbing equipment for systematic study. Fortunately, the foundation and base of the mound are extensively exposed and accessible. In addition, relatively recessive carbonate lithofacies overlie its flanks and top making them widely exposed and accessible. The bioherm core has an aggradational to progradational geometry with depositional dips of up to 25 degrees in its core (Fig. 11). The bioherm core is mainly very thick bedded and massive but it shows some large-scale clinoforms and growth increments. We examined the foundation and lower core facies then hiked to the top of the bioherm by scrambling up slope along its base and through the flanking facies. Sponge-*Tubiphytes*-algal boundstone containing *Stromatactis*-like structures constitutes most of the buildup. Radiaxial fibrous to bladed marine calcite cements filled most of the larger voids. Bryozoan cementstone is locally well exposed at the top of the bioherm (Fig. 12). Cross-bedded crinoidal grainstone near the Visean-Serpukhovian boundary occurs in the capping lithofacies, thereby, indicating the mound grew upward to depths above wave base.

August 21

On August 21st, the last day of the field excursions, participants visited the Zhertansay River section. The section exposes Viséan through lower Bashkirian strata within the Maidantal Formation (Fig. 13). The multiple shoaling upward cycles, many caped with paleosols, was the focus of this trip. During the field trip, we also examined beds spanning the Serpukhovian-Bashkirian boundary and discussed the biostratigraphic criteria used for boundary recognition.

6. Discussions about excursion

During the field trips and in the evenings we had several short discussions about the deposits we

Figure 11. Akuyuk River section (Fig. 1, loc. AK) showing large bioherm in middle Viséan to Bashkirian Akuyuk reef complex. Sponge-*Tubiphytes*-algal boundstone containing *Stromatactis* fabric constitutes most of the bioherm. Core facies shows depositional dips of up to 25 degrees at boundaries between major growth increments (arrows). Bioherm developed in slope setting on slope carbonates of Baktysay Formation. Younger bioherms occur in Akuyuk reef complex above major mound in the foreground. View is toward southeast.

Figure 12. Bryozoan cementstone in core facies at top of bioherm shown in Figure 11, Akuyuk reef complex on Akuyuk River. Dark deposits are bladed to fibrous and isopachous submarine cements; arrows indicate fenestrate bryozoans. Diameter of lens cap is 7.8 cm.

Figure 13. The Zhertansay River section (Fig. 1, loc. ZR) showing strata within the Viséan to lower Bashkirian Maidantal Formation. The section displays multiple shoaling upward cycles, many caped by paleosols. Photo taken by Dr. L.V. Shabalina.

examined in the Bolshoi Karatau Mountains. Perhaps one of the most interesting topics that arose concerned the types of future sedimentologic and stratigraphic work the region required. Our principal field-trip leader Dr. Viacheslav G. Zhemchuzhnikov informed us that many of the previous investigators were representatives of the petroleum industry who thought the bioherms did not warrant detailed study because the porosity levels were low and the deposits had little potential for oil and gas exploration. Consequently, there is abundant potential for future collaborative work on the bioherms through the K.I. Satpayev Institute of Geological Sciences. Detailed conodont studies across Upper Devonian and Carboniferous stage boundaries are at an early stage in the Bolshoi Karatau and additional work would be very useful for refining regional correlations.

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TAXONOMICAL REASSIGNMENT OF SOME SIPHONODELLIDS (CONODONTS, EARLY CARBONIFEROUS) FROM W.HASS'S COLLECTION

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Abstract

Restudy of the Tournaisian siphonodellids from the W. Hass' collection demonstrates that *Siphonodella duplicata* var. A Hass 1959 (specimens #USNM 115139 and USNM 115140) (=*Siphonodella jii* sensu Becker, Kaiser, Aretz 2016) is junior synonym of *Siphonodella quadruplicata* (Branson et Mehl).

1. Introduction

Conodont genus *Siphonodella* Branson et Mehl is widely used in biostratigraphy of the terminal Famennian - middle Tournaisian interval (Voges, 1959; Klapper, 1966; Sandberg et al., 1978; Ji, 1985; Becker et al., 2016). A number of species of the genus compose a basis of conodont zonation comprising 9 zones and subzones: Lower, Middle, and Upper *praesulcata* zones, sulcata Zone, Lower *duplicata* and Upper duplicata zones, *sandbergi* Zone (= *belkai* Zone), Lower crenulata Zone (approx. = *quadruplicata* Zone), and Upper *crenulata-isosticha* Zone (= *isosticha* Zone) (Figure 1). Totally about 30 species of the genus are known. Most common and stratigraphically important species had been described by E. Branson and M. Mehl (1934), C. Cooper (1939), and W. Hass (1959). Significant taxonomical and biostratigraphic revision had been produced by C. Sandberg with co-authors (1978).

Wilbert Hass had described a number of species of the conodont genus *Siphonodella*, namely *S. obsoleta*, *S. cooperi*, and varitets of *S. duplicata*, including *S. duplicata* var. A. The last taxon is subject of long-duration taxonomical debates (Klapper,1966; Sandberg et al., 1978; Ji, 1985; Becker et al., 2016; Plotitsyn & Zhuravlev, 2016; Zhuravlev & Plotitsyn, 2017). Due to poor illustrations of *S. duplicata* var. A (Hass, 1959), the morphological traits of this taxon are obscure.

Gilbert Klapper (1966) assigned these forms of siphonodellids as ontogenetic stages of S. *quadruplicata*. However since 1978 (Sandberg et al., 1978) these forms were considered (incorrectly, by our opinion) as separate taxon named *S. duplicata* sensu Hass.

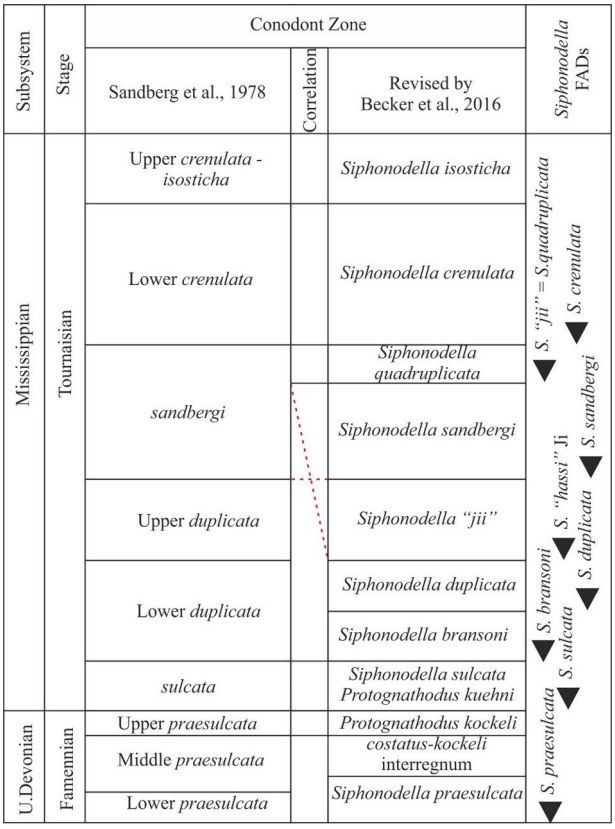

Figure 1. Correlation of the Tournaisian conodont zones. Red line marks correlation error caused by incorrect taxonomic interpretation of *Siphonodella duplicata* var. A Hass 1959.

Ji Qiang (1985) included the specimens figured by Hass (1959, pl. 49, figs. 17, 18) into a new species *Siphonodella hassi*, which is homonym of *Siphonodella cooperi hassi* Thompson et Fellows 1970. Later these two specimens (Hass, 1959, pl. 49, figs. 17, 18) were selected as holotype (*sic*!) for *Siphonodella jii* (Becker et al., 2016). This action led to increasing taxonomical problems with *Siphonodella* "*hassi*" (real taxon that differs from *S. quadruplicata* by having only two rostral ridges at late stage of ontogeny and by possessing a thick, slightly asymmetrical, and narrow platform) and *S. quadruplicata*.

Ontogenetic changes in morphology of Pa elements of advanced siphonodellids were considered in details earlier (Plotitsyn & Zhuravlev, 2016; Zhuravlev & Plotitsyn, 2017). All the advanced siphonodellids bear the rostrum in the anterior part of the platform of Pa element. A number of rostral ridges of various length and orientation are characteristic of the species. Ontogenetic series demonstrate gradual increasing of number of the rostral ridges (Plotitsyn & Zhuravlev, 2016). The third rostral ridge (if applicable for the species) appears when Pa element is composed of 6-8 lamella sets, after appearance of inner platform ornamentation (Plotitsyn & Zhuravlev, 2016).Thus Pa elements of *S. quadruplicata* (presence of more than 2

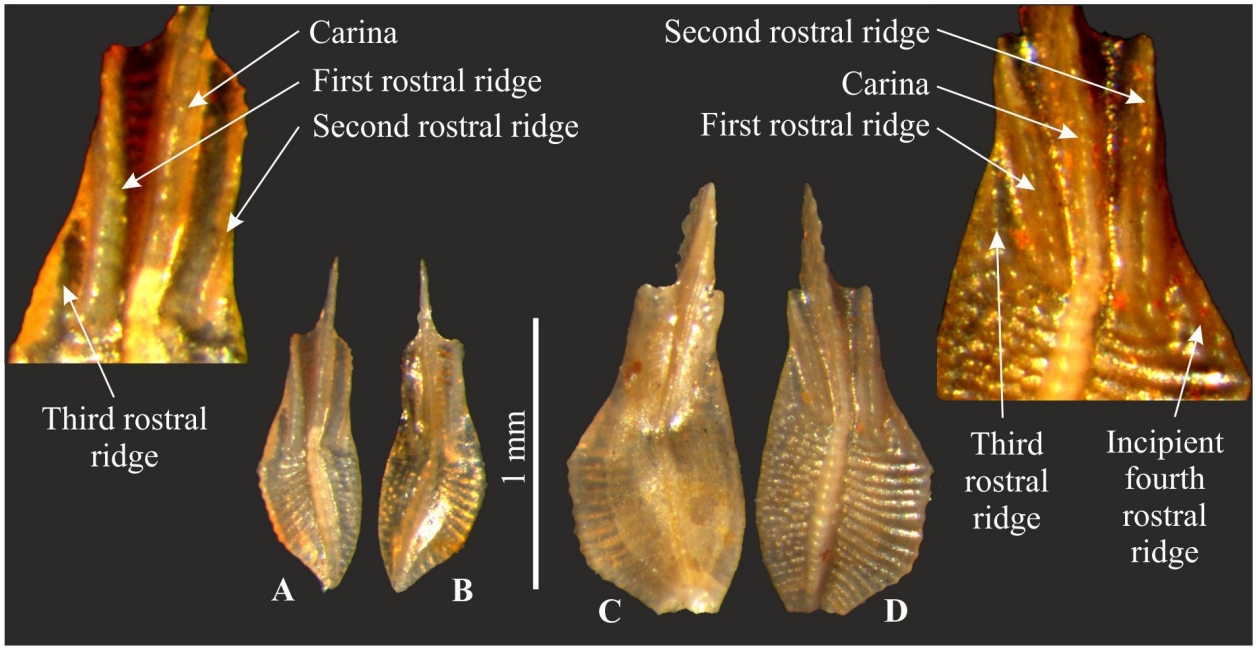

Figure 2. Re-illustration of specimens figured by W. Hass (1959) as *Siphonodella duplicata* var. A. A, B - sinistral Pa element, specimen USNM 115139 (Hass, 1959, pl. 49, fig. 17); A - oral view; B - aboral view. C, D - dextral Pa element, specimen USNM 115140 (Hass, 1959, pl. 49, fig. 18); C - aboral view; D - oral view.

rostral ridges is a diagnostic trait of this species) can be distinguished if they composed of more than 8 lamella sets (length of posterior process > 0.438 mm) (Plotitsyn & Zhuravlev, 2016).

According to Zhuravlev & Plotitsyn (2017) the sequential appearance of rostral ridges during development of Pa element of advanced siphonodellids allows several ontogenetic stages to be distinguished. The first stage corresponds to initial uplifting of the rostrum margins, the second stage is characterized by development of a single rostral ridge, the third stage is marked by appearance of a second rostral ridge, the fourth stage is registered by appearance of a third rostral ridge, and so on.

2. Description of the specimens from the collection of W. Hass

Restudy of the specimens from the collection of W. Hass deposited in the Smithsonian Museum (specimens #USNM 115139 and USNM 115140) allows to improve their description and taxonomical diagnostics. The images of the specimens from Hass's collection (Figure 2) were kindly provided by Thomas Jorstad (Department of Paleobiology, Smithsonian Institution, USA).

Specimen #USNM 115139 (Figure 2, A, B) is sinistral Pa element of advanced siphonodellid possessing 3 short rostral ridges: two ridges on the outer side, and one ridge on the inner side of rostrum. The element length is 1.226 mm, the length of the posterior process is 0.518 mm. Aboral side bears depressed keel. This specimen had been illustrated by W. Hass as *Siphonodella duplicata* (Hass, 1959, pl. 49, fig. 17). According to data on ontogeny of *Siphonodella quadruplicata* (Zhuravlev, 2014; Plotitsyn & Zhuravlev, 2016; Zhuravlev, Plotitsyn, 2017) this specimen corresponds to the early fourth ontogenetic stage (sensu Plotitsyn & Zhuravlev, 2016) of *S. quadruplicata* (Figure 3).

Specimen #USNM 115140 (Figure 2, C, D) is dextral Pa element of advanced siphonodellid possessing 4 short rostral ridges: two ridges on the outer side, and two ridges on the inner side of rostrum. The element length is 1.644 mm, the length of the posterior process is 0.711 mm. Aboral side bears depressed keel. This specimen had been illustrated by W. Hass as *Siphonodella duplicata* (Hass, 1959, pl. 49, fig. 18). However this specimen corresponds to the fifth ontogenetic stage (sensu Plotitsyn & Zhuravlev, 2016) of *S. quadruplicata* (Figure 3).

Thus both specimens illustrated by W. Hass (1959) as *Siphonodella duplicata* var. A (Hass, 1959, pl. 2, figs. 17, 18) can be interpreted as growth stages of "adult" *S. quadruplicata* (see also Plotitsyn & Zhuravlev, 2016), and are not conspecific with specimen illustrated by Ji Q. (1985, pl.2, figs. 5, 6) as *Siphonodella hassi*.

3. Conclusions

Ignoring of ontogenetic changes in morphology of platform conodont elements associated with formal approach to the characteristic traits of species lead to both taxonomical and biostratigraphical misinterpretations. *Siphonodella jii* was selected as index-species of the zone corresponding to the Upper *duplicata* Zone by Sandberg et al. (1978) (Becker et al., 2016). If the proposed by these authors concept of *Siphonodella jii* is accepted, then *S. jii* is junior synonym of *S. quadruplicata*, and the base of *Siphonodella jii* Zone must be correlated with the base of *Siphonodella quadruplicata* Zone, or with uppermost part of *Siphonodella sandbergi* Zone by Sandberg et al. (1978) (Figure 1).

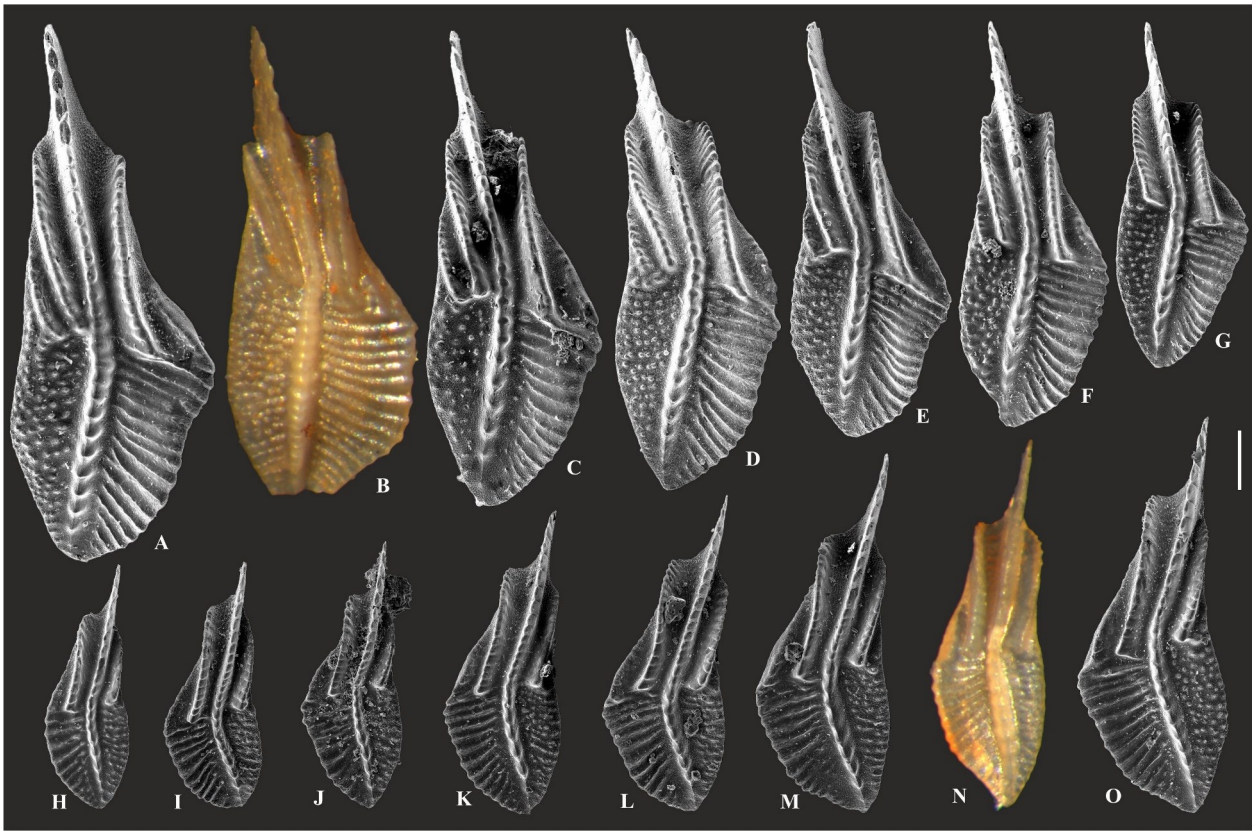

Figure 3. Ontogenetic sequence of Pa elements of *Siphonodella quadruplicata* (Branson et Mehl) from the Subpolar Urals (A, C-M, O) and W. Hass collection (B, N). A-G – dextral Pa elements; H-O – sinistral Pa elements. A – coll. № 512/13-20, sample 0-7k; B - coll. № USNM 115140 (Hass, 1959); C - coll. № 512/13-24, sample 0-7k; D - coll. № 512/13-25, sample 0-7k; E - coll. № 512/13-18, sample Kz81A; F - coll. № 512/13-27, sample 0-7k; G - coll. № 512/13-26, sample 0-7k; H - coll. № 512/13-7, sample Tz-79-1; I - coll. № 512/13-6, sample Tz-79-1; J - coll. № 512/13-3, sample Tz-79-1; K - coll. № 512/13-4, sample Tz-79-1; L - coll. № 512/13-9, sample 81A; M - coll. № 512/13-10, sample 81A; N - coll. № USNM 115139 (Hass, 1959); O - coll. № 512/13-1, sample Tz-79-1. Scale bar – 200 μm.

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SELECTION OF MARKER CONODONT SPECIES FOR THE LOWER BOUNDARY OF THE GLOBAL SERPUKHOVIAN STAGE (MISSISSIPPIAN)

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Abstract

P1 elements of species of the conodont genus *Lochriea* existing in the Viséan were very variable and had a number of transitional morphotypes. This variability is still not sufficiently studied, hence voting on the selection of *L. ziegleri* as the marker of the base of the Serpukhovian, as suggested by Qi et al. (2018), is premature. For example, it is generally assumed that *L. ziegleri* evolved from *L. nodosa*, but it is equally possibly that it might have evolved from *L. costata*, so the phylogenetic lineage essential for the boundary definition could be very different. In addition, no SEM photograph of the holotype of *L. nodosa* has so far been published. The types of species described in the 20th century were poorly illustrated, so species identification is difficult and reliable phylogenetic reconstructions are virtually impossible. The choice of a conodont marker among species of the genus *Lochriea* is additionally complicated by homeomorphy and possible effects of ecology of conodont animals on the morphology of conodont elements. Further study of the type material and phylogeny is necessary before a choice of marker can be made.

1. Introduction

One of the urgent problems in Carboniferous stratigraphy is the selection of the lower boundary level of the Serpukhovian Stage. It was suggested more than 20 years ago (Skompski et al., 1995) that the first appearance of the conodont *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994 could become a marker. This seemed a fortunate suggestion, and in recent years has been so widely accepted among stratigraphers that L. ziegleri has been treated as if it was authorized. It is also fortuitous that the species is named after Willi Ziegler – one of the outstanding conodont researchers and stratigraphers. However, it should be underlined that this suggestion has no formal status yet.

Recently, a very important publication describing the variability of the *Lochriea* P1 elements at the Viséan-Serpukhovian boundary interval in the very promising Naqing section (South China) has become available for analysis (Qi et al., 2018). The main conclusion of the article is outlined as follows: "So, probably it is time to cast a vote for an official boundary marker for the base of the global Serpukhovian Stage by using the FAD of the conodont *L. ziegleri* in the lineage *L. nodosa – L. ziegleri*" (Qi et al., 2018, p. 4). However, it is clear to us, that a call for voting is premature and potentially very precarious.

2. On transitional morphotypes in species of the genus *Lochriea*

As was recently shown in connection with the accumulation of information on the morphology and distribution of the sculptured P1 elements of *Lochriea*, from one point of view in large collections there are numerous and variable forms that cannot be attributed to any of the established species. From the other side, sculptured morphotypes appeared in numerous sections almost simultaneously or with short age intervals, and for this reason, the selection of one of them for a marker can hardly be done easily. In the Russian conodont zonal Carboniferous scale (Kagarmanov & Kossovaya, 2003), the lowermost zone of the Serpukhovian Stage according to Pazukhin's proposal has been named the *L. cruciformis* Zone, because *L. cruciformis* (Clarke, 1960) could be identified more confidently than *L. ziegleri*, and appeared almost simultaneously. Moreover, in 2008 the zonal name was not replaced with *L. ziegleri*, despite the global trend (Alekseev, 2008).

Kullmann et al. (2008) were among the first to recognize intermediate specimens between the species of *Lochriea*, but Barham et al. (2014) studied the

intermediates in greater detail and suggested that some of the transitional specimens could become species in the own right, a view supported by Qi et al. (2018).

In the Table (see below) we show a list of the currently known intermediate forms. In this table the 'first species name' in the table indicates that the morphology of intermediate specimen(s) is more similar to that of this species, but is somewhat modified to become to some extent transitional (intermediate) to the second species. The majority of intermediate forms leading to the five different species are considered as derivatives of the rather primitive species *L. nodosa* (Bischoff, 1957), although its diagnosis needs further refinement.

Qi et al. (2018) have a standard and brief description of species of the genus *Lochriea* found in the Naqing section (South China), and showed a number of intermediate forms, but did not propose criteria of attribution of the P1 elements to species of *Lochriea*. Evidently, quite a number of different intermediate forms can potentially be considered as new species, and the taxonomy of the genus *Lochriea* is certainly far from being resolved. This task should be completed before a choice for the marker for the base of the Serpukhovian is made, whether it is *L. ziegleri*, or any other *Lochriea* species.

Table A list of intermediate morphotypes among *Lochriea* species mentioned in publications

First species name	Second species name	Publication	Illustration
L. commutata	*L. costata*	Barham et al., 2014	Fig. 10: 6
L. costata	*L. cruciformis*	Wang et al., 2018	Fig. 3: 19, 43-48
L. costata	*L. ziegleri*	Qi et al., 2018	Fig. 6: J-L
L. mononodosa	*L. monocostata*	Barham et al., 2014	Fig. 10: 1
L. mononodosa	*L. nodosa*	Qi et al., 2018	Fig. 5: F
L. multinodosa	*L. cruciformis*	Kullmann et al., 2008	Fig. 9: 7
L. monocostata	*L. costata*	Qi et al., 2018	Fig. 5: J, K
L. nodosa	*L. costata*	Kullmann et al., 2008	Fig. 9: 15; Fig. 11: 19, 21
L. nodosa	*L. costata*	Barham et al., 2014	Fig. 10: 2
L. nodosa	*L. costata*	Wang et al., 2018	Fig. 3: 7, 11, 42
L. nodosa	*L. multinodosa*	Kullmann et al., 2008	Fig. 10: 3
L. nodosa	*L. cruciformis*	Barham et al., 2014	Fig. 10: 3, 9
L. nodosa	*L. senckenbergica*	Wang et al., 2018	Fig. 3: 12, 13
L. nodosa	*L. senckenbergica*	Qi et al., 2018	Fig. 5: D; Fig. 7: K
L. nodosa	*L. ziegleri*	Barham et al., 2014	Fig. 10: 4, 7, 8, 11
L. nodosa	*L. ziegleri*	Richards et al., 2017	Pl. 2, fig. 2
L. nodosa	*L. ziegleri*	Qi et al., 2018	Fig. 5: B, C
L. ziegleri	*L. cruciformis*	Barham et al., 2014	Fig. 10: 5, 10

3. On the phylogenetic relationships of *L. ziegleri*

L. nodosa is generally considered to be the immediate ancestor of *L. ziegleri*, and Qi et al. (2018) follow this view. They also selected two phylogenetic lineages: one with a platform ornamentation consisting of nodes (*L. mononodosa* (Rhodes, Austin & Druce, 1969)-*L. nodosa*-*L. ziegleri*, and another with ornamentation consisting of ridges (L. monocostata (Pazukhin & Nemirovskaya, 1992)-*L. costata* (Pazukhin & Nemirovskaya, 1992) à *L. cruciformis*). It seems to be logical, but it is likely to simplify the solution: it is often almost impossible to distinguish a node from a rib. It is noteworthy that details of the platform ornamentation of the holotypes of several species selected in the last century (*L. nodosa* and *L. cruciformis*) remain unknown. This is because the relevant collections have not been reexamined, while previously, conodont specimens were photographed using magnesium or ammonium chloride coating, which obscured fine morphological detail. For example, the SEM image of the holotype of *L. costata* (Nikolaeva et al., submitted) shows that each side of the widened platform of a Pl element has a row of small elongated nodes merged by their bases but not of continuous ridges (such morphology has been documented by the authors of the species, but only for some specimens). This suggests that *L. ziegleri* is more likely to have evolved from *L. costata*. This species was considered as a possible immediate ancestor of *L. ziegleri* by one of its authors (Pazukhin, 2011), although the holotype of *L. costata* comes from the upper part of the Serpukhovian in the Muradymovo section (South Urals), approximately from the middle part of *Gnathodus bollandensis* Zone. However, Pazukhin also identified *L. costata* at lower levels. A specimen from the lower part of the Upper Viséan L. nodosa Zone (51.8 meters from the base) in the Naqing section (South China) has been attributed to *L. costata* (Qi et al., 2018, fig. 6: M).

Importantly, Qi et al (2018), apart from the ornamentation on the flanks of the platform, used the position of ridges and rows of nodes in relation to the dorsal end of the element and the general outline of the platform as specific characters. In particular, a very important difference between *L. ziegleri* and *L. costata* in their opinion is that in the latter species, rows of small nodes are located considerably further from the end of the element leaving a relatively broad field. An increase in the ridge length, number of nodes and their size led to an increase in the platform, or an increased platform facilitated the appearance of more complex ornamentation, or both these factors were involved. The photograph of the holotype of *L. nodosa* (Bischoff, 1957, pl. 4, fig. 13) shows two short, but robust ribs, rather than isometric nodes. The ridges can be crenulated (with small tubercles at the top), but they were obscured by coating during photography. Bischoff himself indicated the presence of robust elongated nodes as a diagnostic character for this species. Therefore, *L. nodosa* can also be included in a phylogenetic lineage with ridge ornamentation. It is not entirely clear why virtually all subsequent authors overlooked this fact. However, Ji (1986) assigned specimens with two rounded nodes to a separate valid taxon, which he called "*Paragnathodus nodosus binodosus* Ji, 1986" from the upper part of the Serpukhovian in South China (found in association with *Gnathodus bollandensis*). Phylogenetic reconstructions of species of *Lochriea* pose more questions than answers. For instance, three, rather than two phylogenetic lineages were proposed by Pazukhin (2011):

(1) *L. commutata – L. mononodosa – L. monocostata – L. costata – L. ziegleri*; (2) *L. commutata – L. mononodosa – L. nodosa – L. multinodosa*; (3) *L. commutata – L. mononodosa – L. monocostata – L. costata – L. cruciformis*. These lineages also deserve consideration and discussion.

The existence of complicated problems with the nomenclature of sculptured species of *Lochriea* has also been affirmed by the exposure of inaccuracy in the designation of the holotype of *L. senckenbergica* and the selection of a lectotype for this species (Herbig, 2017).

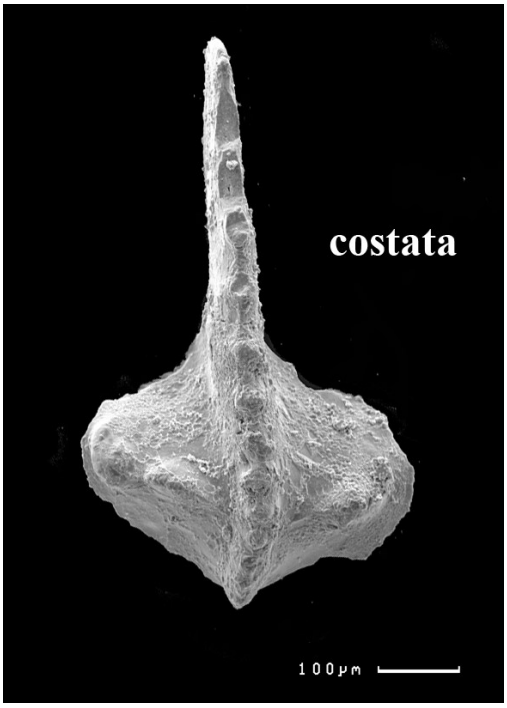

Figure Holotype of *Lochriea costata* (Pazukhin and Nemirovskaya in Kulagina et al., 1992), Institute of Geology, Ufa, specimen No. 104/509. South Urals, western slope, Muradymovo section, sample 70, upper Serpukhovian, middle part of *Gnathodus bollandensis* Zone (Kulagina et al., 2014). Scale bar is 100 µm.

4. On the homeomorphy of Pl elements of *Lochriea* and *Kockelella*

The conodont evolution shows repetition of the same evolutionary pattern: the blade element showed the widening of the area above the basal cavity, with the subsequent development of a widening platform carrying various nodes and ridges with progressively increasing complexity. A similar pattern can be observed throughout the evolution of the genus *Lochriea* – *L. saharae* (Nemyrovska, Perret-Mirouse & Weyant, 2006), the earliest species, which appeared at the beginning of the Viséan, had a narrow P1 element and gave rise to *L. commutata* with a widened, but rounded platform lacking ornamentation. In the Late Viséan, nodes and ridges began to emerge on the platform and became progressively more complex allowing the recognition of a number of different species. Interestingly, in the Serpukhovian, the morphology of *Lochriea* did not exhibit any significant innovations, and all previous species (including *L. commutata*) continued to exist to the end of the Serpukhovian, showing little evidence of further morphogenesis.

It is obvious that *Lochriea* is a homeomorph of the Silurian genus *Kockelella* Walliser, and their Pl elements are extremely close in general morphology. The evolution of the *Kockelella* also began with a narrow platform species *K. ranuliformis* (Walliser, 1964) that produced several morphotypes with a strongly ornamented platform within a short time interval (second half of Sheinwoodian and Homerian). In contrast to *Lochriea*, the platform underwent irregular growth accompanied by the formation of several processes and not all previous morphotypes continued into the (Serpagli and Corradini, 1999).

Apparently there were some general patterns in the evolution of the these two conodont taxa separated by a time interval of 100 million years, and these patterns need to be taken into account and explained before the boundary marker choice. For example, the homeomorphic similarity of *Lochriea* and *Kockelella* to the Permian genus *Iranognathus* Kozur, Mostler and Rahimi-Yazd, 50 million years younger than *Lochriea*, was described by Reimers (1999).

5. On the ecology of the *Lochriea*, reasons for the appearance of strongly sculptured species, and isochronism of these phenomena

We are faced with the question: "Is it possible to consider as isochronous the appearance of the same morphotypes in different sections remote from each other?" The answer depends substantially on the ecology of *Lochriea.*

Another very important question: whether the first appearance of the same morphotype in several distant sections can be considered isochronous? The answer to this question depends to a large extent on ecology. The ecology of conodont animals is poorly known. They were generally small pelagic organisms (usually up to several centimeters long) inhabiting various depths and various areas in relation to the coastline (Sweet, 1988).

Species of *Lochriea* lived in various environments, except in extremely shallow water settings with disrupted salinity (Cavusgnathus biofacies).

In the P1 conodont apparatus, elements were arranged with the oral surfaces facing one another, allowing the possibility of some rotation, and hence they were likely to have been used for grinding and crushing food (Jeppson, 1979; Purnell and von Bitter, 1992; Purnell et al., 1995; Purnell & Donoghue, 1997; Martinez-Perez et al., 2016). Nothing is known for certain about the food preferences of conodont animals, although there are a number of speculations. If increased complexity of ornamentation reflects the appearance of available food resources, of organisms with stronger integuments or with a larger body, such events have some ecological significance, and may be considered globally isochronous. However even in that case, in a marine basin or its part, the emergence of new conditions or new food objects could be delayed, or absent altogether, and the appearance of similar morphotypes of P1 elements of the genus *Lochriea* in different areas of the globe could be profoundly diachronous. If a trend toward the appearance of progressively complex ornamentation was connected to some internal (genetic) reasons and has no adaptive significance, it has far more chances of being considered isochronous.

6. Conclusions

It is obvious that the taxonomy of the large group of sculptured morphotypes of *Lochriea* that existed near the Viséan and Serpukhovian boundary is not sufficiently worked out, and needs much more detailed research based on abundant collections (containing thousands of specimens), only two of which are currently in existence (from the Naqing and Verkhnyaya Kardailovka sections). Ideally, such work should be conducted by an international team using various collections and various methods and combining the effort. The possibility of reconstructing conodont phylogeny near the boundary level and designation of a marker species (quite possibly not L. ziegleri) should be elaborated in the frameworks of such a project, to avoid ambiguity and misconceptions.

Up to the present, the ontogeny of the ornamentation details of in various *Lochriea* species is not sufficiently studied. Even in the most derived *Lochriea* species, juvenile specimens usually lack

ornamentation on the platform, which appears in adolescent stages and becomes mature in adults and senile specimens. Therefore only adult specimens could be identified to species level, but ontogenetic analysis may point to their ancestors. Unnecessary haste in selecting several markers (which happened with some previously ratified GSSPs) can unfortunately lead to poorly based solutions. Hence it is reasonable to continue the efforts to substantiate a reliable marker of the global base of the Serpukhovian, and we agree with the same proposal by Herbig (2017, p. 33).

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JOINT OCCURENCE OF CONODONTS *DECLINOGNATHODUS DONETZIANUS* AND *DIPLOGNATHODUS ELLESMERENSIS* CLOSE TO BASHKIRIAN-MOSCOVIAN BOUNDARY IN THE BASU SECTION, SOUTH URALS, RUSSIA

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1. Introduction

The Basu Section in the South Urals is one of the two candidates for the GSSP of the global base of the Moscovian Stage (Middle Pennsylvanian) (Kulagina et al., 2009). It is represented by relatively deep-water mid- and outer ramp limestones with chert nodules and bands (Gorozhanina et al., 2018), contains relatively rich assemblages of conodonts and fusulinids (Kulagina et al., 2009), calcareous algae (Ivanova and Kulagina, 2018), and so far unstudied brachiopods and solitary Rugosa corals. The section contains the conodont *Declinognathodus donetzianus* Nemirovskaya, 1990, which is considered is one of the most promising markers for the Bashkirian-Moscovian boundary (Task Group).

Another candidate, the Naqing section in South China, contains a good conodont record. However *D. donetzianus* is not found there, so *Diplognathodus ellesmerensis* Bender, 1980 has been proposed as a marker for the base of the Moscovian Stage (Qi et al., 2016).

2. *Diplognathodus* in the Basu 1 section

Pazukhin's original collection from the Basu section did not contain *Diplognathodus*, but the presence of this common, even though shallow-water conodont genus could not be excluded. As Pazukhin's sample were relatively small (unfortunately he did not indicate weight of his samples) it was decided to take several larger samples near the level of the lowermost occurrence of *D. donetzianus*. In 2016 Kulagina took five samples from 8.3 to 10.1 kg (altogether 45.3 kg) from the upper part of Bed 4 and Beds 5–7 in search for *Diplognathodus*. In 2017 two more large samples (7 and 6.5 kg) were collected (17-14Bl and 17-14Bu) from Bed 8. The re-identification of Pazukhin's material and examination of newly collected samples allowed a refined and emended vertical distribution of conodonts in the Basu 1 Section (Fig. 1). The FOD of *D. donetzianus* is in Bed 5, sample 16-11, just above the algal biostrome (Bed 4).

Relatively numerous elements of *Diplognathodus*,

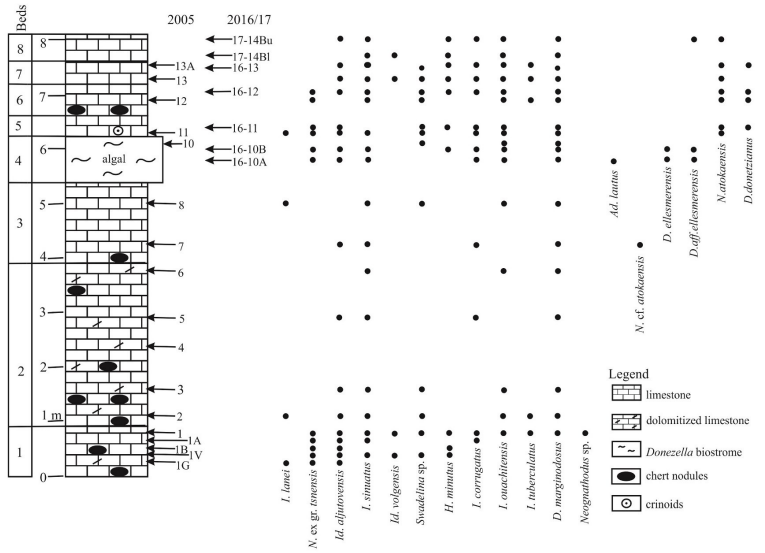

Figure 1. Revised range chart of conodonts in the Basu 1 section, South Urals, Russia. which combined data old collection (slides with conodonts extracted by Pazukhin) and from new samples collected in 2016 and 2017.

altogether around 50 in number, were found. Of these, over 30 specimens are well- and relatively well-preserved. They come from the upper part of Bed 4, which represents an algal *Donezella* biostrome, samples 16-10A and 16-10B. This algal biostrome, 0.8 m thick, suggests a brief shallowing episode, indicated by the presence in sample 16-10A of several specimens of the genus *Adetognathus*.

Three morphotypes can be recognized among diplognathodids. The first morphotype is identified as *D*. aff. *orphanus* (Merrill, 1973), and it is a single specimen found in sample 16-10A (Fig. 2: A). The carina is separated from the blade by a very small notch of one lower denticle. Most specimens of the second morphotype come from samples 16-10A and 16-10B were identified as *D*. aff. *ellesmerensis* Bender, 1980 (Fig. 2: B-M). They are very similar to the morphotype named as *D. orphanus* from the Naqing section (South China) (Qi et al., 2016, fig. 7: D, E), which was proposed as a member of the lineage that eventually evolved into *D. ellesmerensis*. The third morphotype with a lower carina relative to the height of the blade is considered to be an earlier form of *D. ellesmerensis*, more primitive than the specimens of this species at 176.9 m in the Naqing section (Qi et al., 2016, fig. 7: A, B). A single specimen of *D*. aff. *ellesmerensis* is present in sample 17-14Bu from Bed 8 also. These finds confirm that elements of *Diplognathodus* are more common in theBasu 1 section than we thought previously. Much more specimens of *Diplognathodus* are needed to clarify their morphologic and taxonomic relationships.

3. Kurielga Section

The Kurielga section, 6 km southeast of the Basu section (a road cut along the Ufa – Beloretsk highway) (Matenaar et al., 1999; Kulagina et al., 2015), is another prospective section for the study of the Bashkirian-Moscovian boundary interval. The succession is overturned, but has no recognizible faults. Very important that this section shows a thick succession (about 80 m) of Bashkirian limestone with conodonts, fusulinids and colonial rugosa corals, as well as more deep-water unit (25 or more meters) of thin-bedded cherty limestone with clastic intercalations. The latter unit is the same that was studied in the Basu section and it also could span the Bashkirian-Moscovian boundary interval.

4. Conclusions

The co-occurence of *D. donetzianus* with several morphotypes of early *Diplognathodus* including primitive forms of *D. ellesmerensis* in the Basu 1 section for the first time allows a reliable cross-correlation of the Bashkirian-Moscovian boundary interval in the Donets and Moscow basins with the succession of the South China. But much more studies are needed and they were started in 2017 and 2018 in close (12.5 m to the south) section Basu 2.

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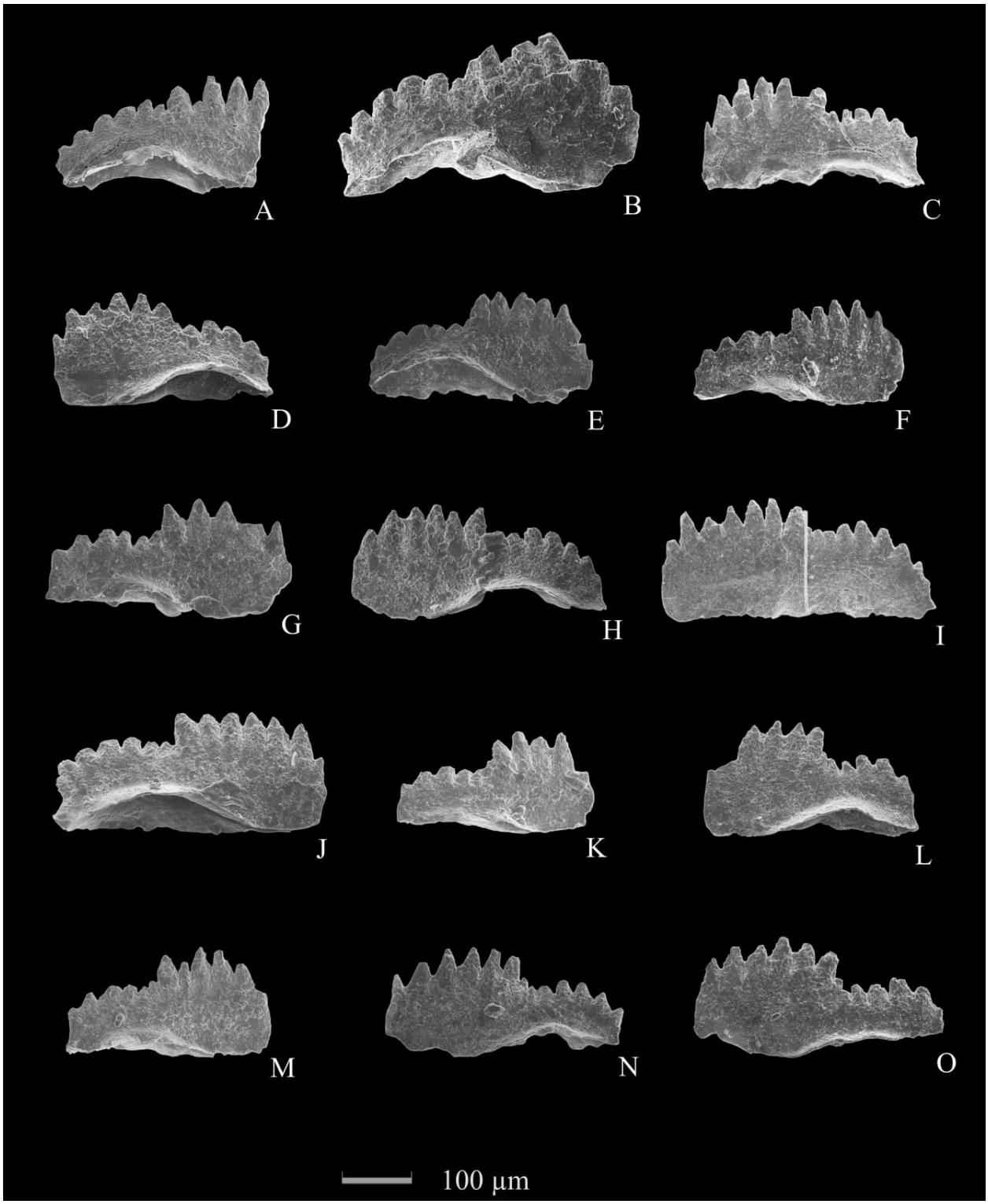

Figure 2. SEM photographs of *Diplognathodus* specimens from the Basu 1 section, South Urals, Russia. (A) *Diplognathodus* aff. *orphanus* (Merrill, 1973), MSU 244/2001, right element, sample 16-10A. (B–M). *Diplognathodus* aff. *ellesmerensis* Bender, 1980: (B, E, K), MSU 244/2002, MSU 244/2003, MSU 244/2004, right elements, sample 16-10A; (C, G, L, M), MSU 244/2005, MSU 244/2006, MSU 244/2007, MSU 244/2008, left elements, sample 16-10A; (D, F, H, J), MSU 244/2009, MSU 244/2010, MSU 244/2011, MSU 244/2012, left elements, sample 16-10B; (I), MSU 244/2013, right element, sample 16-19B. (N, O) *Diplognathodus ellesmerensis* Bender, 1980: (N), MSU 244/2014, right element, sample 16-10B; (O), MSU 244/2015, left element, sample 16-10A. Scale bar is 100 µm. Conodont collection is housed in Department of Paleontology, Faculty of Geology, Lomonosov Moscow State University, Moscow, Russia.

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NEW EVIDENCES TO DEMARCATE THE CARBONIFEROUS-PERMIAN BOUNDARY IN WESTERN ARGENTINA

Carlos R. González & Pamela Díaz Saravia

Abstract

During the Late Paleozoic Ice Age ("middle" Carboniferous to Early Permian) paleontological correlation of the Gondwana sequences with the Global Stratigraphic Chart of the northern hemisphere is difficult. Sequences of western Argentina show continuity throughout the Carboniferous-Permian transition as in no other region of Gondwana, although the location of the systemic boundary is matter of different interpretations. Latest field works in the southern extreme of the Uspallata-Iglesia Basin made possible the finding of the youngest Pennsylvanian invertebrate fauna, and the discovery of an exceptional site where this and the earliest Permian guide fossil occur within a same section. This seems appropriate to consider in this locality a potential stratotype and section of the Carboniferous-Permian boundary in western Argentina.

1. Introduction

The Uspallata-Iglesia Basin of western Argentina shows probably the most important development of the late Paleozoic deposits in south-western Gondwana. This record is important not only because these rocks bear abundant marine and continental fossils that permitted the founding of a comprehensive biostratigraphic orderly throughout the Late Paleozoic Ice Age (LPIA) in Argentina, but also because its significance for the interpretation of the Carboniferous -Permian boundary. However, one of the greatest difficulties to establish the systemic boundary in these sequences is to match them with the stages of the International Chronostratigraphic Chart, which are based on invertebrate groups (ammonoids, conodonts and fusulinid foraminifers) that are absent in the cold Gondwana seas. This makes necessary to appeal to regional subdivisions, as recommended by Heckel (2001) and González (2005). For this purpose, the faunal succession proposed by González (1993) gave the basis for a reasonable organization of local stages. Few available absolute ages are useful as control, but do not afford the same accuracy of the fossils.

During most of the last century, the distinction between the Carboniferous and Permian deposits in Argentina was founded on a modest information of the paleontological record. Posterior advances in the knowledge of the fauna and flora fossils permitted a more detailed biostratigraphic arrangement, and fueled diverse considerations about the position of the boundary between these Systems.

1. The Carboniferous-Permian boundary

In a first attempt, González (1985) claimed that the Carboniferous-Permian boundary should be placed above the last apparition of the *Tivertonia-Streptorhynchus* (abbreviated T-S) fauna and below the first record of the brachiopod *Costatumulus amosi* Taboada (1993), which at that time were regarded the latest Carboniferous and the earliest Permian guide fossils respectively. This was posteriorly ignored by other authors (Archbold et al. 2004; Cisterna 2010; Cisterna et al. 2005, 2011; Gutiérrez and Limarino 2006, and others), who alleged that the boundary should be placed within the *T-S* fauna, although

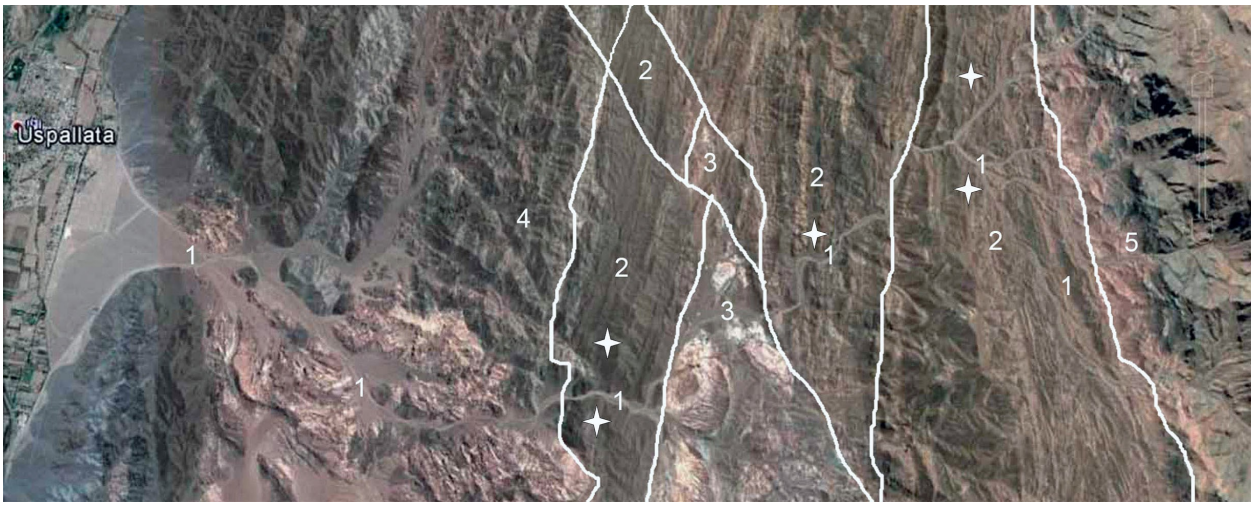

Figure 1. Google Earth map of the region to the east of the Uspallata city at the southern fringe of the Uspallata-Iglesia Basin showing the quebrada de Santa Elena (Santa Elena brook) (1), and relationships of the Santa Elena Formation (2) with the Permo-Triassic tuffs of the Portezuelo del Cenizo Formation (3), the Devonian rocks of the Puntilla de Uspallata Formation (4) to the west and the Early Paleozoic Bonilla Group (5) to the east; white lines: main faults (simplified); white stars: fossiliferous locality.

without defining biostratigraphic limits and based on the presence of some genera that are common in the Early Permian of Australia. However, this assumption is feebly, and the comparison is not possible because in Australia there is a hiatus involving the Carboniferous-Permian boundary (Roberts et al. 1995; Kelly et al. 2001), and the lack of fossil record impede a consistent assessment. It is necessary to emphasize that the Gondwana fauna, commonly known as the "*Eurydesma* fauna", was not exclusive of the Early Permian. It was an endemic dynamic fauna that appeared at the onset of the glaciation during the "middle" Carboniferous and evolved until the Early Permian. This was largely demonstrated with the bivalves (González 1998, 2002, 2003, 2010; González & Waterhouse 2012), and being also valid for the other groups of invertebrates.

Stratigraphic and paleontological evidences support the age of *Costatumulus amosi*, which is regarded the oldest Permian guide fossil in Argentina (Amos et al. 1973; González 1981; Taboada 2010). It is found within the youngest Late Paleozoic marine strata deposited at the southern fringe of the Uspallata-Iglesia Basin of western Argentina, as well as in the Languiñeo-Genoa Basin of central Patagonia, where this brachiopod is stratigraphically below beds bearing the first record of the Glossopterids (Andreis & Cuneo 1985; Cuneo 1990).

To the east of the Uspallata city the Carboniferous -Permian Santa Elena Formation crop out severely faulted between lower Paleozoic rocks and Permo-Triassic tuffs (Figure 1). This unit consists of two Members: the lower is the Jarillal Member that contain the T-S fauna and the *Nothorhacopteris-Botrychiopsis-Ginkgophyllum* (abbreviated NBG) flora (Archangelsky et al. 1987), and the upper is the Tramojo Member that bears the *Costatumulus amosi* fauna. The stratigraphic relationship between the *T-S* and *C. amosi* faunas was during long time hidden by the structural complications that dislocate this Formation.

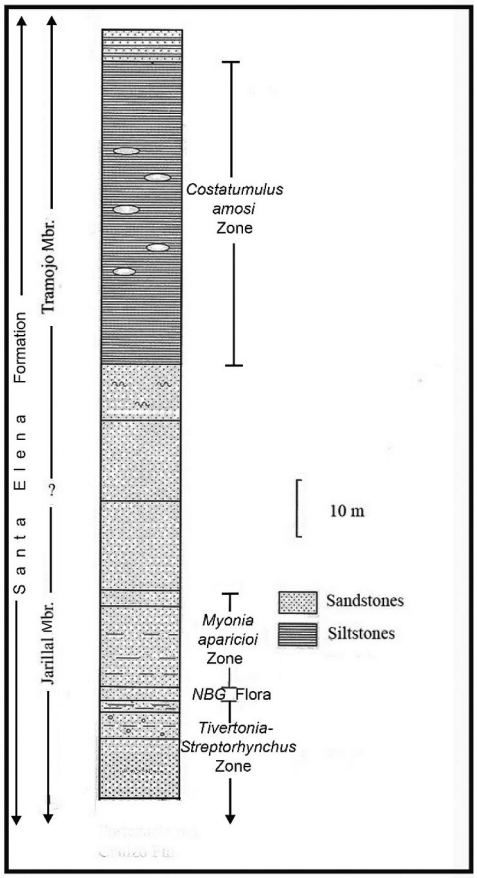

Figure 2 Composite section of a segment of the Santa Elena Formation that shows the relationship between beds bearing the NBG Flora, the *Myonia aparicioi* fauna (latest Carboniferous) and the *Costatumulus amosi* fauna (earliest Permian).

Díaz Saravia & González (in preparation) describe a new faunal assemblage present in the Santa Elena Formation, called after the bivalve *Myonia aparicioi* Díaz Saravia & González (in prep.). In a preliminary report, Rocha Campos (1970) considered this fauna of Early Permian age, although its stratigraphic position within the Formation was at that time, and during long time, unknown. Recently, this uncertainty was solved after detailed field work by the authors that permitted to recognize the precise location of the *M. aparicioi* fauna within the Jarillal Member, just at the top of the T-S Zone and closely associated with the *NBG* flora. This discovery is of the greatest importance for the actual setting in the space and time of the Carboniferous-Permian faunas of western Argentina. In this context, the *M. aparicioi* fauna became the youngest Carboniferous faunal assemblage, much near the upper limit of the Pennsylvanian than the *T-S* Zone. This seems enough support for the proposition of the *M. aparicioi* Zone (Díaz Saravia & González in preparation). Moreover, during the latest explorations carried out in this region, one of us (PDS) was able to find a site to the east of the Uspallata city (Figure 1) where marine beds of the Santa Elena Formation bearing the *M. aparicioi* and the *C. amosi* faunas occur in a single section, separated by few tens of meters of sandstones without fossils (Figure 2). Because the rocks are affected tectonically (Figure 1), this section and its surroundings were scrutinized for possible structural complications, but no major interruptions could be observed. Even though the existence of gaps within the sandstone beds that separate the two marine members cannot be denied, it is assumed that the time elapsed between the existence of the *M. aparicioi* and the *C. amosi* faunas was not significantly extended. This remarkable occurrence of these two faunal assemblages only occur to the east of Uspallata, because of the continuity of subsidence of this region of the Uspallata-Iglesia Basin during the Carboniferous-Permian. Similar tectonic conditions also happened in the Languiñeo-Genoa Basin of central Patagonia, but the paleogeographic position of this region near the polar region, and the cold sea waters, were a barrier that impeded the entrance of the "warm" *T-S* and *M. aparicioi* faunas in this embayment, which remained as a sanctuary for the endemic (Gondwana) fauna during the Late Pennsylvanian (González & Díaz Saravia 2010). In this region, however, a probable equivalent to *M. aparicioi* is the bivalve *Merismopteria salinensis* González (1969) from the uppermost strata of the Las Salinas Formation. The endemic *Merismopteria salinensis* is a good guide fossil for this time, being also abundant in the Upper Carboniferous Mingaletta Formation of eastern Australia (Roberts et al 1995; González 2010).

These findings not only resolve the long-lasting quest of the relationship existing between these faunas, but also provides solid biostratigraphic evidence for a concrete evaluation of the Carboniferous-Permian boundary in western Argentina. We think that there are enough evidence to consider in this region the choosing of a potential stratotype and section for the Systemic boundary in southwestern Gondwana.

A detailed account of these findings and description of the new faunal assemblage will be given in an article in preparation by the present authors.

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MEETINGS

The ICCP, organized every four years, is the most important platform of exchange for all disciplines that deal with the geology and palaeontology of the Carboniferous and Permian periods. The XIX ICCP will be held in Cologne, July 29th – August 2nd, 2019.

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- First circular release: **2018-08-15**
- Second circular: **2018-12-01**
- Deadline for early bird payment/abstract submission: **2019-04-15**
- Deadline for registration and third circular: **2019-05-30**

Registration

Electronic registration will be available on the Congress website http://iccp2019-cologne.uni-koeln.de/ after **February 1, 2019**. It is our wish to organize a meeting at reasonable prices to enable participation of a wide audience. The fees, however, still might be subject to minor changes due to pending funding.

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Regular participant	**280 €;** includes congress fee, printed abstract volume, printed volume of all field trips, additional USB stick with electronic versions of both volumes. Icebreaker party and refreshments during the sessions	**330 €;** includes congress fee, printed abstract volume, printed volume of all field trips, additional USB stick with electronic versions of both volumes. Icebreaker party and refreshments during the sessions
Student	**190 €;** as above, applies only with valid student ID card	**240 €;** as above, applies only with valid student ID card
Accompanying person	**80 €;** icebreaker party and refreshments during the sessions	**100 €;** icebreaker party and refreshments during the sessions

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The 19th ICCP-Venue

Cologne, the fourth biggest German city, is a vibrant metropolis with somewhat more than one million inhabitants in the western part of Germany. Based on an older local settlement, it was founded by the Romans and is thought to be the oldest city of Germany. During centuries people from many countries met in its open-minded atmosphere. Its flair is due to the unique location at River Rhine, the mixture of modern and historical buildings – the famous cathedral is included in the UNESCO world heritage list, and the many students visiting several universities.

The University of Cologne, which will host the 19th ICCP has almost 50,000 students in six faculties covering the complete spectrum of natural and cultural sciences. Cologne is an ideal base to visit classical Carboniferous localities in the near-by Belgian Ardennes, the German Rhenish Mountains and the Ruhr area. Permian outcrops are somewhat more distant, but easily reached via a dense net of highways.

The University of Cologne includes four UNESCO world heritages: scenic “Upper Middle Rhine Valley”, “Germanic-Rhaetic Limes”, the originally 550 km long boundary fortification of the Romans, as well as the rococo castles “Augustusburg” and “Falkenlust”, both only some kilometres south of Cologne.

The 19th ICCP-Travel

Cologne is reached by a dense network of highways and high-speed trains. By air, it is reached via the airport Cologne-Bonn CGN (12,000,000 passengers/year, 130 destinations, also by low-cost carriers). Participants from overseas may find good travel deals to the airports of Düsseldorf DUS, Frankfurt/Main FRA, or even to Brussels BRU (Belgium) and Amsterdam AMS (The Netherlands). All airports are directly connected by high-speed trains with Cologne:

- Düsseldorf (40 km, 25 min)
- Frankfurt (180 km, 1 h)
- Brussels (230 km, 2 h)
- Amsterdam (280 km, 3h)

Please check to see if your visit in Germany will require a visa. On request, we will provide official invitation letters to delegates who need to apply for a visa.

The 19th ICCP-Schedule

* Pre-Congress field trips
* *July 28:* Arrival in Cologne, Registration and welcome reception
* *July 29-August 2:* Talks, poster-sessions, workshops
* *July 31:* Mid-Congress Field trip
* *August 1:* Congress Dinner (River Rhine Cruise)
* *August 3:* Departure
* Post-Congress field trips

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Email: ICCP-2019(at)uni-koeln.de
Website: http://iccp2019-Cologne.uni-koeln.de

The 19th ICCP-Scientific sessions

The congress will take place in the central lecture hall of the University of Cologne. Herein, we propose a framework of sessions/topics. We encourage the scientific community to propose additional sessions or more specialized 'subsessions' to the organization committee until November, 15th 2018. Final acceptance will be based on the potential to attract a wide audience and to stimulate further research. Additional session titles will be published in the second circular.

	SCIENTIFIC SESSIONS	ORGANIZERS
A	**The world of stratigraphy**	
A1	Carboniferous stage boundaries, stratotype sections, and GSSPs	
A2	Permian stage boundaries, stratotype sections, and GSSPs	
A3	Carboniferous and Permian multistratigraphy and correlations (including isotope stratigraphy, magnetostratigraphy, sequence stratigraphy, and cyclostratigraphy)	
A4	Revision of the Devonian-Carboniferous boundary and associated events and extinctions	
A5	End-Permian extinction and early Triassic recovery	
A6	Late Carboniferous to earliest Triassic non-marine – marine correlation	
B	**The world of palaeontology**	
B1	Carboniferous and Permian marine biota: taxonomy, palaeoecology, palaeogeography	
B2	Carboniferous and Permian non-marine biota and plants: taxonomy, palaeoecology, palaeogeography	
C	**The world of facies, environments and basin analysis**	
C1	Carboniferous and Permian reefs, mounds, and biostromes	
C2	Carboniferous and Permian carbonate platforms and basins from cold-water to the tropics	
C3	Permian evaporite basins	
C4	Carboniferous and Permian siliciclastics and shales	
C5	Non-marine basins and environments of the Variscides and beyond	
C6	Permo-Carboniferous basins and environments from Gondwana	
C7	The Permo-Carboniferous glaciations - record and impact	
D	**The world of oceans and mountains**	
D1	Carboniferous and Permian plate tectonics and the evolution of relief (building and deconstruction of mountains)	
D2	Carboniferous and Permian palaeooceanography	
E	**The world of economic geology**	
E1	Carboniferous and Permian coals and evaporites	
E2	Carboniferous and Permian conventional and unconventional hydrocarbon systems	
E3	Carboniferous and Permian geothermal resources	

The XIX ICCP-Fieldtrips

Field trip participation will be on a first-come first-served base. Independently to modifications/restrictions by the fieldtrip leaders a maximum of 30 persons per field trip is expected. Duration, excursion routes, and costs will be detailed in the Second Circular. Pre-congress and post-congress field trip themes supplement each other to enable maximum coverage for participants interested in two field trips. Field trips will not require extensive walking or walking in rugged landscape except for some stops in post-Congress field trip C3.

A. Pre-Congress field trips

- A1. The Mississippian carbonate platform of the Ardennes, Belgium – fauna, facies, and stratigraphy.
- A2. The Mississippian Kulm Basin of the Moravo-Silesian Zone, southern Czech Republic – counterpart of the German Rhenish Mountains.
- A3. The classical Northwest-Central European Permian: continental "Rotliegend", restricted marine to evaporitic deposits of "Zechstein", and the Permian-Triassic transition in central Germany.
- A4. The Pennsylvanian of the Ruhr area, western Germany – fauna, facies, and stratigraphy of a paralic foreland basin of the Variscides including coal formation.

B. Mid-Congress field trips: to be announced in the Second Circular.

C. Post-Congress field trips

- C1. The Mississippian Kulm Basin of the Rhenish Mountains, western Germany – fauna, facies, and stratigraphy of a mixed carbonate-siliciclastic foreland basin.
- C2. The Pennsylvanian–Permian of the Saar-Nahe Basin, southwestern Germany – fauna, facies, and stratigraphy of an intramontane continental molasse basin of the Variscides.
- C3. The Pennsylvanian–Permian of the Southern Alps (Carnic Alps/Karavanke Mts.), Austria/Italy/ Slovenia – fauna, facies and stratigraphy of a mixed carbonate-siliciclastic shallow marine platform along the northwestern Palaeotethys margin.

3rd International Congress on Stratigraphy

strati 2019

2-5 July 2019, Milano, Italy

We are pleased to announce the third International Congress on Stratigraphy, which will be held in Milano (Italy), 2-5 July 2019. Following the first edition of this congress, held in Lisbon (Portugal) in 2013 and the second edition organized in Graz (Austria) in 2015, the third edition of STRATI has been assigned by the International Commission on Stratigraphy (ICS) to Italy, a country with a long historical tradition in Stratigraphy since the 17th century. Some milestones in the history of Stratigraphy were added in Italy by outstanding scientists such as Niels Stensen and Giovanni Arduino. Moreover, a wide variety of extraordinary stratigraphic successions and settings, often preserved in breath-taking natural environments, can be visited in Italy.

The topics of the congress will range from the Precambrian to the Holocene and will include all the stratigraphic techniques. The congress will provide the opportunity to discuss the recent developments in the study of the stratigraphy of the volcanic areas, Antarctic and Arctic sedimentary successions and ice caps, as well as of crystalline rocks. We also invite specialists from georesources exploration and hydrogeology to present their most advanced contributions to subsurface stratigraphy. As in previous editions, the congress will also host meetings of the ICS and of its Subcommissions to debate topics and problems in updating and improving the geological time scale.

We thank you in advance for your attention and hope to welcome many of you in Milano in July 2019!

The General Chairs of the Congress
Marco Balini and Elisabetta Erba

Important deadlines:

Early Registration: before May 15, 2019

Late Registration: after May 15, 2019

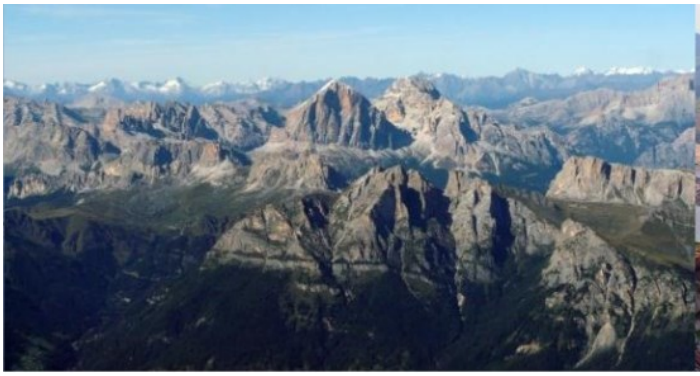
Abstracts submmission: 10 March 2019

For more information: http://www.strati2019.it/index.php

3rd International Congress on Stratigraphy

strati 2019

2-5 July 2019, Milano, Italy



Scientific Program

- **T1. History of Stratigraphy**
- **T2. Stratigraphic tools**
- **T3. Erathemes, Systems, Series and Stages**
- **T4. Stratigraphy of carbonates and carbonate platforms**
- **T5. Stratigraphy of volcanoes and of volcanic areas**
- **T6. Antarctic and Arctic**
- **T7. Stratigraphy and geological mapping**
- **T8. Subsurface stratigraphy**
- **T9. Geochronology and time scales**
- **T10. Stratigraphy in crystalline rocks**
- **T11. Open theme**

Commissione Italiana di Stratigrafia

SOCIETÀ GEOLOGICA ITALIANA 1881 MENTE ET MALLEO

UNIVERSITÀ DEGLI STUDI DI MILANO

DIPARTIMENTO DI SCIENZE DELLA TERRA "ARDITO DESIO"

- **Funds to attend the congress:**

The organizing committee will be able to provide financial support for **at maximum 10 graduate and PhD students** to attend the Congress. **The deadline for applying for support is 31st January 2019**. All applications will be considered by a panel of experts, and decisions will be announced by the end of March 2019. Awards will cover the registration fee (travels, accommodation and field excursion costs will not be covered). The applicants should be registered on the Congress website (deadline 31st January) and they should send (to info@strati2019.it; "Funds application" in the heading of the email) the following documents: - A letter from their University documenting their status; - A detailed personal CV including education, research and working experiences, and list of publications; - A personal statement, including the formal commitment to submit an abstract for oral presentation or poster for STRATI 2019.

11TH NORTH AMERICAN PALEONTOLOGICAL CONVENTION

JUNE 23 - 27, 2019 RIVERSIDE, CALIFORNIA



Welcome to **the 11th North American Paleontological Convention (NAPC)** to be held at the University of California, Riverside, June 23–27, 2019. NAPC is an international conference that meets every 4-5 years, bringing together all branches of paleontology (vertebrate, invertebrate, paleobotany, micropaleontology, paleo-related organic and inorganic geochemistry, paleoecology, paleoclimatology, and astrobiology) for a joint meeting typically hosted on a campus.

The meeting attracts professional scientists, graduate and undergraduate students, serious amateur paleontologists, and interested members of the public. The purpose is to exchange research findings, define future directions, and be a forum for extended and relaxed interactions between professionals and early career scientists, most particularly graduate and undergraduate students. NAPC meetings are generally less formal than annual association meetings, and allow time for more extended and relaxed interactions. They also serve a major role in public outreach through public lectures and other activities.

Important dates:

Registration opens: *mid-January 2019 to February 28, 2019*

Late Registration: *March 1 to May 15, 2019*

Abstracts submmission: *mid-January 2019 to March 1, 2019*

For more information: https://napc2019.ucr.edu/

CELEBRATING 50 YEARS OF NAPC

The 11th NAPC -Scientific sessions

The Plenary opening session ceremony will take place on the morning of June 23. The poster session, symposium talks and topical sessions will be held on the campus of University of California, Riverside between June 23 and June 27.

	SYMPOSIA	ORGANIZERS
S1	Behavioral Innovations and Environmental Feedbacks: Insights from the Trace Fossil Record and Other Archives	Lidya Tarhan, Dan Hembree, Jon Smith, Jim Gehling
S2	Tiny fossils, big questions, big data	Moriaki Yasuhara, Aaron O'Dea, Elizabeth Sibert, Jack Williams
S3	Plankton and Earth System Evolution	Pincelli Hull and Sandra Kirtland Turner
S4	Avalon to Zaris: A Global Perspective on the Ediacaran Biosphere	Emily Mitchell, Charlotte Kenchington, Chrissy Hall
S5	Arthropod evolution through deep time: a tribute to Richard Fortey	Javier Ortega-Hernández, Jorge Esteve, Joe Moysiuk, Alejandro Izquierdo López
S6	Paleobiology of Cephalopods	Lucy Chang, Benjamin Linzmeier, Margaret Yacobucci
S7	Cambrian Konservat-Lagerstätten and the emergence of modern-style marine ecosystems	Rudy Lerosey-Aubril, Robert Gaines, Xingliang Zhang
S8	Symposium in honor of the career of Michael A. Murphy	Kathleen Springer, Stanley Finney, Jonathan Matti
S9	Peering into the Past with Ancient DNA	Julie Meachen, David Jacobs
S10	Deep Time Paleogenomics	David Gold, Jeffrey Thompson
S11	Proteins from the Past	Jeana Drake
S12	Environmental change and the dawn of animal life: Integrating geochemical and paleontological data	Charles Diamond and Scott Evans
S13	The end of Cambrian "boom and bust" and the onset of the Great Ordovician Biodiversity Event (GOBE): diversity patterns, paleoecology, and paleobiogeography - IGCP 653-668 combined symposium	Alycia Stigall, Sara Pruss, Rebecca Freeman, Shelly Wernette
S14	Ecosystem recovery in the aftermath of the end-Permian mass extinction in the marine and terrestrial realms	Adam Huttenlocker, David Bottjer
S15	Scales of Ecological Development in the Mesozoic	Kathleen Ritterbush, Lydia Tackett
S16	Climate and Environmental Change in High-Latitude Fossil and Modern Ecosystems	Kelly Cronin, Sally Walker
S17	Conservation Paleobiology: natural systems in a human world	Susan Kidwell, Rebecca Terry, Wesley Parker, Yuren Yanes, Martin Zuschin
S18	The Sixth Extinction: Integrating Paleobiological, Ecological, and Physiological Perspectives	Noel Heim, Jonathan Payne
S19	Paleozoic Extinctions: Environmental Call and Biotic Response	Diana Boyer, Phoebe Cohen
S20	Stratigraphic Paleobiology	Steve Holland, Emilia Jarochowska, Mark Patzkowsky
S21	Evolution, communities and ecosystems: systems approach to paleoecology	Peter Roopnarine
S22	Fossil Marine Tetrapods of the Eastern Pacific	James Parham, Ana Valenzuela-Toro, Jorge Velez-Juarbe
S23	Evolution of Flight	Michael Habib, Cheng-Ming Chuong

S24	Recent advances in Central American and Mexican mammalian paleontology	Eduardo Jiménez-Hidalgo, Bruce Lander
S25	The Evolutionary Transition from Non-avian Dinosaurs to Birds	Cheng-Ming Chuong, Luis Chiappe
S26	Paleontological history of the Indian subcontinent	Devapriva Chattopadhyayand Steve Manchester
S27	New frontiers in paleobotany: tools, digitization, techniques, insights	Jonathan Wilson, Cindy Looy
S28	Growth, development, and evolution in the fossil record	Melaine Hopkins
S29	Environmental change and the evolution of form and function	Shaun Huang, Stewart Edie, Katie Collins
S30	New insights into functional morphology: Microstructures, Modeling, and Experimental approaches	Carlie Pietsch, Brendan Anderson, Kathleen Ritterbush, Nick Hebdon
S31	Paleontology on Public Lands: Research, Outreach and Resource Management	Kathleen Springer, Vincent Santucci
S32	Two to tango: amateur-professional interactions in advancing paleontological knowledge	Jack Kallmeyer, David Meyer
S33	Testament of Time	Nigel Hughes
S34	Exploring eLearning in the paleosciences: Visualizing the past and inspiring learners through the use of digital technologies	Wendy Taylor, Robert Ross
S35	Broadening horizons of broader impacts	John Orcutt, Sarah Jacquet
S36	Past, Present, and Future of the FOSSIL Project	Jen Bauer
S37	Engaging Diverse Communities in Paleontology: Innovative educational initiatives that connect culture to natural history	Gabriel-Philip Santos, Sadie Mills, Isaac Magallanes
T38	Macroevolutionary dynamics	
T39	Advances in understanding of Precambrian and Paleozoic life and environments	
T40	Advances in understanding of Mesozoic and Cenozoic life and environments	
T41	Taphonomy	
T42	Paleoenvironments and Paleobiology	
T43	Systematics and Phylogeny	
T44	Archean and Proterozoic paleontology and environments	
T45	Marine paleobiology	
T46	Paleobiology and climate change in the fossil record	
T47	General Session	

UNIMORE
UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA

13th International Symposium on Fossil Cnidaria and Porifera Modena, 3-6 September 2019

We are pleased to invite you to the 13th International Symposium on Fossil Cnidaria and Porifera, that will be held in Modena (Italy) on 3-6 September 2019, at the Department of Chemical and Geological Sciences (DSCG) of the University of Modena and Reggio Emilia.

For the first time organized in Italy, the Symposium aims to bring together participants from all over the world to discuss and share the most recent advances of studies on fossil corals and sponges, coral reefs and associated biota. The theme for the upcoming Symposium "Looking back to see ahead" highlights the importance of the fossil archives to understand response of the biosphere to long term environmental perturbations. We promote interdisciplinary approaches from a body of interested paleontologists, biologists but also scholars in other disciplines, and aim to push new boundaries for coral science.

We are looking forward to welcoming you in Modena!
The Organizing Committee

International Symposium on
Fossil Cnidaria and Porifera
Modena 2019

Important deadlines:

2nd Circular: 31 January 2019

Early Registration: 30 April 2019

Late Registration: after 30 April 2019

Abstracts submmission: 30 April 2019

For more information: http://www.13thfossilcnidaria.unimore.it/

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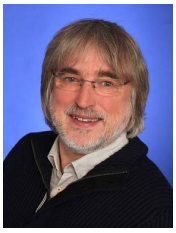

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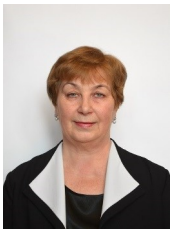

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