



INTERNATIONAL UNION OF GEOLOGICAL SCIENCES
INTERNATIONAL COMMISSION ON STRATIGRAPHY



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December 2009

Compiled ICS Subcommission Annual Reports for 2009

SUBCOMMISSION ON QUATERNARY STRATIGRAPHY

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

Subcommission on Quaternary Stratigraphy (SQS)

Philip GIBBARD*Chairman, SQS*

Cambridge Quaternary, Department of Geography, University of Cambridge, Downing Street, CAMBRIDGE CB2 3EN, England.

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2. OVERALL OBJECTIVES AND FIT WITHIN IUGS SCIENCE POLICY

1. Rationalisation of global chronostratigraphical classification.
2. Intercalibration of fossil biostratigraphies, integrated zonation and recognition of global datum points.
3. Definition of Subseries/Series boundaries and selection of global stratotype sections.
4. Correlation of Quaternary rock successions and events, including terrestrial to marine sequences.

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 what related programmes are being undertaken.

3. ORGANISATION

ISQS is a Subcommission of the International Commission on Stratigraphy.

Officers (chairman, one vice-chairman, secretary), voting members (18). (*see Appendix for complete listing*). There are currently four Working Groups established the remit of three of which is the definition of GSSPs for the Early-Middle, Middle/Late Pleistocene and Late Pleistocene/Holocene boundaries and the fourth is to investigate the validity and applicability of the term Anthropocene. A fifth working group is currently planned that will examine the utility of formal definition of short-time divisions.

These individuals represent a broad spectrum of specialised stratigraphical disciplines from throughout the World. Publication of information is by website.

3a. Nominated Officers for 2008-2010:

Chairman: Professor Philip Gibbard
Godwin Institute of Quaternary Research
Department of Geography, University of Cambridge
Downing Street, Cambridge CB2 3EN, England
E-mail: plg1@cus.cam.ac.uk

Vice-Chair: Professor Jerry McManus
Wood's Hole Oceanographic Institute
Wood's Hole, MA, USA
E-mail: jmcmanus@ldeo.columbia.edu

2nd Vice-Chair: Dr. John van Couvering (resigned September 2009)
American Museum of Natural History
Central Park West at 79 St., New York, NY 10024 USA
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E-mail: vanc@amnh.org

Secretary: Professor Thijs van Kolfschoten
Faculty of Archaeology, Leiden University
Reeuvenplaats 4, 2300 RA Leiden, The Netherlands
E-mail: T.van.Kolfschoten@rulpre.leidenuniv.nl

4. EXTENT OF NATIONAL/REGIONAL/GLOBAL SUPPORT FROM SOURCES OTHER THAN IUGS

Support of the Chairman's University (University of Cambridge), and the International Quaternary Association (INQUA). Also support from national stratigraphical bodies, including in particular the Geological Society Stratigraphical Commission (GB) and the German Stratigraphy Commission.

5. CHIEF ACCOMPLISHMENTS IN 2009

Three GSSP Working Groups are established and all continue to have fully functioning formal working groups (see below for membership lists). An additional working group on the Anthropocene was established during the year.

The Working Group on the Lower/Middle Pleistocene Subseries boundary currently comprises 11 members. It is chaired by Professor B. Pillans (ANU). Work has continued this year on the boundary to be defined in a marine section at a point “close to” the Matuyama/Brunhes boundary, three candidate GSSPs were to be evaluated: two in southern Italy (Montalbano Jonico

section and Valle di Manche section), and a third in Japan (Chiba section). Following last year's withdrawl of the Montalbano Jonico section as a candidate GSSP, investigations have continued on the choice of GSSP between the two remaining candidate sections; either the Valle di Manche section (Italy) and the Chiba section (Japan). The group had planned to have the GSSP decision made, by voting, earlier this year. However, this process was not completed, with some members asking for further information on the two candidate sections before making a decision.

Japanese and Italian colleagues have been asked to prepare final cases for their respective candidate sections. Once these are received, a summary document will be prepared, outlining the relative merits and weaknesses of each candidate section, with a view to reaching a decision early in 2010. The GSSP proposal is likely to require linkage with a proposed GSSP for the base of a 'standard stage' for the period – provisionally termed the Ionian.

The Working Group on the Middle/Upper Pleistocene Subseries boundary has continued throughout the year under the chairmanship of Professor T.Litt (Bonn). The aim was to find an agreement about the selection of a geological section for a potential boundary stratotype (GSSP).

A GSSP proposal defining the Middle/Upper (Late) Pleistocene boundary was already submitted last year. It was proposed that a high-resolution core sequence from the Amsterdam Terminal (the Eemian Stage parastratotype) should constitute the Global Stratotype Section and Point (GSSP) for the base of the Upper (Late) Pleistocene Subseries (Quaternary System/Period). The International Commission of Stratigraphy has approved this GSSP proposal. The voting by the Quaternary Subcommission was 100% "Yes" (18 voting). The votes received from the ICS Full Commission were 10 "Yes"(71%), and 4 "No". The request for IUGS ratification of this GSSP definition was considered by the IUGS Executive Committee, however especially based on procedural matters, protocol and principle, the IUGS EC did not ratify this proposal as presented by the SQS/ICS. We were encouraged to prepare a revised version, which is in preparation (with special emphasis on stage/age definition). The resubmission is planned for 2010.

The Working Group on the Pleistocene-Holocene boundary, chaired by Professor M.Walker (Lampeter), completed its primary task last year by defining the base of the Holocene Series in the new Greenland NorthGRIP (NGRIP) ice core. A publication detailing the GSSP information was published in issue 1 of the *Journal of Quaternary Science*:

Walker, M., Johnsen, S., Rasmussen, S. O., Popp, T., Steffensen, J.-P., Gibbard, P., Hoek, W., Lowe, J., Andrews, J., Björk, S., Cwynar, L. C., Hughen, K., Kershaw, P., Kromer, B., Litt, T., Lowe, D. J., Nakagawa, T., Newnham, R., and Schwander, J. 2009 Formal definition and dating of the GSSP (Global Stratotype Section and Point) for the base of the Holocene using the Greenland NGRIP ice core, and selected auxiliary records. *Journal of Quaternary Science*, 24, 3-17.

The Holocene working group will remain constituted to examine the potential utility of possible formal subdivision of the series.

The Anthropocene Working Group, chaired by Dr J.Zalasiewicz (Leicester) was created in the summer of 2009, following the proposal of the term Anthropocene by Crutzen (2002), its subsequent analysis by the Stratigraphy Commission of the Geological Society of London

(Zalasiewicz et al. 2008) and a session convened at the 2008 Fall Meeting of the American Geophysical Union on this theme.

The purpose of the Working Group is to examine the term and its underlying stratigraphic basis in more detail and to consider, and subsequently make recommendations on, its possible formalization.

Activities this year have included the submission to (and acceptance by) the Royal Society of London of a special volume of the *Proceedings of the Royal Society of London* devoted to this theme. This will include papers on historical perspectives, stratigraphic context, sedimentation, climate, land cover, ocean chemistry, cryosphere, biodiversity, deep time analogues and societal response. Publication will likely be in late 2010 or early 2011. In addition, invited papers on the Anthropocene have been submitted to the *Geological Time Scale 2010* volume being compiled (Gradstein *et al.*) and to *Environmental Science and Technology*.

The aim for the forthcoming year is to continue setting up the Working Group, to provide appropriate cover of disciplines in both ‘deep time’ stratigraphy (to include the Holocene) and in contemporary environmental phenomena, and also to provide appropriate global representation; to establish and discuss methodologies to enable realistic comparison of present and deep time processes; and to make initial comparisons of the scale of contemporary change relative to changes seen in the geological record.

In addition to the Working Group activities noted above, the Subcommission website continues to be expanded at: <http://www.quaternary.stratigraphy.org.uk> This site is used as the main line of communication for the Subcommission. It continues to be sponsored by the *Journal of Quaternary Science* and *Boreas* (published by Wiley-Blackwell publishers). The pages are maintained by Phil Gibbard.

This has been an historic year for the SQS; the dispute over the definition of the basal Quaternary/Pleistocene boundary which began in 2001, was finally brought to a close. The chair and colleagues (jointly from INQUA and SQS) were invited by the incoming ICS chair Professor Finney to make a proposal and presentation at a specially convened discussion session at the Oslo International Geological Congress in August. This discussion arises from the demand by IUGS executive that the topic must be discussed in open session to allow both parties, for and against, to air their opinions. Following this session a formal proposal was prepared jointly by SQS and INQUA colleagues that formally requests that the base of the Quaternary/Pleistocene be defined at the base of the Gelasian Stage at c. 2.558 Ma. The results of this voting round (the third in the last 3 years), which is currently in progress, will be available in the coming year.

- In connection with the voting on the definition of the Quaternary three papers have been published:
- Gibbard, P. & Head, M.J. 2009 The definition of the Quaternary System/Period and the Pleistocene Series/Epoch. *Quaternaire* 20, 125-133.
- Gibbard, P.L. & Head, M.J. 2009 IUGS ratification of the Quaternary System/Period and the Pleistocene Series/Epoch with a base at 2.58 Ma. *Quaternaire* 20, 271-272 (in press).
- Gibbard, P. Head, M.J., Walker, M.J.C. & The Subcommission on Quaternary Stratigraphy 2009 Formal ratification of the Quaternary System/Period and the Pleistocene Series/Epoch with a base at 2.58 Ma. *Journal of Quaternary Science*, DOI: 10.1002/jqs.1338 (in press).

6. SUMMARY OF EXPENDITURE IN 2009:

Cost of website domain name	£10.00
Colour printing for three articles in special volume Episodes	£76.33
	£161.04
	£322.08
TOTAL	£569.45

7. SUMMARY OF INCOME IN 2009:

Amount received from ICS	*none received in 2009
Royalty for use of illustration Iwanami Shoten Publishers	£25.00
Amount received from Wiley-Blackwell (website sponsorship)	£200
TOTAL	£225.00

8. BUDGET FROM ICS IN 2009-10

Actual costs 2009

Amount carried over from 2008	£1180.42
Expenditure	£569.45
Income	£225.00
Current balance	£820.97

Proposed costs for 2010

Contribution towards cost of website (5 year subscription)	£50
Contributions to Working Groups	£100
Support for meetings	£200

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

All three working groups will continue to function in 2010. The Working Group on the Pleistocene-Holocene Boundary will change focus to examine the possibility of defining formal subdivisions for the Holocene. Other groups will also continue their deliberations. The additional working group is now being established by Dr J. Zalasiewicz on the definition and status of the term Anthropocene. At the time of writing he has already established a working-group membership of 10 colleagues. As noted above, a fifth working group is being planned. This group will be charged with the task of assessing the case for formal definition of short-time divisions of the Quaternary. Professor Martin Head (Brock University, St.Catherines) has

already agreed to convene this group and some workers have already expressed an interest in joining the group.

Potential funding sources outside IUGS

Apart from on-going sponsorship of the website, financial support will be sought by individual members from their grant-awarding bodies for specific projects, such as research projects and meetings, but support has also been received from INQUA through continued interaction with the INQUA Commission on Stratigraphy and Geochronology.

10. OBJECTIVES AND WORK PLAN FOR NEXT 2 YEARS (2010-2011)

The Science plan to be completed before the year 2010 will be as follows:

- a. Formalisation of Global Stratotype section and Points (GSSP) for the Lower/Middle and for the Middle/Upper subseries/subepoch boundaries of the Pleistocene Series/Epoch. The formal nomenclature for the subseries/subepoch divisions of the Pleistocene will be Lower/Early, Middle/Mid, and Upper/Late.
- b. No international stage-level subdivisions for the Pleistocene or Holocene will be formalised.
- c. The voting members, and make-up of each GSSP task group, should strive to provide a uniform coverage of terrestrial, shallow-marine and pelagic settings with global coverage.
- d. As noted above, the Subcommission will investigate the need and potential value in establishing the term Anthropocene for the last 200 yr or so, i.e. the period during which human modification of natural systems has become predominant.
- e. As noted above, a fifth working group will assess the case for formal definition of short-time divisions of the Quaternary.
- f. Progress and discussions within the Subcommission are summarised and communicated through the SQS website.

Together the officers “will compile a list of active persons willing to act as voting members. The latter will consist of individuals who will represent the widest-possible range of Quaternary stratigraphical expertise and will include no more than two persons from each geographical region”. The full list is given below.

PL GIBBARD
Cambridge
6.11.09

APPENDIX [Names and Addresses of Current Officers and Voting Members)

Nominated officers

Chairman: Professor Philip Gibbard
Cambridge Quaternary
Department of Geography, University of Cambridge
Downing Street, Cambridge CB2 3EN, England
E-mail: plg1@cus.cam.ac.uk

Vice-Chair: Professor Jerry McManus
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2nd Vice-Chair: Dr. John van Couvering (resigned September 2009) – this officer will not be replaced.

American Museum of Natural History
Central Park West at 79 St., New York, NY 10024 USA
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Secretary: Professor Thijs van Kolfschoten
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Dr Sune Olander Rasmussen
Centre Coordinator
Centre for Ice and Climate
Niels Bohr Institute
University of Copenhagen
Denmark
Ph:)
Fax:
E-mail: olander@nbi.ku.dk

Working group leaders and corresponding members

Working Group on the Pleistocene/Holocene Boundary

convenor: Professor M.J.C. Walker (Lampeter)

members:

INTIMATE group members

Working Group on the Middle/Late Pleistocene Boundary

convenor: Professor Thomas Litt (Bonn, Germany) t.litt@uni-bonn.de

members:

Dr. Art Bettis (Iowa, USA) art-bettis@uiowa.edu

Dr. Aleid Bosch (Zwolle, The Netherlands) A.Bosch@nitg.tno.nl

Dr. Andrey Dodonov (Moscow, Russia) dodonov@geo.tv-sign.ru

Professor Philip Gibbard (Cambridge, UK) plg1@cus.cam.ac.uk

Prof. Liu Jiaqi (Beijing, China) liujiaqi2001@yahoo.com.cn

Prof. Peter Kershaw (Clayton, Australia) Peter.Kershaw@arts.monash.edu.au

Prof. Wighart von Koenigswald (Bonn, Germany) koenigswald@uni-bonn.de

Dr. Jerry McManus (Wood's Hole, USA) jmcmanus@whoi.edu

Prof. Tim Partridge (Johannesburg (South Africa)

Dr. Charles Turner (Milton Keynes, UK) c.turner@open.ac.uk

Working Group on the Early/Middle Pleistocene Boundary

convenor: Professor Brad Pillans (Canberra)

members:

Professor Thijs van Kolfschoten (Leiden),

Professor Anastasia Markova (Moscow),

Professor Jiaqi Lui (Beijing),

Dr Charles Turner (Cambridge),

Professor Luc Lourens (Utrecht),

Dr Martin Head (Cambridge),

Dr Cesare Ravazzi (Bergamo),

Dr Craig Feibel (New Jersey)

Dr Tom Meijer (Leiden).

Working Group on the Anthropocene

convenor: Dr J. Zalasiewicz (Leicester)

members (to date):

Paul Crutzen (Mainz, Germany)
Eric O'Dada (Nairobi, Kenya)
Erle Ellis (Baltimore, USA)
Mike Ellis (BGS, UK)
Philip Gibbard (Cambridge; Chair SQS)
Alan Haywood (Leeds, UK)
Andrew Kerr (Cardiff, UK)
Carlos Nobre (INPE, Brazil)
Simon Price (BGS, UK)
Will Steffen (ANU, Australia)
Mark Williams (Leicester, UK; Secretary)
An Zhisheng (Xian, China))

Working Group on the short-time divisions
convenor: Professor Martin Head (Brock University, St.Catherines)

potential members:

Professor Allan Mix (Oregon State University, Corvallis, USA)
Professor Michal Kucera (Tübingen, Germany)

PL GIBBARD
Cambridge
00.10.09

SUBCOMMISSION ON NEOGENE STRATIGRAPHY

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

Subcommission on Neogene Stratigraphy (SNS)

Frederik J. Hilgen, Chairman SNS
Faculty of Geosciences, Utrecht University
P.O. Box 80021, 3508 TA Utrecht, Netherlands. E-mail: fhilgen@geo.uu.nl.

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. ORGANIZATION

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 21 voting members and 35 corresponding members (*see Appendix for full list of officers and voting members*). The SNS has presently one active working group for defining the GSSP remaining for the Langhian and Burdigalian chaired by Isabella Raffi. The SNS web site (www.geo.uu.nl/SNS) is used for news release and contains the following sections: Home, News, Board, Members, Newsletters, GSSP's, and Links.

3a. Officers for 2008-2012:

Chair: Frits Hilgen, Utrecht, The Netherlands

Vice-Chairs: Francisco Javier Sierro, Salamanca, Spain
David Hodell, Cambridge, UK

Secretary: Elena Turco, Parma, Italy

Support for the SNS comes from the Chairman's Institute in the Netherlands (Faculty of Geosciences, Utrecht University). This institute also hosts the SNS web-site.

4. 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.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009

A short paper about the formal definition of the Serravallian GSSP following ratification by IUGS has finally been accepted for publication in *Episodes* and will still be published this year (Hilgen et al., 2009).

An integrated magnetostratigraphic and calcareous plankton stratigraphic study has been carried out on the downward extension of the La Vedova section near Ancona (central Italy) which is one of the most promising, potential boundary stratotype sections for defining the Langhian GSSP (Iaccarino et al., 2009). The La Vedova section itself has been studied in detail and an astronomical tuning has been established (Hüsing et al., 2009). An alternative section to define the Langhian GSSP is St. Peter's Pool located on Malta for which a preliminary astronomical tuning and astrobiochronology was introduced ((Mazzei et al., 2009; Lirer et al., 2009)). Both sections were presented in considerable detail at the RCMNS congress in Napels (2-6 September). The study of these sections is part of the ongoing Italian research project (PRIN 2006 - prot. 2006047534 - "In search of the Global Stratotype Sections and Points of the Burdigalian and Langhian Stages and paleoceanographic implications") directed at defining the remaining GSSPs (Langhian and Burdigalian) in the Neogene.

In the aftermath of the debate and formal decision on the definition and status of the Quaternary, members of SNS were heavily involved in the publication of several papers to express the general viewpoint and concern of the Neogene community (Aubry et al., 2009; McGowran et al., 2009; Van Couvering et al., 2009).

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

A remaining problem 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 alternative option to have this boundary defined in (I)ODP cores is being seriously considered by the Working Group on the Langhian and Burdigalian GSSPs, and a decision about this issue will probably be made in 2010.

The other main problem is the outcome of the ICS vote on the Quaternary issue and the formal ratification by IUGS which is considered unacceptable by many SNS members.

7. SUMMARY OF EXPENDITURES IN 2009:

Credit on Nov 2008	Euro	3428,60
Contribution 2009 ICS to SNS	Euro	+1394,84
RCMNS Napels Hilgen	Euro	-879,98
Episodes article costs	Euro	-191,73
Banking costs	Euro	-12,88
Credit on Nov 2009	Euro	3738,85

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2009):

The study of the two potential boundary stratotype sections of La Vedova and St. Peter's Pool for defining the Langhian GSSP will be continued. Continuing search for suitable sections and/or cores for defining the Burdigalian GSSP. In absence of suitable Mediterranean sections for defining the Burdigalian GSSP, the option to formally designate this boundary in an ODP core will be seriously explored.

9. BUDGET AND ICS COMPONENT FOR 2009

Organization workshop on base-Langhian and base-Burdigalian Euro 1500
Optional: Fieldtrip to the La Vedova section (base-Langhian) Euro 1500

10. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2005-2009)

See Accomplishments in 2009 (above) for additional details.

2005

Selection of the Ras il Pellegrin section on Malta as the most suitable (Mediterranean) section to define the Serravallian GSSP and the mid-Miocene Mi-3b oxygen isotope event as prime guiding criterion for the boundary. Preparation of the Serravallian GSSP proposal.

2006

Serravallian GSSP proposal was sent out to SNS voting members; a quorum of about 86% was reached and all votes were positive except for one which was positive but with reservations. Submission of revised proposal to ICS and acceptance of proposal by ICS with a 83% majority. Submission of the Serravallian GSSP proposal to IUGS for formal ratification.

2007

Ratification of the Serravallian GSSP proposal by IUGS. Pilot study of the La Vedova section, a candidate section for the Langhian GSSP. Revision and update of SNS website.

2008

Integrated stratigraphic studies of the La Vedova section and its downward extension by Italian and Dutch research teams, the latter section being candidate for defining the Langhian GSSP. Revision and update of SNS website. Publication of several papers on the definition and status of the Quaternary and Neogene. Preparation of a “Neogene” proposal for the formal ICS voting procedure on the Quaternary-Neogene issue.

11. OBJECTIVES AND WORK PLAN FOR NEXT 2 YEARS (2009-2010)

Organization of a workshop 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. Potentially suitable sections in the Mediterranean region that may serve as Langhian GSSP have been identified (La Vedova; 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, and 3) 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 landbased section, or should we define this GSSP in drilled ODP sequences at Ceara Rise or any other tuned sequence drilled by (I)ODP.

Selection of most suitable section/ODP core and guiding criteria for defining the Langhian and Burdigalian GSSPs before 2012. Writing of proposals for the Langhian and Burdigalian GSSPs in 2010-2012.

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

Subcommission officers

Chairman: Frederik J. Hilgen, Faculty of Geosciences, Utrecht University, P.O. Box 80021, 3508 TA Utrecht, The Netherlands, e-mail: fhilgen@geo.uu.nl

Vice Chairmen: David Hodell, Department of Geological Sciences, University of Florida, Gainesville, FL 32611, USA. Email: dhodell@geology.ufl.edu

Now at: University of Cambridge, UK

Francisco Javier Sierro Sánchez, Departamento de Geología, Facultad de Ciencias, Universidad de Salamanca, 37008 Salamanca, España. Email: sierro@usal.es

Secretary: Elena Turco, Dipartimento di Scienze della Terra, Universita' degli Studi di Parma, Viale G.P. Usberti 157A, 43100, Parma, Italia. Email: elena.turco@unipr.it

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References:

- Aubry, M.P., W.A. Berggren, J. Van Couvering, B. McGowran, F. Hilgen, F. Steininger, L. Lourens, 2009. The Neogene and Quaternary: chronostratigraphic compromise or non-overlapping magisteria? *Stratigraphy*, 6, 1-16.
- Hilgen, F.J., H.A. Abels, S. Iaccarino, W. Krijgsman, I. Raffi, R. Sprovieri, E. Turco and W.J. Zachariasse, 2009. The Global Stratotype Section and Point (GSSP) of the Serravallian Stage (Middle Miocene). *Episodes*.
- Iaccarino, S.M., E. Turco, A. Cascella, R. Gennari, F.J. Hilgen, and L. Sagnotti, 2009. Integrated stratigraphy of La Vedova section (Conero Riviera, Italy), a potential candidate for the Langhian GSSP. 13th RCMNS conference Napels, abstract vol.
- Mazzei, R., N. Baldassini, S. Da Prato, L.M. Foresi, F. Lirer, G. Salvatorini, M. Verducci, M. Sprovieri, 2009. The St. Peter's Pool section in the Malta Island. Work in progress on the Langhian GSSP. 13th RCMNS conference Napels, abstract vol.
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- Van Couvering, J.A., M.-P. Aubry, W.A. Berggren, F.M. Gradstein, F.J. Hilgen, D.V. Kent, L.J. Lourens, and B. McGowran, 2009. What, if Anything, is Quaternary? Episodes

SUBCOMMISSION ON PALEOGENE STRATIGRAPHY

ANNUAL REPORT 2009

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.

3. ORGANIZATION

ISPS is a Subcommission of the International 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. There are 20 Voting Members (Mikhail Akhmetiev, Marie Pierre Aubry, Rodolfo Coccioni, Vlasta Cosovic, Richard H. Fluegeman, Jean Pierre Gely, Philip D. Gingerich, Yuri B. Gladenkov, Jan Hardenbol, Christopher J. Hollis, Jerry J. Hooker, Kenneth G. Miller, Eustoquio Molina, Simonetta Monechi, Carolina Nañez, Heiko Palike, Birger Schmitz, Ellen Thomas, Noël Vandenbergh and Dalila Zaghibib-Turki) 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.

Under the umbrella of the Subcommission, we set up Working Groups and Regional Committees. At present are active the following:

- 1) Paleocene Working Group. Chairman: Birger Schmitz, Sweden.
- 2) Ypresian/Lutetian Boundary Stratotype Working Group. Chairman: Eustoquio Molina, Spain. Secretary: Silvia Ortiz, Spain.
- 3) Lutetian/Bartonian Boundary Stratotype Working Group. Chairman: Richard Fluegeman, USA.
- 4) Bartonian/Priabonian Boundary Stratotype Working Group. Chairwoman: Isabella Premoli Silva, Italy.
- 5) Rupelian/Chattian Boundary Stratotype Working Group. Chairwoman: Isabella Premoli Silva, Italy.
- 6) Paleogene Planktonic Foraminifera Working Group. Chairwoman: Bridget Wade, USA. Secretary: Hellen Coxall, UK.
- 7) Paleogene Larger Foraminifera Working Group. Chairman: Lukas Hottinger, Switzerland.
- 8) Paleogene Deep-Water Benthic Foraminifera Working Group. Chairman: Michael Kaminski, UK. Secretary: Laia Alegret, Spain.
- 9) Paleogene Calcareous Nannofossils Working Group. Chairwoman: Simonetta Monechi, Italy.
- 10) Regional Committee in North-European Paleogene Stratigraphy. Chairwoman: Gitte Vestegaard Laursen, Norway. Secretary: Rui da-Gama, Netherlands.
- 11) South-American Regional Committee on Paleogene Stratigraphy. Chairman: Carlos Jaramillo, Panama. Secretary: Carolina Nañez, Argentina.
- 12) Russian Paleogene Commission. Chairman: Mikhail A. Akhmetiev, Russia. Secretary: G.N. Aleksandrova.
- 13) Working Group on Paleogene Stratigraphy of the North Pacific. Chairman: Yuri B. Gladenkov, Russia.

Furthermore, the Subcommission sponsors and International Meeting on the Paleogene about every two years: Zaragoza, Spain (1996); Göteborg, Sweden (1999); Powell, USA (2001); Leuven, Belgium (2003); Luxor, Egypt (2004); Bilbao, Spain (2006); Wellington, New Zealand (2009).

Officers for 2008-2012:

Chair: Prof. Eustoquio Molina. Departamento de Ciencias de la Tierra. Universidad de Zaragoza. Calle Pedro Cerbuna, 12. E-5009 Zaragoza. Spain. emolina@unizar.es

Vice-Chair: Prof. Nöel Vandenberghe. Department Geografie-Geologie. Afdeling Geologie. Redingenstraat, 16. B-3000 Leuven. Belgium. noel.vandenberghe@geo.kuleuven.be

Secretary: Prof. Simonetta Monechi, Dipartimento di Scienze della Terra. Universitá di Firenze. 4, Via la Pira. I-50121 Firenze. Italy. monechi@unifi.it

Procedure used for selection: The procedure was suggested by the Secretary of ICS. Consequently, we sent an e-mail to all Subcommission voting members that invites nominations for Chair and Vice-Chair: *"In order to comply with the ICS procedures for the composition of the board of ISPS, in the light of the IGC 2008 next year, ISPS needs to communicate to ICS the composition of its board. At present Eustoquio Molina is chairman, Jan Hardenbol is vice chairman and the secretary is Noël Vandenberghe. The secretary being a non elected office, we have to propose to ICS only a chairman and a vice-chairman. The present board proposes to reappoint Eustoquio Molina for a second 4 years term (2008-2012). Jan Hardenbol having served 8 years would like to be replaced as vicechairman. The present Chair and vice Chair nominate Noel Vandenberghe, the current secretary, to the position of Vice Chair. If you concur or want to nominate someone else let us know ASAP and at the latest before 11/15. We will inform you of the nominations obtained and the consequent proposition the present board will do to ICS, who needs our proposition by 15th of November"*. The result was: No other nominees apart from us, 12 responded supporting our nominations and 8 did not respond. The new Secretary was appointed with the support of the current Chairman, Vicechairman and Secretary.

Website status and activities: The Web address for ISPS site is: <http://wzar.unizar.es/isps/index.htm> The web site content is the following: Home (overall objectives, organization), Past & Future (accomplishments, problems and plans), Working Groups and Regional Committees (annual reports), Literature (a selection of monographies on the Paleogene). News/Books (two monographies on Paleogene Stratigraphy edited by Luterbacher and Vandenberghe in 2004) and News/Events (Symposium on the Paleogene of South, Central America and the Caribbean, La Plata, Argentina, 20-24th September, 2010).

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

Some of our members participate also in the work of the following International projects:

Ocean Drilling Programme.
International Subcommissions on Cretaceous and Neogene Stratigraphy.
International Geoscience Programme (IGCP).
ProGEO, Geosites and Geoparks Initiatives.
UNESCO World Heritage Sites.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009

5a. Progress with selection of GSSPs for Paleogene Stages.

Danian (Cretaceous/Paleogene boundary): The GSSP for the base of the Danian was defined in the El Kef Section (Tunisia) and ratified by the IUGS in 1991. However, this GSSP was not officially published in a prestigious stratigraphical journal of wide distribution. Since that time, some problems arose because the detailed proposal was unknown to many scientists working on the K/Pg boundary, new sections in Mexico were found and controversial interpretations were proposed. Therefore, in order to resolve these problems, the ICS has required the ISPS to finally publish the proposal and it was published in *Episodes*: Molina E., Alegret L., Arenillas I., Arz J.A., Gallala N., Hardenbol J., Von Salis K., Steurbaut E., Vandenbeghe N. & Zaghibib-Turki D. (2006). The Global Boundary Stratotype Section and Point for the base of the Danian Stage (Paleocene, Paleogene, "Tertiary", Cenozoic) at El Kef, Tunisia - Original definition and revision. *Episodes*, 29(4), 263-278. In 2009 a second paper has been published in *Episodes*: Molina, E., Alegret, L., Arenillas, I., Arz, J.A., Gallala, N., Grajales-Nishimura, J.M., Murillo-Muñetón, G. & Zaghibib-Turki D. (2009). The Global Boundary Stratotype Section and Point for the base of the Danian Stage (Paleocene, Paleogene, "Tertiary", Cenozoic): auxiliary sections and correlation. *Episodes*. 32 (2), 84-95.

Paleocene (Selandian and Thanetian): During 2009 in May several of the members of the PWG participated in a major film project, directed by Alberto J. Gorritiberea and Asier Hilario, about the Zumaia section, including coverage of the two GSSPs in the section. Early in 2009 we were reached by the decision that the ICS had approved and ratified the suggested GSSPs for the D-S and S-T boundaries. During the year work has focussed on finalizing the final document on the GSSPs for publication in *Episodes*. This is planned to be submitted in time prior to a formal inauguration procedure in Spring 2010.

Ypresian (Paleocene/Eocene boundary): The Working Group completed its task and proposed to place the GSSP for the base of the Eocene Series in the Dababiya Section near Luxor in Upper Egypt. The GSSP is located at the base of the Carbon Isotope Excursion, which was selected as the criterion for the recognition of the Paleocene/Eocene boundary in 2002. The proposed boundary section has a good chemostratigraphic (stable isotopes) and biostratigraphic record. The "Benthic Foraminiferal Extinction Event", the peculiar planktonic foraminiferal and calcareous nannoplankton assemblages linked to the Initial Eocene Thermal Maximum are well represented in connection with the Carbon Isotope Excursion. The proposal for this GSSP was accepted by the ISPS (May 2003) and the ICS (August 2003) and ratified by the IUGS (August

2004). A complete documentation of the proposed GSSP was published by Micropaleontology Press and the official definition was published in Episodes: Aubry M.P., Ouda K., Dupuis, C., Berggren W.A., Van Couvering J.A. and the Members of the Working Group on the Paleocene/Eocene Boundary (Ali J., Brinkhuis H., Gingerich P.R., Heilmann C., Hooker J., Kent D.V., King C., Knox R., Laga P., Molina E., Schmitz B., Steurbaut E. and Ward D.R.) (2007). The Global Standard Stratotype-section and Point (GSSP) for the base of the Eocene Series in the Dababiya section (Egypt). *Episodes*. 30(4), 271-286.

Lutetian: After many years searching for a suitable section to define the Ypresian/Lutetian boundary Stratotype, the Gorrondatxe section was found and the Lutetian GSSP was defined in a very expanded and continuous section. The Ypresian/Lutetian Working Group decided, during the final Workshop in Getxo (near Bilbao, Spain) in September 26, 2009, to define the Lutetian GSSP at meter 167.85 of the Gorrondatxe section in a dark marly level where the nannofossil *Blackites inflatus* first appears, approximately 48 Ma ago. Two candidate sections Agost and Gorrondatxe were proposed and the Lutetian GSSP at Gorrondatxe was elected by consensus after long discussions. All the events near the base of the Lutetian Stage were discussed and it was considered that the absence of *B. inflatus* is not so certain and relevant like the presence of *B. inflatus* in the lower sample of the Lutetian Stage Stratotype found by Aubry (1986) in Palaeo.Palaeo.Palaeo. The FO of *Discoaster sublodoensis* was considered too old because it appears in Chron 22n, which is clearly Ypresian. Consequently, it was considered that the FO of *B. inflatus* is the best marker because it appears at or just below the base of the Lutetian Stage Stratotype of Paris. Furthermore, in the lower Lutetian of Paris there is *Nummulites laevigatus* and in Gorrondatxe the first sample above, with larger foraminifera, contains the first *Nummulites laevigatus* like in the Paris basin. Planktic foraminifera were not used because of their absence in the Lutetian Stage Stratotype in Paris. Nevertheless, it is clear that the first appearance of *Hantkenina* in all the sections studied is about 4 Ma younger than the FO of *B. inflatus*. The report to be voted by ISPS, ICS and IUGS is being prepared. The following papers co-authored by the members of the Y/L Working Group were published:

- Larrasoña, J.C., Gonzalvo, C., Molina, E., Monechi, S., Ortiz, S., Tori, F. & Tosquella, J. (2008). Integrated magnetobiochronology of the Early/Middle Eocene transition at Agost (Spain): implications for defining the Ypresian/Lutetian boundary stratotype. *Lethaia*. 41, 395-415.
- Ortiz, S., Gonzalvo, C., Molina, E., Rodríguez-Tovar, F.J., Uchman, A., Vandemberghe, N., & Zeelmaekers, E. (2008). Palaeoenvironmental turnover across the Ypresian-Lutetian transition at the Agost section, southeastern Spain: in search of a marker event to define the Stratotype for the base of the Lutetian Stage. *Marine Micropaleontology*. 69, 297-313.
- Payros, A., Orue-Etxebarria, X., Bernaola, G., Apellaniz, E., Dinarès-Turell, J., Tosquella, J., & Caballero, F., (2008). Characterization and astronomically calibrated age of the first occurrence of *Turborotalia frontosa* in the Gorrondatxe section, a prospective Lutetian GSSP: implications for the Eocene time scale. *Lethaia*. 42, 255-264.
- Payros, A., Tosquella, J., Bernaola, G., Dinarès-Turell, J., Orue-Etxebarria, X. & Pujalte, V. (2009). Filling the North European Early/Middle Eocene (Ypresian/Lutetian) boundary gap: Insights from the Pyrenean continental to deep-marine record. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 280, 313-332.

Bartonian: The work of the Lutetian-Bartonian Boundary Working Group during 2007, 2008 and 2009 has continued its focus on the base of magnetic polarity chron 19N as a guide horizon for the base of the Bartonian. For the base of chron 19N to be a useful guide horizon for the base of the Bartonian Stage, its correlation potential must be demonstrated. The working group has continued to focus field and laboratory studies on the correlation potential of this horizon. The section along the Contessa Highway near Gubbio, Italy remains the primary candidate for a GSSP. Historically, this section has been the focus of important biostratigraphic studies of planktonic foraminifera and calcareous nannofossils. The Contessa Highway section also contains an excellent magnetic stratigraphy record in the Paleocene and Eocene. Results of a high-resolution geomagnetic, geochemical, and biostratigraphic study of the Contessa Highway section were published during 2007 (Jovane et al. 2007). Studies of the Barton Clay at Alum Bay and Barton-on-Sea, U.K: Further study of the Barton Clay at Barton-on-Sea and at Alum Bay on the Isle of Wight is desirable to clarify the magnetic stratigraphy of the traditional "unit stratotype" of the Bartonian. Magnetic stratigraphy has been completed on the underlying Bracklesham beds on the Isle of Wight and correlated with polarity chronozones through the use of calcareous nannofossils. To date, no paleomagnetic data has been collected from the Barton Clay. Results from this work will enhance our understanding of the chronostratigraphy of the type Bartonian and enable better decision-making when selecting a final GSSP. Future Work: Identifying reliable biostratigraphic horizons to serve as additional guides to the base of the Bartonian remains a challenge. Several important biostratigraphic events occur near, but not precisely at, this horizon and may assist with correlation. Several of these events are listed in Fluegeman (2007). The working group hopes to complete its work and propose a GSSP for the Bartonian by 2011. References:

Fluegeman, R. H., 2007, Unresolved issues in Cenozoic chronostratigraphy. *Stratigraphy*, vol. 4, p. 109-116.

Jovane, L., Florindo, F., Coccioni, R., Dinarès-Turell, J., Marsili, S., Monechi, S., Roberts, A. P., and Sprovieri, M., 2007, The middle Eocene climatic optimum event in the Contessa Highway section, Umbrian Apennines, Italy: *Geological Society of America bulletin*, vol. 119, p.413-427; doi: 10.1130/B25917.1.

Priabonian: Tasks of the Italian scientific community were to search for GSSPs of the Middle-Upper Eocene and Lower-Upper Oligocene Transitions. Investigations on both transitions have been undertaken by a number of researchers from several Italian Universities (i.e. Padua, Ferrara, Florence, Urbino, Milan) and CNR Institutes as well as from some European and USA Universities and Institutions of the "ALANO NET" and by the numerous scientists of the OLIS Working Group coordinated by Rio (University of Padua) and Coccioni (University of Urbino), respectively. During the first half of 2009 the multidisciplinary studies on the Alano di Piave section (Veneto region, NE Italy), the potential candidate for defining the GSSP of the Middle/Upper Eocene, equated to the base of the Priabonian Stage, have been completed. An article, entitled "Integrated bio-magnetostratigraphy of the Alano section (NE Italy): a proposal for defining the Middle-Late Eocene boundary" co-authored by Agnini, Fornaciari, Giusberti, Grandesso, Rio & Stefani (Univ of Padua), Lanci (Univ. of Urbino), Luciani (Univ. of Ferrara), Muttoni (Univ. of Milan), Palike & Spofforth (Univ. of Southampton, UK), have been submitted for publication to the Geological Society of America Bulletin in August 2009; it was already reviewed and the revised version will be returned to the Editor before the end of October. The Alano section consists of ca. 120-130 m of bathyal gray marls interrupted in the lower part by 8

meters-thick package of laminated dark to black marlstones. Intercalated in the section there are prominent marker beds, six of which are crystal tuff layers, whereas the other two bioclastic rudites, useful for regional correlation. The section is easily accessible, crops out continuously, is unaffected by any structural deformation, is rich in calcareous plankton and contains an expanded record of the critical interval for defining the GSSP of the Priabonian. Integrated calcareous plankton quantitative biostratigraphy (nannofossils and foraminifera), and a detailed magnetostratigraphic analysis have been conducted in high resolution especially across the critical intervals for defining the Priabonian Stage. Moreover, the depositional paleodepth of the Alano section was estimated through the study of benthic foraminifera, whereas the detailed oxygen and carbon isotope curve for the entire section is included in another paper, submitted to Paleoceanography also in 2009, by Spofforth and co-authors entitled "Organic Carbon Burial following the Middle Eocene Climatic Optimum (MECO) in the central-western Tethys"

Rupelian (Eocene/Oligocene boundary): The GSSP for this boundary was selected in the Massignano Section (central Italy), ratified by the IUGS in 1992 and officially published by Premoli Silva and Jenkins (1993). Decision on the Eocene-Oligocene boundary stratotype. *Episodes*. 13(3), 379-382.

Chattian: The formal proposal of the GSSP for the Rupelian/Chattian boundary at the Monte Cagnero section (Umbria-Marche basin, NE Apennines, Italy) is in progress under the leadership of R. Coccioni and A. Montanari, two of the co-authors of the paper on "Integrated stratigraphy of the Oligocene pelagic sequence in the Umbria-Marche basin (Northeastern Apennines, Italy): A potential GSSP for the Rupelian/Chattian boundary", published on the GSA Bulletin v. 120 in 2008.

5b. Annual reports 2008 of the other working groups

Paleogene Planktonic Foraminifera Working Group.

Chairwoman: Bridget Wade, USA. Secretary: Helen Coxall, UK.

The Paleogene Planktonic Foraminifera Working Group continued their work towards a major revision of the Oligocene planktonic foraminifera. A meeting attended by 14 members was held at the University of Fribourg in June hosted by Silvia Spezzaferi. Here the group reported on progress and discussed species concepts over first drafts of illustrative taxonomic plates, collated through the hard work of Dick Olsson with members contributing numerous SEM images of representative specimens from around the globe. The inventory of Oligocene type SEM images has also continued to grow, thanks to the efforts of Brian Huber and other members in tracking down as many of these essential reference specimens as possible from far flung official and unofficial repositories. Phylogenetic frameworks for many lineages have now started to crystallize. For the Oligocene, which contains the roots of many modern planktonic lineages, this has been aided by the results of molecular studies on Recent species. Michal Kurcera's report at the Fribourg meeting this year for example, provided insight into possible relationships among Oligocene Globorotaloides, Globigerinella and microperforates after the recent gene-sequencing

of modern counterparts. Responsibilities for individual taxonomic chapters of the future Oligocene Atlas have been defined and the goal for the next meeting (Stockholm University or Amherst, UMAS) is to have draft versions of text. It has been agreed that our Oligocene studies should extend to the base of the early Miocene where necessary to follow the evolution of a number of key lineages that straddle the Oligocene-Miocene boundary.

Paleogene Larger Foraminifera Working Group.

Chairman: Lukas Hottinger, Switzerland.

I have been discharged two years ago from the responsibility of leading the working group of larger foraminifera. Therefore I can give you only my personal contributions of the matter at hand. My state of health does not permit me to do fieldwork anymore but there are many corpses in the cellar awaiting a decent burial. Thus, I have finished and published a monograph on the Miscellaneidae and am working now on a revision of the larger Tethyan Paleogene Rotaliidae, mainly from Pakistan and Oman. This paper is scheduled to go to print in the same place in spring next year. Publications on paper take more and more time and increasing amounts of funding to be published. I have no more energy and time to wait. At request of the Museum Basel I just finished a bibliographic list of 2009:

Hottinger, L. (2009). The Paleocene and Earliest Eocene foraminiferal family Miscellaneidae: neither nummulitids nor rotaliids. *Carnets de Géologie*, article 2009/06, PDF p. 1-41.

Bassi, D., Hottinger, L. & Iryu, Y. (2009). Reassessment of "Boueina" pacifica Ishijima 1978 (Orbitolininae, Foraminiferida). Formerly considered as a green halimedacean alga. *Journal Foraminiferal Research*. 39 (2), 120-125.

Hottinger, L. & Caus, E. (2009). Meandropsinidae, an ophtalmidid family of Late Cretaceous K-strategist foraminifera endemic in the Pyrenean Gulf. *Neues Jahrbuch Geologie Paläontologie, Abhandlungen*, vol. 253, no. 2-3, p. 249-279.

Boix, C., Vilalonga, R., Caus, E. & Hottinger, L. (2009). Late Cretaceous rotaliids (Foraminiferida) from the Western Tethys. *Neues Jahrbuch Geologie Paläontologie, Abhandlungen*. 253, 197-227.

Vicedo, V., Aguilar, M., Caus, E. & Hottinger, L. (2009). Fusiform and laterally compressed alveolinaceans (Foraminiferida) from both sides of the Late Cretaceous Atlantic. *Neues Jahrbuch Geologie Paläontologie, Abhandlungen*. 253 (2-3), 229-247.

Paleogene Deep-Water Benthic Foraminifera Working Group.

Chairman: Michael Kaminski, UK. Secretary: Laia Alegret, Spain.

The Paleogene Deep-Water Benthic Foraminiferal Working Group has continued its researches this year, investigating the benthic foraminiferal turnover and distribution across the Paleogene. Special attention has been paid to the following intervals: 1.- The Cretaceous/Paleogene transition: Investigations have been concentrated on the Pacific Ocean, where a new species (*Adercotryma kuhnti*) has been described, and the evolution of the food supply to the seafloor after the K/Pg boundary has been studied. 2.- The Paleocene Eocene Thermal Maximum: The extinction event of deep-water benthic foraminifera has been identified at the base of the Eocene in two Spanish sections, and its potential causes have been analyzed in detail. Environmental instability during the latest Paleocene, and the recovery of the assemblages during the early Eocene have been investigated. 3.- The Ypresian/Lutetian boundary: The group has been looking

for benthic foraminiferal events and potential sections to locate the GSSP of the base of the Lutetian Stage. Finally, after a successful meeting in Getxo (Spain), during the Workshop on the Ypresian/Lutetian boundary stratotype, the Gorrodatxe section was selected as the GSSP of the base of the Lutetian. 4.- Oligocene: A Ph.D thesis on Oligocene benthic foraminifera will be presented by the end of this year by R. Fenero (University of Zaragoza). References:

Alegret, L. and Thomas, E. (2009). Food supply to the seafloor in the Pacific Ocean after the Cretaceous/Paleogene boundary event. *Marine Micropaleontology*, 73: 105-116.

Alegret, L. and Thomas, E. (2009). Cretaceous evolution of the genus *Adercotryma* (Foraminifera) in the deep Pacific. *Micropaleontology*, 55 (1): 49-60.

Alegret, L., Ortiz, S., Orue-Etxebarria, X., Bernaola, G., Baceta, J.I., Monechi, S., Apellaniz, E. and Pujalte, V. (2009). The Paleocene-Eocene Thermal Maximum: new data from the microfossil turnover at the Zumaia section, Spain. *Palaios*, 24: 318-328.

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Fenero, R. (2009). Los microforaminíferos bentónicos del Eoceno terminal hasta el Mioceno inicial: taxonomía, inferencias paleoecológicas y paleoambientales. Ph.D Thesis, University of Zaragoza.

Ortiz, S., Alegret, L., Payros A., Orue-Etxebarria X., Apellaniz E., Molina, E. (2009). Benthic foraminiferal turnover across the Ypresian/Lutetian transition at the Gorronatxe section (N Spain): response to sedimentary disturbance. In: Orue-Etxebarria et al., eds., *The Ypresian/Lutetian transition in the Gorronatxe Beach (Getxo, W Pyrenees): Review, recent advances and future prospects*. Bilbao, p. 173-176. ISBN: 978-84-692-44876.

Paleogene Calcareous Nannofossils Working Group.

Chairwoman: Simonetta Monechi, Italy.

During this first year the Paleogene calcareous nannofossil working group has organized several meetings:

-November 2008 at the University College of London under the banner of INA and the ISPS hosted by Paul Bown. During the meeting, attended by around 20 participants, we have agreed on the general aims of the WG: the first one is to develop a taxonomic atlas and at the same time populate the Nannotax web resource and the second one is to address Paleogene nannofossil biostratigraphy. Furthermore, it has been discussed a list of objectives that should be implemented: 1.- A list of species for input into Nannotax (but also to be used as a basis for the IODP Paleogene expeditions). 2.- Once the species list is in Nannotax, we will then add information and images into Nannotax (initially focussing on the principal biostratigraphic marker species and dominant taxa). The information to include a short description, maximum and minimum age data, names of variants. 3.- A case study on the taxonomy of the reticulofenestrids (?+Prinsius and Toweius). 4.- A Paleogene calcareous nannofossil biostratigraphy revisited. 5.- A PalNWG meeting/presentation at the Houston Microfossil Meeting March 2009.

-A meeting of the Paleogene Nannofossil Working Group was held in Padova (NE Italy) at the beginning of 2009, hosted by Claudia Agnini and attended by 9 members. This short session

was mainly focused on the calcareous nannofossil Paleogene biostratigraphy and taxonomy. In particular, was generated a taxonomic list for the entire Cenozoic to be entered in the new IODP dataset system for the future IODP Expeditions (i.e. 320-321 Equatorial Pacific Expeditions). In addition, was extensively discussed about the present status of early Paleogene calcareous nannofossil biostratigraphy, the available dataset and unpublished results and the possibility to improve the standard zonations (NP; Martini, 1971- Okada & Bukry, 1980). Finally, was produced a biostratigraphic and biochronologic scheme for the entire Cenozoic based on most recent and reliable data to be used as a common language for calcareous nannofossil specialist and also entered in the IODP dataset system.

- A workshop on Paleogene calcareous nannofossils has been organized at Houston in March 2009, hosted by Mike Styzen. The workshop was well attended and productive. The participants examined the species list compiled by PalNWG and discussed issues at the generic and specific levels.

Regional Committee on North-European Paleogene Stratigraphy.

Chairwoman: Gitte Vestegaard Laursen, Norway. Secretary: Rui.da-Gama, Netherlands.

The committee held one meeting this year, in Fribourg Switzerland. The meeting was quite successful and it shows that the stratigraphic community of Northern Europe is still active, trying to combine the different stratigraphic methods and correlate to/from other basins as well. The 11th joint Meeting of RCNPS/RCNNS in 2009 was held in the city of Fribourg, situated in the Molasse Basin in Switzerland from Thursday, August 27 till Saturday, August 29. The number of attendants were 31. The lectures and posters represented a broad spectre of stratigraphy from the Northern Hemisphere, ranging from problems when creating a new lithostratigraphic chart for the Paleogene and Neogene of Switzerland; overview of the molasse of W.-Switzerland an E.-France; the possible identification of early Eocene hyperthermals in the Corbières in SW France by means of Foraminifera and Ostracoda; construction of a new database of Tertiary index fossils for the Mainz Basin; incursions of Nummulites in the Belgian Ypresian to Early Lutetian; orbital forcing that can be recognised in the marly parts of the Oligocene Boom Clay of Belgium; Iran, where micropaleontology is being used to solve the age of the Asmari Formation (Chattian/Aquitanian), calibrated with Sr87/Sr86 dating; Mammalia stratigraphy represented by relatives of Tapirs from the Swiss Molasse Basin, and by the Ruminantia, which shows several changes during the Oligocene and at the transition Oligocene-Miocene. All posters were briefly presented as powerpoint/pdf in the lecture room, so that discussion at the posters them selves flowed freely in the coffee breaks. This meeting, although the group was small, was very successful. There was a good exchange of opinions in a very relaxed atmosphere, and, although it did not concern the North Sea Basin strictly speaking, this is a region, which is important in the understanding of possible connections to other parts, together with the effects of the Alpine orogeny. It was decided to continue the work of the Regional Committee, and a process for finding a venue for the next meeting in 2011 has started.

South-American Regional Committee on Paleogene Stratigraphy.

Chairman: Carlos Jaramillo, Panama. Secretary: Carolina Nañez, Argentina.

This year was dedicated to the organization of a symposium on the Paleogene of South and Central America and the Caribbean, to be held at the X Argentinean Congress of Paleontology

and Biostratigraphy and VII Latin American Congress of Paleontology (La Plata, Argentina, 20-24th September, 2010). The aim of the symposium is to have an overview of research related to the Paleogene of South and Central America, and to provide an opportunity for the meeting of members of the Regional Committee to discuss current activities and working plans for 2011-2012. The web page for the Regional Committee (<http://striweb.si.edu/jaramillo/committee/index.html>) has been maintained and actualized, including news, research activities and a list of recent publications concerning the Paleogene of South and Central America.

Russian Paleogene Commission.

Chairman: Mikhail A. Akhmetiev, Russia. Secretary: G.N. Aleksandrova. Russia.

Russian Paleogene Stratigraphical Commission numbers about 50 Members now, introduced 17 Geoscientific Organisations Russian Academy of Sciences (Moscow, St. Petersburgh, Ekaterinburg, Novosibirsk, Vladivostok etc) States Universities (Moscow, St. Petersburgh, Saratov, Vladivostok, Novosibirsk, Tomsk), the Branches Geological Institutions, Departments and Regional Geological Expeditions of Geological Survey. There are several participants from Ukraine, Kazakhstan, Azerbaijan, Bielorussia, which took part in Paleogene Commission activity. Members of Russian Paleogene Commission published (2009): 1 Monograph, 1 Paleontological Atlas. 13 papers and more than 27 abstracts to International and all Russian Meetings, Symposia and Workshops. Popov S.V., Akhmetiev M.A., Lopatin A.V., Sychevskaya E.K., Andreeva-Grigorovich A.S., Bugrova E.M., Nikolaeva I.A., Zaporozhets N.I. (specialists by malacology, plant megafossils, mammals, fishes, dinocysts, nannoplankton, foraminifera, ostracodes, organic-walled phytoplankton + pollen and spores) "Paleogeography and biogeography Paratethys basins" Part 1. Late Eocene – Early Miocene // Moscow, Nauchny Mir. 2009, P. 174 + 10 maps (Paleontological Inst. RAS; Transaction Vol. 292). Andreeva-Grigorovich A.S (Ukr.), Aleksandrova G.N.(Russia), Iakovleva A.I (Russia), Shevchenko T.V.(Ukr.), Zaporozhets N.I (Russia). Atlas Paleogene dinocysts of the USSR former (Geological Institute Ac. Sci Ukraine, Geological Ins. Russian Ac Sci) (Explan. text - 45 p and 61 Paleont. plates). Ph.D. and D. Sci Theses (maintained): Dolya Zh. A. (St. Petersburg). Stratigraphy and Minerageny of the Meso-Cenozoic sedimentary cover of the south part of West Siberian Plate (Omsk district). (Abstract 22 p.). Zykin V.S. (Novosibirsk). Oligocene and Neogene stratigraphy West and Middle Siberia (stratigraphy, paleogeography and environments) (Abstract 52 p.). Pavlyutkin B.I (Vladivostok). Phytostratigraphy, Paleogene and Miocene Deposits South part of Russian Far East (Abstract 54 p.).

Papers published:

Akhmetiev M.A, Beniamovsky V.N. (2009) Paleogene floral assemblages around epicontinental seas and straits in Northern Central Eurasia: proxies for climate and paleogeographic evolution, *Geologica Acta*. Vol. 1-2, 297-309.

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Gavrilov Ju., Shcherbinina E., Golovanova O., Pokrovsky B. (2009). A variety of PETM in different settings, North-Eastern Peri-Tethys // *GNS Science Miscellaneous Series* 18. P. 66-69.

Radionova, Aleksandrova, Gavtadze, T.T., Stupin S.I., Khokhlova I.E. (2009). Analysis of the Late Paleocene-Early Eocene microplankton from the Kheu River section, West Pre-Caucasus // *GNS Science Miscellaneous Series* 18. P. 110-115.

- Herman A.B., Akhmetiev M.A., Kodrul T.M., Moisseeva M.G., Iakovleva A.I., (2009). Flora Development in Northeastern Asia and Northern Alaska during the Cretaceous-Paleogene Transitional Epoch // *Stratigraphy, Geol. Correlation*, Vol. 17 N1, P. 88-109.
- Oreshkina T.V. (2009). New data on Diatoms marine Paleogene deposits of Western Kamchatka// *Stratigraphy, Geological Correlation*.Vol. 17 N3 P. 105-119.
- Shcherbinina E.A., Aleksandrova G.N. (2009). High-Resolution Paleogene Study of nannofossil and dinocysts assemblages from the Eastern Caucasus, Southern Russia // *GNS. Science Miscellaneous Series*, 18. P. 122-128.
- Vassilyeva O.N., Mussatov V.A. (2009). Paleogene nannoplankton and dinoflagellate cysts biostratigraphy of Northern Prycaspian Depression // *GNS Science Miscellaneous Series* 18, P.148-153.
- Beniamovsky V.N. (2009). Dnieper-Donets basin – is connecting link between North-Western Eurasia seas by benthonic foraminifera // *Transaction of Geological Inst. Ukrain. Ac. Sci . Kiev*, p. 207-211.
- Vassilieva O.N., Mussatov V.A. (2009). Paleogene biostratigraphy of Northern Prycaspian depression // *Stratigraphy. Geol. Correlation*. 30 p. (in press).
- Akhmetiev M.A., Walter H., Kvachek Z. (2009). Mid latitude Paleogene Floras of Eurasia bound the volcanic setting and paleoclimate events experience obtained the Far East Russia (Sikhote-Alin) and Central Europe. (Charles Univ. publ.) (in press) , 70 p.
- Akhmetiev M.A. (2009). Paleocene and Eocene Floristic and Climatic Change in Russia and Northern Kazakhstan (in press) (publ. in Great Britain).
- Kezina T.V. (2009). To the Paleocene age of Wuyun Formation (China) by palynological data // *Stratigraphy., Geological Correlation* 2008 (in press)
- Symposia and Meetings:**
- Paleogene Commission Members took part in 9 International and Russian Meetings and Symposia and had 27 presentations.
- CBER 2009 Wellington, New Zealand (Beniamovsky, Gavrilov, Shcherbinina, Vassilieva, Mussatov, Iakovleva) (12-15 January 2009).
- Paleostrat – 2009 Moscow) (Annual Meeting of Paleontol. Section Natural History Soc (Moscow) (Beniamovsky) (February, 2009).
- LIV Session Paleontological Society St Petersburg (Beniamovsky) (6-9 April 2009).
- Sino-Russian Symposium on Evolution and Development of Eastern Asian Flora based on Paleontological Data Guangzhou, China, (Akhmetiev, Herman, Kodrul) November 24-29 2009.
- International Symposium on Geosciences in Northeast Asia, Changchun, China 27-28 2009.
- 7-Micropaleontological workshop Micro-2009, Poland) (Beniamovsky) September 2009.
- Diatom- 2009 Conference Minsk, Byelorussia (Oreshkina) September 2009.
- 8-International Symposium on the Cretaceous system Plymouth University (Great Britain) 6-12 September (Probleme K/T boundary) (Beniamovsky).
- Annual Paleogene Commission Meeting St Petersburg. 8-9 April 2009 (17 participants).
- Program of this Meeting:**
- Akhmeiev M.A. Introduction. and Information about Paleogene Commission Activity 2008 and main problems to 2009.
- Beniamovsky V.N. Information about Meeting “Climate and Biota Events SBER– 2009”
- Oreshkina T.V., Aleksandrova G.N. “New Data on diatoms and dinocysts PETM Transuralian zone (Volga River Basin)

Popov S.V., Akhmetiev M.A., Sychevskaya E.K., Zaporozhets N.I. New Data oh Maykopian Group stratigraphy (North Azerbaijan).

Fieldworks:

Study and sampling borehole material (K/T Boundary to Oligocene) (4 boreholes to 400-500 m) South Part of West Siberian Plate (Omsk district) (Foraminifera, Diatoms, Dinocysts) (Beniamovsky, Aleksandrova).

Study and sampling borehole 13) 200 km south-west from Volgograd (Paleocene-Eocene deposits 250 m) (Nannoplankton, Fotaminifera, Dinocysts, Pollen and Spores, Mollusks, Nummulites) (Popov, Zastrozhnov, Beniamovsky, Aleksandrova, Tabachnikova, Zaporoxhets, Zakrevskaya).

Central Dagestan Area sections (nannoplankton, palynology) (Aleksandrova G.N., Shcherbinina E.A.). (Gerga River Area sections), Danian and Zelandian deposits. Upper Dzhengutay village vicinity (Thanetian- Ypresian deposits). Chirkey-water reservoir (Lower part of Maylopiian Group (Oligocene).

The main results of studying Paleogene deposits:

Reconstruction paleogeography, environment, biotic and abiotic changes on the main Paleogene biospheric events (South Russia, West Siberian plate Far East) Correlation of regional subdivisions based on different biotic groups. Paleoclimatic reconstructions and reflections of climatic events on different biotic groups. Detail regional zonal subdivisons by different microplanktonic groups. The Transition "Warm"-to "Cool" biosphere in Central Part of Extratropical Eurasia.

Working group on Paleogene Stratigraphy of the North Pacific

Chairman: Yuri B. Gladenkov, Russia

A meeting on the Sakhalin-Kamchatka Paleogene was held in Moscow, April 2009, to consider new materials and to outline plans of works for 2010-2011. The works include particularly a part of a special project on geological evolution of the North Pacific shelf zones during the Cenozoic (biotic changes, sedimentational features, tectono-magmatic activity, paleogeographic rearrangements, climatic fluctuations, etc). Now it is very important to combine bio-, sequence-, seismostratigraphic investigations. We began to study new material on diatom flora from the Eocene of Kamchatka. The study of planktonic and benthic foraminifers and mollusks from the Cretaceous/Paleogene boundary beds of Sakhalin has been completed. Planktonic foraminifers were found there for the first time. A special paper "New Data on Maastrichtian-Paleogene Foraminifers from Sinegorsk Horizon of Southern Sakhalin" was published in "Stratigraphy. Geol. Correlation", 2009, Vol. 17, No. 4, pp. 443-453. A monographic treatment of Paleocene and Ypresian of Kamchatka is continued. The Thanetian-Ypresian fauna (mollusks and foraminifers) reflecting the known climatic optimum is unique for these latitudes. The study of planktonic and benthic foraminifers from the Cretaceous/Paleogene boundary beds of Sakhalin has been completed. Planktonic foraminifers were found there for the first time. A special publication is under preparation. A monographic treatment of Paleocene and Ypresian of Kamchatka is continued. The Ypresian fauna reflecting the known climatic optimum is unique for these latitudes.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

The problems encountered this year are essentially the same as those discussed in the previous annual reports. ISPS can support only very insufficiently its working groups and regional committees. In particular, we would need a substantial increase in our budget in order to support and in part to reactivate regional committees in poorer areas (e.g. Africa, Indian Subcontinent, SE Asia). 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.

7. SUMMARY OF EXPENDITURES IN 2009:

INCOME

Carried forward from 2008	Euro 0
ICS Allocation for 2009	Euro 1817.29
TOTAL	Euro 1817.29

EXPENDITURE FROM 2009 BUDGET

General office expenses	Euro 217.29
Professional help with the website	Euro 700
Support for Working Groups and Regional Committees	Euro 900
TOTAL	Euro 1817.29

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2010):

Complete the work on the GSSPs of the base of the Priabonian and Chattian.

Screen and rejuvenate the list of the Corresponding Members.

Reactivate or close those Regional Committees and Working Groups which are asleep.

Update periodically the ISPS website.

Organize an International Symposium on the Paleogene of South, Central America and the Caribbean, La Plata, Argentina, 20-24th September, 2010.

9. BUDGET AND ICS COMPONENT FOR 2010

Projected Budget for 2010:

General office expenses	Euro 500
Professional help with the website	Euro 800
Contributions to Officers travel costs	Euro 900
Support for Working Groups and Regional Committees	Euro 2500
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TOTAL BUDGET PROJECTED	Euro 4700
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Please note that the financial situation has deteriorated in recent years, particularly in Latin America and the former Soviet Union; an increase would help us to support the corresponding Regional Committees more actively. We also will need some seed money to start new regional committees or working groups.

10. SUMMARY OF ACTIVITIES OVER PAST FOUR YEARS (2006-2009)

At present, the GSSPs of the base of the Danian (= Cretaceous/Paleogene Boundary), the base of the Ypresian (= Paleocene/Eocene Boundary), the base of the Rupelian (= Eocene/Oligocene Boundary) and the base of the Aquitanian (= Paleogene/Neogene Boundary) have been established and ratified by the International Union of Geological Sciences. Furthermore, in 2007 the base of the Selandian and Thanetian stages was defined by the Paleocene Working Group by unanimous majority, both GSSPs were approved by the ISPS and the ICS and finally were ratified by the IUGS in September 23, 2008.

In 2009 the base of the Lutetian has been defined and the proposal to be voted is being prepared. Regarding the rest of the Paleogene Stages, good progress has been made in the search for the remaining GSSPs.

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>

11. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2010-2013)

Complete and publish the GSSPs of the Paleogene. We hope to present proposals for the remaining GSSPs in the year 2010 (Priabonian and Chattian) and by the year 2011 (Bartonian). Support the organization of the International Symposium on the Paleogene of South, Central America and the Caribbean, La Plata, Argentina, 20-24th September, 2010.

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.

APPENDIX (Names and Addresses of Current Officers and Voting Members, 2008-2012)
INTERNATIONAL SUBCOMMISSION ON PALEOGENE STRATIGRAPHY

Subcommission officers

Chairman:

Eustoquio Molina, Departamento de Ciencias de la Tierra, Universidad de Zaragoza, Calle Pedro Cerbuna, 12, E-50009 Zaragoza, Spain.
emolina@unizar.es

Vice-Chairman:

Noël Vandenberghe, Departement Geografie-Geologie, Afdeling Geologie, Redingenstraat, 16, B-3000 Leuven, Belgium.
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Secretary:

Simonetta Monechi. Dipartimento di Scienze della Terra. Università di Firenze.
4 Via la Pira. I-50121 Firenze. Italy.
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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. wade@geo.tamu.edu Secretary: Helen Coxal, UK. hkc@gso.uri.edu

Paleogene Larger Foraminifera Working Group. Chairman: Lukas Hottinger, Switzerland. lukas.hottinger@bluewin.ch

Paleogene Deep-Water Benthic Foraminifera Working Group. Chairman: Michael Kaminski, UK. m.kaminski@ucl.ac.uk Secretary: Laia Alegret, Spain. laia@unizar.es

Paleogene Calcareous Nannofossils Working Group. Chairwoman: Simonetta Monechi, Italy. monechi@unifi.it

Regional Committee in North-European Paleogene Stratigraphy. Chairwoman: Gitte Vestegaard Laursen, Norway. gila@statoil.com Secretary: Rui da-Gama, Netherlands.

South-American Regional Committee on Paleogene Stratigraphy. Chairman: Carlos Jaramillo, Panama. JaramilloC@si.edu Secretary: Carolina Nañez, Argentina.

cnaviez@fullzero.com.ar

Website: <http://striweb.si.edu/jaramillo/committee/index.html>

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

List of Voting Members

Mikhail A. Akhmetiev, Russian Academy of Science, Moscow, Russia, akhmetiev@ginras.ru

Mary Pierre Aubry, Rutgers University, New Jersey, USA, aubry@rci.rutgers.edu

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Philip D. Gingerich, University of Michigan, USA, gingeric@umich.edu

Yuri B. Gladenkov, Russian Academy of Science, Moscow, Russia, gladenkov@ginras.ru

Jan Hardenbol, Global Sequence Chronostratigraphy, Houston, USA, jhardenbol@sbcglobal.net

Christopher Hollis, GNS Science, Lower Hutt, New Zealand, c.hollis@gns.cri.nz

Jerry J. Hooker, Natural History Museum, London, UK, jjh@nhm.ac.uk

Kenneth G. Miller, Rutgers University, New Jersey, USA, kgm@rci.rutgers.edu

Eustoquio Molina, Universidad de Zaragoza, Spain, emolina@unizar.es

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Carolina Náñez, Servicio Geológico, Buenos Aires, Argentina cnaviez@fullzero.com.ar

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Birger Schmitz, University of Lund, Sweden, birger.schmitz@geol.lu.se

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Dalila Zaghbib-Turki, University of Tunis, Tunisia, dalila.zaghbib@fst.rnu.tn

SUBCOMMISSION ON CRETACEOUS STRATIGRAPHY

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Cretaceous Stratigraphy (SCS)

SUBMITTED BY

Prof. Isabella Premoli Silva, Chair

University of Milano

Dipartimento di Scienze della Terra “Ardito Desio”

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2. 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.*

3. ORGANIZATION

SCS is a Subcommission of the International Commission on Stratigraphy.

Membership: Chair: Prof. Isabella Premoli Silva, Italy

Vice Chair: Dr. Irek Walaszczyk, Poland

Secretary: Dr. Silvia Gardin, France

In addition, there are 12 Voting Members of the Subcommission, from all the continents (to be implemented). 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.***

3a. Officers for 2008-2012:

Chair:	Prof. Isabella Premoli Silva (Milan, Italy)
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Vice-Chair:	Dr. Irek Walaszczyk (Warsaw, Poland)
Secretary:	Dr. Silvia Gardin (Paris, France)

*The WEB site for the Subcommission is in preparation; its address will be
<www.iscs.upmc.fr>*

4. 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 now taken over the responsibility for selection of future venues, though the successful applicants will organize individual congresses. At the *8th International Symposium on Cretaceous System* in September 2009, it was decided that the *9th International Symposium on Cretaceous System* will be convened in 2013 at Ankara, Turkey.

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

When appropriate, the Subcommission liaises also with IGCP projects. In particular, a strong liaison was established by our colleagues from IGCP 507 – “Cretaceous paleoclimatology”, and IGCP Project 506 - Marine and Non-marine Jurassic: Global correlation and major geological events (Project Co-Leader W. Wimbledon).

ICS has always been directly or indirectly linked to big international Projects as IODP, IGCP, and CHRONOS (Mesozoic Planktonic Foraminifera Working Group, MPFWG).

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009

General Activities

The Subcommission on Cretaceous Stratigraphy was deeply involved at the *8th International Symposium on Cretaceous System* in Plymouth (6-12 September 2009) with two sessions dedicated to the “Cretaceous Stratigraphy and Stage Boundaries” and with a third session that concerned specifically “The Jurassic/Cretaceous Boundary”.

Out of the eleven presentations two emphasized the need for an integrated multidisciplinary approach to overcome the problems of “worldwide” applicability of the criteria chosen for identifying any GSSP. As an example of the validity of this approach it can be mentioned specifically the presentation on “A new integrated stratigraphy for the Albian Stage” by Gale and co-authors.

In fact, since 2005 (Neuchatel Cretaceous Symposium) none of the missing Cretaceous GSSPs have been ratified, even though the Santonian and Albian GSSP proposals have been circulated for approval.

From the numerous recent contributions, although most of them not specifically dedicated to Cretaceous GSSP sections, it clearly emerges that for global correlations there is a strong need for stratigraphic tools other than fossils, that frequently suffer a spatially limited distribution and too many times are affected by remarkable bioprovincialism. Based on these works a solid integrated multiple stratigraphic framework is now available: carbon isotope stratigraphy from continuous pelagic successions provided by deep-sea drilling in all oceans and/or

magnetostratigraphy turned out to be the best tools for long distance correlations.

A very well attended, **business meeting** of the Subcommission was held at the end of the *8th International Symposium on Cretaceous System* (Plymouth) in the afternoon of September 12. The two hours meeting included (1) a brief presentation on the base Coniacian by Chris Wood for the GSSP of which it was proposed tentatively a composite section merging the data from the Salzgitter-Salder section (northern Germany) with the Slupia Nadbrze~na (central Poland). However, some attendants, including ICS Secretary P. Bown, disagreed with this proposition being against the ICS rules, and (2) a brief presentation on the base Santonian by C. Paul who illustrated advantages/disadvantages of the two candidate GSSP sections, Olazagutia (Spain) and Ten Miles Creek (Texas). No decision was made.

The Kilian Group (Lower Cretaceous Ammonite Working Group).

The Report on the 3° International Meeting of the “Kilian Group”, held in Vienna the 15th April 2008, was published in 2009 by S. Reboulet & J. Klein (reporters) and 10 Others (Cretaceous Research , v. 30: 496–502). During the 2008 Vienna meeting of the Kilian Group, the chair S. Reboulet underlined that it would be necessary to preserve the stability in the stratigraphic nomenclature, particularly for the first zone of sub/stages (for example zones recommended by the 1° and 2° International Symposia on Cretaceous Stage Boundaries or chosen in the 2004 Geological Time Scale), to make easier the comparison of zonal schemes between different works and to improve communications. Changes (more or less important) could be a potential source of trouble and/or confusion (see different proposals on the Aptian/Albian boundary).

Most activities of the Kilian Group are now focused on ammonite zonal scheme at substage levels (i.e. Lower/Upper Valaginian, etc.).

The next meeting of the Kilian Group will be held during the next congress of the "Cephalopods, past and present" in September 2010 at Dijon (France).

The Berriasian GSSP and the J/K boundary.

In 2009 the Berriasian Working Group, convened by the chair W. Wimbledon, had two meetings, the first one at the University of Milan (Italy), 4-6 March, and the second one in Plymouth the 5th September, just prior to the Cretaceous Symposium.

The progresses made by the WG are summarized in the abstract presented at Plymouth by the chair W. Wimbledon, who acknowledged the contributions of 34 scientists (from Canada, China, Czech Republic, France, Italy, Slovakia, Spain, Sweden, Russia, The Nederlands, Tunisia, Ukraina, United Kingdom, and USA).

Wimbledon wrote: “The issue of a Jurassic/Cretaceous boundary was seriously considered time ago only in two colloquia (Lyon and Lyon/Neuchatel) during which formal votes adopted the ammonite assemblages of the *Pseudosubplanites grandis* and *Berriasella jacobi* subzones as indicators for the base of the Berriasian. The overwhelming majority of authors have continued to use the *jacobi* subzone (base of *grandis* zone) or *grandis* subzone in defining a stage base, or a vaguer *grandis* or *jacobi/grandis* zone. It has become clearer that these subzones are not really separable, but, that fact notwithstanding, even in the large part of the World outside Tethys, work on fixing a boundary has continued to concentrate on correlating with.

In the first three meetings of the new Berriasian Working Group consideration has focussed on a boundary interval in the lower and middle *jacobi/grandis* zone, and specifically on the best markers already identified in Tethys and some of the better correlative tools for

achieving correlation there and with both Boreal marine and non-marine (Purbeck) sequences - wider correlation being the primary aim. There has been a clear acceptance that ammonites alone are unlikely to effect consistent and widely applicable correlation, nor can they contribute in the widespread non-marine sequences.

As a first step, the WG has agreed that the interval offering the best opportunities for study, because it is the one with most, well-defined, markers, is that just below and above the base of chron M18r. The upward sequence from the middle of M19n through M19n.ln, M19.ln and into M18r, in particular, provides several well-established datums in close order, notably based on calpionellids and nannofossil ranges, the calpionellid biozonation and magnetostratigraphy. In particular, four reliable well-marked datums occur in an even shorter interval giving a core framework for comparison. These are the base of calpionellid zone B, the 'explosive' appearance of a monospecific association of small, globular *Calpionella alpina* (the *alpina* "acme", or the *alpina* "bloom" *auctorum*), the FAD for two subspecies of *Nannoconus* (*N. steinmannii minor* and *N. kampfneri minor*) and the base of M18r. In all cases, these are horizons which have been widely and consistently recognized by a number of researchers, and where biozone B is concerned, it has in recent years become a *de facto* working base for the Berriasian Stage amongst a wider group of users. Macrofossil datums will be linked to this framework, and, for instance, foraminiferid, radiolarian, geochemical and cyclostratigraphic signals must also be added.

Thus primary markers and secondary constraining datums can be listed as follows:

Primary markers

1. base calpionellid biozone B
2. 'explosion' of small globular *C. alpina*
3. FAD *Nannoconus steinmannii minor* & *N. kampfneri minor*
4. base M18r

Secondary supporting markers

5. base M19n.ln
6. base M19n.lr
7. FAD *Nannoconus wintereri* & *N. cuvillieri*
8. base *jacobi* subzone
9. FAD *Warrenia californica*, *Dichadogonyaulax bensonii* & *Ampulatisporis verbitskayae*
10. base *lamplughii* biozone
11. base *grandis* subzone
12. LAD *Dichadogonyaulax pannea*, *Egmontodinium polyplacophorum* etc. in the late Portland extinction.

(The labels "primary" and "secondary" are indicative, not absolute. They reflect the WG's current focus of attention on the four closely located datums.)

Having discussed the consistency of proposed datums overall, the WG now studies the precise stratigraphic relationships in this limited interval; that is, testing current assumptions on the sequence of the four datums, on their ranges, relationships to one another and to other datums. In addition, thought is being directed to secondary markers which could be tied directly to the primary datums, or interdigitated between them, allowing correlation to wider geographical areas. Thus the work of the WG in coming months is of precise calibration of stratigraphic markers in the chosen M18r/M19n interval.

The base of M18r has been chosen in preference to short magnetic intervals below because such short intervals are less easy to detect in shallow marine and non-marine settings. The list above is far from exhaustive and more data will be added, to reinforce the framework that is emerging. In relation to sequences that have been well documented, this interval can be identified (using at least some of the chosen markers) and equates to, for instance, sections at Bosso, Brodno, Torre de' Busi, Puerto Escano in Tethys, Durlstone non-marine western Boreal, and Nordvik in the far eastern Boreal.

Clearly the approach is constrained by the fact that the fuller range of evidence of the kind discussed here comes from sequences in the Tethyan Realm and in Boreal regions, though a number of localities in England and N. France have, for instance, a magnetostratigraphic record, that can only be said of one other site (Nordvik, Siberia). Further, many more coherent sequences of the 'right' age have been identified and documented in Tethys. Much detailed study and refinement of the data lies ahead." A paper on the main results is in preparation.

The next meeting of the Berriasian Working Group is planned at the Smolenice Castle (50 km NE of Bratislava) for 6-9 April 2010, hosted by Dr Jozef Michalik and Slovak colleagues.

Base Valanginian GSSP.

The activities in 2007 concentrated on the section at Montbrun-les-Bains (S. France) that was logged again in more detail by Bulot and Reboulet in order to provide a reliable correlation to the Sr and d13C curves established by McArthur et al. (2007). For the same section detailed data on ammonites, calpionellids, and calcareous nannofossils (still unpublished) are also available and chemostratigraphy is in progress, but no magnetostratigraphy. For the alternate section near Caravaca (Spain) Aguado et al. (2000, Cret. Res., v. 21) provided a detailed synthesis of biostratigraphic and magnetic events and they note that the Spanish sections are the only ones in the world where a direct correlation has been made between magnetic chronos and ammonite zones at this level. In the Spanish section, although richer in ammonites, the calpionellid record is "weak" compared to Montbrun-les-Bains, mainly for preservation problems. The chair of the Valanginian WG, Luc Bulot, and S. Reboulet are working with a multidisciplinary approach for better characterizing the lower part of the Vergol section and so the Berriasian/Valanginian boundary. However, the GSSP proposal will be not submitted probably until 2010.

In addition, Reboulet and Bulot are working hard on substage subdivision and could write a proposal on the Lower/Upper Valanginian GSSP on the Vergol section for the end of 2010-beginning of 2011.

Base Hauterivian GSSP.

Luc Bulot has now received the various contributions from colleagues who have been analysing data from the intended GSSP at La Charce, France. He is collating the data to send to P. Rawson so that he can then put the whole draft report together, then send it to the chair of the group, Joerg Mutterlose, for him to check and send to members of the WG. The whole procedure is expected to be completed and the report sent to Voting members hopefully within the next months. Based on the works by Bulot and Reboulet, the La Charce section could be a very good candidate also for the Lower/Upper Hauterivian boundary.

Base Barremian GSSP.

The Spanish colleagues (led by Miguel Company) have prepared data on the proposed section in Spain and as far as the chair, P. Rawson, knows it is more or less complete. Based on the work by the Kilian Group, the ammonite zonal scheme for the Barremian is now revised with the *Taveraidiscus hugii* auctorum (index-species must be revised) Zone as the first zone of the Barremian. Thus the Barremian Working Group is now able to prepare a formal proposal as currently recommended.

As far as substage subdivision is concerned, most of members of the Kilian Group agree to use the solution of the Brussels meeting: *T. vandenheckii* Zone as first zone of the Upper Barremian.

Base Aptian GSSP.

A wealth of data have been added and published since 2007 by our French colleagues on the stratotype sections of Bedoulian and Gargasian substages including revised biostratigraphies, $\delta^{13}\text{C}$ curve and cyclostratigraphy. A memoire edited by Moullade et al., synthetising all the gathered data can be found also in Notebooks on Geology (on-line). 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. A formal proposal is expected soon by the chair of the WG.

Base Albian GSSP.

The formal proposal, prepared early in 2007 by J. Kennedy and distributed to the members of the WG has received only very few comments. In spite of that, the proposal was sent to the Voting Members, however, the ballot did not reach the quorum (6 YES, 5 NO, 1 abstain). Voting Members against the proposal commented that 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.) makes the Tartonne section unsuitable as the basal Albian GSSP. In addition, the sampling across the Aptian/Albian boundary is loose and not at the high resolution as requested for such critical interval, and the applicability of the proposed event (FO of *L. tardefurcata*) to other sections, especially outside SE France, is not documented. To overcome the difficulties for worldwide correlations a specific Working Group was set up in Plymouth (Gale, Kennedy, Huber, Jenkyns, and Paul Bown as the coordinator) with the task to re-sampling and re-studying at really high resolution the Tartonne section or any other suitable one.

Base Coniacian GSSP.

There is a general consensus to use the first appearance of *C. deformis erectus* (Meek), a well recorded cladogenetic speciation event, for identifying the base of the Coniacian. This event is clearly recognizable in the whole Euramerican biogeographic region, and in the Tethyan Realm; and it appears to be easily correlatable outside these areas. This Euramerican biomarker is therefore either valid on its own for recognizing the base of the Coniacian Stage directly, or it enables indirect correlation with most of the coeval marine successions elsewhere in the world. The inoceramid-based lower Coniacian boundary slightly post-dates the traditional ammonite (FAD of *Forresteria petrocoriensis*) position of the boundary. Among the candidate sections, included in the Brussels 1995 report, the Wagon Mound section (US Western Interior) turned out to be entirely Turonian and the Pueblo section (US Western Interior) appears to be incomplete a small distance above the boundary, and the Salzgitter-Salder section (northern Germany), was shown to be condensed or to contain a short gap just at the accepted boundary level. The Slupia Nadbrze~na (central Poland), the most complete succession across the boundary known to date, is unfortunately poorly exposed. To overcome such multiple problems, the WG chair I. Walaszczyk and his collaborators will propose as the boundary stratotype the Salzgitter-Salder - Slupia Nadbrzezna composite section. The final report on the base of Coniacian will be

submitted for publication in *Acta Geologica Polonica* and contemporaneously to the Subcommission before the end of 2009. Besides multiple biostratigraphies, the report now includes also the isotope curves by Silke Voigt for both sections.

Base Santonian GSSP.

The final proposal for the base Santonian at Olazagutia (Spain), prepared by the chair M. Lamolda, was distributed for approval and/or comments to the Voting Members first at the end of July 2008, and again in Spring 2009 without reaching the quorum of positive votes. The proposal will be distributed again soon to the Voting Members.

Base Campanian GSSP.

The paper on the base of the Campanian at the Waxahachie dam spillway section (northcentral Texas) was published in 2008 by Gale et al. (*Cretaceous Research*, v. 29: 131-167). The problem concerning who owns the land where the Texas section is situated is still unsolved. Moreover, it is worth mentioning that the correlation of the Waxahachie dam spillway section and Seaford Head (Sussex, England) section, with the pelagic successions based on calcareous plankton is not straightforward. A new section is needed.

Base Maastrichtian GSSP.

To overcome the problem of correlation, stable isotopes were measured in high resolution at Tercis. Data will be published in the next few months and Tercis isotope curve will be compared with those from the Vistula River section (Poland) and the magnetostratigraphically calibrated Gubbio sections (Italy) by Silke Voigt and collaborators.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

The need nowadays for a high-resolution framework to be exportable worldwide resulted in the necessity of re-visiting several candidate sections, already studied paleontologically, by implementing multiple biostratigraphies and stratigraphic tools other than fossils - those are profoundly affected by bioprovincialism in several intervals - like magnetostratigraphy, stable isotope stratigraphy, etc. In several cases, especially in the Late Cretaceous, the integration of multiple bio-, physical stratigraphies revealed that the candidate sections were unsuitable as GSSP. Consequently, new sections had to be searched and studied from the beginning. This resulted in a delay in submitting the GSSP proposals, taking also into account that scientists from different subdisciplines do not necessarily work at the same speed.

7. SUMMARY OF EXPENDITURES IN 2009 (ANTICIPATED THROUGH MARCH 2010):

I. INCOME

ICS subvention for 2009 (2500 \$)	Euro 1826.31
ICS extra subvention for support to Russian scientists (1000\$)	Euro 676.37
Total income	Euro 2502.68

II. EXPENDITURE

J/K meeting,, Milan, 6-8 March (organization+lodging)	Euro 1034.00
Participation to Plymouth Symposium (Chair+other participants)	Euro 864.00
1 st Contribution to Russian scientists	Euro 500.00
2 nd Contribution to Russian scientists	Euro 200.00
Office (chair & secretary) expenses	Euro 250.00
Bank Expenses (twice)	Euro 24.00
Total expenditure	Euro 2872.00

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2010):

Membership of Cretaceous Subcommission.

The Voting Membership of the Cretaceous Subcommission will be implemented during the next few months. In fact, the mandate for 5 Voting Members expired in 2008. Nominations have already been requested.

Meetings

- The 5° meeting of the Berriasian and J/K boundary WG is planned for 2-4 April, 2010 at Smolenice Castle, Slovakia.
- The 4° meeting of the Kilian Group will be held during the next congress of the "Cephalopods, past and present" in September 2010 at Dijon (France).
- ICS workshop, Prague, late May 2010
- The 6° meeting of the Berriasian and J/K boundary WG, pending

Work Plan and anticipated Results

- To bring recommendations for 6 of the remaining GSSPs to ICS as soon as possible
- To advance considerably on definition of criteria for identifying the base of the Berriasian and the J/K boundary.

9. BUDGET AND ICS COMPONENT FOR 2010

Office expenses (Fax, phone, postage, etc)	Euro 250
Organization expense for the J/K Smolenice Castle, (Slovakia) Meeting	Euro 500
Support to participants to the J/K Smolenice Castle Meeting	Euro 1000
Contributions to help costs of participants to the ISCS Workshop, Prague	Euro 2000

Total estimated expenditure	Euro 3750

10. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2005-2009)

See Accomplishments in ICS Annual Reports 2005 to 2009 (above) for additional details.

- Renewed research by WG members (resulting in a great number of publications, still ongoing), based on research needs pinpointed by the 1995 Brussels, 2005 Neuchâtel and 2008 Oslo meetings.
- Presentation of the latest results to *7th International Cretaceous Symposium*, Neuchâtel, Switzerland. September 4-9, 2005.
- Workshop on the Aptian ammonite zonation, held in Lyon (Nov. 2005) focused the discussion mainly on the ammonite faunal turnovers and the Lower/Middle Aptian (Bedoulian/Gargasian) boundary in relation to the position of the Furcata Zone.
- Set up of the renewed Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon (Dec. 2006-Spring 2007).
- 2nd Workshop of the Kilian Group on the Hauterivian-Barremian zonation, held in Digne-les-Bains (May 2007), from the **Radiatus** (base of the Hauterivian) to the **Sarasini** (top of the Barremian) zones.
- 3rd Workshop of the Kilian Group on the Hauterivian and Barremian zonation, held in Vienna (April 2008)
- 1st official meeting of the renewed Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Bristol (July 2007).
- 2nd official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Marseille (July 2008).
- 33rd Geological Congress, August 2008, Oslo: SCS Symposium on “Stratigraphic subdivisions of the Cretaceous System: State of the Art”. (Conveners: I. Premoli Silva, F. Surlyk & I. Walaszczyk).
- 3rd official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Milan (March 2009).
- 4th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Plymouth (September 2009).

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

SCS meeting during the *7th International Cretaceous Symposium*, Neuchâtel, Switzerland, September 2005

1° meeting of the *Berriasian and J/K boundary Working Group*, Bristol (UK), July 2007

2° meeting of the *Berriasian and J/K boundary Working Group*, Marseille, July 2008

SCS Symposium HPS-10 on “Stratigraphic subdivisions of the Cretaceous System: State of the Art”. (Co-conveners: I. Premoli Silva, F. Surlik & I. Walaszczyk), at 33° Geological Congress, August 2008, Oslo:

3° meeting of the *Berriasian and J/K boundary Working Group*, Milan, March 2009

4° meeting of the *Berriasian and J/K boundary Working Group*, Plymouth, September 2009

11. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2009-2013)

Meetings

- September 2009 - the 4th Workshop of the Berriasian and J/K boundary WG at the 7th International Symposium on Cretaceous System, Plymouth (UK)
- September 2009 - Subcommission Official Meeting at the 7th International Symposium on Cretaceous System, Plymouth (UK)
- April 2010 – the 5th Workshop of the Berriasian and J/K boundary WG is planned in (near Bratislava, Slovakia)
- September 2010 – 4th Workshp of the Kilian Group at the 8th International Symposium “Cephalopods present an past”, Dijon (France), focused on problems of the Aptian and Albian stages
- September 2013 – 9th International Symposium on Cretaceous System, Middle East Technical University, Ankara, Turkey. Convenor: Ismail Omer Yilmaz.

Details of other meetings are not yet available.

Objectives

- To submit the proposal of Santonian GSSP to ICS, and to submit it to Episodes for publication
- To re-submit the proposal of Albian GSSP to the Cretaceous Subcommision voting members, then to submit it to ICS, and possibly to Episodes for publication
- To bring recommendations for 6 of the remaining GSSPs to ICS as soon as possible
- To advance considerably on definition of criteria for identifying the base of the Berriasian and the J/K boundary.
- To communicate the results as widely as possible.
- To develop new directions for the Subcommission as GSSP proposals are completed. Specifically, future objectives will concern the subdivision of stages, with definition of substages and related GSSPs.

Work Plan

2009 (end) - Complete voting on the proposal for the base of the Santonian

2010 – Finalize the proposal for the base of the Albian

2010 - Finalize proposals for the base of Valanginian, Hauterivian, Barremian, Aptian, Coniacian, and Campanian
2010 - Finalize the proposal for the base of Berriasian (Jurassic/Cretaceous boundary)
2010 to 2013 – Definition of substages.

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

Subcommission officers (with addresses)

Chair: Prof. I. Premoli Silva

Dipartimento di Scienze della Terra “A. Desio”, Via Mangiagalli, 34, 20133 Milano, Italy
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Vice Chair: Dr. I. Walaszczyk

Faculty of Geology, University of Warsaw, Al. Zwirki i Wigury 93, PL02-089 Warsaw, Poland
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Secretary: Dr. Silvia Gardin

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List of Voting Members

E Baraboshkin (Russia)	barabosh@geol.msu.ru
Prof. Jim Channel (USA)	jetc@nersp.nerdc.ufl.edu
Dr. James Crampton (New Zealand)	J.Crampton@gns.cri.nz
Dr. Jim Haggart (Canada)	jhaggart@nrcan.gc.ca
Prof. Malcom Hart (UK)	M.Hart@plymouth.ac.uk
Dr. Peter Hochuli (Switzerland)	peter.hochuli@erdw.ethz.ch
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Prof. Marcos Lamolda (Spain)	mlamolda@ugr.es
Prof. David Watkins (USA)	dwatkins@unlserve.unl.edu
Prof. Helmut Weissert (Switzerland)	helmut.weissert@erdw.ethz.ch
Dr. William A.P. Wimbledon (UK)	newaberdon@tiscali.co.uk

List of Task Groups and their officers

Maastrichtian WG:	GSSP ratified. Giles Odin, France. gilodin@moka.ccr.jussieu.fr
Campanian WG:	jim.kennedy@oum.ox.ac.uk, Andy Gale (UK) asg@nhm.ac.uk
Santonian WG:	Marcos Lamolda, Spain. mlamolda@ugr.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: 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

Hauterivian WG: Jörg Mutterlose, Germany. Joerg.Mutterlose@rz.ruhr-uni-bochum.de

Valanginian WG: Luc Bulot, France. lucgbulot@aol.com

Berriasian (J/K boundary) WG: William A.P. Wimbledon, UK. newaberdon@tiscali.co.uk

Kilian Group [formerly Lower Cretaceous ammonite WG]:

Chairman: Stéphane Reboulet, France. stephane.reboulet@univ-lyon1.fr
Vise-chairmen: Peter Rawson, UK. peter.rawson1@btinternet.com,
Jaap Klein, NL. j.klein@amc.uva.nl

SUBCOMMISSION ON JURASSIC STRATIGRAPHY

ANNUAL REPORT 2009

2. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Jurassic Stratigraphy

SUBMITTED BY

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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). At a lower, zonal level, updated definitions of standard and regional zones will be 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 four 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) 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;
- (c) During IGCP Project 506, initiated by the Subcommission, the development of methods of correlation between the units of the standard chronostratigraphic scale, established in marine Jurassic successions, and non-marine successions, to enable reconstruction of the history of the global biosphere and the lithosphere during the Jurassic Period;
- (d) International coordination of and collaboration in research on Jurassic environments, through the establishment of Thematic Working Groups, for example on Paleobiogeography, Paleoclimate, Sequence Stratigraphy and Tectonics. 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 Symposia on the Jurassic System, held in every fourth year and sponsored by ISJS.

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 or ASPs; 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. It is emphasised here that for Jurassic stratigraphers the Stage is not regarded by most as the basic unit of chronostratigraphy, but as a group of Standard (Normally ammonite-based) Zones;
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. ORGANIZATION

The Subcommission has an Executive consisting of Chairman, Vice-Chairman and Secretary, who are all Voting Members of the Subcommission. There are normally twenty other Voting Members, and it is emphasised that they are not elected to represent a country or region, but for their personal expertise and experience. Each has agreed defined areas of responsibility, which are published in the Subcommission Directory. Renewal of the membership has been pursued this year. Replacement of those who have served the maximum allowed three terms or otherwise wished to withdraw from duty now awaits ratification by the ICS Executive. The following 10 new voting members have been asked to serve, and each of them accepted the invitation:

Mabrouk Bougdiri (Tunisia)

Angela Coe (UK)

Susanne Feist-Burkhardt, (UK)

Bruno Galbrun (France)

Linda A. Hinnov (USA)

Atsushi Matsuoka (Japan)

Christian Meister (Switzerland)

Federico Olóriz (Spain)

Mikhail A. Rogov (Russia)

Yongdong Wang (China)

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, either Stratigraphical or Thematic, and each group is organized by a Convenor, sometimes assisted by a Secretary, who are Voting or Corresponding Members.

The Subcommission sponsors an International Symposium on the Jurassic System every four years. The next one is scheduled for 2010, to be held in China, and activities in preparation of this major event have been a focal point of ISJS in the reported year. The Chairman of the Organizing Committee is normally a Voting Member of the Subcommission, at this occasion the Vice Chair, but the Committee is independent of the Subcommission.

3a. Officers in year 2009 (for term of office 2008-2012)

Chair: József PÁLFY, Hungary

Vice-Chair: Jingeng SHA, China

Secretary: Stephen HESSELBO, UK

WEB address for Subcommission: <http://jurassic.earth.ox.ac.uk/>

(Please note that the site underwent a major update and was migrated from its former address and server to this new one, hosted at the Oxford University and managed by the Secretary.)

4. 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 Working Groups and the Jurassic Symposia.

4a. International Geoscience Programme (IGCP)

4a IGCP Project 506: Marine and Non-marine Jurassic: Global correlation and major geological events. This Project, which is associated with the Jurassic Subcommission, is led by Vice Chair SHA Jingeng (China), with one Voting Member (Nicol MORTON, France) and five Corresponding Members as Co-Leaders. The 8th Symposium of IGCP 506 was held in Bucharest, Rumania in 28 August–3 September 2009.

The symposium was organised by Mihai E. POPA (University of Bucharest) and his colleagues. It was held in the University of Bucharest, Faculty of Geology and Geophysics. The successful symposium was attended by some 20 participants from 9 countries. Two days devoted to scientific communications included 17 oral presentations, followed by a three-day field trip to key Jurassic localities in the Iron Gates National Park and the Anina coal district in the Southern Carpathians. The Abstracts and Field Guide Volume consists of 91 pages (available for download at the conference website: <http://mepopa.com/igcp506>).

4b. Colorado Plateau Coring Project (CPCP)

This project, although not formally associated with the Jurassic Subcommission, is in overlap of scientific interest with many of the ISJS activities and that of the members of the Jurassic research community. A workshop was convened in May 2009, in Albuquerque, New Mexico, to further advance planning for the Colorado Plateau Coring Project (CPCP), and identify the target site for initial coring. The giant continental and paralic epicontinental basins of the American southwest are particularly well exposed on the Colorado Plateau and its environs and contain one of the richest records of lower Mesozoic strata. This time period includes the major mass extinction which marks the Triassic-Jurassic boundary and is notable by the evolutionary appearance of the modern biota, and dramatic climate changes on the continents. Thirty-seven researchers from nine countries (including several voting and corresponding members of ISJS) participated in the CPCP workshop, its discussion, and its field trip visiting sites exposing the latest Triassic to (?) Middle Jurassic Glen Canyon Group and Middle to (?)Late Jurassic San Rafael Group, at Petrified Forest National Park, northern Arizona and other localities. Drilling proposals have been and will be submitted to the US NSF and International Continental Drilling Program (ICDP).

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009

5a. Progress with selection of GSSPs for Jurassic Stages

Five of the eleven Jurassic Stages now have ratified GSSPs (Sinemurian, Pliensbachian, Aalenian, Bajocian, Bathonian), whereas the GSSP of the base of the Jurassic System was submitted for ratification this year. The status of all Jurassic GSSPs is reviewed below.

5a (i) Hettangian and Triassic/Jurassic Boundary

After several rounds of ballots held in rapid succession within the Triassic/Jurassic Boundary Working Group (TJB WG) and the ISJS in 2008, a majority favored the definition of the TJB by the first occurrence of the ammonite *Psiloceras spelae* GUEX n. ssp. at a level 5.80 m above the base of the Tiefengraben Member of the Kendelbach Formation in the Kuhjoch section, Karwendel Mountains, Northern Calcareous Alps, Austria (47°29'02"N/11°31'50"E). Subsequently, a slightly revised proposal was submitted to ICS in August 2008. The vote within the ICS took place in early 2009, again with the Kuhjoch proposal receiving the required majority of the vote. It is our understanding that the ICS executive forwarded the proposal for ratification to the IUGS. To date the ISJS has not been notified of the ratification.

5a (ii) Sinemurian. The Sinemurian GSSP in Somerset (S.W. England) was ratified by IUGS in 2000 and published in *Episodes* **25/1**, 22-28, 2002.

5a (iii) Pliensbachian. The Pliensbachian GSSP in Wine Haven section in Yorkshire (E. England) was ratified by IUGS in 2005 and published in *Episodes* **29/2**, 93-106, 2006.

5a (iv) Toarcian

There is generally accepted agreement, as reported by the late Serge Elmi to the 7th International Congress on the Jurassic System in Krakow, Poland in September 2006, that the GSSP for the base of the Toarcian Stage be placed at the base of bed 15e in the Ponta da Trovao section,

Peniche, Portugal. The basis for a proposal will be papers published in the proceedings of the meeting of the Toarcian Working Group in Peniche in July 2005. The formal proposal, based partly on files left by Serge Elmi, is being prepared by Rogerio Rocha, Antonio Goy and colleagues. A first draft has been produced by this team in 2009, and it is currently under revision. The Task Group has been reorganized, under the leadership of Rogerio Rocha, with Emanuela Mattioli as secretary.

5a (v) Aalenian and Lower/Middle Jurassic Boundary. GSSP proposal of Fuentelsaz section (Spain) ratified by IUGS in 2000 and published in *Episodes* 24/3, 166-175, 2001.

5a (vi) Bajocian. Proposal of GSSP at Cabo Mondego section (Portugal) and ASP at Bearreraig, Isle of Skye section (NW Scotland) was ratified by IUGS in 1996 and published in *Episodes* 20/1, 16-22, 1997.

5a (vii) Bathonian. Proposal of GSSP at the Ravin du Bès section near Digne Haute-Alpes, France was ratified by IUGS in July 2008. Publication in *Episodes* is forthcoming.

5a (viii) Callovian

Research by the Working Group, Convenor John CALLOMON, to select the best marker for the base of the basal zone and subzone of the Callovian Stage, and of the best section for GSSP were completed in the early 1990s. The marker and section selected are the *Kepplerites keppleri* horizon in the Albstadt-Pfeffingen, Swabia (S. Germany) section. A description and discussion were published in the Proceedings of 5th International Jurassic Symposium (*GeoResearch Forum* 6, 41-54, 2000). The procedure should be completed in the near future and votes should be formalized in compliance with the requirements of the ICS Statutes.

5a (ix) Oxfordian and Middle/Upper Jurassic Boundary

The Working Group, Convenor Guillermo MELENDEZ, has over the past five years decided to focus attention on two candidate sections, at Savouron, Provence (S.E. France) and Redcliff Point, Dorset (S.W. England). Descriptions of both sections were presented at the Krakow Congress. Most of the multidisciplinary work on the Redcliff Point section has been completed and will be published in *Volumina Jurassica no. 6* (expected to appear in 2009, but delayed). Only part of the work on the Savouron section has been published; the rest has not yet been submitted to the Working Group. Detailed comparative work on the critical ammonite faunas across the boundary in both sections was carried out at Lyon and in the field during the summer of 2007. This proved that the detailed succession of ammonites established at Redcliff Point could also be recognised in the Savouron section, confirming the suitability of the *Cardioceras redcliffense* Horizon as the primary marker for the base of the Oxfordian Stage. Recently objections were raised by some French colleagues to the elimination from consideration of another section in France. The situation remains that as soon as the results of work on the Savouron section are available, details of both sections will be submitted to members of the Working Group for selection and a proposal for the GSSP and ASP submitted.

5a (x) Kimmeridgian

The basal boundary of the Kimmeridgian Stage has been, historically, a difficult problem because of faunal provincialism so that it became clear some time ago that the Boreal/Subboreal

boundary was significantly older than the Submediterranean/Mediterranean boundary. The former has several advantages, not least historical precedent. Therefore, a vote was held within the Working Group to use the Subboreal base of the Kimmeridgian as the level at which the GSSP should be placed and this was approved by a strong majority (67%), endorsed by an even larger majority (77%) within the ISJS. Therefore, the base of the Kimmeridgian Stage should be defined at the base of the Baylei Zone. In a vote within the Working Group, the Flodigarry section, Staffin Bay, Isle of Skye, Scotland received a clear majority as the proposed GSSP section. However, no clear support emerged for either of the two proposed ammonite horizons (the *Pictonia flodigarriense* Horizon or the *Pictonia densicosta* Horizon) as the primary marker for recognition and correlation of the base of the Baylei Zone and the Kimmeridgian Stage. New magnetostratigraphic results will be published soon and these may shed new light to the independent correlation potential of the horizons. The issue will be submitted to the Working Group members for a new vote.

5a (xi) Tithonian

Progress in identifying a possible GSSP for the base of the Tithonian is the least advanced of any of the Jurassic Stages. Completion of ammonite biostratigraphic work on a possible candidate section, Canjuers in southern France, offers the best hope for a GSSP proposal to emerge in the near future.

5b. Publication of the Proceedings of the 7th International Congress on the Jurassic System

After some delay in editing and printing, the first of two volumes containing the proceedings of the 7th International Congress on the Jurassic System held in Kraków, Poland in September 2006, was published as vol. 6 of *Volumina Jurassica*. It contains an Introduction, followed by three sections which comprise thematic sets of papers on Facies analysis and reconstruction of paleoenvironments, Palaeoecology, palaeobiogeography, and Geoconservation and palaeontological heritage. The volume comprises a total of 14 papers on 173 pages of sub-A4 size, printed on high-quality glossy paper. The papers are also available for free download at www.voluminajurassica.org.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

This year saw a continuation of the problems which already emerged last year in terms of limited time and energy available to devote to ISJS business from all three members of the executive, due to their multiple other commitments in their professional life. Thus, albeit inadvertently, this year can be regarded as an experiment to gauge the momentum of the Task Groups in their independent effort to resolve the outstanding stage boundary definitions. Unfortunately, it can be observed that to move the issue of the remaining GSSP definitions forward, a much more active leadership role of the executive is needed. There simply isn't enough self-motivation in most of the task groups to finish their business in a reasonable time, if not for the stirring, encouragement, and active involvement of the ISJS executive. It is hoped that in 2010 more resources will be available from the executive, and the upcoming 8th Jurassic Congress will provide additional stimulus.

7. SUMMARY OF EXPENDITURES IN FISCAL YEAR 2009 (UP TO DATE OF REPORT)

To be appended.

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR

8a. Proposals for GSSPs of Jurassic Stages

Completion of the project to define the basal boundaries of all eleven Jurassic Stages is the priority of the Jurassic Subcommission, with five remaining to be defined. Progress slowed down in 2009 but expected to be reinvigorated again in 2010, the year of the next international Jurassic congress.

The GSSP section, level and primary marker have been selected for the Toarcian, Callovian and Kimmeridgian. Preparation of a formal proposal is well underway for the Toarcian, and forthcoming in the near future for the Callovian and Kimmeridgian. The Oxfordian Task Group awaits publication of the latest results from the leading candidate GSSP section, before proceeding with the formal proposal and ballots. More research and publication is needed for the Tithonian. A status summary is listed below:

- (i) *Toarcian*: under the leadership of new Convenor, proposal being revised before circulation among TG members;
- (ii) *Callovian*: details of previous deliberations being prepared for publication and resubmission of proposal;
- (iii) *Oxfordian*: publication of key papers with relevant new results awaited in *Volumina Jurassica*, before Task Group vote could be organized;
- (iv) *Kimmeridgian*: GSSP section and basal zone agreed upon in Task Group and Subcommission vote, precise level and marker not yet decided, impasse after an inconclusive TG vote may be resolved after new magnetostratigraphic results will be available.
- (v) *Tithonian*: further work on candidate sections required, Canjeur.

8b. 8th International Congress on the Jurassic System, China, 2010

The next major ISJS-sponsored conference, the 8th International Congress on the Jurassic System will be held in Shehong of Suining, Sichuan, China from August 9-13, 2010. Preparations are well underway. The central theme of the congress will be "Marine and Non-marine Jurassic System", and a variety of scientific sessions and programs will be arranged, including: 1. Marine and non-marine Jurassic boundaries and stratotypes; 2. Biostratigraphy, sequence stratigraphy, isotopic stratigraphy, magnetostratigraphy, cyclostratigraphy of the Jurassic; 3. Biodiversity and evolution of Jurassic life; 4. Depositional facies, palaeogeography, palaeoenvironment and ecosystem reconstruction; 5. Jurassic paleoclimate and paleo-atmospheric CO₂ circulation; 6. Major bio- and geological events of the Jurassic and their causes and mechanics; 7. Mineral and energy resources (oil, gas and coals, etc) of Jurassic deposits; 8. Jurassic Geoparks and museums: their roles in geological heritage protection and public education.

Eight field excursions are planned to complement the scientific program. These include pre-congress excursions: (A1) non-marine Triassic and Jurassic sequences and T/J boundary in

Xinjiang, NW China (A2) Non-marine Jurassic and Cretaceous deposits and the Jehol Biota in Western Liaoning Province, NE China; Mid-congress excursions: (B1). Excursion to National Geopark and Museum of Jurassic Petrified Forest of Shehong, (B2) Visit the quake relics and museum of the Wenchuan magnitude 8.0 Earthquake of May 12, 2008 in Sichuan and (B3) Visits around Chengdu City for cultural and historic monuments; and post-congress excursions: (C1) Non-marine Triassic and Jurassic in the Sichuan Basin, (C2) Marine Triassic, Jurassic and Cretaceous in southern Tibet, and (C3) Marine and non-marine Jurassic deposits in Thailand.

8c. Proceedings of 7th International Congress on the Jurassic System, Krakow, Poland, 2006

All 35 papers submitted for publication in the Proceedings Volume have been peer reviewed and 14 of them were published in 2009. The remaining set of papers will appear in *Volumina Jurassica* vol. 7. Publication was previously envisioned for 2009 but after some delay it is now expected for early 2009.

8c. ISJS website maintainance

In 2009, the website for the Jurassic Subcommission was entirely revamped and migrated to a new server at the Oxford University, thanks to the efforts of Secretary Steve HESSELBO. It remains a priority to maintain the website as one of the main lines of communication within the Jurassic community.

8d. Publication of Jurassic Newsletters

An important medium of communication is the ISJS Jurassic Newsletter, which electronically publishes reports of the Working Group and other articles, of varying length. This is emailed to all Honorary, Voting and Corresponding Members and should be forwarded to others who have an interest in Jurassic geology. Preparation of Volume 36 is underway and it should appear in early 2010.

8e. IGCP Project 506 Marine and Non-marine Jurassic: Global Correlation and Major Geological Events: plans for 2010

This project is entering its fifth and final year. It is expected that the project, under the leadership of ISJS Vice-Chair Jinjeng SHA, will showcase its results at the upcoming 8th International Congress on the Jurassic System in China. In addition, there are tentative plans for an additional field meeting in Argentina.

9. BUDGET AND ICS COMPONENT FOR FISCAL YEAR 2010

To be appended.

9b. Potential funding sources outside IUGS. Much of the costs of Task Group meetings and other activities will be met by local support from host institutions and participation by individuals by national research and travel grants from their own authorities. Benefits from use of IGCP 506 funds will also overlap with the objectives of ISJS.

SUBCOMMISSION ON TRIASSIC STRATIGRAPHY

ANNUAL REPORT 2009

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
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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.

3. ORGANIZATION

STS is a Subcommission of the International Commission on Stratigraphy. Officers (chairman, two vice-chairmen, secretary), Editor/ Webmaster of newsletter *Albertiana*, voting members (25), and corresponding members (~100). 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 both hardcopy and web release.

3a. Officers for 2004-2008:

Chair: Dr. Michael J. Orchard, Canada
Vice-Chair: Prof. Marco Balini, Italy
Vice-Chair: Prof. Yin Hongfu, China
Secretary: Prof. Christopher R. McRoberts, USA

3b. Officers for 2008-2012:

Chair: Prof. Marco Balini, Italy
Vice-Chair: Dr. Mark Hounslow, UK
Vice-Chair: Prof. Jinnan Tong, China
Secretary: Prof. Christopher R. McRoberts, USA

The official newsletter of the STS is *Albertiana*, printed twice in the year in Utrecht (The Netherland) and downloadable at the website:

<http://www3.bio.uu.nl/palaeo/Albertiana/Albertiana01.htm>

The web site of the STS is hosted at SUNY – Cortland, where all the information on the Subcommission activities are available: <http://paleo.cortland.edu/sts/>

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

IGCP Project 572: Restoration of marine ecosystems following the Permian-Triassic mass extinction: Lessons for the present (2008-2012).

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009**Publications**

“The Triassic Timescale” S.G. Lucas (ed.), Geological Society of London Special publications. The volume includes 15 contributions. The final version of the volume, including all the peer reviewed manuscripts, has been submitted to the GSL in September 2009. The book reviews the state-of-the-art of the Triassic time-scale and includes comprehensive analyses of Triassic radioisotopic ages, magnetostratigraphy, isotope-based and cyclostratigraphic correlations and timescale relevant marine and nonmarine biostratigraphy.

Proceedings of “The Triassic climate” workshop, Bolzano/Bozen, 2008

Special Issue of Palaeogeography, Palaeoclimatology, Palaeoecology, The peer review of the manuscripts submitted at the end of 2008 is over, and the volume will be printed in the first half of 2010.

Two volumes of *Albertiana* are scheduled for this year:

#37. Formerly scheduled for December 2008, but published in March, about 90 pages.

#38. Scheduled for the end of September, with editing in progress.

The primary aim of Albertiana is to promote the interdisciplinary collaboration and understanding among members of the Subcommission and within this scope serves as a platform for announcements, meeting reports, business minutes, reviews, and Triassic literature compilations as well as preliminary notes, progress reports, and articles on Triassic research.

Electronic versions are also available in PDF format at:

<http://www3.bio.uu.nl/palaeo/Albertiana/Albertiana01.htm>

Meetings:

8-11 May 2009. Albuquerque, New Mexico, USA. Colorado Plateau Coring Project Workshop

2. The workshop consisted of two days of talks focused on nonmarine Upper Triassic stratigraphy and correlation followed by a fieldtrip to the Petrified Forest National Park in Arizona to examine nonmarine Upper Triassic strata. 35 scientists from 9 countries participated.

http://www.ldeo.columbia.edu/~polsen/cpcp/CPCP_09_workshop.html

21-26 June 2009. Cincinnati, USA. IGCP 572 Session at the 2009 North American Paleontological Convention (NAPC 2009).

14-17 October, 2009, Nanjing, China. IGCP 572 workshop 4: Ecosystem evolution over the Permian-Triassic transition, 10th Paleontological Society of China Congress & 25th CPC, This symposium aims to update the studies on ecosystem collapse and re-building over the Permian-Triassic transition based on sedimentary and fossil records from South China. There is a growing number of new P/Tr boundary and Lower-Middle Triassic sections studied in South China in recent years. The IGCP 572 symposium hopes to offer opportunities for various Chinese working groups to communicate their new discoveries obtained from the newly found P/Tr boundary and Triassic sections. The IGCP 572 session also provides unique opportunity for non-Chinese working groups to communicate directly with various Chinese researchers, and thus bridge their collaborations in short future.

Progress on outstanding Triassic GSSPs:

Induan-Olenekian

At the end of 2007 after very lively discussions and two rounds of votes, the Task Group selected as best GSSP candidate the Mud section (Spiti, India), with the proposed base of the Olenekian at the FAD of the conodont *Neospaphodus waageni sensu latu* at level MO4-13A3 of Mud O4 section. In 2008 further research aimed at refining the taxonomic variability of *N. waageni* leads to discover some specimens possibly belonging to morphotypes of the group of *N. waageni* also below the level MO4-13A3. In order to come to a stable conclusion one year of time was given to the research group working on Mud section, with dead line the ICOS 2009 (Calgary, July, 12-17). Two conodont specialists (M. J. Orchard and N. Goudemand) were involved in the study and they both confirm the conclusion that *N. waageni* sensu latu first appears about 1 m below

the level MO4-13A3. In October 2009 the Task Group is reactivated, with a suggested schedule to fix another session of vote by the end of 2010.

Olenekian-Anisian:

Two boundary proposals were presented in 2007 (Albertiana #36). The first proposal was based on the FAD of the conodont *Chiosella timorensis* supported by multidisciplinary data at Desli Caira (Gradinaru et al.). The second proposal suggested the base of the magnetozone MT1n at the same section (Hounslow et al.). During the Bad Goisern meeting in September, 2008 the conodont specialists unanimously supported the FAD of *C. timorensis* as the best marker event for the O-A boundary, as already stated by Gradinaru et al., 2006 (Albertiana #34). In 2009 the research focused on the ammonoid calibration of the boundary interval, to test the isochrony of the first occurrence of *C. timorensis*. Such a test is very difficult because often the Olenekian-Anisian sections show reduced sedimentation rate and poor and/or not continuous ammonoid record. H. Bucher expressed some concerns on the completeness of the uppermost Olenekian at Desli Caira because some faunas correlative with part of the Haugi Zone of north America have not yet been found. This part of the section was sampled again in late summer by Gradinaru together with the latest Anisian, showing rather impoverished ammonoid faunas. The possibilities of gaps at the top of the Olenekian at Desli Caira leads some authors 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 succession in the same section.

Ladinian-Carnian

The GSSP for the base of the Carnian stage has been defined in 2008 at level SW4 of the Prati di Stuores/Stuores Wiesen (Dolomites, Italy) with the first occurrence of the ammonoid *Daxatina canadensis*. The GSSP has been ratified in June, 2008 and the final paper for Episodes is in progress.

Carnian-Norian

After the proposal of two candidate sections Black Bear Ridge (Williston Lake, British Columbia, Canada) and Pizzo Mondello (western Sicily, Italy), the work of the Task Group is now focusing on the selection of the primary and additional marker events. This implies refinement on conodont and halobiid taxonomy and correlations. The research teams studying the two sections work in very close cooperation, making the Task Group a really collaborative and stimulating environment.

This year Zonneveld et al. have submitted to Stratigraphy the description of the stratigraphic and sedimentologic framework of BBR section and have presented a second contribution on the Upper Triassic of Williston Lake to the GSA. The monograph on halobiid and monotid bivalves from Black Bear Ridge and other sections in the Williston Lake area by C. McRoberts is near to the completion. The conodont monograph by M.Orchard is also close to the end.

The progress on Pizzo Mondello section is mostly due to the two PhD thesis of M.Levera and M. Mazza (Milano University) and to M. Rigo (Padova University). Two contributions on

conodonts have been presented at the ICOS 2009 (Mazza et al.; Rigo et al.). Moreover a paper on the turnover of conodont genera at the C/N boundary (Mazza et al.) is in press in the special volume of Paleo3 dedicated to the Proceedings of the Bolzano Triassic Climate symposium. M. Mazza, M. Rigo, A. Nicora and M. Orchard have discussed and compared the conodonts from both the candidate sections during a post ICOS informal meeting at Vancouver (end of July). M. Levera is ending his PhD on the C/N halobiids. This year he discussed his collections with L. Krystyn, P. De Capoa and C. McRoberts and compared his collections with type material in Vienna and C. McRoberts collections from North America. Next year two field trips to BBR (May) and PM (September) sections are planned. The Triassic workshop held in Sicily in September will be a crucial opportunity for the Task Group to try to come to a conclusion.

Norian-Rhaetian

The study of the GSSP candidate Steinbergkogel (Austria) has been finished with a complementary high-resolution palaeomagnetic sampling of the late Norian part for a still more detailed correlation with other Tethyan sections. The distinct and sudden frequency change from *Epigondolella* to *Misikella* conodont dominance identified in 2008 in the Steinbergokel section, has been investigated and proven for contemporaneity in 20 sections from various Tethyan regions between Austria and Indonesia. This easily detectable event can now be used as the most important proxy for identifying the Norian–Rhaetian boundary in marine sediments of the Tethys Realm. Additional conodont studies further have demonstrated the widespread occurrence of the *Epigondolella mosheri* group in the Tethys. Some morphotypes of this group may allow a cross-correlation of the boundary into the Panthalassa Realm of North America.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

The slackening of the activities experienced in 2008 unfortunately is still continuing in 2009. The lack of IGCP support with the end of IGCP 467 is only one of the reasons, being the most important the reduction of research funding related to the general economic crisis started with the second half of 2008. In several countries the budget for the research is notably reduced and the allocation of funds delayed. This affects the field work, data analysis and, most dramatically lead to a reduction of research contracts for PhD students and post-doc young scientists. The IGCP 572 still provide some support for investigations on the Early Triassic.

7. SUMMARY OF EXPENDITURES IN 2009 (in US\$)

ICS FUNDING

Subcommission allocation	\$ 2500
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STS EXPENDITURES

Albertiana	\$ 800
Contribution to Officer's travel expenses	\$ 800
Preliminary test of Sicily 2010 field trip*	\$ 900

TOTAL	\$ 2500
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*2 day excursion for 3 people (September 14-17, 2009)

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2010):

Meeting/field workshop schedule

February 20-26, 2010. IGCP 572, 5th workshop. Recovery of ecosystems after the P-Tr mass extinction: Field workshop in Oman, Gutech of Muscat, Oman. The field workshop aims to investigate the recovery of ecosystems following the end-Permian mass extinction through analyses of the rock and fossil records via studies of biostratigraphy, paleontology, paleoecology, sedimentology, geochemistry and biogeochemistry in Oman, which was situated at the northern margins of the Gondwana during the P/Tr transition. Scientific Committee for the Fieldworkshop: Michaela Bernecker (GUtech, Muscat), Sylvie Crasquin (Paris), Alda Nicora (Milano), Aymon Baud (Lausanne), Charles Henderson (Calgary), Leopold Krystyn (Vienna) and Oliver Weidlich (Kassel).

May, 21-24, 2010. Field trip to Black Bear Ridge, Williston Lake (British Columbia, Canada). The field trip is organized by J.P. Zonneveld (Univ. Alberta, Edmonton) and will allow the visit of one of the two GSSP candidate section.

June, 3-6, 2010. Wuhan, China, IGCP 572, 6th workshop. Meeting and Field Workshop in South China, International Conference of Geobiology, China University of Geosciences, Wuhan. IGCP 572 is one of major sponsors of the ICG2010 and will organize three sessions: Permian/Triassic (P/Tr) mass extinction, Triassic restoration of marine ecosystems and Global distribution of Early Triassic microbialites at the IGC, Wuhan in the summer of 2010. The symposium aims to update the studies on the P/Tr mass extinction and possible causes, investigate the restoration mechanisms and processes of marine ecosystems following the P/Tr mass extinction through studies of biostratigraphy, palaeontology, palaeoecology, sedimentology, geochemistry and biogeochemistry, and elucidate the growing mechanisms and environmental significance of the Early Triassic microbialites. Three potential field excursions are also organized before and after the symposium: 1) Meishan-Chaohu excursion route: examining the P/Tr mass extinction and its aftermath from platform ramp to basin setting; 2) Guizhou excursion route: assessing recovery pattern and processes of palaeo-communities in various facies settings; 3) Southern Tibet excursion route: collapse and re-building of marine ecosystems in Gondwana margins.

June 28 to July 3, 2010. London, UK, IGCP 572, 7th workshop. Permo-Triassic ecosystems session and workshop; 3rd International Palaeontological Congress (IPC 3), London; 2010. IGCP 572 is organizing a thematic session addressing the Permian-Triassic mass extinction and subsequent recovery and a half-day workshop on the microbial ecosystem following the end-Permian mass extinction.

More information on IGCP activities can be found at the following link: <http://www.ipc3.org>, <http://www.igcp572.org>.

September, 5-10, 2010. Dolomites (Italy). 7th International Field Workshop on Triassic. Triassic of the Dolomites. This excursion is a great opportunity to visit the best Triassic sections of the Dolomites, that are recently been recognized as World Heritage Site for the superb Triassic successions by the UNESCO. The excursion is organized by G. Bachmann (Halle University) and P. Gianolla (Ferrara University).

September, 12-16, 2010. Palermo. Triassic workshop in western Sicily. The workshop includes 2 days of presentations at the Museo Geologico Gemmellaro and 2 days of field excursions in western Sicily and immediately follows the International Field Workshop in the Dolomites. The field excursion program includes the historical Permian of the Sosio Valley, some significant Upper Triassic sections in platform and basinal settings, including the Pizzo Mondello section, candidate for the definition of the GSSP of the Norian Stage. Correspondence: M. Balini, University of Milano and P. Di Stefano, University of Palermo.

GSSP deliberations

The I-O Boundary: A new vote is scheduled for the end of 2010.

The O-A Boundary: Two competing GSSP proposals based on fossils and on magnetozone on the same Desli Caira section (Romania) have been submitted to the Task Group. Concerns on the time significance of the first occurrence of the conodont Chiosella timorensis lead to a new sampling of ammonoids at Desli Caira section and re-opened the discussions. In such a situation it is difficult to schedule a vote.

The L-C Boundary: The GSSP has been ratified by IUGS in June, 2008. The final presentation of the GSSP on Episodes is in progress.

The C-N Boundary: The search for the primary and additional marker events in progress and several new data are in press. For this reason the final proposals, expected for the end of 2009, have been delayed to the end of 2010, after the visit of the two candidate sections by the Task Group scheduled for May and September 2010.

The N-R Boundary: The primary marker event and the candidates section was designated in 2008. The final proposal for the Steinbergkogel section, Austria is expected by few months.

9. BUDGET AND ICS COMPONENT FOR 2010 (in US\$)

Albertiana - STS Newsletter production	\$ 800
Support for Black Bear Ridge excursion (May 2010) and Sicily	
Workshop (September 2010)	\$3500
TOTAL	\$4300

Potential funding sources outside IUGS

Dept. of Geosciences, University of Utrecht provides facilities for the production of Albertiana and hosts its web-site.

Dept. of Geosciences, Cortland, New York hosts the STS website.

National research and travel grants provide support to individuals, and host institutions provide in-kind support to the executive and task group chairs.

Because of lack of IGCP financial cover, in 2009 no funding are available for the organization of meetings of the Middle and Upper Triassic Task Groups.

10. REVIEW CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2003-2008)

Organization

Renewal of STS voting and corresponding membership in 2001. Voting membership was reduced from 31 to 26, and a broader geographical and disciplinary base established. This was the first significant turnover of voting members since the inception of the STS. A summary of all members' research interests was published in Albertiana 26. Four new GSSP Task Group chairs were appointed. A second renewal took place in the Fall of 2004 with 11 new voting members amongst 25: this addressed the ICS recommended limit for terms served as well as lapsed members. A second web site was created to supplement that of Albertiana and host discussion groups.

Meetings/ workshops

1. Extinction events, faunal turnovers, and natural boundaries within and around the Late Triassic. Vancouver, Canada. May 25th -28th, 2003. Conodont workshop on the Carnian-Norian boundary.
2. Triassic geochronology and cyclostratigraphy a field symposium, September 11th -15th 2003. Focus on Secada core research and Middle Triassic time scales. Conodont workshop on the Olenekian-Anisian boundary.
3. Field workshop in Spiti, India, 26th June-6th July 2004. Conodont workshop on the Ladinian-Carnian boundary.
4. International Geological Congress, Florence, Italy, August 20-28, 2004. G22-06: Triassic in Tethys Realm; DWO-09: Upper Triassic boundaries.
5. Meeting on Triassic Chronostratigraphy and Biotic Recovery. Chaohu, China, May 23-25, 2005. Focus on I-O boundary
6. Symposium on Circum-Panthalassa Triassic Faunas and Sequences, at INTERRAD conference. Te Papa Tongarewa, Museum of New Zealand, in Wellington, Wellington, New Zealand. March 19-24, 2006.
7. Symposium on Triassic Conodonts: Taxonomy and Time Scales, at the First International Conodont Symposium (ICOS1), in Leicester, England, July 17-21, 2006.
8. Conference, The Boreal Triassic. Longyearbyen, Svalbard, Arctic Norway, August 16-20, 2006.

9. International meeting on The Global Triassic. Albuquerque, New Mexico, USA. May (19-)23-25, 2007.
10. Field workshop on the Carnian-Norian boundary, Williston Lake, NE BC, Canada. May 27-31, 2007.
11. Symposium, The Triassic climate, Bolzano/Bozen, Italy, June 3-6, 2008.
12. Symposium and field workshop, Upper Triassic subdivisions, zonations and events, Bad Goisern, Austria, September 28-October 2, 2008.

Publications

14 issues of Albertiana (#24-37) were published in 2000 thru 2008. Each of these issues was made available for download from the web.

Abstract volumes/ field guides prepared for meetings in Romania, Oman, Stuores, Felsoors, Vancouver, St Cristina, Spiti, Chaohu, Wellington, Leicester, Longyearbyen, Albuquerque, Bolzano and Bad Goisern.

Task groups

Base-Induan

The Permian-Triassic boundary Task group ended the activities in 2001, with the ratification of the GSSP at the first appearance of the conodont *Hindeodus parvus* at the base of bed 27c, within the Yinkeng Formation at Meishan, Changxing County, Zhejiang Province, South China.

Induan-Olenekian

The Induan-Olenekian boundary Task Group, formed in 1997, reviewed the options for a GSSP in the Russian Far East but found them lacking because of strong remagnetization of Triassic rocks and poor recovery of I/O conodont assemblages. A section in Chaohu, Anhui Province, China subsequently became the focus of intensive study. Ammonoid and conodont biostratigraphy, magnetostratigraphy, and chemostratigraphy were undertaken. The FAD of the conodont *Neospaphodus waageni* was identified as a potential GSSP datum: it lies 26 cm below the FAD of the flemingitid ammonoids, and is located slightly prior to the top of the second Triassic normal magnetozone, and prior to the peak of the first Triassic positive excursion of $\delta^{13}\text{C}$. A preliminary conodont biostratigraphy for Chaohu was summarized in Albertiana #29 (2004), and the ammonoids described in Albertiana #31. This boundary and proposed GSSP was the focus of a meeting held in China during June 2005, at which time many members of the task group were able to examine the section. Several publications on Chaohu appeared in 2006 (see Albertiana #33 and 34), including an account of the conodont succession, and papers on the bivalves, ammonoids and palynomorphs.

After 2004 field work carried out in Mud, Spiti, an evaluation of the Mikin Fm. for establishing an Induan-Olenekian boundary GSSP candidate began (see Albertiana #35). The rocks include

top *Gyronites*, complete *Flemingites*, and basal *Euflemingites* ammonoid intervals. Three boundary options based in ammonoids were suggested and provisionally tied to the FAD of *Neospathodus waageni* subsp. Initial conodont studies identified useful taxa common to Chaohu. The ammonoid record appears superior to that at Chaohu but the section lacks a magnetostratigraphy. Both the proposal and studies on the conodonts and C-isotopes from Spiti appeared in Albertiana #36, as did an account of the considerable discussion on this boundary that took place during and after the Svalbard meeting.

Two ballots were organized in 2007, based on the FAD of *Neospathodus waageni sensu lato* at Mud and at Chaohu. Mud got the majority of votes at the end of 2007, with proposed GSSP at the base of level MO4-13A3 of Mud section 4. In 2008 further research on Mud samples, aimed at refining the taxonomic variability of *N. waageni*, leads to discover some specimens possibly belonging to morphotypes of the group of *N. waageni* also below the level MO4-13A3. In order to come to a stable conclusion one year of time was given to the research group working on Mud section, with dead line the ICOS 2009 (Calgary, July, 12-17). Two conodont specialists (M. J. Orchard and N. Goudemand) were involved in the study and they both come to the conclusion that *N. waageni sensu lato* first appears about 1 m below the level MO4-13A3. In October 2009 the Task Group is reactivated and the discussion re-opened. The mandate of the Task Group is to organised a round of vote by the end of 2010.

Olenekian-Anisian

A field workshop was held at Desli Caira, in Dobrogea, Romania, in June 2000, to view the Olenekian-Anisian boundary candidate. Major work was undertaken on ammonoid, nautiloid, conodont, and foraminiferid biostratigraphy. Both chemo- and magneto-stratigraphic analyses were largely completed. At the 2003 field workshop in St. Christina, a conodont workshop amongst task group members agreed that the appearance of the conodont *Chiosella timorensis* at the base of bed 7 was a suitable datum for GSSP definition. Further geochemical sampling was undertaken in 2004 to fill a perceived gap in the coverage at the principal section. Further work has been undertaken on correlative sections in South China, Spiti, and South Primorye, Russia. In particular, a section at Guandao in the Nanpanjiang Basin of Guizhou Province, South China produced an excellent dataset, including isotopic dates from about this boundary (~247 Ma).

At Desli Caira, the FAD of the conodont *Chiosella timorensis* corresponds to a significant change in the ammonoid fauna, and a little below a peak of a positive C isotope excursion; it falls within a short reversed polarity interval situated between two short normal intervals that follow the longer reversed interval in the upper Spathian. The Guandao section lacks rich ammonoid faunas but it is relatively expanded and has an excellent conodont succession and numerous dated ash beds that place the O-A boundary at 247.2 Ma. At the Svalbard meeting, E. Grădinaru presented data on the ammonoids and nautiloids of Desli Caira: the boundary is placed between beds with *Deslicairites simionescui* n.g. n.sp., *Procarnites kokeni* and other upper Spathian ammonoids below and the *Paracrochordiceras-Japonites* Beds of basal Anisian age above. Especially important for correlation with the Boreal Realm is the outstanding occurrence of olenekitids (*Deslicairites*, ?*Svalbardiceras*) in the topmost Olenekian of the Tethys and of ?*Karangatites* at the very base of the Anisian at Desli Caira. *Karangatites* is the zonal marker for the base of the Anisian in Arctic Siberia. The use of the FAD of the conodont *Chiosella*

timorensis as a datum for the O-A boundary was challenged due to variation in its taxonomic treatment and evolution in our understanding of the group leading to historical records of the species occurring within Olenekian strata. A study of *Chiosella* based on the collections from both Desli Caira and Guandao was undertaken in order to clarify its taxonomy and demonstrate its utility as a global index. A paper on this topic was published in Albertiana #34.

The proposal for the GSSP at Desli Caira on the first occurrence of *C. timorensis* at the base of the level GR7 was published in Albertiana #36 (Gradinaru et al.) that included also the report of ammonoid faunas. In the same issue of Albertiana a second GSSP proposal was presented by Hounslow et al. They suggested the base of the magnetozone MT1n at Desli Caira section to bypass bio-chronostratigraphic problem. This proposal is supported by an extremely interesting and detailed magnetostratigraphic correlation schemes including South China, Kcira, Desli Caira, Spitzbergen, Spain, UK, Germany and Poland.

In 2009 the discussion in the Task Group stalled on test of the isochrony of the first occurrence of *C. timorensis*. Such a test is necessary to demonstrate the significance of this bioevent as primary marker for the GSSP, but on the other hand it is very difficult because the ammonoid record of the best O-A sections is poor or discontinuous. H. Bucher expressed some concerns on the completeness of the uppermost Olenekian at Desli Caira because some faunas correlative with part of the Haugi Zone of north America have not yet been found. For this reasons this part of the section was sampled again in late summer by Gradinaru together with the latest Anisian, showing rather impoverished ammonoid faunas. The possibilities of gaps at the top of the Olenekian at Desli Caira leads some authors 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. Another interesting section is Atlasov Cape in South Primorye (Russia). However the ammonoid record of this section is endemic and no data on conodonts are available.

Anisian-Ladinian

During the St. Christina meeting (2003) a formal task group was formed in order to finalize the more than 10 year of research and discussions on the Anisian-Ladinian boundary. Three alternate proposals were published in Albertiana #28, and the choice was concluded in a series of votes within STS during 2004. The IUGS ratified the choice on 21st March 2005. The GSSP is thus defined at the top of "Chiesense groove", located about 5 m above the base of the Buchenstein Beds at Bagolino, northern Italy; the lower surface of the overlying thick limestone bed has the lowest occurrence of the ammonoid *Eoprotrachyceras curionii*. Secondary global markers in the uppermost Anisian include the lowest occurrence of conodont *Neogondolella praehungarica* and a brief normal-polarity magnetic zone. The GSSP level is bracketed by U-Pb single zircon age data, indicating that the boundary age is within the range 240-242 Ma. A description of the GSSP was published in Episodes. Since summer 2009 the GSSP site is accessible through a geological pathway with explanatory notes and ammonoid casts provided by the local administration of Bagolino and the Natural History Museum of Brescia.

Ladinian-Carnian

A field workshop in the Italian Dolomites during July 1998 focused on the section at Prati di Stuores, the subject of a formal Ladinian-Carnian boundary GSSP proposal. A dedicated Task Group was established in 2001. Subsequently fieldwork was carried out in two other regions: Spiti and Nevada. Studies in Spiti have included four expeditions, with two in Nevada. Crucial biostratigraphic data concerns the distinction between prospective index ammonoids *Daxatina* and *Trachyceras*, the FAD of the prospective conodont *Metapolygnathiformis polygnathiformis*, and the appearance of the bivalve *Halobia*.

Work in the Dolomites included a very heavy resampling of the Prati di Stuores section which resulted in a single incomplete specimen of *Metapolygnathus polygnathiformis noah* near the bed with the FAD of *Daxatina*. The Padova research group sought new sections in the Eastern Dolomites to better document the interval between the top of *Daxatina* beds and base of *Trachyceras aon*. In Spiti, as in Prati di Stuores, *Daxatina* appears towards the top of the range interval of the genus *Frankites*, and *Trachyceras* overlaps with highest *Daxatina*. However, the FAD of the conodont *M. polygnathiformis* predates the oncoming of *Daxatina* by several meters. Doubtful *Halobia* still appear within the *Frankites* beds but well established occurrences are higher, within the beds with *Trachyceras*. The pros of the Spiti sections are the concurrent record of ammonoids, conodonts and bivalves, which allows the intercalibration of the bioevents. The cons are the remagnetization of the section, the thermally degraded/destroyed palynomorph content, and the accessibility limited to the summer months, due to the altitude.

In the successions in New Pass, Nevada, *Frankites sutherlandi* overlaps the lower part of the range of *Trachyceras* gr. *T. desatoyense*, several meters above the FAD of *T. desatoyense*. *Halobia* appears in the same beds from where *F. sutherlandi* was recovered and possibly is even older. The richest beds in ammonoids of the South Canyon section overlie a sudden facies change, with the drowning of a carbonate platform. South Canyon does not appear to be a possible GSSP candidate mostly because of the facies change and the remagnetization due to the nearby Cenozoic volcanic rocks. The section is, however, of great significance for large-scale correlations of North America with the Tethyan realm

M. Gaetani, the task group chair, distributed a questionnaire in June 2006 concerning the status of the boundary deliberations and the pros and cons of various fossil criteria. An outcome of this was that, in spite of a lack of an ancestor for *Daxatina*, ammonoids were favored for definition of the boundary. M. Balini, the principal worker on the ammonoid faunas of this boundary interval, visited the Smithsonian Museum for comparative studies and then completed his collections in South Canyon, Nevada. He reports a much more detailed view of the lithologic as well as of the faunal succession, with bed-by-bed data from 5 sites: A, B, D, E, F, three of which have yielded conodont fauna.

The Albuquerque Symposium (May 2007) was the most important moment for the discussion of the GSSP options. The third and last possible candidate section, South Canyon (Nevada), was visited by the Task Group during the pre-congress field trip. Several contributions on British Columbia, Nevada and Prati di Stuores were presented at the symposium and data were published in the New Mexico Musuem Bulletin (#40 and #41: Balini et al., Balini & Jenks; Orchard; Orchard & Balini; Mietto et al.). The detailed bed-by-bed study of South Canyon, the

most important site to test the correlations of the Tethyan bioevents with North American successions, shows interesting faunal similarity with the Tethyan successions. This locality, that previously was regarded to as representing the basal part of the Carnian in North America actually yields typical Upper Ladinian fossils in the lower part, such as *Frankites sutherlandi*, *Metapolyganthus intermedius* and bivalves of the group of *Daonella elegans*. The stratigraphic position of *Daxatina* is also very similar with respect to the Tethys. The upper part of the range of the overlaps with the lower part of the range of *Trachyceras*.

The significance of the new data and the selection of the marker event for the definition of the GSSP of the Carnian stage was discussed during the Business Meeting of the STS. The FO of *Metapolyganthus polygathiformis*, previously considered as possible marker for the base of the Carnian, was no more supported by the conodont specialists while the FAD of *Daxatina canadensis* achieved the general consensus. A final dossier was published in Albertiana #36, and the proposal was voted by 72% of the Task Group members. IUGS ratified the GSSP in June 2008.

Carnian-Norian

The Task Group on the Carnian-Norian boundary was established in 2001. Key sections in Canada, Sicily, Slovakia, Turkey, and Oman have been studied resulting in an integrated bio-, magneto- and chemostratigraphic cross-correlation of key sections in the Tethys. The Pizzo Mondello section in Sicily contributes a magnetostratigraphic profile tied to a preliminary conodont zonation for the C-N boundary interval in Tethys. Alternate views of its correlation with the cyclostratigraphically calibrated Newark non-marine successions, place the base of the Norian at about 214 Ma or 228 Ma. A preliminary new conodont zonation from a potential GSSP at Black Bear Ridge, Western Canada was presented during a formal Workshop on Upper Triassic boundaries at the IGC in Florence in 2004.

Discussions during ICOS1 centered on the suitability of key CNB conodont taxa for intercontinental correlation. It was agreed amongst those present that the FAD of *Epigondolella quadrata*, a higher level than those previously considered, might be a suitable index but this was not widely supported. New work in both Canada and Sicily was planned.

New integrated biostratigraphic investigations at Pizzo Mondello started at the end of 2006 in connections with three PhD thesis of Milano and Padova Universities. Two of them focus on conodonts and halobiids. Preliminary results were presented at the Albuquerque meeting (May 2007) and a more advanced report was printed in Albertiana #36 (Nicora et al.). The biostratigraphic record of Pizzo Mondello is more complete than reported in literature. Besides conodonts, new ammonoids, halobiids and radiolaria were documented. Ammonoids document the last two chronozones of the Carnian and the first zone of the Norian. Halobiids also document the Upper Carnian and the Lower Norian. The radiolarian faunas although found in relatively few samples are very rich with more than 45 taxa.

In 2009 some data from the two sections have been submitted for publications. These include stratigraphic and sedimentologic description of Black Bear Ridge section and conodont data from Pizzo Mondello section. At the end of July the conodont specialists working on the two

sections (M. Mazza, A. Nicora, M. Orchard and M. Rigo) met in Vancouver and discussed taxonomy and correlations. Nearly at the same time the bivalve specialists C. McRoberts and M. Levera compared faunas and discussed taxonomy in a meeting at SUNY Cortland. In September Pizzo Mondello section was visited by J.P. Zonneveld and Milano team in the framework of preparation of the field excursion for the Triassic Workshop Sicily 2010.

Norian-Rhaetian

A Norian-Rhaetian boundary Task Group was formed in 2001. Sections in western Canada, USA, and Austria were studied and produced important ammonoid, bivalve, and conodont data. Magnetostratigraphic and chemostratigraphic studies were undertaken in Queen Charlotte Islands, Canada. Rock magnetism carried a Cretaceous overprint. A carbon isotopic anomaly was identified at a potential boundary where radiolarians show distinctive faunal change and which is the FAD of the conodont *Epigondolella mosheri*, which approximates the Amoenum Zone in North America. A field workshop in the Gabbs Valley Range of Nevada in March 2005 included sampling of both N/R and T/J boundary strata. Palynology results were disappointing, but the presence of the 'Tethyan' conodont *Misikella* was confirmed - a first for the North American autochthon.

In Austria, a section in the Hallstatt and Zlambach Formation produced good ammonoids, pelagic bivalves, conodonts, rare radiolarians, and palynomorphs, as well as a magnetostratigraphy. A distinctive dinoflagellate change occurs midway through the Zlambach section with the FO of *Rhaetogonyaulax rhaetica*, a datum that may have potential in correlation with shallow marine and/or high latitude basins.

At Steinbergkogel, Austria, a potential GSSP candidate, 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. The 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*. A formal presentation of Steinbergkogel as candidate section was done for the Albuquerque Symposium (Krystyn et al., New Mexico Museum Bulletin 41) and updated with magnetostratigraphy in Albertiana #36. Steinbergkogel section was visited during the Bad Goisern meeting in 2008 and impressed the participants for the amount of work done by the group leaded by L. Krystyn. The thickness of the boundary succession is unfortunately rather thin, and the facies is not constant. However the section is of great interest because the Norian-Rhaetian boundary is commonly very poorly documented all over the world. The last problem to be solved in order to come to the final vote of the Task Group consists in the demonstration of the significance of events recorded at Steinbergkogel by their correlations with other sections. This rather complex task engaged L. Krystyn team for most of 2009. 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.

11. OBJECTIVES AND WORK PLAN BEYOND 2009.

The slowing down of the research activities in 2009, unfortunately forces a revision of the work plan scheduled last year. Realistically the objective of the STS, i.e., the completion of the definition of the GSSP of the Triassic System (I-O, O-A, C-N and N-R) can be achieved by 2012. The schedule is strictly depending on the end of the economic crisis.

Work plan:

2010: vote of the I/O and N/R boundary Task Groups. Possibly also for the O/A and C/N T.G.

2011: further ballots, if necessary

2012: start of work on the substages, but only if the primary goals of the STS are accomplished.

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

2004-2008 Subcommission officers (with addresses)

Chairman: M. J. Orchard, Geological Survey of Canada, 625 Robson Street, Vancouver, B.C. V6B 5J3, Canada, e-mail: morchard@nrcan.gc.ca

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Vice Chairman: Marco Balini, Dipartimento di Scienze della Terra, via Mangiagalli 34, I-20133 Milano, Italy. Marco.Balini@unimi.it

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Task Groups and their officers

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Base Ladinian: A. Baud, Switzerland. Aymon.Baud@sst.unil.ch. Mission ended in 2004.
Base Carnian: M. Gaetani, Italy. maurizio.gaetani@unimi.it Mission ended in 2008.
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SUBCOMMISSION ON PERMIAN STRATIGRAPHY

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Permian Stratigraphy (SPS)

SUBMITTED BY:

Charles M. Henderson, Chairman SPS

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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 frameworks and systems to encourage international collaboration in understanding the evolution of the Earth during the Permian Period.

3. ORGANIZATION

The Subcommission has an Executive consisting of a Chairman, a Vice-Chairman, and a Secretary; all three are Voting Members of the Subcommission. There are sixteen total Voting Members representing most regions of the world where Permian rocks are exposed. The objectives of the Subcommission are pursued by both stratigraphic and thematic Working Groups that are retired upon completion of their directed task. For example, the Working Groups on the Carboniferous-Permian Boundary, on the Guadalupian stages (Middle Permian), on the base-Lopingian boundary (base-Wuchiapingian Stage), and on base-Changhsingian have been retired upon the successful establishment of their defining GSSP's and ratification by IUGS. The current working groups include the following: 1. Cisuralian stages, 2. Continental Permian, 3. Transitional biotas as gateways for global correlation, 4. Neotethys, Paleotethys, and S. China Correlations, and 5. International Lopingian Working Group.

3a. Officers for 2008-2012:

Chair: Professor Charles M. Henderson, University of Calgary

Vice-Chair: Dr. Vladimir Davydov, Boise State University

Secretary: Dr. Shuzhong Shen, Nanjing Institute of Geology and Palaeontology

SPS website is located at <http://159.226.74.3:7006/web/index.asp>. This site includes all back issues of *Permophiles* in downloadable PDF format (#1 in 1978 to #53 June. 2009). A link to *Permophiles*/Permian research has also been established at <http://www.ucalgary.ca/conodont/spes>.

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

SPS interacts with many international projects on formal and informal levels. SPS has taken an active role on the development of integrated chronostratigraphic databases by participating with CHRONOS and PALEOSTRAT (now GeoStratSys), which are NSF funded initiatives. Vladimir Davydov and Walter Snyder are concentrating on developing their system to include improved taxonomic dictionaries, database sharing and manipulation with PALEOSTRAT. SPS is also involved in a NSFC supported study comparing the Proterozoic-Cambrian transition with the Permian-Triassic transition.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009

GSSPs: Progress was made on the three remaining Lower Permian (Cisuralian) stage GSSPs including base-Sakmarian, base-Artinskian, and base-Kungurian. Samples collected during an international field excursion conducted in early July 2007 (reported in *Permophiles* #49; p. 4-6) have been processed for stable isotope geochemistry, radioisotopic ages and biostratigraphy. These results were discussed at the Calgary business meeting in July 2009 and some decisions were made (see *Permophiles* 53 for fuller explanation). In summary, we have decided to change the section and point for the base-Sakmarian to the Usolka section. The Kondurovsky section failed to reproduce the requisite conodont results and problems about the evolution of *Sweetognathus merrilli* were discussed during ICOS2009. Fortunately, the Usolka section had been fully worked up as a potential parastratotype and we have excellent carbon isotope, U-Pb isotopic ages and abundant conodonts to define the boundary. It was also decided that the base-Artinskian is ready to prepare a final proposal and vote by SPS now that conodonts have been reproduced and carbon isotopes have been added to the excellent U-Pb dates as correlation tools. At both of these sections the Sr isotopes of conodonts have also been shown to be an accurate correlation tool. Finally, it was decided that the Mechetlino section in Russia is not satisfactory for a GSSP – samples did not yield conodonts, zircons are all reworked, and the rocks are too deeply weathered to produce meaningful carbon isotopic values. Two sections in the United States, which have already been extensively studied are now being considered as potential GSSPs using the same point (FAD of *N. pnevi*); these include the Cassia Mts in southern Idaho and Rockland sections in northern Nevada. We plan to complete proposals and vote for the base-Sakmarian and base-Artinskian early in 2010. We hope to complete the final GSSP for the base-Kungurian early in 2011.

Publications: The December 2008 issue of *Permophiles* (#52) was produced online during January 2009 and distributed as a pdf document to a mailing list of 280. The June 2009 issue (#53) was produced in July 2009 during a conodont symposium at the University of Calgary. *Permophiles* 53 has three parts including: 1) the regular issue with an edited version of the field guide on Argentine Late Paleozoic, 2) the abstract volume for ICOS2009, and 3) the fieldtrip guidebook for ICOS 2009 on the geology of the southern Canadian Rocky Mts. We have a complete series of *Permophiles* on our website (1978 to 2009).

Meetings: The SPS conducted two business meetings including 1) at the end of a field expedition (Feb 16 to March 2, 2009) to Patagonia Argentina at the Museo Paleontologico Egidio Feruglio in Trelew, Argentina and 2) during the International Conodont Symposium (ICOS) at the University of Calgary July 14, 2009. These were reported in *Permophiles* 53.

Membership: There was one addition to the membership in 2009. During the business meeting in Argentina it was decided that SPS should have more representation from countries where the Gondwanan succession is exposed. Dr. Nestor R. Cuneo from Argentina has agreed to become a voting member. We therefore now have 17 voting members representing Argentina (1), Australia (2), Canada (1), China (3), France (1), Germany (1), Italy (1), Japan (1), Russia (3), and United States (3). We also have five honorary Members.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

There were no major problems in 2009, but decisions to reject one of our potential GSSP sites will delay the completion of SPS GSSP activity.

7. SUMMARY OF EXPENDITURES IN 2009:

INCOME

University of Calgary (1): \$5,900.00

NIGPAS (2): \$2,100.00

Donations and ICS (3): \$ 2,000.00

TOTAL: \$10,000.00 (quoted in US\$ using 0.90 as the conversion from Canadian\$.) (1)

University of Calgary support from NSERC grant to Charles Henderson for travel to Argentina and from the Department of Geoscience as a subsidy toward ICOS2009 to support partial costs of some participants and business meeting and dinner. (2) NIGPAS (Nanjing Institute of Geology and Palaeontology) support from NSF-C grant to Shuzhong Shen for travel support to Calgary, printing and website costs. (3) Most of this from ICS with extra support for participants of the SPS Business Meeting at ICOS2009. 1 and 2 do not include costs of sample shipment, conodont processing, and isotope analyses in order to test the GSSPs.

EXPENDITURES

Printing, Mailing, and Web support *Permophiles*: \$1,100.00

Travel costs to Argentina \$3,400.00

Travel costs for *Permophiles* Production: \$2,100.00

Logistical costs for ICOS2009 SPS activities \$3,400.00

TOTAL: \$10,000.00 (quoted in US\$)

BALANCE: \$0.00

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2010):

1. Production of *Permophiles* #54 in China during January 2010.
2. Vote on base-Artinskian in February 2010.
3. Vote on base-Sakmarian in April 2010.
4. SPS business meeting during ICS meeting in Prague May 30-June 3, 2010; the SPS executive plans to attend at this time at least.
5. Production of *Permophiles* #55 in Calgary during July 2010.
6. Completion of new GSSP proposal for base-Kungurian by December 2010 and vote in 2011.

9. BUDGET AND ICS COMPONENT FOR 2010

EXPENDITURES

Travel by Executive (Henderson, Davydov and Shen) to Prague ICS Mtg (1) \$7,500.00

Permophiles and GSSP proposals printing and postage and web \$1,250.00

TOTAL 2009 BUDGET \$8,750.00

Income

Support from University of Calgary (Henderson; NSERC) \$2,500.00

Support from NIGPAS (Shen; NSF-C) \$2,500.00

Support from Boise State (Davydov; NSF) \$500.00

Anticipated donations for *Permophiles* \$ 250.00

Requested ICS contribution (1) \$3,000.00

TOTAL BUDGET REQUEST (ICS) \$3,000.00

Request is for \$1000.00 to cover expenses for printing and postage for *Permophiles*, GSSP proposals, and some correspondence as well as website costs. In addition, SPS requests an extra \$2,000.00 to partially subsidize travel costs for participants to the ICS workshop to be held in Prague during May 30-June 3, 2010 (especially for Davydov).

10. REVIEW CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2005-2009)

The SPS has approved the general divisions of the Permian and has now had 6 GSSP's ratified by ICS and IUGS (Asselian, Roadian, Wordian, Capitanian, Wuchiapingian, Changhsingian). Proposals for the latter two stages were published in Episodes in 2006. Support for documentation (fieldwork and publications) of the various chronostratigraphic methods for the establishment of the GSSP's has been the most outstanding and differentiating character of this Subcommission. Substantial work has been conducted toward producing excellent proposals for the remaining stages. *Permophiles* has become an internationally respected newsletter and bears an ISSN designation (1684-5927) and is deposited in the National Library of Canada; nine issues were published during the five year period. See Accomplishments in 2009 (above) for additional details.

11. OBJECTIVES AND WORK PLAN FOR NEXT 3 YEARS (2009-2012)

The primary objectives are to complete the GSSP's for the last three GSSP's (Sakmarian, Artinskian, and Kungurian); the first two early in 2010 and the latter early in 2011. We will continue to produce two issues of *Permophiles* each year. We anticipate the following schedule:

1. Production of *Permophiles* #54 in China during January 2010.
2. Vote on base-Artinskian in February 2010.
3. Vote on base-Sakmarian in April 2010.
4. SPS business meeting during ICS meeting in Prague May 30-June 3, 2010; the SPS executive plans to attend at this time at least.
5. Production of *Permophiles* #55 in Calgary during July 2010.
6. Completion of new GSSP proposal for base-Kungurian by December 2010.
7. A vote by SPS on the base-Kungurian proposal by March 2011.
8. Production of *Permophiles* #56 (Dec. 2010), #57 (June 2011), #58 (Dec. 2011), #59 (June 2012) and #60 (Dec 2012).
9. Business meeting at International Congress on Carb and Permian July 2011; Perth Australia.
10. New SPS Chair to take effect at IGC in Brisbane in 2012.

Once the GSSP process is completed SPS will shift focus toward three directions beginning in 2011:

1. correlations into continental deposits,
2. correlations across provincial boundaries and within the Tethys region,
3. detailed documentation of the geologic evolution of the Earth during the Permian with respect to the established chronostratigraphic framework.

12. WEBSITE STATUS AND ACTIVITIES:

SPS website is located at <http://159.226.74.3:7006/web/index.asp>. This site is updated regularly and includes all back issues of *Permophiles* in downloadable PDF format (#1 in 1978 to #53 June. 2009) as well as other information about SPS activities including annual reports,

membership.... Shuzhong Shen at Nanjing China maintains the site and Henderson and Shen both have administrator rights.

13. FOUR YEAR SUMMARY OF ACTIVIES:

GSSP's: The proposal for the base-Lopingian (base-Wuchiapingian) was ratified by ICS and IUGS in 2004. The proposal for the base-Changhsingian was voted and ratified by SPS in 2004. The proposal for the base-Changhsingian was voted and ratified by ICS/IUGS in 2005. The base-Wuchiapingian and base-Changhsingian (Upper Permian or Lopingian Series) GSSPs were published in Episodes (volume 29, No. 3&4) in 2006. Progress was made on the three remaining Lower Permian (Cisuralian) stage GSSPs including base-Sakmarian, base-Artinskian, and base-Kungurian. An international field excursion was conducted in early July 2007 (reported in *Permophiles* #49; p. 4-6) and samples for carbon isotopes, geochronology and biostratigraphy were collected and have now been processed. The geochemical samples will provide further correlation potential for the proposed GSSPs; these materials are being analyzed at Boise State University and the Nanjing Institute of Geology and Palaeontology. The biostratigraphy samples will determine reproducibility of GSSP definitions. Decisions have been made on the basis of this new work and this is described above in section 5.

Publications: The December 2003 issue of *Permophiles* (#43) was produced at Reston, Virginia in February 2004 and distributed to a mailing list of 280 from the University of Calgary later in the year. The June/December 2004 issue of *Permophiles* (#44) was produced at Pend Oreille, Idaho during October 2004 and was distributed in December 2004 from the University of Calgary. The June 2005 issue of *Permophiles* (#45) was produced at Nanjing China during June 2005 and distributed to a mailing list of 280. The December 2005 issue of *Permophiles* (#46) was produced at the University of Calgary during November 2005 and distributed as a pdf on our website. In addition the remaining back issues of *Permophiles* were scanned and added to our website providing a complete series of communications by *Permophiles* since 1978. The June 2006 issue of *Permophiles* (#47) was produced at Nanjing China during June 2006 and distributed as a pdf document to a mailing list of 280. The December 2006 issue of *Permophiles* (#48) was produced at the University of Calgary during November 2006 and distributed as a pdf on our website. We now have a complete series of *Permophiles* on our website (1978 to 2006). The June 2007 issue of *Permophiles* (#49) was produced at Nanjing China during June 2007 and distributed as a pdf document to a mailing list of 280. The December 2007 issue (#50) was produced in January 2008 after a field excursion to Australia. June 2008 issue (#51) was produced in Calgary in July 2008. December 2008 (#52) was produced online in January 2009 and #53 was produced in July 2009 in Calgary. We now have a complete series of *Permophiles* on our website (1978 to 2009).

Meetings: The SPS conducted its annual business meeting at the IGC meeting in Florence, Italy on August 23, 2004 with 23 people in attendance. This business meeting was preceded by a session on "The Lower Permian Cisuralian Stages" co-chaired by Boris Chuvashov and Charles Henderson. This was a successful session with six oral presentations and several posters that demonstrated clear progress in the definitions for the Cisuralian stages. Abstracts for these papers appear in *Permophiles* issue #44. The SPS conducted two business meetings in 2005 including at the Triassic Chronostratigraphy and Biotic Recovery meeting in Chaohu, China on May 23, 2005 with 27 in attendance and at the Non-marine Permian Conference at Albuquerque New Mexico on Oct. 23, 2005 with 28 in attendance. This latter conference was organized by Spencer Lucas and was very successful with 68 people in attendance from 12 countries. The SPS conducted one business meeting at the 2nd International Palaeontology Congress in Beijing, China in June 2006.

The SPS conducted one business meeting at the XVI International Congress on the Carboniferous and Permian in Nanjing, China in June 2007 and is reported in *Permophiles* #49. Business meetings were held in Sydney Australia (January 2008; *Permophiles* #50) and IGC in Oslo (August 2008). In 2009 business meetings were held in Trelew Argentina and at ICOS2009 in Calgary.

Membership: During 2004 the voting membership of SPS saw considerable renewal. We have a completely new executive and six new voting members. In order to allow this renewal, a few members were asked to retire their voting status. The SPS executive has decided to name a new membership category, Honourary Members, to reflect the significant past and continuing contributions of these retiring voting members. The first Honourary Members are Professors Brian Glenister, Heinz Kozur, and Claude Spinosa. Honourary Members will receive GSSP proposals and be invited to comment on the merits of the proposal, but they will not vote on the proposal. The comments of Honourary Members will be included in subsequent versions of the proposal. Only one change in voting membership occurred in 2005. Professor Giuseppe Cassinis of Italy retired as a voting member and Dr. Marc Durand of Universite de Nancy, France was voted by the executive as a replacement. Two changes were made to voting membership in 2006. Dr. John Utting retired as a voting member and was named by the SPS Executive as a Honourary Member given his long service to SPS (past Secretary) and distinguished research record in Late Paleozoic palynology. Dr. Lucia Angiolini was nominated by the executive to fill this vacancy. This increased the membership from Europe bringing it more in line with other major regions. Secondly, we sadly lost our distinguished colleague and friend Professor Jin Yungan who died in June 2006 (see *Permophiles* 48 for a tribute). His was a very distinguished career in Late Paleozoic paleontology and service including as a past-Secretary and past-Chairman of SPS. He has been replaced as a voting member by Professor Yue Wang. There were no changes to the membership in 2007, but as noted in the 4 year summary we have made several changes over the past four years. In addition, the current executive will continue for a second term. We currently have 16 voting members representing Australia (2), Canada (1), China (3), France (1), Germany (1), Italy (1), Japan (1), Russia (3), and United States (3). We also have five honourary Members. No changes in 2008. In 2009 we added one new voting member, Dr. Nestor R. Cuneo from Argentina to add to our complement noted above.

Summary (2004-2009): In 2004 a new SPS executive was named including Charles Henderson as Chair, Vladimir Davydov as Vice-Chair, and Shuzhong Shen as Secretary. In terms of the voting membership, nine of sixteen members were new during the reporting period (56% renewal). SPS also instituted a new membership category, Honourary Member, and five individuals have been sonamed. SPS conducted five business meetings during the fouryear period at major international meetings. Two GSSP proposals for the base-Wuchiapingian (also base-Lopingian Series) and base-Changhsingian were prepared, voted, ratified and published in Episodes during the past four years. Significant progress has been made on the last three Cisuralian GSSP proposals for the base-Sakmarian, base-Artinskian, and base-Kungurian stages. An international workshop was conducted in July 2007 to determine reproducibility and accessibility as well as collect new geochemical data. During the reporting period, *Permophiles* #43 to #53 have been produced with #54 to come later this year. In addition, a website was constructed and hosted by the Nanjing Institute of Geology and Palaeontology during the reporting period. Among other items, this website has pdf versions of all issues of *Permophiles* dating back to #1 in 1978.

APPENDIX

Officers and Voting Members as of November 2009

Dr. Lucia Angiolini

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Dr. Boris I. Chuvashov

Institute of Geology and Geochemistry
Urals Branch of
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Dr. Nestor R. Cuneo

Director, Museo Paleontologico Egidio Feruglio
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Dr. Vladimir Davydov, SPS Vice-Chairman

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Prof. Ernst Ya. Leven
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Dr. Tamra A. Schiappa
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Prof. Joerg W. Schneider
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Institute of Geology, Dept. of Palaeontology, Bernhard-von-Cotta-Str.2 Freiberg, D-09596,
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Prof. Yue Wang
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Dr. Bruce R. Wardlaw
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Honourary Members

Prof. Giuseppe Cassinis
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Prof. Brian F. Glenister
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Dr. Heinz Kozur
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Prof. Claude Spinosa
Department of Geosciences
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Dr. John Utting
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SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY

ANNUAL REPORT 2009

SUBMITTED BY (with contact information)

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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 Devonian-Carboniferous boundary at the base has been selected in southern France, and the Carboniferous-Permian boundary at the top has been selected in northern Kazakhstan. The Mid-Carboniferous boundary has been selected in Nevada, U.S.A., and it subdivides the Carboniferous into two subsystems, the Mississippian Subsystem below and the Pennsylvanian Subsystem above. As pointed out by the former chair, Philip Heckel, in the SCCS annual report for 2007, there are serious problems with the GSSP at the base of the Carboniferous, such that the boundary will need to be placed at another stratigraphic position, and a new event marker may also be required. The immediate SCCS goals are to redefine the Carboniferous-Devonian boundary and select the best stage boundaries within the two Carboniferous subsystems to facilitate global correlation within the system. The ultimate goal is to calibrate biostratigraphy with other methods of correlation, such as chemostratigraphy, magnetostratigraphy, and radiometric dating, so that the successions dominated by terrestrial and endemic cold-water marine biotas in the Gondwana and Angara regions can be correlated with the biostratigraphic framework of the pan-tropical standard succession.

3. ORGANIZATION

3a. Officers for 2008-2012:

Chair: Barry C. Richards (Canada)

Vice-Chair: Xiangdong Wang (China)

Secretary: Markus Aretz (France)

Website

During the 2008-2009 fiscal year, the SCCS established an official website:

www.nigpas.ac.cn/carboniferous. At present, the site is basic but the membership is striving to improve each of the main pages by including data, line figures and photographs. The site has eight main pages containing the following information: 1) Homepage - list of SCCS officers, task groups and leaders, and voting members, 2) GSSPs - shows ratified GSSPs and those in progress, 3) Working Groups - lists task groups and provides latest task-group progress reports, 4) Annual Reports - includes annual reports submitted to the ICS by the SCCS, 5) News - information about current SCCS activities and progress, 6) Forthcoming Meetings - lists conventions for professional societies and field meetings that are relevant to membership goals and activities, 7) Newsletters - back issues of the Newsletter on Carboniferous Stratigraphy are available in pdf

format for download, and 8) Links - provides web links to important websites such as those of the ICS and IUGS.

Membership

The SCCS has a total of 21 voting members (see list at end of report), and approximately 278 corresponding members (see latest issue of Newsletter on Carboniferous Stratigraphy for contact information). Meetings of the SCCS are held every two years, both at the quadrennial meetings of the International Congress on the Carboniferous and Permian, and at a Field Meeting convened by the SCCS alone midway between the congresses. The latest Field Meeting was held in Russia from August 11th to 19th, 2009 (see Newsletter on Carboniferous Stratigraphy, v. 26 for details).

SCCS has six current task groups and one exploratory Project Group:

Task Group to redefine the Devonian-Carboniferous Boundary [which is also the base of the Lower Mississippian Series and Tournaisian Stage], a joint task group was established in early 2008 that comprises 10 members appointed by Thomas Becker of the Devonian Subcommission and 10 members selected by Philip Heckel 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]. At present the SCCS executive are directing the task group but a chairman will be appointed by the SCCS if required. Richards summarized the recent work of the group through May 2009 in this year's Newsletter on Carboniferous Stratigraphy [v. 27, p. 7-9].

Task Group to establish the Tournaisian-Viséan Boundary [which is also the base of the Middle Mississippian Series], chaired by George Sevastopulo (Ireland). Using e-mail communications from the chairman, Richards and Aretz summarized the recent activities of the group through May 2009 in the Newsletter on Carboniferous Stratigraphy for 2009 [v. 27, p. 9-10].

Task Group to establish the Visean-Serpukhovian Boundary [which is also the base of the Upper Mississippian Series], chaired by Barry Richards (Canada), who summarized the recent work of the group through May 2009 in this year's Newsletter on Carboniferous Stratigraphy [v. 27, p. 10-12].

Task Group to establish the Bashkirian-Moscovian Boundary [which is also the base of the Middle Pennsylvanian Series], chaired by John Groves (USA), who summarized the recent work of the group through May 2009 in this year's Newsletter on Carboniferous Stratigraphy [v. 27, p. 12-14].

Task Group to establish the Moscovian-Kasimovian Boundary [which is also the base of the Upper Pennsylvanian Series], and the **Kasimovian-Gzhelian Boundary**, chaired by Katsumi Ueno (Japan) who succeeded Elisa Villa (Spain) at the Oslo IGC meeting in August 2008. Ueno summarized the recent work of the group through May 2009 in this year's Newsletter on Carboniferous Stratigraphy [v. 27, p. 14-18].

Project Group on Upper Paleozoic boreal biota, stratigraphy and biogeography, chaired by Marina Durante (Russia), who did not submit reports since 2005, is terminated because of sickness.

Project Group on Carboniferous magnetostratigraphy, chaired by Mark Hounslow (United Kingdom), who summarized the recent work of the group through May 2009 in this year's Newsletter on Carboniferous Stratigraphy [v. 27, p. 18-19].

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

The SCCS has worked closely with the Subcommissions and task groups on Devonian and Permian Stratigraphy 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 Carboniferous-Permian successions in the Ural Mountains and elsewhere.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2008-2009 fiscal year

Newsletter on Carboniferous Stratigraphy, Volume 26, published in July 2009. Its 49 pages include commentaries by the current SCCS executive on various current issues, reports of the task groups for 2008-9 [typically containing much current detail], and 4 articles on various topics of interest: 1) Tethyan affinities of Pennsylvanian non-marine bivalves of southwestern Gondwana (Argentina), 2) *Idiognathodus turbatus* and other key taxa of the Moscovian-Kasimovian boundary interval in the Midcontinent region, North America, 3) a note on recently discovered fossiliferous sections embracing the Moscovian-Kasimovian boundary (Andara Massif, Picos de Europa, N.W. Spain), and 4) the foraminiferal assemblage in the Viséan-Serpukhovian boundary interval at the Yashui section, Guizhou, south China. Volume 27 also contains a revised directory for the corresponding membership. As usual, 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.

Summary of Task Group Reports

The full text of the reports, including references, have been shortened and updated from the 2009 Newsletter on Carboniferous Stratigraphy and are provided in Appendix B.

Task Group to redefine the Devonian-Carboniferous Boundary Following the initial workshop of the D-C boundary task group, held at the 2008 IGC in Oslo, basic plans for future work by the task group were included in the 2008 SCCS Annual Report that Richards submitted to the International Commission of Stratigraphy (ICS) in November 2008. The work plan outlined the problems with the current GSSP at the base of bed 89 in the La Serre section, France and made three recommendations: 1) the use of the first evolutionary occurrence of the conodont *Siphonodella sulcata* in the lineage *S. praesulcata* to *S. sulcata* for boundary definition requires re-evaluation; 2) if the FAD of *S. sulcata* is retained for boundary definition, either the position of the GSSP at La Serre must be lowered from the base of bed 89 or a more suitable section for the GSSP must be located, and 3) because the first appearance of *S. sulcata* may not be the best event for boundary definition, other conodont lineages require evaluation.

Since the report's submission, substantial progress has been made. Task-group member Sandra Kaiser continued with her work on the La Serre section and published her latest results (Kaiser, 2009). New data presented by Kaiser show the first occurrence (FO) of the index fossil

S. sulcata is slightly earlier than reported by Heckel (2008) and at the 2008 IGC workshop and is at the base of bed 84b at La Serre rather than the base of bed 85. At this position, *S. sulcata* co-occurs with *S. praesulcata* at a sharp facies break and the evolutionary lineage from *S. praesulcata* to *S. sulcata* is absent in the underlying strata. Because the FO of *S. sulcata* may not be the best event to define the D/C boundary, Kaiser (2009) suggested the evolutionary lineage from *Protognathodus kockeli* to *Protognathodus kuehni* could be used to define the D-C boundary as there are many sections worldwide that contain the lineage. She also indicated other protognathodid lineages show potential for boundary definition; however, more study of those lineages is required before one can be used.

Task-group members Carlo Corradini and Sandra Kaiser have started to work on the taxonomic and phylogenetic problems within the *S. Praesulcata - S. sulcata* lineage and protognathodid lineages. They presented their initial findings in a paper (Morphotypes in the early *Siphonodella* lineage: implications for the definition of the Devonian/Carboniferous boundary) presented at the Second International Conodont Symposium (ICOS 2009) held in Calgary, Canada from July 12th to 17th 2009. Their study (Corradini and Kaiser, 2009) indicates several morphotypes occur in the transition from *S. praesulcata* to *S. sulcata* and that the position of the current D-C boundary at La Serre is based on subjective interpretations.

During the SCCS workshop following the ICOS 2009 conference session, no consensus was reached on whether or not the *Siphonodella* lineage could be used for D-C boundary definition or even if *S. praesulcata* and *S. sulcata* should be considered as two different species. Specialists attending the workshop agreed that the D-C boundary can not remain at its present position at La Serre (base of bed 89) and that a new GSSP must be selected either lower in the section or in another section. They also decided that the initial problem to resolve was the selection of a suitable taxon for boundary definition. Three options were presented: continue use of the *S. praesulcata-S. sulcata* lineage but find a better way to speciate it, select a different lineage (protognathodids), and use the first occurrence of another taxon.

On August 14th, during the southern Uralian component of the SCCS field meeting in Russia, several SCCS members visited two sections that spanned the D-C boundary and contained the *S. praesulcata-S. sulcata* lineage (see Pazukhin *et al.*, 2009). At the related technical session, the conclusions reached about the GSSP at La Serre were similar to those made at the Calgary ICOS 2009 meeting, but the Russian conodont specialists thought the current event marker, the FAD of *S. sulcata*, could be used for boundary definition.

Task Group to establish the Tournaisian-Viséan boundary

Following approval of the proposed GSSP [see Devuyst *et al.* (2003) for early version of proposal] at Pengchong in southern China, by the SCCS in late 2007 and its ratification by the ICS and IUGS, task-group member François-Xavier Devuyst has been preparing the final report about the Tournaisian-Viséan boundary GSSP. After completion of the report, the task group will be dissolved according to ICS rule (7.5).

Task-group member Hongfe Hou is trying to organize an official ceremony for the placement of the "golden spike" in the GSSP section at Pengchong. Several task-group members and SCCS officials plan to attend the historic ceremony.

The **Task Group to establish the Viséan-Serpukhovian boundary** considers the first evolutionary appearance of the conodont *Lochriea ziegleri* in the lineage *Lochriea nodosa-Lochriea ziegleri* to be the best event for boundary definition. The lineage along with associated faunas and strata are being studied in several areas but the Nashui section in south China and the Verkhnyaya Kardailovka section in Russia have the best potential as GSSP candidates and are receiving intensive study.

Task-group member Yuping Qi and associates at the Nanjing Institute of Geology and Palaeontology recognized the *L. nodosa* – *L. ziegleri* lineage in the Nashui section in southern Guizhou province, People's Republic of China (Qi and Wang 2005). Qi has finished his detailed analysis of the conodonts across the Viséan/Serpukhovian boundary in the Nashui section and incorporated the results in his doctoral thesis (Qi, 2008). In the Nashui section, conodonts within the *L. nodosa* - *L. ziegleri* lineage are well preserved and abundant. Elements transitional between *L. nodosa* and *L. ziegleri* are plentiful at Nashui, occurring through several metres of section, and the oldest representatives of *L. ziegleri* could be readily distinguished from the associated transitional forms of *L. nodosa*.

Several task-group members and John Groves are continuing a detailed analysis of the foraminifers, stable-isotope geochemistry and sedimentology of the Nashui section and a nearby shallow-water limestone-dominant section at Yashui (by city of Huishui) in Guizhou province that spans the Viséan/Serpukhovian boundary. The goal of studying the Yashui section is to establish the relationship of the coral and foraminiferal zones to the *L. nodosa* - *L. ziegleri* lineage.

Nikolaeva *et al.* (2005) recognized the *L. nodosa* – *L. ziegleri* lineage in a, deep-water, carbonate section along the Ural River opposite the village of Verkhnyaya Kardailovka in the southeastern Urals, Russia. During the SCCS field meeting, held in Russia in August 2009, task-group and other SCCS members visited the Kardailovka section to determine how it compared with Nashui in terms of its suitability as a GSSP candidate. They concluded the boundary interval was well exposed but noted only three to five metres of well-exposed strata lay below it, whereas at Nashui many metres of conodont-bearing strata are exposed. More of the section below the boundary interval at Kardailovka can be excavated and the section has the advantage of containing abundant ammonoids. Nikolaeva and her colleagues have thoroughly examined the section and published a synthesis of their studies on the ammonoids, conodonts, and ostracodes (Nikolaeva *et al.*, 2009). The synthesis indicates conodonts that are transitional between *L. nodosa* and *L. ziegleri* occur in the Kardailovka section immediately below the FAD of *L. ziegleri*.

The task group and SCCS have not voted on either rejecting or accepting the first evolutionary appearance of *L. ziegleri* for boundary definition.

The **Task Group to establish the Bashkirian-Moscovian boundary** is conducting research at several locations in Europe and Asia and continues to evaluate three conodont evolutionary events that have potential for defining the base of the Moscovian: 1) derivation of *Idiognathoides postsulcatus* from *Id. sulcatus*, 2) derivation of *Declinognathodus donetzianus* from *D. marginodosus*, and 3) the appearance of *Diplognathodus ellesmerensis*. The fusulinids *Eofusulina ex gr. triangula* and *Profusulinella* [= *Depratina*] *prisca* recently emerged as additional taxa with considerable potential for boundary characterization.

South China. Specialists with the Nanjing Institute of Geology and Palaeontology organized an excursion in May 2008 to Guizhou Province to collect conodont and foraminifer samples from slope carbonates spanning the Bashkirian-Moscovian boundary interval at the Nashui section. Sampling was also conducted across the boundary at the nearby Yashui section, a shallow-water carbonate succession containing abundant micro- and macrofossils. Thin sections have been made from the samples and Groves has completed a preliminary analysis of foraminifers from the Bashkirian-Moscovian boundary at Nashui. 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 Nashui section. That level contains a foraminiferal association dominated by *Profusulinella* spp. and *Pseudostaffella* spp. The lowest occurrence of a

demonstrably Moscovian fusulinid is at 183.45 m, where a specimen of *Eofusulina* sp. was recovered.

Donets Basin, Ukraine. Katsumi Ueno and Tamara Nemyrovska continue their work on fusulinids and conodonts from the Donets Basin. The Malonikolaevka section has yielded interesting results that were summarized by Ueno and Nemyrovska (2008). At Malonikolaevka, the proposed boundary marker *Declinognathodus donetzianus* first occurs in Limestone K1 in evolutionary continuity with its ancestor *D. marginodosus*. Limestone K1 also contains unquestioned occurrences of the Moscovian fusulinid *Eofusulina*.

Northwest Spain. Javier Sanz-López, Silvia Blanco-Ferrera and Elisa Villa are conducting integrated foraminifera and conodont biostratigraphic analyses at the San Antolin-La Huelga section along the Bay of Biscay in the Cuera area (Villa 1995; Villa *et al.* 1997). The Bashkirian-Moscovian boundary is provisionally placed about 180 m above the base of the section in lower-slope deposits. The boundary is marked by the lowest occurrence of *Idiognathoides postsulcatus*, and this level is slightly higher than the lowest occurrences of *Declinognathodus marginodosus* and *Profusulinella ex gr. prisca*. The San Antolin-La Huelga section contains four conodont taxa identified as potential Bashkirian-Moscovian boundary markers: *Id. postsulcatus*, *Diplognathodus ellesmerensis*, *Neognathodus nataliae* and *Declinognathodus donetzianus*. The lowest occurrences of these conodonts are in the order listed, spanning a stratigraphic interval of over 300 m.

South Urals, Russia - Elena Kulagina has completed a study of *Depratina prisca* in which she documented its evolutionary origin and showed its first occurrence in the south Urals can be used to identify the base of the Moscovian (Kulagina 2009). [Many western specialists regard *Depratina* as a junior synonym of *Profusulinella*.] Kulagina showed that *D. prisca* was derived from *Staffellaformes staffellaformis* via the intermediates *Staffellaformes eoprisca* and *Depratina praeprisca*. Occurrences of *D. prisca* have been examined at the Askyn, Basu and Utklykaya sections. The well-exposed Basu section, visited during the August 2009 SCGS field meeting, contains the first appearance of *Depratina prisca* a few metres below that of *D. donetzianus* (Kulagina *et al.*, 2009). 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 **Task Group to establish the Moscovian-Kasimovian Boundary** is focusing on the stratigraphic occurrences and distribution of the conodonts *Idiognathodus sagittalis* Kozitskaya 1978 and *Idiognathodus turbatus* Rosscoe and Barrick 2009a and their ancestors as potential biostratigraphic markers for defining the base of the Kasimovian Stage. The use of either conodont would raise the boundary level one substage from the traditional position at the base of the Krevyakinian Substage, to approximately the base of the Khamovnikian but the move will facilitate global correlation. Other biostratigraphic and lithostratigraphic events near the FAD levels of the species will be examined because of their potential as auxiliary events for identifying the base of the Kasimovian. Using the new research direction, the group made the progress summarized below.

Andara Massif, N.W. Spain. Spanish task-group members are studying the Moscovian-Kasimovian transition in the Castillo del Grajal and Morra del Lechugales sections, which embrace the uppermost part of the carbonate-dominant Picos de Europa Formation and the Las Llacerias Formation. Fusulinid biostratigraphic data indicate the study interval ranges from the top of the *Fusulinella* Zone (upper Moscovian) to the lower *Montiparus* Zone (Khamovnikian). The *Protriticites* Zone, spanning at least 245 m, is well exposed and fusulinid rich. Preliminary sampling indicates the occurrence of the conodont *Idiognathodus sagittalis* and its potential

ancestor *I. n. sp. 1* of Goreva *et al.* (2009), allowing correlation with the Moscow Basin and the North American Midcontinent.

Moscow Basin, Russia. The section in the Afanasievo quarry (Kasimovian neostratotype in Moscow Basin) is a potential GSSP candidate for the lower boundary of the Kasimovian. The section has diverse macrofaunas and microfaunas and offers potential for precise correlation with Eurasian sections. The best-recognized and most-correlated levels are the base of the *Montiparus montiparus* fusulinid zone, defined by the first occurrence of the genus *Montiparus*, and base of the *Idiognathodus sagittalis* conodont zone. In the quarry, *Idiognathodus sagittalis* first appears at the base of the middle member of the Neverovo Formation along with *I. turbatus*. The position is close to the FAD of the fusulinid *Montiparus (M. paramontiparus)* at the base of the Neverovo. Goreva *et al.* (2009) recognized *Idiognathodus n. sp. 1* as the possible ancestor of *I. sagittalis*. The form appears in the lower Suvorovo Formation, but becomes more advanced and abundant in the overlying Voskresensk Formation. The first appearance of *I. sagittalis* in the lineage is a potential marker for the base of the Kasimovian.

Donets Basin, Ukraine. Davydov and his student Rimma R. Khodjanyazova recently studied the taxonomy and biostratigraphy of fusulinids within the Moscovian-Kasimovian transition in the Kalinovo section of the Donets Basin, examining fusulinids from limestone units of the C₃¹ (N) and C₃² (O) suites and correlated them into the Moscow Basin. They concluded that within the Kalinovo succession the base of the Krevyakinian (traditional base of the Kasimovian) can be placed at the N3 limestone, based on the occurrence of *Protriticites* with thick walls penetrated by coarse pores. Age-diagnostic fusulinids are less abundant in the N5-N5/1 interval but it is probably equivalent to the Voskresensk Formation in the upper part of the Krevyakinian Substage because of the potential Ratmirovo age of O1. The O1-O1/1 interval is correlated with the Ratmirovo and the lower part of the Neverovo Formation because O1 contains abundant *Obsoletes* but also yields *Montiparus montiparus* and *M. paramontiparus*. The O2-O3 interval is correlated with the middle to upper part of the Neverovo as O2 contains *M. subcassulus*, which occurs in the middle member of the Neverovo in the Moscow Basin (Goreva *et al.*, 2007). The correlations that Davydov and Khodjanyazova propose differ substantially from those of Heckel *et al.* (2007), which are based on integrated cyclothem and conodont correlations. To cross-check the results with those of Heckel, Nemyrovska and Ueno have initiated an analysis of the conodont and fusulinid biostratigraphy in the Kalinovo section.

Midcontinent Basin, U.S.A. Rosscoe and Barrick recently carried out a more detailed study of *Idiognathodus turbatus* (established by Rosscoe and Barrick, 2009a) and related forms using specimens from several sections in the Midcontinent Basin. They restricted the species concept to include only elements with expanded, well-developed rostral lobes and a distinctive medial nodosity. The revision placed the FAD of (revised) *I. turbatus* at the base of the Hertha Cyclothem, two cycles higher than it was originally recognized in Rosscoe and Barrick (2009a).

Nashui section, south China. The Nashui section (Qi *et al.*, 2007) in southern Guizhou Province is one of the most-continuous and best-exposed sections embracing the Moscovian-Kasimovian boundary. It consists of carbonate-slope deposits that are rich in conodonts and contains some fusulinids. Qi and Wang Zhihao investigated the conodont succession across the boundary at Nashui and recognized the *Idiognathodus podolskensis*, *Swadelina subexcelsa*, *Swadelina makhlinae* - *Sw. nodocarinata*, *Idiognathodus sagittalis*, *Streptognathodus cancellatus*, and *Streptognathodus gracilis* zones, in ascending order. The first occurrence of *I. sagittalis* occurs 225 m above the base of the section. Ueno systematically sampled the boundary interval for fusulinids and the conodont-fusulinid biostratigraphy is being investigated.

The **Task Group to establish the Kasimovian-Gzhelian boundary** has selected the conodont *Idiognathodus simulator* (s.s.) as the event marker for defining the base of the Gzhelian Stage (Heckel *et al.*, 2008) and is directing its research toward selecting a suitable section for the GSSP in three main areas.

Moscow Basin, Russia. The Russian task-group members have completed a comprehensive study of the lithostratigraphy and biostratigraphy of the stratotype of the Gzhelian Stage in the Gzhel quarry in the Moscow Basin near Moscow. In the quarry only the lower part of the stage is exposed, occurring in the Rusavkino Formation. The section comprises bed 1 of member 4 (middle Rusavkino) and beds 2-9 of member 5 (upper Rusavkino). Two ecological assemblages of fusulinids are recognized, replacing each other upwards in the section. The lower one occurs in beds 4 and 5 and includes *Quasifusulina longissima*, *Q. ultima*, *Q. eleganta*, *Rauserites postarcticus*, *R. paraarcticus*, and others. The upper assemblage is preserved in bed 8 and consists of a rich population of *Rauserites*, including dominant *R. rossicus* and minor *R. postarcticus* and *R. paraarcticus*. Three morphological groups are distinguished in the *R. rossicus* population from bed 8. It is, therefore, necessary to consider the polymorphic status of *R. rossicus* for regional correlation.

The Gzhel section contains abundant conodonts. A single juvenile specimen of *Idiognathodus simulator* was extracted in the top of bed 3, but typical *I. simulator* first appear in bed 4 along with *Streptognathodus pawhuskaensis* and *Idiognathodus tersus*. Alekseev and others also re-examined conodonts from the stratotype of the Rusavkino Formation situated near Rusavkino east of Moscow and in borehole 6k, drilled at Konyashino village north of Gzhel. They showed that *I. aff. simulator* (= *Idiognathodus eudoraensis* Barrick, Heckel and Boardman, 2008), a potential ancestor of *I. simulator*, appears in the late Kasimovian Troshkovo Formation and also in the lower and middle members of the overlying Rusavkino Formation. The FAD of *I. simulator* in the Moscow Basin is close to that of *Rauserites rossicus*.

In the Moscow Basin, a specific and well recognizable assemblage characterizes the *I. simulator* Zone (Barskov *et al.*, 1982, 1984; Alekseev and Goreva, 2007). In addition to *I. simulator*, it includes *Streptognathodus pawhuskaensis*, *Idiognathodus tersus*, *I. toretzianus*, *I. luganicus*, *I. sinistrum*, and *Gondolella bella*. Based on the first appearance of *I. simulator*, the lower boundary of the Gzhelian lies within the Rusavkino Formation near the base of its upper member. Although the proposed stage boundary is somewhat above the formation's base, the regional and interregional correlations will not be significantly impacted.

Nashui section, South China. Qi (2008) established a detailed conodont biostratigraphy across the Kasimovian-Gzhelian transition in the Nashui section. In ascending order, he recognized the *Streptognathodus gracilis*, *Streptognathodus guizhouensis*, *Streptognathodus simulator* (= *Idiognathodus simulator* sensu Barrick *et al.*, 2008), *Streptognathodus nashuiensis*, and *Streptognathodus firmus* zones. According to Qi, the first occurrence of *S. simulator* is 265 m above the base of the section. Last December, Ueno and Wang Yue measured the Kasimovian-Gzhelian boundary interval in the section, and collected samples for fusulinid study. The work suggests that a composite conodont/fusulinid biostratigraphy can be developed for the section. Because the Nashui section is a completely exposed carbonate-slope succession containing a rich conodont record throughout, it has great potential as a GSSP candidate for the Kasimovian-Gzhelian boundary.

Usolka section southern Urals, Russia

For establishment of the GSSP, Russian colleagues are undertaking a detailed re-description and recollection of the Usolka section in the southern Urals and have published a comprehensive synthesis of their preliminary results (Davydov *et al.*, 2008).

Progress by the **Project Group on Carboniferous Magnetostratigraphy** has been hampered by a shortage of members and lack of integration with the activities of the other SCCS task groups. The group is particularly interested in collaborating with task groups working on sections and boundaries where magnetostratigraphy could be employed, to facilitate international correlations. Sections that have low thermal maturity and are dominated by siliciclastics are the most suitable for magnetostratigraphic analyses (based on the review in the SCCS Newsletter, v. 22: 35-41) but carbonates can be used.

The search for Mississippian sedimentary rocks that are likely to carry a primary magnetisation, to construct a magneto-stratigraphic timescale, have focused on two sections in southern Scotland. Both sections have good potential for recovery of primary magnetisation because they are dominated by siliciclastics and their thermal maturity is low. The first section (~400 m thick) is at Cove in the Cockburnspath outlier on the southern flank of the Midland Valley Basin and shows a transition from fluvial red-bed facies into lacustrine and flood-plain deposits with local marine influence. The succession includes the Inverclyde and Strathclyde groups and represents an interval from the latest Devonian into the late Viséan (Asbian) (Cossey *et al.*, 2004). The second section (~600 m thick) is at Kirkbean on the northern edge of the Northumberland Basin and is of early to late Viséan age, overlapping in age with the upper part of the Cove section. The Kirkbean succession represents shallow-marine setting with intervals recording fluvial and distal delta-front progradation. The section contains conodonts but their biostratigraphy has not been studied in detail and chronostratigraphic relationships to other sections in the Northumberland Basin are not well established (Cossey *et al.* 2004). The Kirkbean section is adjacent to a granite batholith that was unroofed in the Mississippian and could have provided igneous detritus carrying a palaeomagnetic signal. Both sections contain numerous silty and fine-sandy intervals and are continuously and well exposed, thereby providing good targets for palaeomagnetic work.

The magnetostratigraphic work on the Carboniferous-Permian boundary (CPB) section at New Well Peak, S.W. New Mexico (Hounslow, 2009; SCCS Newsletter, v. 23, p. 11-12) indicates that section was remagnetised during the Late Cretaceous to early Tertiary. The targets for that work were short normal polarity magnetozones lying both above and below the CPB and known from sections in central Asia to lie within the Permian-Carboniferous reverse superchron. In contrast, a review of Permian magnetostratigraphic data from Spitsbergen (Hounslow and Nawrocki, 2008) has indicated that a normal polarity interval in the Tyrrellfjellet Member of the Gipsdalen Group potentially validates one or other of the normal-polarity magnetozones from the latest Gzhelian or earliest Asselian, thereby providing a useful additional proxy for the CPB interval in the arctic sections.

SCCS FIELD MEETING, RUSSIA 2009-11-22

The SCCS Field Meeting held in the Moscow Basin region and southern Urals of Russia from the 11th to 19th of August 2009 was a great learning experience and well organized by members of the Russian Academy of Sciences in Moscow and Ufa. All SCCS members who attended the meeting substantially broadened their knowledge of the Carboniferous successions in western to central Russia. The principal objectives of the meeting were adequately met: 1) examined numerous key Carboniferous sections including stratotypes and neostratotypes for Global Carboniferous Stages and were introduced to their lithology, biostratigraphy, and intra- to interbasinal correlations; 2) were provided with a comprehensive overview of the Carboniferous fossil record in Russia including the major zonal schemes and their correlation; and 3) examined three Russian sections that have been selected as GSSP candidates (Basu River, Usolka, and Kardailovka sections) so they could be compared with those in other regions in terms of exposure and the development of faunal lineages used for definition and correlation of stage boundaries.

All task-group members and chairs had an opportunity to present new data and accomplishments in poster and oral sessions as well as discuss plans for future research.

Two informative and well-illustrated guidebooks were printed for the meeting (Alekseev and Goreva, 2009; Puchkov *et al.*, 2009) and provide considerable new data as well as syntheses of previously published information.

References

- Alekseev, A.S. and Goreva N.N. (eds.) 2009. Type and reference Carboniferous sections in the south part of the Moscow Basin. Borissiak Paleontological Institute of Russian Academy of Sciences, Moscow, August 11-12, 2009 Field Trip Guidebook, 147 p.
- Puchkov, V.N., Kulagina, E.I., Nikolaeva, S.V. and Kochetova, N.N. (eds.) 2009. Carboniferous type sections in Russia and potential global stratotypes; Proceedings of the International Field Meeting Ufa-Sibai, 13-18 August, 2009; southern Urals Session; Design Polygraph Service Ltd., 240 p.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

Several problems confronted the SCCS task groups during the last fiscal year and most will be ongoing. Many of the most active specialists are working on two or more task groups and have over extended themselves, making it difficult to make substantial progress during any one fiscal year. They have found it difficult to find a balance between employment-related projects, SCCS projects and family requirements.

The most significant issue confronting the SCCS is the difficult and time-consuming task of locating suitable evolutionary lineages and first occurrences for boundary definition. Within the Carboniferous, the endemism of conodont, foraminiferal and ammonoid lineages between Eurasia and North America, which slowed down submission of the Tournaisian-Viséan boundary proposal, continues to hamper the choice of the boundary levels for the Viséan-Serpukhovian and Bashkirian-Moscovian boundaries. The problem is being overcome somewhat by correlating other fossil groups to bracket the boundary levels in major regions where the boundary-event taxa have not been found. In the case of the higher two boundary levels [Moscovian-Kasimovian, Kasimovian-Gzhelian], there are enough conodont species in common between the regions to achieve what appears to be fairly precise correlations based on utilizing the positions and scales of cycloths in conjunction with biostratigraphy. However, the strong cyclic control over sedimentation and consequent widespread disconformities across entire shelves, still hampers the selection of acceptable GSSPs for these younger boundaries, which will require successions of relatively continuous sedimentation. We are now focusing study on deeper water, carbonate-slope and basinal sections in southern China and southern Urals of Russia, which can be correlated with the shelf cyclothem successions, for potential GSSPs.

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 suitable for global and shelf 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 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 auxiliary stratotypes, need to be located and intensively studied in Western Europe, northern Africa/Middle East, and North America.

Some lineages used in the past for boundary definition such as the *Siphonodella praesulcata*-*Siphonodella sulcata* conodont lineage, used to define the Devonian-Carboniferous boundary, were not sufficiently known prior to being used for GSSP definition. Current

specialists are finding those lineages are either no longer suitable for defining and correlating boundaries or require intensive re-evaluation.

The project for upper Paleozoic boreal biota, stratigraphy and biogeography has collapsed and both new leadership and a revised mandate are required. That project group's work was very important for establishing Global Carboniferous correlations. It focused on establishing biostratigraphic correlations between the well-known, warm-water, carbonate-dominant, tropical belt and the less-studied cool- to temperate-water successions and those dominated by marine and continental siliciclastics.

7. SUMMARY OF EXPENDITURES IN 2009:

STATEMENT OF OPERATING ACCOUNTS FOR 2008-2009 up to October 31, 2009

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

INCOME (Nov. 1, 2008 – Oct. 31, 2009)

IUGS-ICS Grant; Aug. 05, 2009	\$836.80
Donations from Members	\$50.00
Interest Aug. - Sept.	0.04
TOTAL INCOME	\$886.84

EXPENDITURES

Newsletter v. 27 - printing (€414.46)	\$669.44
Newsletter - postage for bulk mailings (€487.50)	\$787.41
Newsletter - office supplies (€100.12)	\$161.71
Postage for files from USA (US 86.17); Sept. 09	\$92.71
Bank Charges: Bank of Montreal	6.50
TOTAL EXPENDITURE	\$1717.77

BALANCE SHEET (2008 – 2009)

Funds carried forward from 2007 – 2008 (US \$3156.42)	\$3312.87
Transferred to BMO Sept. 09/2009	
PLUS Income 2008 – 2009	\$886.84
LESS Expenditure 2008 – 2009	<u>-1717.77</u>
CREDIT balance carried forward to 2009-2010	\$2481.94

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2009-2010):

The following activities are planned for the 2009-2010 fiscal year (Nov. 1, 2009 to Oct 31, 2010) by the task groups, as communicated by task-group chairs and distilled from the reports in # 5 above, for which the full texts including references appear in Appendix B.

Devonian-Carboniferous boundary Since the project's first meeting at the IGC in Oslo 2008, Sandra Kaiser and Carlo Corradini have made considerable progress on re-evaluating the lineage containing the current D-C boundary event marker, the FAD of the conodont *Siphonodella sulcata*. Additional study of the lineage is required, however, and the task group plans to complete that work as soon as possible. At a SCCS workshop (date and venue not determined)

that will be held after the May 30 to June 3, 2010 ICS Workshop (GSSP concept) in Prague, the task-group's conodont specialists will give updates on work accomplished since the D-C boundary workshop held on July 13th at the Second International Conodont Symposium in Calgary, Canada. After the June ICS workshop, some SCCS members plan to visit the La Serre section in the Montagne Noir of France, which contains the current GSSP for the D-C boundary. At La Serre, the SCCS executive plans to resample parts of the section to confirm the conodont results of Kaiser (2009) and Corradini and Kaiser (2009).

At La Serre, Corradini and Kaiser (2009) identified seven morphotypes in the transition from *S. praesulcata* to *S. sulcata*. Unfortunately, the conodonts within the transition are reworked and no apparent correlation exists between the stratigraphic level and individual morphotypes. The task group plans to determine if any correlation between the morphotypes and stratigraphic level exists in other D-C boundary sections, where reworking is not an issue. The morphotype analysis is significant because of its bearing on whether or not the lineage actually comprises two species that can be readily differentiated.

If the FAD of *S. sulcata* in the lineage *S. praesulcata* - *S. sulcata* is retained for boundary definition, a suitable section for the GSSP will probably need to be located because work at La Serre (Kaiser, 2009; Corradini and Kaiser, 2009) indicates the lack of the phylogenetic transition from *S. praesulcata* to *S. sulcata*. In addition, the section may not be suitable because the first occurrence of *S. sulcata* occurs immediately above an abrupt facies change (oolithic grainstone on sandy shale) that is probably erosional. Because of the potential break, the task group plans to complete a sedimentologic assessment of that contact and the entire section.

Kaiser (2009) and Kaiser and Corradini (2009) have started to evaluate the potential of using a protognathodid lineage to define the D-C boundary. Two lineages appear to have considerable potential: derivation of *Protognathodus kockeli* from *Protognathodus collinsoni* (FO of *P. kockeli* is in bed 84a slightly below current GSSP at La Serre), and derivation of *P. kunei* from *P. kockeli* (at La Serre, the FO of *P. kunei* is in bed 93, slightly above the GSSP). The SCCS executive plans to have the conodont specialists evaluate the utility of using the two lineages for boundary definition by studying them in the best of their D-C boundary sections.

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

Viséan-Serpukhovian boundary Since determining that the first appearance of the conodont *Lochriea ziegleri* in the lineage *Lochriea nodosa*—*Lochriea ziegleri* is the best event to define the boundary, work has focused on correlating successions where it occurs in Eurasia with those in North America (where it has not been found) by means of other fossil groups and geochemistry, in order to bracket its appearance level in North America. This includes work on the ammonoid localities of the southern Urals and in the Chainman Shale of Nevada and Utah, and foraminiferal and coral work on the carbonate successions in Western Europe and western Canada. During 2009-2010, the task-group chair intends to submit a proposal to use the *Lochriea* lineage to the task group and SCCS membership for a vote on either accepting or rejecting that lineage as a marker for GSSP definition.

In October 2008, Yuping Qi and Zhihao Wang met with Rich Lane at the Smithsonian Institute in Washington DC to examine the extensive conodont collections extracted from the upper Viséan and lower Serpukhovian of the Mississippi Valley region. During the next couple of years, they plan to continue that work to document the conodonts from that interval and search for conodonts diagnostic of the *L. nodosa* – *L. ziegleri* transition.

The deep-water (lower slope), carbonate-dominant Nashui section in southern Guizhou Province, China is one of the two best candidates for the GSSP at the base of the Serpukhovian because the *L. nodosa*—*L. ziegleri* lineage is well defined within it. During 2008, sedimentologic, geochemical and foraminiferal studies were initiated at that locality and the task group members plan to complete that work within the next couple of years. During 2008, the nearby shallow-water, carbonate-dominant Yashui section in Guizhou Province was measured and sampled for conodonts, foraminifers, and rugose corals. During the next couple of years, task-group members plan to complete their biostratigraphic, sedimentologic, and geochemical studies at that section.

The deep-water section near Verkhnyaya Kardailovka in the southern Urals with its conodonts characteristic of the *Lochriea nodosa*—*Lochriea ziegleri* transition, abundant ammonoids, and moderately common foraminifers remains the other strong candidate for a GSSP. During the SCCS field meeting held in the Moscow region and southern Urals in August 2009, several SCCS members visited that section and discovered the interval below the proposed GSSP level was insufficiently exposed (about 3 m exposed). During the spring and summer of 2010, the task group intends to excavate additional strata below the boundary and study its conodonts.

Several task-group members and other SCCS members feel not enough is known about the geographic distribution of the lineage and the degree of diachroneity of the FAD of *L. ziegleri* to warrant a vote on accepting the FAD of the species for boundary definition. To address some of these problems, Mark Dean and George Sevastopulo are investigating the magnitude of diachroneity in the British Isles by correlating the first appearance of *L. ziegleri* with the ammonoid zonations.

Bashkirian-Moscovian boundary The task group plans to continue its research in three main areas: the southern Urals of Russia, southern Guizhou Province in south China, and northern Spain.

In those regions, the principal short-term goal will be the search for a suitable event marker to define the base of the Moscovian. The group has discovered three conodont evolutionary events that have potential for defining that boundary: 1) derivation of *Idiognathoides postsulcatus* from *Id. sulcatus*, 2) derivation of *Declinognathodus donetzianus* from *D. marginodosus*, and 3) the appearance of the conodont *Diplognathodus ellesmerensis*, which appears in evolutionary continuity from *D. coloradoensis* at the base of the Moscovian at the Nashui section in Guizhou Province and has been widely recognized globally. If either *D. donetzianus* or *I. postsulcatus* are chosen as the marker, the group's challenge will be to demonstrate how the base of the Moscovian Stage might be identified in areas where these taxa do not occur because both have limited geographic distributions.

The first appearance of the fusulinid *Profusulinella prisca* also has considerable merit for boundary definition. Several members plan to further evaluate the utility of that taxon, searching for more appearances near the boundary level in Spain, Turkey and the southern Urals.

At the Basu River section in the southern Urals, Russian workers plan to further evaluate the *Declinognathodus donetzianus* - *Declinognathodus marginodosus* conodont lineage and a distinctive fusulinid group that includes *Profusulinella prisca* to access the section a possible candidate for a GSSP at the base of the Moscovian.

Chinese colleagues and Lance Lambert from the U.S.A. will continue with intensive studies to provide more detailed information on the conodont succession across the Bashkirian-Moscovian boundary in the Nashui section in southern Guizhou Province as another potential GSSP. During the fall of 2010, the task group plans to hold a joint workshop in Nanjing with the

Moscovian-Kasimovian and Kasimovian-Gzhelian task groups and then visit the Nashui section. Several key specialists working at the Nashui section are participants on all three groups. During 2008 foraminiferal, sedimentologic, and geochemical studies were initiated at the relatively deep-water (slope) Nashui section and nearby shallow-water Yashui section. Task-group members plan to continue that work within the 2009-2010 fiscal year.

In northwest Spain, Javier Sanz-López, Silvia Blanco-Ferrera and Elisa Villa plan to continue their integrated foraminifera and conodont biostratigraphic analyses at the San Antolin-La Huelga section along the Bay of Biscay in the Cuera area (Villa 1995; Villa *et al.* 1997). The Bashkirian-Moscovian boundary is provisionally placed about 180 m above the base of the section in lower-slope deposits.

Moscovian-Kasimovian boundary During the 2009-2010 fiscal year, the ongoing biostratigraphic analyses reported on in section #5 above will continue in the Andara Massif of NW Spain, Moscow Basin in Russia, Donets Basin in the Ukraine, and in southern Guizhou Province, China. In these regions, the task group plans to continue its integrated assessment of fusulinids and two species of conodonts as potential biostratigraphic marker by which the base of the Kasimovian Stage can be selected and correlated globally: 1) *Idiognathodus sagittalis* Kozitskaya 1978, based on material from the Donets Basin (Ukraine) and also identified from the Moscow region and southern Urals of Russia, and the Cantabrian Mountains in Spain; and 2) *Idiognathodus turbatus* Rosscoe and Barrick 2008 (*I. n. sp. A* of Barrick *et al.*, 2004), based on material from the Midcontinent region of the U.S.A., and recognized also in the Moscow region, the southern Urals, and the Donets Basin. A potential ancestor-descendent lineage from *I. aff. sagittalis* n. sp. to *I. sagittalis* may be present in the Moscow region. A lineage from *Idiognathodus swadei* Rosscoe and Barrick 2008 to *I. turbatus* has been described from the Midcontinent region of the U.S.A.

Chinese colleagues and Lance Lambert will continue with intensive studies to provide more detailed information on the conodont succession across the Moscovian-Kasimovian boundary at the Nashui section in Guizhou, south China as a potential GSSP locality. During 2008 foraminiferal, sedimentologic and geochemical studies were initiated at that locality and task-group members plan to continue that work within the 2009-2010 fiscal year. During the fall of 2010, this task group and the Kasimovian-Gzhelian group intend to hold a joint workshop in Nanjing with the Bashkirian-Moscovian task group.

Kasimovian-Gzhelian boundary Since 2007, when the Task Group voted overwhelmingly in favor of using the first appearance of the conodont *Idiognathodus simulator* [*sensu stricto*] as the boundary-defining event, the search for a suitable section for the GSSP became the main focus of the task group. The event level is consistent with both the working ammonoid definition of the boundary and with the first appearance of a cotype of the fusulinid *Rauserites rossicus* in the Moscow region. The recent selection of the lectotype of the fusulinid *R. rossicus* at the first appearance of *I. simulator* in Russia will expedite the recognition of this boundary in Eurasia.

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

Chinese colleagues and Lance Lambert are undertaking a detailed sampling across the boundary in the well-exposed, carbonate-slope succession that constitutes the upper part of the Carboniferous component of the Nashui section in Guizhou Province, south China for conodonts and fusulinids. A sedimentological and geochemical analysis of that section at the appropriate level is also in progress.

Much of the work that is ongoing in all task and project groups will be published in Volume 28 of the Newsletter on Carboniferous Stratigraphy in July 2010.

9. BUDGET AND ICS COMPONENT FOR 2010

PROJECTED EXPENSES

Newsletter printing (est. 325 copies @ 55 pages at commercial rates [~0.04 p])	\$715*
Postage for bulk and individual mailings of Newsletters*	\$800*
Mailing and office supplies	\$200
Bank charges at Bank of Montreal	\$25
Travel to ICS Prague GSSP meeting, summer SCCS workshop in Western Europe, and fall 2010 SCCS workshop in Nanjing for Russian conodont specialist and the SCCS chairman	\$2000

TOTAL PROJECTED EXPENSES	\$3740
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INCOME

Carryover (from CREDIT balance in section # 7 above)	
\$2481.94	
Estimated donations	\$200

TOTAL PROJECTED INCOME	
\$2681.94	

BALANCE

Estimated (deficit) / credit from above	-
\$1058.06	
BUDGET REQUEST FROM ICS for 2009	\$2000

*The SCCS has established a website and will attempt to have volume 28 available in pdf format for download so that the considerable expense of printing and mailing of previous years can be avoided.

No direct funding sources for SCCS exist beyond voluntary donations from some SCCS members, which fluctuate from year to year and cannot accurately be predicted.

10. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2004-2009)

This summary is updated from the information provided in last year's annual report by incorporating information from the task-group reports published in the July 2009 issue of the Newsletter on Carboniferous Stratigraphy and from updates received since July, 2009. For the full reports including references see Appendix B.

General. An initial 1997 ballot on the naming of the two subdivisions of the Carboniferous System resulted in a close vote that rejected the names Lower and Upper, and approved the names Mississippian and Pennsylvanian, but just short of the required 60% majority to be declared final. After a long period of wrangling over procedure as well as nomenclatural issues,

the final ballot was ultimately taken at the mandate of former ICS Chair Jurgen Remane in late 1999. As reported in the 2000 Newsletter on Carboniferous Stratigraphy [v. 18, p. 3], this ballot resulted in approval of the names Mississippian and Pennsylvanian by a 76% majority, along with a reconfirmation of the previous decisions of the SCCS to regard their rank as subsystems, by the same 76% majority. 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 all its official global series and stage names, and all effort is now focused on selecting events and GSSPs for stage boundaries. Information on usage of the new official scheme of Carboniferous subdivision was recently published by Heckel and Clayton (2006a, 2006b).

Heckel, P.H., and Clayton, G., 2006a. Use of the new official names for the subsystems, series and stages of the Carboniferous System in international journals: Proceedings of the Geologists' Association, v. 117, p. 1-4.

Heckel, P.H., and Clayton, G., 2006b. The Carboniferous System. Use of the new official names for the subsystems, series, and stages: *Geologica Acta*, v. 4, p. 403-407.

Task Group to redefine the Devonian-Carboniferous Boundary Doctoral work by Sandra Kaiser (2005) and subsequent analysis has demonstrated severe problems exist with the D-C Boundary GSSP (Paproth *et al.*, 1991) at La Serre Hill in the Montagne Noir of France (Kaiser and Becker, 2007; Heckel, 2008; Kaiser, 2009). Because of the serious problems with the integrity of the D-C GSSP, Thomas Becker (chairman of Subcommission on Devonian Stratigraphy) and Philip Heckel (former chairman of SCCS) established the joint Devonian-Carboniferous Boundary GSSP reappraisal task group in early 2008, appointing 10 members from each subcommission (Heckel, 2008). A chairman, if appointed, will be selected from the voting members of the SCCS as that subcommission is responsible for picking the GSSP for the base of the Carboniferous. The SCCS executive has decided to wait and see what direction the group will take and if a chair is necessary before selecting one.

At the 33rd International Geological Congress (IGC) in Oslo, Philip Heckel, Barry Richards and members of the D-C task group met with Thomas Becker and members of the Devonian Subcommission to discuss the reappraisal of the D-C boundary GSSP. Those attending the IGC workshop agreed the issues summarized by Heckel (2008) required resolution. Following the Oslo workshop, Richards included plans for future work by the task group in the 2008 SCCS Annual Report submitted to the ICS. The work plan had three recommendations: 1) the use of the first evolutionary occurrence of the conodont *Siphonodella sulcata* in the lineage *S. praesulcata* to *S. sulcata* for boundary definition requires re-evaluation; 2) if the FAD of *S. sulcata* is retained for boundary definition, either the position of the GSSP at La Serre must be lowered from the base of bed 89 or a more suitable section must be located, and 3) because the first appearance of *S. sulcata* may not be the best marker, other conodont lineages require evaluation.

Since completing her dissertation, Sandra Kaiser has continued her work on the La Serre section. Her research (Kaiser, 2009) shows the first occurrence (FO) of the index fossil *S. sulcata* is earlier than reported by Heckel (2008), occurring at the base of bed 84b rather than the base of bed 85. In bed 84b, *S. sulcata* co-occurs with *S. praesulcata* at a sharp facies break and the underlying strata lack the evolutionary lineage from *S. praesulcata* to *S. sulcata*. Because the FO of *S. sulcata* may not be the best marker for the boundary, Kaiser (2009) suggested the

evolutionary lineage from *Protognathodus kockeli* to *Protognathodus kuehni* could be used to define the boundary and that other protognathodid lineages also show potential.

Carlo Corradini and Sandra Kaiser are studying the taxonomic and phylogenetic problems within the *S. Praesulcata* - *S. sulcata* lineage and protognathodid lineages. They presented their initial findings (Corradini and Kaiser, 2009) at the Second International Conodont Symposium (ICOS 2009) in Calgary, Canada. Their work indicates several morphotypes occur in the transition from *S. praesulcata* to *S. sulcata* and that the position of the current D-C boundary at La Serre is based on subjective interpretations. During the workshop following the ICOS conference session, no consensus was reached on whether or not the *Siphonodella* lineage could be used for D-C boundary definition or even if *S. praesulcata* and *S. sulcata* should be considered as two different species. Specialists attending the workshop agreed that the D-C boundary can not remain at its present position and that a new GSSP must be selected. They also decided that the initial problem to resolve was the selection of a suitable taxon for boundary definition. [see Appendix B for references]

Work by the **Tournaisian-Viséan boundary** Task Group into 2003 progressed to the point that a proposal for the GSSP in south China was published by Devuyst *et al.* (2003). Supplementary information requested by the CCS chair Philip Heckel on correlating this boundary into regions where the defining taxa do not occur was published in the 2004 Carboniferous Newsletter [v. 22, p. 8-11], and further updated and summarized in the full text of this task-group report in Appendix B in the 2004 Annual Report. The task group voted unanimously to approve the Pengchong GSSP in southern China in 2004, further refined correlation with the type Mississippian in 2005, readjusted the boundary slightly in the GSSP section in 2007, and presented the formal proposal to the CCS for ballot in late November 2007. The proposal has now been unanimously approved by the CCS and ratified by the ICS and IUGS. The Secretary's report for 2008 (Newsletter on Carboniferous Stratigraphy, v. 26 p. 4) provides the details about the proposal and CCS ballot. The principal work of this task group has come to completion. Task group members are preparing the final report. [see Appendix B for references]

The **Viséan-Serpukhovian Boundary** task group, established by B. Richards in 2002, initially considered several conodont and foraminiferal lineages for potential boundary-defining events, but in 2004, it began to focus attention on the conodont lineage, *Lochriea nodosa*-*Lochriea ziegleri*, for boundary definition.

In 2005 identification of the conodont lineage along with recognition of the conodont, ammonoid, ostracode, and foraminiferal zones in a deep-water, carbonate section by Verkhnyaya Kardailovka on the eastern slope of the Russian Urals established that section as a strong candidate for a GSSP (Nikolaeva *et al.*, 2005). Since then, Nikolaeva and her colleagues have thoroughly examined the section and published a synthesis of their studies on the ammonoids, conodonts, and ostracodes (Nikolaeva *et al.*, 2009). The synthesis indicates conodonts that are transitional between *L. nodosa* and *L. ziegleri* occur in the Kardailovka section immediately below the FAD of *L. ziegleri*.

In 2006, the *Lochriea* lineage was reported from northern Spain. In 2006 work was also initiated on ammonoid-rich successions in the western U.S.A., southern Urals of Kazakhstan, and on foraminifer- and coral-rich successions in Western Europe and western Canada in order to bracket the level of the first appearance of *L. ziegleri* in North America, where the lineage is not yet known.

In 2005, the *Lochriea* lineage was reported from the carbonate slope facies in the Nashui section in southern Guizhou Province, China (Qi and Wang, 2005). During the 2007 Nanjing

Congress on the Carboniferous and Permian, several task-group members visited the Nashui locality. Since 2007, the conodonts spanning the V-S boundary in the Nashui section have undergone intensive study by Chinese colleagues and the section has become a strong potential candidate for a GSSP at the base of the Serpukhovian. Qi Yuping has finished his detailed analysis of the conodonts across the Viséan/Serpukhovian boundary at Nashui and incorporated the results in his doctoral thesis (Qi, 2008). In the Nashui section, conodonts within the *L. nodosa* - *L. ziegleri* lineage are well preserved and abundant. Elements transitional between *L. nodosa* and *L. ziegleri* are plentiful at Nashui, occurring through several metres of section, and the oldest representatives of *L. ziegleri* could be readily distinguished from the associated transitional forms of *L. nodosa*.

Although the lineage along with associated faunas and strata are being studied in several areas, the task group has recently concluded the Nashui section in China and the Verkhnyaya Kardailovka section in the Russian Urals have the best potential as GSSP candidates. [see Appendix B for references]

The task group on the **Bashkirian-Moscovian Boundary**, established by John Groves in 2002, initially considered several conodont and foraminiferal lineages for GSSP definition; but after the chairman asked for boundary-defining events in 2004, proposals for only three conodont lineages were received. A more recent consensus suggested that only two conodont lineages are viable, and work became concentrated on them. Three new Spanish members who received funding for work on this boundary in the Cantabrian Mountains were added to the task group in 2005. After further investigation of the *Idiognathoides sulcatus*-*Id. postsulcatus* lineage [the most favored of the two remaining proposals for boundary-defining events] resulted in discovery that the event taxon was misidentified in cratonic North America, and also may occur in strata well below the boundary in Japan, some attention turned to reassessing the identity of the older specimens in Japan. Most attention turned to evaluating the less widespread *Declinognathodus marginonodosus*-*D. donetzianus* lineage for defining the event level, and the task group focused on correlating the Bashkirian-Moscovian boundary into the areas it is absent, using other groups and other conodont taxa. Members then 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.

In 2006, Russian workers discovered an evolutionary lineage of *Declinognathodus marginonodosus*-*D. donetzianus* in the Basu River section in the southern Urals, which also contains rich foraminiferal faunas, and might be a candidate for a GSSP. The well exposed Basu section, visited during the August 2009 SCCS field meeting, contains the first appearance of the fusulinid *Profusulinella prisca* a few metres below that of *D. donetzianus*. The discovery of the *Declinognathodus* lineage at the Basu River section along with a rich fusulinid fauna including the *P. prisca* group make it a good potential candidate section for a GSSP (Kulagina *et al.*, 2009).

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

Since 2007 Chinese colleagues have selected the interval spanning the Bashkirian-Moscovian boundary at Nashui for intensive biostratigraphic and sedimentologic study as another potential GSSP. In May 2008, John Groves and several other SCCS members visited the Nashui

section to complete a detailed biostratigraphic/sedimentologic analysis across the boundary in that carbonate section and a nearby shallow-water carbonate section by the city of Huishui that also spanned the boundary. Since that trip, Qi Yiping finished his detailed analysis of the conodonts across the Bashkirian/Moscovian boundary at Nashui and incorporated the results in his doctoral thesis (Qi, 2008). During the 2009–2010 fiscal year, Groves completed a preliminary analysis of foraminifers from the Bashkirian-Moscovian boundary at Nashui. 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 Nashui section. That level contains a foraminiferal association dominated by *Profusulinella* spp. and *Pseudostaffella* spp.

In northwest Spain, Javier Sanz-López, Silvia Blanco-Ferrera and Elisa Villa are conducting integrated foraminifera and conodont biostratigraphic analyses at the San Antolin-La Huelga section along the Bay of Biscay in the Cuera area. The Bashkirian-Moscovian boundary is provisionally placed about 180 m above the base of the section. The boundary is marked by the lowest occurrence of *Idiognathoides postsulcatus*, and this level is slightly higher than the lowest occurrences of *Declinognathodus marginodosus* and *Profusulinella ex gr. prisca*. The San Antolin-La Huelga section contains four conodont taxa identified as potential Bashkirian-Moscovian boundary markers: *Id. postsulcatus*, *Diplognathodus ellesmerensis*, *Neognathodus nataliae* and *Declinognathodus donetzianus*.

In Ukraine, Ueno and Nemyrovska continue their work on fusulinids and conodonts from the Donets Basin. At the Malonikolaevka section, the proposed boundary marker *Declinognathodus donetzianus* first occurs in Limestone K1 in evolutionary continuity with its ancestor *D. marginodosus* (Ueno and Nemyrovska, 2008). [see Appendix B for references]

The **Task Group to establish the Moscovian-Kasimovian and Kasimovian-Gzhelian boundaries**, chaired by Elisa Villa until the International Geological Congress in August 2008 and currently chaired by Katsumi Ueno, has continued studies on fossil lineages and potential levels of correlation within the upper Moscovian to lower Gzhelian. Much new work has been stimulated on both fusulinids and conodonts as a result of the collaboration engendered within the task group at its nearly annual meetings, which started in Ukraine in 1996. Correlation charts based on the scale of glacio-eustatic cyclothsems as well as biostratigraphic events for the successions across both boundaries in the U.S. and Eastern Europe provide a framework for evaluating lineages being considered for boundary markers (Heckel *et al.*, 2007). All this work has engendered new progress in Russia, southwestern U.S.A., and south-central China.

Fusulinid workers have recognized that problems of provincialism across the **Moscovian-Kasimovian boundary** interval preclude the use of that group to define the boundary. Nevertheless, two fusulinid events appear to coincide with events in conodont appearances near the M-K boundary. The higher one, involving *Montiparus*, is readily identified, but the lower one, among protriticitids, is more dependent on preservation.

Despite the recognition of more provincialism than was once thought to exist between Eurasian and North American conodont lineages during the late Moscovian and Kasimovian, more widespread conodont appearances are being recognized, and one soon may be able to be chosen to define the Moscovian-Kasimovian boundary. Until recently, the conodont specialists were clearing up the serious taxonomic problems that stymied progress within that group. Taxonomic and zonation updating of the conodont faunas in eastern Europe (Goreva and Alekseev, 2006; Alekseev and Goreva, 2007; Goreva *et al.*, 2007), and in the Midcontinent region of the U.S.A. (Rosscoe and Barrick, 2008) formed the basis for welcome progress at the June 2008 task-group workshop and general meeting at the University of Oviedo, Spain. The task-group members who attended the 2008 Oviedo meeting, unanimously agreed (Villa and

Task Group, 2008) to focus future work on two conodont species as the potential biostratigraphic marker for the base of the Kasimovian Stage: 1) *Idiognathodus sagittalis* Kozitskaya 1978, based on material from the Donets Basin (Ukraine) and also identified from the Moscow region and southern Urals of Russia, and the Cantabrian Mountains (Spain), and 2) *Idiognathodus turbatus* Rosscoe and Barrick 2008 (*I. n. sp. A* of Barrick et al., 2004), based on material from the Midcontinent region of the U.S.A., and recognized also in the Moscow region, the southern Urals and the Donets Basin. A potential ancestor-descendent lineage from *I. aff. sagittalis* n. sp. to *I. sagittalis* may be present in the Moscow region and a lineage from *Idiognathodus swadei* Rosscoe and Barrick 2008 to *I. turbatus* has been described from the Midcontinent region of the U.S.A.

The use of either conodont would raise the boundary level one substage from the traditional position at the base of the Krevyakinian Substage, to approximately the base of the Khamovnikian but the move will facilitate global correlation. Using the new research direction, the group has made substantial recent progress in northwest Spain, the Moscow Basin (Russia), Donets Basin (Ukraine), Midcontinent Basin in the U.S.A. and at the Nashui section in southern China (see section #5 of the 2008-2009 Annual Report).

Members of the task group have long favored use of the conodont lineage *Idiognathodus* aff. *Simulator*-*I. simulator* [*sensu stricto*] to define the **Kasimovian-Gzhelian boundary** at the first appearance of *I. simulator* [*sensu stricto*]. This event marker was unanimously approved by a vote taken by the task group in April 2007, and has been unanimously approved by the SCCS in a vote that passed the 60% required quorum. Preliminary description of a potential GSSP at Usolka in the southern Urals was published by Chernykh et al. in the 2006 Newsletter on Carboniferous Stratigraphy [v. 24, p. 23-29] and in a 2006 issue of *Geologija* [v. 49, p. 205-217]. Davydov et al. (2008) published a more detailed description of the potential GSSP at Usolka. The appropriate interval in the Nashui section in south China is undergoing a thorough biostratigraphic, sedimentologic and geochemical study as a potential GSSP. In Eurasia, the use of the FAD of *I. simulator* [*sensu stricto*] for boundary definition is reinforced by the appearance of the fusuline *Rauserites rossicus* at a level very close to first appearance of *I. simulator*. [see Appendix B for references]

The SCCS **Project Group on Carboniferous Magnetostratigraphy**, formed in 2004 and chaired by Mark Hounslow to research the potential for identifying correlatable magnetostratigraphic events in the Carboniferous, reported on some aspects of this approach in both the 2004 and 2005 issues 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.

Hounslow (2005) indicated his group was working on the important transition across the Pennsylvanian-Permian boundary in New Mexico, U.S.A. Unfortunately, the magnetostratigraphic work on the Carboniferous-Permian boundary section at New Well Peak, S.W. New Mexico indicates that section was remagnetised during the Late Cretaceous to early Tertiary (Hounslow, 2009) and does not warrant further study.

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

Radiometric dating Precise radiometric U-Pb zircon dating now being undertaken by the Permian Research Group at Boise State University on ash beds from conodont-bearing intervals in the Pennsylvanian-Permian succession in the south Urals has recently provided new dates on the Carboniferous-Permian boundary and the late Moscovian with error bars of ± 0.2 Ma, which Heckel used to more accurately calibrate the late Pennsylvanian time scale by means of cycloths in the 2006 Newsletter on Carboniferous Stratigraphy [v. 24, p. 35-39] and in a chapter in the article on cyclostratigraphy published by Strasser, Hilgen, and Heckel in a 2007 issue of *Newsletters in Stratigraphy* [v. 42, p. 75-114].

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. They plan to continue with that work.

11. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2010-2013)

I am strongly encouraging all SCCS working-group members to maintain progress on researching and selecting defining events and GSSPs for as many stage boundaries as possible in the next four years, keeping in mind the emphasis on selecting readily correlatable boundaries as expressed by Remane *et al.* (1996). Once the principal mandate of a task group has been fulfilled, I will encourage that group to remain together and embark on basin-analysis and Global projects that are appropriate to their time slices and employ integrated paleoclimatic, geochronologic, biostratigraphic, and geochemical studies. An anticipated outcome of the latter work is the establishment of a more precise correlation between successions dominated by terrestrial and endemic cold-water marine biotas in the Gondwana and Angara regions and those of the pan-tropical standard succession. In addition, I will encourage some task groups to consider division of their respective time slices (all of these are stages). Some stages such as the Viséan are inordinately long and require division to facilitate more precise Global correlation. Should a stage such as the Viséan be divided, the name of that stage would be applied to the corresponding series such as the Middle Mississippian in the case of the Viséan, thereby retaining the classic names in current use.

Devonian-Carboniferous boundary

The task group needs to continue with the restudy the conodont lineage containing the current event marker for the D-C boundary, the FAD of *Siphonodella sulcata*. Considerable progress with this research has already been made by Corradini and Kaiser (2009) but their work needs confirmation by other specialists working on different sections. At La Serre, Corradini and Kaiser identified seven morphotypes in the transition from *S. praesulcata* to *S. sulcata*. Unfortunately, the conodonts within the transition there are reworked and no apparent 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. The morphotype analysis is significant because of its bearing on whether or not the lineage actually comprises two species that can be readily differentiated.

Three taxonomic problems identified by the task group at the 2008 IGC meeting in Oslo require resolution: 1) the holotype of *S. sulcata* has been lost; 2) the locations of the paratypes are uncertain; and 3) the holotype of *S. sulcata* was collected from the *Siphonodella duplicata* Zone and may have been *S. duplicata*.

If the FAD of *S. sulcata* is retained for boundary definition, a suitable section for the GSSP must be located because recent studies at La Serre (current location of GSSP) indicate the

lack of the phylogenetic transition from *S. praesulcata* to *S. sulcata*. Because the appearance of *S. sulcata* may not be the best event to define the boundary, other lineages particularly within the upper part of the *praesulcata* Zone will be evaluated.

Kaiser (2009) and Kaiser and Corradini (2009) have started evaluating the potential of using a protognathodid lineage to define the D-C boundary. Two lineages have considerable potential: derivation of *Protognathodus kockeli* from *Protognathodus collinsoni*. The CCS executive plans to have the conodont specialists evaluate the utility of using the two lineages for boundary definition by studying them in their best D-C boundary sections.

Several sections, particularly those in south-central China, which had been proposed as GSSP candidates prior to selection of the La Serre section, will be carefully re-examined. Intensive biostratigraphic, geochronologic, sedimentologic and geochemical studies will be initiated at all potential GGSP sections.

Some members of the task group plan to visit the La Serre section in June 2010 and hold a subsequent workshop to discuss implications of progress made since the meeting at ICOS 2009 in Calgary, Canada.

A formal ballot on the **Tournaisian-Viséan Boundary Task Group**'s proposed GSSP for the base of the Viséan was distributed to the voting members of the CCS in late 2007 and was unanimously approved by the membership in December. The ballot was subsequently ratified in early 2008 by the ICS and IUGS. Now that the boundary proposal has been ratified, the task group is preparing their final report for the project and that needs to be completed as soon as possible.

Since ratification of the boundary proposal, task-group chair George Sevastopulo and some of his students have been attempting to bracket the absolute age of the Tournaisian-Viséan boundary in Europe using the ID TIMS U-Pb radiometric dating method of zircons from ash bands. They plan to continue with that work.

The **Viséan-Serpukhovian Boundary Task Group** will continue to focus study on the most promising conodont lineage *Lochriea nodosa*-*Lochriea ziegleri*. During the 2009-2010 fiscal year, Richards plans to prepare a proposal and submit it to the task group and CCS membership for a vote on either accepting or rejecting the FAD of *L. ziegleri* for GSSP definition. Given the ballot is successful, two sections present substantial potential for the GSSP, and the ongoing integrated biostratigraphic, sedimentological and geochemical studies of those sections will continue. Identification of the *L. nodosa*-*L. ziegleri* lineage and recognition of associated conodont, ammonoid, ostracode, and foraminiferal zones in the richly fossiliferous section near Verkhnyaya Kardailovka in the southern Urals establishes that section as a strong candidate for a GSSP. The other main candidate is the Nashui section near Naqing in southern Guizhou Province, China. In the Nashui section, the *Lochriea* lineage has been recognized and intensively studied across the boundary interval by Chinese colleagues, and intensive sedimentological and geochemical studies initiated.

The *Lochriea* lineage has not yet been found North America. 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 near future.

The **Bashkirian-Moscovian Boundary Task Group** has been evaluating two conodont lineages that have potential for defining the base of the Moscovian: 1) derivation of *Idiognathoides postsulcatus* from *Id. Sulcatus*, and 2) derivation of *Declinognathodus donetzianus* from *D.*

marginodosus. Both lineages have short comings and if either *D. donetzianus* or *I. postsulcatus* are chosen as the marker, the group's challenge will be to demonstrate how the base of the Moscovian Stage might be identified in areas where these taxa do not occur because both have limited geographic distributions. Nevertheless, the *D. marginonodosus*-*D. donetzianus* lineage remains a candidate for the event level, and further work on it and a distinctive fusulinid group that accompanies it is being carried out by Russian workers at the Basu River section in the southern Urals, a well-exposed potential GSSP candidate comprising carbonate-slope lithofacies.

After further investigation of the *Idiognathoides sulcatus*-*Id. postsulcatus* lineage resulted in discovery that the event taxon was misidentified in cratonic North America, and may occur in strata well below the boundary in Japan, some attention has turned to reassessing the identity of the older specimens from Japan. Pending reassessment of the identity of the Bashkirian specimens reported from Japan, the *Id. sulcatus*-*Id. postsulcatus* lineage will be under further consideration for boundary definition.

A third potential boundary marker the task group plans to evaluate is the appearance of the conodont *Diplognathodus ellesmerensis*, which appears in evolutionary continuity from *D. coloradoensis* at the base of the Moscovian in the Nashui section by Naqing in Guizhou Province, China, and has been widely recognized globally. Chinese colleagues have selected the interval spanning the Bashkirian-Moscovian boundary at Nashui for intensive biostratigraphic and sedimentologic study as a potential GSSP for the B-M boundary and are currently working at the locality. In the fall of 2010, the task group intends to hold a joint workshop other CCS task groups in Nanjing to study specimens from the locality.

The appearance of the fusulinid *Profusulinella prisca* has considerable merit for boundary definition and several members plan to further evaluate the utility of this taxon, searching for more appearances near the boundary level in Spain, Turkey and the southern Urals.

Because substantial work still is still required before a GSSP can be selected, 2011-2012 is the earliest likely completion date.

The Moscovian-Kasimovian Boundary and Kasimovian-Gzhelian Boundary Task

Groups are moving ahead as the previously muddled conodont taxonomic problems have been largely resolved. Publication of the cyclothem correlation chart (Heckel *et al.*, 2007) across both boundaries in North America [Midcontinent of U.S.A.] and Eastern Europe where the disconformity-bounded cyclothems are identified [Moscow Basin, Russia, and Donets Basin in Ukraine], has increased the potential for recognizing the conodont events that can be identified in the essentially complete lower-slope to basin successions in the southern Urals and south China. The members of the task group on the **Moscovian-Kasimovian Stage Boundary**, who attended the 2008 Oviedo meeting, reached unanimous agreement to focus future work on two species of conodonts as the potential biostratigraphic marker by which the base of the Kasimovian Stage can be selected and correlated globally. The first is *Idiognathodus sagittalis* Kozitskaya 1978, based on material from the Donets Basin (Ukraine) and also identified from the Moscow region and southern Urals of Russia, and the Cantabrian Mountains (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* Rosscoe and Barrick 2008 (*I. n. sp. A* of Barrick *et al.*, 2004), based on material from the Midcontinent region of the U.S.A., and also recognized in the Moscow, the southern Urals, and the Donets Basin. A lineage from *Idiognathodus swadei* Rosscoe and Barrick 2008 to *I. turbatus* has been described from the Midcontinent of the U.S.A. While the event for the Moscovian-Kasimovian boundary still needs to achieve consensus, continued assessment of the two lineages and clarification of the taxonomy of species involved will hasten the process.

The task group will continue to evaluate the utility of the two lineages in the slope-deposits of the Nashui section; and in fall 2010, they will hold a joint workshop with other SCCS task groups at Nanjing, China to study specimens from the locality.

Members of the **Kasimovian-Gzhelian boundary Task Group** have long favored use of the conodont lineage *Idiognathodus* aff. *simulator*-*I. simulator* [*sensu stricto*] to define the boundary at the first appearance of *I. simulator* [*sensu stricto*]. *I. aff. simulator* is now named *I. eudoraensis* by Barrick *et al.* (2008). This event marker was unanimously approved by a vote taken by the task group in April 2007, and has been unanimously approved by the SCCS. Now that the event marker has been selected, task-group members will focus on the selection of a suitable section for the GSSP. Further taxonomic work is in progress on the morphotypes of the fusulinid *Rauserites*, which accompanies *I. simulator* in Eurasia.

The existence of widespread disconformities within the Kasimovian-Gzhelian transition across nearly all of the well-known 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. Therefore, 2011 is probably the earliest likelihood for GSSP selections.

Chemostratigraphy, magnetostratigraphy and radiometric dating

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

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

Meeting/field workshop schedule with themes and anticipated results.

From May 30th to June 3rd of 2010, the executive and task-group chairs of the SCCS plan to attend the ICS workshop in Prague, Czech Republic. The focus will be on the GSSP concept - successes, shortcomings, and remaining boundary issues - but other stratigraphic issues will be addressed.

Two SCCS workshops/field meetings are scheduled for the 2009-2010 fiscal year. Immediately after the ICS Prague meeting, several members of Devonian-Carboniferous boundary reappraisal task group plan to visit the La Serre section in southern France (location of current D-C boundary GSSP). The purpose of trip will be to collect samples for conodont extraction across the boundary interval (mainly beds 83 to 89) to determine if the results of Kaiser (2009) and Corradini and Kaiser (2009) can be repeated (see discussion for D-C boundary in section #5). In addition, a one-day D-C boundary workshop will be held to discuss progress made since the ICOS 2009 meeting in Calgary, but the date and venue for that meeting have not been established.

In the fall of 2010, the Bashkirian/Moscovian, Moscovian/Kasimovian and Kasimovian/Gzhelian task groups plan to hold a joint workshop in Nanjing, China. The focus of

the workshop will be to study specimens and lineages relevant to defining GSSPs for the boundaries and present the most recent results of ongoing stage-boundary studies. After the workshop, there will be a field trip to the important Nashui section by the village of Naqing in southern Guizhou Province and to some other key Pennsylvanian sections in Guizhou and Guangxi provinces.

Members of the Tournaisian-Viséan task group may also attend the Nanjing meeting. Hongfei Hou is trying to organize an official ceremony for the placement of the "golden spike" in the GSSP section for the Tournaisian/Viséan boundary at Pengchong in Guangxi Province. Several task-group members and CCS officials plan to attend the historic ceremony and it would be logically practical to coordinate the ceremony with the fall Nanjing workshop.

APPENDIX A. [Names and Full Addresses of Current Officers and list of Voting Members]
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APPENDIX B. [Full text of Task Group Reports]

Task Group to redefine the Devonian-Carboniferous Boundary Following the initial workshop of the D-C boundary task group, held at the 2008 IGC in Oslo, basic plans for future work by the task group were included in the 2008 SCCS Annual Report that Richards submitted to the International Commission of Stratigraphy (ICS) in November 2008. The work plan outlined the problems with the current GSSP at the base of bed 89 in the La Serre section (Paproth *et al.*, 1991), France and made three recommendations: 1) the use of the first evolutionary occurrence of the conodont *Siphonodella sulcata* in the lineage *S. praesulcata* to *S. sulcata* for boundary definition requires re-evaluation; 2) if the FAD of *S. sulcata* is retained for boundary definition, either the position of the GSSP at La Serre must be lowered from the base of bed 89 or a more suitable section for the GSSP must be located, and 3) because the first appearance of *S. sulcata* may not be the best event for boundary definition, other conodont lineages require evaluation.

Since the report's submission, substantial progress has been made. Task-group member Sandra Kaiser continued work on the La Serre section that she had started during her dissertation project (Kaiser, 2005) and published her latest results (Kaiser, 2009). New data presented by Kaiser (2009) show the first occurrence (FO) of the index fossil *S. sulcata* is slightly earlier than reported by Heckel (2008) and at the 2008 IGC workshop and is at the base of bed 84b at La Serre rather than the base of bed 85. At this position, *S. sulcata* co-occurs with *S. praesulcata* at a sharp facies break and the evolutionary lineage from *S. praesulcata* to *S. sulcata* is absent in the underlying strata. Because the FO of *S. sulcata* may not be the best event to define the D/C boundary, Kaiser (2009) suggested the evolutionary lineage from *Protognathodus kockeli* to *Protognathodus kuehni* could be used to define the D/C boundary as there are many sections worldwide that contain the lineage. She also indicated other protognathodid lineages show potential for boundary definition; however, more study of those lineages is required before one can be used.

Task-group members Carlo Corradini and Sandra Kaiser have started to work on the taxonomic and phylogenetic problems within the *S. Praesulcata* - *S. sulcata* lineage and protognathodid lineages. They presented their initial findings in a paper (Morphotypes in the early *Siphonodella* lineage: implications for the definition of the Devonian/Carboniferous boundary) presented at the Second International Conodont Symposium (ICOS 2009) in Calgary, Alberta Canada from July 12th to 17th 2009. Their study (Corradini and Kaiser, 2009) indicates several morphotypes occur in the transition from *S. praesulcata* to *S. sulcata* and that the position of the current D-C boundary at La Serre is based on subjective interpretations.

During the SCCS workshop following the ICOS 2009 conference session, no consensus was reached on whether or not the *Siphonodella* lineage could be used for D-C boundary definition or even if *S. praesulcata* and *S. sulcata* should be considered as two different species. Specialists attending the workshop agreed that the D-C boundary can not remain at its present position at La Serre (base of bed 89) and that a new GSSP must be selected either lower in the section or in another section. They also decided that the initial problem to resolve was the selection of a suitable taxon for boundary definition. Three options were presented: continue use of the *S. praesulcata*-*S. sulcata* lineage but find a better way to speciate it, select a different lineage (protognathodids), and use the first occurrence of another taxon.

On August 14th, during the southern Uralian component of the SCCS field meeting in Russia, several SCCS members visited two sections that spanned the D-C boundary and contained the *S. praesulcata*-*S. sulcata* lineage (see Pazukhin *et al.*, 2009). At the related technical session, the conclusions reached about the GSSP at La Serre were similar to those made at the Calgary ICOS 2009 meeting, but the Russian conodont specialists thought the current event marker, the FAD of *S. sulcata*, could be used for boundary definition.

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Task Group to establish the Tournaisian-Viséan boundary

Following approval of the proposed GSSP [see Devuyst *et al.* (2003) for early version of proposal] at Pengchong in southern China, by the SCCS in late 2007 and its ratification by the ICS and IUGS, task-group member François-Xavier Devuyst and his colleagues have been preparing the final report about the Tournaisian-Viséan boundary GSSP. After completion of the report, the task group will be dissolved according to ICS rule (7.5).

Task-group member Hongfe Hou is trying to organize an official ceremony for the placement of the "golden spike" in the GSSP section at Pengchong. Several task-group members and SCCS officials plan to attend the historic ceremony.

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The **Task Group to establish the Viséan-Serpukhovian boundary** considers the first evolutionary appearance of the conodont *Lochriea ziegleri* in the lineage *Lochriea nodosa*-*Lochriea ziegleri* to be the best event for boundary definition. The lineage along with associated faunas and strata are being studied in several areas but the Nashui section in south China and the Verkhnyaya Kardailovka section in Russia have the best potential as GSSP candidates and are receiving the most intensive study.

Task-group member Yuping Qi and associates at the Nanjing Institute of Geology and Palaeontology recognized the *L. nodosa* - *L. ziegleri* lineage in the Nashui section in southern Guizhou province, People's Republic of China (Qi and Wang 2005). Qi has finished his detailed analysis of the conodonts across the Viséan/Serpukhovian boundary in the Nashui section and incorporated the results in his doctoral thesis (Qi, 2008). In the Nashui section, conodonts within the *L. nodosa* - *L. ziegleri* lineage are well preserved and abundant. Elements transitional between *L. nodosa* and *L. ziegleri* are plentiful at Nashui, occurring through several metres of section, and the oldest representatives of *L. ziegleri* could be readily distinguished from the associated transitional forms of *L. nodosa*.

Several task-group members and John Groves are continuing a detailed analysis of the foraminifers, stable-isotope geochemistry and sedimentology of the Nashui section and a nearby shallow-water limestone-dominant section at Yashui (by city of Huishui) in Guizhou province that spans the Viséan/Serpukhovian boundary. The goal of studying the Yashui section is to establish the relationship of the coral and foraminiferal zones to the *L. nodosa* - *L. ziegleri* lineage.

Nikolaeva *et al.* (2005) recognized the *L. nodosa* - *L. ziegleri* lineage in a, deep-water, carbonate section along the Ural River opposite the village of Verkhnyaya Kardailovka in the southeastern Urals, Russia. During the SCCS field meeting, held in Russia in August 2009, task-group and other SCCS members visited the Kardailovka section to determine how it compared with Nashui in terms of its suitability as a GSSP candidate. They concluded the boundary interval was well exposed but noted only three to five metres of well exposed strata lay below it, whereas at Nashui many metres of conodont-bearing strata are exposed. More of the section below the boundary interval at Kardailovka can be excavated and the section has the advantage of containing abundant ammonoids. Nikolaeva and her colleagues have thoroughly examined the section and published a synthesis of their studies on the ammonoids, conodonts, and ostracodes (Nikolaeva *et al.*, 2009). The synthesis indicates conodonts that are transitional between *L. nodosa* and *L. ziegleri* occur in the Kardailovka section immediately below the FAD of *L. ziegleri*.

The task group and SCCS have not voted on either rejecting or accepting the first evolutionary appearance of *L. ziegleri* for boundary definition.

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The **Task Group to establish the Bashkirian-Moscovian boundary**, chaired by John Groves, is conducting research at several locations in Europe and Asia and continues to evaluate three conodont evolutionary events that have potential for defining the base of the Moscovian: 1) derivation of *Idiognathoides postsulcatus* from *Id. sulcatus*, 2) derivation of *Declinognathodus donetzianus* from *D. marginodosus*, and 3) the appearance of *Diplognathodus ellesmerensis*. The fusulinids *Eofusulina ex gr. triangula* and *Profusulinella [= Depratina] prisca* recently emerged as additional taxa with considerable potential for boundary characterization.

South China. Specialists with the Nanjing Institute of Geology and Palaeontology organized an excursion in May 2008 to Guizhou Province to collect conodont and foraminifer samples from slope carbonates spanning the Bashkirian-Moscovian boundary interval at the Nashui section. Sampling was also conducted across the boundary at the nearby Yashui section, a shallow-water carbonate succession containing abundant micro- and macrofossils. Thin sections have been made from the samples and Groves has completed a preliminary analysis of foraminifers from the Bashkirian-Moscovian boundary at Nashui. 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 Nashui section. That level contains a foraminiferal association dominated by *Profusulinella* spp. and *Pseudostaffella* spp. The lowest occurrence of a demonstrably Moscovian fusulinid is at 183.45 m, where a specimen of *Eofusulina* sp. was recovered.

Donets Basin, Ukraine. Katsumi Ueno and Tamara Nemyrovska continue their work on fusulinids and conodonts from the Donets Basin. The Malonikolaevka section has yielded interesting results that were summarized by Ueno and Nemyrovska (2008). At Malonikolaevka, the proposed boundary marker *Declinognathodus donetzianus* first occurs in Limestone K1 in evolutionary continuity with its ancestor *D. marginodosus*. Limestone K1 also contains unquestioned occurrences of the Moscovian fusulinid *Eofusulina*.

Northwest Spain. Javier Sanz-López, Silvia Blanco-Ferrera and Elisa Villa are conducting integrated foraminifera and conodont biostratigraphic analyses at the San Antolin-La Huelga section along the Bay of Biscay in the Cuera area (Villa 1995; Villa *et al.* 1997). The Bashkirian-Moscovian boundary is provisionally placed about 180 m above the base of the section in lower-slope deposits. The boundary is marked by the lowest occurrence of *Idiognathoides postsulcatus*, and this level is slightly higher than the lowest occurrences of *Declinognathodus marginodosus* and *Profusulinella ex gr. prisca*. The San Antolin-La Huelga section contains four conodont taxa identified as potential Bashkirian-Moscovian boundary markers: *Id. postsulcatus*, *Diplognathodus ellesmerensis*, *Neognathodus nataliae* and *Declinognathodus donetzianus*. The lowest occurrences of these conodonts are in the order listed, spanning a stratigraphic interval of over 300 m.

South Urals, Russia - Elena Kulagina has completed a study of *Depratina prisca* in which she documented its evolutionary origin and showed its first occurrence in the south Urals can be used to identify the base of the Moscovian (Kulagina 2009). [Many western specialists regard *Depratina* as a junior synonym of *Profusulinella*.] Kulagina showed that *D. prisca* was derived from *Staffellaeformes staffellaeformis* via the intermediates *Staffellaeformes eoprisca* and

Depratina praeprisca. Occurrences of *D. prisca* have been examined at the Askyn, Basu and Utklykaya sections. The well-exposed Basu section, visited during the August 2009 SCCS field meeting, contains the first appearance of *Depratina prisca* a few metres below that of *D. donetzianus* (Kulagina *et al.*, 2009). 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.

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The **Task Group to establish the Moscovian-Kasimovian Boundary**, chaired by Katsumi Ueno, is focusing on the stratigraphic occurrences and distribution of the conodonts *Idiognathodus sagittalis* Kozitskaya 1978 and *Idiognathodus turbatus* Rosscoe and Barrick 2009 and their ancestors as potential biostratigraphic markers for defining the base of the Kasimovian Stage. The use of either conodont would raise the boundary level one substage from the traditional position at the base of the Kreyakinian Substage, to approximately the base of the Khamovnikian but the move will facilitate global correlation. Other biostratigraphic and lithostratigraphic events near the FAD levels of the species will be examined because of their potential as auxiliary events for identifying the base of the Kasimovian. Using the new research direction, the group made the progress summarized below.

Andara Massif, N.W. Spain. Spanish task-group members are studying the Moscovian-Kasimovian transition in the Castillo del Grajal and Morra del Lechugales sections, which embrace the uppermost part of the carbonate-dominant Picos de Europa Formation and the Las Llacerias Formation. Fusulinid biostratigraphic data indicate the study interval ranges from the top of the *Fusulinella* Zone (upper Moscovian) to the lower *Montiparus* Zone (Khamovnikian). The *Protriticites* Zone, spanning at least 245 m, is well exposed and fusulinid rich. Preliminary sampling indicates the occurrence of the conodont *Idiognathodus sagittalis* and its potential

ancestor *I. n. sp. 1* of Goreva *et al.* (2009), allowing correlation with the Moscow Basin and the North American Midcontinent.

Moscow Basin, Russia. The section in the Afanasievo quarry (Kasimovian neostratotype in Moscow Basin) is a potential GSSP candidate for the lower boundary of the Kasimovian. The section has diverse macrofaunas and microfaunas and offers potential for precise correlation with Eurasian sections. The best-recognized and most-correlated levels are the base of the *Montiparus montiparus* fusulinid zone, defined by the first occurrence of the genus *Montiparus*, and base of the *Idiognathodus sagittalis* conodont zone. In the quarry, *Idiognathodus sagittalis* first appears at the base of the middle member of the Neverovo Formation along with *I. turbatus*. The position is close to the FAD of the fusulinid *Montiparus (M. paramontiparus)* at the base of the Neverovo. Goreva *et al.* (2009) recognized *Idiognathodus n. sp. 1* as the possible ancestor of *I. sagittalis*. The form appears in the lower Suvorovo Formation, but becomes more advanced and abundant in the overlying Voskresensk Formation. The first appearance of *I. sagittalis* in the lineage is a potential marker for the base of the Kasimovian.

Donets Basin, Ukraine. Davydov and his student Rimma R. Khodjanyazova recently studied the taxonomy and biostratigraphy of fusulinids within the Moscovian-Kasimovian transition in the Kalinovo section of the Donets Basin, examining fusulinids from limestone units of the C₃¹ (N) and C₃² (O) suites and correlated them into the Moscow Basin. They concluded that within the Kalinovo succession the base of the Krevyakinian (traditional base of the Kasimovian) can be placed at the N3 limestone, based on the occurrence of *Protriticites* with thick walls penetrated by coarse pores. Age-diagnostic fusulinids are less abundant in the N5-N5/1 interval but it is probably equivalent to the Voskresensk Formation in the upper part of the Krevyakinian Substage because of the potential Ratmirovo age of O1. The O1-O1/1 interval is correlated with the Ratmirovo and the lower part of the Neverovo Formation because O1 contains abundant *Obsoletes* but also yields *Montiparus montiparus* and *M. paramontiparus*. The O2-O3 interval is correlated with the middle to upper part of the Neverovo as O2 contains *M. subcassulus*, which occurs in the middle member of the Neverovo in the Moscow Basin (Goreva *et al.*, 2007). The correlations that Davydov and Khodjanyazova propose differ substantially from those of Heckel *et al.* (2007), which are based on integrated cyclothem and conodont correlations. To cross-check the results with those of Heckel *et al.* (2007), Nemyrovska and Ueno have initiated an analysis of the conodont and fusulinid biostratigraphy in the Kalinovo section.

Midcontinent Basin, U.S.A. Rosscoe and Barrick recently carried out a more detailed study of *Idiognathodus turbatus* (established by Rosscoe and Barrick, 2009) and related forms using specimens from several sections in the Midcontinent Basin. They restricted the species concept to include only elements with expanded, well-developed rostral lobes and a distinctive medial nodosity. The revision placed the FAD of (revised) *I. turbatus* at the base of the Hertha Cyclothem, two cycles higher than it was originally recognized in Rosscoe and Barrick (2009).

Nashui section, south China. The Nashui section (Qi *et al.*, 2007) in southern Guizhou Province is one of the most-continuous and best-exposed sections embracing the Moscovian-Kasimovian boundary. It consists of carbonate-slope deposits that are rich in conodonts and contains some fusulinids. Qi and Wang Zhihao investigated the conodont succession across the boundary at Nashui and recognized the *Idiognathodus podolskensis*, *Swadelina subexcelsa*, *Swadelina makhlinae* - *Sw. nodocarinata*, *Idiognathodus sagittalis*, *Streptognathodus cancellatus*, and *Streptognathodus gracilis* zones, in ascending order. The first occurrence of *I. sagittalis* occurs 225 m above the base of the section. Ueno systematically sampled the boundary interval for fusulinids and the conodont-fusulinid biostratigraphy is being investigated.

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The **Task Group to establish the Kasimovian-Gzhelian boundary** has selected the conodont *Idiognathodus simulator* (s.s.) as the event marker for defining the base of the Gzhelian Stage (Heckel *et al.*, 2008) and is directing its research toward selecting a suitable section for the GSSP in three main areas.

Moscow Basin, Russia. The Russian task-group members have completed a comprehensive study of the lithostratigraphy and biostratigraphy of the stratotype of the Gzhelian Stage in the Gzhel quarry in the Moscow Basin near Moscow. In the quarry only the lower part of the stage is exposed, occurring in the Rusavkino Formation. The section comprises bed 1 of member 4 (middle Rusavkino) and beds 2-9 of member 5 (upper Rusavkino). Two ecological assemblages of fusulinids are recognized, replacing each other upwards in the section. The lower one occurs in beds 4 and 5 and includes *Quasifusulina longissima*, *Q. ultima*, *Q. eleganta*, *Rauserites postarcticus*, *R. paraarcticus*, and others. The upper assemblage is preserved in bed 8 and consists of a rich population of *Rauserites*, including dominant *R. rossicus* and minor *R. postarcticus* and *R. paraarcticus*. Three morphological groups are distinguished in the *R. rossicus* population from bed 8. It is, therefore, necessary to consider the polymorphic status of *R. rossicus* for regional correlation.

The Gzhel section contains abundant conodonts. A single juvenile specimen of *Idiognathodus simulator* was extracted in the top of bed 3, but typical *I. simulator* first appear in bed 4 along with *Streptognathodus pawhuskaensis* and *Idiognathodus tersus*. Alekseev and others also re-examined conodonts from the stratotype of the Rusavkino Formation situated near Rusavkino east of Moscow and in borehole 6k, drilled at Konyashino village north of Gzhel. They showed that *I. aff. simulator* (= *Idiognathodus eudoraensis* Barrick, Heckel and Boardman, 2008), a potential ancestor of *I. simulator*, appears in the late Kasimovian Troshkovo Formation

and also in the lower and middle members of the overlying Rusavkino Formation. The FAD of *I. simulator* in the Moscow Basin is close to that of *Rauserites rossicus*.

In the Moscow Basin, a specific and well recognizable assemblage characterizes the *I. simulator* Zone (Barskov *et al.*, 1982, 1984; Alekseev and Goreva, 2007). In addition to *I. simulator*, it includes *Streptognathodus pawhuskaensis*, *Idiognathodus tersus*, *I. toretzianus*, *I. luganicus*, *I. sinistrum*, and *Gondolella bella*. Based on the first appearance of *I. simulator*, the lower boundary of the Gzhelian lies within the Rusavkino Formation near the base of its upper member. Although the proposed stage boundary is somewhat above the formation's base, the regional and interregional correlations will not be significantly impacted.

Nashui section, South China. Qi (2008) established a detailed conodont biostratigraphy across the Kasimovian-Gzhelian transition in the Nashui section. In ascending order, he recognized the *Streptognathodus gracilis*, *Streptognathodus guizhouensis*, *Streptognathodus simulator* (= *Idiognathodus simulator* sensu Barrick *et al.*, 2008), *Streptognathodus nashuiensis*, and *Streptognathodus firmus* zones. According to Qi, the first occurrence of *S. simulator* is 265 m above the base of the section. Last December, Ueno and Wang Yue measured the Kasimovian-Gzhelian boundary interval in the section, and collected samples for fusulinid study. The work suggests that a composite conodonts/fusulinid biostratigraphy can be developed for the section. Because the Nashui section is a completely exposed carbonate-slope succession containing a rich conodont record throughout, it has great potential as a GSSP candidate for the Kasimovian-Gzhelian boundary.

Usolka section southern Urals, Russia

For establishment of the GSSP, Russian colleagues are undertaking a detailed re-description and recollection of the Usolka section in the southern Urals and have published a comprehensive synthesis of their preliminary results (Davydov *et al.*, 2008).

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Progress by the **Project Group on Carboniferous Magnetostratigraphy** has been hampered by a shortage of members and lack of integration with the activities of the other SCCS task groups. The group is particularly interested in collaborating with task groups working on sections and boundaries where magnetostratigraphy could be employed, to facilitate international correlations. Sections that have low thermal maturity and are dominated by siliciclastics are the most suitable for magnetostratigraphic analyses (based on the review in the SCCS Newsletter, v. 22: 35-41) but carbonates can be used.

The search for Mississippian sedimentary rocks that are likely to carry a primary magnetisation, to construct a magneto-stratigraphic timescale, have focused on two sections in southern Scotland. Both sections have good potential for recovery of primary magnetisation because they are dominated by siliciclastics and their thermal maturity is low. The first section (~400 m thick) is at Cove in the Cockburnspath outlier on the southern flank of the Midland Valley Basin and shows a transition from fluvial red-bed facies into lacustrine and flood-plain deposits with local marine influence. The succession includes the Inverclyde and Strathclyde groups and represents an interval from the latest Devonian into the late Viséan (Asbian) (Cossey *et al.*, 2004). The second section (~600 m thick) is at Kirkbean on the northern edge of the Northumberland Basin and is of early to late Viséan age, overlapping in age with the upper part of the Cove section. The Kirkbean succession represents shallow-marine setting with intervals recording fluvial and distal delta-front progradation. The section contains conodonts but their biostratigraphy has not been studied in detail and chronostratigraphic relationships to other sections in the Northumberland Basin are not well established (Cossey *et al.* 2004). The Kirkbean section is adjacent to a granite batholith that was unroofed in the Mississippian and could have provided igneous detritus carrying a palaeomagnetic signal. Both sections contain numerous silty and fine-sandy intervals and are continuously and well exposed, thereby providing good targets for palaeomagnetic work.

The magnetostratigraphic work on the Carboniferous-Permian boundary (CPB) section at New Well Peak, S.W. New Mexico (Hounslow, 2009) indicates that section was remagnetised during the Late Cretaceous to early Tertiary (Kate Zeigler pers. comm.). The targets for that work were short normal polarity magnetozones lying both above and below the CPB and known from sections in central Asia to lie within the Permian-Carboniferous reverse superchron. In contrast, a review of Permian magnetostratigraphic data from Spitsbergen (Hounslow and Nawrocki, 2008) has indicated that a normal polarity interval in the Tyrrellfjellet Member of the Gipsdalen Group potentially validates one or other of the normal-polarity magnetozones from the latest Gzhelian or earliest Asselian, thereby providing a useful additional proxy for the CPB interval in the arctic sections.

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SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY

Subcommission on Devonian Stratigraphy

Submitted by:

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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Since SDS has formally defined all its series and stage boundaries since many years, it has worked in the last years on the formal definition of substages, on the revision of GSSPs (after 10 years of moratorium), on the improvement of multidisciplinary international correlation, on the organisation of Devonian stratigraphic symposia, and on the publication of monographic books/volumes. SDS objectives for 2009 can be summarized as:

- Work on formal definitions of Pragian, Givetian, Frasnian, and Famennian substages
- Revision of the basal Emsian GSSP in Uzbekistan
- Revision of the D/C boundary in the frame of a new D/C Boundary Working Group and in close collaboration with the Carboniferous Subcommission
- Publication of volumes on Devonian stratigraphy in close co-operation with IGCP 499
- Compilation and distribution of SDS Newsletter 24
- Official Business meeting in conjunction with the 9th North American Paleontological Convention in Cincinnati, USA
- Devonian field trips in conjunction with the 9th NAPC
- Support for additional international Devonian symposia (Paleozoic Seas Symposium, Graz 2009)
- Revision of Devonian chapter for the GTS 2010 volume
- Intensive cooperation with ICS

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.

3. ORGANIZATION

Officers for 2008-2012

Chair: Prof. Dr. R. Thomas BECKER, WWU Münster, Germany

Vice-Chair: Prof. Dr. Ahmed EL HASSANI, Institute Scientifique, Rabat, Morocco

Secretary: Dr. John E. MARSHALL, University of Southampton, U. K.

The Subcommission has currently further 18 Voting Members that cover many major Devonian outcrop areas and many stratigraphical disciplines (see Appendix).

The SDS Membership covers currently the following 29 countries (in alphabetical order): Australia, Austria, Belarus, Belgium, Bolivia, Bulgaria, Canada, China, Czechia, Estonia, France, Germany, Great Britain, Iran, Italy, Latvia, Lithuania, Morocco, Myanmar, New Zealand, Pakistan, Poland, South Africa, Spain, USA, Uzbekistan, Tadzhikistan, Turkey, Vietnam. There is still a lack of active workers from other countries with important Devonian outcrop, especially from Brazil, Argentine, Chile, Algeria, Libya, Kazakhstan, Kyrgisia, Caucasian countries, and Thailand.

At national level several Devonian Subcommissions exist in various countries, partly under different organisational names (e.g., Germany, Russia, “Friends of the Devonian” at GSA meetings).

Website: <http://www.unica.it/sds/>

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

SDS is traditionally strongly tied with IGCP projects that have a Devonian focus. This is currently IGCP 499 on “Devonian land-sea interaction: evolution of ecosystems and climate” (DEVEC), led by P. KÖNIGSHOF and colleagues from the Senckenberg Institute, Frankfurt a. M., Germany. IGCP 499 runs out in 2009 but there are plans for a new successor project. Its meetings have been advertised on the official SDS Homepage. In 2009 two joint symposia were organized during the 9th NAPC in Cincinnati, Symposium S3 on “Rapid Evolution of Terrestrial Ecosystems and their Influence on Marine Realms – Land-Sea Interactions in the Devonian” (Convenors P. KÖNIGSHOF and SDS Secretary J.E.A. MARSHALL: 9 talks) and Symposium S19 on “Biological Response to Devonian Sea-Level and Paleoclimate Changes” (Convenors: SDS Chairman R.T. BECKER and TM C.E. BRETT: 10 talks, 3 posters). Further presentations with a focus on Devonian stratigraphy were given in other Topical Sessions and Symposia.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009

Chronostratigraphic definitions: The SDS Report to ICS for 2008 summarized the main arguments for and the importance of formally defined substages, which is not repeated here (see also SDS Newsletter 18, p. 13-14).

PRAGIAN SUBSTAGES

With respect to the huge amount of work already done in the Zinzilban Gorge and since it has been proposed to use the well documented current basal Emsian GSSP to define in future the

base of an Upper Pragian or Zinzilbanian substage, only specific further research on the Pragian subdivision into two substages is needed. Current work in progress includes a refined correlation of the Zinzilban GSSP into the neritic brachiopod succession of the classical Emsian type region of Germany, utilizing the conodont-brachiopod co-occurrences in Celtiberia (Spain). An outline was published, right after the last SDS report, by CARLS et al. (2008, 2009) in Bulletin of Geosciences (vol. 83/4) and in SDS Newsletter 24. At the Annual Business Meeting in 2009, VALENZUELA-RIOS & CARLS provided a correlation of the “*kitabicus* boundary” into the Iberian Chains and outlined the problems of correlation of European successions with the fine eognathid zonation of western North America.

REVISION OF BASAL EMSIAN GSSP

Different groups (conodont specialists, multidisciplinary Czech group) and individual members are currently working on samples and faunas taken through the (current) lower Emsian in the Zinzilban Gorge. Preliminary reports are due for the next SDS Newsletter (early 2010) and shall eventually lead to a multi-authored paper on the revision and precise stratigraphy across the transition from the *kitabicus* to the *excavatus* conodont zones. This work includes conodonts, dacryoconarids, trilobites, early ammonoids, magnetostratigraphy (magnetic susceptibility), isotope stratigraphy, and facies studies. An outline of the conodont and dacryoconarid lineages that are in the focus of current studies was recently given by CARLS et al. (2008, 2009). The new GSSP will be placed in the Zinzilban Gorge, in uninterrupted successions above the current GSSP (future basal Upper Pragian GSSP).

EMSIAN SUBSTAGES

SDS has decided to delay the subdivision of the Emsian into two formal substages until its basal GSSP has been revised. In spring 2009 the transition from typical lower Emsian limestones (with typical dacryoconarid, conodont and ammonoid faunas) into overlying Daleje Shale equivalents (with rich ammonoids) has been re-sampled in the Tafilalt of southern Morocco.

GIVETIAN SUBSTAGES

The formal submissions to ICS concerning the definitions of formal Middle and Upper Givetian substages (voted on by SDS in 2007) are still in preparation. The Middle Givetian shall start with the base of the *varcus-rhenanus*, the Upper Givetian with the base of the *hermanni* conodont zones. New important data on the Middle/Upper Givetian transition and on the Taghanic Biocrisis, including conodont, goniatite, sequence and magnetostratigraphy, were published after the last report by BAIRD & BRETT (2008) or are currently in press by SDS members in the Middle Devonian thematic volume to be published in Palaeogeography, Palaeoclimatology, Palaeoecology (ELLWOOD et al. in press; ABOUSSALAM & BECKER, in press; MARSHALL et al. in press). BOCKWINKEL et al. (2009, Berliner Paläobiologische Abhandlungen, vol. 10) started to document in detail the extraordinary Upper Givetian ammonoid radiation that gives a strong difference to the much simpler Middle Givetian goniatites. The Guidebook to Field Trip No. 10 of the 9th NAPC (TM BRETT et al., 2009) includes many new data on the Givetian of Kentucky, Ohio, and Michigan, especially concerning sequence stratigraphic correlations; these are useful for the correlation of the substage levels into the Appalachian foreland. A corresponding publication by TM BRETT et al. is in print in the mentioned Middle Devonian volume.

FRASNIAN SUBSTAGES

As in the case of the Givetian, the formal submissions to ICS concerning the definition of Middle and Upper Frasnian substages, voted on by SDS in 2007, are still in progress. The Middle

Frasnian shall start with the base of MN Zone 5 (= base of *punctata* Zone), the Upper Frasnian with the transgressive spread of *Pa. semichatovae* low in MN Zone 11. An important new monograph on conodonts of the Russian Platform by CM N.S. OVNATANOVA and L.I. KONONOVA (2008, Paleontological Journal, vol. 42/10) helps to correlate into more shallow shelf settings.

FAMENNIAN SUBSTAGES

A formal vote on Famennian substages levels was held up by the fact that important new data are still not published. These (HARTENFELS & BECKER in press, KAISER et al. in press) are included in the joint IGCP 499/SDS volume that is just being printed in the Palaeontographica Americana series. The volume should be out still in 2009. The important update of the conodont-miospore correlation was published by STREEL (2009) in the new IGCP 499 volume on "Devonian Change". The new data underline the proposal to place the Upper Famennian base at the base of the Upper *expansa* Zone, which can be recognized by four different conodonts of four different lineages (genera) that enter simultaneously: *Palmatolepis gonioclymeniae*, *Bispathodus ultimus*, *Pseudopolygnathus trigonicus*, and *Branmhela suprema*. HARTENFELS & BECKER (2009) reviewed in SDS Newsletter 24 the conodont succession across potential levels for a Middle/Upper Famennian substage boundary and proposed to use the base of the global Lower *Annulata* Event for definition. A publication on Australian faunas by BECKER & HOUSE (2009, Bulletin of the Geological Survey of Western Australia, vol. 145) clarified the conodont-goniatite correlations in the Famennian, which is of importance for the potential Lower/Middle Famennian substage boundary. The base of the globally widespread and easily identifiable (Lower) *marginifera* Zone correlates with the Prototethys (Australia to Europe/North Africa) spread of advanced paratornoceratines (*Acrimeroceras*).

REVISION OF D/C BOUNDARY

CM KAISER published in spring 2009 (Newsletters on Stratigraphy, vol. 43/2) the critical new conodont data that required a fundamental revision of the current La Serre D/C boundary GSSP. The new D/C Boundary Working Group had a first meeting during the ICOS 2009 Symposium in Calgary, which field trip to the Rocky Mountains offered the possibility to re-examine boundary sections in Alberta (Guidebook by HENDERSON et al., 2009). The necessity for a special conodont workshop in 2010, with a focus on the taxonomy of early siphonodellids and protognathodids, was underlined. H. TRAGELEHN presented at a Field Meeting of the German Subcommission on Devonian Stratigraphy in June 2009 a detailed review of siphonodellids across the D/C boundary of Franconia; a corresponding manuscript with several new taxa and documenting complex evolution in different lineages (genera) is close to completion. Conodont samples from the Kule section near the Uzbekistan/Tadzhikistan boundary border have been processed in 2009 (CM KAISER & TM BECKER) but carbon isotope data are not yet available. These hopefully will allow to recognize the significant positive carbon isotope peaks recognized in Europe and, more recently (CRAMER et al. 2008, Epeireic Seas volume, Geological Association of Canada, Paper series, vol. 48) in North America.

A new boundary section with neritic carbonates across the Hangenberg Crisis (*Bi. ultimus* and *Protogn. kockeli* faunas) into shales with *Gattendorfia* was discovered by the Chairman in spring 2009 in southern Morocco (northern edge of Maider region). A general paper on the D/C boundary of the eastern Anti-Atlas (CM KAISER et al. in press) was submitted to Palaeogeography, Paleoclimatology, Palaeoecology and is currently in review. Some new protognathodid material was sampled from just at the boundary at the Oese section in the Rhenish Massif and should help the taxonomic revision. The Guide to Field Trip No. 2 in

association with the 9th NAPC (ETTENSOHN et al., 2009) includes two important contributions in relation to the D/C boundary: Dropstones from Kentucky as evidence for Appalachian mountain glaciers during the peak of regression and new data on the palynology across the boundary in Kentucky by HEAL et al. BAIRD et al. (2009) presented in the Guide to Field Trip 10 of the 9th NAPC a proposal to correlate formations around the D/C boundary of Ohio into previously poorly studied successions of Pennsylvania, however so far with poor conodont control. These data together document the current and parallel research efforts by several working groups that should lead to a revised conodont stratigraphy and improved regional correlations using isotope and sequence stratigraphy. The amount of progress is encouraging.

Publications: SDS has been very active concerning publications in Devonian thematic issues, in its Newsletter, and in numerous journal contributions that are not listed here:

- BECKER, R. T. (Ed.) 2009. SDS Newsletter 24. - 127 pp., Westfälische Wilhelms-Universität Münster.
[The SDS Newsletter has left the status of “grey literature” It is now a formal publication, with **ISSN No. 2074-7268**, that can be quoted in all publications/journals.]
- BRETT, C.E., BARTHOLOMEW, A.J. & DESANTIS, M.K. (Eds.) 2009. Middle and Upper Devonian Sequences, Sea Level, Climatic and Biotic Events in East-Central Laurentia: Kentucky, Ohio, and Michigan. – North American Paleontological Convention – 2009. Field trip No. 10, 186 pp.
- KAISER, S.I. 2009. The Devonian/Carboniferous boundary stratotype section (La Serre, France) revisited. – Newsletters on Stratigraphy, **43** (2): 195-205.
- OVER, D.J. (Ed.) 2009 (just in print). Studies in Devonian Stratigraphy: Proceedings of the 2007 International Meeting of the Subcommission on Devonian Stratigraphy and IGCP 499. – Paleontographica America, **63**, ca. 205 pp.

SDS members contributed significantly to the following other Devonian volumes:

- KÖNIGSHOF, P. (Ed.) 2009. Devonian Change. Case Studies in Palaeogeography and Palaeoecology. – Geological Society, London, Special Publication, **314**, 298 pp.
- KÖNIGSHOF, P., OBUT, O. & IZOKH, N. (Eds.) 2008. Bulletin of Geosciences, **83** (4): 357-506.

A special issue on Middle Devonian stratigraphy, with guest editors TM C.E. BRETT and TM E. SCHINDLER, is in press with Palaeogeography, Palaeoclimatology, Palaeoecology and should be published in the first half of 2010. Another Devonian volume is in preparation in the Memoirs series of the Association of Australasian Palaeontologists.

The Devonian chapter for the GTS 2010 volume has been significantly revised and is close to completion.

Meetings:

- SDS Annual Business Meeting at the 9th North American Paleontological Convention, Cincinnati, 26th June
- Paleozoic Seas Symposium, Graz 14-18th September 2009 [with formal SDS support]

Membership:

A very experienced new corresponding members from the USA (B. WITZKE) was elected.

6. CHIEF PROBLEMS ENCOUNTERED IN 2008

The wide array of activities, carried forward by a highly active core of SDS Members, especially the high numbers of papers and thematic volumes, did not leave the time to finalize the formal submissions for the ratification of Givetian and Frasnian substages. The delayed publication of important new Famennian data caused a delay of formal voting on Famennian substages; the levels for the base of the Middle and Upper Famennian require a new discussion in the light of the now (end of 2009) available new rich conodont data. The program in 2009 was too full for members of the D/C Boundary Working Group to organize a special conodont workshop and field work in China but conodont specialists of the WG met at the ICOS in Calgary.

SDS is still lacking formal members from a range of countries with extensive and important Devonian outcrop, such as Algeria, Libya, Brazil, Bolivia, Argentine, Turkey, and Caucasian countries. However, there are promising contacts with Devonian stratigraphers from some of these, especially in the frame of IGCP 499, which resulted in important publications on the Devonian of Algeria, Argentine, and Bolivia.

7. SUMMARY OF EXPENDITURES IN 2009

INCOME

carried over from 2008	206 \$
IUGS subvention 2009	1600 \$
Sum	1806 \$

EXPENSES

SDS Newsletter 25, due 01/2010	
printing mailing	450 \$
Support to members to attend the 9 th NAPC and SDS Symposia	1000 \$
balance early 2010	356 \$

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2010)

- Finalize and submit proposals for the formal definition of Givetian and Frasnian substages to ICS for ratification
- Publication of volume on Middle Devonian stratigraphy and multi-disciplinary correlation in Palaeogeography, Palaeoclimatology, Palaeoecology (TMs C.E. BRETT & E. SCHINDLER, Eds.)
- Publication of SDS Newsletter 25 in early 2009
- Compilation of results from the various specialists groups that re-sampled the interval for a revised basal Emsian GSSP in the Zinzilban Gorge
- Publication of Devonian chapter (BECKER, HOUSE & GRADSTEIN) in GTS 2010 (GRADSTEIN et al.)

- Annual Meeting at 3rd International Paleontological Congress, London, 28th June – 3rd July 2010, with SDS Symposium (formally approved by organizers) on “Devonian Bioevents – timing, ecological and evolutionary patterns”
- SDS Field trip in relation with IPC3 to the terrestrial Devonian of the Old Red Continent (Scotland), organized and led by SDS Secretary J.E.A. MARSHALL
- Initiate special volume on Devonian Bioevents in high-level journal, based on contributions to London symposium
- Update of SDS homepage
- Formal vote on Uppermost Famennian substage (end of 2009/early 2010) - discussion of the definition of Middle and Upper Famennian substages at London Business Meeting
- Participation in ICS Workshop in Prague, spring 2010, as part of intense cooperation with ICS and its bodies (e.g., SCS, ISSC)
- Formal support and participation in the 4ème Congrès Français de Stratigraphie, 30th August to 2nd September 2010, Université Pierre et Marie Curie, Paris, with a field trip to the Devonian of the Ardennes (northern France-Belgium)

9. BUDGET AND ICS COMPONENT FOR 2010

INCOME	
balance from 2008	356 \$
EXPENSES	
SDS Newsletter 26	500 \$
support for SDS member from Uzbekistan ('Chairman of Working Group on Emsian revision) to attend Annual Business Meeting and SDS Symposium at IPC3, London	1500 \$
SUM	2000 \$
request for support/subvention from IUGS/ICS	2000 \$

APPENDIX A

Subcommission officers

CHAIRMAN + 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

VICE-CHAIRMAN

Ahmed EL HASSANI, Département de Géologie, Institut Scientifique, B.P. 703-Rabat-Agdal, Marokko; elhassani@israbat.ac.ma

SECRETARY

John E. MARSHALL, School of Ocean and Earth Science, University Southampton, Southampton Oceanography Centre, European Way, Southampton SO14 3 ZH, U. K., jeam@soc.soton.ac.uk

WEBMASTER

Carlo CORRADINI, Dipartimento di Scienze della Terra, Università di Cagliari, Via Trentino 51, I-09127 Cagliari, Italy; corradi@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 Xiuqi: 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
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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. G. YOUNG: Australia, micro- and macrovertebrates, general stratigraphy; g.young@geology.anu.edu.au
18. ZHU Min: Beijing, vertebrates; zhumin@ht.rol.cn.net

SUBCOMMISSION ON SILURIAN STRATIGRAPHY

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY

International Subcommission on Silurian Stratigraphy ISSS

Submitted by:

Michael J. Melchin, Chairman, ISSS

Department of Earth Sciences

St. Francis Xavier University

Antigonish, Nova Scotia B2G 2W5, Canada

Phone: 902-867-5177; Fax: 902-867-2414

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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:

4. 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;
5. Establishment of frameworks and mechanisms to encourage international collaboration in understanding the evolution of the Earth during the Silurian Period;
6. Working towards an international policy concerning conservation of geologically and palaeontologically important sites such as GSSPs

Goals

5. Rationalization of global chronostratigraphical classification.
6. Intercalibration of fossil biostratigraphies, integrated zonations, and recognition of global datums.
7. Establishment of magneto- and chemo-stratigraphic scales.
8. Definition of Stage boundaries and restudy of global stratotype sections.
9. Correlation of Silurian rock successions and events, including marine to non-marine.

3. 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 new Subcommission elected for 2008-2012 there are twelve other Voting Members. The network of Corresponding Members have 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.

Officers for 2008-2012:

Chair: Michael Melchin, Antigonish, Canada.
Vice-Chair: Peep Mannik, Tallinn, Estonia
Secretary: J. Verniers, Ghent, Belgium

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

Websites: <http://www.silurian.cn/home.asp> contains newsletters, meeting announcements, discussion posting-boards, bibliography of Silurian articles, links to related sites, and other information.

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

Collaboration on an IGCP Project N° 503 entitled “*Ordovician Palaeogeography and Palaeoclimate*”. This project ended in 2009 and ISSS members are collaborating with ISOS members in the planning of a follow-up project proposal for IGCP.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009

Silurian Times No 16 was edited by the secretary in February 2009, 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, announcement of upcoming meetings and publications, and the latest news and recent publications on Silurian research.

The Silurian Field Meeting took place in Sardinia, Italy, June 4-11, 2009. The theme of the meeting was “Time and Life in the Silurian: an Interdisciplinary Approach”. This is in keeping with the recommendations of the voting members of the ISSS, as expressed at the 2007 business meeting in Nanjing, that a significant focus of future work of the Subcommission should be chemostratigraphy of the Silurian, integrated with the biostratigraphy of graptolites, conodonts, chitinozoans and acritarchs and the study on the environment, climate and sea level changes. The meeting attracted approximately 50 Silurian specialists who presented a wide range of research results. The meeting was particularly successful in advancing one the stated goals of the ISSS, integration of data from different biostratigraphic, chemostratigraphic and lithostratigraphic perspectives, all focused toward a better resolution of Silurian time and understanding of the processes and events that operated in this interval. The meeting also resulted in the initiation of a number of new and expanded collaborations and research networks, as well as publication of the abstract volume and an excellent field guide and review of the current state of understanding of the Silurian of Sardinia. Another point of particular note for the ISSS was the presentation of the results of the preliminary study of a possible new GSSP candidate section for the Base of the Wenlock.

Plans are well under way for the next International Symposium on the Silurian System. The meeting location will be in St. Petersburg, Russia, with a field trip in the Subpolar Urals of Russia, which has an extremely well-exposed succession of Silurian Strata.

The SSS Chair continued his interaction with scientists at the British Geological Survey to 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 will form 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 (Gorsian), and Ludfordian. Each of these GSSPs can be

shown to be in need of refinement. As part of this the ISSS Chair and several other members attended a Ludlow Research Group field trip to the type Llandovery area, where the GSSPs for the Aeronian and Telychian occur. 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.

At the same LRG meeting it was resolved that the Ludlow Research Group, a primarily British group of geologists interested in the Silurian System, should strengthen its relationship with the ISSS, particularly in terms of communication of research activities.

The ISSS Chair sent a letter to the director of the BGS expressing the strong interest of the ISSS and the international stratigraphic community in the work of restudying the sedimentary basins that host the Silurian GSSPs. The letter also expressed the hope that funding could be continued for this stratigraphic research.

ISSS members were involved in several other conferences in 2009 including a symposium on Paleozoic Seas, held in Graz, Austria, in September, 2009, the European Geosciences Union in Vienna, Austria, April, 2009, and the final conference of IGCP 503, in Copenhagen in September, 2009. In addition, the North American Paleontological Conference had a special session sponsored by the ISSS and a field trip spanning the Silurian succession in the vicinity of the Cincinnati Arch.

6. CHIEF PROBLEMS ENCOUNTERED IN 2008

No major problems except for 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. It would be helpful if IUGS emphasized to its member countries the importance it attaches to the GSSP programme and encouraged the relevant research funding bodies to give priority to funding relevant basic research.

7. SUMMARY OF EXPENDITURES IN 2008

Income

Carried forward from 2008	US\$400
ICS Allocation	US\$2000
Total	US\$2400

Expenditure

ISSS field meeting expenses for Chair	US\$1000
ISSS field meeting expenses Secretary	US\$1400
<u>Balance</u>	<u>US\$0</u>

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2010):

Regular updating the website for Silurian Subcommission. We gratefully acknowledge the support of the Nanjing Institute of Geology and Palaeontology Academia Sinica for this work.

Publication of Silurian Times Newsletter 17

Planning for International Symposium on the Silurian System in St. Petersburg, Russia, July, 2011.

Continued progress on the refinement of our understanding of Silurian GSSPs, particularly in collaboration with the ongoing regional mapping programme of the British Geological Survey in Wales and the Welsh Borders. In particular, collaborative studies of the chemostratigraphy and palynology of the Llandovery sections are planned for 2010.

Publication of the conference proceedings of the 2009 ISSS Field Meeting in Sardinia. This volume will be a special volume of the well-respected, refereed journal *Bollettino della Società Paleontologica Italiana*.

Publication of a special volume of papers entitled “Siluro-Devonian Studies”, to be published as a Memoir of the Association of Australasian Palaeontologists.

Participation in the publication of the research results of IGCP 503 and planning for followup IGCP project proposal.

Active participation in the ICS Workshop “The GSSP Concept”, Prague, May 30-June 3, 2010.

The ISSS chair and some collaborators plan to make visits to Llandovery-Wenlock boundary sections in China and Czech Republic for preliminary assessment of their potential as a replacement for the current GSSP for this boundary (see restudy of the Wenlock Series GSSP below).

Focus of ISSS members on continued collaboration on the process of full integration of the various regional and global biostratigraphic, lithostratigraphic, sequence stratigraphic, and chemostratigraphic scales. This integration is essential for refinement of the Silurian time scale and high-resolution correlation of Silurian events. In addition, some ISSS members plan to focus 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 this scale, which is currently a serious weakness for the Silurian System.

9. BUDGET AND ICS COMPONENT FOR 2010

Contribution toward transportation, accommodation & registration of the Chair, Vice-Chair and Secretary to participate in the in the ICS Workshop The GSSP Concept, in Prague, May 30-June 3, 2010.	\$4000.00
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Since the ISSS has done pioneering work in the area of restudy of previously ratified GSSPs (see below), it is particularly important that members of the ISSS executive participate in this workshop, whose focus is The GSSP Concept.

Total requested from ICS:

\$4000.00

Potential funding sources outside IUGS

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

10. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2005-2009)

Over the period of 2005-2009 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 2009". In addition to those, the following are the most significant accomplishments of the past five years.

- 1) The Silurian Field Meeting of the SSS was held in Gotland, Sweden between August 15 and 22, 2005. A three day symposium followed by five days excursion was organized by M.E. Eriksson, M. Calner, and L. Jeppsson (Lund University and support of the Swedish Geological Survey). The field guide and the abstract book were published in the volume "*The Dynamic Silurian Earth*". In: Eriksson, M.E., Calner, M. (Eds.), *Field Meeting of the Subcommission on Silurian Stratigraphy 2005, Gotland, Rapporter och meddelanden-Sveriges Geologiska Undersökning vol. 121, pp.1-99.*
- 2) The restudy of the base of the Silurian System. A restudy of the GSSP for the Base of Silurian was prepared in 2002 by a working group under the leadership of Michael Melchin. After three years work, the working group has unanimously agreed that the current GSSP, at 1.6 m above the base of the Birkhill Shale, at Dob's Linn, Scotland, should be maintained as the GSSP, but the biostratigraphical definition of the boundary needs to be revised. The GSSP should be regarded as coinciding with the first appearance of *Akidograptus ascensus*, defining the base of the *A. ascensus* Biozone at that GSSP section. By the middle of March 2006 all titular members have voted in favour of the proposal of Mike Melchin for the base of the Silurian at Dob's Linn. It has now been ratified by ICS and IUGS and a final report has been published in the September, 2008 issue of Episodes.
- 3) Regarding the restudy of the base of the Wenlock Series. The working group to restudy the Base of the Wenlock Series (base of Sheinwoodian Stage) was led by David Loydell, looked at potential GSSP sections in the Czech Republic and Wales, as possible alternatives to the current GSSP in England. The primary marker for the base-Wenlock was a graptolite, but the GSSP in England is notably poor in allowing exact determination of their ranges. Recent evidence has shown that the current GSSP does not coincide with the base of the *Cyrtograptus centrifugus* Biozone, as was supposed when the GSSP was defined. It has been suggested to retain the GSSP location in England but revise the level of the GSSP to coincide with a conodont event -- the Ireviken conodont datum 2. The correlation between this level and the graptolite biozonation is a matter of some controversy. It is either approximately correlative with the base of the lower *murchisoni* graptolite Biozone (instead of the current *centrifugus* graptolite zone), or else a level high within the *murchisoni* graptolite Biozone. Alternatively, another GSSP locality with a precise base of the *Cyrtograptus centrifugus* Biozone could be chosen (e.g., potential sections in Great Britain or the Czech Republic), but this process would be quite lengthy. The report of this work at the Silurian Field Meeting in Gotland, in August, 2005, was discussed over the winter and spring, 2006. Most voting members appreciated very much the amount of work by the working group and especially the leader of the group. But most felt that for the moment that no good alternative for the previous GSSP can be proposed. It was decided not to propose a new

GSSP and stick for the time being to the old GSSP, although it had many short comings, until new studies can propose a better alternative. This time consuming study could however not be completed before the deadline of the ISC, ending at the International Geological Congress in Oslo summer 2008.

At the 2009 Silurian Field Meeting many of the ISSS members expressed their desire to continue to search for a new GSSP for the Base of Wenlock to replace the current one. Those members felt that it would be in the best interest of stability to find a new GSSP whose level coincides with the base of the *Cyrtograptus centrifugus* Biozone. Other members expressed the view that, with additional study, it may be that the current GSSP can be shown to provide a high level of biostratigraphic resolution based on its conodont faunas and that it would be in the best interest of stability to keep the current location and level. This is a matter of ongoing research and discussion for the Subcommission.

4) An International Conference on the Silurian System was held in Nanjing, China, in June-July 2007, hosted by the Nanjing Institute of Geology and Palaeontology. 22 talks and posters were presented on the Silurian and three excursions to the extensive Silurian outcrop areas of South China with more than 70 participants impressed the participants by the good exposures and the extensive work that was done in these sections. Conference proceedings were published in a special issue of *Acta Palaeontological Sinica*.

5) ISSS members participated in 19 conferences in which IGCP 503 held sessions or symposia and began collaboration on planning of a followup IGCP project proposal.

OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2010-2013)

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:

Silurian Field Meeting in 2013, location to be announced.

As also noted above, we plan to collaborate with the British Geological Survey in the remapping and stratigraphic reinvestigation of the GSSPs and surrounding type regions for the bases of the Aeronian, Telychian, Wenlock (Sheinwoodian), Homerian, Ludlow (Gorstian), and Ludfordian. It is our objective to complete integrated biostratigraphic, chemostratigraphic, and sequence stratigraphic of each of the GSSPs. At the present time, each of these GSSPs has a significant level of imprecision in its definition for the purposes of high resolution stratigraphic correlation. It is our hope that these restudies will increase the precision with which the GSSPs can be defined and correlated, as has been the case with the restudy of the Base of the Silurian. If not, this work may provide a compelling rationale for seeking a replacement section and point for one or more of the current GSSPs.

We will investigate the establishment of data-bases which would bring together and make available information from all sources associated with the Silurian researchers. Associated with this will be the development and expansion of the Thematic Working Groups: for example, searching for and interpreting data from all sources relevant to reconstructing the palaeobiogeography or the climate of one or more specific time-intervals.

Other related activities include participation in the production of a new volume synthesizing our current understanding of Palaeozoic Palaeobiography. This volume is being edited by D.A.T. Harper and T. Servais.

APPENDIX [Names and Addresses of Current Officers and Voting Members, 2008-2012]

SUBCOMMISSION ON SILURIAN STRATIGRAPHY

Subcommission officers

Chairman: Michael J. Melchin, Department of Earth Sciences, St. Francis Xavier University, Antigonish, NS, Canada, B2G 2W5; mmelchin@stfx.ca.

Vice Chairman: Peep Mannik, Institute of Geology at Tallinn University of Technology Ehitajate tee 5, 19086 Tallinn, Estonia; mannik@gi.ee.

Secretary: Jacques Verniers, Research Unit Palaeontology, Department of Geology and Soil Science, Ghent University, Krijgslaan 281 building S8, B-9000, Gent, Belgium.; Jacques.Verniers@ugent.be.

List of Voting Members

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J. Verniers, Ghent, Belgium, Jacques.Verniers@ugent.be

Zhan Renbin, Nanjing, China, rbzhan@nigpas.ac.cn

SUBCOMMISSION ON ORDOVICIAN STRATIGRAPHY
ANNUAL REPORT 2009

1. Name of constituent body:

Subcommission on Ordovician Stratigraphy (SOS)

Submitted by:

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2. Overall objectives, and Fit within IUGS science policy:

The Subcommission promotes international cooperation on all aspects of Ordovician Stratigraphy.

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

SYSTEM	GLOBAL SERIES	GLOBAL STAGES	KEY GRAPTOLITE/ CONODONT(C) BIOHORIZONS
ORDOVICIAN	UPPER	HIRNANTIAN	← <i>P. acuminatus</i> (GSSP-Dob's Linn)
		KATIAN	← <i>N. extraordinarius</i> (GSSP-Wangjiawan North)
		SANDBIAN	← <i>D. caudatus</i> (GSSP-Black Knob Ridge)
	MIDDLE	DARRIWILIAN	← <i>N. gracilis</i> (GSSP-Fågelsång)
		DAPINGIAN	← <i>U. austrodentatus</i> (GSSP-Huangnitang)
	LOWER	FLOIAN	← <i>B. triangularis</i> (C), (GSSP-Huanghuachang)
		TREMADOCIAN	← <i>T. approximatus</i> (GSSP-Diabasbrottet) ← <i>I. fluctivagus</i> (C) (GSSP-Green Point)

4. Organization

- a. Subcommission Executive (from August 2008)
 - Chairman, David A.T. Harper (Denmark)
 - Vice Chairman Juan Carlos Gutiérrez-Marco (Spain)
 - Secretary, Ian G. Percival (Australia)
 - 16 other Voting Members
 - Over 100 Corresponding Members

Subcommission website: www.ordovician.cn. Alternative website:
<http://seis.natsci.csulb.edu/ISOS> (remains active for facilitating discussion of GSSP proposals, if and when relevant).

The Subcommission officers and voting members have been agreed for the next term from 2008-2011. Following the Subcommission's business meeting during the Nanjing conference (2007) a postal ballot confirmed the election of the new Subcommission officers, and elected a new group of voting members. Details of the procedure and results were included in the report for 2007. 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)
J.C. Gutiérrez-Marco (Spain)
D.A.T. Harper (Denmark)
O. Hints (Estonia)
Li Jun (China)
S. Leslie (USA)
C.E. Mitchell (USA)
A.T. Nielsen (Denmark)
G. Nowlan (Canada)
A.W. Owen (UK)
I.G. Percival (Australia)
L.E. Popov (UK)
M.R. Saltzman (USA)
T. Servais (France)
T. Vandenbroucke (Belgium)
Zhang Yuandong (China).

5. Interfaces with other international projects

IGCP Project 503: Arguably the most sustained rise in marine biodiversity took place during the Ordovician, and the second largest mass extinction event took place close to the end of that Period, coincident with an episode of major climate fluctuation. The results of the very successful IGCP project n° 410 "The Great Ordovician Biodiversification Event" not only included the development of an improved globally-integrated biozonation for graptolites,

conodonts and chitinozoans, but also generated biodiversity curves that have been constructed for all Ordovician fossil groups.

Following the work of the numerous regional teams and of the clade teams, that were established for each fossil group in IGCP project n° 410, a new successor project (IGCP project n° 503) was approved in order to develop a better understanding of the environmental changes that influenced the biodiversity trends in the Ordovician and Early Silurian. In this project, the major objectives are thus to attempt to find the possible physical and/or chemical causes (e.g., related to changes in climate, sea level, volcanism, plate movements, extraterrestrial influences, etc.) for the Ordovician biodiversification, the end-Ordovician extinction, and the subsequent Silurian radiation.

6. Chief accomplishments and products in 2009 cycle

a. The next International Symposium on the Ordovician System will take place in Spain during May, 2011. The conference itself and associated business meetings and workshops will be held in the environs of Madrid with field excursions to various parts of the Iberian Peninsula including the Iberian Chains and northern Portugal. A major post-conference excursion to Morocco will also be offered.

IGCP 503 formally concluded its 5-year program with an International Congress on Palaeozoic Climates in Lille, France during August, 2008. An extension of this successful project was agreed and a further meeting on ‘Early Palaeozoic Palaeogeography’ was held in Copenhagen during late August and early September 2009.

b. The Subcommission completed its GSSP research programme in 2008 and all 7 Stage GSSPs were established and approved by the IUGS before the Ordovician Yangtze Conference (June 2007). Bergström, Chen Xu, Gutiérrez-Marco, and Dronov have compiled a new chronostratigraphic classification of the Ordovician System and its relations to the main regional series and stages. The English version has been published in *Lethaia* and the Chinese version was published in the *Journal of Stratigraphy* in China prior to the 33rd IGC in Oslo during August 2008. Discussion, however, at the business meeting in Copenhagen included the wish to routinely evaluate the efficacy of the current stages. A colour reprint of the Global Ordovician Chronostratigraphy (The Ordovician Time Table) chart is still planned dependent on funding and will be distributed to colleagues in different countries if funding permits.

c. *Ordovician News No. 26* was produced and posted on the Subcommission website and is available for download.

7. Chief problems encountered in 2009

The Subcommission is planning to publish an Ordovician ‘Time Table’ following the approval and ratification of all the GSSPs. This was discussed and agreed at the Yangtze conference during June 2007 in Nanjing. The Subcommission, however, lacks financial support to publish this table although some support has been offered from Chen Xu’s research project.

A lack of travel support limited the participation of Voting Members in the 33rd IGC in Oslo during August 2008. In fact only two members were present (Harper and Gutiérrez-Marco) at the ISOS business meeting. This problem was partly rectified during 2009, when the ISOS business meeting associated with IGCP 503 in Copenhagen was well attended by titular and corresponding members together with other interested parties.

8. Summary of expenditure for 2009

TOTAL INCOME (from ICS): DKK 10,800

Support for attendance at ‘The absolutely final meeting of IGCP 503, Copenhagen 2009: Early Palaeozoic biogeography and palaeogeography’ (<http://snm.ku.dk/english/IGCP503>). DKK 8,000
Miscellaneous expenses: DKK 2,800

TOTAL EXPENDITURE DKK 10,800

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

The new Subcommission came into force during the 33rd IGC in Oslo. Plans for the Subcommission’s future work were initially stated as follows.

- a. Will open debate on the formal definition of chronozones within the Ordovician System. This possibility arises from the time-slice concept of Webby (2004) and the finer subdivision of the system presented by Bergström et al. (2008).
- b. Will establish a forum to assess the efficacy and utility of the newly-established international stages.
- c. 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.
- d. Will open debate on the applicability of non-biologic methods of correlation of Ordovician strata.
- e. Production and internet distribution of *Ordovician News No. 26* in 2009.
- f. Management of Subcommission website will remain based in Nanjing. Following discussions with the webmaster, Fan Junxuan, the site will be remodelled following the general format of the attractive and effective main ICS site. A number of redundant features will be removed and a number of more relevant additions will appear during the next few months.

During the business meeting at the final meeting of IGCP 503 the plans were formalized with the agreement 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.
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.

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.
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.
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.
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.
7. We already have a number of robust absolute dates for parts of the system but it would be useful to develop more, not least to be able to calibrate the true rates of biological and geological process occurring during the period.
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.

10. Budget and ICS component for 2010

- a. Support for publication of Geological Society Memoir on Early Palaeozoic Biogeography and Geography, arising out of the Copenhagen Conference, edited by Harper and Servais (accepted in principle by the Geological Society). This will be a substantial volume with chapters on the main fossil groups, new interactive palaeogeographic base maps provided by Trond Torsvik (BugPlates), and introductory chapters on nomenclature and terminology. The ICS will be credited as a main sponsor. **5000 USD**
- c. Preparation of an Ordovician Time Table, carried over from last year: **1000USD**
- d. Support for attendance of ICS workshop in May 2010 in Prague: **2000USD**
- e. Support for attendance of SOS workshop in June 2010 in London as part of the IPC3: **2000 USD**
- e. Support for production of revised regional correlation charts: **2500 USD**

TOTAL 2010 BUDGET: 12,500USD

REQUESTED FROM ICS: 5000USD

Potential funding sources outside IUGS

The IGCP Project 503, “Ordovician Palaeogeography and Palaeoclimate”, co-funded four meetings (with related field trips) in 2007, including the 10th Ordovician conference China and further relevant meetings in 2008. The project has continued for a final year in 2009 but without funding. This project has in the past provided travel support to a significant number of Ordovician specialists, including voting members of the Subcommission, allowing for regular meetings at the annual workshops scheduled for the project. A new successor project is planned and if successful will continue to support Ordovician geology.

The State Key Laboratory of Stratigraphy and Palaeobiology, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, provides a server for the Subcommission website.

The Subcommission officers are also supported by their research projects for some of their activities.

11. Review chief accomplishments over last eight years (2001-2009)

- 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. 17-26 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 $\delta^{13}\text{C}$ 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.

SUBCOMMISSION ON CAMBRIAN STRATIGRAPHY

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY

International Subcommission on Cambrian 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 Cambrian stratigraphy.

Goals

The goals of the Subcommission fall into two main areas:

- (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.

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. ORGANIZATION

The Subcommission is organized by an Executive consisting of Chairman, two Vice-Chairs, and Secretary, who are all Voting Members of the Subcommission. There are currently 17 other Voting Members. The Voting Members are elected for their expertise and experience, but also represent a diversity of countries and regions.

The objectives of the Subcommission are pursued by Working Groups, both stratigraphic and thematic. Each Working Group is organized by a Chair who is a Voting or Corresponding Member.

The Subcommission sponsors an International Symposium on the Cambrian System at irregular intervals, and sponsors Field Conferences of the Cambrian Stage Subdivision Working Group generally at one-year intervals. The Chair of the Organizing Committee of each of the meetings is normally a Voting Member, Honorary Member, or Corresponding Member of the Subcommission.

The Field Conference will be held in South Kazakhstan on August 22 through September 1, 2009, organized by Voting Member Gappar Kh. Ergaliev.

Officers for 2008-20012:

Chairman:	Prof. Shanchi Peng, China
First Vice-Chair:	Prof. Małgorzata Moczydlowska-Vidal, Sweden
Second Vice-Chair:	Prof. Gerd Geyer, Germany
Secretary:	Prof. Loren E. Babcock, USA

Website: www.uni-wuerzburg.de/palaeontologie/ISCS/index.htm

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

Members of the Cambrian 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. In 2009, VMs of the Cambrian Subcommission participated in a variety of international and regional meetings.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009.

5a. 14th International Field Conference on Cambrian Stage Subdivision, South Kazakhstan, August-September 2009.

The 14th International Field Conference on Cambrian Stage Subdivision was held in August-September 2009 in Southern Kazakhstan. The meeting was organized principally by Gappar Kh. Ergaliev, with significant effort also from V. G. Zhemchuzhnikov, L. E. Popov, M. G. Bassett, O.I. Nikitina, S. V. Dubinina, F. G. Ergaliev, and E. M. Fazylov. A field guide and an abstract volume were published in association with the meeting.

5b. Progress with selection of GSSPs for Cambrian Stages.

Proposals for a GSSP of provisional Cambrian Stage 9 were submitted to Duck K. Choi, Chair of the Working Group on the *Agnostotes orientalis* level, and the Working Group has provided opinions on them. A vote on a GSSP by the Cambrian Subcommission is expected before the end of 2009.

Proposals for a GSSP of provisional Cambrian Stage 5 (and Series 3) are being prepared and are expected to be submitted to Linda McCollum, Chair of the Working Group on the base of Stage 5 (and Series 3) by the end of 2009. A discussion on the key levels defining the base of the stage has been organized in early 2009 by Fred Sundberg who made a trip to E. Guizhou in June, 2009 to examine the Wuliu-Zhenjiayan section in Jianhe. After sufficient proposals have been

received, and after review of all the proposals by Working Group members, the best options will be put forward to the VMs of the Cambrian Subcommission for a vote.

The Subcommission is working toward establishing GSSPs of the remaining undefined series and stages. Discussion on further work on the Siberian sections of lower half of Cambrian has been outlined during the Kazakhstan meeting. Significant progress is being made towards the definition of Stage 10, as well as divisions in the lower half of the system.

5c. New Working Groups established.

At the 14th International Field Conference on Cambrian Stage Subdivision in Kazakhstan, three new Working Groups were formed to investigate potential GSSP horizons for stages 2, 3, and 4. These Working Groups replace the Working Group on the Lower Part of the Cambrian, which was successful in determining the best choices of horizons for intercontinental correlation within the first two series of the Cambrian.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

The principal difficulties encountered in 2009 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.

7. SUMMARY OF EXPENDITURES IN 2009:

INCOME

Carried forward from 2008	\$ 553.12
ICS Allocation	\$ 3000.00
SUBTOTAL 2009 income	\$ 3553.12

EXPENDITURE FROM 2009 BUDGET

Contribution to officer's travel expenses	\$ 3500.00
SUBTOTAL 2009 expenditures	\$ 3500.00

To be carried forward to 2010	\$ 53.12
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8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR

8a. GSSP proposals and names for lowermost series and stage.

Planning is underway for meetings of the Cambrian Stage Subdivision Working Group in 2010.

In 2010, the Subcommission expects to vote on at least one proposal for a stage-level GSSP (Stage 5).

8b. Newsletter

An annual newsletter, highlighting activities of the Subcommission, is expected to be issued by email in 2010.

9. BUDGET AND ICS COMPONENT FOR 2010.

In order to accelerate the pace of work in establishing GSSPs within the Cambrian, we request a modest increase in funds as compared to previous years. The proposed increased funding is targeted at field research on key sections by Working Group members and travel by Voting Members to international meetings where much of the decision-making takes place.

INCOME

Carry-over from 2008	\$ 53.12
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PLANNED EXPENDITURES FOR 2010

Preparation for the XV Cambrian Stage Subdivision	\$ 2000.00
Working Group Conference	
Executive and VMs travel costs, Cambrian	
Subcommission meeting	\$ 3000.00
Executive and VMs travel costs, ICS meeting,	
Prague	\$ 4000.00
General office expenses	\$ 100.00
TOTAL 2010 PLANNED EXPENSES	\$ 9100.00

ICS 2009 BUDGET REQUEST

Total ICS 2009 budget request	\$ 9100.00
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10. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2005-2009)

In 1998, the Cambrian Subcommission began work to define chronostratigraphic subdivisions (stages and series) within the system. Previously, the base and top of the Cambrian were defined by Working Groups on the Precambrian-Cambrian boundary (voted on and ratified in 1992) and Cambrian-Ordovician boundary (voted on in 1999 and ratified in 2000). Most of the Subcommission members share the opinion that the process of defining and ratifying globally appropriate divisions must begin with an evaluation of potential correlation horizons. Following this work, evaluation of candidate sections can begin. The Cambrian Stage Subdivision Working Group has made reconnaissance visits to sections in association with international field conferences. Areas visited include Morocco (1995), Spain (1996), eastern Canada (1997), Sweden (1998), the Great Basin, USA (1999), Argentina (2000), South China (2001), France (2002), South Korea (2004), North and South China (2005), South Australia (2006), East Laurentia (2007), Siberia (2008), and Kazakhstan (2009).

In a seminal paper, John Shergold and Gerd Geyer (Episodes, 2000) reviewed widely recognizable biohorizons having intercontinental correlation value (ones that could potentially serve as stage-level or series-level boundaries for chronostratigraphic units). This work led to a focusing of subsequent effort on the issue of better characterizing potential chronostratigraphic boundary horizons using available stratigraphic tools. A protocol for identifying GSSPs within the Cambrian has been established: 1, selection of a horizon suitable for intercontinental correlation (followed by balloting by the Voting Members); then 2, search for the best sections from which to select a GSSP (followed by balloting by the Voting Members).

A plan has been devised for subdivision of the Cambrian System into four series, each representing roughly equal time intervals. The lowermost two series, which approximately

correspond to the traditional lower Cambrian, are each expected to be divided into two nearly equal stages. The uppermost two stages are each expected to be divided into three nearly equal stages. The plan received overwhelming support from ISCS Voting Members.

With the objectives now better focused, and a procedure in place for selecting the best horizons and locations for GSSPs, work has proceeded toward the establishment of stage-level or series-level GSSPs. Successful GSSP proposals arising from the Cambrian Subcommission were for the bases of the Paibian Stage and Furongian Series (2004), the Drumian Stage (2006), and the Guzhangian Stage (2007). Proposals for Stage 9 were voted within the Working Group of the stage with a single candidate section been selected. A decision on a GSSP for the base of the stage is expected near the end of this year. In addition, names have been ratified for the Terreneuvian Series (2007) and Fortunian Stage (2007).

11. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2010-2014)

The primary objective for the immediate future for the Cambrian Subcommission remains the completion of definition of the stages by GSSPs. It is hoped that all stages of the upper half of the Cambrian will be defined by GSSPs by 2012. Stages of the lower half of the Cambrian are expected to be defined by GSSPs by around 2014.

APPENDIX [Names and Addresses of Current Officers and Voting Members, 2008-2012] INTERNATIONAL SUBCOMMISSION ON CAMBRIAN STRATIGRAPHY

Subcommission officers

Chairman: Shanchi Peng, Nanjing Institute of Geology and Palaeontology, The Chinese Academy of Sciences, 39 East Beijing Street, Nanjing 210008, China, Email: scpeng@nigpas.ac.cn

First Vice Chair: Małgorzata Moczydlowska-Vidal, Department of Earth Sciences, Palaeobiology, Uppsala University, Norbyvägen 22, Box 558, 752 36 Uppsala, Sweden, Email: malgo.vidal@pal.uu.se

Second Vice-Chair: Gerd Geyer, Institut für Paläontologie, Universität Würzburg, Pleicherwall 1, 97070, Würzburg, Germany, Email: gerd.geyer@mail.uni-wuerzburg.de.

Secretary: Loren E. Babcock, School of Earth Sciences, 125 South Oval Mall, The Ohio State University, Columbus, OH 43210, USA, babcock.5@osu.edu

List of Working (Task) Groups and their officers

Stage 2: Michael Steiner Michael.Steiner@FU-Berlin.de

Stage 3: Xingliang Zhang xizhang69@126.com

Stage 4: James B. Jago jim.jago@unisa.edu.au

Stage 5: Linda McCollum lmccollum@ewu.edu

Series 9: Duck K. Choi dkchoi@snu.ac.kr

Stage 10: Shanchi Peng scpeng@nigpas.ac.cn

Geochemistry: Matt Saltzman saltzman.11@osu.edu

List of Voting Members (other than officer) for 2009-2012

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Total number of Voting Members for term 2008-2012: 21.

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Date: November 1, 2009

SUBCOMMISSION ON NEOPROTEROZOIC (EDIACARAN AND CRYOGENIAN) STRATIGRAPHY

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY

Subcommission on Neoproterozoic (Ediacaran and 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 Neoproterozoic 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 and more generally during the late Neoproterozoic (circa 800 – 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

These fall into three main areas:

- (a) The definition of basal boundary stratotypes (GSSPs) and the refinement of standard chronostratigraphic scales, through the establishment of multidisciplinary Working Groups;
- (b) International coordination of and collaboration in research on late Neoproterozoic environments, through the establishment of thematic Working Groups, for example on Neoproterozoic glaciations.
- (c) International coordination of efforts to establish consensus global stratigraphic calibration schemes for the late Neoproterozoic using alternative methods of stratigraphy, such as chemostratigraphy.

In addition, the Subcommission exists to further communication with a wider public through grassroots initiatives to conserve important Ediacaran geological sites, to support International Geoscience Programme (IGCP) projects, and to encourage the wider dissemination of research findings on the World Wide Web 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) Proceed with a program of workshops and symposia to select criteria, boundary stratotype section, and GSSP for a “Cryogenian” period and system, immediately below the Ediacaran;
- (3) 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)** to subdivide the late Precambrian. The Neoproterozoic (Ediacaran and Cryogenian) Subcommission will concentrate on the Neoproterozoic, while the Precambrian Subcommission will work on Archean and older eras of the Proterozoic. Both subcommissions seek to establish “natural” or rock-based boundaries that will enable global correlation.
- (4) Working towards an international policy concerning conservation of geologically and paleontologically important sites such as GSSPs. This relates to, *inter alia*, the IUGS Geosites Programme.

3. ORGANIZATION

Officers for 2004-2012:

Chair:	Dr. James Gehling, Australia
Vice-Chair:	Dr. Shuhai Xiao, USA
Secretary:	Dr. Graham Shields, UK

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 and elected by voting members of the now terminated Terminal Proterozoic Subcommission during late 2003. There are currently 33 other Voting Members, making a total of 36 voting members (see appendix), of whom only 32 responded to emails during 2009. There are currently over 30 additional corresponding members, about half of whom participate actively in online discussions. 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. Four voting members are required to be officers of the Cambrian and Precambrian Subcommissions.

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

Members of the Neoproterozoic (Ediacaran and Cryogenian) Subcommission are lead investigators and officers in a number of related international projects:

IGCP 478 (*Neoproterozoic-early Paleozoic events in SW Gondwana*) led by voting members **Claudio Gaucher, Hartwig Frimmel and Paulo Boggiani**; IGCP 493 (*The Rise and Fall of the Vendian biota*) led by **Mikhail Fedonkin** (Paleontological Institute, Moscow), Patricia Vickers-Rich (Monash Uni.) and **James Gehling**; IGCP 497 (*The Rheic Ocean: its origin, evolution and correlatives*) led by **Ulf Linnemann**; IGCP 512 (*Neoproterozoic Ice ages*) led by **Graham Shields** and Emmanuelle Arnaud.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009

- Decision on criteria to define the base of the Cryogenian Period (17.08.2009): "*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" (see Appendix 2).

5. Discussions were ongoing throughout 2009 with regard to the possible subdivision of the Ediacaran Period (see Appendix 3). On the basis of answers to questionnaires, it will be possible to vote at the end of 2009 on criteria to subdivide the Ediacaran Period.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

- Continuing inadequacy of geochronological control in key sections. This is being addressed continually using new U-Pb and Lu-Hf ages and chemostratigraphy.
- Continuing difficulties communicating with Russian voting members. Three Russian members did not respond to emailed requests during 2009, while the email accounts of some Russian members regularly bounce emails back to sender. It is hoped that the planned conference and workshops in Novosibirsk 2010 will help to improve communication.
- Inconsistent correlation of the 'Wonoka/Shuram' negative isotope excursion(s), 'Gaskiers' glaciation and microfossil events for the Ediacaran Period. This is being addressed by the Chinese national group which is extremely active (Appendix 5).
- After difficulties in organizing field excursions to key localities in northern India in 2009, a workshop, symposium and field trip has been organized for February 2-10, 2010.
- While there are various groups currently working on Neoproterozoic chemostratigraphy, sedimentology and palaeontology, there is a conspicuous lack of Australian-based research funding on the Cryogenian and Ediacaran of Australia, which hosts not only the basal Ediacaran GSSP but also potential contenders for the basal Cryogenian GSSP.
- Due to the limited number of Australia-funded research projects, there is still difficulty in finding excursion leaders to prepare for a subcommission visit to Australia.

7. SUMMARY OF EXPENDITURES IN 2009:

INCOME

To be carried forward to 2009	US\$ 500
ICS	US\$ 3500
TOTAL	US\$ 4000

EXPENDITURE FROM 2009 BUDGET

IGC Travel expenses SX	US\$ 1000
TOTAL	US\$ 1000

To be carried forward to 2009 US\$ 3000

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2010):

(a) Newsletter:

An end-of-year circular is to be distributed during November 2009 to remind all corresponding members of the results of questionnaires distributed during 2009 as well as to solicit interest in 2010 field workshops in India and Russia.

(b) Preparation of GSSP proposals:

The consensus criteria for defining the base of the Cryogenian GSSP allow the first call to be made for submission of informal and then full proposals for a Cryogenian Period basal GSSP.

(c) Subcommission workshops in India 2009:

The subcommission is sponsoring a biostratigraphy laboratory and field workshop and conference in Lucknow, India from Feb 2-9, which follows on from a 12-day field workshop through Proterozoic successions of the Vindhyan succession (see Appendix 4). This is the second of a series of workshops set up to achieve a global acritarch framework for Ediacaran successions. A third acritarch meeting is being organized for Novosibirsk later in 2010 (see d).

(d) International Conference “Neoproterozoic sedimentary basins: stratigraphy, geodynamics and petroleum potential”, Russian Workshop on Ediacaran Acritarch Taxonomy, and IGCP 512 Field Trip to the East Sayan Mountain Ranges will be held in Novosibirsk in August 2-20, 2010. It aims to foster international exchange of ideas in the fields of Neoproterozoic stratigraphy, sedimentology and sedimentary basins to facilitate progress in establishing intercontinental correlation of Neoproterozoic strata. Discussions will include problems in biostratigraphic definition and subdivision of Cryogenian and Ediacaran. They will primarily focus on Neoproterozoic sedimentary basins of Siberian Platform in relation of subsidence regime, climate glacial depositional systems, timing of magmatism and tectonic deformations.

(e) Subcommission workshop in Svalbard 2011:

A meeting in Svalbard to discuss the base of the Cryogenian GSSP is being organized for 2011 with an exploratory field excursion planned for Summer 2010 (chief organizer: Ian Fairchild).

(f) Geological Time Scale book 2010

The new Geological Time Scale book which is due out in 2010 will be the first to contain full chapters on the Ediacaran and Cryogenian periods. IGCP 512 will publish its compendium of Neoproterozoic regional geology during the course of 2010.

(g) Voting:

- Request for informal proposals for Cryogenian basal GSSP (end 2009).
- Voting on criteria for the subdivision of Ediacaran Period (from end 2009).
- Request for informal proposals for Ediacaran Period subdivision (late 2009).

10. BUDGET AND ICS COMPONENT FOR 2010

We anticipate that more than US \$5,000 will be required during 2010 to ensure maximum participation at the India workshop/excursion, especially considering that several members of the subcommission are from developing countries.

Projected Budget for 2010 (details are pending – Nov. 26, 2009):

Carried over from 2009	US \$3000
General office expenses	US \$250
Preparation and production of Newsletter/web support	US \$250
Advance to India workshop JG SX GS	US\$ 3000
Advance to Novosibirsk workshop JG SX GS, etc.	US\$ 4000
 TOTAL BUDGET PROJECTED	 US \$4500

Potential funding sources outside IUGS

National IGCP committees and project groups for IGCP projects 478, 493 and 512.

The Neoproterozoic (Ediacaran and Cryogenian) Subcommission does not receive financial support from outside IUGS-ICS, except for office support (computer, access to internet services, telephone, etc.) from the host institutions of the Executive. Most members are supported by national research grants, normally won competitively. Specific activities, such as meetings and some Working Groups, sometimes receive small grants to Conveners and Organizers from various sources, such as host institutions and national and regional authorities of the country where the meeting is being held.

Additional financial support will be sought from petroleum companies and consortia which are currently turning their attention to successively older successions in their global search for hydrocarbons.

11. REVIEW CHIEF ACCOMPLISHMENTS OF PAST FOUR YEARS (2004-2008)

2004: On February 16th, 2004, the ICS voted 14:1 in favor (with one abstention) on the GSSP and name for the “Ediacaran System”. The results were submitted to IUGS, which ratified the

GSSP and name for the Ediacaran System and Period on March 19th (IUGS E-Bulletin, March 2004).

2005: Interpretive signs and a marker or “golden spike” were dedicated by the South Australian Premier at the Ediacaran GSSP on April 16 at the Ediacaran GSSP site in the Flinders ranges National Park.

Ediacaran paleobiology: paleontological, molecular, embryological, and ecological constraints) NAPC meeting in Halifax Nova Scotia (June 19-26, 2005) and a 5-day pre-conference excursion to the Ediacaran succession of SE Newfoundland.

2006: 2nd International Palaeontological Congress held in China from June 17-24, 2006, Chinese voting members Zhu Maoyan, Yin Chongyu and Shuhai Xiao and a team of colleagues and their students organized a *Neoproterozoic field workshop* from June 6-16, to study the Cryogenian and Ediacaran successions of South China of the Neoproterozoic Subcommission. At the 2nd International Palaeontological Congress held on the Beijing University campus, (June 17-21), the Neoproterozoic Subcommission organized a very-well attended symposium and poster session on *Neoproterozoic Palaeontology and Geobiology*, that extended over two days. “*Snowball Earth 2006 appraisal conference*” was held at the Centro Stefano Franscini, Ascona, Switzerland, July 16-21, 2006. The conference brought together many of the world’s experts in Neoproterozoic Earth System Science.

2007: Kimberley field meeting (Neoproterozoic glaciogenic successions of NW Australia) organised by Maree Corkeron (Australia) attended by 14 participants from 7 countries (Canada, USA, China, Brazil, Germany, Spain and Australia). At this meeting, evidence for post-Elatina glaciation in Australia was presented, indicating that the c. 582 Ma ‘Gaskiers’ glaciation may be of widespread significance.

Two discussion documents on acritarch biostratigraphy of the Ediacaran and Cryogenian Periods, respectively, were compiled by Kath Grey (Australia), circulated widely and discussed using the IGCP 512 discussion forum. This led to informal workshops in Perth, Australia (Aug. 1 and 14, 2007) and calls to hold a meeting in 2008 to discuss global taxonomic standards (Uppsala, Sweden, Aug. 18-21, 2008).

Six special volumes and books on Neoproterozoic stratigraphy and earth system evolution were published during 2007.

2008: IGCP 512-sponsored field meeting: Neoproterozoic glacial and associated facies in the Varanger (ex-type) area Excursion 42 at IGC 2008 (July 29 – Aug. 5, 2008).

Subcommission business meeting at IGC 2008, Oslo, Norway following the IGCP 512-sponsored symposium Stratigraphic correlation of Neoproterozoic strata and IGCP493 sponsored symposium Rise and fall of the Ediacaran (Vendian) biota (Aug. 6-14, 2008). Approximately two thirds of the voting membership attended the IGC.

Swedish Workshop for Ediacaran Acritarch Taxonomy (SWEATshop), Uppsala, Sweden (Aug. 18-21, 2008) attended by 12 scientists from six countries represented the first of a series of attempts to unravel taphonomic hindrances to biostratigraphic subdivision of the Ediacaran period (see App. 2).

12. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2009-2012)

The Neoproterozoic (Ediacaran and Cryogenian) Subcommission aims to encourage research that will facilitate a consensus subdivision of the late Neoproterozoic (circa 800 – 542 Ma) by end-2012.

End-2009

- Voting on consensus criteria for the subdivision of the Ediacaran Period.

2010

- Lucknow, India February 2010; Field and lab workshops, conference and atlas of Neoproterozoic acritarch biostratigraphy.
- Submission of informal proposals for Cryogenian Period basal GSSP.
- Novosibirsk, Russia, August 2010; Field and acritarch workshops and conference.
- Submission of informal proposals for subdivision of the Ediacaran Period.

2011

- Field excursions to key GSSP candidates in 2011.
- Submission of full GSSP proposals.

2012

- Voting and ratification of subcommission decisions on base of Cryogenian Period and on Ediacaran Period subdivision.

**APPENDIX 1: NEOPROTEROZOIC (EDIACARAN AND CRYOGENIAN)
SUBCOMMISSION
Voting Members 2008-2010**

Subcommission officers

- Chairman:** **James Gehling**, South Australian Museum, North Terrace, Adelaide, 5000 Australia; Tel. +61-8-8207-7441, email: jgehling@ozemail.com
- Vice-Chairman:** **Shuhai Xiao**, Department of Geological Sciences, Virginia Polytechnical Institute and University, 4044 Derring Hall, Blacksburg, VA 24061-0420, USA; Tel. +1-540-231-1336, email: xiao@vt.edu
- Secretary:** **Graham A. Shields**, [Department](#) of Earth Sciences, University College London, Gower Street, WC1E 6BT, London, UK; Tel. +44 207-679 7821; email: g.shields@ucl.ac.uk

Voting Members (currently unresponsive members in italics)

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APPENDIX 2

Cryogenian Period Questionnaire

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. After voting, Dr Gerard Germs asked to step down as a voting member of the subcommission.

Six members offered criticisms or suggestions for changes to the proposed definition (see appended results). The officers have considered these suggestions at length and have decided upon some minor changes to the definition as a result. We hope these changes have clarified the job at hand and will not prove controversial. I have included the original definition below for comparison. In making the slight amendments we considered that:

1. The word “acritarch” could be replaced by “microfossil” in response to Andrew Knoll’s suggestion.
2. The word “preferably” could be removed to avoid ambiguity (Weiguo Sun, Nick Christie Blick, Nikolay Cumakov). However, we have kept this word in the definition to avoid the need for another vote in the understanding that the demonstrated potential for microfossil biostratigraphy, direct dating and any additional methods of global correlation will strengthen the case for a GSSP to be placed in any given section.
3. “Truly widespread” caused a problem for FOUR members (Weiguo Sun, Nick Christie Blick, Nikolay Cumakov, Hans Hofmann), which led to a simplification of the first sentence.
4. Magnetostratigraphy has now been given a lower priority in the definition in order to reflect earlier questionnaire results and two new comments (Weiguo Sun, Nick Christie Blick).

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".

Graham Shields (17.08.2009)

Update (24.11.2009): No negative feedback received

APPENDIX 3

Results of Ediacaran Period Questionnaire:

1. We received 31 responses from 36 voting members.
2. 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.
3. Consistent with results #1, most people believe that we should focus on successions with mixed lithologies, geochronological constraints, and chemostratigraphic and biostratigraphic potential.
4. We should proceed from Series to Stages, rather than from Stages to Series (as practiced in Phanerozoic stratigraphy). The Ediacaran System can be divided into two or more Series.
5. 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).
6. 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).

Shuhai Xiao (06.04.2009)

APPENDIX 4

International Conference, Biostratigraphy Workshop & Field Meeting on “PRECAMBRIAN LIFE, TIME AND ENVIRONMENT : EVOLVING CONCEPTS AND MODERN ANALOGUES”

The conference and workshop will be followed by a 5 day Field Work in the Lesser Himalayan Krol Belt in which Cryogenian sections of Pre-Blaini to Tal formations as a post-Conference event. Since a number of International experts are keen to visit India to look at these exceptionally well developed sections, the event would provide an opportunity to the participants to evaluate these crucial sections of the Indian sub-continents for global correlation of successions.

Schedule

(February 2 - 9, 2010)

The entire schedule has been drawn considering the interest of different groups of participants who want to visit Lesser Himalayan Neoproterozoic successions.

The participants would be assembling at **Lucknow**, the capital of Uttar Pradesh, a city well connected by Air and Train from **Delhi**. The first part of the event incorporates the International Conference & Symposium cum Workshop on Acritarchs between February 2nd to February 4th, 2010. The Field Meeting in Lesser Himalaya begins on February 5th at Dehradun and ends on February 9th at **Chandigarh** from where participants can fly or travel by train to **Delhi, Kolkata, Agra** etc. and return back to their respective places. Due to logistic requirement, a maximum number of 25 participants can be accommodated in the Field excursion.

(Costs: US \$ 900 per person for both the Conference + Himalayan Excursion, that includes the Registration Fee for conference of US \$ 100); The costs include expenses related to lodging, boarding at **Lucknow/ Dehradun** and **Chandigarh** besides train/bus/taxi travel between **Lucknow** to **Chandigarh**. Conference Fee - US \$ 400 (Includes Registration, lodging/ boarding at **Lucknow**), Field-Work Fee – US\$ 500 (Includes Lodging/boarding & Travel).

- | | |
|----------|--|
| Feb. 2nd | International Conference begins at Lucknow . Inauguration and Technical |
| Feb. 3rd | Technical Sessions of the Conference |
| Feb. 4th | Workshop on Acritarchs + Valedictory Function
<i>(overnight travel by train from Lucknow to Dehradun)</i> |
| Feb. 5th | Arrival at Dehradun and Fieldwork around Phosphorite Mines |
| Feb. 6th | Dehradun to Kauriyala and back – Evaluation of Varanger to Toyonian Succession (Blaini to Tal Formation) |
| Feb. 7th | Dehradun to Mussoorie and Dhanaulti and back - Complete succession of Ediacaran age (Krol and Tal Formations) |
| Feb. 8th | Dehradun to Solan (Himachal Pradesh)– On the way, exposures of Varanger and Ediacaran successions would be evaluated. Stay in Solan . |
| Feb. 9th | Solan to Simla – Evaluation of different levels of Varanger glacials, type area of Blaini Formation and older Cryogenian deposits, Return to Chandigarh . |

Organiser: Dr. Vibhuti Rai (Emails: vibhutirai@gmail.com; vibhutirai@rediffmail.com)

APPENDIX 5

Country and group reports from 2009

5a. (1) The Geological and Paleontological Institutes of RAS organized field investigations of key sections of the Vendian in the North Part of Patom Highland, Siberia. Fossils of *Beltanelloides sorichevae* were found closely overlying the glacial Bolshoy Patom Formation and below the Shuram-Zhuya negative $\delta^{13}\text{C}$ anomaly. Numerous samples were collected for the study of acritarch and other microfossils, ages of detrital zircons and structures of cap-dolomite
(2) M.A. Fedonkin gave a lecture and there was related discussion in Geological Institute of RAS on Vendian and Proterozoic biotas. (3) N.M. Chumakov gave a lecture on "Problem of Total glaciation of the Earth in Late Precambrian" and there was related discussion in Geological Institute of RAS

submitted by N. M. Chumakov (23.10.2009)

5c. On April 2, 2009 a workshop on Neoproterozoic stratigraphy was organized by the NSFC in Beijing. Participants were active colleagues from four institutes who are working on the Neoproterozoic in China, including voting members, Dr. Yin Chongyu, Dr. Sun Weiguo, Dr. Peng Shanchi, and Dr. Zhu Maoyan. During the workshop, the following issues have been discussed: 1. current definition for defining the base of Cryogenian, possible definitions for series and stages of Ediacaran. 2. Whether is it possible to look for a section in Guizhou and Guangxi provinces which can be a potential candidate for GSSP of the base of the Cryogenian 3. An integrated working team should be organized to work on the Ediacaran sections in the Yangtze Gorges, particularly focusing on the middle and upper Doushantuo Formation, key question including the LAD of large acanthomorphs and its stratigraphic relation with the DOUNCE (equivalent to the Shuram or Wonoka excursion).

During the workshop, a Chinese working group on the Neoproterozoic stratigraphy was set up. The working group, led by Dr. Zhu Maoyan and Dr. Yin Chongyu, aims to coordinate works of all Chinese colleagues in the field and communicate with subcommission.

During April 19-21, 2009 the working group investigated a Cryogenian section in Guizhou (see attached photo). A transitional interval from non-glacial to glacial deposition is well exposed in the section. Further detailed investigation is planned for 2009-2010.

submitted by Maoyan Zhu (23.10.2009)

5c. Other reports are given in Nov. 2009 newsletter



APPENDIX 6

International Conference “**Neoproterozoic sedimentary basins: stratigraphy, geodynamics and petroleum potential**” combined with the Russian Workshop on Ediacaran Acritarch Taxonomy and IGCP 512 Field Trip to the East Sayan Mountain Ranges will be held in Novosibirsk in August 2010. It aims to foster international exchange of ideas in the fields of Neoproterozoic stratigraphy, sedimentology and sedimentary basins to facilitate progress in establishing intercontinental correlation of Neoproterozoic strata. Discussions will include problems in biostratigraphic definition and subdivision of Cryogenian and Ediacaran. They will primarily focus on Neoproterozoic sedimentary basins of Siberian Platform in relation of subsidence regime, climate glacial depositional systems, timing of magmatism and tectonic deformations.

Invitation

Dear colleagues:

The Trofimuk Institute of Petroleum Geology and Geophysics of Siberian Branch of Russian Academy of Sciences in collaboration with the Subcommission on Neoproterozoic Stratigraphy cordially invite you to participate in the International Conference “**Neoproterozoic sedimentary basins: stratigraphy, geodynamics and petroleum potential**” to be held in August 2010 in Novosibirsk, Russia. The conference offers a unique opportunity for discussions and exchange of ideas between geologists and paleontologists on a wide range of topics related to paleoclimatic, geochemical, tectonic and sedimentological aspects of correlation of Neoproterozoic depositional systems with special emphasis on Russia. We look forward to seeing you in Novosibirsk next August!

Sincerely,
Organizing Committee (November, 2009)

Sponsors: Presidium of the Siberian Branch Russian Academy of Sciences; Russian Foundation for Basic Researches; Trofimuk Institute of Petroleum Geology and Geophysics of Siberian Branch, Russian Academy of Sciences; Subcommission on Neoproterozoic Stratigraphy; International Geoscience Programme (IGCP 512)

Academic and Organizing Committee:

Chairman Academician Aleksey E. Kontorovich

Co-Chairman Academician Mikhail A. Fedonkin

Honorary Chairman Academician Boris S. Sokolov

Honorary Chairman Prof Vsevolod V. Khomentovsky

Vice-Chairman Corresponding Member of the RAS Vladimir A. Kashirtsev

Vice-Chairman Corresponding Member of the RAS Valeriy A. Vernikovsky

Vice-Chairman Prof Nikolay V. Sennikov

Members Corresponding Member of the RAS Aleksandr V. Kanygin; Corresponding Member of the RAS Andrey V. Maslov; Prof Vladimir N. Sergeev; Prof Nikolay M. Chumakov; Dr Anatoliy Postnikov; Dr Evgeniy M. Khabarov

Secretaries Dr Julius K. Sovetov; Dr Dmitriy V. Grazhdankin; Dr Larisa N. Konstantinova

Preliminary Program:

August 2 Registration

August 3 Russian Workshop on Ediacaran Acritarch Taxonomy
August 4–6 International Conference on “Neoproterozoic sedimentary basins: stratigraphy, geodynamics and petroleum potential” August 7–20 IGCP 512 Working Group Field Trip to the East Sayan Ranges

Agenda Items for the Conference (preliminary):

- 1. Paleontological, sedimentological and chemostratigraphic criteria for definition and subdivision of Neoproterozoic Systems and Series.**
- 2. Neoproterozoic stratigraphy and sedimentary basins in the Siberian Platform and surrounding folded belts.**
- 3. Reconstruction of Neoproterozoic paleogeography and paleogeodynamics based on sedimentological, geochronological and paleomagnetic data.**
- 4. Petroleum potential of Neoproterozoic basins.**

IGCP 512 Working Group Field Trip to Nizhneudinsk area (Irkutsk region) in the foothills of the East Sayan Ranges will take place on August 7–20, 2010. The number of participants is restricted to 15–17 persons. The logistics includes transportation by train from Novosibirsk to Nizhneudinsk and then by other vehicles from Nizhneudinsk to field area. During the field trip the participants will examine Neoproterozoic Karagassy and Oselok Groups that unconformably overlie the basement of the Siberian Platform (ca. 1.8 Gy old). Dolerite dykes and sills intruding the non-marine and marine strata of the Karagassy Group yielded a Cryogenian age. Among the excursion highlights are the shoreface and shelf deposits from the middle and upper parts of Karagassy Group, glaciogenic facies in Marnya Formation and a succession of marine and continental deposits in Marnya, Uda and Aisa formations as well as contacts between (1) Ulyakha

tillite and the tidal flat deposits of Tagul Fm, (2) between the Plity tillite and the shelf deposits of Ipsit Fm., (3) between the Ozerki cap dolomite and the Ulyakha tillites; and (4) between the Upper Ediacaran continental molasse deposit of the Aisa Fm and the overlying Lower Cambrian Ust'-4 Tagul Fm; as well the lower boundary of the Ipsit Formation of the Karagassy Group representing lowstand marine deposits. Estimated cost of the field trip is 32,300 Russian rubles (equivalent to 1,120 USD) per person and includes travel expenses, accommodation costs and meals, transportsations, and printed guidebook. More information on geology will be provided in the guidebook. You'll find more details and recommendations for participation in the field excursion in the Second Circular. The field trip fees are expected to be paid in Novosibirsk, on August 2, 2010. The Second circular will be provided in April, 2010 for those who will respond to the First circular.

SUBCOMMISSION ON PRECAMBRIAN STRATIGRAPHY

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY

Subcommission on Precambrian Stratigraphy

Submitted by:

Martin Van Kranendonk, *Chair*

Geological Survey of Western Australia, Mineral House, 100 Plain Street, East Perth, Western Australia 6004, Australia, e-mail: martin.vankranendonk@dmp.wa.gov.au

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).

3. ORGANIZATION

Officers for 2004-2008:

Chair: Dr. Martin Van Kranendonk, Geological Survey of Western Australia

Vice-Chair: Dr. Wouter Bleeker, Geological Survey of Canada

Secretary: Dr. Robert Rainbird, Geological Survey of Canada

Website: www.stratigraphy.org/precambrian -- lists all relevant information, including downloadable pdf files of key papers and reports. The page was constructed by Wouter Bleeker and Martin Van Kranendonk and is maintained and Dr. Sorin Filipescu (Dept. of Geology, Babes-Bolyai University, in Cluj-Napoca, Romania), the ICS webmaster.

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

Work of the Precambrian Subcommission interfaces closely with:

- The subcommission on the Neoproterozoic, currently chaired by Dr. Jim Gehling.
- The main body of ICS (International Commission on Stratigraphy)
- IGCP Project 509, led by Drs. Steven Reddy (Curtin University, Western Australia), David Evans (Yale University, USA), and R. Mazumder (India): Paleoproterozoic Supercontinents and Global Evolution.
- IGCP Project 512, led by Dr. Graham Shields and Emmanuelle Arnaud: Neoproterozoic Ice Ages.
- FARDEEP drilling project, through Victor Melezhik and Aivo Lepland

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2009

- Analysis of samples collected last year from the Australian Archean-Proterozoic transition section was undertaken. Results have been obtained for S isotopes of pyrite from shales, C and O isotopes of carbonates, O isotopes of chert, Pb-Pb dating of carbonate, and Re-Os dating of pyrite. Results will be written up for publication in 2010.
- A fieldtrip was made by Van Kranendonk, together with Prof. W. Altermann, to South Africa, to investigate the contact relationships between Neorchean-Paleoproterozoic banded iron-formation and Paleoproterozoic glacial diamictites near the town of Prieska. Samples were collected for O and C isotope studies and one sample of quartz sandstone was collected for U-Pb SHRIMP detrital zircon geochronology at Geoscience Australia.
- A second fieldtrip was made by Van Kranendonk, Prof. P. Philippot and Dr. A. Lepland (FARDEEP) in July to the contact between the top of thick banded iron-formations of the 2.63-2.45 Ga Hamersley Group and the basal glacial diamictites of the Turee Creek Group (c. 2.4-2.2 Ga), Western Australia, in order to undertake further measurements and sampling as to its suitability as a potential GSSP site for the Archean-Proterozoic boundary. A suite of samples was collected for geochemistry and analysis of Mo isotopes. An additional sample was collected of the glacial diamictite for U-Pb SHRIMP zircon geochronology at Geoscience Australia. These studies are underway, with some results already obtained.
- Together with several co-authors, writing of the new chapter on the Precambrian time scale for the new time scale book “GTS2010” has continued, with significant progress. This is a large review of the whole of the geotectonic and geobiological evolution of the whole of the Precambrian, which will act as the basis for future timescale revisions.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009

The busy regular job of Chair, Martin Van Kranendonk, has meant that the establishment of working groups for the Hadean and Archean-Proterozoic boundary, as well as writing of the book chapter for GTS 2010 has been delayed.

7. SUMMARY OF EXPENDITURES IN 2009:

\$2000 was granted to Van Kranendonk to help him to travel to South Africa in 2009 and \$1000 was granted to support other work in relation to the Precambrian timescale.

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2010):

- Completion of the chapter on the Precambrian time scale for the new time scale book “GTS2010”
- Establishment of a working group to formalize the Hadean Eon and write a formal proposal for voting by the Precambrian Subcommission and whole of the ICS.

- Continued research into the potential GSSP site for the Archean-Proterozoic boundary in Western Australia, and commencement of writing a paper on the results for publication in an international research journal.
- Host a workshop at the 5th International Archean Symposium (5IAS: Perth, Australia) on the Precambrian timescale, including a possible vote for the Hadean Eon and establishment of a working group for the Archean-Proterozoic boundary
- Lead a fieldtrip to visit the potential GSSP site for the Archean-Proterozoic boundary in Western Australia, as part of the 5IAS.

9. BUDGET AND ICS COMPONENT FOR 2010

- Support is requested for the proposed workshop of the 5IAS: \$500 (US\$), to cover venue hire, lunch for participants and printing costs of flyers.
- Support is requested for Van Kranendonk to attend the Prague 2010 ICS workshop in the Czech Republic; \$3000, to cover flights and accommodation

10. REVIEW CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2004-2010)

- The new Subcommission on Precambrian Stratigraphy is now fully activated.
- Chapters contributed to GTS2004, the highly successful new comprehensive book on the time scale, edited by Gradstein et al.
- Proposal for new approach published in Lethaia.
- New website up and running (<http://stratigraphy.org/precambrian/>).
- Operational links with allied subcommissions (e.g., on the Ediacaran Period) firmly established.
- First ‘concept’ workshop held in Perth, Australia, in 2005.
- Follow-up workshop held in conjunction with IGCP 509, in 2007.
- Follow-up workshop held during the Australian Earth Sciences Convention, Perth, 2008.
- Chapter outline submitted and writing commenced for new GTS2010 book.
- Active participation at the 33rd International Geological Congress in 2008, where a proposal for revision of the Precambrian timescale was unveiled.
- Detailed scientific research on the Archean-Proterozoic transition in Western Australia and South Africa
- Active participation in the overall body of ICS.

11. OBJECTIVES AND WORK PLAN FOR NEXT 5 YEARS (2010-2014)

- A complete Precambrian time scale in place, based on the rock record and adhering to stratigraphic principles, with formalized Hadean and Archean Eons.
- Formal GSSP for the Archean-Proterozoic boundary.
- Natural subdivisions of the Archean Eon, with GSSPs for each era-rank subdivision, where possible (Eo-, Paleo-, Meso-, and Neoarchean).
- In cooperation with the Neoproterozoic Subcommission, an advanced plan on how to naturalize the time scale for the Proterozoic.

- Full incorporation of latest insights from planetary science in the earliest part of the terrestrial Precambrian time scale.
- Prepare appropriate chapter on the Precambrian timescale for the 2010 version of the Geological Time Scale.
- Submit an ICDP project proposal to investigate the Archean-Proterozoic boundary in Western Australia, through drilling.
- In 2010, we aim to advance the idea of a formalized Hadean Eon and lead a fieldtrip to the Archean-Proterozoic boundary in Western Australia.

November 2009,
Perth, Western Australia

APPENDIX

Subcommission officers:

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Secretary: Dr. Robert Rainbird, Geological Survey of Canada, 601 Booth Street, Ottawa, Canada, K1A0E8, e-mail: rrainbir@nrcan.gc.ca

List of voting members (see website):

Australia:

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SUBCOMMISSION ON STRATIGRAPHIC CLASSIFICATION

ANNUAL REPORT 2009

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

Subcommission on Stratigraphic Classification (ISSC)

submitted by:

Prof. Brian R. Pratt¹

Chair, ISSC

Dr. Maria Rose Petrizzo²

Secretary, ISSC

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28th October 2009

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.

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 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 ODP-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 2009

5.1 ISSC NEWSLETTERS

ISSC Newsletter no. 15 was distributed in September 2009 (later than expected because of conflicting summer commitments). It advertised the status of review papers on the subdisciplines of Stratigraphy. It also described the results of ICS votes on the base of the Jurassic (Hettangian) and the Quaternary-Pleistocene-Neogene situation. It chronicled a current controversy about formalized abbreviations for units of geological time, be they measured dates or spans of time. Newsletters and other documents are available on the ISSC website: <http://users.unimi.it/issc>

5.2 NEW DEVELOPMENTS IN STRATIGRAPHIC CLASSIFICATION

5.2.1 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 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 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 *Newletters on Stratigraphy* where the various review articles are being published. This series of review 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.

After the Oslo workshop and the publication of the various review articles in the coordinated series, 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 2011 will coincide with the 50th anniversary of IUGS, and this would be a fitting tribute to the fine achievements made by IUGS in so many stratigraphic matters.

5.2.2 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.

5.2.3 STATE OF THE ART (as of October 2009)

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 [in review].

5.2.3.1 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. Sarthein, 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

Current task group:

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

Outline will be distributed in late 2009.

Comments will be forwarded to the leader, and made available in the ISSC archive.

Full text will be distributed in March 2010, and comments will be incorporated.

Previous task group:

Leader: Ashton Embry, Canada, AEmbry@NRCan.gc.ca

Donald E. Owen, USA, owende@hal.lamar.edu

Benoit Beauchamp, Canada, bbeacha@ucalgary.ca

Erik Johannessen, Norway, EPJ@statoil.com

Piero Gianolla, Italy, piero.gianolla@unife.it

Outline distributed in ISSC Newsletter 8 (October 2005).

Comments received and forwarded to the leader; available in the ISSC archive.

Full text distributed in February 2007, comments received and followed by a heated on-line debate (see <http://strata.geol.sc.edu/SeqStratForm.html>). Rejected in its first version. Revised version rejected by an ad-hoc international review committee of five experts chaired by Chris Kendall. Gianolla did not contribute to this version. Task group was disbanded and the current group appointed during the sequence stratigraphy discussion session at 33rd IGC in Oslo. Vitor Abreu, USA (ExxonMobil) was invited onto the new task group but resigned in August 2009.

5.2.3.2 Working Groups

BIOSTRATIGRAPHY

Leader: **Jacques Thierry**, France, jthierry@mail.u-bourgogne.fr; jacques-thierry2@wanadoo.fr
Stan Finney, USA, scfinney@csulb.edu

Yuri Gladenkov, Russia, gladenkov@ginras.ru

Outline distributed in ISSC Newsletter 9 (June 2006).

Comments received and distributed in ISSC Newsletter 10 (November 2006).

Full text in progress; a fourth member of the group is being contemplated

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.

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 in review: Langereis, C., Krijgsman, W., Muttoni, G. and Menning, M., 2010.

6. CHIEF PROBLEMS ENCOUNTERED IN 2009.

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 2008 (\$500) was devoted to maintaining the website and assembling the two newsletters. ICS was able with the 2009 allotment to continue to subsidize the website and newsletter preparation (\$500) plus offset some of the expenses incurred by the incoming Chair to attend the 33rd IGC in Oslo in 2008 (\$1000).

In the meantime, progress slow but sure is being made in the preparation of the four remaining chapters on facets of Stratigraphy.

7. SUMMARY OF EXPENDITURES IN 2009:

I. INCOME

2008 ICS travel support for Pratt to attend IGC in Oslo	\$1000
2009 ICS subvention	\$ 500

II. EXPENDITURES

Newsletter preparation and website maintenance	€ 340
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8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2010):

Publication expected:

- *Magnetostratigraphy*

Final draft form:

- *Biostratigraphy*
- *Chronostratigraphy*
- *Lithostratigraphy*
- *Sequence Stratigraphy*

Newsletters:

- December 2009
- June 2010
- December 2010

9. BUDGET AND ICS COMPONENT FOR 2010

ISSC Newsletter nos. 17 and 18 and website maintenance	\$ 500
Subsidies to help attendance at ICS workshop in Prague in May	\$4500
Total request	\$5000

Rationale—The remaining manuscripts should be prepared in 2010. 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 AAPG–SEPM, EGU and GSA annual meetings. Some members of ISSC plan to attend the ICS workshop in Prague, May 2010.

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 (2004–2009)

See Accomplishments in ISSC Annual Reports 2004–2009 as well as relevant newsletters.

11. OBJECTIVES AND WORK PLAN FOR NEXT 2 YEARS (2010–2012)

- (1) All the various review papers on the various branches of Stratigraphy will have been submitted and printed over this period.
- (2) The series of papers will 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, and will be done so under the general auspices of IUGS and ICS and timed to coincide with the 50th anniversary of IUGS.
- (3) ISSC will take the initiative to encourage special sessions and symposia at conferences that advance stratigraphic principles, in collaboration with other ICS subcommissions.
- (4) ISSC will make a recommendation on time-rock versus rock nomenclature (e.g. Early versus Lower).
- (5) 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.
- (6) 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.

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

Subcommission officers:

Chair:

Prof. Brian R. Pratt 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

Vice-Chairs:

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Prof. Helmut Weissert, Geologisches Institut, Eidgenössische Technische Hochschule Zürich, Universitätstrasse, 168092 Zürich, Switzerland; Tel.: +41 44 632 37 15; Fax: +41 44 632 10 30; E-mail: helmut.weissert@erdw.ethz.ch

Secretary:

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List of Members:

VOTING (includes all members of working and task groups):

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Weissert Helmut, Zürich, SWITZERLAND helmut.weissert@erdw.ethz.ch (Vice-Chair – ISSC)
Winter Henk de la R., Johannesburg, SOUTH AFRICA winterh@xconnect.co.za
Zalasiewicz Jan, Leicester, UK jaz1@leicester.ac.uk (Vice-Chair – ISSC)

CORRESPONDING (includes present and past chairs of subcommissions):

Beauchamp Benoit, Calgary, CANADA bbeacha@ucalgary.ca
Becker Thomas, Münster, GERMANY rbecker@uni-muenster.de, Chair – Devonian Subcommission
Bleeker Wouter, Ottawa, CANADA Wbleeker@NRCan.gc.ca, Chair – Precambrian Subcommission
Chen Xu, Nanjing, CHINA xu1936@yahoo.com, Chair – Ordovician Subcommission
Cita M. B., Milano, ITALY maria.cita@unimi.it (Past-Chair – ISSC)
Embry A., Calgary, CANADA AEmbry@NRCan.gc.ca (Past-Vice Chair – ISSC)
Gehling James, Adelaide, AUSTRALIA, jgehling@ozemail.com, Chair – Ediacaran Subcommission
Gibbard Phil, Cambridge, UK plg1@cus.cam.ac.uk, Chair – Quaternary Subcommission
Gradstein Felix, Oslo, NORWAY felix.gradstein@nhm.uio.no, Past-Chair – ICS
Henderson Charles, Calgary, CANADA charles.henderson@ucalgary.ca, Chair – Permian Subcommission
Johannessen Erik, Stavanger, NORWAY, EPJ@statoil.com
Luterbacher H.P., Barcelona, SPAIN, HPLUTER@telefonica.net
Molina Eustoquio Zaragoza, SPAIN emolina@posta.unizar.es, Chair – Paleogene Subcommission
Morton Nicol, FRANCE NICOL.MORTON@wanadoo.fr, Chair – Jurassic Subcommission
Ogg James G., West Lafayette, USA jogg@purdue.edu, Past-Secretary – ICS
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Peng Shanchi, CHINA scpeng@nigpas.ac.cn, Chair – Cambrian Subcommission

Premoli Silva Isabella, Milano, ITALY isabella.premoli@unimi.it, Chair – Cretaceous Subcommission

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Robb Laurence, Witwatersrand, SOUTH AFRICA 065LJR@cosmos.wits.ac.za

Rong Jiayu, Nanjing, CHINA jyrong@nigpas.ac.cn, Chair – Silurian Subcommission

Zachariasse W.J., Utrecht, NETHERLANDS, jwzach@geo.uu.nl

Zhamoida A.I., St. Petersburg, RUSSIA MSK@vsegei.ru

SUBCOMMISSION ON STRATIGRAPHIC INFORMATION

ANNUAL REPORT 2009

TITLE OF CONSTITUENT BODY

ICS Subcommission for Stratigraphic Information

Submitted by James Ogg, chair

1. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Mission Statement

The Subcommission for Stratigraphic Information promotes and coordinates the gathering of selected stratigraphic information worldwide and organizes logically its presentation through the ICS website. The Subcommission first priority is to enable the world geoscience community to have quick and free access to a vast amount of stratigraphic information, thus helping to spread the knowledge and foster the advancement of the science globally.

Goals

The Subcommission was established in 2000, and assigned an extensive set of goals (Appendix 1). A streamlined version was adopted in 2003, with a simplified task set (diagrammed in Appendix 1)

SIS goal is to gather selected stratigraphic information (such as databases, compilation of biozonal schemes, regional time scales, stratigraphic standards, and geohistory teaching modules) and develop a method of classification to organize, logically, the databases and related links, and make easy search and use of the contents through its website to the world scientific community. The Subcommission primarily aims to promote scientific cooperation and the advancement of the science worldwide, and to maintain the leading role of ICS in the stratigraphic information network. The four-fold set of tasks are:

- (1) Geologic time scale information (from posters and cards to multi-author compilations)
- (2) Stratigraphic database center and links (with visualizations; links to lexicons, etc.)
- (3) Stratigraphic standards (GSSP information, stratigraphic code in different languages)
- (4) Geohistory education and links

2. Organization

During 2009, the Subcommission strove to attain an extended international and thematic membership. It must be emphasized that this subcommission is task-oriented, and it is expected that the membership will be active in undertaking those tasks. A detailed current and pending list with addresses and expertise is in Section 10 of this report.

Officers and current Voting Members

Name	Office or Expertise	Country (Institution)
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Ogg, James G.	<i>Chair</i> ; TS-Creator database and visualization	USA (Purdue University)
Ogg, Gabi M.	<i>Secretary/Webmaster</i> ; graphics, GSSP tables	USA (Purdue University)
Crampton, James S.	<i>Vice-Chair</i> , Global Change Through Time Programme of GNS	NEW ZEALAND (Inst. Geol. Nucl. Sci.)
Asch, Kristine	OneGeology Europe	GERMANY (BGR)
Fan, Junxuan	Geobiodiversity database	CHINA (Nanjing Inst.)
Filipescu, Sorin	Microfossils (Ceno-Mesoz.)	ROMANIA (Babes-Bolyai Univ.)
Galeotti, Simone	Microfossils ; co-founder of 2002 subcommission	ITALY (Univ. Urbino)
Howe, Richard	Global stratigraphy	USA (Chevron)
IODP (Jamus Collier)	Information and Data Manager	JAPAN (IODP)
Koren', Tat'yana N.	Head of Russian stratigraphy (bio, litho, etc.) database group;	RUSSIA (All-Russian Geological Research, Institute)
Nowlan, Geoffrey S.	Paleozoic stratigraphy; geo-education	CANADA (Canad. Geol. Surv.)
Van Couvering, John	Microfossil databases	USA (Micropress)

We are currently recruiting voting members from Africa, South America, an additional international programs.

3. Interfaces with other international projects

(1) **One-Geology** and **One-Geology-Europe** geoinformatics teams. We will be working with One-Geology-Europe program during summer 2010 to interface our database structure with their preliminary one and the lexicons. During the IGC of 2008, a project was initiated with Simon Cox (coordinator of One-Geology geoinformatics) to provide an RSS-feed of the main ICS standards, especially GSSP definitions and approximate ages, to the One-Geology program. This was completed in April 2009.

(2) **UNESCO Commission for the Geologic Map of the World (CGMW)**. We have worked with CGMW in Paris on standardizing the CMYK and RGB colors for chronostratigraphic units, and co-produced a poster with these colors and GSSPs. We are coordinating with CGMW on inter-linking our *TimeScale Creator* databases and different regional lexicons to their geological maps.

(3) National Geological Surveys and Strat Commissions. As of 2009, we have joint projects (mainly *TimeScale Creator* datapacks) with: Geoscience Australia, New Zealand geologic survey, British Geologic Survey, Norwegian offshore lexicon, Austria Stratigraphy Commission, German Stratigraphy Commission and German Geological Survey (BGS), Russia

(biostratigraphy compiled by All Russian Geological Institute). Details of these projects and new ones initiated in late 2009 with China, Canadian Geological Survey, USGS and India are given later.

4. Chief accomplishments and products in 2009

a. Websites and RSS-feeds

Two websites were designed and populated with a wide array of information in 2009:

- (1) The main Subcommission site, <http://stratigraphy.science.purdue.edu/>, became active in November, 2008:

The screenshot shows a web browser window for the Subcommission for Stratigraphic Information. The title bar reads "Subcommission for Stratigraphic Information". The address bar shows the URL "http://stratigraphy.science.purdue.edu/". The page header features the ICS logo and the text "SUBCOMMISSION FOR STRATIGRAPHIC INFORMATION" and "PROVIDING INFORMATION ABOUT EARTH HISTORY". A blue navigation bar at the top includes links for "Home", "GSSPs", "Charts & Books", "Stratigraphic Guide", "Resources", "TS Creator", and "To ICS". On the right side of the header, there is an "Admin" link. The main content area contains three logos: "Subcommission for Stratigraphic Information (SSI)" with its logo, "International Commission on Stratigraphy" with its logo, and "International Union of Geological Sciences" with its logo. Below these, a paragraph explains the mission of the Subcommission, mentioning GSSPs, charts, stratigraphic guides, resources, and the TS-Creator software. It also notes the international reference for geological time stages and the availability of correlations, lexicons, and the GeoWhen database.

Earth's history is a fascinating topic. The **Subcommission for Stratigraphic Information** (of **International Commission on Stratigraphy** of IUGS) strives to provide the global public and geoscience community with quick and free access to a wealth of information about our planet's past.

On our website, among other items, you will find:

- (1) [GSSPs](#) – The divisions of geologic time, such as Jurassic or Danian, are defined at a Global Boundary Stratotype Section and Point (GSSP) that marks the international reference for their base. We have compiled summary tables and graphics for all ratified GSSPs and pending candidates.
- (2) [CHARTS & BOOKS](#) – From the popular page-sized geologic time scale to poster-sized Earth's history, all in official colors.
- (3) [STRATIGRAPHIC GUIDE](#) – a concise version of the official manual.
- (4) RESOURCES – including diagrams of inter-regional [correlations](#), links to [lexicons](#) (national rock formations), "[GeoWhen](#)" database of historic and regional stage names, and selected links to other [Earth history sites](#).
- (5) [TS-CREATOR](#) – our *Time Scale Creator* visualization package (free JAVA program for all platforms) enables you to explore relationships and make custom charts from a database suite of over 20,000 biologic, geomagnetic, sea-level, and other events. Plus, you can load datapacks ranging from British Isles geology to New Zealand fossil ranges. On-screen displays have extensive hot-links to provide additional information.

The SSI website contains:

- (a) GSSPs – The divisions of geologic time, such as Jurassic or Danian, are defined at a Global Boundary Stratotype Section and Point (GSSP) that marks the international reference for their base. We have compiled summary tables and graphics for all ratified GSSPs and pending candidates. The main tables are dynamically generated (see below).
- (b) CHARTS & BOOKS – From the popular page-sized geologic time scale to poster-sized Earth's history, all in official colors.

- (c) STRATIGRAPHIC GUIDE – a concise version of the official manual.
 - (d) RESOURCES – including diagrams of inter-regional correlations, links to lexicons (national rock formations), “GeoWhen” database of historic and regional stage names (contributed by R. Rohde; Univ. Calif. Berkeley), and selected links to other Earth history sites.
 - (e) Link to our TS-CREATOR public site (see next section).
- (2) TS-CREATOR – our *Time Scale Creator* visualization package is a free JAVA program for all platforms to explore Earth history. Details are given in section “c” below. The *TimeScale Creator* site, <http://www.tscreator.org/>, was completely redesigned and became active in January, 2009:



The screenshot shows the homepage of the TimeScale Creator website. The title "TimeScale Creator" is prominently displayed in a large, stylized font. Below the title is a cartoon illustration of a person holding a guitar, with geological time periods labeled (Cenozoic, Mesozoic, Paleozoic, Precambrian) visible on the guitar's body. A navigation bar at the top includes links for Home, Manuals, Datapacks, Download, FAQs, Contact Us, News Letter, TSC Pro, Sponsors, and Login. The main content area features a brief introduction to the software and a "How to use the program" section. To the right of the main content is a sidebar with a similar cartoon illustration and a "click to enlarge" link.



The screenshot shows the Time Scale Creator software interface. It has a menu bar with File, Data, Image, Help, and a toolbar with Settings..., Generate Chart, and a search icon. A message "Data loaded successfully!" is displayed. The main window shows a "Time Scale Creator PRO 1.4.3" panel with information about the software's coordinators and developers. It also displays a "TS Creator Pro" license message and a "Time Scale Creator" logo. To the right is a "From Data to finished Chart in 3 simple steps" guide, which shows three panels: Step 1: Pick Time Interval (By Stage or By Age, Set scale), Step 2: Select stratigraphy & regional columns (with a note about over 200 stratigraphic columns), and Step 3: GENERATE on-screen display and Save (with a note about generating charts in GVS, Grayscale Vector Graphics, or PDF formats). A "click to enlarge" link is located at the bottom right of this guide.

[DOWNLOAD](#) the free TimeScale Creator.

See [FAQs](#) for common questions.

TimeScale Creator provides a wealth of information for making charts and posters, such as these [CHARTS](#) produced by the ICS Subcommission on Stratigraphic Information.

Try some of our additional [DATAPACKS](#) of selected regional (e.g., British Isles facies successions, New Zealand range charts) or specialty stratigraphy (e.g., global reconstruction images, Ice cores and archeological culture intervals) from the *TimeScale Creator* library.

In addition to providing the free software and on-line and PDF manuals, the site provides an array of datapacks ranging from British Isles geology to New Zealand fossil ranges (see below).

(3) RSS-Feed:

The ICS was requested by the IUGS and One-Geology Geoinformatics groups to provide a web-based authoritative digital dataport for basic GSSP parameters (stage, ratification status, location, definition, main correlation methods, approximate age, color of stage, etc.). This RSS-feed (or ATOM output) could be automatically queried by other applications; rather than individuals having to search through the ICS sites to see if a GSSP had been defined, revised, etc.

A dynamic feed was created by the Purdue University “VIP” undergraduate engineering project under a “contract” to SSI. In addition, this project provided a dynamic-generation for all GSSP tables and individual stage-level pages on the SSI website, including Google-Earth display of each location.

b. Printed Material on Earth’s History

We have concentrated on global distribution of free or “at cost” teaching resources for Earth History. Funding for production, printing and distribution of these products have been sponsored by EAS/Purdue, the International Union of Geological Sciences (IUGS, headquartered in Norway), Australian National University, Geoscience Australia, and a consortium of petroleum companies (ExxonMobil, ChevronTexaco, BP, Statoil, Shell, ENI, Conoco, Neftex). Some are joint products to be distributed by UNESCO (Commission for Geologic Map of the World).

Book, *Concise Geological Time Scale 2008*, (\$35 for the full-color, 160-page, hardback via Cambridge Univ. Press) is a comprehensive review of all geological time divisions and the associated absolute (millions of years) time scale. As with the 2004 version, this program involves a large global network of geoscientists contributing their expertise. IUGS reviewed the contents, especially guidance on their preferred way to display the Quaternary in diagrams and text, A plastic timescale card is included in each book. Approximately 1500 copies were sold between Aug, 2008 and Sept, 2009.

Poster “*History of the Earth*” (geologic time scale, life-through-time, and global reconstructions). This was one of our contributions for the United Nations 2008 “*International Year of Planet Earth*”. The target audiences are secondary schools. The IYPE reviewed and approved the product.

2500 copies were printed/distributed during 2007 in Australia

2000 copies were printed/distributed in 2007-09 through Purdue (another 1000 will be distributed in 2010).

Poster “*A Geologic Time Scale 2008*” (3x2 feet; prepared and printed in coordination with UNESCO Commission for the Geologic Map of the World). The first printing was sold out at the International Geological Congress (Oslo, August, 2008). This is available through the SSI or CGMW websites.

Chart “*International Divisions of Geologic Time*” is freely available through the International Commission of Stratigraphy website (www.stratigraphy.org).

Chart “*Geologic Time Scale 2004*” (A3-sized).

Plastic card “*International Geologic Time Scale*”. Versions were sponsored by Neftex, Chevron, ExxonMobil, ConocoPhilips and ENI.

Mousepad “***International Divisions of Geologic Time***”. This was a joint production with the UNESCO Commission for the Geologic Map of the World. The first printing with was sold out at the International Geological Congress (Oslo, August, 2008). The second printing is available through the CGMW website.

Detailed **Charts for each geologic period**. These poster-sized summaries of major biostratigraphic, sea-level and geochemical trends can be downloaded from the SSI website.

c. Global databases and Visualization

“***TimeScale Creator***” (*Version 4.2 released in August, 2009 – Free JAVA suite*). This is our continuously-expanding “flagship” database-visualization system with hyperlinks to our stratigraphic-information website (www.stratigraphy.org). The major “versions” are a new software package, but database updates/enhancements are mounted approximately every three months. This free JAVA-based visualization application has a built-in database of approximately 25,000 biologic, magnetic and other major events in Earth’s history (status in Nov’09), plus an extensive set of geochemical and sea-level curves. The user selects the interval of time, chooses the type of data to be displayed, and this windows into Earth’s history appears on the screen, or can be downloaded as an SVG or PDF file for use in popular graphics programs. On-line “quick-start”, tutorials, exercises and a manual (courtesy of ExxonMobil) provide independent training in usage and developing one’s own datasets for insertion.

Public Version 4.2 (August 2009) has capabilities for lithologic columns, images of paleogeographic maps, range charts, URL-hotlinks, and other valuable features. The extension to regional geology has produced joint public products in coordination with Geoscience Australia, New Zealand geologic survey, British Geologic Survey, Austria Stratigraphy Commission, etc.; as summarized below.

Software enhancements added in 2009 (selected):

Basin transect capability with floating labels and pop-ups (and a colorful user manual for self-entry of transects), revised pop-up window system that no longer has 256 character limitations, internal “standard” image set for oil-gas occurrences – impacts - large-igneous provinces, capability for superimposed curves of different colors.

Global datapack enhancements added in 2009 (selected):

Paleozoic Sequence Stratigraphy and Onlap Curve. This includes the recent (October 2008) *Science* paper of Haq and Schutter, plus their on-line supporting documentation tables and charts.

Onlap Curves for Phanerozoic. This is based on SEPM 1998 sequence-stratigraphy and eustacy charts, plus the above paper by Haq-Schutter for Paleozoic; but applying a mathematical model to generate a synthetic onlap curve for margins.

Global Impact, and Large-Igneous-Province Records, plus icons for impacts and eruptions of varying magnitudes. These are sub-grouped into “global” and individual regional events. The events are provided by the International Association of Volcanology and Chemistry of the Earth’s Interior, and to PASSC at Planetary and Space Science Centre, Univ. New Brunswick.

Mars, Moon, and Venus geologic history and stratigraphic units
Dinoflagellate events were enhanced and linked to Dinoflaj2 database; and Paleogene foraminifers linked to the CHRONOS page for each species from the different Paleogene working groups.

Astronomical Solutions for Earth Paleoclimates for past 3 myr and past 100 myr based on calculations provided by Jacques Laskar. These curves of eccentricity, obliquity and precession indicate the variations in solar radiation; of which Pleistocene ice ages are the most dramatic results. These sets have over 10,000 points; therefore were mounted as separate datapacks.

Cenozoic Oxygen Isotope Trends (and high-resolution marine isotope stages). This includes digital versions of the compilation by Zachos et al (2008, with conversion and interpolations to GTS2004 time scale) and by Raffi et al (2006; for past 25 myr), plus labeled “oxygen-isotope episodes”. A detailed Plio-Pleistocene curve includes labels for all marine isotope stages. These sets have nearly 15,000 points; therefore were mounted as a separate datapack.

Past 10,000 years – Greenland ice core and preliminary “human culture” compilation; provided courtesy of Grace Conyers, Purdue University. This popular datapack will be enhanced during the coming year.

d. Summary of coordination activities by regional database teams

Nov, 2008; Nottingham, England (British Geological Survey) – on-site work to finalize British lithostratigraphy array for TS-Creator visualization (Colin Waters, Jim Ogg).

Dec, 2008; Nanjing, China (Geobiodiversity group) – on-site visit by Purdue Univ. student (Alex Huang, expert with TS-Creator) for presentations and discussions on developing a China-region bio/lithostrat datapack and on-line version of TS-Creator.

March, 2009; Houston, USA – workshop at N.Amer. microfossil conference (SEPM) for TS-Creator to academic and industrial users; and user-feedback was obtained for potential 2009-2011 enhancements to user-interfaces, datasets, and applications.

May-June, 2009; Canberra and Darwin, Australia – on-site collaboration with Geoscience Australia for their flagship Australian geohistory visualization suites (Daniel Mantle of GA, Jim Ogg, Adam Lugowski, et al.)

July, 2009; Lower Hutt, New Zealand – on-site collaboration with GNS (N.Z. geological survey) to complete the biostrat datapacks and initiate an impressive basin-transect system (34 initial transects), plus age-depth conversion software add-ons (Craig Jones, James Crampton, Jim Ogg, Adam Lugowski, et al.).

September, 2009; Calgary, Canada -- on-site collaboration with Geological Survey of Canada to develop integrated biostrat, lithostrat and sequence-strat for Arctic regions (first priority) and mainland of Canada, potentially (Godfrey Nowlan, Jim Ogg, et al.).

October, 2009; GSA Annual Meeting – planning for USGS-coordinated program for a comprehensive offshore and onshore array.

e. Regional Lexicon-linked databases and Other datapacks

NOTE: All regional visualization suites produced directly with geological surveys are freely available as datapacks through the SSI/TSC websites and as special pre-packaged TS-Creator versions through the websites of the individual geological surveys. All of the following projects were put on-line during late 2008 and 2009:

Australian Geo-History – this was developed with Geoscience Australia (the Australian geological survey) during 2007-2008; and greatly enhanced in 2009. In addition to all types of Australian biostratigraphy with full references of calibrations, the

datapack for visualization in *TimeScale Creator* has a comprehensive array of lithologic columns (about 200) of all Australian Proterozoic and Phanerozoic basins and subbasins (and even finer detail in some regions), with each formation hot-linked into the GA Oracle database. Images of paleogeographic maps, tectonic maps and facies maps (about 50 of each) provide visual columns on Australian history, and are also hot-linked to additional on-line summaries. The suite also includes reference wells for all major oil-gas reservoirs (hot-linked to appropriate databases). There are over 9000 events/datums/formations. This extensive system is intended to be a model to put the geology of other continents “on-line”.

Russian Biostratigraphy. An extensive (7000 entries) array for visualization in *TimeScale Creator*. This includes most biostratigraphic zones and major bioevents for all regions of Russia through the entire Phanerozoic,. The suite is based on a book and extensive charts by T. Koren' et al (2006).

British Isles Lithostratigraphy. An extensive (ca. 2000 entries) array for visualization in *TimeScale Creator*. This includes the Phanerozoic of all British basins, and has been vetted by the British Geological Survey. All formations are tied to the Lexicon of BGS.

New Zealand Biostratigraphy– An extensive (ca. 3000 entries) array for visualization in *TimeScale Creator*. This includes the main and all secondary biostratigraphic events and ranges for this region. Palynology events are linked to the NZ-hosted pollen-spore database. In 2010, we will add lithostratigraphy and transects for most NZ basins.

Gulf of Mexico Biostratigraphy and Lithostratigraphy– An extensive (ca. 2000 entries) array for visualization in *TimeScale Creator*. This suite integrates biostratigraphy/sequence stratigraphy charts of Shell (provided by Mike Styzen), of Dick Fillon (formerly at Chevron), of PaleoData, of the USA MMS, and lithostratigraphy columns from the Gulf of Mexico DNAG volume (in turn, linked to the USGS Lexicon).

Lithostratigraphy of Russian Hydrocarbon Basins. For visualization in *TimeScale Creator*. This set was mainly compiled from Siberian, Caspian and other regional reports of the U.S. Geological Survey.

Lithostratigraphy of Svalbard and Norwegian Sea. For visualization in *TimeScale Creator*. All formations are tied to entries in Norlex.

Lithostratigraphy of Alaskan and other Arctic Hydrocarbon Basins. For visualization in *TimeScale Creator*. This includes conversions of many regional reports of the U.S. Geological Survey.

Marine Genera ranges. For visualization in *TimeScale Creator*. This is based on the Sepkoski (2002) compilation, as revised and updated by Leif Tapanila. A user selects from 30,000 genera according to phylum and orders. We will enhance this in 2010 by adding major land vertebrates and linking the orders to explanatory websites with images.

5. Chief problems encountered in 2009

During 2009, the many activities listed as achievements “of the subcommission” were essentially accomplished by a core group of dedicated researchers and students, who devoted their academic and summer time to accomplishing these products. In order to maintain this level of activity, it is essential that more researchers and students, especially in other nations, become

actively involved in a coordinated suite of tasks.

The Geoscience Australia team was the only one that made extensive in-house datasets for distribution by the Subcommission as TS-Creator datapacks. We think that the benefits of providing a central and organized source of authoritative information and visualization on Earth history and its regional manifestations will provide such volunteers a sense of fulfillment, albeit with low monetary compensation for their devoted time. To this end, in 2010, we will investigate the possibility of “wiki” systems for public contributions of datasets. As the Subcommission products, especially the TS-Creator visualization suite, become more widely used and volunteer contributions are promoted, it is anticipated that a larger audience will begin to directly provide packages and enhancements.

6. Summary of expenditures in 2009

TOTAL: \$4000 [from IUGS via ICS Executive]

\$3000 – To Purdue’s school of engineering for developing dynamic GSSP tables for the SSI website, plus easy system for updating GSSP databases. This also included a RSS-feed for One-Geology, and a Google-display of GSSP locations.

\$1500/semester for Spring’09 and for Fall’09. The Fall’09 projects include a geographic interface and possible full RSS-feed for the global database (~20,000 events).

(another \$1500 in matching funds for RSS-feed was provided by James Ogg)

\$500 – Compensation for GSSP graphics and summaries and for web-development, to Gabi Ogg (100 hours)

\$400 – Web-design and graphics software (*Dreamweaver CS4*)

\$100 – Postage for shipping posters/cards/etc; and mailing tubes

NOTE: The majority of the *TimeScale Creator* software development and datapack preparation during 2009 was mainly funded through US National Science Foundation, donations by and to Purdue University (especially by Geoscience Australia), and other grants to James Ogg and Felix Gradstein. These funds supported 3 full-time students during summer 2009, 3 half-time students during Spring of academic year 2009, and 5 half-time students during Fall 2009; plus ~\$20,000 paid for programming assistance, and costs of travel to England to work with British Geological Survey, to Australia (Geoscience Australia), to New Zealand (their geological survey), to Calgary (Canadian Geological Survey) and to Portland (GSA annual meeting, to coordinate with OneGeology geoinformatics and USGS). We anticipate similar external donations or contributions during 2010 as we work with the different geological surveys and authoritative teams.

7. Work plan, anticipated results and communications to be achieved in 2010

a. Printed Material on Earth’s History

10. School-level educational posters and cards in both printed and Internet form for the final months of INTERNATIONAL YEAR OF PLANET EARTH. Through Purdue University, we anticipate mailing the remaining 1000 (of a total 3000) “History of the Earth” posters to high-school classrooms. We have placed a free PDF version on-line for people to locally print their own copies, and indicate that the pre-printed quality-paper versions are

available for mailing-cost-only. We will continue to provide updated reference cards for the geologic time scale for all audiences.

11. Plastic cards – for the 2010 EGU (May in Vienna), the Neftex company will fund printing a revised set of time-scale cards.
12. Coordinate a comprehensive “Geologic Time Scale 2012” volume. This book, originally planned for 2010 but delayed to take advantage of major new radiometric standards and cycle-stratigraphy developments during 2009-2010, will be similar (and even expanded) in scope to GTS2004; but in full color. In addition to the new GSSPs, it is important to summarize the major advances in bio-mag-sealevel-geochem stratigraphy of the past decade. There are about 30 authors, including the officers of several ICS subcommissions.
13. Coordinate a comprehensive summary of all GSSPs. We are providing standardized descriptions and graphics as these are formally published. A colorful photo-filled booklet would be ideal for reference; and we will work with Stan Finney on a prototype.

b. Digital Material on Earth’s History

14. Website: We will continue to enhance the SSI website for easy usage and add more content. GSSP documentation/graphics will be continuously updated and enhanced. Links to additional regional stratigraphic lexicons will be provided, where such on-line sources have been made available. We will also link to translated versions of the stratigraphic guide. [*Essentially, strive to accomplish the goals assigned to the Subcommission in this area.*]
15. Establish an on-line “booklet” for the geological time scale. The publication of time-scale books is fine for quick browsing; but can’t be easily updated. We would like to place the main contents of our “*Concise*” book onto the website, but enable updating of the critical graphics. At this point, we have only mounted versions of the period-level graphics for this timescale compilation.
16. Update and enhance the summaries of the correlation of “regional stages” to the international scale. The current “*Geowhen*” (provided by R. Rohde, at Univ. Calif. Berkeley) is now out-of-date, and we would either revise it or remove it. For now, new summary graphics at the SSI site provide the basic information; but we need to include hot-links to details.
17. RMS feed to additional numerical time-scale and stratigraphic information. Having accomplished the basic GSSP-feed, we are considering providing the entire “global” database of TimeScale Creator (about 25,000 datums) with commentary for each item.
18. Promote *TimeScale Creator* visualization package for exploring Earth history. Currently, this is very poorly displayed and advertised.
19. Place additional databases on-line to support “hot-link” version of TimeScale Creator, and create an academic “Pro” version with research applications.
20. Add more datapacks to TimeScale Creator for public usage. Several of these have been compiled, but need to be reviewed by specialists in the different regions:

Germany Lithostratigraphy. This includes the Phanerozoic of basins and mountain belts, and is based on charts produced by the German stratigraphic commission. The initial data entry was completed in Summer 2008; but review/deployment will occur in conjunction with the BGR and German Commission on Stratigraphy in May 2010. All formations are linked to the German stratigraphic on-line Lexicon.

Austria Lithostratigraphy. This is based on charts produced by the Austrian stratigraphic commission and includes the Phanerozoic of basins and mountain belts. The initial data entry was completed in Summer 2008; and we are invited by the Austria

Stratigraphic Commission to Vienna for a thorough review before deployment in May 2010. Simultaneously, they will complete the on-line Lexicon for inter-linking.

Europe Lithostratigraphy. Having completed British Isles, Norway offshore, Austria and Germany; we will work in May 2010 with OneGeology Europe to prepare a seamless European suite and visualization.

Russia Lithostratigraphy. This project has already been discussed with Tanya Koren, who will coordinate the difficult task of assembling the information as part of state-supported project; and we will provide the digitization/visualization.

India and Adjacent Regions Lithostratigraphy. This datapack has already been completed; but requires vetting by stratigraphic experts. It includes the Phanerozoic of all onshore and offshore basins and mountain belts of the Indian subcontinent, and is based on charts produced by Rao et al (2007). Details on formations (and links) are from publications and the Indian directorate for hydrocarbons.

New Zealand Lithostratigraphy – We will enhance the current biostratigraphy datapack with transects for most NZ basins. This is in conjunction the GNS (N.Z. geological survey), who will contribute to student labor for the transects.

China lithostratigraphy. This project has been discussed with the stratigraphic database team hosted in Nanjing; and a Purdue University student went to Nanjing for presentations and discussions in Dec, 2009. In July, 2010, Jim Ogg will go to Nanjing for a prototype development.

Middle East Lithostratigraphy – This is based on charts produced by GeoArabia and includes the Phanerozoic of basins and mountain belts. The initial data entry was completed in Summer 2009; but requires a thorough review before deployment in May 2010. ExxonMobil and Qatar Petroleum will aid in reviewing this public database.

Human Time Scale (Creator) – This is for an entirely different audience than normal geoscientists (but potentially more numerous!). The initial compilation was completed in 2009, but needs to be reviewed by other archeologists. We plan to develop some “lab modules” around this database (one was already tested in March 2009). John Van Couvering will aid in portions of this review; and we will produce associated on-line summaries for the SSI website on Late Pleistocene and early Holocene “Human-stratigraphy”.

Summary set of Phanerozoic time scales with GTS2012 calibrations. A suite of poster-sized figures for each geologic period will be made with major biostratigraphic zonations, sea-level trends, relevant geochemical events, etc. These could be downloaded from the SSI website after *Geologic Time Scale 2012* goes to press. In addition, all the TimeScale Creator datapacks would require updating to the new age scales developed from cycle stratigraphy (Cenozoic-Cretaceous), revised radiometric ages, and new interpolation methods.

21. Enhance *TimeScale Creator* capabilities:

Geographic interface for visualization software. The growing suites of regional lithostratigraphy and transect datasets of Earth history require a map-based selection system (and, potentially, a map-based display one). Such a software enhancement is currently being developed by Purdue University (Engineering department) under contract to SSI through its undergraduate research-project “VIP” program.

Evolutionary tree visualization software. In order to dynamically display “evolutionary trees” for public and research usage that include images, we must develop an intelligent display method with appropriate user-menus. The initial “test bed” will be

Paleogene foraminifers (courtesy of biostratigraphers at ExxonMobil); but we mainly desire to present an overview of evolution of all major organisms at the family level; and selected ones at the genera level. This “family tree” project will involve collaborations with the Paleobiology database and other geobiodiversity groups.

NOTE: Some of the above projects will require continuation into 2011.

c. Educational Material on Earth's History

22. Work with geoscience educators on creating modules for exploring Earth history, and link to existing ones.
23. Create a “educational” version of *TimeScale Creator* with more graphics, plus material that is mainly aimed at a high-school or early undergraduate level. We will apply for an NSF grant to accomplish this important prototype, testing-feedback and deployment; but ICS/IUGS support and matching funds would be essential.

d. Planned coordination activities by regional database teams

- Jan, 2009; Oslo, Norway – workshop with British, Norwegian, Danish and Dutch geological surveys and planning for finalizing a comprehensive North Sea and northernmost Atlantic region dataset (biostrat, lithostrat, transects) for TS-Creator visualization (Colin Waters, Jim Ogg, Felix Gradstein, et al.).
- Feb, 2010; Washington, USA – on-site collaboration with USGS for prototype of USA onshore/offshore datasets (mainly lithostrat)
- March, 2010; Houston, USA – presentations to petroleum industry on TS-Creator, plus finalizing the comprehensive Gulf of Mexico regional dataset (biostrat, lithostrat, potential transects) for TS-Creator visualization (Richard Howe, Jim Ogg, et al.)
- March, 2010; Lower Hutt, New Zealand – on-site collaboration with GNS (N.Z. geological survey) to finalize basin-transect system and enhance the age-depth conversion software extension (Craig Jones, James Crampton, Adam Lugowski, et al.).
- May, 2010; Vienna, Austria -- on-site collaboration with Austrian Geological Survey to finalize the Austria region and Alpine datapack (mainly lithostrat) for TS-Creator visualization (Werner Piller, Jim Ogg, et al.).
- May, 2010; Hannover, Germany -- on-site collaboration with BGR to finalize the German region datapack (mainly lithostrat) for TS-Creator visualization and to develop a OneGeology Europe prototype (Kristine Asch, Jim Ogg, et al.).
- June, 2010; Calgary, Canada – (planned) on-site collaboration with Geological Survey of Canada to finalize datapack for the integrated biostrat, lithostrat and sequence-strat for Arctic regions, and a prototype for the mainland regions (Godfrey Nowlan, Jim Ogg, et al.).
- July, 2010; Nanjing, China -- on-site collaboration with Geobiodiversity Database team for a prototype integrated biostratigraphy/lithostratigraphy data array for Chinese regions (Fan Junxuan, Jim Ogg, et al.).

8. Budget and ICS component for 2010

As in 2009, the Subcommission is planning a very active program of publications, education outreach and public awareness, web enhancements, regional and thematic databases for research and public usage, and extensive international linking. Accomplishing this involves supporting students for the database preparation, web-related expenses, paying a programmer for visualization software enhancements, etc.

However, unlike in 2009, we can not count on the extensive support from Purdue University, Cambridge University Press, NSF and Geoscience Australia. Therefore, we are submitting a budget that optimistically presumes that nearly three-quarters of our costs will be covered by external donations/grants and internal support; but one-quarter will need ICS/IUGS budgeting:

PROJECTED "ICS-SUPPORTED" EXPENSES (a fraction of the actual total)

Web-enhancement and GSSP graphic production	\$ 800
Computer programming (<i>Geographic interfaces for TS-Creator</i>)	\$2000
Printing posters/cards/etc; shipping to conferences; and mailing tubes	\$ 500
Student support for datapacks and modules – 25% of this category	\$1700
TOTAL PROJECTED EXPENSES (ICS portion only)	\$5000

9. Objectives and Work Plan for the Next 4 Years (2009-2012)

Much of this topic was originally laid out in the original Subcommission mission, as summarized in the Appendix.

The main aspects that we are adding are:

(1) Comprehensive book (GTS2012) and website that summarizes all aspects of global stratigraphy, inter-regional correlations, and estimated numerical ages.

(2) Our major *TimeScale Creator* database and visualization system to place all Earth history onto a convenient framework that is accessible to both the general public and to specialty researchers. At this point, everyone is delighted to contribute, and we give adequate credit (or blame) to all those who provide the data and correlations. It is intended that this program will morph to fit different audiences; and become an important tool for both geoscience research and for public exploration. The databases and visualization package are envisioned as a convenient reference tool, chart-production assistant, and a window into our planet's fascinating history.

10. Voting members (2009-2012)

ICS Subcommission for Stratigraphic Information

2009-Sept, 2012 – Voting Members

NAME	COUNTRY/Organization	Specialty	Mail address
Asch, Kristine	GERMANY (OneGeology Europe; BGR)	Compiled "interactive Geological web map of Europe and adjacent areas"	Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), GeoZentrum Hannover, Stilleweg 2; D-30655 Hannover, GERMANY
Crampton, James S.	NEW ZEALAND (Inst. Geol. Nucl. Sci.)	Leader, Global Change Through Time Programme of GNS	GNS Science: Postal address: P.O. Box 30-368, 5040, Lower Hutt; Physical address: 1 Fairway Drive, Avalon, 5010, Lower Hutt, NEW ZEALAND

Fan, Junxuan	CHINA (Nanjing Inst.)	Coordinator of Geobiodiversity database (web)	Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, 39 East Beijing Road, Nanjing 210008, P.R. China
Filipescu, Sorin	ROMANIA (Babes-Bolyai Univ.)	Webmaster; microfossils (Ceno-Mesoz.)	Department of Geology, Babes-Bolyai University, Str. Kogalniceanu 1, 3400, Cluj-Napoca, ROMANIA
Galeotti, Simone	ITALY (Univ. Urbino)	Microfossils (Ceno-Mesoz.) ; co-founder of 2002 subcommission	Istituto di Geologia, Università degli Studi di Urbino, Campus Scientifico, Località Crocicchia, 61029 Urbino, ITALY
Howe, Richard	USA (Chevron)	Global stratigraphy	CHEVRON Energy Technology Co., Biostratigraphy Team , 1500 Louisiana St., Houston, TX 77002
IODP (Jamus Collier)	JAPAN (IODP)	Information and Data Manager of IODP	Hokkaido University, CRIS Bldg. 05-104 & 105; N21 W10, Kita-ku, Sapporo, 001-0021, Japan
Koren', Tat'yana N.	RUSSIA (All-Russian Geological Research, Institute)	Head of Russian stratigraphy (bio, litho, etc.) database group; also Paleozoic graptolites	Head of Paleontology and Stratigraphy Dept., All-Russian Geological Research, Institute (VSEGEI), Srednij Prospect 74, St. Petersburg 199026, RUSSIA
Nowlan, Geofrey S.	CANADA (Canad. Geol. Surv.)	Paleozoic stratigraphy; past President of the Geological Association of Canada;	Geological Survey of Canada / CGC-Calgary 3303-33rd Street N.W., Room 238 / 3303, 33 rue nord-ouest, pièce 238 Calgary, Alberta, T2L 2A7 CANADA
Ogg, Gabi M.	USA (Purdue University)	Secretary/Webmaster; graphics, GSSP tables	Dept. Earth & Atmos. Sci, Purdue University, 550 State Street, West Lafayette, Indiana, 47907 USA
Ogg, James G.	USA (Purdue University)	Chair; TS-Creator database and visualization; also Mesozoic stratigraphy	Dept. Earth & Atmos. Sci, Purdue University, 550 State Street, West Lafayette, Indiana, 47907 USA
Van Couvering, John	USA (Micropress)	Microfossil databases	Micropaleontology Press, 256 Fifth Ave., New York NY 10001 USA [NOTE: This will move to Queens Univ, NYC]

2010-Sept, 2012 – invited; not yet formally accepted

NAME	COUNTRY/Organization	Specialty	Mail address
Cox, Simon	AUSTRALIA (CSIRO)	OneGeology; Geologic mark-up language (GeoSciML)	WAS: CSIRO Exploration & Mining, 26 Dick Perry Avenue, Kensington WA 6151 [PO Box 1130, Bentley WA 6102] AUSTRALIA
Menning, Manfred	GERMANY (GFZ)	Chair of German Strat. Comm.; Devon-Tri paleo database	
Richard, Stephen	USA (Arizona Geol. Survey)	OneGeology (N. Amer. geologic map data model); Geologic mark-up language (GeoSciML)	Arizona Geological Survey, 416 W. Congress St., #100; Tucson, Arizona, 85701 USA
Rossi, Philippe, or Jean-Paul Cadet	FRANCE (Comm. Geol. Map World)	UNESCO Commission for the Geological Map of the World	CCGM/CGMW; 77, rue Claude-Bernard, 75005 Paris, FRANCE
Soller, Dave (and Nancy Stamm) -- joint	USA (USGS)	Coordinator, USGS National Geologic Map Database [Nancy Stamm is database developer for Geologic names and paleontologic databases]	U.S. Geological Survey, MS 926-A National Center, Reston, VA 20192 USA
Waters, Colin N.	ENGLAND (Brit. Geol. Survey)	Manager of Geoscience Standards & Nomenclature project	British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG GREAT BRITAIN

Appendix:

Original task suite (2001) established for the Stratigraphic Information

In 2001, a suite of proposed objectives were established for the Subcommission on Stratigraphic Information which included brief indications of their importance to the global geoscience community. It was planned that most of these components will be accessible through the ICS/SSI Web site at www.stratigraphy.org.

(1) ICS/SIS Website

24. Develop a method of classification to organize, logically, the data-bases, related links and make easy search and use of the contents.
25. Open forum: Electronic discussion group (SIS-Net ?). In addition to the Web site, a link to a thematic discussion group (electronic mailing list) could be set up for SIS. Its purpose would be to make it possible to exchange useful information quickly and efficiently. Scientific comments, debates, and discussions of problems within the areas of interest, announcements and specifically addressed questions, would be all encouraged, as long as they are of relevance to SIS. Maps and stratigraphic charts are of obvious interest and photographs of taxonomically significant and/or problematic fossils could be launched for discussion among specialists.

(2) Biostratigraphy Zonations and Stratigraphic Lexicons

26. Regional biozonal schemes: with definitions of zones and type-sections (link to the iconographic atlases of index fossil species).
27. Regional lithostratigraphic frameworks and time scales, with definitions of individual lithostratigraphic units, photos of type-sections, chronostratigraphic correlations, and references.
28. This would have the enormous advantage of making easily accessible the regional lithostratigraphy and time scales of basins worldwide, with links to related data-bases.

(3) Geohistory Data-bases.

29. Facies Stratigraphy: Data base of outcrop and core sections. Iconographic atlases showing types of siliciclastic and carbonate macro- and micro-facies, diagnostic sedimentary structures, ichnofossils/ichnofabrics and ichnofacies, etc., including, wherever possible, interpretations, paleogeographic facies models, and references.
30. Paleogeographic and Paleoclimatic Maps. The data base for the paleogeographic maps, sourced from the published literature, ongoing research, and from still unpublished M.Sc./Doctorate research results, could be collected and plotted on base paleogeographic maps (e.g., <http://www.scotese.com>).
31. Continental Ecosystems. Stratigraphic correlations, distribution of paleoclimatic indicators, and the relationship (depositional and time-equivalence of events) of continental ecosystems with adjacent marginal marine basins.
32. Marine Ecosystems. Paleoceanographic belts, approximate paleobathymetric contour curves, areas of paleo-upwelling, phosphate deposits, black shales, carbonate platforms, turbidites, major trends of surface and bottom currents.

(4) Iconographic Atlases.

33. Index fossil species: systematics, biostratigraphy and paleoecology. Iconographic atlases of stratigraphically significant fossil groups (ammonites, inoceramids, foraminifers,

ostracodes, radiolarians, calcareous nannofossils, palynomorphs), to be accompanied by biostratigraphic frameworks for the various basins worldwide.

34. Biostratigraphy in thin-sections. Atlas of index fossil species (e.g., foraminifers, radiolarians, pithonellid calcispheres, calpionellids, roveocrinids) examined in thin sections, illustrating the diagnostic features.

Biostratigraphic and paleoecological data are indispensable to establish an integrated stratigraphy for interbasinal correlation. While an enormous amount of data exist based mainly on outcrop sections and on thousands of oil exploration boreholes, surprisingly few recent synthetic biostratigraphic and paleogeographic studies have actually been published. In addition, many of the published data are in need to be brought up to date.

To be able to acquire these, it would be necessary to determine and illustrate (with good SEM photographs), if not all, at least the index species and these illustrations along with the stratigraphic distribution of these species. Simply giving stratigraphic charts without illustrations is not sufficient, as diverse forms are often used as index species under the same name.

The final aim would be, among others, the publishing of iconographic atlases of index fossils for the various sedimentary basins around the globe.

In some offshore basins, with well established stratigraphic scales, the solution would be simple, if oil companies active in the area allow the release of existing data and make possible to present these in published format through the ICS/SIS website. The first step could be to approach individually prospective authors, who could accept to collaborate and, if necessary, contact officially their company.

To maximize application, the biostratigraphic frameworks, to be included as part of the Taxonomic, Iconographic and Biostratigraphic Atlases of Index Fossil Species, have to be presented per study basin, thus reflecting differences in regional tectono-sedimentary characteristics and biogeographic differentiation.

(5) Quantitative Biostratigraphy Programs

- Interest in quantitative biostratigraphy is flourishing, and there is demand for teaching modules of key techniques and its computer programs. Compact demonstration modules will be prepared of the three methods Unitary Association (UA), Ranking and Scaling (RASC) and Constrained Optimization (CONOP) that can be downloaded via the ICS master website.

(6) Teaching & Research.

35. Easy-to-follow teaching guides: quantitative techniques of stratigraphic interpretation, chemostratigraphy, cyclostratigraphy, and Sr-stratigraphy, applied techniques to sequence stratigraphy: state-of-the-art, among others.

Virtual field-trips to key type-sections: stratotypes, GSSPs, stage boundaries' sections: with location map; photos and zoom showing details of beds down to thin sections; stratigraphic charts with litho-, magneto-, isotope-, chemo-, and biochronostratigraphy; distribution charts of fossils, composite graphic correlation of key markers, etc.; published references and non-published theses on the area.