# Newsletter 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 spectacular valley, cutting through the Tournaisian strata in Bolshoi Karatau Mountains, which is 700 meters to the northeast of the Akuyu section.
*(by the courtesy of Wenkun Qie)*

# EXECUTIVE'S COLUMN

Dear Fellow Carboniferous Researchers,

Welcome to the SCCS newsletter 2017, 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 2016-2017, the progresses on establishing GSSPs for the Viséan-Serpukhovian, Moscovian-Kasimovian and Kasimovian-Gzhelian boundaries provided by the task group leaders and members, results of International Conferences ("Uppermost Devonian and Carboniferous carbonate buildups and boundary stratotypes") held in Kazakhstan, and the conference/ field-workshop schedule for 2018 and 2019 along with themes and anticipated results.

In October 2015, we learnt of the sad news about the loss of long-term SCCS member Dr. Harold Richard Lane. He was a leading expert for Carboniferous conodonts and stratigrapher, and a respected program director in NSF. There is an obituary for Rich in this Newsletter, and SCCS members Jim Barrick and Paul Brenckle had been preparing a memorial volume in *Stratigraphy* in honor of Rich, which contains many papers on Devonian and Carboniferous stratigraphy and conodonts, and should be issued in 2018.

In early December 2017, SCCS Chairman Xiangdong Wang submitted the official annual report of Subcommission on Carboniferous Stratigraphy for 2016-2017 to the International Commission of Stratigraphy (ICS). The income of SCCS in this fiscal year includes the funds carried forward from 2015-2016 ($ 1, 732) and the grant from ICS ($ 800), and the total number is $2,532. The main expenditures in 2017 include the support for the International conference "Uppermost Devonian and Carboniferous carbonate buildups and boundary stratotypes" in Almaty and Turkestan, Kazhakstan (August 15-22, 2017) and the Newsletter's editing, printing and mailing, with a total amount of $ 2182. As for the budget in 2017-2018, the executive committee plan to apply for $3,450 from ICS to support SCCS voting members, executives, and students to participating in the 5$^{th}$ IPC (July 9th to 13th, 2018) and to edit and print the SCCS Newsletter 2018.

**Results from Conferences and field meetings during November 1, 2016-October 31, 2017 :**

During the 2016 fiscal year, there were several geological conferences, field meetings and workshops that were of substantial importance and interest for SCCS members. The first one was the ICOS 4 (International 4th Conodont Symposium "Progress on Conodont Investigation"), held on the 25th-30th June 2017 in Valencia, Spain. The second one was the International Conference "Uppermost Devonian and Carboniferous Carbonate Buildups and Boundary Stratotypes", held on the 15–22 August 2017 in Turkestan, Kazakhstan. The last one was The Kazan Golovkinsky Stratigraphic Meeting joint with Fourth All-Russian Conference "Upper Palaeozoic of Russia", held in Kazan, Russia on the 19-23 September 2017.

The ICOS 4, jointly with the International Subcommission on Devonian Stratigraphy (SDS) and the International Subcommission on Silurian (ISSS), covered all aspects of conodonts, and the Devonian and Silurian events, stratigraphy and palaeontology. The ICOS 4 included five days of scientific sessions and fifteen days of field trips to the most famous Ordovician, Silurian, Devonian and Carboniferous outcrops in Central Pyrenees, Iberian Range, Prague Synform and Carnic Alps. The meeting provided a great opportunity for all conodont workers to present and exchange their ideas. During the meeting, five distinguish conodont researchers were awarded the Pander Medals. Since the ICOS 4 was joint with SDS and ISSS meetings, only few SCCS members attended this meeting and reported on: the conodont fauna around the DCB in South China, 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 (Liao and Valenzuela-Ríos, eds., 2017).

The International Conference "Uppermost Devonian and Carboniferous Carbonate Buildups and Boundary Stratotypes" in Kazakhstan was co-organized by the K.I. Satpayev Institute of Geological Sciences and SCCS. Approximate 40 participants, including 4 current voting members, Markus Aretz, Hans-Georg Herbig, Yuping Qi and Wenkun Qie, former SCCS chair Dr. Barry Richard, and former VM Elena Kulagina, attended the meeting and visited the Upper Devonian (Famennian) and Carboniferous reef deposits in the northwestern part of the Bolshoi Karatau Mountains. These successions also expose

boundaries of the Carboniferous stages. Detailed results of this meeting were published on the abstracts and fieldtrip guidebook.

The Kazan Golovkinsky Stratigraphic Meeting 2017 was organized in the Kazan Federal University, and covered all aspects of Upper Paleozoic stratigraphy, bioevents, taxonomy, Nonmarine-Marine correlation, the evolution of sedimentary basins and their resources and other related fields. It aimed to provide a platform for discussion of research fields and for international exchange of ideas between research groups working on Upper Paleozoic. The SCCS Chairman Xiangdong Wang, and the SCCS VM and CM Alexander S. Alekseev, Elena I. Kulagina etc. were present. The meeting included three days of oral and poster presentations and several days of field trips to the Carboniferous and Permian outcrops of Volga Region. Several business meetings and workshops were also held during the meeting. SCCS members presented their latest research results, e.g. the problems of Bashkirian/Moscovian boundary (Alexander S. Alekseev); the fusulinids data from Bashkirian/Moscovian boundary interval of Basu section (Elena I. Kulagina); the updated Carboniferous chronostratigraphic scheme of China (Xiangdong Wang) and other important issues. Their abstracts were published in the conference abstract volume (Nurgaliev et al., eds., 2017).

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**Next important Carboniferous meetings:**

- *The 5th International Palaeontological Conference , Paris, 2018*

  During the 2018, there will be several conferences and field meetings in which the SCCS membership will participate but the most important one is the 5th IPC in Paris, France, during July 9th to 13th. The task group for the redefinition of the base of the Carboniferous will hold a workshop to discuss recent advances in the new potential boundary criteria proposed in the last group meeting in Montpellier, 2016. Two post -conference fieldtrips (FT7 & FT8) are dedicated to the Paleozoic successions in France and Belgium, and the Carboniferous MoNTCEAU-LES-MINES LAGERSTäTTE in French Massif Central.

- *The 19th International Congress on the Carboniferous and Permian, Cologne, 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. In the remaining weeks of 2017, a website and the organization committee will be set up, and all help is greatly appreciated to make the congress a success. 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.

**DCB Special Volume in *Palaeobiodiversity and Palaeoenvironments* in 2020**

The last formal meeting of the task group for the redefinition of the base of the Carboniferous was the workshop in Montpellier in September 2016. During the workshop, task group leaders, Markus Aretz and Carlo Corradini, proposed to publish a special volume summarizing the current knowledge on the DCB around global and the outlook for its redefinition. In the statements below, Markus provide detailed instructions for contributing to the special volume.

*The aim of the volume is to publish modern review papers on the different regions and facies the DCB is exposed. It is definitively not the aim to describe a single section in the view of a future GSSP!*

*Carlo and I worked on a list of possible manuscripts. We then attributed one coordinator to every manuscript (exceptionally 2), which to our best knowledge has a long experience in studying the DCB in the region in question. We are well aware that there are more colleagues who studied or study sections in the region, and we invite them to join the coordinator in the effort to produce the overview paper. The coordinator should also actively look for colleagues to get involved in the manuscript. We remind you that the coordinator is not necessarily the first author of the manuscript – this is a decision of the involved authors.*

*Montagne Noire: Feist*

*……*

*We ask to write manuscripts, (i) that summarize and illustrate the current knowledge in a region, (ii) give detailed data and correlations of the important stratigraphic markers for the region and then **BRIEFLY** correlate them outside the region, and (iii) highlight sections, which are the most representative for the DCB in the region and discuss if the criteria defined in Montpellier for a revised DCB would fit for the representative sections and/or the region.*

*Manuscripts should be well-illustrated including photos of relevant sections, stratigraphic intervals, and rocks/facies, all stratigraphic markers and correlation schemes of the important sections in the region. Please provide for the most representative sections all available detailed stratigraphic data including the range of all biostratigraphic markers.*

*We have found an agreement with the editors of Palaeobiodiversity and Palaeoenvironments (http:// www.springer.com/palaeo) to publish the DCB volume as one of their 'normal' volumes in 2020 with Carlo and myself as guest editors. Palaeobiodiversity and Palaeoenvironments will publish longer papers, but please synthesis your data and do not extend your contribution into a book. Although the publication date of the printed version will be 2020, the online versions of the contributions will be progressively added. So the first manuscripts should be available in early 2019. You all know that progress of multi-authored thematic volumes is never even, but we will stick to a tight timeframe. We expect that manuscripts will be submitted via the homepage of Palaeobiodiversity and Palaeoenvironments by **15.06.2018**. So that the review process can be done during the summer and revised manuscripts could be send back by the end of 2018.*

*Many of you will attend the IPC in Paris in July next year. We will try to organise a meeting of the working group to discuss recent advances either at the 8th or 11th of July. We will then also decide about the date and place of the next workshop, where we will hopefully have the final vote on the criterion and then if accepted by SCCS, to start the process for the search of a new stratotype.*

*To plan a little bit ahead to 2019, meetings of the working group will be held at Strati 2019 in Milan and the Permian-Carboniferous Congress in Cologne.*

*Best regards,*
*Markus Aretz*

**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.

# OBITUARY

## Harold Richard Lane

(07.03.1942-16.10.2015)

On October 16, 2015, Dr. Harold Richard Lane, the well-known U.S. conodont taxonomist, stratigrapher, and the longstanding member of SCCS passed away at home in Washington, DC. Rich is probably best known to North American and Chinese geologists for his distinguished career at the National Science Foundation (NSF).

After a childhood in Danville, Illinois, Rich graduated from the University of Illinois with a BS degree in geology (1964), followed by MS (1966) and PhD (1969) degrees at the University of Iowa. His graduate work concentrated on the systematics and zonation of Late Mississippian–Early Pennsylvanian conodonts in the type Morrowan region of Arkansas and Oklahoma (Lane and Straka, 1974). Charlie Collinson introduced Rich to the conodonts during his undergraduate days as a research assistant at the Illinois State Geological Survey, and with the encouragement of Brian Glenister and Gil Klapper, his thesis advisors at Iowa, he interned at the Amoco (then Pan American Petroleum) Tulsa Research Center during summers in the late 60s. Upon receiving his PhD, Rich accepted an appointment in Tulsa as a Research Scientist specializing in conodont studies, a position that gave him the opportunity to investigate diverse geological problems worldwide, leading to more than 100 published articles, abstracts for oral presentations, and edited volumes, as well as an even greater number of internal Amoco research reports and technical memoranda.

One of Rich's major research-career accomplishments was his leadership role in the selection of the GSSP (Global Stratotype Section and Point) for the Mid-Carboniferous (Mississippian-Pennsylvanian) boundary in Arrow Canyon, Nevada, USA. In 1981 the SCCS assembled an expert panel in Leeds, UK, to identify potential taxa for defining the boundary (Ramsbottom et al., 1982). Following that meeting Rich was selected to chair an *ad hoc* Mid-Carboniferous Boundary Committee charged with producing a recommendation for a boundary-defining taxon to be presented at the 1983 Carboniferous Congress in Madrid. That recommendation—the evolutionary appearance of the conodont *Declinognathodus noduliferus*, essentially a proxy for the entrance of the geographically restricted *Homoceras* faunas—was approved by the SCCS titular membership in Madrid, who then appointed Rich Chairman of a Mid-Carboniferous Boundary Working Group to locate an appropriate stratigraphic section for a boundary stratotype (Lane and Ziegler, 1985). After visiting numerous candidate sections in Eurasia and North America, the working group in 1994 chose the appearance of *D. noduliferus* in the lower Bird Spring Formation at Arrow Canyon for the GSSP, a selection later approved by the SCCS and ratified by the International Union of Geological Sciences (Lane et al., 1999).


Large black arrow indicates the Mid–Carboniferous GSSP within the lower Bird Spring Formation (after Lane et al., 1999, Episodes)

Rich's eclectic research interests produced at the same time many fruitful publications covering topics as varied as Siluro–Devonian conodont biostratigraphy in east-central Alaska (Lane and Ormiston, 1979), Devonian–Carboniferous conodonts from Malaysia (Lane et al., 1979), a preliminary Lower Carboniferous conodont zonation (Lane et al., 1980), the distribution of Waulsortian bioherms in the Lake Valley Formation of southern New Mexico (Lane, 1982), taxonomic

studies of the genera *Scaliognathus* (Lane and Ziegler, 1983), *Rhachistognathus* (Baesemann and Lane, 1985), and *Polygnathus* (Klapper and Lane, 1985), evolutionary cycles in Devonian–Mississippian conodonts (Ziegler and Lane, 1987), and even a description of a Mississippian radiolarian fauna from Oklahoma (Ormiston and Lane, 1976).

Rich's management career started in 1984 when he became supervisor of the Paleozoic Biostratigraphy Group in Tulsa. Even with his extensive managerial duties Rich maintained outside interests in biostratigraphy/paleontology, including a position as vice-chairman of the International Commission on Stratigraphy and chairing the organizing committee for a workshop on "Paleontology in the 21st Century," a look at future directions for the discipline, held at the Senckenberg Museum in Frankfurt (Lane et al., 1997).

For the last 18 years, Rich served as a National Science Foundation (NSF) program director in the Sedimentary Geology and Paleobiology Program. In that position he and his staff semi-annually reviewed numerous research proposals and funded more than 1000 of them during his tenure. He was also deeply involved in many other ancillary activities, such as leading the Advancing Digitization of Biodiversity Collections Program, the Genealogy of Life Program, the Coastal SEES Program and supporting the NCED, the Paleobiology Database, Macrostrat, NEOTOMA, Morphobank, the IEDA, iDigBio, the University of Texas CT-Scanning Facility, the Tree of Life, Chronos, Earthtime, SESAR, the Earth-Life Transition and the STEPPE office. During this time, he was also very devoted to the paleontological collaborations between NSF-USA and NSF-China and created a bilateral workshop on the Critical Transitions in the History of Life between the USA and China that met yearly from 2005–2015. He also led an international qualification and assessment in 2003 for the Nanjing Institute of Geology and Palaeontology of the Chinese Academy of Sciences and developed a close relationship with the staff of that institute, with whom he continued his research on conodont biostratigraphy and systematics, especially of assemblages in Chinese candidate sections for Carboniferous stage GSSPs.

Especially during his NFS days Rich vigorously promoted paleobiology with some success to counteract the decline that has overtaken the science in the past few years. As a fitting tribute to his enthusiasm and involvement, the Paleontological Society recently announced creation of the H. Richard Lane Student Research Award to help fund research grants. It is an appropriate way to honor this individual who devoted so much of his career to the pursuit of excellence in paleontology and related fields. *(provided by Drs. Paul Brenckle and Jim Barrick)*

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# SCCS REPORTS

## Annual report to ICS for 2016-2017

**SCCS Chairman Xiangdong Wang**

**1.** This version of the 2016-2017 SCCS Annual Report is abbreviated from the document submitted by our chairman to the International Commission of Stratigraphy in December 2017. The full version of the Annual Report has been posted on our website at http://www.stratigraphy.org/ carboniferous/

### 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. (c) to facilitate global 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 2016-2017

#### 3.1. The base of the Carboniferous:

The last formal meeting of the task group for the redefinition of the base of the Carboniferous was the workshop in Montpellier in September 2016. Since then, members of the task group have continued the work on boundary sections and started to test the application of the criteria voted in Montpellier. It must be underlined that those criteria are actual being tested for their potential if there are suitable for the definition of the boundary. Hence, these criteria are currently only for the informal use within the work group, and in no circumstances to be used for a formal work on the boundary.

The task group is also currently preparing a volume with a series of contributions giving an overview on the DCB in different regions around the globe. Contributions are expected for following regions: France (Montagne Noire, Pyrenees), German (Rheinisches Schiefergebirge, Thuringia), Austria/Italy (Carnic Alps, Graz Palaeozoic, Sardinia), Czech Republic, Belgium, British Islands, Balkan, Poland, Russia, China, USA, Canada, Greenland, South America, South East Asia, Morocco, Iran, CAOB (Kazakhstan, Uzbekistan, etc), Australia and Turkey. This volume will be published as a regular volume in *Palaeobiodiversity and Palaeoenvironments (http:// www.springer.com/palaeo)* in 2020. The next formal meeting of the task group will be organised in July 2018 in Paris (International Palaeontological Congress, see details in **Meetings section**).

#### 3.2. The Visean-Serpukhovian Boundary:

A potential index for the Viséan-Serpukhovian Boundary definition, the first evolutionary occurrence of the conodont *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957) -*Lochriea ziegleri*, has been selected, but not voted on by the task group and SCCS for final approval. Work is well advanced at two prime GSSP candidate sections: the Naqing (Nashui) section in southern Guizhou, China and the Verkhnyaya Kardailovka in the southern Ural Mountains of Russia.

In south China, the boundary index – the FAD of *L. ziegleri* has been precisely located in the Naqing section (Qi *et al*., 2013; Chen *et al*., 2016). A manuscript titled "Conodonts of the genus *Lochriea* near the Viséan-Serpukhovian boundary (Mississippian) at the Naqing section, Guizhou Province, South China" by Yuping Qi, Tamara Nemyrovska, Qiulai Wang, and Keyi Hu is nearing completion. Their study enables confirmation and refinement of known lineages within the genus, and two lineages are proposed: 1) noded *Lochriea* species, such as *L. mononodosa–L. nodosa–L. ziegleri, L. senckenbergica* and *L. multinodosa*, and 2) ridged *Lochriea* species such as *L. monocostata–L. costata–L. cruciformis*. In addition, the foraminifera *Janishewskina delicata* (Malakhova, 1956), an auxiliary index to the base of the Serpukhovian, has also been found by Dr. Qingyi Sheng (Ph.D. dissertation) at 2.15 m above the FAD of *L. ziegleri* in the Naqing section.

In the Verkhnyaya Kardailovka section, the task group completed sedimentologic, paleontologic, and stable isotope studies across the boundary level and presented their work in a comprehensive work (Richards *et al.*, in press). The publication confirmed results by the task-group members in previous reports Nikolaeva *et al.* (2014, 2009) and demonstrated the boundary level, defined by the FAD of *L. ziegleri*, lies in stylonodular, deep-water, pelagic carbonate lithofacies between 19.53 and 19.63 m (midpoint 19.58 m) above base of the Kardailovka section. The report by Richards *et al.* (in press) included preliminary $\delta^{13}C_{carb,}$ $\delta^{18}O_{carb,}$ and $\delta^{18}O_{apatite}$ studies across the boundary.

In the Cantabrian Mountains of northwest Spain, work continued on the Millaró and Vegas de Sotres sections, two other potential candidate sections for the GSSP. A detailed description of the Vegas de Sotres section was provided by Cózar et al. (2016), and the location of the Viséan/Serpukhovian boundary and correlations with the Venevian to the Protvian are based mainly on foraminifer occurrences. In the Millaró section, the precise first occurrence of conodont *Lochriea ziegleri* just above *L. nodosa* has been located by Drs. Javier Sanz-López and Silvia Blanco-Ferrera. Furthermore, some faunas of ostracodes from the Alba Formation at the Triollo section were recently described (Sánhez de Posada et al., 2016).

### 3.3. The Bashkirian-Moscovian boundary:

The best potential indexes for defining the Bashkirian-Moscovian boundary include First Appearance Datum of conodonts *Declinognathodus donetzianus* Nemirovskaya, 1990 or *Diplognathodus ellesmerensis* Bender, 1980, although the official criterion has not been selected and voted on. In the Basu River section, group members have done substantial works on the conodont and foraminifer fauna, and recognized an evolutionary lineage of *Declinognathodus marginonodosus-D. donetzianus* and the first appearance of the fusulinid *Profusulinella prisca* a few meters below that of *D. donetzianus*. It might be a good candidate for a GSSP, but is now fully covered. Russian colleagues are currently looking for a new suitable section in adjacent area. In the Naqing (Nashui) section, the *D. donetzianus* is absent, and the first appearance of conodont *D. ellesmerensis*, which has a broader global distribution, has been considered as the marker event for this boundary. The ancestral species is being intensively studied and its evolutionary first occurrence would provide an ideal GSSP to define the boundary.

### 3.4. The Kasimovian-Gzhelian boundary:

Task group members of establishing the Kasimovian-Gzhelian boundary agreed to use the FAD of the conodont *Idiognathodus simulator* s.s. (Ellison, 1941) as the definition of the base of the Gzhelian since 2008, however, its ancestral species is still not well known. Sino-US colleagues (Profs. Yuping Qi and James Barrick) are currently working on large conodont collections, recovered from the continuously deposited and fully exposed deep-water Carboniferous successions at Naqing (Nashui), to gain a better understanding of the evolutionary lineage of conodont fauna around this boundary. In 2013 and 2014, sedimentologic and stable-isotope geochemical researches at Naqing were initiated by Dr. Jitao Chen and Isabel Montanez.

### 3.5. International conference in Kazakhstan:

"Uppermost Devonian and Carboniferous carbonate buildups and boundary stratotypes" and field trip to visit the upper Devonian-Carboniferous reef buildups of the Bolshoi Karatau Mountains in South Kazakhstan were co-organized by K.I. Satpayev Institute of Geological Sciences and SCCS during August 15-22, 2017. Approximate 40 participants, including 4 current voting members and former SCCS chair Dr. Barry Richard, attended the meeting and visited the pre-reef, reef and post-reef Upper Devonian (Famennian) and Carboniferous deposits in the north-western part of the Bolshoi Karatau Mountains. These successions also expose boundaries of the Carboniferous stages. For detailed information on the abstracts and fieldtrip guidebook, please check our official website under the subsection 'Publications - Conference Abs&Guide'.

### 3.6. The Kazan Golovkinsky Stratigraphic Meeting:

During September 19-23, 2017, the Kazan Golovkinsky Stratigraphic Meeting joint with Fourth All-Russian Conference "Upper Palaeozoic of Russia" was held in Kazan, Russia, covering all aspects of Carboniferous and Permian stratigraphy, bioevents, taxonomy, nonmarine-marine correlation, the evolution of sedimentary basins and their resources etc. The aims of the meeting were to provide a platform for discussion of research fields and for international exchange of ideas between research groups working on the Carboniferous and Permian periods. The meeting included three days of oral and poster presentations and several days of field trips to the Carboniferous and Permian outcrops of Volga Region. Many SCCS members attended this meeting and presented their latest research results, e.g. the problems of the Bashkirian/Moscovian boundary (Alexander S. Alekseev), the fusulinids data from Bashkirian/Moscovian boundary interval of Basu section (Elena I. Kulagina) and the updated Carboniferous chronostratigraphic scheme of China (Xiangdong Wang). Their abstracts were published in the conference abstract volume (Nurgaliev et al., eds., 2017).

### 3.7. Mississippian Stratigraphy and International Cooperation:

From Oct. 26th to Nov. 6th, guided by Dr. Paul Brenckle, SCCS chair Dr. Xiangdong Wang and his Nanjing colleagues Drs. Yuping Qi, Qingyi Sheng and Le Yao had a field trip of the Mississippian Subsystem in its type region in North America, the Mississippi River Valley of Illinois, Missouri, and Iowa. Twenty-seven classic exposures along the Mississippi River from north of Burlington, Iowa, to southern Illinois contain all formations of the Kinderhookian, Osagean, Meramecian, and Chesterian stages, in ascending order. This field trip familiarized Chinese group with the important lithostratigraphic and biostratigraphic information on the Mississippian stratotype, and would help them develop further research on global correlation and Carboniferous GSSPs.

**Publications related to the Carboniferous stratigraphy:**


CORRANIDI, C., SPALLETTA, C., MOSSONI, A., MATYJA, H. & OVER, D. J. (2016): Conodonts across the Devonian/Carboniferous boundary: a review and implication for the redefinition of the boundary and a proposal for a updated conodont zonation. – *Geological Magazine*, Doi: 10.1017/ S001675681600039X

COZAP, P., SOMERVILLE, I.D., SANZ-LOPEZ, J. & BLANCO-FERRERA, S. (2016): Foraminiferal biostratigraphy across the Visean/Serpukhovian boundary in the Vegas de Sotres section (Cantabrian Mountains, Spain). – *Journal of Foraminiferal Resea*rch, 46: 171–192

HU, K.Y. & QI, Y.P. (2017): The Moscovian (Pennsylvanian) conodont genus *Swadelina* from Luodian, southern Guizhou, South China. – *Stratigraphy*, 14 (1-4): 197-215.

NURGALIEV, D., SILANTIEV, V. & V. ZHARINOVA (eds.) (2017): Kazan Golovkinsky Stratigraphic Meeting -2017 and Fourth All-Russian Conference "Upper Palaeozoic of Russia", Upper Palaeozoic Earth systems high-precision biostratigraphy, geochronology and petroleum resources. – Abstract Volume, Kazan University Press, Kazan, 232 p.s

SANCHEZ DE POSADA, L.C., BLANCO-FERRERA, S. & SANZ-LOPEZ, J. (2016): On some bythocytherid (Ostracoda) from the Viséan of Triollo (N Palencia, Cantabrian Mountains, Spain). – *Spanish Journal of Palaeontology* 31, 221–230.

SPALLETTA, C., PERRI, M.C., OVER, D.J. & CORRADINI, C., (2017): Famennian (Upper Devonian) conodont zonation: revised global standard. – *Bulletin of Geosciences* 92, 31-57.

WANG, Q.L., WANG Y., QI Y.P., WANG X.D., CHOH SUK-JOO, LEE DONG-CHAN & LEE DONG-JIN. (2017): Revised conodont and fusuline biostratigraphy of the Bamchi Formation (Pyongan Supergroup) at the Bamchi section, Yeongwol and the Carboniferous–Permian boundary in South Korea. – *Alcheringa.* Doi. 10.1080/03115518.2017.1395077.


## 4. SUMMARY OF INCOME IN 2016-2017

Prepared by Prof. Xiangdong Wang, Chair of SCCS (Accounts maintained in U.S dollar)

| | |
|---|---|
| Funds carried forward from 2016 | $1,732 |
| **ICS Grant** | **$800** |
| TOTAL INCOME | $2,532 |

## 5. SUMMARY OF EXPENDITURE IN 2016-2017:

Prepared by Prof. Xiangdong Wang, Chair of SCCS (Accounts maintained in U.S dollar)

| | |
|---|---|
| Travel and conference registration support for SCCS Vice-Chair | $500 |
| Support for the International conference "Uppermost Devonian and Carboniferous carbonate buildups and boundary stratotypes" in Almaty and Turkestan, Kazhakstan (August 15-22, 2017) | $1,232 |
| SCCS Newsletter 2017 editing, printing, and mailing | $450 |
| TOTAL EXPENDITURE | $2,182 |

**6. BUDGET FROM ICS IN 2017-2018**

| | |
|---|---|
| PROJECTED EXPENSES | |
| Support for voting members, executive, and students to participate in 5th IPC, in Paris, France | $3,000 |
| SCCS Newsletter 2018 editing, printing, and mailing | $450 |
| TOTAL PROJECTED EXPENSES | $3,450 |
| INCOME | |
| Carryover (from CREDIT balance of 2017 fiscal year) | $350 |
| Estimated donations | $00.00 |
| TOTAL PROJECTED INCOME | $350 |
| BALANCE | |
| Estimated (deficit) /credit from above | -$3,100 |
| BUDGET REQUEST FROM ICS for 2017-2018 | $3,100 |

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

- A final report in Episodes needs to be published for the chosen GSSP of the Tournaisian-Viséan boundary in the Pengchong section, southern China, following its approval by the SCCS in late 2007 and its ratification by the ICS and IUGS.
- An index for the Viséan-Serpukhovian boundary needs to be voted on by the task group and SCCS in the next year.
- In 2017, many VMs and CMs will meet in Paris at the 5th IPC in June, we will have a Carboniferous session.

**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:**

www.stratigraphy/org/carboniferous

### 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 2016-2017 AND WORK PLANS FOR 2017 FISCAL YEAR

## REPORT OF THE TASK GROUP TO ESTABLISH A GSSP CLOSE TO THE EXISTING VISÉAN-SERPUKHOVIAN BOUNDARY

**Barry C. Richards[1] and Task Group**

[1] Geological Survey of Canada-Calgary, 3303 – 33rd St. NW, Calgary, Alberta, Canada T2L 2A7, barry.richards@canada.ca

### Introduction and general progress

A potential index for boundary definition has been selected, but not voted on by the task group and SCCS for final approval, and work is well advanced at two prime GSSP candidate sections: the Verkhnyaya Kardailovka in the southern Ural Mountains of Russia and the Naqing (Nashui) section in southern Guizhou Province, China. In the Cantabrian Mountains of northwest Spain, work continued on the Millaró and Vegas de Sotres sections, two other potential candidate sections for the GSSP.

For boundary definition, the group hopes to use the first evolutionary occurrence of the conodont *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957) - *Lochriea ziegleri. L. ziegleri* appears in the Brigantian Substage of NW Europe somewhat below the current base of the Serpukhovian as defined by its lectostratotype section in the Zaborie quarry near Serpukhov in the Moscow Basin, Russia (Kabanov *et al*., 2012, 2014a, b). *L. ziegleri* is most abundant in slope and basin carbonate successions and is rare to absent in shallow-shelf carbonates. Stable-isotope stratigraphy and various fossil groups including foraminifers, ammonoids and rugose corals are being intensively studied to find auxiliary taxa and events suitable for correlating between shallow- and deep-water successions.

### Progress in southern Guizhou Province, China


**Fig. 1.** Map showing location of Naqing section in southern Guizhou Province, south China.

In south China, the boundary index – the FAD of *L. ziegleri* has been precisely located in the Naqing section (Figs. 1, 2; Qi *et al*., 2013; Chen *et al*., 2016). A manuscript titled "Conodonts of the genus *Lochriea* near the Viséan-Serpukhovian boundary at the Naqing section, Guizhou Province, South China" by Yuping Qi, Tamara Nemyrovska, Qiulai Wang, and Keyi Hu is nearing completion. Their study enables confirmation and refinement of known lineages within the genus, and two lineages are proposed: 1) noded *Lochriea* species, such as *L. mononodosa–L. nodosa–L. ziegleri, L. senckenbergica* and *L. multinodosa*, and 2) ridged *Lochriea* species such as *L. monocostata–L. costata–L. cruciformis*. The numerous and variable species of *Lochriea* across the V/S boundary in the Naqing section have been sorted out and the possibilities for their derivation evaluated.

After the foraminiferal study of Groves *et al*. (2012), foraminifers across the V/S boundary in south China have been intensely studied by Paul Brenckle and Qingyi Sheng, who found age-diagnostic Serpukhovian foraminiferal species including *Janishewskina delicata* (Malakhova, 1956), an auxiliary index to the base of the Serpukhovian. Their study is nearing completion and the highlights are below.

The foraminiferal zone - *Janischewskina delicata* Zone (62.25-70.15 m above base of section of Qi, 2008) is identified in the Naqing section. The first occurrence of *Janischewskina delicata* marks the base of this zone. Other species include *Asteroarchaediscus baschkiricus*, *Bradyina* aff. *cribrostomata*, *Bradyina*

*modica*, *Climacammina antiqua*, *Condrustella modavensis*, *Consobrinellopsis consobrina*, *Cribrostomum paraeximium*, *Cribrospira panderi*, *Endostaffella discoidea*, *Endothyra bowmani*, *Endothyranopsis compressa*, *Endothyranopsis crassa*, *Eostaffella ovoidea*, *Forschiella mikhailovi*, *Janischewskina isotovae*, *Janischewskina typica*, *Koskinobigenerina breviseptata*, *Koskinotextularia cribriformis*, *Loeblichia* sp., *Mediocris breviscula*, *Mediocris mediocris*, *Mikhailovella gracilis*, *Omphalotis minima*, *Omphalotis omphalota*, *Palaeotextularis brevisepta*, *Planoendothyra aljutovica*, *Plectogyranopsis regularis*, *Pojarkovella nibelis*, *Pseudoammodiscus volgensis*, *Tetrataxis* ex gr. *conica*, *Pseudoendothyra struvii*, *and Tetrataxis* ex gr. *maxima*. The nominal species *Janischewskina delicata* is reliable marker for the Serpukhovian Stage. It is widely distributed in deep- and shallow-water carbonates in South China. This species occurs 2.15 m above the FAD of *L. ziegleri* (60.1m above base of section of Qi, 2008 and 17.94 m above base of section measured by SCCS in 2008-2009; Fig. 2) in the Naqing section.

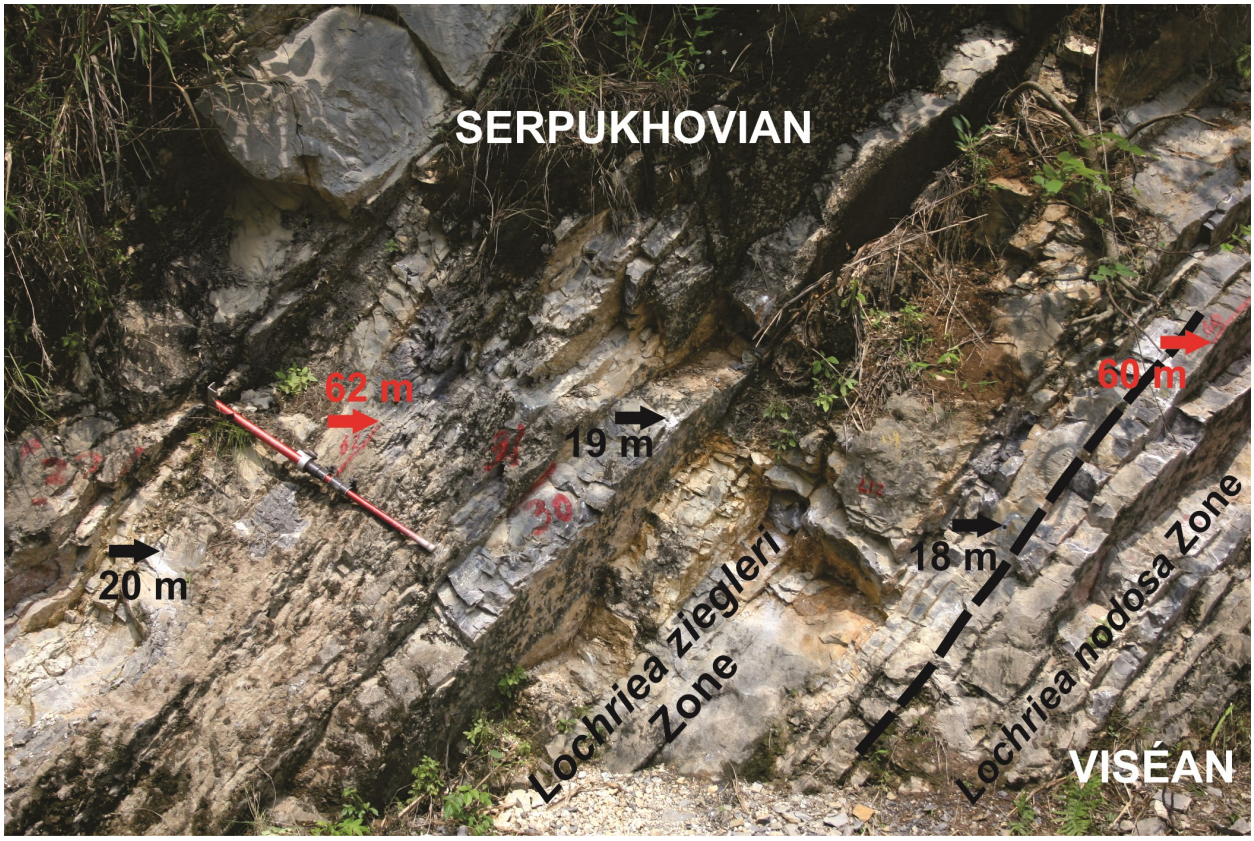


**Fig. 2.** Carbonate slope deposits (turbidites and nodular intervals) in Naqing section, south China at level of Viséan-Serpukhovian boundary (17.94 m above base section). Black arrows indicate marker pins placed by members of SCCS in 2008 and 2009; red arrows indicate painted markers from earlier studies (Qi, 2008; Qi and Wang, 2005).

**Progress in South Ural Mountains, Russia**

The task group completed sedimentologic, paleontologic, and stable isotope studies across the boundary level in the Verkhnyaya Kardailovka section (Figs, 3, 4) and presented their work in a comprehensive work (Richards *et al.*, in press). The publication confirmed results by the task-group members in previous reports Nikolaeva et al. (2014, 2009) and demonstrated the boundary level, defined by the FAD of *L. ziegleri*, lies in stylonodular, deep-water, pelagic carbonate lithofacies between 19.53 and 19.63 m (midpoint 19.58 m) above base of the Kardailovka section (Fig. 4). The report by Richards et al. (in press) included preliminary $\delta^{13}C_{carb}$, $\delta^{18}O_{carb}$, and $\delta^{18}O_{apatite}$ studies across the boundary. In contrast to δ13C trends observed in south China (Buggisch et al., 2011; Chen et al., 2016), the pattern in theKardailovka section lacks significant excursions near the boundary. Instead, the Kardailovka section shows a substantial positive shift of about 1‰ (from +2 to +3‰) between 2.58 and 1.83 m below the

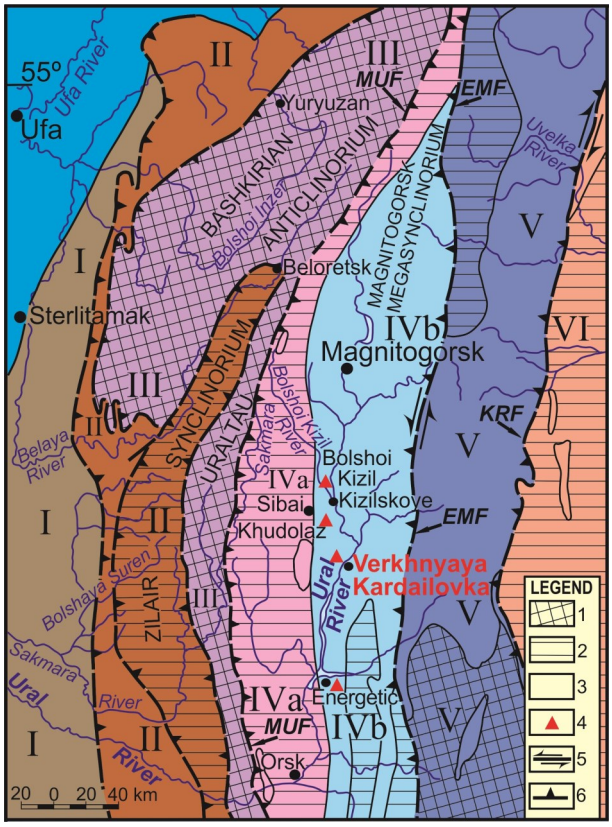


**Fig. 3.** Generalized map showing geographic and tectonic setting of the Verkhnyaya Kardailovka section, south Urals, Russia. Tectonic zones and faults from Puchkov (2009a, b). Map legend: 1 – pre-Paleozoic and metamorphic rock complexes, 2- pre-Carboniferous Paleozoic rocks, 3-Carboniferous and younger strata and intrusives, 4-localities, 5-relative direction of movement, 6-thrust fault; MUF –main Uralian Fault, EMF-East Magnitogorsk Fault, KRF-Kartaly (Troitsk) Fault. I to VI are the main tectonic zones of the southern Urals: I-Cisuralia (Preuralian Foredeep); II-West Uralian Zone; III-Central Uralian Zone: IV-Magnitogorsk Zone; (IVa-Western Subzone, IVb-Eastern Subzone); V-East Uralian Zone, and VI-

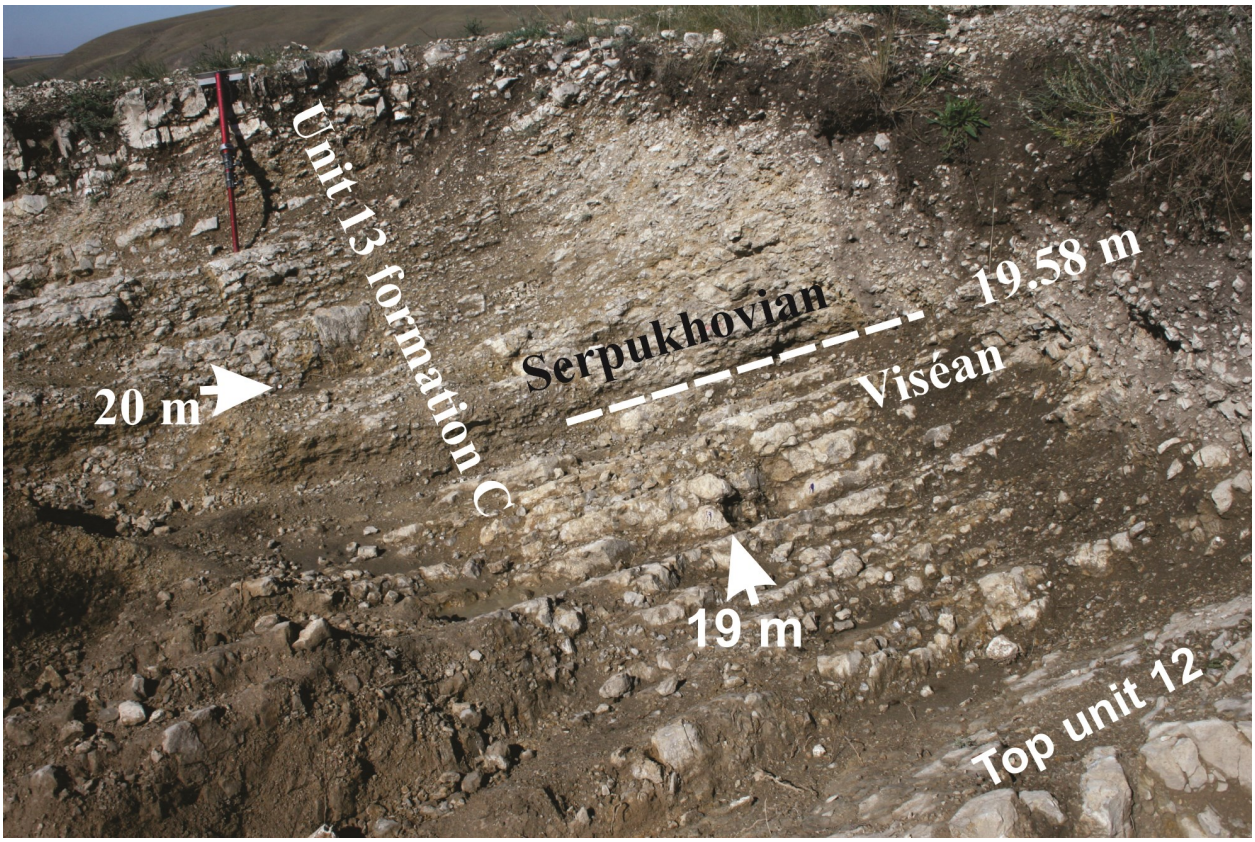


**Fig. 4.** The Visean-Serpukhovian boundary level in unit 13 (18.50-21.76 m) of the Verkhnyaya Kardailovka section, south Urals, Russia. Arrows point to marker pins at 19.0 and 20.0 m. The Viséan-Serpukhovian boundary, defined by the first occurrence of Lochriea ziegleri, lies at 19.58 m.

boundary and very stable $\delta^{13}C_{carb}$ values from 1.83 m below the boundary to the top (at 21.75 m) of the lower segment of the section at 2.05 m above the boundary.

The lack of significant excursions near the level of the FAD of *L. ziegleri* in the Kardailovka section suggests $\delta^{18}O_{carb}$ excursions will also be of minimal use for global correlations at the base of the Serpukhovian. In contrast, the $\delta^{18}O_{apatite}$ plot, based on measurements from conodont apatite phosphate, shows a prominent positive shift from 19.9 to 21.1‰ V-SMOW in the *nodosa* conodont Zone between 19.15 and 19.51 m above the section's base, which is immediately below the FAD of *Lochriea ziegleri* at 19.58 m. The latter prominent positive shift could be a useful auxiliary marker for the lower boundary of the Serpukhovian.

During the 2016 fiscal year, a study describing new ammonites from the Kardailovka section was completed (Nikolaeva and Konovalova, in press). At Verkhnyaya Kardailovka, the Viséan-Serpukhovian boundary recognized by the FAD of the conodont *L. ziegleri* lies within the *Hypergoniatites-Ferganoceras* Genozone. The ammonoid assemblages allow the recognition of the Hypergoniatites-Ferganoceras Genozone and a correlation with the synchronous zonations of North Africa, Spain, and China. The lowermost occurrence of the ammonoids of the Hypergoniatites-Ferganoceras Genozone is at 17.2 m above the base of the section and the highest occurrence is at 20.8 m.

**Progress Western Europe and North Africa**

Task-group members made a major update and revision of the calcareous algae and foraminifers in the uppermost Viséan and Serpukhovian of the Montagne Noire, France and two manuscripts have been completed: Vachard *et al*., (2016) and Cózar *et al*., (in press).

Work on corals in Morocco and Algeria is progressing and one publication on late Serpukhovian sections in the Algerian Béchar Basin was published in 2016: Atif *et al*. (2016).

**Progress Western Canada**

Task-group members completed a major manuscript about late Viséan and Serpukhovian rugose corals of the Rocky Mountain region of western Canada (Bamber et al., in press).

**WORK PLANS FOR 2017 FISCAL YEAR**

General plans

The task group has determined the FAD of the conodont *Lochriea ziegleri* in the lineage *Lochriea nodosa – Lochriea ziegleri* is the best index for boundary definition. The FAD of *L. ziegleri* has been precisely located in the Naqing section in southern Guizhou Province, China and the Verkhnyaya Kardailovka section on the Ural River in southern Russia and preliminary sedimentologic and geochemical studies completed. During the 2015-2016 fiscal years, Qi Yuping and Tamara Nemyrovska largely completed their manuscript on the systematics and phylogeny of conodonts within the genus *Lochriea* from the Naqing section in south China and plan to publish this important work in 2017 (Qi *et al*., in press). During 2017, the team will continue to direct its attention toward studying various aspects of the two best candidate sections for the GSSP: the Naqing section and the Verkhnyaya Kardailovka section. An important project for the task group in the 2017 to 2018 fiscal years will be to complete a proposal advocating the use of the FAD of *L. ziegleri* for boundary definition.

**Activities in South China**

Paul Brenckle and Qingyi Sheng are continuing with their study of foraminifers in the Naqing section and several other sections in southern Guizhou Province including the important Yashui and Dianzishang sections (see Groves *et al*. 2012). To place the Naqing section into its sedimentologic and paleoenvironmental context and to determine the relationship of shallow-water foraminiferal zones to the deeper-water (carbonate slope) *L. nodosa* - *L. ziegleri* transition in south China, the investigation of four reference sections - the Yashui, Dianzishang, Luokun, and Narao sections - will continue.

**Activities in Southern Urals, Russia**

With conodonts of the *L. nodosa-L. ziegleri* transition, abundant ammonoids, and moderately common foraminifers, the Kardailovka section, a deep-water carbonate succession on the Ural River near the village of Verkhnyaya Kardailovka remains a strong candidate for the Viséan-Serpukhovian boundary GSSP. Conodonts, foraminifers and ammonoids in the section have been studied in detail but additional conodont work across the boundary level (between 19.53 and 19.63 m above base of section) is required to more precisely locate the FAD of *L. ziegleri*.

Preliminary work on the sedimentology and stable -isotope geochemistry of the section (Richards *et al.*, in press) have been completed but additional work on the succession from slightly below the boundary level to the base of the Bashkirian is required and will be a focus of the team's investigations in 2017 and 2018. The Kardailovka section contains several volcanic ash layers slightly below the boundary. The task group is having the ashes that are closest to the boundary dated using the U-Pb isotope dilution thermal ionization mass spectrometry (ID-TIMS) methodology. In conjunction with the U-Pb dating, the geochemistry of the ashes is being studied.

**Activities in Cantabrian Mountains, Spain**

The FAD of *L. ziegleri* has been precisely located in the Millaró and Vegas de Sotres sections and the group plans to publish the details of the conodont sequence in those sections. Little detailed work has been done on the sedimentology and geochemistry of these stratigraphically condensed, basin to lower-slope carbonate sections. In the 2017 and 2018 fiscal years, the group plans to continue the comprehensive sedimentologic and stable-isotope geochemistry investigation of the Millaró and Vegas de Sotres sections that commenced in 2016. As part of the work, the group plans to search for shallow-water sections correlative with the sections.

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# REPORT OF THE TASK GROUP TO ESTABLISH A GSSP CLOSE TO THE EXISTING BASHKIRIAN-MOSCOVIAN BOUNDARY

**Alexander S. Alekseev and task group**

In 2017 members of the Task Group received some important results which promise essential progress in the final selection of marker and section for the Bashkirian-Moscovian (B-M) GSSP.

**South China**

In 2017 Chinese members of the Task Group showed a serious progress on study of B-M boundary in South China. They continue working on conodonts and fusulinids from the Naqing and Narao sections. Jitao Chen et al. (submitted) studied the strontium isotopes from the Naqing section. In addition, they collected a lot of conodont and fusulinid samples from the Shanglong section, a new road cut in the Luodian County of the Guizhou.

The B-M boundary was shown in Naqing section at level 176.9 m where elements of *Diplognathodus*. *ellesmerensis* Bender, 1980, *D*. aff. *ellesmerensis* and *D*. aff. *orphanus* (Merrill, 1973) occur all three (Qi et al., 2016). In the Luokun section B-M boundary traced on appearance of small and partly broken elements of *D*. cf. *ellesmerensis* at level 121.0 m (Hu et al., 2017).

**South Urals**

The Russian team continue study the most complete Basu section (western slope of the South Urals) (Kulagina et al., 2009). The sedimentological analysis of the B-M interval in the Basu section shows the terminal Bashkirian setting was on middle ramp, but during earliest Moscovian a fast deepening of the basin took place (outer ramp position) (Gorozhanina et al., 2017). To find *Diplognathodus ellesmerensis* in the Basu section, Elena Kulagina collected 5 large samples (about 10 kg each) in 2016 from critical levels with samples 10–13. They were processed in 2017 in the Lomonosov Moscow State University laboratory (Goreva, Alekseev, 2017). The sample 10 (two subsamples 10A and 10B) contains transitional specimens (> 30) from *D. orphanus* to *D. ellesmerensis*. Similar transitional elements were also found in the Naqing section of the South China recently (Qi et al., 2016).

Because old profile in the Basu section was partly destroyed in 2016–2017, a field team (Elena Kulagina, Guzel Sungatullina, Raphael Sungatullin and others) sampled new one closer to the highway 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).

**Donets Basin**

Tamara Nemyrovska (2017) to continue analysis of condont distribution in the B-M interval of the Donetz Basin succession. She submitted together with Keyi Hu a paper in "Spanish Journal of Paleontology" describing in detail succession of condont taxa across the B-M boundary interval and with many new illustrations of conodont elements. First occurrence of *D. donetzianus* Namirovskaya, 1990 is confirmed in limestone $K_1$.

**South America**

Last decade new and very interesting data on conodont distribution in Pennsylvanian strata of the Amazonas Basin, Brazil, were published (Lemos, 1992; Nascimento et al., 2009; Scomazzon et al., 2016; Cardoso et al., 2017a,b etc). The elements of *Diplognathodus orphanus – D. ellesmerensis* complex are common and lowermost Moscovian *D. ellesmerensis* Zone proposed above *D. coloradoensis* Zone (Cardoso et al., 2017a). Bolosovian (Westphal C) palynofossil assemblage of *S. incrassatus* Zone was found with *D. ellesmerensis*, that permit to establish more exact correlations with continental successions. The specimen identified as *Declinognathodus noduliferus* (Ellison and Graves, 1941) by Lemos (1992, pl. 3, fig. 3) was reinterpreted as *D. donetzianus* by Cardoso et al. (2017a), but illustration is not enough clear. Although occurrence of *D. donetzianus* in Amazonas Basin is not firmly demonstrated, these data argued in favour more wide distribution of this conodont species, that important for correlation of basal level of the Moscovian Stage.

**Foraminifers**

The important progress was made in analysis of stratigraphic distribution of most common Bashkirian-Moscovian fusulind taxa. Eight regions were involved in the consideration (Middle and South Urals, South-West and South Tien Shan (Akhuntau section), South-East Turkey, North Spain, Donets Basin and South China (Zhongdi section). Two levels selected as most promising: (lower) with *Depratina prisca* (Deprat, 1912) and last *Verella*; (upper) with *Aljutovella aljutovica* (Rauser, 1938) or *Eofusulina triangula* (Rauser and Beliaev, 1936) (Dzhenchuraeva, 2017; Isakova et al., 2017).

**WORK PLANS FOR 2017 FISCAL YEAR**

More and more data confirm very wide geographical occurrences of *D. ellesmerensis*, but taxonomy of *D. orphanus – D. ellesmerensis* group yet not clarified and it is important task for studies in 2018. Another conodont species *D. donetzianus* easily to discriminate from its ancestor *D. marginodosus* (Grayson, 1984), but it yet not known in the South China and USA Midcontinent.

In the next year, members of the Task Group from China will continue working on the B-M boundary in the South China together with their foreign colleagues including Tamara Nemyrovska, Lance Lambert, Ueno Katsumi and the others. Russian team hope to process conodont samples from the new profile in the Basu section (South Urals) together with stable isotope and fusulinid studies from this locality.

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# REPORT OF THE TASK GROUP TO ESTABLISH THE MOSCOVIAN–KASIMOVIAN AND KASIMOVIAN–GZHELIAN STAGE BOUNDARIES

**Katsumi Ueno and the Task Group**

In the past year, task group members continued investigation on these relevant stage boundaries in their respective areas and fossil groups. Their researches are summarized below.

**Tamara I. Nemyrovska** (Ukraine) investigated the N Limestone suite of the Donets Basin, covering the Moscovian–Kasimovian boundary, and found a very good specimen of *Swadelina subexcelsa* from N1 Limestone. This species is known to characterize the traditional base of the Kasimovian stage (base of the Krevyakinian) in the Moscow Basin (Alekseev and Goreva, 2007), and was so far considered to occur first in N3 limestone in the Donets Basin. She is now preparing a taxonomic paper on conodonts from the N Limestone suite.

**Valery V. Chernykh** (Russia) investigated faunal characteristics of Gzhelian conodonts (Chernykh, 2016). This study clarified the complex characteristics of all zonal subdivisions of Gzhelian conodonts and considerably strengthened the correlation potential of the scale.

**Alexander S. Alekseev** (Russia) now proposes to recur to the original definition for the base of the Kasimovian stage; that is at the base of the Krevyakinian (base of the Suvorovo Formation in the Moscow Basin). This level is accepted as the base of the Kasimovian in the Geological Time Scale 2012 (Davydov et al., 2012). Alekseev considered the finding of *Swadelina subexcelsa* from South China very important because it clarified more correlation potential of basal Kasimovian strata by using this species, among major Pennsylvanian basins of the world, including the Moscow Basin, Midcontinent (Oklahoma, South Sasakwa Section) in U.S.A., South China, and Donets Basin. But in this case, the disappearances of the conodont genus *Neognathodus*, colonial Rugosa, and chaetetids, recorded in benthic taxa near the Moscovian–Kasimovian boundary are probably diachronous worldwide. Alekseev and his colleagues (Natalia V. Goreva, Tatiana N. Isakova, Olga L. Kossovaya, and Svetlana V. Nikolaeva) are now planning to make a paper on the Moscovian–Kasimovian boundary interval in the Moscow Basin and its correlation.

For the Kasimovian–Gzhelian boundary, Alekseev considers that the Naqing section of South China is very promising for the potential candidate of the base-Gzhelian GSSP, based on the FAD of *Idiognathodus simulator*, although its direct ancestor is still equivocal. He also noted that the Usolka section of the Southern Urals also might be good, but rocks in this

section are too siliceous to dissolve, so that extracting conodonts is not easy.

**Guzel M. Sungatullina** (Russia) published several reports on the Pennsylvanian/Upper Carboniferous conodont succession of the Usolka section in the Southern Urals (Sungatullina et al., 2016; Sungatullina et al., 2017a, 2017b). She studied morphological changes of the conodont genus *Idiognathodus* across the Moscovian-Kasimovian boundary. Particular attention was paid to the species *Streptognathodus subexcelsus* (*Swadelina subexcelsa* of some authors) as a possible species marker of the lower boundary of the Kasimovian stage (Fig. 1).

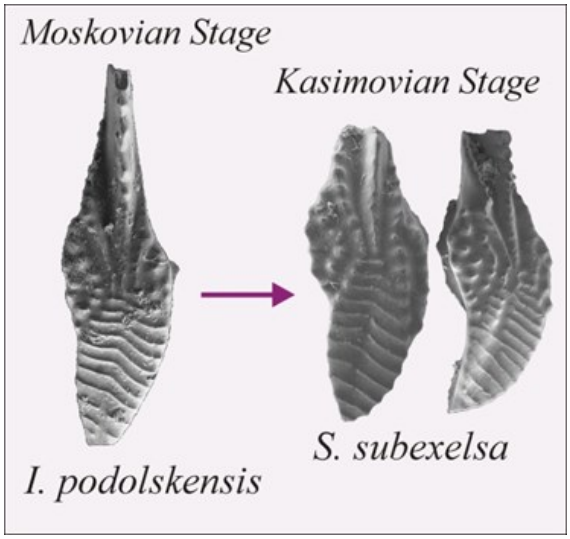


Fig. 1. The lineage *Idiognathodus podolskensis–Streptognathodus subexcelsus*.

Sungatullina recognized six conodont zones in the upper Moscovian to lower Gzhelian succession of the Usolka section (Fig. 2). They are, in ascending order; *Neognathodus roundyi* Zone, *Streptognathodus subexcelsus* Zone, *Streptognathodus makhlinae* Zone, *Idiognathodus sagittalis* Zone, *Streptognathodus firmus* Zone, and *Streptognathodus simulator* Zone. Paleomagnetic studies were also conducted. The conodont biostratigraphic study on the Kasimovian–Gzhelian boundary in the Usolka section is now in progress.

**Gregory P. Wahlman** (U.S.A.) completed three papers related to the fusuline biostratigraphy of the Kasimovian–Gzhelian boundary interval in North America (Rogers et al., 2015; Wahlman et al., 2016; Wahlman, 2018). In Roger et al. (2015), Missourian–Virgilian (Kasimovian–Gzhelian) fusulines in the subsurface of Colorado and Nebraska were discussed. Wahlman et al. (2016) and Wahlman (2018) dealt with the Pennsylvanian and Lower Permian fusuline biostratigraphy of the Permian Basin region. Wahlman is also preparing a paper on the Missourian–Virgilian fusuline biostratigraphy of the Sacramento Mountains, south-central New Mexico.

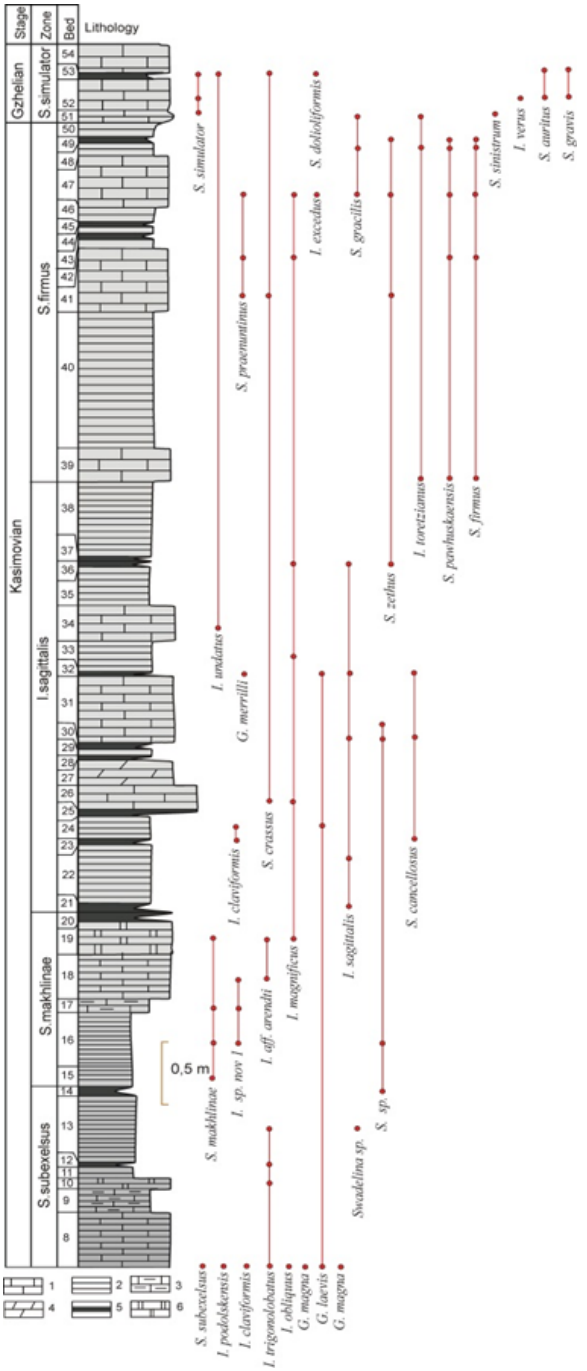


Fig. 2. Conodnont Zones of Kasimovian strata in the Usolka section.

**Yuping Qi** (China) keeps working on Kasimovian–Gzhelian conodonts from the Naqing and Narao sections in Guizhou (South China), in cooperation with American colleagues (Jim Barrick and his student) for morphometric analysis. Also fusulines and strontium isotopes were investigated from the same sections. In addition, he and his colleagueshas started the study of conodonts and fusulines from the Shanglong section (a new road cut) of Guizhou and the Sanlichong section of Shanxi. They are going to continue working on the two boundaries in South China, collaborating with foreign

colleagues including Jim Barrick, Katsumi Ueno, Nicholas Hogancamp, and the others. This last year, Qi and his colleagues completed one manuscript discussing the decoupling of atmospheric $pCO_2$ from continental weathering at the apex of the late Paleozoic glaciation (Chen et al. in submit). Another published paper (Hu and Qi, 2017) has presented the results of the Bashkirian and Moscovian *Swadelina* species from South China. They offered an evolutionary hypothesis of *Swadelina* species, in which *Sw. einori* could be the ancestor of *Sw. subexcelsa* although it needs more data to confirm (Fig. 3). Meanwhile, more elements within the lineage *I. swadei-I. heckeli-I. turbatus* have been found from new samples of the Moscovian-Kasimovian boundary interval in the Naqing section, as well as a number of specimens of *I. sagittalis* (Hu, 2016).

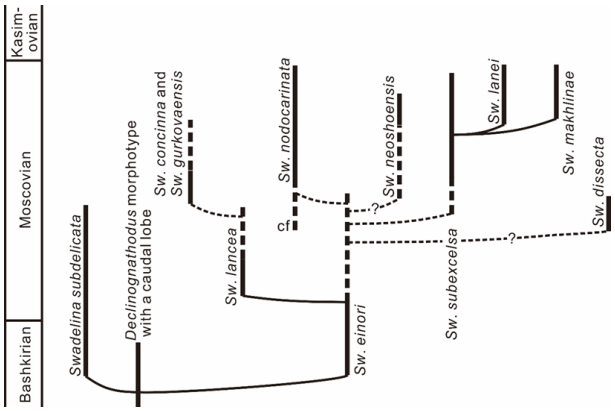


Fig. 3. Phylogenetic hypothesis of *Swadelina* species in the Early-Middle Pennsylvanian.

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# SCCS DOCUMENTS

## SHALLOW-WATER SIPHONODELLIDS AND DEFINITION OF THE DEVONIAN-CARBONIFEROUS BOUNDARY

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**Abstract**

The shallow-water representatives of the conodont genus *Siphonodella* compose two separate lineages, Chinese and European. Study of speciation and phylogeny of the European lineage composed of *Siphonodella bella* Kononova et Migdisova 1984, *S. quasinuda* Gagiev, Kononova et Pazuhin 1987, *S. semichatovae* Kononova et Lipnjagov 1976, and two new species (in press) *S. ludmilae* Zhuravlev et Plotitsyn 2017 and *S. carinata* Zhuravlev 2017, allows proposing phylogenetically based shallow-water conodont zonation for the Devonian-Carboniferous boundary interval. The DCB in present definition is roughly coincides with the base of *Siphonodella semichatovae* Zone and FAD of *Patrognathus crassus* Kononova et Migdisova 1984.

### 1. Introduction

Species of the conodont genus *Siphonodella* are used for biostratigraphy of the lower part of the Tournaisian (Sandberg et al., 1978; Ji, 1985; Ji and Ziegler, 1992; Kaiser and Corradini, 2011). FAD of *Siphonodella sulcata* marks the boundary of the Devonian and Carboniferous (Paproth et al. 1991). However due to wide morphological variability of *Siphonodella praesulcata* Sandberg 1972 and *S. sulcata* (Huddle 1934) this D/C boundary definition is problematic and requires revision (Kaiser 2009, Kaiser & Corradini 2011). Besides "true" siphonodellids composing basis of the standard conodont zonation in the latest Famennian-Tournaisian interval, two derived shallow-water lineages of the genus are known.

### 1.1. Chinese lineage

This group of the shallow-water siphonodellids is known from the China only. These endemic species including *S. levis levis* (Ni 1984), *S. levis favosa* Zhang 1996, *S. sinensis* Ji 1985, *S. homosimplex* Ji et Ziegler 1992, *S. dasaibaensis* Ji, Qin et Zhao 1990, and *S.eurylobata* Ji 1985 were considered in details by Ji (1985) and Ji and Ziegler (1992).

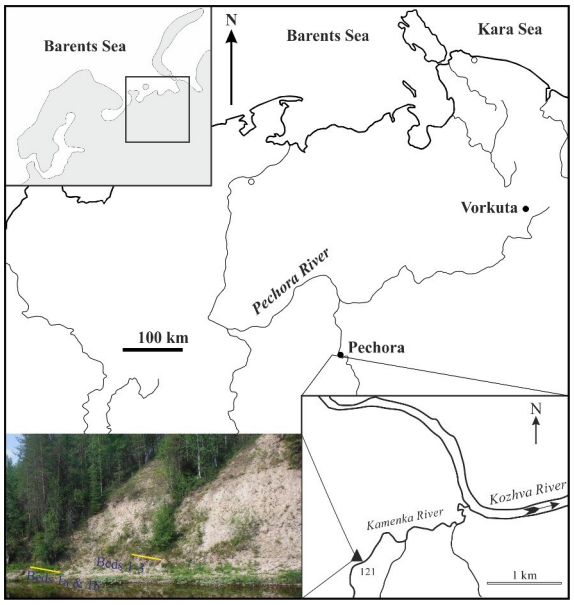


Fig. 1. Location map of the studied section

### 1.2. European lineage

The European lineage of the specific siphonodellids dwelt shallow-water facies comprises *Siphonodella bella* Kononova et Migdisova 1984, *S. quasinuda* Gagiev, Kononova et Pazuhin 1987, *S. semichatovae* Kononova et Lipnjagov 1976, and two new species (in press) *S. ludmilae* Zhuravlev et Plotitsyn 2017 and *S. carinata* Zhuravlev 2017. All these species demonstrate specific morphology, which differs from the other species of the genus. Poorly ornamented platform in association with wide depressed keel and S-like bowed carina are characteristic for this group of siphonodellids.

Despite of Chinese siphonodellids evidently compose separate lineage they share some features with the European shallow-water siphonodellids. All the species demonstrate poor ornamentation of the platform and wide pseudokeel or depressed keel at the aboral side of Pa elements.

The shallow-water siphonodellids appeared in the latest Famennian (*Siphonodella praesulcata* Zone) and ranged up to early late Tournaisian (Lower *Siphonodella crenulata* Zone).

### 2. Material

Study of the uppermost Devonian-Lower Carboniferous beds in the Kamenka River section (N 65°04'27.4" E 56°42'50.9"; Pechora-Kozhva uplift of the Timan-Pechora platform, North-East of European Russia) (Fig. 1) delivers additional information on the distribution of the conodonts in the shallow-water facies (Zhuravlev et al., 1998, 1999; Vevel' et al.,

2012). All the species of the shallow-water siphonodellids of the European lineage were found in this section. The early representatives occur in association with *Siphonodella praesulcata* Sandberg 1972 and *S. sulcata* (Huddle 1934). Distribution of the siphonodellids and some associated conodont species in the Devonian/Carboniferous boundary beds is shown in the Fig. 2. The lithological description and facial interpretation of the sequence were published earlier (Vevel' et al., 2012).

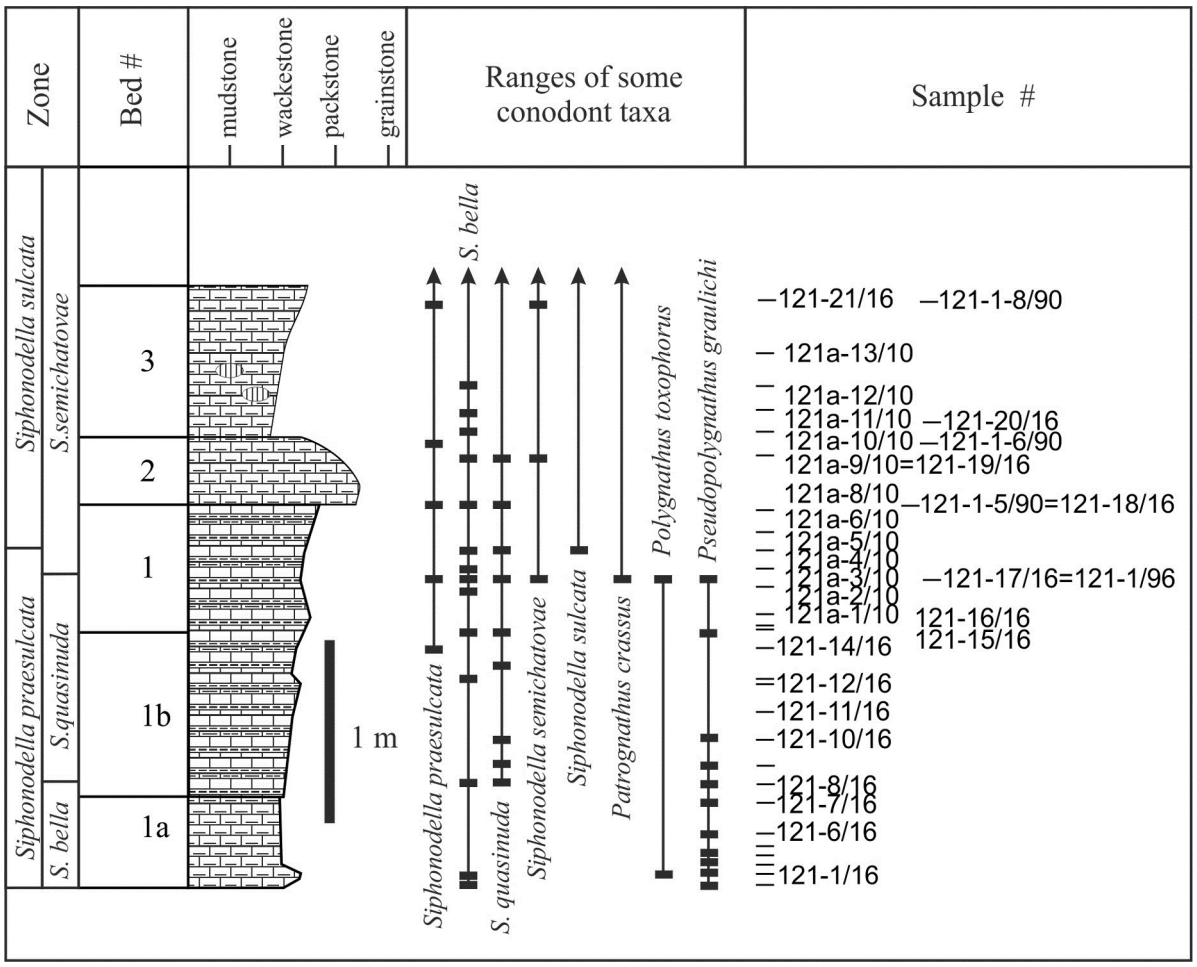


Fig. 2. Conodont distribution in the Devonian/Carboniferous boundary interval, Kamenka River section, outcrop # 121

## 3. Description of the earliest shallow-water siphonodellids

*Siphonodella bella* Kononova et Migdisova 1984

Fig. 3A, B

1984. *Siphonodella bella*–BARSKOV, KONONOVA, IGDISOVA, p. 24, pl. I, fig. 14, 15.

Diagnosis: Pa-elements having lanceolate, slightly asymmetrical platform poorly ornamented with short transverse costa. Low nodular carina is straight. Aboral side of the platform bears wide depressed keel with small slit-like basal pit.

Remarks: *Siphonodella bella* contains a number of morphotypes including forms that demonstrate similarity with *S. praesulcata* and *S. sulcata* in platform outline and ornamentation (Fig. 3 C, D). The most prominent difference between these species is morphology of the aboral side. *Siphonodella bella* differs from *Siphonodella praesulcata* by poorer ornamentation of platform and having depressed keel instead of inverted keel. Transient forms *S. bella*-*S. quasinuda* are similar to *S. sulcata* but have depressed keel instead of pseudokeel, and nearly smooth platform.

Range and occurrence: Late Famennian-Tournaisian, *S. praesulcata*-L. *S. crenulata* zones, shallow water deposits of East European Platform (Barskov et al., 1984; Zhuravlev, 2003), and east Kazakhstan (Obut & Izokh, 2013).

*Siphonodella quasinuda* Gagiev, Kononova et Pazuhin 1987

Fig. 3K

1987. *Siphonodella quasinuda*–GAGIEV, KONONOVA, PAZUKHIN, p. 96-97, pl. XXVII, fig. 8-10

2012. *Siphonodella quasinuda* Gagiev, Kononova et Pazukhin–VEVEL' et al., pl. 1, fig. 3.

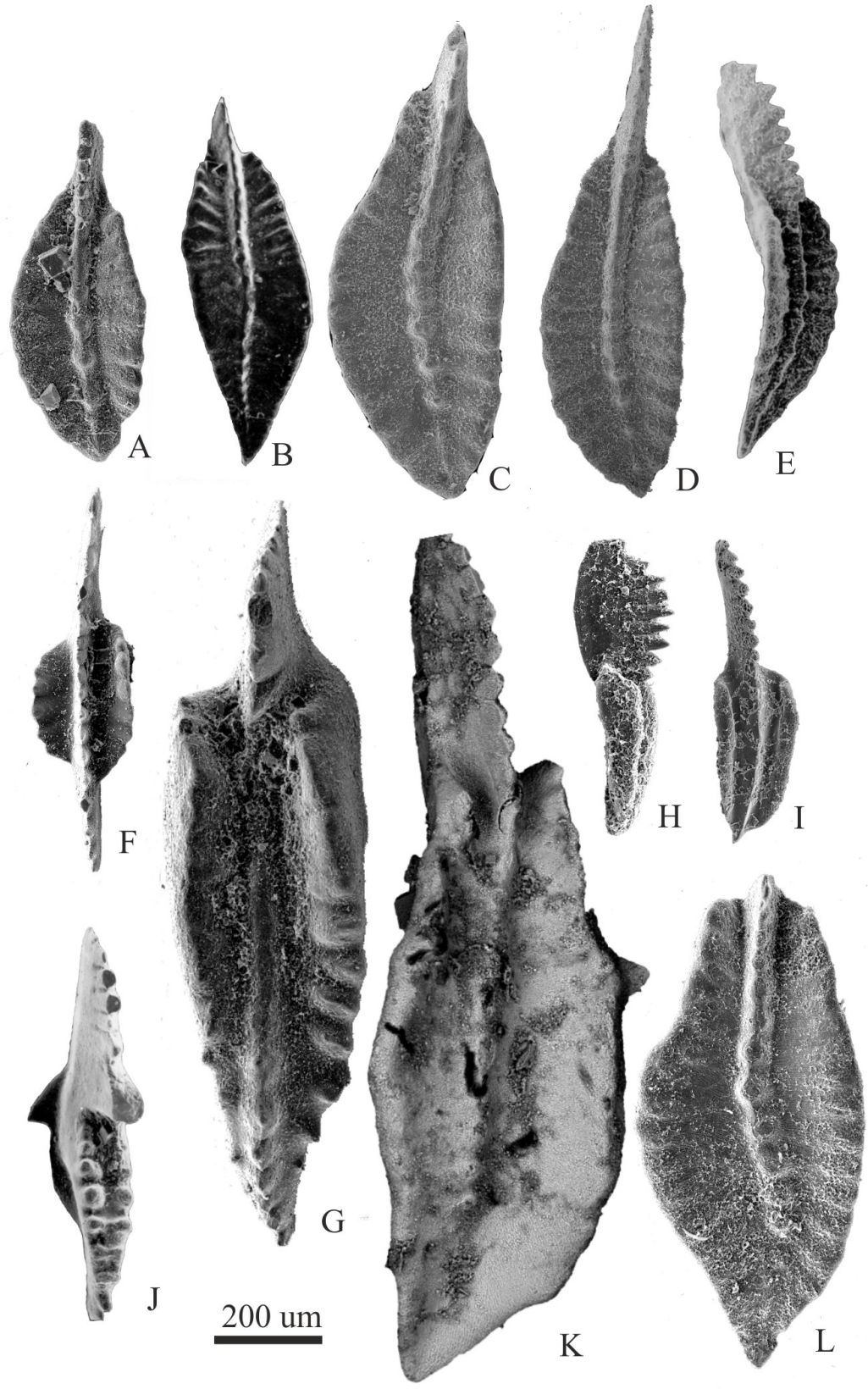


Fig. 3. Conodonts from the Kamenka River section. A-*Siphonodella bella*, sample 121-8a/16; B-*Siphonodella bella*, sample 121-1-5/90; C, D-*S. praesulcata-S. bella* transient forms, sample 121-13/16; E – *S. praesulcata*, sample 121-1/96; F - *Polygnathus taxophorus*, sample 121-2/16; G - *Pseudopolygnathus graulichi*, sample 121-4/16; H, I - *Polygnathus communis communis*, sample 121-10/16; J - *Patrognathus crassus*, sample 121-1/96; K -*S. quasinuda*, late form, sample 122-7; L-*S. semichatovae*, sample 121-19/16

Diagnosis: Pa-elements having lens-like, relatively thick, slightly asymmetric and mostly smooth platform. The platform is almost smooth, only the outer edge can be ornamented by short and low costa. Simple rostrum is composed of the uplifted platform margins which form up two rostral ridges at the late stages of ontogeny. The aboral side is characterized by wide depressed keel and small narrow basal pit. Basal pit is located in the middle of platform. Sinistral and dextral elements demonstrate mirror symmetry (Class II of symmetry sensu Lane, 1968).

Remarks: Some early forms of *S. quasinuda* possessing lack of rostral ridges show transient morphology to *S. semichatovae*.

Range and occurrence: Uppermost Famennian-Tournaisian, *S. praesulcata*-L. *S. crenulata* zones, shallow-water deposits of Central Kazakhstan and East European Platform. Reworked conodont elements of similar morphology were found in the deep-water sections of the Polar Urals as well.

*Siphonodella semichatovae* Kononova et Lipnjagov 1976
Fig. 3L

1976. *Siphonodella semichatovae*–KONONOVA, LIPNJAGOV, p. 118, pl. 1, fig. a-d (only)
1992. *Siphonodella semichatovae* Kononova, Lipnjagov Morphotype 1 – JI, ZIEGLER, p. 232, Text-fig. 9.

Diagnosis: Pa-elements having lanceolate strongly asymmetrical platform, which is ornamented by wide fan-like transverse costa. The outer part of the platform is much wider than inner. Anterior part of the platform is constricted and bears uplifted margins. The aboral side is characterized by wide depressed keel and small narrow basal pit located in the anterior third of platform. The keel doesn't reach the posterior tip of the platform in some specimens. Sinistral and dextral elements demonstrate mirror symmetry (Class II of symmetry sensu Lane, 1968).

Range and occurrence: Tournaisian, *S. sulcata*-L. *S. crenulata* zones, shallow-water deposits of the East European Platform.

## 4. Phylogeny

The oldest representative of the siphonodellids under consideration, *S. bella*, demonstrating simplest morphology is considered as a root species of the shallow-water siphonodellids. Similarity between *Siphonodella bella* and *S. praesulcata* suggests evolving of *S. bella* from the early forms of *S. praesulcata* (morphotype 3 of Kaiser, Corradini, 2011) by transformation of inverted keel into depressed keel accompanied by reduction of the platform ornamentation (Fig.3C,D; Fig. 4). Transition between *S. bella* and *S. quasinuda* is similar to transition between *S. praesulcata* and *S. sulcata*. Uplifts of anterior platform margins become more prominent and form the primitive rostrum, which becomes a full rostrum composed of two ridges in the late (advanced) forms. *Siphonodella bella* probably also gave rise to the Tournaisian *Siphonodella belkai* Dzik (Class III of symmetry sensu Lane, 1968) by development of the numerous rostral ridges (Fig. 4). The transient forms between *S. bella* and *S. belkai* are unknown yet. *Siphonodella quasinuda* gave rise to *S. semichatovae* by widening of the outer platform ornamented by wide costa. Subsequent forming of the true rostrum composed of one or two rostral ridges led to evolving of S. ludmilae (=*S. semichatovae* Morphotype 2). The multiplication of the rostral ridges and transition to Class of symmetry III (absence of mirror symmetry of the sinistral and dextral elements) marked evolving of *Siphonodella carinata* from *S. ludmilae*. It is notable that smooth (not nodose) rostral ridges are characteristic of *S. semichatovae* lineage (*S. semichatovae*, *S. ludmilae*, and *S. carinata*). Evolving of *S. semichatovae* from *S. quasinuda*, *S. ludmilae* from S. semichatovae, and *S. carinata* from *S. ludmilae* is supported by presence of the transient forms.

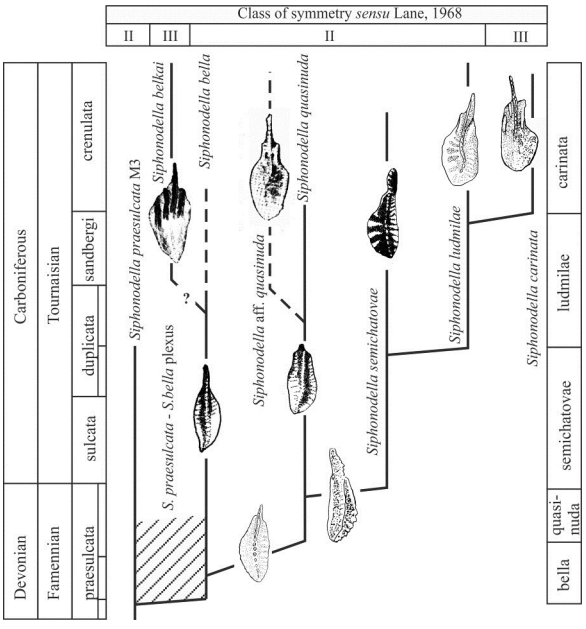


Fig. 4. Phylogeny of the shallow-water siphonodellids of the European lineage and proposed shallow-water conodont zonation

## 5. Shallow-water conodont zonation

The shallow-water siphonodellids promise opportunity to develop phylogeny-based conodont zonation for the shallow-water facies (Fig. 4). *Siphonodella bella* is the oldest representative of the European lineage and has its FAD below the present

DCB in the upper part of *Siphonodella praesulcata* Zone. *Siphonodella quasinuda* and *S. semichatovae* have their FADs in the uppermost *Siphonodella praesulcata* Zone just below the FAD of *Siphonodella sulcata* (Fig. 4).

### 5.1. *Siphonodella bella* Zone

Lower boundary: FAD of *Siphonodella bella*.
Upper boundary: FAD of *Siphonodella quasinuda*.
Remarks: The zone roughly corresponds to the middle or upper part of *S. praesulcata* Zone.

Conodont association of the zone includes typical Famennian forms, such as *Pseudopolygnathus graulichi* Bouckaert et Groessens 1977 and *Polygnathus taxophorus* Cooper 1939.

### 5.2. *Siphonodella quasinuda* Zone

Lower boundary: FAD of *Siphonodella quasinuda*.
Upper boundary: FAD of *Siphonodella semichatovae*.
Remarks: The zone corresponds to the upper part of *Siphonodella praesulcata* Zone.

Conodont association of the zone includes the Famennian forms, such as *Pseudopolygnathus graulichi* Bouckaert et Groessens 1977, Mehlina aff. kielcensis Dzik 2006, *Mehlina strigosa* (Branson et Mehl 1934), *Polygnathus taxophorus* Cooper 1939, which becomes extinct at the top of the zone. Transient Famennian-Tournaisian species occur as well, e.g. *Pandorinellina nota* Kononova et Migdisova 1984, *Siphonodella bella*, *Siphonodella praesulcata*.

### 5.3 *Siphonodella semichatovae* Zone

Lower boundary: FAD of *Siphonodella semichatovae*.
Upper boundary: FAD of *Siphonodella ludmilae*.
Remarks: The zone roughly corresponds to *Siphonodella sulcata* Zone and the lower part of *Siphonodella duplicata* Zone. *S. semichatovae* has its FADs close to FAD of *S. sulcata* and the present DCB.

Conodont association of the zone includes *Siphonodella bella*, *S. quasinuda*, *S. sulcata*, and the Tournaisian representatives of *Patrognathus* (*Patrognathus crassus* Kononova et Migdisova 1984, *Patr. variabilis* Rhodes, Austin et Druce 1969) among others. *Patrognathus crassus* Kononova et Migdisova 1984 has its FAD close to the base of the zone (see also Barskov et al., 1984).

## 6. Conclusions

The FAD of *Siphonodella semichatovae* is close to FAD of *S. sulcata* and the Devonian/Carboniferous boundary in present definition. The FAD of *Siphonodella semichatovae* (base of *Siphonodella semichatovae* Zone) can be used as the boundary marker in the shallow-water facies. The proposed conodont zones (*S. bella*, *S. quasinuda*, and *S. semichatovae*) are rather regional in nature and obviously restricted facially. They can be used in the nearshore carbonate platform facies belt in the northern Cis-Uralian region and, probably, in central regions of the East European Platform.

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## REPORT FOR PROGRESS FOR 2017 ACTIVITIES IN THE CANTABRIAN MOUNTAINS, SPAIN AND THE AMAZONAS BASIN, BRAZIL

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University of Oviedo, Spain

### 1. Activities in 2017 the Cantabrian Mountains, Spain

The work focused in the Valdediezma Limestone located in the easternmost part of the Cantabrian zone together with Silvia Blanco-Ferrera and Pedro Cózar. A manuscript is submitted to be published and two communications were presented in the Spanish Palaeontological Congress 2017 (33th Jornadas de Paleontologia) and the IV International Conodont Symposium. The Valdediezma Limestone deposited in a shallow-water carbonate platform contemporaneous with the prevailing condensed nodular cephalopod-bearing sedimentation in the southern branch of the Variscan basin (Fig. 1). Limestone rocks were previously assigned to the Bashkirian to Moscovian, but conodont, foraminifer and algae contents indicate a Viseán (probably upper Tournaisian) to lower Bashkirian age. The reworked deposits of this platform deposited at the toe of slope were described in the Vegas de Sotres section by Cózar et al. (2016). The location of the Viséan/Serpukhovian boundary and correlations with the Venevian to the Protvian are based mainly on foraminifer occurrences. The comparison between sections in the shallow-water carbonate platform and others in deep water setting may provide correlations among groups as conodonts, ammonoids, foraminifers and algae in the Cantabrian Mountains. The Millaró section in the deep-water part of the basin is an important section to the location of the Viséan/Serpukhovian boundary based on conodonts. We have studied the precise first occurrence of conodont *Lochriea ziegleri* just above *L. nodosa* in this section as at the Vegas de Sotres section and are waiting for time availability to dedicate to the communicate results. In 2015 summer, Alison Champion and Adam C. Maloof from the University of Princeton have been collecting samples in different Mississippian to Early Pennsylvanian sections of the Cantabrian Mountains in collaboration with researchers of the University of Oviedo. They planned to perform geochemical studies at the Millaró and the Vegas de Sotres sections. Furthermore, some faunas of ostracodes from the Alba Formation at the Triollo section were recently described (Sánhez de Posada et al., 2016).

Fig. 1. The lower beds of the Valdediezma Limestone (grey colour beds with persons) above the nodular limestone of the Alba Formation (red coloured rocks) at the early Serpukhovian part of the Vegas de Sotres section.

Study of Tournaisian/Viséan boundary based on conodonts in some sections of the Cantabrian Mountains, mainly the first occurrence of *Pseudognathodus homopunctatus*, is now submitted to be published in the volume in honour of several North American "Big" conodontologists (Harris-Wardlaw-Sweet-Merrill-Rexroad BAP special volume). At time, a revision of the species in the genus *Pseudognathodus* by S. Blanco-Ferrera, G. Miller and me is mainly based on specimens from the Ronald Austin Collection housed in the Natural History Museum, London. It is submitted to a special volume of the Spanish Journal of Palaeontology (in honour of the palaeontologist L.C. Sánchez de Posada and M.L. Martínez-Chacón).

**2. Activities in 2017 in the Amazonas basin, Brazil**

The collaboration with C.N. Cardoso in the study of Pennsylvanian conodonts of the Amazonas Basin was published in the journal Geobios this year 2017. It is mainly a systematic study where a new Moscovian species (Idignathodus itaitubensis) is defined and affinity of conodont faunas with the Midcontinent-Andean Province is suggested. The biostratigraphic zonation and correlation of the Amazonian conodont is developed in a new manuscript accepted to be published in the journal Stratigraphy (special volume in honour of R.H. Lane). The first occurrence of *Diplognathodus ellesmerenis* is the common datum horizon to recognize the Bashkirian/Moscovian boundary in the Amazonas basin. Correlation between the conodont occurrences and the spores/pollen zones previously published is another subject included in this manuscript.

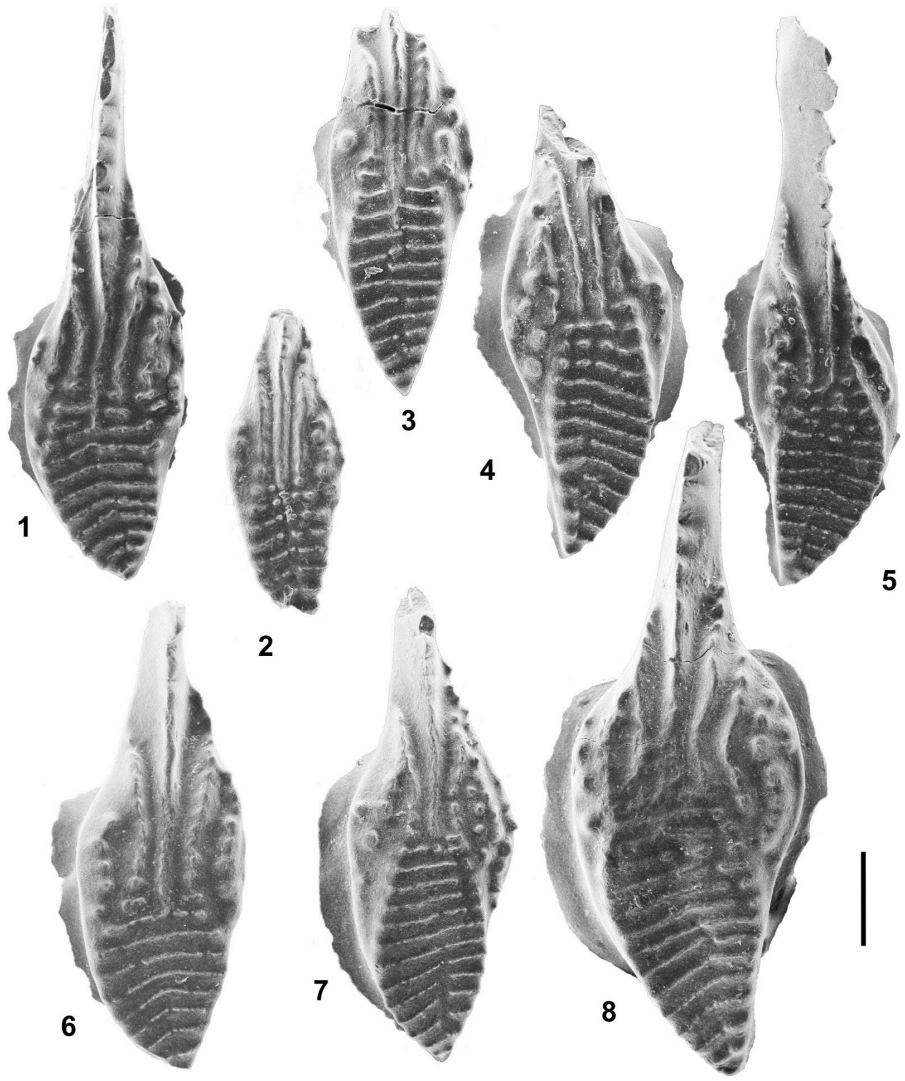


Figure 2. Holotype (1) and paratypes (2–8) of conodont *Idiognathodus itaitubensis* Cardoso, Sanz-López and Blanco-Ferrera. All specimens are P1 elements from sample 25, well 1- FZ-1-AM, Itaituba Formation, Amazonas Basin. Scale bar: 200 μm.

**3. Work plans for 2017 and 2018**

Blanco-Ferrera and Sanz-López are working in the team of the Spanish Project "Serpukhovian from Western Palaeotethys: climatic changes and their consequences on the palaeodiversity,

biostratigraphic, palaeogeographic and environmental aspects" leaded by Sergio Ródriguez (University Complutense of Madrid) and together others researchers as Pedro Cózar, Ismail Said, Ian Somerville, Felipe González and Ismael Coronado. The team will continue to direct its attention toward the study of the Viséan shallow water carbonate platform of the Valdediezma Limestone. Particularly, study of the lower Viséan and upper Tournaisian rocks is a priority. Blanco-Ferrera and Sanz-López want to publish the conodont sequence in the Vegas de Sotres and Millaró sections. They are also collaborating with Giles Miller to discuss the systematics of the Tournaisian *Gnathodus simplicatus* Rhodes, Austin and Druce.

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# TAXONOMIC AND STRATIGRAPHIC PROBLEMS CONCERNING THE CONODONTS *LOCHRIEA SENCKENBERGICA* NEMIROVSKAYA, PERRET & MEISCHNER, 1994 AND *LOCHRIEA ZIEGLERI* NEMIROVSKAYA, PERRET & MEISCHNER, 1994– CONSEQUENCES FOR DEFINING THE VISÉAN-SERPUKHOVIAN BOUNDARY


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**Abstract**

Study of literature and new data from the Rhenish Mountains (Germany) clarified taxonomic and stratigraphic problems concerning *Lochriea senckenbergica* Nemirovskaya, Perret & Meischner, 1994 and *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994. For *L. senckenbergica* a holotype was missing. Herein, a lectotype is designed. The hitherto contradictory entry of *L. ziegleri* in the Rhenish Mountains is discussed. New data suggest its First Occurrence Datum (FOD) in the interval of the late Brigantian *L. eisenbergensis* and *L. liethensis* ammonoid zones. This is similar to the postulated late entry in northern England according to foraminifers (Cózar & Somerville, 1916). The suitability of *L. ziegleri* as an index fossil for a future Viséan-Serpukhovian boundary is not yet proved. Multi-taxononomic long-distance correlations are necessary to prove an isochronous First Appearance Datum (FAD). Moreover, the taxon is mostly missing in Northern America. Therefore, foraminifers are still a promising alternative. In summary, the present approach of the task group to establish a Viséan-Serpukhovian boundary is critized, as it will favour a biased premature decision.


## 1. Introduction

A recent study of conodonts from a late Viséan to early Namurian section in the Northern Rhenish Mountains, Germany, revealed problems concerning the taxonomy of *Lochriea senckenbergica* Nemirovskaya, Perret & Meischner, 1994 (Bätz et al., 2017, Herbig et al., 2017). Moreover, the First Occurrence Datum (FOD) of *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994 in Germany was discussed which up to now was ambiguous (Sevastopulo & Barham, 2014). A further evaluation of the results herein might bear consequences for the definition of a future conodont-based Viséan-Serpukhovian boundary.

First of all, however, the meanwhile confusing usage of the term 'Serpukhovian' has to be clarified. In spite that the quest for a biostratigraphic marker of a future GSSP at a revised Viséan–Serpukhovian boundary centred on the FAD of the conodont *Lochriea ziegleri* in the lineage *L. nodosa – L. ziegleri*, there is no vote on the taxon by the task group and SCCS for final approval (Richards and Group, 2016). Accordingly, no conodont-based revised Serpukhovian Stage exists and, as already stressed by Cózar and Somerville (2016), the usage of the 'Serpukhovian Stage' has to rely on its classical definition to maintain stability in nomenclature. This means, the current lower boundary of the Serpukhovian still is based on its definition in the lectostratotype in the Moscow basin, i.e. the Zaborie section near the town of Serpukhov (Kabanov et al. 2009, 2016).

In northwestern Europe, the Viséan Namurian boundary is approximately correlative with the Viséan-Serpukhovian boundary in the type region (Skompski et al., 1995, Nikolaeva & Kullmann, 2001). According to the decision of the Heerlen Congress 1958 (van Leckwijck, 1960), that boundary is based on the First Appearance Datum (FAD) of the ammonoid "*Cravenoceras leion* Bisat, 1930" [= *Emstites leion* (Bisat, 1930), Korn, 1988]. In the Rhenish Mountains the FAD of *Edmooroceras pseudocoronula* (Bisat, 1950) was proposed to be a more suitable index ammonoid for the base of the Namurian, as *E. leion* apparently is restricted to northern England and only determinable in good preservation (Korn, 1996; Nikolaeva & Kullmann, 2001). An apparently widely overlook fact is that redefinition of the base of the formal Serpukhovian Stage also will change this very well defined, ammonoid-based lower boundary of the northwestern European Namurian Regional Stage.

## 2. *Lochriea senckenbergica* Nemirovskaya, Perret & Meischner, 1994 – a *nomen nudum*. Designation of a lectotype

*Lochriea senckenbergica* Nemirovskaya, Perret & Meischner, 1994 is based on type material from the section Schälk (also spelled Schaelk) near Lethmathe (meanwhile part of the town Iserlohn), which is situated at the northwestern flank of the Remscheid-Altena Anticline, Rhenish Massif, Germany. The section, originally, described by Ruprecht (1937) and later by Horn (1960) is not any more accessible. The illustration and conodont distribution shown by Meischner (in Skompski *et al*., 1995) is a combination from several sections, but mainly is based on the former Schälk quarry. The nearby Edelburg section and its ammonoid fauna is illustrated in Korn & Horn (1997). The research well 'Schälk' penetrated same strata, but results are not yet published (pers. comm. M. Piecha & M. Salamon, Geological Survey of Northrhine-Westphalia, Krefeld).

All specimens of *L. senckenbergica* figured from Germany have been derived from sample Schälk-43, section Schälk, although the authors stated the existence of the species elsewhere the Rhenish Mountains. (Nemirovskaya *et al*., 1994). Most specimens were refigured in Skompski *et al.* (1995). Confusion concerns the enumeration of the specimens. Thus, specimen GER-13 (Nemirovskaya *et al*., 1994, pl. 2, fig. 10) is refigured as specimen GER-17 in Skompski *et al.* (1995, pl. 2, fig. 1). This also led to the fact that *Lochriea senckenbergica* has no holotype and, therefore, is a *nomen nudum* (Herbig *et al*. 2017). The holotype should be specimen GER-5, sample Schälk-43, figured on pl. 2, fig. 8 in Nemirovskaya *et al*. (1994). However, specimen GER-5 is a *Lochriea commutata* (Branson & Mehl, 1941) from the same sample, figured on pl. 2, fig. 1. Another *L. senckenbergica* (specimen GER-11) was placed at the indicated position of the holotype. Both specimens are refigured in Skompski *et al*. (1995, pl. 1, fig. 10; pl. 2, fig. 5,) under same collection numbers, even in better quality, thus ruling out any spelling errors in Nemirovskaya et al. (1994).

The *L. senckenbergica* specimen GER-11, which was figured instead of a supposed holotype in the original description of Nemirovskaya *et al*. (1994) is a syntype of the species, deriving from the same sample Schälk-43 than the supposed holotype. Therefore, Herbig *et al.* (2017) proposed it as lectotype of the species. Herein, this specimen GER-11 and corresponding figuration in Nemirovskaya et al. (1994, pl. 2, fig. 8) is formally designated as the lectotype of *L. senckenbergica* (ICZN 1999, § 75).

## 3. New data on the entry of *Lochriea ziegleri* Nemirovskaya, Perret & Meischner 1994 in the Rhenish Mountains (Germany)

Prior to the contributions of Bätz *et al.* (2017) and Herbig *et al.* (2017) the distribution of *Lochriea ziegleri* in Germany was only treated by Nemirovskaya *et al*. (1994) and Skompski *et al.* (1995). Altogether three specimens (GER-1, GER-2, GER-21) had been figured, which like the figured specimens of *L. senckenbergica* had been derived from the single sample Schälk-43. It cannot be evaluated, if conodonts from other sections were taken into account at all. As already elucidated by Sevastopulo and Barham (2014), the FOD of *L. ziegleri* was treated extremely ambiguously in these two publications and in later usage in spite of relation to the same material.

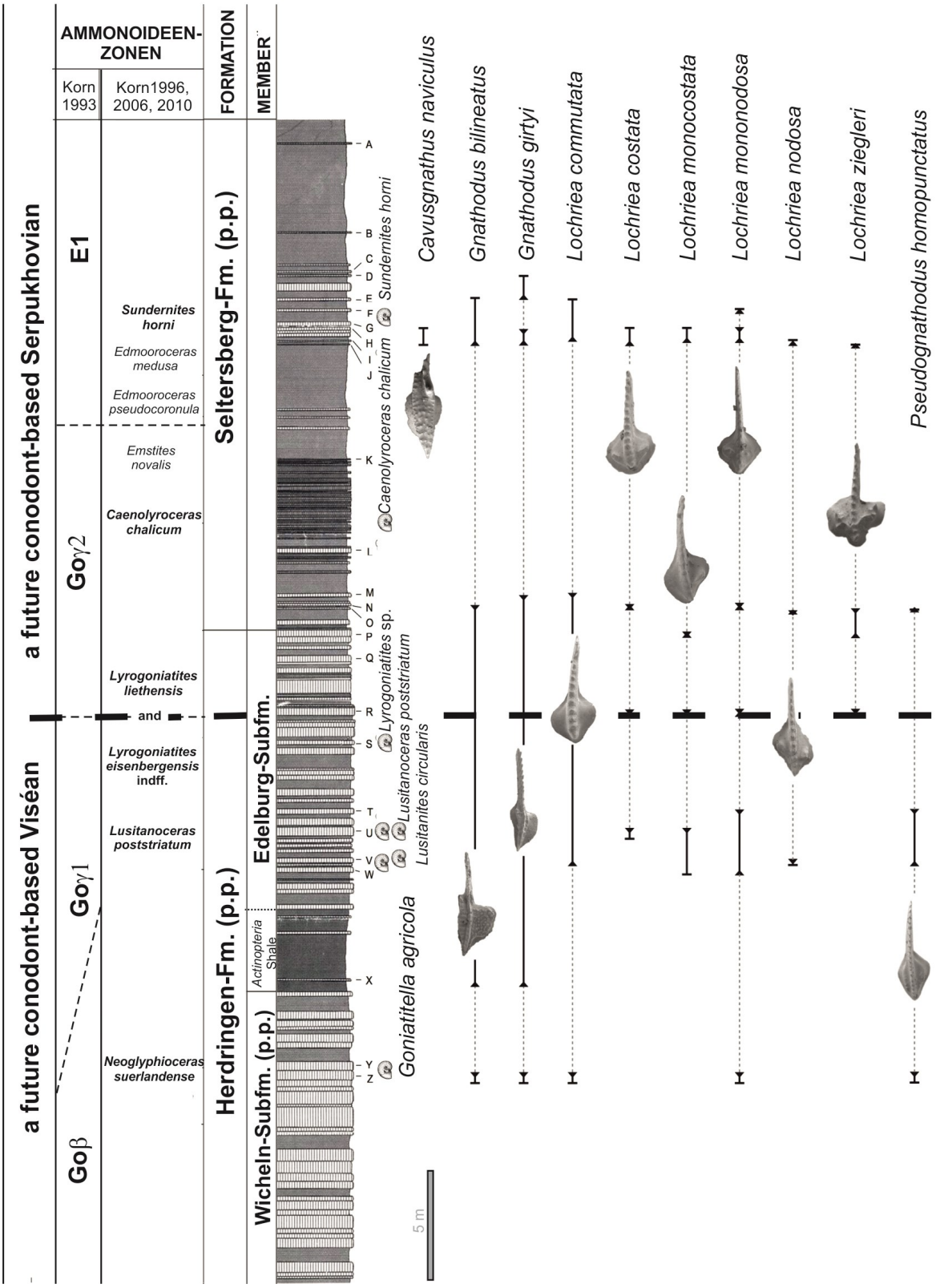


Fig. 1 Conodont distribution in the Arnsberg section (Rhenish Mountains, Germany) and correlation with proven ammononoid zones (in bold); ammonoid bearing horizons are shown, but zonal boundaries are unknown and not indicated. Position of a future Viséan-Namurian boundary based on Lochriea ziegleri is within the undifferentiated Lyrogoniatites liethensis and L. eisenbergensis ammonoid zones. White vertically ruled: calciturbidites; grey: shales; dark grey: black shales; black: siliceous shales and bedded cherts. Ammonoid data and section from Korn (1993). From Herbig et al. (2017).

In Nemirovskaya *et al*. (1994), the FOD of *L. ziegleri* was placed in the "subzone of *Neoglyphioceras spirale* ($cdIIIb_{spi}$)", but in Skompski *et al.* (1995) in the "*Emstites schaelkensis* Ammonoid Zone", which was considered to be the uppermost Viséan subzone ("$cdIIIg_2$"). In fact, an "*Emstites schaelkensis* Zone" is not recognized in the Rhenish Mountains and the uppermost Viséan is named *Emstites novalis* Zone (Korn 1996, 2006). This means an unexplained mismatch of seven ammonoid zones of the Rhenish zonation. *Emstites schaelkensis* (Brüning, 1923) is morphologically strikingly similar to *Emstites leion* (Bisat, 1930) and its entry almost exactly matches the entry of *Edmooroceras pseudocoronula* (Korn, 1996; Korn & Horn, 1997). As the latter species is used as index for the base of the formal Serpukhovian in Germany (see above), Korn (2010) correlated the entry of *L. ziegleri* with the base of the Stage, respectively with the base of the Namurian, which is current usage in Germany.

Increasing the confusion, Korn & Titus (2011) adopted the view expressed in Skompski *et al* (1995) and correlated the base of the *L. ziegleri* Zone with a horizon within the upper part of the *Emstites novalis* Zone. Almost certainly this assumption is based on the Schälk section, where *Edmooroceras wedekindi* (Brüning, 1923), *Emstites novalis* Korn, 1988, and *Emstites schaelkensis* (Brüning, 1923) occur in the same bed (Korn 1988, p. 71, p. 146). According to the confusing stratigraphic statement of Meischner (in Skompski *et al*.,1995), it seems reasonable that the condont sample Schälk-43 bearing *Lochriea senckenbergica* and *L. ziegleri* has been derived also from that bed.

Already in the nearby Edelburg section only *Ed. wedekindi* and *E. novalis* co-occur, latest in a shaly horizon above a conspicuous 0.65 m thick limestone bed, "and *Emstites schaelkensis* enters immediately above" (Korn & Horn, 1997, p. 103). Co-occurrence in the Schälk section is clearly related to reworking of the two older species *Ed. wedekindi* and *E. novalis*, as Korn (1988, p. 143) stated that almost all specimens of his *E. schaelkensis* have been derived from the same limestone bed in that section. There, all conchs were lumachelle-like enriched and therefore frequently broken. Already Horn (1960) had mentioned the co-occurrence of these species in a limestone bed 0.6 m below a conspicuous, one meter thick limestone bed. The latter was figured by Ruprecht (1937, fig. 8, "section south of Edelburg") bearing "*Goniatites granosus schaelkensis*". The lumachelle or the one meter thick bed are most probably correlated with the thick limestone bed in the adjacent Edelburg section mentioned above, which, however, did not yield ammonoids. Both beds are apparently related to the base of sequence 12 in the Rhenish Kulm basin at the base of the Namurian (Herbig, 2016), when during low sealevel important reworking of intrabasinal sediment deposited on submarine swells during previous highstand took place. The same phenomenon is known from the base of sequence 11 at the Asbian-Brigantian boundary. There, locally occurring debrites contain clasts of a pelagic microbe-cephalopod limestone (*crenistria* Limestone) deposited during the maximum flooding interval of the preceding sequence 10 (Piecha *et al.*, 2004; Herbig, 2016).

Based on a section north of the town of Arnsberg at the motorway A46 (Korn, 1993), Bätz *et al.* (2017) and Herbig *et al.* (2017) refined the FOD of *Lochriea ziegleri* in the Rhenish Mountains (Fig. 1). The first two specimens were recorded 0.6 m above a horizon yielding *Lyrogoniatites* sp. This genus marks the upper Brigantian *L. eisenbergensis* and *L. liethensis* ammonoid zones, which could be not differentiated in the section. Thus, in Arnsberg a potential future conodont-based Viséan–Serpukhovian boundary would be located within these zones, but below the *Caenolyroceras chalicum* Zone (Korn, 1996); this zonal marker occurs higher up-section (Korn 1993).

In lithostratigraphic terms, the FOD of *L. ziegleri* is 12.8 m above the base of the isochronous *Actinopteria* Black Shale interval (Nyhuis *et al.*, 2015). It forms the base of the Edelburg Member (upper part of Herdringen Formation), respectively the base of the upper Brigantian sequence 11 (Herbig, 2016). In spite of the relatively poor faunal recovery from the Arnsberg section, unpublished data from the research well Schälk (M. Piecha & M. Salamon, Geological Survey of Northrhine-Westphalia), situated about 35 km further West, gives more credibility to the data. There, the entry of *L. ziegleri* is about 11.5 m above the base of *Actinopteria* Black Shale interval, which is remarkably similar to Arnsberg.

According to the preceding discussion, there is no indication that *L. ziegleri* would appear as early as in the *Neoglyphioceras spirale* Ammonoid Zone (Nemirovskaya *et al*., 1994).

**4. First occurrence of Lochriea ziegleri in the NW European Subvariscan realm**

Sevastopulo & Barham (2014) discussed the FOD of *L. ziegleri* in Ireland, northern England (Als. and Ask. blocks) and the Rhenish Mountains in relation to the ammonoid zonation and showed uncertainties, which might result from diachronous entries of the species. In the Alston and Askrigg blocks, the entry appears to be extremely early, either in ammonoid zone P1d or P1c, based on the applied correlation of the ammonoid fauna (Fig. 2).

However, based on correlation of foraminifers with the Russian Tarussian substage, i.e. the lowermost substage of the formal Serpukhovian, Cózar & Somerville (2014, 2016) considered the Viséan–Namurian (Brigantian–Pendleian) boundary in Northern England considerably lower than hitherto. Cózar & Somerville (2014) placed it below the Tarussian Three Yard Limestone Member, probably within the Five Yard Limestone Member, which according to ammonoids was regarded to be at the P2a –P2b transition (Ramsbottom, 1974; see fig. 3 in Sevastopulo & Barham, 2014). Refining their earlier data, Cózar & Somerville (2016) placed the boundary still below and also included into the Tarussian the Five Yard Limestone Member and the underlying Scar Limestone, which was thought to be the base of the P2a Ammonoid Zone. This implies that the late Brigantian in Northern England already correlates with the lower part of the formal Serpukhovian (with the Tarussian and even part of the following Steshevian substages); it also implies a much later entry of *L. ziegleri* than depicted by Sevastopulo & Barham (2014).

In lithostratigraphic terms, the FOD of *L. ziegleri* is known from the lower Middle Limestone Member. The Member splits laterally from below in Single Post, Cockleshell, and Scar limestones (Ramsbottom, 1974) As the Single Post Limestone is correlated with the lower Middle Limestone Member (Sevastopulo & Barham, 2014) and the Scar Limestone already constitutes the base of the formal Serpukhovian (Cózar & Somerville, 2016), the FOD of *L. ziegleri* also is quite close to the present Viséan-Serpukhovian boundary concerning lithostratigraphic relations. This approaches the late entry of the species in the Rhenish Mountains reported by Bätz *et al.* (2017) and Herbig *et al.* (2017). The obvious mismatch between ammonoid and foraminifer stratigraphic in northern England is probably caused by the scarcity of ammonoids north of the Craven Basin Cózar & Somerville (2016).

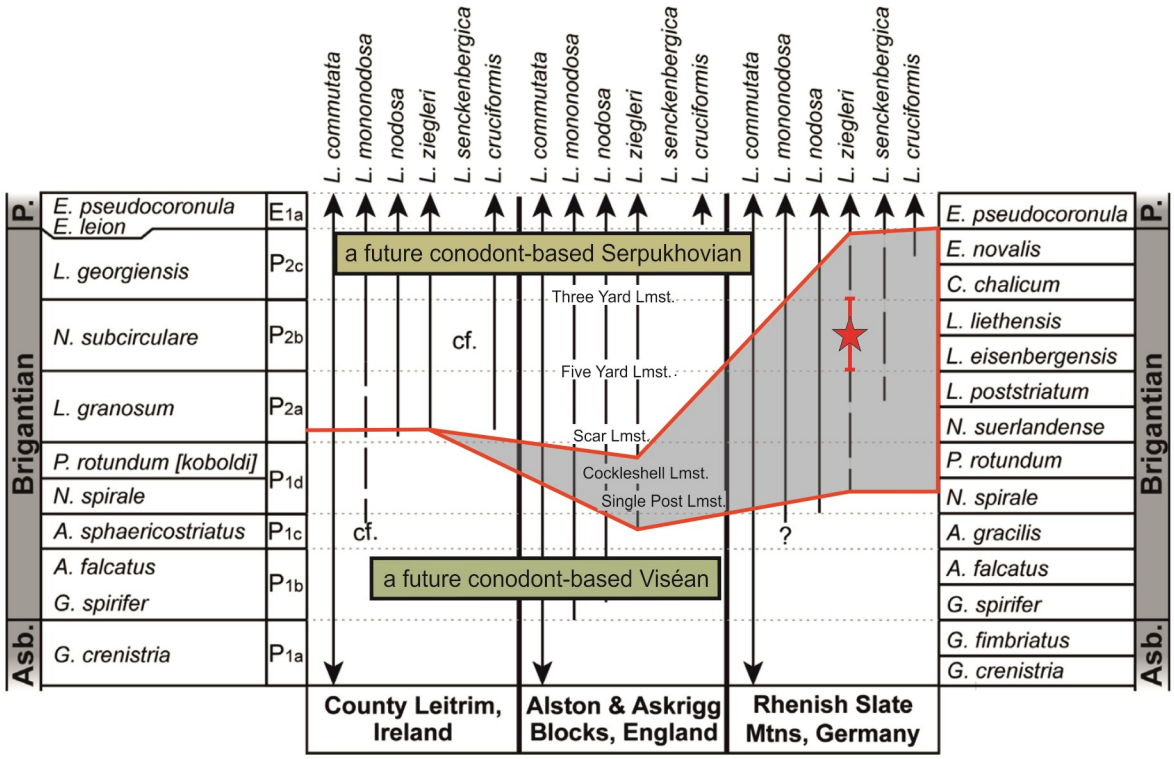


Fig. 2 First occurrence datums (FODs) of *Lochriea ziegleri* in the NW European Subvariscan realm and lithostratigraphyc of the Alston and Asgrigg blocks in correlation to the ammmonoid zonation according to Sevastopulo & Barham (2014). Uncertainty interval of the FODs in grey shading. Note that according to foraminifers the Viséan-Serpukhovian boundary in the Alston & Askrigg blocks is below the Scar Limestone (Cózar & Somerville, 2016). Red bar indicates the first occurrence interval of *Lochriea ziegleri* in the Arnsberg section (Rhenish Mountains, Germany). Modified from Herbig et al. (2017).

## 5. Conclusions and perspectives

First of all, usage of the term 'Serpukhovian' has to rely on its present definition. To maintain stability in nomenclature, a future potential conodont-based lower boundary must not be used.

An isochronous FAD of *Lochriea ziegleri* is not yet settled in the Northwest European Subvariscan faunal realm. Instead, the discussion herein demonstrates that thorough checks against the entries of ammonoids and smaller foraminifers inside of supposedly homogeneous faunal provinces are necessary, as well as a proper evaluation of earlier data and taphonomic problems like reworking and hydraulic sorting (Herbig & Mamet, 1994). Finally, facies dependencies have to be evaluated. In general, multitaxonomic long-distance correlation of at least several well-studied sections are necessary to settle these problems.

According to Bätz *et al*. (2017) and Herbig *et al*. (2017), the previously enigmatic FOD of *L. ziegleri* in Germany now is preliminarily fixed in the middle part of the upper Brigantian, within the undifferentiated *Lyrogoniatites eisenbergensis* and *L. liethensis* ammonoid zones. This interval is correlated with the $P_{2b}$ Zone of the British ammonoid zonation. Although approaching the proposed late entry of *L. ziegleri* in the Alston and Askrigg blocks (northern England) according to the foraminifer data presented by Cózar & Somerville (2016), additional data are in need. In the Rhenish sections, foraminifers are abundant in the exclusively calciturbiditic succession and might be of special value. Even, if the late entries of *L. ziegleri* in the Rhenish Mountains and northern England now seem to be comparable, the early FOD at the base of the P2a ammonoid zone in Ireland (Sevastopulo & Barham, 2014) has to be explained. Unfortunately, the vast pelagic Viséan-Serpukhovian deeper water carbonate platforms in the southern branch of the European Variscides seem to be strongly underexplored. The type section of *L. ziegleri* in the Pyrenees (section Tantes near Gavarnie, Nemirovskaya *et al*., 1994), like other sections in this mountain chain, were never restudied after the monograph of Perret (1993) and summarizing remarks in Skompski *et al*. (1995), in spite of the existence of rich conodont faunas. Sections in the Cantabrian Mountains (Northern Spain), in the western continuation of the Pyrenees, show outstanding potential for fine-tuned conodont stratigraphic and multi-taxonomic correlation between conodonts, foraminifers, and ammonoids (among others Higgins & Wagner-Gentis, 1982; García-López & Sanz-Lopéz, 2002; Nemyrovska, 2005; Blanco-Ferrera *et al.* 2008, 2009; Cózar *et al.*, 2015, 2016; see also Richards & Aretz, 2011).

In North America, the lineage *L. nodosa* – *L. ziegleri* is absent and *L. ziegleri* itself is extremely rare (Brenckle *et al*., 2005; see also Richards (2016, pp. 19, 22). This is a major disadvantage of the proposed boundary marker.

In summary, opposed to the general view adopted by the SCCS Task Group to establish the Viséan-Serpukhovian boundary, the suitability of *L. ziegleri* as index fossil of a future GSSP is far from being settled. Instead of focussing on few sections, first the isochronous appearance of *L. ziegleri* by multitaxonomic correlation of different sections within (apparently) homogeneous faunal realms has to be unequivocally proved. The second step has to be the final choice and formal decision on the biostratigraphic marker. Still, smaller calcareous foraminifers might provide alternative index fossils for the boundary, as they could locate the boundary also in carbonate platform settings that are unsuitable for conodonts, or in Northern America. The present approach of the task group favouring *L. ziegleri* without formal decision, and simultaneously looking for a conodont-based GSSP has to be critized, as this will favour a biased premature decision.

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## PROGRESS ON THE VISÉAN-SERPUKHOVIAN BOUNDARY IN SOUTH CHINA AND GERMANY

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**Abstract**

Abundant P1 elements of *Lochriea* species, with its wide morphological transitional elements throughout the late Viséan–early Serpukhovian boundary interval in the Naqing section are well studied, and two lineages are proposed: (1) noded *Lochriea* species, such as *L. mononodosa – L. nodosa – L. ziegleri, L. senckenbergica* and *L. multinodosa*, and (2) ridged *Lochriea* species such as *L. monocostata – L. costata – L. cruciformis*. Significant Serpukhovian foraminiferal species including *Janishewskina delicata* and *Bradyina* ex gr. *cribrostomata* are found shortly above the Viséan-Serpukhovian (V/S) boundary which is defined by the first appearance of *Lochriea ziegleri* in the Naqing section. Isotopic chemostratigraphy studies show that multiple negative $\delta^{13}C$ excursion (>1‰) can be correlated across the V/S boundary interval in several slope sections including the Naqing, Luokun and Narao sections in South China. Moreover, latest study results on conodonts and ammonoids from the Wenne river bank section in the Rhenish Mountains, Germany indicate that the debut of *L. ziegleri* in this section is at a horizon just 0.5 m below the "*Actinopteria* Shale" and has a position in the ammonoid *Neoglyphioceras suerlandense* Zone which is contemporary to P2a biozone (*Lusitanoceras granosum*) in British Isles.

## 1. Introduction

Significant progress has been made on the study of the Viséan-Serpukhovian (V/S) boundary since the Task Group decided to establish a GSSP close to the V/S boundary. Before evaluating potential GSSPs, the Task Group had to decide on the biostratigraphic tool to identify the boundary. Candidate fossil groups were ammonoids, conodonts and foraminifers. Correlation among these three main fossil groups have been studying intensely in recent years. New breakthroughs have been made not only on the study of the biostratigraphy but also on the isotopic geochemistry, particularly in South China and Germany.

The First Appearance Datum (FAD) of the conodont *Lochriea ziegleri* Nemirovskaya, Perret and Meischner, 1994 in the lineage *Lochriea nodosa–Lochriea ziegleri* is still the best biostratigraphic event for marking the boundary, although this marker still awaits formal ratification.

*Lochriea ziegleri* Nemirovskaya, Perret and Meischner, 1994 was published by Nemirovskaya et al. (1994) based on type material from the Tantes section, Gavarnie (Hautes-Pyrenees, France), the Rhenish Mountains (Germany) and the Dnieper-Donets Basin (Ukraine). This species is characterized by the platform of the P1 element ornamented by large discrete or partly fused nodes which are located on ridge-like elevations (bars) or thick long ridges on both sides of the platform close to its dorsal margin. It differs from the more simply ornamented *L. nodosa* and *L. costata* by (1) a much stronger and prominent ornament of the platform and (2) the dorsal location of bars or ridges in comparison to more central position of nodes or ridges in *L. nodosa* and *L. costata.* The latter feature distinguishes *L. ziegleri* from the other strongly ornamented *Lochriea* species such as *L. cruciformis* and *L. senckenbergica*. In addition, *L. ziegleri* differs from *L. cruciformis* by having more complicated ridges or bars which are not connected to the carina. *L. ziegleri* differs from *L. senckenbergica* by having lower ridges or bars decorated with partly fused nodes which are not as prominent and as high as more ventrally located bars in *L. senckenbergica. L. ziegleri* differs from *L. multinodosa* by in the ornament of the platform; small nodes cover both sides of the platform of *L. multinodosa.* In South China collections, there are many specimens with partly or completely fused nodes on the bars.

## 2. Progress on the study of conodonts, ammonoids and foraminifers

### 2.1. Conodonts

During the Mississippian, southern Guizhou belonged to the Dian-Qian-Gui Basin that developed on a passive continental margin of the South China Craton. The Dian-Qian-Gui Basin was bordered to the north and west by the Yangtze oldland and connected with the Paleo-Tethys Ocean to the south and east (Feng et al., 1999). The paleogeographic architecture in this region was mainly influenced by rifting along NW- and NE-trending fault zones, which led to a complex submarine landscape of small regional basins surrounded by carbonate platforms. In the southern Guizhou region, the Mississippian strata are well exposed in a suite of outcrops and highway road-cuts, bearing a complex variety of marine facies and faunas (Qi et al., 2014; Chen et al., 2016). A number of studies on biota, sedimentology, and geochemistry of these sections were carried out in the context of selection of the GSSP of the V/S boundary.

The Naqing section, one of the superbly exposed Carboniferous sections in China, is located near the Naqing village (25°15′03.9″N, 106°29′06.9″E) in Luodian County, southern Guizhou Province;

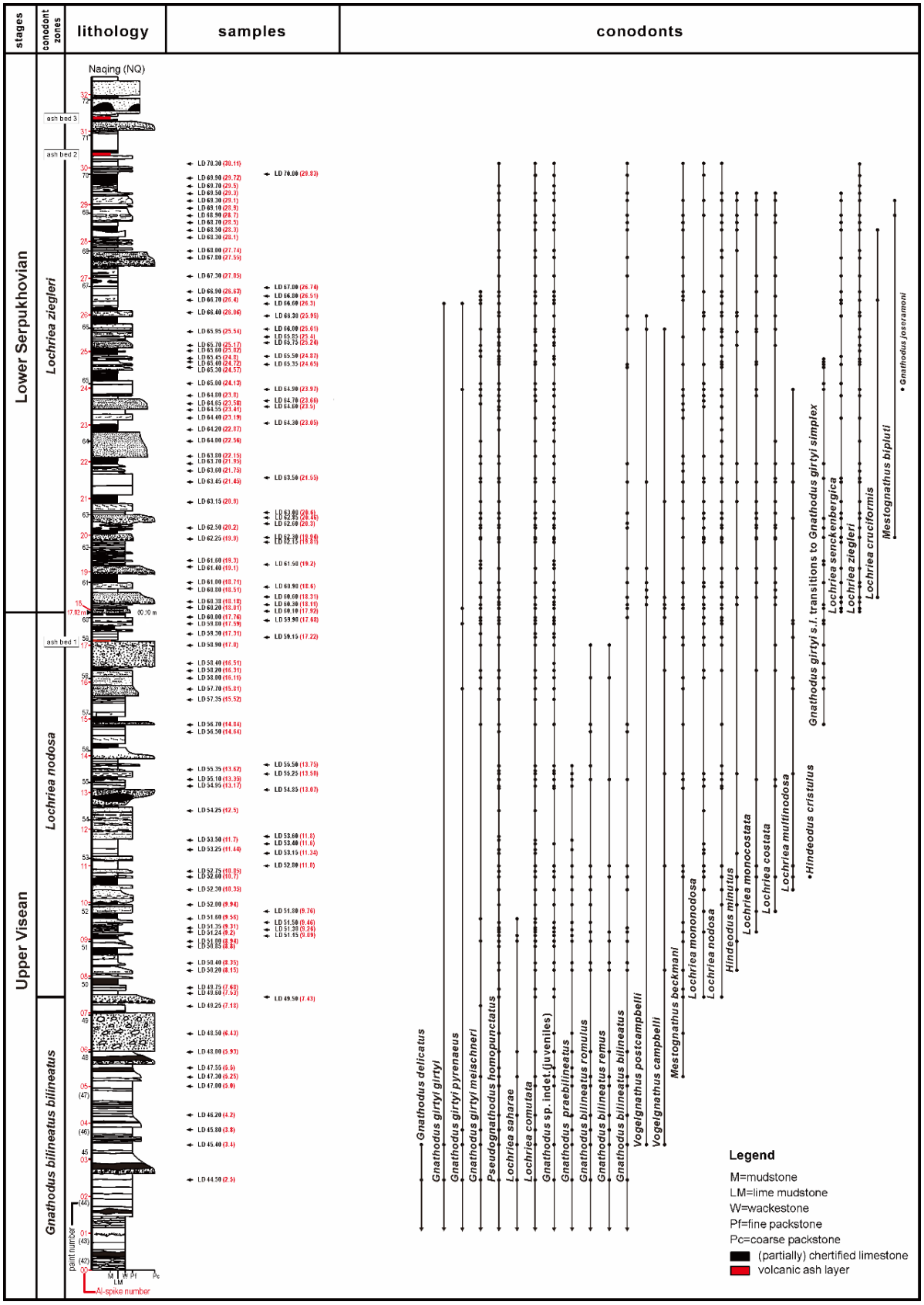


Fig.1 Range chart of conodonts across the Viséan/Serpukhovian boundary in the Naqing section in South China

it has been considered as an excellent GSSP candidate for the V/S boundary. The late Viséan to early Serpukhovian succession in the Naqing section most probably preserves a complete phylogenic lineage of the genus *Lochirea* in a continuous succession with relatively high sedimentation rate (ca. 9 m/m.y.) and the abundant occurrence of conodonts . The studied interval consists mainly of thin- to medium-bedded, partially silicified lime mudstone, laminated wacke- to packstone, and normal-graded packstone (Chen et al., 2016). Although the frequent occurrence of normal-graded bioclastic wacke- to packstones most likely resulted from turbidity currents or debris flows on a carbonate slope setting, the lack of obvious incision or slump structures suggests that substantial submarine erosion did not occur. In total, approximately 11 000 well-preserved platform conodont elements were extracted from the 32 metres thick upper Viséan to lower Serpukhovian interval (Fig.1), which warrants a high-resolution conodont biostratigraphy and a precise correlation with the global chronostratigraphic scale.

The abundance of P1 elements of the *Lochriea* species, with its wide morphological variability throughout the late Viséan–early Serpukhovian boundary interval in the Naqing section, enables confirmation and refinement of known lineages within the genus (Nemirovskaya et al., 1994, p. 312; Skompski et al., 1995, p. 180–181; Nemyrovska, 2005, p. 25; Nemyrovska et al., 2006, p. 366).

Numerous and diverse species of *Lochriea* display the change from simple unornamented platforms to strongly decorated platforms with nodes or ridges. The distinction between species is generally based upon the shape and ornament of the platform (Nemirovskaya et al., 1994, Skompski et al., 1995; Nemyrovska et al., 2006), as it was illustrated in the method of speciation of *Lochriea* proposed by Skompski et al. (1995). The noded species with weakly developed ornament are considered to give rise to the noded species with a strong ornament. Thus, *L. mononodosa* could have given rise to *L. nodosa* and the latter could have given rise to *L. senckenbergica* and *L. multinodosa*. In the same way the ridged species, such as *L. monocostata* could have given rise to *L. costata*, which in turn could have given rise to *L. cruciformis*. As to *L. ziegleri*, of which the platform is ornamented by thick bars with large nodes on them, it could have derived likely from *L. nodosa*. Therefore, two lineages are proposed herein based on the conodont material from the Naqing section: (1) noded *Lochriea* species, such as *L. mononodosa – L. nodosa – L. ziegleri, L. senckenbergica* and *L. multinodosa*, and (2) ridged *Lochriea* species such as *L. monocostata – L. costata – L. cruciformis* (Qi et al., 2017 submitted).

Extensive studies of conodonts across the V/S boundary in Europe and Asia have provided additional data for identification of the global FAD of the conodont *L. ziegleri* in the lineage *L. nodosa – L. ziegleri*. This lineage is proposed as the definition and global correlation-level for the base of the Serpukhovian Stage.

**2.2 Ammonoids**

Ammonoid biozones provide high-resolution biostratigraphy in the late Mississippian, but unfortunately, ammonoids around the base of the Serpukhovian are strongly provincial in their distribution. Their provincialism prevents their effective use for interregional and intercontinental correlation. For example, the ammonoid assemblages of the Urals are markedly different at the level of species and largely different at the level of genus from those of NW Europe (Korn et al., 2012). A high-resolution ammonoid biozonal framework has been developed for the Rhenish Mountains in Germany (Korn, 1996, 2010) and in Britain and Ireland (George et al., 1976; Riley, 1993). The correlation of the ammonoid and conodont schemes suffered from the separate approaches in sampling. According to literature data, Korn (1996, 2010) thought that *L. ziegleri* and *L. senckenbergica* first occur at the base of the *Edmooroceras pseudocoronula* Biozone (E1a) at the base of the Namurian regional stage. Nemirovskaya, Perret and Meischner (1994) reported rare *L. ziegleri* from the *Neoglyphioceras spirale* Biozone (P1d) and the earliest *L. senckenbergica* from the *Lusitanoceras poststriatum* Biozone (P2a). Korn and Titus (2011) correlated the base of the *L. ziegleri* Biozone with a horizon within the *Emstites novalis* Biozone (P2c) in Germany. These differences made clear that there is an urgent need to restudy the range of *L. ziegleri* relative to the ammonoid zones in Germany (Sevastopulo and Barham, 2014). Therefore, in July, 2015, DK, YQ and QW visited several sections in the Rhenish Mountains in Germany and collected a large number of conodont samples for a further correlation study of conodonts with ammonoids.

In the Yoredale sequence of N England, the FOD of *L. ziegleri* is within the *Paraglyphioceras rotundum* and *Neoglyphioceras spirale* Biozone (P1d) or possibly the *Arnsbergites sphaericostriatus* Biozone (P1c). In NW Ireland, the FOD of *L. ziegleri* is at the base of the *Lusitanoceras granosum* Biozon (P2a). Thus, the FODs of *L. ziegleri* in sections in NW Europe may be close to isochronous, but conflicting information from the Rhenish Slate Mountains and sections in Britain

and Ireland needs to be resolved to confirm this (Sevastopulo and Barham, 2014).

The Early Carboniferous rock succession of the Rhenish Mountains is characterized by numerous vertical and lateral facies changes caused by eustatic and climatic fluctuations at the beginning of the Variscan orogenesis (Korn, 2010). During the Visean-Serpukhovian boundary interval, the ammonoid assemblage belongs to the North Variscan province and can be correlated with those in the British Isles (Korn et al., 2010). Fortunately, the latest study on conodonts and ammonoids of the Wenne river bank section (Rhenish Mountains) eliminates the conflicts mentioned above to a great extent. The Wenne river section is located at the northern margin of the Rhenish Mountain at the southern flank of the Lüdenscheid Syncline（51.34719° N, 8.17695° E）, and contains grey or black shales intercalated with thin to thick bedded limestones which are belonging to the Wennemen Formation (Korn, 2006). High-resolution ammonoid biozones have been confirmed in the Wenne river bank section as index species including *Paraglyphioceras rotundum*, *Neoglyphioceras suerlandense*, *Lusitanoceras poststriatum*, *Lyrogoniatites eisenbergensis*, *Lyrogoniatites liethensis* and *Caenolyroceras chalicum* were collected in ascending order (Korn and Horn, 1997). The "*Actinopteria* Shale", one remarkable alum shale horizon in the *Neoglyphioceras suerlandense* Zone, can serve as index horizon in the Rhenish Mountains (Korn and Kaufman, 2009). According to the recent study of conodonts, the potential index *Lochriea ziegleri* is first recorded in limestone bed 19 (sample W19) and about 7.5 m above the base of the Wenne river bank section (Wang et al., 2017, submitted). This horizon is just 0.5 m below the "*Actinopteria* Shale" and has a position in the *Neoglyphioceras suerlandense* Zone (Fig. 2) which is contemporary to P2a biozone (*Lusitanoceras granosum*) in British Isles (Korn and Titus, 2011). Studies in other sections in Rhenish Mountains are still in process.

Restudies of ammonoids from the same interval in China are also carried out by the present authors. Near Kalajila, a village in northern Xinjiang, many ammonoid specimens belonging to various genera (according to the previous identifications, including: *Goniatites*, *Hypergoniatites*, *Neogoniatites*, *Dombarites*, etc.) of the superfamily Goniatitoidea have been described and figured in the Chinese monograph but without showing the exact horizons (Liang and Wang, 1991). In summer of 2017, the present authors went to this place and measured one almost continuous section. Abundant ammonoids were collected from limestone lenses and debris in various horizons intercalated in the blue-grey shales. Simultaneously, conodont samples were also collected from these limestone beds for a crosscheck of the biostratigraphy in this section. This research is still ongoing by Qiulai Wang and Dieter Korn.

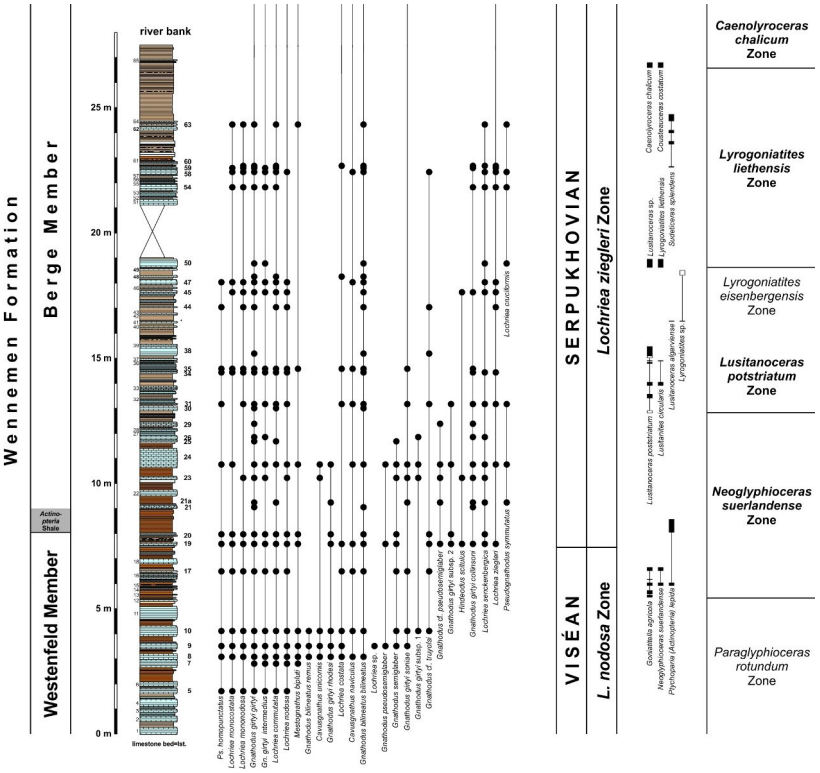


Fig. 2 Range chart of conodonts near the Viséan/ Serpukhovian boundary in the Wenne river bank section and correlation with the ammonoid zonation

### 2.3. Foraminifers

Foraminiferal successions across the V/S boundary in the type area of the Serpukhovian Stage (Moscow Basin, Russia), elsewhere in Russia and in the central United States suggest that the appearances of *Asteroarchaediscus postrugosus*, *Janischewskina delicata*, *Eolasiodiscus donbassicus* and specimens controversially referred to "*Millerella tortula*" are reliable, auxiliary indices to the base of the Serpukhovian (Groves et al., 2012; Kulagina et al., 2011). In the southern Guizhou Province, China, Viséan–Serpukhovian rock sequences from slope and platform settings have yielded rich associations of conodonts and foraminifers, respectively. Wu (2008), Wu et al. (2009) and Groves et al. (2012) reported abundant foraminifers from the V/S boundary intervals of the calciturbiditic Naqing slope section and the nearby shallow-water Yashui section. However, none of the above basal Serpukhovian indices were found in the Naqing section (Groves et al., 2012). Because of this, the present authors more densely collected samples for foraminifers across the V/S boundary interval in South China sections in recent years and some significant Serpukhovian foraminiferal species including *Janishewskina delicata* (62.25m) and *Bradyina* aff. *cribrostomata* (62.3m) were found. They are about two meters above the V/S boundary (60.1m) that is defined by the first appearance of *Lochriea ziegleri* in the Naqing section. *Planoendothyra aljutovica* occurred at 68.5m (Sheng, 2016). The more detailed study is ongoing by Qingyi Sheng and Paul Brenckle.

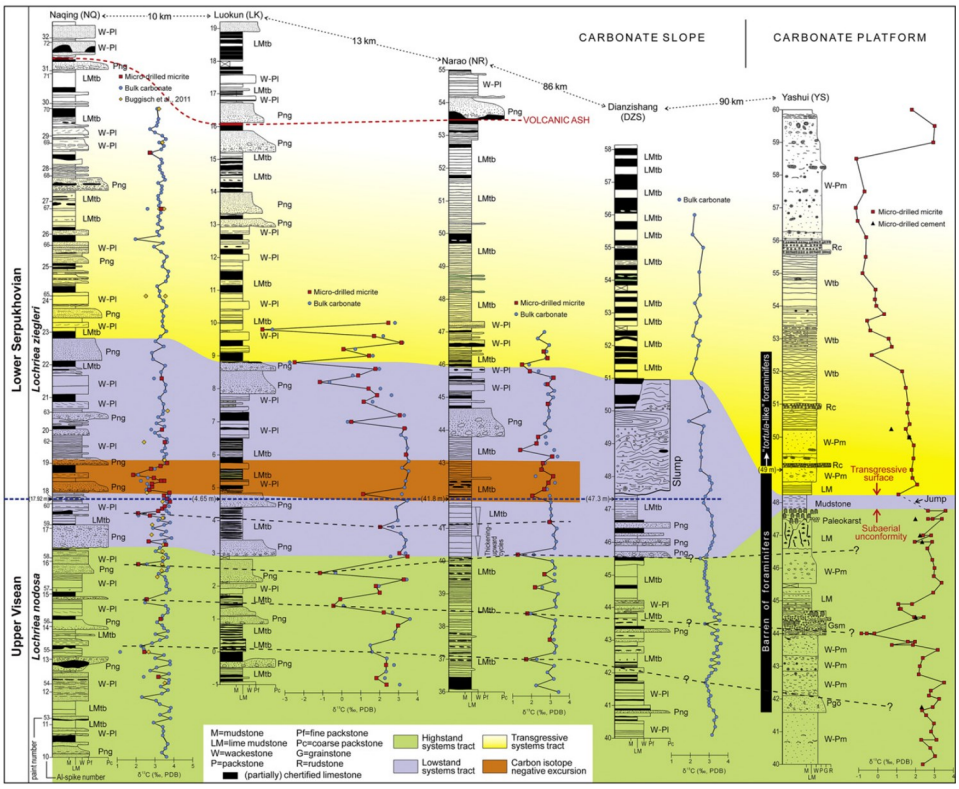


Fig. 3 Integrated sedimentary facies and $\delta^{13}C$ chemostratigraphy of the Viséan-Serpukhovian boundary interval in South China sections. The $\delta^{13}C$ curve in the slope sections are plotted, using bulk carbonate samples and micro-drilled samples wherever present instead, whereas the $\delta^{13}C$ in the Yashui section is plotted, using only micro-drilled micrite (after Chen et al., 2016)

## 3. Progress on the study of the isotopic geochemistry

Chen et al. (2016) reported a high-resolution $\delta^{13}C$ chemostratigraphy and detailed sedimentary facies of late Viséan–early Serpukhovian carbonate platform-to-slope successions in southern Guizhou, South China. Multiple negative $\delta^{13}C$ excursion (>1‰) can be correlated across the V/S boundary interval in several slope sections including the Naqing, Luokun and Narao sections (Fig. 3). A long-term decrease in $\delta^{13}C$ values through the Serpukhovian of the Yashui section likely records local influences on carbon cycling in a restricted platform setting. This negative $\delta^{13}C$ trend and associated depositional facies at the Yashui section can be correlated to the Arrow Canyon section, USA, which, together with other coeval global sedimentary and geochemical records, indicates a widespread eustatic drawdown in the late Viséan with initial buildup of Gondwanan ice sheets. As a result, integrated sedimentary facies analysis and $\delta^{13}C$ chemostratigraphy can be used for stratigraphic correlation when interpreted within a well-constrained sedimentary and carbon-isotope regional framework.

## 4. Remarks

The evolutionary lineage of *Lochriea nodosa-L. ziegleri* with many transitions in between in the Naqing section and in many other sections in South China and elsewhere in the world seems to be quite reliable, therefore, it has the greatest potential to be used for defining the Viséan-Serpukhovian boundary. In addition, the entry of strongly ornamented *L. ziegleri* is widespread in Eurasia; a well preserved specimen has been found in North America but not published (Qi et al., 2014) and its FAD can be well correlated with index foraminifers and ammonoids. Furthermore, this species could be easily recognizable and much numerous elsewhere than the other strongly ornamented *Lochriea* species. Thus, the FAD of *Lochriea ziegleri* is therefore the best marker for the base of the global Serpukhovian Stage without other better options. So properly it is time to take a vote for an official boundary marker for the base of the global Serpukhovian Stage by using the FAD of the conodont *Lochriea ziegleri* Nemirovskaya, Perret, and Meischner, 1994 in the lineage *Lochriea nodosa-Lochriea ziegleri.*

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# POTENTIAL FOR A MORE PRECISE CORRELATION OF THE BASHKIRIAN AMMONOID AND FORAMINIFERAL ZONES IN THE SOUTH URALS

**Svetlana V. Nikolaeva and Elena I. Kulagina**

(1) Ruzhencev and Bogoslovskaya (1978) described multiple ammonoid localities of Lower Bashkirian age in the Zilair Megasynclinorium (western subregion of the South Urals) assigned to the *Homoceras-Hudsonoceras* and *Reticuloceras-Bashkortoceras* Genozones. These Genozones are included in the General Stratigraphic Scale of the Carboniferous of the Russian Federation.

(2) The Bashkirian Stage in the Urals includes the Syuranian, Akavasian, Askynbashian and Arkhangelskian Substages. The Syuranian Substage includes the Bogdanovkian and Kamennogorian regional substages, and the Arkhangelskian includes the Tashastinian and Asatauian regional substages. All these substages are official units of the General Stratigraphic Scale of the Carboniferous of the Russian Federation. The regional substages are based on foraminiferal assemblages, each corresponding to one or more foraminiferal zones (Kulagina, 2008).

(3) However the precise correlation between the regional substages and ammonoid genozones is still incomplete. The exact position of ammonoid occurrences described by Ruzhencev and Bogoslovskaya (1978) in relation to the foraminiferal levels, and the ranges of the ammonoid genozones (and species zones within them) need to be more precisely correlated with the foraminiferal scale. Knowledge of the actual positions of ammonoid and foraminiferal levels in the sections where these two groups are found together is useful for analysing and dating sections where only one of the groups is present.

(4) It has been shown based on the Bogdanovskii and Kugarchi sections in the Zianchurin District of Bashkortostan that the *Homoceras-Hudsonoceras* and *Reticuloceras-Bashkortoceras* genozones correspond to the Syuranian (Kulagina et al., 2000), i.e., to the *Plectostaffella bogdanovkensis, Semistaffella minuscilaria,* and *S. variabilis* foraminiferal zones (Kulagina, 2008) and partly to the Akavasian Regional Substage, i.e., to the *Plectostaffella antiqua* (pars) foraminiferal zones (Nikolaeva et al., in press). However, the exact position of the base of the *S. variabilis* zone within the *Reticuloceras-Bashkortoceras* Genozone remained unresolved,

partly because the foraminiferal; assemblage from Bogdanovskii did not contain *S. variabilis*, and the lower boundary of the *S. variabilis* zone (and the base of the Kamennogorian) was drawn based on the appearance of *Semistaffella primitiva* (see Kulagina et al., 2001, pl. 2, fig. 28).

(5) The purpose of our field trip to the western slope of the South Urals in June 2017 was to locate other ammonoid sites described by Ruzhencev and Bogoslovskaya (1971) and resample them for foraminifers. We re-examined and resampled a locality near the village of Suleymanovo (Fig. 1), a section of the Kamennogorian Regional Substage near the village of Bogdanovskii ("section 3" of Kulagina et al. 2000), and re-examined the topmost part of the Kugarchi (Yamashly) section for ammonoids and foraminifers.

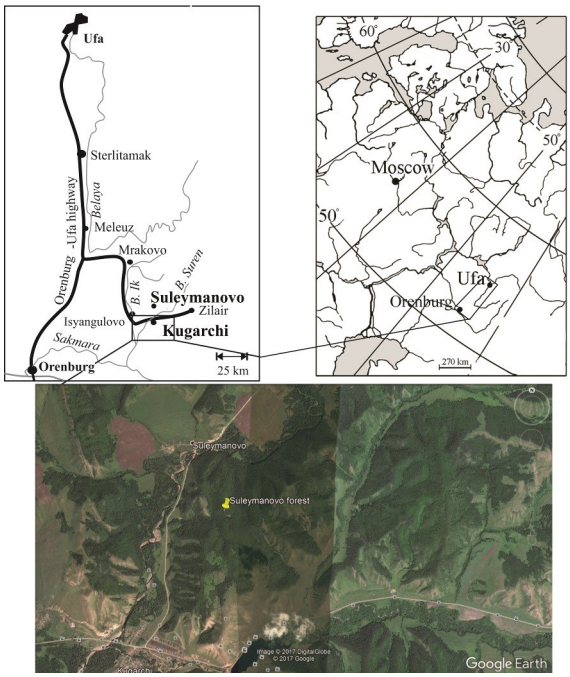


Fig. 1. Localities of the Lower Bashkirian ammonoids in the Zilair Megasynclinorium, western megaregion of the South Urals. The Google Earth map shown the position of the Suleymanovo section.

(6) The section near the village of Suleymanovo contains species of *Decorites, Ramosites and Surenites*, indicating the lower part of the *Reticuloceras-Bashkortoceras* Genozone (*Surenites krestovnikovi* Zone). In the Uralian correlation scheme the *Reticuloceras-Bashkortoceras* Genozone corresponds completely or partly to the *Semistaffella variabilis* foraminiferal zone, with the base somewhere within the *Reticuloceras-Bashkortoceras* Genozone. The biostratigraphy of the ammonoid *Surenites krestovnikovi* Zone is discussed in detail by Nikolaeva et al. (in press), and some considerations are added below.

(7) The base of the *Reticuloceras–Bashkortoceras* Genozone coincides with the base of the *Surenites krestovnikovi* Zone. The assemblage of this zone is dominated by representatives of the endemic families Surenitidae and Decoritidae. The assemblage also contains the derived homoceratids *Vallites henkei* (Schmidt, 1925) and *V. schmidti* Ruzhencev and Bogoslovskaya (1971). In general the shell size of ammonoids in this genozone in the South Urals is smaller than in the previous *Homoceras-Hudsonoceras* Genozone. The shells are mostly coarsely ribbed; many of them with paedomorphic features, and umbilical and ventral shell embellishments (nodes and grooves) are very common. In the Kugarchi section on the right bank of the Yamashly River, ammonoids of the *Surenites krestovnikovi* Zone occur 10 m above the occurrence of *Homoceras haugi* (Ruzhencev and Bogoslovskaya, 1978; Nikolaeva et al., in press). The *Semistaffella minuscilaria*, and *S. variabilis* zones recognized in the Bogdanovskii section (Kulagina et al., 2000) and Muradymovo Section (Kulagina et al., 2014) have not been found in the Kugarchi Section. In the Bogdanovskii section (Outcrop 3) (Kulagina et al. 2000, Fig. 5) and in the Muradymovo section (Kulagina et al., 2013, 2014) *Semistaffella minuscilaria* Reitlinger is found below the level with *Surenites krestovnikovi*, in in the Bogdanovkian (*Semistaffella minuscilaria* foraminiferal zone) within the *Idiognathoides sinuatus* conodont zone, within the *Homoceras-Hudsonoceras* ammonoid genozone.

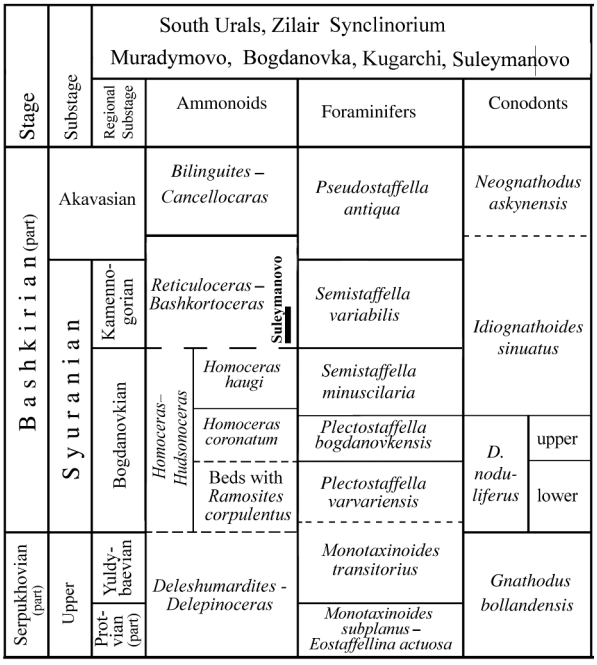


Fig. 2 Correlation scheme of the Lower Bashkirian ammonoid and foraminiferal zones in the Zilair Megasynclinorium, western megaregion of the South Urals showing the range of the Suleymanovo section

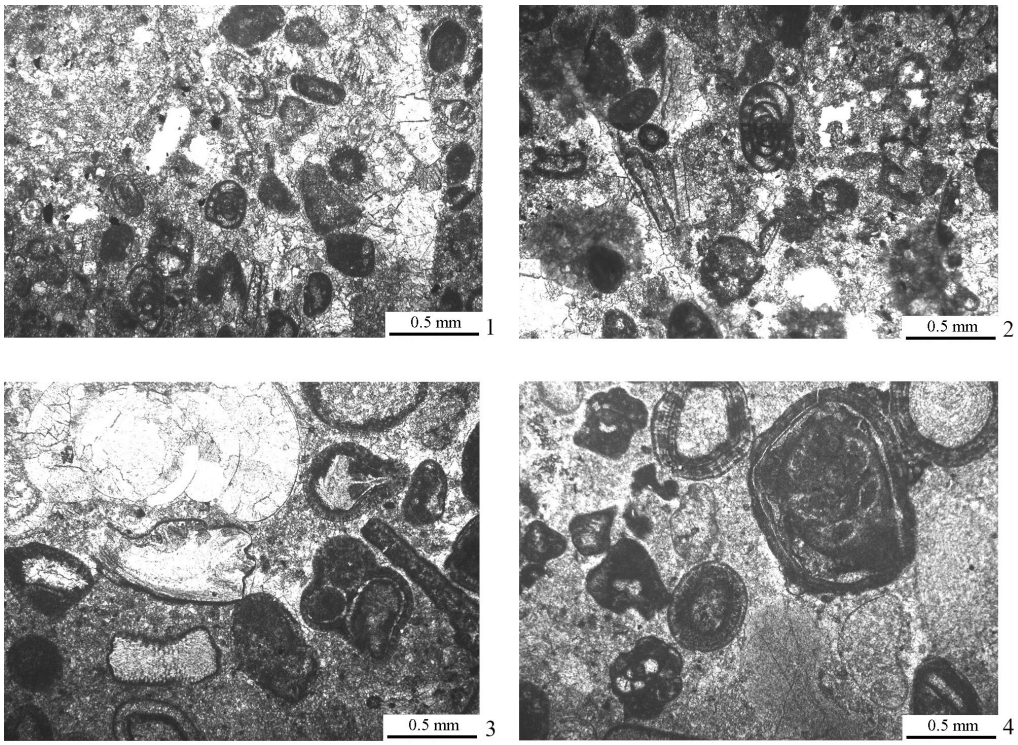


Fig. 3. Microphotographs of limestones of the Bogdanovskii section, with ammonoids (Outcrop 3, Kulagina et al., 2001, fig. 16); (1) Grainstone with foraminifers Parastaffella sp. (upper) and Semistaffella ex gr. variabilis (Reitlinger, 1961) (in the center). Bogdanovskii section, Outcrop 3, base of Bed 9, Sample 13, thin section 9; (2) Grainstone with Plectostaffella bogdanovkensis Reitlinger, 1980 in the center. Sample 13, bed 8, thin section 7; (3, 4) Grainstone with ammonoid shell, oolite grains, crinoids, rounded bioclasts, clotted mucritic cement. Bogdanovskii, Outcrop 3, base of Bed 9, Sample 14, thin section 5.

(8) The level of the FAD of *S. variabilis* Reitlinger (at the base or within the Surenites krestovnikovi ammonoid genozone) has not been confirmed by ammonoids. The species *S. variabilis* has not been identified from the Bogdanovskii or Kugarchi sections, while the Muradymovo section does not continue beyond the *Homoceras-Hudsonoceras* Genozone.

(9) This level probably corresponds to Beds U and V with *S. minuscilaria* and *S. variabilis* from the Upper Djebel Ouarkziz Formation in the Tinguiz Remz, Tindouf Basin, S. Morocco, where these foraminifers are found together, in association with the conodonts *Idiognathoides sulcatus sulcatus* (Cózar et al., 2014). Based on ammonoids and conodonts this interval corresponds to the Kinderscoutian in England (R1 ammonoid zone, *Id. corrugatus-Id. sulcatus* conodont zone) (Waters, 2011). In the Donets Basin the *Reticuloceras-Bashkortoceras* Genozone correlates with the interval E10-E7 in the Fenino Horizon (Amvrosievo Formation), with the *S. minuscilaria-S. variabilis* foraminiferal zones and with the *Idiognathoides sinuatus-Idiognathoides sulcatus sulcatus* conodont zone (Efimenko, 2013). The same beds contain *Surenites beshevensis* Popov, 1979, which is similar to *Surenites krestovnikovi* (Popov, 1979).

In summary, the position of the base of the *S. variabilis* zone in relation to the base of the *Reticuloceras-Bashkortoceras* (=revised base of the Kinderscoutian, see Waters et al., 2011) is not evident and the succession of species in the critical interval needs to be recalibrated.

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## CHEMOMETRICS AND CARBONIFEROUS MEDULLOSALEAN FRONDS: IMPLICATIONS FOR CARBONIFEROUS PHYTOSTRATIGRAPHY

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Phytostratigraphy of the Carboniferous rock column is presumably as robust as the taxonomy upon which plant-fossil species are based. Experience with plant-fossil compressions freed with hydrofluoric acid over the past 30 years, and corresponding ca. 2,000 glass-covered cuticular slides from the Late Pennsylvanian Sydney Coalfield in Canada, prompted a few comments regarding future taxonomic developments for Carboniferous plant fossils. Firstly, higher order rachides and their compression/cuticle characteristics hardly ever entered into species' diagnostics, as they are most commonly based on smaller or fragmentary foliar specimens, duly noting exceptions. But most importantly, ignored has been the set of chemical parameters resident in compressions and cuticles as the only survivors of the biological chemistry of the original plants. However, necessarily recognized is that diagenesis biased biomolecules that produced geomolecules (Berner, 1980).

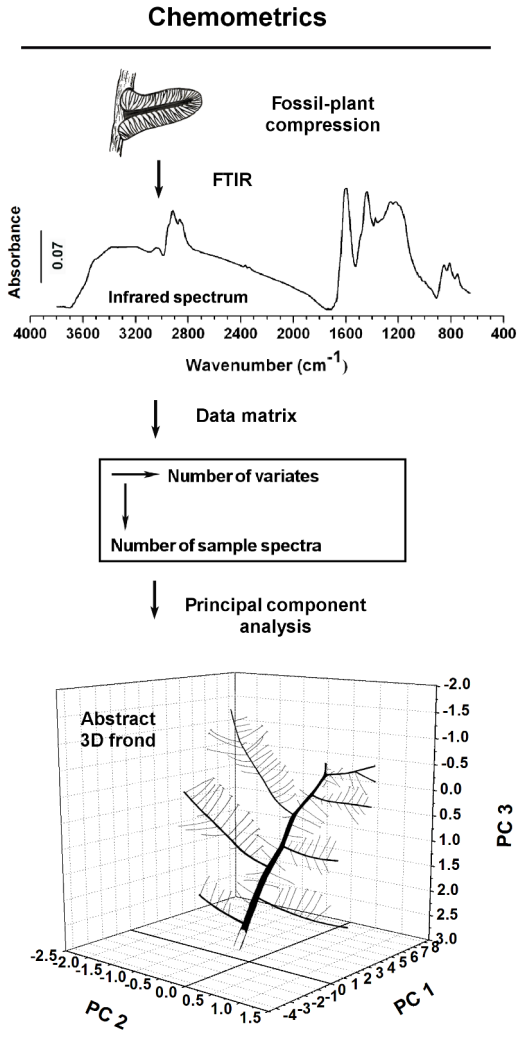


Fig. 1 Simplied flow chart for the chemometric method

Considering this circumstance, Lyons et al. (1995) pioneered a phytochemicotaxonomic research path concerning Carboniferous plant fossils using spectrochemical methods, notably Fourier transform infrared (FTIR) spectroscopy. Spectral studies of bond vibration to identify functional groups in molecules (moieties) for interpretation of compounds dates back to Nobel Laureate Gerhard Herzberg (1938). Today, FTIR is a most widely used analytical tool because it is reliable, non-destructive, fast, and inexpensive. The phytochemotaxonomic approach has been honed since by replacing it with the chemometric method that was introduced to palaeobotany by D'Angelo and Zodrow (2011; 2017 Ms); Zodrow et al. (2017). Basically chemometrics is the treatment of chemical data by a variety of statistical methods (see International Chemometrics Society, Newsletter, 2002; Miller and Miller, 2010). The chemistry (semi-quantitative chemical data) is derived by mathematical manipulation of infrared spectra from compressions/ cuticles of the plant fossils, where the compression is chemically treated. Specifically, this involved calculating eleven-peak area ratios (variates) obtained from the infrared spectra and representing functional-group content, noting that additional ratios can be defined. For the statistical treatment, principal component analysis of the data matrix of the eleven variates has been used with great success, achieving simplification for interpretation by reducing the data complexity represented by the eleven variates. This is under the condition that by subjective choosing an 80% level of cumulative explained variance the dimensionality (D) of the component space greatly reduced from the original eleven to three components, which parenthetically mimicked three-dimensional physical space. Of interest are the component scores that were used for interpreting chemical-structure groupings that otherwise were not so obvious. This, in effect, is a paradigmatic shift as the medullosalean frond is represented by an abstract, three-dimensional component space (3D). A simplified version of the chemometric process is shown in Figure 1.

Practical utility of chemometrics is independent of the architectural size or complexity of the fossil specimen, but it stands to reason that the larger the specimen the more detailed information is potentially obtainable. As we amply demonstrated (D'Angelo et al., 2012; D'Angelo and Zodrow, 2011; 2016, 2017 Ms; Zodrow et al., 2017), morphology and architecture of fossil fronds are reflected by the chemistry of their different constituting parts. The latter is explained by the morphological and architectural continuities of fossilized tissues changing in complexity from proximal to distal parts of the plant e.g., from bottom to top in the large, compound fronds of Medullosales. In other words, morphology, architecture, and chemistry are closely interrelated and chemical signatures can be tracked throughout the frond.

This has implications for not only distinguishing among fronds, but also to aid grouping of fragments, and minimize hence the use of varietal and duplicating species' names. Following the relative contents of functional groups (chemical structures) permitted a better understanding of the likely position of disarticulated frond parts (e.g., lower or upper pinnules). The latter allowed chemical predictions that ultimately may be related to the missing (non-collected) frond parts for frond architecture, and is distinctly different from palaeobotanical reconstructions, that if based on fragmentary and non-contiguous parts, can only be validated by 'bigger' frond finds. An example is the testable chemistry prediction of the "missing parts" and the likely quadripinnate condition of *Alethopteris ambigua* frond, i.e. the petiole, frond bifurcation, and their adjacent proximal parts (Zodrow et al., 2017).

In summary, emphasized is that spectrochemistry by itself is not taxonomic hence phytostratigraphic panacea; rather, underpinning the quest for a natural phytostratigraphy is the parametric combination of the traditional morphology in the sense of Brongniart and the modern spectrochemical methodologies for plant fossils. This, in effect, is realizing the Aristotelian thought of the unity of form and substance, or the philosophy of 'Einheit der Natur' by von Weizsäker (1959-1970).

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# MEETINGS


**The IPC is organized every four years under the auspices of the International Palaeontological Association (www.ipa-assoc.org). After Sydney (Australia) in 2002, Beijing (P.R. China) in 2006, London (United Kingdom) in 2010 and Mendoza (Argentina) in 2014, it will convene in Paris (France).**

## Key dates

Deadline for early bird registration: 2017-12-31

Deadline for abstract sub mission: 2018-2-15

Deadline for second wave registration: 2018-3-31

Scientific program and 3rd circular: 2018-05/06

| SUNDAY JULY 8TH | MONDAY JULY 9TH | TUESDAY JULY 10TH | WEDNESDAY JULY 11TH | THURSDAY JULY 12TH | FRIDAY JULY 13TH | SATURDAY JULY 14TH |
|---|---|---|---|---|---|---|
| | Registrations<br>Plenary opening session | Scientific sessions | Free day or workshops; Mid-congress fieldtrips | Scientific sessions | Scientific sessions | |
| Registrations | Scientific sessions | Scientific sessions | Free day or workshops; Mid-congress fieldtrips | Scientific sessions | Plenary closing ceremony and IPA session | French National Day |
| | | IPC5 cocktail dinatoire | | Gala dinner | | |

## Registration

The registration fees will include the admission to all conference sessions, poster area and exhibition, the Tuesday "cocktail dinatoire", the coffee breaks and the congress documents (congres bag, final programme, etc.). The Gala Diner is not included. *Please note that the registration and the payment of registration fee are independant of the submission of abstract*.

| | Full registration | Students |
|---|---|---|
| September to December 31st, 2017 | 360 € | 200 € |
| From January 1st to March 31st, 2018 | 460 € | 290 € |
| From April 1st, 2018 to June 30th, 2018 | 560 € | 380 € |

**Note** : *Both PhD students have to send a proof of their status (student card) to angelina.bastos@mnhn.fr.*

* Official website: https://ipc5.sciencesconf.org/
* English will be the official language of the meeting and excursions.

# The 5th IPC-Location

The meeting will take place in the **Pierre & Marie Curie University** and in the **National Museum of Natural History**, both located in the 5th arrondissement, in the center of Paris, along the left bank of the Seine River. This district is commonly known as the *Quartier Latin* because it is where the first great Parisian university, the Sorbonne, was founded, and because Latin was the language of scholars at the time. The 5th arrondissement was also the core of Lutetia, the antique city of Paris.


The most famous building of the 5th arrondissement is probably **the Pantheon**, where graves of influential French personalities are clustered, but there are many other noteworthy sights, such as the magnificent **Val-de-Grâce Church**, the intriguing **St-Etienne-du-Mont Church**, **the Cluny Museum**, **the Roman Arènes de Lutèce** and the city's botanical garden, **the Jardin des Plantes**. This institution housed one of **the largest collections of natural objects of the world** with more than **68 million specimens**. The palaeontology collection itself contains between 5 and 6 million specimens.

The opening plenary session will take place in "La Maison de la Mutualité". During its 80 years of existence, this building has hosted many historical events and welcomed prominent personalities.

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# The 5th IPC-Scientific sessions

The Plenary opening session ceremony will take place at the Mutualité; it will include some invited talks. The scientific sessions will be organized in parallel on the Pierre & Marie Curie University Campus and in the National Museum of Natural History amphitheatres. All these places are separated by less than 500 m.

| | SCIENTIFIC SESSIONS | ORGANIZERS |
|---|---|---|
| **S1** | Ancient ecosystems trapped in amber | B. Wang, V. Perrichot, E. Jarzembowski |
| **S2** | Angiosperms, from the beginning to their diversification | A. Boura, D. De Franceschi, J.B. Diez-Ferrer |
| **S3** | Back to the sea: from Late Palaeozoic to Cenozoic, the Tetrapod adventure | N. Bardet, V. Fischer, A. Houssaye, S. Jouve, O. Lambert, P. Vincent |
| **S4** | Big Data in Palaeontology: sharing knowledge for leveraging research options | W. Kiessling, L. Villier, J. Bardin |
| **S5** | Biodiversity changes through times: crisis and radiations | S. Crasquin, T. Adatte |
| **S6** | Biominerals through time: evolution, taphonomy and traces in the geological record | A.H. Knoll, K. Benzerara, S. Bernard |
| **S7** | Bird in the past environments | D. Angst, A. Chinsamy-Turan |
| **S8** | Cenozoic palaeobiology of the tropical Americas: palaeoecology, biodiversity and evolution | D.A.T. Harper, S.K. Donovan, R.W. Portell |
| **S9** | Coevolution of life and environments: integrating the palaeoecological, sedimentological and geochemical Records | L. Tackett, L. Tarhan |
| **S10** | Conservation palaeobiology and historical ecology of marine ecosystems | P.G. Albano, A. O'Dea, M. Zuschin |
| **S11** | Data, dispersals and interchanges through time: a land mammal perspective | P.O. Antoine, V. Zeitoun, L.J. Flynn |
| **S12** | Early animal life | J. Vannier, J.B. Caron |
| **S13** | Evolution of Indo-Pakistan biotas from the break-up of Gondwanaland (Late Jurassic) to the initiation of the collision with Eurasia (Eocene): between endemism and dispersals | G. Métais, D. De Franceschi, G.V.R. Prasad |
| **S14** | Evolution of trees and forests | B. Meyer-Berthaux, A.L. Decombeix, P. Gerrienne |
| **S15** | Experimental approaches in palaeontology: new data from old fossils | G. Merceron, T. Tütken, G. Bérillon |
| **S16** | Fossil 2D/3D imagery: approaches, advances, management | R. Lebrun,M. Orliac, I. Rahman I. Rouget, G. Clément |
| **S17** | Fossils and Recent, molecules and morphology: dialogs in phylogenetics | G. Billet, N. Puillandre, G. Giribet |
| **S18** | Functional morphology of the cranium in vertebrates | C. Pfaff, J. Kriwet |
| **S19** | How to build a palaeontological collection : expeditions, excavations, exchanges | E. Buffetaut, I. Podgorny |
| **S20** | Intimate interactions | O. Béthoux, N. Robin, T. Wappler |
| **S21** | Konservat-Lagerstätten | S. Charbonnier, J.T. Haug |
| **S22** | Life in Palaeozoic seas and oceans | E. Nardin, V. Perrier, T. Vandenbroucke |
| **S23** | Life in the time of Pangaea: volcanism, warming, anoxia, acidification and extinction | A.M. Dunhill, D.P.G. Bond, P.B. Wignall |

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|---|---|---|
| **S24** | Macroecology and the fossil record | G. Escarguel, E. Fara, S. Fritz |
| **S25** | Mesozoic palaeontology and palaeoenvironments of Indochina | J. Legrand, T. Tsuihiji, T. Komatsu |
| **S26** | Microorganism evolution and interaction with biogeochemical cycles and climate | A. Bartolini, S. Gardin, L. O'Dogherty |
| **S27** | Neogene continental environments in Africa and Eurasia | B. Senut, L. Ségalen, N. Fagel |
| **S28** | New trends in biostratigraphy - Stratigraphic section (SGF) session | E. Nardin, D. Desmares, J. Palfy |
| **S29** | Palaeobiodiversity of Southeast Asia | H. Tong, V. Suteethorn, J. Claude |
| **S30** | Palaeontology and geological heritage | G. Egoroff, S. Charbonnier, A. Lefort |
| **S31** | Palaeobiodiversity and evolutionary history of vertebrates in Africa | N. Jalil, E. Gheerbrant, A. Chinsamy-Turan, E. Seiffert |
| **S32** | Palaeobiogeography | S. Kiel |
| **S33** | Shell beds through time: implications for palaeoecology, taphonomy and evolution | J.H. Nebelsick, M. Zuschin, A. Tomasovych |
| **S34** | Testing and developing phylogenetic methods in palaeontology | J.O'Reilly, M. Puttick, D. Pisani, P. Donoghue |
| **S35** | The conservation of palaeontological collections: challenge and perspectives | V. Rouchon |
| **S36** | The Devonian: life, environments and time | J. Marshall, L. Slavik, C. Brett |
| **S37** | The onset of the Great Ordovician Biodiversification (GOBE): fossils, radiations and Lagerstätten - IGCP 653 session | T. Servais, D. Harper, B. Lefebvre, A. Hunter |
| **S38** | The role of biotic interactions in the evolution of tropical ecosystems | J.R. Boisserie, F. Bibi |
| **S49** | Timetrees | M. Laurin, G. Didier, R. Warnock |
| **S40** | Vertebrate paleophysiology | J. Cubo, A.K. Huttenlocker |
| **S41** | XXIst Century palaeohistology of mineralized tissue | M. Rücklin, G. Cuny, D. Germain, S. Sanchez |
| **S42** | Open session | D. Gommery, S. Peigne, M.B. Forel |

# The 5th IPC-Short courses

- **SC1 Geobiodiversity Database** (1 half day session - maximum of 60 participants in this session)

  Organizer: Fan Junxuan, fanjunxuan@gmail.com

- **SC2 Palaeontology, databases and interactive keys, a winning combination?** (1 half day session - maximum of 20 participants in this session)

  Organizer: Adeline Kerner, adeline.kerner@mnhn.fr

- **SC3 Scientific illustrations** (2 half day sessions - maximum of 20 participants per session)

  Organizer: Sophie Fernandez, sophie.fernandez@mnhn.fr

# The 5th IPC-Field Excursions

The field trips will offer the opportunity to (re)discover many aspects of **France** and of **Belgium** and **Italy**.

France is unique for the outstanding richness and importance of its fossil localities, all easily accessible, with all periods of the Phanerozoic geological time represented. Some of the earliest geological maps were produced here by Cuvier and Brongniart, and many stratotypes (Cenomanian, Givetian, Lutetian, Turonian, etc.) are located here.

*The number of participants for field trips is limited and requests will be filled on a first-come first-served basis. Registrations to the field trips be done when ering to the conference. Trips may be cancelled if under-subscribed.*

* FT1 Anjou noir, Anjou blanc, Anjou rouge: palaeontology and geology of the Loire Valley (4 days)
* FT2 Excavations at the Early Cretaceous Dinosaur Bonebed of Angeac-Charente (5 days)
* FT3 Geology, wine and culture: Jura, Bourgogne and Champagne (6 days)
* FT4 Jurassic from Normandy (4 days)
* FT5 Jurassic from Northern Burgundy to Lyon area: fossils, wine and patrimonial aspects (4 days)
* FT6 Luberon & Haute-Provence palaeontological sites (Southeast France) (5 days)
* FT7 Mid-Late Palaeozoic of western Europe: the Belgian Classics (3 days)
* FT8 Montceau-les-Mines Lagerstätte (Carboniferous) and Autunian Stratotype (Permian) (2days)
* FT9 Permian and Mesozoic environments in southern France (4 days)
* FT10 The end-Permian mass extinction and the Early Triassic biotic recovery in the Dolomites (Southern Alps, Italy) (4 days)

# The 5th IPC-Mid-congress excursions (11/07)

- E1 Geological strolls: Paris 5th arrondissement
- E2 Geological strolls: Paris La defense
- E3 Visit SOLEIL synchrotron and the AST-RX CT Scan, Paris Region
- E4 Visit at IPANEMA, SOLEIL synchrotron, Saint Aubin, Paris Region
- E5 Field trip to underground quarries at Meudon
- E6 Visit of the “Centre de Recherche pour la Conservation des Collections”

# The XIX International Congress on the Carbonifeorus and Permian


The 19th International Congress on the Carboniferous and Permian will take place from July 29th to August 2nd, 2019, in Cologne, Germany.

Four days with scientific sessions and a mid-congress field trip will provide ample time for scientific presentations and discussions. Pre-congress and post-congress field trips are planned to visit Carboniferous and Permian strata in Germany and adjacent countries. After the Carboniferous congresses held in Krefeld (1971), Kraków (1998) and Utrecht (2003), the meeting finally will find its way back to central Europe, giving a splendid opportunity to explore some of the most classical regions of the Carboniferous and the special Rotliegend and Zechstein facies of the Permian outside of the Palaeotethys realm.

In the remaining weeks of 2017 we will set up the organization committee and a website. However, all help is greatly appreciated to make the congress a success. Therefore, we invite everybody to propose topics for sessions, workshops, fieldtrips, etc. For the time being, please address me for all information and proposals.

To know more, visit the website of the preceding ICCP in Kazan, where you will find our successful proposal to host the congress in Cologne at http://kpfu.ru/iccp2015

Looking forward to meet you in summer 2019!

Hans-Georg Herbig

herbig.paleont@uni-koeln


We are pleased to invite you to participate in **the XVII Argentine Symposium of Paleobotany and Palynology (SAPP 2018)**, **TOWARDS NEW CHALLENGES**. This prestigious scientific event brings together the most recognized specialists both locally and worldwide, and its importance is reflected in the significant number of participants who have attended each one, which has risen in the last two symposia, 150 in Corrientes 2012 to 180 in La Plata 2015.

In this edition it will be held for the first time in the **city of Paraná**, Entre Ríos province, between **July 30 and August 5**, co-organized by the Latin American Association of Paleobotany and Palynology and the Universidad Autónoma de Entre Ríos, declared of Institutional Interest (CS Res. N ° 121/17).

We thank you for the diffusion of this invitation and we hope to have your valuable contribution.

Important dealines:

Early Registration: ***2018-01-30***

Abstracts submmission: ***2018-01-31***

**For more information: http://fcyt.uader.edu.ar/web/sapp2018**

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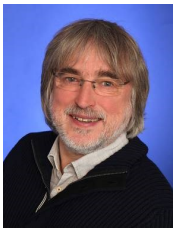

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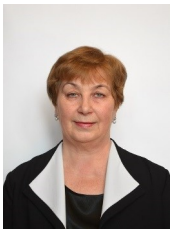

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