1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY

ANNUAL REPORT **2012**

SUBMITTED BY
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2. 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 at the top has been selected 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 subdivides the Carboniferous into two subsystems, the Mississippian Subsystem below and the Pennsylvanian Subsystem above. There are serious problems with the GSSP at the base of the Carboniferous (Kaiser, 2009), such that the boundary needs to be at least placed at lower stratigraphic position, and both a new event marker and stratigraphic section are probably required. The immediate SCCS goals are to redefine the Carboniferous-Devonian boundary and select the best stage boundaries within the two Carboniferous subsystems to facilitate global correlation within the system.

3. ORGANIZATION

3a. Officers for 2012-2016:
Chair: Barry C. Richards (Canada)
Vice-Chair: Xiangdong Wang (China)
Secretary: Markus Aretz (France)

Website

During the Nov. 1st, 2008 to Oct. 31st 2009 fiscal year, the SCCS established an official website www.nigpas.ac.cn/carboniferous but it is not up to date and is being reconstructed using a new platform. The present site has eight main pages containing the following information: 1) Homepage - list of SCCS officers, task groups and leaders, and voting members, 2) GSSPs - shows ratified GSSPs and those in progress, 3) Working Groups - lists task groups and provides latest task-group progress reports and work plans, 4) Annual Reports - includes annual reports submitted to the ICS by the SCCS, 5) News - information about current SCCS activities and progress, 6) Forthcoming Meetings - lists conventions for professional societies and field meetings that are relevant to membership goals and activities, 7) Newsletters - the current 2012 v. 30 issue and back issues of the Newsletter on Carboniferous Stratigraphy are available in pdf format for download, and 8) Links - provides web links to important websites such as those of the ICS and IUGS.

Membership

In addition to the three executive voting members, the SCCS has 17 rank-and-file voting members and approximately 280 corresponding members (see latest issue of Newsletter on Carboniferous Stratigraphy for contact information). The main business meetings of the SCCS are held every two

years, both at the quadrennial meetings of the International Congress on the Carboniferous and Permian (ICCP), and at a field meeting convened by the SCCS midway between the congresses. The last ICCP was the 17th, held in Perth Australia from July 3rd to 8th, 2011. The latest major field meeting was held in southern China from November 22nd to 30th, 2010 (see Newsletter on Carboniferous Stratigraphy, v. 29, p. 26-27, 30) but subordinate meetings and workshops are held every year as the opportunities arise. A SCCS business meeting is also held at the quadrennial International Geological Congress (IGC); the last was at the 34th IGC in Brisbane, Australia in 2012.

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 a task group established in early 2008 that is chaired by Markus Aretz (France) and comprises 10 members appointed by Thomas Becker former Chairman of the Devonian Subcommission (SDS) and 10 members selected by Philip Heckel former Chairman of the SCCS in 2008, who summarized the reasons for establishing the group in the 2008 issue of Newsletter on Carboniferous Stratigraphy [v. 26, p. 3]. Carlo Corradini is the Vice-chairman. Aretz has summarized the recent work of the group through October 2012 in this annual report and in volume 30 of the Newsletter on Carboniferous Stratigraphy.
Task Group to establish the Tournaisian-Viséan Boundary [which is also the base of the Middle Mississippian Series] is chaired by George Sevastopulo (Ireland). Using e-mail communications from the chairman, the recent activities of the group are summarized herein through October 31st 2012.
Task Group to establish the Viséan-Serpukhovian Boundary [which is also the base of the Upper Mississippian Series] is chaired by Barry Richards (Canada), who summarized the recent work of the group through October 31st, 2012 in volume 30 of the Newsletter on Carboniferous Stratigraphy and herein.
Task Group to establish the Bashkirian-Moscovian Boundary [which is also the base of the Middle Pennsylvanian Series] is chaired by Alexander Alekseev (Moscow State University, Russia), who summarized the recent work of the group through October 31st, 2012 in volume 30 of the Newsletter on Carboniferous Stratigraphy and herein. On June 15th, 2012 Dr. John Groves leader of the Bashkirian-Moscovian boundary task group since the middle of 2002 submitted his resignation to the SCCS executive. In August 2012, the SCCS Chairman Barry C. Richards appointed Dr. Alexander S. Alekseev as the new Chairman.
Task Group to establish the Moscovian-Kasimovian Boundary [which is also the base of the Upper Pennsylvanian Series], and the **Kasimovian-Gzhelian Boundary** is chaired by Katsumi Ueno (Japan). Ueno summarized the recent work of the group through October 31st, 2012 in volume 30 of the Newsletter on Carboniferous Stratigraphy and herein.
Project Group on Carboniferous magnetostratigraphy, chaired by Mark Hounslow (United Kingdom), who did not submit a progress report this year for the Newsletter on Carboniferous Stratigraphy but summarized the recent work of the group through June 2009 in volume 27 of the Newsletter on Carboniferous Stratigraphy.

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

The SCCS works closely with the subcommissions and task groups on Devonian (SDS) and Permian Stratigraphy (SPS) to establish the common boundaries with the Carboniferous. The SCCS expects to cooperate with the NSF-sponsored Chronos initiative, which has a website at www.chronos.org, and with the NSF-sponsored PaleoStrat community digital information system for sedimentary, paleontologic, stratigraphic, geochemical, geochronologic, and related data, hosted at Boise State University, and with a website at www.paleostrat.org . It also has established a working relationship with the Permian Research Group at Boise State, which has initiated a program of obtaining precise ID-TIMS U-Pb radiometric dates from biostratigraphically constrained uppermost Devonian to Permian successions in the Ural Mountains and elsewhere.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN November 1st 2011 - October 31st 2012 fiscal year

The **Newsletter on Carboniferous Stratigraphy, Volume 30**, to be published in February 2013 and available for download from our website, includes commentaries by the current SCCS executive on various current issues, summaries about field meetings and workshops, reports of the task groups for November 1st 2011 to October 31st 2012, and articles on various topics of interest. Volume 30 also 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 journal venues. During the last fiscal year, task-group and corresponding members have published a number of papers in refereed journals and in abstract volumes associated with conventions. Many of the most important of these publications are cited in the Annual Report.

Summary of Task Group Reports

The references and full text of the reports are provided in the references at the end of this report and in Appendix B, respectively.

Task group to redefine the Devonian-Carboniferous Boundary

Introduction and general activities

Members of the task group for the redefinition of the Devonian-Carboniferous (D-C) boundary are conducting paleontologic and multi-disciplinary research on several continents. Their work focuses on goals that were defined near the project's onset (Richards and task group, 2010) and at the 2010 Third International Palaeontological Congress (IPC3) in London, United Kingdom (Aretz, 2011). During the fiscal year, the group continued with it primary tasks – the search for a suitable criterion for the redefinition of the D-C boundary and the hunt for a suitable section for the GSSP. Studies by Ji *et al.* (1989) and subsequent analysis (Kaiser, 2009) demonstrated severe problems exist with the D-C boundary GSSP (Paproth *et al*., 1991) at La Serre Hill, France. The boundary at La Serre is currently defined by the first evolutionary occurrence of the conodont *Siphonodella sulcata* (Huddle, 1934) in the lineage *Siphonodella praesulcata* Sandberg, 1972 to *S. sulcata* but both the definition and the section are considered deficient. The current search for a boundary index is focused on conodonts and the geochemical-sedimentologic events in the multi-phase Hangenberg Event (Kaiser, 2005; Kaiser *et al*., 2008). More data on the precise timing of phases of the Hangenberg and the correlation of the biostratigraphic, geochemical, sedimentologic and sequence stratigraphic patterns within it are needed to evaluate the potential of the event for boundary definition. The group has been gathering such data and plans to present the results at a major D-C boundary workshop in Morocco from (March 25th to April 1st, 2013). A few task-group members attended the 34th International Geological Congress in Brisbane where a short discussion of research activities around the D-C boundary occurred during the SDS business meeting.

Progress reports from members

J. Kalvoda (Bruno, Czech Republic). Czech researchers have been working in Central and Western Europe and are accumulating large multidiscinplinary datasets for key sections in different facies and countries. Results of their multidisciplinary correlation of the D-C boundary sections from the Moravian Karst (Czech Republic) and the Carnic Alps (Austria) have been submitted to the Geological Magazine. Their study focused on the interval from the Middle *Palmatolepis gracilis expansa* Zone (late Famennian) to the *Siphonodella sandbergi* Zone (early Tournaisian). In the Lesní lom quarry (Moravian Karst), a positive $O^{13}C$ excursion in the *Bisphatodus costatus – Protognathodus kockeli* interval (in middle *Siphonodella praesulcata* Zone) from a laminated carbonate horizon was correlated to the Grüne Schneid section, Carnic Alps by using a carbon-isotope excursion. The carbonates in the Lesni lom section were interpreted as being equivalent to the Hangenberg black shales and a local expression of the global Hangenberg Event. Higher values of the Mn/Al ratio were documented from the level in the Moravian Karst (Lesní lom quarry, Mokrá) and Carnic Alps (Grüne Schneid). Up

section in the Moravian Karst sections (Lesní lom quarry, Mokrá, Křtiny), a significant increase in the terrigenous input, which is inferred from the gamma-ray signal and elevated concentrations of terrigenous elements (Si, Ti, Zr, Rb, Al, etc.), provided a correlation tieline interpreted as the equivalent of the Hangenberg sandstone. The presence of Famennian foraminiferal genus *Quasiendothyra* was documented up to the Tournaisian *Siphonodella bransoni* Zone in the Moravian Karst where the FAD of *Tournayellina beata pseudobeata* was recognized. The latter foraminifer, also reported from Belgium (Poty *et al*., 2006), the Urals (Reitlinger and Kulagina, 1987; Pazukhin *et al*., 2009) and China (Hance *et al*. 2011), represents an important event close to the D-C boundary. In contrast to the other sections, the Moravian sections enable the precise establishment of its FAD to the upper part of the *Bispathodus costatus – Protognathodus kockeli* interval.

Recent studies (Aretz and task-group, 2011) demonstrated there are serious issues with using conodonts for boundary definition. Because of the shortcommings of the conodonts, the correlative potential of geochemical and petrophysical signatures of phases in the Hangenberg event offer an alternative to the refining of the problematic biostratigraphic definition of the D-C boundary. The results obtained by the Czech team support the views of Walliser (1984) who regarded the Hangenberg Event as worldwide, synchronous, and a natural D-C boundary.

E. Poty and M. Aretz (Belgium and France)

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

C. Corradini (Cagliari, Italy)

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

T. Becker (Münster, Germany) and research group

Thomas Becker and his researchers continued their investigation of the Lalla Mimouna North section at the northern margin of the Maider region, SE Anti-Atlas, Morocco. All conodont samples collected during 2011 and the spring of 2012 have been processed and the identifications will be included in the Field Guide for the spring 2013 field symposium in Morocco as an update to the preliminary reports in the SCCS and SDS Newsletters (Becker *et al*., 2011; 2012). D. Brice submitted a faunal list of the brachiopods from the Hangenberg Sandstone interval (Fezzou Formation tongue), situated between the local pre- and post-Hangenberg Event crinoidal limestones. A new collection of ammonoids from the overlying *Gattendorfia* shale increases the number of basal Tournaisian ammonoid taxa and includes the first *Eocanites* from the section. The Münster isotope laboratory provided stable- carbon and oxygen-isotopes data for all beds sampled for conodonts and for samples from the adjacent section with “Stockum level” goniatites. Thin sections of all beds have been produced for microfacies analyses.

Malaysian colleagues, contacted Becker's group in relation to the succession of the Perlis region, where an occurrence of deposits that overly the Chepor Formation (Meor and Lee, 2005) and contain “*Posidonia*” (probably *Guerichia*) and ammonoids may lie within the Hangenberg Black Shale level. The deposits have been mostly overlooked by other D-C boundary workers but cooperation concerning

underlying Famennian conodont faunas was agreed upon and the black shale will be sampled for palynomorphs.

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

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

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

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

B. Ellwood (Baton Rouge, U.S.A.)

Brooks Ellwood and colleagues have been working on D-C boundary intervals in the Woodford Shale of Oklahoma, where there is fair knowledge of the conodont biostratigraphy. They have been sampling and measuring magnetic susceptibility on collected samples, and obtained gamma-ray measurements from outcrops and collected samples. Although they are working in silicified shale with limited biostratigraphic information, the sections are easily correlated over a distance of about 100 km using geophysical data.

Ji Qiang (Beijing, China) and his research group have worked in recent years on the D-C boundary and the phylogeny of *Siphonodella* in South China. The principal results of their work are outlined below. 1) Three D-C boundary sections in Muhua area of Guizhou Province are being re-studied, and additional conodont samples collected from them. According to the morphology, ornamentation and symmetry of the platforms, the ratio of platform to anterior blade dimensions, and the size, morphology and position of the basal cavity, four new genera of siphonodellids can be differentiated: *Protosiphonodella* n. gen., *Siphonodella*, *Eusiphonodella* n. gen. and *Eosiphonodella* n. gen. (Ji *et al*., in progress). Among them, only *Eosiphonodella* can be found in shallow-water facies. 2) The

phylogeny of the siphonodellid group is restudied, and the D-C boundary can be defined by the first occurrence of *Siphonodella sulcata* morphotype 1. 3) The *Protognathodus* is rare in China, and it is difficult to recognize the D-C boundary based on the first occurrence of either *Protognathodus kockeli* (Bischoff, 1957) or *Protognathodus kuehni* Ziegler & Leuteritze, 1970. 4) A bentonite layer occurs in bed E of the Dapoushang Member of the Wangyou Formation, and has provided a radiometric age of 359.6 Ma (Liu *et al.*, 2012). The age of the D-C boundary at Dapoushang, Guizhou province, South China, is estimated at 358.6 Ma or 359.58 Ma.

Barry Richards (Calgary, Canada)

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

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

Conodont data indicate the contact between the Devonian and Carboniferous lies in the upper part of the black shale member of the Exshaw at its type section and some other localities; but the position of the D-C boundary has not been precisely located.

Outlook

Results presented at the SDS/SCCS Morocco workshop in March 2013 will determine the future steps and directions of the group's work in the next years. The primary task of the group remains – to locate either a suitable event horizon or a suitable event in a biological lineage to define the D-C boundary.

Task Group to establish the Tournaisian-Viséan Boundary

Following approval of the proposed GSSP (see Devuyst *et al.*, 2003) at Pengchong in southern China, by the SCCS in late 2007 and its ratification by the ICS and IUGS, task-group member François-Xavier Devuyst had been preparing the final report about the Tournaisian-Viséan boundary GSSP but during last fiscal year, the task-group chairman George Sevastopulo took over that role.

Task Group to establish the Viséan-Serpukhovian Boundary

Introduction

During the past fiscal year, the task group made substantial progress toward establishing a GSSP for the Viséan-Serpukhovian Stage boundary. An index for boundary definition has been selected, but not voted on by the task group and SCCS for final approval, and work is well advanced at the two prime GSSP candidate sections: the Verkhnyaya Kardailovka in the southern Ural Mountains of Russia and the Nashui section in southern Guizhou Province, China. Work is continuing on other potential candidate sections for the GSSP in the Cantabrian Mountains of northwest Spain. For boundary definition, the group is using the first evolutionary appearance of the conodont *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957) –*Lochriea ziegleri. L. ziegleri* appears in the Brigantian Substage, which is somewhat below the current base of the Serpukhovian as defined by its lectostratotype section in the Zaborie quarry near the city of Serpukhov in the Moscow Basin, Russia (Kabanov *et al*., 2009, 2012). Task-group members are

conducting research on biostratigraphy, sedimentology and lithostratigraphy, stable-isotope geochemistry and magnetic susceptibility at several locations in Western Europe, Russia, China and North America.

The most important accomplishments were the publication of a comprehensive study of the foraminifers spanning the Viséan-Serpukhovian boundary at several sections in South China (Groves *et al*., 2012), the completion of the preliminary phase of an ammonite study across the boundary level in the Verkhnyaya Kardailovka section (Nikolaeva, in press), and completion of a comprehensive bed-by-bed sedimentologic and geochemical analysis of the Serpukhovian Sage in its type area, the Moscow Basin of Russia (Kabanov *et al*., 2012).

Meetings

34th International Geological Congress in Brisbane, Australia

Several task-group members attended the August 2012 congress in Brisbane and gave project-related presentations in various Symposia.

Progress in southern Urals,

During August 2012, task-group members worked at the condensed, deep-water, carbonate section along the Ural River opposite the village of Verkhnyaya Kardailovka on the eastern slope of the southern Ural Mountains in Russia. Nikolaeva and her colleagues have worked on the Kardailovka section for several years and published several syntheses about the ammonoids, conodonts, foraminifers and ostracodes (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 immediately above an interval containing elements transitional between *L. nodosa* and *L. ziegleri.*

In August 2011, the lower 22 m of the Verkhnyaya Kardailovka section including the boundary level was extensively excavated and additional excavation work across the boundary was completed in August, 2012. Following the excavations in 2012, the interval spanning the Viséan-Serpukhovian Boundary was systematically sampled for conodonts. Conodont samples had been collected from the section on several prior occasions but additional sampling was required to more precisely tie the conodont biostratigraphy into the new measurements and to confirm the FAD of *L. ziegleri* in the recently excavated boundary interval. In August 2011, the limestone-dominant component of the section was measured and sampled bed-by-bed for lithology and geochemical samples from about 12 m to 35 m above the section's base. During 2012 the sampling for lithology and geochemistry was completed into the lower Bashkirian.

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

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

Progress in southern Guizhou province, Nashui section

In the Nashui section in southern Guizhou province, the Viséan-Serpukhovian boundary is currently placed at 60.1m above the base of the original section measured by Qi and Wang (2005), which is equivalent to a position 17.94 m above the base of the new section measured and permanently marked by aluminum pins by the task group in 2008. In the Nashui section, conodonts within the *Lochriea nodosa* – L*ochriea ziegleri* lineage are well preserved and abundant (Qi, 2008). Elements transitional between *L. nodosa* and *L. ziegleri* are plentiful, occurring in several samples. The conodonts do not allow direct correlation from the Nashui section to the nearby shallow-water Yashui section because of their paucity in the neritic to restricted-shelf facies at the latter locality. The Yashui section was measured to determine the relationship of the coral and foraminiferal zones to the *L. nodosa – L. ziegleri* transition. During 2012, John Groves and colleagues completed their study of the foraminifers across the boundary interval in the section (Groves *et al*., 2012).

Progress in southern Guizhou province, Yashui section

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

The foraminiferal successions across this boundary in the type area of the Serpukhovian Stage in the Moscow Basin of Russia (Kabanov *et al*., 2009; Gibshman *et al*., 2009), the Uralian region of Russia (Nikolaeva *et al.,* 2005; 2009a,b) and in the central United States suggest that the appearances of *Asteroarchaediscus postrugosus* (Reitlinger, 1949), *Janischewskina 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.,* 2012). *Asteroarchaediscus postrugosus* and *Eolasiodiscus donbassicus*, useful markers for the base of the Serpukhovian elsewhere in Eurasia and North America, have not been observed at Yashui.

Progress Moscow Basin, type area of Serpukhovian

Recent biostratigraphic and sequence stratigraphic studies in the type area of the Serpukhovian in the Moscow Basin (Kabanov *et al*., in press) reveal that the first appearance of *Lochriea ziegleri* is in the uppermost Venevian Substage of the Viséan (about 3 m below its top) rather than in the lowermost Tarusian Substage of the Serpukhovian as previously reported. Nikolaeva *et al*. (2002) and Kabanov *et al*. (2009) reported that in the Zaborie quarry section, lectostratotype of the Serpukhovian Stage, *L. ziegleri* appears with *Lochriea senckenbergica* Nemirovskaya, Perret & Meischner, 1994 in the basal bed of the Tarusian but not as a first evolutionary appearance.

Task Group to establish the Bashkirian-Moscovian Boundary

Significant progress was achieved by the task-group members during last fiscal year. They have located a couple of conodont taxa that appear to have good potential for defining the base of the Moscovian Stage at a level near its current position (base of Vereian Substage) and have located a new index that could be used if the base was raised one substage higher. The Task group has also been evaluating several successions to locate suitable GSSP candidate sections. About10 taxa (conodonts

and fusulinids) were proposed during last five years as potential indices for the lower boundary of the Moscovian Stage, but only two - *Diplognathodus ellesmerensis* Bender, 1980 and *Declinognathodus donetzianus* Nemirovskaya, 1990 have received even moderate support from the task-group members. The relatively restricted geographic distribution of most of the proposed taxa has been the most important factor limiting their utility for boundary definition.

Data from the Nashui section in Guizhou province, South China (Qi *et al*., 2007; 2010; Groves and task group, 2011) continue to indicate that the first evolutionary occurrence of the conodont *D. ellesmerensis* in the lineage *Diplognathodus coloradoensis* Murray & Chronic, 1965 - *D. ellesmerensis* is one of the best potential markers the task group has investigated. Elements of *D. ellesmerensis* are easy to identify, the species has a wide geographic distribution (China, Russia, North America), and it occurs in the lowermost Moscovian strata (Alyutovo Formation; Kashirian regional Substage) in the type Moscovian area (Makhlina *et al*., 2001).

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

Donets Basin, Ukraine

During September 2012, Tamara Nemyrovska and colleagues worked in the Donets Basin, Ukraine and near the town of Malonikolaevka they sampled in detail the Bashkirian-Moscovian boundary interval including the marine-shale interval above limestone K_1. The conodonts from all of the limestone and shale beds will be studied for stable-oxygen isotopes to permit the reconstruction of paleoclimatic fluctuations, which are potentially important for long-distance correlations.

Katsumi Ueno and Tamara Nemyrovska have been working in the Donets Basin on the Bashkirian-Moscovian boundary in the Zolotaya and Malonikolaevka sections in the Lugansk region, eastern Ukraine. During October 2012, they continued with that work and collaborated with Titima Thassinee (Bangkok University, Thailand) to investigate a new section near the town of Shterovka, sampling the latter exposure for conodonts and fusulinids. In the Donets Basin, the Bashkirian-Moscovian boundary has traditionally been placed somewhere in the basal or lower part of the C_2^5 (K) formation (Einor, 1996). Of the three sections, the Malonikolaevka section recently provided some important information on the Bashkirian-Moscovian boundary (Ueno and Nemyrovska, 2008; Nemyrovska *et al*., 2010). In the Malonikolaevka section, the conodont and fusuline composite biostratigraphy was examined, with special attention given to the lower boundary of the Moscovian. It is important to note that, in the latter section, limestone K_1 registered the first occurrence of the conodont *Declinognathodus donetzianus*, which has been considered one of the best conodont species for defining the Bashkirian-Moscovian boundary (Groves and task group, 2009). Moreover, this limestone contains the first occurrence of strongly Moscovian-type *Eofusulina* in the fusuline fauna. The latter genus is also considered to have considerable potential as an index for defining the base of the Moscovian Stage (Groves and task group, 2011). Thus, Nemyrovska *et al.* (2010) consider the base of the Moscovian in the Donets Basin to lie within limestone K_1.

Saori Tanaka, a student of Katsumi Ueno, studied samples from the Malonikolaevka section (Tanaka, 2012). In limestone I_2^2 she found an elongate fusuline, which looks like a species of *Eofusulina*, and another elongated form that resembles specimens of *Verella transiens* reported from the Cantabrian Mountains of northern Spain (van Ginkel, 1987). Another important occurrence from limestone I_2^2 is a large rhomboidal *Profusulinella* that is somewhat similar to *P. rhombiformis* and resembles *Profusulinella albaensis* from the Alba Limestone (≈lower Kashirian) of the Cantabrian Mountains (van Ginkel, 1965). Whatever its exact age, the peculiar species resembling *Profusulinella albaensis* provides a good level of inter-regional correlation near the Bashkirian-Moscovian boundary.

The age of limestone I_2^2 has not been precisely determined and a discrepancy may occur between fusuline-based correlations and those based on conodonts because in the Malonikolaevka and Zolotaya sections fusulines of Moscovian aspect occur in strata below the conodont-based Moscovian base (FAD of *Declinognathodus donetzianus*).

South China

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

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

In 2012 Qi visited the U.S.A. to work with Jim Barrick and Lance Lambert on Bashkirian-Moscovian conodonts from South China and the United States. It was a productive trip because Qi found that *Diplognathodus ellesmerensis* is common in some North America collections. Thus, Yuping Qi and his colleagues think the FAD of *D. ellesmerensis* is the best marker for the base of the Moscovian and global correlation at that level. Although there are transitions for different morphologies of *Streptognathodus expansus* and *S. suberectus* in the Naqing (Nashui) section that may have utility for global correlations (Qi *et al*., 2010), it is thought their stratigraphic first occurrence is too low to permit their use as the basal marker of the Moscovian Stage.

Moscow Basin

Using conodont data from the Moscow Basin, Goreva and Alekseev (2012) proposed moving the lower boundary of the Moscovian one substage higher than the position discussed above; that is from the base of the Vereian regional Substage (lowermost Moscovian substage) to the base of Kashirian regional Substage. A proposed marker for the new level is the FAD of *Neognathodus bothrops* Merrill, 1972 from its ancestor *Neognathodus atokaensis* Grayson, 1984. Both species occur in the Midcontinent region of the U.S.A., Moscow Basin and South Urals of Russia, and the Donets Basin in Ukraine. The section containing the components of this lineage is the Yambirno quarry (Kabanov and Alekseev, 2011a, b), an abandoned quarry in the eastern part of the Ryazan region of central Russia. There is justification for shifting the boundary: 1) the Vereian ammonoid assemblage closely resembles that of the former regional Russian Kayalian stage (= upper part Bashkirian and Vereian) (Ruzhencev, 1969), 2) the Vereian brachiopods have characteristics that are typical of the Bashkirian taxa (Lazarev in Makhlina *et al*., 2001), and 3) the Vereian conodont assemblage consists mainly of genera that are widely distributed in the Bashkirian and include the important genera *Idiognathoides* and *Declinognathodus*, a taxon that does not cross the Vereian-Kashirian boundary.

<u>Task group to establish the Moscovian–Kasimovian and Kasimovian–Gzhelian boundaries</u>,

Task-group activities are focused on the study of fusulines and conodonts from sections in South China, the Midcontinent region of the U.S.A. and Russia. Substantial progress has been made on

locating an event marker for the Moscovian-Kasimovian boundary and the FAD of a conodont has been selected for definition of the Kasimovian-Gzhelian boundary.

MOSCOVIAN-KASIMOVIAN BOUNDARY

Introduction

In recent years, the task group has thought the first appearance datums (FADs) of *Idiognathodus sagittalis* Kozitskaya, 1978 and *Idiognathodus turbatus* Rosscoe and Barrick, 2009 have good potential as markers for the base of the Kasimovian (Villa and task group, 2008; Ueno and task group, 2011). Their occurrence (near base of Khamovnikian Substage, the second substage of the Kasimovian in current definition) is approximately one substage higher than the traditional base of the Kasimovian (base of Krevyakinian Substage). Raising the boundary level one substage higher would facilitate global correlation and most task-group members consider it appropriate to narrow the focus of study to an interval that encompasses the FADs of these conodonts. A formal proposal for the marker species that will define the base of the Kasimovian Stage has not been presented and voted on.

Progress in North America

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

Progress in South China

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

Progress in Spain

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

In addition, the Spanish team are investigating the Vegas de Ándara section (also in the Ándara Massif), where late Moscovian to middle Kasimovian strata are present. Recent investigations by the Spanish group confirmed the completeness of the fusuline record in the area and facilitated the discovery of beds providing assemblages of the *Fusulinella schwagerinoides*, *Protriticites*, and *Montiparus* zones. A thick stratigraphic interval shows the gradual transition from *Fusulinella* to *Protriticites* species. Apart from species belonging to the *Fusulinella-Protriticites-Montiparus* lineage, the sections also yielded species belonging to *Fusiella*, *Pseudotriticites*, *Ozawainella*, *Pseudostaffella*

(*Quasistaffella*), and *Schubertella*, as well as some forms questionably and tentatively assigned to primitive *Quasifulina*. A systematic study of these fusulines is currently in progress.

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

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

Intensive sampling for conodonts in Spain has revealed that only some open-marine to deep-water lithofacies provide a significant number of specimens. At several localities, new samples were collected from beds yielding scarce but important taxa. Such is the case of the Krevyakinian beds (currently the lower substage of Kasimovian) from the Morra de Lechugales section, which contain a middle-sized element of *Idiognathodus* sp. 1 of Goreva *et al.* (2009), the proposed ancestor of *I. sagittalis*.

Progress in Russia

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

Ukraine

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

KASIMOVIAN-GZHELIAN BOUNDARY

Introduction

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

Progress in North America

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

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

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

Progress in South China

Qi Yuping and Jim Barrick continued with their intensive study of the conodonts across the Kasimovian-Gzhelian boundary in the Naqing section (Nashui section) in southern Guizhou province of South China (Barrick *et al*., 2010) using closely-spaced samples. In that section, *Idiognathodus simulator* appears abruptly in a diverse conodont fauna, but the immediately underlying beds have yielded few conodonts. Forms ancestral to *I. simulator* occur in strata a few meters lower in the section but are not especially common; consequently, the section does not appear to be a good candidate for the boundary stratotype.

Progress in Russia

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

Alexander Alekseev and colleagues from Moscow, together with Olga Kossovaya, continued with their investigation of the Yablonevyy Ovrag quarry section in the Zhiguli Mountains, Samarskaya Luka. This completely exposed section in the Samara Bend of the Volga River about 800 km east of Moscow extends from the upper Kasimovian up to the Sakmarian Stage of the Permian. The section is the hypostratotype of the Gzhelian and shows a nice basal Gzhelian conodont assemblage with *I.*

*simulato*r; however, conodonts are scarce in strata below the level containing *I. simulator* and *I. eudoraensis* has not been found. Related to the work at the Yablonevyy Ovrag quarry, they visited the Kholodny Log section on the Kosva River in the Perm region in 2010. At the latter locality, they found an interesting interval close to the Kasimovian-Gzhelian boundary but conodonts (including *Streptognathodus pawhuskaensis*) and fusulines were not abundant enough to precisely locate the boundary.

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

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

Project Group on Carboniferous Magnetostratigraphy

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

During the May 31st to June 3rd 2010 ICS meeting in Prague, the task-group leader discussed with Barry Richards and Svetlana Nikolaeva 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. These initial discussions have not developed into tangible outcomes and the main problems stem from a lack of funding and suitable investigators.

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

CONFERENCES AND FIELD MEETINGS NOVEMBER 1ST, 2011 - OCTOBER 31ST, 2012

There were several geological conferences, field meetings and workshops that were of interest to SCCS members but the most significant meeting was the 34th International Geological Congress in Brisbane, Australia. Several voting members of the subcommission attended the congress in Brisbane (5th - 10th of August 2012) and gave project-related presentations in various Symposia including 35.7

"The Devonian-Carboniferous-Permian Correlation Chart" chaired by Manfred Menning. In this Annual Report, we summarize relevant components of the SCCS business meeting held at the IGC. The full report from the business meeting will be published in volume 30 of the Newsletter on Carboniferous Stratigraphy.

Report on business meeting at 34th International Geological Congress

The report is based on information presented at the joint business meeting for the Subcommission on Carboniferous Stratigraphy (SCCS) and Subcommission on Permian Stratigraphy (SPS) on Tuesday evening of August 7th, 2012. In attendance were the SCCS Chairman Barry Richards, Secretary Markus Aretz, and several regular SCCS voting members. The meeting was attended by some SCCS corresponding members and members of the Subcommission on Permian Stratigraphy including the outgoing Chairman Charles Henderson and the new Chairman Shuzhong Shen. At the end of the meeting, SCCS members attended the meeting of the Subcommission on Devonian Stratigraphy (SDS), convened by the outgoing Chairman Thomas Becker, to discuss the status of the Devonian-Carboniferous Boundary GSSP at La Serre, France. The report is based on minutes taken by voting member Svetlana Nikolaeva and PowerPoint presentations for the SCCS and SDS meetings.

Resignation of John Groves, leader of the Bashkirian-Moscovian boundary task group

In June John Groves, Chairman of the Bashkirian-Moscovian Boundary task group since the Utrecht ICCP in 2003, stepped down from the position and from voting membership in the SCCS. We gratefully acknowledge his leadership role and the important contributions he made toward the establishment of the GSSP for the Bashkirian-Moscovian Boundary. He was also an active participant on the Viséan-Serpukhovian task group, recently completing a major study (Groves *et al*., 2012) of the foraminifers at the proposed boundary level – the FAD of the conodont *Lochriea ziegleri*. John accepted a position with the Carmeuse Group and indicated he could not pursue his Carboniferous biostratigraphic research while working for Carmeuse.

At the business meeting, I indicated it was necessary to appoint a new task-group leader and asked those present to suggest potential replacements. At the meeting, the geoscientists suggested as potential replacements were: Alexander S. Alekseev (Russia), and Qi Yuping (China).

Website for Subcommission on Carboniferous Stratigraphy

The SCCS website is in poor condition and I have received numerous complaints about it from the ICS Chairman Stan Finney and SCCS members. A major problem with our site is it has not been possible to update its main components during the last fiscal year. The website is stored on a server at the Nanjing Institute of Geology and Paleontology in Nanjing, China and maintained by Fan Junxuan, the webmaster for the ICS. The apparent causes of our problems are antiquated software and Fan's other commitments.

Good news- immediately prior to the joint SCCS and SPS meeting, Shuzhong Shen informed me that our website in Nanjing was being replaced by a new one and during the August 9th meeting of the ICS at the 34th IGC, Fan Junxuan told me the software for our website was not adequate and that the entire site was being reconstructed.

Newsletter on Carboniferous Stratigraphy

I reminded those present that it was time to prepare articles for the next issue of the Newsletter on Carboniferous Stratigraphy (volume 30 for 2012). We also discussed the editing of the newsletter. Now that we have an ISSN number for the online version of the Newsletter (delivered by downloading from the SCCS website when it was functional) I would like to improve the articles by sending them out to SCCS members for critical review and for assistance with editing for grammar, spelling and scientific content. In particular, it has been substantial work for Markus Aretz and me to review and edit papers written by many of our authors who do not use English as their native language.

Work plans A. next important meetings

During 2013 there will be several conventions and meetings of substantial interest to our members. Four of the meetings were discussed at our business meeting but for a more complete listing of the

meetings and their content, see the sections of the 2011 and 2012 Newsletter on Carboniferous Stratigraphy that deal with meetings.

Meeting 1: The Devonian and Lower Carboniferous of northern Gondwana

Dates: March 22nd – March 29th, 2013

Venue: Institute Scientifique, University Mohammed V – Agdal, Rabat, Morocco

Contact: Prof Dr. Ahmed Elhassani, Director, Institut Scientifique Rabat B.P. 703 Rabat -Agdal, 10106 Rabat, Morocco; Telephone: + 212 537 77 45 48; E-mail: elhassani@israbat.ac.ma or devonian2013@gmail.com

Webpage: http://www.israbat.ac.ma/seminaires.htm

The meeting includes one day of oral and poster presentations and six days of field trips in the eastern Anti-Atlas Mountains of Morocco.

Meeting 2: The Carboniferous-Permian Transition

Dates: 20th -22nd May, 2013

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

Contacts: For further information contact: Spencer G. Lucas - spencer.lucas@state.nm.us or James E. Barrick - jim.barrick@ttu.edu

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

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

Dates: 1st July to 7th July, 2013

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

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

The 1St International Congress on Stratigraphy will be held under the auspices of the International Commission of Stratigraphy and ICS Chairman Dr. Stan Finney has urged all of the subcommission chairs to attend. Stan would like to hold the executive business meetings of the ICS at this venue instead of at the very expensive quadrennial meetings of the International Geological Congress. Future congresses could become the primary venue for carrying out ICS business particularly business meetings of subcommissions. The scientific program for the 1st International Congress on Stratigraphy comprises 22 sessions covering three main themes: A - Principles and methods, B - Regional stratigraphy, and C -Applied stratigraphy.

Meeting 4: XIVIII International Congress on the Carboniferous and Permian

Dates: August 7-15, 2015

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

Contact: iccp2015@ksu.ru

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

The 2015 ICCP in Kazan is the most important of the upcoming meetings and many of our members will be deeply involved with the organization, leading field trips and giving presentations. The first circular was published in volume 29 of the newsletter and the second circular will be ready in 2014.

Work plans B: Formal ICS recognition of substages

During the meetings of the International Commission of Stratigraphy at the 34th IGC in Brisbane, Australia, the full body of the ICS including the executive and subcommission chairs will discuss the formal ICS recognition of substages. Should the ICS call for the formalization of substages, major

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

Work plans C: Division of the Tournaisian and Viséan

Division of some of the longer stages in the Carboniferous such as the Tournaisian and Viséan might be useful to facilitate more precise Global correlation; however, before embarking on division of such stages, we will ask our voting members to prepare formal proposals for such division and have those proposals voted on via ballots by the full body of the SCCS voting members. In the case of the Tournaisian and Viséan, some of our members have made substantial progress toward developing proposals. The suggestion to divide the Tournaisian and Viséan was met with considerable enthusiasm but we have not followed through with the establishment of task groups to establish GSSPs for division of the two stages. Until recently, the SCCS executive thought the subcommission had enough work to complete without the added burden of establishing additional stages. Also, Stan Finney wants to see the present stage boundaries defined by GSSPs before we consider additional work.

Work plans D: Our principal mandate

The establishment of GSSPs for the Carboniferous and its main subdivisions is our principle mandate from the ICS. During the next four-year term, the ICS executive wants to have the SCCS establish GSSPs for as many of the Carboniferous Stage boundaries as possible. At present, GSSPs need to be established for the Viséan-Serpukhovian, Bashkirian-Moscovian, Moscovian-Kasimovian and Kasimovian-Gzhelian boundaries. In addition, the GSSP at the base of the Tournaisian has been reassessed and both a new marker event and a new section will probably be required for that boundary. Based on the information our task-group leaders have provided us in the last two issues of the SCCS annual report to the International Commission of Stratigraphy and volume 29 of the Newsletter on Carboniferous Stratigraphy, we are confident that during the next four years GSSPs can be established for most of the boundaries with the possible exception of the base of the Tournaisian.

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

Markus Aretz indicated another problem is the final report on the Tournaisian-Viséan Boundary GSSP has not been published. I indicated Francois-Xavier Devuyst was working on the paper but the task-group Chairman George Sevastopulo did not know when it would be finished.

Work plans E: ICS encyclopedia of stratigraphy project

At the end of the SCCS component of the business meeting, I provided some information about the Encyclopedia of Stratigraphy project, which is coordinated by the ICS Chair Dr. Stan Finney and will be published in the encyclopedia series of Springer. The SCCS has been asked to work on a series of short to moderate-length articles dealing with various aspects of Carboniferous stratigraphy including Carboniferous chronostratigraphic-geochronologic units and the stratigraphic framework of important regions and basins. The subcommission has agreed to participate in this major project and the SCCS Chairman and Assistant Chairman will coordinate the contribution of the SCCS. An outline showing the main topics has been prepared.

I sent a version of our outline for the encyclopedia project to Chairman Stan Finney on October 27, 2011 and modified it in November after receiving his comments. By August I had not received any additional instructions from Stan Finney and told those attending our SCCS meeting that I thought he would address the issue at our closed ICS business meeting at the 34th IGC on Thursday night August 9th.

GSSP for base of Carboniferous at La Serre, France

During the final part of the SCCS business meeting, I briefly discussed the current status of the Devonian-Carboniferous Boundary GSSP at La Serre France and the ongoing work being done by the D-C Boundary reappraisal task group. I showed location maps, photographs, and a stratigraphic log of the section.

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

6. CHIEF PROBLEMS ENCOUNTERED IN 2012

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

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

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

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

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

7. SUMMARY OF EXPENDITURES IN 2012: STATEMENT OF OPERATING ACCOUNTS FOR NOVEMBER 1st, 2011 TO OCTOBER 31st, 2012

Prepared by Barry Richards, Chairman SCCS
(Accounts maintained in Canadian currency)

INCOME (November 1, 2011 – October 31, 2012)

IUGS-ICS Grant; June 3, 2012 (US $3,000 = $3,012.00 Cdn.)	$3,012.00
Donations from Members; November 1, 2011 - October 31 2012	$200.00
Interest Bank of Montreal; November 1, 2011 - October 31, 2011	0.05
TOTAL INCOME	**$3,212.05**

EXPENDITURES (November 1, 2011 – October 31, 2012)

Bank Charges: Bank of Montreal July 14, 2011	$0.00
Richards travel to Brisbane Australia for 34th International Geological Congress; Aug. 05 - Aug. 10, 2012	$2000.00
Registration support for SCCS chairman for 34th IGC, Brisbane, Aug. 5t- Aug. 10, 2012	$500.00
Travel support for a SCCS voting member to attend 34th IGC and give oral presentations	$500.00

Travel support for SCCS chairman to attend SCCS field meetings in southern Urals, Russia in August 14 - 31, 2012	$500.00
TOTAL EXPENDITURE	**$3,500.00**
BALANCE SHEET (2011 – 2012)	
Funds carried forward from October 31, 2011	$994.57
Plus Income November 1, 2011 – October 31, 2012	$3,212.05
Total assets	**$4,206.62**
Less Expenditures November 1, 2011 – October 31, 2012	$3,500.00
BALANCE CARRIED FORWARD (to Nov. 1, 2012 - Oct. 31, 2013 fiscal year)	**$706.62**

8. WORK PLANS, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2013):

The following activities are planned for the Nov. 1, 2012 to Oct 31, 2013 fiscal year by the task groups, as communicated by task-group chairs and distilled from the reports in # 5 above, for which the full texts including references are in Appendix B.

Devonian-Carboniferous boundary During the 2013 fiscal year, the primary tasks for the D-C Boundary task group will be the location of a suitable event marker to define the boundary and the discovery of a suitable section for the GSSP. A biostratigraphic analysis by Ji Qiang and his colleagues (Ji *et al*., 1989) and further work (Kaiser, 2009) indicates that there are problems with the D-C Boundary GSSP (Paproth *et al*., 1991) at La Serre, France and the conodont lineage used for boundary definition.

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

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

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

At recent meetings, it has been proposed that the task group consider using some component of the multiphase Hangenberg Event Interval (Kaiser *et al*., 2008) for boundary definition. Markus Aretz has asked members to prepare for the D-C boundary workshop in Morocco from (March 22nd to 29th, 2013; see circular in v 30 of Newsletter on Carboniferous Stratigraphy), by developing precise correlation charts for their regions of study showing the biostratigraphic, geochemical and depositional events within the Hangenberg Event.

Several of the D-C boundary projects that are planned for next four to five years are outlined below. 1) Vladimir Pazukhin along with Yuriy Gatovsky and Lyudmila Kononova (Moscow State University) plan to complete a monograph on the conodont biostratigraphy of D-C boundary interval in the Ural Mountains of Russia. The study will consider the interval from the Famennian *marginifera* Zone into the Tournaisian *isosticha* Zone. 2) Chinese colleagues along with the SCCS executive and task-group leaders initiated a re-assessment of the best D-C boundary sections in China by visiting the Dapoushang section (Ji *et al*., 1989) in southern Guizhou Province during the November 22nd - 29th 2010 SCCS workshop and field meeting. 3) Task-group member Jiri Kalvoda and colleagues from the Czech Republic are conducting a multidiscipline project to study the D-C Boundary interval in Western and Central Europe including the La Serre section. The project's principal goal is the correlation of evolutionary changes in foraminifer and conodont faunas in the D-C Boundary interval with a high-resolution stratigraphic framework arising from multidiscipline stratigraphic-paleoenvironmental analysis. Anticipated benefits of the project for the ICS and SCCS are a better understanding of the *S. praesulcata - S. sulcata* lineage and whether or not it is suitable for definition of the D-C Boundary GSSP. Other conodont lineages relevant to the boundary (protognathodids lineages) will also be evaluated. The resulting high-resolution stratigraphy will be used to test the isochroneity of the events within the Hangenberg Event Interval and contribute to a better correlation between basinal and shallow-water successions. 4) In western Canada, Barry Richards intends to continue ongoing studies of the latest Famennian to early Tournaisian Exshaw Formation (see Richards *et al*., 2002) and its correlatives to see if the main events in the multi-phase Hangenberg Event Interval can be more precisely located in the formation by using a multidisciplinary approach that includes radiometric dating. The work is part of a broader investigation intended to access the hydrocarbon resources of the interval and will include examination of coeval correlatives (including Bakken Formation) in adjacent areas. 5) Carlo Corradini has several ongoing projects related to the D-C boundary study in various part of northern Gondwana. In Sardinia (Italy) the Monte Taccu section has been resampled, and a new section has been measured in the Clymeniae limestone of the southwestern part if the island. Further studies of D-C sections are being conducted in Iran (collaboration with A. Bahrami) and in the Montagne Noire of France. 6) Thomas Becker (Münster) and his research group plan to continue their investigation of the D-C boundary transition in Morocco, particularly at the Lalla Mimouna North section at the northern margin of the Maider region, SE Anti-Atlas Mountains. They are preparing the field guide for the spring 2013 field symposium that will be held in Morocco (The Devonian and Lower Carboniferous of northern Gondwana; March 22nd – 29th, 2013). The full set of conodont identifications from samples collected during 2011 and 2012 will be included in the Field Guide as an update to the preliminary reports in the SCCS and SDS Newsletters (Becker *et al*., 2011; 2012).

It is anticipated that the results from recent D-C boundary investigations that will be presented at the Morocco workshop in March 2013 will determine the future steps and directions of the task group's work in the next years. The primary task of the group remains, however, to locate either a suitable event horizon or a suitable event in a biological lineage to define the D-C boundary.

Tournaisian-Viséan boundary The task group plans to continue with preparation of the final manuscript for the project. George Sevastopulo, the task group chairman, is leading that work.

Viséan-Serpukhovian boundary The task group has determined that the FAD of the conodont *Lochriea ziegleri* in the lineage *Lochriea nodosa -Lochriea ziegleri* is the best index for boundary definition and plans to draft a proposal advocating the use of that index. During the 2013 and 2014 fiscal years, the team plans to direct its attention toward selecting the best candidate section for the GSSP. The best two candidate sections are the Nashui section by the village of Naqing in southern Guizhou Province, China and the Verkhnyaya Kardailovka section on the Ural River in southern Russia. A third section by the village of Millaró in the Cantabrian Mountains of northern Spain may have potential rivaling that of the others.

Activities in South China

The deep-water (slope), carbonate-dominant Nashui section in southern China is an excellent candidate for the GSSP at the base of the Serpukhovian because the *L. nodosa-L. ziegleri* lineage is well defined and the FAD of *L. ziegleri* has been precisely located. The conodont studies for the locality are essentially complete and the FAD of *L.* ziegleri is located at 60.10m (Qi *et al*., 2010) above the base of the section. In addition, John Groves and his colleagues (Groves *et al*., 2012) have completed their study of the foraminifers in the section, thereby finishing most of the work needed for that important fossil group. Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the boundary interval are less advanced than the paleontological investigations and will be the focus of the team's work in the next two fiscal years. To place the Nashui section into its sedimentologic and paleoenvironmental context and to determine the relationship of shallow-water coral zones to the deeper-water *L. nodosa - L. ziegleri* transition in south China, the investigation of three reference sections - the Yashui, Dianzishang, and the Luokun sections - will continue.

The most important reference section for Nashui is the Yashui section, near the city of Huishui in Guizhou province. It is an important section because it contains abundant well-preserved rugose corals and foraminifers (Wu *et al*., 2009; Groves *et al*., 2012) and is dominated by shallow-marine, neritic- to peritidal-ramp facies. In 2010 the Yashui section was measured and described by at a bed-by-bed level of detail and sampled by team members for lithology, conodonts, foraminifers, and rugose corals. 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 2013 and 2014.

Strata in the Dianzishang section, situated by Dianzishang village along the Zin Zai River 1 km upstream from the Red Flag Bridge, are intermediate between the lower-slope to basin deposits at Nashui and the shallow-marine ramp deposits at Yashui. The Dianzishang section includes spectacular syndepositional slump deposits formed in slope settings and provides another opportunity to see conodonts and foraminifers spanning the *L. nodosa- L. ziegleri* transition in the region. In February 2010, task-group members measured 72.7 m of strata extending from the uppermost Viséan into lowermost Bashkirian. Conodont work at the locality has been completed to the extent that the Viséan-Serpukhovian boundary has been located using the *L. nodosa - L. ziegleri* transition. John Groves completed his study of the foraminifers in the section during the 2012 fiscal year. Work on the sedimentology, stable-isotope geochemistry and geophysical characteristics of the boundary interval and section are not as advanced as the paleontological studies and will be an important aspect of the work at the locality in the next two fiscal years.

During 2010, the task group commenced measuring and sampling of the Luokun section, situated by the village of Luokun several kilometres from Naqing and the Nashui section. Like the Nashui section, the exposure at Luokun is essentially 100% complete but dominated by slope carbonates of that are more proximal aspect than those at Nashui. Study of the section will provide another opportunity to see conodonts and foraminifers spanning the *L. nodosa- L. ziegleri* transition in the region. Foraminifers are more abundant and better preserved than at Nashui, and it is anticipated that a better correlation between conodonts and foraminifers can be achieved by the study of the Luokun section. Study of all aspects of the section is at a preliminary level but sufficient biostratigraphic work has been completed to locate the approximate positions of the Viséan-Serpukhovian and Serpukhovian-Bashkirian stage boundaries. During 2013, the task group plans to complete the measurement and sampling of the section at a bed-by-bed level.

Activities in Southern Urals, Russia

With its conodonts characteristic of the *L. nodosa-L. ziegleri* transition, abundant ammonoids, and moderately common foraminifers, the Kardailovka section, a deep-water, basinal-carbonate succession on the Ural River near the village of Verkhnyaya Kardailovka in the Urals remains the other strong candidate for the Viséan-Serpukhovian boundary GSSP. Conodonts, foraminifers and ammonoids in

section have been studied in detail (Nikolaeva *et al*., 2009; Pazukhin *et al*., 2010) but additional work is required. Sufficient conodont work been done to locate the approximate position of the FAD of the conodont *L. ziegleri* in the lineage *L. nodosa-L. ziegleri* but additional collecting of closely-spaced samples may be required to more completely document the transition and precisely locate the FAD of *L. ziegleri*. Work on the sedimentology, stable-isotope geochemistry and geophysical characteristics of the section is less advanced than the paleontological work and will be a focus of the team's investigations in 2013. The team is currently preparing a preliminary paper on the lithostratigraphy and sedimentology of the lower part of the section including the boundary interval for publication in the proceedings volume arising from The Carboniferous-Permian Transition Conference being held in Albuquerque New Mexico from May 20-22, 2013. The Kardailovka section 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.

Activities in Cantabrian Mountains, northern Spain

Several well-exposed sections span the Viséan-Serpukhovian boundary in the Cantabrian Mountains of northwestern Spain. The Millaró section by the village of Millaró in the fold and Nappe province of the Cantabrian zone, is excellent rivaling the better known Kardailovka and Nashui exposures. Conodonts within the *L. nodosa - L. ziegleri* lineage are well preserved and abundant; in addition, the first occurrence of *L. ziegleri* has been located with moderate precision. A major biostratigraphic advantage of the section is the common occurrence of abundant, well-preserved ammonoids being studied by team-member Svetlana Nikolaeva. Deposits within the *L. nodosa - L. ziegleri* transition are dominated by nodular, deep-water, basin carbonates of the Alba Formation. The conodont biostratigraphy has been moderately well established (Sanz-López *et al*., 2007) but the FAD of *L. ziegleri* may need to be more precisely located and sedimentological, geophysical and geochemical analyses are required. During 2013 to 2014, the team plans to systematically sample the section for ammonoids and commence sedimentological, geophysical and geochemical analyses.

Activities in Rocky Mountains, Canada

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

Bashkirian-Moscovian boundary The task group plans to continue with its research in Eurasia to evaluate lineages suitable for definition of the Bashkirian-Moscovian boundary. Investigations will focus on evolutionary transitions in conodont lineages and it is anticipated that during the November 1, 2012 - October 31, 2013 fiscal year a lineage and taxon suitable for boundary definition will be selected.

A major effort will be devoted to the continued study of the conodonts within the Bashkirian-Moscovian transitional interval in the Naqing (Nashui) section and nearby sections in southern Guizhou Province, South China. Special attention will be directed toward the study of the lineage containing *Diplognathodus ellesmerensis* Bender 1980, one of the taxa considered to have the best potential for boundary definition. Another priority will be the continued evaluation of the FAD of *Neognathodus bothrops* Merrill 1972, the other conodont considered to have the best potential for boundary definition. Use of *N. bothrops* will necessitate moving the base of the Moscovian up one substage from the base of the Vereian regional Substage of Russia (lowermost Moscovian substage) to the base of Kashirian regional Substage of Russia.

Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the boundary interval in the Nashui and nearby sections are not as advanced as the paleontological investigations and need to be a focus of the team's work in 2013. During 2013 at the Nashui section, the task group plans to complete measuring the Moscovian component of the section into the lower Kasimovian and finish a bed-by-bed analysis of the strata over a 10 to 20 metre-thick interval on either side of the two proposed boundary levels as defined by the FADS of *D. ellesmerensis* and *N. bothrops.*

Isabel Montanez and her students will continue their studies of stable-oxygen isotopes using conodonts derived from the Pennsylvanian succession in the Donets Basin, Ukraine. Their objective is to develop a high-resolution (near cyclothem-scale) record of the oxygen-isotope composition of conodonts from the Donets Basin limestones. This will be the highest resolution record of its type for the Carboniferous. The record derived from the conodonts will be compared to the sea-level history that was recently defined for the Donets Basin (Davydov *et al*., 2010) and correlated with the sea-level curves derived from the Midcontinent of the U.S.A. (Heckel *et al*., 2007) and Pennine Basin. Their ultimate objective is to determine the degree that shifts in conodont-oxygen-isotope composition track the established sea-level changes that were based on sedimentologic analyses.

Moscovian- Kasimovian boundary During the 2013 fiscal year, the ongoing biostratigraphic analyses reported on in section #5 above will continue particularly in southern China. The task group has concluded the first appearance datums (FADs) of *Idiognathodus sagittalis* Kozitskaya, 1978 and *Idiognathodus turbatus* Rosscoe and Barrick, 2009 have good potential as markers for the base of the Kasimovian (Villa and task group, 2008; Ueno and task group, 2009, 2011). The task-group leader hopes a proposal to use either *I. turbatus* or *I. sagittalis* for boundary definition can be developed in the new fiscal year. After such a proposal is made and voted on, additional taxonomic work and comparison of morphotypes from different regions can be continued. The proposal would be based on specimens from south China and also recognized in the Midcontinent region of the U.S.A., the Moscow Basin, the southern Urals of Russia, and Donets Basin of Ukraine. The use of either species would raise the base of the Kasimovian up one substage from the traditional position at the base of the Russian Krevyakinian Substage, to approximately the base of the Khamovnikian Substage but will facilitate global correlation.

Activities in southern China

During the last several years, Qi Yuping and James Barrick have been studying conodonts from the uppermost Moscovian to lower Gzhelian slope carbonates in the Naqing (Nashui) section, southern Guizhou Province. As a consequence of that work, they consider that the FAD of *Idiognathodus turbatus* is the best potential boundary marker for the base of the Kasimovian. They will continue with intensive studies to provide more detailed information on the conodont succession across the Moscovian-Kasimovian boundary in the Nashui section (Qi *et al*., 2007, 2009; Barrick *et al*., 2010) as a potential GSSP locality.

Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the Moscovian-Kasimovian boundary interval at Nashui is less advanced than the paleontological investigations and need to be a focus of the team's field work in 2013-2014. The task group needs to complete a bed-by-bed study through about 10 metres of strata on either side of the proposed Moscovian-Kasimovian boundary level. That work will include taking a continuous sample through about one metre of strata on each side of boundary to determine the location of all principal sedimentary events and the characteristics and origins of the beds.

To place the Nashui section into its sedimentological and paleoenvironmental context and determine the relationship of shallow-water coral, conodont and foraminiferal zones to the deeper-water conodont markers within the Moscovian-Kasimovian transition in south China, the investigation of reference sections including the Zhongdi (Ueno *et al*., 2007) and the Luokun sections will continue. Like the Nashui section, the exposure at Luokun is essentially 100% complete and dominated by slope carbonates of turbiditic and hemipelagic aspect but the lithofacies are of more proximal aspect. Study

of the section will provide another opportunity to see conodonts and foraminifers spanning the Moscovian-Kasimovian transition in the region. Foraminifers are more abundant and better preserved than at Nashui and it is anticipated that a better correlation between conodonts and foraminifers can be achieved by the study of the Luokun section.

Activities in Moscow Basin, Russia

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

Activities in Spain

Spanish members of the task group plan to continue with investigations in most of the regions reported on in the progress report for the last fiscal year. Elisa Villa reported that the University of Oviedo is devoted to the study of the Moscovian-Kasimovian boundary in the Cantabrian Mountains and will continue with intensive research of the Carboniferous limestones outcropping in the Ándara Massif of the Picos de Europa Mountains.

The Spanish team will continue investigating the Vegas de Ándara section (also in the Ándara Massif), where late Moscovian to middle Kasimovian strata are present. Sampling of Podolskian (middle Moscovian) to Khamovnikian beds in the Vegas de Ándara and the Castillo de Grajal sections are being undertaken to analyze the succession of the conodont faunas (J. Sanz and S. Blanco, in progress). These studies include the systematics of *I. sagittalis* collected from the base of the Khamovnikian Substage and their relationship with much scarcer *I. turbatus* and *I. swadei*.

Idiognathodus sagittalis, one of the two best potential indices for the lower Kasimovian boundary, occurs within other sections in the Cantabrian Mountains such as the Las Llacerias (Méndez, 2006). To confirm the potential of *I. sagittalis* for global correlation, the study of its variability (preferably in the type bed in Ukraine) and more illustrations documenting its characteristics at various occurrences are necessary.

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

So far, only the Usolka section in the southern Ural Mountains of Russia has been proposed as a candidate section for the GSSP at the base of the Gzhelian (Chernykh *et al.*, 2006; Davydov *et al*., 2008). We strongly encourage all task-group members and other interested teams to complete high-quality studies across the Kasimovian-Gzhelian boundary in their respective areas of study in the search for additional candidate sections.

Activities in Russia

The Usolka section requires substantial new lithostratigraphic, sedimentologic and biostratigraphic work. On August 14 2009, a team of SCCS representatives visited the Usolka section during a Field Meeting and observed that only fragments of the section were exposed and they were in narrow, partly

filled to overgrown trenches. In response to that observation, the task group needs to extensively excavate the site during its re-assessment.

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

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

Activities in China

Yuping Qi and colleagues will continue detailed sampling and analysis across the proposed Kasimovian-Gzhelian boundary level in the Nashui section (Wang and Qi, 2003) in Guizhou Province, south China for conodonts and fusulinids. Conodont recovery across the boundary level has not been as good as expected and large samples are required to obtain an adequate understanding of evolutionary trends. A sedimentologic, geophysical and geochemical analysis of that section at the appropriate level is required. During 2013 to 2014, the task group plans to complete the measurement and sampling of the upper Kasimovian to Lower Permian component of the Nashui section (for lithology, stable-isotope geochemistry, and geophysics). In conjunction with the latter work, the task group plans to complete a bed-by-bed study through 10 metres of strata on either side of the proposed Kasimovian-Gzhelian boundary level. That work will include taking a continuous sample through about 1.5 m of strata on each side of boundary to determine the location of all principal sedimentary events and the characteristics and origins of the beds.

9. BUDGET AND ICS COMPONENT FOR Nov. 1, 2012 - Oct. 31, 2013 fiscal year

PROJECTED EXPENSES

Sample shipping from Moscow and Nanjing to GSC-Calgary for thin-section preparation, geochemical analyses, and U-Pb radiometric dating (Viséan/Serpukhovian task group)	$500
Travel support for SCCS Chairman and other voting members to attend March SDS/SCCS workshop (Devonian and L. Carboniferous of northern Gondwana) in Morocco	$1000
Travel support for SCCS voting members to attend May SCCS and SPS conference and field meeting in Albuquerque New Mexico (Carboniferous-Permian Transition)	$1000
Travel support for chairman to continue work with Chinese colleagues on several boundary levels in South China in April 2013	$250
TOTAL PROJECTED EXPENSES	$2,750.00
INCOME	
Carryover (from CREDIT balance at end Nov. 1, 2011 - Oct. 31 2012 fiscal year)	$706.62
Estimated donations	$200.00
TOTAL PROJECTED INCOME	$ 906.62
BALANCE	
Estimated (deficit) / credit from above	-$1,843.38
BUDGET REQUEST FROM ICS for 2012	$2,000.00

10. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2008-2012)

Background A vote by the ICS in late 1999 resulted in approval of the names Mississippian and Pennsylvanian along with a reconfirmation of the previous decisions of the SCCS to regard their rank as subsystems. In 2003 the SCCS voted to classify the two subsystems into Lower, Middle, and Upper Mississippian Series and Lower, Middle, and Upper Pennsylvanian Series, by a 74% majority of those

90% of the total membership who voted. This vote with its implicit acceptance of the stage names used in Russia as the global stage names for the Carboniferous now provides the Carboniferous with its official global series and stage names (Heckel and Clayton, 2006a, 2006b), and all effort is now focused on selecting events and GSSPs for stage boundaries.

Task Group to redefine the Devonian-Carboniferous Boundary

Studies by Ji *et al*. (1989) and subsequent analysis (Kaiser, 2009) demonstrated severe problems exist with the Devonian-Carboniferous Boundary GSSP (Paproth *et al*., 1991) at La Serre Hill, France. Because of the serious problems with the integrity of the GSSP, Thomas Becker (Chairman of Subcommission on Devonian Stratigraphy) and Philip Heckel (former Chairman of SCCS) established the joint Devonian-Carboniferous Boundary GSSP reappraisal task group in 2008, appointing 10 members from each subcommission. In June 2010, the SCCS Chairman Barry Richards appointed Markus Aretz to chair the task group.

Following a 2008 SCCS workshop at the 33rd International Geological Congress (IGC) in Oslo, Richards included plans for future work by the task group in the 2008 SCCS Annual Report submitted to the ICS. The plan had three recommendations: 1) the use of the first evolutionary occurrence of the conodont *Siphonodella sulcata* (Huddle, 1934) in the lineage *S. praesulcata* Sandberg, 1972 to *S. sulcata* for boundary definition requires re-evaluation; 2) if the FAD of *S. sulcata* is retained for boundary definition, either the position of the GSSP at La Serre must be lowered from the base of bed 89 or a more suitable section must be located, and 3) because the first appearance of *S. sulcata* may not be the best marker, other conodont lineages require evaluation.

Progress

Since 2008 the *S. praesulcata* to *S. sulcata* conodont lineage used to define the boundary has been re-evaluated by several scientists including Kaiser and Corradini (2011), and the protognathodids, the other conodont group that had shown potential for boundary definition is being re-studied (Corradini *et al*. 2011). The conodont studies have been disappointing because it appears that neither the siphonodellid lineage nor the protognathodids are suitable for D-C boundary definition and other appropriate taxa have not been discovered. However, there is considerable disagreement among the conodont specialists about the utility of the siphonodellid lineage and the conclusions of Kaiser and Corradini (2011) require testing by other specialists before the FAD of *S. sulcata* is abandoned for boundary definition.

During the 2010 IPC3 workshop in London, the multi-phase Hangenberg Event (Kaiser, 2005; Kaiser *et al*., 2008) was identified as a level of interest for boundary definition. However, more data on the precise timing of phases of the Hangenberg and the correlation of the biostratigraphic, geochemical, sedimentologic and sequence stratigraphic patterns within it are needed to evaluate the event's potential for boundary definition. To obtain a better understanding of the Hangenberg and its utility for boundary definition, group members have embarked on multi-disciplinary investigations aimed at understanding the event and plan to present results at the joint SDS/SCCS meeting planned for March 2013 in Morocco.

From the work completed from 2009 through 2011, it is clear that the La Serre section is not suitable for the GSSP. A major issue is the base of bed 84b, which contains the FAD of *S. sulcata* is a sharp facies change Kaiser (2009) and probably erosional; in addition, underlying strata lack the evolutionary lineage from *S. praesulcata* to *S. sulcata*. Although an event for boundary definition boundary has not been chosen, the search for better GSSP sections is progressing. New D-C boundary sections are being evaluated and previously studied sections such as the Hasselbachtal in Germany and those in southern China (Ji *et al*., 1989) are being re-evaluated.

Tournaisian-Viséan Boundary By 2003 work by the Tournaisian-Viséan Boundary task group progressed to the point that a proposal for the GSSP in south China was published (Devuyst *et al*, 2003), unanimously approved by the SCCS, and ratified by the ICS and IUGS. The Secretary's report for 2008 (Newsletter on Carboniferous Stratigraphy, v. 26 p. 4) provides the details about the proposal

and SCCS ballot. The principal work of the task group has come to completion and task-group Chairman George Sevastopulo is preparing the final report.

Viséan-Serpukhovian Boundary The Viséan-Serpukhovian Boundary task group plans to use the FAD of *Lochriea ziegleri* Nemirovskaya, Perret & Meischner 1994 in the conodont lineage, *Lochriea nodosa* (Bischoff, 1957) -*Lochriea ziegleri,* for boundary definition. By 2010 the *L. nodosa-L. ziegleri* lineage had become widely recognized in Western Europe, Russia and Asia (Skompski *et al*., 1995; Nikolaeva *et al*., 2009b; Qi and Wang, 2005) and although the lineage is not yet known from North America, specimens of *L. ziegleri* and other species in the genus have been discovered. By late 2010, the task group decided the FAD of *L. ziegleri was* suitable for boundary definition and a proposal is being written in preparation for a vote by the task group and SCCS.

The identification of the *Lochriea* lineage along with recognition of the conodont, ammonoid, ostracode, and foraminiferal zones in a deep-water (basinal), carbonate section by the village of Verkhnyaya Kardailovka on the eastern slope of the Russian Urals established that section as a strong candidate for a GSSP (Nikolaeva *et al*., 2005). Since 2005 the section has been thoroughly examined and a synthesis published about the ammonoids, conodonts, and ostracodes (Nikolaeva *et al*., 2009b). The synthesis indicates conodonts that are transitional between *L. nodosa* and *L. ziegleri* occur in the section immediately below the FAD of *L. ziegleri.* Prior to 2010, extensive parts of the section were poorly exposed but during August 2010 and 2011 the covered components of the section were excavated and permanent aluminum marker pins placed at one metre intervals in preparation for a bed-by-bed sedimentological analysis and the systematic sampling for conodonts, stable-isotope geochemistry and magnetic susceptibility studies, which were largely completed in 2011 and 2012.

In 2005 the *Lochriea* lineage was reported from carbonate-slope facies in the Nashui section in southern Guizhou Province, China (Qi and Wang, 2005). Since 2007, the conodonts spanning the Viséan-Serpukhovian boundary in the Nashui section have undergone intensive study by Chinese colleagues and the section has become a strong potential candidate for a GSSP at the base of the Serpukhovian. Qi Yuping has finished his analysis of the conodonts across the Viséan-Serpukhovian boundary at Nashui and incorporated the results in his doctoral thesis and subsequent papers (Qi, 2008). In the Nashui section, conodonts within the *L. nodosa - L. ziegleri* lineage are well preserved and abundant. Elements transitional between *L. nodosa* and *L. ziegleri* are plentiful, occurring through several metres of section. A detailed stratigraphic section extending from the upper Viséan into the Bashkirian has been measured at Nashui and aluminum marker pins placed at one-metre intervals through the section. Bed-by-bed sampling for sedimentologic and geochemical analyses has been completed across the Viséan-Serpukhovian and Serpukhovian-Bashkirian boundaries and the samples are being processed. John Groves completed his study of the foraminifers in time for the November 2010 SCCS workshop and field meeting in Nanjing. His work (Groves *et al*., 2012) indicates foraminifers can be used to bracket the level of the FAD of *L. ziegleri* thereby facilitating correlations into shallow-water carbonate sections lacking diagnostic conodonts. The measurement and intensive study of several other sections (Yashui, Loukun and Dianzishang sections) in the region from 2009 through 2012 is enabling the task group to place the Nashui section into its paleogeographic, stratigraphic, and lithofacies contexts.

In June 2010, Spanish colleagues introduced task-group members to several sections spanning the Viséan-Serpukhovian boundary in the Cantabrian Mountains of Spain. Two of the sections, the Vegas de Sotres and Millaró (Sanz-López *et al*. 2007) in the Alba Formation, are excellent deep-water carbonate sections rivaling the better known Kardailovka and Nashui exposures. In the Vegas de Sotres and Millaró sections, conodonts within the *L. nodosa - L. ziegleri* lineage are well preserved and abundant; in addition, the first occurrence of *L. ziegleri* has been located with moderate precision. A major biostratigraphic advantage of the two sections is the common occurrence of abundant, well-preserved ammonoids that are being studied by Svetlana Nikolaeva. The conodont biostratigraphy has been relatively well established in the two sections (Sanz-López *et al*., 2007; Blanco-Ferrera *et al*.,

2009) but the biostratigraphic and sedimentologic work at the two localities is less advanced than at the Nashui and Verkhnyaya Kardailovka sections.

Work has been initiated on ammonoid-rich successions in the western U.S.A. (Korn and Titus, 2011), southern Urals of Kazakhstan, and on foraminifer- and coral-rich successions in Western Europe and western Canada in order to bracket the level of the first appearance of *L. ziegleri* in North America. By the end of the 2012 fiscal year, the lineage had not been identified in North America but *L. ziegleri* has been found in the Barnett Shale in Texas and other species of *Lochriea* have been identified at several localities (Brenckle *et al*., 2005; Qi Yuping, pers. com., 2010).

Although the *Lochriea* lineage along with associated faunas and strata are being studied in several areas, the task group has concluded the Nashui section in China and the Verkhnyaya Kardailovka section in Russia have the best potential as GSSP candidates.

Bashkirian-Moscovian Boundary Several conodont and foraminiferal lineages have been appraised and potential candidate sections located but a marker for the Bashkirian-Moscovian Boundary has not been selected and voted on. At present, the conodonts *Diplognathodus ellesmerensis* Bender, 1980 and *Declinognathodus donetzianus* Nemirovskaya, 1990 are considered to have the best potential for boundary definition. Another potential index for the boundary is the FAD of the conodont *Neognathodus bothrops* Merrill, 1972.

Substantial work has gone into evaluating the *Declinognathodus marginonodosus—D. donetzianus* lineage for boundary definition but the lineage appears to lack a sufficiently wide geographic distribution. Other conodont taxa and fusulinids are being used for correlations into successions where the latter lineage has not been located. For example, members reported the appearance of the distinctive *Profusulinella prisca* fusulinid group near this boundary level in Spain, Turkey, southern Urals, and possibly North and South America. Most recently (2010-2011), the group developed a proposal to use the (FAD) of the fusulinoidean genus *Eofusulina* Rauser-Chernousova in Rauser-Chernousova *et al.* 1951in evolutionary continuity with its ancestor for boundary definition (Groves *et al*., 2011). They also started to develop a proposal using a new conodont level (Qi *et al*., 2010).

Russian colleagues discovered an evolutionary lineage of *Declinognathodus marginonodosus—D. donetzianus* in the Basu River section in the southern Urals, which also contains rich foraminiferal faunas, and might be a candidate for a GSSP. The well exposed Basu section contains the first appearance of the fusulinid *Profusulinella prisca* a few metres below that of *D. donetzianus*. The discovery of the *Declinognathodus* lineage at the Basu River section along with a rich fusulinid fauna including the *P. prisca* group make it a good potential candidate section for a GSSP (Kulagina *et al*., 2009).

In northwest Spain, Javier Sanz-López, Silvia Blanco-Ferrera and Elisa Villa are conducting integrated foraminifera and conodont biostratigraphic analyses at the San Antolin-La Huelga section along the Bay of Biscay in the Cuera area (Bahamonde *et al*., 2008; Villa *et al*. 1997). The Bashkirian-Moscovian boundary is provisionally placed about 180 m above the base of the section. 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 Antolin-La Huelga section contains four conodont taxa identified as potential Bashkirian-Moscovian Boundary markers: *Id. postsulcatus, Diplognathodus ellesmerensis, Neognathodus nataliae* and *Declinognathodus donetzianus.*

Qi *et al.* (2007) reported the appearance with *D. donetzianus* of another conodont, *Diplognathodus ellesmerensis*, which has a broader more global distribution and would help identify the level of *D. donetzianus* in places where it is absent. At the Nashui section in Guizhou Province, *D. ellesmerensis* appears in evolutionary continuity from *D. coloradoensis* at the base of the Moscovian. Several task-group members have proposed that the first appearance of *D. ellesmerensis* be considered as the marker event for this boundary because of its distribution is broader than that of *D. donetzianus.*

The Bashkirian-Moscovian Boundary interval at Nashui has been selected for intensive biostratigraphic and sedimentologic study as a potential candidate for a GSSP. In 2008 John Groves and colleagues visited the carbonate-dominant section and initiated a detailed biostratigraphic and sedimentologic analysis across the boundary. Since that trip, Qi Yuping finished his analysis of the conodonts across the Bashkirian-Moscovian Boundary and incorporated the results in his doctoral thesis (Qi, 2008). A detailed stratigraphic section extending from the upper Serpukhovian into the Moscovian was measured at Nashui and aluminum marker pins placed at one-metre intervals. Groves (2010) completed his study of the foraminifers in the Nashui section and presented the findings at the November 2010 SCCS workshop in Nanjing.The provisional Bashkirian-Moscovian boundary recognized by Qi *et al*. (2007) on the lowest occurrence of *Diplognathodus ellesmerensis* falls 173 m above the base of the section, a level containing a foraminiferal association dominated by *Profusulinella* spp. and *Pseudostaffella* spp.

During 2010, Qi Yuping and Lance Lambert were examining conodonts from the Nashui section that span the Bashkirian-Moscovian Boundary interval and discovered that rapid morphologic evolution in P_1 elements of *Streptognathodus expansus* and *S. suberectus* permit the identification of a new and possibly better biostratigraphic level at which the base of the Moscovian might be placed and presented initial findings (Qi *et al*., 2010) at a November 2010 SCCS workshop and field meeting in Nanjing, China. They advocated placement of the base of the Moscovian at the joint first appearances of advanced morphotypes of *Streptognathodus expansus* and *Streptognathodus suberectus* in the Nashui section. That 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.

In 2010, the task group developed a new proposal (Groves *et al*., 2011) to mark the base of the Moscovian using the (FAD) of the fusulinoidean genus *Eofusulina* Rauser-Chernousova in Rauser-Chernousova *et al.* 1951 in evolutionary continuity with its ancestor *Verella* Dalmatskaya 1951. The level is recognized by the lowest stratigraphic occurrence of a fusulinoidean exhibiting septal fluting across the entire length of its shell. The proposal was circulated within the task-group for comments but not voted on. A widely held concern was that relatively few sections were known in which the *Verella–Eofusulina* transition could be documented with closely spaced sampling.

Goreva and Alekseev (2012) proposed moving the base of the Moscovian one substage higher than the position discussed above; that is from the base of the Vereian regional Substage of Russia (lowermost Moscovian substage) to the base of Kashirian regional Substage of Russia. A proposed marker for the new level is the FAD of *Neognathodus bothrops* Merrill, 1972 from its ancestor *Neognathodus atokaensis* Grayson, 1984. Both species occur in the Midcontinent region of the U.S.A., Moscow Basin and South Urals of Russia, and the Donets Basin in Ukraine.

Moscovian-Kasimovian Boundary The Moscovian-Kasimovian task group has extensively evaluated conodonts and fusulinoideans as indices for definition of the base of the Kasimovian and has concluded that conodonts present the best potential. The first appearance datums (FADs) of *Idiognathodus sagittalis* Kozitskaya, 1978 and *Idiognathodus turbatus* Rosscoe and Barrick, 2009a have good potential as markers for the base of the Kasimovian (Villa and task group, 2008; Ueno and task group, 2009, 2011). Their occurrence (near base of Khamovnikian regional Russian Substage, the second substage of the Kasimovian in current definition) is approximately one substage higher than the traditional base of the Kasimovian (base of Krevyakinian Substage). Fusulinid workers have conceded that problems of provincialism across the boundary interval preclude the use of that group to define the boundary. Two fusulinoidean events appear to coincide with events in conodont appearances near the M-K Boundary. The higher one, involving *Montiparus*, is readily identified, but the lower one, among protriticitids, is more dependent on preservation.

Despite major provincialism between Eurasian and North American conodont lineages during the late Moscovian and Kasimovian, widely distributed conodont appearances have been recognized.

Taxonomic and zonational updating of the conodont faunas in Eastern Europe (Goreva and Alekseev, 2006; Goreva *et al*., 2007), and in the Midcontinent of the U.S.A. (Rosscoe and Barrick, 2009) formed the basis for welcome progress at the June 2008 meeting at the University of Oviedo, Spain. Members attending the Oviedo meeting unanimously agreed (Villa and task group, 2008) to focus study on two conodont species as the potential biostratigraphic marker for the base of the Kasimovian: 1) *Idiognathodus sagittalis*, based on material from the Donets Basin (Ukraine) and also identified from the Moscow region and southern Urals of Russia, and the Cantabrian Mountains (Spain), and 2) *Idiognathodus turbatus* based on material from the Midcontinent U.S.A., and recognized also in the Moscow Basin, southern Urals, and Donets Basin. A potential ancestor-descendent lineage from *I.* aff. *sagittalis* n. sp. to *I. sagittalis* may be present in the Moscow Basin and a lineage from *Idiognathodus swadei* Rosscoe and Barrick 2008 to *I. turbatus* has been described from the Midcontinent of the U.S.A. The use of either conodont would raise the boundary one substage from the traditional position at the base of the Krevyakinian Substage, to approximately the base of the Khamovnikian but will facilitate global correlation. Using the new research direction, the group has made substantial progress in selecting GSSP candidate sections.

Kasimovian-Gzhelian boundary Members of the Kasimovian-Gzhelian Boundary task group plan to use the FAD of the conodont *Idiognathodus simulator s.s.* (Ellison, 1941) in the lineage *Idiognathodus eudoraensis* - *I. simulator s.s.* to define the boundary (Heckel *et al*., 2008; Barrick *et al*., 2008).

The search for a suitable candidate section for the GSSP has started with the investigation of two sections; additional candidates are required. A preliminary description of the potential GSSP at Usolka in the southern Urals was published by Chernykh *et al.* (2006) and in more detail by Davydov *et al.* (2008). In 2009 SCCS geologists examined the section and discovered it required substantial excavation work and additional study before a proposal could be put to ballot. The other potential candidate section lies within the Nashui section in south China and is undergoing a thorough biostratigraphic, sedimentologic and geochemical investigation. Within the section, the presence of the lineage containing *I. simulator* has been proven. Existing conodont collections from the Kasimovian-Gzhelian Boundary interval at Naqing permit recognition of the boundary but are insufficient to make a complete description of the boundary conodont faunas. Qi and Barrick are working on new and larger collections to obtain a more complete understanding of the fauna and enable a better evaluation of the section as a GSSP for the base of the Gzhelian.

Project Group on Carboniferous Magnetostratigraphy The magnetostratigraphy project group was formed in 2004 and chaired by Mark Hounslow to research the potential for identifying correlatable magnetostratigraphic events in the Carboniferous. Hounslow (2009) reported on some aspects of this approach in the 2009 issue of the Carboniferous Newsletter. Progress by the magnetostratigraphy project group has been hampered by a shortage of members and lack of integration with the activities of the other SCCS task groups.

During the November 1st 2008 to October 31st 2009 fiscal year, the search for Mississippian sedimentary rocks that are likely to carry a primary magnetisation, to construct a magneto-stratigraphic timescale, focused on two sections in southern Scotland but no analytical results are available yet. Both sections have good potential for recovery of primary magnetisation because they are dominated by siliciclastics and their thermal maturity is low (Hounslow, 2009).

During the May 31st to June 3rd 2010 ICS meeting in Prague, the project-group leader discussed with Barry Richards and Svetlana Nikolaeva the possibility of designing a magnetostratigraphic project that would evaluate Late Mississippian and Pennsylvanian sections in the Moscow Basin, Liard 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.

Peter Giles (Geological Survey of Canada-Atlantic) and colleagues have largely completed a useful magnetostratigraphic study of the Brigantian, Pendleian and much of the Arnsbergian substages (upper

Viséan and Serpukhovian) in the Maritimes Basin of eastern Canada (Giles *et al*., in progress). They have correlated the polarity reversal patterns in the Maritimes Basin with published data from the Brigantian to mid-Arnsbergian interval in the central part of the Appalachian Basin in the eastern United States (Di Venere and Opdyke, 1990, 1991).

Radiometric dating Precise radiometric U-Pb zircon dating (CA and ID-TIMS U-Pb methods) now being undertaken by several groups including the Permian Research Group at Boise State University on ash beds from the Carboniferous successions in several basins has led to the precise dating and correlation of important Carboniferous events and assisted substantially with calibration of the Carboniferous time scale (Menning *et al*., 2006; Davydov *et al*., 2010). The Pennsylvanian-Permian succession in the south Urals has provided new dates on the Carboniferous-Permian Boundary and the late Moscovian with error bars of ± 0.2 Ma, which Heckel used to more accurately calibrate the late Pennsylvanian time scale by means of cyclothems (Strasser *et al*., 2007). Since ratification of the Tournaisian-Viséan boundary proposal in 2007, task-group chair George Sevastopulo and his students have been attempting to bracket the absolute age of the Tournaisian-Viséan boundary in Europe by using the ID-TIMS U-Pb method of dating zircons from ash bands and plan to continue with that work.

11. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2013-2016)

The SCCS executive is encouraging its task groups to maintain progress on researching and selecting defining events for as many stage boundaries as possible in the next four years. Within the next two years, we think it will be possible to select the defining events for all of the stage boundaries with the possible exception of the base of the Tournaisian and then progress toward selecting sections for the GSSPs. Most task groups have either selected an event to define their respective boundary and held a successful vote on it (Kasimovian-Gzhelian task group) or have located an event and are preparing proposals in preparation for taking the proposal to ballot (Viséan-Serpukhovian, and Moscovian-Kasimovian task groups).

We will encourage some task groups to consider division of their respective time slices (all are stages). Some stages such as the Viséan are inordinately long and require division to facilitate more precise Global correlation. Should a stage such as the Viséan be divided, the name of that stage would be applied to the corresponding series such as the Middle Mississippian in the case of the Viséan, thereby retaining the classic names in current use. A strong possibility exists that the ICS will call for the formal recognition of substages and should this occur, major tasks for the SCCS subsequent to establishment of GSSPs for our current stage boundaries will be the selection of substages for inclusion in the ICS chronostratigraphic chart, establishment of task groups for the substages, and initiation of the search for events and GSSPs for boundary definition.

Devonian-Carboniferous Boundary

The main four-year goal of the Devonian-Carboniferous Boundary task group is the selection of an event for defining the base of the Carboniferous because the current definition, the FAD of *Siphonodella sulcata* is apparently deficient. The SDS and SCCS will hold an important joint meeting - *The Devonian and Lower Carboniferous of northern Gondwana* - in Morocco in March, 2013 (Webpage: http://www.israbat.ac.ma/seminaires.htm) that should lead to substantial progress on selecting the boundary event and provide direction for future research. Following selection of the event, suitable candidate sections for the GSSP must be located.

Since the project was initiated in 2008, substantial progress has been made on evaluating potential conodont event markers. Corradini and Kaiser (2009) re-evaluated the *Siphonodella praesulcata* - *Siphonodella sulcata* lineage used to define that boundary and Corradini *et al*. (2010) along with other conodont experts have studied the protognathodids, the other conodont group that had potential for boundary definition. It appears that neither the siphonodellids nor the protognathodids are suitable for D-C boundary definition. There is, however, some hope the siphonodellid lineage can still be used because considerable disagreement exists among conodont specialists about its utility and the

conclusions of Kaiser and Corradini require additional testing before the FAD of *S. sulcata* is abandoned.

In the Devonian-Carboniferous Boundary GSSP section at La Serre, seven morphotypes in the transition from *S. praesulcata* to *S. sulcata* have been identified (Corradini and Kaiser, 2009; Kaiser, 2009). Conodonts within the transition are reworked and no correlation exists between the stratigraphic level and individual morphotypes. The task group plans to determine if a correlation exists between the morphotypes and stratigraphic level in other D-C boundary sections, where reworking is not an issue.

Even if the FAD of *S. sulcata* is retained for boundary definition, a suitable section for the GSSP must be located because recent studies at La Serre indicate the lack of the phylogenetic transition from *S. praesulcata* to *S. sulcata* and the base of bed 84b, which contains the FAD of *S. sulcata,* immediately overlies a probable erosion surface and major lithofacies facies change (Corradini and Kaiser, 2009; Kaiser, 2009). Several sections, particularly those in south-central China, which had been proposed as GSSP candidates prior to selection of the La Serre section, will be carefully re-examined. Intensive biostratigraphic, geochronologic, sedimentologic and geochemical studies will be initiated at all potential GGSP sections.

The siphonodellids and protognathodids may not be as useful for boundary definition as previously thought, but other significant latest Famennian to earliest Tournaisian biostratigraphic events may have potential for boundary definition and an intensive search will be undertaken to locate them. The task group also plans to explore the possibility of using either a sedimentological or geochemical event such as a component of the multiphase Hangenberg extinction event (Kaiser, 2005; Cramer *et al.*, 2008) for boundary definition. The event presents potential for correlation into both shallow and relatively deep-water marine facies; consequently, the task group wants to know how the phases of the Hangenberg are represented in different facies and how well they can be correlated globally. The latter question is being investigated and results will be presented at the joint SDS/SCCS workshop in Morocco in March, 2013. At the International Commission of Stratigraphy meeting held in Prague from May 31st to June 3rd, 2010 to discuss the GSSP concept, Vladimir Davydov (Boise State University, Idaho USA) proposed that volcanic-ash layers could be used to define boundaries such as the D-C boundary. Ash layers represent instants in deep time and can be precisely dated using U-Pb isotope dilution thermal ionization mass spectrometry (ID-TIMS) methodology.

Tournaisian-Viséan Boundary By 2003 work by the Tournaisian-Viséan Boundary task group progressed to the point that a proposal for the GSSP in south China was published (Devuyst *et al,* 2003). The principal work of the task group has come to completion and the task-group members are preparing the final report.

Viséan-Serpukhovian Boundary Task Group The Viséan-Serpukhovian task group plans to use the FAD of *Lochriea ziegleri* in the conodont lineage *Lochriea nodosa - Lochriea ziegleri* for boundary definition. A proposal for submission to the task group and SSCS membership for a vote on either accepting or rejecting the FAD of *L. ziegleri* for GSSP requires completion. Two well-known sections, Verkhnyaya Kardailovka and Nashui present the best potential for the GSSP, and the ongoing integrated biostratigraphic, sedimentological and geochemical studies of those sections will continue to project completion. Most of the field work has been completed at both localities and the remaining objective is to complete the sample study and compile the final synthesis. Identification of the *L. nodosa-L. ziegleri* lineage and recognition of associated conodont, ammonoid, ostracode, and foraminiferal zones in the richly fossiliferous section near Verkhnyaya Kardailovka in the southern Urals establishes that section as a strong candidate for the GSSP (Nikolaeva *et al*., 2009; Pazukhin *et al*., 2010). In the Nashui section in southern Guizhou Province, China (Qi and Wang, 2005), the *Lochriea* lineage has been intensively studied and the FAD of *L. ziegleri* precisely located. Field work is essentially complete at Nashui and the remaining objective is to complete the analytical work and prepare the final synthesis for publication.

The *Lochriea* lineage has not been found North America but specimens of *Lochriea ziegleri* and other species within the genus have been discovered. In order to identify correlatable faunal zones that can closely bracket the boundary interval on that continent, a Global study of conodonts, ammonoids, foraminifers, and corals across the boundary interval in North America, Europe and Asia will continue. All this suggests selection of the GSSP is possible in the next four years.

Bashkirian-Moscovian Boundary Task Group The high-priority plans for the Bashkirian-Moscovian Boundary task group during the next four years are to select an event marker for the Bashkirian-Moscovian boundary and then to look for GSSP candidate sections. Several conodont lineages require immediate evaluation. Until the fall 2010, much of the task group's time was directed toward the evaluation of two conodont lineages that had moderate potential for boundary definition: 1) derivation of *Idiognathoides postsulcatus* from *Id. Sulcatus*, and 2) derivation of *Declinognathodus donetzianus* from *D. marginodosus*. Both lineages have short comings and if either *D. donetzianus* or *I. postsulcatus* are chosen, the group's challenge will be to demonstrate how the base of the Moscovian can be identified in areas where these taxa do not occur. Nevertheless, the *D. marginonodosus-D. donetzianus* lineage remains a candidate for the event level.

A third potential marker the task group has been evaluating is the appearance of the conodont *Diplognathodus ellesmerensis*, which appears in evolutionary continuity from *D. coloradoensis* at the base of the Moscovian in the Nashui section by Naqing in Guizhou Province, China (Qi *et al*., 2007, 2009) and has been widely recognized globally. The interval spanning the Bashkirian-Moscovian boundary at Nashui is undergoing intensive biostratigraphic and sedimentologic study as a potential GSSP for the base of the Moscovian.

Another potential index for the boundary, the FAD of the conodont *Neognathodus bothrops* Merrill, 1972, was recently proposed Goreva and Alekseev (2012) and requires intensive investigation. Using conodont data from the Moscow Basin, Goreva and Alekseev proposed moving the lower boundary of the Moscovian one substage higher than its traditional position; that is from the base of the Vereian regional Substage of Russia (lowermost Moscovian substage) to the base of Kashirian regional Substage. Their proposed marker for the new level is the FAD of *Neognathodus bothrops* Merrill, 1972 from its ancestor *Neognathodus atokaensis* Grayson, 1984. Both species occur in the Midcontinent region of the U.S.A., Moscow Basin and South Urals of Russia, and the Donets Basin in Ukraine.

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 being considered for boundary definition are abundant and their first occurrences precisely located. Foraminifers are also present and have been thoroughly investigated (Groves, 2010). Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the boundary interval at Nashui are less advanced than the paleontological investigations and will be the focus of the team's work in 2013 and 2014. 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 Zhongdi, and the Luokun sections - will continue.

Because substantial work still is still required before a GSSP can be selected, 2016 is the earliest likely completion date.

The **Moscovian-Kasimovian Boundary and Kasimovian-Gzhelian Boundary Task Groups** are moving ahead as the previously muddled conodont taxonomic problems have been largely resolved.

Moscovian-Kasimovian Stage Boundary The high-priority plans for the Moscovian-Kasimovian task group during the next four years are to select an event marker for the Moscovian-Kasimovian boundary and then to search for GSSP candidate sections. Task-group members, who attended the 2008 Oviedo meeting, reached unanimous agreement to focus future work on two conodont species as the potential biostratigraphic marker by which the base of the Kasimovian can be selected and

correlated globally. The first is *Idiognathodus sagittalis*, based on material from the Donets Basin (Ukraine) and also identified from the Moscow region and southern Urals of Russia, and the Cantabrian Mountains (Spain). A potential ancestor-descendent lineage from *I.* aff. *sagittalis* n. sp. to *I. sagittalis* may be present in the Moscow region. The second potential marker is *Idiognathodus turbatus* based on material from the Midcontinent region of the U.S.A., and also recognized in the Moscow Basin, the southern Urals, and the Donets Basin. A lineage from *Idiognathodus swadei* to *I. turbatus* has been described from the U.S. Midcontinent. While the event marker for the Moscovian-Kasimovian boundary still needs to achieve consensus, continued assessment of the two lineages and clarification of the taxonomy of species involved will hasten the process.

The task group will continue to evaluate the utility of the two lineages in the slope-deposits of the Nashui section, a good potential candidate section for the GSSP. Other candidate sections need to be located and intensively studied.

Kasimovian-Gzhelian Boundary Members of the Kasimovian-Gzhelian task group plan to use the conodont lineage *Idiognathodus eudoraensis - I. simulator s.s.* to define the boundary at the first appearance of *I. simulator s.s.* Now that an event maker has been selected, task-group members will proceed on selecting a suitable section for the GSSP. So far only the Usolka section in the southern Ural Mountains of Russia has been proposed as a candidate section for the GSSP (Davydov *et al*., 2008); other proposals are required.

The widespread disconformities within the Kasimovian-Gzhelian transition across most of the shelf regions presents a substantial problem for selecting a section for the GSSP**,** but work on the essentially complete carbonate-slope sections in the southern Urals (Usolka River section) and on the slope deposits in the Nashui section, are providing more appropriate sections for a potential GSSP. Conodont studies are well advanced at the two localities, but sedimentologic, geochemical and geophysical studies at the sections are at an early stage. The Usolka section requires substantial excavation, new stratigraphic work, and re-assessment.

Therefore, 2014 - 2016 is probably the earliest a GSSP for the boundary will be selected and approved.

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 will eventually 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, 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 will both narrow the age disparities that currently exist within much of the Carboniferous and also provide better correlation with more precise modern radiometric dates that will hopefully be obtained from the Angara and Gondwana regions.

Meeting-field workshop schedule with themes and anticipated results.

During the November 1, 2012 - October 31, 2013 fiscal year, there will be two major workshops of particular importance to SCCS members. From the 22nd to the 29th of March, 2013 members will be attending a workshop and field meeting in Morocco - The Devonian and Lower Carboniferous of northern Morocco. This is a joint meeting of the SDS and SCCS and several members of the task group to redefine the Devonian-Carboniferous boundary will be presenting results of recent work. The group will hold a business meeting and establish work plans for the next two to four years on the basis of the presentations. From May 19 to 25 2013, the SCCS and SPS will be holding a joint meeting at Albuquerque, New Mexico - The Carboniferous-Permian Transition. The meeting will consist of two and a half days of oral and poster presentations and four and a half days of field trips to localities in New Mexico. The SCCS will hold a business meeting at the conference.

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APPENDIX B. ***[Full text of Task Group Reports]***

Report of task group to redefine the Devonian-Carboniferous Boundary

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Introduction and general activities

Members of the task group for the redefinition of the Devonian-Carboniferous (D-C) boundary are conducting paleontologic and multi-disciplinary research on several continents. Their work focuses on goals defined near the project's onset (Richards and task group, 2010) and at the task-group workshop held during the 2010 Third International Palaeontological Congress (IPC3) in London, United Kingdom (Aretz, 2011). During the fiscal year, the group continued with it primary tasks – the search for a suitable criterion for the redefinition of the D-C boundary and the hunt for a suitable section for the GSSP. Studies by Ji *et al*. (1989) and subsequent analysis (Kaiser, 2009) demonstrated severe problems exist with the D-C boundary GSSP (Paproth *et al*., 1991) at La Serre Hill, France. The boundary at La Serre is currently defined by the first evolutionary occurrence of the conodont *Siphonodella sulcata* (Huddle, 1934) in the lineage *Siphonodella praesulcata* Sandberg, 1972 to *S. sulcata* but both the definition and the section are considered deficient. The current search for a boundary index is focused on conodonts and the geochemical-sedimentologic events in the multi-phase Hangenberg Event (Kaiser, 2005; Kaiser *et al*., 2008). More data on the precise timing of phases of the Hangenberg and the correlation of the biostratigraphic, geochemical, sedimentologic and sequence stratigraphic patterns within it are needed to evaluate the potential of the event for boundary definition. The group has been gathering such data and plans to present the results at a major D-C boundary workshop in Morocco from (March 22nd to March 29th, 2013). A few task-group members attended the 34th International Geological Congress in Brisbane where a short discussion of research activities around the D-C boundary occurred during the SDS business meeting.

Progress reports from members

J. Kalvoda (Bruno). Czech researchers have been working in Central and Western Europe and are accumulating large multidiscinplinary datasets for key sections in different facies and countries. The group comprises J. Kalvoda, T. Kumpan (bio- stratigraphy of foraminifers and conodonts), J. Frýda (isotope geochemistry), T. Grygar (element geochemistry) and O. Bábek (petrophysical logging, sedimentology, sequence- stratigraphic interpretation). The results of their multidisciplinary correlation

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

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

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

C. Corradini (Cagliari)

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

T. Becker (Münster) and research group

Thomas Becker and his researchers continued their investigation of the Lalla Mimouna North section at the northern margin of the Maider region, SE Anti-Atlas, Morocco and report the following progress. All conodont samples collected during 2011 and the spring of 2012 have been picked but not fully identified. The full set of identifications will be included in the Field Guide for the March 2013

field symposium in Morocco as an update to the preliminary reports in the SCCS and SDS Newsletters (Becker *et al*., 2011; 2012). D. Brice submitted a faunal list of the brachiopods from the Hangenberg Sandstone interval (Fezzou Formation tongue), situated between the local pre- and post-Hangenberg Event crinoidal limestones. A new collection of ammonoids from the overlying *Gattendorfia* shale increases the number of basal Tournaisian ammonoid taxa and includes the first *Eocanites* from the section. The Münster isotope laboratory provided stable- carbon and oxygen-isotopes data for all beds sampled for conodonts and for samples from the adjacent section with "Stockum level" goniatites. In the latter section, a dark marker bed containing *Postclymenia evoluta* (*kockeli* Zone) produced an unusual, strong negative carbon isotope signal, which suggests a substantial influx of diagenetically mobilized and recycled organic carbon. Thin sections of all beds have been produced and will be subject to detailed microfacies analyses.

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

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

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

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

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

A new monograph on the Lower Carboniferous trilobites of southern Morocco (Hahn *et al*., 2012) includes new records of a few rare taxa from just before or within the wider Hangenberg Event Intervall (*Pudoproetus zhorae* from Mkakrig, eastern Tafilalt, *Pseudowaribole conifer* aff. *Pseudowaribol gibber* from Kheneg Lakahal, western Dra Valley). The first implication of the trilobite study is that *Pudoproetus* can be used to locate the initial phase of the post-Hangenberg transgression in Morocco, thereby extending the known region impacted by the event into northern Gondwana. The second major impact of the study is that it suggests all of the Maader Talmout Member of the Tazout

Formation, including the characteristic, supposed basal Tournaisian brachiopod fauna 2 of Brice *et al*. (2005, 2008), still falls in the pre-Hangenberg Event Interval. *Pudoproetus* has significant implications for the brachiopod stratigraphy across the Hangenberg Event Interval and D-C boundary. Its presence suggests a correlation of the subsequent, unfossiliferous, marginal-marine Kheneg Lakahal Member of the Tazout Formation with the Hangenberg Regression.

B. Ellwood (Baton Rouge, U.S.A.)

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

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

1. Three D-C boundary sections in Muhua area of Guizhou Province are being re-studied, and additional conodont samples collected from them. According to the morphology, ornamentation and symmetry of the platforms, the ratio of platform to anterior blade dimensions, and the size, morphology and position of the basal cavity, four new genera of siphonodellids can be differentiated: *Protosiphonodella* n. gen., *Siphonodella*, *Eusiphonodella* n. gen. and *Eosiphonodella* n. gen. (Ji *et al*., in progress). Among them, only *Eosiphonodella* can be found in shallow-water facies.
2. The phylogeny of the siphonodellid group is restudied, and the D-C boundary can be defined by the first occurrence of *Siphonodella sulcata* morphotype 1.
3. The elements of *Protognathodus* are very rare in China, and it is difficult to recognize the D-C boundary based on the first occurrence of either *Protognathodus kockeli* (Bischoff, 1957) or *Protognathodus kuehni* Ziegler & Leuteritze 1970.
4. A bentonite layer occurs in bed E of the Dapoushang Member of the Wangyou Formation, and has provided a radiometric age of 359.6 Ma (Liu *et al*., 2012). The age of the D-C boundary at Dapoushang, Guizhou province, South China, is estimated at 358.6 Ma or 359.58 Ma.

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

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

Knowledge of the succession's conodont biostratigraphy was greatly advanced by Johnston *et al.* (2010). The conodont data indicate the contact between the Devonian and Carboniferous lies in the

upper part of the black shale member of the Exshaw at its type section and some other localities; but the position of the D-C boundary has not been precisely located. It is anticipated that data from a multidisciplinary approach including stable-isotope geochemistry and radiometric dating will more tightly constrain the position of the boundary.

Outlook

The results presented at the Morocco workshop in March 2013 will determine the future steps and directions of the task group's work in the next years. The primary task of the group remains – to locate either a suitable event horizon or a suitable event in a biological lineage to define the D-C boundary. Recent progress shows that new detailed correlations and agreements on taxonomy and temporal distribution of many taxa are needed, especially when the Global correlations are still primarily based on either the *Siphonodella praesulcata* – S. *sulcata* lineage or on protognathodids. The problems outlined by Kaiser and Corradini (2011) and Corradini *et al.* (2011) have to be fully integrated in the current discussions. The paradigm that conodonts are the best markers boundary definition cannot be upheld and the task group needs to reevaluate the potential of other fossil groups.

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Task Group to establish the Tournaisian-Viséan boundary

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Following approval of the proposed GSSP (see Devuyst *et al.*, 2003) at Pengchong in southern China, by the SCCS in late 2007 and its ratification by the ICS and IUGS, George Sevastopulo and his colleagues have been preparing the final report about the Tournaisian-Viséan boundary GSSP.

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Report of task group to establish the Viséan-Serpukhovian Boundary

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Introduction

During the past fiscal year, the task group made substantial progress toward establishing a GSSP for the Viséan-Serpukhovian Stage boundary. An index for boundary definition has been selected, but not voted on by the task group and SCCS for final approval, and work is well advanced at the two prime GSSP candidate sections: the Verkhnyaya Kardailovka in the southern Ural Mountains of Russia and the Nashui section in southern Guizhou Province, China. Work is continuing on other potential candidate sections for the GSSP in the Cantabrian Mountains of northwest Spain. For boundary definition, the group is using the first evolutionary appearance of the conodont *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957) –*Lochriea*

ziegleri. *L. ziegleri* appears in the Brigantian Substage somewhat below the current base of the Serpukhovian as defined by its lectostratotype section in the Zaborie quarry near the city of Serpukhov in the Moscow Basin, Russia (Kabanov, 2003, 2004; Kabanov *et al*., 2009, 2012). Task-group members are conducting research on biostratigraphy, sedimentology and lithostratigraphy, stable-isotope geochemistry and magnetic susceptibility at several locations in Western Europe, Russia, China and North America.

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

Meetings

34th International Geological Congress in Brisbane, Australia

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

Progress in southern Urals,

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

In August 2011, the lower 22 m of the Verkhnyaya Kardailovka section including the boundary level was extensively excavated with backhoes and front-end loaders. Additional excavation work across the boundary was completed in August, 2012. Following the excavations in 2012, the interval spanning the Viséan-Serpukhovian Boundary was systematically sampled for conodonts. Conodont samples had been collected from the section on several prior occasions but additional sampling was required to more precisely tie the conodont biostratigraphy into the new measurements and to confirm the FAD of *L. ziegleri* in the recently excavated boundary interval. In August 2011, the limestone-dominant component of the section was measured and sampled bed-by-bed for lithology and geochemical samples from about 12 m to 35 m above the 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 2012 the sampling for lithology and geochemistry was completed into the lower part of the Bashkirian.

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

Hypergoniatites–Ferganoceras Genozone (Upper Viséan and Lower Serpukhovian), and the *Uralopronorites–Cravenoceras* Genozone (Lower Serpukhovian).

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

Progress in southern Guizhou province, Nashui section

In the Nashui section (by village of Naqing) near the city of Luodian in southern Guizhou province, the Viséan-Serpukhovian boundary is currently placed at 60.1m above the base of the original section measured by Qi and Wang (2005), which is equivalent to a position 17.94 m above the base of the new section measured and permanently marked by aluminum pins glued into drill holes by the task group in 2008. In the Nashui section, conodonts within the *Lochriea nodosa* – L*ochriea ziegleri* lineage are well preserved and abundant (Qi, 2008); elements transitional between *L. nodosa* and *L. ziegleri* are plentiful, occurring in several samples. The conodonts do not allow direct correlation from the Nashui section to the nearby shallow-water Yashui section because of their paucity in the neritic to restricted-shelf facies at the latter locality. The Yashui section was measured to determine the relationship of the coral and foraminiferal zones to the *L. nodosa – L. ziegleri* transition. During 2012, John Groves and colleagues completed their study of the foraminifers across the boundary interval in the section (Groves *et al*., 2012). Unfortunately, the association of foraminifers from a 20-meter-thick interval centered about the boundary at Nashui lack species diagnostic of the boundary but contain ones whose previously established ranges were known to extend from the upper Viséan into the lower Serpukhovian.

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

The foraminiferal successions across this boundary in the type area of the Serpukhovian Stage in the Moscow Basin of Russia (Kabanov *et al*., 2009; Gibshman *et al*., 2009), the Uralian region of Russia (Nikolaeva *et al*., 2005; 2009a,b) and in the central United States suggest that the appearances of *Asteroarchaediscus postrugosus* (Reitlinger, 1949), *Janischewskina 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.*, 2012). *Asteroarchaediscus postrugosus* and *Eolasiodiscus donbassicus*, useful markers for the base of the Serpukhovian elsewhere in Eurasia and North America, have not been observed at Yashui.

Progress Moscow Basin, type area of Serpukhovian

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

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Report of task group to establish a GSSP close to the existing Bashkirian–Moscovian Boundary

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Introduction

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

Boundary definition

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

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

Progress in Donets Basin, Ukraine

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

In the last few years, Katsumi Ueno and Tamara Nemyrovska have been working in the Donets Basin on the Bashkirian-Moscovian boundary in the Zolotaya and Malonikolaevka sections in the Lugansk region, eastern Ukraine. During the first half of October 2012, they continued with that work and collaborated with Titima Thassinee (Bangkok University, Thailand) to investigate a new section near the town of Shterovka, sampling the latter exposure for conodonts and fusulinids. They also collected additional samples from limestones I_3 and I_4 in the Malonikolaevka section. In these sections, strata of the C_2^4 (I) and C_2^5 (K) formations (from limestones I_2 to K_3) are exposed. The Shterovka section, which includes limestones I_2 to K_3^1, is situated several kilometers west of the Malonikolaevka section. In the Donets Basin, the Bashkirian-Moscovian boundary has traditionally been placed somewhere in the basal or lower part of the C_2^5 (K) formation (Putrya, 1956; Einor, 1996). Of the three sections, the Malonikolaevka section recently provided some important information on the Bashkirian-Moscovian boundary (Ueno and Nemyrovska, 2008; Nemyrovska *et al*., 2010). In the Malonikolaevka section, the conodont and fusuline composite biostratigraphy was examined, with special attention given to the lower boundary of the Moscovian. It is important to note that, in the latter section, limestone K_1 registered the first occurrence of the conodont *Declinognathodus donetzianus*, which has been considered one of the best conodont species for defining the Bashkirian-Moscovian boundary (Groves and task group, 2004, 2005, 2009). Moreover, this limestone records the first occurrence of strongly Moscovian-type *Eofusulina* in the fusuline fauna. The latter genus is also considered to have considerable potential as an index for defining the base of the Moscovian Stage (Groves and task group, 2011). Thus, Nemyrovska *et al.* (2010) consider the base of the Moscovian in the Donets Basin to lie within limestone K_1.

Saori Tanaka, a student of Katsumi Ueno, recently studied additional samples from the Malonikolaevka section for her Bachelor of Science thesis and provided interesting information on fusulines (Tanaka, 2012). In limestone I_2^2 she found an elongate fusuline, which looks like a species of *Eofusulina*, and another elongated form that resembles specimens of *Verella transiens* reported from

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

Progress in South China

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

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

In the summer of 2012, Yuping Qi visited the U.S.A. for three months; there, he worked with Jim Barrick and Lance Lambert on Bashkirian-Moscovian conodonts from South China and the United States. It was a productive trip because Qi found that *Diplognathodus ellesmerensis* is common in some North America collections. Thus, Jim Barrick, Lance Lambert and Yuping Qi think the FAD of *D. ellesmerensis* is the best marker for the base of the Moscovian and global correlation at that level. Although there are transitions for different morphologies of *Streptognathodus expansus* and *S. suberectus* in the Naqing (Nashui) section that may have utility for global correlations (Qi *et al*., 2010), it is thought their stratigraphic first occurrence is too low to permit their use as the basal marker of the Moscovian Stage. For this reason, Yuping Qi and some students went to the Naqing section to collect more samples below the FAD of *D. ellesmerensis* in late October.

Progress in Moscow Basin

Goreva and Alekseev (2012), on the basis of conodont data from the Moscow Basin, proposed moving the lower boundary of the Moscovian one substage higher than the position discussed above;

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

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

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Report of task group to establish the Moscovian–Kasimovian and Kasimovian–Gzhelian boundaries

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Moscovian–Kasimovian Boundary

Introduction

During the last few years, the task group has thought the first appearance datums (FADs) of *Idiognathodus sagittalis* Kozitskaya, 1978 and *Idiognathodus turbatus* Rosscoe and Barrick, 2009a have good potential as markers for the base of the Kasimovian (Villa and task group, 2008; Ueno and task group, 2009, 2010, 2011). Their occurrence (near base of Khamovnikian Substage, the second substage of the Kasimovian in current definition) is approximately one substage higher than the traditional base of the Kasimovian (base of Krevyakinian Substage). Nevertheless, raising the boundary level one substage higher would facilitate global correlation and most task-group members consider it appropriate to narrow the focus of study to an interval that encompasses the FADs of these conodonts. Until now, however, no formal proposal for the marker species that will define the base of the Kasimovian Stage has been presented and voted on.

Progress in North America

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

Progress in South China

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

proposal using the first evolutionary appearance of *I. turbatus* as the index for the base of the Kasimovian.

Progress in Spain

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

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

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

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

Intensive sampling for conodonts in Spain has revealed that only some open-marine to deep-water lithofacies provide a significant number of specimens. At several localities, new samples were collected from beds yielding scarce but important taxa. Such is the case of the Krevyakinian beds (currently the lower substage of Kasimovian) from the Morra de Lechugales section, which contain a middle-sized element of *Idiognathodus* sp. 1 of Goreva *et al.* (2009), the proposed ancestor of *I. sagittalis*.

Progress in Russia

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

Ukraine

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

Kasimovian–Gzhelian Boundary

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

Progress in North America

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

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

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

Progress in South China

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

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

Progress in Russia

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

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

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

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

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