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Table of Contents

Newsletter edited by Markus Aretz with the assistance of Barry Richards, Pavel Kabanov and Svetlana Nikolaeva.

Thanks to all colleagues who contributed to this newsletter!

Cover Illustration:

The cover shows an overview photograph of the Viséan succession in the eastern Tafilalt region in the Anti-Atlas Mountains of Morocco (see forth-coming SDS-SCCS meeting). Fine-grained sandstones, siltstones and intercalated shales of the Mougui Ayoun Formation (indicate the age Viséan) form the ridge from which the photograph was taken towards the Zrigat Plain in the north. The plain is widely underlian by shales of the Zrigat Formation, but several belts of small hills cross the plain from west to east. Several of these hills, which are thought to represent mud-mounds, are visible in the centre of the photograph. Several rich fossil localities of Late Viséan are known next to the flat-lying Cretaceous to Cenozoic sediments forming the hill (Gara El Itima) and escarpments (Hamada de Guir) in the back of the photograph.

(Photo courtesy of Markus Aretz)

EXCECUTIVE'S COLUMN

Dear Fellow Carboniferous Researchers,

Important meetings

During the November 1st 2012 to October 31st 2013 ICS fiscal year there will be several professional/societal meetings our members will want to attend but the two meetings discussed below will probably be the most important and of greatest interest to our members. The first of the meetings is titled "The Devonian and Lower Carboniferous of northern Gondwana" and it is an International Field Symposium of the SDS, SCCS, and Task Group for the "Devonian–Carboniferous Boundary"; the dates are March 23rd to 30th, 2013 and it will be held in Morocco. The venue for the Morocco meeting is the Palm's Hotel in the city of Erfoud and the field trips will be in the Tafilalt region of the Anti-Atlas Mountains. The second of the meetings is titled "The Carboniferous-Permian Transition" and it is an International Field Symposium of the SCCS and SPS; the dates are May 20-22 and it will be hosted by the New Mexico Museum of Natural History and Science, in Albuquerque, New Mexico, U.S.A. The venue for the Albuquerque meeting is the Rio Grande Inn in Albuquerque and the field trips will be in the surrounding region. For more details about these events and other meetings, please see the circulars included in the 2011 issue of the Newsletter on Carboniferous Stratigraphy and the section about meetings in the current issue.

We try to hold at least one formal SCCS workshop and field meeting every fiscal year but this year we plan to hold two such events. The first of these will be a workshop for "The joint Devonian–Carboniferous boundary GSSP reappraisal task group" at the March meeting in Morocco. The second will be a general business meeting for the SCCS at the May meeting in Albuquerque, New Mexico.

Financial statements for 2012

Each fiscal year, the SCCS receives a small grant from the International Commission of Stratigraphy (ICS) that generally ranges from $500 to $1000 in United States dollars. But in the November 1st, 2011 to October 31st, 2012 year we received a substantially larger grant of $3000.00 in United States dollars from the ICS. Most of that unusually large grant ($2500.00) was specifically provided for the chairman to attend the formal ICS business meetings at the 34th International Geological Congress in Brisbane, Australia in August, 2012. Attendance at such ICS meetings is compulsory for all subcommission chairs; consequently, the ICS Chairman Stan Finney provides subcommission chairs with a substantial grant so all of us can attend. In my case (Richards), the grant was sufficient to pay for a one-way trip to Brisbane from western Canada and half of my registration fee. Most other subcommission chairs received similar grants from the ICS to attend the 34th IGC. For legitimate SCCS-related activities, I am extremely reluctant (because of internal SCCS complaints) to use any of the funds we receive from the ICS, even those specifically allotted for attending compulsory ICS meetings, but I do not receive any financial support from my principal employer the Geological Survey of Canada to attend any international meetings (including the IGCs), SCCS workshops, and SCCS field meetings. In addition, because, I am employed by the Government of Canada I am not legally authorized to apply for any external research grants to support international activities; therefore, I generally use either personal funds or a combination of private funds and ICS grant money to attend most SCCS activities.

In the last fiscal year, the SCCS received an ICS grant of $500 U.S. for general purposes. Stan Finney likes the voting members and task-group leaders of the subcommissions to hold regular workshops and field meetings related to the principal mandates of the ICS and its subcommissions. A substantial component of our annual grant usually goes toward providing some logistic support for our members to attend such meetings. Unfortunately, very few members request any of the available money from the executive and we currently hold a balance of $706 in Canadian dollars from last fiscal year. Each fiscal year, we need to use most of the money we receive through donations and ICS grants. If we incur a substantial balance like we have now, the size of the ISC grant we will receive will be correspondingly reduced. If you require any financial support, even a couple of hundred dollars, to attend any of the main meetings and workshops related to the mandate of the SCCS in this fiscal year please ask me for a small grant. Some funds can also go toward supporting field activities. The requests will be kept confidential unless you want them to be publicized in the Newsletter on Carboniferous Stratigraphy. Also, you can ask for the grant either before or after the meeting it is intended to provide logistic support for, but please make your request within the fiscal year.

Barry C. Richards, Wang Xiangdong and Markus Aretz

MEMBERSHIP

During the last fiscal year, six SCCS geoscientists retired from their positions as regular voting members after serving for 12 years. In addition, one voting member who could continue on for another four-year term submitted his resignation. Elections were held for the regular voting members and for the SCCS executive. As a consequence of the retirements and elections our membership, including the SCCS executive, currently stands at 20.

Retirement of voting members

At the conclusion of the 34th International Congress (IGC) on August 10th, 2012, six of our valued voting members were required to retire from their positions as regular voting members in the SCCS because they had served for 12 years. Paragraph 9.2 of the 2002 revision of the Statutes of the International Commission on Stratigraphy [ICS] entitled 'Terms of Office for Voting Members' states: "The terms of office for voting members of Subcommissions and Task Groups shall be the period between two IGCs (International Geological Congresses), normally four (4) years, and can be extended for a maximum of two additional four (4) year periods." A list of the retiring members and their main areas of expertise is provided below. We gratefully acknowledge the contributions they have made toward the establishment of GSSPs as leaders on the subcommission during their 12 years and encourage them to continue on as active corresponding members.

Members who retired from regular voting membership in 2012

Demir Altiner [Turkey] (foraminifers, biostratigraphy)

Darwin Boardman [USA] (ammonoids, conodonts)

Katsumi Ueno [Japan] (fusulinids, biostratigraphy)

Luc Hance [Belgium] (foraminifers, biostratigraphy)

Tamara Nemyrovska [Ukraine] (conodonts, biostratigraphy)

Barry Richards [Canada] (stratigraphy, sedimentology)

Please note that if any of you voting members who are only in your first or second terms feel that you are not able to continue to contribute at a satisfactory level to the SCCS, you may resign by informing me by e-mail. In this regard, John Groves [USA], an expert on foraminifers and chairman of the Bashkirian–Moscovian Boundary task group since the Utrecht ICCP in 2003, has resigned from the position as task-group chairman and as an SCCS voting member. He submitted his resignation to me as a short e-mail message on June 15, 2012.

Members who can continue for additional terms

James Barrick [USA] (conodonts, biostratigraphy)

Holger Forke [Germany] (forams, conodonts, biostratigraphy)

Nataliya Goreva [Russia] (conodonts, biostratigraphy)

Jin Xiao-Chi [China] (stratigraphy, paleogeography)

Jiri Kalvoda [Czech Republic] (forams, conodonts)

Dieter Korn [Germany] (ammonoids, biostratigraphy)

Olga Kossovaya [Russia] (corals, general stratigraphy)

Elena Kulagina [Russia] (forams, biostratigraphy)

Svetlana Nikolaeva [Russia] (ammonoids, biostratigraphy)

Edouard Poty [Belgium] (corals, sequence stratigraphy)

Yuping Qi [China] (conodonts, biostratigraphy)

Wang Xiangdong [China] (corals, conodonts, biostratigraphy)

David Work [USA] (ammonoids, biostratigraphy)

Welcome to the new voting members

The executive of the Subcommission on Carboniferous Stratigraphy (SCCS) is pleased to welcome five new regular voting members to the SCCS: Markus Aretz, Ondrej Bábek, Zhong Chen, Lance Lambert, and Javier Sanz-López. On October 12 2011, I (the SCCS Chairman) sent an e-mail message to the voting members [we had 18 regular voting members, a Chairman, Assistant Chair (Dr. Wang Xiangdong) and an appointed Secretary/Treasurer (Dr. Markus Aretz)] requesting them to nominate appropriate scientists for regular voting membership in the SCCS. After the nomination process was completed, I sent a list of the nominees along with their resumes to the voting membership asking them to study the list and report on any problems or concerns they might have with the nominees. Regarding the nominees, article 9.6 of the ICS statutes states: "New voting members of existing subcommissions are elected by its executive, upon consultation with existing voting members, and confirmed by the Executive Committee of ICS." After receiving comments from the voting members, ballots were prepared by the chief returning officer Dr. Svetlana Nikolaeva and sent by e-mail to the three executive members of the SCCS. The results of the vote were tallied by the returning officer and the final results made available to the executive on February 16. A final decision about the selection of the new voting members, who would start their first term of service at the end of the 34th IGC in Brisbane, was made by the SCCS executive in late March and the list of new voting

members was sent to the ICS executive on April 10th for approval.

Most of the new voting members are actively working on various SCCS task groups and it is anticipated they will continue working in that capacity. Some of the new members are not associated with specific task groups and I will urge the current task-group leaders to incorporate those geoscientists into their tasks groups when and where it is appropriate.

The names, contact information, and some brief background information for the five geoscientists selected through the election process (Markus Aretz, Ondrej Bábek, Zhong Chen, Lance Lambert, and Javier Sanz-López) are listed below.

1 Name: Dr. Markus Aretz

Affiliation: Université de Toulouse (UPS), Géosciences Environnements Toulouse (OMP); 14 Avenue Edouard Belin, 31400 Toulouse, France; E-mail: markus.aretz[at]get.obs-mip.fr

Education: 1998 - Diplom (=Masters of Science) Universität zu Köln, Germany; 2002 - Ph.D. Universität zu Köln, Germany; 2011 - HDR Université Paul Sabatier, France.

Background and research interests: Markus is currently working in the Department of Environmental Geosciences at the University of Toulouse as the Maitre de Conférences, which is equivalent to an associate professor or lecturer. Some of his many responsibilities at the University include: 1) teaching paleontology, sedimentary geology, and field geology for Bachelor and Master students; 2) supervision of graduate and Ph.D. students at the universities of Toulouse, Cologne, Liège and Nanjing; and 3) administration tasks such as acting as the representative for sedimentology and paleontology in the "Committee for Education in Geoscience", which organize and coordinates the departmental teaching activities.

Since the fall of 2008, Markus has worked diligently and effectively for the SCCS as our Corresponding Secretary and Treasurer with his main job being the time-consuming and demanding task of compiling and editing the Newsletter on Carboniferous Stratigraphy. In June, 2010, Markus accepted the challenging SCCS task of chairing the Task Group to redefine the Devonian–Carboniferous Boundary.

Markus takes an enthusiastic interest in most aspects of late Paleozoic geology but his principal research interests are: Carboniferous corals, Paleozoic reefs, stratigraphy of the late Devonian and Carboniferous, analyses of Carboniferous ecosystems, evolution of Late Paleozoic sedimentary basins, and the correlation of shelf and basin successions from regional to global scale.

Nominated by: Barry C. Richards

2 Name: Dr. Ondrej Bábek

Affiliation: Masaryk University of Brno, Department of Geological Sciences; Kotlarska 2, 61137 Brno, Czech Republic; E-mail: babek[at]sci.muni.cz

Education: 1992 - M.Sc. at Masaryk University of Brno, Czech Republic; 1995 - Ph.D. at Masaryk University of Brno, Czech Republic.

Background and research interests: Ondrej Bábek is and active geological research scientist and associate professor. His principal research interests are: high-resolution stratigraphy employing carbonate sedimentology, sequence stratigraphy, environmental geology, and petrophysical methods such as gamma-ray spectrometry, spectral reflectance and magnetic susceptibility. Ondrej studies both Paleozoic and Quaternary deposits. From 2010 to the present, Ondrej has been employed as a lecturer, associate professor and department head at the Geology Department of the Palacky University of Olomouc. From 2005 to the present, he has worked in the Czech Republic as an associate professor at the Masaryk University of Brno and at the Palacky University Olomouc. Ondrej is an associate editor of the Central European Journal of Geosciences (Versita-Springer) and a Journal reviewer for the Bulletin of Geosciences, Geologica Belgica, Science of the Total Environment, and Geoderma. He is also a member of the Czech National Geological Committee (IUGS) http://www.geology.cz/cngk.

Nominated by: Jiri Kalvoda

3 Name: Dr. Zhong Chen

Affiliation: 1) State Key Laboratory of Biology and Environmental Geology, China University of Geosciences (Wuhan), 388 Lumo Road, Wuhan 430074, China; E-mail: zhong.qiang.chen[at]cug.edu.cn

Education: 1990 - B.Sc. (Honors) in Paleontology and stratigraphy at China University of Geosciences, Wuhan, China; 1993 - M.Sc. in Paleontology and stratigraphy at Nanjing Institute of Geology and Paleontology, Chinese Academy of Sciences, Nanjing, China; 2001 - Ph.D. in earth sciences at Deakin University, Melbourne, Australia.

Background and research interests: Until early 2012, Dr. Zhong Chen worked at the University of Western Australia, 35 Stirling Highway, Crawley, Western Australia as an Associate Professor (Research) and his main duties were research and the supervision of postgraduate projects. While he

was at the University of Western Australia, he convened the 17th International Congress on the Carboniferous and Permian. At the China University of Geosciences in Wuhan, he a researcher and lecture professor, delivering lectures to both undergraduate and postgraduate students. Zhong Chen has a broad range of research interests but is mainly interested in the Late Paleozoic: 1) Multidisciplinary studies on biotic extinction and subsequent recovery during the Permian-Triassic, Guadalupian/Lopingian, Frasnian/Famennian crises; 2) Carboniferous, Permian and Triassic biostratigraphy and paleontology; 3) macroevolution, paleoecology, and systematics of fossil brachiopods (Devonian–Carboniferous, Permian-Triassic), and Ophiuroids and crinoids (Echinodermata, Permian-Triassic); and 4) Geobiology - A] Microbialites from the Present-day, Early Triassic, and Ediacaran; B] predation in fossil records; C] fossil ecosystem structure, and D] Ediacaran biota of Kimberley region in Northwest Australia.

Nominated by: Barry C. Richards, seconded by Xiangdong, Wang

4 Name: Dr. Lance Lambert

Affiliation: Department of Earth and Environmemtal Sciences, University of Texas, at San Antonio, Texas U.S.A. 78249; E-mail: lance.lambert[at]utsa.edu

Education: 1982 - B.Sc. at Texas A & M University; 1989 - M.Sc. in Pennsylvanian biostratigraphy and sedimentology at Texas A & M University, College Station, Texas USA; 1992 - Ph.D. in Pennsylvanian biostratigraphy at University of Iowa, Iowa City, Iowa, U.S.A.

Background and research interests: From 2001 to 2006, Dr. Lambert worked as an assistant professor in the department of Earth and Environmental Science University of Texas at San Antonio, Texas and from 2006 into early 2012 he worked as an associate Professor in the same department. In the new 2012 academic year, Lance attained the status of full professor at the University of Texas. His principal research interests are the biostratigraphy and taxonomy of Pennsylvanian and Permian conodonts. He is also interested in Carboniferous sequence stratigraphy, carbonate sedimentology and palaeoenvironments. During the last two years, Lance has been very active on Carboniferous Subcommission stage-boundary projects in south China, working closely with Qi Yuping on Pennsylvanian conodonts from the well known Nashui section in southern Guizhou Province.

Nominated by: Barry C. Richards, seconded by Qi Yuping and Markus Aretz

5 Name: Dr. Javier Sanz-López

Affiliation: Department of Geology, University of Oviedo, Arias de Velasco s/n 33005 Oviedo, Spain; E-mail: jasanz[at]geol.uniovi.es

Education: 1980-1985 - B.Sc. in Geology, University of Barcelona (Central), Spain; 1986 - Thesis of degree in Geology, University of Barcelona (Central), Spain; 1995 Ph.D. in Geology, University of Barcelona (Central), Spain.

Background and research interests: Javier Sanz-López works in the Department of Geology (led by Professor Dr. Agustin Martin-Izard) in the Faculty of Geology, University of Oviedo. In the university, he teaches theoretical and practical lectures in general geology and paleontology. Javier is a member of two research teams in the university. Professor Dr. Luis Carlos Sánchez de Posada leads the first of these teams, which includes Professor Dr. Elisa Villa, and involves the study of biostratigraphic subjects in the Carboniferous sequences of the Cantabrian Mountains. The focus of the other team is the thermal evolution of the rocks in the Cantabrian Mountains. Javier is the researcher in charge of the project of the National Plan of Research and Development (Spain): "Thermal and microstructural modeling of the diagenesis-metamorphism transition in carbonate rocks of the Cantabrian Zone"

Javier's main scientific interest is applying conodont evolution or their changes to the study of geological issues, particularly related to biostratigraphic topics. His expertise covers biostratigraphy in upper Ordovician to Carboniferous rocks, colour and textural alteration in conodonts associated to geological processes, stratigraphy and cartography in Paleozoic outcrops. Active research fields are: 1) biostratigraphy in Carboniferous sequences, 2) systematics and evolution in Carboniferous conodont taxa, 3) conodont paleoecology and paleobiogeography, 4) colour alteration index on conodonts and applications, and 5) textural alterations on conodonts.

Positions held: 1990-1992 Contract for geological cartography in the Spanish Geological Survey, Spain; 1995-2001 Teaching assistant in Geology at the University of A Coruna, Spain; 2002-2005 Instructor in Geology in the University of A Coruna, Spain; 2005-2011 Tenured reader in Geology at the University of A Coruna, Spain; 2011 Instructor in Palaeontology at the University of Oviedo, Spain.

Nominated by: Markus Aretz, seconded by Barry Richards

Election of the Chairman and Asistant Chairman of the SCCS

During May of 2012 we held elections for the Chairman and Assistant Chairman positions. Under the ICS rules, a geoscientist can serve two terms as either a Chairman or Assistant Chairman of a subcommission. Article 9.1 of the 2002 revision of the Statutes of the International Commission on Stratigraphy [ICS] entitled Terms of Office for Officers states: "The terms of office for the officers of the ICS Executive Committee, the Subcommissions, Ad Hoc Committees, and Task Groups shall be the period between two International Geological Congresses (IGS), normally four (4) years. All officers, except for the councilor, can be re-elected for one additional term of four (4) years." The end of the first four-year term of the current SCCS Chairman and Assistant Chairman will be the International Geological Congress (August 5-10, 2012) in Brisbane, Australia. The SCCS executive is permitted to carry on for a second term but there needs to be a competition for the position involving a nomination process and subsequent vote using a secret ballot (postal or e-mail).

Report on the results of the election of the Chairman and Assistant Chairman of the SCCS

I have received from the SCCS Chairman Barry C. Richards the mandate to chair the Nominating Committee for the election of the Chairman and Assistant Chairman of the SCCS. The Nominating Committee consisted of Dr. Elena Kulagina and me, Dr. Svetlana Nikolaeva. We have been charged with the task of selecting two candidates for each of the two positions, to organize the ballot, and to report the results to the present Chairman of the SCCS. The Chairman will subsequently report the results of the election to the ICS Chairman Dr. Stan Finney.

On 26 April 2012 the members of the Commission were invited to nominate candidates for the positions of the Chairman and Assistant Chairman of the SCCS.

After the call for nominations, the Nominating Committee has collected nominations for one candidate for each of the two positions (Barry Charles Richards for the position of Chairman and Wang Xiangdong for the position of Assistant Chairman). In each case, the candidates undoubtedly had the experience and willingness to serve the SCCS and the parent organization the International Commission of Stratigraphy (ICS). All the necessary accomplishments required by the statutes of the ICS have been completed.

On 15 May the members of the Commission were invited to vote on the candidates. At the close of the voting period on 31 May 20121 the votes were as follows: Of 21 SCCS voting members and executives eligible to cast votes, 19 sent their votes. Thereby a quorum of 60% has been attained.

(1) Richards:

Affirmative votes – 15, Negative votes – 3, Abstained – 1 (78%).

(2) Wang:

Affirmative votes – 18, Negative votes – 0, Abstained – 1 (95%).

Thereby, the sixty percent (60%) majority of delivered votes has been attained for both candidates (as required by the ICS statutes).

I am sending this result to the current Chairman to be sent for ratification by the ICS Executive Committee.

Svetlana Nikolaeva

Chair the Nominating Committee for the election of the Chairman and Assistant Chairman of the SCCS

The contact information and some brief background information for the Chairman and Assistant Chairman are provided below.

Name: Barry Charles Richards

Affiliation: Geological Survey of Canada-Calgary, 3303 33rd St. NW Calgary, Alberta, Canada T2L 2A7; E-mail: barry.richards[at]NRCan-RNCan.gc.ca

Education: 1973 - B.Sc. with distinction (major in geology minor in biology) at University of Calgary, Calgary Alberta, Canada; 1983 - Ph.D. in geology (Mississippian stratigraphy and basin analysis) at University of Kansas, Lawrence, Kansas, U.S.A.

Background and research interests: Since 1980, he has worked as a research scientist at the Geological Survey of Canada in Calgary, Alberta. The focus of Richard's work with the Geological Survey of Canada has been the Carboniferous and Permian succession in the Western Canada Sedimentary Basin, but he has also worked on the upper Paleozoic in northern Yukon Territory and in the allochthonous terranes of British Columbia. In addition, he is currently studying carbonate-hosted lead-zinc ore deposits in southwestern Canada.

Since the 33rd International Geological Congress in August 2008, Richards has worked as the Chairman of the Subcommission on Carboniferous Stratigraphy (SCCS), a subcommission of the International Commission of Stratigraphy. The SCCS is large group of international geoscientists whose main assignment is the establishment of Global Stratotype Sections and Points (GSSPs) for the stage boundaries of the Carboniferous System. In his capacity as Chairman of the SCCS, Richards has

directed the activities of the task groups and examined various aspects of the Carboniferous globally. The current focus his international work is the stratigraphy, geochemistry, and sedimentology of upper Viséan to lower Bashkirian carbonate-dominant successions in the southern Ural Mountains of Russia and the mountains of southern Guizhou Province, China to facilitate establishment of the GSSP for the Viséan–Serpukhovian Boundary.

Nominated for a second term by: Dr. Svetlana Nikolaeva, seconded by Dr. Elena Kulagina

On May 10, 2012, the Chairman sent the following message to the SCCS voting members indicating his willingness to serve for a second term.

Dear Voting Members of the Subcommission on Carboniferous Stratigraphy,

During the last four years (2008 – 2012), I have been proud to serve as the Chairman of the Subcommission on Carboniferous Stratigraphy (SCCS) and represent you at the formal meetings of the International Commission of Stratigraphy (ICS) executive and at various other professional meetings such as the XVII International Congress on the Carboniferous and Permian. I have also been pleased to organize elections for the selection of new voting members, prepare the annual reports that the SCCS submits to the ICS each year, and to assist with the assembly and publication of the Newsletter on Carboniferous Stratigraphy.

During late April of 2012 Svetlana Nikolaeva, a voting member of the SCCS in good standing and a person appointed to lead a nominating committee, sent out a letter calling for the nomination of geoscientists to serve in the capacity of either the Chairman or Assistant Chairman of the SCCS. She indicated that the nominating committee can collect nominations from third persons, but candidates are also invited to apply directly by submitting: 1) a short *Curriculum Vitae (CV)*, and 2) a half page to one-page text in which they present their view on the future activities of the SCCS and indicate their willingness to serve in either the Chairman or Assistant Chairman positions. Today, I am pleased to volunteer to serve as the Chairman in the 2012 to 2016 term and will let my name stand for ballot. In addition, I have sent a short statement outlining my plans for the SCCS over the next four years. I have also sent a short *CV*.

Name: Xiangdong, Wang

Affiliation: Nanjing Institute of Palaeontology and Geology; 39 East Beijing Road, Nanjing, 210008, Peoples Republic of China; E-mail: xdwang[at]nigpas.ac.cn

Education: 1983 - B.Sc. at Department of Earth Sciences, Nanjing University, Nanjing, Peoples Republic of China; 1989 - M.Sc. at Department of Earth Sciences, Nanjing University; 1992 - Ph.D. at Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China.

Background and research interests: From April 2000 to the present Dr. Xiangdong Wang has worked as a research professor at the Nanjing institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS). He is also the Deputy Director of the institute. His principal research interests are late Paleozoic coral paleobiology, paleoecology, and paleobiogeography. Closely related interests are late Paleozoic reefs and their paleo-environmental implications, Carboniferous and Permian stratigraphy, chronostratigraphy, and global correlations. During his tenure at NIGPAS, Xiangdong has directed several major late Paleozoic projects and was the principal organizer and co-chairman for the XVI International Congress on the Carboniferous and Permian that was held in Nanjing in 2007.

Within the SCCS, Xiangdong Wang has worked as the Assistant Chairman of the subcommission since the 33rd International Geological Congress in August 2008 and is an active participant on several of the SCCS task groups, particularly those striving to establish GSSPs for the Viséan–Serpukhovian and Bashkirian–Moscovian boundaries.

Nominated for a second term by: Dr. Svetlana Nikolaeva, seconded by Dr. Elena Kulagina

REPORT FROM THE BUSINESS MEETING OF SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY AT THE 34TH IGC IN BRISBANE, AUSTRALIA

Barry C. Richards

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Introduction

This report is based on information that was presented at the joint business meeting for the Subcommission on Carboniferous Stratigraphy (SCCS) and Subcommission on Permian Stratigraphy (SPS) on Tuesday August 7th, 2012 during the 34th International Geological Congress in Brisbane, Australia. The meeting was held in room P9 at the Brisbane Convention and Exhibition Centre. The SCCS executive members present were the Chairman Barry C. Richards and Secretary

Markus Aretz. The regular SCCS voting members Svetlana Nikolaeva, Olga Kossovaya and Ondrej Bábek were also present. In addition, the meeting was attended by some SCCS corresponding members and members of the Subcommission on Permian Stratigraphy including the outgoing Chairman Charles Henderson and the new Chairman Shuzhong Shen. The meeting convened at 7:00 pm with the SPS meeting and was followed by that of the SCCS. At the end of the meeting, SCCS members attended the meeting of the Subcommission on Devonian Stratigraphy (SDS), convened by the outgoing Chairman Thomas Becker, to discuss the status of the Devonian–Carboniferous Boundary GSSP at La Serre, France.

I opened the SCCS component of the meeting by welcoming the members and visitors present and by presenting a PowerPoint showing the itinerary. The report is based on minutes taken by voting member Svetlana Nikolaeva and my PowerPoint presentations for the SCCS and SDS meetings. Some additional material, mainly references and background information, is included.

Itinerary for meeting discussions

1) Resignation of John Groves the task-group Chairman for Bashkirian–Moscovian Boundary task group

2) Website – new website for SCCS is being constructed

3) Newsletter on Carboniferous Stratigraphy

4) Work plans for next four years

A) Next important meetings
B) Formal ICS recognition of substages
C) Division of Tournaisian and Viséan
D) Principal SCCS mandate
E) Encyclopedia of Stratigraphy project

5) GSSP for base of Carboniferous at La Serre, France

1. Resignation of John Groves, leader of the Bashkirian–Moscovian Boundary task group

I informed those present that Dr. John Groves, Chairman of the Bashkirian–Moscovian Boundary task group since the Utrecht ICCP in 2003 had stepped down from the position. John Groves was an active and valuable member of the subcommission, attending most of our workshops, field meetings, and conventions. We gratefully acknowledge his leadership role and the important contributions he made toward the establishment of the GSSP for the Bashkirian–Moscovian Boundary. He was also an active participant on the Viséan–Serpukhovian task group, recently completing a major study (Groves *et al*., 2012) of the foraminifers at the proposed boundary level – the FAD of the conodont *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994. John submitted his resignation to me as a short e-mail message on June 15, 2012. The University of Northern Iowa had terminated the geology program at the Department of Earth Sciences, where John was employed as a professor, prompting him to seek employment elsewhere. John accepted a position with the Carmeuse Group, a leading producer of lime, high-calcium limestone and dolomitic stone, in Pittsburg Pennsylvania, USA. He indicated he could not pursue his Carboniferous biostratigraphic research interests while working for Carmeuse and subsequently resigned as the Chairman of the Bashkirian–Moscovian Boundary task group.

At the business meeting, I indicated it was necessary to appoint a new task-group leader as soon as possible and asked those present to suggest potential replacements. I also informed them that John Groves had suggested Demir Altiner of Turkey (an outgoing voting member specializing in the study of foraminifers and biostratigraphy) as a potential replacement. At the meeting, the geoscientists I suggested as potential replacements were: Alexander S. Alekseev (Russia), and Qi Yuping (China). I indicated I would contact the persons named to see if they were interested in the position and would search for others if necessary.

Markus Aretz asked if John Groves had stepped down as a SCCS voting member as well as resigning from the task-group Chairman position and I indicated that was the case but did not understand why he would do so.

Olga Kossovaya supported the choice of candidates and asked if they need to be voting members. My reply was they did not need to be voting members and reminded those present that task-group leader George Sevastopulo is not a voting member and Katsumi Ueno's 12-year term as a voting member will end at the closing of the 34th IGC.

2. Website for Subcommission on Carboniferous Stratigraphy

The SCCS website is in poor condition and that I have received numerous complaints about it from the ICS Chairman Dr. Stan Finney and SCCS members. Stan places great importance on the subcommission websites and has told us they should be the primary entry site for those in the geoscience community, as well as the general public, wanting information on the boundaries of a system and the series and stages within it. The main problem with our site is it has not been possible to get any of the main components updated during the last fiscal year. In particular, it has not been possible to have the 2011 version of the Newsletter on Carboniferous Stratigraphy placed on the site and I have not been able to get the 2010 version of the Annual Report to the ICS placed on the site. Also,

task-group reports from November 2011 and the latest news including information about important upcoming meetings (discussed below under work objectives for next 4 years) could not be posted.

The website is stored on a server at the Nanjing Institute of Geology and Paleontology in Nanjing, China and maintained by Fan Junxuan, the webmaster for the ICS. The apparent causes of our problems are antiquated software and Fan's other commitments such as maintenance of the higher-priority ICS website and sites for several other subcommissions including the Subcommission on Permian Stratigraphy have made it difficult for him up date ours. It is not possible for Markus Aretz and me to make the updates because the code and instructions are in Mandarin.

Good news- immediately prior to the joint SCCS and SPS meeting, Shuzhong Shen informed me that our website in Nanjing was being replaced by a new one and during the August 9th meeting of the ICS at the 34th IGC, Fan Junxuan told me the software for our website was not adequate and that the entire site was being reconstructed. If the reconstruction is not successful, we may need to consider using commercial sites such as those available through Google. Also, Markus Aretz said he might be able to have the website posted on one of the servers at the Université de Toulouse in France.

I concluded this part of the meeting by telling those attending those present that I would wait to see if the new version of the website in Nanjing met our needs and if it did not we would consider moving it to another server such as either one with Google or in Toulouse.

3. Newsletter on Carboniferous Stratigraphy

I reminded those present that it was time to prepare articles for the next issue of the Newsletter on Carboniferous Stratigraphy (volume 30 for 2012). We also discussed the editing of the newsletter. Now that we have an ISSN number for the online version of the Newsletter (delivered by downloading from the SCCS website when it was functional) I would like to improve the articles by sending them out to SCCS members for critical review and for assistance with editing for grammar, spelling and scientific content. In particular, it has been substantial work for Markus Aretz and me to review and edit papers written by many of our authors who do not use English as their native language. I asked those present if they thought it was a reasonable and useful to ask the voting and corresponding members to assistance with the editing and those present confirmed it was. Markus Aretz suggested the papers should just be returned to authors for revision. Svetlana Nikolaeva replied that she was concerned the Russians and Chinese would not get the English reasonably correct.

4. Work plans for next four years

Work plans A. Next important meetings

During 2012 there will be several conventions and meetings that will be of substantial interest to most of our voting and corresponding members. Four of the meetings were discussed at our business meeting. For a more complete listing of the meetings and their content, see the sections of the 2011 and 2012 Newsletter on Carboniferous Stratigraphy that deal with meetings.

Meeting 1: The Devonian and Lower Carboniferous of northern Gondwana

Dates: March 23th – March 30th, 2013

Venue: Field Meeting in Tafilalt organized by the Institute Scientifique, University Mohammed V – Agdal, Rabat, Morocco

Contact: Prof Dr. Ahmed Elhassani, E-mail: elhassani[at]israbat.ac.ma or devonian2013[at] gmail.com

The first meeting discussed is an international field symposium organized by the Subcommission on Devonian Stratigraphy (SDS) and task group to redefine the Devonian–Carboniferous Boundary. Dr. Thomas Becker, the outgoing SDS Chairman invited our members to attend and the meeting has become an official meeting for both the SDS and the SCCS. The meeting includes one day of oral and poster presentations and six days of field trips in the eastern Anti-Atlas Mountains of Morocco. Most of the field trips will be devoted to examining Devonian exposures but some Devonian–Mississippian Boundary sections will be included. Markus Aretz indicated there are also some exposures of younger Carboniferous (Tournaisian and Viséan) strata in the region and arrangements can be made to see some of them. Many of the exposures are richly fossiliferous. The first circular is included in volume 29 of the Newsletter on Carboniferous Stratigraphy and a subsequent one in this volume. The abstract deadline is October 31, 2012.

Meeting 2: The Carboniferous-Permian Transition

Dates: 20th -22nd May, 2013

Venue: Hosted by the New Mexico Museum of Natural History and Science, Albuquerque, New Mexico, USA

Contacts: Spencer G. Lucas, spencer.lucas[at] state.nm.us or James E. Barrick, jim.barrick[at]ttu.edu

The Carboniferous-Permian Transition meeting will be an exciting international event devoted to all aspects of Carboniferous and Permian geology with a special emphasis on the Carboniferous-Permian transition. The organizers invited us to participate,

thereby making this an official meeting for the SCCS and we have accepted their thoughtful offer. The event will include a pre-meeting field trip to well-known exposures of the Pennsylvanian-Permian transition in Carrizo Arroyo, central New Mexico (see Lucas and Zeigler, 2004), two and a half days of oral and poster presentations, an afternoon trip to see the Upper Pennsylvanian strata in the Kinney Brick Quarry near Albuquerque, and a three-day post-meeting field trip to see Pennsylvanian and Permian exposures in Joyita Hills-Cerros de Amado (along eastern margins of Rio Grande Rift) east of Socorro, New Mexico. The deadline for the submission of abstracts is the end of 2012. A proceedings volume will be printed.

In addition to the localities that will be visited on the conference field trips there are many other spectacular Carboniferous exposures in New Mexico, such as the Waulsortian mounds in the Sacramento Mountains near Alamogordo. If those localities are of interest to some of our members, they will need to make their own arrangements to visit them.

Svetlana Nikolaeva asked if there were Carboniferous ammonite localities we could visit in the region. I told her I did not know of any but suggested she ask Rich Lane and others who had worked extensively in New Mexico. We could also go to the GONIAT-Online website (http://www.goniat.org/) and check their database for localities.

Markus Aretz asked whether or not additional sections of the marine Upper Pennsylvanian succession in the region could be visited because he felt there was a need to focus on sections that could become GSSP candidates.

Meeting 3: 1st International Congress on Stratigraphy (STRATI 2013)

Dates: 1st July to 7th July, 2013

Venue: Faculdade de Ciencias e Tecnologia, Universidade Nova Lisboa in Lisbon Portugal

Website: http://www.strati2013.org/

The 1st International Congress on Stratigraphy will be held under the auspices of the International Commission of Stratigraphy and Chairman Dr. Stan Finney has urged all of the subcommission chairs to attend. Stan would like to hold the executive business meetings of the ICS at this venue instead of at the very expensive quadrennial meetings of the International Geological Congress. A major part of ICS budget for 2012 (more than half of the $60,000 budget allocation awarded to ICS by the IUGS in 2012) was spent on travel to the 34th IGC so that subcommission chairs and members of the ICS executive could attend the business meetings. Normally most of annual allocation is distributed to the subcommissions with highest priority for allocations going to potential progress on GSSPs and webpage rejuvenation. Stan Finney would like most of the subcommissions to consider holding the business meetings for their task groups at the Lisbon congress in June. Future congresses could become the primary venue for carrying out ICS business particularly business meetings of subcommissions. Such meetings will likely be held in locations that are readily accessible and inexpensive for large numbers of subcommission members in contrast to the expensive IGCs, which historically were the main events for subcommission business meetings. However, the main venue for the business meetings of the SCCS will continue to be the International Congress on the Carboniferous and Permian.

The scientific program for the 1st International Congress on Stratigraphy comprises 22 sessions covering three main themes: A - Principles and methods, B - Regional stratigraphy, and C -Applied stratigraphy. Many of the sessions will be of interest to the SCCS members particularly session 4 (GSSP and stratotypes) under theme A and chaired by Stephen Hesselbo and Markus Aretz.

Meeting 4: XIVIII International Congress on the Carboniferous and Permian

Dates: August 7-15, 2015

Venue: Kazan, Russia

Contact: iccp2015ksu.ru

Website: http://www.iccp2015.ksu.ru

The 2015 ICCP in Kazan is the most important of the upcoming meetings and many of our members will be deeply involved with the organization, leading field trips and giving presentations. Although the meeting appears to be a long time off, the time will pass rapidly and our subcommission needs to start preparations. I would like all of the task groups to hold their business meetings at the congress.

One of the chief organizers, Dr. Olga Kossovaya said some new excavation work would be done to improve several sections for the field trips and that in the summer of 2013 there will be a special trip to the Urals to prepare the sections. I asked her to inform me who will be leading the fieldtrips and how the members of the SCCS should be involved (important the task-group members participate on field trip organization). The first circular was published in volume 29 of the newsletter and the second circular will be ready in 2014.

Work plans B: Formal ICS recognition of substages

During the meetings of the International Commission of Stratigraphy at the 34th IGC in Brisbane, Australia, the full body of the ICS including the executive and subcommission chairs will discuss

the formal ICS recognition of substages. Should the ICS call for the formalization of substages, major tasks for the SCCS subsequent to establishment of GSSPs for all of our current stage boundaries will be the selection of substages for inclusion in the ICS chronostratigraphic chart, establishment of task groups for the substages, and initiation of the search for events and GSSPs to define the boundaries.

Olga Kossovaya asked what events would be used to define the substage boundaries. I indicated it would probably need to be largely the first appearance of taxa but geochemical and eustatic events may be useable for some boundaries.

Work plans C: Division of the Tournaisian and Viséan

Division of some of the longer stages in the Carboniferous such as the Tournaisian and Viséan might be useful to facilitate more precise Global correlation; however, before embarking on division of such stages, we will ask our voting members to prepare formal proposals for such division and have those proposals voted on via ballots by the full body of the SCCS voting members. In the case of the Tournaisian and Viséan, some of our members (Poty *et al.*, 2011; Aretz *et al.*, 2012) have made substantial progress toward developing proposals. During March and April of 2009, I discussed the possibility of dividing the Tournaisian and Viséan with the Assistant Chairman Wang Xiangdong, Edouard Poty and Markus Aretz. In addition, I asked Edouard Poty if he would be interested in leading a working group to evaluate the utility and consequences of dividing the Viséan and Tournaisian.

The suggestion to divide the Tournaisian and Viséan was met with considerable enthusiasm but we have not followed through with the establishment of task groups to establish GSSPs for division of the two stages. Until recently, the SCCS executive thought the subcommission had enough work to complete without the added burden of establishing additional stages. Also, Stan Finney wants to see the present stage boundaries defined by GSSPs before we consider additional work. However, now that the ICS is considering the formalization of substages and we have several new voting members, it may be time to reconsider division of the Tournaisian and Viséan. If the Tournaisian and Viséan are divided, the Lower and Middle Mississippian Series will be renamed Tournaisian and Viséan, respectively. The result will resemble the situation that existed prior to the development of the current chronostratigraphic chart for the Carboniferous, which was established by the previous SCCS Chairman (Heckel, 2004; Heckel and Clayton, 2006), and divisions currently designated as substages will become stages again. As much as possible, to retain some stability in name usage, the executive would like to see the names and boundaries of the divisions correspond to the regional substage boundaries that are currently most commonly used – those of Russia and Western Europe.

Work plans D: Our principal mandate

The establishment of GSSPs for the Carboniferous and its main subdivisions is our principle mandate from the ICS. During the next four-year term, the ICS executive wants to have the SCCS establish GSSPs for as many of the Carboniferous Stage boundaries as possible. At present, GSSPs need to be established for the Viséan/Serpukhovian, Bashkirian/Moscovian, Moscovian/Kasimovian and Kasimovian/Gzhelian boundaries. In addition, the GSSP at the base of the Tournaisian has been reassessed and both a new marker event and a new section will probably be required for that boundary.

Based on the information our task-group leaders have provided us in the last two issues of the SCCS annual report to the International Commission of Stratigraphy and volume 29 of the Newsletter on Carboniferous Stratigraphy, we are confident that during the next four years GSSPs can be established for most of the boundaries with the possible exception of the base of the Tournaisian.

Within the next two years, we think it will be possible to select the boundary defining events for all of the stage boundaries with the exception of the base of the Tournaisian and then direct full effort toward selecting sections for the GSSPs. At present, most SCCS task groups have either selected an event to define their respective boundary and held a successful vote on it (Kasimovian–Gzhelian task group) or have located an event and are preparing proposals in preparation for taking the proposal to ballot (Viséan–Serpukhovian and Bashkirian–Moscovian task groups).

At this point in the meeting, Markus Aretz asked about the current status of the Mid-Carboniferous Boundary GSSP at Arrow Canyon, Nevada. I explained its status had not changed and was still based on FAD of the conodont *Declinognathodus noduliferous sensu lato*. At the time *D. noduliferous s. l.* was selected as the index species (Lane *et al.*, 1999), it included several subspecies including *D. noduliferous noduliferous* (Ellison & Graves, 1941) and *D. noduliferous inaequalis* (Higgins, 1975). Some conodont specialists subsequently separated those forms into discrete species of *Declinognathodus*, but *D. noduliferous s. l.* has still been retained as the boundary marker. Some conodont experts including Javier Sans-López of Spain recently informed me that the lowest occurrence of *D. noduliferous s. l.* in the Arrow Canyon section is *D. noduliferous inaequalis*. Markus Aretz said that information

needed to be put forward for a vote and ratified. He also indicated there are problems with the section because it contains unconformities and marked facies changes near the boundary level. I replied the boundary lies in a marine (neritic) carbonate unit and is not at an unconformity.

Markus Aretz indicated another problem is the final report on the Tournaisian-Viséan Boundary GSSP has not been published. I indicated Francois-Xavier Devuyst was working on the paper but the task-group Chairman George Sevastopulo did not know when it would be finished. Markus Aretz said he would contact Devuyst and encourage him to finish the paper and it would be ready within in a year.

Work plans E: ICS encyclopedia of stratigraphy project

At the end of the SCCS component of the business meeting, I provided some information about the Encyclopedia of Stratigraphy project, which is coordinated by the ICS Chair Dr. Stan Finney and will be published in the encyclopedia series of Springer. The SCCS has been asked to work on a series of short to moderate-length articles dealing with various aspects of Carboniferous stratigraphy including Carboniferous chronostratigraphic-geochronologic units and the stratigraphic framework of important regions and basins. The subcommission has agreed to participate in this major project and the SCCS Chairman and Assistant Chairman will coordinate the contribution of the SCCS. An outline showing the main topics has been prepared (included in this issue of the Newsletter on Carboniferous Stratigraphy). Authors have not been selected for most of the articles and volunteers are required. Authors have been located to write some of the documents and we have provided the names of several scientists that we thought were well qualified to write the articles. We need to have the people we have suggested to confirm their willingness to contribute. Stan Finney will provide guidelines.

I sent a version of our outline for the encyclopedia project to Chairman Stan Finney on October 27, 2011 and modified it in November after receiving his comments. By June 2012, I had not received any further information about the project from Stan Finney and was concerned we should have had our contribution finished months ago. I sent an e-mail message to Stan Finney about this issue on June 13th and he told me that we didn't need to have it completed yet and that he would provide further instructions to all of the participants shortly. By August I had not received any additional instructions from Stan Finney and told those attending our SCCS meeting that I thought he would address the issue at our closed ICS business meeting at the 34th IGC on Thursday night August 9th.

At this point the regular SCCS meeting was closed and those present moved next door to attend the SDS meeting and discuss the Devonian–Carboniferous Boundary with Thomas Becker and his subcommission members.

5. GSSP for base of Carboniferous at La Serre, France

During this part of the SCCS business meeting, I briefly discussed the current status of the Devonian–Carboniferous Boundary GSSP at La Serre France and the ongoing work being done by the D-C Boundary reappraisal task group at La Serre and elsewhere. I showed location maps of the section and a modified log of the section published by Flajs and Feist (1988). In addition, I showed photographs of the GSSP section that I took on a visit to the locality in December, 2011.

Main points: At present, the La Serre section is rather poorly exposed being partly grown over with vegetation and debris from various collecting expeditions. Some of beds in the section (particularly 84 to 77) are not easy to correlate with those on the stratigraphic columns and photographs of Flajs and Fleist (1988) and Kaiser (2009). Parts of section require careful re-excavation (locality not a natural exposure and is a trench). Work published by Kaiser (2009) indicates the FAD of the conodont *Siphonodella sulcata* (Huddle, 1934), used for boundary definition, occurs as low as bed 84b and an evolutionary lineage from *Siphonodella praesulcata* Sandberg, 1972 to *S. sulcata* is not preserved in the section. Ji *et al.* (1989, p. 71) recognized both problems many years earlier but their work was not taken into account when the La Serre locality was chosen for the GSSP.

Since the problems with the conodont lineage *S. praesulcata – S. sulcata* and the FAD of *S. sulcata* that are used to define the D/C Boundary GSSP at La Serre were recognized (Kaiser 2005, 2009), the clarification of the lineage has been a prime task for the conodont workers (e.g. Spalletta *et al*., 2010). Results have been published for siphonodellids (Kaiser and Corradini, 2011) and protognathodids (Corradini *et al*., 2011). Their papers indicate that the two conodont groups probably do not contain potential index fossils for the D/C boundary. The currently used lineage represents a series of taxonomic problems and instability, which result from the diverging identification and naming of transitional forms between *S. praesulcata* and *S. sulcata*.

Current work indicated neither *S. sulcata* not events within the protognathodids can be used for boundary definition.

The task group is actively looking for new event markers and new candidate sections for the GSSP and progress will be reported at the joint SDS/SCCS

March meeting (The Devonian and Lower Carboniferous of northern Gondwana) in Morocco.

At this point, the SCCS component of the meeting was closed.

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ANNUAL REPORT FOR NOVEMBER 1ST, 2010 TO OCTOBER 31ST, 2011

This version of the SCCS annual report is abbreviated from the document submitted by our chairman Barry C. Richards to the ICS. The complete annual report for 2011 will be posted on our new website at www.nigpas.ac.cn/carboniferous and we encourage our members to examine it to obtain a more complete overview about the activities and goals of the SCCS.

OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

The SCCS promotes and coordinates international cooperation among various geologic specialists for the purpose of defining standard Global chronostratigraphic boundaries within the Carboniferous System. The GSSP for the Devonian–Carboniferous boundary is at La Serre in southern France (Paproth *et al*., 1991), and the Carboniferous–Permian boundary GSSP lies in northern Kazakhstan (Davydov *et al*., 1998). The Mid–Carboniferous boundary GSSP is preserved in Arrow Canyon, Nevada, U.S.A. (Lane *et al.,* 1999), and it divides the Carboniferous into the Mississippian Subsystem below and the Pennsylvanian Subsystem above. A website (www.nigpas.ac.cn/carboniferous) with eight main pages was established in 2009 but it is being reconstructed.

MEMBERSHIP

In addition to the three executive voting members, the SCCS has 18 rank-and-file voting members (list at end of current issue of newsletter), and approximately 280 corresponding members. The main business meetings of the SCCS are held every two years, both at the quadrennial meetings of the International Congress on the Carboniferous and Permian (ICCP), and at a field meeting convened by the SCCS midway between the congresses. The last ICCP was the 17th, held in Perth Australia from July 3rd to 8th, 2011. The latest major field meeting was held in southern China from November 22nd to 30th, 2010.

CHIEF ACCOMPLISHMENTS AND PRODUCTS IN NOVEMBER 1st, 2010 to OCTOBER 31st, 2011 FISCAL YEAR

The **Newsletter on Carboniferous Stratigraphy, Volume 29**, published in November 2011, includes commentaries by the SCCS executive on current issues, summaries about field meetings and workshops, reports of the task groups for November 1st 2010 to October 31st 2011, and articles on various topics of interest. Volume 29 also contains a revised directory for the corresponding membership. During the last fiscal year, task-group and corresponding members have published a number of papers in refereed journals and in abstract volumes associated with conventions.

Summary of Task Group Reports

The SCCS has six current task groups and one exploratory Project Group.

Task Group to redefine the Devonian–Carboniferous Boundary [which is also the base of the Lower Mississippian Series and Tournaisian Stage] is chaired by Markus Aretz (France) is chaired by Markus Aretz and was established in early 2008. It comprises 10 members appointed by Thomas Becker former Chairman of the Devonian Subcommission (SDS) and 10 members selected by Philip Heckel former Chairman of the SCCS in 2008, who summarized the reasons for establishing the group in the 2008 issue of Newsletter on Carboniferous Stratigraphy [v. 26, p. 3].

Members of the task group are conducting research in several parts of the world and their work focuses on several goals, defined in previous years (Richards and task group, 2010; Aretz, 2011). The task group has been collecting data for a first synthesis on their progress that will be presented at the March, 2013 workshop in Morocco. A few task-group members attended the XVII ICCP in Perth Australia, and three contributions related to the D–C boundary were made.

Boundary criterion. The group is searching for an event for redefining the D–C Boundary, currently defined by what was considered as the first evolutionary occurrence of the conodont *Siphonodella sulcata* (Huddle, 1934) in the lineage *Siphonodella praesulcata* Sandberg, 1972 to *S. sulcata* in the GSSP section at La Serre, France (Paproth and Streel, 1984). A new boundary position that does not substantially change the current level of the D–C Boundary is favored and the search for a new marker is focused on both biotic events and depositional to geochemical markers. The multi-phase Hangenberg Event Interval (Kaiser *et al.*, 2008) is a level of interest but more data on the timing an correlation of phases within the Hangenberg are required before any component of the event can be used for global correlations.

Since the problems with the conodont lineage *S. praesulcata – S. sulcata* and the FAD of *S. sulcata* that are used to define the D–C Boundary at La Serre were recognized (Ji *et al.*, 1989; Kaiser, 2009) clarification of the lineage has been a prime task for the conodont workers. Results have been published for siphonodellids (Kaiser and Corradini, 2011) and protognathodids (Corradini *et al*. 2011), but the two conodont groups do not appear to contain potential index fossils for the boundary. The identification of *S. sulcata* is subjective and, therefore its FAD may not be a suitable boundary marker.

The second conodont group, which is often used as an alternative index to the siphonodellids, is the protognathodids. They have several shortcomings: rarity in many sections, regional variation in the first occurrence data, and restricted stratigraphic and global rages. Thus, none of the *Protognathodus* species [*Protognathodus meischneri* Ziegler, 1969, *Protognathodus collinsoni* Ziegler, 1969, *Protognathodus kockeli* (Bischoff, 1957) and *Protognathodus kuehni* Ziegler & Leuteritze, 1970)] have high potential as an index for boundary redefinition.

Data arising from the current work will be incorporated into correlation charts that will be presented at a March 2013 joint workshop of the SCCS and Subcommission on Devonian Stratigraphy in Morocco.

Progress in Europe. Researchers from the Czech Republic are using a multidisciplinary approach to study the D–C boundary interval. They are working on sections in the southern part of the Moravia – Silesian Basin (Central Europe, Czech Republic) ranging from the late Famennian *expansa* to the early Tournaisian *sandbergi* zones. Protognathodid faunas are rather abundant in the calciturbidite succession in the Lesni lom quarry, where the Hangenberg Event facies are developed. The foraminiferal studies confirm the presence of *Quasiendothyra* up to the *duplicata* Zone. Petrophysical measurements show a relatively good correlation potential within turbiditic facies but the

correlation with the nodular facies is limited. First results of carbon-isotopic studies are interesting and show a positive peak of $\delta^{13}C_{carb}$ in the middle to upper *praesulcata* zones in the Lesni lom quarry.

Hanna Matyja is working with colleagues from Poland and Germany on D–C boundary projects in the subsurface of northwest Poland and in Tian-Shan Range of Central Asia. Their short-term objectives are the establishment of a high-resolution biostratigraphic scheme and stable-oxygen and carbon-isotope profiles but a longer-term goal is to identify the signatures of the Hangenberg Event. Results of the multidisciplinary study of the Pomeranian Basin will be published in a Special Volume of the Geological Society of London. Task-group member D. Brice and B. Mottequin continue to study brachiopods from the boundary interval in Europe and Northern Africa.

North America. Barry Richards continues his ongoing studies of the latest Famennian to early Tournaisian Exshaw Formation in the southern Canadian Rocky Mountains and Foothills of southwestern Canada to see if the main events in the multi-phase Hangenberg Event Interval, can be more precisely located in the formation with a multidisciplinary approach including stable-carbon isotope geochemistry and U-Pb geochronology. Conodont data (Johnston *et al.,* 2010) indicate the contact between Devonian and Carboniferous strata lies in the upper part of the black shale member of the Exshaw at its type section and at several other localities. The position of the D–C boundary has not been precisely located in the Exshaw and it is hoped a multi-discipline approach will more tightly constrain its position.

China. Task-group members E. Poty, M. Aretz and co-workers continue their work on the correlation of latest Devonian to Mississippian shallow-water sequences in Southern China with those in Europe. First results, indicating a high correlation potential of many sequence boundaries, were presented at the XVII International Congress on the Carboniferous and Permian in Perth.

Task Group to establish the Tournaisian-Viséan Boundary [which is also the base of the Middle Mississippian Series] is chaired by George Sevastopulo (Ireland).

Following approval of the proposed GSSP (see Devuyst *et al.,* 2003) at Pengchong in southern China, by the SCCS in late 2007 and its ratification by the ICS and IUGS, task-group member François-Xavier Devuyst has been preparing the final report about the Tournaisian-Viséan Boundary GSSP.

Task Group to establish the Viséan–Serpukhovian Boundary [which is also the base of the Upper Mississippian Series] is chaired by Barry Richards (Canada).

An index for boundary definition has been selected but not voted on and work is well advanced at two prime candidate sections. The group has concluded that the first evolutionary appearance of the conodont *Lochriea ziegleri* Nemirovskaya, Perret & Meischner 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957) -*Lochriea ziegleri* presents the best potential for boundary definition. *L. ziegleri* appears in the Brigantian Substage somewhat below the current base of the Serpukhovian as defined by its lectostratotype section in the Zaborie quarry near the city of Serpukhov in the Moscow Basin, Russia (Kabanov *et al*., 2009). *G*roup members are conducting multidisciplinary research in Europe, Russia, China and North America.

A major accomplishment was completion of the comprehensive study of the foraminifers spanning the Viséan–Serpukhovian boundary in southern Guizhou Province, China by Groves *et al.* (in press).

Meetings. The task group participated in two important meetings during the fiscal year: 1) "The SCCS Workshop on GSSPs of the Carboniferous System: Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou Province, China" and 2) the XVII International Congress on the Carboniferous and Permian in Perth, Australia. The SCCS Workshop, held in Nanjing consisted of two days of working sessions (examination of fossils) and a day of oral presentations. The workshop was followed by a six-day field excursion to Carboniferous and latest Devonian exposures in southern Guizhou province. The field excursion guidebook "Carboniferous carbonate succession from shallow marine to slope in southern Guizhou" edited by Wang Xiangdong *et al*. contains ten chapters dealing with conodonts and foraminifers from the Viséan–Serpukhovian, Bashkirian–Moscovian, Moscovian–Kasimovian and Kasimovian–Gzhelian boundaries in southern Guizhou.

Several task-group members attended the XVII International Congress on the Carboniferous and Permian in Perth presented at Symposium 2 "SCS: Carboniferous stage boundaries" and in several other sessions.

Field activities

Southern Guizhou province, Nashui section. In December a team visited the Nashui section (by village of Naqing) near the city of Luodian in southern Guizhou province to finish measuring and sampling the boundary interval for lithostratigraphic and sedimentologic data. Ten metres of strata on either side of the Viséan–Serpukhovian boundary as defined by the first evolutionary appearance of the conodont *Lochriea ziegleri* were measured at a bed-by-bed level for lithological and geochemical studies. The Viséan–

Serpukhovian boundary is currently placed at 60.1m above the base of the original section measured by Qi and Wang (2005), which is equivalent to a position 17.94 m above the base of the new section measured and permanently marked by aluminum pins glued into drill holes by the task group in 2008.

In the Nashui section, conodonts within the *L. nodosa – L. ziegleri* lineage are well preserved and abundant (Qi, 2008). Elements transitional between *L. nodosa* and *L. ziegleri* are plentiful, occurring in several samples. Unfortunately, the conodonts do not allow direct correlation from the Nashui section to the nearby shallow-water Yashui section because of their paucity in the neritic to restricted-shelf facies at the latter locality. Groves *et al*. (in press) completed their study of the foraminifers across the boundary interval in the section. The association of foraminifers from a 20 meter-thick interval centered about the boundary at Nashui lack species diagnostic of the boundary but contain ones whose previously established ranges were known to extend from the upper Viséan into the lower Serpukhovian.

Southern Guizhou province, Yashui section. The Yashui section, situated near the city of Huishui in Guizhou province, is important because it contains abundant rugose corals and foraminifers and is dominated by shallow-marine neritic to supratidal facies. A major reason for studying the section is to determine the relationship of the coral and foraminiferal zones to the *L. nodosa – L. ziegleri* transition in south China. In February 2010, 101.4 m of the Yashui section were measured and sampled (bed by bed) from the upper Viséan into the upper Serpukhovian. In December of 2010, measurement of the section at a bed-by-bed level was extended into the lower Bashkirian at 121.12 m. Conodont samples collected from the section in 2008-2009 have been processed but yields were poor and the *L. nodosa – L. ziegleri* transition could not be precisely located. The section provides an excellent opportunity to see what the shallow-marine and supratidal platform facies are like in southern Guizhou Province. Groves *et al.,* (in press) completed a comprehensive study of the foraminifers, using samples he collected in May 2008. They found that the base of the Serpukhovian could be approximated using foraminifers but a precise correlation with the first evolutionary occurrence of *L. ziegleri* in the Nashui section could not be established because of the lack of foraminiferal indices for the boundary in the Nashui section and the paucity of conodonts through the boundary level at Yashui.

The foraminiferal successions across the Viséan–Serpukhovian boundary in the type area of the Serpukhovian Stage in the Moscow Basin of Russia (Kabanov *et al*., 2009; Gibshman *et al*., 2009), the Uralian region of Russia (Nikolaeva *et al.,* 2009) and in the central United States suggest that the appearances of *Asteroarchaediscus postrugosus* (Reitlinger, 1949), *Janischewskina delicata* (Malakhova, 1956), "*Millerella*" *tortula* Zeller, 1953 and *Eolasiodiscus donbassicus* Reitlinger, 1956 are useful auxiliary indices to the base of the Serpukhovian. The stage boundary at Yashui is provisionally identified at 41.6 m above the base of the section on the appearance of *Janischewskina delicata*. "*Millerella*" *tortula*, another possible index to the base of the Serpukhovian, appears at 49 m above the base of the section (Groves *et al.,* in press). *Asteroarchaediscus postrugosus* and *Eolasiodiscus donbassicus*, useful markers for the base of the Serpukhovian elsewhere in Eurasia and North America, were observed at Yashui.

Southern Urals, Verkhnyaya Kardailovka section. During August 2011, task-group members worked at the condensed, deep-water, carbonate section along the Ural River near the village of Verkhnyaya Kardailovka on the eastern slope of the Ural Mountains in southern Russia. Nikolaeva and her colleagues have worked on the section for several years and published several syntheses including that of Pazukhin *et al*. (2010). Their syntheses demonstrate the first evolutionary appearance of *L. ziegleri* occurs in the lower part of the limestone-dominant component of the section immediately above an interval containing elements transitional between *L. nodosa* and *L. ziegleri.*

In August 2010 and 2011, the lower 22 m of the Verkhnyaya Kardailovka section was excavated with backhoes and front-end loaders. The section was subsequently permanently marked with aluminum pins glued into drill holes at one metre intervals. In August 2011, the limestone-dominant component of the section was measured and sampled bed-by-bed for lithology and geochemical samples from about 12 m to 35 m above the section's base. During August 2011, the section was systematically sampled for conodonts from 12 m to 20 m above its base. Conodont samples had been collected from the section on prior occasions but additional sampling was required to more precisely tie the conodont biostratigraphy into the new measurements and to confirm the FAD of *L. ziegleri*.

Task Group to establish the Bashkirian–Moscovian Boundary [which is also the base of the Middle Pennsylvanian Series] is chaired by John Groves (U.S.A.).

The task group is conducting research at locations in Europe and Asia and their investigations continue to focus on evolutionary transitions in conodont and fusulinid lineages. Members participated in two salient events: 1) SCCS Workshop on GSSPs of the Carboniferous System:

"Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou", and 2) the preparation of a new proposal for a formal marker event for the lower Moscovian Boundary. In addition, members presented papers at the 2010 XVII International Congress on the Carboniferous and Permian in Perth, Australia.

The SCCS Workshop was held in November, 2010 in southern China and consisted of working sessions and presentations at the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS) followed by a field excursion to southern Guizhou. The field excursion guidebook edited by Wang Xiangdong *et al.* contains ten chapters dealing with conodonts and foraminifers from several levels including the Bashkirian–Moscovian Boundary in southern Guizhou.

At the NIGPAS workshop, Qi Yuping and co-authors gave an important paper: "New interpretation of the conodont succession of the Naqing (Nashui) section: Candidate GSSP for the base of the Moscovian Stage, Luosu, Luodian, Guizhou, South China." They advocated placing the base of the Moscovian in the Nashui section at the joint first appearances of advanced morphotypes of *Streptognathodus expansus* and *Streptognathodus suberectus*. The level coincides with the local appearance of *Neognathodus kanumai* and it occurs about 4 m below the local appearance of *Diplognathodus ellesmerensis*, an event previously identified as a potential boundary marker. Qi *et al.* (2010) clarified the taxonomic distinctions between stratigraphically lower morphotypes of *S. expansus* and *S. suberectus* and the higher, advanced morphotypes of the same species. Additional work is necessary: 1) to show that the advanced morphotypes of *S. expansus* and *S. suberectus* occur elsewhere in evolutionary continuity with their respective ancestors; and 2) to test the biostratigraphic fidelity of the advanced morphotypes relative to other, potential lower Moscovian indices.

Members of the task group developed a new proposal to mark the base of the Moscovian with the FAD of the fusulinoidean genus *Eofusulina* Rauser-Chernousova in Rauser-Chernousova *et al.* 1951 *in* evolutionary continuity with its ancestor *Verella* Dalmatskaya 1951. Operationally, the level can be recognized by the lowest stratigraphic occurrence of a fusulinoidean exhibiting septal fluting across the entire length of its shell. The proposal was circulated within the task group for comments, but a formal vote was not held because a widely held concern was that relatively few sections were known in which the *Verella–Eofusulina* transition could be documented with closely spaced sampling.

Eofusulina triangula (Rauser-Chernousova and Beljaev in Rauser-Chernousova *et al.*, 1936) is among the stratigraphically oldest and most widespread species in the genus. It is distinguished from other early species in the genus by its unusual triangular shell outline. The proposal's authors do not designate this species as the boundary marker, however, because in some areas its FAD is slightly above the FAD of congeneric species that exhibit a more nearly fusiform shape. In other words, the boundary shall be marked by the advent of a genus-rank character (pole-to-pole septal fluting) rather than a species-rank character (shell shape).

Specimens assigned to *Verella spicata* Dalmatskaya, 1951 occur widely in uppermost Bashkirian rocks and specimens assigned to *Eofusulina triangula* occur widely in lower Moscovian rocks. As implied by its name, *Verella transiens* Ginkel and Villa in Ginkel 1987 is intermediate between typical representatives of the two genera. Septal fluting in this species is more intense than in typical *Verella*, but less intense than in typical *Eofusulina*. The type specimens of *V. transiens* are from the lower, but not lowest Vereian of northwestern Spain. Other conspecific specimens are known from Limestone I3 in the Donets Basin of Ukraine, just below the joint appearances of *Eofusulina* sp. and *Declinognathodus donetzianus* in Limestone K1 (Nemyrovska *et al.,* 2010). Thus, the stratigraphic range of *V. transiens* spans the Bashkirian–Moscovian boundary as traditionally recognized. The existence of this morphologically and stratigraphically transitional form further demonstrates the concept of the *Verella–Eofusulina* evolutionary continuum.

FADs of the fusulinoideans *Profusulinella prisca* (Deprat, 1912) and *Aljutovella aljutovica* (Rauser-Chernousova, 1938) are designated as auxiliary events for marking the base of the Moscovian. Both species are widespread throughout the geographic area containing *Eofusulina* spp., and both have been utilized in formal zonal schemes for marking the base of the Moscovian.

Fusulinoideans are rare in many deeper-water deposits. The base of the Moscovian can be approximated in the absence of fusulinoideans by the FADs of the conodonts *Declinoghathodus donetzianus* and *Diplognathodus ellesmerensis* (Nemyrovska, 1999; Qi *et al.*, 2007), and possibly by the FADs of advanced morphotypes of *Streptognathodus expansus* and *S. suberectus* (Qi *et al.*, 2010).

Additional Activities

Katsumi Ueno (Fukuoka University, Japan) along with his students and colleagues recently studied latest Bashkirian–earliest Moscovian fusulinoidean biostratigraphy of the Zongdi section in southern Guizhou Province, South China. They investigated a 50-m interval, focusing on the *Verella-Eofusulina* lineage. This interval in the Zongdi section consists chiefly of shallow-marine bioclastic limestone with

frequent dolomitic levels and several subaerial exposure surfaces with paleosols. At Zongdi the lowest *Verella* occurs at 56 m and specimens continue up to 76 m. The lowest *Eofusulina* occurs at 80.5 m and others are commonly found up to 95 m. It is important to note that the FAD of *Eofusulina* is just below the first subaerial exposure in the studied interval, suggesting that the evolutionary first appearance event of *Eofusulina* from *Verella* might be recorded here. The Zongdi section is one of few sections on the Yangtze Carbonate Platform of South China that yield both *Verella* and *Eofusulina*.

Demir Altiner and colleagues from Ankara studied the sequence stratigraphy and fusulinoidean biostratigraphy of Bashkirian–Moscovian boundary beds in the Tauride Belt in southern Turkey. Three sections spanning the Lower Bashkirian (Askynbashky) to Lower Moscovian (Solontsovsky) beds were measured on a bed-by-bed basis. The Bashkirian–Moscovian boundary is recognized by the first occurrence of *Profusulinella prisca* within the *P. staffellaeformis-P. paratimanica* lineage. This level coincides with the first occurrence of *Aljutovella aljutovica*. The lowest occurrence of the genus *Eofusulina* is slightly higher than that of *P. prisca* and *A. aljutovica*. Upward-shoaling cycles indicate the presence of two third-order sequences dated as Askynbashky to lowermost Asatausky and Asatausky to Solontsovsky. Sandstone intercalated within the Upper Bashkirian carbonate succession represents a falling-stage systems tract deposited during the culmination of the second Carboniferous glacial interval. Following the sea-level fall in the earliest Asatausky, a new carbonate regime was installed in the Asatausky-Solontsovsky interval by a glacio-eustatic sea-level rise. The Bashkirian–Moscovian boundary seems to be located within the transgressive systems tract of the new regime.

Task Group to establish the Moscovian–Kasimovian Boundary [which is also the base of the Upper Pennsylvanian Series], and the **Kasimovian–Gzhelian Boundary** is chaired by Katsumi Ueno (Japan).

Task-group members are working in several parts of the world but current activities are focused on the study of fusulines and conodonts from sections in South China and Russia. Substantial progress has been made on locating an event marker for the Moscovian–Kasimovian Boundary and the FAD of a conodont has been selected for definition of the Kasimovian–Gzhelian Boundary

Progress reports from task group members

South China. Qi Yuping and James Barrick have been studying conodonts from the uppermost Moscovian to lower Gzhelian slope carbonates in the Naqing (Nashui) section, southern Guizhou, South China. They think the FAD of *Idiognathodus turbatus* Rosscoe and Barrick 2009 is the best potential boundary marker for the base of the Kasimovian Stage. Conodonts are abundant in late Moscovian deposits, but they are strongly dominated by a succession of morphotypes of *Swadelina*. The Naqing *Swadelina* interval can be correlated with the Krevyakian Substage in the Moscow Basin type succession and with the latest Desmoinesian in North American. In the Naqing section, a new association of *Idiognathodus* morphotypes appears at 236.0 m and elements of *Swadelina* disappear by this level. Some new morphotypes resemble the characteristic early Kasimovian species *Idiognathodus turbatus*. In the collection from 235.75 m to 236.60 m, many transitional morphotypes (which are similar to *Idiognathodus sagittalis* Kozitskaya 1978) with rapid morphological transformation from *Idiognathodus swadei* Rosscoe and Barrick 2009 to *I. turbatus* occur. Therefore, the important conodont evolutionary lineage from *I. swadei* to *I. turbatus* is confirmed in the Moscovian–Kasimovian boundary interval in the Naqing section.

The task group to establish the Kasimovian–Gzhelian boundary has selected the conodont *Idiognathodus simulator* (Ellison, 1941) *s.s.* as the event marker for defining the base of the Gzhelian (Heckel *et al*., 2008) and is directing research toward selecting a suitable section for the GSSP. Within the Naqing section, Qi and Barrick have been investigating the conodont faunal change of the Kasimovian–Gzhelian transitional interval. In the uppermost Kasimovian, the less common *Idiognathodus* species include morphotypes with reduced lobes, and more significantly, forms with a weakly developed eccentric groove that could be the ancestor of *I. simulator.* After a thin (about 1.5 m thick) conodont-poor interval in the uppermost Kasimovian, diverse and abundant conodonts appear at 255.6 m and they include the first *Idiognathodus simulator*, which marks the base of the Gzhelian in the Naqing section. Therefore, the presence of the lineage of *I. simulator* from its potential ancestor has been proven using the new conodont collections from the section. Although they allow recognition of the boundary, existing collections from the Kasimovian–Gzhelian boundary interval at Naqing are not sufficient to make a complete description of the boundary conodont faunas. Qi and Barrick are working on new and larger collections from the critical boundary interval to obtain a more complete understanding of the conodont fauna and to enable a better evaluation of the Naqing section as a stratotype section for the base of the Gzhelian Stage.

In addition to the Naqing section, Qi Yuping recently found several new sections covering the Moscovian–Kasimovian and Kasimovian–Gzhelian boundary intervals in southern Guizhou. Among them the Narao and Fengting sections seem to be

promising for further boundary work as many debris flows containing fusulines occur together with fine-grained, potentially conodont-rich limestones in both sections. The new sections probably represent shallower environments than the lithofacies in the Naqing section and present a potential for correlating the chronostratigraphic framework within the Yangtze Carbonate Platform by using conodont and fusuline biostratigraphy.

Russia Valery Chernykh recently studied in detail the morphological status of "*Streotognathodus*" *simulator* (=*Idiognathodus simulator* by some authors) from the Urals and compared them with the representatives of this species from the Midcontinent region of North America. Chernykh proposed to change the diagnosis of this conodont species. This taxonomic modification would enlarge the morphological range of the species, making it possible to explain the difference between the American and Eurasian forms as intraspecific variability. Chernykh also examined the stratigraphic value of associated conodonts from the group *simulator*.

Ukraine Tamara I. Nemyrovska and Katsumi Ueno recently worked in the Lugansk region of the Donets Basin in Ukraine, studying the Annovka section in the Bryanka area. The Annovka section includes the upper part of the C2\7 Suite (Limestone M) and the C3\1 (Limestone N), broadly corresponding to the Moscovian–Kasimovian Boundary interval.

General activities

Task-group members attended several meetings and workshops but the most significant were "The SCCS Workshop on GSSPs of the Carboniferous System: Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou" (November, 2010) and the XVII International Congress on the Carboniferous and Permian held in Perth, Australia (July, 2011).

The SCCS November workshop, held in Nanjing China consisted of working sessions (examination of fossils) and a day of oral presentations that included several talks of interest to the task group. The workshop was followed by a field excursion to southern Guizhou province that enabled participants to examine the Moscovian–Kasimovian and Kasimovian–Gzhelian boundaries at the shallow-water Zhongdi section and the deep-water Nashui (Naqing) section. The guidebook "Carboniferous carbonate succession from shallow marine to slope in southern Guizhou" edited by Wang Xiangdong *et al*. contains ten chapters dealing with conodonts and foraminifers from several levels including the Moscovian–Kasimovian and Kasimovian–Gzhelian boundaries in southern Guizhou.

At the XVII International Congress on the Carboniferous and Permian, held in Perth Australia in July 2011, task-group members gave several presentations directly related to the group's activities.

The Project Group on Carboniferous Magnetostratigraphy is chaired by Mark Hounslow (United Kingdom), who did not submit a progress report the November 1st, 2010 to October 31st, 2011 fiscal year but summarized the recent work of the group through June 2009 in volume 27 of the Newsletter on Carboniferous Stratigraphy.

Progress by the project group has been hampered by a shortage of members, insufficient funding, and a lack of integration with the activities of the other SCCS task groups. The group is particularly interested in collaborating with task groups working on sections and boundaries where magnetostratigraphy could be employed, to facilitate international correlations. Sections that have low thermal maturity and are dominated by siliciclastics are the most suitable for magnetostratigraphic analyses (review in SCCS Newsletter, v. 22: 35-41) but carbonates can be used. Unfortunately, most of the best GSSP candidate sections are carbonate dominant and thermally over mature but some reference sections and stratotypes for stages show potential. The study of Mississippian magnetostratigraphic has languished and much remains to be done before Carboniferous magnetostratigraphy can be widely applied to facilitate global correlations.

During the May 31st to June 3rd 2010 ICS meeting in Prague, the task group leader discussed with Barry Richards and Svetlana Nikolaeva (Russia) the possibility of designing a magnetostratigraphic project that would evaluate Late Mississippian and Pennsylvanian sections in the Moscow Basin, Lard Basin in northwestern Canada and sections in the mid-continent region of the USA. So far, these initial discussions have not developed into tangible outcomes and the main problems stem from a lack of funding and suitable investigators.

John Utting (member Viséan–Serpukhovian boundary task group) and colleagues Peter Giles (Geological Survey of Canada-Atlantic) and Neil Opdyke (University of Florida) have completed a very useful magnetostratigraphic study of the Brigantian, Pendleian and much of the Arnsbergian substages (upper Viséan and Serpukhovian) in the Maritimes Basin of eastern Canada (Giles *et al*., in progress). They have correlated the polarity reversal patterns in the Maritimes Basin with published data from the Brigantian to mid-Arnsbergian interval in the central part of the Appalachian Basin in the eastern United States (Di Venere and Opdyke, 1990, 1991).

Conferences and field meetings November 1st, 2010 – October 31st, 2011

During the last fiscal year there were several geological conferences, field meetings and workshops that SCCS members needed to attend. The most significant meetings for the subcommission were "The SCCS Workshop on GSSPs of the Carboniferous System: Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou Province, China" (November 22nd – 29th, 2010) and the XVII International Congress on the Carboniferous and Permian in Perth, Australia (July 3rd -8th, 2011). In this Annual Report, we summarize relevant components of the Nanjing-southern Guizhou field meeting and the business meeting associated with the XIVICCP. The full report from the latter business meeting (Aretz *et al*., 2011) is published in volume 29 of the Newsletter on Carboniferous Stratigraphy.

Report on the SCCS Workshop on GSSPs of the Carboniferous System: Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou Province, China (November, 2010)

The SCCS Workshop, November 22nd to 24th 2010, was organized by Xiangdong Wang and his colleagues and held at the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS). It consisted of two days of working sessions (examination of fossils) and a day of oral presentations. Several talks of interest to the task groups were given and are listed under the full task-group reports in Appendix B of the full annual report. The workshop was followed by a six-day field excursion to Carboniferous and latest Devonian exposures in southern Guizhou province. The 2010 field excursion guidebook "Carboniferous carbonate succession from shallow marine to slope in southern Guizhou" edited by Wang Xiangdong *et al*. contains ten chapters dealing with conodonts and foraminifers from the Viséan–Serpukhovian, Bashkirian–Moscovian, Moscovian–Kasimovian and Kasimovian–Gzhelian boundaries in southern Guizhou. The excursion enabled the participants to examine boundary sections for all of the Carboniferous stage boundaries that the SCCS is currently working on to establish GSSPs.

Report on business meeting at XVII International Congress on the Carboniferous and Permian held in Perth, Australia (July 3rd - 8th, 2011)

The SCCS business meeting was held on the 4th of July 2011 at Perth, Australia during the 17th ICCP and was attended by the SCCS executive and several regular voting members. The meeting dealt with several topics, presented here in the order discussed at Perth.

Membership and Composition of Subcommission 2012-2016

The leadership and membership situation within the SCCS was outlined by the Chairman as follows. The current Chairman and Assistant Chairman were voted into office in 2008 and can be re-elected for one additional term. The Secretary/Treasurer was appointed by the subcommission Chairman; an election was not required. Six regular SCCS voting members D. Altiner, D.R. Boardman, L. Hance, T.I. Nemyrovska, B.C. Richards and K. Ueno will complete their third term in 2012 and must step down from that position during the August 2012 IGC.

During the meeting, a lively discussion occurred over the issue of whether or not the work of the SCCS can be carried out satisfactorily if subcommission Chairs and task-group leaders are required to retire as regular voting members. Some meeting participants felt that the SCCS should be more flexible and ensure the continuity of work within task groups by not requiring task-group leaders to retire after serving three terms. Scientists supporting this position suggested exceptions should be made because in several other ICS subcommissions some voting members retain their status well over 16 years. Other members expressed that the SCCS has always worked well with the 12 years rule, since it guarantees a high and diverse level of participation by the community of Carboniferous researchers. The Chairman indicated that task-group leaders can function adequately if they are not voting members and that some task groups have been led for years by scientists who were not voting members.

Xiangdong Wang and I (B. Richards) declared our willingness to serve for a second term as Chairman and Assistant Chairman, respectively. Markus Aretz was asked if he would continue as the SCCS Secretary-Treasurer for another term but he replied by stating the Chairman for 2012-2016 must be elected before the secretary position can be filled.

Newsletter

It was announced that the publication date shown on the Newsletter on Carboniferous Stratigraphy has been changed from July to November and that the change will be mentioned in the Annual Report the SCCS submits to the ICS. The question of whether or not we should apply for an ISSN number for the newsletter was discussed briefly.

SCCS Mandate

I (Chairman) indicated that establishing GSSPs for stage and series boundaries is the primary task of the SCCS and that ICS want to see the subcommission make more rapid progress on

defining the remaining GSSPs. In this regard, I reminded participants that proposals for boundary definition and the use of specific sections for GSSPs need to be written and put to vote. It was suggested that the task group for the definition of the base of the Serpukhovian should have a formal vote on the boundary criterion.

A lively discussion about holding a vote on a published proposal submitted by Vladimir Davydov and his colleagues to use the Usolka section in the southern Ural Mountains of Russia for the GSSP of the Kasimovian–Gzhelian boundary followed. Katsumi Ueno, Chairman of the Kasimovian–Gzhelian task group along with some other SCCS members, stated that before a decision can be made on the Usolka section, the boundary level must be adequately excavated.

CHIEF PROBLEMS ENCOUNTERED IN 2011

Several problems confronted the SCCS task groups during the fiscal year and most are ongoing. Many of the most active specialists are working on two or more task groups and have over extended themselves, making it difficult to make substantial progress during any one fiscal year. Progress by the project group on Carboniferous magnetostratigraphy has been hampered by a shortage of members, insufficient funding, and a lack of integration with the activities of the other task groups.

The most significant issue confronting the SCCS is the difficult and time-consuming task of locating suitable evolutionary lineages and first occurrences for boundary definition. Within the Carboniferous, the endemism of conodont, foraminiferal and ammonoid lineages between Eurasia and North America continues to hamper the choice of the boundary levels for the Viséan–Serpukhovian and Bashkirian–Moscovian boundaries. The problem is being overcome somewhat by correlating other fossil groups to bracket the boundary levels in major regions where the boundary-event taxa have not been found.

Essentially all lineages being chosen for GSSP definition are conodont based and have the most utility in carbonate-dominant lower-slope and basin deposits containing few other taxa than ammonoids that are suitable for global correlations. The best of the known deeper water successions in terms of abundance and diversity of conodonts and continuity of outcrop are in southern China and the southern Urals. The direction the current work of the SCCS is advancing indicates all of the remaining GSSPs will be placed in south China and Russia. Additional suitable sections, even if they just become reference sections, should be located and intensively studied in Western Europe, northern Africa/Middle East, and North America.

Some lineages used in the past for boundary definition such as the *Siphonodella praesulcata*-*Siphonodella sulcata* conodont lineage, used to define the Devonian–Carboniferous boundary, were not sufficiently known prior to being used for GSSP definition. Specialists are finding those lineages are either no longer suitable for defining and correlating boundaries or require intensive re-evaluation.

Bureaucratic regulations have made it exceedingly difficult to export ordinary rock samples from Russia, thereby impeding progress on the study of Russian sections by SCCS members outside of Russia.

SUMMARY OF EXPENDITURES IN 2011

Statement of operating accounts for November 1st, 2010 to October 31st, 2011

Prepared by Barry Richards, Chairman SCCS

(Accounts maintained in Canadian currency)

INCOME (November 1, 2010 – October 31, 2011)

IUGS-ICS Grant; July 14, 201 (US $1,800 = $1,679.40 Cdn.)	$1,679.40
Donations from Members; November 1, 2010 – October 31 2011	$100.00
Interest Bank of Montreal; November 1, 2011 – October 31, 2011	$0.17
TOTAL INCOME	**$1,779.57**

EXPENDITURES (November 1, 2010 – October 31, 2011)

Bank Charges: Bank of Montreal July 14, 2011	$0.00
Richards travel to Nanjing for SCCS workshop and field meeting; Nov. 23 – Dec. 7, 2010	$500.00
Travel and registration support for SCCS chairman and voting members to XVII International Congress on the Carboniferous and Permian in Perth, Australia; July 2011	$1,000.00
Travel support for SCCS chairman to attend SCCS field meetings in southern Urals, Russia in August 2011	$500.00
TOTAL EXPENDITURE	**$2,000.00**

BALANCE SHEET (2010 – 2011)

Funds carried forward from October 31, 2010	$1,215.00
Plus Income November 1, 2010 – October 31, 2011	$1,779.57
Total assets	**$2,994.57**

Less Expenditures November 1, 2010 – October 31, 2011 $2,000.00

BALANCE CARRIED FORWARD (to 2011 – 2012 fiscal year) **$994.57**

WORK PLANS, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2012):

The following activities are planned for the new fiscal year (Nov. 1, 2011 to Oct 31, 2012) by the task groups, as communicated by task-group chairs and distilled from the progress reports.

Devonian–Carboniferous boundary The primary tasks for the D-C boundary task group continues to be the location of a suitable event marker to define the boundary and location of a suitable section for the GSSP. A biostratigraphic analysis by Ji Qiang and his colleagues (Ji *et al*., 1989) and further work (Kaiser, 2009) indicates that there are problems with the D-C Boundary GSSP (Paproth *et al*., 1991) at La Serre, France.

At the onset of the reappraisal project in 2008, the SCCS executive hoped the current event marker, the FAD of the conodont *Siphonodella sulcata,* could be used for boundary definition. Preliminary results from the re-evaluation of the lineage containing that index (Kaiser and Corradini, 2011) suggest it is not useable but addition work is required by other specialists to test their findings. Slightly later in the project, it was thought a protognathodid conodont lineage could be used for D-C boundary definition but the assessment of that group has not provided favorable results (Corradini *et al*., 2011).

Considerable progress on re-evaluating the lineage containing the current D-C boundary marker, the FAD of the conodont *S. sulcata,* has been made. Additional study of the lineage is required, however, and the task group plans to complete that work shortly. In the La Serre section, Corradini and Kaiser (2009) identified seven morphotypes in the transition from *S. praesulcata* to *S. sulcata*. Unfortunately, the conodonts within the transition are reworked and no correlation exists between the stratigraphic level and individual morphotypes. The task group plans to determine if any correlation between the morphotypes and stratigraphic level exists in other D-C boundary sections, where reworking is not an issue.

Several task-group members have been studying the taxonomic and phylogenetic problems within the protognathodid conodont lineages (Corradini *et al*., 2011). Four species of *Protognathodus* are known from the relevant time span: *Protognathodus meischneri, P. collinsoni, P. kockeli* and *P. kuehni.* Presently favoured for boundary definition are the first occurrences of *P. kockeli* from *P. collinsoni* and *P. kuehni* from *P. kockeli.* The SCCS executive has asked the conodont specialists to evaluate the utility of using the lineages for boundary definition by studying them in the best of their D-C boundary sections.

If the FAD of *S. sulcata* is retained for boundary definition, a suitable section for the GSSP is required because work at La Serre (Ji *et al*., 1989; Kaiser, 2009; Corradini and Kaiser, 2009) indicates the lack of a phylogenetic transition from *S. praesulcata* to *S. sulcata* in that section. In addition, the section is not suitable because the first occurrence of *S. sulcata* occurs immediately above an abrupt facies change (ooid grainstone on sandy shale) that is probably erosional. Because of the potential break, some task-group members are completing independent sedimentologic assessments of that contact and section.

At the July 2010 ICP3 workshop in London and at other recent meetings, it was proposed that we consider using some component of the multiphase Hangenberg Event Interval (Kaiser *et al*., 2008) for boundary definition. At the end of the meeting, Markus Aretz asked participants to prepare for the D-C boundary workshop in Morocco from (March 25th to April 1st, 2013; see circular in v 29 of Newsletter on Carboniferous Stratigraphy), by developing precise correlation charts for their regions of study showing the biostratigraphic, geochemical and depositional events within the Hangenberg Event.

Four of the D-C boundary projects that are planned for next four to five years are outlined below. 1) Vladimir Pazukhin along with Yuriy Gatovsky and Lyudmila Kononova (Moscow State University) plan to complete a monograph on the conodont biostratigraphy of D-C boundary interval in the Ural Mountains of Russia. The study will consider the interval from the Famennian *marginifera* Zone into the Tournaisian *isosticha* Zone. 2) Chinese colleagues along with the SCCS executive and task-group leaders initiated a re-assessment of the best D-C boundary sections in China by visiting the Dapoushang section (Ji *et al*., 1989) in southern Guizhou Province during the November 22nd – 29th 2010 SCCS workshop and field meeting. 3) Task-group member Jiri Kalvoda and colleagues from the Czech Republic are conducting a multidiscipline project to study the D-C Boundary interval in Western Europe including the La Serre section. The project's principal goal is the correlation of evolutionary changes in foraminifer and conodont faunas in the D-C Boundary interval with a high-resolution stratigraphic framework arising from multidiscipline stratigraphic-paleoenvironmental analysis. Anticipated benefits of the project for the ICS and SCCS are a better understanding of the *S.*

praesulcata – S. sulcata lineage and whether or not it is suitable for definition of the D-C Boundary GSSP. Other conodont lineages relevant to the boundary (protognathodids lineages) will also be evaluated. The resulting high-resolution stratigraphy will be used to test the isochroneity of the events within the Hangenberg Event Interval and contribute to a better correlation between basinal and shallow-water successions. 4) In western Canada, Barry Richards intends to continue ongoing studies of the latest Famennian to early Tournaisian Exshaw Formation (see Richards *et al.*, 2002) and its correlatives to see if the main events in the multi-phase Hangenberg Event Interval can be more precisely located in the formation by using a multidisciplinary approach. The work is part of a broader investigation intended to access the hydrocarbon resources of the interval and will include examination of coeval correlatives (including Bakken Formation) in adjacent areas.

Tournaisian-Viséan boundary The task group plans to continue with its preparation of the final manuscript for the project.

Viséan–Serpukhovian boundary. Since determining that the FAD of the conodont *Lochriea ziegleri* in the lineage *Lochriea nodosa – Lochriea ziegleri* is the best index for boundary definition, the task group will draft a proposal advocating the use of that index and direct its attention toward selecting the best candidate section for the GSSP. The best two candidate sections are the Nashui section by the village of Naqing in southern Guizhou Province, China and the Verkhnyaya Kardailovka section on the Ural River in southern Russia. A third section by the village of Millaró in the Cantabrian Mountains of northern Spain may have potential rivaling that of the others.

Activities in South China

The deep-water (slope), carbonate-dominant Nashui section in southern Guizhou Province, China is an excellent candidate for the GSSP at the base of the Serpukhovian because the *L. nodosa – L. ziegleri* lineage is well defined and the FAD of *L. ziegleri* precisely located. The conodont studies for the locality are essentially complete and the FAD of *L.* ziegleri is located at 60.10m (Qi *et al.*, 2010) above the base of the section. Some additional work is required including the slicing the bed (parallel to bedding) containing the FO and the immediately underlying bed to see if boundary can be more precisely located. John Groves plans to complete his study of the foraminifers in the section, thereby finishing most of the work needed for that important fossil group. Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the boundary interval are less advanced than the paleontological investigations and will be the focus of the team's work in the next two fiscal years. To place the Nashui section into its sedimentologic and paleoenvironmental context and to determine the relationship of shallow-water coral zones to the deeper-water *L. nodosa – L. ziegleri* transition in south China, the investigation of three reference sections - the Yashui, Dianzishang, and the Luokun sections - will continue.

The most important reference section for Nashui is the Yashui section, near the city of Huishui in Guizhou province. It is an important section because it contains abundant well-preserved rugose corals and foraminifers (Wu *et al.*, 2009) and is dominated by neritic- to peritidal-ramp facies. In 2010 the Yashui section was measured and described by at a bed-by-bed level of detail and sampled by team members for lithology, conodonts, foraminifers, and rugose corals. John Groves plans to complete his study of the foraminifers in the lower part of the section prior to the end of the fiscal year. Investigations on the sedimentology, stable-isotope geochemistry and geophysical characteristics of the section are less advanced than the paleontological work and will be the focus of the team's work in 2012.

Strata in the Dianzishang section, situated by Dianzishang village along the Zin Zai River 1 km upstream from the Red Flag Bridge, are intermediate between the lower-slope to basin deposits at Nashui and the shallow-marine ramp deposits at Yashui. The Dianzishang section includes spectacular syndepositional slump deposits formed in slope settings and provides another opportunity to see conodonts and foraminifers spanning the *L. nodosa – L. ziegleri* transition in the region. In February 2010, task-group members measured 72.7 m of strata extending from the uppermost Viséan into lowermost Bashkirian. Conodont work at the locality has been completed to the extent that the Viséan–Serpukhovian boundary has been located using the *L. nodosa – L. ziegleri* transition. J. Groves plans to complete his study of the foraminifers in the section by the end of the fiscal year. Work on the sedimentology, stable-isotope geochemistry and geophysical characteristics of the boundary interval and section are not as advanced as the paleontological studies and will be an important aspect of the work at the locality in the next two fiscal years.

During 2010, the task group commenced measuring and sampling of the Luokun section, situated by the village of Luokun several kilometres from Naqing and the Nashui section. Like the Nashui section, the exposure at Luokun is essentially 100% complete but dominated by slope carbonates of that are more proximal aspect than those at Nashui. Study of the section will provide another opportunity to see conodonts and foraminifers spanning the *L. nodosa – L. ziegleri* transition in the

region. Foraminifers are more abundant and better preserved than at Nashui, and it is anticipated that a better correlation between conodonts and foraminifers can be achieved by the study of the Luokun section. Study of all aspects of the section is at a preliminary level but sufficient biostratigraphic work has been completed to locate the approximate positions of the Viséan–Serpukhovian and Serpukhovian-Bashkirian stage boundaries. During 2012 – 2013, the task group plans to complete the measurement and sampling of the section at a bed-by-bed level.

Activities in Southern Urals, Russia

The Kardailovka section, a deep-water basinal succession on the Ural River near the village of Verkhnyaya Kardailovka in the Urals remains the other strong candidate for the Viséan–Serpukhovian boundary GSSP because of its conodonts characteristic of the *L. nodosa*-*L. ziegleri* transition, abundant ammonoids, and moderately common foraminifers. During the summers of 2010 and 2011, the lower part of section was completely exposed using a backhoe and aluminum marker pins were placed at one-metre intervals. Conodonts, foraminifers and ammonoids in section have been studied in detail (Nikolaeva *et al*., 2009; Pazukhin *et al*., 2010) but additional collections will be required when the section is measured and sampled at a bed-by-bed level in August 2012. Sufficient conodont work been done to locate the approximate position of the FAD of the conodont *L. ziegleri* in the lineage *L. nodosa* – *L. ziegleri* but additional collecting of closely-spaced samples is required to more completely document the transition and precisely locate the FAD of *L. ziegleri*. Work on the sedimentology, stable-isotope geochemistry and geophysical characteristics of the section is less advanced than the paleontological work and will be a focus of the team's investigations in 2012 and 2013. The sections contains numerous volcanic ash layers near the boundary level and the task group will have the most important ashes dated using the U-Pb isotope dilution thermal ionization mass spectrometry (ID-TIMS) methodology. A couple of relatively shallow-water but poorly-exposed sections such as the Bolshoi Kizil River section (Kulagina *et al*., 2009) occur in the region. The task group plans to start measuring the best of them in 2012 to place the important Kardailovka section into its sedimentological and paleoenvironmental context and to determine the relationship of shallow-water coral and foraminiferal zones to the deeper-water *L. nodosa* – *L. ziegleri* transition at Kardailovka.

Activities in Cantabrian Mountains, northern Spain

In June 2010, Javier Sanz-López and Silvia Blanco-Ferrera introduced task-group members to several sections spanning the Viséan–Serpukhovian boundary in the Cantabrian Mountains of northwestern Spain. One of the sections, the Millaró section by the village of Millaró in the fold and Nappe province of the Cantabrian zone, is excellent rivaling the better known Kardailovka and Nashui exposures. Conodonts within the *L. nodosa* – *L. ziegleri* lineage are well preserved and abundant; in addition, the first occurrence of *L. ziegleri* has been located with moderate precision. A major biostratigraphic advantage of the section is the common occurrence of abundant, well-preserved ammonoids being studied by team-member Svetlana Nikolaeva. Deposits within the *L. nodosa* – *L. ziegleri* transition are dominated by nodular, deep-water, basin carbonates of the Alba Formation. The conodont biostratigraphy has been moderately well established (Sanz-López *et al*., 2007) but the FAD of *L. ziegleri* may need to be more precisely located and sedimentological, geophysical and geochemical analyses are required. During 2012 to 2013, the team plans to systematically sample the section for ammonoids and commence sedimentological, geophysical and geochemical analyses.

Activities in Rocky Mountains, Canada

The task-group chairman along with corresponding members Sergio Rodriguez and Wayne Bamber will continue to study carbonate-dominant sections across the Viséan–Serpukhovian boundary interval in the upper Viséan to Serpukhovian Etherington Formation in the southern Canadian Rocky Mountains. They are preparing a monograph on the taxonomically diverse rugose coral faunas that span the boundary within the Etherington. Although none of the Etherington sections are likely to be candidates for the GSSP, the investigation will provide valuable biostratigraphic and sedimentologic data that will assist correlations between Western North America and the low-latitude tropical-marine successions of Europe and Asia.

Bashkirian–Moscovian boundary The task group is conducting research in Eurasia to continue its evaluation of lineages suitable for boundary definition. Investigations focus on evolutionary transitions in conodont and fusulinid lineages and it is anticipated that during the new fiscal year a lineage and taxon suitable for boundary definition will be selected.

During the coming fiscal year, most work will be directed on localities in Guizhou Province, South China. The well-known Naqing (= Nashui) section contains exceptionally abundant and diverse conodonts in a relatively deep-water, slope setting (Qi *et al*., 2007; 2010). Fusulinids are present at Naqing, but they are less abundant and not as well preserved the conodonts. Qi Yuping is leading a

group of conodont specialists who have identified three levels at which a lower Moscovian boundary might be placed. The lowest potential marker is the appearance of *Streptognathodus expansus* Igo & Koike, 1964 at 169.05 m above the base of the section. This species appears in evolutionary continuity with a yet-to-be-named ancestor. The next higher potential marker is the appearance of *Diplognathodus ellesmerensis* Bender, 1980 at 174.3 m. Whereas the evolutionary origin of *D. ellesmerensis* was once unclear, Qi and his colleagues now report the discovery of a transitional form linking *D. orphanus* with *D. ellesmerensis*. The highest potential boundary level is the appearance of *Mesogondolella* spp. (e.g., *M. donbassica*) at 179.9 m. *Mesogondolella* is an attractive marker because it is easily identified and widespread geographically, but its appearance is consistently above those of *Declinognathodus donetzianus*, *Neognathodus kanumai* and *N. atokaensis*, which are conventionally regarded as Moscovian indices. Work for the coming year will involve formally describing the ancestor to *S. expansus*, fleshing out evolutionary relationships between *D. orphanus* and *D. ellesmerensis* and testing the intercontinental biostratigraphic fidelity of the potential marker events.

Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the boundary interval in the Nashui section are not as advanced as the paleontological investigations and need to be a focus of the team's work in 2012. During 2012, the task group plans to complete measuring the Moscovian component of the section into the lower Kasimovian and finish a bed-by-bed analysis of the strata over a 10 to 20 metre-thick interval on either side of the probable boundary level.

Fusulinid specialists in the task group recently proposed the FAD of *Eofusulina* as a potential marker for the base of the Moscovian Stage. This prompted Katsumi Ueno along with Japanese and Chinese colleagues to re-sample platform carbonates at the Zongdi section (Ueno *et al*., 2007) in an attempt to demonstrate a continuous *Verella–Eofusulina* lineage. At Zongdi the lowest *Verella* was found at 56 m and specimens continue up to 76 m. The lowest *Eofusulina* occurs at 80.5 m and others are commonly found up to 95 m. Ueno *et al*. noted that the FAD of *Eofusulina* is just below a subaerial exposure surface at 83.0 m, suggesting that at this locality the derivation of *Eofusulina* from *Verella* might be a true evolutionary first appearance event. Ueno and colleagues will continue their investigation of the *Verella–Eofusulina* lineage at Zongdi and also at the recently discovered Luokun and Dianzishang sections, which are known to contain good conodont and fusulinid faunas.

Demir Altiner and colleagues conducted an analysis of the sequence stratigraphy and fusulinid biostratigraphy of Bashkirian–Moscovian boundary beds in the Tauride Belt, southern Turkey. Three overlapping sections spanning the Lower Bashkirian (Askynbashky) to Lower Moscovian (Solontsovsky) beds were measured and sampled on a bed-by-bed basis. The Bashkirian–Moscovian boundary is recognized locally by the first occurrence of *Profusulinella prisca* within the *P. staffellaeformis-P. paratimanica* lineage. Turkish sections might rival those in South China as candidates for the basal Moscovian GSSP but it is necessary to undertake detailed analyses of the conodonts in order to integrate sequence stratigraphy with a combined conodont-fusulinid biostratigraphy.

Moscovian–Kasimovian boundary During the 2012 fiscal year, the ongoing biostratigraphic analyses reported on in the 2011 progress report will continue particularly in southern China. Qi Yuping and James Barrick have been studying conodonts from the uppermost Moscovian to lower Gzhelian slope carbonates in the Naqing (Nashui) section, southern Guizhou, South China. They consider that the FAD of *Idiognathodus turbatus* Rosscoe and Barrick 2009 is the best potential boundary marker for the base of the global Kasimovian Stage. The task-group leader hopes a proposal to use *I. turbatus* for boundary definition can be developed in the new fiscal year. After such a proposal is made and voted on, additional taxonomic work and comparison of morphotypes from different regions can be continued. The proposal would be based on specimens from south China and also recognized in the Midcontinent region of the U.S.A., the Moscow Basin, the southern Urals of Russia, and Donets Basin of Ukraine. The use of *I. turbatus* would raise the base of the Kasimovian up one substage from the traditional position at the base of the Krevyakinian Substage, to approximately the base of the Khamovnikian Substage but will facilitate global correlation.

Activities in southern China

During the last several years, Qi Yuping and James Barrick have been studying conodonts from the uppermost Moscovian to lower Gzhelian slope carbonates in the Naqing (Nashui) section, southern Guizhou Province. As a consequence of that work, they consider that the FAD of *Idiognathodus turbatus* is the best potential boundary marker for the base of the Kasimovian. They will continue with intensive studies to provide more detailed information on the conodont succession across the Moscovian–Kasimovian boundary in the Nashui section (Qi *et al*., 2007; Barrick *et al*., 2010) as a potential GSSP locality.

Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the Moscovian–Kasimovian boundary interval at Nashui is less advanced than the paleontological investigations and need to be a focus of the team's field work in 2012-2013. The task group needs to complete a bed-by-bed study through about 10 metres of strata on either side of the proposed Moscovian–Kasimovian boundary level. That work will include taking a continuous sample through about one metre of strata on each side of boundary to determine the location of all principal sedimentary events and the characteristics and origins of the beds.

To place the Nashui section into its sedimentological and paleoenvironmental context and determine the relationship of shallow-water coral, conodont and foraminiferal zones to the deeper-water conodont markers within the Moscovian–Kasimovian transition in south China, the investigation of reference sections including the Zhongdi (Ueno *et al*., 2007) and the Luokun sections will continue. Like the Nashui section, the exposure at Luokun is essentially 100% complete and dominated by slope carbonates of turbiditic and hemipelagic aspect but the lithofacies are of more proximal aspect. Study of the section will provide another opportunity to see conodonts and foraminifers spanning the Moscovian–Kasimovian transition in the region. Foraminifers are more abundant and better preserved than at Nashui and it is anticipated that a better correlation between conodonts and foraminifers can be achieved by the study of the Luokun section.

Activities in Moscow Basin, Russia

The task group will continue to study specimens from the Stsherbatovka quarry section on the Oka-Tsna Swell of the Ryazan Region, east of the town of Kasimov in the Moscow Basin. In the section, the middle part of the Neverovo Formation (Khamovnikian Substage) contains abundant macrofauna. Conodonts occur as well but are not common and most elements are juveniles of the *Idiognathodus sagittalis-I. turbatus* group. *Idiognathodus sulciferus* was also identified. Earlier, fusulines were used to correlate this interval with the Krevyakinian *Obsoletes obsoletus* Zone, but the conodonts suggest a younger age. The Stsherbatovka section, situated about 250 km southeast of the better-known Afanasievo section (Goreva *et al.*, 2009) in the Moscow Basin, demonstrates a wider distribution of the marker conodont species for identifying the base of the Kasimovian. The section is better than the Afanasievo section (neostratotype of Kasimovian and potential candidate for GSSP at its base), because it was deposited in somewhat deeper water and elements of the *I. sagittalis-I. turbatus* group are more abundant.

Kasimovian–Gzhelian boundary Since 2007, when the task group voted in favor of using the first appearance of the conodont *Idiognathodus simulator* (Ellison, 1941) in the lineage *Idiognathodus eudoraensis* – *I. simulator* as the boundary-defining event (Heckel *et al*., 2008), the search for a suitable section for the GSSP has been the task-group's main objective. The event level is consistent with both the working ammonoid definition of the boundary and with the first appearance of a cotype of the fusulinid *Rauserites rossicus* in the Moscow region. The recent selection of the lectotype of the fusulinid *R. rossicus* at the first appearance of *I. simulator* in Russia will expedite the recognition of this boundary in Eurasia. So far, only the Usolka section in the southern Ural Mountains of Russia has been proposed as a candidate section for the GSSP (Chernykh *et al.,* 2006; Davydov *et al*., 2008); other proposals are being developed.

Activities in Russia

The Usolka section requires substantial new stratigraphic work and re-assessment. On August 14 2009, task-group members and other SCCS representatives visited the Usolka section during a Field Meeting. The fieldtrip participants observed that only fragments of the section were exposed and they were in small, partly filled to overgrown trenches. In response to that observation, the task group needs to extensively excavate the site during its re-assessment.

In the summer of 2010, Russian colleagues briefly visited the Kholodny Log section on the western slope of the Middle Urals. The upper part of the section is a famous shallow-water Asselian (Lower Permian) succession containing abundant fusulinids but the lower part of the section spans the Kasimovian–Gzhelian boundary interval, which contains abundant fusulinids and the conodont *Streptognathodus pawhuskaensis*. The task group plans to visit the locality to collect more samples for conodonts.

Task-group member Alexander Alekseev and colleagues are working in the Yablonevy Ovrag Quarry, Zhiguli Mountains, by Samarskaya Luka National Park in the Volga River region, Russia. The section contains abundant *Idiognathodus simulator*, the index conodont for the boundary and it is anticipated the group will develop a GSSP proposal based on studies at the locality.

Activities in China

Yuping Qi and colleagues plan to continue with detailed sampling and analysis across the proposed Kasimovian–Gzhelian boundary level in the Nashui section (Wang and Qi, 2003) in Guizhou Province,

south China for conodonts and fusulinids. Conodont recovery across the boundary level has not been as good as expected and large samples are required to obtain an adequate understanding of evolutionary trends. A sedimentologic, geophysical and geochemical analysis of that section at the appropriate level is required. During 2012 to 2013, the task group plans to complete the measurement and sampling of the upper Kasimovian to Lower Permian component of the Nashui section (for lithology, stable-isotope geochemistry, and geophysics) In conjunction with the latter work, the task group plans to complete a bed-by-bed study through 10 metres of strata on either side of the proposed Kasimovian–Gzhelian boundary level. That work will include taking a continuous sample through about 1.5 m of strata on each side of boundary to determine the location of all principal sedimentary events and the characteristics and origins of the beds.

BUDGET AND ICS COMPONENT FOR Nov. 1, 2011 – Oct. 31, 2012 fiscal year

PROJECTED EXPENSES

INCOME

Carryover (from CREDIT balance at end Nov. 1, 2010 – Oct. 31 2011 fiscal year)	$994.57
Estimated donations	$200.00
TOTAL PROJECTED INCOME	$1,194.57

BALANCE

Estimated (deficit)/credit from above	-$3,339.43
BUDGET REQUEST FROM ICS for 2012	**$3,330.00**

MEETING-FIELD WORKSHOP SCHEDULE WITH THEMES AND ANTICIPATED RESULTS

During the November 1, 2011 – October 31, 2012 fiscal year, the 34th International Geological Congress (IGC) in Brisbane, Australia will be the most important meeting in terms of the goals of the subcommission and is discussed below.

From the 5th – 10th of August 2012, the IGC will be held in Brisbane, Australia (website at www.34igc.org). The SCCS will not hold a symposium and workshop at the meeting because we held the XVII International Congress on the Carboniferous and Permian in Perth, Australia last July and do not anticipate many of our members will take the expensive trip to Australia two years in a row. We encourage you, however, to try and attend the meeting and submit abstracts to symposia that are relevant to your task-groups activities. Within congress theme 35 (Geostandards), Marco Balini, Jim Ogg and Stan Finney are chairing Symposium 35.1 GSSPs (Global Boundary-Stratotype Section and Point) as global standards. For symposium 35.1, contributions on all aspects of GSSPs as global standards are encouraged. Several members of the SCCS plan to give oral presentations at Symposium 35.7 "The Devonian–Carboniferous-Permian Correlation Chart" chaired by Manfred Menning. Goals of the presentations are to give progress reports on the activities of the SCCS.

We will hold a joint business meeting for the Subcommission on Carboniferous Stratigraphy (SCCS) and Subcommission on Permian Stratigraphy (SPS) on Tuesday August 7th, 2012 during the 34th IGC. The meeting will be held in room P9 at the Brisbane Convention and Exhibition Centre. At the meting we plan to discuss the membership and outline work plans for the next four years.

Members will also attend the ICS meetings. Two meetings are planed: a public meeting on August 6th and a second on August 9th for subcommission chairs and the ICS executive. Expectations are to receive direction for activities over the next four years.

Mailing and sample shipping	$500
Bank charges at Bank of Montreal	$25
Travel support for SCCS Chairman to attend 34th IGC in Brisbane (August 2 to 10, 2012) to participate in ICS meetings on August 6th and 9th, attend joint SCCS and SPS business meeting on August 7th and give presentation about Carboniferous stage boundaries in symposium 35.1	$1000
Travel support for other SCCS voting members to attend 34th IGC	$2000
Travel support for SCCS Chairman and voting members to southern Urals in August for field meeting and work on the Kardailovka GSSP candidate for Viséan–Serpukhovian boundary	$500
Travel support for SCCS Chairman and voting members to attend meeting for IUGS 575 in Ukraine during late September 2012	$500
TOTAL PROJECTED EXPENSES	**$4,525.00**

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SUMMARY OF EXPENDITURES

Statement of operating accounts from November 1, 2011 to October 30, 2012

Prepared by Barry Richards, Chairman SCCS

(Accounts maintained in Canadian currency)

INCOME (Nov. 1, 2011 – June 30, 2012)	
IUGS-ICS Grant; June 3, 2012 (US $3,000 = $3,012.00 Cdn.)	$3,012.00
Donations from Members; November 1, 2011 – October 31 2012	$200.00
Interest Bank of Montreal; November 1, 2011 – October 31, 2012	$0.05
TOTAL INCOME	**$3,212.05**
EXPENDITURES	
Bank Charges: Bank of Montreal July 14, 2011	$0.00
Richards travel to Brisbane Australia for 34th International Geological Congress; August 05 – August 10, 2012	$2,000.00
Registration support for SCCS chairman for 34th IGC, Brisbane, August 5 – August 10, 2012	$500.00
Travel support for a SCCS voting member to attend 34th IGC and give oral presentations	$500.00
Travel support for SCCS chairman to attend SCCS field meetings in southern Urals, Russia in August 14 – August 31, 2012	$500.00
TOTAL EXPENDITURE	**$3,500.00**
BALANCE SHEET (2011 – 2012)	
Funds carried forward from October 31, 2011	$994.57
Plus Income November 1, 2011 – October 31, 2012	$3,212.05
Total assets	**$4,206.62**
Less expenditure Nov. 1, 2009 – October 31, 2010	-$3,500.00
Balance carried forward (to 2012 – 2013 fiscal year)	**$706.62**

BUDGET AND ICS COMPONENT FOR NOV. 1, 2012 – OCT. 31, 2013 FISCAL YEAR

Prepared by Barry Richards, Chairman SCCS

PROJECTED EXPENSES	
Sample shipping from Moscow and Nanjing to GSC-Calgary for thin-section preparation, geochemical analyses, and U-Pb radiometric dating (Viséan–Serpukhovian task group)	$500.00
Travel support for SCCS Chairman and other voting members to attend March SDS/SCCS workshop (Devonian and L. Carboniferous of northern Gondwana) in Morocco	$1,000.00
Travel support for SCCS voting members to attend May SCCS and SPS conference and field meeting in Albuquerque New Mexico (Carboniferous-Permian Transition)	$1,000.00
Travel support for chairman to continue work with Chinese colleagues on several boundary levels in South China in April 2013	$250
TOTAL Projected Expenses	**$2,750.00**
INCOME	
Carryover (from CREDIT balance at end Nov. 1, 2011 – Oct. 31 2012 fiscal year)	$706.62
Estimated donations	$200.00
TOTAL PROJECTED INCOME	**$906.62**
BALANCE	
Estimated (deficit) / credit from above	-$1,843.38
Budget request from ICS for 2012	$2,000.00

TASK-GROUP REPORTS FOR THE NOV. 1ST, 2011 TO OCT. 31ST, 2012 FISCAL YEAR

REPORT OF THE JOINT DEVONIAN–CARBONIFEROUS BOUNDARY GSSP REAPPRAISAL TASK GROUP

Markus Aretz and Task Group

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Introduction and general activities

Members of the Task Group for the redefinition of the Devonian–Carboniferous boundary are currently conducting research at a variety of locations in Europe, North Africa, Russia, Asia and North America. Task group members and co-workers are focusing on generating data of various sections which should be presented in spring 2013 at a workshop in Morocco. Few task group members have been present at the 34th International Geological Congress at Brisbane where a short discussion of research activities around the Devonian–Carboniferous boundary took place during the SDS business meeting. During the discussion it became evident that a series of research activities is going on in very different countries, but that these activities are not necessarily communicated within or to the task group.

Progress reports from members

J. Kalvoda (Bruno). Czech researchers have been working in Central and Western Europe and are accumulating large multidiscinplinary datasets for key sections in different facies and countries. The group comprises J. Kalvoda, T. Kumpan (bio-stratigraphy of foraminifers and conodonts), J.

Frýda (isotope geochemistry), T. Grygar (element geochemistry) and O. Bábek (petrophysical logging, sedimentology, sequence stratigraphic interpretation). The results of their multidisciplinary correlation of the D-C boundary sections from the Moravian Karst (Czech Republic) and the Carnic Alps (Austria) have been submitted to the Geological Magazine.

Their study focused on the interval from the Middle *Palmatolepis gracilis expansa* Zone (late Famennian) to the *Siphonodella sandbergi* Zone (early Tournaisian). In the Lesní lom quarry (Moravian Karst), a positive $O^{13}C$ excursion in the *Bisphatodus costatus – Protognathodus kockeli* Interregnum (middle *Siphonodella praesulcata* Zone) from a laminated carbonate horizon was correlated to the Grüne Schneid section, Carnic Alps by using a carbon-isotope excursion. The carbonates in the Lesni lom section were interpreted as being equivalent to the Hangenberg black shales and a local expression of the global Hangenberg Event. Higher values of the Mn/Al ratio were documented from the level in the Moravian Karst (Lesní lom quarry, Mokrá) and Carnic Alps (Grüne Schneid). Up section in the Moravian Karst sections (Lesní lom quarry, Mokrá, Křtiny), a significant increase in the terrigenous input, which is inferred from the gamma-ray signal and elevated concentrations of terrigenous elements (Si, Ti, Zr, Rb, Al, etc.), provided a correlation tieline interpreted as the equivalent of the Hangenberg sandstone. The presence of Famennian foraminiferal genus *Quasiendothyra* was documented up to the Tournaisian *Siphonodella bransoni* Zone in the Moravian Karst where the FAD of *Tournayellina beata pseudobeata* was recognized. The latter foraminifer, also reported from Belgium (Poty *et al*., 2006), the Urals (Reitlinger and Kulagina, 1987; Pazukhin *et al*., 2009) and China (Hance *et al*. 2011), represents an important event close to the D-C boundary. In contrast to the other sections, the Moravian sections enable the precise establishment of its FAD to the upper part of the *Bispathodus costatus – Protognathodus kockeli* Interregnum.

Recent studies (Aretz and task-group, 2011) demonstrated there are serious issues with using conodonts for boundary definition because of taxonomic problems within the earliest siphonodellids and they are strongly facies dependant; in addition the protognathodids, the other conodont group with some potential for boundary definition, are commonly rare at the D-C boundary level. Because of the shortcommings of the conodonts, the correlative potential of geochemical and petrophysical signatures of phases in the Hangenberg event offer an alternative to the refining of the problematic biostratigraphic definition of the D-C boundary. The results obtained by the Czech team support the views of Walliser (1984) who regarded the Hangenberg Event as worldwide, synchronous, and a natural D-C boundary.

Studies similar to those of the Czech researchers have been started in sections in the Namur-Dinant Basin (Gendron-Celles, Rivage and Avesnois) of Belgium in cooperation with task-group member Eddy Poty and in the French Pyrenees (Miles, Saubette) and the Montagne Noire (La Serre, Puech) in cooperation with task-group member Markus Aretz. First results from the Namur-Dinant Basin show a distinct positive $\delta^{13}C$ excursion in the basal part of the Avesnelles Limestone in Avesnois and the Hastiere Limestone in the Gendron-Celles section, which is different from the excursion in the *Bisphatodus costatus – Protognathodus kockeli* Interregnum. In the Avesnois the basal part of the Avesnelles Limestone contains advanced *Chernyshyshinella* foraminifers indicating a higher level in the lower Tournaisian than the *Bisphatodus costatus – Protognathodus kockeli* Interregnum.

C. Corradini (Cagliari) Carlo Corradini has several ongoing projects related to the D-C boundary study in various part of northern Gondwana. In Sardinia (Italy) the Monte Taccu section has been resampled, and a new section has been measured in the Clymeniae limestone of the southwestern part if the island. Further studies of D-C sections are being conducted in Iran (collaboration with A. Bahrami) and in the Montagne Noire (collaboration with C. Girard).

T. Becker (Münster) reports for his research group following activities in 2012.

The work on the Lalla Mimouna North section at the northern margin of the Maider region, SE Anti-Atlas, Morocco continues. All conodont samples collected during 2011 and the spring of 2012 have been picked but not fully identified. The full set of identifications will be included in the Field Guide for the spring 2013 field symposium in Morocco as an update to the preliminary reports in the SCCS and SDS Newsletters (Becker *et al*., 2011; 2012). D. Brice submitted a faunal list of the brachiopods from the Hangenberg Sandstone interval (Fezzou Formation tongue), situated between the local pre- and post-Hangenberg Event crinoidal limestones. A new collection of ammonoids from the overlying *Gattendorfia* shale increases the number of basal Tournaisian ammonoid taxa and includes the first *Eocanites* from the section. The Münster isotope laboratory provided stable- carbon and oxygen-isotopes data for all beds sampled for conodonts and for samples from the adjacent section with "Stockum level" goniatites. In the latter section, a dark marker bed containing *Postclymenia evoluta* (*kockeli* Zone) produced an unusual, strong negative

carbon isotope signal, which suggests a substantial influx of diagenetically mobilized and recycled organic carbon. Thin sections of all beds have been produced and will be subject to detailed microfacies analyses.

Becker (2012) listed poorly known and recent publications on D-C boundary sections in southern Saskatchewan of Canada (Bakken Fm.), Iran, Russia (Moscow Syncline, southern Urals, Vaygach Island), Azerbaijan, China (Hainan Island), and Vietnam. The task group leadership thinks it is important to involve the various authors listed in the work of the group.

Colleagues from Malaysia, especially Hakif Hassan Meor (Kuala Lumpur, University of Malaya), contacted Becker's group in relation to the succession of the Perlis region, where an occurrence of deposits that overly the Chepor Formation (Meor and Lee, 2005) and contain "*Posidonia*" (probably *Guerichia*) and ammonoids may lie within the Hangenberg Black Shale level. The deposits have been mostly overlooked by other D-C boundary workers but cooperation concerning underlying Famennian conodont faunas was agreed upon and the conspicuous black shale will be sampled for palynomorphs.

4. In the frame of the Convention of cooperation between Germany and Morocco [DFG-CNRST (Maroc)] project on the Eovariscan evolution of the southern and northern external margins of the Variscides, Becker and colleagues took some preliminary samples from several sections across the D-C boundary in the Moroccan Meseta. All sections are in clastic facies but palynomorphs may provide some biostratigraphic control. The Meseta lacks potential for a conodont-defined boundary but may provide important auxiliary clastic sections.

Becker and associates assisted H. Tragelehn to finish the extensive photography of his important early siphonodellids and related new genera from the pre-Hangenberg limestones of Franconia and Thuringia. He commented on the contemporaneous and closely related new forms from the Wocklumian (Upper Devonian VI) of the Tafilalt region in Morocco (Hartenfels and Becker, 2012), which will be published in detail in 2013. These forms further underline the taxonomic complexity at the transition from polygnathids to siphonodellids in the uppermost Devonian, with implications for our understanding of the siphonodellid lineage through the Hangenberg Crisis and into the post-event radiation phase.

For his M.Sc. research, T. Fischer is investigating the ontogenetic morphometry of uppermost Famennian ammonoids from Morocco, Franconia (eastern part historic Duchy of Franconia in Germany), and other parts of Germany. First results show that the early ontogenetic opening of the umbilicus is not restricted to the *Acutimitoceras* group during and after the Hangenberg Event Interval but is already rather wide-spread in specific Prionoceratidae ("imitoceratids") before the event. This has implications for the understanding of the phylogeny of ammonoids across the D-C interval, with possible implications for the stratigraphic significance of some taxa.

A new monograph on the Lower Carboniferous trilobites of southern Morocco (Hahn *et al*., 2012) includes new records of a few rare taxa from just before or within the wider Hangenberg Event Intervall (*Pudoproetus zhorae* from Mkakrig, eastern Tafilalt, *Pseudowaribole conifer* aff. *Pseudowaribol gibber* from Kheneg Lakahal, western Dra Valley). The first implication of the trilobite study is that *Pudoproetus* can be used to locate the initial phase of the post-Hangenberg transgression in Morocco, thereby extending the known region impacted by the event into northern Gondwana. The second major impact of the study is that it suggests all of the Maader Talmout Member of the Tazout Formation, including the characteristic, supposed basal Tournaisian brachiopod fauna 2 of Brice *et al*. (2005, 2008), still falls in the pre-Hangenberg Event Interval. *Pudoproetus* has significant implications for the brachiopod stratigraphy across the Hangenberg Event Interval and D-C boundary. Its presence suggests a correlation of the subsequent, unfossiliferous, marginal marine Kheneg Lakahal Member of the Tazout Formation with the Hangenberg Regression.

B. Ellwood (Baton Rouge) and colleagues have been working on some D-C boundary intervals in the Woodford Shale of Oklahoma, where there is fair knowledge of the conodont biostratigraphy (from J.Over). They have been sampling and measuring magnetic susceptibility on collected samples, and obtained gamma-ray measurements from outcrops and collected samples. Although they are working in silicified shale with limited biostratigraphic information, the sections are easily correlated over a distance of about 100 km using geophysical data. Such data may provide good, diagnostic secondary parameters for correlation among other sections.

Ji Qiang (Beijing) and his research group have worked in recent years on the D-C boundary and the phylogeny of *Siphonodella* in South China. The principal results of their work are outlined below.

1. Three D-C boundary sections in Muhua area of Guizhou Province are being re-studied, and additional conodont samples collected from them. According to the morphology, ornamentation and symmetry of the platforms, the ratio of platform to anterior blade dimensions, and the size, morphology and position of the basal cavity, four new genera of

siphonodellids can be differentiated: *Protosiphonodella* n. gen., *Siphonodella*, *Eusiphonodella* n. gen. and *Eosiphonodella* n. gen. (Ji *et al*., in press). Among them, only *Eosiphonodella* can be found in shallow-water facies.

2. The phylogeny of the siphonodellid group is restudied, and the D-C boundary can be defined by the first occurrence of *Siphonodella sulcata* morphotype 1.

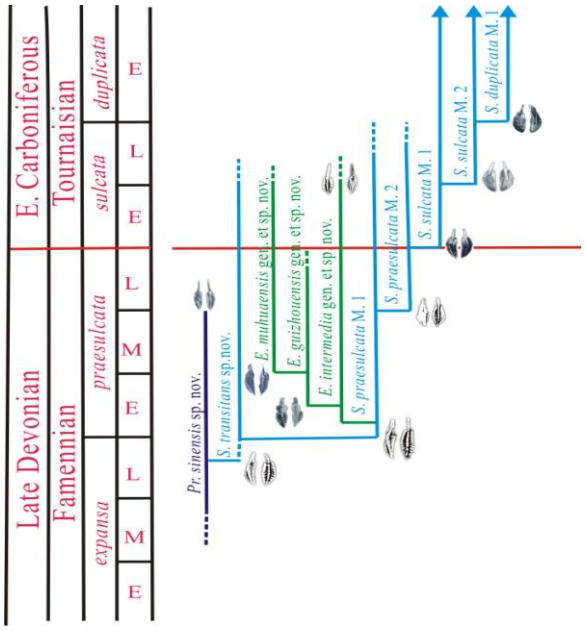

Figure 1: Phylogenetic relationships of *Protosiphonodella*, *Siphonodella* and *Eusiphonodella*.

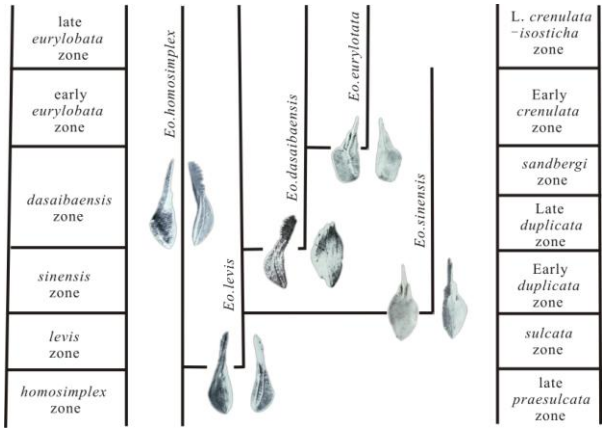

Figure 2: Phylogeny of *Eosiphonodella* of shallow-water facies in China.

3. The elements of *Protognathodus* are very rare in China, and it is difficult to recognize the D-C boundary based on the first occurrence of either *Protognathodus kockeli* (Bischoff, 1957) or *Protognathodus kuehni* Ziegler & Leuteritze 1970.

4. A bentonite layer occurs in bed E of the Dapoushang Member of the Wangyou Formation, and has provided a radiometric age of 359.6 Ma (Liu *et al*., 2012). The age of the D-C boundary at Dapoushang, Guizhou province, South China, is estimated at 358.6 Ma or 359.58 Ma.

Barry Richards (Calgary) and colleagues continued their studies of the upper Famennian to lower Tournaisian (includes Exshaw, Bakken, Three Forks, and Banff formations) in the Western Canada Sedimentary Basin (WCSB) and adjacent Montana to see if the main events in the multi-phase Hangenberg Event Interval (Kaiser *et al*., 2008), can be more precisely located in the region using a multidisciplinary approach. The year's activities included the measurement of surface sections in Alberta and study of several bore-hole cores from southern Alberta in preparation for a core conference. For comparative purposes and to assist with Global correlations, the group measured and sampled the GSSP section at La Serre, France during December 2011 for geochemistry, sedimentology and conodonts. The work in Canada is part of a broader investigation intended to access the extensive conventional and non-conventional hydrocarbon resources of the interval in Western Canada.

Conodont data from the Exshaw and high-resolution U-Pb dates from its black shale member (Richards *et al*., 2002; Johnston *et al*., 2010) indicate the onset of wide-spread anoxia in the WCSB and main phase of black shale deposition occurred prior to the Middle *praesulcata* Zone and the transgressive phase of the Hangenberg Event in Western Europe. In much of the basin, anoxia continued into the *Siphonodella duplicata* Zone and the position of the maximum flooding surface is highly diachronous. The implications are the onsets of the Hangenberg transgression and subsequent regression are highly diachronous in the WCSB and not primarily the result of eustatic events.

Outlook

The results presented at the Morocco workshop in March 2013 will determine the future steps and directions of the task group's work in the next years.

The primary task of the group remains – to locate either a suitable event horizon or a suitable event in a biological lineage to define the D-C boundary. Recent progress shows that new detailed correlations and agreements on taxonomy and temporal distribution of many taxa are needed, especially when the Global correlations are still primarily based on either the *Siphonodella praesulcata* – S. *sulcata* lineage or on protognathodids. The problems outlined by Kaiser and Corradini (2011) and Corradini *et al.* (2011) have to be fully integrated in the current discussions. The paradigm that conodonts are the best markers boundary definition cannot be upheld

and the task group needs to reevaluate the potential of other fossil groups.

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

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Introduction

During the past fiscal year, the task group made substantial progress toward establishing a GSSP for the Viséan–Serpukhovian Stage boundary. An 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 the two prime GSSP candidate sections: the Verkhnyaya Kardailovka in the southern Ural Mountains of Russia and the Nashui section in southern Guizhou Province, China. Work is continuing on other potential candidate sections for the GSSP in the Cantabrian Mountains of northwest Spain. For boundary definition, the group is using the first evolutionary appearance 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, which is somewhat below the current base of the Serpukhovian as defined by its lectostratotype section in the Zaborie quarry near the city of Serpukhov in the Moscow Basin, Russia (Kabanov, 2003, 2004; Kabanov *et al*., 2009, 2012). Task-group members are conducting research on biostratigraphy, sedimentology and lithostratigraphy, stable-isotope geochemistry and

magnetic susceptibility at several locations in Western Europe, Russia, China and North America.

The group's most important accomplishments were the publication of a comprehensive study of the foraminifers spanning the Viséan–Serpukhovian boundary at several sections in South China including the Nashui section in southern Guizhou Province (Groves *et al*., 2012), the completion of the preliminary phase of an ammonite study across the boundary level in the Verkhnyaya Kardailovka section, one of the best candidate sections for the GSSP at the base of the Serpukhovian (Nikolaeva, in press), and completion of a comprehensive bed-by-bed sedimentologic and geochemical analysis of the Serpukhovian Sage in its type area, the Moscow Basin of Russia (Kabanov *et al*., 2012). During 2012, the main field program for the task group was held in the southern Urals of Russia but ongoing studies of upper Viséan to Serpukhovian successions in Western Europe, western North America, and South China continued.

Meetings

34th International Geological Congress in Brisbane, Australia

Several task-group members attended the congress in Brisbane (5th – 10th of August 2012) and gave project-related presentations (Alekseev, *et al*., 2012; Aretz *et al*., 2012; Nikolaeva *et al*., 2012; Richards *et al*., 2012) in various Symposia including 35.7 "The Devonian–Carboniferous-Permian Correlation Chart" chaired by Manfred Menning.

Progress in southern Urals

During August 2012, a team of task-group members (Alexander Alekseev, Elena Kulagina, Svetlana Nikolaeva, Barry Richards, and Yuriy Gatovsky) worked at the condensed, deep-water, carbonate section along the Ural River opposite the village of Verkhnyaya Kardailovka on the eastern slope of the southern Ural Mountains in Russia. Nikolaeva and her colleagues have worked on the Kardailovka section for several years and published syntheses about the ammonoids, conodonts, foraminifers and ostracodes (Nikolaeva *et al.,* 2005; Nikolaeva *et al*., 2009b; Pazukhin *et al*., 2010). Their syntheses demonstrate that the first evolutionary appearance of *L. ziegleri* occurs in the lower part of the limestone-dominant component of the section immediately above an interval containing elements transitional between *L. nodosa* and *L. ziegleri.*

In August 2011, the lower 22 m of the Verkhnyaya Kardailovka section including the boundary level was extensively excavated with backhoes and front-end loaders. Additional excavation work across the boundary was completed in August, 2012. Following the excavations in 2012, the interval spanning the Viséan–Serpukhovian boundary was systematically sampled for conodonts. Conodont samples had been collected from the section on several prior occasions but additional sampling was required to more precisely tie the conodont biostratigraphy into the new measurements and to confirm the FAD of *L. ziegleri* in the recently excavated boundary interval. In August 2011, the limestone-dominant component of the section was measured and sampled bed-by-bed for lithology and geochemical samples from about 12 m to 35 m above the base. The underlying deposits are dominated by thin-bedded to laminated shale, siltstone and volcanic ash that are not measurable at a bed-by-bed level of detail. During 2012 the sampling for lithology and geochemistry was completed into the lower part of the Bashkirian.

Svetlana Nikolaeva made large collections of ammonites from the newly excavated boundary interval at Verkhnyaya Kardailovka in August 2012 and presents her preliminary results in the Newsletter on Carboniferous Stratigraphy (Nikolaeva, in press). Her results are summarized here. Three ammonoid assemblages are recognized in the Viséan–Serpukhovian boundary beds in the Verkhnyaya Kardailovka section and are assigned to: the *Goniatites* Genozone (Upper Viséan), *Hypergoniatites–Ferganoceras* Genozone (Upper Viséan and Lower Serpukhovian), and the *Uralopronorites–Cravenoceras* Genozone (Lower Serpukhovian).

It was shown (Nikolaeva *et al*., 2009a) that the base of the Serpukhovian, as provisionally defined by the FAD of the conodont *Lochriea ziegleri,* lies within the *Hypergoniatites–Ferganoceras* Genozone, and more precisely in the Dombar Hills of Kazakhstan within its upper *Dombarigloria miranda* Zone (Nm1a2). The underlying *Pachylyroceras cloudi* Zone (Nm1a1) is entirely Viséan, whereas the *Dombarigloria miranda* Zone (Nm1a2), is partly Viséan and partly Serpukhovian. This position of the FAD of *L. ziegleri* is supported by the new data from the Verkhnyaya Kardailovka section. In that section, the documented first appearance of *L. ziegleri* is in sample 013 (Bed 21), which lies within the *Hypergoniatites–Ferganoceras* Genozone (Nikolaeva *et al*., 2009b; Pazukhin *et al*., 2010).

Progress in southern Guizhou province, Nashui section

In the Nashui section (by village of Naqing) near the city of Luodian in southern Guizhou province, the Viséan–Serpukhovian boundary is currently placed at 60.1m above the base of the original section measured by Qi and Wang (2005), which is equivalent to a position 17.94 m above the base of the new section measured and permanently marked by aluminum pins glued into drill holes by the task group in 2008. In the Nashui section, conodonts

within the *Lochriea nodosa* – L*ochriea ziegleri* lineage are well preserved and abundant (Qi, 2008). Elements transitional between *L. nodosa* and *L. ziegleri* are plentiful, occurring in several samples, and the oldest representatives of *L. ziegleri* could be readily distinguished from the associated transitional forms of *L. nodosa*. The conodonts do not allow direct correlation from the Nashui section to the nearby shallow-water Yashui section because of their paucity in the neritic to restricted-shelf facies at the latter locality. The Yashui section was measured to determine the relationship of the coral and foraminiferal zones to the *L. nodosa – L. ziegleri* transition. During 2012, John Groves and colleagues completed their study of the foraminifers across the boundary interval in the section (Groves *et al*., 2012). Unfortunately, the association of foraminifers from a 20 meter-thick interval centered about the boundary at Nashui lack species diagnostic of the boundary but contain ones whose previously established ranges were known to extend from the upper Viséan into the lower Serpukhovian.

Progress in southern Guizhou province, Yashui section

The Yashui section, situated near the city of Huishui in Guizhou province, is important because it contains abundant rugose corals and foraminifers (Wu *et al*., 2009) and is dominated by shallow-marine neritic to supratidal facies. A major reason for studying the section is to determine the relationship of the coral and foraminiferal zones to the *L. nodosa – L. ziegleri* transition in south China. Conodont samples were collected from the section in 2008-2009 but the *L. nodosa – L. ziegleri* transition could not be precisely located. The section provides an excellent opportunity to see what the shallow-marine and supratidal platform facies are like in southern Guizhou Province. John Groves and his colleagues (Groves *et al.,* 2012) completed a comprehensive study of the foraminifers. They found that the base of the Serpukhovian could be approximated using foraminifers but a precise correlation with the FAD of *L. ziegleri* in the Nashui section could not be established because of the lack of foraminiferal indices for the boundary in the Nashui section and the paucity of conodonts through the boundary level at Yashui.

The foraminiferal successions across this boundary in the type area of the Serpukhovian Stage in the Moscow Basin of Russia (Kabanov *et al*., 2009; Gibshman *et al*., 2009), the Uralian region of Russia (Nikolaeva *et al.,* 2005; 2009a, b) and in the central United States suggest that the appearances of *Asteroarchaediscus postrugosus* (Reitlinger, 1949), *Janischewskina delicata* (Malakhova, 1956), "*Millerella*" *tortula* Zeller, 1953 and *Eolasiodiscus donbassicus* Reitlinger, 1956 are useful auxiliary indices to the base of the Serpukhovian. The stage boundary at Yashui is provisionally identified at 41.6 m above the base of the section on the appearance of *Janischewskina delicata* (Malakhova, 1956). "*Millerella*" *tortula* Zeller, 1953 is another possible index to the base of the Serpukhovian and appears at 49 m above the base of the section (Groves *et al.,* 2012). *Asteroarchaediscus postrugosus* and *Eolasiodiscus donbassicus*, useful markers for the base of the Serpukhovian elsewhere in Eurasia and North America, have not been observed at Yashui.

Progress in Moscow Basin, type area of Serpukhovian

Recent biostratigraphic and sequence stratigraphic studies in the type area of the Serpukhovian in the Moscow Basin (Kabanov *et al*., in press) reveal that the first appearance of *Lochriea ziegleri* is in the uppermost Venevian Substage of the Viséan (about 3 m below its top) rather than in the lowermost Tarusian Substage of the Serpukhovian as previously reported. Nikolaeva *et al*. (2002) and Kabanov *et al*. (2009) reported that in the Zaborie quarry section, lectostratotype of the Serpukhovian Stage, *L. ziegleri* appears with *Lochriea senckenbergica* Nemirovskaya, Perret & Meischner, 1994 in the basal bed but not a first evolutionary appearance. The latter occurrence was in the lowermost Tarusian slightly above the Venevian, traditional top of the Viséan in the Moscow Basin. Once the GSSP has been established using the FAD of *L. ziegleri* for boundary definition, the base of the type Serpukhovian must be shifted slightly downward from its current position at the base of the Tarusian.

Work plans for 2013

The task group's work plans for the new fiscal year are a continuation of those outlined in the SCCS Annual Report submitted to the ICS for the November 1st, 2011 to October 31st, 2012 fiscal year. Since determining that the FAD of the conodont *Lochriea ziegleri* in the lineage *Lochriea nodosa –Lochriea ziegleri* is the best index for boundary definition, the task group will continue developing a proposal advocating the use of that index and then direct its full attention toward selecting the best candidate section for the GSSP. The best two candidate sections are the Nashui section by the village of Naqing in southern Guizhou Province, China and the Verkhnyaya Kardailovka section on the Ural River in southern Russia. A third section by the village of Millaró in the Cantabrian Mountains of northern Spain may have potential rivaling that of the others and the study of the section is continuing.

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

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Significant progress was achieved by the task-group members during last fiscal year. They have located a couple of conodont taxa that appear to have good potential for defining the base of the Moscovian Stage at a level near its current position (base of Vereian Substage) and have located a new index that could be used if the base was raised one substage higher. The Task group has also been evaluating several successions to locate suitable GSSP candidate sections. Around 10 taxa (conodonts and fusulinids) were proposed during last five years as potential indices for the lower boundary of the Moscovian Stage, but only two *Diplognathodus ellesmerensis* Bender, 1980 and *Declinognathodus donetzianus* Nemirovskaya, 1990 have received even moderate support from the task-group members. The relatively restricted geographic distribution of most of the proposed taxa has been the most important factor limiting their utility for boundary definition. Another problem that has inhibited substantial progress on selecting a suitable taxon is that many members of the task group are working on several other task groups and lack sufficient time to devote to the study of faunas associated with the Bashkirian–Moscovian boundary.

Data from the Nashui section in Guizhou province, South China (Qi *et al.*, 2007; 2010; Groves and task group, 2011) continue to indicate that the first evolutionary occurrence of the conodont *D. ellesmerensis* in the lineage *Diplognathodus coloradoensis* Murray & Chronic, 1965 – *D. ellesmerensis* is one of the best potential markers the task group has investigated. Elements of *D. ellesmerensis* are easy to identify, the species has a wide geographic distribution (China, Russia, North America), and it occurs in the lowermost Moscovian strata (Alyutovo Formation; Kashirian regional Substage) in the type Moscovian area (Makhlina *et al.*, 2001, pl. 14, fig. 17). A shortcoming of the species is its long range - occurring not only in the lower Moscovian, but also in upper Moscovian (Podolskian regional Substage) strata in the Moscow Basin, South Urals (Dalniy Tyulkas) and Arkhangelsk Region.

The FAD of *D. donetzianus* has long been consider as a potential index for the base of the Moscovian but its apparent absence in North American successions prevented it from being an ideal candidate. Specimens of the species have, however, been recently located in the Appalachian Basin in the eastern U.S.A. (Work *et al.*, 2012). They reported *D. donetzianus* in the lower Atokan Magoffin Member of the Four Corners Formation in eastern Kentucky, the first discovery of the taxon in the Western Hemisphere. Because of the new discovery, the FAD of *D. donetzianus* warrants further evaluation as a potential marker.

Donets Basin, Ukraine

During the second half of September 2012, Tamara Nemyrovska together with Isabel Montanez and Jlie Griffit (California, Davis University) participated in field work in the Donets Basin, Ukraine. Near the town of Malonikolaevka, they sampled in detail the Bashkirian–Moscovian boundary interval including the marine-shale interval above limestone K_1. The conodonts from all of the limestone and shale beds will be studied for stable-oxygen isotopes to permit the reconstruction of paleoclimatic fluctuations, which are potentially important for long-distance correlations.

In the last few years, Katsumi Ueno and Tamara Nemyrovska have been working in the Donets Basin on the Bashkirian–Moscovian boundary in the Zolotaya and Malonikolaevka sections in the Lugansk region, eastern Ukraine. During the first half of October 2012, they continued with that work and collaborated with Titima Thassinee (Bangkok

University, Thailand) to investigate a new section near the town of Shterovka, sampling the latter exposure for conodonts and fusulinids. They also collected additional samples from limestones I_3 and I_4 in the Malonikolaevka section. In these sections, strata of the C_2^4 (I) and C_2^5 (K) formations (from limestones I_2 to K_3) are exposed. The Shterovka section, which includes limestones I_2 to K_3^1, is situated several kilometers west of the Malonikolaevka section. In the Donets Basin, the Bashkirian–Moscovian boundary has traditionally been placed somewhere in the basal or lower part of the C_2^5 (K) formation (Putrya, 1956; Einor, 1996). Of the three sections, the Malonikolaevka section recently provided some important information on the Bashkirian–Moscovian boundary (Ueno and Nemyrovska, 2008; Nemyrovska *et al.*, 2010). In the Malonikolaevka section, the conodont and fusuline composite biostratigraphy was examined, with special attention given to the lower boundary of the Moscovian. It is important to note that, in the latter section, limestone K_1 registered the first occurrence of the conodont *Declinognathodus donetzianus*, which has been considered one of the best conodont species for defining the Bashkirian–Moscovian boundary (Groves and task group, 2004, 2005, 2009). Moreover, this limestone records the first occurrence of strongly Moscovian-type *Eofusulina* in the fusuline fauna. The latter genus is also considered to have considerable potential as an index for defining the base of the Moscovian Stage (Groves and task group, 2011). Thus, Nemyrovska *et al.* (2010) consider the base of the Moscovian in the Donets Basin to lie within limestone K_1.

Saori Tanaka, a student of Katsumi Ueno, recently studied additional samples from the Malonikolaevka section for her Bachelor of Science thesis and provided interesting information on fusulines (Tanaka, 2012). In limestone I_2^2 she found an elongate fusuline, which looks like a species of *Eofusulina*, and another elongated form that resembles specimens of *Verella transiens* reported from the Cantabrian Mountains of northern Spain (van Ginkel, 1987). Another important occurrence from limestone I_2^2 is a large rhomboidal *Profusulinella* somewhat similar to *P. rhombiformis* (but definitely larger than the types). This peculiar *Profusulinella* species, also occurring commonly in limestone I_2^2 of the nearby Zolotaya section, resembles *Profusulinella albaensis* originally reported from the Alba Limestone (≈lower Kashirian) of the Cantabrian Mountains (van Ginkel, 1965). From the viewpoint of the evolutionary characteristics of fusulines, the relevant *Profusulinella* from limestone I_2^2 does not look like a Bashkirian form. Evidence from the fusulines suggests that limestone I_2^2 can be correlated with the *Verella transiens*-bearing strata in the Cantabrian Mountains. Interestingly, that level has been correlated to the Vereyan of the earliest Moscovian (van Ginkel, 1987; Villa, 1995). Whatever its exact age, the peculiar species resembling *Profusulinella albaensis* provides a good level of inter-regional correlation near the Bashkirian–Moscovian boundary. So far the age of limestone I_2^2 has not been precisely determined and a discrepancy may occur between fusuline-based correlations and those based on conodonts because in the Malonikolaevka and Zolotaya sections fusulines of Moscovian aspect occur in strata below the conodont-based Moscovian base (i.e. FAD of *Declinognathodus donetzianus*).

South China

Yuping Qi, Lance Lambert, and Tamara Nemyrovska are collaborating to study large collections of conodonts from deep-water (carbonate slope) sections that were sampled in detail in southern Guizhou province, South China. The collections contain several lineages spanning the mid-Bashkirian to early Moscovian interval. In ascending order the lineages include species of the *Streptognathodus expansus* Igo & Koike, 1964 to *Streptognathodus suberectus* Dunn, 1966 lineage, the *Gondolella –Mesogondolella* group, *Diplognathodus coloradoensis – Diplognathodus ellesmerensis* lineage and a group of *Neolochriea* species. For the Bashkirian–Moscovian boundary, only *D. ellesmerensis* has substantial potential as an index for the boundary GSSP and can be used for the regional and global correlation of sections lacking *Declinognathodus donetzianus* Nemirovskaya, 1990. Qi and his colleagues are preparing a manuscript with illustrations for the next issue (v. 31) of the "Newsletter on Carboniferous Stratigraphy" describing all the lineages and including a recommendation for the marker taxon.

In the Naqing section, there are several important conodont lineages that span the Bashkirian–Moscovian boundary (see paragraph above). One of them, the FAD of *D. ellesmerensis* could be proposed for the marker of this boundary; however, more specimens are required to document the transition from its ancestor *Diplognathodus coloradoensis*. Yuping Qi has discovered two new sections that span the Bashkirian–Moscovian boundary in nearby areas of southern Guizhou, South China in 2011. There are many more fusulinid beds in the new sections because they consist of lithofacies that were deposited at shallower water depths than those in the Nashui section. Both the conodonts and fusulinids from the new sections are being studied.

In the summer of 2012, Yuping Qi visited the U.S.A. for three months; there, he worked with Jim Barrick and Lance Lambert on Bashkirian–Moscovian conodonts from South China and the

United States. It was a productive trip because Qi found that *Diplognathodus ellesmerensis* is common in some North America collections. Thus, Jim Barrick, Lance Lambert and Yuping Qi think the FAD of *D. ellesmerensis* is the best marker for the base of the Moscovian and global correlation at that level. Although there are transitions for different morphologies of *Streptognathodus expansus* and *S. suberectus* in the Naqing (Nashui) section that may have utility for global correlations (Qi *et al*., 2010), it is thought their stratigraphic first occurrence is too low to permit their use as the basal marker of the Moscovian Stage. For this reason, Yuping Qi and some students went to the Naqing section to collect more samples below the FAD of *D. ellesmerensis* in late October.

Moscow Basin

Goreva and Alekseev (2012), on the basis of conodont data from the Moscow Basin, proposed moving the lower boundary of the Moscovian one substage higher than the position discussed above; that is from the base of the Vereian regional Substage (lowermost Moscovian substage) to the base of Kashirian regional Substage. A proposed marker for the new level is the FAD of *Neognathodus bothrops* Merrill, 1972 from its ancestor *Neognathodus atokaensis* Grayson, 1984. Both species occur in the Midcontinent region of the U.S.A., Moscow Basin and South Urals of Russia, and the Donets Basin in Ukraine. A few specimens have also been reported from South China. The section containing the components of this lineage is the Yambirno quarry (Kabanov and Alekseev, 2011a, b), an abandoned quarry in the eastern part of the Ryazan region of central Russia (ca. 400 km southeast of Moscow). Although the Vereian-Kashirian boundary interval is not presently exposed in the quarry, it can be excavated and restudied in detail.

If the base of the Moscovian is shifted upward to the base of the Kashirian as proposed by Goreva and Alekseev (2012), both the Bashkirian and Moscovian will require redefinition and the Vereian Substage included in the upper Bashkirian. There is some justification for shifting the boundary because the Vereian ammonoid assemblage closely resembles that of the former regional Russian Kayalian stage (= upper part Bashkirian and Vereian) (Ruzhencev, 1969). In addition, the Vereian brachiopods have characteristics that are typical of the Bashkirian taxa (Lazarev in Makhlina *et al*., 2001). The conodont assemblage of the Vereian Substage consists mainly of genera that are widely distributed in the Bashkirian and include the important genera *Idiognathoides* and *Declinognathodus*, a taxon that does not cross the Vereian-Kashirian boundary.

Plans for 2013

Task-group members will continue their investigations of potential boundary markers for the base of the Moscovian Stage and GSSP candidate sections. A major effort will be devoted to the continued study of the conodonts within the Bashkirian–Moscovian transitional interval in the Naqing (Nashui) section especially in the lineages containing *D. ellesmerensis* and *Declinognathodus donetzianus*, two of the taxa considered to have the best potential for boundary definition. Another priority is the continued evaluation of the FAD of *Neognathodus bothrops*, another potential boundary index.

Isabel Montanez and her students will continue their studies of stable-oxygen isotopes using conodonts derived from the Pennsylvanian succession in the Donets Basin, Ukraine. Their objective is to develop a high-resolution (near cyclothem-scale) record of the oxygen-isotope composition of conodonts from the Donets Basin limestones. This will be the highest resolution record of its type for the Carboniferous because only multi-million (stage-level) records currently exist. The record derived from the conodonts will be compared to the sea-level history that was recently defined for the Donets Basin (Davydov *et al.,* 2010) and correlated with the sea-level curves derived from the Midcontinent of the U.S.A. and Pennine Basin. Their ultimate objective is to determine the degree that shifts in conodont-oxygen-isotope composition track the established sea-level changes that were based on sedimentologic analyses. It is anticipated that the final results of the study will be useful for detail correlation between distant sections.

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

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MOSCOVIAN–KASIMOVIAN BOUNDARY

Introduction

During the last few years, the task group has thought the first appearance datums (FADs) of *Idiognathodus sagittalis* Kozitskaya, 1978 and *Idiognathodus turbatus* Rosscoe and Barrick, 2009a have good potential as markers for the base of the Kasimovian (Villa and task group, 2008; Ueno and task group, 2009, 2010, 2011). Their occurrence (near base of Khamovnikian Substage, the second substage of the Kasimovian in current definition) is approximately one substage higher than the traditional base of the Kasimovian (base of

Krevyakinian Substage). Nevertheless, raising the boundary level one substage higher would facilitate global correlation and most task-group members consider it appropriate to narrow the focus of study to an interval that encompasses the FADs of these conodonts. Until now, however, no formal proposal for the marker species that will define the base of the Kasimovian Stage has been presented and voted on.

Progress in North America

Jim Barrick reported that *I. turbatus* is easily recognized and widespread across North America in lower Missourian (Khamovnikian) strata. Although transitional forms from the ancestor *Idiognathodus swadei* Rosscoe and Barrick, 2009a to *I. turbatus* occur in successive minor and intermediate cyclothems (Rosscoe and Barrick, 2009b), the vertically discontinuous nature of the marine intervals prohibit selection of a GSSP in the Midcontinent region of the U.S.A. In contrast to *I. turbatus*, nothing seems to match well with *I. sagittalis* in the North American conodont collections. Barrick suggests that more detailed work is needed on the taxonomy and morphological characterization of *I. sagittalis* from Eurasia before it can be used as a reliable biostratigraphic index for the base of the Kasimovian.

Progress in South China

Qi Yuping, in collaboration with James Barrick, continued their study of the Moscovian–Kasimovian transition in the Naqing (Nashui) section (Barrick *et al*., 2010) in southern Guizhou province, South China. From that section, they collected a series of closely spaced samples that preserve the transition from *I. swadei* to *I. turbatus* without apparent interruption. The transition is so complete that determining the exact level at which the oldest *I. turbatus* occurs is difficult (+/−10 cm). Because the transition is so well developed, the Naqing section is a good candidate for the GSSP, if one wants to rely on a transitional series of morphotypes. The section is strongly condensed, so the transitional interval is thin, which could prove to be problematic. Qi and Barrick plan to prepare a proposal using the first evolutionary appearance of *I. turbatus* as the index for the base of the Kasimovian.

Progress in Spain

Elisa Villa reported that the University of Oviedo that is devoted to the study of the Moscovian–Kasimovian boundary in the Cantabrian Mountains is continuing intensive research of the Carboniferous limestones outcropping in the Ándara Massif of the Picos de Europa Mountains. In that area, a continuously exposed carbonate succession, which is more than 300 m thick, comprises strata from the upper Moscovian (Myachkovian) to the lower-middle Kasimovian. The particularly well-exposed Castillo Del Grajal and Morra de Lechugales sections exhibit the most favorable conditions for establishing the biostratigaphic distribution of relevant fusuline and conodont taxa (see preliminary report by Villa *et al*., 2009b for main sedimentological and biostratigraphic characteristics of both sections).

In addition, the Spanish team are investigating the Vegas de Ándara section (also in the Ándara Massif), where late Moscovian to middle Kasimovian strata are present. Recent investigations by the Spanish group confirmed the completeness of the fusuline record in the area and facilitated the discovery of beds providing assemblages of the *Fusulinella schwagerinoides*, *Protriticites*, and *Montiparus* zones. A thick stratigraphic interval shows the gradual transition from *Fusulinella* to *Protriticites* species. Apart from species belonging to the *Fusulinella-Protriticites-Montiparus* lineage, the sections also yielded species belonging to *Fusiella*, *Pseudotriticites*, *Ozawainella*, *Pseudostaffella* (*Quasistaffella*), and *Schubertella*, as well as some forms questionably and tentatively assigned to primitive *Quasifulina*. A systematic study of these fusulines is currently in progress.

Sampling of Podolskian (middle Moscovian) to Khamovnikian beds in the Vegas de Ándara and the Castillo de Grajal sections are also being undertaken to analyze the succession of the conodont faunas (J. Sanz and S. Blanco, in progress). These studies include the systematics of abundant *I. sagittalis* specimens collected from the base of the Khamovnikian Substage and their relationship with much scarcer *I. turbatus* and *I. swadei*.

Idiognathodus sagittalis, one of the two best potential indices for the lower Kasimovian boundary, occurs within other sections in the Cantabrian Mountains such as the Las Llacerias (Méndez, 2006). To confirm the potential of *I. sagittalis* for global correlation, the study of its variability (preferably in the type bed in Ukraine) and more illustrations documenting its characteristics at various occurrences are necessary. Nevertheless, the occasional presence of *I. turbatus* (a species originally described from the Midcontinent region of U.S.A.) in the Castillo de Grajal section together with the first occurrence of *I. sagittalis*, reinforces the biostratigraphic significance of *I. turbatus* because the latter species may assist with correlating *I. sagittalis* occurrences with strata in the Midcontinent region of the U.S.A.

Intensive sampling for conodonts in Spain has revealed that only some open-marine to deep-water lithofacies provide a significant number of specimens. At several localities, new samples were collected from beds yielding scarce but important

taxa. Such is the case of the Krevyakinian beds (currently the lower substage of Kasimovian) from the Morra de Lechugales section, which contain a middle-sized element of *Idiognathodus* sp. 1 of Goreva *et al.* (2009), the proposed ancestor of *I. sagittalis*.

Progress in Russia

Alexander Alekseev, together with Natalia Goreva, Tatiana Isakova, and Olga Kossovaya, are continuing their paleontological examination of specimens from the Stsherbatovka section in the southern part of the Oka-Tsna Swell on the left bank of the Oka River in the Ryazan Region. The section was measured in an abandoned quarry and intensively surveyed by them during 1990s. Good morphotypes of *I. sagittalis-I. turbatus* were discovered by recent examination of conodont collections from the section. Unfortunately the abandoned quarry is old and the outcrops no longer exist but can be excavated.

Ukraine

During the last fiscal year, Tamara Nemyrovska and Katsumi Ueno, in collaboration with Thasinee Charoentitirat (Chulalongkorn University, Thailand), continued fieldwork in the Donets Basin on the N and O suites strata exposed at Kalinovo, and also at a new section in the Annovka area. The work is ongoing.

KASIMOVIAN–GZHELIAN BOUNDARY

The task group to establish the Kasimovian–Gzhelian boundary selected the first appearance datum (FAD) of the conodont *Idiognathodus simulator* (Ellison, 1941) *sensu stricto* in its potential lineage *Idiognathodus eudoraensis – I. simulator* as the event marker for defining the base of the Gzhelian Stage (Heckel *et al*., 2008; Villa *et al*., 2009a) and is directing research toward selecting a suitable section for the GSSP in China, Russia and North America. Encouraging progress has been made on locating a suitable candidate section for the GSSP through intensive searching and the resulting substantial increase of boundary-related information. To date, however, the only section that has been formally proposed as a potential candidate for the basal Gzhelian GSSP is the Usolka section in the southern Ural Mountains of Russia (Chernykh *et al*., 2006; Davydov *et al*., 2008). During a 2009 field meeting in Russia, the section was examined by a team of SCCS members and was found to be poorly exposed and in need of additional study. Since that trip, Davydov and colleagues have initiated additional work on the Usolka section.

Progress in North America

Heckel *et al.* (2011) published a paper documenting the conodont-based correlation of lower Missourian (Kasimovian) to lower Virgilian (lower Gzhelian) Conemaugh marine units in the Appalachian Basin with the Midcontinent cyclothems. Their study illustrates the value of using the first appearance datum of *I. simulator* for identifying the base of the Gzhelian Stage, and it notes the similarity of some morphotypes of an unnamed early Missourian Appalachian relative of *Idiognathodus cancellosus* to the Russian species *Idiognathodus neverovensis*, which was described from early Kasimovian strata of the Moscow Basin. In addition, the paper provides a stronger framework for correlating the Appalachian terrestrial succession with the global marine successions.

During recent studies of *I. simulator*, Jim Barrick confirmed that its FAD works well as a biostratigraphic indicator for the base of the Gzhelian. He further noted that forms like *I. simulator* occur globally, but the species should be constrained better taxonomically to permit more reliable correlation. On the other hand, he recognized in the North American Midcontinent succession that *Idiognathodus eudoraensis* Barrick, Heckel and Boardman 2008, the potential ancestor of *I. simulator*, is mostly restricted to one cyclothem (Stanton/Eudora) of the upper Missourian regional stage (upper Kasimovian). A few isolated similar specimens have been recovered from the succeeding cyclothems below the FAD of *I. simulator* in the Ordead/Heebner cyclothem in the lower Virgilian (Gzhelian), which means a significant gap occurs in the record from *I. eudoraensis* to *I. simulator* in the North American Midcontinent region. The number of specimens available between the two stratigraphic levels is insufficient to provide substantial information about the details of the transition. Without additional specimens, it is not be possible to establish the GSSP in the region.

For a project on Pennsylvanian paleoceanic circulation and geochemistry, Jim Barrick is measuring and sampling a series of sections through the Heebner Shale (level of holotype of *I. simulator*) from Oklahoma to Nebraska. The work will provide large collections of conodonts (many will be used by geochemists), and will enable him to conduct a more detailed analysis of morphological variation within the species in different geographic and environmental settings in the North American Midcontinent.

Progress in South China

During the last fiscal year, Qi Yuping and Jim Barrick continued with their intensive study of the conodonts across the Kasimovian–Gzhelian boundary in the Naqing section (Nashui section) in southern Guizhou province of South China (Barrick *et al*., 2010) using closely-spaced samples. In that section, *Idiognathodus simulator* appears abruptly in a diverse conodont fauna, but the immediately

underlying beds have yielded few conodonts. Forms ancestral to *I. simulator* occur in strata a few meters lower in the section but are not especially common; consequently, the section does not appear to be a good candidate for the boundary stratotype.

Progress in Russia

In the Moscow Basin, Alexander Alekseev has been studying the Kasimovian–Gzhelian boundary in the Rusavkino quarry. In that quarry, *I. simulator* had been discovered in an earlier study (Alekseev and Goreva, 2007) but the locality was recently re-sampled for conodonts. In the new collections, Alekseev and colleagues found an *I. eudoraensis* morphotype from the middle part (Member 2) of the Rusavkino Formation, which is below an important gap in the succession and has been correlated to the uppermost Kasimovian. A close form even occurs in the underlying Troshkovo Formation. Because the Moscow Basin provides good sections through the Kasimovian–Gzhelian boundary level, Alekseev and his colleagues plan to prepare a formal proposal for the GSSP at base of the Gzhelian based on either the Rusavkino quarry section or the stratotype of the Gzhelian Stage in the abandoned Gzhel quarry (Alekseev *et al.*, 2009).

Alexander Alekseev and his colleagues from Moscow, together with Olga Kossovaya, continued with their investigation of the Yablonevyy Ovrag quarry section in the Zhiguli Mountains, Samarskaya Luka. This completely exposed section in the Samara Bend of the Volga River about 800 km east of Moscow extends from the upper Kasimovian up to the Sakmarian Stage of the Permian. The section is the hypostratotype of the Gzhelian and shows a nice basal Gzhelian conodont assemblage with *I. simulat*or; however, conodonts are scarce in strata below the level containing *I. simulator* and *I. eudoraensis* has not been found. Related to the work at the Yablonevyy Ovrag quarry, they visited the Kholodny Log section on the Kosva River in the Perm region in 2010. At the latter locality, they found an interesting interval close to the Kasimovian–Gzhelian boundary but conodonts (including *Streptognathodus pawhuskaensis*) and fusulines were not abundant enough to precisely locate the boundary.

Chernykh (2012) published an important monograph on Gzhelian conodonts from the Urals in which he established the Gzhelian biostratigraphy of the region based on a sequence of species consisting of *Streptognathodus firmus*, *S. simulator*, *S. vitali*, *S. virgilicus*, *S. simplex*, *S. bellus*, *S. wabaunsensis*, and *S. isolatus*. Chernykh used the first appearance of *S. simulator* (=*Idiognathodus simulator* (Ellison, 1941)) for defining the base of the Gzhelian. S. *firmus* is the zonal species of the underlying strata, but *S. simulator* is not its evolutionary descendant.

Vladimir Davydov and his colleagues recently re-measured and resampled the Usolka section, formally proposed as a GSSP candidate section (Chernykh *et al.*, 2006; Davydov *et al.*, 2008), in the South Urals for conodonts. The resulting conodont collection was studied by Jim Barrick and Guzel Sungatulina (Kazan University, Russia). Unfortunately, the new conodont collections through the Kasimovian–Gzhelian transitional lack numerous elements and taxa. Moreover, they were not able to reproduce the lineage of *Streptognathodus praenuntius* to *S. simulator* reported in earlier studies of the Usolka section (Davydov *et al.*, 2008). Thus the Usolka section requires additional sampling and study before it can be considered as a viable candidate for the GSSP at the base of the Gzhelian.

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(Views and interpretations expressed / presented in contributions by members are those of individual authors / co-authors and are not necessarily those of the SCCS and carry no formal SCCS endorsement.)

CARBONIFEROUS FLORAS AND STRATIGRAPHY OF VERKHOYANIE (NORTHEASTERN RUSSIA)

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Abstract. *This paper provides a brief review of the Carboniferous plant assemblages of the Verkhoyanie, as well as their correlation with the megafloral succession of the Kuznetsk Coal Basin (the key section of continental late Palaeozoic deposits of Angaraland). The tracing of the mid-Carboniferous boundary at the top of the Setachanskaya suite, where the replacement of the post-Lepidophytean flora by the Pteridosperm-Cordaitean one took place, is debated.*

Introduction

The Verkhoyansk Range (Verkhoyanie) is bordering the Siberian platform from the northeast. The range exposes thick terrigenous deposits attributed to the late Paleozoic – early Mesozoic Verkhoyanian complex. The thickness of the Palaeozoic part of the complex is about 10 km. It contains extratropical endemic assemblages of marine fauna and land plants (Durante, 2003, 2010; Durante and Izrailev, 1977). The Carboniferous flora of Verkhoyanie belongs to the boreal Angaran Palaeofloristic Kingdom (Vakhrameev *et al*., 1978; Meyen, 1982).

This report is based on the latest data coming from the Orulgan Ridge (central Verkhoyanie cordillera) and the Western Verkhoyanie (drainage basins of Jundulung, Kjundjudey, and Djanishka Rivers). Most sections yield rich fossil plant assemblages. Correlation of main stratigraphical units are shown on Fig. 1.

Floral assemblages

Carboniferous-age floras are grouped into three successive floral assemblages (*Lepidophytean, post-Lepidophytean* and *Pteridosperm–Cordaitean*; Figs. 1 and 2). These floral assemblages have analogues elsewhere across the Angaran Palaeofloristic Kingdom.

The *Lepidophytean* Flora is known from the Bylykatskaya Suite (=Formation) of the Orulgan Ridge and Sobopol River Basin. It is dominated by lepidophytes, (mostly poorly preserved large stems up to 10 cm in diameter) belonging to the genera *Angarodendron* Zalessky, *Lophiodendron* Zalessky, and possibly some undescribed genera. Shwedov (1970) has also mentioned fern-like plants with cyclopteroid pinnules (*Abacanidium* Radczenko, *Angaropteridium* Zalessky).

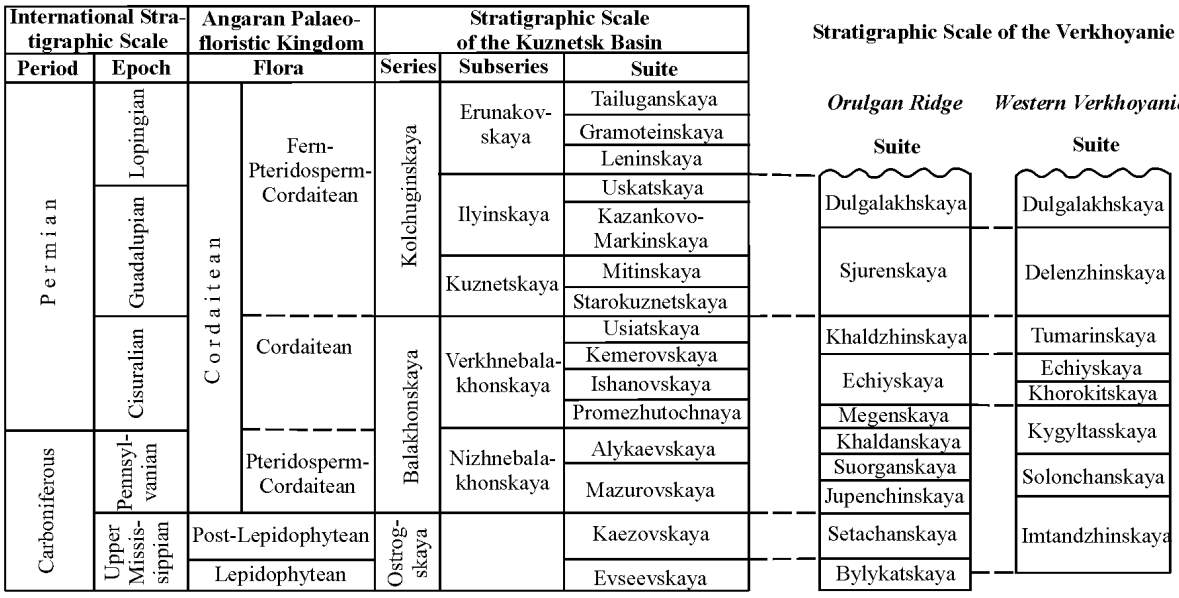

Figure 1. Correlation of Palaeozoic stratigraphic schemes of Verkhoyanie and Kuznetsk Basin

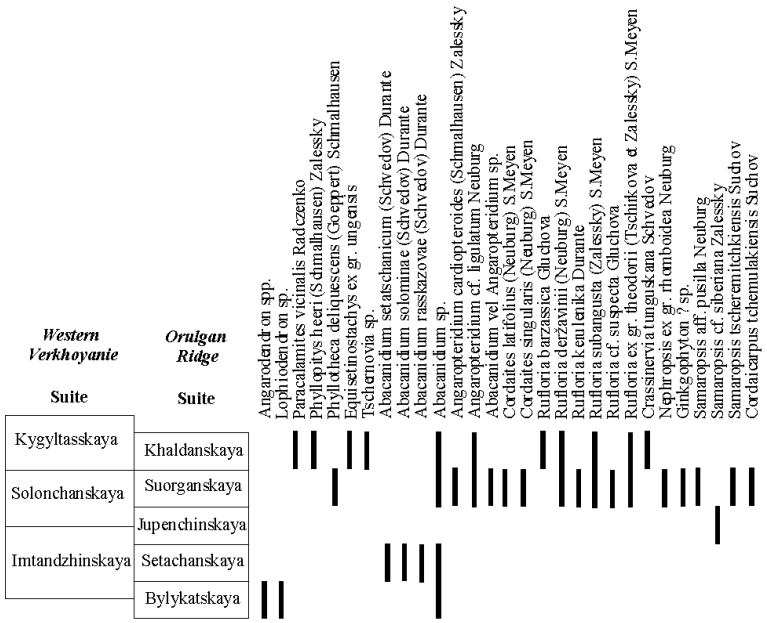

Figure 2. Stratigraphic ranges of most common plant species in the Carboniferous of the Verkhoyanie

The *post-Lepidophytean* flora is known from very few localities of the Setachanskaya Suite (=Formation) and also suffering from poor preservation: remains of cyclopteroid pinnules of *Abacanidium* and *Angaropteridium* and poorly preserved horsetails. The *post-Lepidophytean* flora may be regarded as an impoverished derivation from the *Lepidophytean* flora devoid of lepidophyte components.

In the Kuznetsk Basin (the Southern part of the Angaran Palaeofloristic Kingdom), lepidophytes disappear at the boundary of Evseevskaya and Kaezovskaya suites (= formations) (Fig. 1). This boundary is marked by a limestone bed that yielded upper Viséan brachiopods (ammonoid zone P2; Ganelin and Durante, 2002) thus constraining the age of the post-*Lepidophytean* flora to the late Viséan – Serpukhovian.

The *Pteridosperm–Cordaitean* flora has been colleded from Jupenchanskaya, Suorganskaya, and Khaldanskaya suites (=formations) of the Orulgan Ridge. Among its dominant components are middle-sized leaves of *Rufloria* with wide dorsal furrows, as well as endemic pteridosperms *Angaropteridium* and *Angaridium* Zalessky. Rare *Neuropteris sternberg* (Ad. Brongniart) and a few ginkgophyte leaves *Ginkgophyllum* Saporta occur. Ferns are also rare.

In the Jupenchanskaya Suite (= Formation), the first locality of *Pteridosperm–Cordaitean* flora is marked by large seeds resembling those from the Mazurovskaya Formation of the Kuznetsk Basin.

The middle part of Jupenchanskaya Suite (= Formation) is characterized by ammonoids, mainly Orulganitidae with narrow umbos. According to V.G. Ganelin (personal communication), this assemblage may be correlated to the standard ammonoid zone *Diaboloceras – Axinolobus* (upper Bashkirian). Thus, the appearance of the Pteridosperm–Cordaitean flora may correlate to the base of the Pennsylvanian.

The Pennsylvanian-age Suorganskaya and Khaldanskaya suites (= formations) are characterized by ammonoids *Metapronorites* sp., *Glaphyrites* sp., *Agathiceras* sp., *Dunbarites* sp., *Eoshumardites artigensis* Popow, and *E. lenaensis* Popow (Andrianov, 1985). The latter species known from the uppermost Carboniferous (Ruzhentsev, 1975) is found in top of the Khaldanskaya Suite (= Formation) which presumably correlates to the Carboniferous/Permian boundary. Younger succession contains only Permian fauna.

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AMMONOIDS FROM THE VISÉAN–SERPUKHOVIAN BOUNDARY BEDS IN THE VERKHNYAYA KARDAILOVKA SECTION: A PROGRESS REPORT

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Introduction

In August 2012, the Viséan–Serpukhovian Boundary task group (B.C. Richards, A.S. Alekseev, E.I. Kulagina, Yu.A. Gatovsky, and S.V. Nikolaeva) continued excavations on the Viséan–Serpukhovian boundary beds near the village of Verkhnyaya Kardailovka on the right bank of the Ural River in the Baimak District of Bashkortostan, Russia. This section has been proposed as a GSSP for the base of the Serpukhovian Stage (Pazukhin *et al*., 2010 and others) and has a long history of excavations and research. Prior to the 21st century, the Viséan–Serpukhovian boundary was traditionally placed at the base of the beds containing the ammonoids *Cravenoceras* and/or *Edmooroceras pseudocoronula* (see historical review in Nikolaeva and Kullmann, 2003). The *Hypergoniatites–Ferganoceras* Genozone was originally thought to be Viséan, although it was evident that at least in the Urals the ammonoid assemblage of this genozone was very closely related to the assemblage of the overlying *Uralopronorites–Cravenoceras* Genozone (Ruzhencev and Bogoslovskaya, 1971). The base of the Serpukhovian was difficult to identify based on ammonoids only because of their scarcity, hence from the end of the 1990s an international search for a better boundary marker was launched. It was suggested that the boundary be drawn at the level of the FAD of the conodont *Lochriea ziegleri* (Skompski *et al*., 1995; Nikolaeva *et al*., 2002, 2005; Cozar *et al*., 2008), which was assumed to be close to the traditional base of the Serpukhovian. The Verkhnyaya Kardailovka section in the South Urals is considered to be one of the best candidate sections, because of the multiple ammonoid occurrences throughout the upper Viséan and the Serpukhovian. Ammonoids from the Serpukhovian part of the section have previously been described (e.g., Ruzhencev and Bogoslovskaya , 1971), but those from the Viséan portion of the section have not been systematically studied, although their presence has been mentioned several times in the literature (Nikolaeva *et al*., 2002; Nikolaeva *et al*., 2009b; Pazukhin *et al*., 2010).

New ammonoid records in 2012

The total thickness of the interval of the Viséan–Lower Serpukhovian boundary beds discussed in this paper is ca. 25 m. This interval includes beds previously correlated to the Aleksinian and Mikhailovian regional substages of the Russian Platform, and now assigned to the Kamenskuralian, Averinian, Bogdanovichian and basal Kosogorian regional substages (Fig. 1). The Viséan portion of the section (below the first documented appearance of the conodont *Lochriea ziegleri* in sample 013) is 9.77 m (beds 19–21). The Lower Serpukhovian portion of this interval is 15.2 m thick, which includes bed 22a (Kosogorian) and beds 22b–24 (Khudolazian).

In 2012, the members of the working group widened and deepened the horizontal trench connecting trenches 2 and 3 and considerably enlarged trench 3. In the process of excavation we discovered new ammonoid horizons in trench 3, which suggests that this trench may be a better choice for the GSSP than the previously considered trench 4 (Nikolaeva *et al*., 2009b) because the first *L. ziegleri* was also recorded from this trench. The beds in trench 3 were sampled for conodonts by A.S. Alekseev and Yu.A. Gatovsky. New ammonoids from this section allow the refinement of the ammonoid zonation and recognition of new zonal assemblages.

Ammonoids in the boundary beds of the Verkhnyaya Kardailovka section come from several levels in the Viséan and Lower Serpukhovian portions of the section. The Serpukhovian ammonoids come from a natural outcrop and trenches, whereas

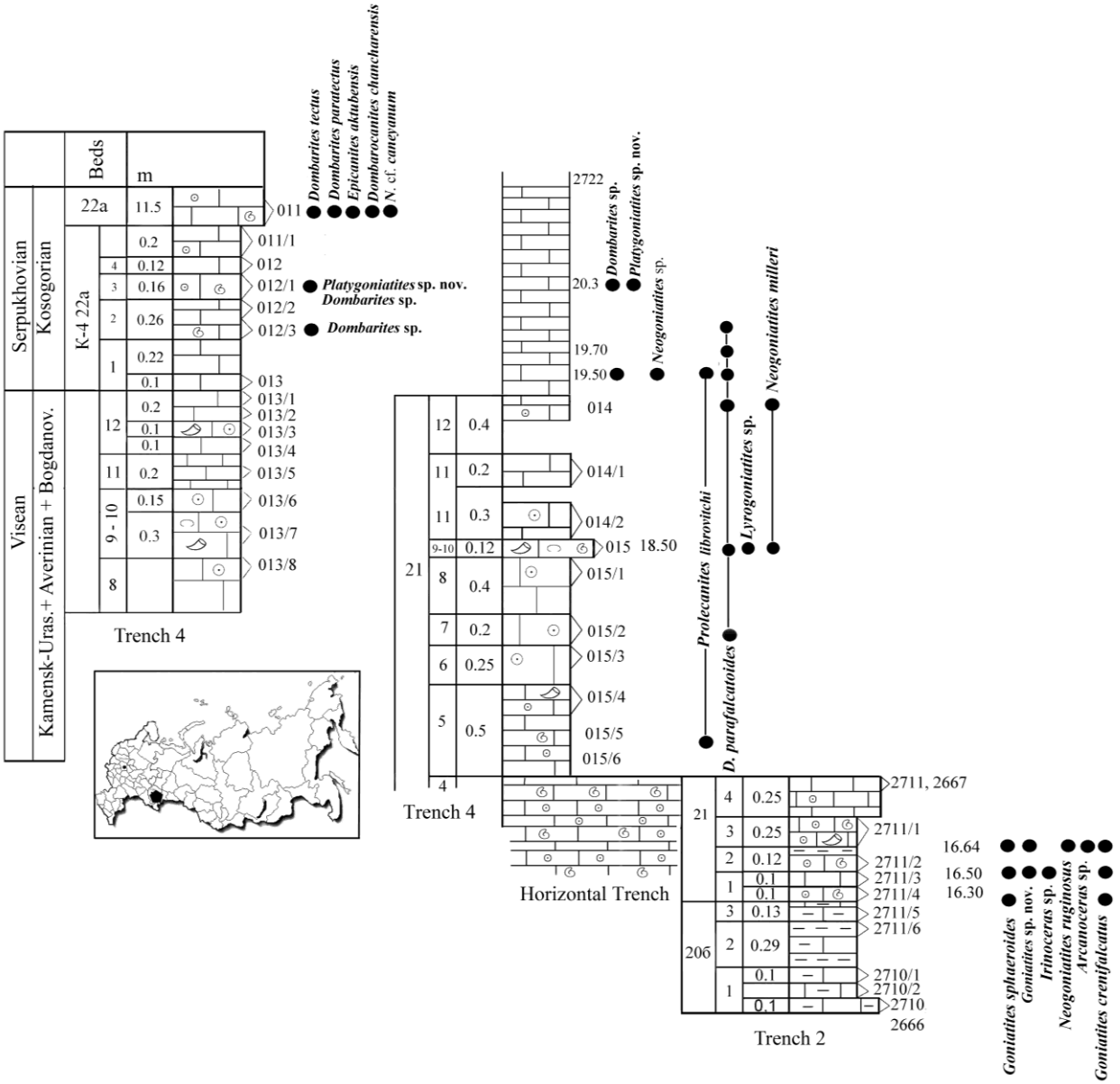

Figure 1: Ammonoid records in the Verkhnyaya Kardailovka Section.

the Viséan ones were collected from trenches on the saddle between the Viséan (Tulian) crinoid limestones and Serpukhovian (Kosogorian (partly), Khudolazian and Chernyshevkian (= Yuldybaevian) goniatite limestones. The trenched part of the section, therefore, corresponds to the Kamenskuralian, Averinian, Bogdanovichian and partly Kosogorian Regional Substages. The detailed stratigraphy and microfacies are described by Nikolaeva *et al*. (2009b) and Pazukhin *et al.* (2010).

The new excavations of 2010–2012 revealed previously unknown assemblages in the Viséan–Lower Serpukhovian beds. These successive Viséan–Serpukhovian faunas are particularly interesting in view of the currently topical problems of the Viséan–Serpukhovian boundary. The study has also contributed to the previously unknown history of the terminal stage in the evolution of the family Goniatitidae in the Uralian Paleoocean.

Three ammonoid assemblages are recognized. These are referred to the *Goniatites* Genozone (upper Viséan), *Hypergoniatites–Ferganoceras* Genozone (upper Viséan and lower Serpukhovian), and the *Uralopronorites–Cravenoceras* Genozone (lower Serpukhovian).

It was shown (Nikolaeva *et al*., 2009a) that the base of the Serpukhovian determined by the FAD of *L. ziegleri* lies within the *Hypergoniatites–Ferganoceras* Genozone, and more precisely in the Dombar Hills (Western Kazakhstan) within its upper *Dombarigloria miranda* Zone (Nm1a2). Therefore the underlying *Pachylyroceras cloudi*

Zone (Nm1a1), is entirely Viséan, whereas the *Dombarigloria miranda* Zone (Nm1a2), is partly Viséan and partly Serpukhovian. This position of the FAD of *L. ziegleri* is supported by the data from the Verkhnyaya Kardailovka section. In this section the documented appearance of *L. ziegleri* is in Sample 013 (bed 21), and hence it is also within the *Hypergoniatites–Ferganoceras* Genozone (Nikolaeva *et al.*, 2009b; Pazukhin *et al.*, 2010). This is indirectly supported by the occurrence of *L. ziegleri* in in the top part of the P1d Zone in the British Isles (George Sevastopulo, pers. comm.).

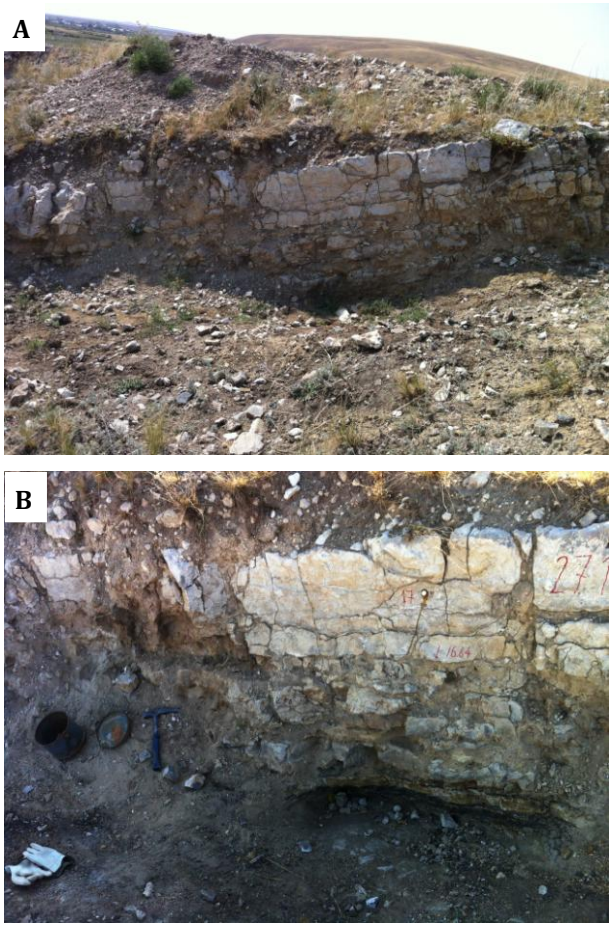

Figure 2a-b: Fossiliferous level 16.64 m in trench 2.

Goniatites Genozone

This genozone, as recognized in the Verkhnyaya Kardailovka section, embraces bed 21 (interval 16.30 –17.0 m from the base of the section). Ammonoids are found in three layers of limestone interbedding with volcanic ashes (Fig. 1). The main fossiliferous levels are at 16.30, 16.50, and 16.64 m from the base of the section. The assemblage contains *Goniatites sphaeroides*, *G. crenifalcatus*, *Goniatites* sp. nov., *Neogoniatites ruginosus*, *Neogoniatites* sp., *Arcanoceras* sp., and *Irinoceras* sp. This assemblage in the South Urals falls between the assemblage of the *Beyrichoceras–Goniatites* Genozone and the earliest occurrences of ammonoids of the *Hypergoniatites–Ferganoceras* Genozone. The comparison of the shell shape and the suture of the *Goniatites* species found in this section with those of species from other regions suggests that the interval 16.30–17 m is similar in age to the *G. spirifer–Arnsbergites falcatus* zones of the Rhenish Massif, the *G. deceptus* and *G. eganensis* zones of Utah and Nevada (Korn and Titus, 2011) and to GI-2 Horizon in the Asbian-Brigantian boundary beds in the Anti-Atlas Morocco (Klug *et al.*, 2006; Korn and Ebbighausen, 2008; Nikolaeva, in press).

Hypergoniatites–Ferganoceras Genozone

In the Verkhnyaya Kardailovka section, ammonoids of this genozone are found in the interval 18.5–20.10 (bed 21 in trench 3). Ammonoids from samples 015/5, 015/2 and 015 (= 18.50 m) were previously reported (Nikolaeva *et al.*, 2009; Pazukhin *et al.*, 2010 and Nikolaeva and Konovalova, 2011). Ammonoid occurrences at levels 19.0, 19.20, 19.44, 19.50, 19.55-19.65, and 19.75-19.88 m are new. Like in the Dombar Hills, this genozone is partly Viséan and partly Serpukhovian in age, because the first appearance of *L. ziegleri* in bed 013) (Nikolaeva *et al.*, 2009a, b; Pazukhin *et al.*, 2010) is within this genozone.

The assemblage contains *Prolecanites librovitchi*, *Dombarites parafalcatoides*, *Neogoniatites milleri*, *Platygoniatites* sp., *Lyrogoniatites* sp. and corresponds to those from the *Hypergoniatites–Ferganoceras* Zone from the Dombar Hills (Ruzhencev and Bogoslovskaya, 1971), Tian-Shan (Librovitch, 1934; Pitinova, 1974; Nikolaeva, 1995), and Novaya Zemlya (Kuzina and Yatskov, 1988). The correlation of the genozone is complex beyond the Urals and Tian-Shan, and is based on the presence of *Hypergoniatites*, *Ferganoceras*, and *Neogoniatites*. Ammonoids of this genozone are close in age to those from the faunas G-3, G-4, G-5 of Gara el Itima, Anti-Atlas, Morocco (Korn *et al.*, 1999; Klug *et al.*, 2006), Cantabrian Mountains (Wagner-Gentis, 1980), Xinjiang and Xizang, China (Ruan, 1984; Liang and Wang, 1991).

Uralopronorites–Cravenoceras Genozone

The zonal assemblage for the *Uralopronorites–Cravenoceras* Genozone is present at several levels in trench 4 and in the outcrop above the trench and includes *Uralopronorites mirus*, *Dombarites tectus*, *D. paratectus*, *Platygoniatites* sp. nov., *Cravenoceras lineolatum*, *C. leionoides, Tumulites eurinus*, *Cravenoceras leionoides* and others. These ammonoids first appear in Sample 012/1 (or possibly in Sample 012/3) (ca. 20.30 m from the base of the section = 0.7 m below sample 2722 in trench 3) and continue

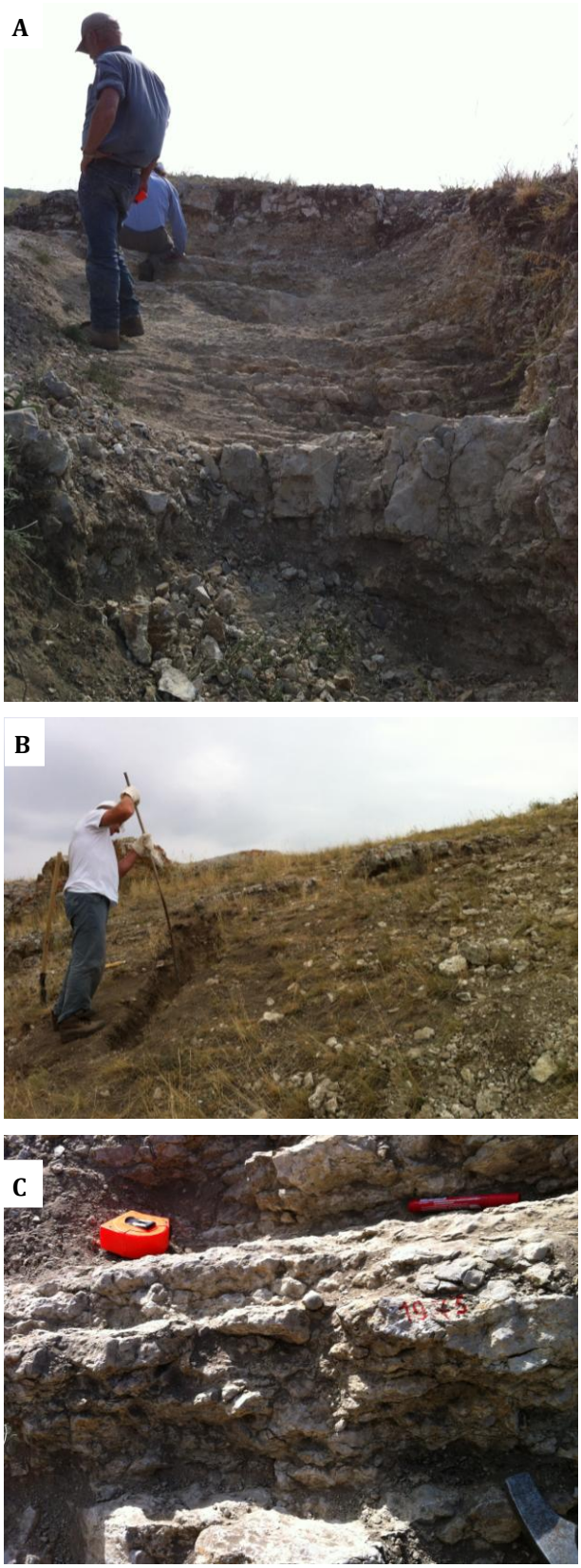

Figure 3a-c: Excavations in trench 3: (3a) general view of trench 3 showing thick beds containing Sample 015 (ca. 18.50 m from the base of the section); (3b) excavation of level 0.7 m below Sample 2722; (3c) sampling level 19.75 m from the base of the section.

throughout the Kosogorian and the lower part of the Khudolazian. The base of the genozone is traditionally drawn based on the entry of *Dombarites tectus*, *D. paratectus*, and *Cravenoceras*. Nikolaevav(2009b) previously suggested that the interval between Samples 015 and 012/3 (ca. 2 m thick), could correspond to the Nm1b1 Zone (= *Dombarites carinatus*), basal in the *Uralopronorites–Cravenoceras* Genozone. However, it has since become apparent that the base of the Serpukhovian lies within this interval, so it should also include beds of the *Hypergoniatites–Ferganoceras* Genozone (Nm1a2).

Conclusions and prospects

The new ammonoid records from the Verkhnyaya Kardailovka section enhance its importance as one of the best potential choices for the GSSP of the base of the Serpukhovian.

Future research will focus on identification of ammonoids from the newly excavated beds of trench 3 and co-ordination of the ammonoid records with the conodont records from the newly sampled levels to reveal the levels with the best correlation potential.

Acknowledgements

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ESTABLISHING THE MOSCOVIAN–KASIMOVIAN BOUNDARY IN THE NORTHERN URALS (THE ILYCH RIVER)

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Introduction

Carbonate facies are widely present in the Pennsylvanian of the western slope of the Northern Urals (Fig. 1). This succession was studied back in 1970s mainly from the paleontological perspective with its stratigraphy focused on foraminifers (Mikhailova, 1974).

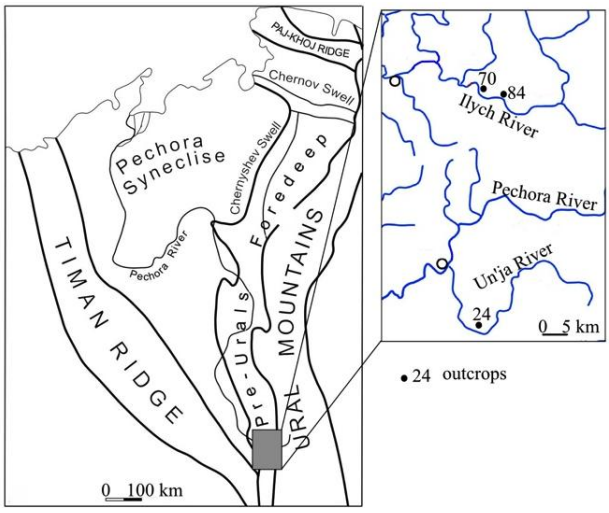

Figure 1: Location of studied outcrops of the Moscovian/Kasimovian transitional interval of the Northern Urals.

We studied the Moscovian–Kasimovian boundary in outcrops No. 70 and No. 84 along the Ilych River (outcrops numbers after Varsanofieva, 1940). The stratigraphy of the middle Pennsylvanian part of the section was developed by Varsanofieva and Rauser-Chernousova (1960).

The Moscovian Stage in outcrop No. 70 are represented by the Kaschirian, Podolian and Myachkovian regional substages (originally called horizons, Varsanofieva and Rauser-Chernousova, 1960). This limestone-dominated section is composed of packstones and wackestones with rare algal bafflestone beds (Antoshkina *et al*., 2011) and a total thickness of the Moscovian is about 40 m. The boundary interval is characterized by the following succession (Fig. 2):

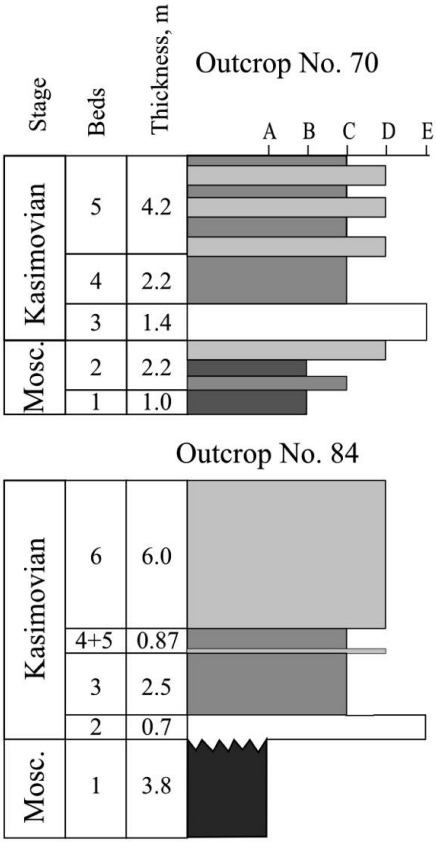

Figure 2: Sections of the Moscovian–Kasimovian boundary deposits in the outcrops No. 70 and No. 84 in the Ilych River. A – mudstones; B – wackestones; C – packstones, D – bafflestones; E – grainstones.

Myachkovian (upper Moscovian)

1. Limestone. Bioclastic wackestones with foraminifera *Ozowainella* ex gr. *mosquensis* Rauser, *Beedina samarica* (Rauser-Chernousova & Belyaeva), *Dagmarella ilychensis* (Rauser-Chernousova) [1.0 m thick]

2. Limestone. Alteration of bryozoan packstones and wackestones, and algal bafflestones [2.2 m thick]

Kasimovian

3. Limestone. Bioclastic-oolithic grainstones (Fig. 3a) with fusulinoids *Kanmeraia solovievae* Ivanova, *K. hatchetensis* (Stewart), *K.* aff. *dissorta* Solovieva, *Kanmeraia sp., Protriticites sp., Obsoletes spectabilis* Vol [1.4 m thick]

4. Limestone. Crinoidal packstones [2.2 m thick]

5. Limestone. Dark fine-grained bioclastic packstones with algal and palaeoaplisinid bafflestones [4.2 m thick]

The total thickness of the Kasimovian interval is 40.9 m, predominantly represented by wackestones and packstones with palaeoplesinid bafflestones and rare algal bafflestones (Ponomarenko *et al.* 2009).

The Moscovian and Kasimovian limestones are lithologically similar and they can be interpreted as subtidal open-marine sediments accumulated below the fair weather wave base. The Moscovian–Kasimovian boundary is marked by an oolithic grainstones interpreted as shoal deposits. Oolithic grainstones are also found at this stratigraphic position in outcrop No. 65 located to the west of outcrop No. 70 (Varsanofieva and Rauser-Chernousova, 1960).

The Moscovian–Kasimovian boundary was studied in a different facies in outcrop No. 84. There the sucession consist of:

Myachkovian (upper Moscovian)

1. Lime mudstones with small bioclasts, allegedly Moscovian according to Varsanofieva and Rauser-Chernousova (1960) attributed to Moscovian. The top of this unit (Fig. 3c, e) is undulated and contains erosional pockets, up to 5-6 cm in diameter, that are filled with crinoid-rich grainstone [3.8 m thick]

Kasimovian (Protriticites pseudomontiparus-Obsoletes obsoletus Zone)

2. Limestrone. Crinoid grainstones with fusulinoides *Pulchrella hayasakai* (Watanabe), *P. eopulchra* (Rauser-Chernousova), *P. pulchra* (Rauser-Chernousova & Belyaeva), *P. pokojamensis* (Leb.)*, Kanmeraia sp., Protriticites plicatus* Kireeva. [0.7 m thick]

3. Limestone. Bryozoan packstones with chert lenses (10x30 cm) [2.5 m thick]

4. Limestone. Algal-palaeoaplysinid bafflestones with lenses of fine-grained bioclastic packstones containing *Pulchrella sp., Obsoletes sp* [0.17 m thick]

5. Limestone. Fine-grained crinoidal-foraminiferal packstones [0.75 m thick]

6. Limestone. Palaeoaplysinid bafflestones with lenses of lime mudstones [6.0 m thick]

The thickness of the Kasimovian deposits in this section is about 10.12 m.

The Moscovian–Kasimovian boundary in the studied sections is marked by a sea level drop interpreted from facies changes and disconformity. A similar character of the Moscovian–Kasimovian boundary was observed to the south at the Un'ja River (Ponomarenko and Isakova, 2011). In that region, the boundary is marked by an erosional surface.

In conclusion, the Moscovian–Kasimovian boundary on the western slope of the Northern Urals records an important sea-level fall manifested by a discontinuity and/or the accumulation of shoal deposits.

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PROGRESS IN SEQUENCE STRATIGRAPHY OF UPPER VISÉAN AND LOWER SERPUKHOVIAN OF SOUTHERN MOSCOW BASIN, RUSSIA

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Introduction

The sequence stratigraphy of the Oka and Zaborie groups of the southern Moscow Basin, including the type area for the Serpukhovian Stage, commenced when Shvetsov (1922, 1932) used the traceable blackened limestones containing *Stigmaria* and solution features ("rhizoid limestones") to define the Aleksinian-Mikhailovian and Mikhailovian-Venevian substage boundaries (Fig. 1). This proto-sequence stratigraphic framework has been proving its sturdiness since then. A two-sequence composition of the Venevian Substage with "rhizoid limestones" in the upper parts of the sequences was recognized by Osipova and Belskaya (1965, reviewed in Hecker and Osipova, 2007; the word "sequence" was not originally applied though). After the work of Osipova and Belskaya (1965), development of disconformity-based correlation in the Oka Group essentially stalled with various cyclicity/sequence models produced but little progress in rock interpretation. Now it's time to look back at disconformities as prime horizons for regional (and maybe global?) correlation, especially taking into account characterless carbonate facies and unsteady siliciclastic units none of which can be taken as regionwide markers. Recent field and microfacies descriptions of carbonate facies reveal minor fluctuations from bioturbated bioclastic packstones to wackestones and back, without any rounded-grain grainstones or mud-dominated facies that would vividly point to shallowing or deepening (Kabanov, 2003; Gibshman *et al*., 2009; Kabanov *et al*., 2012). Remarkably, typical intertidal facies are absent as well. The facies pattern is changing upward from the Forino disconformity with ongoing basin deepening, and first rounded (oncoidal) grainstones appear in the Steshevian top (Shvetsov, 1948; Kabanov, 2003; Kabanov *et al*., 2012).

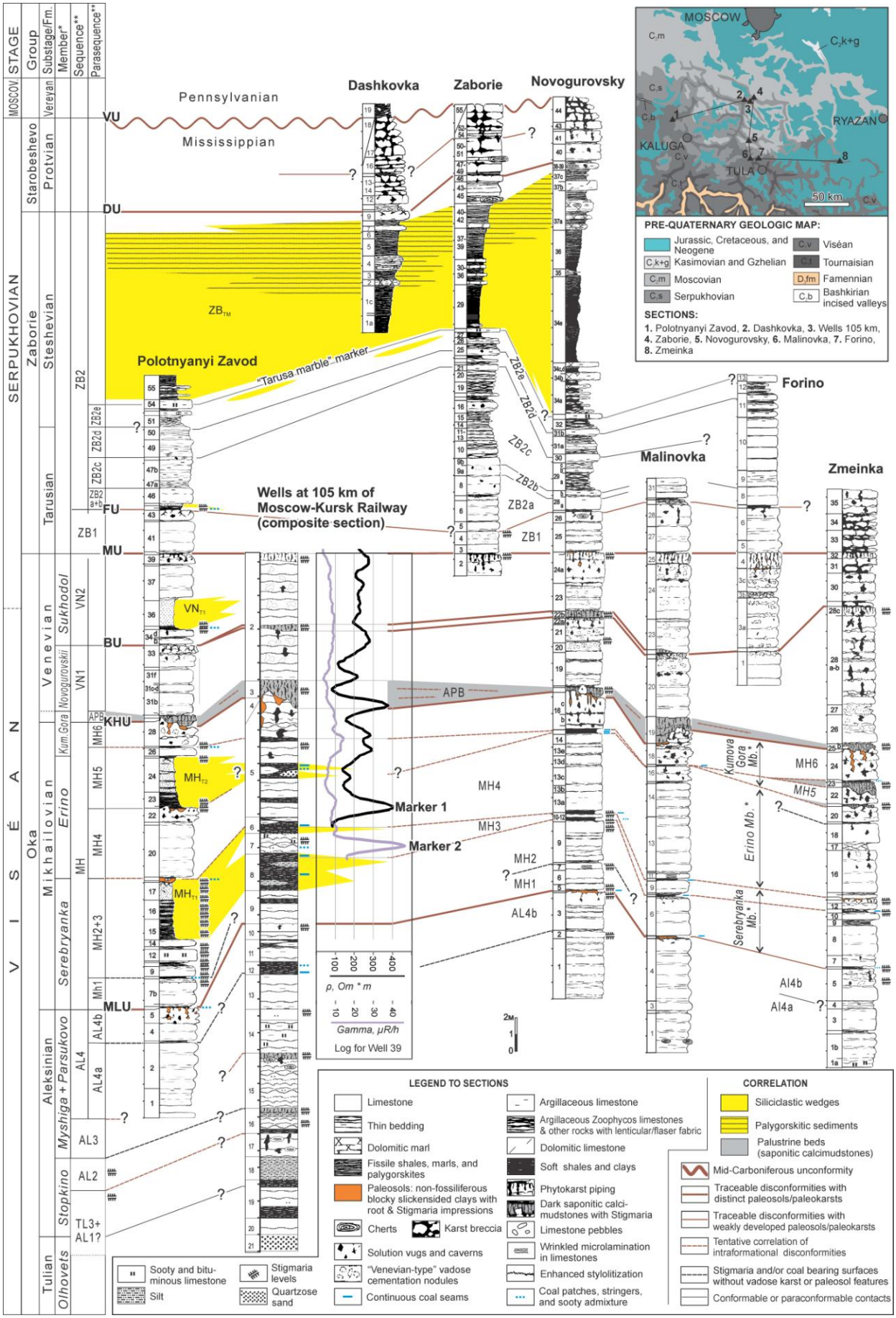
MOSCOV STAGE
Group
Substage/Fm.
Member*
Sequence**
Parasequence**
SERPUKHOVIAN
VISÉAN
Oka
Aleksinian
Tulian
Mikhailovian
Venevian
Tarusian
Zaborie
Starobeshevo
Protvian
Steshevian
Vereyan
Serebryanka
Erino
Sukhodol
Novogurovskii
Kum.Gora
Myshiga + Parsukovo
Stopkino
Olhovets
Pennsylvanian
Mississippian
VU
DU
FU
MU
BU
KHU
MLU
ZB2
ZB1
VN2
VN1
MH
MH6
MH5
MH4
MH2+3
Mh1
AL4
AL4b
AL4a
AL3
AL2
TL3+ AL1?
Dashkovka
Zaborie
Novogurovsky
Polotnyanyi Zavod
"Tarusa marble" marker
Wells at 105 km of Moscow-Kursk Railway (composite section)
Forino
Malinovka
Zmeinka
Marker 1
Marker 2
APB
MH4
MH3
MH2
MH1
AL4b
Al4b
Al4a
Kumova Gora Mb.*
Erino Mb.*
Serebryanka Mb.*
ρ, Om * m
Gamma, μR/h
Log for Well 39
MOSCOW
RYAZAN
KALUGA
TULA
50 km
PRE-QUATERNARY GEOLOGIC MAP:
Jurassic, Cretaceous, and Neogene
Kasimovian and Gzhelian
Moscovian
Serpukhovian
Viséan
Tournaisian
Famennian
Bashkirian incised valleys
SECTIONS:
1. Polotnyanyi Zavod, 2. Dashkovka, 3. Wells 105 km, 4. Zaborie, 5. Novogurovsky, 6. Malinovka, 7. Forino, 8. Zmeinka
LEGEND TO SECTIONS
Limestone
Thin bedding
Dolomitic marl
Fissile shales, marls, and palygorskites
Paleosols: non-fossiliferous blocky slickensided clays with root & Stigmaria impressions
Cherts
Karst breccia
Solution vugs and caverns
"Venevian-type" vadose cementation nodules
Continuous coal seams
Argillaceous limestone
Argillaceous Zoophycos limestones & other rocks with lenticular/flaser fabric
Dolomitic limestone
Soft shales and clays
Phytokarst piping
Dark saponitic calci-mudstones with Stigmaria
Limestone pebbles
Wrinkled microlamination in limestones
Enhanced stylolitization
Coal patches, stringers, and sooty admixture
Sooty and bituminous limestone
Silt
Stigmaria levels
Quartzose sand
CORRELATION
Siliciclastic wedges
Palygorskitic sediments
Palustrine beds (saponitic calcimudstones)
Mid-Carboniferous unconformity
Traceable disconformities with distinct paleosols/paleokarsts
Traceable disconformities with weakly developed paleosols/paleokarsts
Tentative correlation of intraformational disconformities
Stigmaria and/or coal bearing surfaces without vadose karst or paleosol features
Conformable or paraconformable contacts

Figure 1 (previous page): Section correlation based on subaerial disconformities. *Accepted Aleksinian-Venevian formations and members (Makhlina *et al*., 1993); **hierarchy of sequences and parasequences proposed herein. Acronyms for stratigraphic unconformities (disconformities): MLU: Malinovka, KHU: Kholm, BU: Barsuki, MU: Muratovka, FU: Forino, DU: Dashkovka; VU: Vysokoe. APB: Akulshino palustrine bed. Siliciclastic units at Polotnyanyi Zavod: MH_{T1}: lower Mikhailovian, MH_{T1}: upper Mikhailovian, VN_{T1}: Venevian; ZB_{tm}: Main Steshevian shale unit of (ZB from Zaborie Group).

Up to seven "rhizoid limestones" were originally described in the Mikhailovian Substage (Shvetzov, 1922, 1932; Belskaya *et al*., 1975). The basal one of these seven beds matched the Aleksinian top (Osipova and Belskaya, 1975; Makhlina *et al*., 1993), and it is now proposed that the upper one is moved into the lower part of the Venevian (Fig. 1; Gibshman *et al*., 2009; Kabanov *et al*., 2012). Correlation of the other five "rhizoid limestones" to present-day sections remains unclear. The problems of the lower Serpukhovian local correlation, facies and sequence stratigraphic interpretation has been recently addressed in several papers (Kabanov, 2003; Gibshman, 2003; Hecker and Osipova, 2007; Gibshman *et al*., 2009; Kabanov *et al*., 2012) and are not discussed herein. Problems in correlation also remain in the Aleksinian and Tulian regional substages. Unfortunately, our own material from the lower Aleksinian is limited to one well (no. 42) from the bridge construction site (the 105 km milestone of Moscow-Tula railway; Fig. 1). Material shortage is aggravated by disappearance of representative outcrops soon after the Moscow Coal Basin had been shut down. Therefore, we will give only a brief and cautious outlook on the interval around the Tulian-Aleksinian boundary.

Material

Open-pit quarry sections used in this study were measured by the first author from 2001 to 2012. In addition to sections displayed on Figure 1, studied material includes less detailed descriptions of Parsukovo, Brontsy, Eastern Berniki, Kholm, Alulshino, and Gurievo quarries. Descriptions of representative core from 35 wells drilled from 2011-2012 on the bridge construction site on both banks of Oka River, south of the city of Serpukhov (referred to below as wells of 105 km), was handled by R.R. Gabdullin and A.S. Alekseev. Petromodelling Ltd. conducted well logging in 31 of these wells. In this study we use only gamma-ray and effective resistivity logs that reveal traceable stratigraphic signals (Fig. 1). These wells provide valuable information on the Tulian through Venevian interval in close proximity to the Serpukhovian Stage lectostratotype at the Zaborie quarry. Data on foraminifers for wells 41 and 39 of this well set have been prepared by N.B. Gibshman. The outcrop sections on Figure 1, except for the most recently described sections in the Polotnyanyi Zavod and Zmeinka quaries, have been published elsewhere (Kabanov, 2003; Gibshman *et al*., 2009; Kabanov *et al*., 2012). Alternative descriptions and lithologs of the sections in the Novogurovsky, Polotnyanyi Zavod, and Zaborie quaries can be found in Belskaya (1975), Barskov and Alekseev (1979), Makhlina and Zhulitova (1984), Makhlina *et al*. (1993), and Vevel *et al*. (2007). The Zmeinka Quarry and Spartak Quarry, which was described by Makhlina *et a*l. (1993), are situated in the same mining area (west of town of Mikhailov). It seems that both descriptions can be matched bed-by-bed allowing the transfer of some biostratigraphic information from the Spartak section onto the Zmeinka litholog (Fig. 2).

Types of subaerial exposure horizons and associated sediments

It is obvious now that the "rhizoid limestone" is not one facies. Lenses of the "rhizoid limestone" have been described in the layers of overcompacted sooty shales (e.g., bed 11 of Zmeinka quarry) implying that the intra-Mikhailovian "rhizoid limestones" described by M.S. Shvetsov (1932) can be correlated to thin (<5 cm) and frequently overlooked solution horizons. A tentative field classification of subaerial exposure horizons ("disconformity facies") is given below. Multiproxy data on these paleosols and palustrine facies have been reported in occasional notes (Alekseeva *et al*., 2010, 2012) with a major publication expected in the near future.

Type 1. The type 1 subaerial exposure horizons are represented by paleokarst displaying irregular solution vugs and upright pipes. The pipes mostly represent solution-enlarged *Stigmaria* rootlets (sometimes referred to as rootlets or "root hairs"). The top of the limestone substrate is normally riddled by solution pockets and brecciated, mottled from the development of replacive argillaceous mottles and dark gray or brownish micritic calcrete. Solution voids contain loose blocky clay, normally mottled gray to yellow, that easily crumbles out. The marine limestone substrate is bleached (complete decomposition of coal detritus), often mottled from development of darker potato-shaped cementation nodules in soft chalky matrix ("Venevian– type" mottling; Kabanov, 2004). Three intergrading sub-types occur: *(1a)* pipe dominated (phytokarst; Fig. 3g), *(1b)* vug and cavern dominated (Fig. 3e), and (*1c*) calcrete-rich, usually in combination with phytokarst (Fig. 3c).

Type 2. The type 2 subaerial exposure horizons are represeneted by pinkish, fissile, overcompacted marls with collapsed, essentially flat brachiopods including gigantoproductids, topped by thin (< 2-3 cm) coal seams and gypsiferous (selenite) sooty shales

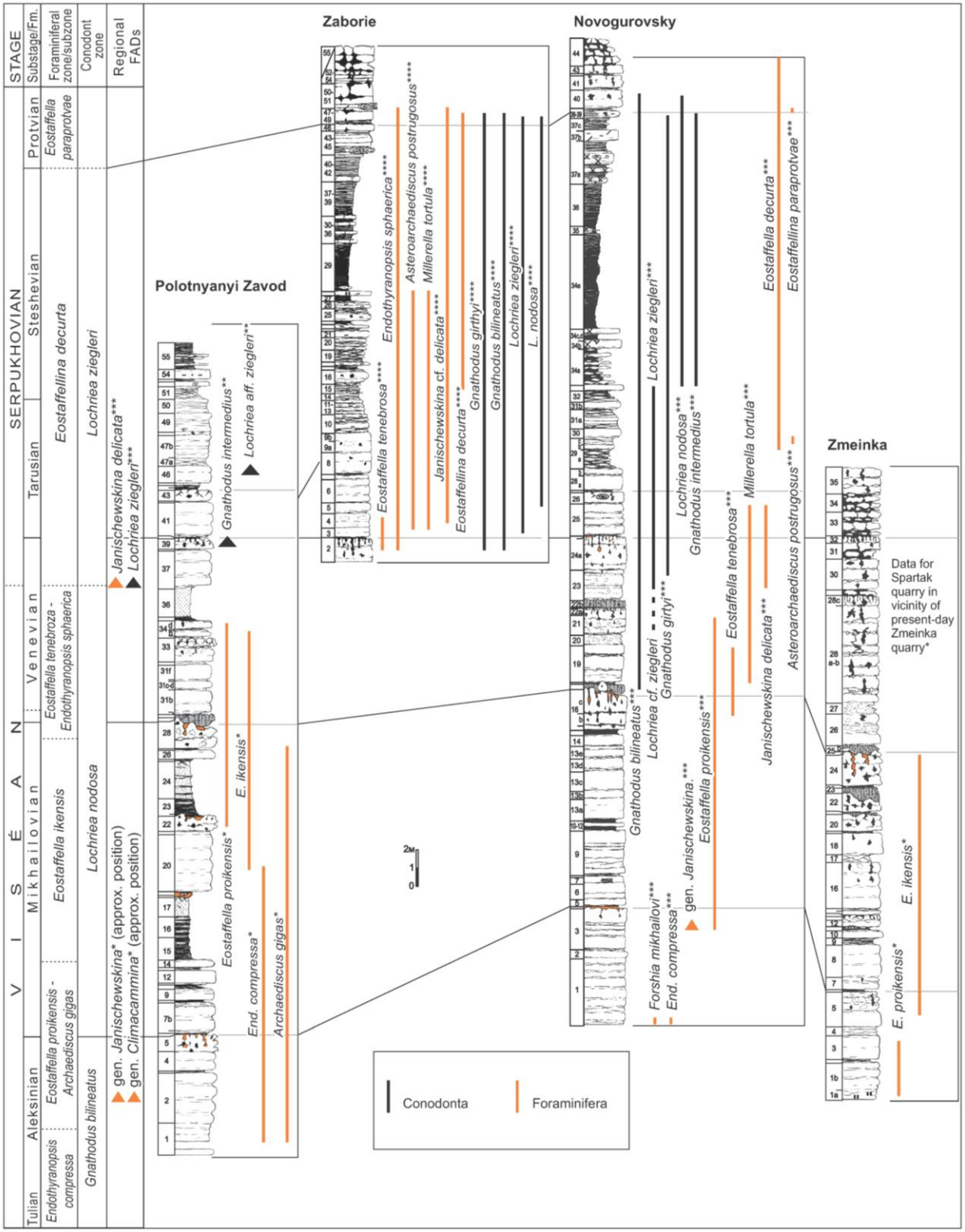

Figure 2: Ranges of stratigraphically important conodonts and foraminifers in Polotnyanyi Zavod, Zaborie, Novogurovsky, and Mikhailov quarry sections. Compiled from: *M.V. Vdovenko and V.E. Zhulitova in (Makhlina *et al.*, 1993); **Vevel *et al.* (2007); ***Gibshman *et al.* (2009); ****Kabanov *et al.* (2009). Zonal divisions according to Gibshman *et al.* (2009).

(Fig. 3b). Such profiles are usually limonitized (decomposed siderite?). Root traces are poorly preserved and often unrecognizable, but sooty horizons in the upper part of these profiles may contain abundant ferruginized *Stigmaria* impressions. Vadose solution features are either lacking or uncomon and bleaching is eveident in the underlying limestone. Such profiles apparently record low-pH fresh-water environments with vigorous calcite dissolution under peat.

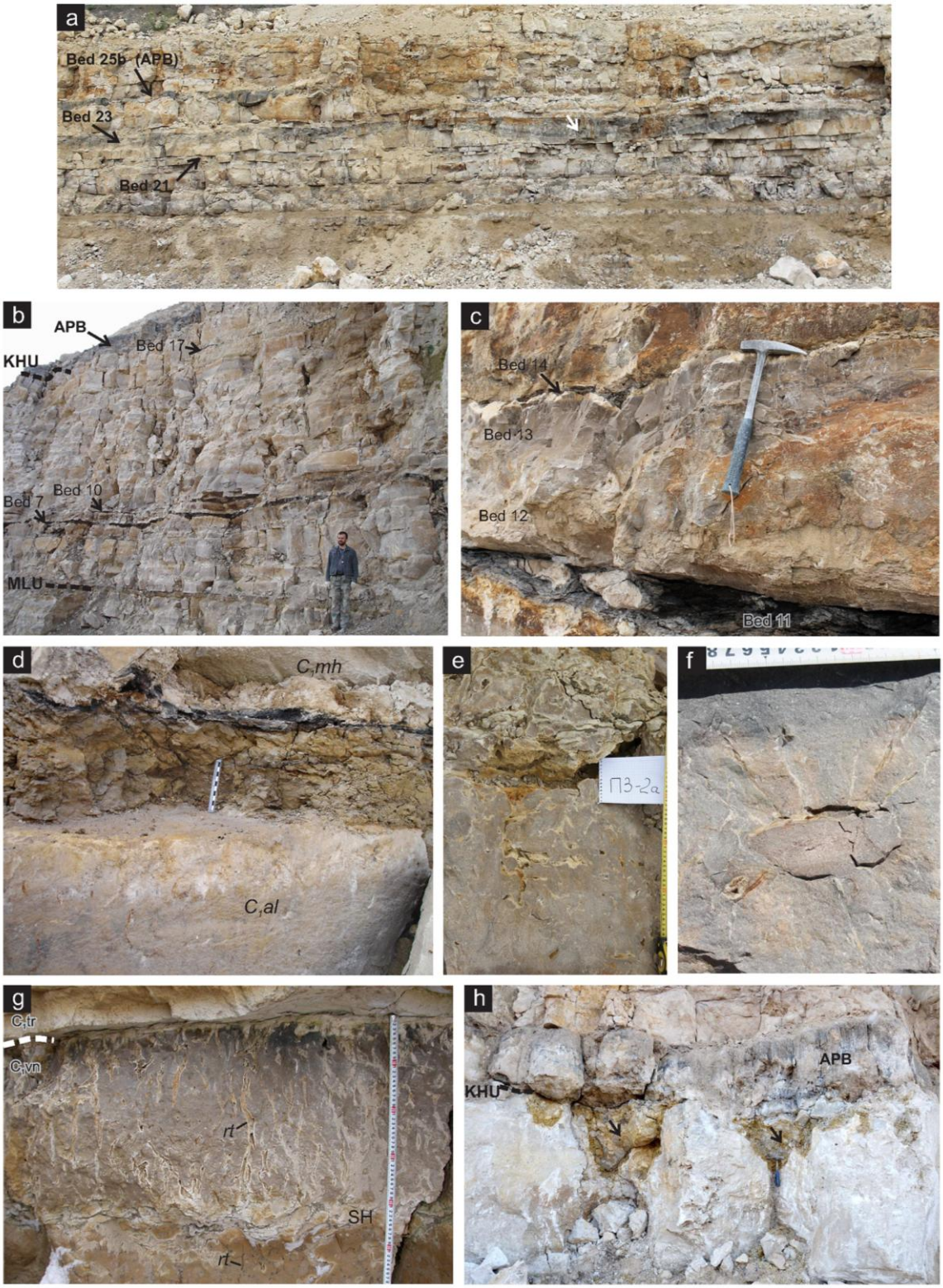

Figure 3: Disconformities and associated features. (a) the upper part of Mikhailovian and lower Venevian at Zmeinka; black arrows point to three dark palustrine beds (type 4 disconformity-associated feature); white arrow shows a stratified fill in a former depression, probably a former pond. (b) Malinovka disconformity (MLU) and Mikhailovian succession at Malinovka; marker sooty shales are arrowed; note continuous yellow shale of MLU. (c) Beds 11-14 of Zmeinka; note brown calcrete of bed 13, thin topsoil clay of bed 14, and lenses of palustrine limestone in sooty bed 11 (arrowed); (d) MLU at type locality; (e) same disconformity at Polotnyanyi Zavod expressed as type 1b paleokarst. (f) In situ *Stigmaria* with rootlets (appendages) in a shallow subtidal limestone of bed 12, Polotnyanyi Zavod; vertical section; note geopetal bioclastic infill of the rhizophore. (g) Muratovka disconformity at Forino (type 1a phytokarst); (h) Kholm disconformity and APB at Novogurovsky; yellow clayey paleosol in deep solution pockets is arrowed. Acronyms for disconformities same as on Figure 1.

Type 3. Type 3 subaerial exposure horizons comprise continuous layers of mottled gray-yellow shale (Figs. 3b, d) that are either non-fossiliferous or contain a few corroded bioclasts and half-dissolved limestone fragments. They are slickensided andhave a blocky fabric with abundant poorly preserved *Stigmaria*. The top of the limestone substrate shows gentle solution sculpture and a few solution voids that terminate less than 50 cm below the paleosol's top. Penetrating from top, the *Stigmaria* are generally cemented by calcite, siderite, and limonite but sometimes they have dark (coaly?) linings. They were not corroded by vadose dissolution. A thin (0.1-1 cm) sooty shale to shaly coal may be present in the uppermost part of the paleosol. An example of the type 3 horizon is the Malinovka unconformity (Fig. 1) where a clay-bearing paleo-epipedon has a montmorillonite composition (T. Alekseeva, pers. comm.). On younger Mikhailovian-Tarusian unconformities, all clay-rich epipedons seem to have been totally truncated or reworked into transgressive marls. A non-truncated clay-rich paleosol matching this type but developed on a sandy substrate has been described in the upper part of the MH_{T1} unit in the Polotnyanyi Zavod quarry (Fig. 1).

Type 4. The type 4 exposure horizons consist of "black" (dark gray), non-marine limestones and marls with abundant *Stigmaria* (Fig. 3 a, h). These syngenetically brecciated calcimudstones either lack characteristic marine fossils or contain very few of them and only in transitions to marine bioclastic facies. The thickest, up to 2.5 m, layer onlapping the Kholm unconformity (Akulshino bed, APB on Fig. 1) has been used as a marker for the top of the Mikhailovian Substage (Shvetsov, 1932; Osipova and Belskaya, 1965; Belskaya *et al*., 1975). This bed has up to 50% authigenic saponite clay, an admixture of gypsum, and low freshwater $\delta^{13}C$ (- 5.9 to -10.7 ‰ for calcite components; Alekseeva *et al*., 2012). The APB contains an undescribed fauna of tiny ostracods, rare small (<1 cm) gastropods, and nacre fragments (aragonite preservation!) of larger mollusk shells first noted by Shvetsov (1932). This facies also occurs as small lenses on other unconformities in the Mikailovian and Venevian substages (Fig. 1). Vadose solution vugs and pipes formed after *Stigmaria* rootlets, as well as non-corroded empty rootlet channels, are usually abundant; the coaly root components were not preserved. Such beds, containing multiple internal discontinuities, apparently record high-Mg palustrine events.

Type 5. The type 5 subaerial horizons are represented by limestones that lack either paleokarst or paleosol features but are penetrated by *Stigmaria* (Figs. 1, 3f). In these horizons, the rhizophores are filled with bioclastic limestone, sometimes with geopetal features. *Stigmaria* may preserve thin coaly skins decomposing to ferruginous haloes in weathered rocks. The limestones contain normal-marine microfossils and sometimes brachiopods including gigantoproductids. Observations on *Stigmaria* distribution were made in several sections (wells of 105 km, and the Novogurovsky, Polotnyanyi Zavod, Zmeinka, and Brontsy quarries); hence the absence of *Stigmaria* picks on other sections on Figure 1 does not mean they are not present.

Type 6. Type 6 subaerial profiles consist of shales, silts, and fine-grained quartzose sands containing dense *Stigmaria* penetrations (Fig. 1). This type of profile is represented by siliclastic wedges in the Polotnyanyi Zavod quarry section (Fig. 1). An absence of marine fossils in these siliciclastic beds suggests fluvial-overbank or delta-plain depositional settings. The basal Aleksinian siliciclastic unit with coals seams and *Stigmaria* (Belskaya *et al*., 1975) may also belong in this type. More observations are required to reveal the distribution of *Stigmaria* in other sections containing siliciclastic wedges. However, shales and silts of bed 8 of the wells of 105 km (Fig. 1) contain several coal seams. Such seams in the best documented sections are usually either associated with *Stigmaria* or cap *Stigmaria*-penetrated horizons. Unlike the situation in the Polotnyanyi Zavod quarry, bed 8 of the wells of 105 km is fossiliferous (brachipods, crinoids, ostracods), in accordance with the eastward land-sea gradient (Belskaya *et al.*, 1975).

Type 7. Type 7 subaerial exposure horizons consist of incised fluvial channels. These features are not obvious in the sections between Kaluga and Ryazan, although one would anticipate them from the nature of the deposits in the studied sections. The Oka-age fluvial channels have been mapped to the west-northwest of the town of Yukhnov (85-100 km NW of Kaluga; Dagaeva, 1960). There the deepest (at least 15 m) incision developed from a level supposedly correlated to the Kholm unconformity. Channel incisions having estimated minimal depths of 5-7 m also developed at the Malinovka unconformity. At least one level with incised channels occurs close to the Tulian-Aleksinian substage boundary. Fluvial channels cut from several unconformities in the Oka Group, including the deepest incision from the top of the Mikhailovian Substage, have been long known on the northwestern flank of the Moscow Basin (Savitsky *et al*., 2012).

Biostratigraphic constraints

Recent efforts to define the base of the Serpukhovian Stage in its type area were focused on foraminifers and conodons from the Zaborie and Novogurovsky quarry sections (Gibshman, 2003; Gibshman and Baranova, 2007; Gibshman *et al*.,

2009; Kabanov *et al*., 2009). Other groups used for biostratigraphic control are miospores, corals, and ostracods (Byvsheva and Umnova in Makhlina *et al*., 1993; Hecker, 2001; Zainakaeva and Kochetova, 2012). It was shown that FADs of potential markers for the base of the Serpukhovian extend below the originally defined base of the Serpukhovian at the Venevian-Tarusian disconformity (Fig. 2). Among the foraminifers identified in these two sections, *Asteroarchaediscus postrugosus* and *Janischewskina delicata* seem to be most relevant for international correlation (review by Groves *et al*., 2012). The FAD of *J. delicata* in the Novogurovsky quarry coincides with the appearance of *Lochriea ziegleri* in the middle of sequence VN2, thereby indicating the base of the Serpukhovian is probably conformable at the locality (Fig. 1). *Millerella tortula* identified by Gibshman (2003) from the Zaborie and Novogurovsky quarries and proposed as an index for the base of the Serpukhovian (Gibshman and Baranova, 2007; referred to as "*tortula*-like" forms by Groves *et al*., 2012) has its FAD at the very base of the Venevian marine limestone (Fig. 2), but this form is markedly different from typical *M. tortula* Zeller, which puts its stratigraphic value in question (Groves *et al*., 2012). It should be noted that apparent perching of *L. ziegleri* and stratigraphically important foraminifers in the base of the Tarusian in the Zaborie quarry (Fig.2) resulted form insufficient sampling from underlying bed 2 rather than from any increased truncation at the base of the Serpukhovian as suggested by Groves *et al*. (2012).

Pilot data from wells 49 and 41 reveal the presence of *Neoarchaediscus parvus* and the genus *Janischewskina* above bed 10 of the composite section (uppermost Aleksinian; Fig. 1). Foraminiferal assemblages in these wells are typical for the Oka Group. More data from the wells of 105 km are on the way.

Less is known about foraminifer and conodont distribution in other sections. New data are on the way, but until they arrive, summaries of M.V. Vdovenko and V.E. Zhulitova in Makhlina *et al*. (1993) help to characterize the Oka Group of the Polotnyanyi Zavod and Mikhailov (Zmeinka-Spartak) sections by *Eostaffella proikensis, E. ikensis,* and *E. tenebrosa*. However, all these species sporadically occur in the Serpukhovian. An important level in the upper Aleksinian Substage is defined by FADs of genera *Janischewskina* and *Climacammina* (Fig. 2; Belskaya *et al*., 1975; Maklina *et al*., 1993; Gibshman *et al*., 2003). This level separates distinctive Tulian assemblages containing numerous *Endothyranopsis compressa, Archaediscus krestovnikovi*, *Forschia spp.* (work of E.V. Fomina; Makhlina *et al*., 1993) from younger Oka assemblages that are essentially transitional to the Serpukhovian. Conodons in the Aleksinian – lower Venevian are too scarce for credible biostratigraphic resolution (less than 3 specimens/kg) apparently because of the shallowness and certain degree of restriction of the late Visean sea. Conodont abundance tends to gradually increase upward in the Venevian to reach 90 elements/kg in the VN2 sequence (Gibshman *et al*., 2009), thereby providing enough material to confirm the presence of *Lochriea ziegleri* in the upper Venevian (Fig. 2). Most recently, the discovery of one specimen of *L.* cf. *ziegleri* in bed 21 of the Zaborie quarry section (upper half of sequence VN1; Fig. 1) may necessitate further lowering of the base of the Serpukhovian; however, resolution of this matter requires additional conodonts. A zonal index, the conodont *Lochriea nodosa* occurs in the region at least from the Mikhailovian Substage well into the Serpukhovian (Fig. 2). Finding *L.* aff. *ziegleri* in the upper Tarusian of the Polotnyanyi Zavod quarry (Fig. 2; Vevel *et al*., 2007) confirms the Serpukhovian age of that unit. Its absence below probably indicates insufficient limestone has been processed to obtain the age-diagnostic conodonts.

The FADs of *Janischewskina* and *Climacammina* suggest correlation of the upper Aleksinian – lower Venevian interval to the late Brigantian Substage of the United Kingdom and the foraminiferal subzone MFZ16s of Mamet (1974) (see review in Somerville, 2008). The Brigantian age of the upper Aleksinian – Venevian is also confirmed by the presence of the genus *Neoarchaediscus* (Somerville, 2008). Conodont data with *Lochriea nodosa* ranging upward from at least the base of the Mikhailovian are consistent with this correlation.

Mikhailovian

The base of the Mikhailovian Substage is traced in present-day and historical sections by the presence of distinct *Stigmaria*-penetrated and moderately karsted limestone with type 3 subaerial profile (MLU on Fig. 1). In the Polotnyanyi Zavod and Zmeinka quarrries, this disconformity displays type 1b features. The MLU separates thick (over 6 m) conformable middle-upper Aleksinian limestone from the Mikhailovian disconformable succession (Fig. 1). In the studied sections, vadose karsting, bleaching, mottling, and *Stigmaria* rootlets (appendages) do not penetrate deeper than 1.0 m below the disconformity, which indicates the drop in sea level was not substantial.

The top of the Mikhailovian is traced by using the mature type 1 Kholm disconformity (KHU), a prominent paleokarst displaying vugs, caverns, solution pipes and flutes that penetrate downward for several meters, at least down to shale layers that were thick enough to act as aquicludes (Fig. 1). In the Zmeinka quarry where shale seams are too thin, karst extends down to 7 m below KHU. The rundkarren sculpture with amplitude exceeding

1.5m, with breccia and residual boulders, and the traceable APB on top, makes this disconformity easy to recognize. More detailed descriptions from the Novogurovsky quarry are available in (Gibshman, 2009; Kabanov *et al*., 2012). The KHU appears to mark the longest lowstand (but below biostratigraphic resolution) with the greatest base level fall among the studied Oka and Zaborie disconformities.

The Mikhailovian succession between MLU and KHU is a shallow-water section with facies changes and many disconformities that are not easy to correlate (Fig. 1). A characteristic feature is the presence of many *Stigmaria* levels that are not associated with subaerial exposure profiles (Fig. 1). These occurrences suggest the presence of mangrove-like forms of certain arborescent lycopsids. At least two thick and internally conformable limestone units without *Stigmaria* are traced in Novogurovsky and other sections around Tula, as well as in the Zmeinka quarry (parasequences MH2 and MH4 on Fig. 1). These limestones are rich in *Gigantoproductus* and other normal-marine fauna. The section is changing to the west with the lower half of the Mikhailovian appearing to be mostly shallow-water (persistent *Stigmaria*). The clastic unit MH_{T1} can be traced in wells of 105 km, in Brontsy, and elsewhere providing that the adequate description or litholog is available (e.g., Ignatova Gora near Tarusa; Arendt, 2002). In wells of 105 km, these organic-rich shales and siltstones contain coal seams and an impoverished shallow-water conodont fauna containing *Cavusgnathus*. At Ignatova Gora, the shallowness of MH_{T1} is suggested by the presence of thin lenses of "rhizoid limestone" (Arendt, 2002). Apparently, deposition at very shallow water depths was maintained over the coast-sea transition in the area during deposition of the $MH_{T1.}$ Preservation of organic matter (coaly seams, pervasive coal attritus and micropyrite) indicates that sediments were not exposed to early vadose oxidation. The middle of the Mikhailovian (parasequence MH3) is marked by a distinct "double bed" of collapsed pinkish, partly sooty marls (type 2 subaerial horizons) divided by a thin marine limestone (Fig. 1). At the Zmeinka quarry, this double disconformity may correlate to beds 11-14 where the lower disconformity is a type 2 coaly shale with lenses of type 4 "rhizoid limestone". The upper disconformity is associated with a thin (<20 cm) laterally persistent calcrete (type 1c). Solution pockets in the top of the calcrete preserve a clay-rich epipedon (bed 14).

The second major transgressive parasequence MH4 seems to correlate well between outcrops, but its position in wells of 105 km is less certain. The MH_{T2} clastic unit of the Polotnyanyi Zavod quarry may correspond to shale and sandstone interlayers of bed 5 in the wells of 105 km. Further southeastward, the MH_{T2} probably pinches to the sooty shale (type 2 subaerial exposure horizon; bed 15 of Novogurovsky). This interval is less than 20 cm thick and only a few centimetres in some sections around Tula, but in Novogurovsky it contains up to three coal seams suggesting prolonged development. Eastward (Zmeinka), this shale may expand into ingressive marine to palustrine limestones of sequence MH5 (Fig. 1).

Whatever the intra-Mikhailovian correlation is, it is obvious that this polyfacies formation is constrained by two pronounced disconformities one at its base and the other at its top. The upper one records the most substantial sea-level drop that occurred during deposition of the Oka Group. Evidence for major base-level drops are lacking within the Mikhailovian Substage.

Venevian and Tarusian

Our materials confirm the long-known two-sequence composition of the Venevian (Fig. 1). In sections around Tula, the "rhizoid limestone" at the Barsuki disconformity (BU) appears to be a discontinuous incursive shallow-marine or palustrine limestone that was karstified and pedogenically altered from its top. A thin clayey paleosol preserved in solution pockets below this bed suggests the presence of a composite (doubled) disconformity (Kabanov *et al*., 2012). However, no incursive beds were detected at BU in the Zmeinka and Polotnyanyi Zavod quaries (Fig. 1). The Muratovka disconformity (MU) in the top of the Venevian appears to be a simple subaerial profile varying in different sections from type 1a to 1b and 1c. The top of the VN2 sequence is locally blackened (most distinctly in Malinovka). This blackening is likely explained by hydromorphic adsorption of organic material and pyritization during the onset of the Tarusian transgression. In the Zmeinka quarry, details of the Venevian and Tarusian disconformities are obscured by strong post-Carboniferous karstification (Fig. 1).

The sequences VN1 and VN2 are composed of photozoan bioclastic packstones with abundant algae-like problematica *Calcifolium okense* Shvetsov and Birina, 1935. The presence of some wackestones in the lower part of the VN1 (bed 19 at Novogurovsky; Kabanov *et al*., 2012) probably records maximal transgression. In the absence of rounded bioclasts, local grainstone-like textures are more likely the result of vadose dissolution of carbonate mud and calcite redistribution into equant sparite cement. Some poorly sorted primary grainstones comprising angular grains may also be present. Both the VN1 and VN2 sequences are subaerially altered to depths of several meters, which is expressed in visually bleached matrix (no

coaly particles preserved), some solution vugs and channels, branching root channels penetrating to the depth of at least 3.5 m from the BU, and micro-scale matrix dissolution. The latter led to development of soft chalky limestone and distinct potato-shaped vadose cementation nodules ("Venevian-type" mottling or pseudo-breccia; Shvetsov, 1932). Some of these nodules developed around root channels (Kabanov, 2004). The abundance of vadose features gradually diminishes downward in bed 19 of the Novogurovsky quarry section and its correlatives in other sections.

The siliciclastic unit VN_{T1} in the sequence VN2 pinches out to the east of Polotnyanyi Zavod. This unit may correspond to the upper Venevian siliciclastic unit below the limestone A_8 of the northwestern flank of the Moscow Basin (Savitsky, 2012). Noteworthy, the Venevian there retains its distinct two-sequence composition with "rhizoid limestones" developed in upper parts of limestones A_7 and A_8 in local nomenclature (Belskaya *et al*., 1975; Savitsky, 2012).

The Zaborie Group records a major transgression as suggested by the gradual upward increase in conodont number (Gibshman *et al*., 2009), growing echinoderm diversity (Arendt, 2002), changes in lithofacies, ichnofacies, and geochemical indicators sensitive to oxygen level (Kabanov *et al*., 2012). Above the Forino disconformity (FU), no subaerial exposure surfaces are confirmed up to the top of the Steshevian. The FU is a weakly developed subaerial profile recorded by the presence of solution vugs, solution-enhanced burrows, accumulation of loose Fe^{3+} rich material in solution voids, and some root penetrations (Kabanov *et al*., 2012). The strongest development of this profile was observed at the Polotnyanyi Zavod quarry where it has the characteristics of an immature type 1a exposure horizon. This locality was the only one providing undoubted *Stigmaria* impressions in the overlying shale (bed 44a). Upright penetrations closely resembling *Stigmaria* rootlets (appendages) were also reported from other sections (Kabanov *et al*., 2012). Vadose features do not penetrate deeper than 0.5 m below the FU surface. In the paraconformable section above the FU, sedimentary cyclicity is expressed by the presence of *Zoophycos-Scolithos* cycles/couplets. Cyclicity becomes completely obscure in the Upper Steshevian shale unit (ZB_{TM} on Figure 1; Kabanov *et al*., 2012). The Dashkovka disconformity is a palygorskitic calcrete (XRD data of T.V. Alekseeva). Descriptions of DU subaerial features are given in (Kabanov, 2004; Kabanov *et al*., 2012). The depth of the paleo-vadose zone under the DU is obscured by vadose alterations resulting from development of the major mid-Carboniferous unconformity (Fig. 1).

Aleksinian

Below the Malinovka disconformity in the wells of 105 km, the 0.6 m thick coaly shale with a coal seam in its basal deposits (bed 12) probably corresponds to the shoaling level with *Stigmaria* but without notable subaerial exposure features (bed 2 of Novogurovsky). Below bed 13 of the composite section of wells of 105 km, only the core from well 42 is available. A grey chertified "rhizoid limestone" described in the top of bed 15 has a hardground-like top and solution channels pointing to development of a subaerial disconformity. This horizon probably occurs just below the available exposures in quarries where the Aleksinian limestone is notably monotonous and conformable. Below the "rhizoid limestone", bed 15 of well 42 is a soft silty, partly chertified limestone containing large plant impressions, and the open-marine conodonts *Lochriea commutata* and *Gnathodus bilineatus* s.l. A hard "rhizoid limestone" in the upper part of bed 16 and karsted limestone of bed 17 would match "mottled limestone with *Stigmaria* and rooting traces" comprising the upper part of the Stopkino Member (Makhlina *et al*., 1993). If this correlation is correct, then the transition to the Tulian in beds 18-19 looks conformable (downward gradation from laminated siltstone to fossiliferous carbonaceous black shale and then to the argillaceous limestone of the bed 19). However, this correlation leaves no room for the "traceable, up to 2 m thick, sandstone and shales in the base of the Myshiga Member" (Makhlina *et al*., 1993). It is thus highly possible that bed 18 of well 42 belongs in the Myshiga Member. Bed 21 in this case is the basal Aleksinian sandstone. Tulian limestone beds are typically mottled, karsted up to disintegration into breccia, and penetrated by *Stigmaria* (Shvetsov, 1932, 1948; Belskaya *et al*., 1975; Makhlina *et al*., 1993).

A brief assessment of the middle and lower Aleksinian succession suggests deposition occurred in very shallow water (Mikhailovian-like) sedimentary environments because the lower half of Aleksinian is characterized by several disconformities and significant *Stigmaria* distribution. The thick (≥5 m) conformable limestone of parasequence AL4a (Fig. 1) is interpreted to be the record of the greatest transgression during the Aleksinian Substage.

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MEETINGS

SCCS Activities in 2011-2012

Business meeting of SCCS at the *34th International Geological Congress* at Brisbane

Future Meetings

2013

The Devonian and Lower Carboniferous of northern Gondwana

International Field Symposium of SDS, SCCS and Task Group "Devonian–Carboniferous Boundary"

Dates: March 23–30

Venue: Tafilalt area

The Carboniferous-Permian Transition

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

Venue: New Mexico Museum of Natural History and Science, Albuquerque, New Mexico, USA

Dates: May 20-22

For further information contact:
Spencer G. Lucas, spencer.lucas[at]state.nm.us

Pre-Cenozoic climates

A multidisciplinary workshop that broadly addresses the pre-Cenozoic climatic phenomena and processes.

Venue: Toulouse, France

Dates: June 17-19

For further information contact:
Yves Goddéris: pc2iwget.obs-mip.fr

Website: http://pc2iw.scienceconf.org

1st International Congress on Stratigraphy (STRATI 2013)

Dates: July 1-7

Venue: Faculdade de Ciencias e Tecnologia, Universidade Nova Lisboa, Lisbon, Portugal

Website: http://www.strati2013.org/

Geophysical and Geochemical Techniques: A Window on the Palaeozoic World - Joint meeting IGCP-580 & IGCP-596

Dates: August 27 – 31

Venue: University of Calgary and Core Research Centre Calgary, Canada

For further information contact:
mtwhalen[at]gi.alaska.edu

Website:
www2.ulg.ac.be/geolsed/MS/01meetingindex.html

1st International Palaeogeography Conference

Venue: China University of Petroleum, Beijing, China

Dates: September 14–17

For further information contact:
Wang Yuan, jpalaeo2012[at]163.com

2014

4th International Palaeontological Congress

Dates: September 28 – Oktober 4 2-10

Venue: Mendoza, Argentinia

Contacts:
ipc4chairs[at]mendoza-conicet.gov.ar
ipc4secretary[at]mendoza-conicet.gov.ar

Website: http://www.ipc4mendoza2014.org.ar

2015

18th International Congress on the Carboniferous and Permian

Dates: August 7-15

Venue: Kazan, Russia

Organizing committee: A.S.Alekseev, I.V.Budnikov, A.S.Byakov, B.I.Chuvashov, I.R.Gafurov, V.G.Golubev, N.V.Goreva, O.L.Kossovaya, G.V.Kotlyar, E.I.Kulagina, D.K.Nourgaliev, S.V.Nikolaeva, and V.V.Silantiev

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Past Meetings

17th International Congress on the Carboniferous and Permian

The proceedings of the congress are currently published in a series of special volumes in different journals. A volume in the Geological Journal has been published in 2012.

Somerville, I., Wbb, G. & Chen Z-Q. (2012): Upper Palaeozoic reef complexes and carbonate platforms.– *Geological Journal*, **47** (5) 447-552.

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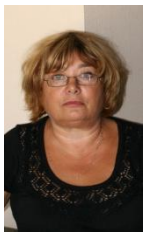

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