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Newsletter edited by Markus Aretz with the assistance of Barry Richards.

Thanks to all colleagues who contributed to this newsletter!

Cover Illustration:

The cover shows on overview photograph of the carbonate-dominant Nashui section by the village of Naqing in southern Guizhou Province, South China. The Carboniferous component of the Nashui section and the interval illustrated is dominated by fine-grained limestone turbidites of lower-slope to basin aspect. A few debris-flow deposits containing large blocks occur in the Pennsylvanian part of the section and higher. Intervals of nodular limestone, bedded chert, and shale to mudstone also occur. The section is a good GSSP candidate for stage boundaries including: Viséan/Serpukhovian, Bashkirian/Moscovian, Moscovian/Kasimovian and Kasimovian/Gzhelian.

(Photo courtesy of Barry Richards)

EXCECUTIVE'S COLUMN

Dear Fellow Carboniferous Researchers,

Important meetings

During the November 1st 2011 to October 31st 2012 ICS fiscal year there will be numerous professional/societal meetings our members will want to attend but the 34th International Geological Congress (IGC) is probably of most importance and greatest interest to our members. We try to hold at least one formal SCCS workshop and field meeting every year but this year we do not plan to hold any because of the high importance of the 34th IGC and the opportunity to participate on the great diversity of pre- and post-congress field trips associated with that meeting.

From the 5th - 10th of August 2012, the quadrennial IGC will be held in Brisbane, Australia. Please examine the website at www.34igc.org for details about the scientific program, congress field trips and general information. The SCCS will not be holding a symposium 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 long and 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, particularly for periods (such as the Carboniferous) not covered in other theme sessions, are encouraged. New GSSP proposals, evaluations of existing GSSPs, preservation of GSSPs, and all aspects of their age, calibration, and correlation are welcome contributions in 35.1. The deadline for abstracts is the 17th of February, 2012 and field-trip booking closes on the 31st of March 2012. Early-bird registration closes on the 30th of April and standard registration rates commence.

At the 34th IGC, our ICS Chairman Stan Finney plans to hold one long public meeting (open to all who want to attend) for ISC business on August 6th and a second shorter meeting on August 9th that will be only for subcommission chairs and the ICS executive. One important matter that will be addressed is the formal ICS recognition of substages. The Subcommission on Carboniferous Stratigraphy has joined with the Subcommission on Permian Stratigraphy to hold a business meeting for all of our members. The meeting has been scheduled for the evening of August 7th (room to be announced in the program) and we will be developing an agenda for the meeting. We encourage all members to submit agenda items you wish addressed at the SCCS/SPS meeting to the SCCS chairman.

Newsletter and ISSN number

In late November 2011, our chairman applied for an ISSN number for the Newsletter on Carboniferous Stratigraphy by on-line application to Library and Archives Canada. Because of the international nature of our serial, the request was forwarded to the ISSN International Centre and we were informed by Sylvie Viel at ISSN Canada that our online serial has been recorded provisionally in the ISSN Register as: ISSN 2225-8981. This means an ISSN number can only be applied to our online (webpage and e-mail) versions of our newsletter and another application will need to be submitted for our print version. The number must be prominently displayed on the title screen or home page of our online publication. The assignment of the ISSN number is important because it gives our Newsletter on Carboniferous Stratigraphy the status of a formal publication instead of that of a simple newsletter. Because of the change in status, we should probably deal with papers submitted to the newsletter more formally and rigorously - perhaps more careful editing and sending each paper out for peer review. Regular news items, such as material in the Executive's column, the simplified version of the ICS Annual Reports, and task-group reports would not be sent out for review. We look for your ideas and suggestions on these matters.

Nominations for voting members

Article 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." Therefore, the following six voting members who will have served three terms [12 years] are required to retire from regular voting membership in the SCCS at the time of the IGC in Brisbane, Australia, in August of 2012.

<u>Members who will retire as regular voting members in 2012</u>

Darwin Boardman [USA] (ammonoids, conodonts)
Katsumi Ueno [Japan] (fusulinids, biostratigraphy)
Luc Hance [Belgium] (forams, biostratigraphy)

Tamara Nemyrovska [Ukraine] (conodonts, biostratigraphy)
Demir Altiner [Turkey] (forams, biostratigraphy)
Barry Richards [Canada] (stratigraphy, sedimentology)

Current members who can continue automatically for the next term

James Barrick [USA] (conodonts, biostratigraphy)
Holger Forke [Germany] (forams, conodonts, biostratigraphy)
Nataliya Goreva [Russia] (conodonts, biostratigraphy)
John Groves [USA] (forams, 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 [United Kingdom] (ammonoids, biostratigraphy)
Edouard Poty [Belgium] (corals, sequence stratigraphy)
Yuping Qi [China] (conodonts, biostratigraphy)
Wang Xiangdong [China] (corals, conodonts, biostratigraphy)
David Work [USA] (ammonoids, biostratigraphy)

Markus Aretz is not a regular voting member but is one through appointment to the executive position of Corresponding Secretary/Treasurer by the Chairman Barry C. Richards. If Markus Aretz is nominated for regular voting membership in 2012, he will be eligible to be selected for three 4-year terms as a regular voting member. The president for this was set by the previous SCCS chairman, Philip Heckel, when David Work (former SCCS Corresponding Secretary) was nominated for the position of regular voting member in 2008. Markus is eligible to continue as the Corresponding Secretary/Treasurer of the SCCS until he either decides to step down or is replaced by the SCCS chairman that succeeds the current chair. At the time volume 29 of the Newsletter was ready for distribution, we had received the names of ten nominees who were willing to let their names stand for the selection process. Regarding the new group of nominees, paragraph one of 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." The executive of the SCCS consists of the Chair, Secretary, and Vice Chair. After input from other voting members, we will select new members from these nominees with a view toward achieving and maintaining regional and methodological diversity as much as possible, as indicated in the third paragraph of section 9.6 of the ICS Statutes.

Nominations for the positions of SCCS chairman and assistant chairman

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 (4) 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).

Paragraph one of article 9.4 in the 2002 ICS statutes state: "A chair and one or two optional vice chairs of a Subcommission of ICS are proposed to ICS after appropriate ballot within each Subcommission with the names submitted to the ICS General Secretary not later than twelve (12) months prior to the next IGC." Our subcommission is somewhat late in completing the nomination and election process but a nomination committee comprising three voting members - Svetlana Nikolaeva, Elena Kulagina, and Yuping Qi has been established. The committee is searching for nominees within the subcommission and will circulate a ballot to the current SCCS voting members for a secret vote using e-mail. I (Barry C. Richards) anticipate several people will let their names stand for the nominations so the resulting vote should be interesting. Both Xiangdong Wang and I are willing to continue in our executive positions for another four-year term but we need someone to nominate us for the positions and a 60% vote of confidence is required to win in this process. Paragraph 1 of article 9.7 titled Voting Procedures in ICS states: "For approval, all decisions, including elections, require a sixty (60%) majority of delivered votes, provided that a quorum of 60% has been attained. In cases where no quorum is attained the first time around, a second round of voting is organized."

REPORT OF THE SCCS BUSINESS MEETING HELD AT PERTH, AUSTRALIA

Markus Aretz[1], Barry C. Richards[2] and Svetlana V. Nikolaeva[3]

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Introduction

The business meeting for the Subcommission on Carboniferous Stratigraphy (SCCS) was held on the 4th of July 2011 at Perth, Australia during the 17th International Congress on the Carboniferous and Permian. The business meeting was attended by Barry Richards (chair of SCCS), Xiangdong Wang (vice-chair), Markus Aretz (secretary/treasurer), the voting members X. Jin, J. Kalvoda, O. Kossovaya, S. Nikolaeva, E. Poty, K. Ueno, Y. Qi, and several corresponding members and guests from the Permian Subcommission. Svetlana Nikolaeva took the minutes for the meeting and they form the basis for this article. The business meeting dealt with several topics, which are presented here in the order discussed at Perth.

1. Membership and Composition of Subcommission 2012-2016

According to the statutes of the International Commission on Stratigraphy (ICS), a regular voting member is normally required retire from a subcommission after three terms, thus voting members cannot serve longer than 12 years. Within a subcommission, the executive officers for the next four years have to be elected by the voting members in the year before the next International Geological Congress (IGC), and their appointment is ratified by the ICS executive. The chair and vice-chair of a subcommission can be reelected for one additional term.

The leadership and membership situation within the SCCS was outlined by the chairman as follows. The current chair and vice-chair were voted into office in 2008 and can be re-elected for one additional term. The secretary/treasurer was appointed by the subcommission chair; 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 business 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. The participants at the meeting agreed that the SCCS officers should discuss the issues about serving more than 12 years with the ICS executive and leaders of other subcommissions.

During the business meeting, Barry Richards and Xiangdong Wang declared their willingness to serve for a second term as chair and vice-chair, respectively. Markus Aretz was asked if he would continue as the SCCS secretary/treasurer for another term but he replied by stating the chair for 2012-2016 must be elected before the secretary position can be filled.

2. 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. Some members thought that the granting of an ISSN number could give more recognition to contributions in the newsletter, thereby encouraging more submissions. Other members stated that the newsletter is a medium the Carboniferous community needs for quickly distributing information on ongoing research and news, which does not necessarily warrant official status and peer-reviews.

3. SCCS Tasks

The chair indicated that establishing GSSPs for stage and series boundaries is currently the primary task of the SCCS and its task groups, and that ICS want to see the subcommission make rapid progress on defining the remaining GSSPs. In this

regard, Richards 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. When the section was visited by a team of SCCS members during the 2009 field meeting and workshop held in Russia, the section was found to be largely covered with soil and vegetation.

4. SCCS field meetings and workshops in 2012

Later in the meeting, the chairman discussed the problem of holding a SCCS field meeting and workshop during the next fiscal year and asked those present for suggestions. He indicated that some of our members will attend the International Geological Congress in Brisbane, Australia in August 2012 but no formal SCCS technical sessions are planned. A business meeting will be held but because of the relatively poor attendance by members at the expensive IGC meetings, the main formal SCCS business meetings are held every four years at the Carboniferous-Permian congress.

Vladimir Davydov mentioned that in 2012 a meeting for International Geoscience Program (IGCP) project 575 "Pennsylvanian terrestrial habitats and biotas of southeastern Euramerica" is planned for the Donets Basin in Ukraine and will be of interest for some SCCS members.

Markus Aretz proposed that SCCS field meetings should focus on the task of establishing GSSPs. In this respect, the task groups should plan and announce their field campaigns well in advance.

The task group for the revision of the Devonian-Carboniferous boundary plans to hold a combined field and indoor meeting in either March or April 2013 in southern Morocco. The meeting will be organized by A. El-Hassani, T. Becker and M. Aretz.

5. Publications

Near the close of the meeting, Richards informed the members of the subcommission about the Encyclopedia of Stratigraphy project. It is coordinated by ICS chair 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 chair will coordinate the task. An outline showing the main topics along with authors that have agreed to contribute to the documents will be sent out shortly to the voting members and corresponding members. Authors have not been selected for several of the articles and will need to be located.

Richards reminded the subcommission about the ongoing Carboniferous of the World project. The subcommission initiated the project in the 1980's. Several volumes were published but require updating, whereas the important North American and Western European volumes have not been completed. During a business meeting with Robert Wagner and Cor Winkler Prins (editors and project leaders) at the June 2010 SCCS field meeting in Northern Spain, the SCCS agreed to continue working on the project. Some chapters for the two unpublished volumes have been written but require extensive revision; others still need to be written. Following the meeting in Spain, M. Aretz and Hans-Georg Herbig agreed to assist Wagner and Winkler-Prins with editing the European volume.

ANNUAL REPORT FOR NOVEMBER 1ST, 2009 TO OCTOBER 31ST, 2010

This version of the SCCS annual report is abbreviated from the document submitted by our chairman Barry C. Richards to the ICS in February 2011. The complete annual report for 2010 is posted on our website 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 and Streel, 1984; 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; Richards *et al.*, 2002), and it divides the Carboniferous into the Mississippian Subsystem below and the Pennsylvanian Subsystem above.

During 2009, a website with eight main pages was established: www.nigpas.ac.cn/carboniferous.

MEMBERSHIP

The SCCS has 21 voting members (list at end of newsletter), and approximately 280 corresponding members as of October 31st, 2010. The main SCCS business meetings are held every two years, both at the quadrennial meetings of the International Congress on the Carboniferous and Permian, and at a Field Meeting convened by the SCCS midway between the congresses. The latest major Field Meeting was held in Russia from August 11th to 19th, 2009 but subordinate meetings and workshops are held every year.

CHIEF ACCOMPLISHMENTS AND PRODUCTS IN NOVEMBER 1st, 2009 to OCTOBER 31st, 2010 FISCAL YEAR

The **Newsletter on Carboniferous Stratigraphy, Volume 28**, published in November 2010, includes commentaries by the current SCCS executive on various current issues, summaries about field meetings and workshops, reports of the task groups for July 1st 2009 to September 30th 2010, and articles on various topics of interest. Volume 28 contains a revised directory for the corresponding membership. The Newsletter provides a significant outlet for timely presentation and discussion of useful information relating to boundary selection, often from areas that are not typically covered in other journals. During the last fiscal year, members 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).

The biologic-sedimentologic event used to define the boundary has not been chosen, but the search for better GSSP sections is progressing. The *Siphonodella praesulcata* Sandberg, 1972 - *Siphonodella sulcata* (Huddle, 1934) conodont lineage used to define the current boundary at La Serre in France may not be suitable for boundary definition and is being intensively restudied along with other conodont lineages that have potential for D-C boundary definition; in addition, recent task-group studies indicate the La Serre section is no longer suitable for the GSSP and another section is required.

At the 2010 Third International Paleontological Congress (IPC3) workshop in London England, Carlo Corradini gave an important presentation outlining the problems of the *praesulcata-sulcata* lineage. Most conodont workers at the workshop did not see much potential for the continued use of the *Siphonodella* lineage for boundary definition. However, Carlo suggested his observations and conclusions along with those of Sandra Kaiser should be independently tested by other conodont specialists before the lineage is abandoned. In the La Serre section, the *S. praesulcata* and *S. sulcata* morphotypes that Corradini and Kaiser recognized lacked any apparent relationship with the stratigraphic level (several morphotypes occurred together in the beds); but it is necessary to determine if this is the case in several sections, where the extensive reworking observed at La Serre is not an issue.

At the D-C boundary workshop held at the ICP3 meeting in London on July 2, 2010, Carlo Corradini summarized the current stage of knowledge of the various species within the genus *Protognathodus* across the D-C boundary. He indicated there are problems with the first appearances and distribution of the protognathodid species and especially emphasized the group's rareness to absence in many sections and facies dependence. He concluded that none of the *Protognathodus* species has the potential to be the primary marker for the D-C boundary but could be used in conjunction with other taxa.

At the July ICP3 workshop in London and at other recent meetings, it was proposed that we consider using an event such as some component of the multiphase Hangenberg extinction for boundary definition.

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) for early version of proposal] 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).

The group continues to find 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. Task-group research is currently focused on using the lineage to define the boundary at the two GSSP candidate sections that have the best potential - the Nashui section in southern Guizhou province of China and Verkhnyaya Kardailovka section in the southern Urals of Russia.

Sevastopulo and colleagues have tied the first appearance of *L. ziegleri* to ammonoid-bearing marine bands and the ammonoid zonation scheme used in Western Europe. The preliminary results indicate minimal diachroneity. Taxa in the lineage containing *L. ziegleri* display a broad range of morphological variations and studies by task-group members are underway to access the variations and more precisely define the limits of *L. ziegleri*, its immediate ancestor *L. nodosa* (Bischoff, 1957), and *L. cruciformis* (Clarke, 1960), which appears near the first occurrence of *L. ziegleri*.

Richards and task-group members from the Nanjing Institute of Geology and Paleontology completed a bed-by-bed study of the boundary interval in the Nashui section in southern China and measured the nearby Yashui and Dianzishang sections to place the Nashui section into its geological context. At Nashui conodonts within the *L. nodosa* - *L. ziegleri* lineage are well preserved and abundant. The Yashui section, near the city of Huishui in Guizhou province, is important because it contains abundant rugose corals and foraminifers, and is dominated by shallow-neritic to peritidal facies. John Groves completed his study of the foraminifers and can bracket the Viséan-Serpukhovian boundary with them. Slope deposits in the Dianzishang section includes spectacular syndepositional slumps deposited on a carbonate ramp and provide another opportunity to see conodonts and foraminifers spanning the *L. nodosa*-*L. ziegleri* transition.

During August 2010, task-group members worked at the Verkhnyaya Kardailovka section, a deep-water, carbonate succession along the Ural River opposite the village of Verkhnyaya Kardailovka in the southern Urals, Russia. Nikolaeva *et al.* (2009) published a synthesis of the studies showing that specimens transitional between *L. nodosa* and *L. ziegleri* occur in the Verkhnyaya Kardailovka section immediately below the first appearance of *L. ziegleri*. Deposits below the boundary were extensively excavated, exposing several metres of carbonates underlain by a 12 - 13 m thick succession of marine shale and volcanic ash. A major biostratigraphic advantage of the Kardailovka section is the abundant, ammonoids spanning the boundary level.

In June 2010, Javier Sanz-López and Silvia Blanco-Ferrera introduced task-group members to deep-water carbonate sections spanning the Viséan-Serpukhovian boundary in the Cantabrian Mountains of northwestern Spain. The Vegas de Sotres and Millaró sections in the Alba Formation, are excellent, rivaling the better known Kardailovka and Nashui exposures. In the Vegas de Sotres section (by village of Sotres) and Millaró section (by village of Millaró), conodonts within the *L. nodosa* - *L. ziegleri* lineage are well preserved and abundant and the first occurrence of L. ziegleri has been located with moderate precision. A major biostratigraphic advantage of the two sections is the occurrence of abundant, ammonoids.

Task Group to establish the Bashkirian-Moscovian boundary [which is also the base of the Middle Pennsylvanian Series] is chaired by John Groves (USA).

A taxon suitable for boundary definition has not been selected and investigations focus on several conodont lineages, with fusulinid biostratigraphy providing auxiliary information. Conodont evolutionary events that have potential for defining the base of the Moscovian include: 1) derivation of *Idiognathoides postsulcatus* from *Id. sulcatus*, 2) derivation of *Declinognathodus donetzianus* from *D. marginodosus*, and 3) the appearance of *Diplognathodus ellesmerensis*. The fusulinids *Eofusulina* ex gr. *triangula* and *Profusulinella* [= *Depratina*] *prisca* recently emerged as additional taxa with considerable potential for boundary characterization. Rapid morphologic evolution in P_1 elements of *Streptognathodus expansus* and *S. suberectus* permit the identification of a new biostratigraphic level at which the base of the Moscovian Stage might be placed.

South China - Qi Yuping, assisted by Lance Lambert and Jim Barrick, continued with an analysis of the conodonts derived from several collecting expeditions to the Nashui section in southern Guizhou province. They established that conodonts are abundant and taxonomically diverse in the slope carbonates of the 20 m thick Bashkirian-Moscovian boundary interval. The provisional Bashkirian-Moscovian boundary recognized by Qi *et al.* (2007, 2009) on the lowest occurrence of *Diplognathodus ellesmerensis* lies at 173 m above the base of the Nashui section, at a position containing a foraminiferal association dominated by *Profusulinella* spp. and *Pseudostaffella* spp. The lowest occurrence of a Moscovian fusulinid is at

183.45 m, where *Eofusulina* sp. was recovered. In the section, rapid morphologic evolution in P_1 elements of *Streptognathodus expansus* and *S. suberectus* permit the identification of a new biostratigraphic level at which the base of the Moscovian might be placed. The level coincides with the entry of *Neognathodus kanumai* and *Neognathodus atokaensis,* traditional markers for the base of the Moscovian in North America. Several evolutionary events offer potential for boundary definition in the section, including the appearances of *Diplognathodus ellesmerensis* and *Neognathodus atokaensis*, and chronoclines within *Declinognathodus*, *Idiognathoides*, *Idiognathodus*, *Gondolella*, *Mesogondolella* and *Streptognathodus* s.l.

Northwest Spain - Javier Sanz-López, Silvia Blanco-Ferrera and Elisa Villa are conducting integrated foraminiferal and conodont biostratigraphic analyses at the San Antolín-La Huelga section along the Bay of Biscay. The Bashkirian-Moscovian boundary is provisionally placed 180 m above the section's base in slope deposits. The boundary is marked by the lowest occurrence of *Idiognathoides postsulcatus*, and this level is slightly higher than the lowest occurrences of *Declinognathodus marginodosus* and *Profusulinella* ex gr. *prisca.* The San Antolín-La Huelga section contains four conodont taxa identified as potential Bashkirian-Moscovian boundary markers: *Id. postsulcatus*, *Diplognathodus ellesmerensis*, *Neognathodus nataliae* and *Declinognathodus donetzianus*. The lowest occurrences of these conodonts are in the order listed, spanning a stratigraphic interval of over 300 m.

Donets Basin, Ukraine - Katsumi Ueno and Tamara Nemyrovska continued their work on fusulinids and conodonts from the Donets Basin. The Malonikolaevka section yielded interesting results summarized by Ueno and Nemyrovska (2008). At Malonikolaevka, the proposed boundary marker *Declinognathodus donetzianus* first occurs in Limestone K1 in evolutionary continuity with its ancestor *D. marginodosus*.

Davydov (2009) summarizes fusulinid occurrences in the Bashkirian-Moscovian transition in the Donets Basin with proposed correlations to the Moscow Basin. Davydov follows Ueno and Nemyrovska (2008) in placing the base of the Moscovian Stage at the K_1 limestone on the appearance of *Declinognathodus donetzianus*. He regards limestones I_2, I_3 and I_4 as pre-Vereian in age (older than basal Moscovian Substage), although those units contain fusulinids such as *Verella*? *transiens* that occur elsewhere in Moscovian strata. Davydov suggests that the appearances of *Paraeofusulina* and *Eofusulina* are potential markers for the base of the Moscovian in Tethyan regions.

South Urals, Russia - The Basu River section, one of the best GSSP candidate sections in the southern Urals, contains the first appearance of *Depratina prisca* a few metres below that of *Declinognathodus donetzianus.* The discovery of the *Declinognathodus* lineage and a fusulinid fauna including the *P. prisca* group make the Basu section a good potential GSSP candidate. Kulagina *et al.* (2009) provisionally place the boundary, and that of the Solontsian Horizon (local unit in lowermost Moscovian), 0.9 m above the base of the section coincident with the appearance of *Depratina prisca*. The appearance of *Aljutovella aljutovica*, an index to the base of the Moscovian Stage in many areas, occurs 28.8 m above the section's base. The uppermost Bashkirian and basal Moscovian strata contain *Declinognathodus marginodosus*. The appearance of *D. donetzianus* is 6.2 m above the base of the section, about 5.3 m above the appearance of *D. prisca*.

Task Group to establish the Moscovian-Kasimovian boundary [which is also the base of the Upper Pennsylvanian Series] is chaired by Katsumi Ueno (Japan).

The task group is focusing on the stratigraphic occurrence and distribution of the conodonts *Idiognathodus sagittalis* Kozitskaya 1978 and *Idiognathodus turbatus* Rosscoe and Barrick 2009 and their ancestors as potential markers for defining the base of the Kasimovian. The use of either conodont would raise the boundary level 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.

Cantabrian Mountains, NW Spain - Spanish task-group members are continuing their study of the Moscovian-Kasimovian transition in the Castillo del Grajal and Morra del Lechugales sections, in the uppermost part of the carbonate-dominant Picos de Europa Formation and Las Llacerias Formation. Fusulinid biostratigraphic data indicate the study interval ranges from the top of the *Fusulinella* Zone (upper Moscovian) to the lower *Montiparus* Zone (Khamovnikian Substage). The *Protriticites* Zone, spanning at least 245 m, is well exposed and fusulinid rich. Preliminary sampling indicates the occurrence of the conodont *Idiognathodus sagittalis* and its potential ancestor *Idiognathodus* n. sp. 1 of Goreva *et al*. (2009), allowing correlation with the Moscow Basin and the North American Midcontinent.

South China - James E. Barrick and Qi Yuping have collaborated to examine conodonts from the Nashui section in southern Guizhou Province and plan to publish preliminary results in the field guide for the November 2010 SCCS field meeting in

Nanjing. At Nashui, latest Moscovian conodont faunas are characterized by abundant elements of *Swadelina* spp. and a few elements of *Idiognathodus* spp. The base of the Kasimovian is marked by the disappearance of *Swadelina* and appearance of *Idiognathodus* morphotypes of the *I. swadei-I. sagittalis* group, including at least one form that may be the early Missourian species *I. turbatus* Rosscoe and Barrick 2009. Overlying Kasimovian conodonts include, in ascending order, the *Streptognathodus guizhouensis*, *Idiognathodus magnificus*? and *Streptognathodus excelsus* faunas.

The recently discovered Loukun section in southern Guizhou Province along a road to the village of Loukun was measured and sampled for fusulinids and conodonts to place the Nashui section into its geological context, to provide another opportunity to study conodonts and fusulinids spanning the Moscovian-Kasimovian boundary, and to prepare the field guide for the November 25th-30th 2010 field excursion for the SCCS field meeting organized by the Nanjing Institute of Geology and Palaeontology. The Loukun section occupies an intermediate depositional position between the shallow-marine shelf deposits in the Zhongdi section 30 km southeast of the town of Ziyun and lower- to middle-slope deposits at Nashui.

Moscow Basin, Russia - The task group has been studying specimens from the Stsherbatovka quarry section on the Oka-Tsna Swell of the Ryazan Region, east of the town of Kasimov, Moscow Basin. In the section, the middle part of the Neverovo Formation (Khamovnikian Substage) contains abundant macrofauna. Conodonts occur 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, about 250 km southeast of the better-known Afanasievo section (Moscow Basin), a potential candidate for the GSSP of the Kasimovian Stage, demonstrates a wider distribution of the marker conodont species for identifying the base of the Kasimovian.

Southern Urals, Russia - The Dalniy Tyulkas section, several kilometres south of the Usolka section in the Urals, is a composite comprising three segments (Dalniy Tyulkas 1, 2 and 3) and ranges from upper Moscovian to the Artinskian Stage. It is a deeper-water succession containing abundant conodonts. Segment 1 spans the upper Moscovian to basal Kasimovian and Alekseev, Goreva, and others recognized the *Streptognathodus subexcelsus* and *Swadelina makhlinae* assemblages in the section's upper part. These assemblages are characteristic of the Suvorovo and Voskresensk formations, respectively, of the regional Krevyakinian Substage (traditional lower substage of Kasimovian) in the Moscow Basin. Dalniy Tyulkas 1 is the first section outside the Moscow Basin where these two lower Kasimovian conodont zones have been recognized. Dalniy Tyulkas 2 comprises upper Moscovian to lower Gzhelian strata. Alekseev, Goreva, and others are reinvestigating the conodonts in segment 2 and in the segment's middle part they found *Idiognathodus sagittalis*, a species chosen as a potential biostratigraphic marker for defining the base of the Kasimovian. Segment 2 is a promising candidate for the Moscovian-Kasimovian boundary stratotype.

Ukraine - Davydov *et al*. (2010) published data on high-precision U-Pb ages of volcanic ashes to radiometrically calibrate the detailed lithostratigraphic, cyclostratigraphic, and biostratigraphic frameworks of the Donets Basin in the Ukraine. Based on this precision, they confirmed the long-standing hypothesis that individual high-frequency Pennsylvanian cyclothems and bundling of cyclothems into fourth-order sequences are the eustatic response to the orbital eccentricity (~100 and 400 ka) forcing within the Milankovitch Band. Their work facilitates a more precise cyclostratigraphic calibration for the Moscovian-Gzhelian interval in the basin.

The **Task Group to establish the Kasimovian-Gzhelian boundary** is chaired by Katsumi Ueno (Japan) and has selected the conodont *Idiognathodus simulator* (Ellison, 1941) [s.s.] as the event marker for defining the base of the Gzhelian Stage) and is directing research toward studying the Gzhelian in the vicinity of its stratotype and selecting a suitable section for the GSSP.

Russia - In August 2009, the Subcommission on Carboniferous Stratigraphy held a field meeting in the Moscow Basin and southern Urals of Russia to examine Carboniferous stratotype sections and GSSP candidate sections. The visited sections that are closely related to the task group's work are the Gzhel stratotype in the Moscow region and the Usolka and Dalniy Tyulkas sections in the southern Urals.

With the help of Aleksey Reimers and Yuliya Ermakova, Alekseev and others studied an important Gzhelian-Asselian reference section at Yablonovyy Ovrag in the Samara Bend of the Volga River, about 800 km east southeast of Moscow. They found *Idiognathodus simulator*) in the interval traditionally considered to contain the base of the Gzhelian. The occurrence is important because it fills a geographical gap in the distribution of *I. simulator* between the Moscow Basin and southern Urals, and reinforces the importance of the taxon for defining the base of the Gzhelian Stage.

In the southern Urals the Usolka section, the only section formally proposed as a potential candidate for the GSSP defining the base of the Gzhelian, was visited during the 2009 SCCS field meeting to investigate its utility as a base-Gzhelian GSSP candidate. Davydov *et al.* (2008) documented in detailed the fauna and correlation of the Kasimovian-Gzhelian transition at Usolka. The Kasimovian-Gzhelian boundary interval of the Usolka section is largely concealed by soil and vegetation but the task group plans to re-expose the succession and inspect the results reported by Chernykh *et al.* (2006) and Davydov *et al.* (2008).

The Dalniy Tyulkas section, located several kilometers south of the Usolka section, comprises three separate segments (Dalniy Tyulkas 1, 2, and 3) ranging from the upper Moscovian to the Permian Artinskian Stage andrepresents a deeper-water succession with abundant conodonts. Dalniy Tyulkas 2 is an upper Moscovian-lower Gzhelian section, and conodonts were reported earlier by Chernykh and Reshetkova (1987). Alekseev, Goreva and others are reinvestigating the conodont succession in segment 2 and have discovered *Idiognathodus eudoraensis* Barrick, Heckel and Boardman and *I. simulator* in the section's upper part. *I. simulator* is the event marker for the base of the Gzhelian, and *I. eudoraensis* is interpreted to be its probable ancestor. Segment 2 of the Dalniy Tyulkas section is a promising candidate for the Kasimovian-Gzhelian boundary stratotype.

South China - James Barrick and Qi Yuping are examining conodonts from the Nashui section in southern Guizhou Province and plan to publish preliminary results in the field guide for the November 2010 SCCS field meeting in south China. Uppermost Kasimovian strata are characterized by morphotypes of *Idiognathodus (I. praenuntius*? and *I. eudoraensis*?) that appear to be transitional to *I. simulator*. The base of the Gzhelian is marked by the appearance of *I. simulator*, *I. auritus* and rare specimens of *I. sinistrum*. The distinctive genus *Solkagnathus*, described from the Gzhelian in the Urals, appears with *I. simulator*. The *Idiognathodus nashuiensis* fauna occurs slightly higher in the Gzhelian, and is followed by the middle Gzhelian *Streptognathodus vitali* fauna. Because the Nashui section is a completely exposed carbonate-slope succession containing a rich conodont record throughout, it has great potential as a GSSP candidate for the Kasimovian-Gzhelian boundary.

Project Group on Carboniferous Magnetostratigraphy chaired by Mark Hounslow (United Kingdom)

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 wants to collaborate 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 (based on the review in the SCCS Newsletter, v. 22: 35-41) but carbonates can be used. Most of the best GSSP candidate sections are carbonate dominant and thermally over mature but some reference sections and stratotypes for stages show potential. In general, the study of Mississippian magnetostratigraphy has languished and much remains to be done before Carboniferous magnetostratigraphy can be widely applied to facilitate global correlations.

During the year, little progress was made on the initial palaeomagnetic assessment of the two sections in southern Scotland that were discussed in the SCCS annual report for the Nov. 1st 2008 to Oct. 31st 2009 fiscal year. The first section is at Cove in the Cockburnspath outlier on the southern flank of the Midland Valley Basin and includes the Inverclyde and Strathyclyde groups of latest Devonian to (Asbian) late Viséan age (Cossey *et al*., 2004; Hounslow 2009). The second section is at Kirkbean on the northern edge of the Northumberland Basin and is of early to late Viséan age, overlapping in age with the upper part of the Cove section. Some progress may occur on the two Scottish sections in 2011, if grant income from United Kingdom sources is forthcoming.

During the May 31st to June 3rd 2010 ICS meeting in Prague, the task-group leader discussed with Barry Richards and Svetlana Nikolaeva (United Kingdom) 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 magnetostratigraphic study of the Brigantian, Pendleian and much of the Arnsbergian substages 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, 2009 - October 31st, 2010

During the fiscal year there were several geological conferences, field meetings and workshops that SCCS members needed to attend. Some of these meeting such as the workshop at the Third International Paleontological Congress in London (June 28th to July 3rd, 2010) were mainly of interest to the D-C boundary task group and the notes taken at those meetings are incorporated into the task-group report for the D-C boundary working group. The most significant meetings for the full subcommission were the Prague 2010 International Commission of Stratigraphy workshop (The GSSP Concept, May 31–June 3), and the 2010 field meeting held Spain (SCCS field meeting in Cantabrian Mountains, northwestern Spain, June 4th - 10th). The full reports are published in volume 28 of the Newsletter on Carboniferous Stratigraphy.

Report on the International Commission on Stratigraphy Workshop - The GSSP Concept; Prague, May 31st –June 3rd, 2010.

The Prague ICS workshop, held in the Geoscience Building of Charles University, was hosted by the Institute of Geology and Palaeontology at Charles University, and the Institute of Geology, Academy of Sciences, Czech Republic. Most of the approximately 60 delegates were executive members of ICS subcommissions, with others representing national stratigraphic commissions. Our subcommission was well represented by: Markus Aretz, Svetlana Nikolaeva, Barry Richards, Katsumi Ueno, Wang Xiangdong, and Qi Yuping.

Report on the SCCS field meeting in the Cantabrian mountains, northwest Spain, June 4th - 10th, 2010

At the Second International Conodont Symposium, held in Calgary from July 12-17th 2009, the SCCS executive met with Spanish colleagues Javier Sanz-López and Silvia Blanco-Ferrera to discuss their recent work on conodonts from Carboniferous sections in the Cantabrian Mountains of northwest Spain. At the end of that meeting, we discussed the possibility of arranging a four- to five-day SCCS fieldtrip for early June of 2010 to see some of the Spanish sections that they have been studying and are relevant to SCCS projects. Javier and Silvia assisted by Elisa Villa, Cor Winkler Prins, Luis C. Sánchez de Posada and Roberto Wagner, organized a field trip to the Cantabrian Mountains for us. A principal objective was to visit several of the best carbonate-dominated sections that span the Viséan-Serpukhovian boundary and have yielded conodonts within the *Lochriea nodosa-Lochriea ziegleri* lineage. Additional objectives were to obtain structural and paleogeographic overviews of the Cantabrian region and examine some of the best sections spanning the Devonian-Carboniferous, Mississippian-Pennsylvanian, and Bashkirian-Moscovian boundaries to see how they compared with other sections SCCS task groups are studying. The Cantabrian Mountains probably have the longest marine-carbonate record in the Carboniferous of Central and Western Europe and is of great interest for global stratigraphic correlations.

CHIEF PROBLEMS ENCOUNTERED November 1st, 2009 - October 31st, 2010

Several ongoing problems confronted SCCS task groups but the most significant issue was 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, which slowed down submission of the Tournaisian-Viséan boundary proposal, continues to hamper the choice of the boundary levels for the Viséan-Serpukhovian and Bashkirian-Moscovian boundaries. The problem is being overcome by correlating other fossil groups to bracket the boundary levels in regions where the boundary-event taxa have not been found. At the Moscovian-Kasimovian and Kasimovian-Gzhelian boundaries, there are enough conodont species in common between the regions to achieve fairly precise correlations. However, the strong cyclic control over sedimentation and consequent widespread disconformities across entire shelves still hampers the selection of acceptable GSSPs for these younger boundaries.

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 taxa beside 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 Urals. The direction that work of the SCCS is advancing suggests 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.

WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED IN THE NOVEMBER 1st, 2010 - OCTOBER 31st, 2011 FISCAL YEAR

The following activities are planned for the new fiscal year by the task groups, as communicated by task-group chairs and distilled from task-group reports.

Devonian-Carboniferous boundary - The D-C Boundary is defined by the first occurrence of the conodont *Siphonodella sulcata* (Huddle, 1934) in the evolutionary lineage *Siphonodella praesulcata* Sandberg, 1972 to *S. sulcata* (Paproth and Streel, 1984). The boundary section best displaying the lineage was thought to be in trench E' at La Serre and the base of bed 89 was selected as the D-C Boundary GSSP (Paproth *et al*., 1991). Recent studies demonstrate there are severe problems with the D-C Boundary GSSP at La Serre (Kaiser, 2009).

The primary task is the location of either a suitable first appearance datum in a biotic lineage or another event for boundary definition. Re-evaluation of the *S. praesulcata* to *S. sulcata* lineage strongly suggests the current event marker is not useable but addition work is required to test the findings. Corradini and Kaiser (2009) identified seven morphotypes in the transition from *S. praesulcata* to *S. sulcata* at La Serre. 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 exists between the morphotypes and stratigraphic level in other D-C boundary sections, where reworking is not an issue.

Early in the project, it was thought a protognathodid conodont lineage could be used for D-C boundary definition but to date the assessment of that group has not provided favorable results. Several task-group members are studying taxonomic and phylogenetic problems within the protognathodid conodont lineages. In a paper at the July 2010 IPC3 convention in London, Corradini *et al*. (2010) concluded that a comprehensive study of *Protognathodus*, a genus appearing in the latest Devonian and extending into the Mississippian, would permit a more precise definition of the D-C boundary than is presently available using that group of conodonts. Four species of *Protognathodus* are known from the relevant time span: *Pr. meischneri* Ziegler 1969, *Pr. collinsoni* Ziegler 1969, *Pr. kockeli* (Bischoff, 1957) and *Pr. kuehni* Ziegler & Leuteritze, 1970. Presently favoured for boundary definition are the first occurrences of *Pr. kockeli* from *Pr. collinsoni* and *Pr. kuehni* from *Pr. 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 will need to be located because work at La Serre (Kaiser, 2009; Corradini and Kaiser, 2009) indicates the section lacks the phylogenetic transition from *S. praesulcata* to *S. sulcata*. In addition, the section is not suitable because the first occurrence of *S. sulcata* occurs immediately above an abrupt facies change that is probably erosional and the task group plans to complete a sedimentologic assessment of that contact and the section.

At the July 2010 ICP3 workshop in London, it was proposed that we explore the possibility of using an event such as some component of the multiphase Hangenberg extinction event for boundary definition. We want to know how the phases of the Hangenberg are represented in different facies and how well they can be correlated globally.

Several comprehensive D-C boundary projects are planned for next four to five years. Vladimir Pazukhin along with Yury 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 concentrate on the Famennian *marginifera* Zone into the Tournaisian *isosticha* Zone. Chinese colleagues along with the SCCS executive and task-group leaders plan to initiate a re-assessment of the best D-C boundary sections in China, starting in November 2010 with the examination of the Dapoushang section (Ji, 1987) in southern Guizhou Province with Ji Qiang during the November 22nd - 29th 2010 SCCS Nanjing workshop and field meeting.

Task Group member Jiri Kalvoda and colleagues from the Czech Republic have initiated a multidiscipline project to study the Devonian-Carboniferous 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 Devonian-Carboniferous boundary interval with a high-resolution stratigraphic framework arising from multidiscipline stratigraphic-paleoenvironmental analyses.

Workshops relevant to the task group are planned for the upcoming major meetings of the SCCS (Nanjing, China November 21st - 30th) and SDS. The SDS chairman Thomas Becker and vice-chairman El Hassani, Rabat and the SCCS secretary Markus Aretz plan to organize a field meeting for early 2013 in Morocco.

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* Nemirovskaya, Perret & Meischner, 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957)-*Lochriea ziegleri* is the best event to define the boundary, the task group is drafting a proposal advocating the FAD of *L. ziegleri* be used for boundary definition. The group plans to focus attention on selecting the best candidate section for the GSSP. At this point, the two best 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.

Activities in South China

The deep-water carbonate-dominant Nashui section in southern Guizhou Province, China is one of the best candidates for the GSSP at the base of the Serpukhovian because the *L. nodosa-L. ziegleri* lineage is well defined in it and has been precisely located. This section is most intensively studied of the candidate sections but still requires additional work before the final proposal is submitted. The conodont studies for the locality are almost complete and the FAD of *L.* ziegleri is located at 60.10 m (Qi *et al.*, 2010) above the base of the section. Some additional work is required including slicing (parallel to bedding) the bed 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 in time to present his results at the November 21st - 30th 2010 SCCS Nanjing workshop and field meeting. Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the boundary interval are not as advanced as the paleontological investigations and will be the focus of the team's work in 2011. During December, 2010 Barry Richards plans to complete a bed-by-bed analysis of the strata over a 10-metre-thick interval on either side of the boundary. That work will include taking a continuous sample through about two metres of strata on each side of boundary to determine the location of all principal sedimentary events and the characteristics and origins of the beds.

In order to place the important Nashui 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 in south China, the investigation of three reference sections - the Yashui, Dianzishang, and the Luokun sections - will continue during the new fiscal year.

The most important reference section is the Yashui section, situated near the city of Huishui in Guizhou province. It is important because it contains abundant well-preserved rugose corals and foraminifers (Wu *et al.*, 2009) and is dominated by shallow-marine, neritic- to peritidal-ramp facies. In early 2010, most of the Yashui section was measured and described at a bed-by-bed level of detail and sampled for conodonts, foraminifers, and rugose corals. During December 2010, the team plans extend the measurement of section into the lowermost Bashkirian. John Groves plans to complete his study of the foraminifers in the lower part of the section in time to present his results at the November 21st - 30th 2010 SCCS Nanjing workshop and field meeting. The conodont study is partly finished but recovery has been poor and many additional samples need to be processed in the November 1st to October 31st 2011 fiscal year to locate the Viséan-Serpukhovian boundary. 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 2011.

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 emplaced in slope setting and provides another opportunity to see conodonts and foraminifers spanning the *L. nodosa*- *L. ziegleri* transition. 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* lineage. John Groves plans to complete his study of the foraminifers and present results at the November 21st - 30th 2010 SCCS Nanjing workshop. 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 the focus of the teams work at the locality in 2011.

During 2010, the task group commenced measuring and sampling the Luokun section, situated by the village of Luokun several kilometres from Naqing and the Nashui section. The exposure at Luokun is essentially 100% complete and dominated by slope carbonates of turbiditic and hemipelagic aspect. At Luokun, the deposits are of more proximal aspect than those at Nashui but are of deeper water aspect than deposits at Yashui.

Study of the section provides another opportunity to see conodonts and foraminifers spanning the *L. nodosa- L. ziegleri* transition. 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. During 2011, the task group plans to complete the measurement and sampling of the section at a bed-by-bed level and place aluminum maker pins at one metre intervals.

Activities in Southern Urals, Russia

With its conodonts characteristic of the *Lochriea nodosa-Lochriea ziegleri* transition, abundant ammonoids, and foraminifers, the Kardailovka section, a deep-water basinal succession on the west bank of the Ural River near the village of Verkhnyaya Kardailovka in the southern Urals remains the other strong candidate for the Viséan-Serpukhovian boundary GSSP. During the summer of 2010, the lower part of section was excavated using heavy equipment and aluminum marker pins were placed at one-metre intervals. Conodonts, foraminifers and ammonoids in the section have been studied in substantial detail (Nikolaeva *et al*., 2009; Pazukhin *et al*., 2010) but will require additional study when the section is measured at a bed-by-bed level in August 2011. Sufficient conodont work has been completed to locate the approximate position of the FAD of the conodont *Lochriea ziegleri* in the lineage *L. nodosa-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 investigations in 2011 when the team plans to complete a detailed sampling and analysis of the conodonts over a five-metre-thick interval on either side of the Viséan-Serpukhovian boundary and the collecting of a continuous lithologic 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. 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.

The Verkhnyaya Kardailovka section is geographically isolated from other well-exposed Viséan/Serpukhovian boundary sections in the region and the relationship of its basin deposits to slope- and shallow-shelf successions in region are poorly known. Some 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 2011 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.

Activities in Cantabrian Mountains, northern Spain

In June 2010, task-group members were introduced by Javier Sanz-López and Silvia Blanco-Ferrera to 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, 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. 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. During 2011, the team plans to systematically sample the section for the abundant ammonoids and commence sedimentological, geophysical and geochemical analyses.

Activities in Rocky Mountains, Canada

The task-group chairman along with 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 Viséan-Serpukhovian 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 tropical-marine successions of Europe and Asia.

Bashkirian-Moscovian boundary The task group is conducting research at locations in Europe and Asia and it is anticipated that during this fiscal year a lineage and taxon suitable for boundary definition will be selected. Investigations focus on evolutionary transitions in several conodont lineages, with fusulinid biostratigraphy providing auxiliary information. Until the fall of 2010, it was thought that the conodont evolutionary events that had the best potential for defining the base of the Moscovian include: 1) derivation of *Idiognathoides postsulcatus* from *Id. sulcatus*, 2) derivation of *Declinognathodus donetzianus* from *D. marginodosus*, and 3) the appearance of *Diplognathodus ellesmerensis*. Recent conodont studies by Qi Yuping and Lance Lambert, however, suggest there are better alternatives and that rapid

morphologic evolution in P_1 elements of *Streptognathodus expansus* and *S. suberectus* permit the identification of a new biostratigraphic level slightly below the traditional base of the Moscovian. The fusulinids *Eofusulina* ex gr. *triangula* and *Profusulinella* [= *Depratina*] *prisca* recently emerged as additional taxa with considerable potential for boundary characterization.

Qi Yuping and Lance Lambert are drafting a proposal for boundary definition in which the appearances of advanced morphotypes of *Streptognathodus expansus* and *S. suberectus* will be used to mark the Bashkirian-Moscovian Stage boundary. Qi and Lambert must finalize some basic taxonomic work on these two species before they can distribute a formal proposal. Their proposal would slightly lower the base of the Moscovian to a level that historically has been regarded as upper Bashkirian. Their work will use collections from the Nashui section (Qi *et al*., 2007, 2009) in Guizhou Province in southern China.

John Groves, Katsumi Ueno and other fusulinid specialists within the task group are developing the second proposal for Bashkirian-Moscovian boundary definition. Their proposal will advocate using the FAD of the fusulinid *Eofusulina triangula* to mark the base of the Moscovian. The FAD of *Profusulinella prisca* will probably be used as an auxiliary marker. Both species are widespread geographically, have been used historically as basal Moscovian indices, and are well understood in terms of their evolutionary origins. As an outgrowth of using the fusulinids for boundary definition, Demir Altiner will analyze fusulinids from two localities in the Tauride Belt of southern Turkey where *E. triangula* and *P. prisca* are known to appear at the base of the Moscovian. Altiner is attempting to demonstrate that the appearances of the potential markers occur in evolutionary continuity with their ancestors.

Activities in South China

The carbonate-dominant Nashui section in Guizhou Province is one of the best candidates for the GSSP at the base of the Moscovian because the conodonts the task group is considering for boundary definition are abundant, well preserved, and their first occurrences quite precisely located. John Groves plans to complete his study of the foraminifers in the section in time to present results at the November 21st - 30th 2010 SCCS Nanjing workshop. Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the boundary interval are not as advanced as the paleontological investigations and will be the focus of the team's work in 2011. During 2011, 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-metre-thick interval on either side of the boundary. That work will include taking a continuous sample through about two metres of strata on each side of boundary to determine the location of principal sedimentary events and the characteristics and origins of the beds.

In order to place the important Nashui section into its sedimentological and paleoenvironmental context and to determine the relationship of shallow-water coral and foraminiferal zones to the deeper-water conodont markers within the Bashkirian-Moscovian transition in south China, the investigation of two reference sections - the Zongdi, and the Luokun sections - will continue during the new fiscal year. If the fusulinid proposal gains support, it will trigger more work in both sections because they are known for their fusulinid successions and both would be logical sections in which to search for an eventual GSSP. In February 2011, Katsumi Ueno and Wang Yue will re-visit the well-known Zhongdi section in southern Guizhou (Ueno *et al*., 2007) for additional sampling of a critical biostratigraphic interval. At Zhongdi *Eofusulina* and its ancestor *Verella* occur in stratigraphic succession, but with a gap between their ranges. Katsumi and Yue will focus on this gap in hopes of finding evolutionarily transitional forms.

During 2010, the task group commenced measuring the Luokun section by the village of Luokun several kilometres from Naqing and the Nashui section. The exposure at Luokun is essentially 100% complete and dominated by slope carbonates of turbiditic and hemipelagic aspect. Study of the section is at a preliminary level but sufficient biostratigraphic work has been completed to locate the approximate position of the Bashkirian-Moscovian Stage boundary. During 2011, the task group plans to complete the measurement and sampling of the section (for lithology, microfossils, stable-isotope geochemistry and geophysics) at a bed-by-bed level and place aluminum maker pins at one metre intervals.

The task group will participate along with other SCCS Task Groups in a workshop in Nanjing and field excursion in southern Guizhou Province, China in November 2010, organized and hosted by Wang Xiangdong and colleagues with the Nanjing Institute of Geology and Palaeontology

Activities in Northwest Spain.

Javier Sanz-López, Silvia Blanco-Ferrera and Elisa Villa will continue with their ongoing integrated foraminiferal and conodont biostratigraphic analyses at the San Antolín-La Huelga section along the Bay of Biscay (Bahamonde *et al*., 2008; Villa 1995; Villa *et al.* 1997; Blanco-Ferrera, S. *et al*., 2009) and elsewhere in the

Cantabrian Mountains. If the fusulinid proposal being developed by Groves and Ueno gains widespread support, it will trigger additional work in the Cantabrian Mountains, because they are known for their fusulinids and would be a logical place (along with Turkey and Guizhou Province in China) to search for an eventual GSSP.

Activities in South Urals, Russia - Elena Kulagina and her team will continue their ongoing work on the Basu River section, visited during the August 2009 SCCS field meeting (Kulagina *et al*., 2009), and other well-exposed sections spanning the Bashkirian-Moscovian boundary in the Urals. The Basu section was recently considered to be one of the best GSSP candidate sections in the southern Urals. It contains the fist appearance of *Profusulinella* [= *Depratina*] *prisca* a few metres below that of *Declinognathodus donetzianus.* At the Basu River the discovery of the *Declinognathodus* lineage along with a fusulinid fauna including the *prisca* group made it a good candidate section. Kulagina *et al.* (2009) provisionally place the boundary, and that of the Solontsian Horizon (local unit in lowermost Moscovian), 0.9 m above the base of the section coincident with the appearance of *P. prisca*. If the boundary is placed at this level, more strata at the base of the section will need to be excavated.

Moscovian- Kasimovian boundary Ongoing biostratigraphic analyses will continue in southern China, the Cantabrian Mountains of Spain, Moscow Basin and southern Urals in Russia, and Donets Basin in Ukraine. In these regions, the task group will continue its integrated assessment of fusulinids and two species of conodonts as potential biostratigraphic markers by which the base of the Kasimovian can be selected and correlated globally: 1) *Idiognathodus sagittalis* Kozitskaya 1978, based on material from the Donets Basin (Ukraine) and also identified from the Moscow region and southern Urals of Russia, and the Cantabrian Mountains in Spain; and 2) *Idiognathodus turbatus* Rosscoe and Barrick 2008, based on material from the U.S.A. Midcontinent region, and recognized also in the Moscow region, the southern Urals, and the Donets Basin. The use of either conodont 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

Chinese colleagues along with Steven J. Rosscoe and James E. Barrick will continue with studies to provide detailed information on the conodont succession across the Moscovian-Kasimovian boundary in the Nashui section (Qi *et al*., 2007, 2009) in southern Guizhou Province as a potential GSSP locality. Barrick and Qi Yuping have collaborated to examine conodonts from the Nashui section and plan to publish preliminary results in the field guide for the November 21st to 30th 2010 SCCS workshop in Nanjing and Guizhou Province.

Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the Moscovian-Kasimovian boundary interval at Nashui are not as advanced as the paleontological investigations and will be a focus of field work in 2011. During 2011, the task group plans to complete the measurement and sampling of the upper Moscovian to lower Kasimovian component of the Nashui section (for lithology, stable-isotope geochemistry, and geophysics) and place aluminum maker pins at one metre intervals from the Moscovian into the Lower Permian. 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 Moscovian-Kasimovian boundary level. That work will include taking a continuous sample through about two metres of strata on each side of boundary to determine the location of all principal sedimentary events and the characteristics and origins of the beds.

In order 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 the Zhongdi (Ueno *et al*., 2007) and the Luokun sections - will continue. During 2010, the task group commenced measuring the Luokun section by the village of Luokun several kilometres from the Nashui section in Guizhou. 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 than those at Nashui and include submarine-debris-flow deposits. 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 the section is at a preliminary level but sufficient biostratigraphic work has been completed to locate the approximate position of the Moscovian-Kasimovian Stage boundary. The task group is preparing a field guide for the November 25th to 30th 2010 field excursion for the SCCS field meeting organized by the Nanjing Institute of Geology and Palaeontology. During 2011, the task group plans to complete the measurement and sampling of the section (for lithology and microfossils) at a bed-by-

bed level and place aluminum maker pins at one metre intervals.

Activities in Cantabrian Mountains, NW Spain

Spanish task-group members will continue to study the Moscovian-Kasimovian transition in the Castillo del Grajal and Morra del Lechugales sections, in the uppermost part of the carbonate-dominant Picos de Europa Formation and Las Llacerias Formation (Villa *et al*., 2009). Fusulinid data indicate the study interval ranges from the top of the *Fusulinella* Zone (upper Moscovian) to the lower *Montiparus* Zone (Khamovnikian Substage). The *Protriticites* Zone, spanning at least 245 m, is well exposed and fusulinid rich. Preliminary sampling indicates the occurrence of the conodont *Idiognathodus sagittalis* and its potential ancestor *Idiognathodus* n. sp. 1 of Goreva *et al*. (2009), allowing correlation with the Moscow Basin and the North American Midcontinent.

Activities in Moscow Basin, Russia

The task group will continue to study specimens collected from the Stsherbatovka quarry on the Oka-Tsna Swell of the Ryazan Region, east of the town of Kasimov in the Moscow Basin but they also plan to visit the quarry in the fall of 2011 to determine if additional strata in the lower part of the section can be exposed. Conodonts occur but are not common and most elements are juveniles of the *Idiognathodus sagittalis-I. turbatus* group; *Idiognathodus sulciferus* was also identified. The section is better than the Afanasievo section, a potential GSSP candidate, because it was deposited in somewhat deeper water and elements of the *I. sagittalis-I. turbatus* group are more abundant. Tatiyana Isakova will work on the *Fusiella* fusulinid lineage as a potential marker for a slightly lower position of the Moscovian-Kasimovian boundary than the one defined by the *I. sagittalis-I. turbatus* group.

Activities in Southern Urals, Russia

The Dalniy Tyulkas section, several kilometres south of the Usolka section in the Urals, is a composite comprising three segments (Dalniy Tyulkas 1, 2, and 3) and ranges from upper Moscovian to the Artinskian Stage. Segment 1 spans the upper Moscovian to basal Kasimovian and Alekseev, Goreva, and others recognized the *Streptognathodus subexcelsus* and *Swadelina makhlinae* assemblages in the section's upper part. Dalniy Tyulkas 1 is the first section outside the Moscow Basin where the two lower Kasimovian conodont zones have been recognized. Dalniy Tyulkas 2 comprises upper Moscovian to lower Gzhelian strata. Alekseev, Goreva, and others are reinvestigating the conodonts in segment 2 and in the middle part of the segment they found *Idiognathodus sagittalis*, one of the species chosen as a potential biostratigraphic marker for defining the base of the Kasimovian. Segment 2 is a promising candidate for the Moscovian-Kasimovian boundary stratotype.

Kasimovian-Gzhelian boundary Since 2007, when the task group voted in favor of using the first appearance of the conodont *Idiognathodus simulator* (Ellison, 1941) [*sensu stricto*] as the boundary-defining event, the search for a suitable section for the GSSP became the main focus of the task group. 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.

For establishment of the GSSP, Russian colleagues are undertaking a re-description and recollection of the Usolka section in the southern Urals and have published a comprehensive synthesis (Davydov *et al*., 2008). On August 14 2009, task-group members along with other SCCS representatives visited the Usolka section during the SCCS Field Meeting, held in the Moscow Basin region and southern Urals. The field-trip participants observed that only fragments of the Usolka section were exposed and they were in narrow, partly filled to overgrown trenches. In response to that observation, the task group plans to extensively excavate the site during its re-assessment.

Last September, 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 in 2011to collect conodont samples.

Chinese colleagues and collaborator James E. Barrick are undertaking a detailed sampling for conodonts and fusulinids across the boundary in the well-exposed, carbonate-slope succession that constitutes the upper part of the Carboniferous component of the Nashui section in Guizhou Province. A sedimentological and geochemical analysis of that section at the appropriate level is also in progress. During 2011, the task group plans to complete the measurement of the upper Kasimovian to Lower Permian component of the Nashui section (for lithology, stable-isotope geochemistry, and geophysics) and place aluminum

maker pins at one metre intervals from the Moscovian into the Lower Permian. 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 two metres of strata on each side of boundary to determine the location of all principal sedimentary events and the characteristics and origins of the beds.

Chemostratigraphy, magnetostratigraphy and radiometric dating

The SCCS executive is hopeful that ongoing work in chemostratigraphy and magnetostratigraphy will identify events that can be used to supplement the boundaries that will be defined by means of faunal events, and eventually will provide the basis for correlating these boundaries into the northern-hemisphere Angara region and the southern-hemisphere Gondwana region, where the pan-tropical biotas are replaced by provincial cold-climate communities.

We are also hopeful that new, more coordinated precise radiometric dating on biostratigraphically well-constrained marine successions, such as are being reported from the Pennsylvanian of the southern Urals by the Boise State group, and from the Mississippian of Belgium by the Tournaisian-Viséan task group, will both narrow the age disparities that currently exist within much of the Carboniferous and provide better correlation with more precise modern radiometric dates that will hopefully be obtained from the Angara and Gondwana regions.

BUDGET AND ICS COMPONENT FOR NOVEMBER 1st, 2010 - OCTOBER 31st, 2011 FISCAL YEAR

PROJECTED EXPENSES

Mailing and sample shipping	$200
Bank charges at Bank of Montreal	$25
Travel support for SCCS chairman to attend SCCS workshop and field meeting at Nanjing Institute of Geology and Paleontology November 21 to December 7, 2011	$500
Travel support for SCCS chairman and secretary to XVII International Congress on the Carboniferous and Permian in Perth, Australia; July 2011 (will hold business meeting and have special session for SCCS)	$1000
Travel support for task-group leaders and selected voting members to XVII International Congress on the Carboniferous and Permian in Perth, Australia; July 2011 (for presentations at business meeting and SCCS special session)	$1000
Travel support for SCCS chairman to attend SCCS field meetings in south China (September 2011) and southern Urals, Russia in August 2011	$500
Total Projected Expenses	$3,225

INCOME

Carryover (from credit balance in section # 7 above)	$1,215
Estimated donations	$200
Total Projected Income	**$1,415**

BALANCE

Estimated (deficit) / credit from above	-$1810.00
BUDGET REQUEST FROM ICS for 2011	$1800.00

MEETING-FIELD WORKSHOP SCHEDULE WITH THEMES AND ANTICIPATED RESULTS.

During the November 1st to October 31st 2011 fiscal year, there will be many meetings of substantial interest to SCCS members but two of them are considered to be the most important in terms of the goals of the subcommission.

November 21st to 30th 2010: GSSPs of the Carboniferous System - a SCCS Workshop and Field Excursion - Nanjing and southern Guizhou Province, China

From November 21st to 30th 2010, all SCCS task groups will participate in a workshop in Nanjing and attend a subsequent field excursion in southern Guizhou Province organized and hosted by Wang Xiangdong and colleagues with the Nanjing Institute of Geology and Palaeontology.

At the meeting in Nanjing (November 21st to 24th), the task groups will discuss the present status of their boundary studies and present plans leading toward the final designation and ratification of the GSSP that their group is responsible for. The workshop and field meeting will provide Carboniferous specialists an opportunity to compare and discuss specimens and data from relevant areas of the World. Principal objectives of the comparative analysis are to reach a consensus on the taxonomic assignment of specimens and agreement about the limits of morphologic variation permitted within taxa. Participants will be able to examine conodonts and foraminifers from the

Naqing (Nashui) section of South China, one of the world's most complete and continuously exposed Carboniferous carbonate-slope sections. Following the Nanjing workshop, there will be a field excursion (November 25th to 30th) to southern Guizhou Province to examine and sample Carboniferous successions deposited on the Yangtze carbonate platform and in the adjacent basin. Some of these successions contain sections such as the Nashui section by the village of Naqing that have substantial potential as GSSP candidates.

July 3-8, 2011: The XVII International Congress on the Carboniferous and Permian - Perth Australia:

From July 3-8, the SCCS task groups will attend the XVII ICCP in Perth, hosted by the University of Western Australia. Details about the congress are available on the website- http://www.iccp2011.org/. The congress on the Carboniferous and Permian is held every four years and is our most important meeting, providing an excellent opportunity to present results from research on faunas and sections leading to the selection of GSSPs for stage boundaries. The ICCP offers an opportunity to place our research into a global context and to renew links with colleagues. The conference organizers have given the SCCS a special session - "Carboniferous Stage Boundaries: the Present State and Future", at which members will present progress reports relevant to their specific boundaries. During the congress, the SCCS will hold a business meeting for task-group leaders and SCCS voting members. A proceedings volume will be published in which task-group members are encouraged to publish their results.

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SUMMARY OF EXPENDITURES

Statement of operating accounts from November 1, 2010 to October 30, 2011

Prepared by Barry Richards, Chairman SCCS

(Accounts maintained in Canadian currency)

INCOME (Nov. 1, 2009 – June 30, 2010)	
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	
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	$1000.00
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 (2009 – 2010)	
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 expenditure Nov. 1, 2009 – October 31, 2010	-$2,000.00
Balance carried forward (to 2010 - 2011 fiscal year)	**$994.57**

BUDGET AND ICS COMPONENT FOR NOV. 1, 2011 - OCT. 31, 2012 FISCAL YEAR

Prepared by Barry Richards, Chairman SCCS

PROJECTED EXPENSES	
Mailing and sample shipping	$500
Bank charges at Bank of Montreal	$25.00
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 IGCP 575 in Ukraine during late September 2012	$500
TOTAL Projected Expenses	**$4,525.00**
INCOME	
Carryover (from CREDIT balance at end Nov. 1, 2010 - Oct. 31 2011 fiscal year)	$994.57
Estimated donations	$200.00
TOTAL PROJECTED INCOME	**$2,000.00**
BALANCE	
Estimated (deficit) / credit from above	-$3,339.43
Budget request from ICS for 2012	$3,330.00

TASK-GROUP REPORTS FOR THE NOV. 1ST, 2010 TO OCT. 31ST, 2011 FISCAL YEAR

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

Markus Aretz and Task Group

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Introduction

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. The current work focuses on several aims, which have been defined in previous years and at the workshop of the task group during the last IPC at London (see reports in SCCS and SDS newsletters for 2010).

General activities

Following the workshop at London, the task-group members are actively collecting data and a first synthesis of these data should be presented at a workshop in Morocco (spring 2013). Until this date no formal meeting is planned, and news and progress are presented in the usual forums (newsletters, congresses, and publications). Few members of the task group attended the ICCP at Perth, and thus only three contributions related to the D/C boundary were made (keynote by the task-group leader, poster on brachiopods by Brice and Mottequin, and a poster on the D/C boundary in Czech Republic).

Boundary criterion

The group is currently searching for a suitable criterion for the redefinition of the boundary. For the moment the task group favors a position that does not change the current base of the Carboniferous too much, because stratigraphic stability is required. However, the search for a criterion is not focused on a specific fossil group or technique. During the workshop at London, the interval of the Hangenberg Event was identified as one potential interesting level. However, more data on its precise timing and the correlation of biostratigraphical, geochemical, sedimentological and sequence stratigraphical patterns are needed to evaluate the potential of the event horizon for boundary definition on a global scale. It must be noted here that the interval to be studied should include the strata below and above the Hangenberg event level, which can be associated with black shales in specific facies realms.

Since the problem with the conodont lineage *Siphonodella praesulcata* – *Siphonodella sulcata* and the FAD of *S. sulcata* in the GSSP at La Serre (see e.g. Kaiser 2005, 2009) was recognized, the clarification of the lineage has been a prime task for the conodont workers in and outside the working group (e.g. Spalletta *et al*. 2010). Results have been published for siphonodellids (Kaiser and Corradini, 2011) and protognathids (Corradini *et al*. 2011). These papers show that the two conodont groups 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 the species *S. praesulcata* and *S. sulcata*. Thus the determination of *S. sulcata* is subjective and the species is not a suitable marker for the base of the Carboniferous.

The second conodont group, which is often used as an alternative index to the siphonodellids, is the protognathodids and they show a variety of problems. They suffer from a general rarity of the taxa, regional variation in the first occurrence data, restricted stratigraphic ranges and global distribution, and poorly understood facies occurrences. Thus none of the four species (*Pr. meischneri*, *Pr. collinsoni, Pr. kockeli* and *Pr. kuehni*) within the boundary interval have a high potential as an index for redefintion of the D/C boundary.

Because in the current state the most often used conodonts do not provide a good candidate for defining the base of the Carboniferous, other fossil groups require comprehensive analysis like that used on the conodonts. Additionally, the new results also show that current correlations may be ill-defined because they rely on those conodont datums, which have been identified as being problematic for global correlation. Thus the task group has to establish new tools for correlation and revise the old global correlations.

The conodont workers of the task group continue their studies in various late Famennian-early Carboniferous sections. These data will be part of the planned correlation charts.

Progress reports from members

Europe. A team of Czech researchers is currently studying with a multidisciplinary approach the D-C boundary interval (Babek- geophysical methods, sedimentology, sequence stratigraphy; Fryda- C isotopes; Grygar- element geochemistry; Kalvoda- foraminifers, conodonts; and Kumpan- conodonts, geophysical logging, C isotopes). This team is working intensively on Devonian – Carboniferous 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. Lower and upper protognathodid faunas are rather abundant in the calciturbidite succession in the Lesni lom quarry, where the Hangenberg event facies are developed. The specimen of *Siphonodella* found in 1986 below the Hangenberg event facies can be assigned to the *sulcata* morphotype, which underlines the problems of the biostratigraphic definition of the D/C boundary. The foraminiferal studies confirm the presence of the genus *Quasiendothyra* up to the *duplicata* Zone. Petrophysical measurements (gamma-ray spectrometry, bulk magnetic susceptibility and colour parameters /spectral reflectance in visible light) show a relatively good correlation potential within the carbonate turbiditic facies but the correlation with the nodular facies is limited. First results of carbon isotopic studies show a positive peak of $\delta^{13}C_{carb}$ in the middle/upper? *preasulcata* zone in the Lesni lom quarry. Preliminary results were presented in a poster at the International Congress on the Carboniferous and Permian in Perth. The Czech workers have extended their work to sections in Austria (Carnic Alps and Graz Palaeozoic).

Task-group member Hanna Matyja continues to work with colleagues from Poland and Germany (T. Becker, S. Kaiser) on two projects related to the D/C boundary in the subsurface of NW Poland and in the Tian-Shan Range, central Asia. Short-term objectives of their work are the establishment of high-resolution biostratigraphy as well as geochemical profiles using stable- carbon and oxygen isotopes. A longer-term goal is to identify the signatures of the global Hangenberg Event. Results of a multidisciplinary study of the Pommerian 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.

Morocco. The working group of Thomas Becker continues their research in central and southern Morocco (see also contribution in this newsletter). The new results and sections will be presented at the 2013 workshop of the task group.

Pre-Caspian region. Task-group member P. Brenckle continues his investigations of foraminifera in shallow-water facies of the North Caspian Basin.

North America. Task-group member Barry Richards continues his ongoing studies of the latest Famennian to early Tournaisian Exshaw Formation in the southern Canadian Rocky Mountains and Foothills 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 using stable-carbon isotope geochemistry combined with U-Pb geochronology, biostratigraphy and sedimentology. Conodont data indicate the contact between Devonian and Carboniferous strata lies in the upper part of the black shale member of the Exshaw Formation at its type section and at several other localities. The position of the D/C boundary has not been precisely located in the Exshaw Formation and it is hoped evidence from stable-isotope geochemistry will more tightly constrain the position of the boundary.

China. Task-group members E. Poty and M. Aretz and co-workers continue their work on the correlation of latest Devonian-Mississippian third-order sequences in Southern China with those in Europe. The studied sections are all in shallow-water facies. First results indicating high correlation potentials of many sequence boundaries were presented at the International Congress on the Carboniferous and Permian in Perth. The work on these correlations will also facilitate correlations to other regions in shallow water facies.

Outlook

The work of the task group starts to become more organized. The lack of data on many fossils groups and especially the correlation of the "old" data with the new results on the conodonts are a constant problem and strongly influence the future work of the task group. First of all, the task group has to continue gathering biostratigraphical, sedimentological, geochemical and petrophysical data in the next years. These data have to come from different facies and also different fossil groups to insure good correlations in various facies realms and regions.

As decided at the workshop at London, one focus should be correlation charts for the different phases of the Hangenberg Event. However, this must not exclude or slow down the work on stratigraphic ranges of taxa in the latest Famennian and earliest Carboniferous, because the level of the Hangenberg Event is only one possibility among others.

The work of the task group is not limited to the task-group members and input from all researchers interested in the subject is welcome and necessary.

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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 (November 1, 2010 - October 31, 2011) year, the task group to establish the Viséan-Serpukhovian boundary made encouraging progress toward the selection of a GSSP for the Viséan/Serpukhovian stage boundary. Most importantly, the group continues to find 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 upper part of the Brigantian Substage, which is slightly 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).

Members of the task group are conducting research on biostratigraphy, sedimentology and lithostratigraphy, stable-isotope geochemistry and magnetic susceptibility at a variety of locations in Europe, Russia, China and North America. Because the first evolutionary appearance of the conodont *L. ziegleri* in the lineage *L. nodosa-L. ziegleri* has unofficially been selected by the task group as the best potential for boundary definition, biostratigraphic investigations continue to focus mainly on refining the biostratigraphic work done on the conodonts, ammonoids, foraminifers corals and other fossil groups.

Members of the 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 [November 22 - 29, 2010] and 2) the XVII International Congress on the Carboniferous and Permian in Perth, Australia [July 3-8, 2011]. During the fiscal year, the most important accomplishment was the completion of a comprehensive study of the foraminifers spanning the Viséan/Serpukhovian boundary in southern Guizhou Province, China by John Groves and his co-authors. The biostratigraphic studies are much further advanced than the other aspects of the work and the focus in the 1st November 2011- 31st October 2012 fiscal year needs to be on the stratigraphy, sedimentology and geochemistry.

Meetings

The SCCS Workshop on GSSPs of the Carboniferous System: Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou Province, China

The SCCS Workshop, held in Nanjing China from November 22nd to 24th 2010 was organized by Xiangdong, Wang, Yuping, Qi, Yue, Wang and their colleagues and held at the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS) in Nanjing. It consisted of two days of working sessions (examination of conodonts and other fossil groups by task-group members and a day of oral presentations (November 24th). Talks of principal interest to the task group were: 1)

Foraminiferal basis for recognizing the Viséan-Serpukhovian boundary at Yashui - by Groves, J., Wang, Y. and Wang W.; 2) Research progress on both conodonts and foraminifers from the candidate GSSP of the Carboniferous Viséan-Serpukhovian boundary in the Naqing (Nashui) section of South China - by Qi, Y. *et al*.; 3) New results from the Verkhnyaya Kardailovka section (south Urals) - a candidate for the Viséan-Serpukhovian boundary GSSP - by Nikolaeva, S.V., Richards, B.C., Kulagina, E.I., Alekseev. A.S., Pazukhin, V.N. and Konovalova, V.A.; 4) Global ammonoid biostratigraphy of the Viséan/Serpukhovian boundary - by Nikolaeva, S.V. and 5) The Viséan/Serpukhovian boundary - an overview and progress report - by Richards, B.C. The workshop was followed by a six-day field excursion (November 25 to 30th) 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 field-meeting participants to examine the Viséan/Serpukhovian boundary at the shallow-water (peritidal to non marine) Yashui section, the deep-water (lower to middle slope and basin) Nashui (Naqing) and Luokun sections, and the intermediate section at Dianzishang (slope turbidites disrupted by impressive submarine slump to landslide deposits).

XVII International Congress on the Carboniferous and Permian in Perth, Australia (July 3-8, 2011)

Several members of the task group attended the congress in Perth, organized by the convener Zhong Qiang Chen and his colleagues at the University in Western Australia, and gave presentations at the Monday July 4 Symposium 2 - "SCS: Carboniferous stage boundaries" convened by B. Richards, X. Wang and K. Ueno. Task-group members also presented papers in other sessions. Of special interest to the task group were the papers: 1) Correlation of the base of the Serpukhovian Stage in northwest Europe and North America - by Sevastopulo, G.; 2) Summary of research at the Verkhnyaya Kardailovka section (south Urals) - a candidate for the Viséan-Serpukhovian boundary GSSP by Nikolaeva, S., Richards, B., Kulagina, E., Alekseev, A., Pazukhin, V. and Konovalova, V.; 3) Global correlations and the Viséan -Serpukhovian stage boundary - by Richards, B. and the task group; and 4) Progress on the study of conodonts from candidate GSSPs for the bases of Carboniferous stages in South China - by Qi, Y., Wang, X., Barrick, J., Lambert, L., Richards, B., Groves, J., Ueno, K., Lane R., Wu, X., and Hu, K. The scientists that presented the papers plan to have them published in two special journal issues organized by Zhong Chen and his colleagues. The first special issue, provisionally titled- "Multidisciplinary studies of global Carboniferous stage boundaries: toward a better definition and global correlations", will be published in the Geological Magazine in 2012 and the second special issue in the Geological Journal in 2014.

Field activities

Task-group field activities were conducted in several parts of North America, Western Europe and Asia. During late November and early December of 2010, their field work was concentrated in southern Guizhou province, People's Republic of China. In August of 2011, field activities were concentrated in the southern Ural Mountains of Russia.

Southern Guizhou province, Nashui section

From December 1st to 3rd, 2010 a small team including task-group members Qi Yuping and Barry Richards along with two students Wang Wei-jie and Hu Keyi briefly 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* in the lineage *Lochriea nodosa-Lochriea ziegleri* were measured at a bed-by-bed level for lithological and geochemical studies. In addition, about one metre of strata on either side of the boundary was sampled continuously by extracting large blocks from each bed in that interval. The beds will be sliced into slabs to reveal sedimentary structures and the nature of depositional events within the beds. 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. The base of the 2008 section was placed substantially higher in the succession because a thrust fault and associated tectonic deformation was recognized in the underlying Viséan component of the section.

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, and the oldest representatives of *L. ziegleri* could be readily distinguished from the associated transitional forms of *L. nodosa*. 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. During the fiscal year, John Groves and colleagues completed their study of the foraminifers across the boundary interval in the section (Groves *et al.*, in press). 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 (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. 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. From the 4th to the 6th of December of 2010, the 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. Additional samples were collected in 2010. Although conodonts have not been recovered, valuable sedimentologic and paleogeographic data were obtained from the section and the diverse coral and foraminifer faunas have proven worthy of study. 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.,* in press) completed a comprehensive study of the foraminifers, using samples he collected in May 2008 while Richards was measuring the lower part of the section, gluing aluminum marker pins in holes drilled at 1 metre intervals and starting a sedimentological analysis. Groves *et al.* 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 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 delicate* (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, have not been observed at Yashui.

Southern Urals, Verkhnyaya Kardailovka section

During August 2010, task-group members Svetlana Nikolaeva, Vera Konovalova, Elena Kulagina, and Barry Richards along with students and several other SCCS members including Alexander Alekseev and Uriy Gatovsky visited and 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 southern Russia. Nikolaeva and her colleagues have worked on the Kardailovka section for several years and published several syntheses about the ammonoids, conodonts, foraminifers and ostracodes (Nikolaeva *et al.,* 2005, Nikolaeva *et al.*, 2009b; 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 (basal part bed 22a in Pazukhin *et al.*, 2010) 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 extensively excavated with hydraulic equipment (backhoes and front-end loaders). Following the excavations, the section was permanently marked with aluminum pins glued into drill holes at one metre intervals commencing in the upper part of a Viséan crinoid-lime grainstone to packstone unit and ending in lower Bashkirian limestone. In August 2011, the limestone-dominant component of the section was also measured and sampled bed-by-bed for lithology and geochemical samples from about 12 m to 35 m above the section's 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 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 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*.

Future work

Now that several excellent stratigraphic sections containing the *Lochriea* lineage have been located, the task group's goals will be to more precisely establish the FAD of *L. ziegleri* in some of the sections and better document the occurrence of the other biostratigraphically useful fossils. A comprehensive study of the ammonoids is considered particularly significant and is being actively pursued by Svetlana Nikolaeva. Foraminifers are the other main fossil group with substantial biostratigraphic utility and are being actively studied by several task group members including John Groves, Nilyufer Gibshman, and Elena Kulagina. The regional stratigraphy, geochemistry, sedimentology and geophysical attributes of the GSSP candidate sections for the boundary are not well known; consequently, the Nashui and Verkhnyaya Kardailovka sections are being aggressively studied, and the two best Spanish sections will be studied in the current fiscal year.

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

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Members of the Bashkirian-Moscovian Boundary Task Group are conducting research at a variety of locations in Europe and Asia. Investigations continue to focus mainly on evolutionary transitions in conodont and fusulinid lineages. Members of the group participated in two salient events during the past year:

SCCS Workshop on GSSPs of the Carboniferous System: Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou. The SCCS Workshop was convened in November, 2010, by Wang Xiangdong, Qi Yuping, Wang Yue and their colleagues with the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS). It consisted of three days of working sessions and formal presentations in Nanjing followed by a six-day field excursion to southern Guizhou. Of special relevance to this Task Group, the excursion allowed participants to examine the Bashkirian-Moscovian boundary at the shallow-water Zongdi and Luokun sections and the deeper-water Nashui section. The field excursion guidebook 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.

During the Workshop at NIGPAS Qi Yuping and co-authors presented an important paper titled: "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." In this paper they advocated placing the base of the Moscovian Stage in the Nashui section at the joint first appearances of advanced morphotypes of *Streptognathodus expansus* and *S. suberectus*. This level coincides with the local appearance of *Neognathodus kanumai* and it occurs approximately 4 m below the local appearance of *Diplognathodus ellesmerensis*, an event previously identified as a potential boundary marker. An article in the field excursion guidebook (Qi *et al.*, 2010) clarifies the taxonomic distinctions between stratigraphically lower morphotypes of *S. expansus* and *S. suberectus* and the higher, advanced morphotypes of the same nominal species. This article was accompanied by a detailed range chart and seven plates in which representative specimens were illustrated. 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.

New proposal for a formal marker event for the lower Moscovian boundary. Eight members of the Bashkirian-Moscovian Boundary Task Group collaborated on a new proposal to mark the base of the Moscovian Stage by the first appearance datum (FAD) of the fusulinoidean genus *Eofusulina* Rauser-Chernousova *in* Rauser-Chernousova *et al.* 1951 *in* evolutionary continuity with its ancestor *Verella* Dalmatskaya 1951. Operationally, this 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 among all members of the Task Group for their comments, but a formal vote was not held. A widely held concern is the relatively few sections in which the *Verella–Eofusulina* transition might be documented with closely spaced sampling. The search for such localities will become a priority during the next fiscal year and in the future (see item 3, below).

Eofusulina triangula (Rauser-Chernousova and Beljaev *in* Rauser-Chernousova *et al.*, 1936) is the 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).

The genus *Eofusulina* and its ancestor *Verella* are distinctive among early fusulinoideans in that they possess highly elongate tests with primitive, three-layered wall structure consisting of two prothecal layers and an epitheca. The two genera differ mainly in the degree of septal fluting. Septal fluting in *Verella* usually is restricted to the poles and lateral slopes, whereas in *Eofusulina* it extends across the entire length of the test. Thus, the proposed event employs the concept of morphologic grade: the boundary shall coincide with a specified point in an evolutionary morphologic continuum. Of secondary importance, the proloculus in *Eofusulina* is much larger relative to overall test size than in *Verella*. Evolutionary relationships between *Verella* and *Eofusulina* have been addressed by Leven (1979) and Ivanova (2008).

In practice, 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 NW Spain. Other conspecific specimens are known from Limestone I_3 in the Donets Basin, just below the joint appearances of *Eofusulina* sp. and *Declinognathodus donetzianus* in Limestone K_1 (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.

The proposed marker event is attractive in that specimens of *Eofusulina* are very easy to identify. Juvenile specimens can be identified by their large proloculi and elongate shape, even in the first volution. Tangential and/or oblique sections through larger specimens can be identified by their elongate shape and intense septal fluting. The proposed marker is further attractive because of its widespread distribution in North Africa, the Arctic, Eurasia, and accreted Panthalassan oceanic carbonates in circum-Pacific areas. It is known from no fewer than 17 distinct geologic basins.

The authors noted that although *Eofusulina triangula* and other early species in the genus are widespread geographically, *Eofusulina* spp. typically do not occur as abundantly as certain other fusulinoideans. Further, like all fossils, they occur only where a suitable environment allowed colonization. Where they are rare, potential sampling bias means that the lowest observed occurrence might be in rocks slightly younger than basal Moscovian as determined on independent criteria. Similarly, where they were temporarily excluded by inhospitable environments, their local appearance clearly will post-date earliest Moscovian. For these reasons it is desirable to designate auxiliary markers for the base of the Moscovian Stage.

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 Stage. 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.

Eofusulina and the auxiliary markers are not known to occur in Australia, Antarctica or sub-Saharan Africa. In the Western Hemisphere *Eofusulina* is known only from an accreted terrane of Panthalassan origin. Of the areas where the various markers do not occur indigenously, only North and South America contain significant marine deposits of Bashkirian and Moscovian age. The base of the Moscovian Stage can be approximated in the Western Hemisphere by the FAD of *Profusulinella fittsi* (Thompson, 1935), which is known to coincide with *Eofusulina* in Eurasia (Solov'eva, 1963), and other early species in *Profusulinella*. Species in *Profusulinella* are thought to have arrived in the Western Hemisphere in early Moscovian time as immigrants via the Franklinian Shelf. Many North American species strongly resemble and might be conspecific with early Moscovian Eurasian counterparts (Groves *et al.*, 2007).

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) and his students Mikio Shinohara, Keishi Hamachi, Naoki Hayakawa and Yusaku Hoshiki, in collaboration with Tsutomu Nakazawa (AIST, Japan), Yue Wang and Xiangdong Wang (NIGPAS) recently studied latest Bashkirian-earliest Moscovian fusulinoidean biostratigraphy of the Zongdi section in southern Guizhou Province, South China. They investigated a 50-m interval (50-100 m above the base) of the section, focusing particularly on the *Verella-Eofusulina* lineage. This interval of the Zongdi section consists chiefly of shallow-marine bioclastic limestone with frequent dolomitic levels. The interval includes four subaerial exposure surfaces (probably minor unconformities) at 83.0 m, 92.3 m, 93.0 m and 96.0 m. The exposure surfaces are underlain immediately by very thin paleosols and organically pigmented limestones with pendant cements. At Zongdi the lowest *Verella* is found at 56 m and specimens continue up to 76 m. The lowest (but poorly preserved) *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 further important because it is one of few sections on the Yangtze Carbonate Platform of South China that yield both *Verella* and *Eofusulina*.

Demir Altiner and colleagues at Middle East Technical University (Ankara) conducted an analysis of the sequence stratigraphy and fusulinoidean biostratigraphy of Bashkirian-Moscovian boundary beds in the Tauride Belt in southern Turkey. Three overlapping sections spanning the Lower Bashkirian (Askynbashky) to Lower Moscovian (Solontsovsky) beds were measured and collected 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. This level also 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*. Stacking patterns of upward-shoaling meter-scale cycles indicate the presence of two third-order sequences dated as Askynbashky to lowermost Asatausky and Asatausky to Solontsovsky. A prominent quartz arenitic sandstone intercalated within the Upper Bashkirian carbonate succession has been interpreted as a falling stage systems tract corresponding to stratal offlap during the culmination phase of the second glacial interval in the Carboniferous. 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 this new carbonate regime.

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

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General activities

At the occasion of the XVII International Congress on the Carboniferous and Permian, held in Perth, Australia, in early July, 2011, the SCCS organized a symposium entitled "Carboniferous Stage Boundaries." In this congress, a number of abstracts, that have contents directly related to the task group activities, were submitted by task group members. They are listed below.

Ueno K. & Task Group: The Moscovian-Kasimovian and Kasimovian-Gzhelian boundaries – an overview and progress report.

Leontiev D. & Kossovaya O.: Preliminary data on the pre-*sagittalis* interval from the Kasimovsky quarry section, Ryazan district, Russia.

Qi Y., Wang X., Barrick J., Lambert L., Richards B., Groves J., Ueno K., Wang Z., Lane R., Wu X. & Hu K.: Progress on the study of conodonts from candidate GSSPs for the bases of Carboniferous stages in South China.

Ueno K., Hayakawa N., Nakazawa T., Wang Y. & Wang X.: *Carbonoschwagerina*-mimics from the Zongdi section of South China: New relatives or homeomorphic strangers?

Djenchuraeva A.: Biostratigraphy of the upper Moscovian-Kasimovian boundary sediments of low foothills of the Turkestan-Alai, South Tien-Shan.

Goreva N. & Alekseev A.: New Russian sections as potential GSSP of the global Kasimovian and Gzhelian stages.

Progress reports from task group members

South China. Qi Yuping, in collaboration with James E. Barrick, studied a number of samples from uppermost Moscovian to lower Gzhelian slope carbonates at Naqing (Nashui), southern Guizhou, South China. Conodonts are abundant in the Late Moscovian fauna, 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 the North American succession. 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 *I. turbatus*. In the collection from 235.75 m to 236.60 m, many transitional morphotypes (which are similar to *I. sagittalis*) with rapid morphological transformation from *I. swadei* to *I. turbatus* are found. Therefore, the important conodont evolutionary lineage from *I. swadei* to *I. turbatus* is confirmed in the Moscovian-Kasimovian boundary interval in South China. Accordingly, Qi and Barrick consider that the FAD of *I. turbatus* is the best potential boundary marker for the base of the global Kasimovian Stage.

Qi and Barrick are working on new and larger collections from the critical boundary interval in order to obtain a more complete understanding of

the conodont fauna and enable a better evaluation of the Naqing section as a stratotype section for the base of the global Gzhelian Stage.In the uppermost Kasimovian interval, the less common *Idiognathodus* species include morphotypes with reduced lobes, and more significantly, forms with a weakly developed eccentric groove could be the ancestor of *I. simulator*. After a thin (about 1.5 m thick) conodont-poor interval in the topmost 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 lineage of *I. simulator* from its potential ancestor would be proved based on the new conodont materials from this section. Although they allow recognition of this boundary, existing collections from the Kasimovian-Gzhelian boundary interval at Naqing are not sufficient to make complete description of the boundary conodont faunas. Qi and Barrick are now working on new and larger collections from the critical boundary interval to understand full characterization of the boundary conodont fauna and better evaluation of the use of the Naqing section as a stratotype section for the base of the global Gzhelian Stage.

In addition to the Naqing section, several new sections covering the Moscovian-Kasimovian and Kasimovian-Gzhelian boundary intervals have been found recently in southern Guizhou by Qi Yuping. Among them the Narao and Fengting sections seem to be promising for the further boundary work as many debris flows containing fusulines are found together with fine-grained, potentially conodont-rich limestones in both sections. They probably show shallower facies than the Naqing section and have a potential to tie chronostratigraphic frameworks by conodont and fusuline biostratigraphy of the Yangtze Carbonate Platform.

Russia. Valery V. 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. In this study, he proposed to change the diagnosis of this conodont species. This taxonomic modification would enlarge the morphological range of the relevant species, which makes it possible to explain the difference between the American and Eurasian forms as intraspecific variability. Chernykh also examined the stratigraphic value of some associated conodonts from the group *simulator* in this study. The paper will be published in Lithosphere, No. 1 in 2012.

Ukraine. Recently, Tamara I. Nemyrovska and Katsumi Ueno carried out a fieldwork in the Lugansk region of the Donets Basin and newly studied the Annovka section in the Bryanka area. This section covers the upper part of the C2\7 Suite (Limestone M) and the C3\1 (Limestone N), broadly corresponding to the Moscovian-Kasimovian boundary interval. Their work is now in progress.

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IRIKLINSKOE SECTION: CARBONATE-PLATFORM SLOPE CEMENTSTONES AND SERPUKHOVIAN PALEOGEOGRAPHY OF EASTERN SOUTH URALS (RUSSIA)

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Introduction

The Iriklinskoe section of the eastern slope of the South Urals (Fig. 1) was measured and described by the author in 2007 in a quarry operated since the 1990s. The section ranges in age from latest Viséan (Venevian in Russian Platform scheme) through late Serpukhovian based on quarry office reports and preliminary foraminifer identification by E.I. Kulagina. The section, ignored prior to this study by the geological research community, is remarkable because of the extensive development of cementstone facies and syngenetically cemented slope breccia in the Serpukhovian part of the section. To author's knowledge, Iriklinskoe is the first pre-Permian cementstone dominated section reported in the outcrop belt of the South Urals.

Cementstone facies are boundstones composed predominantly of coarsely crystalline marine cements, typically radiaxial and recrystallized fibrous botryoidal (Wright, 1992). Cementstones may contain few, if any, skeletal reef-builders. Marine cements in such facies are commonly intermingled with microbial accretionary micrites (automicrites). Transitions to automicritic "microbial boundstones" are common as the proportion of micrite increases. One notable episode of cementstone development occurred in the Paleotethys realm in the Late Mississippian through the Early Pennsylvanian , which is recorded by the late Viséan through Bashkirian bioherms of Bolshoi Karatau (Cook *et al.*, 2002; Zempolich *et al.*, 2002), Bashkirian through lower Moscovian high-rising carbonate platforms of Asturias (Della Porta *et al.*, 2003; Bahamonde *et al.*, 2004, 2008), and their late Visean through Serpukhovian subsurface analogues in the North Caspian Basin (Zempolich *et al.*, 2002; Kenter *et al.*, 2005).

Section characteristics

The outcrop containing the cementstone is restricted to the quarry located in the lowland south of the Iriklinskoe Reservoir (51° 41.415'N, 058° 50.417'E). Within the pit, strata dip at 70-80° W-WSW with some decrease in dipping angle up section. The lower 65-70 m of the section is pale-gray bioclastic packstones, grainstones and rudstones that are notably rich in *Gigantoproductus* (Fig. 2). Two samples from Beds 1 and 2 (IR-1 and IR-8) contain a Bogdanovichian (Venevian) foraminiferal assemblage with *Eostaffella* cf. *tenebrosa* Vissarionova and *Archaediscus gigas* Rauser-Chernousova, whereas samples IR-101 and IR-110 (beds 15 and 16 respectively) are already Serpukhovian in age with *Eostaffellina actuosa subsymmetrica* Reitlinger, *Eostaffella mirifica* Brazhnikova, *Globivalvulina bulloides* (Brady), and *Spiroplectammina* aff. *tocmovensis* Reitlinger (data of E.I. Kulagina). The V/S boundary is tentatively placed at the main fault plane (Fig. 2) and cannot be precisely located without further biostratigraphic study.

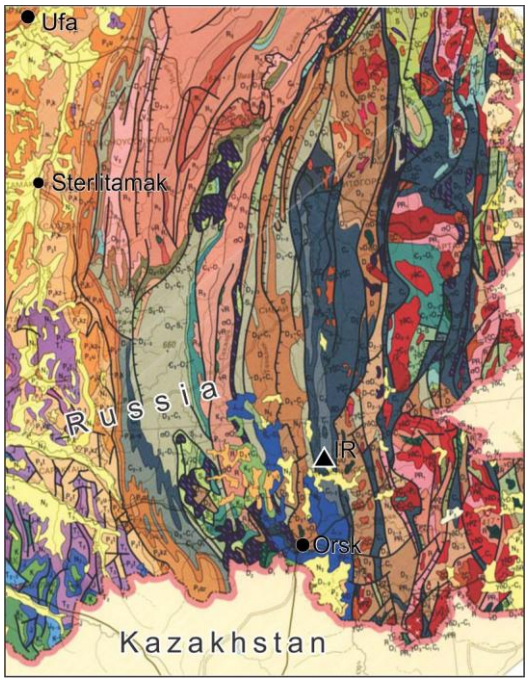

Figure 1: Location of Iriklinskoe Section (triangle) on the Geological map of Russia 1:2500k, (2004 edition).

The commencement of buildup construction is marked by the appearance of fenestellid-supported radiaxial-cementstone lenses above bed 2 (Fig. 2). The boundstone part of the section is at least 290 m thick and is built of radiaxial and botryoid cemenstones with subsequent algal and bryozoan frame builders (Figs. 2, 3, 4, 5A-B). The boundstone

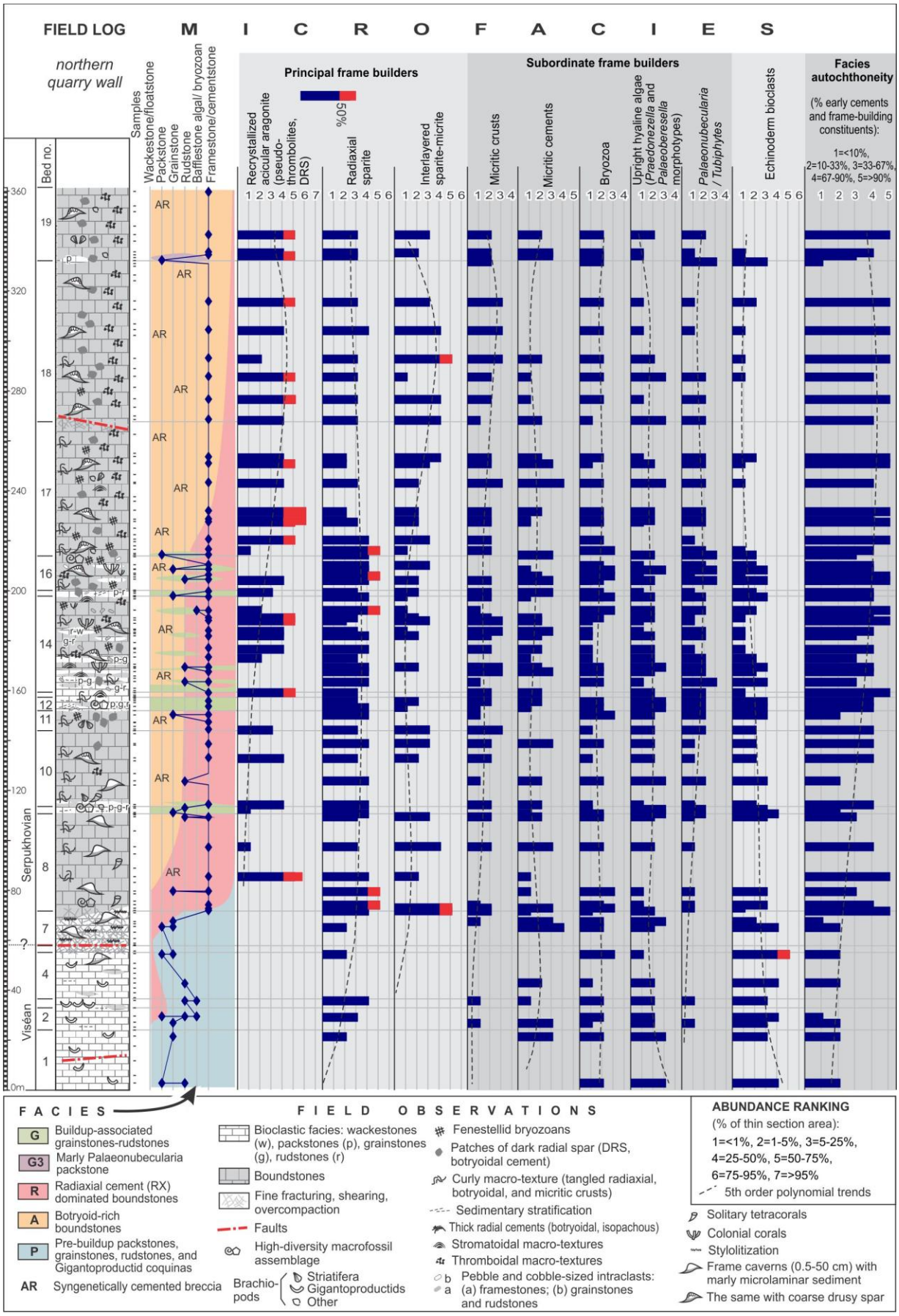

Figure 2: Field and microfacies characterization of Iriklinskoe section.

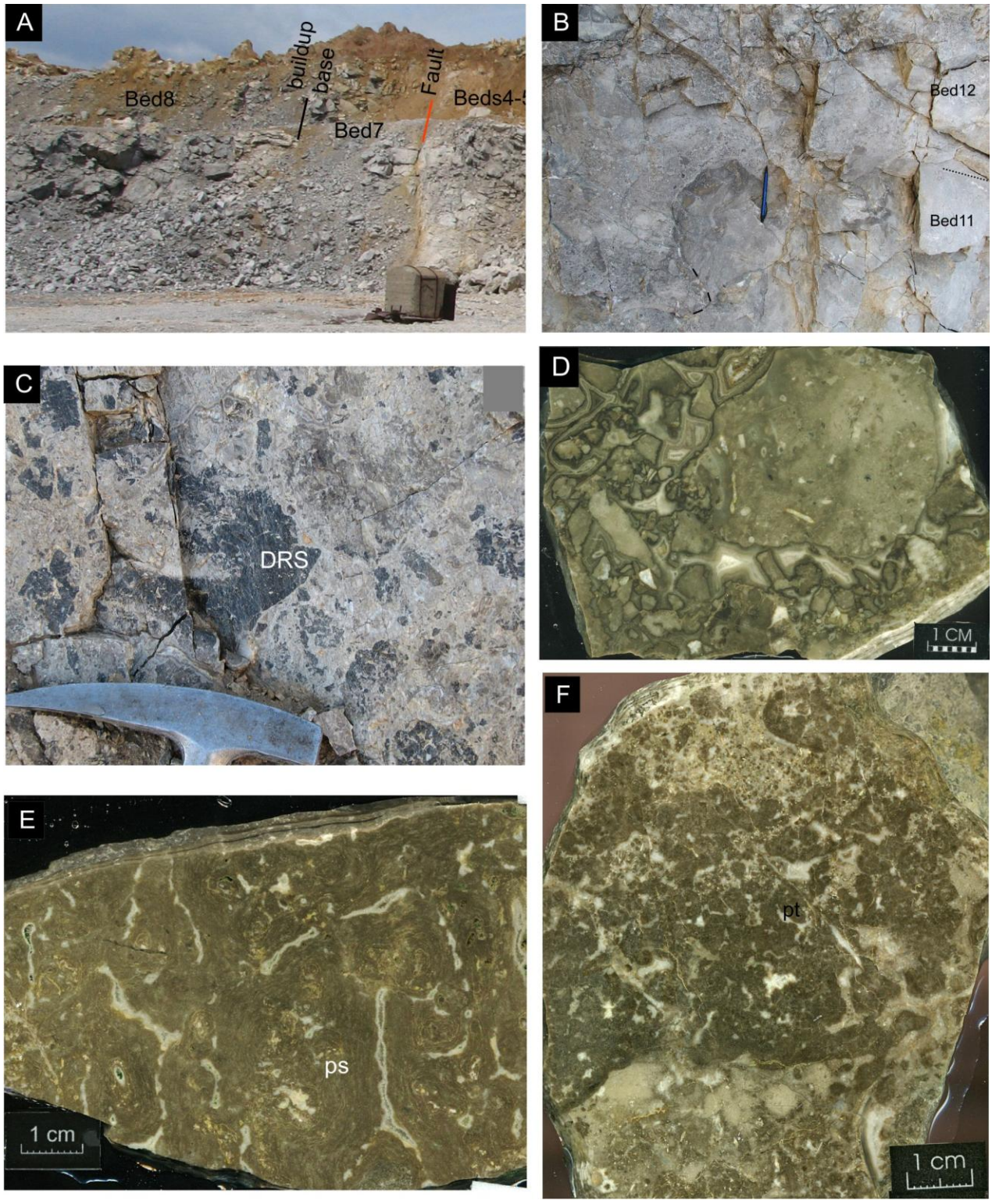

Figure 3: Field and polished slab photos. A) Fault zone and base of massive boundstones; bed numbers correspond to Fig. 2. B) Irregular top of massive framestone of bed 11 with grainstone-filled pocket on lower right (partly traced); 15 cm tall pencil is pointing stratigraphically upward. C) Brecciated "dark radial spar" (DRS) is clearly seen on background of whitish multilayered radiaxial cement; grainstone-framestone transition, boundary of beds 12 and 13. D-F) polished slabs; (pt) pseudothrombolites, (ps) pseudostromatolite, (rx) radiaxial cement veins. D) Synsedimentary breccia cemented by layered, polyphase, radiaxial cement; sample IR34, bed 8. E) - Thick pseudostromatoid with radiaxial spar filled interstices; sample IR 141, bed 18. F) Pseudothrombolite; sample IR 153, base of bed 19.

facies is separated by thin (< 2 m) bioclastic beds. These bioclastic grainstones and rudstones are cemented by radiaxial sparite (Fig. 5 C-D). Bioclastic beds usually rest on uneven surfaces of boundstone with some erosion, fill up pockets in boundstone tops (Fig. 3B) and grade upward into cementstone and framestone. The upper 140 m are composed of tight botryoid-dominated cementstones (Figs. 3E, 3F, 4D, 4E, 5B, 5F) with a few packstone and grainstone lenses. The top of the buildup is not exposed. The section is complicated by one major strike-slip fault (Fig. 3A) and at least two minor faults. Continuity of pre-buildup type facies across the major fault (Fig. 2) suggests that the amount of translation along this fault was not substantial and that sub-fault and above-fault blocks belong at least to the same carbonate platform.

The field observations, main macro- and microfacies features are summarized graphically on Figure 2. Within the boundstone part of the section, the diversity of fossils and sedimentary/early diagenetic features is remarkably high. The main frame-building constituents are summarized below.

Bryozoa: The deposits contain a diverse assemblage of bryozoan species dominated by fenestellids (Fig. 4A). Although they rarely make up more than 5-10% of the area in a thin section (Fig. 2), the fenestellids were crucial for bioconstruction acting as reinforcement bars for thick cementstone outgrowths.

Algae: The algae constitute a high-diversity assemblage dominated by hyaline upright and encrusting forms of variable morphology ranging from *Donezella/Praedonezella*, beresellaceans, *Fasciella,* and calcifolean algae (*Calcifolium/Frustulata*). These algae (many of them are algosponges according to D. Vachard) locally form small-scale areas of geopetal structure (frames) (Fig. 4E). Udotean phylloid algae (Anchicodiaceae) locally contribute to framework (Fig 5E) and occur as fragments in bioclastic facies, thereby indicating a shallow-water, well-lit environment. Thin sections also show rare *Ungdarella, Anthracoporella*, and some other forms of algal (or algosponge) affinity. The notable rarity of dasyclads (only *Anthracoporella*) may indicate a lack of shallowest water settings. Typical *Calcifolium okense* Shvetzov and Birina and *Koninckopora* occur in pre-buildup packstones and grainstones. The algal assemblage within the section deserves special study because it comprises many species represented by numerous individuals.

Palaeonubecularia: The *Palaeonubecularia* are encrusing, thick-walled, ammovertellid (calcitornellid/apterrinellid) foraminifers (Figs. 4C, 5C). Serpukhovian *Palaeonubecularia* from Iriklinskoe seem to be equivalent to the *Tubiphytes* reported elsewhere starting from Serpukhovian (e.g. Zempolich *et al.*, 2002) and may be the ancester/transition to *Tubiphytes* s.s. (Vachard and Krainer, 2001).

Radiaxial spar cement: In the buildup, radiaxial spar cement occurs as (1) thick isopachous to fan-shaped areas of cement in boundstones and bioclastic facies (Figs 14C-E, 15A, 16, 18A,C), (2) an intimate mixture with micrite forming thick "cementstone" masses (Figs 14A,B), and(3) whitish cement veins in breccia, synsedimentary fissures, and frame cavities that impart a curly pattern to the rock (Figs. 3 D-F). In the pre-buildup facies, the radiaxial spar forms cementstone laminae and occurs in fissures that penetrate over 10 m downward from the buildup-forming environment.

Intermingled laminar-radiaxial spar and micrite is an important frame constituent in the basal part of the boundstone facies (Figs. 4A, B) and sporadically occurs above. In the botryoid-rich facies, botryoidal aragonite (now recrystallized to calcite) sometimes forms micrite-enriched stromatoidal masses (Fig. 15B).

Automicrite: In the buildup, dense to micropeloidalmicrite cements (automicrite), geopetal sediments, and crusts occur as subordinate to minor frame constituents (Figs. 2, 4A). Buildup-associated grainstones and rudstones lack micritic cements, whereas pre-buildup packstones and grainstones contain it in significant quantity (Fig 13A-D).

Recrystallized aragonite botryoids:

Type 1 – pseudothrombolites: To the naked eye, *pseudothrombolites* resemble thrombolite (Fig 3F), and the texture consists of botryoids in micritic sheaths (Fig 4D). Pseudothrombolite clots (fans) are the major frame builder in beds 17 through 19 (Fig 2), where they overgrew fenestellid fronds, upright algae, foraminiferal-micropeloidal clots (Fig 5A), or sometimes seem to be self-supporting.

Type 2 – dark radial spar, DRS: The dark radial spar forms large botryoids that are stained black by finely dispersed pyrite and microinclusions of organic matter (Fig. 3C). DRS occurs as cement precipitated in framestone cavities and synsedimentary breccia. DRS tends to pre-date radiaxial cement in cementation sequence. Reworked DRS clasts are common. Botryoids pseudothrombolite and DRS types often grade into each other.

Type 3 – pseudostromatoids (Figs. 3E) occur where botryoid growth was repeatedly disrupted by the formation of micrite crusts.

Paleogeographic significance of Iriklinskoe section

Insight into the depositional setting of the Iriklinskoe boundstone is provided by the examination

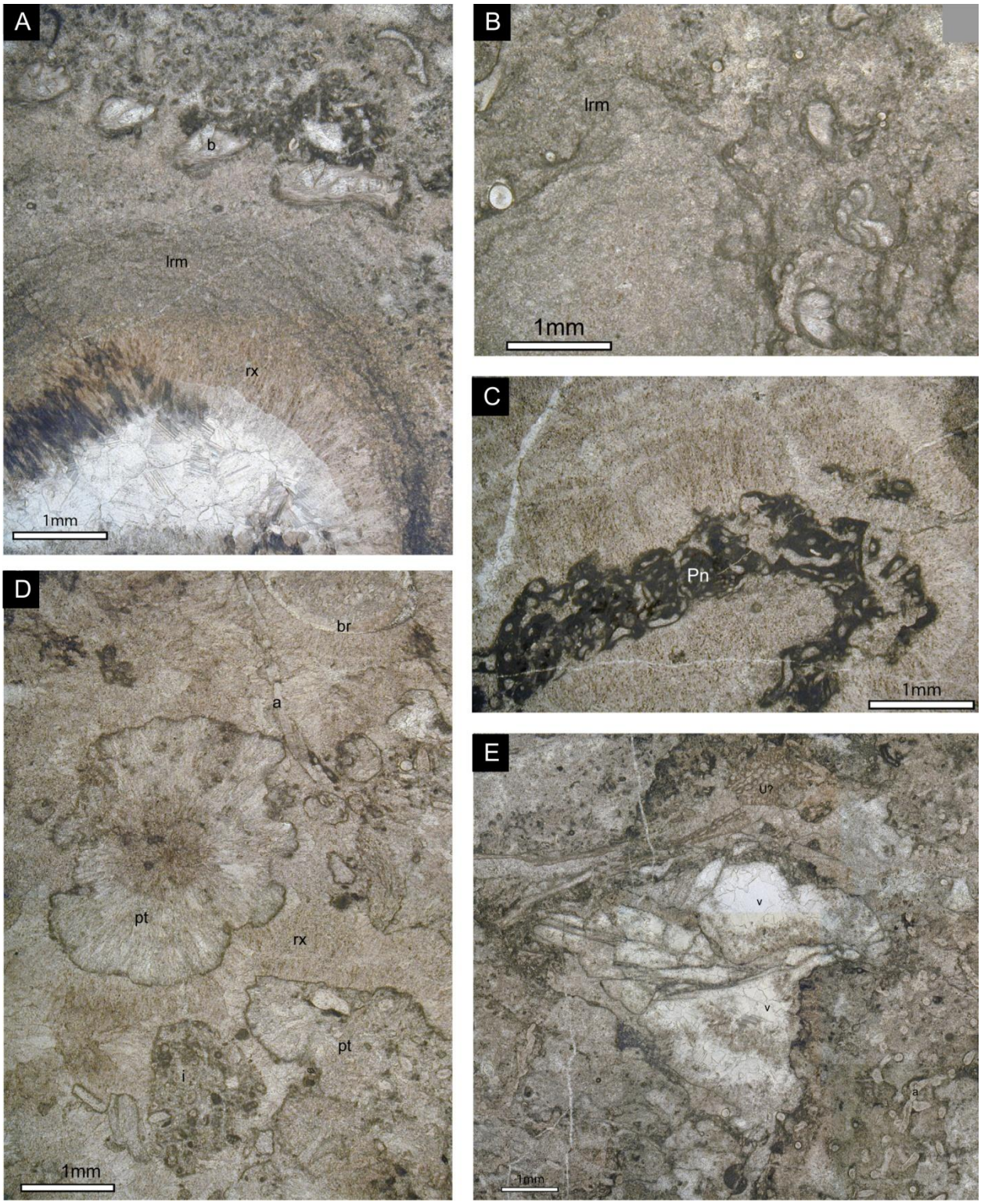

Figure 4: Cemenstones in thin sections. A,B) Radiaxial-spar-dominated bryozoan framestone; irregular to laminar masses of intermingled radiaxial sparite and micrite *(lrm)* is a volumetrically important feature of this facies; fenestellid fronds are labeled by *(b)*; sample IR31, bed 8. C) Radiaxial-spar cementstone with thick *Palaeonubecularia* encruster; sample IR110, Bed 16. D) Pseudothrombolite; framework is formed by mesoclots of recrystallized acicular aragonite (pt) with minor algae (a) and fenestellids; interclot space is occuded by radiaxial spar (rx); note in situ brachiopod (br) and intraclast (i); sample IR88, bed 14. E) A complex algal-DRS framestone; a collapsed DRS botryoid with leached interior suggests early leaching of aragonite botryoids; note *Praedonezella* - *Frustulata* boundstone in lower right (a) and non-identified ramose alga resembling Ungdarellaceae (U?).

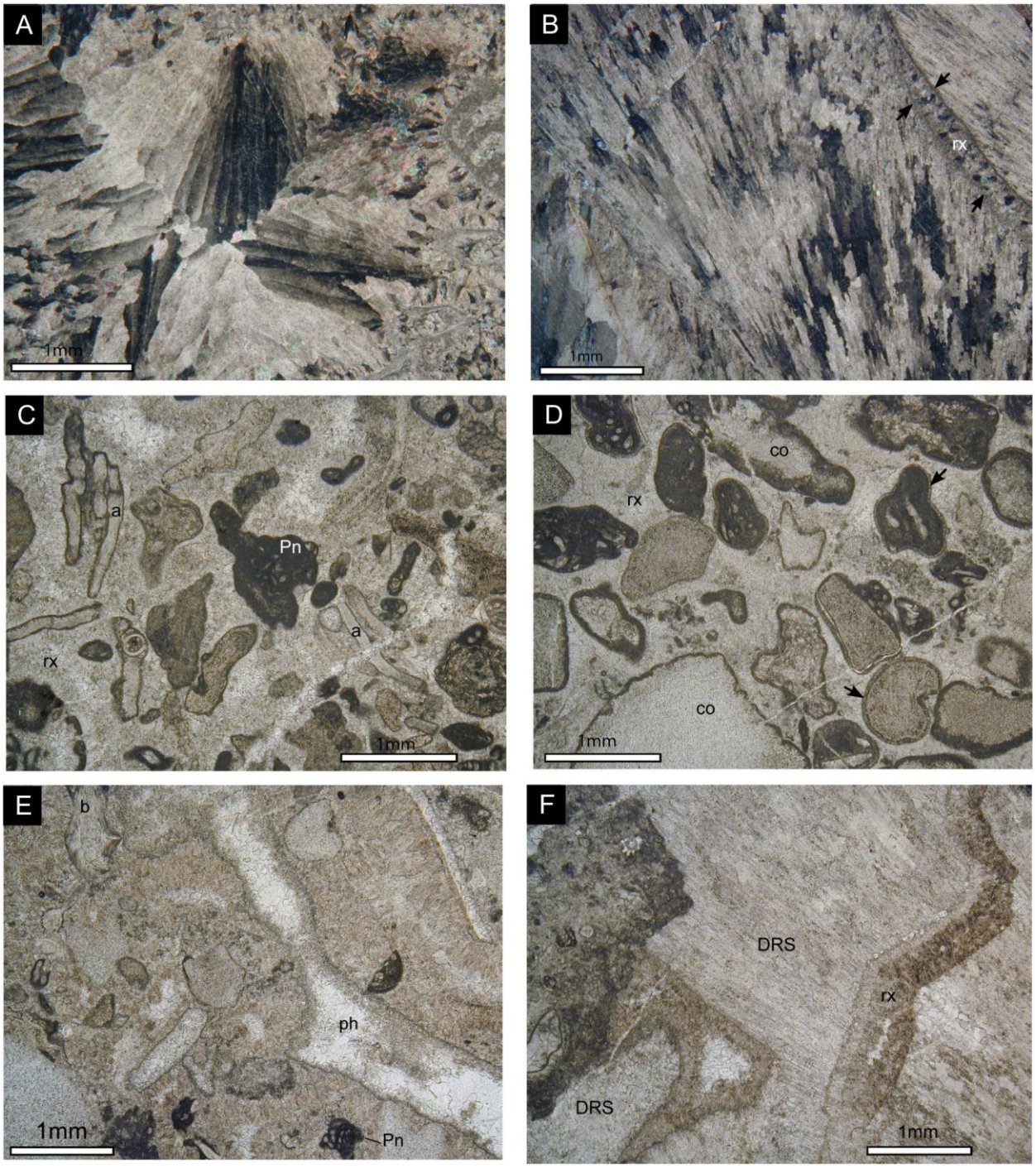

Figure 5: A, B) Radiaxial (A) and botryoidal DRS (B) frame-building cements from Iriklinskoe in crossed-polarized light. C-E) Shallow-water bioclastic facies intercalated in boundstone section: C) rounded grainstone with thin-cortex ooids (arrowed) and cortoids (co) suggesting lowstand/transgressive incursion of topsets, sample IR105, bed 16, D) moderately rounded and micritized grainstone with *Praedonezella* or *Frustulata* algae (a) and *Palaeonubecularia* (Pn), sample IR110, bed 16. E) Radiaxial-spar-dominated framestone with phylloid algae (ph) and fenestellid bryozoans (b) as frame builders; sample IR35, bed 8. F) Termination of a large DRS fan, fractured and recemented by radiaxial spar; sample IR71, top of bed13.

of latest Viséan through lower Pennsylvanian analogues that have been documented from other regions. In those well-studied examples, microbial micrites, botryoidal (primary aragonitic), and radiaxial cements volumetrically prevail in the boundstone, whereas the proportion of skeletal biota, primarily fenestellid bryozoans and upright algae of *Donezella/Praedonezella* and Beresellaceae affinity, is relatively small. Such cementstone-rich boundstones accrete on the slopes of high-rising carbonate platforms in rapidly subsiding settings. These high-rising carbonate slopes, with declivity of up to 35°, were self-nourished (the bulk of carbonate sediment was produced in situe), largely

though microbial biochemical and organo-mineralization processes. Unlike in modern carbonate slope setting, shedding from platform tops did not play a significant role in supplying the slope carbonates. The carbonate production could have extended to water depths of over 300 meters down slope where the the deposystem would not have been substantially influenced by sea level fluctuations or paleowind directions. Carbonate platforms of that type apparently lacked a raised rim at the margin. Breccia is an important constituent of slope boundstones, and its proportion increases downslope (Della Porta, 2003; Bahamonde *et al.*, 2004, 2008; Kenter *et al.*, 2005). Compared to the above examples, the Iriklinskoe boundstone section appears to represent a basin-facing slope of a carbonate platform that had high relief. The slope interpretation is supported by the importance of breccia which occurs throughout the boundstone part of the section in varying quantity but tends to increase upward (Figs. 2, 3D). Bioclastic beds separating boundstone facies may represent lowstand wedges derived from platform topsets. The Iriklinskoe boundstone is different from the best studied example of Sierra del Cuera (Della Porta, 2003; Kenter *et al.*, 2005) by containing a higher proportion of cementstone and fewer microbial micrites.

The discovery of a high-relief carbonate platform adds to the understanding of the complex nature of the paleogeography in the basin that occupied the eastern part of the South Urals region during the Serpukhovian (Puchkov, 2000; Gorozhanina *et al.*, 2009). The interpretation proposed here is more or less consistent with the model of Gorozhanina *et al.* (2009, fig. 4). Their model shows a region that comprises shallow shelves (developed on continental crust and microcontinents) separated by a complex region with troughs and "reefs" (more likely high-rising isolated carbonate platforms). This complex developed as a carbonate veneer above a submerged volcanic arc and rift complex within the Magnitogorsk Synclinorium during the late Viséan and Serpukhovian (Gorozhanina *et al.*, 2009, fig. 4). Syndepositional differential tectonic movements have been evoked to explain facies transitions from shallow platform (e.g. Khudolaz, Kizilskoe) to deep platform-to-basin carbonate sections (e.g. Verkhnyaya Kardailovka; Gorozhanina *et al.*, 2009), but it is unclear how much these differential movements actually contributed to "shelf and trough" seafloor topography. It is likely that the seafloor relief was maintained and even enhanced by growth of carbonate platforms upon antecedent highs of the submerged Magnitogorsk complex while starved-basin conditions developed in adjacent troughs because of the low influx levels of siliciclastics and carbonate material shed from platforms.

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PROGRESS IN CYCLOTHEM/ SEQUENCE STRATIGRAPHY OF TYPE LOWER MOSCOVIAN SUCCESSION OF MOSCOW BASIN, RUSSIA

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Abstract

The Kashirian Substage of the Moscow Basin and the adjacent Oka-Tsna Swell is the least known part of the type succession of the Moscovian Stage. This work summarizes information published in a new publication that was written in Russian (Kabanov and Alekseev, 2011) and provides detailed descriptions of two outcrop sections (Yambirno and Malyi Studenets) and correlates them to two reference wells. The Yambirno section reveals meter-scale (2.5 to 5.5 m) stacking, of unconformity-bound cyclothems (sequences, synthems). Within the section, the Novoselki cyclothem (upper Vereyan) is succeeded by the Yambirno, Innaya Sloboda, Useinovo, Rakovo, Usady, and Aglomazovo cyclothems, all occurring within the Tsna Formation of the lower Kashirian. Both the cyclothems and subaerial unconformities between them have been given toponymic names. The lower five cyclothems of the Yambirno section can be traced to well 19 and in part to well 4k where they belong to the upper Vereyan Ordynka (Novoselki cyclothem) and the lower Kashirian Nara Formation. New data confirm that the Tsna Formation is a lateral correlative of the lower two thirds of the Nara Formation. The Malyi Studenets section exposes three cyclothems and the base of a fourth one. At Malyi Studenets, the lower cyclothem is assigned to the Lopasnya Formation and the second one to the Smedva Formation of the upper Kashirian. The overlying Studenets cyclothem occurs in the allegedly Podolskian part but correlates to the upper part of the Kashirian Smedva Formation. of the southern Moscow Region. The Rostislavl' siliciclastic red bed of the southern Moscow Region probably accumulated during the highstand through regressive depositional stages of the last major T-R cycle of the Lopasnya Formation. The exact number of Lopasnya cyclothems remains unknown. In Malyi Studenets, the Rostislavl' Formation may have its partial correlative in the highstand bed 2 of the upper Lopasnya cyclothem. The number of cyclothems in the Kashirian Substage that have nearly the same rank is more than twice that of the Podolskian through Myachkovian interval. With their high potential for local and regional correlation, cyclothems are better candidates for lithostratigraphic units than officially accepted formations.

Introduction

Despite more than one century of study since the Moscovian Stage was erected, the sequence stratigraphic architecture of the lower Moscovian succession (Vereyan + Kashirian) in the type region remains essentially unknown. This article presents new information about the lower Moscovian cyclothem (T-R sequence) succession that was recently published in Russian by Kabanov and Alekseev (2010). The study is based on two quarry sections, Yambirno and Malyi Studenets, that are correlated to two old reference wells 4k Kiyasovo and 19 Pochinki (Fig. 1). Reconstruction of sea-level curves and identification of unconformities are made with the approach used by Kabanov and Baranova (2007) and Kabanov *et al.* (2010) for the upper Moscovian part of the succession. However, thin sections are not available for the Yambirno section, and only few of them have been made for samples from Malyi Studenets, so interpretations are mostly based on field observations. Bed-by-bed descriptions of the Yambirno (Fig. 2) and Malyi Studenets (Fig. 3) sections are provided by Kabanov and Alekseev (2011) but omitted here. The cored section of the well 4k Kiyasovo (Fig. 4) has been re-interpreted using the description provided by Shik (1975) and Makhlina *et al.* (2001). The core description of the well 19 Pochinki made by Shik in 1979 is published for the first time in Kabanov and Alekseev (2011). Cyclothems and the unconformities dividing them have been given toponymic names derived from local villages that are (or were) situated within 8 km of the type section. Fully preserved paleosol profiles at Moscovian subaerial unconformities (disconformities) exhibit a number of diagnostic macrofeatures like calcretes, root traces (rhizocretions, root moulds), *Microcodium,* vadose solution voids, and the upper clay-dominated layer (topclay). The latter represents former in situ topsoils and pedogenically altered playa sediments (Kabanov *et al.*, 2010). However, most paleosols are more or less truncated with no topclays preserved.

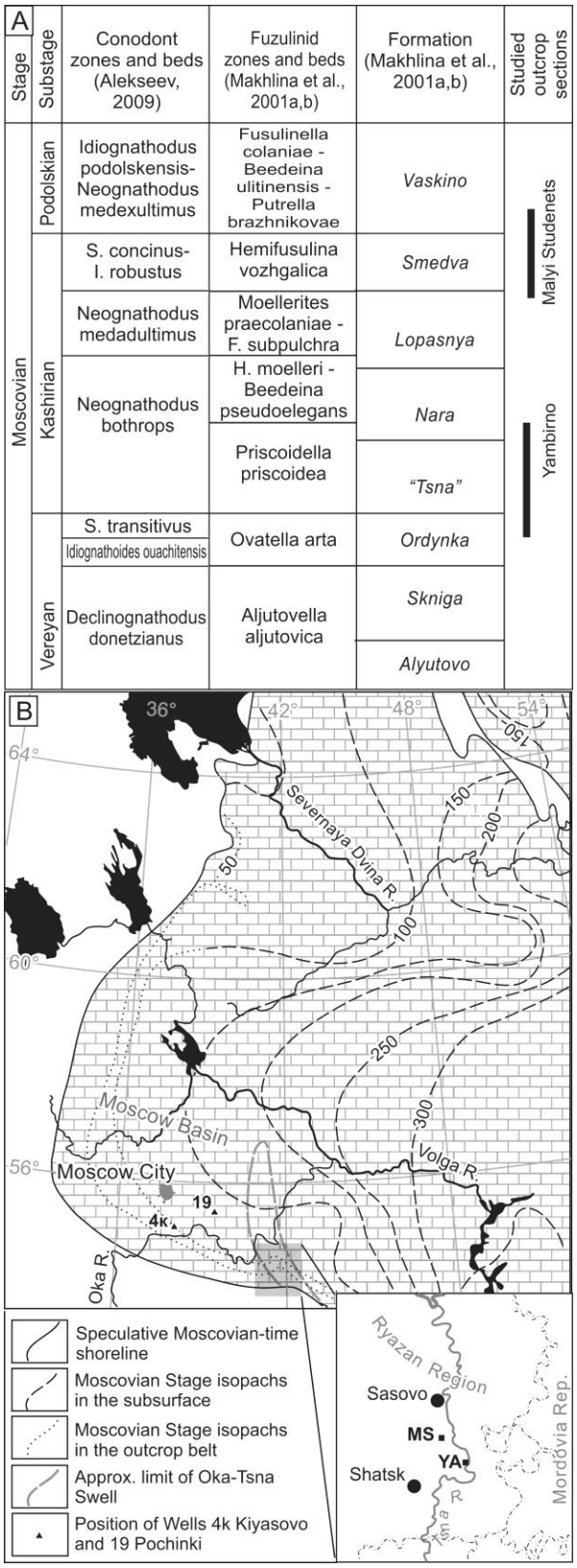

Figure 1: A. Local stratigraphic scheme and stratigraphic range of studied outcrop sections. B. Moscovian stage of central East European Craton (modified from Atlas litologo-paleogeograficheskikh kart SSSR, 1966), locations of wells 4k, 19, and outcrop sections Yambirno (YA) and Malyi Studenets (MS).

Most of the unconformities are composites composed of two or more subaerial surfaces divided by thin, shallow-marine, incursive carbonate beds (Figs. 2, 3).

This study is also intended to resolve the controversy over the basal Kashirian "Tsna Horizon" erected by Solovieva (1986) based on her study of the Yambirno section and its fusulinid assemblages. A new fusulinid zone that contains *Aljutovella priscoidea*, *A. znensis*, and *Hemifusulina volgensis* and was proposed by Solovieva (1986) for her "Tsna Horizon" has not been adopted in the unified stratigraphic scheme although favoured by some authors for the eastern Russian Platform. However, conodont assemblages of the "Tsna Horizon" revealed no significant difference from that of the *Neognathodus bothrops* zone of the Nara Formation, and validity of the new horizon has been questioned (Gereltsetseg, 1996; Makhlina *et al.*, 2001b).

Conodont assemblages of Yambirno

The interest in Vereyan through lower Kashirian conodonts is spurred by the need to find a good taxon and evolutionary lineage for defining the Bashkirian/Moscovian boundary (Groves, 2010). In the Moscow Basin, the boundary may be moved from the base of the Vereyan up to a level close to Vereyan/Kashirian boundary as was earlier supposed by Barskov *et al.* (1980). The distribution of conodonts in the Yambirno section has been published earlier (Makhlina *et al.*, 2001b). Reexamination of L. Gereltsetseg's conodont samples from Yambirno reveals the presence of *Streptognathodus izvaricus* Nemyrovska (Fohrer *et al.*, 2007) and rare *Idiognathoides*. Previously, the latter genus was unknown from above the top of the Vereyan in the Moscow Basin but was known to range into the Kashirian in the Donets and Volga-Uralian basins (Fig. 2; Kabanov and Alekseev, 2011). *Streptognathodus izvaricus* Nemyrovska occurs in the Donets Basin in limestones L_5 through L_7 that were correlated to the upper Tsna Formation and lower Nara Formation (Makhlina *et al.*, 2001a, p. 221). Conodonts are also useful for interpreting the depositional environments of the facies discussed below.

Cyclothem succession of Yambirno

Vereyan Substage

The *Novoselki cyclothem* corresponds to the Upper Ordynka Member of Makhlina *et al.* (2001a) and includes beds 1 through 9 (Fig. 2; bed numbering of Alekseev, 1993). The base of the Novoselki records transgressive onlap, as suggested by the 15 cm thick dark-pebble conglomerate reported in the vicinity of the town of Yambirno (Ivanova and Khvo-

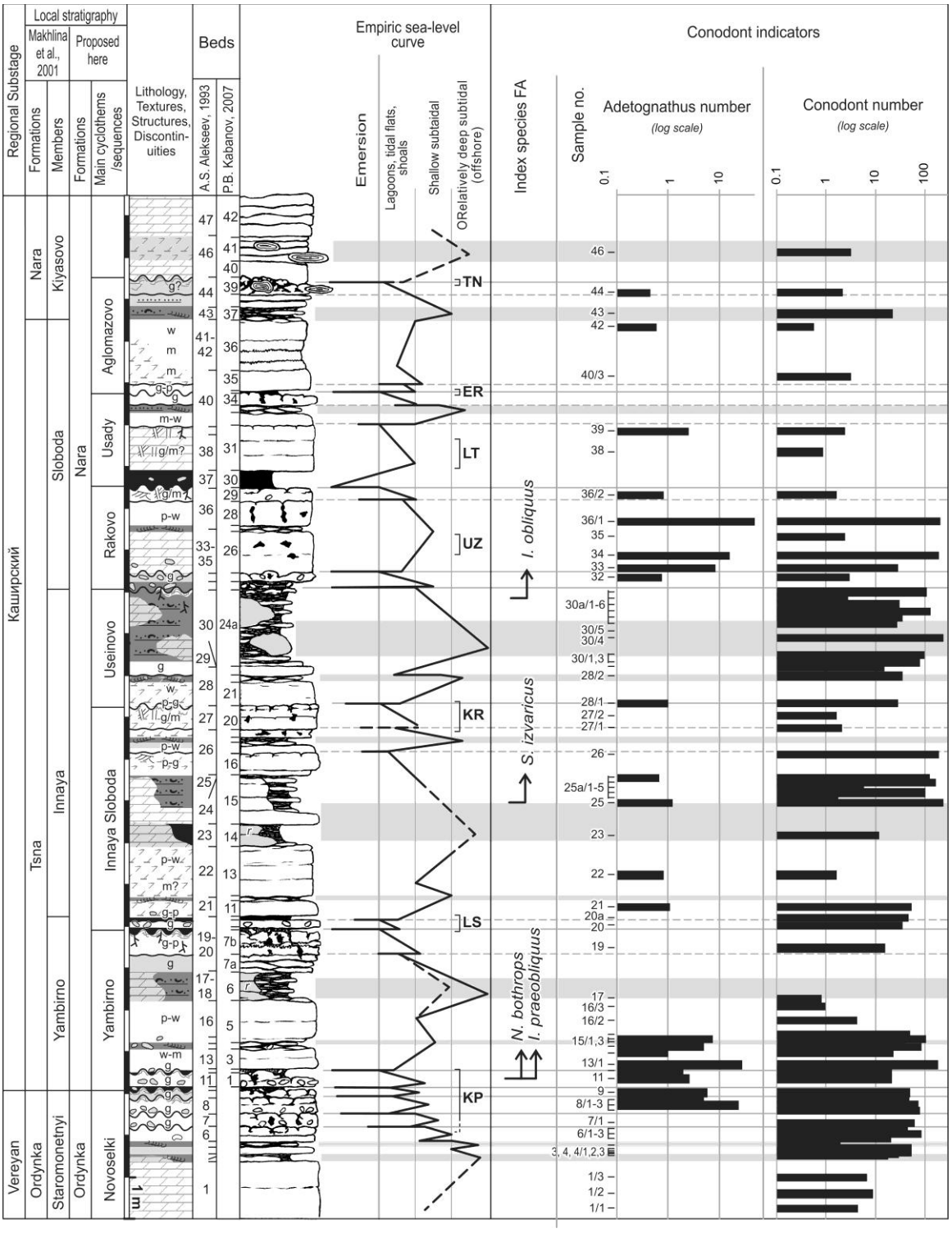

Figure 2: Yambirno Section and conodont facies indicators (conodont number and *Adetognathus* number). The latter stands for quantity of *Adetognathus lautus* elements per kg of rock. Abreviations for unconformity names to the left of Empiric sea-level curve: KP - Kuplino, LS – Lesnaya Sloboda, KR – Kormilitsa, UZ – Uzhovo, LT – Lotkazino, ER – Erneevo, TN – Tensyupino. For legend see Fig. 3.

rova 1955; their bed 6). The unconformity that should underlie this conglomerate is herein named the Kuchasievo unconformity. Marls and argillaceous limestones of beds 2–5 with their characteristic *Zoophycos* trace fossils and abundant conodonts (up to 56 elements/kg) but without shallow-water *Adetognathus* elements are thought to represent the highstand interval or "cyclothem core". The shallow-water regressive grainstones of beds 8 and 9 contain *Adetognathus* and at least four

erosional surfaces. The upper three erosion surfaces are marked by calcretization and blackened pebbles implying significant subaerial hiatuses of the composite Kuplino unconformity. The total thickness of the Novoselki cyclothem in the vicinity of the present-day Yambirno Quarry is estimated as 3.5 m.

Kashirian Substage

The *Yambrino cyclothem* (beds 1-8 on Fig. 2; bed numbers used here and below refer to Kabanov's beds) mostly corresponds to the lower member of the Tsna Formation and Yambirno cyclite of Makhlina *et al.* (2001a). Bed 6 (shale with limestone intercalations partly replaced by red mottled dolomarl) is thought to represent the highstand interval, although the paucity of conodonts in this bed hampers such an interpretation. Taking into account the species richness of the conodonts and lack of *Adetognatus* in sample 19, the "cyclothem core" may include the lower part of bed 7 (Fig. 2). The cyclothem top is marked by calcrete development in beds 7b and 8. At least two closely spaced subaerial surfaces in beds 7b through 10 constitute the Lesnaya Sloboda composite unconformity.

The *Innaya Sloboda cyclothem* (beds 9–20 on Fig. 2) is a 5.3 m thick composite unit consisting of at least three smaller scale cyclothems or parasequences marked by marly dolomitized highstand beds 12, 14–15, and 18. The middle parasequence with the thickest highstand interval records the most extensive transgression. The base of bed 15 may represent a minor shoaling event but insufficient data prevent proper interpretation. Above the basal massive dolostone, bed 15 in non-dolomitized areas contains tempestite shale-dominated facies with abundant and diverse conodonts. Presence of rare *Adetognathus* may indicate either erosion of shallow-water beds or shedding of some shallow-water material from coeval shallow-water settings. The upper parasequence of Innaya Sloboda cyclothem (beds 17–20) is distinct because of the highstand *Zoophycos* textured marl of bed 18. The ravinement at its base is marked by lenses of brown mudstone that are probably calcretized. The truncated paleosol in the top of Bed 20 defines the Kormilitsa unconformity. Another subaerial surface may be present at the top of bed 19, which is obscured by dolomitization.

The *Useinovo cyclothem* (beds 21–24a on Fig. 2) is a 2.8 m thick composite unit containing two parasequences separated by a ravinement surface and shallow-water grainstone of bed 23. Highstand facies are present in bed 22 and the lower part of bed 24a, where conodont abundance attains 304 elements/kg. Unlike the vast majority of other early and late Moscovian cyclothems where terrigenous content declines in regressive phases, the late regressive part of the Useinovo cyclothem is shaly. Limestone pebbles in beds 24b and 25 suggest that there might have been a late regressive limestone that was thin enough to be entirely eroded off by successive transgression. The subaerial surfaces in tops of beds 30 and 32 represent a Uzhovo composite unconformity.

The *Rakovo cyclothem* (beds 24b–29 on Fig. 2) is a relatively simple, shallow-water cyclothem in which the unconformity-bound incursive beds 24b–25 are tentatively included in the lower part and bed 29 included in the upper part. The highstand facies is thin (0.15 m) and is interpreted to be present because of the increased marliness and *Zoophycos* traces. However, the occurrence of numerous *Adetognathus* elements in sample 36/1 close to the highstand level (Fig. 3) suggest only moderate deepening and proximity to shallow-water environments with deviated salinity. The Lotkazino composite unconformity at the top of the cyclothem is represented by at least two subaerial surfaces at the tops of beds 28 and 29. The upper paleosol seems to be the most complete subaerial profile in the section with preserved montmorillonite topclay of bed 30. The latter needs to be checked for volcanic material content.

The *Usady cyclothem* (beds 30–34 on Fig. 2) features one thin highstand interval (bed 33) and at least two ravinement surfaces that divide the cyclothem into three parasequences. The highstand interval of this cyclothem is distinctly shifted toward the top (Fig. 2), whereas most Moscovian cyclothems in studied outcrops are either symmetric or have thicker regressive parts. The regressive calcretized grainstone of bed 34 truncates the highstand marly interval of bed 33. The presence of the Erneevo unconformity at the top of the Usady Cyclothem is indicated by the presence of rhizocretions, brownish vadose cement, solution voids, and lenses of paleosol topclay (bed 34b).

The *Aglomazovo cyclothem* (beds 35–39 on Fig. 2) is a 2.8 m thick T-R unit with thicker (1.8–2.0 m) lower limestone part and thin highstand interval (bed 37). The Aglomazovo cyclothem crosscuts the conventional boundary of the Tsna and Nara formations. Bed 36 seems to be entirely shallow-water judging from a lack of conodonts other than *Adetognathus*, but the presence of an erosional surface at its top and interpreted as a formation boundary by Makhlina *et al.* (2001a) was not confirmed during the present study. The cyclothem is capped by the Ten'syupino unconformity, identified by relatively strong calcretization, brecciation, chertification, and argillation in bed 39. The argillation records patchy clay replacement of carbonate substrate characteristic of paleosols (Kab-

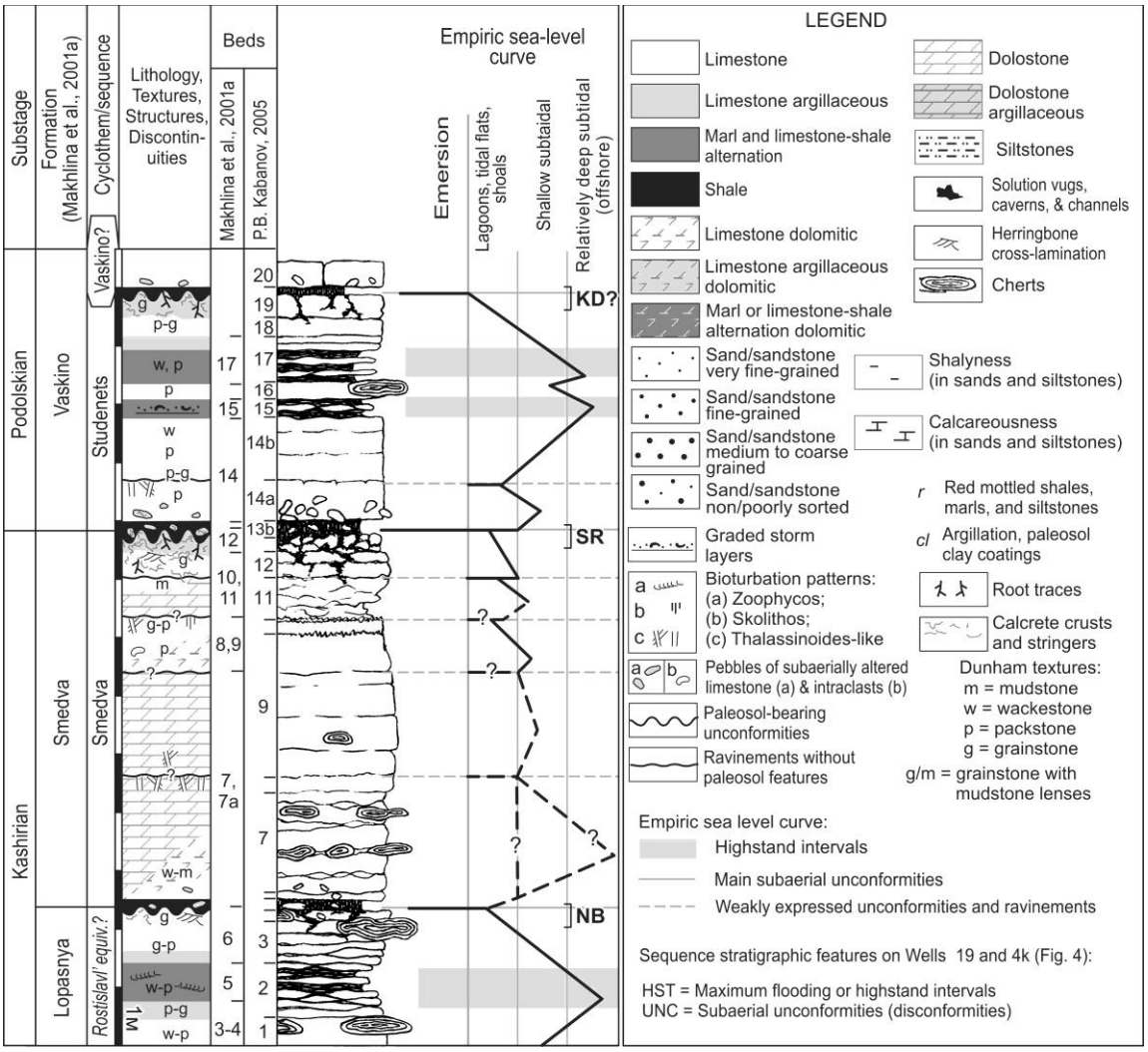

Figure 3: Malyi Studenets Section. Abreviations for unconformity names: KD? – supposedly Kudrino, CR – Serovskoe, and NB– Novoe Berezovo.

anov *et al.*, 2010). The apparent maturity of the Ten'syupino paleosol roughly equals that of the Lesnaya Sloboda subaerial profile. These two paleosols may correspond to the longest hiatuses in the Innaya Sloboda – Aglomazovo part of the section.

The overlying part of the section is mostly replaced by dolomite. Available observations are insufficient to interpret its cyclicity.

Cyclothems exposed in Malyi Studenets

Three unconformities revealed in the Malyi Studenets section define the boundaries of three main cyclothems and the base of a fourth unit that is supposedly of the same rank as the underlying cyclothems (Fig. 3). The lowermost cyclothem belongs to the Lopasnya Formation and its base is not exposed. The Novoe Berezovo unconformity at its top is a well-preserved, practically complete (non-truncated) paleosol profile (beds 3–5 on Fig. 3; numbers used here and below refer to P. Kabanov's bed numbers unless otherwise indicated).

The *Smedva cyclothem* is a composite unit that spans beds 6–13b and consists of at least 5 parasequences and is equivalent to the Smedva Formation as defined in the Malyi Studenets section by Makhlina *et al.* (2001a). Primary facies of the Smedva cyclothem are largely obscured by dolomitization. Bed 7, which supposedly contains the maximum flooding interval, differs from the highstand beds of other Moscovian cyclothems by its low terrigenous content, dominance of mudstone texture, and considerable chertification. At first glance, bed 7 has more similarity to the upper Moscovian "lagoonal mudstones" (Kabanov, 2003; Kabanov *et al.*, 2006). However, thin sections show abundant hyalosponge spicules, which are not characteristic of either lagoonal mudstones or highstand beds at other stratigraphic levels in this succession. It has to be admitted, that the correct facies interpretation and evaluation of the extent of Smedva transgression is pending until further investigations can be completed. The Smedva cyclothem is capped by the Serovskoe unconformity.

The *Studenets cyclothem* (beds 14a–19 on Fig. 3) deserves special consideration because of its position at the Kashirian-Podolskian boundary. This is a relatively simple cyclothem with an argillaceous-carbonate highstand interval (beds 15–17) split by a "middle limestone" of bed 16 that may represent moderate shoaling. The unconformity at the cyclothem top supposedly correlates to the Kudrino unconformity of the southern Moscow Region (Kabanov, 2003; Kabanov and Baranova, 2007).

The Studenets cyclothem seems to correlate to beds 24–26 of the composite section in the southernmost part of the Moscow Basin as measured by Ivanova and Khvorova (1955). By convention, these strata have been included in the Smedva Formation (Makhlina *et al.*, 2001a). Underlying bed 23 of Ivanova and Khvorova (1955) reveals subaerial karst features described by them as "Dolostone secondary, very porous from dissolved gastropod and bivalve detritus, with small upturned *Chaetetes* colonies... thin seams of tight aphanic dolostone usually pierced by numerous upright burrows which are so densely spaced that they locally convert the rock into breccia" (Ivanova and Khvorova, 1955, p. 57). Like elsewhere in the studied succession, "upright burrows" in that description might have included true root traces. In overlying bed 24, Ivanova and Khvorova referred to "thin (< 1 mm) branching tubules" that are most likely root traces. Their bed 24 may correlate to shallow-water bed 14a in the Malyi Studenets section (Fig. 3). An unconformity is interpreted to occur at the top of bed 26 of Ivanova and Khvorova because of the presence of "stromatolite", i.e. undoubtedly laminar calcrete (Kabanov *et al.*, 2010), and the onlapping transgressive conglomerate. In the Malyi Studenets section, this paleosol could be more complete than in the type sections of the southernmost part of the Moscow Region.

Matching the Studenets cyclothem to the one in the Vaskino quarry is unlikely because there are too many differences in the composition of their regressive parts. Beds 17–19 of the Malyi Studenets section are only 1.1 m thick and mostly composed of coarser bioclastic limestones (Fig. 3). The regressive limestones of the Vaskino cyclothem, currently exposed in the Vaskino and Akatievo quarries of the southern Moscow Region, are 4–6 m thick bioclastic wackestones with minor mudstones and packstones. Significant decrease in thickness from the southern part of the Moscow Region to the Oka-Tsna Swell would be inconsistent with the general tendency of moderate thickening and insertion of new cyclothems northward and eastward of southernmost Moscow Region (Makhlina *et al.*, 2001a; Kabanov and Baranova, 2007). In the reference well sections (Fig. 4), the top of the Studenets cyclothem correlates to the unconformities at the tops of bed 2 of well 4k and bed 43 of well 19. The unconformity at the base of Studenets cyclothem cannot be recognized in the old well descriptions for one or more reasons including: insufficient core coverage (soft paleosols tend to crumble while drilling), obliteration of primary facies by dolomitization, and omitted details in core descriptions. However, all of the above considerations need verification with more properly described sections available from the southern part of the southern Moscow Region.

Correlation of cyclothems of Yambirno Section

In the southern part of the Moscow Region, the Novoselki cyclothem correlates to either the upper part or entire bed 72 of the well 19 and to the beds 42 and 43 of the well 4k (Fig. 4). The unconformity at the base of the Novoselki cannot be recognized from available core descriptions. The analogues of the Yambirno, Innaya Sloboda, and Useinovo cyclothems and part of the Rakovo cyclothem of Solovieva's "Tsna Horizon" are recognized in the sections of the southern Moscow Region with anticipated net moderate decrease in thicknesses westward from the Oka-Tsna Swell (Fig. 4). The Yambirno Cyclothem in the well 19 is slightly thicker than its stratotype, which can be explained by its higher terrigenous composition. Terrigenous wedges develop on many stratigraphic levels towards the southwesterly situated Moscovian-shoreline. The Rakovo, Usady, and Aglomazovo cyclothems cannot be recognized in well 19 as descriptions of beds 62 and 61 do not provide sufficient details. The predominantly pure carbonate of the Rakovo cyclothem may be correlated to bed 32 of well 4k (Fig. 4).

Lopasnya and Rostislavl' formations

The Lopasnya Formation. consists of at least three main cyclothems. The unconformities separating the cyclothems can be recognized from the description of beds 14–15 and 18а–в by Ivanova and Khvorova (1955, p. 55), which record the presence of "stromatolites" (i.e. actually they are laminar calcretes) and "small-pebble conglomerates". The upper of these unconformities probably corresponds to the unconformity at the depth 145.5 m in well 19 (Fig. 4). The Lopasnya Formation contains two thick units that comprise limestone alternating with shale and contain tempestite features suggesting at least two significant, relatively long-lasting highstands. The lower of these highstand units is bed 13 of Ivanova and Khvorova, and the upper one is their beds 19-20 (1955, p. 53–56). Thickness of the upper highstand unit may exceed 3.0 m.

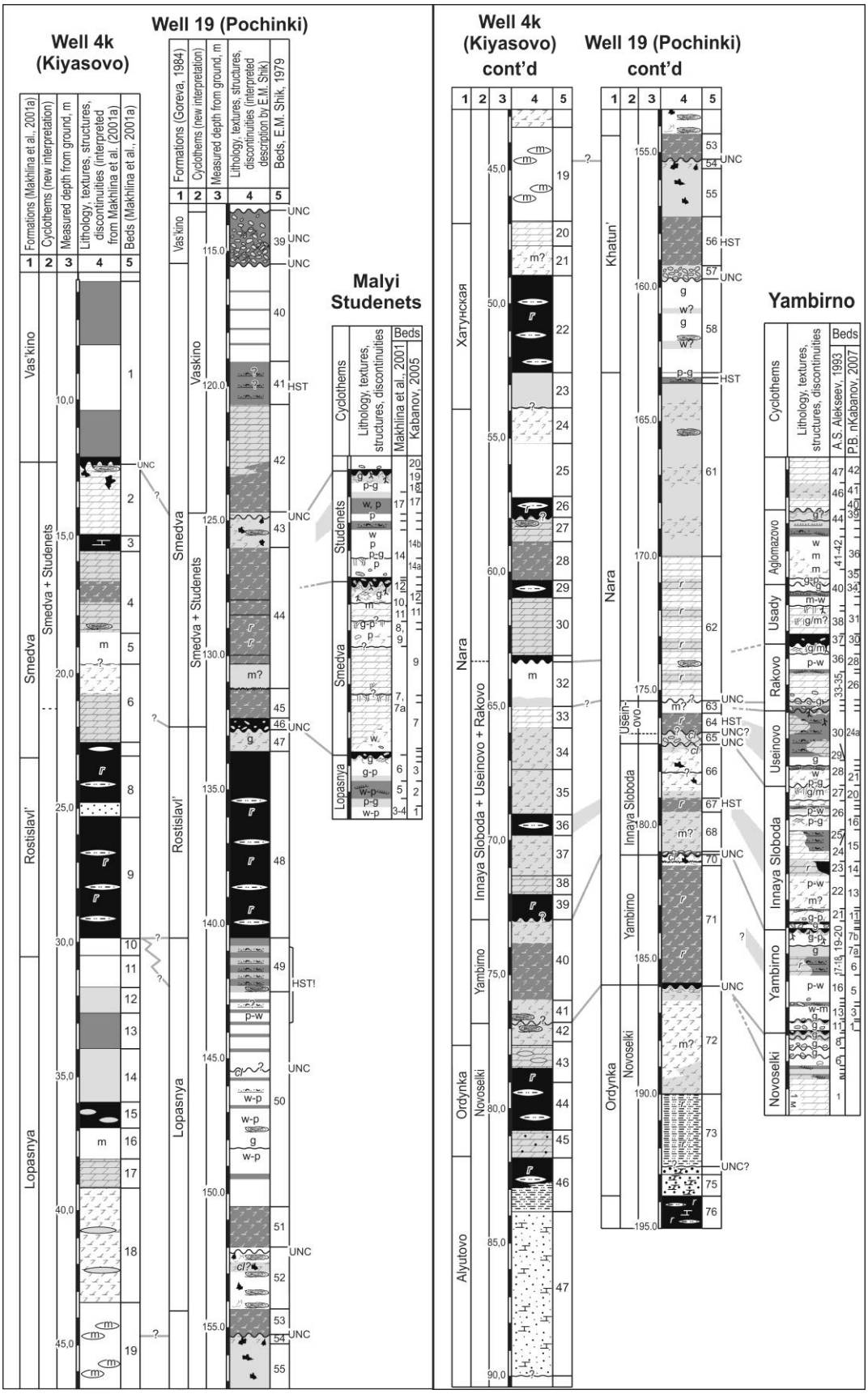

Figure 4: Lithologs of wells 4k and 19 and their correlation to the Yambirno and Malyi Studenets outcrop sections. For legend see Fig. 3.

In well 19, the lower highstand unit supposedly corresponds to the bed 51 where primary tempestite features were obliterated by dolomite replacement (Fig. 4). The upper highstand unit is interpreted with confidence in bed 49 (Fig. 4). It is possible that the upper part of bed 50 can also be included into that highstand interval, which by its inclusion attains a total thickness exceeding 3 m. The Rostislavl' red siliciclastic unit occurs on the upper highstand unit either conformably or with some erosion but apparently without subaerial exposure features. In the Malyi Studenets section, the shallow-water grainstones of beds 3 and 4 in the top of the Lopasnya Formation (Fig. 3) accumulated after the influx of siliciclastic fines ended. Those grainstones correlate to bed 47 of well 19, and the unconformity above bed 47 should thus correspond to the Novoe Berezovo unconformity of Malyi Studenets.

The Rostislavl' beds, whether included in the Lopasnya Formation as a member (Makhlina *et al.*, 2001a) or given formation status (Shik, 1979), is a deltaic complex that prograded from the southerly located Voronezh paleo-land and thined to the north and east of the southernmost Moscow Basin (Khvorova, 1953; Ivanova and Khvorova, 1955). The Rostislavl' unit may partly or completely correspond to the carbonate-argillaceous bed 2 of Malyi Studetets (Figs. 3, 4). It appears that the Rostislavl' siliciclastic wedge developed during early and middle regressive phases of the late Lopasnya T-R cycle. Taking into account net base level fall, one can expect erosion of up to several meters into the underlying sediment. This erosion must have been most severe in more proximal, southerly located zones located mainly behind the present-day erosional edge of the Moscovian succession (Fig. 1b). It seems reasonable to return the Rostislavl' unit back to formation status (Shik, 1979).

Time represented by the Kashirian Substage

The number of main cyclothems/sequences in different substages of the type Moscovian succession varies significantly. The Myachkovian Substage comprises 2.5 cyclothems and the Podolskian 4.5 (Kabanov, 2003; Kabanov and Baranova, 2007). Only one "Tsna Horizon" of the Kashirian Substage at Yambirno reveals 6 main cyclothems that are likely to be of the same order as the seven main upper Moscovian cyclothems. The most natural explanation of smaller average thicknesses of lower Kashirian cyclothems (3–4 m) is less accommodation space (lower subsidence rate) during Kashirian time. The Smedva Formation in the southern Moscow Region appears to consist of two main cyclothems (Smedva and Studenets), and the Lopasnya Formation hosts at least three cyclothems. Out of 61 m of the total thickness of the Kashirian Substage in well 19, the Yambirno-Aglomazovo and Lopasnya-Studenets intervals together include at least 11 cyclothems and comprise 46 m or 75% of the substage thickness. It appears that the Kashirian Substage of the type succession represents at least twice as much time as the Podolskian through Myachkovian time span.

The most recent time calibrations based on ID-TIMS U-PB dates from the Donets Basin provide 306.65 Ma for the top of the Moscovian Stage and 314.6 Ma for its base (Davydov *et al.*, 2010; Eros *et al.*, 2011). With a duration of 7.95 Ma for the Moscovian, the duration of the main T-R cycles within it will be close to 400 Ka, as shown for the Midcontinent succession in the U.S.A. (Heckel, 2003), only if the number of main cyclothems does not exceed 20. However, our updated knowledge suggests that the number of cyclothems in the Moscovian of the southern Moscow Basin (including the Oka-Tsna Swell) is unlikely to be less than 23. Also, a long duration for the Kashirian that was over half the length of the entire Moscovian Epoch is inconsistent with recent high-precision time calibrations of Davydov *et al.* (2010). In their calibration, the Kashirian is equivalent to limestones K9 through L8 in the Donets Basin, which represent only 1.6 Ma and that equals the duration of the Vereyan but is shorter than the Podolskian (2.4 My). In the southern part of the Moscow Basin, the Vereyan Substage is a predominantly siliciclastic and relatively thin (12-20 m) unit that would hardly comprise more than 3-4 cyclothems. However, this latter number is largely (but not entirely) speculative as no new data on the type Vereyan succession are available.

The information summarized herein is just a progress report and substantial additional work is required before a well-founded chart of the type Lower Moscovian cyclothem succession can be developed. This report highlights problems, inconsistencies in previous schemes, and gaps in data. The local correlation models shown here contain a large degree of incompleteness and speculation. Yet it is believed to be an important step forward.

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THE VISÉAN-SERPUKHOVIAN BOUNDARY ON THE EASTERN SLOPE OF THE SOUTH URALS

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Introduction

On the eastern slope of the South Urals, the upper Viséan and Serpukhovian beds are composed of various carbonate shelf facies, dominated by the shallow-water coral-brachiopod limestone (Kizil Formation) and relatively areally restricted cephalopod-deep-water carbonates (formation not formally named) (Stepanova and Kucheva, 2009a). The exposures of the Kizil Formation are traced in the meridional direction from the latitude of Magnitogorsk southwards to Iriklinskoye Lake (Fig. 1). The Kizil Formation is subdivided into regional substages ("horizons") of the unified scheme of the East Uralian Subregion, recognized in the coral-brachiopod facies (Stratigraficheskie, 1993).

Geological background

Sections along the Ural River and its left (western) tributaries, the Bolshoi Kizil River (stratotype of the Kizil formation) and the Khudolaz River (stratotype of the regional Serpukhovian substages for the East- Uralian Subregion) are the most important exposures of the Kizil Formation. The Kizil Formation contains taxonomically diverse and rich (many specimens) assemblages of various groups of fossil organisms (algae, foraminifers, brachiopods, and corals) (Ivanova *et al.*, 1972; Kulagina *et al.*, 2002, 2009; Stepanova and Kucheva, 2006, 2009b). Ostracodes, bryozoans, and conodonts (in the upper part) are less commonly found. The formation ranges from the Zhukovian (upper Viséan) to the Tashastinian (Bashkirian) inclusive. The formation is characteristically thick and contains numerous and widespread carbonate mounds. The total thickness of the upper Viséan in this formation is up to 1000 m, whereas that of the Serpukhovian ranges from 260 to 550 m. In the Bolshoi Kizil section, parts of the formation are covered but it is extensively exposed, whereas in the Khudolaz section, it is exposed from the upper part of the Kamenskouralskian Substage. The Bolshoi Kizil section begins on the right (west) bank of the Ural River, with the exposures of the lower horizons of the Kizil FormationThe lower outcrops are exposed near the underlying rhyolites of the Berezovskaya Formation (Salikhov, 2009). The latter are found in the outcrops along the left (east) bank of the Ural River and in loose debris on the right (west) bank of the Ural River. The Bolshoi Kizil section continues on the left bank of the Bolshoi Kizil River, upstream of its confluence with the Ural River (see Fig. 1). The Kizil Formation is unconformably overlain by conglomerates of the Moscovian Urtazym Formation. The deep-water cephalopod facies are so far known only on the right bank of the Ural River opposite the village of Verkhnyaya Kardailovka where they are mainly represented by wackestone and mudstone with radiolarians, deep-water ostracodes of Thüringian ecotype, ammonoids, and conodonts (Nikolaeva *et al.*, 2009), approximately 60 m thick. The differentiation of carbonate facies is related to tectonic processes, development of spreading zones and volcanism that began in the late Tournaisian and continued up to the beginning of the late Viséan inclusively (Salikhov, 2009).

The Viséan-Serpukhovian boundary deposits exposed along the Bolshoi Kizil and Khudolaz rivers are very similar in composition and fossils. The Viséan-Serpukhovian boundary is placed herein between the Bogdanovichian and Sunturian (substages accepted for the East Uralian Subregion) (Fig. 2)

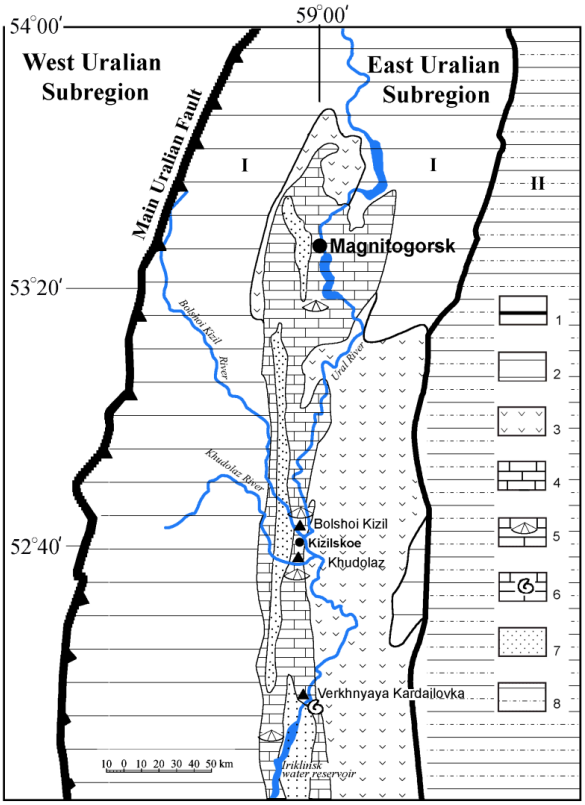

Figure 1: Early Carboniferous formations and facies in the East Uralian Subregion of the South Urals. I: Magnitogorsk Megazone: II: East Uralian Megazone; 1: borders of tectonic megazones; 2: pre-Carboniferous deposits; 3: area of volcanic rocks of the Upper Tournaisian: Zhukovian Substage of the lowermost upper Viséan with interrupted exposures of Viséan-Serpukhovian carbonates; 4-6: Viséan-Serpukhovian and Bashkirian carbonates: 5: shallow-water facies, 6: deep-water facies; 7: Moscovian siliciclastics and carbonates; 8: area of mainly Tournaisian-Lower Viséan carbonates and siliciclastics.

Description of the boundary beds

Khudolaz Section

In the Khudolaz River section, the Bogdanovichian comprises beds 13–30, composed of coral-brachiopod and crinoid-brachiopod limestones with beds of fine-grained and micritic limestones (Stepanova and Kucheva, 2006, 2009b).

Beds 13-20 are observed in the high rocky exposures on the left (west) bank of the Khudolaz River (Fig. 3). Bed 17 comprises brachiopod-crinoidal grainstone and packstone with foraminifers similar to those of the underlying beds. Brachiopods are represented by thin layered accumulations of *Spirifer trigonalis uralicus* Donakova, and *Striatifera striata* (Fischer). The thickness is 15.5 m.

Bed 18 consists of peloid packstone with fragments of cyanobacteria and Palaeoberesellacea. The bed contains numerous foraminifers

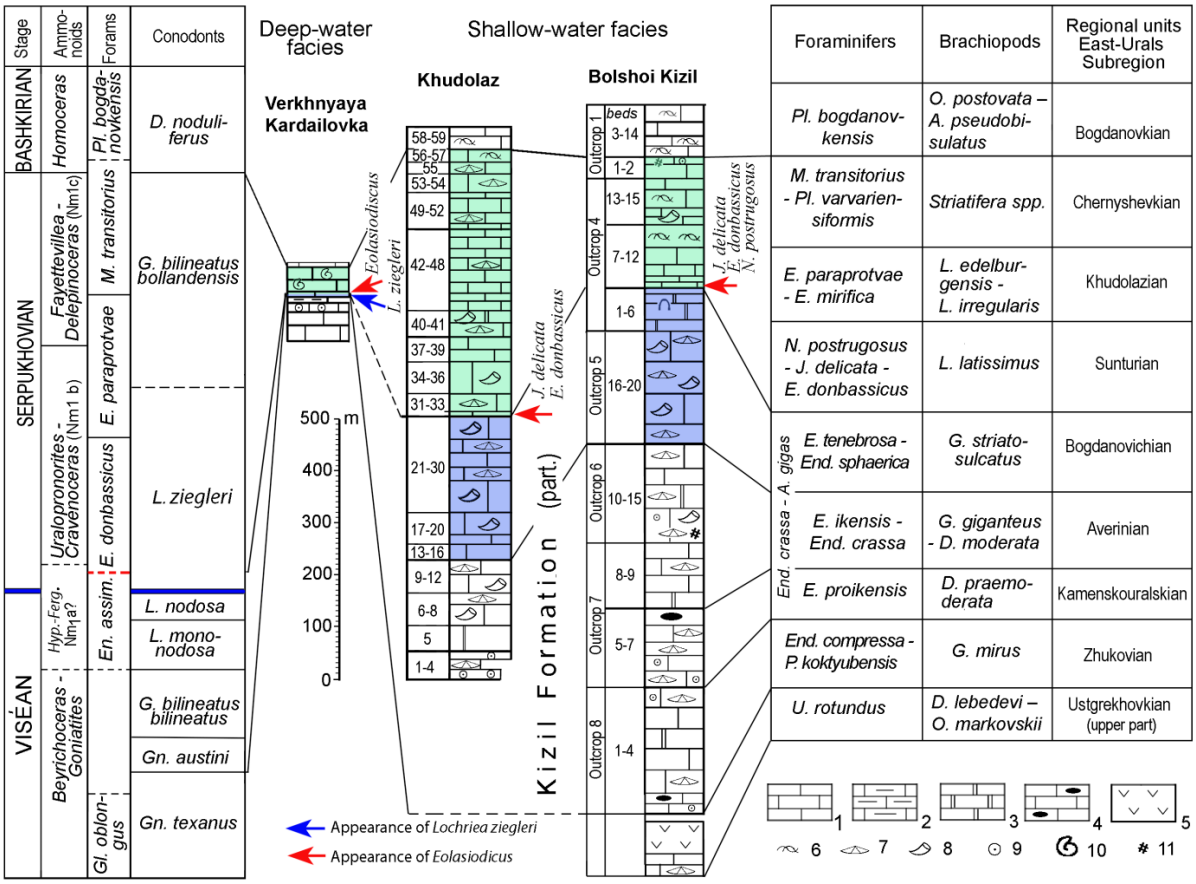

Figure 2: Stratigraphy of the deep-water and shallow-water Viséan-Serpukhovian carbonates in the eastern subregion of the South Urals and their correlation. The brachiopod zones of the shallow-water facies are proposed here by Kucheva, foraminiferal zones after Kulagina and Gibshman (2002), and Stepanova and Kucheva (2009b); zonation of the deep-water facies is after Nikolaeva *et al.* (2009). 1 – limestones, 2 – clayey limestones, 3 – dolomites, 4 – limestones with cherty nodules, 5 – volcanic rocks, 6 – algae, 7 – brachiopods, 8 – corals, 9 – crinoids, 10 – ammonoids, 11 – bryozoans.

Pachysphaerina pachysphaerica (Pronina), *Pojarkovella nibelis* (Durkina), *Vissarionovella* sp., *Globoendothyra* sp., *Mediocris breviscula* (Ganelina), and *Parastaffella* spp., occasional *Asteroarchaediscus* ex gr. *parvus* (Rauser-Chernousova) and frequent *Biseriella parva* (N. Tchernysheva). The bed also contains infrequent *Davidsonina carbonaria* (McCoy). The thickness is 4 m.

Bed 19 is bioclastic grainstone with numerous foraminifers, similar to those from beds 13–16. Brachiopods include: *Gigantoproductus giganteus* (Sowerby), *Semiplanus* cf. *semiplanus* (Schwetzow), *Flexathyris variabilis* (Moeller), and less commonly *Striatifera striata, Spirifer* cf. *trigonalis uralicus*. The middle part of the bed shows the first appearance of occasional small accumulations and isolated shells of *Latiproductus* cf. *latissimus* (Sowerby). The thickness is 40 m.

Bed 20 comprises peloid, fine-grained, bioclastic packstone with numerous *Pachysphaerina pachysphaerica,* small *Mediocris*, *Dainella* spp., *Biseriella* cf. *parva*, and *B. procera* (Postovalko), with infrequent brachiopods. The bed is 10 m thick.

Figure 3: Bogdanovichian in the Khudolaz River section, South Urals.

The overlying beds are observed in small (not over 2 m thick) exposures of limestone beds.

Beds 21-30 are bioclastic packstone and grainstone, with unevenly distributed brachiopods, corals, crinoids, and algae, dominated by *Frustulata* sp., *Calcifolium okense* Schwetzow et Bir., less commonly *Koninckopora* sp. and others. Foraminifers are represented by a rich (many specimens) and diverse assemblage, renewed in the upper part by the occurrences of *Klubonibelia immanis* Conil et Lys, *Vissarionovella poststaffelliformis* (Ponomarjova), *Janischewskina typica* Mikhailov, *J. minuscularia*

(Ganelina), *Eostaffellina sub-sphaerica* (Ganelina), *Pseudoendothyra globosa* Rosovskaya, *Ps. averinensa* Postovaloko, and *Asteroarchaediscus parvus.* All brachiopods are represented by species continuing from the lower horizons. The interval thickness is 197 m.

The total thickness of the substage is about 300 m.

The Bogdanovichian typically contains foraminifers of the genera *Pojarkovella, Endothyranopsis, Janischewskina,* and *Bradyina*, with numerous representatives of *Eostaffella ikensis*. The foraminiferal assemblage represents the foraminiferal zone *Endothyranopsis sphaerica – Eostaffella tenebrosa* corresponding to the upper part of the *Endothyranopsis* crassa – *Archaediscus moelleri* Zone of the general scale of Russia (Postanovlenie, 2003). The brachiopod assemblage is characterized by the dominance of coarsely plicated gigantoproductids and the appearance in the middle part of the Bogdanovichian of the species *Latiproductus latissimus.* This assemblage is indicative of the *Gigantoproductus striatosulcatus* Zone.

Sunturian (Serpukhovian)

The Sunturian beds are traced as small exposes of beds 31-40.

Bed 31 is lithoclastic, crinoidal-brachiopodal and peloid grainstone with strong micritization of grains, frequent *Striatifera striata, Flexathyris* ? sp., uncommon *Latiproductus* sp. indet., and *Davidsonina* sp. indet. The foraminiferal assemblage is inherited from the underlying levels, with 80% of species continuing from the late Viséan. The base of the Serpukhovian is marked by the appearance of numerous species of *Pseudoglomospira*, uncommon *Haplophragmina* ex gr. *anomalis* (Vdovenko), *H. beschevensis* Brazhnikova, *Janischewskina delicata* (Malakhova), *Eostaffellina* sp., *Pseudoendothyra averinensa complanata* Postovalko, and occasional *Eolasiodiscus donbassicus* Reitlinger. The interval is 10.5 m thick.

Beds 32-33 are fine-grained, bioclastic, peloid packstone with numerous foraminifers of the genera *Pseudoglomospira, Pojarkovella, Vissarionovella, Mediocris, Parastaffella,* and *Biseriella*, uncommon *Eostaffellina schartimiensis* (Malakhova) and *E. paraprotvae* (Rauser-Chernousova). Brachiopods are found as infrequent isolated shells of *Striatifera striata* and *Latiproductus* sp. indet., and form a small bank with *Striatifera angusta* (Janischewsky), large *S. striata*, and a few Rugosa. The thickness is 38.5 m.

Beds 34–36 consist of bioclastic, peloid grainstone, in places dolomitized, with foraminiferal assemblage similar to that of bed 31, in addition with large *Eostaffellina schartimiensis*, *E. paraprotvae ovaliformis* Melnikova, and *Eostaffellina optata* (Malakhova). The assemblage contains crinoid ossicles, tabulate and rugose corals. *Striatifera striata* and *Actinoconchus* cf. *adepressiorus* (Einor) are the dominant brachiopods. The interval is 64.5 m thick.

Beds 37–39 are packstone and fine-grained, bioclastic, peloidal packstone/grainstone with numerous *Pachysphaerina pachysphaerica*, *Pseudoglomospira* spp. interbedded with fine-grained, bioclastic wackestone and patterned mudstone. Grainstone and packstone contain corals and brachiopods. The interval is 48 m thick.

The total thickness of the Sunturian is 162 m.

The Viséan-Serpukhovian boundary in the Khudolaz River section is drawn at the base of bed 31 based on the first occurrence of the Serpukhovian foraminiferal assemblage including *Janischewskina delicata,* occasional *Eolasiodiscus donbassicus,* and also *Haplophragmina* ex gr. *anomalis*, *H. beschevensis*., and *Paracaligelloides* (?) *serpuchoviensis.* The abundance and diversity of the Viséan taxa gradually decreases upward in the section, and infrequent *Eostaffellina* begin to enter. The Sunturian corresponds to the *Janischewskina delicata – Eolasiodiscus donbassicus* Zone (Stepanova and Kucheva, 2009b), which correlates with the *Neoarchaediscus postrugosus* of the general scale of Russia (Postanovlenie, 2003). In the Sunturian, the brachiopod assemblage is now renewed even at the species level, although *Semiplanus semiplanus* and *Flexathyris variabilis* become extinct. Gigantoproductini pass their dominant role to the genera *Striatifera* and *Latiproductus.* The *Latiproductus latissimus* Zone is recognized.

Bolshoi Kizil section

Bogdanovichian (upper Viséan)

The section along the Bolshoi Kizil River (Fig. 4), in the lower part of the Bogdanovichian (outcrop 5, beds 16-18, ca. 200 m), contains foraminiferal, crinoidal-brachiopod, crinoidal, oolitic varieties, in places with numerous brachiopods and corals. The foraminiferal assemblage is similar to that of the Khudolaz River section. Upward in the section (56 m), the succession is dominated by bioclastic, foraminiferal, crinoidal-brachiopod limestone- but at some levels it is just crinoidal, and often contains rounded grains, with interbeds of peloid-pachyspheric packstone. Foraminifers are usually distorted, abraded, and rounded. Very large specimens of *Lituotubella, Globoendothyra, Endothyranopsis,* and *Bradyina* are present.

Further on, the beds of the section are observed in outcrop 4, for its detailed description see Kulagina and Gibshman (2002) and Kulagina *et al.*

(2009). Outcrops are traced along the left (east) slope of the Bolshoi Kizil River, interrupted by covered intervals. Therefore, the thickness is difficult to estimate precisely.

Figure 4: Viséan-Serpukhovian boundary beds in the Bolshoi Kizil section, South Urals.

The lower member (beds 1-2, ca. 40 m), is composed of bioclastic packstone, secondarily dolomitized, in the upper part replaced by packstone-rudstone, with corals, frequent crinoidal fragments, and bryozoans. The foraminiferal assemblage is supplemented by *Eostaffella tenebrosa*, *Rugosoarchaediscus celsus* (Conil and Lys). These beds are overlain by dolomites (beds 3-4, 20.5 m), cavernous in the upper part, containing a cave. These are overlain by 4.8 m of crinoidal, algal-bioclastic packstone-rudstone, with rare foraminifers, numerous brachiopods *Striatifera*. The algae are mostly *Calcifolium okense*, and also *Koninckpora* sp. and *Ungdarella* sp. The covered interval of 12 m is overlain by algal packstone-boundstone with many foraminifers: *Pseudoglomospira* spp., *Endothyranopsis sphaerica, Globoendothyra inconstans, Omphalotis omphalota, Bradyina rotula*, *Eostaffella ikensis*, *Janishewskina typica*, and *Rugosoarchaediscus celsus.* The thicknes of the latter interval is 4 m.

The total thickness of the Bogdanovichian is over 330 m.

Sunturian (Serpukhovian)

The exposures of the Sunturian (lower Serpukhovian) are observed above a 6.7 m thick covered interval in a small outcrop (bed 7. 1 m). This is a boundstone in places becoming algal grainstone with remains of thin-shelled brachiopods. Among the algae, *Calcifolium okense* are dominant, while the rock also contains *Praedonezella cespeformis* Kulik, *Koninckopora* sp., and *Ungdarella* sp. Foraminifers include: *Pseudoglomospira* spp., *Haplophragmina* cf. *beschewensis*, *Endothyranopsis sphaerica*, *Omphalotis omphalota minima, Globoendothyra globulus, Bradyina* cf. *rotula, Janishewskina delicata*, *Climacammina* sp., *Cribrostomum* sp., *Palaeotextularia* spp., *Rugosoarchaediscus celsus, R. akchimensis, Archaediscus ovoides* (very large), *Astero-archaediscus* ex gr. *bashkiricus, Neoarchaediscus postrugosus* (small-sized), *Permodiscus vetustus, Howchinia bradyana,* and *Eolasiodiscus donbassicus.* Above the next covered interval (18 m thick) the section continues with boundstone (bed 8), formed by *Calcifolium okense* and less commonly *Fasciella kisilia*. The deposits are strongly dolomitized, containing brachiopods, crinoids and corals with foraminifers continuing from the underlying bed, alongside *Janishewskina* aff. *minuscularia*, *J.* cf. *typica, Eostaffella ex gr. ikensis, E. mirifica, Climacammina* aff. *fragilis,* and *Monotaxinoides* sp. The thickness is three meters. Further on, bioclastic and algal packstone are exposed in interrupted outcrops of small thickness of 5-7 m, separated by covered intervals (beds 9-14). The upper part of the Sunturian (bed 15, over 45 m) is composed of massive and indistinctly bedded algal boundstone and grainstone with frequent bioencrustations. The beds are strongly dolomitized in places and contain, foraminifers, brachiopods, echinoderm, and bryozoan remains. Some photographs of algal boundstone are shown by Kulagina *et al.* (2009, Pl. 1, figs. 1, 7, 3, 4, 5), although in the explanation of the plate it is erroneously stated that all samples come from the Khudolazian.

The total thickness of the Sunturian is 110-120 m.

In the Bolshoi Kizil Section, the base of the Serpukhovian is drawn at the base of bed 7 based on the first appearance of *Eolasiodiscus donbassicus, Janischewskina delicata,* and *Neoarchaediscus postrugosus.* However, because the first appearance of these marker species occurs above the covered interval, the precise position of the boundary is difficult to assess.

Verkhnyaya Kardailovka Section

A considerably different lithology of the Viséan-Serpukhovian boundary interval is observed in the deep-water cephalopod facies in the Verkhnyaya Kardailovka section (Nikolaeva *et al.*, 2009). It is composed of wackestone-mudstone, sometime becoming packstone. Fossil remains include frequent radiolarians, sponge spicules, thin-shelled ostracodes, ammonoids, fragments of trilobites, and conodonts; foraminifers and rugose corals are uncommon. The total thickness of the upper Viséan-Serpukhovian in this section is 60 m. The equivalents of the Bogdanovichian are recognized conventionally, based on conodonts characteristic of the *Lochriea nodosa* zone (beds 21.9-21.12). The foraminiferal assemblage is taxonomically impoverished and can be identified as belonging to the local beds with *Endostaffella asymmetrica* (3 m thick), embracing in this section also the underlying

beds (equivalents of the Averinian). The beds contain tiny shells of *Pseudoammodiscus* sp., *Planoendothyra* sp., *Mediocris breviscula* (Ganelina), *Endostaffella delicata* Rosovskaya, *End. asymmetrica* Rosovskaya, and *Asteroarchaediscus parvus*.

The base of the Serpukhovian is drawn at the FAD of the conodont *Lochriea ziegleri* Zone (at the base of bed 22a.1). A single specimen of the foraminiferal species *Eolasiodiscus muradymicus* Kulagina was found 1.4 m above the base of the Serpukhovian. Upward in the section, the beds contain *Monotaxinoides*(?) sp., very small *Neoarchaediscus* sp., and *Neoarchaediscus postrugosus*, which is also known in the Serpukhovian of the Bolshoi Kizil Section and in Zaborie (type Serpukhovian section) (Gibshman, 2003). In the Verkhnyaya Kardailovka section, these taxa first appear 7 m above the base of the Serpukhovian. The Lower Serpukhovian beds are 17.5 m thick (beds 22a.1-22a.4).

Summary of carbonate facies on the eastern slope of the South Urals

Thus, there are two types of carbonate sections on the eastern slope of the South Urals: 1)
one dominated by shallow-water facies including grainstone shoal deposits and algal mounds, and 2) a second consisting mainly of fine-grained deep-water limestone

The Bogdanovichian (upper Viséan) in the Khudolaz and Bolshoi Kizil sections is dominated by grainstone with rounded bioclasts, which formed on shoals in high-energy settings. The Sunturian (lower Serpukhovian) on the Bolshoi Kizil River is dominated by algal boundstone and foraminiferal-algal grainstone formed in a facies belt containing carbonate mounds. Sunturian limestones on the Khudolaz River were formed in shallow-water settings, similar to those of the Bogdanovichian horizon, which is supported by the thick series of bioclastic algal-foraminiferal grainstone, often with rounded grains.

The deep-water facies in the region consists of micritic limestones containing numerous cephalopods, including ammonoids. They accumulated in the late Viséan and early Serpukhovian on a deep outer shelf (lower slope of a carbonate platform and adjacent basin) in low-energy settings well below wave base (example – the Verkhnyaya Kardailovka section).

In the shallow-water coral-brachiopod facies, the upper Viséan foraminifers continue higher up in the section, and the Serpukhovian species appear against a taxonomically diverse background assemblage containing many specimens characteristic of the underlying Viséan. In the absence of the diagnostic conodonts of the *Lochriea* lineage, the exact position of the Viséan-Serpukhovian boundary is impossible to identify, but for practical purposes it is drawn at the first appearance of the foraminifers *Janischewskina delicata, Eolasiodiscus donbassicus, Neoarchaediscus postrugosus,* and *Haplophragmina beschevensis*, which are known to appear near the boundary in the conodont-bearing successions.

The local correlation of the beds of the shallow-water coral-brachiopod facies and deep-water cephalopod facies is based on foraminifers of the order *Archaediscida*, i.e., species of the genera *Eolasiodiscus, Monotaxinoides,* and *Neoarchaediscus*, known from the Serpukhovian of the shallow-water facies of the eastern slope of the South Urals and of the Moscow Basin. In the deep-water facies, the marker species of foraminifers enter above the boundary, defined by the FAD of the index conodont *Lochriea ziegleri* (probably these are not the first evolutionary appearances because of the generally low abundance of foraminifers in deep-water facies in the South Urals). Therefore the correlation of the deep-water and shallow-water deposits is provisional.

Conclusions

Correlations within the Viséan and Serpukhovian stratigraphic succession on the eastern slope of the South Urals is largely based on the foraminiferal succession, because of the widespread occurrence of the shallow-water deposits lacking conodonts. A number of sections on the eastern slope of the South and Middle Urals, in the shallow- water carbonates were subdivided based on foraminifers (Plyusnina and Ivanova, 1983). In the area where the Kizil Formation is exposed, a number of sections are described to the south of Magnitogorsk on the Yangelka River, in the Agapovka Quarry and in other sites (Chuvashov *et al.* 1984). Thanks to the sections, which like that at Verkhnyaya Kardailovka, contain foraminifers, ammonoids and conodonts, the level of the first appearance of the index foraminiferal species *Eolasiodiscus donbassicus* and *Neoarchaediscus postrugosus,* can be correlated with the FAD of the index conodont species *Lochriea ziegleri*, thereby providing a higher correlation potential across large territories.

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PRELIMINARY MOSCOVIAN CONODONT SCALE OF THE DONETS BASIN, UKRAINE

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Introduction

The well exposed Pennsylvanian succession in the Donets Basin of Ukraine with its abundant and diverse conodont faunas has an advantage over most other areas in the world for the construction of conodont zonal schemes. To date, however, for the Carboniferous of the Donets Basin conodont zonations have been constructed and described for

only the Serpukhovian and Bashkirian (Nemyrovska, 1999). The first Moscovian conodont zonation was presented in 2007 but without a description of the zones (Nemyrovska in Fohrer *et al.*, 2007).

The conodont zonation of the Moscovian Stage in its type area (Moscow Basin) was constructed earlier (Alekseev and Goreva in Makhlina *et al.*, 2001), but the correlation with the rest of the world is difficult due to increasing provincialism and endemism of conodont faunas after the Aegiranum Flooding Event (early Moscovian time), which was characterized by distribution of cosmopolitan faunas in the Northern Hemisphere. After this event, the evolution of the Moscovian or Desmoinesian conodonts took place in restricted marine basins, which resulted in a great number of endemic species. This makes correlations difficult and requires detailed conodont studies of relatively continuous successions. The construction of the conodont zonation of such a continuous Moscovian succession as in the Donets Basin is especially important.

Data recently acquired by the author on the Moscovian conodonts of the Donets Basin is the basis for updating the conodont zonation given in 2007 (Fig. 1). This updated but still preliminary zonation with revised conodont zones and their boundaries was constructed for the larger part of the Moscovian Stage that includes three suites of strata: C_2^5(K), C_2^6(L) and C_2^7(M).

Another reason to present at least a preliminary conodont zonation is a reaction to the paper of Davydov *et al.* (Davydov *et al.*, 2010) where incorrect conodont zonation (the author is not indicated) for the Moscovian Stage of the Donets Basin was given, which can confuse the Carboniferous workers.

Stratigraphic framework of Donets Basin

The Donets Basin in southeastern Ukraine and western Russia is part of a large geological structure known as the Don-Dnieper Rift, which developed at the southern margin of the East European Platform. The Carboniferous of the Donets Basin is regarded as an eastern European standard of the Carboniferous System because it contains very few significant unconformities and records almost continuous deposition. It consists of a thick succession of sandstone, siltstone and calcareous shale with intercalations of limestone and coal. The Kholodnaya, Khartsyzskaya and Sorocha valleys (Nemyrovska, 1999; Nemyrovska *et al.*, 1999) as well as near the Malo-Nikolaevka Village (Nemyrovska *et al.*, 2010). The Moscovian deposits (C_2^6 (L) and C_2^7(M) suites) were studied in the key sections of the Moscovian Stage of the Donets Basin – the Izvarino section and the Gurkova Valley. The C_3^1(N) Suite was studied near the village of Carboniferous in the Donets has been divided into lithostratigraphic units called suites (equivalent to formations) designated by a system combining numbers and letters. Each suite includes a number of limestone intervals and coal seams, which are labeled using the first letter in the name of the respective suite (formation), followed by a number. Capital letters refer to major marine limestone units and numerals indicate stratigraphic order. This nomenclatural scheme was developed by Ukrainian geologists at the beginning of the twentieth century. Lithological correlation of the limestone units and beds was first done by direct tracing and later supported by paleontological evidence. The Carboniferous in the basin is subdivided biostratigraphically into seven regional stages and a number of superhorizons and horizons

Previous conodont-based biostratigraphic studies

The conodonts of the Moscovian Stage of the Donets Basin were first studied by Kossenko (Kossenko, 1975; Kossenko in Kozitskaya *et al.*, 1978) from borehole core samples from the southwestern part of the Donets Basin and later by Kozitskaya (Kozitskaya *et al.*, 1978). At the same time, the early Moscovian conodonts from the outcrops of the Donets Basin were studied by Nemyrovska (Nemirovskaya in Kozitskaya *et al.*, 1978: Nemyrovska, 1999).

The detailed investigations of conodonts from well-exposed strata of the key sections of the Moscovian Stage in the Donets Basin started in 1994 as part of multidisciplinary studies of the Carboniferous of the basin with French, German, American and Japanese workers (Nemyrovska *et al.*, 1999; Fohrer *et al.*, 2007; Nemyrovska and Ueno, 2008; Nemyrovska *et al.*, 2010; Nemyrovska, in press). At present collaborative studies of the Donets Basin Pennsylvanian conodonts and foraminifers are being done by the author and K. Ueno (Fukuoka University, Japan).

Material and methods

During the last decades, a number of Donets Basin sections including the Bashkirian/Moscovian boundary beds and the Moscovian deposits were studied in detail. The Bashkirian/Moscovian boundary beds (C_2^4(I) and C_2^5(K) suites) were studied along the Zolotaya Valley, Karaguz, Pashennaya, Kalinovo. The study of conodonts of the last suite is in progress and not discussed in this paper.

The seven conodont zones herein distinguished in the Moscovian of the Donets Basin (Fig. 1) are interval-zones. The lower boundaries of the majority of these zones are defined by the evolutionary appearances (FAD) of indexspecies. At least two groups of the latest Bashkirian and

Figure 1: Correlation chart of Moscovian conodont zones of the Donets and Moscow basins (updated from Nemyrovskaya *in* Fohrer *et al.*, 2007)

Moscovian conodonts have great potential for subdivision of the studied interval and intercontinental correlation. These are the *Declinognathodus noduliferus* – *Declinognathodus marginodosus* – *Declinognathodus donetzianus* group for the latest Bashkirian and earliest Moscovian (Nemyrovska, 1999, Nemyrovska *et al.*, 1999, Nemyrovska *et al.*, 2010) and the *Swadelina* group for late Moscovian (Nemyrovska in press). The first occurrence in the sequence of the most characteristic species, which ancestors are unknown was used for two zones of the Lower Moscovian (the third and fourth zones).

The updated correlation scheme of the Moscovian conodont zonation of the Donets Basin and the Moscow Basin is given below (modified from Nemyrovska in Fohrer *et al.*, 2007). The most stratigraphically important species (zonal markers) are illustrated herein on plate 1.

Conodont zonation

The conodont zones (Fig. 1) starting from the latest Bashkirian zone are as followings:

1. The *Declinognathodus marginodosus* Zone covers the uppermost part of the Bashkirian deposits from limestone I_2 of the C_2^4(I) Suite up to limestone K_1 of the C_2^5(K) Suite. The lower boundary of this zone is defined by entry of *Declinognathodus marginodosus* (Graysons). Its upper boundary coincides with entry of *Declinognathodus donetzianus* Nemyrovska. The characteristic species are *D. marginodosus*, diverse species of the *Idiognathoides* genus such *as Idiognathoides sinuatus* (including *Idiognathoides corrugatus*), *Idiognathoides. fossatus, Idiognathoides tuberculatus, Idiognathoides lanei* and *Idiognathoides sulcatus sulcatus,* species of the *Idiognathodus* genus such as *Idiognathodus sinuosus, Idiognathodus aljutovensis, Idiognathodus incurvus* and several unnamed species of *Idiognathodus, Idiognathoides sinuatus* and *Idiognathoides fossatus* dominate.

2. The *Declinognathodus donetzianus* Zone embraces the interval from limestone K_1 up to limestone K_6 of the C_2^5(K) Suite. Its lower boundary is defined by FAD of *Declinognathodus. donetzianus* Nemyrovska, its upper boundary is determined by the first appearance of "*Streptognathodus" transitivus* (Kossenko). *D. donetzianus* is proposed as the index-species for the Bashkirian/Moscovian boundary within the lineage *D. noduliferus* – *D. marginodosus* – *D. donetzianus*. If this conodont marker will be accepted as the index species for the Bashkirian/Moscovian boundary, this boundary in

the Donets Basin will be lowered to limestone K_1 or down to the base of the C_2^5(K) Suite. In the Donets Basin, this boundary is traditionally placed at limestone K_3. The characteristic species of this zone are the latest representatives of the genus *Declinognathodus*: *D. donetzianus* and *D. marginodosus*, and the latest species of the genus *Idiognathoides*: *I. sinuatus, I. fossatus* and *I. tuberculatus*, which dominate in this interval of the sequence. *Idiognathodus aljutovensis, Idiognathodus volgensis* and *Idiognathodus sinuosus* are common. The entry of *Diplognathodus ellesmerensis* is characteristic for this zone.

3. "*Streptognathodus" transitivus – Neognathodus atokaensis* Zone embraces the interval from limestone K_6 of the C_2^5(K) Suite up to limestone L_5 of the C_2^6(L) Suite. The lower boundary of this zone is defined by FAD of "*Streptognathodus*" *transitivus* Kossenko and its upper boundary is determined by the first appearance of *Idiognathodus izvaricus* Nemyrovska. The characteristic species of the lower part of the zone are still species of the genus *Idiognathoides*: *I. sinuatus, I. fossatus* and *I. tuberculatus* and *Idiognathodus aljutovensis*. In the entire zone *Diplognathodus ellesmerensis Diplognathodus coloradoensis, "S." transitivus, Neognathodus atokaensis, Neognathodus bothrops,* and *Idiognathodus volgensis* are common.

4. *Idiognathodus izvaricus* Zone covers the interval from limestone L_5 of the C_2^6(L) Suite up to limestone M_2 of the C_2^7(M) Suite. Its lower boundary is defined by FAD of *Idiognathodus izvaricus* Nemyrovska. Its upper boundary is defined by entry of *Swadelina dissecta* (Kossenko). The characteristic species are *I. izvaricus, Neognathodus atokaensis, Idiognathodus praeobliquus* and *Diplognathodus coloradoensis.*

5.The *Swadelina dissecta* Zone embraces the interval from limestone M_2 up to limestone M_9 of the C_2^7(M) Suite. Its lower boundary is defined by entry of *Swadelina dissecta* (Kossenko), its upper boundary is determined by the first appearance of *Swadelina concinna* (Kossenko). The characteristic species are *S. dissecta, Neognathodus colombiensis, Idiognathodus obliquus* and *Diplognathodus coloradoensis.*

6. The *Swadelina concinna* Zone is characteristic for the short interval between limestone M_9 and limestone M_{10} of the C_2^7 (M) Suite. Its upper boundary is defined by the FAD of *Swadelina concinna* (Kossenko) and its upper boundary is determined by FAD of *Swadelina* sp 1. Nemyrovska. The zone includes *S. concinna, Swadelina dissecta, Idiognathodus obliquus, Diplognathodus nodulosus* and *Neognathodus colombiensis*.

7. The *Swadelina* sp. 1 Zone. Its lower boundary at limestone M_{10} of the C_2^7(M) is defined by entry of *Swadelina* sp. 1 Nemyrovska and the position of its upper boundary is still provisional as the study of conodonts from the overlying C_3^1(N) Suite is in progress. The characteristic species from the uppermost deposits of the C_2^7(M) Suite are *S.* sp. 1, *Swadelina concinna, Neognathodus colombiensis, Neognathodus* aff. *inaequalis, N.* sp. 1 and *Mesogondolella clarki.*

Conclusions

Seven conodont zones herein distinguished in the key sections of the Moscovian Stage in the Donets Basin with updated boundaries are a reliable basis for the construction of the regional conodont zonation of the Moscovian Stage of the Donets Basin in Ukraine and can contribute to the construction of the global conodont scale. The regional conodont scale of the Moscovian Stage of Donbas as a part of the global Carboniferous standard will help to understand better the evolution of conodonts in various paleoenvironments of the Moscovian time in Donbas and other areas.

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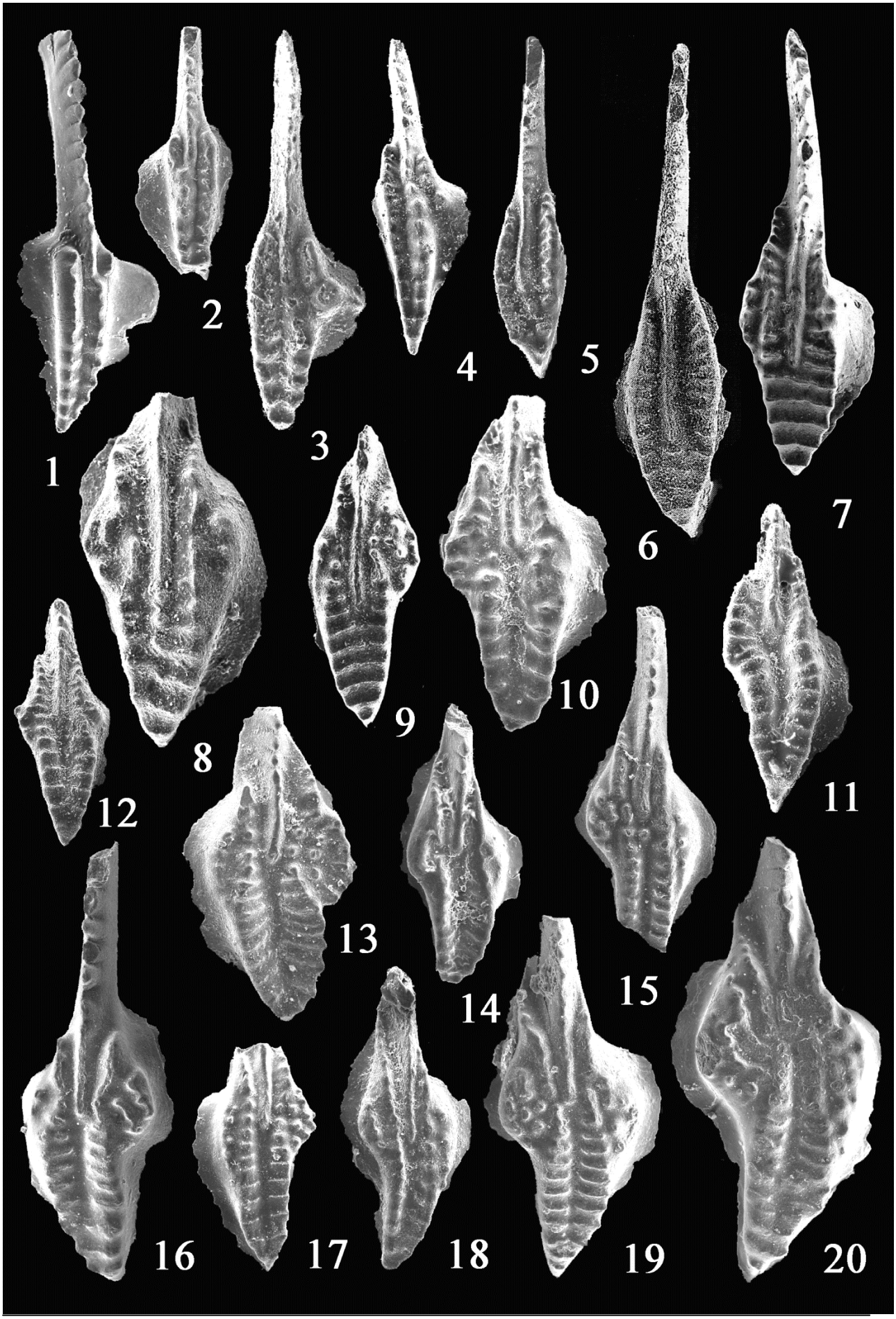
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Plate 1 (previuous page): All illustrated specimens are housed in IGS National Academy of Sciences of Ukraine, Kiev. Magnification x60. Figs. 1-2. *Declinognathodus marginodosus* (Grayson, 1984): 1– specimens IGSU-0850, the Malo-Nikolaevka Village, limestones K_1. 2 – specimen IGSU-0851, the same locality, limestone I_2^2. Figs. 3-4. *Declinognathodus donetzianus* Nemirovskaya, 1990: 3 – specimen IGSU-0852, the Zolotaya Valley, limestone K_2, 4 – specimen IGSU-0853, the Malo-Nikolaevka Village, limestone K_1. Figs. 5-6. "*Streptognathodus" transitivus* Kossenko, 1978: 5 – specimen IGSU-0854, the Karaguz Valley limestone K_7, 6 – specimen IGSU-0704, the Izvarino section, limestone L_4 top. Figs. 7-9. *Idiognathodus izvaricus* Nemyrovska, 2007: 7 – specimen IGSU-0755, Holotype, Morphotype 1, the Izvarino section, limestone L_7^1, 8 – specimen IGSU-0770, Morphotype 2, the Gurkova Valley, limestone M_2 top. 9 - specimen IGSU-0855, Morphotype 2, the Izvarino section, limestone L_5^1. Figs. 10-11. *Swadelina dissecta* (Kossenko, 1975) Morphotype 1: 10 – specimen IGSU-0856, the Gurkova Valley, limestone M_7^2, 11 – specimen IGSU-0807, the same locality, limestone M_5 base. Figs. 12 - 14. *Swadelina dissecta* (Kossenko, 1975) Morphotype 2: 12 – specimen IGSU-0857, the Gurkova Valley, limestone M_5 base, 13, 14 - specimens IGSU-0821 and IGSU-0819, the same locality, limestone M_7^2, Figs. 15, 17. *Swadelina concinna* (Kossenko, 1975): 15 – specimen IGSU-0858, the Gurkova Valley, limestone M_{10} top, 17 - specimen IGSU-0831, the same locality, limestone M_{10} base. Figs. 16, 18-20. *Swadelina* sp. 1. 16 - specimen IGSU-0815, the Gurkova Valley, limestone M_{10}, 18 – specimen IGSU-0828, transitional from *Sw. concinna*, the same locality, limestone M_9 top, 19 – specimen IGSU-0836, the same locality, limestone M_{10}, 20 - specimen IGSU-0838, the same locality, limestone M_{10} top.

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THREE POTENTIAL LEVELS FOR THE BASHKIRIAN-MOSCOVIAN BOUNDARY IN THE NAQING SECTION BASED ON CONODONTS

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The endemism of biota, the strong glacial-eustatic control over sedimentation and consequent widespread disconformities hamper the selection of acceptable GSSPs for the Carboniferous stages, including the Serpukhovian, Moscovian, Kasimovian and Gzhelian stages. Only the relatively deeper-water, carbonate-slope and basinal sections can be used as potential candidate sections for these GSSPs. The Naqing section, formerly named the Nashui section, in Luosu, Luodian, Guizhou Province, South China, is such a section dominated by slope facies. Additional detailed conodont biostratigraphic collecting carried out in the past two years, mainly from the Bashkirian-Moscovian (B/M) boundary interval, provides more information about the faunal transition across this boundary and the potential of the Naqing section as the GSSP.

A new conodont succession across the B/M boundary interval in the Naqing section is recognized (Fig. 1). In ascending order, the major biostratigraphic units are the "*Streptognathodus preexpansus"* (ancestor of *Streptognathodus expansus,* not formally named), *Streptognathodus expansus*, *Diplognathodus ellesmerensis* and *Mesogondolella donbassica-M. clarki* zones, which occur over an interval of about 20 m.

Groves and Task Group (2006) evaluated three proposals to define the base of the Moscovian Stage: 1) appearance of an advanced morphotype of *Neognathodus nataliae*; 2) appearance of *Idiognathoides postsulcatus* from *I. sulcatus sulcatus;* and 3) appearance of *Declinognathodus donetzianus* from *D. marginodosus*. However, all three of these proposals for definition of the base of the Moscovian Stage have disadvantages based on the conodont data from the Naqing section (Qi, 2008; Wang *et al.*, 2008; Qi *et al.*, 2010; Wang *et al.*, 2011).

We recognize three different potential levels at which the base of the Moscovian Stage might be placed, based on the new conodont data from the B/M boundary interval in the Naqing section (Fig. 2). The first level is the FAD of *Streptognathodus expansus* within the conodont lineage "*Streptognathodus preexpansus"- Streptognathodus expansus* (169.05 m above the base of the Naqing section), the second is at the FAD of *Diplognathodus ellesmerensis* within the conodont lineage *Diplognathodus orphanus-D. ellesmerensis* (174.30 m), and the third is at the FAD of *Mesogondolella* (179.90 m).

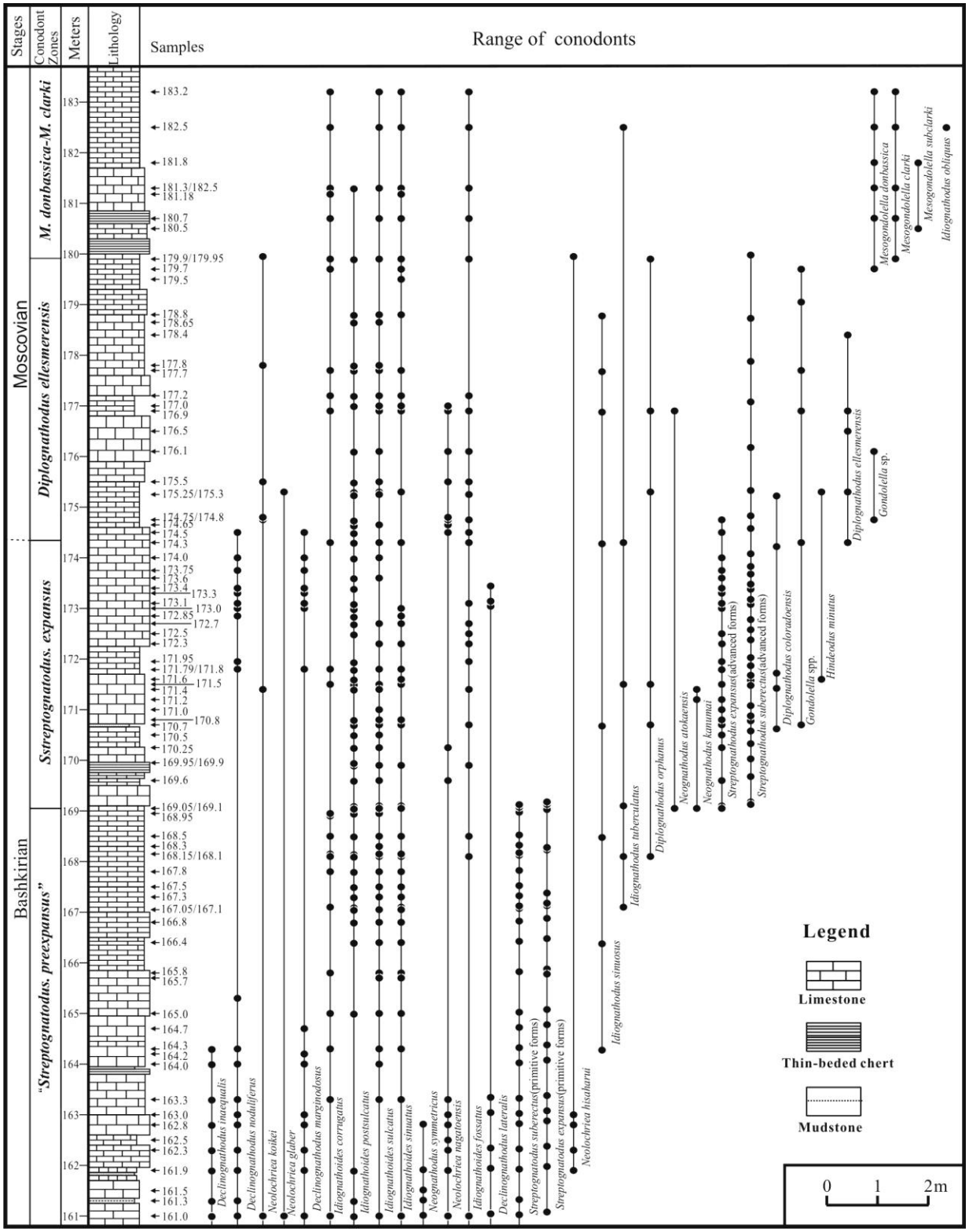

Figure 1: The range chart of conodonts from the Bashkirian and Moscovian boundary interval in the Naqing section, Luodian, Guizhou of South China

Rapid morphologic evolution in P_1 elements of *Streptognathodus expansus* permits the identification of a new biostratigraphic level within the lineage at which the base of the Moscovian Stage might be placed. Older forms of the species possess short adcarinal ridges that are not clearly separated from the platform, but starting at 169.05 m above the base of the section, new morphotypes with significantly longer, more clearly distinct adcarinal ridges appear. This level coincides with the entry of

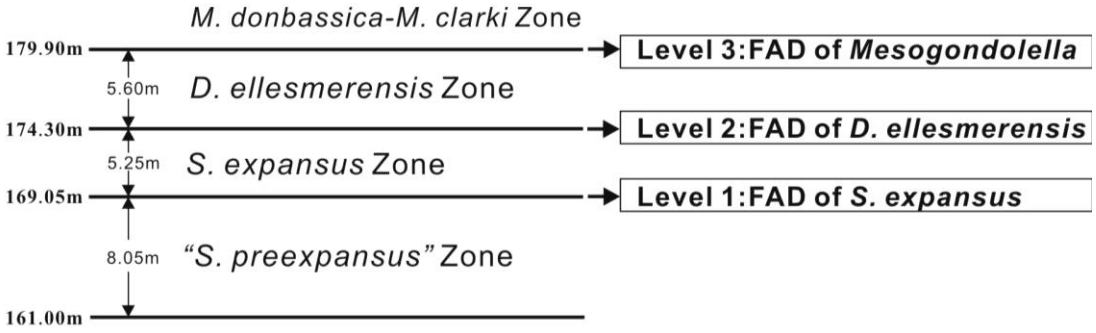

Figure 2: Three potential levels for the base of the Moscovian Stage in the Naqing section based on conodonts.

Neognathodus kanumai and *N. atokaensis,* which are traditional markers for the base of the Moscovian Stage in North America. It is also near the entry of the fusulinid *Profusulinella*. P_1 elements of *Streptognathodus expansus* are very abundant, easily recognizable, and widespread globally. The first occurrence of *S. expansus* lies 5.25 m below the first occurrence of *Diplognathodus ellesmerensis* in the Naqing section (Qi *et al.*, 2010a).

The first occurrence of *Diplognathodus ellesmerensis* is another potential boundary event recommended by Qi *et al.* (2007, 2009), Qi (2008) and Wang *et al.* (2008). The important conodont marker for the base of the Moscovian Stage in its type area in the Moscow Basin of Russia is *Declinognathodus donetzianus* (Alekseev and Goreva, 2000), which appears a little below the occurrence of *D. ellesmerensis* in the Zolotaya Valley section of the Donets Basin, so the base of the *De. donetzianus* Zone can be also recognized by the occurrence of *D. ellesmerensis* (Nemyrovska, 1999). Therefore, the occurrence of *D. ellesmerensis* in South China can be correlated with the appearance of *De. donetzianus* in the Donets Basin. *D. ellesmerensis* is widespread globally, easily identified, and has a restricted and well-defined stratigraphic ranges. Moreover, we recently found a reliable transitional element from *Diplognathodus orphanus* to *D. ellesmerensis* in the Naqing section, which clarifies the evolutionary relationship between *D. orphanus* and *D. ellesmerensis*. However, there are still some disadvantages with *D. ellesmerensis* as a GSSP definition: 1) *D. ellesmerensis* occurs sporadically in most localities; and 2) many specimens of *D. ellesmerensis* (as well as other *Diplognathodus* species) seem to be juvenile morphologies, with large, fully developed adult specimens being exceedingly rare. Nevertheless, conodont specialists agree that the appearance of *D. ellesmerensis* in most areas coincides very closely with the base of the Moscovian (Groves and Task Group, 2008; Qi *et al.*, 2010b; Wang *et al.*, 2011).

The entry of the *Mesogondolella* fauna at 179.90 m in the Naqing section is a very important conodont event in the B/M boundary interval. *Mesogondolella* is easily recognized and widely distributed in the world. The species of the *Mesogondolella* fauna are quite different from other conodont taxa in the boundary interval. However, the first occurrence of *Mesogondolella* lies 5.60 m above the first occurrence of *D. ellesmerensis* in the Naqing section.

To sum up, there are three potential levels in the Naqing section by which to define the base of the Moscovian Stage. The FAD of *Diplognathodus ellesmerensis* could be a good boundary marker and lies nearest the traditional base of the Moscovian Stage as indicated by the first occurrence of *Declinognathodus donetzianus*. The FAD of *Mesogondolella* may also be a good marker for the base of Moscovian, but many important early Moscovian conodonts, including *De. donetzianus*, *D. ellesmerensis, Neognathodus kanumai* and *Neognathodus atokaensis*, which begin to appear below the FAD of *Mesogondolella,* would become late Bashkirian in age. Thus, most conodont specialists will disagree with this proposal because they consider that the FAD of *Mesogondolella* is too high. However, the FAD of *Streptognathodus expansus* may be the best marker for the base of the Moscovian Stage (Qi *et al.*, 2010a), but the only problem is that we would need to move the boundary one zone (*Streptognathodus expansus* Zone, which is 5.25 m in thickness in the Naqing section) below the traditional base of the Moscovian Stage, which is marked by the FAD of *D. donetzianus* or *D. ellesmerensis*.

Acknowledgments

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LALLA MIMOUNA NORTH, AN IMPORTANT DEVONIAN / CARBONIFEROUS BOUNDARY SECTION AT THE NORTHERN MARGIN OF THE MAIDER, ANTI-ATLAS, SE MOROCCO

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Introduction

The resampling of the current Devonian/Carboniferous Boundary stratotype in trench É on La Serre Hill in the Montagne Noire of southern France; (Kaiser, 2009), resulted in the confirmation of the claim by Sandberg *et al.* (1988) and Ziegler and Sandberg (1996) that siphonodellids with the morphology used to place the GSSP at the base of Bed 89 occur significantly lower (about 38 cm), near the base of the exposed upper oolitic unit. This demonstrated that a gradual morphological (Flajs and Feist, 1988) or even phylogenetic transition within the supposed *Siphonodella praesulcata* Sandberg, 1972 to *Siphonodella sulcata* (Huddle, 1934) lineage was not preserved in the stratotype. Since there is no other criterion, such as a marker fossil or geochemical signal, that allows the correlation of the base of Bed 89 with reasonable precision into any other known boundary section, it was decided that the GSSP and base of the Carboniferous needed to be revised (Kaiser, 2009). Consequently, a new international D/C boundary working or task group was formed (Heckel, 2008; Marshall, 2008) for which the activities through the summer of 2010 have been summarized by Richards and task group (2010) and Aretz (2011). A range of key work objectives were formulated: 1. the taxonomic revision of siphonodellids, their relatives, and of protognathodids across the Hangenberg Crisis (e.g., Tragelehn, 2010; Kaiser and Corradini, 2011; Corradini *et al.,* 2011; Spalletta *et al.,* 2011), 2. search for new boundary sections, 3. obtain new data for other fossil groups, 4. search for alternative boundary levels, including the "natural boundary" at the onset of the Hangenberg Mass Extinction, and at

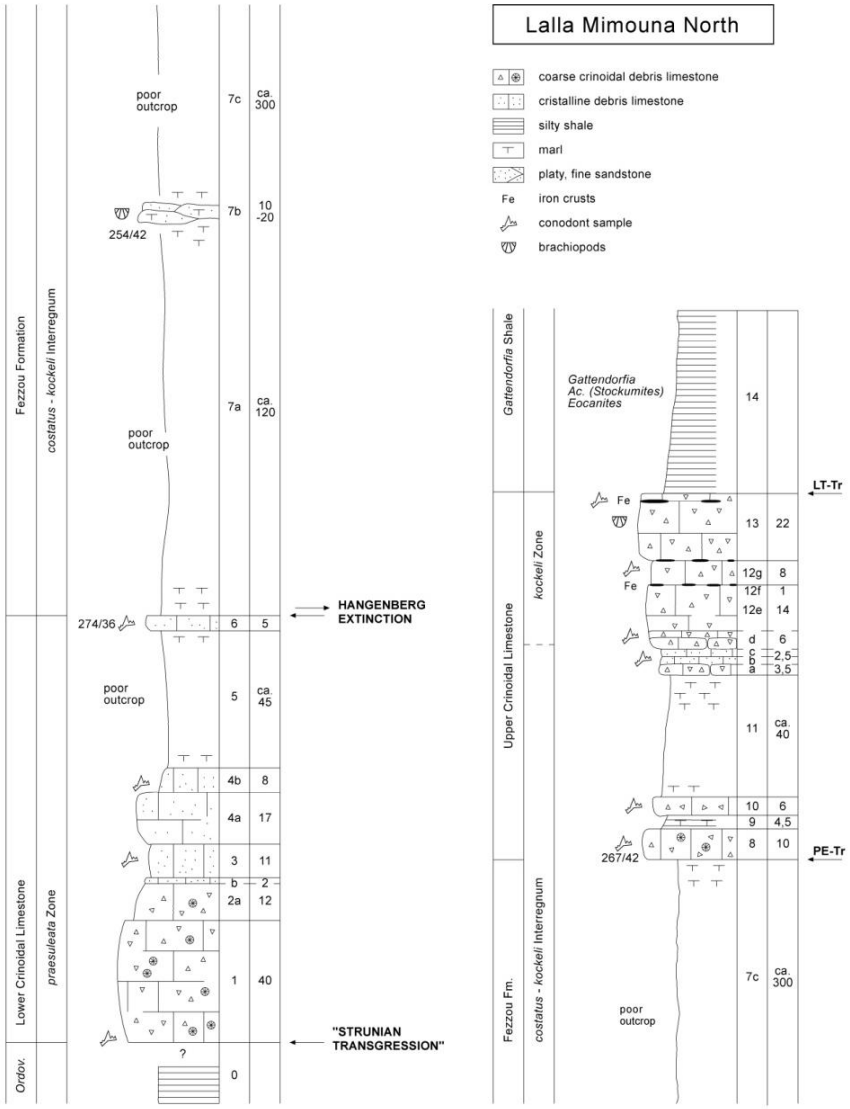

Figure 1: Litho-, conodont, sequence and event stratigraphy at Lalla Mimouna North, with the position of conodont samples. PE-Tr = initial post-glacial transgression of the Hangenberg Crisis, LT-Tr = Lower Tournaisian transgression.

the base of the Hangenberg Black Shale (Walliser, 1984). Phases of the Hangenberg Crisis led to an interruption of carbonate sedimentation and the conodont record on an almost global scale, either by the intercalation of fine (Hangenberg Shale equivalents) to coarse (Hangenberg Sandstone equivalents) siliciclastics, or by episodes of erosion forming disconformities, which sometimes have been overlooked or ignored. In this context, any section with carbonates from the main crisis interval, between the main extinction (base of *costatus-kockeli*-Interregnum, Kaiser *et al.,* 2009) and the initial recovery phase of the *kockeli* (Upper *prsaesulcata*) Zone, deserves special attention. Our knowledge of conodonts from this interval is currently very restricted, with records of impoverished assemblages from single thin beds of Grüne Schneid (Carnic Alps, Kaiser *et al.* 2006) and Trolp (Graz Palaeozoic, Kaiser *et al.* 2009).

The southeastern Anti-Atlas, especially in the southern Maider and southern and eastern Tafilalt regions, include a range of important D/C boundary sections with different facies and faunas that were deposited in the Maider Basin, on the Tafilalt Platform, and in the Tafilalt Basin. These are described and correlated precisely with the German (Rhenish) succession by Kaiser *et al.* (2011), mostly based on ammonoid, event and sequence stratigraphy. Conodonts are sparse in the pre-event nodular limestones and only a few lower Tournaisian specimens could be obtained since limestone deposition almost ceased during the main phase of the Hangenberg Event until late in the upper Tournaisian. In addition, the upper part of the pre-event beds (at least the *Wocklumeria* Zone, UD VI-D) is missing at an unconformity just below the Hangenberg Black Shale equivalents all over the Tafilalt. Few brachiopod taxa occur in the latest Devonian Hangenberg Shale and Sandstone equivalents (Brice *et al.,* 2005, 2007). Rich goniatite faunas re-appear after the main extinction with a delay, rather late in the lower Tournaisian (last summary in Korn *et al.* 2007).

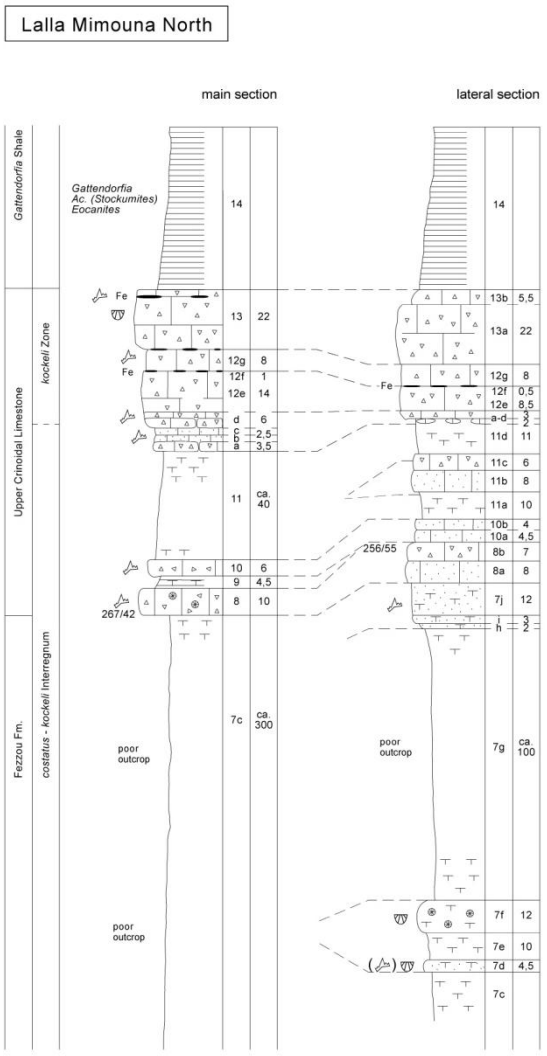

Figure 2: Correlation of the upper part of the main section at Lalla Mimouna North with the lateral section, ca. 30 m to the south, showing the wedging out of some crinoidal debris beds, and the gradual transition from the Fezzou Formation to the Upper Crinoid Limestone. Legend as for Fig. 1.

Lalla Mimouna sections

Based on a detailed survey of the Jebel Rheris area at the northern margin of the Maider region (Fröhlich, 2004), Korn *et al.* (2004) described an important locality (their section A) from the northern slope of the Lalla Mimouna Mountain north of Msissi. It represents one of the two small most northerly Devonian outcrops of the Maider region. Vertically-bedded, dark, bioclastic limestones of the *kockeli* Zone yielded an association of *Postclymenia evoluta* Schmidt, 1924 and *Acutimitoceras* (*Stockumites*) *hilarum* Korn in Korn and Klug 2002, accompanied by abundant gastropods and small, ribbed brachiopods. This mixed neritic-pelagic assemblage confirmed the short-term survival of last clymeniids into the terminal Devonian (of current definition), into the initial post-event recovery interval (*Stockumites* Zone, UD VI-F). New conodont samples from the adjacent crinoidal limestones yielded *Palmatolepis (Tripodellus) gracilis gracilis* Branson and Mehl, 1934, *Bispathodus costatus* (Branson, 1934) Morphotype 2, *Bispathodus ultimus* (Bischoff, 1957), *Bispathodus spinulicostatus* (Branson, 1934) (two morphotypes), and others. This fauna clearly falls in the pre-Hangenberg *ultimus* Zone (= Upper *expansa* Zone) to (Lower) *praesulcata* Zone. It confirms the section log in Korn *et al.* (2004), which placed the crinoidal packstones below the ammonoid level mentioned above. The latter is vertically overlain by about 2 m of unfossiliferous, orange-grey, fine siltstones and subsequent white to orange-weathering shales. The Hangenberg Event Interval is either represented by a thin unit (25 cm) of weathered marls between the crinoidal limestone and ammonoid bed or it is missing at an unconformity. In any case, there is no continuous section through the event and current D/C boundary interval at Section A.

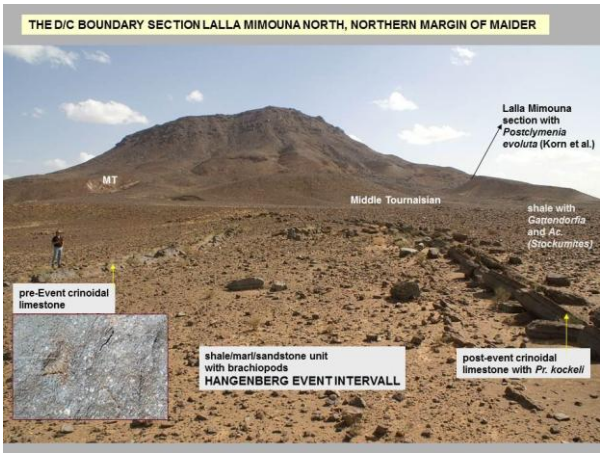

Figure 3: Overview on the Devonian/Carboniferous boundary sections Lalla Mimouna north; left side = east.

Our sampling and field survey, therefore, concentrated in 2009 to spring 2011 on the wider exposed succession on the lower slope of Lalla Mimouna, which was discovered independently from the Tübingen group. It is close to or identical with section B of Korn *et al.* (2004). Our GPS coordinates (N 31° 16,502´ W 4° 49,092´) are almost identical with those given in Fröhlich (2004). Fig. 3 gives a photographic illustration of the flat exposure with two separate limestone units that overlie unconformably (to the east) fine Ordovician siliciclastics. The local Lower Crinoidal Limestone (beds 1-6, Fig. 1), a new and locally the only member of the Ibaouane Formation, fines upwards and contains common conodonts but only sparse macrofauna apart from crinoid fragments. During the uppermost Famennian eustatic transgression,

crinoid communities started to settle the slope of Lalla Mimouna, which formed a small island north of the Maider Basin. The shallow-water crinoidal banks are followed in the main section by about 4.5 m of deeply weathered, greenish marls/shales with lenses of marly, partly brachiopod-rich siltstones. Unfortunately, these are either difficult to process for conodonts or proved to be barren. They represent a thin development of the Devonian part of the Fezzou Formation of the southern Maider. Dominant brachiopod groups (Fig. 4) are rhynchonellids and orthids that are currently under study by D. Brice. The subsequent Upper Crinoidal Limestone (beds 10-13), a local new member of the Fezzou Formation, records high-energy shedding of crinoidal debris, which resulted in lateral thickness variations. Some beds may wedge out laterally, especially in the upper part. Therefore, we measured a lateral section just 30 m to the south (Fig. 2), which includes solid, marly brachiopod siltstones (again without conodonts) and a peculiar, coarse encrinite marl (bed 7f) below the Upper Crinoidal Limestone. Iron encrustations within the latter testify occasional periods of starved sedimentation. The last crinoidal packstone (bed 13b) is overlain by thick greenish silty shales with rare, small goniatites (Fig. 5) in its lower part. There are two new species of *Gattendorfia*, the first Moroccan *Eocanites* of the *supradevonicus* Group, *Acutimitoceras* (*Stockumites*) n. sp., *Imitoceras* n. sp., and rare gastropods. This new local member is named as *Gattendorfia* Shale. Even higher, to the south on the slope, and separated by a long gap in outcrop, there are deeply weathered shales with a few brownish sideritic nodules (Rharriz Formation). These contain the middle Tournaisian index goniatite *Protocanites* sp. and orthocones.

Main advantages of Lalla Mimouna North

Currently Lalla Mimouna North is the only known North African section with conodont-rich limestones from just below and above the Hangenberg Event Interval. To the east, in the Algerian Bechar Basin (Weyant 1988), both levels have been recognized in separate but closely adjacent sections.

The Lower Crinoidal Limestone includes rare *P. gracilis gracilis* and *B. ultimus* as well as *B. costatus* (Fig. 6) and, therefore, is of pre-Hangenberg age, correlating with the *praesulcata* Zone. There are also longer ranging taxa, such as, *B. spinulicostatus*, *Bispathodus aculeatus aculeatus* (Branson and Mehl, 1934), *Neopolygnathus communis* (Branson and Mehl, 1934*), Branmehla suprema* (Ziegler, 1962) and *Mehlina strigosa* (Branson and Mehl, 1934).

Bed 6 yielded a few siphonodellids, including curved forms ("S. *sulcata* s.l.") in direct association with the last *P. gracilis gracilis* and *B. ultimus*. They require further study and the bed was re-sampled in spring 2011 (results are not yet available).

Beds 1-6 are additionally characterized by frequent strange forms ("siphonodelloids", Fig. 6) that combine polygnathid platform shapes and ornament with *Siphonodella*-type large basal cavities. There are specimens with either narrow or wide platforms and with regular transverse or more irregular ornament. Marked anterior platform shoulders are typical. The basal cavities differ much from the smaller pits in the types of *Polgnathus inornatus* Branson, 1934 or *Polygnathus symmetricus* Branson, 1934. There may be relationships with poorly understood taxa, such as "*P*olygnathus" *spicatus* Branson, 1934 and *Pseudopolygnathus scitulus* Ji and Xiong, 1985. A closely related form was illustrated from the upper Wocklum Limestone of Drewer (Rhenish Massif) by Korn *et al.* (1994) as *P*olygnathus cf. *longiposticus* Branson and Mehl, 1934. The Lalla Mimouna specimens belong to a group of *Siphonodella*-relatives or ancestors that will be published by H. Tragelehn, based on extensive collections from Franconia and Thuringia. They prove that these phylogenetically significant taxa are not restricted to Germany. In addition, there are specimens (e.g., Figs. 6.7-8) with a morphological trend towards the *Pseudopolygnathus primus* Branson and Mehl, 1934 Group, which is normally absent in pre-Hangenberg beds. The definitions and pre-event relationships of polygnathids, pseudopolygnathids, and siphonodellids have to be re-considered (compare discussion in Spalletta *et al.,* 2011).

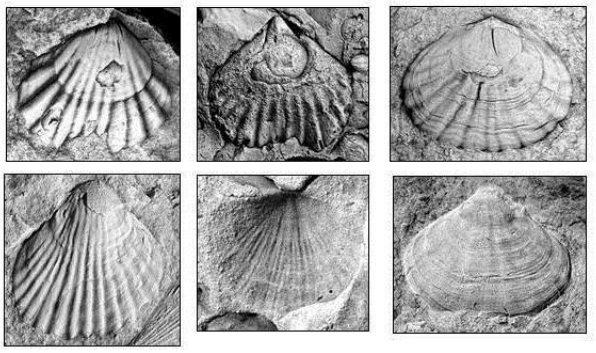

Figure 4: Rhynchonellids, orthids and other brachiopods from bed 7 (Fezzou Formation).

The siliciclastic, brachiopod-rich Fezzou Formation (bed 7) represents the glacially induced, eustatic Hangenberg Regression. The Hangenberg Black Shale was either not developed locally or it was cut out subsequently by submarine erosion during the main sea-level fall. The contact between beds 6 and 7 can be interpreted as a sequence boundary and the brachiopod siltstones as lowstand deposit. The brachiopods (Fig. 4) should allow a correlation with the much thicker contemporaneous clastics of the southern Maider and southern

Tafilalt, as well as with more distant clastic basins of the Dra Valley (Brice *et al.* 2007) and Algeria.

The gradual transition between the marly and crinoidal siltstones at the top of the Fezzou Formation and the subsequent Upper Crinoidal Limestones, especially in the lateral section, records a very gradual deepening (transgression during early post-glacial re-warming), without any gaps.

The main part of the Upper Crinoidal Limestone represents on a global scale one of very few sections where the *costatus-kockeli*-Interregnum (upper part of "Middle *praesulcata* Zone") contains abundant conodonts in a sequence of beds and without any evidence of reworking. Apart from long-ranging bispathodids, *Neopolygnathus communis*, and *Mehlina* sp., the strange "siphonodelloids" continue. There are no *Palmatolepis spp.*, as in southern Europe (Kaiser *et al.* 2009) and, unfortunately, also very few *Protognathodus* spp. in the upper event interval. Other "siphonodelloids" have been figured occasionally from even younger strata (e.g., *Pseudopolygnathus* cf. *dentilineatus* in Wang and Yin 1984, P*seudopolygnathus* cf. *multistriatus* in Yu 1988, *Polygnathus symmetricus* in Mawson and Talent 1999, a *P*olygnathus *inornatus* in Boncheva *et al.* 2007).

The *kockeli* (Upper *praesulcata*) Zone commences with bed 13, based on the index taxon. There are no clymeniids or goniatites at this level, only a few poorly preserved terebratulids. Section A of Korn *et al.* (2004), therefore, provides significant additional information from the same area.

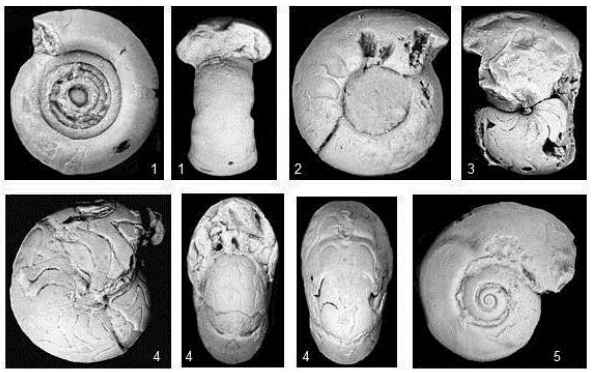

Figure 5: Goniatites and gastropod from the *Gattendorfia* Shale. 1. *Gattendorfia* aff. *jaquelinae*, lateral and adoral views, 2. *Gattendorfia* n.sp., 3. *Imitoceras* n.sp., 4. *Acutimitoceras* (*Stockumites*) n.sp., lateral adoral, and central views, 5. Almost planspiral gastropod.

The *Gattendorfia* Shale clearly falls in the lower Tournaisian but its fauna (Fig. 5) is very different and possibly older than the *Gattendorfia* faunas of the southern Maider (Ebbighausen and Bockwinkel 2007) and southeastern Tafilalt (Bockwinkel and Ebbighausen 2007).

Outlook

The Lalla Mimouna North succession and faunas fill gaps of the conodont and ammonoid succession of the eastern Anti-Atlas. Since the Hangenberg Black Shale is not developed and since the *Gattendorfia* faunas come from shale without conodonts, the section is not suitable as stratotype if the "*sulcata*", *Protognathodus kuehnei* Ziegler & Leuteritz, 1970 or Hangenberg extinction event levels are chosen for GSSP definition. If, however, the base of the *kockeli* Zone is taken into consideration, there is currently no known section in the world that has a better and more continuous conodont record from below and into the *kockeli* Zone. Current investigations at Lalla Mimouna North include: study of additional conodont faunas from new samples obtained in spring 2011, the taxonomy of ammonoids and brachiopods, microfacies analysis, and stable isotope analyses. Description of the "siphonodelloids" has to await the revision of pre-Hangenberg siphonodellids by H. Tragelehn.

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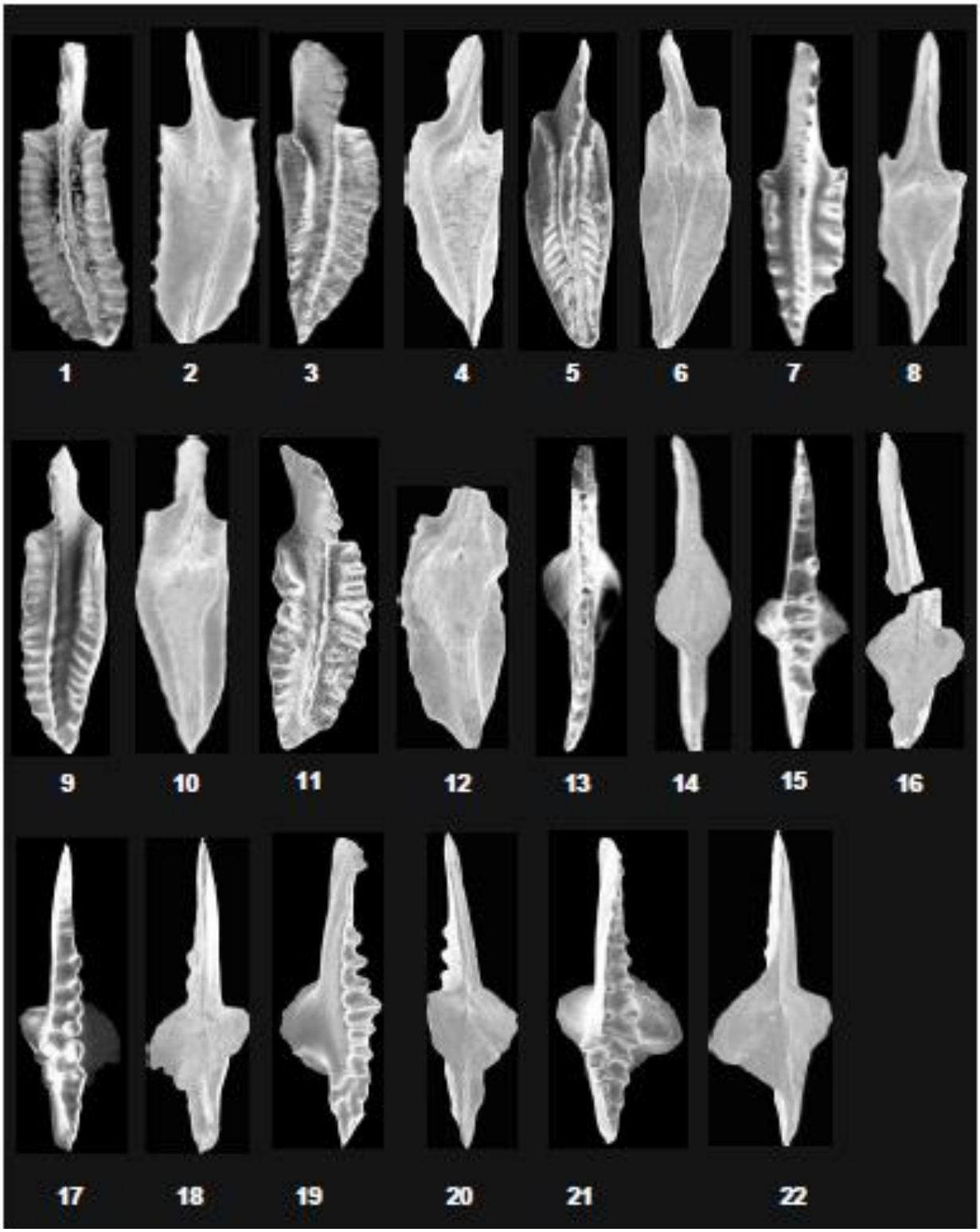

Figure 6: Conodonts from the base (Bed 1) of the Lower Crinoid Limestone. 1-6 and 9-12. various "siphonodelloids", 7-8. specimen with trend to the *Pseudopolygnathus primus* Gp., but with pronounced anterior platform shoulders and deep adcarinal troughs delimiting the transverse nodes and costae, 13-14. *Bispathodus stabilis vulgaris*, 15-16. *Bispathodus aculeatus aculeatus*, 17-18. *Bispathodus costatus* Morphotype 2, 19-22. *Bispathodus spinulicostatus*.

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MEETINGS

SCCS Activities in 2010-2011

Business meeting of SCCS at the *17th International Congress on the Carboniferous and Permian* at Perth

Future Meetings

2012

34th International Geological Congress

Dates: August 2-10

Venue: Brisbane Convention and Exhibition Centre, Brisbane, Australia

webpage: http://www.34igc.org

IGCP project 575 "Pennsylvanian terrestrial habitats and biotas of southeastern Euramerica"

Dates: September

Venue: 2 day indoor meeting at Luganski, Ukraine followed by 3 day field trip in the Donets Basin

Contact : Vladislav Poletaev, vlad_poletaev[at]ukr.net

webpage: http://igcp575.org/events.htm

For further information see the page 72.

2013

The Devonian and Lower Carboniferous of northern Gondwana

International Field Symposium of SDS and Task Group "Devonian-Carboniferous Boundary"

Dates: March 25 – April 1

Venue: Tafilalt area

The first circular is included into the newsletter.

The Carboniferous-Permian Transition

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

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

Dates: 20-22 May

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

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

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

For further information, please contact: iccp2015[at]ksu.ru; see also the announcement on the next page of the newsletter.

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

Past Meetings

17th International Congress on the Carboniferous and Permian

The abstract volume and many other documents on the Carboniferous and Permian succession of Western Australia can be still downloaded via the conference webpage.

http://www.iccp2011.org/gswa-publications.html

The proceedings of the congress will be published in a series of special volumes in different journals as Gondwana Research, Episodes, Geological Journal, ….

XVIII INTERNATIONAL CONGRESS ON CARBONIFEROUS AND PERMIAN

KAZAN, RUSSIA, August 7-15, 2015

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

Venue
The city of Kazan is one of the ancient cities in Russia. The population is 1.2 million people. It is a cultural and industrial center included in the UNESCO World Heritage list. The combination of Muslim and Christian monuments creates a unique atmosphere and scenery. The city of Kazan is easily accessable from Europe through Frankfurt, Moscow and Saint-Petersburg. The location of Kazan in the center of European Russia allows the organizers to propose the observation of a variety of sections and outcrops located in the several districts of Russia.

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

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

Geological excursions:

Pre-congress excursions:
1a. Lower Carboniferous of the **Saint-Petersburg region** (north-western Russia).
1b. Moscow basin. Stratotypes of the Serpukhovian, Moscovian, Kasimovian and Gzhelian stages.
1c. Southern Urals. Deep water successions of the Carboniferous and Permian.
1d. Middle Permian – Lower Triassic continental sequences in Vologda and Arkhangelsk regions (**North of European Russia**) and localities of flora, tetrapods, non-marine fishes and invertebrates.

Post-congress excursions
2a. Volga and Kama Region. Middle and Upper Permian.
2b. Central Urals. Carboniferous-Permian marine succession.
2c. Carboniferous reference sections, **Southern Urals**.
2d. Permian of Omolon massif, **North-Eastern Russia**

Mid-congress excursion:
3. Permian deposits along the Volga River.

Accommodation: A large variety of hotels is available in the city of Kazan.

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

For further information, please contact: iccp2015[at]ksu.ru

The information will be also available through the congress website: www.iccp2015.ksu.ru

Organizers: Russian Academy of Sciences, Interdepartmental Stratigraphical Committee of Russia, Carboniferous and Permian subcommissions of Russia, Kazan Federal University, Moscow State University, All-Russian Research Geological Institute, and International subcommissions on Carboniferous and Permian stratigraphy

IGCP project 575 "Pennsylvanian terrestrial habitats and biotas of southeastern Euramerica"

Another important meeting of considerable interest to many of our subcommission members is the September 2012 meeting for the International Geoscience Program (IGCP) project 575 "Pennsylvanian terrestrial habitats and biotas of southeastern Euramerica" (see project 575 description on IUGS website http://iugs.org under links). The meeting will be held in the town of Lugansk in Ukraine (2 days of talks) and be followed by an excursion to see the Upper Carboniferous of the Donets Basin near the village of Kalinovskoe, Ukraine (3 days). Several of our voting members and corresponding members including Vladimir Davydov and Katsumi Uyeno are project participants. The organizer, Vladislav Poletaev (e-mail: vlad_poletaev[at]ukr.net) has told SCCS member Svetlana Nikolaeva that SCCS members could join them for the meeting and field trip. This meeting and field trip should be useful and informative for SCCS members because we do not have a separate field meeting organized for 2012 and many of us are interested in seeing the Carboniferous succession in the Donets Basin. Details about the meeting will be posted for the project under events. The focus of the meeting and field trip will be terrestrial Pennsylvanian deposits but marine strata occur in the basin and it may be possible to get some of our members that are working in the Donets Basin to show us the best carbonate-dominated sections. SCCS members Vladimir Davydov and Katsumi Uyeno are project participants and can provide more information about the project and meeting.

FIRST CIRCULAR

International Subcommission on Devonian Stratigraphy (SDS)
IGCP 596 on "Climate Change and Biodiversity patterns in the Mid-Paleozoic"
Institut Scientifique, University Mohammed V – Agdal, Rabat

International Field Symposium

"The Devonian and Lower Carboniferous of northern Gondwana"

in memory of Dr. Volker EBBIGHAUSEN

25th March to 1st April, 2013

An international meeting hosted by SDS, IGCP 596, the Institut Scientifique, Rabat, and the D/C Boundary Task Group will take place in the Tafilalt/Maider areas (eastern Anti-Atlas, Morocco) in late March and early April of 2013. It is devoted to the richly fossiliferous Devonian and Lower Carboniferous of the region, with some focus on the boundary between both systems. The weather in March will be ca. 25-30° C during the day. The field symposium will come as a complete package of conference fees, accommodation, food and field transportation (4-wheel drive).

Organization
Institute Scientifique, University Mohammed V, Agdal, Rabat, Morocco
Institute of Geology and Palaeontology, Westphalian Wilhelms University Münster, Germany
UNESCO IGCP 596 on "Climate Change and Biodiversity patterns in the Mid-Paleozoic"
IUGS, International Subcommission on Devonian Stratigraphy (SDS)
Task Group Devonian-Carboniferous Boundary

Co-Sponsors
Hassan II Academy of Sciences and Technology, Morocco
UNESCO Young Scientist Initiative Program

Organizing Committee

Prof. Dr. A. EL HASSANI	Institute Scientifique, Rabat
Prof. Dr. A. TAHIRI	Institute Scientifique, Rabat
Prof. Dr. R. T. BECKER	WWU Münster, Germany
Prof. Dr. L. BAIDDER	University Hassan II, Casablanca
Dr. P. KÖNIGSHOF	Senckenberg Forschungsinstitute und Naturkundemuseum, Frankfurt
Dr. habil. D. KORN	Museum für Naturkunde, Humboldt University, Berlin
Dr. Z. S. ABOUSSALAM	WWU Münster, Germany
Dr. M. ARETZ	Université Paul Sabatier, Toulouse

Symposium Topics:
A – The impact of Mid-Paleozoic climate on evolution and palaeodiversity
B – Devonian chronostratigraphy – revisions, updates and regional correlations
C – The Devonian and Lower Carboniferous of North Africa
D – Open Session (Devonian/Lower Carboniferous)

Venue and Program
Current plans are to hold a one-day meeting with talks and poster contributions in a hotel of the Tafilalt area (NE Anti-Atlas, southern Morocco), where participants will be housed. The talks will be embedded in field trips to the Devonian and Lower Carboniferous of the Tafilalt and Maider. Additional talks, the Annual Business Meeting of SDS, and discussion rounds of IGCP 596 and the D/C Boundary Task Group will take place in the evenings. It is planned to show sections that have not been demonstrated during previous meetings and excursions. They will include:

1. A complete traverse through the Devonian, from the top Silurian to the uppermost Famennian
2. A sequence of Lower Carboniferous outcrops
3. Devonian/Carboniferous boundary sections of different facies settings
4. Sections with a focus on the climatically induced/influenced Devonian event succession

Accepted oral contributions will be 20 minutes (including discussion time). The conference room will be equipped for PowerPoint presentations and will have an overhead projector. Conference language is English. Poster presentations are encouraged in order to keep a tight schedule. Special time for poster presentation will be provided. Depending on the interest of participants, there is the option, on the way to Rabat, for an additional post-meeting excursion to the Devonian/Carboniferous of the Moroccan Meseta.

Preliminary Itinery

Day 1: Arrival
Arrival at Ouarzazate, stay there for the night. There are cheap daily morning flights from Agadir and evening flights from Casablanca International Airport. As an alternative you can use the Lexus buses leaving from Agadir, Marrakesch, Fes, or Rabat.

Day 2: The boundary between stable and Variscan Gondwana
Guides: R. T. Becker (with data from Münster research students) and L. Baidder
-- Drive from Ouarzazate towards the Tinerhir region.
-- Examination of the southern margin of the Variscan orogenic front S of Jebel Tisdafine, with reworked fossiliferous Lower to Middle Devonian re-deposited in Viséan conglomerates/breccias or olistolites.
-- Drive to the Tindjdad region, with examination of the autochthonous Devonian at Oued Ferkla.
-- Drive in the late afternoon to the Tafilalt area.
-- Welcome reception at a hotel of the Tafilalt region (still to be selected).

Day 3: Overview of the Devonian at the western margin of the Tafilalt Basin
Guides: R. T. Becker, A. El Hassani and L. Baidder
Complete Devonian traverse at El Khraouia in the NE corner of the Amessoui Syncline (southern Tafilalt). The section ranges from the basal Lochkovian *Scyphocrinites* Limestone to the argillaceous upper/uppermost Famennian with clymeniids. Some focus lies on the Pragian-Emsian transition, the Eifelian change from stable platform to turbiditic basin, Kacak, *pumilio* and Taghanic Events, and the Frasnian-Famennian boundary interval in a thick basinal setting.

Day 4: **Symposium**
Morning and afternoon: Oral and poster presentations in the hotel
Evening: **SDS Business Meeting**

Day 5: Devonian to Lower Carboniferous of the Amessoui Syncline (southern Tafilalt Plattform)
Guides: Z. S. Aboussalam, R. T. Becker, S. Hartenfels, D. Korn, J. Bockwinkel,
-- Middle to Upper Devonian at Oum el Jerane, with some focus on coral biostromes, the Taghanic Event in a neritic setting, Upper Givetian goniatite shales, shallow-water Frasnian and lower Famennian, and the Dasberg Event.
-- The Devonian-Carboniferous transition at El Atrous, starting in the middle Famennian, with thick topmost Devonian siliciclastics, partly with brachiopods, and ending with deep-water Middle Tournaisian shales.
-- Famennian of the Jebel Ouaoufilal region (eastern Amessoui Syncline), with isolated slabs of the *Annulata* Event interval, very rich ammonoid fauna of the Dasberg Event interval, and thick siliciclastics around the D/C boundary.
-- Short stop at the Upper Tournaisian at "Bouhamed" *(Korn & Bockwinkel)*
-- (option, if time allows: Frasnian-Famennian boundary interval in condensed facies).

Evening: **IGCP 596b Discussion**.

Day 6: Lower Carboniferous of the SE Tafilalt
Guides: D. Korn, J. Bockwinkel, M. Aretz, A. Tahiri et al.
Pelagic Lower Carboniferous with ammonoids, alternating with crinoidal or microbialithic limestones and mudmounds with neritic faunas, such as sponges, corals, and brachiopods.

Day 7: Upper Devonian to Lower Carboniferous of the Maider
Guides: D. Korn, J. Bockwinkel, R. T. Becker, Z. S. Aboussalam, S. Hartenfels,
-- The "Stockum level" at Lalla Mimouna *(Korn & Bockwinkel).*
-- The D/C boundary section Lalla Mimouna North *(Becker, Aboussalam & Hartenfels).*
-- The uppermost Famennian to Tournaisian of the Aguelmous Syncline *(Korn et al.).*
Evening: **D/C Boundary Task Group discussion**.

Day 8: Lower/Middle Devonian Events of the condensed western Tafilalt Platform
Guides: R. T. Becker, Z. S. Aboussalam
-- The lower Eifelian Chotec Event at Jebel Amelane.
-- Givetian/Frasnian bio- and event stratigraphy at Mdoura-East, with a focus on the Taghanic, Frasnes, Rhinestreet, and Kellwasser Events.
-- The Emsian at Jebel Ihrs, with a focus on the Chebbi, Upper Zlichov and Daleje Events.
Afternoon: Drive to Ouarzazate.

Optional post-meeting excursion to the Devonian-Carboniferous of the Moroccan Meseta
-- Drive from Ourzazate towards the Meseta, potential outcrops on the way (Day 1).
-- Carboniferous of the Meseta: probably of the Khénifra region: details to be specified (Day 2).
-- Oulmes area. Ain Jemaa: pelagic Eifelian, followed by Givetian reef, condensed and incomplete pelagic Upper Devonian, with the Hangenberg Event at the top; laterally with Eovariscan reworking of the whole succession. Moulay Hassane: Emsian to Famennian deeper-water succession of an adjacent tectonic block, overlain by synorogenic clastics with brachiopods near the D/C boundary (Day 3).
-- Oued Cherrat Zone: Emsian and Givetian reefs, locally (Ain-as-Safah) with condensed *Manticoceras* Limestone, followed by siliciclastic Famennian and an Eovariscan major reworking event (conglomerates) (Day 4). End of excursion in Rabat.

Abstracts
Abstract should not exceed two A4 pages, written in Times New Roman 11, and including references (to be formatted in the style of "Palaeo x 3"). An additional page with figures/photos is allowed. It is planned to publish the abstracts and excursion guide in the "Documents de l´Institute Scientifique" series.

Costs
Preliminary upper estimates for the complete package (conference fees, abstract book, accommodation, all food, transportation from and to Ouarzazate and in the field) are at 100 €/day. A precise calculation will be included in the 2nd Circular. It is planned to (partly) support the attendance of some young scientists and organization members.

Dates/Deadlines:
Answer to this Circular: ***March 15th 2012***
Second Circular will be sent: June 2012 (with all details, including payment)
Abstracts: ***October 31st 2012***
Registration fee: ***November 30th 2012***

Contact and correspondance:

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Director, Institut Scientifique RABAT
B.P. 703 RABAT-AGDAL
10106 RABAT, MOROCCO

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This Circular (and forthcoming information) can be viewed on the homepages of the Institut Scientifique, Rabat, and of SDS:
http://www.israbat.ac.ma/seminaires.htm
http://www.unica.it/sds/

PRELIMINARY REGISTRATION FORM

SDS- IGCP 596 - Institute Scientifique Meeting
Morocco, 2013

First name:

Surname:

Title:

Address:

(City) (State)

(Post or Zip code) (Country)

Phone: (office) (home)

E-mail address:

Fax:

I will attend the SDS/IGCP 596 meeting in the Tafilalt:

Yes No possibly

I will present a paper: ***Yes*** ***No***

Preliminary title:

I will present a poster: Yes No

Preliminary title:

I intend to publish a paper (s) in a meeting volume:

Yes No

I am interested in a post-meeting field trip (three days) to the Moroccan Meseta

Yes No

This form should be returned as soon as possible **(before March 15th, 2012)** to:

Prof Dr. Ahmed ELHASSANI,
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B.P. 703 RABAT-AGDAL
10106 RABAT, MOROCCO

Tel: + 212 537 77 45 48
Fax: + 212 537 77 45 40
E-mail: elhassani[at]israbat.ac.ma or
devonian2013[at]gmail.com

THE CARBONIFEROUS-PERMIAN TRANSITION
May 20-22, 2013

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

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

Organizing Committee:

Spencer G. Lucas (Albuquerque), James E. Barrick (Lubbock), Vladimir Davydov (Boise), William DiMichele (Washington, D. C.), Karl Krainer (Innsbruck), John Nelson (Champaign) and Joerg W. Schneider (Freiberg)

Schedule:

19 May: Pre-meeting fieldtrip to the Carboniferous-Permian transition section at Carrizo Arroyo, central New Mexico (limited to 25 participants)

20-22 May: Talks and posters.

21 May: Afternoon fieldtrip to Late Pennsylvanian Kinney Brick quarry

23-25 May: Post-meeting fieldtrip to Pennsylvanian-Permian rocks exposed in Joyita Hills-Cerros de Amado east of Socorro, New Mexico

Fieldtrips:

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

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

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

Symposium proceedings:

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

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

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

For further information contact:

Spencer G. Lucas	spencer.lucas[at]state.nm.us
James E. Barrick	jim.barrick[at]ttu.edu
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Joerg W. Schneider	schneidj[at]geo.tu-freiberg.de

THE CARBONIFEROUS-PERMIAN TRANSITION
PREREGISTRATION/EXPRESSION OF INTEREST

Name_____
Postal address_____
_____

Email address: _____

Meeting

I am definitely attending the meeting _____
I may attend the meeting _____

Fieldtrips

I hope to participate in:

Fieldtrip 1_____

Fieldtrip 3_____

Contributions

I intend to present an oral/poster/written contribution(s) with the tentative title(s):

Please return to:

Spencer G. Lucas
New Mexico Museum of Natural History
1801 Mountain Road NW
Albuquerque, New Mexico 87104 USA

FAX: 505-841-2808

EMAIL: spencer.lucas[at]state.nnm.us

Registration information will be sent by June 2012.

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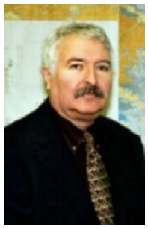

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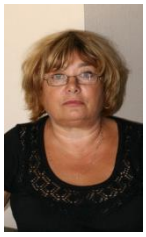	Dr. Olga L. Kossovaya VSEGEI Sredni pr. 74 199106 St. Petersburg RUSSIA olga_kossovaya[at]vsegei.ru		Dr. Elena I. Kulagina Institute of Geology Ufa Research Center Russian Academy of Sciences ul. Karla Marksa, 16/2 Ufa 450077 RUSSIA kulagina[at]anrb.ru
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