INTERNATIONAL UNION OF GEOLOGICAL SCIENCES
INTERNATIONAL COMMISSION ON STRATIGRAPHY

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December 2014

Compiled ICS Subcommission Annual Reports for 2014

SUBCOMMISSION ON QUATERNARY STRATIGRAPHY
ANNUAL REPORT 2014

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1. TITLE OF CONSTITUENT BODY

Subcommission on Quaternary Stratigraphy (SQS)

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

1. Chronostratigraphic subdivision of the Quaternary System/Period facilitated by the intercalibration of biostratigraphies, construction of integrated zonations, and recognition of global datum points, allowing correlation worldwide and between terrestrial and marine sequences.

2. Definition of Series/Subseries/Stage and, where appropriate Substage, boundaries through the selection of recommended GSSPs.

3. Promoting SQS's activities within the wider Quaternary geoscience community through publications, symposia, and the SQS website, and creating opportunities to study and compare stratigraphic sections by means of field meetings.

4. The objectives satisfy the IUGS mandate of fostering international agreement on nomenclature and classification in stratigraphy; facilitating international co-operation in geological research; improving publication, dissemination, and use of geological information internationally; encouraging new relationships between and among disciplines of science that relate to Quaternary geology world-wide; attracting competent students and research workers to the discipline; and fostering an increased awareness among individual scientists world-wide of those related programs being undertaken.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

1. First International Meeting of the SQS Anthropocene Working Group, Berlin, Germany, October 16–18, 2014. Made possible through kind support of the Haus der Kulturen der Welt. Seventeen members attended, and agreed that the Anthropocene should be formalized with an onset some time in the mid-20th century.

2. Following publication of a discussion paper in 2012 (Walker et al., 2012, *Journal of Quaternary Science*, 27, 649–659) by an SQS / INTIMATE Working Group exploring the formal subdivision of the Holocene, comments were solicited from the wider stratigraphic community during 2013–14. The Working Group is now moving towards the subdivision of the Holocene into named stages corresponding to the widespread but inconsistent informal usage of a tripartite division of the Holocene ('early', 'middle' and 'late'). Each stage is to be defined by a GSSP, the highest two with their timing now agreed at 8.2 ka BP and 4.2 ka BP.

3. Field excursion to the Middle–Upper Pleistocene Fronte section, Taranto, Italy, October 14, 2014. Arranged in conjunction with the SQS Middle–Upper Pleistocene Working Group, this trip allowed the detailed inspection of the marine Fronte section, a candidate GSSP for the Upper Pleistocene Subseries boundary, and numerous associated deposits. Ten participants including four from Japan. Facilitated with

the generous assistance of the Italian Air Force, upon whose land the Fronte section is situated. Televised report: Studio 100 TV Italy (aired 14 Oct 2014).

4. Field Workshop on the Lower–Middle Pleistocene Transition in Italy. University of Bari Aldo Moro, Bari, Italy, October 11–13, 2014. A three-day international meeting co-sponsored by SQS involving a one-day symposium of invited talks in Bari, followed by two days spent visiting two candidate GSSP sections, Montalbano Jonico and the Valle di Manche, and the coeval lacustrine Sant'Arcangelo section. There were about 28 participants including five proponents of the third candidate Middle Pleistocene GSSP, the Chiba section in Japan. Televised report: RAI 3, the regional station of the main Italian National TV company (aired 12 Oct 2014).

3B LIST OF MAJOR PUBLICATIONS OF SUBCOMMISSION WORK (BOOKS, SPECIAL VOLUMES, KEY SCIENTIFIC PAPERS)

Waters, C. N., Zalasiewicz, J. A., Williams, M., Ellis, M. A. & Snelling, A. M. (eds) 2014. A Stratigraphical Basis for the Anthropocene. *Geological Society, London, Special Publications*, 395. Edited by members of the Anthropocene Working Group (AWG) and containing 17 papers of which many are authored or coauthored by members of the AWG. The first batch of papers was published online in 2013.

The new journal *Anthropocene Review*, published by SAGE, was launched in 2014 (http://anr.sagepub.com) with many of the editorial board, including the Editor-in-Chief, serving also on the AWG. AWG members have published in the journals *Anthropocene*, *Anthropocene Review*, *Nature Geoscience*, *Rendiconti Lincei*, *Continental Shelf Research*, *Science of the Total Environment*, and *Climate Law*.

Head, M.J., Gibbard, P.L., and van Kolfschoten, T. (eds.) in prep. "The Quaternary System/Period and its Formal Subdivision". *Quaternary International*, special issue. A total of 15 papers to be included, and scheduled for publication in 2015.

3C. PROBLEMS ENCOUNTERED, IF APPROPRIATE

The Working Group on the Upper Pleistocene Subseries Boundary, after five years of inactivity, is now beginning to make progress, with the proposal of a new candidate GSSP, the Fronte section, in Taranto, Italy, and a field trip to this section (see above). Dr Alessandra Negri, a key proponent of the Fronte section, has joined the Working Group. But finding such a recent GSSP (~130 ka) in marine deposits on land that do not display facies changes at the boundary presents special challenges. Therefore a search for additional candidate GSSPs is also underway.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015)

1. The 19th INQUA (International Union for Quaternary Research) Congress, to be held in Nagoya, Japan, July 27–August 2, 2015, will be the premier event for Quaternarists in 2015. INQUA congresses are held every four years. M.J. Head (SQS chair) is to give a plenary keynote talk at the Congress on the work of the SQS. Three events are being sponsored by SQS: 1) a special symposium "The Early–Middle Pleistocene transition: local records, global correlations" co-convened by M.J, Head and others; 2) a Business Meeting of the SQS; and 3) a two-day trip to see the Chiba Section, a candidate GSSP for the Middle Pleistocene Subseries boundary. This is a sequel to the SQS-sponsored field workshop in Italy, October 2014, where the two other candidate GSSPs in Italy were examined. The overall intent is to consolidate understanding of the three Middle Pleistocene candidate GSSPs in advance of preparations to submit formal GSSP proposals, hopefully the following year.

2. SQS plans to co-sponsor the following special session "Neogene–Quaternary Integrated Stratigraphy: SQS-SNS-RCMNS joint session" at STRATI 2015 in Graz, Austria, in July, 2015. The co-conveners will include Fabrizio Lirer (for SQS) and Isabella Raffi.

3. Special issue of *Quaternary International*, editors: M.J. Head, P.L. Gibbard, and T. van Kolfschoten, to be finalized early in 2015. This is based on papers presented at "The Quaternary System/Period and its Formal Subdivision" during STRATI 2013.

4. Proponents of the three candidate GSSPs for the Middle Pleistocene Subseries boundary (two in Italy, one in Japan) will be asked late in 2015 to provide a timetable for submitting formal proposals to SQS, with the hope that a decision by SQS on this GSSP can be accomplished by 2016.

5. During 2015, the SQS / INTIMATE Working Group on the formal subdivision of the Holocene will be working towards submitting a formal proposal to subdivide the Holocene into three named stages defined by GSSP, with the two highest at 8.2 ka BP and 4.2 ka BP.

5. SUMMARY OF EXPENDITURES IN 2014 (Can $)

	Payment	Deposit	Balance
Carried forward (November 28, 2013)			1693.38
Prof. S. Finney (ICS funds for 2014)		1855.00	3548.38
John Wiley & Sons sponsorship for 2013		431.10	3979.48
Prof. M.J. Head (attendance at Bari*)	2133.51		1845.97
Balance at November 7, 2014			1845.97

ICS–NSF Special Funding (2013) – reimbursement in progress:
Dr. Osamu Kazaoka (attendance at Bari*) allowance up to US$2000.00
Prof. Makoto Okada (attendance at Bari*) allowance up to US$2000.00

*= Field Workshop on Lower–Middle Pleistocene Transition in Italy, October 11th–13th, 2014, based at Bari University, Italy.

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2015

Funds are requested to enable one proponent from each of the two Italian Middle Pleistocene candidate GSSPs (Montalbano Jonico and the Valle di Manche) to visit the Chiba candidate GSSP as part of the INQUA Congress in Japan, 2015, and to participate in the special symposium "The Early–Middle Pleistocene transition: local records, global correlations" co-convened by the Chair of SQS. This is a sequel to the Italian field workshop in 2014 where the Italian candidate GSSPs were visited and discussed. A total of $2000 each is requested for one representative of each of the two Italian candidate GSSPs to attend the Congress. In addition, $2000 is requested for the Chair of SQS to visit the Congress in order to examine the Chiba section, to convene the special symposium on the Early–Middle Pleistocene transition, and to chair a scheduled SQS Business Meeting. This GSSP is presently the main priority of SQS, and all three candidate sections are being researched with considerable energy and focus.

SQS is co-convening a joint session with SNS-RCMNS on "Neogene–Quaternary Integrated Stratigraphy" at STRATI 2015 in Graz, Austria, in July, 2015, and the co-convener Dr. Fabrizio Lirer (a voting member of SQS) will represent SQS. $800 is requested to support Fabrizio Lirer's attendance at this important meeting.

In summary, a total of $6800 is requested to assist the chair of SQS (Canada) and two members of the Italian working groups (both from Italy) in attending the INQUA Congress in Japan; and to assist a representative of SQS in attending STRATI 2015 in Graz.

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2010–2014)

1. Calabrian Stage/Age ratified in December 2011. Reference:
2. Cita, M.B., Gibbard, P.L., Head, M.J., and The Subcommission on Quaternary Stratigraphy, 2012. Formal ratification of the base Calabrian Stage GSSP (Pleistocene Series, Quaternary System). Episodes 35(3): 388–397.
3. Strong progress towards defining named stages for the Holocene.
4. Strong progress on all three candidate GSSPs for the Middle Pleistocene.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015–2018) – ranked according to priority.

1. Nominate GSSP for the Middle Pleistocene Stage/Subseries boundary.
2. Nominate two GSSPs to subdivide the Holocene Series into three named stages.
3. Explore further chronostratigraphic subdivision of the Quaternary System/Period, including the duration and status of the "Anthropocene".
4. Nominate GSSP for the Upper Pleistocene Stage/Subseries boundary.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

Officers of SQS

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9B LIST OF WORKING (TASK) GROUPS AND THEIR OFFICERS

Working Group on the "Anthropocene"

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Full membership of the Working Group: Tony Barnosky (USA), Alejandro Cearreta (Spain), Paul Crutzen (Germany), Matt Edgeworth (UK), Erle Ellis (USA), Mike Ellis (UK), Ian Fairchild (UK), Agnieszka Gałuszka* (Poland), Philip Gibbard (UK), Jacques Grinevald (Switzerland), Peter Haff (USA), Irka Hajdas* (Switzerland), Alan Haywood (UK), Catherine Jeandel* (France), Reinhold Leinfelder (Berlin), John McNeill (USA), Cath Neal* (UK), Eric Odada (Kenya), Naomi Oreskes* (USA), Clement Poirier (France), Simon Price (UK), Andrew Revkin (USA), Dan Richter (USA), Mary Scholes (South Africa), Bruce Smith (USA), Victoria C. Smith* (Oxford), Will Steffen (Australia), Colin Summerhayes* (UK), James Syvitski* (USA), Davor Vidas (Norway), Michael Wagreich (Austria), Colin Waters (Secretary, UK), Mark Williams (UK), Scott Wing* (USA), Alex Wolfe (Canada), Jan Zalasiewicz (Chair, UK), An Zhisheng (Xi'an) (China). * = new member in 2014.

Working Group on the subdivision of the Holocene Series

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Full membership of the Working Group: M. Berkelhammer (USA), S. Björck (Sweden), L.C. Cwynar (Canada), D.A. Fisher (Canada), A.J. Long (UK), J.J. Lowe (UK), R.M. Newnham (New Zealand), S.O. Rasmussen (Denmark), M.J.C. Walker (Convener, UK), and H. Weiss (USA). No change in membership from 2013.

Working Group on the Middle/Upper Pleistocene Subseries Boundary

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Full membership of the Working Group: Art Bettis (USA), Aleid Bosch (Netherlands), Philip Gibbard (UK), Liu Jiaqi (China), Peter Kershaw (Australia), Wighart von Koenigswald (Germany), Thomas Litt (Co-convener, Germany), Jerry McManus (USA), Alessandra Negri* (Italy), Charles Turner (UK), Martin J. Head (Canada), and Jan A. Zalasiewicz (Co-convener, UK). * = new member in 2014.

Working Group on the Lower/Middle Pleistocene Subseries Boundary

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Full membership of the Working Group: Luca Capraro (Italy), Neri Ciaranfi (Italy), Craig Feibel (USA), Martin J. Head (Co-convener, Canada), Hisao Kumai (Japan), Luc Lourens (Netherlands), Jiaqi Lui (China), Anastasia Markova (Russia), Tom Meijer (Netherlands), Brad Pillans (Co-convener, Australia), Yoshiki Saito* (Japan), Charles Turner (UK), Cesare Ravazzi (Italy), Thijs Van Kolfshoten (Netherlands). * = new member in 2014.

9C INTERFACES WITH OTHER INTERNATIONAL PROJECTS

The Subcommission on Quaternary Stratigraphy (SQS) maintains close ties with The International Union for Quaternary Science (INQUA) through its Commission on Stratigraphy and Chronology (SACCOM). Prof. Phil Gibbard is both president of SACCOM and a voting member of SQS, and five other members of SACCOM are also members of SQS. This continues to lead to co-sponsorships of meetings/symposia by SQS and SACCOM.

Respectfully submitted:
Martin J. Head, Chair SQS
St. Catharines, 9th November, 2014

SUBCOMMISSION ON NEOGENE STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

Subcommission on Neogene Stratigraphy (SNS)

Isabella Raffi, Chairman SNS (from August 1, 2012) Università "G. d'Annunzio" di Chieti-Pescara, Dipartimento di Ingegneria e Geologia (InGeo), Via dei Vestini 31, 66013 Chieti Scalo, Italy. E-mail: raffi@unich.it

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

The SNS is the primary body responsible for providing optimum clarity and stability in the Neogene Chronostratigraphic Scale by selecting and defining Global Stratotype Sections and Points (GSSPs) for Series and Stages.

3. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

Burdigalian and Langhian GSSPs working group

Frits Hilgen is the new chair of the working group for the remaining GSSPs, base-Langhian and base-Burdigalian. Most of the members of this working group have been designated, also some corresponding members will be involved in the discussion dedicated to the final selection of the GSSP section, and the WG will be completed within December 2014.

Update of the studies for defining the Langhian GSSP

Studies are in progress to complete the stratigraphic information on the two potentially suitable sections for defining the Langhian GSSP selected in the Mediterranean, namely the downward extension of the La Vedova beach section (Northern Italy) and St. Peter's Pool (Malta Island). The research in progress focuses on the stable isotope stratigraphy, and cyclostratigraphy and astronomical tuning of these sections. A meeting of the newly established working group is scheduled during the STRATI 2015 Congress in Graz. Discussion on the problematic Burdigalian GSSP will be a major task to face for the WG (see below).

3b. No major publications of subcommission work

3c. CHIEF PROBLEMS ENCOUNTERED IN 2014

As already stated in the previous reports, a problem that remains is the possible lack of suitable sections in the Mediterranean for defining the Burdigalian GSSP. This is certainly the case if we prefer to have the Burdigalian GSSP defined in an astronomically tuned deep marine section in the Mediterranean that directly underlies the geologic time scale. The SNS chair will suggest to the new members of Langhian/Burdigalian WG to take into consideration alternative options: to have this boundary defined in (I)ODP cores, or to highlight the problem of survival of the Burdigalian as a chronostratigraphic unit. Hopefully, a decision about this issue should be made in the coming years.

4. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015):

The study of the two potential boundary stratotype sections of La Vedova and St. Peter's Pool for defining the Langhian GSSP will be completed on the astronomical tuning of the sections and the construction of a stable isotope record for St. Peter´s Pool. It is anticipated that a workshop will be held as soon as the two studies will be completed. Following these studies a decision regarding which section and criterion are most suitable for defining the Langhian GSSP will be taken before the end of 2015. The search for suitable sections and/or cores for defining the Burdigalian GSSP will continue.

5. SUMMARY OF EXPENDITURES IN 2014:

Credit on Nov 2013	**Euro**	**4610,74**
Expense for website updating	**Euro**	**500,00**

Credit on Nov 2014	**Euro**	**5494,74**

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2015

Field trip to suitable section for the definition of base-Burdigalian Euro 1500

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APPENDIX

7. SUMMARY OF MAIN ACCOMPLISHMENTS OVER PAST FIVE YEARS (2010-2014)

2010

Preparation of several papers on the two candidate sections for defining the Langhian GSSP for publication in a special volume of Stratigraphy, on the historical stratotype of the Langhian, and on the taxonomic concept of *Praeorbulina*.

2011

Publication of papers about potential Langhian GSSP sections in a special volume of Stratigraphy. Preparation of the Neogene chapter (ATNTS2012) of the GTS2012 (Hilgen et al., 2012, in press).

2012

Publication of the Neogene chapter ATNTS2012 in GTS2012 (Hilgen et al., 2012). Publication of a new Neogene calcareous nannofossil zonation (Backman et al., 2012).

2013

Presentation of a new Paleogene calcareous nannofossil zonation at the STRATI 2013 Congress in Lisbon (by I. Raffi et al.).

2014

Talk at the Congress of Italian Geological Society (SGI-SIMP) in Milan (September 2014) about: "The Italian contribution to the definition of the ICS timescale: ongoing research" (by I. Raffi and coauthors M. Balini and S. Monechi).

8. OBJECTIVES AND WORK PLAN FOR NEXT 2 YEARS (2015-2016)

A workshop will be organized to discuss on the selection of boundary criteria and sections for defining the 2 remaining stage boundaries in the Miocene, namely the base-Langhian and the base-Burdigalian. A decision will be taken for the Langhian GSSP taking into consideration the two selected sections of La Vedova and St. Peter's Pool. Crucial questions to be addressed during the workshop are: 1) which section is most suitable to be proposed as Langhian GSSP, 2) which prime guiding criterion should be selected. As regards the thorny issue of the Burdigalian GSSP, critical questions are: 1) should we abandon the ambition of having the Burdigalian GSSP directly tied within an astrochronologic framework in order to have the GSSP defined in a Mediterranean land-based section, or should we define this GSSP in drilled ODP sequences at Ceara Rise or any other tuned sequence drilled by (I)ODP, or 2) should the Burdigalian as Stage denotation be disused because no suitable onland stratigraphic sections are available.
Writing of proposals for the Langhian GSSP, and writing on discussion about Burdigalian GSSP in 2015.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

The SNS is a subcommission of the ICS, founded in 1971. Reference is made to the annual report of 1995 for a brief historical resume of the SNS. The subcommission has four regional committees (Mediterranean, Pacific, Atlantic and Nordic) and keeps close contacts with the Russian Neogene Commission chaired by Prof. Yuri B. Gladenkov. Apart from the executive bureau, the SNS has 22 voting members and 24 corresponding members (*see Appendix for full list of officers and voting and corresponding members*). The SNS has presently one active working group for defining the GSSP remaining for the Langhian and Burdigalian chaired by Frits Hilgen, with 11 active members (listed below - section 9a). Composition of this WG will be completed within December 2014.
The SNS web site (www.sns.unipr.it) has been renewed and published in December 2013.
Support for the SNS comes from the Chairman's Institution in Italy (Università degli Studi "G. d'Annunzio di Chieti-Pescara). The Secretary's Institution in Parma (Università degli Studi di Parma) hosts the SNS web-site.

9a. CURRENT OFFICIERS, VOTING AND CORRESPONDING MEMBERS

Subcommission officers (from August 1, 2012)

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9c. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

There is a close link with (I)ODP because of its important role in the development of integrated time scales for the Neogene, in testing the global correlation potential of bio-events, and in a better understanding of climate and ocean history during this time span.

There is even a link with the activity of the EARTHTIME-EU Research Networking Programme (RNP), that is part of a broader international initiative “EARTHTIME: a community-based scientific effort aimed at sequencing Earth history through an integrated geochronologic and stratigraphic approach”.

SUBCOMMISSION ON PALEOGENE STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Paleogene Stratigraphy

Submitted by:
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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Mission statement

The Subcommission is the primary body for facilitation of international communication and scientific cooperation in Paleogene Stratigraphy, defined in the broad sense of multidisciplinary activities directed towards better understanding of the evolution of the Earth during the Paleogene Period. Its first priority is the unambiguous definition, by means of agreed GSSPs, of a hierarchy of chronostratigraphic units, which provide the framework for global correlation.

Goals

a) to agree on an international set of stages and series for the Paleogene.
b) to establish basal boundary stratotypes (GSSPs) of the Paleogene stages and series.
c) to encourage research into the Paleogene by setting up and supporting Working Groups and Regional Committees to study and report on specific problems.
d) to organize symposia and workshops on subjects of Paleogene stratigraphy.
e) to maintain a website informing on progress and coming events in Paleogene stratigraphy.

Fit within IUGS Science Policy

The objectives of the Subcommission relate to three main aspects of IUGS policy:
1) Establishment of an internationally agreed scale of chronostratigraphic units, fully defined by GSSPs. A set of Paleogene stages has been voted and agreed on by the ISPS in 1989. Subsequently, Working Groups have been set up to find a Global Stratotype Sections and Points (GSSPs) for the boundary of each of these stages.
2) Establishment of frameworks and mechanisms to encourage international collaboration in understanding the evolution of the Earth during the Paleogene Period.
3) Working toward an international policy concerning conservation of geologically and paleontologically important sites such as GSSPs. This relates to, inter alia, the IUGS Geosites Programme and the UNESCO Geoparks Programme.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

The Subcommission was deeply involved into the Climate and Biotic Events of the Paleogene (CBEP) conference in Ferrara (1-6 July 2014). Numerous voting and corresponding members attended the meeting and contribute with oral and poster presentations. A meeting of the Subcommission has been organized during the conference, in which has been presented an up-date of the subcommision's work and programs. Prof. Jerry Hooker of the Bartonian Working Group presented the progress in searching a suitable GSSP.
At present most of the Paleogene GSSPs have been formalized and there are only three of them pending formal definition: the bases of the Bartonian, Priabonian and Chattian. Significant progress has been done during 2014, and the formal proposal of Priabonian will be submitted at the end of the year.
A new calcareous nannofossil biozonation for the Paleogene has been published by Agnini and co-authors in 2014, based on data acquired on last three decades from key low to middle latitude deep-sea drilling sequences and Tethyan on-land pelagic sections. A new code system has been suggested: 11 Paleocene biozones (CNP1–CNP11), 21 Eocene biozones (CNE1–CNE21), and 6 Oligocene biozones (CNO1–CNO6).
Besides the primary biohorizons a number of additional biohorizons are also included, age estimates have been calculated for all primary and additional biohorizons, using both magnetostratigraphic and astronomically tuned cyclostratigraphic data.

The Subcommission has been financed by the NSF–ICS for the reconstruction of the website. An experienced team linked to the University of Firenze has been chosen. The new website will be operative at the end of this year or beginning 2015.
A geological fieldtrip in Armenia has been organized by the Armenian and Russian colleagues from August 24th to September 8th on " The Bartonian, Priabonian and Rupelian boundaries in Southern Armenia. Problems and solutions", At the field trip partecipate around 20 researchers, it has been very well organized, and successful. The sections, excellent exposed seem to be promising for correlating shallow to deep-water settings with magnetostratigraphy and plankton stratigraphy. The partecipants at the fieldtrip agree on working together and presenting the new data at the Strati2015 conference in Graz in July 2015.
Cesare A. Papazzoni, Department of Chemical and Geological Sciences of Modena and Reggio Emilia University, Italy and Carles Ferrandez Cañadell, Department of Stratigraphy, Paleontology and Marine Geosciences, University of Barcelona, Spain are the new Chairman and Secretary of the Paleogene Larger Foraminifera Working Group after the passing of Lukas Hottinger

Bartonian GSSP:
As anticipated on 2013 Report, in 2014 italian researches focused on the Lutetian-Bartonian transition from the Bottaccione section (Gubbio, Umbria-Marche Basin). The integrated stratigraphy of planktonic foraminifera (E8-E15), calcareous nannofossils (NP15b-NP19/NP20) and paleomagnetic reversal sequence (C20r-C15n) has been implemented, revised and corrected. Isotope stratigraphy and orbital tuning are in progress.

Priabonian GSSP:
Studies by the Working Group had continued on the Alano section, the candidate GSSP of base Priabonian. A cyclostratigraphic analysis of the Alano section has been integrated with several radiometric data (U/Pb) resulting in improved chronologic framework for the section. These results will be submitted soon, hopefully by the end of this year (lead by Simone Galeotti and Daniel Condon).
Moreover, the Alano section was the focus of the post-conference field-trip of the Climatic and Biotic Events of the Paleogene 2014 (CBEP 2014) Congress, held in Ferrara (Italy) in July 1-6, 2014. A field-trip guide entitled "THE PALEOGENE RECORD OF THE VENETO REGION (NE ITALY)" was specifically prepared. The Alano Working Group is preparing the proposal to be submitted to ISPS by the end of this year.
The Varignano section (Trento province, northern Italy), which straddles the Bartonian/Priabonian boundary located 80 km west of the Alano section, has been studied in detail. This section, deposited in bathyal paleoenvironment containing eight resedimented bioclastic levels with larger foraminifera, provided a direct correlation between the calcareous plankton standard zones and the Shallow Benthic Zones (SBZ). The preliminary results show that the integrated plankton biostratigraphy from Varignano reproduces well that recorded in the Alano section including the bioevents proposed as possible markers of the base Priabonian, namely the *Morozovelloides* extinction and the *Cribrocentrum erbae* acme. In term of larger foraminifera, both calcareous plankton bioevents fall within the SBZ 18.
The study of the Varignano section is nearly completed, with the sampling for magnetostratigraphy scheduled for November 2014. The final results will be submitted for publication in early 2015.

Chattian GSSP:
The proposal of the base Chattian GSSP at Monte Cagnero (central Italy) is in the final stage of preparation by A. Montanari, who completed the revision of the orbital tuning based on high-resolution magnetic susceptibility and calcium carbonate data series, and by R. Coccioni who is performing the final editing. The proposal will be submitted to ISPS in a short time.

3b List of major publications of subcommission work
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3c. Problems encountered

The problems encountered this year are essentially the same as those discussed in the previous annual reports. ISPS can support only very insufficiently the working groups and regional committees for attending field workshop and/or conferences. In particular, we would need a substantial increase in our budget in order to support and in part to reactivate regional committees in poorer countries. Most of the secretarial and other expenses have been covered by the institutions of the officers and other members of ISPS. Since money becomes tighter everywhere, these sources may dry up.

4a. OBJECTIVES AND WORK PLAN FOR THE NEXT YEAR (2015):

- Full support will be given to the working groups on the GSSPs of the Bartonian, Priabonian and Chattian.
- Prepare and submit to the Subcommission the proposals for the establishment of a basal GSSP for the Priabonian and Chattian.
- Formalisation of the GSSPs for the bases of the Priabonian and Chattian stages.
- Support a field meeting of the Bartonian WG in Central Italy and southern England to evaluate the potential value of three potential GSSP candidate sections.
- Organize and support a meeting of the Paleogene Subcommission in STRATI2015
- Support a field workshop in the Gubbio area (Central Italy) to evaluate the auxiliary sections of the GSSP of the Selandian.
- Screen and rejuvenate the list of the Corresponding Members.
- Reactivate or close those Regional Committees and Working Groups that are asleep.

- Update and renew the ISPS website.

4b. Specific GSSP Focus for 2015

Bartonian GSSP: In search of a possible candidate section for the base Bartonian GSSP.
Studies on the Bottaccione section have been focused on the Lutetian Bartonian transition. During the next year the integrated stratigraphy of calcareous plankton and the paleomagnetic reseversal sequence will be implemented and revised. High-resolution studies on isotopes and orbital cycles will be performed.
A field workshop will be organized in England on the Bartonian area.

Priabonian GSSP:
Studies will continue on the Alano section: cyclostratigraphic studies will be integrated with radiometric data (lead by Simone Galeotti and Daniel Condon). Studies on the Varignano section will continue. The calcareous plankton biostratigraphy will be implemented with magnetostratigraphic data.
During the next year studies on biostratigraphy, magnetostratigraphy and geochemistry will be performed on the Urdsadzor section in Armenia.
The Alano Working Group is preparing the proposal to be submitted to ISPS by the end of 2014. The proposal will be voted by the voting members of the Subcommission in early 2015.

Chattian GSSP:
At the beginning of 2015 the astrochronological calibration of the Monte Cagnero section based on orbital tuning of high-resolution magnetic susceptibility and calcium carbonate data series will be completed. The calcareous plankton biostratigraphy will be implemented with a new high-resolution dinocyst biostratigraphy and accurately calibrated with the magnetostratigraphy. Some critical calcareous plankton bioevents will be controlled across some key-intervals.
The GSSP proposal will be submitted officially by the leaders of the WG R. Coccioni and A. Montanari to the Paleogene Subcommission in early 2015.

5. SUMMARY OF EXPENDITURES IN 2014:

INCOME

Carried forward from 2013	Euro 0
ICS Allocation for 2014	Dollar 4000
TOTAL	Dollar 4000

EXPENDITURE FROM 2014 BUDGET

General office expenses	Dollar 400
Professional help with the website	Dollar 800
Contributions to Officers travel costs	Dollar 300
Support of Working Groups and Regional Committees,	Dollar 500
Support Field Trip Armenia	Dollar 2000
TOTAL	Dollar 4000

6. BUDGET REQUEST AND ICS COMPONENT FOR 2015

Projected Budget for 2015:

General office expenses	Dollar 400
Professional help with the website	Dollar 1000
Contributions to Officers travel costs	Dollar 1200
Support for GSSP's field meetings (Priabonian, Chattian, Bartonian) Working Groups and Regional Committees, Strati 2015	Dollar 3700
TOTAL BUDGET PROJECTED	Dollar 6300

Please note that the financial situation has deteriorated in recent years, an increase would help us to support the travel cost and the participation of the members of the ISPS to GSSP's field meetings in Italy, Spain, England and Strati 2015.

APPENDICES

7 . CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2010-2014)

See Accomplishments in ICS Annual Reports 2010 to 2013 for additional details.

- The Subcommission sponsors International Meeting on the Paleogene: Salzburg, Austria (2011), Lisbona (2013) and Ferrara (2014).
- Formalization of the GSSP for the bases of the Selandian (Middle Paleocene) and Thanetian (Upper Paleocene) stages have been defined at Zumaia, Spain. The GSSP was officially published in *Episodes* (2011).
- Formalization of the GSSP for the base Lutetian Stage (early/middle Eocene boundary) was defined in the Gorrondatxe section (Basque Country, northern Spain). The GSSP was officially published in *Episodes* (2011).
- On February 13, 2012 the official ceremony to define the Global Stratotype Section and Point (GSSP) for the base of the Lutetian Stage took place in Getxo village and Gorrondatxe beach (Northern Spain).
- Field workshop of the Priabonian WG in Alano (June 2012) and proposal of the Alano section as the Stratotype section of the base of Priabonian.
- Ninth International Workshop on Aglutinated Foraminifera, Zaragoza, Spain, 3-7, September, 2012.
- VIII South American Symposium on Isotope Geology (VIII. SSAGI), Medellin, 2012
- The Subcommission holds a session "Paleogene events, evolution and stratigraphy" during the Strati 2013 meeting in Lisbon.
- The Subcommission helds a meeting during the CBEP in Ferrara.

Regarding the rest of the Paleogene Stages, good progress has been made in the search for the remaining GSSPs (Bartonian, Priabonian, Chattian).
The detailed reports of activities during the past four years of the Working Groups and Regional Committees are included in the ISPS website: **http://wzar.unizar.es/isps/index.htm**

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015-2018)

- Complete and publish the GSSPs of the Paleogene.
- To submit the proposal of Priabonian and Chattian GSSPs to the Paleogene Subcommission voting members, then submit it to ICS and possibly to Episodes for publication during 2014-2015
- To advance on the definition criteria for identifying the base of Bartonian, choose a type section and submit a proposal to Paleogene Subcommission voting members 2014.
- To submit the proposal Bartonian GSSP to ICS and possibly to Episodes for publication within 2015.
- Support the organization of the Paleogene Subcommission meeting in Ferrara (Italy) during the CBEP 2014 conference, July 2014.
- Support of the organization of the field workshops and meeting of the remaining GSSPs.
- Support the attendance at the Strati 2015 in Austria and IGC 34 in South Africa.
- Produce an updated version of an integrated Paleogene Time Scale.
- Produce a state-of-the-art review of the stratigraphic tools used in the Paleogene.
-Preparation of standardized regional correlation charts and paleogeographic maps by the Regional Committees.
- Revise and find auxiliary sections to better characterize the:
    - P/E boundary (i.e., Alamedilla, Caravaca and Zumaia in Spain, Forada and Contessa Highway in Italy, Polecat Bench in Wyoming);
    - Danian/Selandian: Contessa and Bottaccione in Italy; Caravaca and Sopelana in Spain; Selandian/Thanetian: Contessa, Italy
    - Bartonian: Contessa and Bottaccione in Italy; Alum Bay and Barton in the UK;
    - Priabonian: Egypt Wadi HitanValley, in the Fayum; Urdsadzor, Armenia; E/O: Monte Cagnero in Italy, Fuente Caldera in Spain, Landzhar in Armenia;

9) ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

The Palegeone Subcommission consists of 21 Voting Members elected for their personal expertise and experience and about 100 Corresponding Members, who have a responsibility for communication in both directions between the Subcommission and researchers on Paleogene topics in their region. Voting and Corresponding Members were selected regionally to provide expertise in the Paleogene stratigraphy of each major area and according to their speciality in order to cover the main fields of stratigraphic tools used in the Paleogene.

9a Names and Addresses of Current Officers and Voting members
Subcommission officers

Chair:
Simonetta Monechi. Dipartimento di Scienze della Terra. Universitá di Firenze.
4 Via la Pira. I-50121 Firenze. Italy. simonetta.monechi@unifi.it
Vice-Chair:
Noël Vandenberghe, Departement Earth and Environmental Sciences, Celestijnenlaan 200 E, B-3001 Heverlee-Leuven, Belgium.
noel.vandenberghe@ees.kuleuven.be
Secretary:
Laia Alegret, Departamento de Ciencias de la Tierra, Universidad de Zaragoza, Calle Pedro Cerbuna, 12, E-50009 Zaragoza, Spain. **laia@unizar.es**

List of Voting Members

Laia Alegret Departamento de Ciencias de la Tierra, Facultad de Ciencias. University of Zaragoza. 50009 Zaragoza Spain**, laia@unizar.es**
Rodolfo Coccioni, Dipartimento di Scienze della Terra, della Vita e dell'Ambiente, Universita' degli Studi "Carlo Bo" Campus Scientifico. Localita' Crocicchia I-61029 Urbino (Italy)
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Margaret Collinson, Department of Earth Sciences Royal Holloway University, of London Egham, Surrey, TW20 0EX, UK, **m.collinson@es.rhul.ac.uk**
Vlasta Cosovic, Department of Geology, University of Zagreb, Horvatovac 102, 10 000 Zagreb, Croatia, **vcosovic@geol.pmf.hr**
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Jean Pierre Gély, Museum d'Histoire Naturelle Paris, France **jean-pierre.gely@gazdefrance.com**
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Christopher Hollis, GNS Science, Institute of Geological and Nuclear Sciences, PO Box 30-368, Lower Hutt, New Zealand., **c.hollis@gns.cri.nz**
Eustoquio Molina, Departamento de Ciencias de la Tierra, Facultad de Ciencias. Universidad de Zaragoza. 50009 Zaragoza, Spain, **emolina@unizar.es**
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Dalila Zaghbib-Turki, Département de Geologie, University of Tunis. 2092 Tunis El Manar Tunisia, **dalila.zaghbib@fst.rnu.tn**
James Zachos, Earth & Planetary Sciences Univ. of Calif., Santa Cruz CA, USA, jzachos@ucsc.edu

9b *List of Working (Task) Groups and their officers*

Paleocene Working Group. Chairman: Birger Schmitz, Sweden. **birger.schmitz@geol.lu.se**
Ypresian/Lutetian Boundary Stratotype Working Group. Chairman: Eustoquio Molina, Spain. **emolina@unizar.es** Secretary: Silvia Ortiz, Spain. **silortiz@unizar.es** Website**:** http://wzar.unizar.es/perso/emolina/ypresian.html
Lutetian/Bartonian Boundary Stratotype Working Group. Chairman: Richard Fluegeman, USA. **fluegem@bsu.edu**
Bartonian/Priabonian Boundary Stratotype Working Group. Chairwoman: Isabella Premoli Silva, Italy. **isabella.Premoli@unimi.it**
Rupelian/Chattian Boundary Stratotype Working Group. Chairwoman: Isabella Premoli Silva, Italy. **isabella.Premoli@unimi.it**
Paleogene Planktonic Foraminifera Working Group. Chairman: Bridget Wade, USA. b.wade@ucl.ac.uk Secretary: Helen Coxall, UK. **hkc@gso.uri.edu**
Paleogene Deep-Water Benthic Foraminifera Working Group. Chairman: Michael Kaminski, UK. **kaminski@kfupm.edu.sa** Secretary: Laia Alegret, Spain. **laia@unizar.es**
Paleogene Calcareous Nannofossils Working Group. Chairwoman: Simonetta Monechi, Italy. Simonetta.**monechi@unifi.it**
South-American Regional Committee on Paleogene Stratigraphy. Chairman: Juan Carlos Silva Tamayo, Colombia. jsilvatamayo@yahoo.com Secretary: Diana Ochoa, Panama. dianita.ochoa@gmail.com
Russian Paleogene Commission. Chairman: Mikhail A. Akhmetiev, Russia. **akhmetiev@ginras.ru** Secretary: G. N. Aleksandrova.
Working Group on Paleogene Stratigraphy of the North Pacific. Chairman: Yuri B. Gladenkov, Russia. **gladenkov@ginras.ru,** agladenkov@ilran.ru
Paleogene Larger Foraminifera Working Group, Chairman: Cesare Papazzoni, Italy. cesareandrea.papazzoni@unimore.it Secretary: Carles Ferrandez Cañadell, Spain carlesferrandez@ub.edu

9c Interfaces with other international project

Some of our members participate also in the work of the following International projects:
Integrated Ocean Drilling Programme
International Subcommissions on Cretaceous and Neogene Stratigraphy
International Geoscience Programme (IGCP)
ProGEO, Geosites and Geoparks Initiatives
UNESCO World Heritage Sites

10. Annual reports 2014 of the other working groups:

The detailed and complete reports of activities during 2014 of the Working Groups and Regional Committees are included in the ISPS website: **http://wzar.unizar.es/isps/index.htm**

Russian Paleogene Commission.
Chairman: Mikhail A. Akhmetiev, Russia. Secretary: G.N. Aleksandrova. Russia.
Meetings and field-trips
29-01-2014 Meeting of the Moscow Department together with the Paleontological section Moscovian natural Sciences Society.
July 2014 Annual meeting
August-September 2014 International Meeting and geological excursions in Armenia
August-September 2014. International field–excursion Paleogene and Miocene deposits on Belaya River section (North Caucasus)

Working group on Paleogene Stratigraphy of the North Pacific
Chairman: Yuri B. Gladenkov, Russia
August 2014 Petropavlovsk-Kamchatsky (Kamchatka, Russia) meeting of Working Group. The stratigraphic schemes for the Kamchatka region were discussed and ways of their improvement were outlined.
August 2014 a field-work in Kamchatka was organized to study one of the key marine Paleogene stratigraphic sections of West Kamchatka (Kvatchina Bay).

Annual Report 2014 of the Paleogene Deep-Water Benthic Foraminifera Working Group.
Secretary: Laia Alegret, Spain.

A selection of the contributions presented during the 9th International Workshop on Agglutinated Foraminifera (IWAF-9) was published in a special volume of *Micropaleontology* 60 (1). The Working Group has continued to work on the taxonomy and evolution of Paleogene benthic foraminifera, with special emphasis on the analysis of the early recovery of the assemblages after the Paleocene/Eocene extinction (combined with organic biomarker studies, Arreguín-Rodríguez et al., *Micropaleontology* 60, 43-51; and Arreguín-Rodríguez & Alegret, *Estudios Geológicos*, in press). M. Kaminski was a shipboard scientist on the Alpha Ridge-Lomonosov Ridge Expedition (ALEX 2014) organized by the Alfred Wegner Institute (AWI), Helmholtz Centre for Polar and Marine Research to carry out geoscientific investigations in the central Arctic Ocean.

Annual Report of the Paleogene Planktonic Foraminifera Working Group 2014
Helen Coxall (Secretary) Bridget Wade (Chairwoman)
The Paleogene Planktonic Foraminifera Working Group is moving ahead with the Atlas of Oligocene Planktonic Foraminifera. Mark Leckie hosted a working group meeting at University of Massachusetts, Amherst (USA) in March 2014, which 11 of our members attended.

Paleogene Larger Foraminifera Working Group 2014 Chairman Cesare Papazzoni
The International fieldtrip held in Armenia in 2014, aimed to sample Bartonian-Priabonian sections and to publish the results with an integrated biostratigraphic scheme including the SBZ and the plankton/nannoplankton biozones.
The effort to integrate the plankton/nannoplankton scales with the LBF is under way also in the western Europe, with some papers trying to find platform/basin direct correlations, again around the Bartonian-Priabonian boundary and in the Early Eocene.

SUBCOMMISSION ON CRETACEOUS STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Cretaceous Stratigraphy (SCS)
SUBMITTED BY
Prof. Malcolm Hart, Chair
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Plymouth University
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OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

_ *To facilitate international communication in all aspects of Cretaceous stratigraphy and correlation*

_ *To establish a standard global stratigraphic subdivision and nomenclature for the Cretaceous, as part of the ICS standard global stratigraphic scale;*

- *To produce a stratigraphic table displaying agreed subdivision to substage level and intervals of disagreement, marking boundaries that are defined by a GSSP.*

ORGANIZATION

SCS is a Subcommission of the International Commission on Stratigraphy.

Membership:	Chair:	Prof. Malcolm Hart, UK
	Vice Chairs:	Dr James Haggart, Canada
		Dr Brian Huber, USA
	Secretary:	Prof. Bruno Granier, France

In addition, there are **18** Voting Members of the Subcommission, from most continents. Over 130 Cretaceous scientists from all over the world and in many different disciplines belong to one or more of the 9 Stage Working Groups of the SCS still active, or to the Kilian Group. All WG members are treated as Corresponding Members of the Subcommission. Effectively, anyone with interest and expertise that can contribute to our objectives is welcome to do so. ***The great bulk of the Subcommission's work is carried out by these Working Groups***.

Officers for 2013-2016:

Chair:	Prof. Malcolm Hart (Plymouth, UK)
Vice-Chairs:	Dr James Haggart (Canada)
	Dr Brian Huber (Washington D.C., USA)
Secretary:	Prof. Bruno Granier (Brest, France)

Thanks to Silvia Gardin, former SCS secretary for her work with the website. The SCS website is now relocated at http://www.univ-brest.fr/geosciences/ISCS/

INTERFACES WITH OTHER INTERNATIONAL PROJECTS

The Subcommission has liaised with successive meetings of the *International Cretaceous Symposium*, which until 2004 have been promoted by the German *Subkommission für Kreide-Stratigraphie*. The SCS has since taken over the responsability for selection of future venues, though the successful applicants will organize individual congresses. The *8th International Symposium on the Cretaceous System* was held in Plymouth during September 2009, and the *9th International Symposium on the Cretaceous System* was held in Ankara (Turkey) during September 2013. This Symposium was held from the 1st to 7th September 2013 at the Middle East Technical University in Ankara. The local organisation was managed by Ass. Prof. Dr. Ismail Omer Yilmaz, who will also act as an Editor of a special volume of *Cretaceous Research*. The *10th International Symposium on the Cretaceous System* is planned for July or September 2017 and will be held in Austria (Vienna or Saltzburg) organised by Prof. M. Wagreich.

The Subcommission also liaises closely with the Subcommission on Jurassic Stratigraphy over the definition of the Jurassic/Cretaceous boundary.

The Subcommission had strong links with IGCP projects: IGCP 507 – "Cretaceous paleoclimatology", IGCP Project 506 - Marine and Non-marine Jurassic: Global correlation and major geological events (Project Co-Leader W. Wimbledon) and IGCP Project 608 "Asia – Pacific Cretaceous Ecosystems". The 1st Meeting of IGCP 608 was held at the Birbal Sahni Institute of Paleobotany over the Christmas period in December 2012.

IGCP 609 "Climate-environmental deteriorations during greenhouse phases:Causes and Consequences of short-term sea-level change" involves many Cretaceous workers and has had its 1st meeting in Ankara (2013) and a 2nd meeting in Bucharest (2014) and another planned in Nanjing (2015).

SCS has always been directly or indirectly linked to important international Projects such as IODP, IGCP, CHRONOS (Mesozoic Planktonic Foraminifera Working Group, MPFWG), EARTH TIME EUROPE (ESF-European Science Fundation), and ICDP (International Continental Scientific Drilling Project).

CHIEF ACCOMPLISHMENTS IN 2013 and 2014

Highlight

One of the most important highlights for 2014 was the inscription of the Stevns Peninsula (Denmark) on the UNESCO World Heritage List. The Stevns Peninsula was 'inaugurated' at a reception on the 22nd October 2014, graced by Her Royal Highness Princess Marie of Denmark. The Cretaceous Subcommission applauds the work of Tove Damholt and Finn Surlyk in achieving this international recognition for an important Cretaceous succession. Reference to the nomination document is given below.

Damholt, T. & Surlyk, F. 2012. *Nomination of Stevns Klint for inclusion in the World Heritage List*. Østsjælands Museum, St. Heddinge, Denmark

General Activities

A wealth of data on various aspects of Cretaceous stratigraphy has continued to be published during 2013 and 2014 providing a continuous stream of new data that spans the whole Cretaceous in increasingly higher resolution. This is particularly true in the fields of stable isotopes and the astronomical tuning of sedimentary sequences.

Battenberg, S.J., Sprovieri, M., Gale, A.S., Hilgen, F.J., Hüsing, S., Laskar, J., Liebrand, D., Lirer, F., Orue-Extebarria, X., Pelosi, N., and Smit, J., 2012, Cyclostratigraphy and astronomical tuning of the Late Maastrichtian at Zumaia (Basque country, Northern Spain): *Earth and Planetary Science Letters*, v. 359–360, p. 264–278.

N. Thibault, D. Husson, R. Harlou, S. Gardin, B. Galbrun, E. Huret, F. Minoletti, 2012. Astronomical calibration of upper Campanian–Maastrichtian carbon isotope events and calcareous plankton biostratigraphy in the Indian Ocean (ODP Hole 762C): Implication for the age of the Campanian–Maastrichtian boundary. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **337–338**, 52–71.

Important Cretaceous issues have been considered by the ICDP, within which coring was undertaken in the Cretaceous Songliao Basin (northeastern China) with the aim to recover a nearly complete Cretaceous terrestrial sedimentary record. The first results of this multidisciplinary study are now published.

Z. Feng, C. Wang, S. Graham, C. Koeberl, H. Dong, Y. Huang, Y. Gao, 2013. Continental Scientific Drilling Project of Cretaceous Songliao Basin: Scientific objectives and drilling technology *Palaeogeography, Palaeoclimatology, Palaeoecology*, **385**, 6-16.

C.P. Chamberlain, X. Wan, S.A. Graham, A.R. Carroll, A.C. Doebbert, B.B. Sageman, P. Blisniuk, M.L. Kent-Corson, Z. Wang, C. Wang, 2013. Stable isotopic evidence for climate and basin evolution of the Late Cretaceous Songliao basin, China. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **385**, 106-124.

C.L. Deng, H.Y. He, Y.X. Pan, R.X. Zhu, 2012. Chronology of the terrestrial Upper Cretaceous in the Songliao Basin, northeast Asia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **385**, 44-54.

C. Wang, Z. Feng, L. Zhang, Y. Huang, K. Cao, P. Wang, B. Zhao, 2013. Cretaceous paleogeography and paleoclimate and the setting of SKI borehole sites in Songliao Basin, northeast China. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **385**, 17-30.

H. Wu, S. Zhang, G. Jiang, L. Hinnov, T. Yang, H. Li, X. Wan, C. Wang, 2013. Astrochronology of the Early Turonian–Early Campanian terrestrial succession in the Songliao Basin, northeastern China and its implication for long-period behavior of the Solar System. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **385**, 55-70.

Note: there are a range of other papers in this Special Issue of *Palaeogeography, Palaeoclimatology, Palaeoecology*, Volume 385, pages 1-228 (published in September 2013).

Of general interest:

Fernando A.G.S., Nishi H., Tanabe K., Moriya K., Iba Y., Kodama K., Murphy M.A., Hokada H., 2011. Calcareous nannofossil biostratigraphic study of forearc basin sediments: Lower to Upper Cretaceous Budden Canyon Formation (Great Valley Group), northern California, USA. *Island Arc*, **20**, 346–370.

K. B. Foellmi, M. Bole, N. Jammet, P. Froidevaux, A. Godet, S. Bodin, T. Adatte, V. Matera, D. Fleitmann,J. E. Spangenberg, 2012**.** Bridging the Faraoni and Selli oceanic anoxic events: late Hauterivian to early Aptian dysaerobic to anaerobic phases in the Tethys. *Climate of the Past*, **8**, 171–189.

O. Friedrich, R.D. Norris, J. Erbacher, 2012. Evolution of middle to Late Cretaceous oceans—A 55 m.y. record of Earth's temperature and carbon cycle. *Geology*, **40**/2, 107-110.

Y. Huang, G. Yang, C. Wang, H. Wu, 2012. The stabilisation of the long-term Cretaceous greenhouse climate: Contribution from the semi-periodical burial of phosphorus in the ocean. *Cretaceous Research*, **38**, 7-15.

G.D. Price, I. F**ő**zy, N.M.M. Janssen, J. Pálfy, 2011. Late Valanginian–Barremian (Early Cretaceous) palaeotemperatures inferred from belemnite stable isotope and Mg/Ca ratios from Bersek Quarry (Gerecse Mountains, Transdanubian Range, Hungary). *Palaeogeography, Palaeoclimatology, Palaeoecology*, **305**, 1–9.

G.D. Price, T. Williamson, R.A. Henderson, M.K. Gagan, 2012. Barremian–Cenomanian palaeotemperatures for Australian seas based on new oxygen-isotope data from belemnite rostra. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **358–360**, 27–39.

S. Reboulet, F. Giraud, C. Colombié, A. Carpentier, 2013. Integrated stratigraphy of the Lower and Middle Cenomanian in a Tethyan section (Blieux, southeast France) and correlations with Boreal basins. *Cretaceous Research*, **40**, 170-189.

L. Simone, S. Bravi, G. Carannante, I. Masucci, F. Pomoni-Papaioannou, 2012. Arid versus wet climatic evidence in the **"**middle Cretaceous**"** calcareous successions of the Southern Apennines (Italy). Cretaceous Research, **36**, 6-23.

The Kilian Group (Lower Cretaceous Ammonite Working Group).

The Kilian Group met in September 2013 at the 9th International Symposium on the Cretaceous System in Ankara (Turkey). The Kilian Group has focussed on the Berriasian, Valanginian and Hauterivian stages, attempting to calibrate different ammonite zonations of the Tethyan, Boreal and Austral realms with the "standard" Mediterranean region zonation.

Reboulet, S. & 18 others, 2014, Report on the 5th International Meeting of the IUGS Lower Cretaceous Ammonite Working Group, the Kilian Group (Ankara, Turkey, 31st August 2013). *Cretaceous Research*, v. 50, p. 126–137.

The Berriasian GSSP and the J/K boundary.

This is a summary of progress for the Berriasian WG, written by the chair, W.A.P. Wimbledon.

The year has been most productive, with new fieldwork areas investigated and the launching of new projects. Andrea Svobodova joined the team already working on integrated studies of the St Bertrands Spring, Le Chouet, Charens and Beaume sites (Drome). Ammonite studies at Charens (led by Camille Frau) have yielded plentiful faunas from the uppermost Tithonian to basal Berriasian. Thus four overlapping local J/K sections have been collected for ammonites, nannofossils and calpionellids, two of them with magnetostratigraphy (Pruner, Schnabl, Grabowski). A paper has been published on Le Chouet ammonites (Bulot, Frau, Wimbledon), and a second on himalayitid ammonites is in press (Frau, Bulot).

Work of microfossil samples from Fiume Bosso continues (Gardin, Rehakova). The study of magnetostratigraphy, calpionellids and nannofossils at Strapkova (Slovakia) continues (Michalik et al) as well as preliminary results published on the bio- and magnetostratigraphy of the Barlya section (Bulgaria) (Grabowski, Lakova, Schnabl, Sobień, Petrova). A review of calpionellids zonations from the Tithonian to the Valanginian of Tethys has also been published (Lakova, Petrova). First discussed at our Marseille meeting, a complete revision of Rio Argos J/K ammonites, calpionellids and nannofossils has been undertaken (Hoedemaeker, Rehakova, Gardin, Casellato) and a publication is imminent. Work on analysing the 2013 sampling for conchostracans and ostracods from the Purbeck Formation (Cao, Li) of Dorset continues.

On the Russian Platform, Vasily Mitta has published on the lithostratigraphic divisions of the Upper Berriasian (Ryazanian). In the Caucasus, in October, the Urukh River section (central Caucasus) was restudied (Vuks) with other sections on the rivers Bezeps, Shebsh, and Tuapse (Western Caucasus). Rogov has published three papers in 2014: on

an ammonite zonal scheme for Russian boreal Tithonian-Berriasian (Volgian), on the genus *Khetoceras* from the lower Berriasian (Upper Volgian), and on the ammonite site of Koroshevo (Moscow). A paper on palaeoenvironments and palaeoecology at Nordvik (Siberia) has been published (Zakharov, Rogov, Dzyuba, Kostak, Pruner). And another paper on Nordvik, discussing magnetostratigraphy and biostratigraphic constraints, is in press (Schnabl, Pruner, Wimbledon).

Two regions where security questions have slowed progress may be suitable for renewed fieldwork in 2015. The second stage of fieldwork in central Tunisia (Sidi Khalif - Gardin) and Kurdistan (Garagu and Banik sites - Andreini, Stoykova, Rehakova) is being planned. More sampling of rich nannofossil levels at the first is a priority, and amplification of a clear *C. alpina* zonal boundary at Banik needs to be duplicated at Garagu (Chia Gara).

One paper has been published on calpionellids from southern Ukraine (Platonov, Arkad'ev et al.) Another publication on Theodosia, Crimea is almost completed, with new results for nannofossils (Halasova, Casellato) and magnetostratigraphy (Bakhmutov), as well as some amendment of foraminiferan ranges (Ivanova). Study of anomalous calpionellid and ammonite records continues (Reháková, Wimbledon). An english-language version of the magnetostratigraphy of the Boissieri Zone of the Zavodskaya Balka near Theodosia has been published (Guzhikov, Arkad'ev).

Li Gang has been studying Morrison formation conchostracans, as well as continuing with work on the Jehol Biota, northern China In Mexico, a precise modern analysis of calpionellid and calc. dinoflagellates biostratigraphy results has been published (Apulco and Iturbite sites) and another is in press (Tamazunchale) (López-Martínez, Barragán, Rehakova). More fieldwork in the Mazatapec area is due in 2014. Prospects for palaeomagnetism are to be assessed. Work commenced in May on new sampling the Great Valley Sequence of California (Hull Road , Elder Creek, Grindstone, Thomes and Wilson creeks), with collecting for *Buchia*, belemnites (Dzyuba) nannofossils (Erba, Casellato) and palynology (Galloway, Riding, Harding, Lucas-Clark) -fieldwork was enlivened by some rifle fire at Grindstone Creek). A review of ammonite evidence, particularly, in the New World (Andes, Mexico, California) relative to other biostratography and radiometric dating is in preparation for publication by Alberto Riccardi.

Work continues on Berriasian palaeogeography, and Terry Poulton should be thanked for his stirling efforts on north American seaways.

Up-coming meetings include Southern France (April 2015) and at Samara on the River Volga (September 2015).

Y-Q. Liu, Q. Ji, X-J. Jiang, H-W. Kuang, S. Ji, L-F. Gao, Z-G. Zhang, N. Peng, C-Xi Yuan, Xu-Ri Wang, H. Xu, 2013. UePb Zircon Ages of Early Cretaceous Volcanic Rocks in the Tethyan Himalaya at Yangzuoyong Co Lake, Nagarze, Southern Tibet, and Implications for the Jurassic/Cretaceous Boundary. *Cretaceous Research*, 4**0**, 90-101.

Base Valanginian GSSP.

In the absence of magnetic signals in the Montbrun-les-Bains section, so far the primary candidate for the Valanginian GSSP, and in general in all the southern France successions, scientists from Spain suggest that the alternate sections near Caravaca (SE Spain) should be reconsidered by the WG. The detail synthesis of the biostratigraphic and magnetic events provided by Aguado et al. (2000) shows that the Spanish sections, especially the Caneda Luega, are the only ones in the world where a direct correlation could be made between magnetic chrons and ammonite-nannos-calpionellid zones at this level. Meanwhile, Stephane Reboulet and colleagues are currently gathering new data at Montbrun-les-Bains (S. France) and, in addition, and undertaken the study with a multidisciplinary approach of the Vergol section, which has the advantage of including also the base of the Upper Valanginian.

Barbarin, N., Bonin, A., Mattiol,i E., Pucéat, E., Cappetta, H., Gréselle, B., Pittet, B., Vennin, E. & Joachimski, M. 2012. Evidence for a complex Valanginian nannoconid decline in the Vocontian basin (South East France). *Marine Micropaleontology*, **84-85**, 37–53.

Base Hauterivian GSSP.

Since October 2010 when Luc Bulot (chair of the WG) and I. Premoli Silva (SCS chair) started to assembling the data available so far on La Charce section (Drome, France), the major candidate for the Hauterivian GSSP, the draft of the proposal did not make any progress due to new problems, such as the need of new sampling for up-dating the nannofossil and planktonic foraminiferal distributions across the Valanginian/Hauterivian boundary. Moreover, the chair Luc Bulot was deeply involved on collecting and studying Berriasian ammonites from Le Chouet. Hopefully the Hauterivian GSSP proposal will be completed in 2013.

There will be an 'event' on the 5th December 2014) at Serre de l'Ane near La Charce in the Department of Drôme (France). This is at the site of the proposed GSSP for the Valanginian- Hauterivian boundary, and accepted by the Hauterivian Working Group. Luc Bulot and Stephane Reboulet have indicated that the formal proposal will be submitted to the ISCS in early 2015. Once this is done there should soon be an agreement on the proposal and the GSSP can proceed to official ratification.

J. Mutterlose, M. Malkoc, S. Schouten, J.S. Sinninghe Damsté, 2012. Reconstruction of vertical temperature gradients in past oceans — Proxy data from the Hauterivian–early Barremian (Early Cretaceous) of the Boreal Realm. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **363–364**, 135–143

Base Barremian GSSP.

This report, prepared by Peter Rawson (Chairman of the WG) and Miguel Company (Vice-Chair), is a summary of the formal proposal of the Río Argos section as GSSP of the Barremian stage, which will be submitted shortly to the Sub-commission for approval.

1. Geographical and geological setting:

The candidate section is located on the right bank of the River Argos, some 8 km west of Caravaca (SE Spain). From a geological point of view it belongs to the Subbetic Domain, which corresponds to the pelagic domain of the southern passive margin of the Iberian plate during the Alpine cycle (Triassic-Miocene). The analyzed interval of the section (beds 144 to 193) is 40 m thick and encompasses the uppermost Hauterivian (*Pseudothurmannia ohmi* Zone, with the *Ps. ohmi*, *Ps. mortilleti* and *Ps. picteti* Subzones) and the lowermost Barremian (*Taveraidiscus hugii* Zone, with the *T. hugii* and *Psilotissotia colombiana* Subzones). The lithological succession consists of a monotonous alternation of marls and marly limestones, belonging to the Miravetes Formation, only broken by the occurrence of a thin laminated black shale interval near the base of the section (bed 148), which represents the local equivalent of the Faraoni Level, a well-known organic-rich horizon that has been recognized within the uppermost Hauterivian sediments in several basins of the western Mediterranean Tethys.

Textural (mudstones mainly composed of calcareous nannofossil remains), macropalaeontological (assemblages largely dominated by ammonites), taphonomic (absence of reworking evidence) and paleoichnological (intense bioturbation dominated by *Zoophycos*, *Chondrites* and *Planolites*) features indicate that the Río Argos succession was deposited in a stable, distal, low-energy, deep-water sedimentary environment. Sedimentation seems to have been continuous throughout the studied interval, since no evidence of interruption or condensation has been detected.

2. Fossil Record

2.1. Ammonites - The Río Argos section has provided a rich and diverse ammonite fauna, which has been the subject of several studies. We have collected more than one thousand specimens from the studied interval. All of them belong to Mediterranean taxa.

The primary marker event of the base of the Barremian stage (first occurrence of *Taveraidiscus hugii*) has been recorded in bed 171 (23 m above the base of the studied interval). Other significant bioevents that take place in this interval are the first occurrences of *Pseudothurmannia ohmi* (bed 144), *Pseudothurmannia mortilleti* and *Pseudothurmannia sarasini* (148), *Discoidellia favrei* (149), *Ps. picteti* (156), *Barremites* spp. (160), *Taveraidiscus intermedius* (170), *Psilotissotia chalmasi* (174), *Psilotissotia colombiana* (183), and *Kotetishvilia nicklesi* (193).

2.2. Foraminifera - Although foraminifera are present in all the samples studied, their abundance and degree of preservation varies throughout the section. The diversity of planktonic foraminifers is, in general, relatively low, whereas the benthic ones are more abundant and diverse.

Only few events have been recorded in the Río Argos section. Concerning the planktonic foraminifers, *Hedbergella roblesae* and *Hedbergella semielongata* appear in bed 138, and *Hedbergella similis* in bed 195. Among the benthic foraminifers, the first occurrences of *Dorothia praeoxycona*, *Gavelinella barremiana* and *Conorotalites aptiensis* have been recorded, respectively, in beds 130, 175 and 195.

2.3.Calcareous nannofossils - The calcareous nannofossils assemblages are mostly composed of cosmopolitan and Tethyan taxa, the dominant genera being *Watznaueria*, *Nannoconus* and *Micrantholitus*. All the interval studied corresponds to the Zone NC5. The most significant events recognized in the section are: the last occurrence of *Lithraphidites bollii* (which marks the base of Subzone NC5C, in bed 148), the first occurrence of typical forms of *Nannoconus circularis* (154) and the first occurrence of *Micrantholitus* sp 1 (194). The last occurrence of *Calcicalathina oblongata*, which defines the base of Subzone NC5D, takes place somewhat above the interval studied, within the *Kotetishvilia nicklesi* Zone.

3. Stable isotopes and organic matter

The $\delta^{13}C$ values vary between 0 and 1.75‰ throughout the section, reaching their maximum in a small positive excursion, preceded by a negative peak, at the base of the *Ps. mortilleti* Zone, coinciding with the aforementioned Faraoni Level. The values remain more or less stable, around 1‰, in the *Ps. picteti* Subzone and show a negative trend throughout the *T. hugii* Zone.

The total organic matter content is, in general, very low (0.13% on average). However, the dark laminated sediments of the Faraoni Level show significantly higher values, reaching 3.8%.

4. Cyclostratigraphy

A high-resolution cyclostratigraphic analysis from magnetic susceptibility signal has been performed in the Río Argos section. Its results allow us to assign a duration of 0.78 myr to the *Ps. ohmi* Zone and 0.57 myr to the *T. hugii* Zone. The duration of the Faraoni event is estimated as 100-150 kyr, and the base of the Barremian stage would be located 0.7 myr after the onset of this event. Similar results were obtained from the cyclostratigraphic analysis of clay mineralogy.

5. Magnetostratigraphy

The Cretaceous sediments of the Ríos Argos area are affected by a Neogene remagnetization that prevents any magnetostratigraphic analysis. Nevertheless, correlation by ammonite and isotope stratigraphy with the Gorgo a Cerbara section (central Italy) allows us to correlate the Hauterivian/Barremian boundary with the upper part of chron CM5n.

6. Protection

The Cretaceous outcrops of the Río Argos area are catalogued as a Site of Geological Interest in the General Urban Development Plan of the municipality of Caravaca. We expect the next declaration of the Río Argos section as Palaeontological Zone, with the category of Heritage of Cultural Interest, according to the Law of Cultural Heritage of the Region of Murcia.

Publications relevant to the Hauterivian/Barremian boundary:

Archuby, F.M., Wilmsen, M., Leanza, H.A., 2011. Integrated stratigraphy of the Upper Hauterivian to Lower Barremian Agua de la Mula Member of the Agrio Formation, Neuquen Basin, Argentina. *Acta Geologica Polonica*, **61**, 1-26.

Company, M., Aguado, R., Baudin, F., Coccioni, R., Deconinck, J.F., Frontalini, F., Giusberti, L., Martinez, M., Moiroud, M., O'Dogherty, L., Pellenard, P., Rawson, P.F., Romero, G., Sandoval, J., Tavera, J.M., Weissert, H., 2011. La sección de río Argos (Caravaca, Murcia), candidata a GSSP del límite Hauteriviense-Barremiense (Cretácico inferior). XXVII Jornadas de la Sociedad Española de Paleontología (Sabadell, 2011). *Paleontologia i Evolució, memòria especial*, **5**, 75-78.

Fernando, A.G.S., Nishi, H., Tanabe, K., Moriya, K., Iba,Y, Kodama, K., Murphy, M.A., Okada, H., 2011. Calcareous nannofossil biostratigraphic study of forearc basin sediments: Lower to Upper Cretaceous Budden Canyon Formation (Great Valley Group), northern California, USA. *Island Arc*, **20**, 346-370.

Föllmi, K.B., Bôle, M., Jammet, N., Froidevaux, P., Godet, A., Bodin, S., Adatte, T., Matera, V., Fleitmann, D., Spangenberg, J.E., 2012. Bridging the Faraoni and Selli oceanic anoxic events: late Hauterivian to early Aptian dysaerobic to anaerobic phases in the Tethys. *Climate of the Past*, **8**, 171-189.

Lukeneder, A., 2012. New biostratigraphic data on an Upper Hauterivian-Upper Barremian ammonite assemblage from the Dolomites (Southern Alps, Italy). *Cretaceous Research*, **35**, 1-21.

Martinez, M., Pellenard, P., Deconinck, J.F., Monna, F., Riquier, L., Boulila, S., Moiroud, M., Company, M., 2012. An orbital floating time scale of the Hauterivian/Barremian GSSP from a magnetic susceptibility signal (Rio Argos, Spain). *Cretaceous Research*, **36**, 106-115.

Price, G.D., Főzy, I., Janssen, N.M.M., Pálfy, J., 2011. Late Valanginian-Barremian (Early Cretaceous) palaeotemperatures inferred from belemnite stable isotope and Mg/Ca ratios from Bersek Quarry (Gerecse Mountains, Transdanubian Range, Hungary). *Palaeogeography Palaeoclimatology Palaeoecology*, **305**, 1-9.

Base Aptian GSSP.

A wealth of data have been collected and published on the Aptian stage in the last years by our French collegues on the stratotype sections of the Bedoulian and Gargasian substages including revised biostratigraphies, $\delta^{13}C$ curve and cyclostratigraphy. Although magnetic signature in the French stratotype sections cannot be detected, carbon isotope data allowed a precise correlation between the base of magnetic chron M0, recommended at the 1995 Brussels Meeting for identifying the base of the Aptian, and the Aptian basal ammonite *Deshayesites oglanlensis* Zone. The formal proposal of the Aptian GSSP at Gorgo a Cerbara (central Italy) is still pending.

A. Cherchi, R. Schroeder, 2013. The Praeorbitolina/Palorbitolinoides Association: an Aptian biostratigraphic key-interval at the southern margin of the Neo-Tethys. *Cretaceous Research*, **39**, 70-77.
M. Ivanov, V. Idakieva, 2013. Lower Aptian ammonite biostratigraphy and potential for further studies of OAE 1a in Bulgaria. *Cretaceous Research*, **39**, 47-69.
M.V. Kakabadze, I.M. Kakabadze, 2012. Biostratigraphy and interrelationship of the Lower and Middle Aptian (Cretaceous) sedimentary sequences in Georgia and adjacent regions of the Caucasus. *Revue de Paléobiologie, Vol. spéc.*, **11**, 103-111.
J-P. Masse, M. Fenerci-Masse, 2013. Stratigraphic updating and correlation of Late Barremian-Early Aptian Urgonian successions and their marly cover, in their type region (Orgon-Apt, SE France). *Cretaceous Research*, **39**, 17-28.
J.A. Moreno-Bedmar, M. Company, J. Sandoval, J.M. Tavera, T. Bover-Arnal, R. Salas, G. Delanoy, F.J.-M.R. Maurasse, R. Martinez, 2012. Lower Aptian ammonite and carbon isotope stratigraphy in the eastern Prebetic Domain (Betic Cordillera, southeastern Spain). *Geologica Acta*, 10/4, 1-12 DOI:1 0.1344/105.000001752
Moullade M., Tronchetti G., Balme C., Mauroux P., 2012. A new upper Bedoulian section in the Aptian stratotypic area: Croagnes (5 km NW of Gargas, Vaucluse, SE France). *Carnets de Géologie* [Notebooks on Geology], Brest, Letter 2012/03 (**CG2012_L03**), p. 193-199.
M.L. Quijano, J-M. Castro, R.D. Pancost, G.A. de Gea, M. Najarro, R. Aguado, I. Rosales, J. Martín-Chivelet, 2012. Organic geochemistry, stable isotopes, and facies analysis of the Early Aptian OAE—New records from Spain (Western Tethys). *Palaeogeography, Palaeoclimatology, Palaeoecology*, **365–366**, 276–293.
B. Granier, R. Busnardo, 2013. New stratigraphic data on the Aptian of the Persian Gulf. *Cretaceous Research*, **39**, 170-182.
J. Moreno, R. Barragan, M. Company, L.G. Bulot, 2013. Aptian (lower Cretaceous) ammonite biostratigraphy of the Francisco Zarco Dam stratigraphic section (Durango State, north-east Mexico). *Journal of South American Earth Sciences*, **42**, 150-158.

Base Albian GSSP.

As indicated in previous reports, the formal proposal for the base Albian at Tartonne (SE France), prepared by J. Kennedy, never reached the quorum. Voting Members against the proposal commented on the change of lithofacies at the critical level (from marl to organic-rich laminated black shale), the regional/provincial distribution of the index-species *Leymeriella (L.) tardefurcata,* and the low stratigraphic value of ancillary markers (few, poorly diagnostic planktonic foraminifera; *Predicosphaera* taxonomic problems, etc.), made the Tartonne section unsuitable as the base Albian GSSP. In addition, the sampling across the Aptian/Albian boundary was considered at too low resolution and inadequate for such a critical interval. The proposed event (FO of *L. tardefurcata*) is poorly applicable to other sections, especially outside SE France.

In Spring 2010 members of the new Working Group, set up at Plymouth in 2009 (Paul Bown, coordinator), re-sampled – at high resolution – the Col de Pré-Guittard section, Kennedy's ancillary section near Tartonne. A multidisciplinary study of the new sample set was carried out during 2011 (work is still in progress) by members of the WG. One of the most important results concerns the planktonic foraminifera which display a major turnover across the Niveau Kilian, in parallel with a 1‰ $\delta^{13}C$ excursion. Petrizzo *et al.* (2012) reported that (1) the latest Aptian assemblage, dominated by few long-ranging *Hedbergella* and large-sized *Paraticinella* completely disappear near the base of the Niveau Kilian organic-rich level, (2) planktonic foraminiferal assemblages from across the Niveau Kilian to the top of the studied section are composed of minute, but very distinctive smooth-surfaced species of *Microhedbergella miniglobularis* and *Mi. renilaevis*, (3) the appearance of *Mi. renilaevis* in the middle part of the Niveau Kilian represents a major step in the evolution and diversification of the Albian planktonic fauna. The same sequence of events was reported from several deep-sea sites in the Atlantic and Indian Oceans (Huber & Leckie, 2011). Therefore, documentation of the planktonic foraminiferal turnover, combined with the carbon-isotope stratigraphy in the Col de Pré-Guittard section, provide new criteria, replacing the FO of the unsuitable *L. tardefurcata*, for defining the GSSP for base Albian in a stratigraphically complete succession. A multi-disciplinary paper dealing with the new criteria for identifying the base Albian is now published and being voted on by the working group before being presented to the SCS.

Huber B.T., Leckie R. M. 2011. Planktic foraminiferal species turnover across deep-sea Aptian/Albian boundary sections. *Journal of Foraminiferal Research*, **41**, 53–95
Petrizzo M.R., Huber B.T., Gale A.S., Barchetta A., Jenkyns H.C. 2012. Abrupt planktic foraminiferal turnover across the Niveau Kilian at Col de Pré-Guittard (Vocontian Basin, southeast France): new criteria for defining the Aptian/Albian boundary. *Newsletter on Stratigraphy*, **45**/1, 55-74.
C. Peybernes, F. Giraud, E. Jaillard, E. Robert, M. Masrour, M. Aoutem, N. Içame, 2013. Stratigraphic framework and calcareous nannofossil productivity of the Essaouira-Agadir Basin (Morocco) during the Aptian-Early Albian: Comparison with the north-Tethyan margin. *Cretaceous Research*, **39**, 149-169.

Kennedy, W.J., Gale, A.S., Huber, B.T., Petrizzo, M.R., Bown, P., Barchetta, A. & Jenkyns, H.C. 2014. **Integrated stratigraphy across the Aptian/Albian boundary at Col de Pré-Guittard (Southeast France): A candidate Global Boundary Stratotype Section.** *Cretaceous Research*, **51**, 248-259.

Base Coniacian GSSP.

The main paper describing the criteria for identifying the base Coniacian and the proposal of a candidate composite GSSP section was published in *Acta Geologica Polonica* at the end of 2010. Besides multiple up-dated biostratigraphies, the paper also includes the isotope curves for both the Salzgitter-Salder (northern Germany) and Slupia Nadbrze~na (central Poland) sections. It is confirmed that the inoceramid-based lower Coniacian boundary (= first appearance of *C. deformis erectus*), slightly post-dates the traditional ammonite (FAD of *Forresteria petrocoriensis*) position of the boundary.

In September 2011 the chair of the WG, Irek Walaszczyk, circulated the published proposal to the Working Group members asking for comments and eventual approval. All comments received indicated support for a composite GSSP, although the Working Group has been advised that a single GSSP (with a subsidiary location providing additional information) is the preferred option. Although this is not an ideal choice, there is no single, perfect, section which satisfies the GSSP for the base of the Coniacian. The formal proposal to be submitted to the Voting Members of the Subcommission is in advanced preparation by the WG chair.

In 2013-2014 there were works done on the Turonian/Coniacian sections in the US and Canadian Western Interior, northern Mexico, and in Mangyshlak Mountains, Kazakhstan. It seems that neither of the US and Canadian western interior sections is promising. The sections are either quite condensed or the boundary succession is with gaps (Walaszczyk et al. 2014). A potential has the Rosario section in MExico studied and described by Ifrim et al. (2014); the sections still needs further works, and moreover, there are some safety issues in this part of the country; in January, together with Roger and Dee Ann Coopers, Houston, I am going to Big Bed National Park in SW Texas, which is a part of the same basin to check the succession there. The Big Bend area is in a National Park and if the succession appears complete and with good potential for the basal Coniacian stratotype, it could easily be accessible and studied.

In 2013, together with Russian colleagues, I finished also the study of selected sections from NW part of the Mangyshlak Mountains, in Kazakhstan, including the Shakh-Bogota section, which was once proposed as a candidate stratotype section for the base of the Coniacian stage (Walaszczyk et al. 2013). Although the succession seems to be complete right at the boundary, the rest of the succession, particularly the Turonian part is quite condensed.

Walaszczyk, I., Wood, C.J., Lees, J.A., Peryt, D., Voigt, S. & Wiese, F., 2010. Salzgitter-Salder Quarry (Lower Saxony, Germany) – Slupia Nadbrzena river cliff section (central Poland): a proposed candidate composite Global Boundary Stratotype Section and Point for the Coniacian Stage (Upper Cretaceous). *Acta Geologica Polonica*, **60**/3, 445-477.

Ifrim, C., Wiese, F. & Stinnesbeck, W., 2014. Inoceramids and biozonation across the Turonian - Coniacian boundary (Upper Cretaceous) at El Rosario, Coahuila, northeastern Mexico. *Newsletters on Stratigraphy*, **47** (2), 211–246.

Walaszczyk, I., Shank, J.A., Plint, A.G., & Cobban, W.A., 2014. Interregional correlation of disconformities in Upper Cretaceous strata, Western Interior Seaway: Biostratigraphic and sequence-stratigraphic evidence for eustatic change. *Geological Society of America Bulletin*, in press.

Walaszczyk, I., Kopaevich, L.F. & Beniamovski, V.N., 2013. Inoceramid and foraminiferal record and biozonation of the Turonian and Coniacian (Upper Cretaceous) of the Mangyshlak Mts., western Kazakhstan. *Acta Geologica Polonica*, **63** (4), 469–487.

Base Santonian GSSP.

This is now approved and a proposal to hold an inaugural event at the site is awaited. The article in *Episodes* was published in 2014.

Lamolda, M.A., Paul, C.R.C., Peryt, D. & Pons, J.M. 2014. The Global Boundary Stratotype Section and Point (GSSP) for the base of the Santonian Stage, “Cantera de Margas”, Olazagutia, northern Spain. *Episodes*, v. **37**/1, p. 2–13.

Base Campanian GSSP.

Members of the WG have been searching for a new section across the Santonian/Campanian boundary to be proposed as base Campanian GSSP. So far, the only section not affected by hiatus and/or major dissolution is the Bottaccione section (Gubbio, central Italy), in which the calcareous plankton bioevents are calibrated to magnetostratigraphy. The distribution of planktonic Foraminifera across the Santonian-Campanian interval at Bottaccione was recently revised and up-dated (Petrizzo *et al.,* 2011). Moreover, as the available carbon isotope stratigraphy was considered at too low a

resolution for reliable supra-regional correlation, a new set of carbon isotope analyses across the critical interval has been undertaken by Silke Voigt on the original samples (Premoli Silva & Sliter 1995), calibrated to paleomagnetic scale, and on new samples collected at higher resolution along the same road section and on the opposite side of the valley by Gale and Voigt. A paper with the new carbon isotope curves correlated to that from Lägerdorf (Northern Germany) is ready to be submitted for publication. The main bias of the Bottaccione section is that planktonic foraminifera across the critical interval could not be properly disaggregated from the hard limestones, using cold acetolysis method, and are poorly preserved.

M.R. Petrizzo, F. Falzoni & I. Premoli Silva, 2011. Identification of the base of the lower-to-middle Campanian *Globotruncana ventricosa* Zone: Comments on reliability and global correlations. *Cretaceous Research*, **32**, 387-405.
S. Bey, J. Kussa, I. Premoli Silva, M.H. Negrab, S. Gardin, 2012. Fault-controlled stratigraphy of the Late Cretaceous Abiod Formation at Ain Medheker (Northeast Tunisia). *Cretaceous Research*, **34**, 10-25.

Base Maastrichtian GSSP.
To overcome the problem of correlation between the ratified GSSP and coeval sections, stable isotopes were measured in high resolution from Tercis-les-Bains GSSP (Thibault *et al*., 2012). In this paper the Tercis $\delta^{13}C$ isotope curve was successfully correlated to the isotope curves from two Danish Basin cores (DK) that could represent the standard carbon isotope curve for the Boreal Realm, being calibrated to the nannofossil and dynocyst biostratigraphies. Moreover, Gardin *et al*. (2012) revised the biostratigraphy of the Bottaccione section, already calibrated to magnetostratigraphy, and gathered new calcareous plankton biostratigraphic and magnetostratigraphic data of the upper Campanian-Maastrichtian interval form the nearby Contessa section (Gubbio, central Italy). In addition, both the Contessa and Bottaccione sections have been analysed for stable isotopes by Voigt (2012) who reconstructed carbon isotope curves for both sections and correlated them to her new isotope curve from the Tercis GSSP.

S. Gardin, B. Galbrun, N. Thibault, R. Coccioni, I. Premoli Silva, 2012. Bio-magnetochronology for the upper Campanian – Maastrichtian from the Gubbio area, Italy: new results from the Contessa Highway and Bottaccione sections. *Newsletters on Stratigraphy*, **45**/1, 75–103.
M. Machalski, 2012. Stratigraphically important ammonites from the Campanian–Maastrichtian boundary interval of the Middle Vistula River section, central Poland. *Acta Geologica Polonica*, **62**/1, 91–116.
F. Surlyk, S.L. Rasmussen, M. Boussha, P. Schiøler, N.H. Schovsbo, E. Sheldon, L. Stemmerick, N. Thibault, 2013. *Cretaceous Research*, **46**, 232-256.
N. Thibault, R. Harlou, N. Schovsbo, P. Schiøler, F. Minoletti, B. Galbrun, B.W. Lauridsen, E. Sheldon, L. Stemmerik, F. Surlyk, 2012. Upper Campanian-Maastrichtian nannofossil biostratigraphy and high-resolution carbon-isotope stratigraphy of the Danish Basin: Towards a standard $\delta^{13}C$ curve for the Boreal Realm. *Cretaceous Research*, **33**, 72-90.
N. Thibault, D. Husson, R. Harlou, S. Gardin, B. Galbrun, E. Huret, F. Minoletti, 2012. Astronomical calibration of upper Campanian–Maastrichtian carbon isotope events and calcareous plankton biostratigraphy in the Indian Ocean (ODP Hole 762C): Implication for the age of the Campanian–Maastrichtian boundary. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **337–338**, 52–71.
S. Voigt, Gale A., Jung C., Jenkyns H., 2012. Global correlation of Upper Campanian - Maastrichtian successions using carbon isotope startigraphy: development of a new Maastrichtian timescale. *Newsletters on Stratigraphy*, **45**/1, 25–53.
P.D. Ward, J.W. Haggart, R. Mitchell, J.L. Kirschvink, T. Tobin, 2012. Integration of macrofossil biostratigraphy and magnetostratigraphy for the Pacific Coast Upper Cretaceous (Campanian–Maastrichtian) of North America and implications for correlation with the Western Interior and Tethys. *GSA Bulletin*, **124** (5/6), 957–974.

CHIEF PROBLEMS ENCOUNTERED IN 2014
The need, today, for a high-resolution stratigraphical framework that is applicable worlwide has resulted in the necessity of re-visiting several candidate sections, already studied paleontologically, by implementing multiple biostratigraphies and stratigraphic tools other than fossils (many of which are profoundly affected by provincialism in several intervals), such as like magnetostratigraphy, stable isotope stratigraphy, etc. In several cases, especially in the Late Cretaceous, the integration of multiple biostratigraphical data, together with physical stratigraphies, has shown that the candidate sections were unsuitable as a potential GSSP. Consequently, new sections have had to be considered and studied from scratch. This has resulted in a delay in submitting some GSSP proposals, also taking into account that scientists from different sub-disciplines do not necessarily work at the same speed.

Another problem is the lack of fundings in most countries for carrying out studies that are strictly stratigraphical in nature as these are often deemed of low priority when compared to other more 'sexy' proposals. Funds for just attending workshops and/or conferences are also becoming more limited.

SUMMARY OF EXPENDITURES IN 2014:

I. INCOME

ICS subvention for 2014	£ 9000.00
Other income	£ 0.00
Total income	**£ 9000.00**

II. EXPENDITURE

Attendance at GFC 2014 in Paris (costs awaited) [£000.00]

Berriasian (J/K) autumn meeting in 2014 was cancelled and funding not required

As there was no discussion of Cretaceous stage boundaries amongst ammonite workers at the Cephalopod meeting In Zurich, MBH did not make a claim for travel

Total expenditure (to date) **£ 0000.00**

WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED IN 2015 and 2016:

During 2015 it is hoped that the ***Albian GSSP*** will be approved by the Working Group and be put before the ISCS – and hopefully approved. It is also expected that proposals for the ***Hauterivian GSSP*** and the ***Coniacian GSSP*** will be submitted to ISCS. The ***Barremian GSSP*** should also be progressed during 2015.

Meetings

- The 10th meeting of the Berriasian and J/K boundary WG was held in Perugia (Italy), May 2013.
- The 1st International Congress on Stratigraphy (STRATI) was held in Lisbon from the 1st to 7th July 2013.
- The official meeting of the Cretaceous Subcommission was held at the 9th International Symposium on the Cretaceous System in Ankara, Turkey, 1st to 7th September 2013.
- The 5th Workshp of the Kilian Group was held during the 9th International Symposium on the Cretaceous System, Ankara, September 2013.
- The 1st meeting of IGCP 609 was held during the 9th International Symposium on the Cretaceous System, Ankara, September 2013.
- The 11th meeting of the Berriasian and J/K boundary WG was held in Warsaw, October 2013.
- As a part of the Annual Meeting of the Geological Society of America (October 25th), a ceremony was held at Pueblo, Colorado, marking the inauguration of the GSSP 'spike' for the base of the Turonian Stage.
- A number of sessions on Cretaceous stratigraphy and the K/Pg boundary are being arranged as part of the Annual Meeting of the European Geosciences Union in Vienna, Austria (27th April to 2nd May 2014).
- The 2nd meeting of IGCP 609 was held in Bucharest, Romania, jointly with the Earthtime – EU Sequence Stratigraphy Workshop, August 2014.
- The 2nd Meeting of IGCP 608, 4th – 11th September, 2014, Waseda University, Tokyo, Japan.
- The 2nd International Congress on Stratigraphy (STRATI) which is to be held in Graz, Austria, during July 2015.
- The 3rd meeting of IGCP 609 will be held in Nanjing, China, 5th – 11th September 2015.
- The International Geological Congress (IGC) which will be held in Cape Town (South Africa), 27th August to 4th September 2016.
- The 10th International Symposium on the Cretaceous System will be held in 2017 in either Saltzburg or Vienna.

BUDGET AND ICS COMPONENT FOR 2015

Office expenses (Fax, phone, postage, etc)	£ 50.00
Contribution to a J/K boundary Meeting	

(organization+ participants' support), April 2015	£ 2000.00
Contribution to a J/K boundary Meeting	
(organization+ participants' support), October 2015	£ 1500.00
A number of requests for support for the STRATI 2015	
Meeting are being received	£ 5000.00
Total estimated expenditure in 2015	**£ 8550.00**

10. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2010–2014)

See Accomplishments in ICS Annual Reports 2007 to 2013 for additional details.

· Renewed research by WG members (resulting in a great number of publications, still ongoing), based on research needs pinpointed by the Brussels (1995), Neuchâtel (2005), Oslo (2008), Plymouth (2009) and Ankara (2013) meetings.

· The 5th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Smolenice (Slovakia) (April 2010).

· The 4th Workshop of the Kilian Group on the Aptian and Albian zonation, held in Dijon (August 2010).

· The 6th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Paris (November 2010).

· The 7th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Sofia (October 2011).

· The 8th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Bizerte, Tunisia (May 2012).

· The 9th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Prague (October 2012).

The Chair and/or Vice Chair represented the SCS at:

- The 5th meeting of the *Berriasian and J/K boundary Working Group*, Smolenice, April 2010.
- ICS Meeting, Prague, May 2010.
- The ICS official meeting, at 34th Geological Congress, August 2012, Brisbane.
- The 1st International Congress on Stratigraphy, Lisbon, July 2013. This was a well-attended and well-organised congress, building on the two STRATI meetings previously held in Paris. It is planned that this series of meetings will be held every two years: Graz, Austria, is to host the 2015 congress. Papers on the Cretaceous were well-represented in the programme and some of the field excursions (led by Jacques Rey) looked at the Cretaceous sections both north and south of Lisbon.
- The 9th International Symposium on the Cretaceous System, Ankara, September 2013. This major meeting at the Middle East Technical University, Ankara, Turkey was organised by Ass. Prof. Ismail Omer Yilmaz. Though less well attended than comparable meetings in Western Europe, there was a full programme of lectures, although the number of posters was down on the symposium held in Plymouth. There were informative mid-symposium and post-symposium field trips. Prof. Bruno Granier was accepted as the new SCS Secretary and there were thanks to the past Chair (Isabella Premoli Silva) and Secretary (Sylvie Gardin). There were updates on outstanding GSSP definitions. The 10th International Symposium on the Cretaceous System will be held in 2017 (though this could clash with the two-yearly STRATI meeting), though a venue was not decided. Possible locations include Saltzburg, Vienna, Lausanne and Heidelberg.
- The inauguration of the Turonian GSSP at Pueblo, Colorado, 25th October 2013. At an event organised by Rangers at the Pueblo State park, the GSSP 'marker' was ceremonially placed in the succession. Within the park there is now a comprehensive display board, static binoculars that can be used by visitors to view the 'marker' and a programme of outreach events to involve the community (especially schools). Dr Brad Sageman was thanked for preparing the information boards and choreographing the event. There were speeches by Stan Finney (Chair, ICS), Malcolm Hart (Chair, SCS), Suzanne Mahlburg Kay (President, Geological Society of America) and Brad Sageman. All the speakers and guests were thanked for their attendance and support by the Park Ranger responsible for education and outreach. Later, Brad Sagemen led a geological walk around the site and the various features of the Cenomanian to Turonian succession.
- The Chair (Malcolm Hart) attended the 9th International Symposium "Cephalopods Past and Present", University of Zurich, Switzerland (7th to 10th September, 2014).

- The Chair (Malcolm Hart) attended all the Cretaceous-based sessions at the EGU Annual Meeting in Vienna (27th April to 2nd May, 2014), GCAGS Annual Meeting (5th to 7th October, 2014) and the GSA meeting in Vancouver (18th to 22nd October, 2014).
- The Secretary (Bruno Granier) and the Chair (Malcolm Hart) were scheduled to attend the GFC meeting in Paris (1st to 2nd December, 2014), but the Chair was unable to travel at the last minute.

OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2013-2017)

Future Meetings

- July 2015 – 2nd International Congress on Stratigraphy, Graz, Austria.
- IGCP 609, September, Nanjing, China
- August 2016 – International Geological Congress, Cape Town, South Africa.
- September 2017 – 10th International Symposium on the Cretaceous System (Vienna or Saltzburg, Austria).

Details of other meetings are not yet available.

Objectives

· To submit the proposal for the **Coniacian GSSP** to the Cretaceous Subcommission Voting Members, then submit it to ICS, and possibly to *Episodes* for publication;

· To submit a revised proposal for the **Albian GSSP** to the Cretaceous Subcommission Voting Members, then to submit it to ICS, and possibly to *Episodes* for publication;

· To submit the proposal for the **Barremian GSSP** to the Cretaceous Subcommission Voting Members, then to submit it to ICS, and possibly to *Episodes* for publication;

· To bring recommendations for the remaining GSSPs to ICS as soon as possibile;

· **To prepare the definition of the criteria for the recognition of the base of the Berriasian and the J/K boundary. This is deemed as 'High Priority' and the Working Group have been informed of this, with the expectation that this will be resolved as soon as possible.**

· To communicate the results as widely as possible

· To develop new directions for the Subcommission as GSSP proposals are completed. This specifically concerns the subdivision of stages, with the definition of substages and related GSSPs.

Work Plan

2014 **–** Finalize the proposal for the base of the Albian (achieved)
2015 – Finalize proposals for the base of Hauterivian, Barremian, Aptian, and Coniacian Stages, and to continue with work on the Valanginian and Campanian.
2015–2016 –Finalize the proposal for the base of Berriasian (Jurassic/Cretaceous boundary)
2015–2017 – Definition of substages for discussion at the ISCS in 2017.

APPENDIX [Names and Full Addresses of Current Officers and Voting Members]

Subcommission officers (with addresses)

Chair: Prof. Malcom Hart
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Secretary: Prof. Bruno Granier

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List of Voting Members

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Dr. Bruno Galbrun (France)	bruno.galbrun@upmc.fr
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List of Task Groups and their officers

Maastrichtian WG: *GSSP ratified.* Giles Odin, France. gilodin@moka.ccr.jussieu.fr
Campanian WG: Andy Gale (UK). Andy.Gale@port.ac.uk
Santonian WG: *GSSP ratified*. Marcos Lamolda <gpplapam@lg.ehu.es>
Coniacian WG: Irek Walaszczyk, Poland. i.walaszczyk@uw.edu.pl
Turonian WG: *GSSP ratified*. No chairman at present.
Cenomanian WG: *GSSP ratified.* No chairman at present.
Albian WG: Paul Bown and Malcolm Hart, UK. mhart@plymouth.ac.uk
Aptian WG: Elisabetta Erba, Italy. elisabetta.erba@unimi.it
Barremian WG: Peter Rawson, UK. peter.rawson1@btinternet.com; Miguel Company, Spain. mcompany@ugr.es
Hauterivian WG: Jörg Mutterlose, Germany. joerg.mutterlose@rub.de
Valanginian WG: Luc Bulot, France. lucgbulot@aol.com
Berriasian (J/K boundary) WG: William A. P. Wimbledon, UK. mishenka1@yahoo.co.uk

Kilian Group *[formerly Lower Cretaceous ammonite WG]:*
Chairman: Stéphane Reboulet, France. stephane.reboulet@univ-lyon1.fr
Vice-Chairmen: Peter Rawson, UK. peter.rawson1@btinternet.com
Jaap Klein, NL. j.klein@amc.uva.nl

SUBCOMMISSION ON JURASSIC STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Jurassic Stratigraphy

SUBMITTED BY

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Stephen Hesselbo, Subcommission Chair
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2. OVERALL OBJECTIVES AND FIT WITHIN IUGS SCIENCE POLICY

2a. Mission statement

The Subcommission is the primary body for facilitation of international communication and scientific cooperation in Jurassic stratigraphy, defined in the broad sense of multidisciplinary activities directed towards better understanding of the evolution of the Earth during the Jurassic Period. Its first priority remains the unambiguous definition, by means of agreed GSSPs, of a hierarchy of chronostratigraphic units that provide the framework for global correlation. This mission is well in progress at Stage level, and future plans tentatively include formal definitions of Substages (as Lower/Middle/Upper as appropriate). Updated definitions of standard and regional zones are also pursued, along with efforts towards improved correlation with the zonal schemes of different fossil groups and other stratigraphies (including magneto-, chemo- and cyclostratigraphy).

2b. Goals

These fall into two main areas:

(a) The definition of basal boundary stratotypes (GSSPs) and the refinement of standard and regional hierarchical chronostratigraphical scales down to zonal and subzonal level, through the establishment of multidisciplinary Task (and/or Working) Groups;

(b) Fostering chronostratigraphic research and international collaboration, including the application, where possible, of cyclostratigraphy to develop astrochronologic estimates of durations of chronostratigraphic units, and integration of radiometric dates to improve the numerically calibrated time scale of the Jurassic.

Progress towards these goals are showcased and scientific communications between experts of various aspects of Jurassic stratigraphy is facilitated by the organization of the International Congresses on the Jurassic System, held in every fourth year and sponsored by ISJS. The next congress will be held in 2018.

In addition, the Subcommission has developed lines of communication with a wider public through two initiatives (also called Working Groups for simplicity): one is concerned with conservation of Jurassic geological sites such as those selected as GSSPs; the second encourages collaboration and liaison with non-professionals, notably fossil collectors, who have valuable data to contribute towards the Subcommission's goals.

2c. Fit within IUGS Science Policy

The objectives of the Subcommission relate to three main aspects of IUGS policy:

1. The development of an internationally agreed scale of chronostratigraphic units, fully defined by GSSPs at Series and Stage levels and related to a hierarchy of units (Substages, Standard Zones, Subzones etc.) to maximize relative time resolution within the Jurassic Period;
2. Establishment of frameworks and mechanisms to encourage international collaboration in understanding the evolution of the Earth during the Jurassic Period;
3. Working towards an international policy concerning conservation of geologically and palaeontologically important sites such as GSSPs. This relates to, *inter alia*, the IUGS Geosites Programme and the UNESCO Geoparks Programme. The Subcommission also has links to the Management Group of the UNESCO East Devon and Dorset Coast (The Jurassic Coast) World Heritage Site.

3. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

The chief accomplishments in 2014 were as follows:

- *The 9th International Congress on the Jurassic System* was held from 6th to 9th January 2014 in Jaipur, the capital city of the state of Rajasthan, India, and was organized by Professor D. K. PANDEY and colleagues. The congress was a great success attracting a wide participation. Papers from the conference will be published in Volumina Jurassica in 2014/15. The Congress also included excursions on Middle and Upper Jurassic rocks of the Kachchh Basin (one week) and Middle and Upper Jurassic rocks of the Jaisalmer Basin (one week)
- *GSSP proposal for the base-Toarcian*. The ICS approved the revised proposal in 2014, and the Chair (ROCHA) and Secretary (MATTIOLI) of the Toarcian Task Group will shortly provide the final document for submission to the IUGS.
- *Base Oxfordian field workshop, Redcliff, Dorset, June 2014*. A three-day field workshop was organized by the convenor (MELENDEZ) and secretary (PAGE) of the Oxfordian Task Group, also attended by the chair of the ISJS (HESSELBO) and the Groupe Francais pour Stratigraphie Jurassique (see last years report for account of sister workshop in Provence and section 3b below for full documentation of those sections). Significant progress and clarification of issues was achieved which should lead to a coherent proposal being submitted to the ISJS in the next 24 months.
- *Base Callovian Task Group*. The convenor of the task group Eckhard MÖNNIG has published a summary of history and progress on base-Callovian definition in Volumina Jurassica (www.voluminajurassica.org/index.php/volumina/issue/view/15).

3b List of major publications of subcommission work (books, special volumes, key scientific paper).

The full account of the candidate base Oxfordian GSSP section has been published in Volumina Jurassica (Pellenard, P. et al. 2014. Integrated stratigraphy of the Oxfordian global stratotype section and point (GSSP) candidate in the Subalpine Basin (SE France). Volumina Jurassica 12, www.voluminajurassica.org/index.php/volumina/article/view/147).

3c. Problems encountered, if appropriate

We are still encountering problems launching a new website for the subcommission. We hope to solve remaining problems by the end of 2014.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015)

A meeting of the Kimmeridgian Working Group will take place 18th - 21st May, 2015, in Warsaw, Poland, being convened by Andrzej WIERZBOWSKI, Jacek GRABOWSKI, Bronislaw A. MATYJA, and Hubert WIERZBOWSKI. The four-day meeting will include a field excursion to Bobrowniki and Katarowa Góra in the Wieluñ Upland (Polish Jura). Ammonite collections from the Oxfordian/Kimmeridgian boundary of Isle of Skye, Scotland (proposed GSSP), Poland and Spain will be accessible for examination and discussion.

4b Specific GSSP Focus for 2015

Oxfordian Task Group. Following the successful workshops in Provence and Dorset in 2013 and 2014 we expect rapid progress towards a formal proposal.

Base Kimmeridgian GSSP. After the Oxfordian, the Kimmeridgian Task Group is the closest to being able to make a GSSP recommendation to ICS. Now that the base-Oxfordian proposal is in preparation, the ISJS is focussing its efforts towards supporting the work of the Kimmeridgian task Group.

Base Tithonian and base Callovian GSSP We expect the base Tithonian to follow shortly after that of the Kimmeridgian and finally the base Callovian. This would complete all of the definitions of the base of all the Jurassic stages.

5. SUMMARY OF EXPENDITURE IN 2014

Opening balance £1196.49

Travel expense Oxfordian Task Group Redcliff Meeting (Melendez, Chair Oxfordian Task Group): £546.04
Travel and accommodation expense Oxfordian Task Group Redcliff Meeting (Hesselbo, Chair ISJS): £343.44
Travel and accommodation expense Oxfordian Task Group Redcliff Meeting (Page, secretary of task group): £272.84
Closing balance £34.17

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2015

We request £2000 to support attendance of key scientists at the 2015 Kimmeridgian Task Group Workshop in Poland, June 2015.

APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2009-2013)

- **Volumina Jurassica** In 2010 the ISJS entered into a partnership with the open access periodical Volumina Jurassica. Volumnia Jurassica hosts a 'news and views section' which now routinely contains Jurassic Newsletter articles – previously only available as an informally assembled PDF available from the ISJS website. The editors of Volumina Jurassica, Andrzej WIERZBOWSKI and Grzegorz PIEŃKOWSKI, have also encouraged the Jurassic community to contribute to a discussion on the problems of the Jurassic substage boundaries.

- **Triassic-Jurassic Boundary** Definition of the base Hettangian GSSP, Kujoch, Austria.

- Definition of the base of the Toarcian Stage.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015-2019)

- Completion of the stage GSSP definition process

- Develop strategy for substage definition process

- Develop strategy for integration of cyclostratigraphy and geochronology into knowledge of stages and substages (through integration with the IODP and ICDP programmes)

- Develop website as forum for exchange ideas in relation to Jurassic stratigraphy

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

The Subcommission has an Executive consisting of Chairman, Vice-Chairman and Secretary, who are all Voting Members of the Subcommission. There are twenty other Voting Members, and it is emphasized that they are not elected to represent a country or region, but for their personal expertise and experience.

In addition to the Voting Members, there is a network of Corresponding Members, who have a responsibility for communication in both directions between the Subcommission and researchers on Jurassic topics in their region. Most are also active in one or more Working Groups.

The objectives of the Subcommission are pursued by Task Groups and Working Groups. Task Groups pursue the goal of defining GSSPs for stage boundaries where no GSSP has been fixed yet. Working Groups are either stratigraphical or thematic in scope, furthering stratigraphic research of stages with ratified GSSPs, or dealing with a specific topic related to Jurassic stratigraphy. Each group is organized by a Convenor, sometimes assisted by a Secretary, who are Voting or Corresponding Members.

The Subcommission sponsors an International Congress on the Jurassic System every four years. The 9th Congress was held in 2014 in India, and preparation is now underway to organize the 10th Congress in 2014 in Mexico. The present ISJS Voting Membership is as follows.

Executive				
		Role	*e-mail*	*Address*
Hesselbo	Stephen	Chair	s.p.hesselbo@exeter.ac.uk	Camborne School of Mines, University of Exeter, Penryn Campus, Penryn, Cornwall TR10 9EZ, UK
Sha	Jingeng	Vice Chair	jgsha@nigpas.ac.cn	Nanjing Institute of Geology & Palaeontology, Chinese Academy of Sciences, Nanjing 210008, P.R. China
Coe	Angela	Sec	a.l.coe@open.ac.uk	Department of Environment, Earth and Ecosystems, The Open University, Walton Hall, Milton Keynes, Buckinghamshire, UK
Voting Members				
Boughdiri	Mabrouk		mab_boughdiri@yahoo.fr	University of Carthage, Département de Sciences de la terre, Carthage, Tunisia
Pálfy	Joseph		palfy@nhmus.hu	Department of Physical and Applied Geology, Eötvös University | Pázmány Péter sétány 1/C, Budapest, H-1117 Hungary
Feist-Burckhardt	Suzanne		feistburkhardt@gmail.com	SFB Geological Consulting and Services, Odenwaldstrasse 18, D-64372 Ober-Ramstadt, Germany
Galbrun	Bruno		bruno.galbrun@upmc.fr	Université Pierre et Marie Curie, UMR 7193 ISTeP "Institut des Sciences de la Terre-Paris", Case 117 - Couloir 66-56 - 5è étage, 4 place Jussieu, 75252 Paris cedex 5 - France
Hinnov	Linda		lahinnov@gmail.com	Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD 21218 USA
Matsuoka	Atsushi		matsuoka@geo.sc.niigata-u.ac.jp	Department of Geology, Niigata University, , Niigata 950-2181, Japan
Meister	Christian		christian.meister@ville-ge.ch	Muséum d'Histoire Naturelle de Genève, Département de Géologie et de Paléontologie, 1 Rte de Malagnou, cp 6434, CH-1211 Genève 6, Switzerland.
Olóriz	Frederico		foloriz@ugr.es	Department of Stratigraphy and Paleontology, Faculty of Sciences, University of Granada, Av. Fuentenueva, s/n - 18071 Granada, Spain.
Rogov	Mikhail		russianjurassic@gmail.com	Geological Institute of Russian Academy of Sciences, Pyshevskii Lane 7, Moscow 119017
Wang	Yongdong		ydwang@nigpas.ac.cn	Nanjing Institute of Geology & Palaeontology, Chinese Academy of Sciences, Nanjing 210008, P.R. China
Bown	Paul		p.bown@ucl.ac.uk	Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT, UK

Damborenea	Susan		sdambore@fcnym.unlp.edu.ar	Departamento Científico Paleontología Invertebrados, Museo de Ciencias Naturales La Plata, Paseo del Bosque, s/n 1900 La Plata, Argentina
Ogg	James		jogg@purdue.edu	Department Earth & Atmospheric Science, Purdue Universiry, USA
Ahmad	Fayez		fayezahmad3@hotmail.com	Faculty of Natural Resources and Environment, Department of Earth and Environmental Sciences, The Hashemite University, P.O. Box 150459, 13115 Zarqa, Jordan
Dzyuba	Oksana		dzyubaos@ipgg.sbras.ru	IPGG SB RAS, pr. Akademika Koptyuga 3, Novosibirsk 630090, Russia
Mönnig	Eckhard		e.moennig@naturkunde-museum-coburg.de	Naturkunde-Museum Coburg, Park 6, 96450 Coburg, Germany
Pieńkowski	Grzegorz		gpie@pgi.gov.pl	Polish Geological Institute - National Research Institute, 4 Rakowiecka St., 00-975 Warszawa, Poland
Pandey	Dhirendra		dhirendrakp@gmail.com	Department of Geology, University of Rajasthan, Jaipur, India.
Mattioli	Emanuela		emanuela.mattioli@univ-lyon1.fr	Laboratoire de Géologie de Lyon:, Terre, Planètes, Environnement,UMR 5276 CNRS, Observatoire de Lyon, Université Lyon 1
Goričan	Špela		Spela@zrc-sazu.si	Institute of Paleontology, ZRC SAZU, Novi trg 2, SI-1000 Ljubljana, Slovenia

9b List of Working (Task) Groups and their officers

The active task Groups are as follows

Callovian Task Group (Chair: Eckhard MÖNNIG, Naturkunde-Museum Coburg, Park 6, 96450 Coburg, Germany, Tel. 09561/8081-13, e.moennig@naturkunde-museum-coburg.de)

Oxfordian Task Group (Chair: Guillermo MELÉNDEZ, Dpto. Geología (Paleontología), Universidad de Zaragoza, c./ Pedro Cerbuna 12, 50009 Zaragoza (SPAIN), Tel: (34) 976. 761076, Fax: (34) 976. 761088, e-mail: gmelende@unizar.es; Secretary Kevin PAGE, School of Geography, Earth & Environmental Sciences, Plymouth University, Drake Circus, Plymouth, PL4 8AA, UK)

Kimmeridgian Task Group (Chair: Andrzej WIERZBOWSKI, Polish Geological Institute - National Research Institute, 4 Rakowiecka St., 00-975 Warszawa, Poland, Andrzej.Wierzbowski@pgi.gov.pl)

Tithonian Task Group (Chair: Federico OLORIZ, Department of Stratigraphy and Paleontology, Faculty of Sciences, University of Granada, Av. Fuentenueva, s/n - 18071 Granada, Spain, foloriz@ugr.es)

Geoconservation Working Group (Chair: Kevin PAGE, School of Geography, Earth & Environmental Sciences, Plymouth University, Drake Circus, Plymouth, PL4 8AA, UK)

Liaison Working Group (Chair: Robert CHANDLER, aalenian@blueyonder.co.uk)

9c Interfaces with other international projects

Members of the Jurassic Subcommission are involved in a number of international projects, normally in an individual capacity but sometimes facilitated by contacts through activities related to the Subcommission such as its Task and

Working Groups and the Jurassic Congresses.

International Continental Drilling Program (IGDP) Proposal Workshop – Mochras Revisited: A New Global Standard for Early Jurassic Earth History. This project, led by ISJS Chair Stephen HESSELBO (UK), has proceeded to the third stage – full drilling proposal to be re-submitted January 2015. The aim is to re-drill the >1 km thick Early Jurassic succession of the Cardigan Bay Basin, UK, as a means to calibrate biostratigraphy, chemostratigraphy, magnetostratigraphy and astrochronology for what appears to be an exceptionally complete mudrock succession. ISJS members Linda HINNOV, Susana DAMBORENEA, Christian MEISTER, and Gregory PIENKOWSKI, have contributed to the proposal and/or will be members of the science team.

ProGEO and Geoparks Initiatives. The Subcommission Geoconservation Working Group (Convenor Voting Member Kevin PAGE, UK) has several links with international and national Geoconservation bodies and advisory groups (including himself and Corresponding Members Maria Helena HENRIQUES, Portugal, Platon TCHOUMATCHENKO, Bulgaria and Bill WIMBLEDON, UK). These groups include ProGEO (the European association for the conservation of the geological heritage), BIGC (the British Institute for Geological Conservation. In addition Kevin PAGE was invited by the Geological Society of Australia to take part in the 34th International Geological Congress in Brisbane, Australia, in August 2012, contributing a keynote address on geological conservation within a formal session devoted to "Geoheritage, Geoparks and Geotourism".

UNESCO World Heritage Sites. ISJS liaises with the WH management group of the management of the UNESCO East Devon and Dorset Coast (informally known as the Jurassic Coast) World Heritage Site and engages in debates about approaches to conservation, in particular palaeontological heritage.

Stratigraphy Commission of the Geological Society, London. Bown, Coe, and Hesselbo are all members of Stratigraphy Commission of the Geological Society, London.

S.P. Hesselbo November 19th 2014.

SUBCOMMISSION ON TRIASSIC STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Triassic Stratigraphy

SUBMITTED BY
Prof. Marco BALINI, Chairman
Dipartimento di Scienze della Terra "Ardito Desio"
Università degli Studi di Milano
Via Mangiagalli 34, 20133 Milano, Italy
Tel. ++39 0250315512
E-mail: marco.balini@unimi.it

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Rationalization of global chronostratigraphical classification.
Intercalibration of fossil biostratigraphies, integrated zonations, and recognition of global data.
Establishment of magneto- and chemo-stratigraphic scales.
Definition of Stage boundaries and selection of global stratotype sections.
Correlation of Triassic rock successions and events, including marine to non-marine.
Climatic evolution and modeling.

The objectives satisfy the IUGS mandate of fostering international agreement on nomenclature and classification in stratigraphy; facilitating international co-operation in geological research; improving publication, dissemination, and use of geological information internationally; encouraging new relationships between and among disciplines of science that relate to Triassic geology world-wide; attracting competent students and research workers to the discipline; and fostering an increased awareness among individual scientists world-wide of what related programs are being undertaken.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

Three meetings were originally included in the program of the STS for 2014.

- **February 12–16, 2014**. 11th International Field Workshop on Triassic: NW Gondwana margin of the Neo-Tethys (Negev, southern Israel). About 30 participants attended the field workshop that was very well organized by the Geological Survey of Israel. The small but classic outcrops of Middle and early Late Triassic (Anisian to Carnian) in the Negev desert have been visited. This area is very important because it was part of the Sephardic Bioprovince, which resulted from sympatric speciations of ammonoid and conodont species, migrating from the Tethys to the Gondwana margin during the late Anisian-Early Ladinian transgression. The drawing of the of the Anisian/Ladinian boundary in the Sephardic Bioprovince is especially difficult, because this boundary is defined in the Tethys at Bagolino (Southern Alps).
- **September 4-14, 2014**. 9th International Symposium Cephalopods – Present and Past ISCPP 9, Zurich, Switzerland. The Session 5 was dedicated to the Triassic cephalopods and hosted 7 oral presentations and 6 posters. About fifteen Triassic cephalopod workers attended this meeting and discussed new data. New high resolution chronostratigraphic scales were discussed for the earliest Triassic, the Dinerian and the Induan/Olenekian boundary, and the late Olenekian. A new Ladinian/Carnian boundary succession from South China was also illustrated.
- October 19-22, 2014. GSA Annual Meeting in Vancouver. Session T195. Extreme Environmental Conditions and Biotic Responses during the Permian-Triassic Boundary Crisis and Early Triassic Recovery. Several tens of specialists from North America, Europe and Asia attended this session, whose program included 23 oral presentations. Fifteen out of 23 were on the Early Triassic (4 on continental successions and 11 on marine successions), 5 on the P/T boundary and only 3 on the Permian. Although the emphasis of the session was on the complex interplay of environmental changes and evolutionary events, quite frequently the participants discussed the relative dating of the events and demonstrated the importance of a precise calibration of the chronostratigraphic scales and of the correlations of the marine and continental successions. Some preentations directly dealt with conodonts and ammonoids, the key groups for the definition of the Induan/Olenekian boundary. One of them was on the Nammal Nala section in Pakistan, one of the two candidate sections for the GSSP of the Olenekian stage.

3b List of major publications of subcommission work (books, special volumes, key scientific paper)

- **Albertiana, n.41**. This issue has been printed in May, 2014 and consists of 81 pages. It is the first issue edited by Chris McRoberts, in cooperation with the new editorial board, composed of 10 members. Volume 41 includes 4 papers on the P/T boundary and Lower Triassic, as well as an overview of the Triassic timescales by Ogg et al.
- **New Mexico Museum on Natural History and Science Bulletin 61**. "The Triassic System: New Developments in Stratigraphy and Paleontology", Edited by Lawrence H. Tanner, Justin A. Spielmann and Spencer G. Lucas. This very thick volume of slightly more than 600 pages, comprises 44 papers on Triassic vertebrates and invertebrates, biostratigraphy and chronostratihraphy, marine-land correlations.
- **New Mexico Museum on Natural History and Science Bulletin 64, "**Conodonts from the Carnian/Norian boundary (Upper Triassic) of Black Bear Ridge, northeastern British Columbia, Canada," by M.J. Orchard. This outstanding monongraph (139 pages, 55 plates, several tens of range charts) is the main contribution to the study of the Carnian/Norian boundary in 2014. The monograph has been distributed as PDF at the beginning of December, 2014, and publication date on the paper copy will be January 2015.

3c. Problems encountered, if appropriate

The main problems influencing the STS activities in 2014 are the same already discussed in the 2013 report. There are still difficulties in recruiting new young members, because young Triassic workers quite often do not have full position. The number of retired professors/academic is increasing, and some of them passed away. The most severe loss for the STS was the death of Heinz Kozur, one of the "senators" of the Subcommission. He passed away at the end of 2013, after the submission of the 2013 report of the STS. The 2014 report provides the opportunity to pay a tribute to him. **The major and new problem of the STS in 2014, no doubts has been the lack of connection with the new IGCP 630"Permian-Triassic climatic and environmental extremes and biotic response" has been approved by UNESCO in 2014**, (http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/international-geoscience-programme/igcp-projects/global-change/project-630/). Some of the goals of this new project fully overlap with the mission and the activities of the STS, as demonstrated by the theme of the first field workshop of this project (November 17-22, 2014): The Permian-Triassic transition in the Kashmir Valley (leaders A. Baud and G. Bhat; field guidebook of 37 pp.).

Surprisingly, the Triassic Subcommission was not asked for any support and cooperation neither during the preparation of the IGCP proposal nor after its approval. The consequence of this lack of cooperation are very severe especially for the Induan/Olenekian boundary Working Group. This WG, that is in charge on one of the most difficult GSSP of the Triassic system, is going to be emptied by the new IGCP. A formal letter will be sent to both the Project Leader of the IGCP 630 and the IGCP Scientific Board.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015)

Meetings

STRATI 2015, 2nd International Congress on Stratigraphy, July 19-23, Graz, Austria. The 2nd international Symposium on Stratigraphy will include a session on "Progress in Triassic stratigraphy". Convenors are Marco Balini (marco.balini@unimi.it), Leo Krystyn and Sylvain Richoz. The program of the Congress includes a 3-day field trip (FT 5) to the Upper Triassic of the Northern Alps, with visit to the T/J GSSP and to the Norian/Rhaetian GSSP candidate section Stenibergkogel. For details: http://strati2015.uni-graz.at/.

2nd Boreal Triassic Conference 2015, Svalbard and 12th International Workshop on the Permo-Triassic, Svalbard August 27 – September 1, 2015. Organizing Committee: Atle Mørk (Atle.Mork@sintef.no), Gunn Mangerud, Bjørn Anders Lundschien and Hans Arne Nakrem. The rich program of the workshop includes two days of presentations and two days of excursions. The focused topics include Boreal Triassic biostratigraphy, palynology, sedimentology, and vertebrates. The participants will be able to visit the Festningen section (Permian to Tertiary rocks) and Sassenfjorden section (Upper Permian to upper Carnian). For details: http://foreninger.uio.no/ngf/Boreal2/index.html.

4b Specific GSSP Focus for 2015

- **Rhaetian**. Some years ago the Norian/Rhaetian boundary WG voted for the best primary marker event and the FAD of the conodont *Misikella posthernsteini*, got the majority of votes. Since that decision, the WG has been working on the calibration of this event. Until 2013 only one candidate section, Steinbergkogel in Northern Alps, Austria (leader L. Krystyn), was under examination by the WG. In 2014 another possible candidate section at Pignola (Lagonegro, Southern Italy) has been proposed by Rigo et al. at EGU, Vienna (end of April)

and SGI Congress, Milano (September 12). In 2014, the WG has been alerted for the final discussion and ballot. The composition of the WG has been updated. At present the WG includes 19 specialists, but 4 new members, have been invited to join it. The final schedule of the WG is as follows:

1) Announcement of the deadline for the ballot for August 2015.
2) Open call for contributions on the Rhaetian stage, contributions to be printed in the 1st issue of 2015 of Albertiana (Spring 2015).
3) Invitation to the two research groups working on Steinbergkogel and Pignola to submit a proposal to the WG by Spring. If possible, the proposal will be printed in the Spring issue of Albertiana.
4) Presentation of data and final discussion at STRATI 2015, during the Triassic session.
5) Ballot for the GSSP by August 2015.

- **Norian**. The GSSP of the Norian stage is probably 2nd that will be defined, but most probably the Carnian/Norian boundary WG will be able to vote in 2016. In the last 4 years a wealth of new data have been published and two candidate sections have been proposed: Black Bear Ridge (BBR) in British Columbia and Pizzo Mondello in Sicily. However, the WG has not yet discussed primary and additional marker events and long distance correlations. Ammonoid record is not very good in both the sections, while conodont and halobiid records are very rich. Conodonts faunas seem to be quite different in the two sections, while halobiids are much easier to correlate. The main problem, that has not yet been solved, is the calibration of the FO of *Halobia austriaca*.

In 2014, two important papers have been published. The first is the long-awaited monograph on Carnian/Norian boundary conodonts from BBR by Orchard. With this monograph the dataset from the two candidate sections is now complete, and in 2015 the WG will be able to start the discussion on the bioevents and their correlatability. In this respect an important paper on Berlin section (central Nevada) has been published in 2014 by Balini et al. This section is important for the correlations of the two candidate section because of its original position at low paleolatitude with respect to BBR.
An important deadline for the WG will be STRATI 2015.The Triassic session will be the ideal forum to present and discuss that latest data, in the way that the C/N boundary WG will be able to define the program for the final discussion and the ballot.

- **Olenekian**. The Induan/Olenekian boundary is one of the most complex stage boundaries of the Triassic. In some respects, the STS has a direct responsibility in the present situation, because when the Subcommission voted on the subdivision of the Lower Triassic series (1991), the solution that got the supermajority of votes was the subdivision into two stages: Induan and Olenekian. The Induan was based on tethyan successions (Salt Range and Tethys Himalaya), while the Olenekian was based on Boreal successions in Siberia. Such a decision, unfortunately, was not based on bed-by-bed sampled sections, that is to say following a bottom-up approach, but was instead taken following a top-bottom approach, namely the number of subdivisions of the Lower Triassic that seemed to be logical on the basis of the knowledge available at that time.

  For more than a decade the Induan/Olenekian boundary WG worked on low paleolatitude sections (Chaohu, Mud and Nammal Nala), with a tremendous improvement of knowledge, but when the general picture of ammnoid faunal successions and number and position of conodont events was rather clear, H. Bucher raised the question of the correlatability of tethyan events with those recorded in the boreal successions. This problem was emphasized by Bucher during the business meeting of the STS that took place in Zurich on September 11, 2014. The WG chair, in agreement with the STS chair, decided to give a time to Bucher and Sobolev to study the ammonoid data available at the Russian Academy of Science in Novosibirsk in order to have an updated view of the problem. At present, it is not possible to estimate a deadline for the final decision of GSSP and there is a severe risk of expanding too much the work necessary to define the GSSP of the Olenekian stage. The STS chair, however, will do his best to keep the WG on target.

- **Anisian**. The GSSP of the Anisian Stage, is probably the most difficult to be defined because the sedimentary record of the O/A boundary is usually rather poor (see the 2013 annual report). Even more important, there is not much research in progress on this interval. The specialists on Lower Triassic are working on the Induan and Induan/Olenekian boundary.

5. SUMMARY OF EXPENDITURES IN 2014 (US$)
ICS FUNDING to STS **3250**

- Contribution to participants to the 9th Cephalopod Symposium. **1000**

This contribution allowed the reduction of the registration fee for some participants from the Far East.

- Contribution to participants to GSA Annual Meeting 2014.

Session T195 Extreme Environmental Conditions and Biotic Responses during the Permian-Triassic Boundary Crisis and Early Triassic Recovery. **1000**

The registration fee of some PhD students and young researchers, has been in part covered by this contribution.

- Travel costs of Working Group leaders **1250**

The leaders of the C/N and N/R WGs meet in Vienna at the end of April, to discuss at length with the past leader of the N/R WG the present issues and the strategy for the 2014-2016. This informal meeting was crucial because during 2014 there were no formal opportunities to group together the specialists on Upper Triassic series, which includes 2 out of 4 pending GSSPs for the Triassic system.

TOTAL **3250**

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2015 (US$)

- Contribution to participants to **STRATI 2015**, **2nd Congress on Stratigraphy**. **4000**

This congress is the most important event in the program of the STS for 2014-2016 and is the final deadline for the selection of the GSSP for the Rhaetian stage. One of the two GSSP candidate section will be visited during the field trips. This event is also an important deadline for the Working Group on the Carnian/Norian boundary, that is requested to discuss the state of the art of the research, 4 years after the Palermo workshop. Unfortunately, at the time this report is submitted, the 2nd circular of the congress, including all the information on registration fee and accommodation, has not yet been distributed. Hopefully, this information will be provided at the end of 2014, but the short time, will make the raising of funds by the WG members quite difficult. We ask for a significant support from ICS, in order to provide partial support to as many members of the WGs as possible.

- Contribution to participants to **2nd Boreal Triassic Conference 2015**. **2000**

This conference is probably the most important event on the Boral Triassic since the first conference, held in 2002 and is an extremely important opportunity for meeting and discussion, especially on the Lower and Middle Triassic. The Induan/Olenekian WG will meet during the congress. We are planning to invite few Russian colleagues working on the classic localities along the Olenek River (Siberia), who will illustrate the state of the art of the ongoing research in this area. After the STS meeting in Zurich (September 2014) the problem of the correlation of the Induan/Olenekian boundary low paleolatitude tethyan sections (Nammal Nala and Mud) has became the main hurdle on the way to the definition of the GSSP:

The cost of travel, registration and accommodation for this Conference will be very high, of course much higher than the budget of the STS. We ask for a "symbolic" support for two, maximum three participants, with the hope that the sponsors will cover the rest of their costs.

- Travel costs of Working Group leaders **1000**

Despite of the possibilities provided by technology (e-mail and video conferences) the most productive exchange of opinions occurs during meetings. We ask for a small amount of money in order to support (in part) the travel costs of the WG leaders, in particular those of the I/O, C/N and N/R boundaries.

TOTAL 7000

APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2010-2014)

Organization

- Renewal of STS corresponding membership in 2011. Thirtyone new corresponding members have been involved in the STS.
- In November 2012 W. Kuerschner has replaced L. Krystyn as chair of the Carnian/Norian boundary Working Group, being Krystyn involved in one boundary proposal.

- In 2013 Albertiana, the newsletter of the STS, has been completely renewed. The new Editor is Chris McRoberts and the Editorial Board is now consisting of M. Balini, A. Baud, A. Brayard, P. Gianolla, M. Fraser, M. Hounslow, W. Kuerschner, S. Lucas, M. Orchard, Yu.Zakharov.
- New chair for the Norian/Rhaetian boundary Working Group appointed in 2013. M. Balini has replaced L. Krystyn, who is directly involved in the preparation of the proposal.
- Composition of the Norian/Rhaetian boundary WG updated in 2014, in preparation of the final discussion and ballot, scheduled for 2015.

Meetings/ workshops

- International workshop *New developments on Triassic integrated stratigraphy*, Palermo, Italy, September 12-16, 2010.
- Canadian Paleontology Conference, Vancouver, Canada, August 19-22, 2011. *Special session: Studies on the Triassic, in commemoration of Edward Timothy Tozer*.
- About 10 meetings and field workshops organized in the framework of the IGCP 572 between 2008 and 2012.
- Five International field workshops on Triassic organized every year: Dolomites (2010), Southern France (2011), western Lombardy (2012), Spain (2013) and Israel (2014).
- 2nd International Symposium on Triassic and later marine Vertebrate faunas, Xingyi (China), September 10-15, 2013.
- Special session on Triassic during the 9th International Symposium Cephalopods – Present and Past, September 4-12, 2014 .

Publications

- Four issues of **Albertiana** (#38-41) were published in 2009-2014. Each of these issues was made available for download from the Albertiana and STS websites.
- Abstract volumes/ field guides prepared for meetings in Bad Goisern, Palermo, Vancouver, Xingyi and Zurich.
- **Geological Society of London Special publications 334 "The Triassic Timescale"**, S.G. Lucas (ed.). The volume, printed in 2010, includes 15 contributions (515 pages) reviewing the state-of-the-art of the main tools for the definition of the Triassic time-scale, from classic fossil tools (ammonoids, bivalves, conodonts, radiolarians, palynomorphs, conchostracans, tetrapods and tetrapod footprint) to magnetostratigraphy, geochronologic data ages, isotope variations and cyclostratigraphy.
- The proceedings of "The Triassic climate" workshop, Bolzano/Bozen, 2008 have printed in April 2010 as issue #290 of **Palaeogeography, Palaeoclimatology, Palaeoecology**, The volume includes 13 contributions spanning from the Permo-Triassic to the end of the Triassic.
- The Proceedings of the Palermo workshop "New developments on Triassic integrated stratigraphy", held in September 2010 have been printed in March 2012 in the **Rivista Italiana di Paleontologia e Stratigrafia**, volume 118/1.
- **New Mexico Museum of Natural History & Science Bulletin 61**, "The Triassic System: New Developments in Stratigraphy and Paleontology". Tanner L.H., Spielmann J.A. and Lucas S.G. eds. Printed in 2013, 612 pp.
- **New Mexico Museum of Natural History & Science Bulletin "**Conodonts from the Carnian/Norian boundary (Upper Triassic) of Black Bear Ridge, northeastern British Columbia, Canada," by M.J. Orchard, about 200 pp. PDF available in December 2014, paper copy printed in 2015.
-

Working Groups

Induan-Olenekian boundary Working Group

- The Working Group has been reactivated in October 2009 (chair Y. Zakharov).
- After intensive samplings, in 2010 Hugo Bucher and his team (Switzerland), emphasized Nammal Nala section in Salt Range (Pakistan) as another possible candidate for the GSSP.
- In 2012, after the publication of ammonoid and of some conodont data, the Nammal Nala section results to be the more complete section and the best candidate for the GSSP. The data are presented by Goudemand et al. at 34 IGC, Brisbane, Session 35.1 GSSPs as global geostandards.
- In 2013, in the lack of the publication of the revision of the I/O boundary conodonts, the WG has improved the taxonomy and correlation of ammonoid faunal successions.
- In 2014 the WG has discussed the correlation between Tethys and Boreal realms. This correlation is not easy, but it is important to try to address this issue, because the Induan stage was proposed with a low paleolatitude type area, while the Olenekian stage was based on boral successions.

Olenekian-Anisian boundary Working Group

- In 2010 the possibilities of gaps at the top of the Olenekian at Desli Caira, the candidate section under study since mid of 1990s, lead the WG to reconsider other sections as Guandao (China), characterized by good conodont record accompanied by stable isotope variations and paleomag record, or Nevada, where all the late Olenekian to early Anisian ammonoid faunas are present but not in the same section. Unfortunately no good ammonoids have been reported so far from Guandao, while the Nevada successions are usually remagnetized.
- In 2012 Goudemand et al. published the discovery of *Chiosella timorensis* from the Olenekian Haugi Zone of western Nevada (USA). This finding questions the adequacy of the FAD of this species for the definition of the GSSP of the Anisian Stage.
- In 2013 the study of new ammonoid collection done in 2012 leads to complete the record of the earliest Anisian ammonoid zones. The data are unfortunately still unpublished.

Ladinian-Carnian boundary Working Group

The GSSP has been ratified in 2008 and the Working Group is no more active.

- The official presentation of the GSSP at Prati di Stuores/Stuores Wiesen has been published on **Episodes**, vol. 35/3 (September 2012), by Mietto et al.

Carnian-Norian boundary Working Group

- In 2010 both the GSSP candidate sections have been visited. Black Bear Ridge (British Columbia) was visited in May by the Working Group chair and by members of the two teams working at Black Bear Ridge and Pizzo Mondello sections.
- Pizzo Mondello section (western Sicily) was visited in September 2010, during the field trip of the Palermo workshop. During the indoor session several contributions on BBR and PM section were presented and discussed. The significance of the pelagic bivalve *Halobia austriaca* was emphasized by McRoberts, Krystyn and Levera. The significance of conodonts for the selection of the primary marker event was reduced by faunal differences.
- In 2011 the bivalve faunas from British Columbia, including the Black Bear Ridge section have been described in a large monograph by McRoberts. The possibility to define the GSSP at Black Bear Ridge section, on the basis of the FAD of the bivalve *Halobia austriaca* in anticipated by McRoberts & Krystyn, at Vancouver Conference.
- In 2011 McRoberts & Krystyn proposed in a poster presentation the FAD of the bivalve *Halobia austriaca* as possible marker events. Such proposal was already discussed in some informal and formal meetings of the Working Group (2010).
- The taxonomy and biostratigraphy of ammonoids (Balini et al.), bivalves (Levera) and conodonts (Mazza et al.) from Pizzo Mondello section have been published in 2012 in the Proceedings of the Palermo workshop (**Rivista Italiana di Paleontologia e Stratigrafia**, v. 118/1), together with a paper on nannofossils (Preto et al.).
- A first paper on Black Bear Ridge conodonts has been published in 2013. This paper includes the description of five new genera.
- In 2014 a paper on integrated bio-chronostratigraphy of the Carnian/Norian boundary section at Berlin (central Nevada) has been published (Balini et al., 2014). In this contribution, first study of this locality based on bed-by-bed collections, the ammonoid, bivalve and conodont record is described. The problems of correlations with the sections in British Columbia and western Tethys are also discussed. Berlin is the best in North America for the latest Carnian ammonoid faunas but provides also a good record of the earliest Norian.
- The conodont taxonomy and bio-chronostratigraphy of the Black Bear Ridge is going to be published in January 2015 (PDF already available in December 2014).

Norian-Rhaetian boundary Working Group

Since 2008, Steinbergkogel (Austria), in the historical Hallstatt area, has became the most significant section for the definition of the Norian-Rhaetian boundary. In 2009 the FAD of *M. posthernsteini* was voted by the members of the WG as the best event to be used to define the boundary.

- At Steinbergkogel the FAD of the conodont *Misikella posthernsteini* was proven to be isochronous with the FO of the ammonoid *Cochloceras*. This well-constrained bioevent is closely above the FO of the conodont *Misikella hernsteini* and a magnetic polarity change from a long normal to a well developed reversed interval. A distinctive dinoflagellate change, which occurs with the FO of *Rhaetogonyaulax rhaetica* in the Zlambach

section, is stratigraphically higher than the other two options and corresponds to another ammonoid change with the FO of the widely distributed genera *Cycloceltites* and *Vandaites*.

- The thickness of the boundary succession is unfortunately rather thin, and the facies is not constant, then from 2009 the research group working on the Steinbergkogel section is engaged with the search and sampling of some reference sections, in Northern and Southern Alps, crucial to demonstrate the significance of the rather thin Steinbergkogel section.
- Gardin et al. (2012) reported the occurrence of the first coccolithophores from the Norian-Rhaetian boundary interval in three sections from Northern Alps, including Steinbergkogel section. This first occurrence strengthens the position of Steinbergkogel as the best GSSP proposed section for the base of the Rhaetian.
- At the present a correlation chart for sections in the Tethyan Realm is almost ready and some possibilities of direct correlations with north America, based on conodonts of the group of *Epigondolella mosheri* is under evaluation.
- In 2014 Rigo et al. have announced a second candidate section at Pignola (Lagonegro, southern Italy). A manuscript has been submitted for publication. The succession exposed at this site was deposited in a deep setting then bio-chronostratigraphy is based on conodonts and radiolarians. The section is under study for magnetostratigraphy and stable isotope variation.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015-2018)

- Full revision of the STS Website. This point of the STS program was originally scheduled for Spring 2014 but it is delayed to 2015. In 2014 the STS board has preferred to invest energy and time on the re-organization of the newsletter of the Subcommission.
- Definition of the GSSP of the Rhaetian Stage by 2015. The deadline for the WG is STRATI 2015.
- Definition of the GSSP of the Norian stage. Most of the members of the Carinan/Norian boundary WG are involved also in the Norian/Rhaetian WG. For this reason, realistically this decision will not be possible before the end of 2015, as planned in 2013. The Triassic session of STRATI 2015 will be an important deadline for the discussion on the correlatability of the possible marker events for this GSSP.
- Definition of the GSSP of the Olenekian. At the present is not possible to estimate a deadline for the final decision. In 2014 H. Bucher has re-opened the discussion on the marker events by emphasizing the problem of the correlatability of events recorded in low paleolatitude tethyan sections (Nammal Nala, Pakistan, and Mud, India) with high paleolatitude siberian successions. These successions provided support for the formalization of the Olenekian Stage of the Lower Triassic Series, while the Induan Stage was proposed on low paleolatitude successions. New investigations by H. Bucher are going to be planned, but at present no research project on this topic has been submitted, then it is impossible to estimate a timing or schedule for the WG.
- Definition of the base of the Anisian Stage by 2018. This is the most difficult boundary to be defined, for the combination of scarcity of sections and frequent condensation. The activity of the WG has been delayed in the last 10 years by the very slow progress of the study on the Desli Caira section in Romania. The FAD of the conodont *Chiosella timorensis*, that was voted several years ago by the WG, is now known to be recorded together with late Olenekian ammonoids in north America. This datum is unfortunately from a loose block, then no candidate section is available.
- Improvement of the marine-land correlations. Important continental successions are documented in the Western Interior (USA), Karoo (South Africa), Germanic basin and Newark basins (USA) and are under study by an informal Working Group of the STS. Over the years, this WG has established a Triassic continental scale consisting of 8 stages, whose correlations with the marine scale is updated year by year. The goal is very ambitious and but S. Lucas, the very active leader of this WG, keeps the members of this WG under pressure.
- Improvement of the numerical calibration of the Triassic chronostratigraphic scale, with special care on the definition of the duration of the Induan, Norian and Rhaetian stages. The main problem of the Induan Stage is its short duration, based on radioisotopic dating on zircons, while interpretation of sedimentary cycles in terms of Milankovitch cyclicity would suggest an about 50% longer duration. The duration of the Norian Stage has been a matter of strong discussions during the last 9 years, mostly because of the lack of tuff layers in biostratigraphically calibrated sections. Two notably different estimates have been thus far suggested, one postulating a short 10-12 myr duration while the second estimates a much longer 28myr duration.
- Establishment of Working Groups aimed at the definition of the stratotype of the Triassic Substages. This important step towards the increasing of the power of resolution of the Triassic timescale, is

always kept in the program of the STS, but the launch of the Substage definition program will be possible only after the completion of the definition of all the GSSP of the Stages and in agreement with the ICS board.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

STS is a Subcommission of the International Commission on Stratigraphy.
Officers (chairman, two vice-chairmen, secretary), Editor/ Webmaster of newsletter Albertiana, 23 voting members and 117 corresponding members. The Secretary hosts a web site for STS announcements and task group discussions. Subcommission members represent a broad spectrum of specialized stratigraphical disciplines from those countries or regions where Triassic rocks are extensively studied in relation to fundamental and/or applied geological research. Current research activities and future plans are communicated through publication of the bi-annual STS newsletter *Albertiana* as web release.

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9b List of Working (Task) Groups and their officers

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***Base Norian*:** Wolfram M. Kuerschner, Norway.w.m.kuerschner@geo.uio.no
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9c Interfaces with other international project

The IGCP 572, that was proposed with the support of the STS, ended in 2013. As already reported in section 3c, the new IGCP 630 "Permian-Triassic climatic and environmental extremes and biotic response" has been approved by UNESCO in 2014, (http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/international-geoscience-programme/igcp-projects/global-change/project-630/). Some of the goals of this new project fully overlap with the mission and the activities of the STS but, surprisingly, the Triassic Subcommission was not asked for any support and cooperation neither during the preparation of the IGCP proposal nor after its approval. The **Induan/Olenekian boundary Working Group will be affected by this unusual situation**. A formal letter will be sent to both the Project Leader of the IGCP 630 and the IGCP Scientific Board.

SUBCOMMISSION ON PERMIAN STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Permian Stratigraphy (SPS)
Submitted by:
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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Subcommission Objectives: The Subcommission's primary objective is to define the series and stages of the Permian, by means of internationally agreed GSSP's, and to provide the international forum for scientific discussion and interchange on all aspects of the Permian, but specifically on refined regional correlations.
Fit within IUGS Science Policy: The objectives of the Subcommission involve two main aspects of IUGS policy: 1. The development of an internationally agreed chronostratigraphic scale with units defined by GSSP's where appropriate and related to a hierarchy of units to maximize relative time resolution within the Permian System; and 2. Establishment of framework and systems to encourage international collaboration in understanding the evolution of the Earth during the Permian Period.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

The proposals of the Sakmarian-base and Artinskian-base GSSPs have been published in *Permophiles* (Issue 58). After the proposals were published, we received a couple of comments and discussions on the conodont taxonomy for the index species and quality of the sections from the working group members, which have also been published in the subsequent *Permophiles* 59. Since discrepancies on the taxonomy of conodonts and selection of the conodont index species for the definition of the two GSSPs are present in the working group. So, voting for the proposals in SPS has been postponed.

In addition, we organized an international group to do a joint field excursion on the Guadalupian Series in West Texas in May, 2013. During this field excursion more than 1000 kg samples were collected for conodont and high-resolution geochemical analyses. Three GSSP markers were placed at the GSSP sections. We have processed all conodont samples and tried to get the lineage for the three GSSPs.

3b List of major publications of subcommission work (books, special volumes, key scientific paper)

Two issues of *Permophiles* (Issues 58 and 59) have been published since November, 2013.
Two proposals for the Sakmarian-base and Artinskian-base GSSP have been published in *Permophiles* 58. They will be used for voting in SPS after the WG has updated the proposals following the suggestions and comments from the WG members and SPS voting members.
An updated Permian timescale has been published in the proceeding volume of STRATI 2013 by Shen and Henderson (2014).

A paper to call restudy of the base of the Permian (Lucas, 2013) and a reply (Davydov, 2013) were published in *Permophiles* 58.

3c. Problems encountered, if appropriate

We have encountered problems that discrepancies in conodont taxonomy and selection of the index species of the two proposals for Sakmarian-base and Artinskian-base GSSPs are present.

We also met a problem for the Lopingian-base GSSP which will be flooded after a dam established in 5 years for electronic power in the downstream of the Hongshui River in Guangxi, South China. We have extensively discussed with the local government and a detailed plan for searching the replacement of the GSSP section nearby the GSSP has been made.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2014)

The primary objectives are to complete the last three GSSPs (Sakmarian, Artinskian, and Kungurian stages).

4b. Specific GSSP Focus for 2014

The priority of 2014 for GSSP is to decide which index species we should use for the definitions of the Sakmarian-base and Artinskian-base GSSPs and the index species should be formally described and published before a voting can go ahead.

5. SUMMARY OF EXPENDITURES IN 2013

As planed in the Annual Report 2013, SPS secretary Lucia Angiolini and former SPS chair Charles Henderson visited Nanjing in March, 2014 for *Permophiles* and discussion of the plan for the Sakmarian-base and Artinskian-base GSSPs. The fund from ICS has been partly spent on paying their stay in Nanjing (US$956). An SPS business meeting was held in Freiberg, Germany and chaired by the SPS vice-chair Joreg Schneider, which cost 350US$. Shuzhong Shen has planned to Milan on December 9, 2014 for the editing of *Permophiles* 60 with SPS Secretary Lucia Angiolini. This will cost about 1000US$. We still have ~1200US$ surplus from this year's budget. This is mainly because the Freiberg business meeting did not spend money for inviting young colleagues on the Permian to attend the meeting. We will transfer this money to next year's budget for organizing the field excursion of the three potential GSSPs in southern Urals and ICCP business meeting in 2015 in Kazan, Russia.

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014

1) A field excursion on the three potential GSSP sections in southern Urals will be organized by Valery Chernyk (XVIII ICCP-A3). We will invite all voting members to attend the field excursion (US$4000).
2) A session and an SPS business meeting on the Permian GSSPs will be organized during the 15th ICCP meeting (500US$).
3) Supporting a part of Lucia Angiolini's stay in Nanjing in May, 2015 and editing *Permophiles* (US$1000).
4) I have not decdied to attend the STRATI 2015 Conference yet. I may use a part of budget for this meeting or use my own project money.

In total: **US$4300 [***=5500 (budget for 2015) -1200 (surplus from 2014)***]**

APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2009-2014)

1) A new SPS website has been established.
2) Three GSSP bronze markers have been placed on the GSSPs in the Guadalupe National Park in USA.
3) A high-resolution timescale of the Permian system has been significantly refined (see SPS webpage Permian Timescale).
4) SPS decided to search new GSSP candidate for the Kungurian Stage after an investigation on the previous candidates. Now two candidates for the Kungurian-base GSSP are available, but further work is necessary before a voting process is conducted.
5) Significant progress on the Sakmarian-base and Artinskian-base GSSP candidates has been made. Proposals for voting have been published and extensively discussed.
6) Two monuments have been built and a protected area has been established at Penglaitan, Laibin, Guangxi Province, China for the Wuchiapingian-base GSSP.
7) Seven formal issues and two supplementary issues of *Permophiles* have been published since 2009.
8) A working Group on the Carboniferous-Permian transition between marine and non-marine has been initiated in 2014.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2014-2018)

1) Publishing the revised version of the proposals, organizing the field excursions and establishing the three (at least two) GSSPs for the Cisuralian.
2) Organizing a working group on the Guadalupian and global correlation for chemostratigraphy and geochronologic calibration. Publish the official papers for the three Guadalupian GSSPs.
3) Searching the replacement of the Lopingian-base GSSP nearby the stratotype section at Penglaitan, Guangxi, South China because the original will be flooded in 5-10 years by a dam for electronic power.
4) Developing a large working group on the correlation between marine and continental sequences. This has already been initiated.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP
9a Names and Addresses of Current Officers and Voting Members

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9b List of Working (Task) Groups and their officers

1) Kungurian-base GSSP Working Group; Chair-Bruce Wardlaw.
2) Sakmarian-base and Artinskian-base GSSPs Working Group; Chair-Valery Chernykh.
3) Guadalupian Series and global correlation; Chair-Charles Henderson.
4) Correlation between marine and continental Carboniferous-Permian Transition; Chair-Joerg Schneider.
5) Neotethys, Paleotethys, and South China correlations; Chairs Lucia Angiolini and Yue Wang.

9c Interfaces with other international project

SPS interacts with many international projects on formal and informal levels. SPS has taken an active role in the development of a project on the correlation between marine and continental Permian sequences bilaterally supported under the foundation of the Sino-German Centre for Research Promotion (SGCRP) by NSFC and DFG. In 2014, SPS chair organized an international cooperative project on the correlation of the Guadalupian Series between South China and Mt. Guadalupe in Texas, USA, which has been approved by NSFC.

SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

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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 & 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. 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.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN November 1st 2013 - October 31st 2014 fiscal year

Task Group Progress Reports

The references for the task-group reports are provided after section 6 (Budget and ICS component), which is before Appendix A.

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; aretz@get.obs-mip.fr)

Introduction and general activities

The Devonian-Carboniferous (D-C) boundary task group is conducting paleontological and multi-disciplinary research on several continents. During the fiscal year, the group continued with it primary tasks (see Richards & task group, 2010; Aretz, 2011) – the search for a suitable criterion for 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 occurrence of the conodont *Siphonodella sulcata* (Huddle, 1934) in the lineage *Siphonodella praesulcata* Sandberg, 1972 to *S. sulcata*.

The task group on the Devonian-Carboniferous boundary has not been very active in the last fiscal year, mainly due to the important work load of the task group members including the task group leader. However, individual members continue to work and publish results of their research. These are important contributions, since it will help the task group to progress in the next years. The task group agreed during the workshop at Erfoud, Morocco in 2013 to compile detailed data sets for the best boundary sections throughout the world and to start to correlate these sections. This aim for 2014 was not achieved, but it remains the prime target and duty for the next year since it is the base for any successful work in the future.

Reports from Task-Group members

Barry Richards (Calgary, Canada)

Richards & colleagues (Mark Schmitz and Vladimir Davydov at Boise State, Idaho; Jeffrey Over at SUNY-Geneseo, New York; Tim Hartel, Calgary) continued 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 combining U-Pb radiometric dating (Thermal Ionization Mass Spectrometry CA-TIMS), stable carbon isotope chemostratigraphy ($\delta^{13}C$), conodont biostratigraphy, and magnetic susceptibility.

Activities included continued processing of volcanic ash collected from the Exshaw and Banff during previous years for U-Pb dating and the additional sampling of the Exshaw black shale at three outcrop sections (Jura Creek, Mount Rundle, and Highway 3 at Crowsnest Lake) in the southern Canadian Rockies for stable carbon isotope ($\delta^{13}C$) chemostratigraphic and magnetic susceptibility studies. Samples have been submitted from the three sections for stable carbon isotope studies but the analyses require completion to determine the location of the typical positive ($\delta^{13}C$) excurion at the onset of the Hangenberg Event.

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

Following approval of the proposed GSSP (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 the task-group chairman George Sevastopulo has taken over that role. Substantial progress has been made with writing the final report on the base of the Viséan and Sevastopulo plans to complete a draft during the 2015 fiscal year. Essentially the report provides a brief resume of the GSSP and then lists the successful attempts to identify the boundary in Eurasia by Jiri Kalvoda and others, and discusses the problems of identifying (and best approximation to) the boundary in north America and Gondwana. It also includes contributions by relevant paleontological experts on the up-to-date knowledge of the ranges of different fossil groups over the boundary interval, which is useful because many taxa that were considered to be of early Viséan age are actually restricted to the latest Tournaisian or first occur there.

Task Group to establish the Viséan-Serpukhovian Boundary [which is also the base of the Upper Mississippian Series] is chaired by Barry Richards (Canada; barry.richards@NRCan.gc.ca).

Introduction

An index for boundary definition has been selected and work is well advanced at the two prime GSSP candidate sections: the Verkhnyaya Kardailovka in the southern Ural Mountains of Russia and the Naqing (Nashui) section in southern Guizhou Province, China. In the Cantabrian Mountains of northwest Spain, work continued on the Millaró and Vegas de Sotres sections, two other potential candidate sections for the GSSP. For boundary definition, the group is using the first evolutionary occurrence of the conodont *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957) –*Lochriea ziegleri*. *L. ziegleri* appears in the Brigantian Substage of NW Europe somewhat below the current base of the Serpukhovian as defined by its lectostratotype section in the Zaborie quarry near the city of Serpukhov in the Moscow Basin, Russia (Kabanov *et al*., 2009, 2012, 2013). 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. It is anticipated the work by Paul Brenckle using material from several new sections (including those by villages of Luokun, Narao, and Dianzishang) in addition to those at Naqing and Yashui will permit a more precise correlation based on foraminifers. During 2015 the task group plans to vote on accepting or rejecting the FAD of *L. ziegleri* for boundary definition.

Important accomplishments in 2014 were: 1) the completion of a manuscript by Nemirovska *et al*. (in progress) titled "Conodonts of the genus *Lochriea* near the Viséan/Serpukhovian boundary (Mississippian) at the Naqing section, Guizhou Province, South China". That study enables confirmation and refinement of known lineages within the genus, and two lineages are proposed: a) the noded *Lochriea* species *L. mononodosa–L. nodosa–L. ziegleri, L. senckenbergica* and *L. multinodosa*, and b) the ridged *Lochriea* species *L. monocostata–L. costata–L. cruciformis*. 2) the publication of a paper about the conodonts of the genus *Lochriea* in Ireland and recognition of the Viséan-Serpukhovian boundary (Barham & Sevastopulo 2014), and 3) the publication of two papers about the upper Viséan and Serpukhovian in the Moscow Basin of Russia: a) one about the sequences, disconformities and biostratigraphy(Kabanov *et al*., 2014a) and b) a second about the geochemistry and magnetic susceptibility in the type area of the Serpukhovian Stage in the Moscow Basin, Russia (Kabanov *et al*., 2014b).

Progress in southern Guizhou province, China

A comprehensive study on the biostratigraphy, sedimentology and geochemistry of the upper Viséan to Serpukhovian succession in South China is being undertaken in order to obtain a detailed understanding about the evolutionary change of the biota and global correlations across the Viséan/Serpukhovian boundary. The studied sections include limestone-dominated, shallow-marine Yashui section and deep-water (slope) Naqing, Narao, Luokun, and Dianzishang sections. Detailed conodont and foraminiferal biostratigraphy across the Viséan/Serpukhovian boundary intervals in the Luokun and Narao sections is being done at a bed-by-bed level of detail. Foraminiferal stratigraphy across the Viséan/Serpukhovian boundary intervals in the sections is being studied intensively by Qingyi Sheng and Paul Brenckle. Preliminary stable carbon isotope work reveals a negative carbon isotope excursion shortly above the FAD of *Lochriea ziegleri* in the Naqing, Narao and Luokun sections.

An important discovery made at the Naqing, Narao and Luokun sections was the discovery of several volcanic ash beds in the upper Viséan and another in the lower Serpukhovian. Numerous zircons have been extracted from the ash samples and are being processed in the U.S.A. by Jitao Chen and Isabel Montanez with the ID-TIMS U-Pb age dating method.

Progress in Moscow Basin, Russia

The conodont record in the Upper Viséan and Serpukhovian of the Moscow Basin was revised. In the Novogurovsky quarry section (Tula Region near Moscow), *Lochriea* aff. *ziegleri* Nemirovskaya, Perret & Meischner, 1994 was documented from the lower Venevian Substage and *Lochriea ziegleri* was recorded in the upper Venevian (Kabanov *et al*., 2014a). These results are compatible with those of Skompski *et al*. (1995), who recorded *L. ziegleri* from a correlative stratigraphic position in the middle Brigantian (upper Viséan) at several localities in Western Europe.

Progress in South Urals, Russia

Biostratigraphic, sedimentologic and geochemical studies continued at the Verkhnyaya Kardailovka section in the southern Urals. The conodont work resulted in the placing the FAD of *Lochriea ziegleri* at 19.63 m above the base of the section, which is 7 cm lower than previously reported by Nikolaeva *et al*. (2014). Studies of conodont biofacies using a quantitative analysis of the relative abundance of *Gnathodus bilineatus* (Roundy) (relatively deep-water species), *G. girtyi* Hass (relatively shallow water species), and *Vogelgnathus* (unknown ecology) suggest maximum water depths across the boundary interval were attained during deposition of the 19.00 – 19.20 m interval in the section. Sedimentologic considerations place it somewhat lower (16.45 m) at the transition from dark grey laminated limestone to the overlying light grey nodular limestone.

Michael Joachimski has completed the preliminary phase of his stable oxygen isotope study using elements of the conodont *Gnathodus bilineatus* (Roundy) in 14 samples spanning the upper Viséan/Serpukhovian boundary interval. The $\delta^{18}O$ show a slow upward shift to heavier values through the boundary interval with a more rapid upward rate of increase at the level 19.43 – 19.53 m, close to the transition from the thin bedded to nodular limestone. The Verkhnyaya Kardailovka section will be demonstrated during a field trip of XVIII ICCP in 2015.

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; aaleks@geol.msu.ru).

During the 2014 fiscal year, continued progress was made toward the selection of a marker species and suitable section for the GSSP at the base of the Moscovian Stage during the fiscal year. One fusulinid species *Depratina prisca* (Deprat) and two conodont species *Declinognathodus donetzianus* Nemirovskaya, 1990 and *Diplognathodus ellesmerensis* Bender, 1980 appear to have substantial potential for definition of a boundary position close to the original base of the type Moscovian but the task group thinks the FAD of the conodont *D. ellesmerensis* has the best potential. *D. ellesmerensis* is easily recognized by conodont workers and has been recovered from China, Western and Eastern Europe (Moscow Basin and South Urals), boreal Canada (from where it was named by Bender, 1980), and South America. That makes it one of the most widely recovered conodont species in the Upper Carboniferous. In former years it was thought that *Diplognathodus coloradoensis* Murray & Chronic, 1965 was the immediate ancestor of *D. ellesmerensis*; however, additional work on ancestry of *D. ellesmerensis* is required. Several candidate sections for the GSSP are being studied but the Naqing section in southern Guizhou province of South China appears to have the best potential (Qi *et al*., 2010, 2013).

Moscow Basin

The recent suggestion (Goreva & Alekseev, 2012; Alekseev & Goreva, 2013) to shift the base of the Moscovian one substage higher - from the base of the Vereian regional Substage (lowermost Moscovian substage of stratotype in Moscow Basin) to the base of Kashirian regional Substage using the first appearance of the conodont *Neognathodus bothrops* Merrill, 1972 - received negligible support from the task group and will not receive further evaluation.

Guizhou Province, South China

Task-group members Qi Yuping, Tamara Nemyrovska, and Lance Lambert continued their study of the Bashkirian/Moscovian interval in the deep-water (slope), limestone-dominated Naqing (Nashui) section in South China. All conodont genera known to have numerous species in the late Bashkirian to early Moscovian are recorded in the Naqing section and nearby sections. The conodont genera include *Declinognathodus, Diplognathodus, Gondolella, Idiognathodus, Idiognathoides, Mesogondolella, Neognathodus,* and *Neolochriea*. In the Naqing section, many species of these genera provide a succession of conodont chronomorphoclines throughout the B/M boundary interval. They demonstrate that deposition was remarkably continuous through the turbidite-dominated Bashkirian-Moscovian boundary interval boundary interval, which is a major criterion for selecting a Global Stratotype Section and Point (GSSP). More specimens of *Diplognathodus ellesmerensis* and its ancestral forms were found from both the Naqing

section and the Luokun section in Guizhou during the last fiscal year. The lineage of *D. ellesmerensis* from its ancestral species is being intensively studied and its evolutionary first occurrence would provide an almost ideal GSSP to define the base of the global Moscovian Stage. Jitao Chen is conducting integrated research on sedimentology and stable-isotope geochemistry for the Bashkirian-Moscovian boundary interval in the Naqing section, with Isabel Montanez.

Task group to establish the Moscovian–Kasimovian [which is also the base of the Upper Pennsylvanian Series], and the **Kasimovian –Gzhelian boundaries** is chaired by Katsumi Ueno (Japan; katsumi@fukuoka-u.ac.jp).

In the 2014 fiscal year, the search continued for an index within an evolutionary lineage for definition of the base of the Kasimovian. For that boundary, the use of the FAD of the conodont *Idiognathodus heckeli* Rosscoe & Barrick, 2013 shows great potential and is being tested prior to final approval. The first appearance datum (FAD) of a conodont has been formally selected for defining the base of the Gzhelian Stage (Heckel *et al*., 2008; Villa *et al*., 2009) and the search for a suitable section for the GSSP continued.

MOSCOVIAN-KASIMOVIAN BOUNDARY

As potential marker events for defining the base of the Kasimovian Stage, Villa and the task group (2008) proposed using the FADs of the conodont *Idiognathodus sagittalis* Kozitskaya, 1978 or *Idiognathodus turbatus* Rosscoe & Barrick, 2009a. 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). A new option, discussed below, is to use the first occurrence of *Idiognathodus heckeli* Rosscoe & Barrick, 2013, which is closer to the traditional base.

Progress in North America

Rosscoe & Barrick (2013) documented in detail the morphological transition from *Idiognathodus swadei* Rosscoe & Barrick, 2009a to *Idiognathodus heckeli* Rosscoe & Barrick, 2013 (the transitional form) to *I. turbatus* in the North American Midcontinent succession. The steps in this lineage occur in the offshore-marine intervals within a succession of successive cyclothems resulting from eustasy (Rosscoe & Barrick, 2009b). Rosscoe & Barrick suggested that using the FAD of *I. heckeli,* the precursor species to *I. turbatus*, would be more appropriate for boundary definition than use of *I. turbatus*, because it will bring the stage base closer to the traditional base of the Kasimovian.

Progress in South China

The morphological transition discussed above also occurs in the condensed, deep-water (comprises limestone slope turbidites) Naqing (Nashui) section of southern Guizhou province in South China. A conodont evolutionary lineage of *Idiognathodus swadei – I. heckeli – I. turbatus* was established in the Moscovian–Kasimovian boundary interval of the Naqing section, southern Guizhou province. *I. heckeli*, with a complete eccentric groove on the platform, was named by Rosscoe and Barrick (2013) based on materials from North America, and was suggested to be a suitable bio-marker for the base of the Kasimovian. The Naqing section was studied intensively during the last five years and the exact FADs of *I. turbatus* and *I. heckeli* established on bed-by-bed collections. The documentation of this lineage containing *I. heckeli* in the limestone-dominant Naqing section, which appears to lack substantial breaks resulting from either erosion or nondeposition, makes it a good potential candidate section for the GSSP at the base of the Kasimovian.

The conodont and fusulinid biostratigraphy of the nearby Narao section, deposited in somewhat shallower slope settings than the Naqing section, is being intensively studied.

Progress in Russia

During 2014, Alekseev and Goreva continued their studies of the *Idiognathodus turbatus* and *I. sagittalis* as a possible markers for the base of the Kasimovian Stage. Their lineage are diverse, but mainly evolving in relatively deeper water settings, as in the Stsherbatovka section in Oka–Tsna Swell (Ryazan Region, Russia). Alekseev and Goreva started describing conodonts from the Afanasievo section and Perkhurovo and Ilinsky Pogost bore-holes, which cover together the lower half of the Kasimovian in its type area in the Moscow Basin. They plan to show the Afanasievo section as the Kasomovian Neostratotype during a field trip of the August 2015 XVIII ICCP in Kazan. At this moment, they considered that the mid-Khamonvnikian Substage is the best potential level for the fixation of the base-Kasimovian boundary.

KASIMOVIAN-GZHELIAN BOUNDARY

After fixing the base of the Gzhelian Stage by using the first appearance datum of the conodont *Idiognathodus simulator* (Ellison, 1941) *s.s.* in its potential lineage *Idiognathodus eudoraensis - I. simulator* (Heckel *et al*., 2008; Villa *et al*., 2009), the task group is directing research toward selecting a section for the GSSP.

Progress in Russia

For the base of the Gzhelian, conodonts from the Usolka section (South Urals) is being studied in detail by Guzel Sungatullina (Kazan Federal University, Russia). The section was once proposed as a potential candidate of GSSP for the base of the Gzhelian Stage (Davydov *et al*., 2008). Later the boundary interval became covered by soil and vegetation and was poorly exposed in 2009 when members of the SCCS inspected it. In 2013-2014, the Moscovian – basal Gzhelian interval at Usolka was newly exposed and about 70 new conodont samples collected. Because the rocks are siliceous, the processing of samples for conodonts is proceeding slowly, but the first result show that conodont zones similar to those established in the Moscow Basin are possibly recognizable in the Usolka section. In this section, the basal Gzhelian contains forms close to *Idiognathodus simulator*, but its ancestor *I. eudoraensis* has not been found. Alexander Alekseev expects the results of Gusal's study to be sufficient to propose using the Usolka section as a potential GSSP candidate for the base of the Gzhelian. The Usolka section will be demonstrated during a field trip of XVIII ICCP in 2015.

Progress in South China

Detailed investigations on conodonts across the Kasimovian–Gzhelian boundary interval in the Naqing section and nearby Narao section in southern Guizhou was conducted by Wang Qiulai and Qi Yuping in 2014. Many additional conodont specimens were obtained from new collections from both sections. The conodont fauna from Narao is enriched and more diverse than that of the Naqing section. In the Naqing section, *I. simulator* first appears in 255.55-255.75 m level and ranges upwards in a 3 m thick stratigraphic interval with its possible morphological variations. The underlying 1.5 m thick interval (254~255.55 m level), previously considered to be barren, yielded some small conodont specimens, thereby enabling the recognition of a continuous evolutionary lineage from *I. eudoraensis* to an unnamed new species, then to *I. simulator* in the section. Recently, Wang Qiulai (2013: unpublished Master thesis) established a new conodont succession across the Kasimovian–Gzhelian boundary of the Naqing section, including the *I. guizhouensis* Zone, *I. eudoraensis* Zone, *Streptognathodus zethus* Zone, *I. simulator* Zone, *I. nashuiensis* Zone, and *S. virgilicus* Zone in ascending order.

The Narao section contains abundant and diverse conodont specimens across the boundary interval. In that section, *I. simulator* first occurs at the 229.61 m level and ranges upwards in about a 4 m thick stratigraphic interval. Qi and his colleagues are going to continue with detailed studies in the coming years to better understand both conodont and fusulinid evolutionary changes across the Kasimovian–Gzhelian boundary interval in the Narao section. Sedimentologic and stable-isotope geochemical investigations are being done by Chen Jitao and Isabel Montanez on both the Moscovian–Kasimovian and Kasimovian–Gzhelian boundary intervals in the Naqing and Narao sections.

The Project Group on Carboniferous Magnetostratigraphy, chaired by Mark Hounslow (United Kingdom) m.hounslow@lancaster.ac.uk.

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.

There has been considerable progress in refining and integrating the magnetostratigraphy previously obtained from the Maritime Provinces in Canada and the Mauch Chunk Formation in the Appalachian Basin of the eastern USA by integrating magnetostratigraphy with palynostratigraphy through the work of Opdyke *et al*. (2014). An integrated graphical summary compiled from sections and sources described in their study with existing magnetostratigraphic data from lavas in the Asbian-Brigantian substages described in Hounslow *et al*. (2004) demonstrates a clear and validated pattern of polarity changes through the Brigantian, Pendleian and lower Arnsbergian substages (late Visean and Serpukhovian), from several overlapping sections. The data are predominantly from red-bed alluvial facies, with the sub-stage divisions related to the spore zones of eastern Canada (Utting *et al*. 2010). The Asbian-Brigantian boundary is not well defined, but occurs in the lower part of the Mauch Chunk sections measured. The position of this boundary, proposed by Opdyke *et al*. (2014) appears to approximately concur with the polarity pattern across this boundary seen in the British lava successions (data reviewed in Hounslow *et al*. 2004).

Opdyke *et al*. (2014) clearly identify the base of the Kiaman reverse superchron in the *Raistrickia saetosa* biozone (approximately near the base of the Langsettian substage), which they place at ~318 Ma using the 2012 timescale of Davydov *et al*. (2012). This date agrees closely with the base of the Kiaman Superchron identified in Australia where the normal polarity Wanganui Andesite Member (U-Pb date of 319.2 ± 2.8 Ma), is succeeded by the reversed polarity (within the base of the Kiaman Superchron) Peri–Eastons Arm Rhyolite (U-Pb date of 317.8 ± 2.8 Ma; Opdyke *et al*. 2000).

The new work shows potential to link the boundaries of the polarity chron MI12, in the late Brigantian to the Serpukhovian task forces debate about the definition of the GSSP at the base of the Serpukhovian. It is clear that the geomagnetic polarity stratigraphy as published in the 2012 timescale volumes (Davydov *et al*., 2012) bears little

resemblance to the detailed work of Opdyke *et al*. (2014), which brings into question the reliability of the old Russian data (reviewed by Hounslow *et al*. 2004), on which the 2012 polarity timescale was constructed.

New palaeomagnetic and magnetostratigraphic data from Billefjorden on Spitsbergen across the Serpukhovian-Bashkirian boundary (Iosifi & Khramov, 2013), bears some similarity to the polarity pattern shown in Fig. 1 of Hounslow (in progress), with normal polarity dominating the lower Bashkirian. Unfortunately, insufficient section stratigraphic details, limits any more direct comparisons. The Serpukhovian- Bashkirian interval has also recently been studied in the Tengiz reservoir (Kazakhstan), where a geomagnetic polarity stratigraphy has contributed to a detailed chronostratigraphic sub-division of the reservoir units (Ratcliffe *et al*. 2013). Hopefully this work will eventually be published, and develop the magnetostratigraphic pattern through the Mississippian - Pennsylvanian boundary.

The Project Group on Carboniferous and Permian Nonmarine and Marine Correlations, chaired by Jörg W. Schneider (Germany) Joerg.Schneider@geo.tu-freiberg.de

Last year, during the *International meeting on the Carboniferous and Permian Transition* in Albuquerque, New Mexico, the chairs of the Subcommissions on Carboniferous and on Permian Stratigraphy, Barry Richards and Shuzhong Shen, agreed to organize a joint working group on the global correlation between Carboniferous and Permian marine and nonmarine deposits. As the kickoff for this working group, a Field Meeting on Carboniferous and Permian Nonmarine – Marine Correlation was held at the Technische Universität Bergakademie Freiberg, Germany from July 21 to July 27, 2014. The principal organizers were Jörg W. Schneider, Spencer G. Lucas, and Olaf Elicki.
The meeting brought together about 64 geological scientists who were interested in the correlation of Carboniferous, Permian and Early Triassic continental deposits with the global marine scale. The subject of the meeting was the use of any and all correlative age-relevant data from marine and nonmarine deposits for the solution of the above mentioned problem. In particular, the workers from the various continental basins were asked to promote their detailed local and regional knowledge toward the aims of the project group. Reports about methods, results and perspectives of nonmarine as well as nonmarine – marine intra-basinal and inter-basinal correlation were presented. The meeting provided an opportunity to develop cooperative research projects for the solution of central problems that are suited to raise funds from various national and international sources for the realisation of the group's goals.

Presentations at the 2014 Freiberg meeting indicated reliable correlations between nonmarine and marine successions could be achieved through the use of several methods including palynological studies, U-Pb dating, and stable isotope geochemical studies. Marine microfossils fossils, particularly ostracodes, foraminifers and conodonts, could be used to a limited extent in sections where marine and nonmarine strata intertongue.

RESULTS FROM CONFERENCES AND FIELD MEETINGS NOVEMBER 1ST, 2013 - OCTOBER 31ST, 2014
There were several geological conferences, field meetings and workshops that were of substantial importance and interest for SCCS members but the two most significant meetings were the 1) Field Meeting on Carboniferous and Permian Nonmarine-Marine Correlation, a joint meeting of the SCCS and SPS, held in Freiberg, Germany on the 21-27 of July, 2014 and 2) the Kazan Golovkinsky Stratigraphic Meeting, 2014 on 20-23 October 2014, in Kazan, Russia.

The Golovkinsky Stratigraphic Meeting covered all aspects of Carboniferous and Permian stratigraphy, bioevents and the evolution of sedimentary basins and their resources. The aims of the meeting were to provide a platform for discussion of research fields and for international exchange of ideas between research groups working on the Carboniferous and Permian periods. The meeting served as a platform for organizing the field trips and technical session at the upcoming August 2015 XVIII ICCP in Kazan. The meeting included one day of presentations and several days of business meetings and workshops including a meeting of the Working Group on the Stratigraphy of oil-and-gas bearing reservoirs of the Late Paleozoic. Geoscientists were invited to present contributions on a wide range of topics similar to those that will be covered by the 2015 XVIII ICCP in Kazan.

The Freiberg meeting included two days of oral and poster presentations and five days of field trips to the most important Carboniferous and Permian outcrops in East Germany and the Czech Republic. Several members of the SCCS task groups and corresponding members presented the results of recent work and their abstracts were published the conference abstract volume (Elicki *et al*., eds., 2014). In addition, an important field guidebook presenting substantial information about the Carboniferous and Permian in eastern Germany and the Czech Republic was published (Schneider *et al*., eds., 2014). Presentations at the meeting indicated reliable correlations between nonmarine and marine successions could be achieved through the use of several methods including palynological studies, U-Pb dating, and stable isotope geochemical studies. Marine microfossils fossils, particularly ostracodes, foraminifers and conodonts, could be used to a limited extent in sections where marine and nonmarine strata intertongue.

The Project Group on Carboniferous and Permian Nonmarine and Marine Correlations held their first general business meeting at the conference and the key points will be summarized in the next issue of the Newsletter on Carboniferous Stratigraphy. One of the main goals of the project group at the meeting was to establish work plans for the next two to four years on the basis of the presentations and discussions.

3b. Output

The **Newsletter on Carboniferous Stratigraphy, Volume 31**, published in August, 2013 and available for download from our website www.stratigraphy.org/carboniferous/index.asp 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 2012 to October 31st 2013, and articles on various topics of interest. Volume 31 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 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 progress reports included in this Annual Report. Some of the most important outputs during the year are:

BARHAM, M., MURRAY, J., SEVASTOPULO, G.D. & M. WILLIAMS (2014): Conodonts of the genus *Lochriea* in Ireland and the recognition of the Viséan-Serpukhovian (Carboniferous) boundary. – *Lethaia*, DOI: 10.1111/let.12096.

KABANOV, P.B., ALEKSEEV, A.S., GIBSHMAN, N.B., GABDULLIN, R.R. & A. BERSHOV, A., (2014a): The upper Visean-Serpukhovian in the type area for the Serpukhovian Stage (Moscow Basin, Russia): Part 1. Sequences, disconformities, and biostratigraphic summary. – *Geological Journal*, DOI: 10.1002/gj.2612.

KABANOV. P.B., ALEKSEEV, A.O. & T. ZAITSEV (2014b): The upper Visean-Serpukhovian in the type area for the Serpukhovian Stage (Moscow Basin, Russia): Part 2. Bulk geochemistry and magnetic susceptibility. – *Geological Journal*, DOI: 10.1002/gj.2623.

OPDYKE, N.D. GILES, P.S. & J. UTTING (2014): Magnetic polarity stratigraphy and palynostratigraphy of the Mississippian-Pennsylvanian boundary interval in eastern North America and the age of the beginning of the Kiaman. - *Geological Society of America Bulletin*, **126**: 1068-1083.

SCHNEIDER, J., OPLUSTIL, S., & F. SCHOLZE eds. (2014): CPC-2014 Field Meeting on Carboniferous and Permian nonmarine-marine correlation.- Excursion Guide, *Institut für Geologie, Technische Universität Bergakademie Freiberg*, Wissenschaftliche Mitteilungen, **46**: 121 p.

3c. CHIEF PROBLEMS ENCOUNTERED IN 2014

Several ongoing problems confronted the SCCS task groups during the fiscal year but the most significant issue confronting the SCCS has been 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. 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.

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.

4a. WORK PLANS, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2015):

The following activities are planned for the Nov. 1, 2014 to Oct 31, 2015 fiscal year by the task groups, as communicated by task-group chairs and distilled from the reports in # 3a above.

Our principal mandate

The establishment of GSSPs for the Carboniferous and its main subdivisions is our principle mandate from the ICS. During the current 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 31 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.

Task group and project group work plans

Task group to redefine the Devonian-Carboniferous Boundary A biostratigraphic analysis by Ji Qiang & his colleagues (Ji *et al*., 1989) and further work (Kaiser, 2009) indicates 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. Therefore, the primary tasks for the D-C boundary task group are to locate a suitable event marker to define the boundary and the find a suitable section for the GSSP. To help achieve these goals, work in 2015 will focus on the compilation of detailed data sets for the best boundary sections throughout the world. Data to be integrated will be derived from the evaluation of lithology and facies, distribution of fauna and flora, and geochemical and geophysical data. Markus Aretz, the task-group chairman, plans to have the task group evaluate the results of the compilations at Devonian/Carboniferous boundary workshops held at two important conferences in 2015: 1) the August XVIII International Congress on the Carboniferous and Permian in Kazan, Russia, and 2) the 2nd International Congress on Stratigraphy (STRATI 2015) in Graz, Austria during July 2015. Results of the workshops will provide future direction for the task group.

Considerable progress on re-evaluating all of the conodonts within the D-C boundary interval including the current D-C boundary marker, the FAD of the conodont *S. sulcata,* has been made in recent years (Corradini *et al*., 2013). Additional study of the conodonts is required, however, and the task group plans to complete that work shortly. Several task-group members have also been studying the taxonomic and phylogenetic problems within the protognathodid conodont lineages. Four species of *Protognathodus* are known from the relevant time span: *Protognathodus meischneri, P. collinsoni, P. kockeli* and *P. kuehni*. Markus Aretz has asked the conodont specialists to evaluate the utility of using the conodonts for boundary definition by studying them in the best of their D-C boundary sections.

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 asked members to prepare for the D-C boundary workshop in Erfoud Morocco (March 22nd to 29th, 2013; see circular in v 29 of Newsletter on Carboniferous Stratigraphy), by developing precise correlation charts for the best D-C boundary sections in their regions of study showing the biostratigraphic, geochemical and depositional events within the Hangenberg Event interval. Markus Aretz is requesting the work on the data sets be completed for the 2015 workshops that will be held at the August XIVIII ICCP in Kazan, Russia and the July (STRATI 2015) in Graz, Austria.

Several of the ongoing D-C boundary projects that are planned for next four to five years are outlined below. 1) 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. 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. 3) Task-group member Jiri Kalvoda & 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 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. 4) In western Canada, Barry Richards and several colleagues (include Mark Schmitz and Vladimir Davydov at Boise State, Idaho; Jeffrey Over at SUNY-Geneseo, New York; Tim Hartel, Calgary) intend 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 an approach that includes radiometric dating and stable carbon isotope ($\delta^{13}C$) stratigraphy. 5) Carlo Corradini has several ongoing projects related to the D-C boundary study in various part of northern Gondwana. 6) Thomas Becker (Münster) and his research group plan to continue their investigation of the D-C boundary transition in Morocco, particularly in the SE Anti-Atlas Mountains.

Task Group to establish the 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.

Task Group to establish the 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 is drafting a proposal for discussion at a workshop associated with the XVII ICCP in Kazan, Russia in August 2015. During the 2015 fiscal year, the team will continue to direct its attention toward selecting the best candidate section for the GSSP. The best two candidate sections are the Naqing (Nashui) section by the village of Naqing in southern Guizhou Province, China and the Verkhnyaya Kardailovka section on the Ural River in southern Russia.

Activities in South China

The deep-water (slope), carbonate-dominant Naqing 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 section also contains volcanic ash layers near the boundary level. The conodont studies for the locality are essentially complete and the FAD of *L.* ziegleri has been precisely located (Qi *et al*., 2010; 2013). Qi Yuping and Tamara Nemyrovska plan to complete their manuscript on the systematics and phylogeny of conodonts within the genus *Lochriea* from the Naqing section. Paul Brenckle is continuing with the study of foraminifers in the Naqing section and several other sections in the region including the important Yashui and Dianzishang sections (see Groves *et al*. 2012).

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 Naqing 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 four reference sections - the Yashui, Dianzishang, Luokun, and Narao sections - will continue.

Activities in Southern Urals, Russia

With conodonts of the *L. nodosa-L. ziegleri* transition, abundant ammonoids, and moderately common foraminifers, the Kardailovka section, a deep-water, 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 across the boundary level is required. Sufficient conodont work been done to precisely locate the position of the FAD of the conodont *L. ziegleri*.

Work on the sedimentology, stable-isotope geochemistry and geophysical characteristics of the section are somewhat less advanced than the paleontological work and will be a focus of the team's investigations in 2015. The team will be showing the section on a fieldtrip associated with the XVIII International Congress on the Carboniferous and Permian in Kazan, Russia in August 2015 and plans to have a sedimentologic study of the section up to the base of the Bashkirian completed for that event. The Kardailovka section contains numerous volcanic ash layers near the boundary level and the task group is having the most important ashes dated using the U-Pb isotope dilution thermal ionization mass spectrometry (ID-TIMS) methodology.

Task Group to establish the Bashkirian-Moscovian Boundary The task group plans to continue evaluating conodont lineages suitable for definition of the Bashkirian-Moscovian boundary and it is anticipated that during the 2015 fiscal year a lineage and taxon suitable for boundary definition will be selected. The group also plans to continue its search for suitable GSSP candidate sections particularly in South China, southern Urals, and the Donets Basin.

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, the taxon considered to have the best potential for boundary definition. Qi Yuping, Tamara Nemyrovska, and Lance Lambert are doing the detailed taxonomy work on the conodonts from the Bashkirian-Moscovian boundary interval in the Naqing section. In former years it was thought that *Diplognathodus coloradoensis* (Murray & Chronic, 1965) was the immediate ancestor of *D. ellesmerensis*; instead, the ancestor is likely to be a new species and its taxonomic status needs to be proven. *D. ellesmerensis* appears a little above the FAD of *Declinognathodus donetzianus* Nemirovskaya, 1990 in the Donets Basin, Ukraine. If the ancestry of *D. ellesmerensis* is established in time, the group will plan to prepare a proposal for using this taxon for boundary definition and hold discussions and possibly a vote during the business meeting at the XVIII International Congress on the carboniferous and Permian in Kazan, Russia in 2015.

Another priority for the task group is to make preparations for the showing of the Basu River section (Kulagina *et al*., 2009) in the South Urals of Russia on a fieldtrip associated with the XVIII International Congress on the Carboniferous and Permian in Kazan, Russia in August 2015. Kulagina *et al*. had proposed the Basu River section as potential candidate section for the GSSP at the base of the Moscovian Stage.

Work on the sedimentology, stable-isotope geochemistry, and geophysical characteristics of the boundary interval in the Naqing and nearby sections are not as advanced as the paleontological investigations and need to be a focus of the team's work in 2015.

Task group to establish the Moscovian–Kasimovian and the **Kasimovian –Gzhelian bo**undaries
MOSCOVIAN-KASIMOVIAN BOUNDARY

Until the 2013 fiscal year, the task group had concluded the first appearance datums (FADs) of either *Idiognathodus sagittalis* Kozitskaya, 1978 or *Idiognathodus turbatus* Rosscoe & Barrick, 2009 had the best potential as a marker for the base of the Kasimovian (Villa & task group, 2008; Ueno & task group, 2011). Now, a slightly lower level defined by the first occurrence of *Idiognathodus heckeli* Rosscoe & Barrick, 2013, which is considered as the direct ancestor of *I. turbatus* is newly proposed as a more appropriate position of the potential base of the Kasimovian. The group will plan to prepare a proposal for using *I. heckeli* taxon for boundary definition and vote on it or at least discuss the proposal during their business meeting at the XVIII International Congress on the Carboniferous and Permian in Kazan, Russia in 2015.

After such a proposal is made and voted on, additional taxonomic work and comparison of morphotypes from different regions can be continued.

Activities in southern China

During the last several years, Qi Yuping & James Barrick intensively studied conodonts from the uppermost Moscovian to lower Gzhelian slope carbonates in the Naqing (Nashui) section, southern Guizhou Province (Qi *et al*., 2007; Barrick *et al*., 2010). A conodont evolutionary lineage of *Idiognathodus swadei – I. heckeli – I. turbatus* was established in the Moscovian–Kasimovian boundary interval of the Naqing section, southern Guizhou province and during future studies they will consider the FAD of *Idiognathodus heckeli* as the potential boundary marker. They will continue with intensive studies to provide more detailed information on the conodont succession across the Moscovian-Kasimovian boundary in the Naqing section and several other limestone-dominated, turbiditic sections in the region as a potential GSSP candidate sections. Work on the sequence stratigraphy, sedimentology, stable-isotope geochemistry, and geophysical characteristics of the Moscovian-Kasimovian boundary interval at Naqing is less advanced than the paleontological investigations and will be a focus of the team's field work in 2015 and future years.

To place the Naqing 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), Luokun, and Narao sections will continue. Foraminifers are more abundant and better preserved than at Naqing and it is anticipated that a better correlation between conodonts and foraminifers can be achieved by the study of the other sections.

Activities in Moscow Basin, Russia

The task group will continue to study the conodonts *Idiognathodus turbatus* and *I. sagittalis* as possible markers for the base of the Kasimovian Stage the in the Moscow Basin. They are going to show the Afanasievo section (Goreva *et al*., 2009) as the Kasomovian Neostratotype during a field trip of the XVIII ICCP in 2015. At this moment, they considered that the mid-Khamonvnikian Substage is the best potential level for the fixation of the base-Kasimovian boundary.

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, and will continue to be so in 2015.

Activities in Russia

The Usolka section in the southern Ural Mountains of Russia had been proposed as a candidate section for the GSSP at the base of the Gzhelian (Chernykh *et al*., 2006; Davydov *et al*., 2008) but examination by members of the SCCS on a field trip to the locality in 2009 revealed the section required substantial new lithostratigraphic, sedimentologic and conodont-based biostratigraphic work before it could be considered as a candidate section. During 2013-2014, the section was extensively excavated to improve exposure and was resampled for conodonts. Gusal Sungatullina (Kazan University) has been reevaluating the conodonts form the newly-exposed Usolka section and will continue that work in 2015. Alexander Alekseev anticipates her results will permit the Usolka section to be considered as a GSSP candidate for the base of the Gzhelian.

Activities in China

Yuping Qi and colleagues will continue their intensive investigation across the proposed Kasimovian-Gzhelian boundary level in the Naqing and Narao sections in Guizhou Province, south China. At the Naqing and Narao sections in Guizhou Province, south China, Qi and his colleagues are going to continue with detailed studies in the coming years to better understand both the conodont and fusulinid evolutionary changes across the Kasimovian–Gzhelian boundary interval. Sedimentologic and stable-isotope geochemical investigations are being done by Chen Jitao and Isabel Montanez.

The Project Group on Carboniferous Magnetostratigraphy

During the last several years there was considerable progress in refining and integrating the magnetostratigraphy previously obtained from the Maritime Provinces in Canada and the Mauch Chunk Formation in the Appalachian Basin of the eastern USA by integrating magnetostratigraphy with palynostratigraphy through the work of Opdyke *et al*. (2014). The project group's main efforts will be to extend the pattern established in Canada and the USA, to fill the data gap occupied by the Mississippian-Pennsylvanian disconformable boundary in North American sections, and to extend the polarity pattern down into the Viséan and Tournaisian. The project group is planning for a United Kingdom-based project that will include Andy Biggin of Liverpool and Mark Hounslow of Lancaster to undertake some of this task as part of a bigger geodynamo modelling project. The group plans to start the project in early 2016. Kate Ziegler [ZGC, New Mexico] is planning on some re-evaluation of the Pennsylvanian –Permian boundary strata in central New Mexico by searching for an original hematite magnetization.

The Project Group on Carboniferous and Permian Nonmarine and Marine Correlations

The project group plans to continue with their work on the correlation of the system and stage boundaries into the vast successions of Carboniferous and Permian continental deposits. During the first part of the fiscal year, important goals are to establish the membership of the project group and develop cooperative research projects for the solution of central problems, which are suited to raise funds from various national and international sources for the realisation of our aims.

Meeting-field workshop schedule with themes and anticipated results.

During the November 1, 2014 - October 31, 2015 fiscal year, there will be several conferences and field meetings in which the SCCS membership will participate but the most important two are the 2nd International Congress on Stratigraphy (STRATI 2015), which will be held in Graz, Austria during July, and the August XVIII International Congress on the Carboniferous and Permian (XVIII ICCP) in Kazan, Russia.

At the July meeting in Graz, Markus Aretz, the chairman of Task Group to redefine the Devonian-Carboniferous Boundary, plans to have the group evaluate the results of multi-discipline compilations made by most of the task-group members over the last two years. Results of the workshop will provide future direction for the task group.

All of the SCCS task groups and project groups will hold workshops and business meetings at our important quadrennial meeting, the August XVIII ICCP; in addition, the SCCS will hold a general business meeting at the conference. Many of our members will be deeply involved with the congress organization, leading field trips and giving presentations. The first circular was published in volume 31 of the Newsletter on Carboniferous Stratigraphy and the second circular will be ready in late 2014.

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, & V.V. Silantiev

Contact: iccp2015@ksu.ru

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

4b. Specific GSSP Focus for 2015

Viséan-Serpukhovian boundary

5. SUMMARY OF EXPENDITURES IN 2014: STATEMENT OF OPERATING ACCOUNTS FOR NOVEMBER 1st, 2013 TO OCTOBER 31st, 2014

Prepared by Barry Richards, Chairman SCCS

(Accounts maintained in Canadian currency)

INCOME (November 1, 2013 – October 31, 2014)

IUGS-ICS Grant – May 6, 2014: $2,333.00 US =$2,482.31 Canadian	$2,482.31
Donations from Members; November 1, 2013 - October 31 2014	$0.00

Interest Bank of Montreal; November 1, 2013 - October 31, 2014	$0.00
TOTAL INCOME	$2,482.31
EXPENDITURES (November 1, 2013 – October 31, 2014)	
Bank Charges: Bank of Montreal	$0.00
Travel and conference registration support for SCCS voting members and executive to attend and give presentations (Freiberg, Germany meeting; Russian field trip organization for XVIII ICCP in 2015)	$1,500.00
TOTAL EXPENDITURE	$1,500.00
BALANCE SHEET (2013 – 2014)	
Funds carried forward from October 31, 2013	$706.62
Plus Income November 1, 2013 – October 31, 2014	$2,482.31
Total assets	**$3,188.93**
Less Expenditures November 1, 2012 – October 31, 2013	$1,500.00
BALANCE CARRIED FORWARD (to Nov. 1, 2014 - Oct. 31, 2015 fiscal year)	**$1,688.93**

6. BUDGET AND ICS COMPONENT FOR Nov. 1, 2014 - Oct. 31, 2015 fiscal year

PROJECTED EXPENSES

Support for voting members to participate in July STRATI 2015 conference in Graz, Austria and August 2015, XVIII ICCP in Kazan, Russia $1500.00

TOTAL PROJECTED EXPENSES		$1,500.00
INCOME		
Carryover (from CREDIT balance at end Nov. 1, 2013 - Oct. 31 2014 fiscal year)	$1,688.93	
Estimated donation		$100.00
TOTAL PROJECTED INCOME		$1,788.93
BALANCE		
Estimated (deficit) /credit from above		$288.93
BUDGET REQUEST FROM ICS for 2015		$1,500.00

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APPENDIX A

7. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2010-2014)

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 & Clayton, 2006a, 2006b), and 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 problems exist with the Devonian-Carboniferous Boundary GSSP (Paproth *et al*., 1991) at La Serre Hill, France. Because of the problems with the integrity of the GSSP, the Devonian-Carboniferous Boundary GSSP reappraisal task group was established in 2008.

Initial plans for future work by the task group were outlined 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 or a more suitable section located, and 3) because the first appearance of *S. sulcata* may not be the best marker, other conodont lineages require evaluation.

Progress

The *S. praesulcata* to *S. sulcata* conodont lineage used to define the boundary has been re-evaluated by several scientists including Kaiser & Corradini (2011), and the protognathodids, the other conodont group that had shown potential for boundary definition is being re-studied (Corradini *et al*. 2011; Corradini et al., 2013). 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 & Corradini (2011) require testing by other specialists before the FAD of *S. sulcata* is abandoned for boundary definition.

The multi-phase Hangenberg Event (Kaiser, 2005; Kaiser *et al*., 2008) has been identified as a level of interest for boundary definition. More data, however, 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.

From the work completed through 2014, 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*. An event for boundary definition boundary has not been chosen, but the search for better GSSP sections is progressing.

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. Task-group Chairman George Sevastopulo is preparing the final report and plans to have it completed during the 2015 fiscal year.

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. The *L. nodosa-L. ziegleri* lineage has become widely recognized in Western Europe, Russia and Asia (Nikolaeva *et al*., 2009b; Qi *et al*., 2013). A proposal for using *L. ziegleri* for boundary definition is being written in preparation for discussion at the 2015 XVIII ICCP in Kazan, Russia and a subsequent vote by the task group and SCCS. The task group has concluded the Naqing (Nashui) section in China and the Verkhnyaya Kardailovka section in Russia have the best potential as GSSP candidates.

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. The section has been thoroughly examined and synthesis published about the ammonoids, conodonts, and ostracodes (Pazukhin *et al*., 2010; Nikolaeva, 2013). Conodonts that are transitional between *L. nodosa* and *L. ziegleri* occur immediately below the FAD of *L. ziegleri*. Prior to 2010, extensive parts of the section were poorly exposed but from 2010 to 2012 the covered intervals were excavated and permanent aluminum marker pins placed at one metre intervals in preparation for a bed-by-bed sedimentologic analysis (Richards *et al*., in press) and the systematic sampling for conodonts, stable-isotope geochemistry and magnetic susceptibility studies, which were largely completed by 2014. An important development at the locality has been the discovery of volcanic ash layers below the proposed boundary level. Schmitz and Davydov (2012) dated an ash sample that was considered to lie 1.48 m below FOD of *Lochriea ziegleri*. Four dated zircons gave a weighted $^{206}Pb/^{238}U$ date of 333.87+/-0.08 Ma and that was interpreted as the eruptive age.

The Naqing section in southern Guizhou Province, China has become a strong potential candidate for a GSSP at the base of the Serpukhovian (Qi *et al*., 2013) and conodonts spanning the Viséan-Serpukhovian boundary in the section have undergone intensive study. 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 Naqing 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. A study of the foraminifers (Groves *et al*., 2012) indicates they 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, Narao, & Dianzishang sections) in the region from 2010 through 2014 is enabling the task group to place the Nashui section into its paleogeographic, stratigraphic, and lithofacies contexts. In 2014 at the Naqing, Narao and Luokun sections, several volcanic ash beds in the upper Viséan and another in the lower Serpukhovian were discovered. Zircons have been

extracted from the ash samples and are being processed in the U.S.A. by Jitao Chen and Isabel Montanez with the ID-TIMS U-Pb age dating method.

Several sections span the Viséan-Serpukhovian boundary in the Cantabrian Mountains of Spain and two of those sections, the Vegas de Sotres and Millaró 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 (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.

By the end of the 2014 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. Work has been initiated on ammonoid-rich successions in the western U.S.A. (Korn & Titus, 2011) and on foraminifer- and coral-rich successions in western Canada in order to bracket the level of the first appearance of *L. ziegleri* in North America.

Bashkirian-Moscovian Boundary The conodonts *Diplognathodus ellesmerensis* Bender, 1980 and *Declinognathodus donetzianus* Nemirovskaya, 1990 are considered to have the best potential for boundary definition. A marker for the Bashkirian-Moscovian Boundary has not been selected and voted on but there is a good chance a proposal can be developed advocating the use of *D. ellesmerensis* and discussed at workshops at the August 2015 XVIII ICCP in Kazan, Russia.

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.

An evolutionary lineage of *Declinognathodus marginonodosus—D. donetzianus* occurs 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. The Basu River section in the southern Urals of Russia is undergoing intensive study in preparation for the a field trip for XVIII International Congress on Carboniferous and Permian that will be held in Kazan, Russia in August, 2015.

In the Naqing (Nashui) section south China, 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. 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*. More specimens of *Diplognathodus ellesmerensis* and its ancestral forms were found from both the Naqing section and the Luokun section in Guizhou during the 2014 fiscal year. The lineage of *D. ellesmerensis* from its ancestral species is being intensively studied and its evolutionary first occurrence would provide an almost ideal GSSP to define the base of the global Moscovian Stage.

A detailed stratigraphic section extending from the upper Serpukhovian into the Moscovian has been measured at Nashui and aluminum marker pins placed at one-meter intervals. Groves (2010) completed his study of the foraminifers in the Naqing 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.

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. Fusulinid workers have conceded that problems of provincialism across the boundary interval preclude the use of that group to define the boundary.

The first appearance datums (FADs) of *Idiognathodus sagittalis* Kozitskaya, 1978 and *Idiognathodus turbatus* Rosscoe & Barrick, 2009a have good potential as markers for the base of the Kasimovian (Ueno & task group, 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). In 2013, a slightly lower level defined by the occurrence of *Idiognathodus heckeli* Rosscoe & Barrick, 2013, which is considered as the direct ancestor of *I. turbatus* is newly proposed as a more appropriate position of the potential base of the Kasimovian.

In 2013 and 2014, Yuping Qi and colleagues discovered a conodont evolutionary lineage of *Idiognathodus swadei – I. heckeli – I. turbatus* in the Moscovian–Kasimovian boundary interval of the Naqing section, southern Guizhou province and during future studies they will consider the FAD of *Idiognathodus heckeli* as the potential boundary marker. In 2013 and 2014, sedimentologic and stable-isotope geochemical investigations at the Naqing and Narao sections were initiated by Chen Jitao and Isabel Montanez.

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 three sections: the Usolka section in the southern Urals of Russia (Chernykh *et al*. 2006) and the Naqing and Narao sections in Guizhou Province, South China. In 2013-2014, the Usolka section, once proposed as a potential candidate of GSSP for the base of the Gzhelian Stage (Davydov *et al*., 2008), was extensively excavated to better expose the boundary level. Gusal Sungatullina (Kazan University, Russia) is investigating the conodonts from Usolka & Alexander Alekseev is anticipates her results will permit the Usolka section to be considered once again as a GSSP candidate for the base of the Gzhelian.

The other potential candidate intervals for the GSSP lie within the Naqing (Nashui) and Narao sections in south China and are undergoing a thorough biostratigraphic, sedimentologic and geochemical investigation. Within the sections, the presence of the lineage containing *I. simulator* has been proven by Yuping Qi and his colleagues. Existing conodont collections from the Kasimovian-Gzhelian boundary interval at Naqing and Narao permit recognition of the boundary but are insufficient to make a complete description of the boundary conodont faunas. Yuping Qi & James 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. In 2013 and 2014, sedimentologic and stable-isotope geochemical investigations at the Naqing and Narao sections were initiated by Chen Jitao and Isabel Montanez.

Project Group on Carboniferous Magnetostratigraphy

During the last several years there was considerable progress in refining and integrating the magnetostratigraphy previously obtained from the Maritime Provinces in Canada and the Mauch Chunk Formation in the Appalachian Basin of the eastern USA by integrating magnetostratigraphy with palynostratigraphy through the work of Opdyke *et al*. (2014). An integrated graphical summary compiled from sections and sources described in their study with existing magnetostratigraphic data from lavas in the Asbian-Brigantian substages described in Hounslow *et al*. (2004) demonstrates a clear and validated pattern of polarity changes through the Brigantian, Pendleian and lower Arnsbergian substages (late Visean and Serpukhovian), from several overlapping sections. Opdyke *et al*. (2014) clearly identify the base of the Kiaman reverse superchron in the *Raistrickia saetosa* biozone (approximately near the base of the Langsettian substage), which they place at ~318 Ma using the 2012 timescale of Davydov *et al*. (2012).

The Project Group on Carboniferous and Permian Nonmarine and Marine Correlations

The project group was established in 2014 and held a very successful conference and field meeting in Freiberg, Germany in July 2014. Presentations at the Freiberg meeting indicated reliable correlations between nonmarine and marine successions at stage and system boundaries could be achieved through the use of several methods including palynological studies, U-Pb dating, and stable isotope geochemical studies. Marine microfossils fossils, particularly ostracodes, foraminifers and conodonts, could be used to a limited extent in sections where marine and nonmarine strata intertongue.

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 latest Devonian and 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 (Davydov *et al*., 2010; Schmitz & Davydov, 2012). 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.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015-2018)

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).

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. 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 & Kaiser (2009) re-evaluated the *Siphonodella praesulcata - Siphonodella sulcata* lineage used to define that boundary and Corradini *et al*. (2010; 2011) 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.

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 & Kaiser, 2009; Kaiser, 2009) but 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.

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 & 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.

The task group 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.

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 chairman George Sevastopulo plans to complete the final report within the fiscal year.

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. The task group plans to complete 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 definition. Two sections, Verkhnyaya Kardailovka (Nikolaeva, 2013; Pazukhin *et al*., 2010) and Naqing (Qi *et al*., 2013), 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. Indentification 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. In the Nashui section in southern Guizhou Province, China the *Lochriea* lineage has been intensively studied and the FAD of *L. ziegleri* precisely located. Field work is essentially complete at Naqing 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 will continue. All this suggests selection of the GSSP is possible in the next two 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. Two conodont lineages show substantial potential for boundary definition and their evaluation requires immediate completion: 1) derivation of *Declinognathodus donetzianus* from *D. marginodosus* and 2) the lineage containing *Diplognathodus ellesmerensis*, which appears at the base of the Moscovian in the Naqing section (Nashui) in Guizhou Province, China (Qi *et al*., 2007, 2009) and has been widely recognized globally.

In former years it was thought that *Diplognathodus coloradoensis* Murray & Chronic, 1965 was the immediate ancestor of *D. ellesmerensis*; however, additional work has demonstrated it has a different ancestor and that relationship requires evaluation.

The carbonate-dominant Naqing 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 2015 and 2016. 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**

Moscovian-Kasimovian Stage Boundary The high-priority plans for the Moscovian-Kasimovian task group 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 Mid-continent 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 and a new option that was presented in 2013, is to use the first occurrence of *Idiognathodus heckeli* Rosscoe & Barrick, 2013 in that lineage. *I. heckeli,* the precursor species to *I. turbatus*, might be more appropriate marker because its first appearance is closer to that of the traditional definition of the Kasimovian than that of either *Idiognathodus sagittalis* or *Idiognathodus turbatus*. *Idiognathodus heckeli* is also present in the Naqing section in Guizhou Province of South China, which would allow that section to serve as the GSSP for the base of the Kasimovian. While the event marker for the Moscovian-Kasimovian boundary still needs to achieve consensus, continued assessment of the lineages and clarification of the taxonomy of species involved will hasten the process. The task group will continue to evaluate the utility of the three lineages and potential GSSP candidate sections.

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 and require completion. Gusal Sungatullina (Kazan University, Russia) is restudying the conodonts across the boundary within the Usolka section. Alexander Alekseev is strongly expecting the results of Gusal's study to be sufficient to propose using the Usolka section as a potential GSSP candidate for the base of the Gzhelian.

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.

9. ORGANIZATION AND SUBCOMMISSION 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).

9a. *NAMES AND ADDRESSES OF CURRENT OFFICERS AND VOTING MEMBERS*

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9b. *WORKING GROUPS/TASK GROUPS AND OFFICERS*

The SCCS has six current task groups and two exploratory project groups:

Task Groups and officers

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 that was established in early 2008 and is chaired by Markus Aretz (France; aretz@get.obs-mip.fr). It comprises members appointed by Thomas Becker former Chairman of the Devonian Subcommission (SDS) and 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 2014 in this annual report and in volume 31 of the Newsletter on Carboniferous Stratigraphy, published in August 2014.

Task Group to establish the Tournaisian-Viséan Boundary [which is also the base of the Middle Mississippian Series] is chaired by George Sevastopulo (Ireland; gsvstpul@tcd.ie). Using e-mail communications from the chairman, the recent activities of the group are summarized herein through October 31st 2014.

Task Group to establish the Viséan-Serpukhovian Boundary [which is also the base of the Upper Mississippian Series] is chaired by Barry Richards (Canada; barry.richards@NRCan.gc.ca), who summarized the recent work of the group through October 31st, 2013 in volume 31 of the Newsletter on Carboniferous Stratigraphy (published August 2014) 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; aaleks@geol.msu.ru), who summarized the recent work of the group through October 31st, 2013 in volume 31 of the Newsletter on Carboniferous Stratigraphy and herein.

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; katsumi@fukuoka-u.ac.jp). Ueno summarized the recent work of the group through October 31st, 2013 in volume 31 (published August 2014) of the Newsletter on Carboniferous Stratigraphy and herein.

Project Group on Carboniferous magnetostratigraphy is chaired by Mark Hounslow (United Kingdom), who has summarized the recent work of the group in this annual report.

The Project Group on Carboniferous and Permian Nonmarine and Marine Correlations is chaired by Jörg W. Schneider (Germany) Joerg.Schneider@geo.tu-freiberg.de. The project group was established in 2013 and their recent work is summarized in this annual report.

9c. 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.

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SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY
Subcommission on Devonian Stratigraphy
Submitted by:
John E. A. Marshall, Ocean and Earth Science, University of Southampton, National Oceanography Centre, European Way, Southampton SO14 3 ZH, UK; +44 2380592015 jeam@noc.soton.ac.uk

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY
SDS has continued in 2014 its work on the revision of problematical GSSPs (Emsian, Devonian-Carboniferous boundary) and on the formal definition of substages. Discussions on GSSP revisions were held at the Annual Business Meeting during the 4th IPC (Mendoza, Argentina) in October 2014. Other continued activities include multidisciplinary international correlation, the organisation of Devonian stratigraphic symposia, publication of the SDS Newsletter and of monographic books/journal volumes. The major SDS objectives for 2015 onwards can be summarized as:

- Revision of the basal Emsian GSSP in Uzbekistan
- Working towards the formal definitions of Pragian, Givetian, Frasnian, and Famennian substages.
- Revision of the D/C boundary in the frame of the D/C Boundary Task Group (Chairman: M. Aretz) and in close collaboration with the Carboniferous Subcommission.
- Close co-operation with IGCP 596 on "*Climate Change and Biodiversity Patterns in the Mid-Paleozoic"*, coordinated by P. Königshof et al. and holding a joint meeting in Brussels
- Publication of volumes on Devonian stratigraphy, partly in co-operation with IGCP 596.
- Compilation and distribution of SDS Newsletter 30.
- Annual Business Meeting in conjunction with IGCP 596 in Brussels, Belgium.
- Sponsoring a symposium at STRATI 2015 in Graz, Austria.

All listed objectives fit the directions of IUGS and ICS:
- Development of an internationally approved chronostratigraphical timescale for the Devonian with maximum time resolution.
- Promotion of new and modern stratigraphical techniques and their integration into Devonian multidisciplinary schemes.
- Application of GSSP decisions internationally and as a base for a better understanding of patterns and processes in Earth History, including Devonian major global environmental changes.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014
3b List of major publications of subcommission work (books, special volumes, key scientific papers)
Geological Society of London Special Publication- **Devonian climate, sea-level and evolutionary events** in progess for early 2015.

3c. Problems encountered, if appropriate
- The rarity of polygnathids at Zinzilban in the critical interval for a re-definition of the Emsian GSSP.
- The still unpublished early siphonodellids from the Uppermost Famennian of Franconia/Thuringia.
- The decline of Devonian stratigraphy in other countries (e.g., Canada, Australia) by the lack of replacement of retiring specialists by new active researchers.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015)
- Annual Business Meeting, jointly with IGCP 596 in Brussels, Belgium (September 2015).
- Organising a Symposium in July at STRATI 2015 on *Devonian Events, Correlation and Time*
- Editorial work for a volume on *Devonian Climate, Sea Level and Evolutionary Events* as a Special Publication of the Geological Society of London, edited by Becker, Brett & Königshof.
- Publication of SDS Newsletter 30 in June 2015.
- Update of SDS homepage (pdf files of former SDS Newsletters and new GSSP illustrations).

4b Specific GSSP Focus for 2015

- Active work on the redefinition and sub-division of the Emsian Stage. SDS members are collaboratively working on conodonts from Zinzilban, Uzbekistan and the Pyrenees, Spain in an attempt to find a resolution. Czech colleagues are actively pursuing the problem in the Barrandian Basin.
- Active participation in joint Devonian/Carboniferous Boundary Task Group with a focus on conodont revisions and pelagic-neritic correlations.
- Manuscripts on Givetian and Frasnian substages for *Lethaia*.
- Progress on Famennian substage definitions.

5. SUMMARY OF EXPENDITURES IN 2014

INCOME	
Balance from 2013	0 $
EXPENSES 2013	
SDS Newsletter 29	600 $
Support for SDS Officers to attend the IPC meeting	1150 $
Support/subvention from IUGS/ICS	**1750 $**

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014

$600 for 2015 SDS Newsletter	600$
$1500 for Vice-Chair, Chair and Secretary to attend STRATI 2015 in Graz	1500$

Total Request $2100

There is a separate submission for a grant to move the redefinition of the base Emsian Stage to completion.

APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2010-2014)

- Being a highly proactive subcommission with at least yearly meetings.

2010 3rd IPC London, UK
2011 SDS Novosibirsk, Russia
2012 34rd IGC Brisbane, Australia
2013 SDS/IGCP 596 Morocco
2014 4th IPC, Mendoza, Argentina

- Sponsoring a regular series of publications in international journals and special publication series.
- Promoting and proposing the next level of stratigraphic subdivision: sub-stages
- Time sub-division within the Devonian Period is well organized and defined. This allows us to have highly successful IGCP Projects on Devonian environment, time, evolution, extinctions and sea-levels.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015-2018)

- Redefine the base of the Emsian Stage and the new 'Zinzilbanian' sub-stage. To bring the technical work to completion for the ICOS meeting in Valencia in 2017.
- Redefinition of the Devonian/Carboniferous Boundary with the joint Task Group.
- Publish the definitions of the Givetian and Frasnian substages in *Lethaia*.
- Define and publish the Famennian substages.
- Annual meetings, for 2015 this is in Frankfurt jointly with IGCP 596 on completion of their project and a representative symposium in Graz at STRATI 2015.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

CHAIR

John E. A. Marshall, Ocean and Earth Science, University of Southampton, National Oceanography Centre, European Way, Southampton SO14 3 ZH, UK; +44 2380592015 jeam@noc.soton.ac.uk

VICE-CHAIRMAN

Carl Brett, Department of Geology, University of Cincinnati, Cincinnati, Ohio, OH 45221, USA, 513-566-4556, **carlton.brett@uc.edu**

SECRETARY
Ladislav Sławik, Laboratory of Paleobiology and Paleoecology, Institute of Geology AS CR, Rozvojova 269, CZ-165 02 Praha 6, Czech Republic, Tel.: +420 233087247, Fax: +420220922670, slavik@gli.cas.cz

SDS NEWSLETTER EDITOR
R. Thomas Becker, Westfälische Wilhelms-Universität, Geologisch-Paläontologisches Institut, Corrensstr. 24, D-48149 Münster, Tel. –49-251-83 339 51, fax – 49-251-83 339 68; rbecker@uni-muenster.de

WEBMASTER
Carlo Corradini, Dipartimento di Scienze della Terra, Università di Cagliari, Via Trentino 51, I-09127 Cagliari, Italy; corradin@unica.it

List of voting members, country, special fields, email:

1. A. Blieck: France, micro- and macro-vertebrates; alain.blieck@univ-lille1.fr
2. C.E. Brett: Eastern U.S., sequence and cyclostratigraphy;carlton.brett@uc.edu
3. J.-G. Casier: Belgium, ostracods; casier@naturalsciences.be
4. Chen Xiuqin: Nanjing, brachiopods; xqchen@nigpas.ac.cn
5. J. Hladil: Czechia, stromatoporoids, tabulate corals, various modern stratigraphic methods; hladil@gli.cas.cz
6. N. Izokh: Siberia, Asian Russia, conodonts; izokhn@uiggm.nsc.ru
7. Ma Xueping: Beijing, brachiopods;maxp@pku.edu.cn
8. R. Mawson: Australia, conodonts; rmawson@laurel.ocs.mq.edu.au
9. J. Over: U.S., conodonts; over@geneseo.edu
10. M.C. Perri: Italy, conodonts;perri@geomin.unibo.it
11. G. Racki: Poland, brachiopods, event and sequence stratigraphy; racki@uranos.cto.us.edu.pl
12. J. Day, USA/Canada, brachiopods, sequence stratigraphy; jeday@ilstu.edu
13. E. Schindler: Germany, tentaculites, event stratigraphy; eberhard.schindler@senckenberg.de
14. V. Tsyganko: European Russia, corals; tsyganko@geo.komisc.ru
15. J. I. Valenzuela-Rios, Spain, conodonts; jose.i.valenzuela@uv.es.
16. U. Jansen, Germany, brachiopods; ulrich.jansen@senckenberg.de
17. Zhu Huaicheng, Nanjing, China; palynology, hczhu@nigpas.ac.cn
18. R.T. Becker: Germany, ammonoids, rbecker@uni-muenster.de

9b List of Working (Task) Groups and their officers
There is a working group appointed to reinvestigate the D-C boundary. This has 10 members from the SDS and 10 from the SCS.

The Devonian members are:
Thomas Becker, Germany, Chair of SDS: ammonoids <rbecker@uni-muenster.de>
Denise Brice, France: brachiopods <d.brice@isa-lille.fr>
Carlo Corradini, Italy: conodonts <corradin@unica.it>
Brooks Elwood, USA: magnetostratigraphy <ellwood@lsu.edu>
Ji Qiang, China: conodonts <Jirod@cags.net.cn>
Sandra Kaiser, Germany: conodonts, isotope stratigraphy <kaiser.smns@naturkundemuseum-bw.de>
John Marshall, UK: miospores <jeam@noc.soton.ac.uk>
Hanna Matyja, Poland: conodonts <hanna.matyja@pgi.gov.pl>
Claudia Spalletta, Italy: conodonts <claudia.spalletta@unibo.it>
Wang Cheng-yuan, China <cywang@nigpas.ac.cn>

The Carboniferous members are:
Jim Barrick, USA: conodonts <jim.barrick@ttu.edu>
Paul Brenckle, USA: foraminifers <saltwaterfarm1@cs.com>
Geoff Clayton, Ireland: palynomorphs <gclayton@tcd.ie>
Jiri Kalvoda, Czech Republic: foraminifers <dino@sci.muni.cz>
Rich Lane, USA: conodonts <hlane@nsf.gov>
Svetlana Nikolaeva, Russia: ammonoids <44svnikol@mtu-net.ru>

Vladimir Pazukhin, Russia: conodonts <pazukhin@mail.ru>
Edouard Poty, Belgium: corals <e.poty@ulg.ac.be>
Barry Richards, Canada, Chair of SCCS: stratigraphy, Sedimentology <brichard@NRCan.gc.ca>
Yuan Jin-Liang, China: trilobites <yuanjl403@sohu.com>

9c Interfaces with other international project

SDS is traditionally strongly tied with IGCP projects that have a Devonian focus. The main current project is IGCP 596 on "Climate change and biodiversity patterns in the Mid-Paleozoic", led by P. Königshof, T. Suttner, and others. We have a joint meeting in Brussels in September 2015.

SUBCOMMISSION ON SILURIAN STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY

International Subcommission on Silurian Stratigraphy ISSS

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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Mission statement

The objectives of the Subcommission relate to three main aspects of IUGS policy:

1. The development of an internationally agreed scale of chronostratigraphic units, fully defined by GSSPs at Series and Stage levels and related to a hierarchy of units (Substages, Standard Zones, Subzones etc.) to maximize relative time resolution within the Silurian Period;
2. Establishment of frameworks and mechanisms to encourage international collaboration in understanding the evolution of the Earth during the Silurian Period;
3. Working towards an international policy concerning conservation of geologically important sites (such as GSSPs, global and regional stratotype sections, etc.).

Goals

1. Rationalization of global chronostratigraphical classification.
2. Intercalibration of fossil biostratigraphies, integrated zonations, and recognition of global datums.
3. Establishment of magneto- and chemo-stratigraphic scales.
4. Redefinition of stage boundaries and restudy of global stratotype sections.
5. Correlation of Silurian rock successions and events, including marine and non-marine.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

Silurian Times No 21 was edited by the secretary, Renbin Zhan, and distributed in March, 2014, posted on the web site for the ISSS, and circulated as an email attachment to all titular, corresponding and interested members of the Subcommission. It contained the reports on previous meetings, announcements of upcoming meetings and publications, and the latest news and recent publications on Silurian research.

The IGCP Project 591, Field Workshop 2014, was held jointly with the International Subcommission on Silurian Stratigraphy (ISSS), the International Subcommission on Ordovician Stratigraphy (ISOS) and the International Subcommission on Cambrian Stratigraphy (ISCS), 12–21 August, 2014, in Kunming, China. The meeting included two days of talks and poster presentations, a mid-conference field trip that mainly visited localities featuring the Chengjiang Biota, and a 6-day post-conference field excursion to investigate the Lower Paleozoic successions and fossils in northeastern Yunnan Province (western South China paleoplate) and western Yunnan Province (Indo-China and Sibumasu paleoplates). The meeting was very well organized and attended and strong commendations are extended to the organizing committee of this meeting on behalf of the ISSS.

Work proceeds on the restudy of potential GSSP candidate sections for the Base of Wenlock and the Base of Aeronian and new work has begun on restudy of the base of the Telychian Stage. Seven papers were presented at the IGCP 591/ISSS meeting in Kunming pertaining to recent progress related to these boundaries. In addition, the working group for the Base of Aeronian Stage GSSP held a field trip to visit a proposed candidate section in the Shennongjia District of western Hubei Province in China in early August. Six ISSS titular members participated in the field trip, which was supported by funding from an NSF grant to ICS and also the Nanjing Institute of Geology and Palaeontology. The ISSS particularly thanks Drs Junxuan Fan and Qing Chen, as well as several of their students and colleagues, for their hard work in organizing this trip. This trip also examined a section that is being proposed as a candidate for the restudy of the base of the Telychian Stage GSSP.

The ISSS is a key partner in IGCP 591 – The Early to Middle Paleozoic Revolution. The following additional IGCP 591 meetings occurred in 2014, involving the ISSS members of IGCP 591:

- IGCP 591 4th Annual Meeting. Estonia, June 10-19, 2014
- Who Will Build the 21st Century? Addressing Critical Demographic Gaps in the Geosciences and Our Ability to Research, Assess, and Utilize Our Natural Resources. A two-day symposium hosted by the University of Iowa, Saturday, May 31st and Sunday, June 1st, 2014. Co-sponored by IGCP 591.

A new award, to be given by the ISSS once every four years at the International Silurian Symposium, was initiated at the Lund meeting last year and approved in principle at the Kunming meeting this year to recognize outstanding research contributions by young Silurian researchers, particularly post-graduate researchers under the age of 40. The details of the award are currently under consideration and discussion by the ISSS titular members.

3b. ISSS MAJOR PUBLICATIONS IN 2014

A volume of papers from the 2013 Lund meeting was published as a special issue of the journal GFF (the journal of the Geological Society of Sweden) volume 136, issue 1, 2014, pages 1-340, EPGC - Early Palaeozic Global Change, edited by Mikael Calner, Oliver Lehnert, and Per Ahlberg.

Zhan Renbin and Huang Bing (eds) 2014. IGCP Project 591 Field Workshop 2014 (with ISSS, ISOS and ISCS) Extended Summary, Kunming China, 12-21 August, 2014, Extended Summary. Nanjing University Press. 246 p.

Zhang Yuandong, Wang Yi, Zhan Renbin, Fan Junxuan, Zhou Zhiqiang and Fang Xiang, 2014. Ordovician and Silurian Stratigraphy and Palaeontology of Yunnan, Southwest China. Science Press, Beijing, 138 p.

A publication of the proceedings of the Kunming meeting is currently in preparation as two normal issues of the journal *Palaeoworld* (the last issue this year and the first issue next year), edited by Renbin Zhan, Jisuo Jin and David Harper.

3c. CHIEF PROBLEMS ENCOUNTERED IN 2014

There remains the old problem related to difficulties in obtaining grants for research on stratigraphical topics and travel to meetings of Subcommission. Applications are often given low priority by national grant-awarding agencies in most countries.

4a. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2015):

Regular updating the website for Silurian Subcommission by Junxuan Fan. We gratefully acknowledge the support of the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences for this work.

Publication of Silurian Times Newsletter 22 (scheduled to be out by the end of March 2015), editor Renbin Zhan.

The 5th International Symposium on the Silurian System will be held jointly with the 5th Annual Meeting of the IGCP 591in Quebec City, Canada, July 8 – 10, 2015. The proposed schedule is as follows:

- July 4–7, 2015: Pre-conference excursion in the Gaspe Peninsula
- July 8–10, 2015: Scientific sessions at the INRS-ETE Complex, Quebec City
- July 11–17, 2015: Post-conference excursions on Anticosti Island and St. Lawrence Lowlands

The annual ISSS business meeting will be held at this conference.
This meeting will result in publication of the abstracts volume, field guidebooks, and a special issue of Canadian Journal of Earth Sciences for the conference proceedings papers.

The ISSS will participate in STRATI 2015 — 2nd International Congress on Stratigraphy to be held in Graz, Austria, 19–23 July 2015.

ISSS members continue to collaborate on the process of full integration of the various regional and global biostratigraphic, lithostratigraphic, sequence stratigraphic, and chemostratigraphic scales for the entire Silurian. This integration is essential for refinement of the Silurian time scale and high-resolution correlation of Silurian events. In addition, some ISSS members are focusing on generation of new, high-resolution radiometric dates that are well constrained within the Silurian time scale. This is essential to achieve better calibration of time scale, which has been a serious weakness for the Silurian System.

4b. Specific GSSP Focus for 2014

As noted above, GSSPs currently under active restudy are the bases of Aeronian, Telychian and Sheinwoodian (base of Wenlock). Several research groups are currently undertaking studies specifically focused on candidate sections for these boundaries.

Immediately following STRATI 2015, the ISSS is planning a joint Aeronian-Telychian boundary GSSP working group field workshop in Prague. Tentative plans include an indoor session of talks and examination of research collections, visits to GSSP candidate and associated sections for the Base of Aeronian in the Prague region, followed by a trip to SW Spain to visit a candidate section for the Base of Telychian.

The Rhuddanian-Aeronian and Aeronian-Telychian Boundary Working Groups are discussing a proposal to implement a new, innovative approach to consideration of GSSP candidate sections and improving correlation among sections. It is proposed that as the data from each candidate section are assembled, all of the biostratigraphic, chemostratigraphic, and other data useful for correlation, will be assembled into a database (the Geobiodiversity Database), along with data from other sections, globally. These data will then be studied using quantitative correlation methods, such as CONOP9 and Horizon Annealing. These methods allow for simultaneous correlation of many sections using a range of different types of stratigraphic data, producing a high-resolution correlation between all sections. This approach permits integration of data from different fossil groups that only rarely co-occur, as well as chemo- and lithostratigraphic and radiometric data, thus permitting correlation between different facies and paleogeographic regions. They also permit quantitative assessment of the precision with which particular levels at any given section can be placed within the composite succession. We feel that this may be a good approach to find a GSSP level that can be correlated globally with the highest level of precision and confidence. Presentations outlining these methodologies for Silurian GSSP research were presented at the Kunming meeting and the 2014 annual meeting of the Geological Society of America by the ISSS Chair, Mike Melchin.

5. SUMMARY OF EXPENDITURES IN 2014

Income	
Carried forward from 2013	US$3,319
ICS Allocation	US$4,500
Total	US$7,819
Expenditures	
Expenses for ISSS Chair, Vice-Chair and four other titular members to attend ISSS Field Meeting, Kunming, China	US$6,100
Bank fees for ISSS account	US$ 29
Total	US$6,129
Balance	US$1,690

In addition, ISSS received from ICS NSF funds (up to US$6,600) for titular members to attend a field workshop in the Shennongjia District, western Hubei Province, China, in August, 2014, to study candidate sections for restudy of the GSSPs for the Base of Aeronian and Base of Telychian. Six titular members received this ICS-NSF funding to participate in this field workshop. Final accounting of this fund is not yet complete but will be provided as soon as it becomes available.

6. BUDGET AND ICS COMPONENT FOR 2015

Contribution toward transportation, accommodation & registration of the Chair and Vice-Chair, to participate in the 5th International Symposium on the Silurian System in Quebec City, Canada	US$2,500
Contribution to assist other ISSS titular members to participate in the 5th International Symposium on the Silurian System in Quebec City,	

particularly those non-North American members who lack other travel funds	US$4,000
Contribution toward transportation, accommodation & registration of the Chair and Vice-Chair to attend STRATI 2015 in Graz, Austria	US$2,500
Financial support for GSSP working group members studying potential GSSP candidate sections for the base of Aeronian, Telychian and Wenlock.	US$6,000
New award for an outstanding early career researcher in Silurian studies To be presented at the ISSS meeting in Quebec City	US$300*

*This is a provisional estimate, the value of the award has not been finalized

The ISSS has done pioneering work in the area of restudy of previously ratified GSSPs. Recent work has shown that many of the Silurian GSSPs, all of which were ratified in the mid-1980s, have serious deficiencies in terms of their potential use as benchmarks for high-resolution global correlation. Three working groups are currently focusing on restudy of the base of the Aeronian Stage (R-A boundary), base of the Telychian Stage (A-T boundary) and the base of the Wenlock Series. Future working groups will study the other GSSPs of Silurian System. The funds will be particularly directed at young members of the working group, and members who have no access to other funds for international travel to participate this ongoing research.

The ISSS will be submitting a separate proposal for funds to support the costs of the R-A and A-T Boundary Working Group workshop and field trips within Czech Republic and Spain to study the potential GSSP candidate sections there.

Total proposed budget for 2015	US$15,300
Balance forward from 2014	US$1,690
Total requested from ICS for 2015:	**US$13,610**

Potential funding sources outside IUGS
Most of the remaining costs of Working Group newsletter, meetings and other activities will be met by local support from host institutions and participation by individuals through national research grants and travel grants from their own authorities.

APPENDIX

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2010-2014)
Over the period of 2010-2014 the Subcommission on Silurian Stratigraphy was active in several respects. The most recent of these activities are summarized above under the heading of "CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014". In addition to those, the following are the most significant accomplishments of the past five years.

The ISSS Website was moved to a more secure server in 2013 and also extensively redesigned by our webmaster, Junxuan Fan. The new web site can be found at: http://silurian.stratigraphy.org/.

A major Silurian meeting was held in Lund, Sweden, in June 2013, in association with IGCP 591, as well as the Ordovician and Cambrian subcommissions. The principal conference organizers were Mikael Calner and Oliver Lehnert. An excellent field trip visited localities in SE Sweden and the Oslo region of Norway. The proceedings of this conference were published as:
Lindskog, A. & Mehlqvist, K., 2013: Proceedings of the 3rd IGCP 591 Annual Meeting – Lund, Sweden, 9–19 June 2013. Lund University. 368 pp.
As noted above, another volume of papers emerging from the Lund meeting was published as a special issue of GFF in 2014.

Another recent publication focusing on Silurian research was:
Holloway, D.J. & Laurie, J.R., 2013. Siluro-Devonian Studies 2. Memoirs of the Australasian Association of Palaeontologists 44, 207 pp.

ISSS members organized or participated in 15 conferences related to IGCP 591. ISSS members were also leaders in the initial planning and co-leading of IGCP 591.

A proceedings volume from the 2009 Silurian Field Meeting, called "*Time and life in the Silurian: a multidisciplinary approach*", which was held between 4-11 June 2009 in Sardinia, Italy was published in a special issue of Bollettino of the Società Paleontologica Italiana in 2010.

All three of the ISSS executive members participated in the ICS Workshop "The GSSP Concept", in Prague, May 30-June 3, 2010. The ISSS chair made a brief presentation on the current state of understanding and some of the revisions and remaining problems associated with several of the Silurian GSSPs.

The International Symposium on the Silurian System "Siluria Revisited" took place July 9-15, 2011, in Ludlow, England. There were two days of oral presentations focusing on a wide range of Silurian topics and many of the presentations were also contributions to IGCP 591. Of particular significance were the pre- and post meeting field trips that toured the type areas for the Llandovery Series in Wales and the Wenlock and Ludlow series in England. These trips gave the opportunity to a new generation of Silurian researchers to view the GSSPs for all of the Llandovery, Wenlock and Ludlow series and stages (except the base of the Llandovery, which is in Scotland). This meeting resulted in the publication of a program and abstracts volume, a field guide, which includes many new observations and interpretations of the localities, including the GSSPs visited. This field guide is available for download at: http://www.igcp591.org/books.php. In addition, a conference volume of submitted papers, was published as a special issue of Bulletin of Geosciences in 2012, edited by David Loydell.

The ISSS Chair has interacted with scientists at the British Geological Survey in the development of collaborative research between BGS scientists and members of the Silurian Subcommission, particularly focusing on the restudy of the type areas for the GSSPs for the Silurian, all of which occur in the UK except for the base of the Pridoli. Such work is forming the basis of future refinement of the definition and correlation of the GSSP, particularly those in Wales and the Welsh borders, including the bases of Aeronian, Telychian, Wenlock (Sheinwoodian), Homerian, Ludlow (Gorstian), and Ludfordian. Each of these GSSPs can be shown to be in need of refinement or redefinition and these features were highlighted during the Siluria Revisited field trips. New research by the BGS has resulted in considerable refinement of the stratigraphic and structural framework for this region and this will form an important basis for future deliberations regarding the merits of these GSSPs and their possible need for reconsideration. As a result, a number of the BGS researchers were key participants and co-leaders of the Siluria Revisited field trips and made substantial contributions to the field guide for that trip. The results of some of the research in the type Llandovery area were recently published in: Jeremy R. Davies, Richard A. Waters, Stewart G. Molyneux, Mark Williams, Jan A. Zalasiewicz, Thijs R. A. Vandenbroucke and Jacques Verniers. 2012. A revised sedimentary and biostratigraphical architecture for the Type Llandovery area, Central Wales. Geological Magazine, Available on CJO doi:10.1017/S0016756812000337

As part of the ongoing efforts to resolve this problem of the GSSP for the Base of the Wenlock, the ISSS voting member Dr. Petr Štorch has been working with Chinese researchers on a Llandovery-Wenlock boundary section in Ziyang, China. Another complete and well-exposed Llandovery-Wenlock boundary section has recently found also in Ziyang where conodonts, graptolites and chitinozoans are found. Preliminary study shows a strong potential for regional and global correlation across the L-W boundary. Detailed paleontological, sedimentological and chemostratigraphical studies are being conducted. So, at current stage, there are still no strong candidates for a new GSSP for the Base of Wenlock. As noted above, new research on this problem is under way.

It was decided at the business meeting of the ISSS in Ludlow (2011) to strike a new stage boundary working group to restudy the base of the Aeronian Stage. This was decided after the field trip visit to the current GSSP and extensive discussion at the business meeting. Dr. Petr Štorch has agreed to lead this working group.

Five of the ISSS Titular Members, including the Chair and Vice-Chair, were co-authors on a paper published in Lethaia in 2011, outlining a proposed, informal subdivision of the Silurian time scale into stage slices. The paper also presented a generalized carbon isotope curve for the Silurian as well as an updated proposed correlation of the North American regional stages with the global standard scale.

The ISSS Chair, with several colleagues, prepared the chapter on the Silurian System for the 2012 edition of The Geologic Time Scale. This chapter is now published.

Publication of a special volume of Proceedings of the Yorkshire Geological Society honouring the lifetime contributions of Dr. Barrie Rickards, a well-known and respected Ordovician-Silurian graptolite paleontologist and stratigrapher was published in November, 2011. Invited papers focus on current research in graptolites, including contributions from Silurian graptolite researchers.

IGCP 591 held a special session at the International Geological Congress in Brisbane, Australia in August, 2012, co-organized by ISSS member Kathleen Histon and ISSS chair, Mike Melchin. IGCP 591 also held its annual meeting in July in Cincinnatti, co-organized by ISSS members Carl Brett and Brad Cramer. Special symposium volumes were published from both conferences in refereed journals.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015-2018)
In addition to the points listed above as "WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR", many of which will extend into future years, the priorities (not in order of merit) proposed for the Silurian Subcommission for the next four years include:

Research is currently under way by ISSS members, colleagues and students on the basis of Aeronian, Telychian and Sheinwoodian sections in UK, Czech Republic, Spain and China, as part of the process of selection of possible new GSSP sections. We hope to be in a position to vote on proposals for the Base of the Aeronian shortly after the Prague GSSP Field Workshop.

The research objectives for IGCP Project 591 are to investigate the biological, chemical and physical evolution of the ocean-atmosphere-biosphere system during this dynamic interval of Earth history by addressing in detail the relationships between climate, sea level, tectonics, biology, oceanography, volcanism, and the stratigraphic record of Early to Middle Paleozoic global planetary change. This project is being conducted in collaboration with the International Subcommissions on Ordovician, Silurian, and Devonian Stratigraphy (SOS, SSS, SDS), and will be accomplished over the five-year duration of the project (2011-2016).

IGCP 591 Annual Meeting, Quebec City, Canada, July, 2015 (see above)

IGCP 591 Closing Meeting, Ghent, Belgium, 2016. The ISSS will be a co-sponsor of this meeting.

Other future ISSS field meetings and GSSP workshops remain in the planning stages.

We are working on the development of databases that would bring together and make available information from all sources associated with the Silurian researchers. One such database has been created at the Nanjing Institute of Geology and Palaeontology by Dr. Junxuan Fan, who is also Webmaster for ISSS. This database, called Geobiodiversy Database (GBDB), is fully operational and has been named as the official database of the ICS.

9. ORGANIZATION
The ISSS is a Subcommission of the Commission on Stratigraphy. The Subcommission is organized by an Executive consisting of Chairman, Vice-Chairman and Secretary, who are all Voting Members of the Subcommission. In the Subcommission elected for 2012-2016 there are fifteen other Voting Members. The network of Corresponding Members has first of all a responsibility for communication in both directions between the Subcommission and researchers on Silurian topics in their region. Secondly they represent a broad spectrum of specialized stratigraphical disciplines from those countries or regions where Silurian rocks are extensively studied in relation to fundamental and/or applied geological research.

Current research activities and future plans are communicated through publication of an annual ISSS newsletter, *Silurian Times*, distibuted by both email attachment and as a web release.

Websites: http://silurian.stratigraphy.org/ contains newsletters, meeting announcements, discussion posting-boards, bibliography of Silurian articles, links to related sites, and other information.

Subcommission officers
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Secretary: Renbin Zhan, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China, rbzhan@nigpas.ac.cn

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Working Task Groups
Base of Wenlock GSSP Restudy – Chair – David Loydell
Base of Aeronian GSSP Restudy – Chair – Petr Štorch
Base of Telychian GSSP Restudy – Chair – Michael Melchin

Interfaces With Other International Projects
Collaboration on IGCP Project 591, "The Early to Middle Paleozoic Revolution", which was approved and began its work in May 2011.

SUBCOMMISSION ON ORDOVICIAN STRATIGRAPHY

ANNUAL REPORT 2014

1. Name of constituent body:
Subcommission on Ordovician Stratigraphy (SOS)

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2. Overall objectives, and Fit within IUGS science policy:
The Subcommission promotes international cooperation on all aspects of Ordovician geology, specifically stratigraphy. It has a global network involving both academia and industry.

Specific objectives are:

a. To delimit and subdivide the Ordovician System (and Period) as a part of the overall ICS mission to elaborate the standard global stratigraphic scale. This work aims to establish the boundaries (GSSPs), the correlation of the subdivisions (Stages and Series), the nomenclature of the subdivisions and periodically review the effectiveness and utility of these decisions.

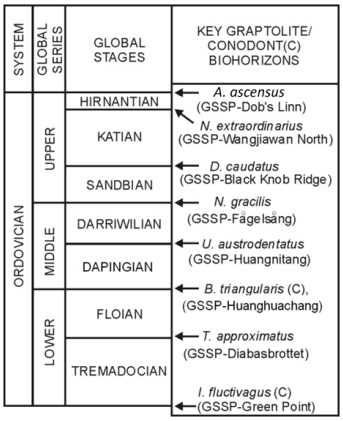
b. To promote regular international meetings on all aspects of Ordovician geology, especially those devoted to clarifying stratigraphic procedures, nomenclature and methods for use in establishing a unified global time scale and to prepare correlation charts with explanatory notes (the main phase of this latter task is now completed).

c. To encourage, promote, and support research on all aspects of Ordovician geology worldwide and to provide outlets, *Ordovician News*, international meetings, and a web page, for promoting discussions and reporting results of this research.

d. To encourage, promote, and support interdisciplinary research on the Ordovician global Earth system, addressing topics that require high-resolution, global correlation.

d. The ultimate goal of the Subcommission is to provide a high-resolution geological time scale that will be a critical foundation for interdisciplinary research on the global Earth system during the Ordovician Period. The work is broad based and must include specialists in palaeontology, all subdisciplines of stratigraphy (bio-, litho-, chemo-, and magneto-), sedimentology, geochemistry, and tectonics. With a large network including active participants from more than 25 countries, the Subcommission thus involves much of the global geological community.

3. Summary table of Ordovician subdivisions



4. Organization

a. Subcommission Executive (from August 2012)
Chairman, David A.T. Harper (UK)
Vice Chairman, Andrei Dronov (Russia)
Secretary, Ian G. Percival (Australia)
16 other Voting Members
Over 100 Corresponding Members

The Subcommission officers and voting members have been agreed for the next term from 2012-2016. Prior to the Subcommission's business meeting during the Brisbane IGC (2012) a postal ballot confirmed the election of the new Subcommission officers, and elected a new group of voting members. The new Subcommission not only includes a broad national representation and coverage of key fossil groups but also specialists in interdisciplinary fields such as geochemistry and sedimentology.

F.G. Aceñolaza (Argentina)
G.L. Albanesi (Argentina)
A.V. Dronov (Russia)
O. Fatka (Czech Republic)
D. Goldman (USA)
M. Ghobadi Pour (Iran)
D.A.T. Harper (Denmark)
O. Hints (Estonia)
Li Jun (China)
S. Leslie (USA)
A.T. Nielsen (Denmark)
I.G. Percival (Australia)
M.R. Saltzman (USA)
A. Sa (Portugal)
T. Servais (France)
T. Tolmacheva (Russia)
T. Vandenbroucke (Belgium)
M. Williams (UK)
Zhang Yuandong (China).

5. Interfaces with other international projects

IGCP Project 591: The early to middle Palaeozoic revolution. This new project involving some 400 participants from nearly 40 countries has a strong Ordovician component and is supported by the subcommission. The project has already featured at international congresses in Spain, the UK and the USA. Last June over 200 colleagues gathered in Lund, Sweden for the first ever meeting of all three Lower Palaeozoic subcommissions under the organizational umbrella of IGCP 591. The thematic issue of GFF arising from the meeting was published in 2013. Two further volumes are planned in 2014-2015 associated with the project's 2014 meetings (see below).

6. Chief accomplishments and products in 2014 cycle

a. **Ordovician News No. 31** was produced and posted on the Subcommission website and is available for download.

b. The Subcommission participated in, and supported the annual meeting of IGCP 591 in Tartu, Estonia, June 2014 and has contributed to the conference proceedings published in the *Estonian Journal of Earth Sciences*.

c. The Subcommission participated in, and supported the annual field meeting of IGCP 591 in Kunming, China, August 2014 and is contributing to the conference proceedings to be published in *Palaeoworld*.

d. The Subcommission convened a thematic session on '*Ordovician biotas of Gondwana: responses to global climatic and eustatic events, and their biogeographic relationships within the Ordovician World'* at the 4th International Geological Congress in Mendoza, Argentina, October 2014. Approximately 70 delegates attended the oral presentations and many more viewed the posters associated with the session.

7. Chief problems encountered in 2014

Critical to the development of the research on the system is the improvement of regional chronostratigraphies, isotope curves, palaeogeographies and zonal schemes. The coming years will see an emphasis on renewed data collection and its integration with the global standard. But this will require global participation of all our regional groups. It is also clear that the system has few reliable, absolute dates. This forms part of a new ISOS sponsored project with StarPlan in the University of Copenhagen.

8. Summary of expenditure for 2013-2014

TOTAL INCOME (from ICS): USD 2000

a. Support for attendance of colleagues at the IGCP 591 Yunnan Field Meeting, China (supported by ISOS): 1400 USD.
b. Meeting with colleagues in the StarPlan dating laboratory in Copenhagen to establish scope of Ordovician dating project: 600 USD.

TOTAL EXPENDITURE **USD 2000**

9. Work plan, critical milestones, anticipated results and communications to be achieved next year

a. To design and execute a programme of radiogenic dating of key Ordovician horizons (using Pb-Pb isotopes) in collaboration with Dr James Connolly and the state-of-the-art StarPlan laboratory in the University of Copenhagen. **Work has already commenced on some key sections in Baltoscandia, Russia and Scotland.**

b. Will stimulate where relevant the production of revised regional correlation charts on the basis of new regional stratigraphic data and their relationship to the newly-established international stages. In additional regional isotope and sea-level data will be added. **During the Prague meeting in May those present agreed to begin discussions in their own regions regarding the possibilities of providing simple correlation charts, linking regional chronostratigraphies to the global stages. Results were discussed in Brisbane, 2012, Lund, 2013, Kunming, 2014; these will be progressed to publication as a Special Paper, Geological Society.**

c. The subcommissions participated in various meetings (and publications arising from these meetings) during 2014, notably in **Tartu** (June), **Kunming** (August) and **Mendoza** (October).

During the business meeting at the final meeting of IGCP 503 and at the ICS meeting in Prague together with the ISOS meeting in Alcalá de Henares, plans were formalized with the agreement of the subcommission to form a number of working groups in the following areas:

1. There may be a requirement to evaluate the efficacy and utility of our stages and stage boundaries. Where appropriate and/or necessary we will have to move to establish some small advisory groups. **One major boundary problem may need urgent attention and was raised at the congress in Madrid. A number of key papers have been published and position paper has been requested and is in preparation. This remains the case.**
2. Clearly the Subcommission can now move with some confidence towards confirming and establishing finer divisions of Ordovician time. In this respect Bergström et al. (2009: *Lethaia*) have divided our international stages into stage slices based mainly on existing biozones. Finer time slices were also proposed by Webby (2004: *The Great Ordovician Biodiversification Event*, Columbia University Press) and used effectively in developing data for the GOBE. As these time divisions are more widely adopted, it would be useful to confirm their definition and status. These time slices have been used in the recent *Palaeogeography, Palaeoclimatology, Palaeoecology* special issue on the palaeoecology of the GOBE edited by Servais and Owen (2010).**This was addressed at the Madrid and Brisbane meetings. There is been no strong commitment to take this forward to date. This remains the case.**
3. Over the last few years we have neglected somewhat the role of the regional groups and the many important regional and diverse stratigraphies that make our system so exciting. A number of the key regional successions were included in the correlation charts provided by Bergström et al. (2009), but there more that require

calibration with our new stages. Moreover a few regions such as Baltoscandia and SE Asia were never formally published. This is a priority for our system and work that can involve all our colleagues. **This was fully addressed at the IGC in Brisbane and at subsequent meetings. Harper and Percival have drafted an outline for the Geol. Soc. London Special Paper on the topic and authors are now being approached.**

4. Work is now far advanced on a Carbon stable isotope curve for the Ordovician. Consistent results have been already achieved for parts of the column. There are of course other stable isotopes and it will be appropriate and useful to evaluate if we can help develop these curves not least as one of our nonbiologic means of correlation. There are other nonbiologic techniques that we could also consider. **These issues were addressed in a recent issue of *Palaeogeography, Palaeoclimatology, Palaeoecology* edited by Munnecke, Calner and Harper (2010). This has encouraged a number of other papers in this key area for Ordovician stratigraphy.**
5. A more difficult area is sea-level or water-depth curves for the period. There have been a number of curves for the Ordovician and many more for particular parts of the period. It would be useful to examine these curves more carefully and the criteria upon which they are based with a move towards developing more standardised curves for the Ordovician. **Some of these issues were addressed in the recent issue of *Palaeogeography, Palaeoclimatology, Palaeoecology* edited by Munnecke, Calnar and Harper (2010) and were addressed further at the Brisbane IGC and in subsequent meetings. This area will be incorporated into the GSL Special Paper.**
6. We now have a number of accurate palaeogeographic maps for our period. Not everyone agrees with all the reconstructions and perhaps they never will. But it is possible to engage in cooperation with some of the groups to develop a more standard set of base maps for the period. **This is now an active area research with the wide availability of Trond Torsvik's BugPlates program has formed the basis for many chapters in the recently published GSL Memoir on Early Palaeozoic biogeography and geography edited by Harper and Servais (2013).**
7. We already have a number of robust absolute dates for parts of the system but it would useful to develop more, not least to be able to calibrate the true rates of biological and geological process occurring during the period. **Discussions are now ongoing with a number of geochronology laboratories, for example the StarPlan group in Copenhagen, whose terrestrial dating facility is headed up by Dr Jim Connelly. These discussions are ongoing.**
8. We have tended as a group to ignore the economic potential of our system. But, for example in New South Wales, nearly all the gold and copper mines are hosted in Ordovician volcanics of the Macquarie Arc and in China considerable funding is being made available through SINOPEC (the Chinese petroleum company) to support research into Ordovician biostratigraphy. **A strategy is still under discussion.**

10. Budget and ICS component requested for 2014-2015

1. Attendance and participation of subcommission officers at STRATI 2015, Graz, Austria: 2500 USD
2. Continued support for the ISOS-StarPlan terrestrial dating project on the Ordovician System: 1000 USD
3. Support for attendance and participation of subcommission officers at the ISOS meeting: 3000 USD

As in previous years it is envisaged that officers will supplement any aid from the ICS with their own research funds. I have not not quantified this support.

TOTAL 2014-2015 BUDGET: 6500 USD
REQUESTED FROM ICS: **6500 USD**

Potential funding sources outside IUGS

The Subcommission officers are mainly supported by their research projects for most of their activities.

11. Review chief accomplishments over last 14 years (2001-2014)

a. Approval, ratification, and dedication of the Green Point GSSP for the base of the Ordovician System.

b. Approval, ratification, and dedication of the Diabasbrottet and Fågelsång GSSPs for the bases of the upper stage of the Lower Ordovician Series and the Upper Ordovician Series, respectively.

c. Approval, ratification, and dedication of the Black Knob Ridge section, Oklahoma, USA and the Wangjiawan North, Yichang, China GSSPs for the bases of the Katian and Hirnantian stages, respectively.

d. Approval, ratification, and dedication of the Huanghuachang section, Yichang, China for the base of the Dapingian Stage, which coincides with the base of the Middle Ordovician.

e. With publication in 2000 of *A Revised Correlation of Ordovician Rocks in the British Isles*, correlation charts have been completed for Ordovician rocks on virtually all continents.

f. The 9th International Symposium on the Ordovician System held in San Juan, Argentina, in August 2003, in conjunction with the 7th International Graptolite Conference and a Field Meeting of the Subcommission on Silurian Stratigraphy and publication of 556 page proceedings, 130 participants represented 18 countries, 124 papers were presented in technical sessions.

g. Publication of *Ordovician News* nos. 17-27 and their posting on the Subcommission's web site.

h. Development of the web site "Ordovician Stratigraphy Discussion Group" to facilitate discussions on selection of the GSSPs. This site has evolved into the Subcommission's web site and also includes postings of *Ordovician News*.

i. Sponsorship of a technical session and field excursion on the GSSP for the base of the Middle Ordovician Series at the Annual Meeting of the Geological Society of America in November 2000.

j. Sponsorship at the 31st International Geological Congress, Rio de Janeiro, Brazil, 2000, of the symposium "Paleontological, stratigraphical, and paleogeographical relations among South America, Laurentia, Avalonia, and Baltica during the Ordovician."

k. Sponsorship at the 32nd International Geological Congress, Florence, Italy, 2004, of the symposium "The global Ordovician Earth system".

l. Launched GOES (Global Ordovician Earth System) Program to stimulate integrated multi-disciplinary studies of global events (mass extinction, sea-level changes, greenhouse conditions, tectonics) during the Ordovician Period.

m. Sponsorship of a special symposium on the Ordovician System at the Geological Society of America Annual Meeting in 2000, of WOGOGOB 2001 in Copenhagen, and the meeting and field excursion "The Gondwanan Platform in Ordovician times: Climatic, eustatic and geodynamic evolution", in Morocco in February 2001.

o. Selection of names for 2nd, 3rd, 5th, 6th and 7th stages of the Ordovician System.

p. Sponsorship of the 2006 IGCP 503 Glasgow meeting on "Changing palaeogeographical and palaeobiogeographical patterns in the Ordovician and Silurian".

q. Sponsorship of the 2007 Yangtze Conference (the 10th Ordovician Conference) that was combined with the 3rd Silurian Conference and the IGCP 503 annual meeting in Nanjing. The combined conference was attended by 140 scientists from 24 countries; 66 papers and 22 posters were presented, with publication of these in a Proceedings volume of 566 pages. Two field guides were also printed.

r. Publication of 'The new chronostratigraphic classification of the Ordovician System and its relations to major series and stages and to $\delta^{13}C$ chemostratigraphy' *Lethaia* 2008.

s. Support and participation in the following major conferences during 2008: 7th Baltic Stratigraphic Conference, Tallinn, and associated field excursions, May 2008 and 'Development of Early Paleozoic Biodiversity: The role of biotic and abiotic factors, and event correlation' Moscow, June 2008 and the subsequent field excursion to the Altai Mountains; 33rd IGC in Oslo during August 2008 and the IGCP 503 'International Congress on Palaeozoic Climates' in Lille, France during August, 2008.

t. Support, participation and sponsorship of the following major conferences during 2009. NAPC Cincinnati 21-26 June and IGCP 503 Copenhagen 31 August – 4 September.

u. Agreement in principle to establish a new range of working groups tackling a wide spectrum of areas of Ordovician with a view to developing new products for the community.

v. Support, participation and sponsorship of Ordovician session at IPC3 in London, June 2010.

w. Publication of a *Special Paper, Geological Society of America* (2010) on Ordovician research (edited by Finney and Berry).

x. Publication of two volumes of *Palaeogeography, Palaeoclimatology, Palaeoecology* (2010) on Ordovician research (edited by Servais and Owen together with Munnecke, Calnar and Harper).

z. Sponsorship of the 2011 Madrid Conference (the 11th Ordovician Congress), held in the spectacular surroundings of Alcalá de Henares, with field excursions to Portugal and central and northern Spain. The proceedings 'Ordovician of the World' was sponsored by the Subcommission on Ordovician Stratigraphy. It contains 100 contributions, most of which in the form of short papers, which were delivered as oral presentations or posters at the symposium. This volume represents a wealth of cutting-edge research on Ordovician rocks from around the world, and includes contributions from 228 authors and coauthors from 23 countries on four continents. Three field guides were also printed.

aa. Launch of IGCP 591: The early to middle Palaeozoic revolution. This new project involving some 400 participants from nearly 40 countries will have a strong Ordovician component and is supported by the subcommission.

bb. Support and attendance at a thematic symposium on Ordovician research during IGC 34 in Brisbane: 35.4 International Subcommission on Ordovician stratigraphy: Ordovician intercontinental correlations: developing global and regional chronostratigraphy. This was well attended and will act as a catalyst for a publication in 2014 on Ordovician chronostratigraphies in the regions.

cc. Publication of the Geological Society, London Memoir 38, 'Early Palaeozoic biogeography and palaeogeography'. This Memoir, edited by Harper and Servais, first introduces the content, some of the concepts

involved in describing and interpreting palaeobiogeography, and the changing Early Palaeozoic geography is illustrated through a series of time slices. The subsequent 26 chapters, compiled by some 130 authors from over 20 countries, describe and analyse distributional and in many cases diversity data for all the major biotic groups plotted on current palaeogeographic maps. Nearly a quarter of a century after the publication of the 'Green Book' (Geological Society, London, Memoir 12, edited by McKerrow and Scotese), improved chronostratigraphic and taxonomic data together with more accurate, digitized palaeogeographic maps, have confirmed the central role of palaeobiogeography in understanding the evolution of Early Palaeozoic ecosystems and their biotas. All the articles are now available online through the Geological Society's 'Lyell Collection'.

dd. Support and attendance at the 2nd Annual Meeting of ICGP 591, supported for the first time by all three Lower Palaeozoic subcommissions. A substantial GFF special issue, edited by Calner, Lehnert, Albanesi, Babcock, Harper & Melchin: Early Palaeozoic Global Change, is near completion and many articles are already available online through the Taylor and Francis website.

ee. A thematic symposium at the International Palaeontological Congress 4, Mendoza, Argentina will be sponsored by the Ordovician Subcommission **'**Ordovician biotas of Gondwana: responses to global climatic and eustatic events, and their biogeographic relationships within the Ordovician world'.

ff. The new website for the Ordovician Subcommission designed and edited by Olle Hints is now very much up and running at http://ordovician.stratigraphy.org/.

gg. The chairman recorded the palaeopodcast 'The Great Ordovician Biodiversification Event' at http://www.palaeocast.com/episode-19-the-great-ordovician-biodiversification-event.

hh. The Subcommission participated in, and supported the annual meeting of IGCP 591 in Tartu, Estonia, June 2014 and has contributed to the conference proceedings published in the *Estonian Journal of Earth Sciences*.

ii. The Subcommission participated in, and supported the annual field meeting of IGCP 591 in Kunming, China, August 2014 and is contributing to the conference proceedings to be published in *Palaeoworld*.

jj. The Subcommission convened a thematic session on '*Ordovician biotas of Gondwana: responses to global climatic and eustatic events, and their biogeographic relationships within the Ordovician World'* at the 4th International Geological Congress in Mendoza, Argentina, October 2014.

SUBCOMMISSION ON CAMBRIAN STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY

International Subcommission on Cambrian Stratigraphy

Prepared by: Prof. Per AHLBERG, Secretary, per.ahlberg@geol.lu.se
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Date: 3 December 2014

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

2.a. Mission Statement

The Subcommission is the primary body for facilitation of international communication and scientific cooperation on Cambrian stratigraphy.

2.b. Goals

The two principal goals of the Subcommission are:
1) To develop a global stage-level and series-level chronostratigraphic classification of the Cambrian System.
2) To complete and publish regional and global correlation charts for the Cambrian System.

2.c. Fit within IUGS Science Policy

The objectives of the Subcommission fall within three main areas of IUGS policy:
1) The development of an internationally agreed scale of chronostratigraphic units, fully defined by GSSPs where appropriate (stages and series), and related to a hierarchy of units (zones) to maximize relative time resolution within the Cambrian Period.
2) Establishment of frameworks and systems to encourage international collaboration in understanding the evolution of the Earth during the Cambrian Period.
3) Working towards an international policy concerning conservation of geologically and paleontologically important sites such as GSSPs.

3. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

3.a. List of major publication of Subcommission work (books, special volumes, key scientific papers)

1) The 19th International Field Conference on Cambrian Stage Subdivision, Morocco

The 19th International Field Conference on Cambrian Stage Subdivisions was held in association with a meeting of the Ediacaran Subcommission (ISES) in September 2014 in Ouarzazate, Morocco. Chief organizers for the conference were J. Javier Álvaro, Sébastian Clausen, and Léa Devaere. An abstract volume and a field guide (*Stratigraphic overview of the Ediacaran and Cambrian from the Anti-Atlas, Morocco*. University of Lille 1, France. 85 pp.) and a special issue (*Geological Evolution of the Ediacaran and Cambrian in the High Atlas and Anti-Atlas Ranges, Morocco*) of *Journal of African Earth Sciences* were published. A theme issue of *Annales de Paléontologie* containing papers resulting from presentations at the meeting is in progress. This issue will be published under the lead editorship of Sébastian Clausen, J. Javier Álvaro and Léa Devaere.

2) Field Workshop on Cambrian Stage Subdivision, China

A field workshop was held in association with meetings of the Ordovician and Silurian subcommissions in August 2014 in Kunming, China. The meeting was organized under International Geoscience Programme Project 591, with Zhan Renbin as the chief organizer. A volume with extended summaries of talks (*IGCP 591 Field Workshop 2014, Kunming China, 12–21 August 2014, Extended Summary*. Nanjing University Press. 246 pp.) and a field guide were published. A proceedings volume containing papers resulting from presentations at the meeting will be published in *Palaeoworld*.

3) The Cambrian GSSP

To facilitate global correlation of the Cambrian base and ensure nomenclatural stability to the extent possible, discussion of the merits and perceived weaknesses of the Cambrian GSSP is sought. Possible solutions to the problems surrounding the current GSSP definition are addressed in a paper published in 2014 (Babcock, L.E. et al.: Proposed reassessment of the Cambrian GSSP. *Journal of African Earth Sciences 98*, 3–10) in hopes that the global scientific community will actively participate in developing a well-reasoned and practical solution that will stand the test of time.

4) ISCS Webpage
The Cambrian Subcommission's webpage was updated in 2014. The webpage accounts for the many important changes that have occurred with respect to global chronostratigraphy of the Cambrian System, and includes updated contact information, lists of important publications, and other essential information.

3.b. Problems encountered
The principal difficulties encountered in 2014 were: 1, obtaining funding to support basic research on key stratigraphic intervals (potential GSSP horizons and sections); and 2, obtaining funding to support travel. A modest increase in funding for the coming year would be of great benefit to members of some of the Working Groups on key horizons who have limited access to funding through nationally competitive research grants.

4. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015)

In 2015 the Cambrian Subcommission will continue work toward defining GSSPs for provisional stages 2, 3, 4, 5, and 10. In addition, the Subcommission will examine issues surrounding possible redefinition of the Cambrian GSSP.

Specific GSSP Focus for 2015
Within the next year, we hope to make a decision on provisional Stage 5 (and Series 3). Earnest work toward definition of a GSSP for the base of provisional Stage 5 has been ongoing for several years, and it is hoped that the work will be finalized within the next year. Secondly, we hope to arrive at a decision on how to define provisional Stage 10 in 2015 or 2016.

5. SUMMARY OF EXPENDITURES IN 2014

INCOME

Carried forward from 2013	$ 0.00
ICS Allocation	$ 3666.70
SUBTOTAL 2014 income	$ 3666.70

EXPENDITURE FROM 2014 BUDGET

Contribution to officer's travel expenses	$ 3666.70
(actual travel expenses exceeded the budget slightly)	
SUBTOTAL 2014 expenditures	$ 3666.70

To be carried forward to 2014 $ 0.00

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2015

In order to accelerate the pace of work in establishing GSSPs within the Cambrian, we request a modest increase in funds from ICS as compared to previous years. This will be especially important in 2015 because of the need for Voting Members of the Subcommission to be present at the ISCS field meeting in Newfoundland, where we will have the opportunity to examine and discuss the Cambrian GSSP. The proposed increased funding is also targeted at field research on key sections by Working Group members and young scientists. Also, we request support for Voting Members to attend the Strati2 meeting in Graz, Austria, where the Subcommission will be sponsoring a symposium on the Cambrian GSSP problem.

INCOME		
Carry-over from 2014		$ 0.00
PLANNED EXPENDITURES FOR 2015		
Preparation for the 20th Cambrian Stage Subdivision Working Group Conference in Newfoundland	$ 1000.00	
Executive and VMs travel cost*s*, Cambrian Subcommission field meeting		$ 3000.00
Support for 2 young scientists to attend the field meeting	$ 2000.00	
General office expenses		$ 100.00
TOTAL 2015 PLANNED EXPENSES		$ 6100.00
ICS 2015 BUDGET REQUEST		$ 6100.00

SUBCOMMISSION ON EDIACARAN STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY

Subcommission on Ediacaran Stratigraphy

Submitted by:

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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Mission statement

The Subcommission is the primary body for facilitation of international communication and scientific cooperation in Ediacaran stratigraphy, defined in the broad sense of multidisciplinary activities directed towards better understanding of the evolution of the Earth and life during the Ediacaran Period (circa 635 – 542 Ma). Its first priority is the unambiguous definition, by means of agreed GSSPs, of a hierarchy of chronostratigraphic units that provide the framework for global correlation.

Goals

The main goals of this Subcommission are

(a) To search for criteria useful in the subdivision and correlation of Ediacaran strata;
(b) To define the basal boundaries of Ediacaran epochs (series) and ages (stages) through the establishment of global stratotype sections and points (GSSP's);
(c) To facilitate international collaboration in research on Ediacaran stratigraphy and Earth history through subcommission sponsored field trips, workshops, and meetings;

In addition, the Subcommission is committed to further communication with a wider public through grassroots initiatives to conserve important Neoproterozoic geological sites, to support International Geoscience Program projects, and to encourage the wider dissemination of research findings on the internet or in popular science publications.

Fit within IUGS Science Policy

The objectives of the Subcommission relate to four main aspects of IUGS policy:

(1) The development of an internationally agreed scale of chronostratigraphic units, fully defined by GSSPs where appropriate (Series and Stages), and related to a hierarchy of units (Standard Zones, Subzones etc.) to maximize relative time resolution within the Ediacaran period;
(2) Establishment of frameworks and systems to encourage international collaboration in understanding the evolution of the Earth during the late Neoproterozoic interval, in particular, cooperating with the **Precambrian Subcommission (M. Van Kranendonk, chair)** and **Cryogenian Subcommission (Graham Shields-Zhou, chair)** to subdivide the late Precambrian.
(3) Working towards an international policy concerning conservation of geologically and paleontologically important sites such as GSSPs and important fossil localities. This relates to, *inter alia*, the IUGS Geosites Programme.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

- The second annual newsletter of the Subcommission was disseminated in February 2014.
- The Subcommission established two working groups to focus on the second stage and the terminal stage of the Ediacaran System. These working groups are chaired by Dr. Chuanming Zhou (Ediacaran stage 2) and Dr. Guy Narbonne (Ediacaran terminal stage).
- The Subcommission sponsored the 2014 International Field Workshop on the Marwar Supergroup, Rajasthan, western India, which was held on 20th-28th January 2014. This field trip examined Ediacaran and Cambrian successions in Rajasthan. Corresponding member Mukund Sharma was the organizer of this field workshop, Chair-person Shuhai Xiao and several corresponding members (e.g., Ulf Linnemann and Mukund Sharma) participated in this field workshop. A report has been published in *Episodes*. See attached.
- The Subcommission sponsored and organized the 2014 Subcommission field workshop "*International Symposium and Field Workshop on Ediacaran and Cryogenian Stratigraphy*" in South China (June 11-22,

2014). Nearly 60 scientists from Australia, Brazil, China, Germany, Mongolia, Russia, UK, and USA participated in this field workshop. Chair-person Shuhai Xiao, Vice-Chair Dmitry Grazhdankin, nine other voting members (James Gehling, Ganqing Jiang, Alan J. Kaufman, Guy Narbonne, Graham Shields-Zhou, Chongyu Yin, Xunlai Yuan, Chuanming Zhou, Maoyan Zhu), and six corresponding member (Carlos Alvarenga, Douglas Erwin, Alex Liu, Pengju Liu Konstantin Nagovitsin, Linzhi Gao) participated in this field trip. In addition, several voting and corresponding members of the Cryogenian Subcommission (Carlos Alvarenga, Linzhi Gao, Alan J. Kaufman, Graham Shields-Zhou, Shuhai Xiao, Qirui Zhang, Chuanming Zhou, Maoyan Zhu) participated in this field workshop. A symposium was also organized as part of the field workshop, and there were 31 oral presentations and 20 poster presentations at the symposium. A report has been published in *Episodes*. See attached.

- The Suubcommission co-sponsored and voting member Jose-Javier Alvaro organized a field workshop on the Ediacaran-Cambrian stratigraphy of Morocco (September 15-24, 2014; Ouarzazate, Morocco). A special volume entitled "*Geological Evolution of the Ediacaran and Cambrian in the High Atlas and Anti-Atlas Ranges, Morocco*" was published in the October 2014 issue of "*Journal of African Earth Sciences*". Voting members Jose-Javier Alvaro and Chuanming Zhou participated in this field workshop.
- Corresponding member James D. Schiffbauer and Chair-person Shuhai Xiao assembled a *Journal of Paleontology* special issue on the Ediacaran-Cambrian transition (*Journal of Paleontology*, 2014, vol. 88, no. 2).
- Secretary Marc Laflamme and corresponding members James D. Schiffbauer and Simon A.F. Darroch organized a short course on exceptional preservation—"*Reading and Writing the Fossil Record: Preservational Pathways to Exceptional Fossilization*"—at the 2014 Geological Society of America annual meeting. This short course included several papers associated with the Ediacaran/Cambrian transition.
- Voting members Jim Gehling and Guy Narbonne organized a symposium entitled "*Neoproterozoic palaeobiology: preservation, palaeobiology, environments and phylogeny*" at the 4th International Paleontological Congress (September 28 - October 3, 2014; Mendoza, Argentina).
- Secretary Marc Laflamme organized a symposium entitled "*Ediacaran Environments and Ecosystems*" at the 10th North American Paleontological Convention (February 15-18, 2014; Gainesville, Florida). Several voting and corresponding members (Martin Brasier, Mary Droser, James Gehling, Marc Laflamme, Alex Liu, Guy Narbonne, Shuhai Xiao, Xunlai Yuan, Chuanming Zhou) co-authored abstracts or presented talks at this symposium.
- The Ediacaran, Cryogenian, and Precambrian subcommissions have submitted a joint proposal for a symposium entitled "Precambrian Stratigraphy and Earth System History" at the STRATI 2015 meeting (19-23 July 2015, Graz, Austria). The proposal has been accepted.

3b. LIST OF MAJOR PUBLICATIONS OF SUBCOMMISSION WORK (BOOKS, SPECIAL VOLUMES, KEY SCIENTIFIC PAPER)

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3c. PROBLEMS ENCOUNTERED IN 2014

None.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015)

- Subcommission annual newsletter will be distributed in February 2015. Secretary Dr. Marc Laflamme will be leading the effort to compile and edit the annual newsletter.
- Continue maintaining and updating Subcommission webpage (http://www.paleo.geos.vt.edu/Ediacaran/).
- The Ediacaran, Cryogenian, and Precambrian subcommissions will sponsor and organize a joint symposium entitled "Precambrian Stratigraphy and Earth System History" at the STRATI 2015 meeting (19-23 July 2015, Graz, Austria).
- Formalize the membership of the two workgroups. Currently, Dr. Chuanming Zhou and Dr. Guy Narbonne are putting together the two working groups to focus on the second stage and the terminal stage of the Ediacaran System.
- 2014 was a busy year, with multiple field workshops and symposia in India, China, Morocco, Argentina, and the USA. In 2015, the Subcommission will likely organize and sponsor two or three field workshops, each focusing on the second stage and the terminal stage of the Ediacaran System. Proposals for field workshops will be solicited immediately after the membership of the two working groups is finalized.
- Activities planned for 2015 will focus on the criteria to define the second and terminal stages of the Ediacaran Systems, and will be guided by consensus from previous discussion (particularly the 2014 Subcommission meeting in Wuhan), which is summarized below.
    - There is very clear consensus that stable carbon isotopes, acritarchs, and Ediacara fossils are the most practical correlation tools. Ediacaran glaciations and oxidation events may be useful. There is very little support for stromatolites or the Acraman impact events as interregional correlation tools.
    - We should focus on successions with mixed lithologies, geochronological constraints, and chemostratigraphic and biostratigraphic potential.
    - In order to make progress, we should start working on the stage boundaries. The two priorities identified at the 2014 Subcommission meeting in Wuhan are the second and terminal stages of the Ediacaran System. Stable carbon isotopes, acanthomorphic acritarchs, biomineralizing animal fossils, and Ediacara fossils should be investigated for their significance in stratigraphic correlation.
    - Another focus in 2015 will be series boundary or boundaries of the Ediacaran System. The Ediacaran System can be divided two or more Series. Although the Series boundary should be unambiguously defined, at the present it is perhaps unrealistic to use the FAD or LAD of an Ediacaran species (with possible exception of *Cloudina hartmannae*) for global correlation. Thus, we should aim at characterizing the Series using a combination of bio- and chemostratigraphic features (e.g., one or two Series in the lower Ediacaran System characterized by Ediacaran acanthomorphs; one or two Series in the upper Ediacaran System characterized by macroscopic Ediacara fossils and skeletal fossils; alternatively, three Series each characterized with a carbon isotope cycle).
    - The broad congruency between evolutionary and physical events in the Ediacaran Period is encouraging, but the uncertainties about each individual criterion demand that we should adopt a holistic approach (i.e., using multiple criteria in order to maximize the usefulness of the GSSP).

4b Specific GSSP Focus for 2015

- Following the establishment of the two working groups to focus on the second and terminal stages of the Ediacaran System, at least two field workshops will be organized to discuss and examine the criteria to be used to define and correlate these two stages.
- The Subcommission will discuss and determine whether the Ediacaran System should be divided into two or three series.

5. SUMMARY OF EXPENDITURES IN 2014:

INCOME	
Forwarded from 2013	US$ 891
ICS	US$ 4000
Total	US$ 4891
EXPENDITURES	
Office and administrative supplies	US$ 450
Software and website maintenance	US$ 502
2014 Marwar workshop sponsorship	US$ 500
2014 Indian and China workshop participation costs	US$ 2700
Total	US$ 4152
To be carried forward to 2015	US$ 739

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2015

In 2014, with the help of ICS and several funding agencies (Chinese Academy of Sciences, Chinese State Key Laboratory of Paleobiology and Stratigraphy, National Natural Science Foundation of China), we were able to financially sponsor the Marwar workshop, to offer registration discount to all student participants in the China workshop, and to offer assistance to five keynote speakers at the China workshop.

In 2015, the Subcommission plans two to three field workshops in 2015. Likely field sites include Ediacaran successions in South Australia, Oman, and possibly Russia. These field workshops will be located in remote areas and will involve significant efforts and financial assistance to prepare. Although we will continue to apply for financial assistance through multiple funding agencies of the host countries, we anticipate that the amount of grants will be smaller than was awarded in 2014. In addition, the Subcommission will sponsor and organize a symposium entitled "Precambrian Stratigraphy and Earth System History" at the STRATI 2015 meeting (19-23 July 2015, Graz, Austria). A business meeting will be held at STRATI 2015. Thus, we request **$7,011** from ICS and NSF to these field workshops in 2015.

PROJECTED EXPENSES	
General office expenses and website maintenance	US$ 350
Field workshop preparation (trip leaders)	US$ 3000
STARTI 2015 travel	US$ 2000
Financial assistance for graduate students and young scientists	US$ 2400
Total	US$ 7750
PROJECTED INCOME:	
Carried over from 2013	US$ 739
Total	US$ 739
BUDGET REQUESTS	
From ICS	US$ 4011
Carried over from 2013	US$ 3000
Total	US$ 7011

APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2009-2013)

2009:

- The Neoproterozoic Subcommission officers received 87% overall response following the request to vote on a working definition for the Cryogenian Period. 79% of replies were positive, which gives us a mandate to move forward on this issue. The vote and the lengthy discussion preceding that vote establish a clear priority order with regard to the criteria likely to be used in the future definition and correlation of the Cryogenian Period. Final definition: "*The base of the Cryogenian should be placed within an outcrop section at a precisely defined stratigraphic level (GSSP) beneath the oldest clearly glacigenic deposits in a Neoproterozoic succession. The chosen section should demonstrate proven potential for global C- and Sr-isotope stratigraphic correlation and preferably be amenable to microfossil biostratigraphy, isotope geochronology and other forms of global correlation such as magnetostratigraphy*" (17.08.2009).
- A good response (31/36) was also received with regard to the Ediacaran Period Questionnaire resulting in a clear consensus that stable carbon isotopes, acritarchs, and Ediacara fossils are the most practical correlation tools. Ediacaran glaciations and oxidation events may be useful. There is very little support for stromatolites or the Acraman impact events as interregional correlation tools. Consequently, most people believe that we should focus on successions with mixed lithologies, geochronological constraints, and chemostratigraphic and biostratigraphic potential; and proceed from Series to Stages, rather than from Stages to Series (as practiced in Phanerozoic stratigraphy). The Ediacaran System can be divided into <u>two or more Series</u>.

  Although the Series boundary should be unambiguously defined (e.g., using fossil FAD or LAD, or isotopic features), at the present it is perhaps unrealistic to use the FAD or LAD of an Ediacaran species (with possible exception of *Cloudina hartmannae*) for global correlation. Thus, we should aim at characterizing the Series using a combination of bio- and chemostratigraphic features (e.g., one or two Series in the lower Ediacaran System characterized by Ediacaran acanthomorphs; one or two Series in the upper Ediacaran System characterized by macroscopic Ediacara fossils; alternatively, three Series each characterized with a carbon isotope cycle).

  The broad congruency between evolutionary and physical events in the Ediacaran Period is encouraging, but the uncertainties about each individual criterion demand that we should adopt a holistic approach (i.e., using multiple criteria in order to maximize the usefulness of the GSSP) (06.04.2009).

2010:

- International conference and field meeting on February 2-9, 2010 on Precambrian Life, Time and Environments: "Evolving Concepts and Modern Analogues" as well as a 2nd acritarch workshop. This followed an international field workshop on the Proterozoic Vindhyan Supergroup (Jan. 20-31, 2010) organized by Mukund Sharma.
- Task groups were assembled during 2010 to direct research to test criteria for correlating and defining a Cryogenian GSSP, and subdivision of the Ediacaran Period.

2011:

- International conference on Neoproterozoic Sedimentary Basins and a Neoproterozoic Subcommission workshop on Ediacaran paleobiology (Novosibirsk, 30 July – 1 August, 2011), followed by a field excursion to the East Sayan Mountains (2 – 14 August, 2011).
- Publication of ***Neoproterozoic Ice Ages*** (editors: Arnaud, Halverson and Shields; Geological Society of London Memoir 36: ISBN 978-1-86239-334-9).
- Ballot on dissolution of Neoproterozoic Subcommission and establishment of two separate subcommissions for the Cryogenian and Ediacaran periods, respectively.

2012:

- Voting members Shuhai Xiao, Chuanming Zhou, and Ganqing Jiang, as well as ICS chair Stan Finney and vice chair Shanchi Peng, participated in a field workshop on Ediacaran stratigraphy in South China, organized by Dr. Xiaofeng Wang at the Wuhan Center of the China Geological Survey. They examined a number of key sections where important fossils and geochemical events have been reported.

- The Ediacaran Subcommission was established in August 2012 at the 34th IGC in Brisbane, Australia.
- A business meeting was held on August 7, 2012, on the side of the 34th IGC in Brisbane. Participants included voting members Shuhai Xiao, Guy Narbonne, Kathleen Grey, Nicholas Christie-Blick, James Gehling, Malgorzata Moczydlowska-Vidal, and Maoyan Zhu, as well as several corresponding members (Patricia Vickers-Rich, Robert Rainbird, Michael Meyer). At the meeting, members discussed the need to more actively engage members of the community, to start an annual newsletter, and to update the Subcommission webpage. Other issues discussed at the meeting include potential criteria for Ediacaran subdivision and global correlation, possible field workshops and symposia for 2013, and a timeline toward the establishment of GSSPs.
- On September 19–21, 2012, voting members Shuhai Xiao, Jay Kaufman, Martin Brasier, Guy Narbonne, Chongyu Yin, and Graham Shields-Zhou participated in the Geological Society Fermor meeting in London that focused on the evolution, glaciation, and oxygenation of the Neoproterozoic Era.
- ***The Geologic Time Scale 2012*** was published. Voting members Guy Narbonne, Shuhai Xiao, Graham Shields-Zhou, and James Gehling contributed a chapter on the Ediacaran Period in this volume.
- In October 2012, the Subcommission webpage has been updated and migrated to a new server at Virginia Tech.

2013:

- An international field workshop, sponsored by the Subcommission and entitled "The Neoproterozoic Paraguay Belt (Brazil): glaciation, iron-manganese formation and biota" was held at Campo Grande and Corumbá, Brazil, August 4-9, 2013. The workshop was organized by corresponding member Detlef Walde at Universidade de Brasília. Voting members (Alan J. Kaufman, Chuanming Zhou) and corresponding members (Paulo Boggiani, Claudio Gaucher, Patricia Rich) participated in the workshop.
- Following the 2012 Subcommission field trip in South China and in preparation for the 2014 Subcommission field workshop in Yichang (June 11-22, 2014), Subcommission chair Shuhai Xiao, voting members (Chuanming Zhou and Xunlai Yuan), and corresponding member (Pengju Liu) carried out joint field excursion to examine outcrops and sections to be visited in 2014. Extensive discussion with members of the Cryogenian Subcommission (Graham Shields-Zhou, Maoyan Zhu, and Linzhi Gao) resulted in a joint field workshop with the Cryogenian Subcommission. Logistic arrangement has been made and the first circular has been sent out.
- Preparation for the 2014 International Field Workshop on the Marwar Supergroup, Rajasthan, Western India (Corresponding member Mukund Sharma) and International Field Workshop on the Ediacaran-Cambrian Stratigraphy of Morocco (Voting member Jose-Javier Alvaro).

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2014-2018)

The Ediacaran Subcommission aims to encourage research that will facilitate a consensus subdivision of the Ediacaran System (circa 635 – 541 Ma).

2014:

- Field workshops and symposia to be held in India, South China, and Morocco, with a focus on the search for appropriate criteria for the subdivision of the Ediacaran Period.
- Establishment of two working groups to focus on the second stage and the terminal stage of the Ediacaran System.

2015-2016:

- The Ediacaran, Cryogenian, and Precambrian subcommissions will organize a symposium entitled “Precambrian Stratigraphy and Earth System History” at the STRATI 2015 meeting (19-23 July 2015, Graz, Austria).
- Organize two to three international field workshops to focus on the second and terminal stages of the Ediacaran System.
- One or more field trip to focus on the subdivision of the Ediacaran System into two or more series.
- A vote will be called to decide whether the Ediacaran System should be divided into two or three series and what criterion or criteria will be the most useful in dividing the Ediacaran System into series and stages.

2016-2017:

- Submission and discussion of formal proposals for Ediacaran Series/Stage GSSP(s);
- Review and vote on Ediacaran Series/Stage GSSP proposals.

2017-2018:

- Ratification of Ediacaran Series/Stage GSSP(s).

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

The Subcommission is organized by an Executive consisting of Chairman, Vice-Chairman and Secretary, who are all Voting Members of the Subcommission. These officers were nominated by the Executive of the predecessor Neoproterozoic Subcommission and appointed by ICS executives in August 2012. There are currently 16 other Voting Members, making a total of 19 voting members. There are currently over 30 additional corresponding members. The Voting Members have been specifically selected for their international reputations, recognized expertise in an area of geoscience relevant to the subcommission, and their willingness to take an active role in the subcommission's activities.

Officers

- Chair: Shuhai Xiao (Department of Geosciences, Virginia Tech, Blacksburg, VA 24061, USA; xiao@vt.edu)
- Vice Chair: Dima Grazhdankin (Institute of Petroleum Geology and Geophysics, Koptyug Avenue 3, Novosibirsk 630090, Russia; dima.grazhdankin@googlemail.com)
- Secretary: Marc Laflamme (Department of Chemical and Physical Sciences, University of Toronto Mississauga, 3359 Mississauga Road N., Mississauga, ON L5L 1C6, Canada; marc.laflamme@utoronto.ca)

Voting Members

• Alvaro, Jose-Javier	alvarobjj@cab.inta-csic.es	Centre of Astrobiology, Spain
• Brasier, Martin D.	martin.brasier@earth.ox.ac.uk	Oxford, UK
• Christie-Blick, Nicholas	ncb@ldeo.columbia.edu	Columbia University, New York, USA
• Gehling, James G.	Jim.Gehling@samuseum.sa.gov.au	South Australian Museum, Australia
• Grazhdankin, Dmitri V.	dima.grazhdankin@gmail.com	Novosibirsk, Russia
• Grey, Kathleen	kath.grey@doir.wa.gov.au	Perth, Australia
• Jensen, Sören	soren@unex.es	Spain
• Jiang, Ganqing	ganqing.jiang@unlv.edu	University of Nevada Las Vegas, USA
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• Laflamme, Marc	marc.laflamme@utoronto.ca	U of Toronto at Mississauga, Canada
• Moczydlowska-Vidal, Malgorzata	malgo.vidal@pal.uu.se	Uppsala, Sweeden
• Narbonne, Guy M.	narbonne@geol.queensu.ca	Queens, Kingston, Canada
• Rai, Vibhuti	vibhutirai@rediffmail.com	Lucknow, India
• Shields-Zhou, Graham A.	g.shields@ucl.ac.uk	University College London, UK
• Xiao, Shuhai	xiao@vt.edu	Virginia Tech, USA
• Yin, Chongyu	chongyuyin@cags.ac.cn	Beijing, China
• Yuan, Xunlai	xlyuan@nigpas.ac.cn	Nanjing, China
• Zhou, Chuanming	cmzhou@nigpas.ac.cn	Nanjing, China
• Zhu, Maoyan	zhumaoyan@gmail.com	Nanjing, China

Corresponding Members

• Antcliffe Jonathan	Bristol University, UK
• Boggiani, Paulo César	São Paulo, Brazil
• Butterfield, Nicholas	Cambridge, UK
• Chen, Xiaohong	Wuhan
• Chumakov, Nikolay	Moscow, Russia
• Erwin, Douglas	Smithsonian NMNH, USA

• Bernd-D. Erdtmann	Germany
• Evans, David A.D.	Yale University, USA
• Fedonkin, Mikhail	Moscow, Russia
• Frimmel, Hartwig	Wuerzburg, Germany
• Gaucher, Claudio	Montevideo, Uruguay
• Hoffmann, Karl-Heinz	Windhoek, Namibia
• Hofmann, Mandy	Germany
• Jenkins, Richard	Adelaide, Australia
• Khomentovsky, Vsevolod	Novosibirsk, Russia
• Knoll, Andrew H.	Harvard University, USA
• Kochnev, Boris	Novosibirsk, Russia
• Linnemann, Ulf	Dresden, Germany
• Liu, Alex	Cambridge, UK
• Liu, Pengju	Beijing
• Melezhik, Victor	Norway
• Nagovitsin, Konstantin	Novosibirsk, Russia
• Patricia Vickers-Rich	Monash University, Australia
• Pokrovskii, Boris G.	Russia
• Rainbird, Robert	Ottawa, Canada
• Schiffbauer, James D.	University of Missouri, USA
• Semikhatov, Mikhail A.	Moscow Russia
• Sergeev Volodya	Russia
• Sperling, Erik	Harvard University, USA
• Van Kranendonk, Martin	University of New South Wales
• Detlef Walde	Universidade de Brasília
• Walter, Malcolm	Sydney, Australia
• Wang, Xiaofeng	Wuhan
• Weiguo, Sun	Nanjing, China

9b List of Working (Task) Groups and their officers

Task Group to redefine the Ediacaran-Cambrian boundary, led by voting member Dr. Maoyan Zhu, with Dr. Shuhai Xiao as a member;

Two working groups have been established to focus on the second and terminal stages of the Ediacaran System.

The Ediacaran, Cryogenian, and Precambrian subcommissions have submitted a joint proposal for a symposium on "Precambrian Stratigraphy and Earth System History" at the STRATI 2015 meeting (19-23 July 2015, Graz, Austria).

9c Interfaces with other international project

Members of the Ediacaran Subcommission are lead investigators and officers in a number of related international projects:
IGCP 587 (*Of Identity, Facies and Time, the Ediacaran Puzzle: Factors Controlling the Observed Diversity and reality of the Relationships of the Earliest Metazoans*) led by Mikhail Fedonkin (Paleontological Institute, Russian Academy of Sciences, Moscow, Russia), **Patricia Vickers-Rich** (School of Geosciences, Monash University, Melbourne, Victoria), **Jim Gehling** (South Australian Museum, South Australia) and **Guy Narbonne** (Dept of Geology, Queens University, Kingston, Ontario, Canada).

SUBCOMMISSION ON CRYOGENIAN STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY

Subcommission on Cryogenian Stratigraphy

Submitted by:

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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Mission statement

The subcommission is the primary body for facilitation of international communication and scientific cooperation in Cryogenian stratigraphy and a range of multidisciplinary activities directed at better understanding Earth system evolution during the Cryogenian Period (850 – c.635 Ma). Its priority is the unambiguous definition, by means of a global stratotype section and points (GSSP), of a hierarchy of chronostratigraphic units that provide the framework for global correlation.

Goals

The main goals of this Subcommission are:

(a) To establish for the first time a rock-based GSSP for the base of the Cryogenian that will also serve as the top of the underlying Tonian.
(b) To search for criteria useful in the subdivision and correlation of Cryogenian strata;
(c) To define the basal boundaries of Cryogenian epochs (series) and ages (stages) through the establishment of GSSPs;
(d) To facilitate international collaboration in research on Cryogenian stratigraphy and Earth history through subcommission sponsored field trips, workshops, and meetings.

In addition, the Subcommission is committed to expanding communication to a wider public through grassroots initiatives to conserve important Neoproterozoic geological sites, to support International Geoscience Programme projects, and to encourage the wider dissemination of research findings on the internet, in popular science publications, and through public lectures.

Fit within IUGS Science Policy

The objectives of the Subcommission relate to three main aspects of IUGS policy:

(1) The development of an internationally agreed scale of chronostratigraphic units, fully defined by GSSPs where appropriate (Series and Stages), and related to a hierarchy of units (Standard Zones, Subzones etc.) to maximize relative time resolution within the Cryogenian Period;
(2) The establishment of frameworks and systems to encourage international collaboration in understanding the evolution of the Earth during the middle–late Neoproterozoic interval, in particular, cooperating with the Precambrian Subcommission (Martin Van Kranendonk, chair) and Ediacaran Subcommission (Shuhai Xiao, chair) to subdivide the late Precambrian.
(3) Working towards an international policy concerning conservation of geologically and paleontologically important sites such as GSSPs and important fossil localities. This relates to, *inter alia*, the IUGS Geosites Programme.

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

- Ediacaran-Cryogenian subcommissions joint field excursion/workshop/conference in South China (June 11-22, 2014). There were 45 participants (6 voting members) on the Cryogenian field trip that resulted in an abstract volume, field guide and workshop report.
- The second Cryogenian Subcommission field workshop is scheduled to take place in Death Valley, California, December 12-14th. The field trip will be led by Francis Macdonald (Harvard), with >12 participants (5 voting members) from 5 countries.
- A formal application was submitted in October to the ICS to remove the numerical age of 850 Ma for the base of the Cryogenian, and to replace it with a rock-based GSSP whose age is yet to be determined, but is approximately ~720 Ma. This decision is pending.

3b LIST OF MAJOR PUBLICATIONS OF SUBCOMMISSION WORK (BOOKS, SPECIAL VOLUMES, KEY SCIENTIFIC PAPER) - none; 3c. PROBLEMS ENCOUNTERED IN 2014 - none

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015)

- It was decided at the subcommission meeting in Guilin on June 21st, 2014 that a special issue of Precambrian Research would provide the most suitable home for articles on regional Cryogenian stratigraphy and an application is being prepared. Submission is envisaged during 2015 with publication of most articles by IGC 2016.
- Preparation for future logistically challenging field visits to the Yukon (possibly in 2016).
- Update of Subcommission webpage to be hosted at NIGPAS, Nanjing, China – upload all field workshop guidebooks from past decade.
- 'Precambrian Stratigraphy and Earth System History' session and subcommission meeting at the STRATI 2015 meeting in Graz (July 19-23, 2015). A major focus of this meeting will be to move forward on establishment of Precambrian GSSPs together with the Precambrian and Ediacaran subcommissions.

4b Specific GSSP Focus for 2014

- The basal GSSP for the Cryogenian System will remain the priority of the subcommission until the IGC in 2020.

5. SUMMARY OF EXPENDITURES IN 2014 (US$):

INCOME	
ICS	$2,000
NSF grant (China June workshop)	$1,000
Carried forward from 2013	$300
EXPENDITURE	
Travel/Registration assistance for China workshop (June)	$1,300
Travel bursaries for voting members to attend field workshop in USA (December)	$2,000
Total	$2,000
To be carried forward to 2014	$0

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2015

PROJECTED EXPENSES	
Travel support for subcommission meeting in Graz (July)	>$10,000
Total	>$10,000
PROJECTED INCOME:	
Carried over from 2012	$0
BUDGET REQUEST	$4,000

APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2009-2013)

2009:

- The Neoproterozoic Subcommission decided on criteria for the Cryogenian GSSP: "***The base of the Cryogenian should be placed within an outcrop section at a precisely defined stratigraphic level (GSSP) beneath the oldest clearly glacigenic deposits in a Neoproterozoic succession. The chosen section should demonstrate proven potential for global C- and Sr-isotope stratigraphic correlation and preferably be amenable to microfossil biostratigraphy, isotope geochronology and other forms of global correlation such as magnetostratigraphy***" (17.08.2009).

2010:

- International conference and field meeting on February 2-9, 2010 on Precambrian Life, Time and Environments: "Evolving Concepts and Modern Analogues" as well as a 2nd acritarch workshop. This followed an international field workshop on the Proterozoic Vindhyan Supergroup (Jan. 20-31, 2010) organized by Dr. Mukund Sharma.
- Task groups were assembled during 2010 to direct research to test criteria for correlating and defining a Cryogenian GSSP and for subdivision of the Ediacaran Period.

2011:

- International conference on Neoproterozoic Sedimentary Basins and a Neoproterozoic Subcommission workshop on Ediacaran paleobiology (Novosibirsk, 30 July – 1 August, 2011), followed by a field excursion to the East Sayan Mountains (2 – 14 August, 2011).
- Publication of ***Neoproterozoic Ice Ages*** (editors: Arnaud, Halverson and Shields-Zhou; Geological Society of London Memoir 36: ISBN 978-1-86239-334-9).
- Ballot on dissolution of Neoproterozoic Subcommission and establishment of two separate subcommissions for the Cryogenian and Ediacaran periods, respectively.

2012:

- The Cryogenian Subcommission was established in August 2012 at the 34th IGC in Brisbane, Australia and launched in September 20th, 2012 at the Geological Society of London attended by 10 voting members and various corresponding members.
- September 19–23, 2012: voting members and corresponding members contributed to a large interdisciplinary 'Fermor' meeting in London – '***The Neoproterozoic Era: evolution, glaciation, oxygenation***'.
- ***The Geologic Time Scale 2012*** was published with a chapter on the Cryogenian Period.

2013:

- The first Cryogenian Subcommission field workshop investigated the Dalradian Supergroup, Scotland, in September 2013, followed by the first subcommission meeting on September 9th, 2013 in Oban.
- Creation of a Subcommission Google Group, allowing easy dissemination of information among voting members and other interested scientists.
-

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015-2018)

Establishment of rock-based Cryogenian GSSP by the 2020 IGC is the main objective of the Cryogenian Subcommission (*only then can subdivision of the Cryogenian be considered*).

2015-2016:

- Encourage widespread use of new calibrated age for the base of the Cryogenian System with likely publication in Episodes.
- Ongoing discussion with the ICS and the Precambrian Subcommission regarding the status of the Tonian Period/System, e.g. at Graz in July 19-23 at STRATI 2015.
- Special issue of Precambrian Research on Cryogenian stratigraphy (in part using GSSP template papers currently in preparation) – first papers to be published in 2016.
- Additional field trips to be organized to examine potential GSSP sections (northwest Canada (?), Yukon (2016), Svalbard (?) and/or East Greenland (?) – possible application for additional funding from the ICS for the Yukon trip.

2017-2018:

- Review of GSSP ideas using template papers and establishing priorities for field excursions. First GSSP proposals submitted and discussed.

2019-2020:

- Discussion and voting on all final Cryogenian GSSP candidates
- Ratification of Cryogenian GSSP at 2020 IGC.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

The Subcommission is organized by an Executive consisting of Chairman, Vice-Chairman and Secretary, who are all Voting Members of the Subcommission. These officers were appointed by ICS executives in August 2012. There are currently 15 other Voting Members, making a total of 18 voting members. There are also additional corresponding members.

Officers

- Chair: Graham A. Shields-Zhou (Department of Earth Sciences, University College, Gower Street, London WC1E 6BT, UK; g.shields@ucl.ac.uk)
- Vice Chair: Galen P. Halverson (Department of Earth and Planetary Sciences, McGill University, 3450 University St., Montreal, QC H3A 0E8, Canada; galen.halverson@mcgill.ca)
- Secretary: Susannah Porter (Department of Earth Science, University of California at Santa Barbara, Santa Barbara, CA 93106-9630, USA; porter@geol.ucsb.edu)

Voting Members

4)	David A.D. Evans	Yale University, USA
5)	Hartwig Frimmel	University of Würzburg, Germany
6)	Karl-Heinz Hoffmann	Geological Survey of Namibia
7)	Andrew H. Knoll	Harvard University, USA
8)	Robert Rainbird	Geological Survey of Canada
9)	Carol Dehler	Utah State University, USA
10)	Vladimir Sergeev	Russian Academy of Sciences, Moscow, Russia
11)	Shuhai Xiao	Virginia Tech, USA
12)	Carlos de Alvarenga	University of Brasilia, Brazil
13)	Mukund Sharma	Birbal Sahni Institute, Lucknow, India
14)	Gao Linzhi	Chinese Academy of Geological Sciences, Beijing, China
15)	Anton Kuznetsov	Russian Academy of Sciences
16)	Ian Fairchild	University of Birmingham, UK
17)	Chuanming Zhou	Nanjing Institute of Geology and Palaeontology, China
18)	Malcolm Wallace	University of Melbourne, Australia

9b List of Working (Task) Groups and their officers - No Working (Task) Groups are formed yet.

9c Interfaces with other international projects – n/a

SUBCOMMISSION ON PRECAMBRIAN STRATIGRAPHY

ANNUAL REPORT 2014

1. TITLE OF CONSTITUENT BODY

Subcommission on Precambrian Stratigraphy

Submitted by:
Prof. Martin J. Van Kranendonk, *Chair*
School of Biological, Earth and Environmental Sciences, University of New South Wales Australia, Kensington, NSW 2052, Australia. E-mail: m.vankranendonk@unsw.edu.au
Vice-Chair: Dr. Wouter Bleeker, Geological Survey of Canada
Secretary: Dr. Robert Rainbird, Geological Survey of Canada

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY
An international subcommission under ICS that has set as its main goal to construct a 'natural' stratigraphy-based time scale for much of the Precambrian, and pin key stratigraphic boundaries with GSSPs as with the Phanerozoic (not GSSAs).

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014
Van Kranendonk continues to work directly on Precambrian timescale issues, specifically through further investigation of the Archean-Proterozoic transitional section in Western Australia, across the boundary between the Hamersley and Turee Creek groups.

At the very end of 2013, Van Kranendonk convened a working group of leading scientists to debate the nature of a possible Hadean Eon. The working group included both current voting members and non-member scientists who are experts in this field. A list of the 19 people who chose to be involved in the discussion are presented in part 9b below.

3b List of major publications of subcommission work (books, special volumes, key scientific paper)
Van Kranendonk, M.J. (2014): Early Earth atmosphere and environments: A review. In: Shaw, G.H. (ed.), Earth's Early Atmosphere and Surface Environment. *Geological Society of America, Special Papers* 504, 105-130.
Van Kranendonk, M.J., Mazumder, R. (in press): Two Paleoproterozoic glacio-eustatic cycles in the Turee Creek Group, Western Australia. *Geological Society of America Bulletin*.
Van Kranendonk, M.J., Mazumder, R., Yamaguchi, K., Yamada, K., Ikehara, M. (in press): Sedimentology of the Paleoproterozoic Kungarra Formation, Turee Creek Group, Western Australia: A conformable record of the transition from early to modern Earth. *Precambrian Research*. DOI: 10.1016/j.precamres.2014.09.015

3c. Problems encountered, if appropriate
The Chair, Van Kranendonk, has been somewhat overcommitted during 2013-14, setting up a new career in academia. His time has been taken up with setting up new courses and attracting funds and Higher Degree Research students. Those elements are all now in place and the chair is committed to applying significant time to the Subcommission in the foreseeable future, including participation at the 2015 STRATI conference and the 2016 IGC.

More problematical, is that there has been a misunderstandings between the Chair and the Subcommission co-chair (Bleeker) and secretary (Rainbird). Early this year I wrote to the Subcommission secretary asking him to write to all subcommision voting members to thank them for their time on the Subcommission but inform them that the length of their service was now up and it was time to look for new members (Appendix 1). This letter was written on the advice of the ICS Chair, Stan Finney, through conversations the previous year and stemmed from the fact that the Subcommission voting membership had been in place since at least 2006, when the current Subcommision chair became involved (a normal term is 4 years).

Co-chair Bleeker wrote back stating that they were unwilling to undertake this task, for the reasons given in Appendix 2 (copy of his email letter). Basically, he misunderstood my intentions and thought that removing voting members meant there would be no concensus on steps made towards a more naturalistic Precambrian timescale – the aim of the subcommision. But I clearly stated in my letter regarding this issue that we would replace voting members with more relevant and active persons in the field of Precambrian stratigraphy and mentioned several possible candidates to consider and discuss. Bleeker then went into a long discussion about his disagreement with what the Hadean working group had reached majority concensus on (part 9b and Appendix 3). It is clear that he disagrees with the majority and

my concern is that he is using this as a basis for refusing to move on the voting membership replacement issue, despite the fact that his (and Rainbird's) opinion regarding suitable members had been canvassed.
I wish to replace the Subcommissin voting membership with a new panel, following the advice given by ICS Chair Stan Finney and adhering to ICS statues. This will be given top priority to ensure the smooth functioning of the Subcommission.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2015)

- Update the Precambrian Subcommission Voting Membership
- Establish the base of the timescale, at T_0, following the concensus reached by the Hadean Working Group
- Continue dialogue regarding the upper boundary for the Hadean and put a boundary to a vote.
- Establish an Archean-Proterozoic boundary working group from active researchers in the field and commence discussions on the definition of the Archean-proterozoic boundary.

4b Specific GSSP Focus for 2015
Base timescale (GSSA), and Hadean-Archean boundary (also GSSA)

5. SUMMARY OF EXPENDITURES IN 2014
Nil

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2015
$5000 for support of members to attend STRATI 2015 and discuss Precambrian timescale issues
APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2009-2013)

- Publication of major overviews of Precambrian Earth history, setting the stage for a comprehensive analysis of potential GGSP candidates.
- Hosted numerous workshops at conferences in the US and Australia on the Precambrian timescale to canvass scientific opinion about the objectives of the Subcommission – almost universally positive.
- Hosted a Workshop Without Walls on the Hadean in 2014.
- Convened and led an email working group on establishing a Hadean Eon in the Geological Timescale

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2015-2019)

- Create a new, smoothly functioning Subcommission
- Update the Subcommission website
- Establish a formalised Hadean Eon in the Geological timescale
- Convene a workshop to discuss and implement change to the Archean-Proterozoic boundary, to commence centring in on a GSSP locality.
- Continue to advertise and broadcast the work of the subcommision

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP
9a Names and Addresses of Current Officers and Voting Members
Australia:
*David Nelson, Curtin University of Technology, D.Nelson@curtin.edu.au
Allen Nutman, Beijing SHRIMP centre, nutman@bjshrimp.cn
Graham Shields, University College London, g.shields@ucl.ac.uk
Ian Tyler, Geological Survey of Western Australia, ian.tyler@doir.wa.gov.au
Brasil:
Reinhardt Fuck, Universidade de Brasília, rfuck@unb.br
*Benjamim Bley Brito Neves, Institute of Geosciences, University of Sao Paulo, bbleybn@usp.br
Cameroon:
*Sadrack Félix Toteu, Centre for Geological and Mining Research, sftoteu@yahoo.fr
Canada:
Donald W. Davis, University of Toronto, dond@geology.utoronto.ca
Mike Hamilton (c), University of Toronto, mahamilton@geology.utoronto.ca
Sandra Kamo (c), University of Toronto, skamo@geology.utoronto.ca
Guy Narbonne, Queen's University, narbonne@geol.queensu.ca

China:
*Huaikun Li, Chinese Geological Survey, tjlhuaikun@cgs.gov.cn
*Songnian Lu, Chinese Geological Survey, tjlsongnian@cgs.gov.cn
*Yusheng Wan, Chinese Academy of Geological Sciences, wanyusheng@bjshrimp.cn
*Huichu Wang, Chinese Geological Survey, tjwhuichu@cgs.gov.cn
Finland:
*Petri Peltonen, Geological Survey of Finland, petri.peltonen@gtk.fi
Germany:
Alfred Kröner, University of Mainz, kroener@mail.uni-mainz.de
Russia:
Andrei Khudoley, St. Petersburg State University, khudoley@ah3549.spb.edu
Sweden:
Martin Whitehouse, Swedish Museum of Natural History, martin.whitehouse@nrm.se
United Kingdom:
Stephen Moorbath, Oxford University, United Kingdom, stephenm@earth.ox.ac.uk
Euan Nisbet, Royal Holloway University of London, nisbet@gl.rhul.ac.uk
United States of America:
Andrey Bekker, University of Manitoba, bekker@cc.umanitoba.ca
David Evans, Yale University, dai.evans@yale.edu
Don Lowe, Stanford University, lowe@pangea.stanford.edu
Stephen J. Mojzsis, University of Colorado, mojzsis@colorado.edu
*Members marked with asterisks have not responded to email messages for over 2 years and their emails are no longer functioning. This amounts to 8 of 25 total members, or 32% of the Subcommission.

9b List of Working (Task) Groups and their officers
Hadean Working Group members

√Prof. Vickie Bennet, Australian National University
X Dr Wouter Bleeker, Geological Survey of Canada
Prof. Aaron Cavosie, University of Puerto Rico
Dr. James Connelly, Geological Museum, Denmark
X Dr. Don Davis, University of Toronto, Canada
√Prof. Lindy Elkins-Tanton, Carnegie Institution of Washington, USA
Prof David Evans, Yale University, USA
√Prof. Reinhardt Fuck, Brazil
Prof. Anthony Kemp, University of Western Australia
√Prof. Don Lowe, Stanford University, USA
√Prof. Stephen Mojzsis, University of Colorado-Boulder, USA
Prof. Guy Narbonne, Queens University, Canada
√Prof. Marc Norman, Australian National University
Prof Allen Nutman, University of Wollongong, Australia
√Dr. Jonathan O'Neill, University of Ottawa, Canada
√Prof. Graham Shields,
√Dr. Kenneth Tanaka, United States Geological Survey
Prof. John Valley, University of Wisconsin-Madison, USA
√Prof. Martin Van Kranendonk, University of New South Wales Australia
X Dr. Martin Whitehouse, Swedish Geological Museum
√ Prof. Simon Wilde, Curtin University, Australia

Upper boundary of Hadean (check marks and X in list above)
11 for; 3 against, 7 no fixed opinion

Lower boundary of Hadean (T_0 at 4567, or 4568 Ma)
21 for

9c Interfaces with other international projects

- IGCP-SIDA 599

- European Cooperation in Science and Technology (COST): Origins and Evolution of life on Earth and in the Universe
- Cryogenian Subbcommission
- NAI Early Earth Focus Group (Co-chair)
-

SUBCOMMISSION ON STRATIGRAPHIC CLASSIFICATION

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

Subcommission on Stratigraphic Classification (ISSC)

submitted by:
Prof. Brian R. Pratt[1]
Chair, ISSC
Dr. Maria Rose Petrizzo[2]
Secretary, ISSC
[1]Department of Geological Sciences, University of Saskatchewan, Saskatoon, Saskatchewan S7N 5E2, Canada; Tel.: +1-306-966-5725; Fax: +1-306-966-8593; E-mail: brian.pratt@usask.ca
[2]Department of Earth Sciences "Ardito Desio", Università di Milano, via Mangiagalli 34, 20133 Milano, Italy; Tel.: +39-02-503 15529; Fax: +39-02-503 15494; E-mail: mrose.petrizzo@unimi.it

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

The Subcommission represents a core business for the International Commission on Stratigraphy, the primary body for creating, discussing, publishing and disseminating an internationally agreed-upon guide to stratigraphic terminology and classification, in other words, standardization of the nomenclature of stratigraphic units. Its immediate priorities are to advertise new developments in stratigraphic methods, check that the procedures are carefully followed, monitor the application of the accepted rules, and encourage the teaching of basic stratigraphic principles and concepts to new generations of students and professionals. Its future goal is a revision of the celebrated International Stratigraphic Guide in order to keep it current but also open to new approaches.

These priorities fall into two categories: (1) the worldwide acceptance of the basic rules of stratigraphy, without which no time-scale is meaningful; and (2) coordination of international application of stratigraphic principles and concepts, with special reference to the "users" of stratigraphy, that is, stratigraphers and mappers in geological surveys, graduate and undergraduate students and their professors, geologists and geophysicists in oil companies, Quaternary geologists and geomorphologists, engineering geologists, archeologists, as well as other professionals who deal with the Earth Sciences plus those interested in the information locked in Earth's historical record in general.

The objectives of the Subcommission are relevant to IUGS policy because standardization of stratigraphic terminology is essential to any and all attempts for global correlation, and requires a large and active international cooperation.

3. ORGANIZATION

Officers for 2012–2016 (renewed from 2008–2012):

Chair:	Prof. Brian R. Pratt, Canada; brian.pratt@usask.ca
Vice-Chairs:	Dr. Jan Zalasiewicz, United Kingdom; Jaz1@leicester.ac.uk
	Prof. Helmut Weissert, Switzerland; helmut.weissert@erdw.ethz.ch
Secretary:	Dr. Maria Rose Petrizzo, Italy; mrose.petrizzo@unimi.it

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

ISSC has always been directly or indirectly linked to big international projects such as IODP and IGCP. It has close ties to national stratigraphic commissions which increasingly look beyond the borders of the parent countries. This is especially true with the North American Commission on Stratigraphic Nomenclature which embraces the USA, Canada and Mexico, and tacitly much of the Caribbean area. ISSC encourages other national bodies to harmonize their codes with each other and the International Stratigraphic Guide.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2014

5.1 Issc newsletter

Owing to the pace of developments of the subcommission and various personal commitments, newsletters are being issued once a year for the time being. ISSC Newsletter 20is in preparation and will be distributed in December 2014. It advertised the status of review papers on the subdisciplines of Stratigraphy. Newsletters and other documents are available on the ISSC website: http://users.unimi.it/issc

5.2 CONFERENCE PARTICIPATION

ISSC organized the session SSP2.1 Earth Systems History – the Need for Integrated Stratigraphy at the EGU General Assembly 2014 (27 April–02 May 2014, Vienna, Austria).

The session convened by Maria Rose Petrizzo, Helmut Weissert, Brian Pratt, Werner Piller, Jan Zalasiewicz was a great success and with this motivation it will be included in the EGU2015 program.

5.3 new developments in stratigraphic classification

5.3.1 The Project

The final goal of ISSC is to update, upgrade and implement the International Stratigraphic Guide (Hedberg, 1976 [1st edition]; Salvador, 1994 [2nd edition]; Murphy and Salvador, 1999 [abridged edition]). The ISG is a most important official document with a large distribution which requires revisiting because of the fundamental advances of stratigraphy in the last 30 years. A project was developed by ISSC following a workshop organized during the 32nd IGC in Florence, entitled "Post-Hedberg Developments in Stratigraphic Classification". A 'bottom-up' or 'grass-roots' approach was initiated with the distinction of seven stratigraphic subdisciplines to be developed by different groups of scientists who werer mostly but not necessarily existing ISSC members. The project is not funded, and is uniquely based on voluntary participation of dedicated scientists with a teamwork approach.

The target audience includes undergraduate and graduate students, and professionals of all stripes, including field geologists, petroleum geologists and so forth.

Each chapter of these review articles starts with a summary of the historical development of that peculiar branch of stratigraphy. Basic concepts are clearly presented, followed by precise definitions. Then real examples (case studies) are presented and discussed. Finally recommendations and the terminology to be adopted and problems in the application of the methods are suggested.

Background and motivation of this ambitious project are clearly expressed in the introductory article (Cita, 2007) printed in *Newsletters on Stratigraphy* where the various review articles are being published. This series of articles falls under the umbrella of "New Developments on Stratigraphic Classification". A workshop with the same title took place during the 33nd IGC in Oslo in 2008. There were not enough abstracsts submitted to support dedicated ISSC-sponsored session during the 34th IGC in Brisbane. The business meeting was held there on Sunday, 5 August.

After all the various review articles in the coordinated series are published, the reprinting of the various articles in a textbook is foreseen, after passing the prescribed check points for approval in order to obtain the permission to use the ICS and IUGS logos. A planned publication date of 2015 would be a fitting tribute to the fine achievements made by IUGS in so many stratigraphic matters.

5.3.2 THE ORGANIZATION

Task Group leaders have been appointed for the following categories of stratigraphic units not included in previous ISG:

- *Chemostratigraphy*
- *Cyclostratigraphy*
- *Sequence stratigraphy*

Working Group leaders have been appointed for categories that were already considered in the ISG:

- *Biostratigraphy*
- *Chronostratigraphy*.
- *Lithostratigraphy*
- *Magnetostratigraphy*

Each Task Group or Working Group consists of a limited number of scientists with broad international experience. Overall, more than two dozen scientists are presently involved in this project. The products of their efforts are circulated through ISSC newsletters, first among members, then within the larger community through corresponding members of ICS and the national liaisons.

Participation of our large and variegated membership to the project proceeds in two steps:

Step 1 – is the distribution of a detailed outline of each chapter (review paper). ISSC members have a one month on-line review time to send comments or additions to the ISSC Chair. Comments are then sent to the group leader, who modifies the text accordingly, while at the same time archived by the Secretary.

Step 2 –When the text and illustrations are ready, they are circulated to ISSC members for another one month on-line review. Additional comments received by the ISSC Chair are assembled and sent to the group leader for revision of the text prior to its finalization.

Step 3 – Once the papers are published in *Newsletters on Stratigraphy*, there will be reactions from the stratigraphic community at large as well as reconsiderations by the authors and other members of ISSC. Revised versions will serve as chapters of the planned textbook, and as the foundation for a revised International Stratigraphic Guide.

5.3.3 STATE OF THE ART (as of October 2014)

Papers published:
Cita, M. B. , 2007. New developments in stratigraphic classification. A project of the International Subcommission on Stratigraphic Classification ISSC: Newsletters on Stratigraphy, v. 42(2), p. 69–74.
Strasser, A., Hilgen, F. and Heckel, P., 2007. Cyclostratigraphy – concepts, definitions, and applications: Newsletters on Stratigraphy, v. 42(2), p. 75–114.
Weissert, H., Joachimski, M. and Sarthein, M., 2008. Chemostratigraphy: Newsletters on Stratigraphy, v. 42(3), p. 145–179.
Langereis, C., Krijgsman, W., Muttoni, G., and Menning, M., 2010. Magnetostratigraphy – concepts, definitions, and applications: Newsletters on Stratigraphy, v. 43(2), p. 207–233.
Catuneanu, O., Galloway, W.E., Kendall, C.G.St.C., Miall, A.D., Posamentier, H.W., Strasser, A., and Tucker, M.E., 2011. Sequence stratigraphy: Methodology and nomenclature: Newsletters on Stratigraphy, Vol. 44(3), p. 173–245.

5.3.3.1 Task Groups
Cyclostratigraphy
Leader: **Andreas Strasser**, Switzerland, andreas.strasser@unifr.ch
Fritz Hilgen, Netherlands, fhilgen@geo.uu.nl
Philip Heckel, USA, philip-heckel@uiowa.edu
Outline distributed in ISSC Newsletter 7 (June 2005).
Comments forwarded to the leader; available in the ISSC archive
Full text distributed in January 2006, comments received.
Paper published: Strasser A., Hilgen F. and Heckel P., 2007.

Chemostratigraphy
Leader: **Helmut Weissert**, Switzerland, helmut.weissert@erdw.ethz.ch
M. Joachimski, Germany, joachimski@geol.uni-erlangen.de
M. Sarnthein, Germany, ms@gpi.uni-kiel.de
Outline distributed in ISSC Newsletter 9 (June 2006).
Comments received and distributed in ISSC Newsletter 10 (November 2006)
Full text distributed in appendix to ISSC Newsletter 11 (June 2007), comments received
Paper published: Weissert, H., Joachimski, M. and Sarthein, M., 2008.

Sequence Stratigraphy
Leader: **Octavian Catuneanu**, Canada, octavian@ualberta.ca
Andreas Strasser, Switzerland, andreas.strasser@unifr.ch
Andrew Miall, Canada, miall@geology.utoronto.ca
William Galloway, USA, galloway@mail.utexas.edu
Maurice Tucker, UK, m.e.tucker@durham.ac.uk
Christopher Kendall, kendall@geol.sc.edu
Henry Posamentier, USA, henry.posamentier@chevron.com
Outline was distributed by the current group and one was distributed by previous group.
Comments from the first outline were forwarded to the leader, and made available in the ISSC archive.
Full text was distributed in 2010, and comments were incorporated.
Paper published: Catuneanu, O., Galloway, W.E., Kendall, C.G.St.C., Miall, A.D., Posamentier, H.W., Strasser, A., and Tucker, M.E., 2011 (as a stand-alone issue of the journal).

5.3.3.2 Working Groups
Biostratigraphy

A new Working Group has been appointed, owing to retirement/commitments of previous members.
Leader: **Maria Rose Petrizzo**, Italy, mrose.petrizzo@unimi.it
Mike Melchin, Canada, mmelchin@stfx.ca
Yuri Gladenkov, Russia, gladenkov@ginras.ru
Brian Pratt, Canada, brian.pratt@usask.ca
Outline in preparation. An earlier outline was circulated in ISSC Newsletter 9 (November 2006). Comments were received and distributed in ISSC Newsletter 10 (November 2006).

Full text in progress

Chronostratigraphy
Leader: **Maria Bianca Cita**, Italy, maria.bianca@unimi.it
Fritz Hilgen, The Netherlands, fhilgen@geo.uu.nl
Jacques Thierry, France, jthierry@mail.u-bourgogne.fr
Jan Zalasiewicz, U.K., jaz1@le.ac.uk
Stan Finney, USA, scfinney@csulb.edu
Brian Pratt, Canada, brian.pratt@usask.ca
Outline distributed in January 2007.
Comments received and distributed in ISSC Newsletter 11 (June 2007).
Full text in progress, half done, five case studies well selected.
Opinion piece was published in *GSA Today* and favourably received by readership.

Lithostratigraphy
Leader: **Brian Pratt**, Canada, brian.pratt@usask.ca
Stan Finney, USA, scfinney@csulb.edu
Werner Piller, Austria, werner.piller@uni-graz.at
Mike Easton, Canada, mike.easton@ndm.gov.on.ca
Outline distributed in ISSC Newsletter 11 (June 2007).
Comments received and forwarded to the leader; available in the ISSC archive.
Full text in progress, half done.

Magnetostratigraphy
Leader: **Cor Langereis**, The Netherlands, langer@geo.uu.nl
Wout Krijgsman, The Netherlands, krijgsma@geo.uu.nl
Giovanni Muttoni, Italy, giovanni.muttoni1@unimi.it
Manfred Menning, Germany, menne@gfz-potsdam.de
Outline distributed in ISSC Newsletter 12 (December 2007).
Comments received and forwarded to the leader; available in the ISSC archive.
Full text distributed in January 2009, comments received
Paper published: Langereis, C., Krijgsman, W., Muttoni, G. and Menning, M., 2010.

6. CHIEF PROBLEMS ENCOUNTERED IN 2013.
The ICS subvention allocated to ISSC was rather low and disproportionate to the overall importance and significance attributed to this subcommission at the IUGS Ad-hoc Review Committee (ARC) meeting in Paris (November 7–8 2005). The entire allocation for 2014 ($1000) was devoted to maintaining the website, assembling the newsletter, and subsidizing the chair's attendance at the EGU meeting in Vienna to attend sponsored special session and meet with secretary to plan for ISSC's role in STRATI 2015. Fortunately, Vice-Chairs Zalasiewicz and Weissert and Secretary Petrizzo were able to attend because they had separate funding.
In the meantime, progress is somewhat slow but sure, and headway is being made in the preparation of the four remaining chapters on facets of Stratigraphy.

7. SUMMARY OF EXPENDITURES IN 2014:
I. INCOME
2014 ICS subvention $1000

II. EXPENDITURES
Newsletter preparation, website maintenance, planning meeting at EGU $1000

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2015):
Final draft form:
- *Biostratigraphy*
- *Chronostratigraphy*
- *Lithostratigraphy*

Newsletter:

- December 2015

9. BUDGET AND ICS COMPONENT FOR 2015

ISSC Newsletter 20, Annual Report and website maintenance	$ 500
Subsidies to help attendance at STRATI 2015 to work over manuscript drafts	$4500
Total request	$5000

Rationale—The remaining manuscripts should be prepared in 2015. It would be desirable that as many authors as possible of individual working and task groups should have a face-to-face meeting along with other ISSC members who can contribute with their special expertise. The most obvious venues for this are the STRATI 2015 gathering, or failing that, at AAPG–SEPM, EGU or GSA annual meetings.

Potential funding sources outside IUGS—The Subcommission does not envisage being able, as an organization, to obtain significant funding from outside IUGS/ICS sources. As in previous years, some financial support is obtained by individual members from their host institutions and/or their personal research funds. In-kind support is provided to the Secretary by the Department of Earth Sciences, University of Milan for equipment including computer, e-mail access and telephone.

10. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2009-2014)

See Accomplishments in ISSC Annual Reports 2009–2014 as well as relevant newsletters.

11. OBJECTIVES AND WORK PLAN FOR NEXT 2 YEARS (2014–2016)

(1) All the remaining review papers on the various branches of Stratigraphy will have been submitted and printed over this period.
(2) The series of papers may form the core of a textbook. Publication details, including arrangements with Nägeli & Obermiller, Stuttgart (the publishers of *Newsletters on Stratigraphy*) remain to be worked out.
(3) ISSC will take the initiative to encourage special sessions and symposia at conferences that advance stratigraphic principles, in collaboration with other ICS subcommissions. Session titles have been proposed for STRATI 2015. A session entitled Earth Systems History – the Need for Integrated Stratigraphy will be held at the EGU General Assembly 2015 (EGU 2015), 12–17 April 2015, Vienna, Austria.
(4) Octavian Catuneanu is planning a draft of a chapter on Sequence Stratigraphy for inclusion in the future international Guide
(5) ISSC will continue to participate in GSSP discussions with ICS subcommissions.
(6) ISSC continues to interface with national stratigraphic commissions although only in an advisory capacity.
(7) ISSC is updating its membership list, in order to eliminate dormant colleagues and incorporate new ones.
(8) ISSC will take the initiative to contact journal editors and scholarly book publishers to remind them of the basic tenets in the existing International Stratigraphic Guide as well as relevant national codes, as well as the background in the review papers.
(9) Potential new executive members will be canvassed from stratigraphically disposed colleagues.
(10) The ULTIMATE GOAL of ISSC is the publication of a new, multi-authored, really multinational International Stratigraphic Guide—a guide not a code, simple, clear, concise, user-friendly, for world wide distribution and acceptance.

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APPENDIX ***[Names and Addresses of Current Officers and Voting Members]***

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