

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES  
INTERNATIONAL COMMISSION ON STRATIGRAPHY



***Chair***

Prof. Stanley **FINNEY**, Department of Geological Sciences, California State University at Long Beach, Long Beach, CA 90840, USA  
TEL: 1-562-985-8637 (office); FAX: 1-562-985-8638; E-mail: [scfinney@csulb.edu](mailto:scfinney@csulb.edu)

***Vice Chair***

Prof. Shanchi **PENG**, Nanjing Institute of Geology & Palaeontology, Chinese Academy of Sciences, 39 East Beijing St., Nanjing 210008, China  
TEL and FAX: 86-25-8328 2135; E-mail: [scpeng@nigpas.ac.cn](mailto:scpeng@nigpas.ac.cn)

***Secretary General***

Prof. Paul R. **BOWN**, Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT, UK  
TEL: 44-0-20-7504-2431 office; FAX 44-0-20-7388-7614; E-mail: [p.bown@ucl.ac.uk](mailto:p.bown@ucl.ac.uk)

December 2011

---

**Compiled ICS Subcommittee Annual Reports for 2011**

# SUBCOMMISSION ON QUATERNARY STRATIGRAPHY

## ANNUAL REPORT 2011

### 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.

Tel: +44 (0)1223 333924; Fax: +44 (0)1223 333392, E-mail: plg1@cam.ac.uk

### 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 2010-2012:

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

Secretary: Professor Thijs van Kolfschoten  
Faculty of Archaeology, Leiden University  
Reuvenplaats 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 Association of Quaternary Research (INQUA). Also support from national stratigraphical bodies, including in particular the Geological Society Stratigraphical Commission (GB).

## 5. CHIEF ACCOMPLISHMENTS IN 2011

Two GSSP Working Groups (Middle Pleistocene and Late Pleistocene) continue to have fully functioning formal working groups (see below for membership lists). The Anthropocene working group, established in 2009, continues to work very actively this year. Following last year's establishment of a small group led by Professor Maria Bianca Cita to compile a proposal for establishment of a basal GSSP for the Calabrian Stage, the proposal was successfully agreed by ICS voting members and was submitted to IUGS for ratification in November 2011. It was decided to wait before developing fledgling working groups into fully functioning organisations until the principal GSSP goals had been settled.

The Working Group on the Lower/Middle Pleistocene Subseries boundary currently comprises: Luca Capraro (Italy), Neri Ciaranfi (Italy), Craig Feibel (USA), Martin Head (Canada, Co-Chair), Hisao Kumai (Japan), Luc Lourens (The Netherlands), Lui Jiaqi (China), Anastasia Markova (Russia), Tom Meijer (The Netherlands), Muneki Mitamura (Japan), Brad Pillans (Australia, Co-Chair), Cesare Ravazzi (Italy), Charles Turner (UK), Thijs Van Kolfschoten (The Netherlands).

Three sections remain under consideration, the Montalbano Jonico section in the Province of Matera, Southern Italy (proponent, Neri Ciaranfi), the Valle di Manche section in the Crotona Basin, Southern Italy (proponent, Luca Capraro), and the Chiba section in Japan (proponent, Hisao Kumai).

Unfortunately, each section has its problems. The Montalbano Jonico section is in many ways ideal but efforts to obtain a magnetostratigraphy have not been successful owing to diagenetic overprinting (Sagnotti et al., 2010). This is a crucial problem because it has long been accepted that the Matuyama–Brunhes boundary should serve as the principal guide to the Early–Middle Pleistocene boundary. Nonetheless, progress is being made on this section. For example  $^{40}\text{Ar}/^{39}\text{Ar}$  dating shows an age of  $805.42 \text{ ka} \pm 12\%$  for the volcanoclastic V3 layer of Montalbano, which is close to that of the Matuyama–Brunhes boundary. Plans are nonetheless in progress to propose the Montalbano Jonico section, even without magnetostratigraphy, on the basis of many other correlatable signals.

The Valle di Manche section has magnetostratigraphy and the Matuyama–Brunhes boundary is clearly demarcated. Detailed bio- and isotope stratigraphies are available for this section, although there seem to be problems with the interpretation of the pollen record. Luca Capraro and colleagues are willing to submit a formal proposal on this section at relatively short notice. The Pitagora Ash, which lies close to the Matuyama–Brunhes boundary in the Valle di Manche section, is not apparently recognised definitively in the Montalbano Jonico section.

The Chiba section in Japan has a recorded magnetostratigraphy, with the Matuyama–Brunhes boundary clearly shown, and there are many additional published studies (mostly in Japanese). However, no synthesis in English is available to evaluate the section. A one-day international symposium, organised by Prof. Hisao Kumai, was held in Ichihara City, Chiba Prefecture, Japan on 15 January 2011 followed by a field trip to the section. Brad Pillans and Martin Head gave invited presentations at the symposium, and evaluated the section with Japanese colleagues the following day. The potential type section is part of a sequence of outcrops exposed along deeply incised valleys of the Yoro River system. Sedimentation is continuous from the Gelasian to the Middle Pleistocene and sedimentation rates are very high, the Calabrian alone being more than 1 km thick. Plans are underway to publish a synthesis paper in English on the Chiba section.

*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).*

The full formal GSSP proposal defining the Middle/Upper (Late) Pleistocene boundary was prepared in 2008 at the Amsterdam Terminal (the Eemian Stage parastratotype). This boundary 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 Subcommittee was 100% in favour (18 voting). The votes received from the ICS voting membership were 10 in favour (71%), and 4 against. The request for IUGS ratification of this GSSP definition was considered by the IUGS Executive Committee in September 2008, however, the IUGS EC did not ratify this proposal as presented by the SQS/ICS, mainly based on procedural matters, protocol and principle. Unfortunately work on this boundary has not progressed and is unlikely to be restarted until the situation concerning the inclusion of the 'Tarentian Stage' as a 'standard stage' or not is clarified. The current chair, Professor Litt, is strongly opposed to this development and therefore progress must await further developments.

The Working Group on the Pleistocene–Holocene boundary, chaired by Professor M. Walker (Lampeter) was completed in 2008. The working group has ceased activity. However, a joint Working Group of INTIMATE and the SQS is

considering a formal subdivision of the Holocene Series/Epoch. Although previous attempts to subdivide the Holocene have proved inconclusive, recent developments in Quaternary stratigraphy, notably the definition of the Pleistocene-Holocene boundary and the emergence of formal subdivisions of the Pleistocene Series/Epoch, mean that it may be timely to revisit this matter. The Quaternary literature reveals a widespread informal usage of a tripartite division of the Holocene ('early', 'middle' or 'mid', and 'late'), and the Working Group has come to the view that this *de facto* subdivision should now be formalised to ensure consistency in stratigraphic terminology. The WG is proposing an Early-Middle Holocene Boundary at 8.2 ka BP and a Middle-Late Holocene Boundary at 4.2 ka BP, each of which is linked to a Global Stratotype Section and Point (GSSP), and is preparing a 'position paper' setting out the details of the proposal for publication in *Journal of Quaternary Science*. Should this find a broad measure of support from the Quaternary community, a submission will be made to the IUGS, via the SQS and the ICS, for formal ratification of a subdivision of the Holocene Series/Epoch.

The Anthropocene Working Group, chaired by Dr J. Zalasiewicz (Leicester). This year the group has published a thematic issue of the *Philosophical Transactions of the Royal Society of London* on the Anthropocene, and is preparing a follow-up volume, specifically dealing with stratigraphical aspects, to be submitted as a *Special Publication of the Geological Society of London*. A successful meeting was held in at the Geological Society of London (Burlington House) in May 2011. There has been a good deal of discussion of the Anthropocene context in both scientific and wider societal circles, it being featured at the Nobel Laureates' meeting in Stockholm, and in *Nature* and *Science* and other journals. The Working Group has applied for funding to allow further discussion and networking, and is working to reach a consensus regarding formalisation by, it is hoped, the 2016 IGC.

*The GSSP for the base Calabrian Stage.* The base 'Quaternary' definition proposal of 2009 requested, *inter alia*, that the Calabrian Stage be officially recognised with its base defined by the Vrica GSSP in Calabria (the previous base of the Pleistocene). Although this request was included in the ballot voted on and accepted by the SQS, it failed to appear on the ballot sent to the ICS voting membership. Hence, while all scientific and technical requirements for acceptance of the Calabrian Stage have otherwise been met (Cita et al., 2008), it had not been voted on by ICS. Therefore following preparation of a proposal by the chair, Martin Head and Maria-Bianca Cita it was submitted and approved by the ICS on 26.04.11. Voting: 15 in favour, 0 against, 1 abstention and 1 no response. It is currently awaiting ratification by the IUGS where it was submitted on 14 November 2011.

In addition to the Working Group activities noted above, the Subcommittee website continues to be expanded at: <http://www.quaternary.stratigraphy.org.uk> This site is used as the main form of communication for the Subcommittee. 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.

During the year a new version of the Subcommittee's correlation poster was produced for presentation at the INQUA Congress in Bern in July 2011 and a new poster showing the detailed events for the last 270 ka was also previewed. Both posters were compiled by Kim Cohen and Phil Gibbard. The 2.7 Ma poster is available as a download from the Subcommittee's website and the new 270 ka poster will be available shortly (following publication in the *Netherlands Journal of Geoscience*) in the same place.

## **6 ELECTION OF OFFICERS TO SERVE FOR THE IGC INTER-CONGRESS PERIOD 2012-2017.**

In accordance with the statutes of the International Commission on Stratigraphy, the officers of the subcommittees can only serve a term of two inter-congress periods and are re-elected at the International Geological Congress (IGC) which will be held next in July 2012 at Brisbane, in Australia. Accordingly at this meeting the three SQS officers posts will be vacated and new officers will be required to fill them.

Following a request by the existing officers for persons to be proposed for election to the offices of chair, vice-chair and secretary, only three persons names emerged as being prepared to take office, one for each post (Each voting member had three votes):

1. Chair: Professor Martin J. Head (Brock University, St Catherines, Ontario, Canada). Yes: 14, No 0, abstain: 3.
2. Vice-chair: Professor Brad Pillans (Australian National University, Canberra, Australia). Yes: 15, No 0, Abstain 2.
3. Secretary: Dr Jan A. Zalasiewicz (University of Leicester, Leicester, England). Yes: 15, No 0, Abstain 2.

I declare the three candidates named duly above elected.

## 7. SUMMARY OF EXPENDITURE IN 2011:

Cost of website domain name	£10.00
-----------------------------	--------

## 8. SUMMARY OF INCOME IN 2011:

Amount received from ICS	£500
Amount received from Wiley-Blackwell (website sponsorship)	£250
TOTAL	£750.00

## 9. BUDGET FROM ICS IN 2011

*Currency in British Pounds (£), based on an exchange rate of £1.00 = 0.84 € (22.11.11)*

### *Actual costs 2011*

Current bank balance	£1706.79
----------------------	----------

### *Proposed costs for 2012*

Contributions to Working Groups	£100
Support for meetings	£200*

\* not including travel for officers to IGC which should include travel for retiring chair and new chair (Professor Martin Head).

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

All three working groups will continue to function in 2011. 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. As noted above, other working groups remain 'on hold' at present.

### **Potential funding sources outside IUGS**

Apart for 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.

## 11. OBJECTIVES AND WORK PLAN FOR NEXT 2 YEARS (2010-2012)

The Science plan to be completed before the year 2012 will be as follows:

- 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.
- No international stage-level subdivisions for the Holocene will be formalised as yet.
- 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.
- 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.
- As noted above, a fifth working group will assess the case for formal definition of short-time divisions of the Quaternary.
- 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.

## 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](mailto:plg1@cus.cam.ac.uk)

Vice-Chair: Professor Jerry McManus  
Lamont-Doherty Earth Observatory  
Columbia University  
239 Comer 61 Route 9W - PO Box 1000  
Palisades, New York  
10964-8000, USA  
Tel.: +1 (845) 365-8722  
Fax.: +1 508 289 2175  
E-mail: [jfm2163@columbia.edu](mailto:jfm2163@columbia.edu)

Secretary: Professor Thijs van Kolfschoten  
Faculty of Archaeology, Leiden University  
Reuvenplaats 4, 2300 RA Leiden, The Netherlands  
E-mail: [T.van.Kolfschoten@rulpre.leidenuniv.nl](mailto:T.van.Kolfschoten@rulpre.leidenuniv.nl)

### *List of Voting Members*

Dr Brent Alloway  
Aurelian Resources Inc.  
1100 - 350 Bay St.  
Toronto, Ontario  
M5H 2S6, Canada  
Phone: +1 416-868-9100  
Fax: : +1 416-868-1807  
E-mail: [balloway@aurelian.ca](mailto:balloway@aurelian.ca)

Dr Alan Glenn Beu  
Institute of Geological & Nuclear Sciences  
P O Box 30368, Lower Hutt, New Zealand  
[Courier address: Gracefield Research Centre  
69 Gracefield Road, Lower Hutt, New Zealand]  
Direct phone: +64-4-570 4847  
Fax: +64-4-570 4600  
E-mail: [a.beu@gns.cri.nz](mailto:a.beu@gns.cri.nz)

Professor Mauro Coltorti  
Dipartimento di Scienze della Terra  
Via di Laterina, 8  
53100 Siena, Italy  
tel +39- (0)577-233814  
fax +39-(0)577-233938  
email: [coltorti@unisi.it](mailto:coltorti@unisi.it)

Professor Valerie Hall  
School of Archaeology and Palaeoecology  
Queen's University  
BELFAST  
N. Ireland

BT7 1NN  
UK  
Tel. +44 (0)28 90973226  
E-mail: [V.Hall@queens-belfast.ac.uk](mailto:V.Hall@queens-belfast.ac.uk)

Professor Martin J. Head  
Department of Earth Sciences  
BROCK UNIVERSITY  
500 Glenridge Avenue  
St. Catharines, Ontario L2S 3A1  
CANADA  
Tel 905-688-5550 ext. 5216  
Fax 905-682-9020  
Email [mjhead@brocku.ca](mailto:mjhead@brocku.ca)

Professor Dr. Liu Jiaqi  
Institute of Geology and Geophysics  
Chinese Academy of Sciences  
Beituchenglu, Qijiahuozhi  
P.O.Box 9825, Beijing  
100029 China  
Tel. +86 10 62008005(0)/62008240(h)  
Fax. +86 10 62052184/62010846  
email: [liujq@mail.igcas.ac.cn](mailto:liujq@mail.igcas.ac.cn)/[liujiaqi2001@yahoo.com.cn](mailto:liujiaqi2001@yahoo.com.cn)

Professor Karen Luise Knudsen  
Department of Earth Sciences  
University of Aarhus  
C.F. Mollers Alle 120  
DK-8000 Aarhus C  
Denmark  
Tel: +45 8942 3557  
Fax: +45 8618 3936  
E-mail: [karenluise.knudsen@geo.au.dk](mailto:karenluise.knudsen@geo.au.dk)

Professor Thomas Litt  
Institute of Paleontology  
University of Bonn  
Nussallee 8  
D-53115 Bonn, Germany  
Phone: +49 228 732736  
Fax: +49 228 733509  
E-mail: [t.litt@uni-bonn.de](mailto:t.litt@uni-bonn.de)

Professor Leszek Marks  
Polish Geological Institute  
Rakowiecka 4, PL 00-975 Warsaw, Poland  
Phone: +4822 849 5096  
Fax: +4822 849 4921  
[lmar@pgi.waw.pl](mailto:lmar@pgi.waw.pl)  
[lmarks@geo.uw.edu.pl](mailto:lmarks@geo.uw.edu.pl)

Professor Tim Partridge

Climatology Research Group  
University of the Witwatersrand  
12 Cluny Road  
Forest Town  
Johannesburg 2193  
South Africa  
Phone (+2711) 646-3324  
Fax (+2711) 486-1689  
E-mail: tcp@iafrica.com

Professor Jan A. Piotrowski  
Department of Earth Sciences  
University of Aarhus  
C.F. Moellers Alle 1120  
DK- 8000 Aarhus C  
Denmark  
Tel.: +45 8942 2555  
Tel.: +45 8942 9402  
Fax: +45 8613 9248  
Skype: jan.a.piotrowski

Professor Brad Pillans  
Research School of Earth Sciences  
The Australian National University  
Canberra, Act, 0200,  
Australia  
Ph: +61-2-6125 9644 (Office)  
+61-2-6249 1507 (Lab)  
+61-2-6232 4687 (Home)  
Fax: +61-2-6125 3683  
E-mail: brad.pillans@anu.edu.au

Dr Denis-Didier Rousseau  
Ecole Normale Supérieure  
Laboratoire de Meteorologie Dynamique  
& CERES-ERTI  
24 rue Lhomond  
F-75231 Paris Cedex 5  
France  
tel +33-(0)14432 2724  
fax: +33-(0)14432 2727  
E-mail: rousseau@lmd.ens.fr

Professor Jean-Pierre Suc  
Directeur de Recherche CNRS  
Laboratoire Paléoenvironnements et Paleobiosphère  
Université Claude Bernard - Lyon 1  
27-43 boulevard du 11 Novembre  
F-69622 Villeurbanne Cedex,  
France  
Tel. (33).(0)4.72.44.85.90  
Fax. (33).(0)4.72.44.83.82  
E-mail: jean-pierre.suc@univ-lyon1.fr  
jean-pierre.suc@wanadoo.fr

Dr. Alexey S. Tesakov  
Geological Institute  
Russian Academy of Sciences  
Pyzhevsky, 7

119017 Moscow  
Russia  
Tel.: +7 495 230-8085  
E-mail: tesak@ginras.ru

Dr. Charles Turner,  
Department of Earth Sciences,  
The Open University,  
Milton Keynes MK7 6AA,  
UK  
Tel: +44 1908 652889  
Fax +44 1908 655151  
E-mail chassturner@aol.com

Professor M.J.C. Walker  
Department of Archaeology and Anthropology  
University of Wales, Lampeter  
Ceredigion, SA48 7ED,  
Wales, UK  
Email: walker@lamp.ac.uk  
Phone: +44 1570 424736  
Fax: +44 1570 423669

Professor Cari Zazo  
Departamento de Geología  
Museo Nacional de Ciencias Naturales (CSIC)  
Jose Gutierrez Abascal 28006-Madrid (Spain)  
Tel.-++34.91.4111328 (ext.11899)  
Fax.-++34.91.5644740  
e-mail.- mcncz65@mncn.csic.es

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 (Utrecht, The Netherlands)  
A.Bosch@nitg.tno.nl

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  
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).  
Professor Hisao Kumai (Osaka, Japan)  
Professor Neri Ciaranfi (Bari, Italy)

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 (Xi'an, China)  
Eric O'Dada (Nairobi)

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  
22.11.11

## SUBCOMMISSION ON NEOGENE STRATIGRAPHY

### ANNUAL REPORT 2011

#### 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](mailto: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](http://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:

<b>Chair:</b>	Frits Hilgen, Utrecht, The Netherlands
<b>Vice-Chairs:</b>	Francisco Javier Sierro, Salamanca, Spain David Hodell, Cambridge, UK
<b>Secretary:</b>	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 (IODP) 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 2011

##### Towards defining the Langhian GSSP

The base of the Langhian and thus the Lower-Middle Miocene boundary is widely accepted to be approximated by the *Praeorbulina* datum and a position close to Chron C5Cn, in agreement with common and consolidated practise. However, the historical stratotype at Cessolo with terrigenous and turbiditic sediments in its lower part is less suitable for defining the GSSP. For that reason, two potentially suitable sections for defining the Langhian GSSP were selected in the Mediterranean, namely the downward extension of the La Vedova beach section in northern Italy and St. Peter's Pool on Malta. These sections were studied as part of the 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.

Research papers directed at selecting the most suitable section and guiding criterion for defining the Langhian GSSP will be published in a special volume of Stratigraphy and are in press. These include papers presenting results of integrated high-resolution magnetostratigraphic and calcareous plankton biostratigraphic studies of the La Vedova and St. Peter's Pool sections (Foresi *et al.*, 2011; Turco *et al.*, 2011). At La Vedova, the reversal boundary that corresponds to the top of C5Cn.1n is found in the interval marked by the so-called megabeds of Montanari *et al.* (1997). However, the *Praeorbulina* datum, marked by the FO of *P. glomerosa curva* according to Turco *et al.* (2011), is located much higher in the section, close to the C5Bn.2n/C5Br reversal boundary. The reason for this is that Turco *et al.* (2011) follow the taxonomic concept of Blow (1956, 1969) and included *P. sicanius* under the genus *Globigerinoides*. Turco *et al.* (2011) therefore conclude that the *Praeorbulina* datum is insufficient to define the base of a chronostratigraphic unit, not only because of the controversial taxonomic concepts, but also because of its rarity and diachroneity, and its discontinuous distribution. At this stage, the best criterium to identify the base of the Langhian thus seems to be the top of Chron C5Cn. The bioevent that approximates the magnetic reversal is the LCO of the nannofossil *H. ampliapertura*, which is a reliable event in the Mediterranean, but defies exportation to open ocean sites at low-latitudes (Turco *et al.*, 2011).

St. Peter's Pool offers an alternative section for defining the Langhian GSSP (Foresi *et al.*, 2011). This cyclic deep marine section provides an excellent calcareous plankton biostratigraphy which allows a straightforward correlation to the La Vedova section (Iaccarino *et al.*, 2011). The section is easily accessible and contains the Burdigalian/ Langhian boundary on the basis of (1) the historical criterion that *P. glomerosa sicana* FO (= *G. sicanus* FO of Foresi *et al.*, 2011) occurs at the base of the Langhian Stratotype (Rio *et al.*, 1997) and (2) that it is close to the top of the C5Cn.1n (Lourens *et al.*, 2004), but the magnetostratigraphy is unfortunately of a rather poor quality (Mazzei *et al.*, 2009; Foresi *et al.*, 2011; Iaccarino *et al.*, 2011).

Ongoing studies focus on the cyclostratigraphy and the astronomical tuning of these sections, which is considered an important criterion for defining GSSPs in the Neogene. The younger La Vedova beach section has been studied in detail and an astronomical tuning established (Hüsing *et al.*, 2009). Also the downward extension covering the interval for defining the GSSP looks promising from an orbital tuning perspective (Iaccarino *et al.*, 2009). A preliminary astronomical tuning and astrobiochronology have been established for the alternative St. Peter's Pool section on Malta (Lirer *et al.*, 2009). Following these studies a decision will be made which section and criterion are most suitable for defining the Langhian GSSP. Evidently, both sections have their strong and weak points and are complementary to each other, with La Vedova having a higher quality magnetostratigraphy and St. Peter's Pool a better preservation of the calcareous plankton. The latter is important for biostratigraphy and stable isotopes.

## 6. CHIEF PROBLEMS ENCOUNTERED IN 2011

A problem that remains is the possible lack of suitable sections in the Mediterranean for defining the Burdigalian GSSP. This is certainly the case if we prefer to have the Burdigalian GSSP defined in an astronomically tuned deep marine section in the Mediterranean that directly underlies the geologic time scale. The 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 the coming year.

The other problem that remains is the outcome of the ICS vote on the Quaternary issue and the formal ratification by IUGS which is unacceptable for many SNS members, including the chair.

## 7. SUMMARY OF EXPENDITURES IN 2011:

<b>Credit on Nov 2010</b>	<b>Euro</b>	<b>2965,35</b>
ICS	Euro	+ 1010,00
Transfer costs	Euro	-7,00
<b>Credit on Nov 2011</b>	<b>Euro</b>	<b>3968,35</b>

## 8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2011):

Publication of the Neogene ATNTS2012 chapter in GTS2012.

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 and focus on the astronomical tuning of the sections and the construction of a stable isotope record for St. Peter's Pool. It is anticipated that a workshop will be held in the second half of next year about the definition of the Langhian and Burdigalian GSSPs. The search for suitable sections and/or cores for defining the Burdigalian GSSP will continue. 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 considered.

## 9. BUDGET AND ICS COMPONENT FOR 2012

Organization workshop on Langhian and Burdigalian GSSPs, Italy	Euro 2500
Optional: Fieldtrip to the La Vedova section (base-Langhian)	Euro 1500

## 10. SUMMARY OF MAIN ACCOMPLISHMENTS OVER PAST FIVE YEARS (2007-2011)

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. Preparation 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.

2009

Publication of several papers by members of SNS on the issue of the Quaternary issue (Aubry et al., 2009; McGowran et al., 2009; Van Couvering et al., 2009). Publication in Episodes about the formal definition of the Serravallian GSSP (Hilgen et al., 2009). Ongoing research on the La Vedova and St. Peter's sections.

2010

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

2011

Publication of several papers about potential Langhian GSSP sections in a special volume of Stratigraphy (in press). Preparation of the Neogene chapter (ATNTS2012) of the GTS2012 (Hilgen et al., 2011, in press).

## 11. OBJECTIVES AND WORK PLAN FOR NEXT 2 YEARS (2011-2012)

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 land-based section, or should we define this GSSP in drilled ODP sequences at Ceara Rise or any other tuned sequence drilled by (I)ODP.

Selection of most suitable section/ODP core and guiding criteria for defining the Langhian and Burdigalian GSSPs before 2013. Writing of proposals for the Langhian and Burdigalian GSSPs in 2012-2013.

\*\*\*\*\*

### **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](mailto:fhilgen@geo.uu.nl)

**Vice Chairmen:** David Hodell, Department of Geological Sciences, University of Florida, Gainesville, FL 32611, USA. Email: [dhodell@geology.ufl.edu](mailto: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](mailto:sierro@usal.es)

**Secretary:** Elena Turco, Dipartimento di Scienze della Terra, Università degli Studi di Parma, Viale G.P. Usberti 157A, 43100, Parma, Italia. Email: [elena.turco@unipr.it](mailto:elena.turco@unipr.it)

#### **List of Voting Members**

Agusti, J., Spain, [jordi.agusti@icrea.es](mailto:jordi.agusti@icrea.es)

Aubry, M.P., USA, [aubry@rci.rutgers.edu](mailto:aubry@rci.rutgers.edu)

Backman, J., Sweden, [backman@geo.su.se](mailto:backman@geo.su.se)

Berggren, W.A., USA, [wberggren@whoi.edu](mailto:wberggren@whoi.edu)

Bernor, R., USA, [rbernor@howard.edu](mailto:rbernor@howard.edu)

Beu, A.G., New Zealand, [a.beu@gns.cri.nz](mailto:a.beu@gns.cri.nz)

Gladenkov, Y.B., Russia, [gladenkov@ginras.ru](mailto:gladenkov@ginras.ru)

Hilgen, F.J., Netherlands, [fhilgen@geo.uu.nl](mailto:fhilgen@geo.uu.nl)

Hodell, D.A., USA, [dhodell@geology.ufl.edu](mailto:dhodell@geology.ufl.edu)

Iaccarino, S., Italy, [iaccarino@unipr.it](mailto:iaccarino@unipr.it)

Kent, D.V., USA, [dvk@rci.rutgers.edu](mailto:dvk@rci.rutgers.edu)

Nagymarosy, A., Hungary, [gtorfo@ludens.elte.hu](mailto:gtorfo@ludens.elte.hu)

Semenenko, V.N., Russia, ---

Sierro, F.J., Spain, [sierro@usal.es](mailto:sierro@usal.es)

Sprovieri, R., Italy, [rspr@unipa.it](mailto:rspr@unipa.it)

Turco, E., Italy, [elena.turco@unipr.it](mailto:elena.turco@unipr.it)

Vai, G.B., Italy, [vai@geomin.unibo.it](mailto:vai@geomin.unibo.it)

Van Couvering, J., USA, [vanc@micropress.org](mailto:vanc@micropress.org)

Wang, P., China, [pxwang@online.sh.cn](mailto:pxwang@online.sh.cn)

Zachariasse, W.J., Netherlands, [jwzach@geo.uu.nl](mailto:jwzach@geo.uu.nl)

#### **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.
- Foresi, L. M., M. Verducci, N. Baldassini, F. Lirer, R. Mazzei, G. Salvatorini, L. Ferraro, S. Da Prato, 2011. Integrated stratigraphy of St. Peter's Pool section (Malta): New age for the Upper Globigerina limestone Member and progress towards the Langhian GSSP. *Stratigraphy*, in press.

- 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*, 32, 152-166
- Hilgen, F.J., L. Lourens and J. Van Dam, 2011. The Astronomical Tuned Neogene Time Scale 2012. In: F. Gradstein et al., eds., *A Geological Time Scale 2012*, Elsevier, in press.
- Iaccarino, S.M., A. Di Stefano, L.M. Foresi, E. Turco, N. Baldassini, A. Cascella, S. Da Prato, L. Ferraro, R. Gennari, F.J. Hilgen, F. Lirer, R. Maniscaldo, R. Mazzei, F. Riforgiato, B. Russo, L. Sagnotti, G. Salvatorini, F. Speranza, M. Verducci, 2011. High-resolution integrated stratigraphy of the Mediterranean early-middle Miocene: Comparison with the Langhian historical stratotype and new perspectives for the GSSP. *Stratigraphy*, in press.
- McGowran, B., B. Berggren, F. Hilgen, F. Steininger, M.-P. Aubry, L. Lourens, and J. van Couvering, 2009. Neogene and Quaternary coexisting in the geological time scale: The inclusive compromise. *Earth Sci. Revs.*, 96, 249-262.
- Turco, E., A. Cascella, R. Gennari, F.J. Hilgen, S.M. Iaccarino, and L. Sagnotti, 2011. Integrated stratigraphy of the La Vedova section (Conero Riviera, Italy) and implications for the Langhian GSSP, *Stratigraphy*, in press.
- 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*, 32, 125-126.

## SUBCOMMISSION ON PALEOGENE STRATIGRAPHY

### ANNUAL REPORT 2011

#### 1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

##### **International Subcommittee on Paleogene Stratigraphy**

*Submitted by:*

Eustoquio Molina, Chairman  
Departamento de Ciencias de la Tierra  
Universidad de Zaragoza  
Calle Pedro Cerbuna, 12  
E-50009 Zaragoza  
Spain.  
Tel. 34 976 761077, Fax. 34 976 761106  
Email: emolina@unizar.es

#### 2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

##### **Mission statement**

The Subcommittee 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 Subcommittee 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 Subcommittee of the International Commission on Stratigraphy. The Subcommittee is organized by an Executive consisting of Chairman, Vice-Chairman and Secretary, who are all Voting members of the Subcommittee. 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 Vandenberghe and Dalila Zaghib-Turki) elected for their personal expertise and experience and about 100 Corresponding Members, who have a responsibility for communication in both directions between the Subcommittee 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 Subcommittee, 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, UK. Secretary: Hellen Coxall, UK.
- 7) Paleogene Larger Foraminifera Working Group. Past-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: Juan Carlos Silva, Colombia. Secretary: Diana Ochoa, Panama.
- 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), Salzburg, Austria (2011).

#### **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](mailto:emolina@unizar.es)

Vice-Chair: Prof. Noël Vandenberghe. Department Geografie-Geologie. Afdelig Geologie. Redingenstraat, 16. B-3000 Leuven. Belgium. [noel.vandenberghe@ees.kuleuven.be](mailto:noel.vandenberghe@ees.kuleuven.be)

Secretary: Prof. Simonetta Monechi, Dipartimento di Scienze della Terra. Università di Firenze. 4, Via la Pira. I-50121 Firenze. Italy. [monechi@unifi.it](mailto:monechi@unifi.it)

**Procedure used for selection:** The procedure was the 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 (Ninth International Workshop on Agglutinated Foraminifera, Zaragoza, Spain, 3-7, September, 2012).

#### **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 2011

### 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. & Zaghbib-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.

Molina, E., Alegret, L., Arenillas, I., Arz, J.A., Gallala, N., Grajales-Nishimura, J.M., Murillo-Muñetón, G. & Zaghbib-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):** The manuscript "The global stratotype and points for the bases of the Selandian (Middle Paleocene) and Thanetian (Upper Paleocene) stages at Zumaia, Spain" with the 28 members of the Paleogene Working Group as authors, was submitted to *Episodes* on April 28. On August 29 the paper came back from review with suggestions for minor revisions, and a revised version was submitted to *Episodes* on October 8. For the coming years studies are planned aiming at an improved high-resolution, global event stratigraphy across the second radiation of the fasciculiths, an event closely tied to the Danian-Selandian boundary event. Studies are continuing in Egypt and Spain with the aim at improving the means for global correlation across both the Danian-Selandian and the Selandian-Thanetian boundaries.

Schmitz B., Pujalte V., Molina E., Monechi S., Orue-Etxebarria X., Speijer R.P., Alegret L., Apellaniz E., Arenillas I., Aubry M.P., Baceta J.I., Berggren W.A., Bernaola G., Caballero F., Clemmensen A., Dinarès-Turell J., Dupuis C., Heilman-Clausen C., Hilario Orus A., Knox R. Martín-Rubio M., Ortiz S. Payros A., Petrizzo M.R., Von Salis K., Sprong J., Steurbaut E. and Thomsen E. (2011). The Global Stratotype Section and Points for the bases of the Selandian (Middle Paleocene) and Thanetian (Upper Paleocene) stages at Zumaia, Spain. *Episodes*. 34(4), *in press*.

**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:** The Global Stratotype Section and Point (GSSP) for the base of the Lutetian Stage (early/middle Eocene boundary) was defined at 167.85 meters in the Gorrondatxe sea-cliff section (NW of Bilbao city, Basque Country, northern Spain; 43° 22' 46.47''N, 3° 00' 51.61'' W). This dark marly level coincides with the lowest occurrence of the calcareous nannofossil *Blackites inflatus* (CP12a/b boundary), is in the middle of polarity Chron C21r, and has been interpreted as the maximum-flooding surface of a depositional sequence that may be global in extent. The GSSP age is approximately 800 kyr (39 precession cycles) younger than the beginning of polarity Chron C21r, or ~47.8 Ma in the GTS04 time scale. The GSSP was approved by the International Commission of Stratigraphy in January 2011, and ratified by the International Union of Geological Sciences in 2011. Finally, the GSSP was officially published in *Episodes*:

Molina E., Alegret L., Apellaniz E., Bernaola G., Caballero F., Dinarès-Turell J., Hardenbol J., Heilman-Clausen C., Larrasoña J.C., Luterbacher H., Monechi S., Ortiz S. Orue-Etxebarria X., Payros A., Pujalte V. Rodríguez-Tovar F.J., Tori F., Tosquella J. & Uchman A. (2011). The Global Stratotype Section and Point (GSSP) for the base of

the Lutetian Stage at the Gorrondatxe section, Spain. *Episodes*. 34(2), 86-108.

**Bartonian:** In search of a possible candidate section for the base Bartonian GSSP, the Middle Eocene sedimentary succession of the Contessa Highway section (CHS, near Gubbio, central Italy), was re-visited. Historically, this section has been the focus of important biostratigraphic studies on calcareous plankton (foraminifera and nannofossils) and magnetostratigraphy (e.g., Lowrie et al., 1982; Napoleone et al., 1983; Monechi & Thierstein, 1985). In the new study (Jovane et al., 2010) the Middle Eocene interval at CHS was sampled at much higher resolution than in previous works (every 5 cm in average). The co-authors of the paper based on the available high resolution bio-, isotope-, magnetostratigraphy and the astronomical tuning of the sedimentary record, and according to IUGS recommendations, suggest the CHS as an excellent GSSP candidate for the Lutetian/Bartonian boundary. Jovane et al. (2010) concluded in proposing the top of Chron C19n as the most useful and best potential criterion (criterion 4) for global correlation and an astronomically calibrated age for that event of 41.25 Ma.

**Priabonian:** 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 presented in an article entitled "Integrated bio-magnetostratigraphy of the Alano section (NE Italy): a proposal for defining the Middle/Late Eocene boundary" (co-authors Agnini, Fornaciari, Giusberti, Grandesso, Rio and Stefani (Univ of Padua), Lanci (Univ. of Urbino), Luciani (Univ. of Ferrara), Muttoni (Univ. of Milan), Palike & Spofforth (Univ. of Southampton, UK)). This article was accepted last year by the Geological Society of America Bulletin. The working group is now writing the proposal to present to the Subcommittee.

**Rupelian (Eocene/Oligocene boundary):** The GSSP for this boundary was selected in the Massignano Section (central Italy), ratified by the IUGS in 1992 and was officially published in *Episodes*: 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 published paper in which the proposal was put forward.

#### **5b. Annual reports 2011 of the other working groups:**

##### **Paleogene Planktonic Foraminifera Working Group.**

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

The Paleogene Planktonic Foraminifera Working Group held their 9<sup>th</sup> meeting on the taxonomy and evolution of Oligocene planktonic foraminifera at the Smithsonian Institution, Washington D.C., Department of Paleobiology, (National Museum of Natural History, hosted by Brian Huber) in September 2011. Work towards completion of the 'Atlas of Oligocene Planktonic Foraminifera' is now at an advanced stage. Syntheses of the taxonomy and plates for a number of groups, such as *Globorotaloides/Catapsydrax*, *Paragloborotalia*, which mark the near completion of work for some chapters, were presented by lead authors. Drafts of the text for Oligocene chronostratigraphy, planktonic wall textures, *Subbotina*, *Dentoglobigerina Pseudohastigerina/Turborotalia*, biserials and the cancellate walled groups were submitted. Other groups, including *Globigerinoides*, *Globigerinella* and Oligocene clavates still require some work, including establishing wall textures and obtaining holotype images. Spring 2012 was set as a deadline for submission of final versions of chapters, including text, phylogenies, range charts and plates. Then will start the process of internal and external review. The working group aim to have the finished atlas ready for FORAMS 2014, which will be held in Chile.

##### **Paleogene Larger Foraminifera Working Group.**

**Chairman: Lukas Hottinger, Switzerland.**

Unfortunately, the chairman died recently and we are looking for a new one.

##### **Paleogene Deep-Water Benthic Foraminifera Working Group.**

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

Following last year's line of research, we have continued to study the behaviour of deep-sea benthic foraminifera during periods of sedimentary disturbance and global warming, such as the Paleocene-Eocene Thermal Maximum and a newly discovered hyperthermal event during the Ypresian (middle Eocene). Much progress is also being made on the recovery of deep-sea benthic foraminiferal assemblages after the Cretaceous/Paleogene impact event, and on integrating the benthic foraminiferal isotope record in the global carbon cycle. Our Working Group will continue to do research on these two topics next year. Important advances on the taxonomy of Paleocene, Eocene and Oligocene deep-sea benthic foraminifera are also being made, and will be discussed in our meeting next year. Finally, the members of our Working Group are organizing the next International Workshop on Agglutinated Foraminifera (IWAFF-2012), which will be held in

Zaragoza (Spain) from the 3rd to the 7th of September 2012. Our Working Group will have a chance to meet during the first day of the meeting. A two-day field excursion has been scheduled for the last 2 days of the Workshop (6-7th Sept). We will visit the picturesque Basque-Cantabrian basin (Northern Spain and Southern France), where some of the best and world-famous Paleogene flysch deposits (including 3 GSSPs!) are exposed. During the fieldtrip, all the attendants will have the opportunity to study Upper Cretaceous to middle Eocene sediments and to pick up samples where they'll find plenty of deep-water benthic foraminifera. And last but not least, we will all enjoy the breath-taking landscape and amazing food... see you in Zaragoza in 2012!

#### **Paleogene Calcareous Nannofossils Working Group.**

**Chairwoman: Simonetta Monechi, Italy.**

The Paleogene calcareous nannofossil working group has continued its work towards a major revision of the early Fasciculithus and the calcareous nannofossil turnover across the Danian-Selandian boundary. Furthermore, has been continued the discussion on reticulofenestrads, initiated in Yagamata (September 2010) during the International Nannoplankton Association, in order to rationalise the complicated taxonomy and produce a review of the group. In 2010-2011 the Paleogene species list was uploaded to the online taxonomic resource 'Nannotax' (nannotax.org) and descriptions and images have been added for most species. The working group will develop this resource over the next year as well as planning a hard copy taxonomic atlas. For the coming year we are planning to focus on Eocene biostratigraphy and organize meeting in June or early September.

#### **Regional Committee on North-European Paleogene Stratigraphy.**

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

The RCNNS/RCNPS encountered problems finding a venue for the bi-annual meeting. As a result the group joined the RCMNS-RCANS Interim Colloquium 21-23th of September in Salamanca Spain. We announced our own session for the Paleogene, and assumed that the Neogene presentations would fit into the 5 other sessions that covered many aspects of Neogene stratigraphy. However, no presentations were entered for the Paleogene, so the session was cancelled again. Only five (5) persons from the previous meetings were present, and 3 presentations were given. In light of the problems finding a host for the meetings and the ever decreasing number of participants, it has been decided (in dialogue with Noël Vandenberghe, Vice-chair of the Sub-commission on Paleogene Stratigraphy) to let RCNNS/RCNPS „rest“ until renewed interest will take up the committee work again. A mail was send out to all participants of previous meetings but none came forward to take over as Chair. Gitte V. Laursen hereby resign as Chair.

#### **South-American Regional Committee on Paleogene Stratigraphy.**

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

This year a new working group was set up for the South and Central American Regional Committee on Paleogene Stratigraphy. New members representing nine Latin American countries were designated as part of this group. The working group is organized as follows: Chairman: Juan Carlos Silva Tamayo (jsilvatamayo@yahoo.com). Secretary: Diana Ochoa (dianita.ochoa@gmail.com). Argentina: Ana Parras (aparras@exactas.unlpam.edu.ar). Brazil: Tania Lindner Dutra (tdutra@unisinos.br). Chile: Luis Felipe Hinojosa (lfhinojosa@abello.dic.uchile.cl). Colombia: German Bayona (gbayona@cgaes.org). Costa Rica: Teresita Aguilar (aaguilar@geologia.ucr.ac.cr). Cuba: Manuel Iturralde-Vinent (iturralde@mnhnc.inf.cu). Mexico: Enrique Martínez-Hernández (emar@servidor.unam.mx). Panama: Carlos Jaramillo (JaramilloC@si.edu). Peru: Javier Jacay (j\_jacay@yahoo.com).

In addition, during this year, members of the Committee promoted several activities under the framework of XIV Latin American Geological Congress. Some of these were:

Courses:1) Taller de Palinología. Aplicaciones en Paleobiología e industria del Petróleo (Palinology workshop. Paleobiological and Petroleum industry applications). This course was delivered by Dr. Carlos Jaramillo, MSc Felipe de la Parra, and Geologist Milton Rueda. The course counted with the participation of students from several Latin American countries. 2) Course on traditional and non-traditional stable isotopes applied to geosciences. This course was delivered by Dr. Juan Carlos Silva, Dr. Alcides N. Sial, Dr. Valderez P. Ferreira, and Dr. Jaime Escobar.

Workshops: 1) Exploring scientific prospectus of the International Continental Drilling Program in NW South America. This workshop, led by the general secretary of the ICDP, counted with the participation of scientist from different Iberoamerican institutions suchlike Universidad de Caldas, Universidad Jorge Tadeo Lozano, Universidad de Los Andes, Universidad EAFIT, Universidad de Salamanca, Universidad de São Paulo, University of Florida, and the Colombian Petroleum Institute.

Special Symposiums:1) Applications of traditional and non-traditional stable isotopes on paleoenvironment, paleoclimatology and paleobiology.

Invited talks: Harms, U. Continental Scientific Drilling Provides Continuous Sampling Of Paleoenvironmental Archives

Flores, J.A. Assessing Modifications In The Sea Surface Dynamics In The Eastern Equatorial Pacific Ocean Between 4 And 2 Ma Cruz, F. South American Monsoon Regime In The Last Two Glacial Cycles.

Additional Talks: .López-Otálvaro, G.E. Coccolith Calcium Carbonate Production In The Eastern Tropical Pacific: A Paleocological Signal For Paleooceanographic Purposes Silva-Tamayo, J.C. The Interaction Between Central And South America From Sr-Isotope Chemostratigraphy Of Cenozoic Coral Reef Sucessions Ferreira, V.P. The Upper Cambrian And Ordovician Of The Precordillera, Argentina: C- And O-Isotope Stratigraphies, Spice-Snice And Gice Anomalies Escobar Jaramillo, J.E. Isotopic Record Of Atmospheric Lead Pollution In Lake Sediments In Florida Vásquez-Bedoya, L.F. Extension Rate In Corals As A Proxy For Sst During The Last Interglacial. Buitrago-Reina, M. Late Miocene-Early Pliocene Calcareous Nannofossil Biochronology In The Western Equatorial Atlantic Ocean (Odp Site 999): A Review.

Posters: Sial, A.N. Mercury Stratigraphy: A Proxy For Volcanism In The Kt Boundary And Volcanogenic Co2 Buildup In Neoproterozoic Snowball Earth Silva-Tamayo, J.C. Multi Isotope Tracers Of Oceanic Acidification And Deoxidification During The Precambrian And The Late Permian Biologic Crisis. Silva-Tamayo, J.C. C-Isotope Age Constrains Of Aptian Marine Extension In Northn Colombia: Pleriminary Data From The Sierra Nevada De Santa Marta Rosero Céspedes, J.S. Cronoestratigrafia Del Tortoniano-Zancleano Basada En Isótopos De Sr (Pozo Tumaco-1-St-S, Pacífico Colombiano) Ballegeer, A.M. Relevant Cooling In The South-Atlantic Linked To The Closure Of The Central American Seaway Ferreira, V.P. Epidote-Bearing Plutons And Their Tectonic Significance Barrios, L Vermetids As Archives Of Climate Change In The Tropical Eastern Pacific Saavedra Pellitero, M Coccolithophore Estimates Of Paleotemperature Changes In The Southeast Pacific Over The Past ~27 Kyr And Comparison To Alternative Proxies.

Initiatives for 2012:

Symposiums: 1) Integrating the Paleogene palynological and paleobotanical record of Southern and Central America (IPC 2012, Japan). Symposium proposal is pending for approval. 2) New advances and developments on the Paleogene Stratigraphy of Latin American basins. To be submitted before December 1st 2011 to the Geological Society of America fall meeting Committee.

Other activities: 1) The committee will try to get together the most recognized scientists working on the Paleogene sedimentary record of Latin America to construct preliminary Paleogene chronostratigraphic charts to be published on the sub-commission website. 2) The committee will update the website of the sub-commission. The new website will include a list of the most recent publications related to the Latin American Paleogene record. Publications will be divided by scientific areas such as stratigraphy, biostratigraphy, geochemistry, tectonics, basin analysis, among others. The website will include a meeting calendar and related links.

### **Russian Paleogene Commission.**

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

Russian Paleogene Commission has 42 members, 36 Russian and 6 Foreign specialists from Ukraine, Kazakhstan and Azerbaidzhan. Members of Commission took part in 10 International and Russian meetings 2011:

1. January 24-26. *Annual Meeting Moscow Paleontological Society + Moscow Natural Sciences Society (МОИП)*. In framework this meeting special Symposium "Problems of Early Paleogene Stratigraphy and Palaeogeography. A. Akhmetiev M.A., Alexandrova G.N., Beniamovsky V.N., Zaporozhets N.I., Oreshkina T.V. Paleocene and Eocene environments of the Central Eurasia (Middle latitudes). B. Beniamovsky V.N. Crimea-Caucasian Middle Eocene planktonic foraminifera infrazonal scale: phylogeny and ecology. C. Zakrevskaya E.Yu. Influences of the tectonic and facial factors the areal differentiation of the North-Eastern Nummulitides and Orthophragminides.

2. *Biosphaeric Programme 25 (Presidium Russian Acad. Sci.)*. Institute Geochemistry and Analytical Chemistry Russian Ac Sci. A. Akhmetiev M.A., Gavrillov Yu.O. Biotic and abiotic events on K/T boundary Transition.

3. March 26-28 *Tormso (Norge) International Meeting "Cretaceous-Paleogene Palaeoenvironments, tectonics and biostratigraphy of the Arctic and Subarctic*. A. Gladenkov A. Ju. Marine diatoms from the Paleogene of northeastern Kamchatka. B. Oreshkina T.V. Late Paleocene-Early Eocene hyperthermal events in biosiliceous deposits of Western Siberia and adjacent regions.

4. April 6-7. *St Petersburg. All-Russian Geological Institute*. Annual Meeting Paleogene Stratigraphical Commission. (16 members of Commission from different Institutes Russian Acad. Sci. Universities and Regional geological organization. Programme: A. Akhmetiev M.A. Information of Paleogene Commission activity 2010. B. Akhmetiev M.A., Alexandrova G.N., Zaporozhets N.I., Beniamovsky V.N., Oreshkina T.V., Jakovleva A.I. Problems of stratigraphy and palaeogeography of the Central Eurasia Middle latitudes. C. Zakrevskaya E.Yu. North-East Peritethys Paleogene large foraminifera: taxonomy, zonal stratigraphy, palaeobiogeography (Doctor Thesis materials). D. Dmitrieva T.V., Meshcheryakova E.Yu. New biostratigraphical data on Paleogene West Kamchatka (Tigil district): foraminifera and palynoflora. E. Fregatova N.A. Benthonic foraminifera of the Paleocene-Eocene Mametchinsky gulf North-East Kamchatka: assemblages, biostratons, stratigraphical significance, palaeobiogeography. F. Beniamovsky V.N., Fregatova N.A. The Paleocene-Eocene benthonic foraminifera of the North-West Pacific: assemblages, biostratons, stages of

development, palaeogeography. G. Dmitrieva T.V. New data on Eocene-Oligocene foraminifera assemblages of the best sections of the Tigil district (West Kamchatka). H. Moskalyova Ju.A., Meshcheryakova E.Yu. New data on assemblages of foraminifera and dinocysts (Middle-Late Eocene deposits of the Tigil district, West Kamchatka) (new bore-hole).

April 8. Beniamovsky, Fregatova and Dmitrieva on the base Micropaleontological laboratory All-Russian Oil – Prospecting Institute (St. Petersburg) organized Micropaleontological Oral examination of Paleogene microplankton Kamchatka peninsula. 11 specialists took part at this Examination.

5. April 18–22 Memorial Meeting by Corresp. Member Russian Acad. Sci. V.N. Saxe (1911-2011). Novosibirsk Instit. Geology of oil, Sib. Branch Russian Acad. Sci. A. Akhmetiev M.A., Zaporozhets N.I. Mechanism of formation of the Eocene Azolla beds on the Lomonosov Ridge (Arctic) and Tavda basin West Siberian plate (aspects of comparison). B. Alexandrova G.N., Ovechkina V.N., Beniamovsky V.N. Late Cretaceous and Paleocene dinocysts, nannoplankton and foraminifera West Siberian and south part of Russian plates. C. Beniamovsky V.N. West Siberian Maastrichtian-Paleocene foraminiferal assemblages, biostratons, stratigraphy, palaeogeography. D. Vassilieva O.N. East Cis-Caspian tectonic depression dinocysts bore-hole Uspenskaya SP-1. Section. E. Oreshkina T.V. West Siberia and Arctic: Early Paleogene biogenic siliceous deposits. F. Iakovleva A.I., Alexandrova G.N., Gnibidenko Z.N. Making more precise the age of Ljulinvor Formation. (West Siberia).

During the Memorial Meeting it was organized new Regional Paleogene Subcommittee staff including 13 members Chairman this Commission was elected Dr. Golovina A.G. (West-Siberian Geological and Mineral Resources Institute, Novosibirsk).

6. April 27. Geological Institute Russian Acad. Sci., Moscow Supporting of the Doctor (Professor) A. Thesis Zakrevskaya E.Yu. Paleogene large foraminifera of the North-Eastern Peri-Tethys: taxonomy, zonal stratigraphy, palaeogeography, palaeoecology and palaeobiogeography.

7. May 21-23 I Int. Symposium on Paleontology and Geology Liaoning, China. (Shenyang, Paleontological Museum. A. Herman A.B. Albian – Paleocene Flora of the North Pacific Region. B. Kodrul T.M. Jin J.H., Alexandrova G.N., Zhou W.J., Wang L., Song Y.S., Liu X.Y. Preliminary data on the first discovered fossil flora of the Late Cretaceous – Neogene Maomong basin and Changcjang basin, South China. C. Akhmetiev M.A. The Early Eocene subtropical flora the Raichikha coal field (Amur River Region, Far East Russia). D. Kezina T.V. The Cenozoic stratigraphy of the Amur River Basin deposits.

8. June 5-8. Salzburg (Austria) International Symposium “Climate and biota Early Paleogene (SVEP-011)”. A. Akhmetiev M.A., Beniamovsky V.N., Zaporozhets N.I. E/O transition biospheric crisis “warm” and “cold” biosphere of central part of extratropical Eurasia (stratigraphy, palaeogeography and palaeoclimatology). B. Akhmetiev M.A., Zaporozhets N.I., Beniamovsky V.N., Alexandrova G.N., Iakovleva A.I., Oreshkina T.V. Open and semi-closed the Paleogene marine systems on Northeastern Peri-Tethys stable and transitional biostratigraphic, paleogeographic and paleoclimatological aspects. C. Beniamovsky V.N. Detailed planktonic foraminiferal zonation of Middle Eocene in Crimea-Caucasian Region of Northeastern Peri-Tethys. D. Gavrilo Ju.O. Diagenetic nature of I – anomalies: an alternative of impact hypothesis? E. Gladenkov A.Ju. First data on the Eocene diatoms from the marine Paleogene key-section of northeastern Kamchatka, Russia. F. Iakovleva A.I., Alexandrova G.N., Gavrilo Yu.O., Golovanova O.N., Pokrovsky B.G. A new high resolution palynological and geochemical study of PETM from Eastern Peri-Tethys. G. Khoroshilova M.A., Shcherbinina E.A. Sea level changes and lithological architecture of the Paleocene- Early Eocene sediments of the Westerns Crimea basin, Ukraine. H. Musatov V. Cretaceous-Paleocene boundary in the Saratov Volga Region as determined from nannoplankton. I. Oreshkina T.V. Diatom and silicoflagellate response to the hypothermal events of Late Paleocene – Early Eocene in biosilicious deposits of West Siberia and adjacent areas. J. Shcherbinina E.A., Gavrilo Yu., Golovanova O, Pokrovsky B. High-resolution study of PETM record in the key-sections of the NE Peri-Tethys.

9. August 20-25. I Intern. Symposium on Geology and Paleontology in Yichun, China. A. Akhmeiev M.A. When and why dinosaurs extincted to the Heilongjiang River basin? B. Sun Ge, Akhmetiev M.A., Markevich V.S., Kodril T.m., Kezina T.V. et al. Late Cretaceous Biota and K/T Boundary in Jiayn, NE China.

10. September 5–8. XIII All-Russian Palynological Conference. Syktyvkar Komi Republik. Institutes Geology and Biology Uralian Branch Russian Acad. Sci. A. Vassilieva O.N. Evolution Wetzelliaceae (Dinophyceae) to the Eocene basin North Peri-Tethys. B. Gladenkov A.Yu. Some mysteries the beginning Early Oligocene diatoms distribution. C. Zaporozhets N.I. Organic-walled phytoplankton, pollen and spores assemblages of the Omsk trough, West Siberia (Middle and Late Eocene). D. Alexandrova G.N., Kuzmichev A.B. To the age Paleogene deposits to Nerpalach lagoon, Kotelný island (Arctic ocean)

11. September 19-21. Paleontological Institute Russian Acad. Sci. Moscow “Sixth International Conference Environmental Micropaleontology, Microbiologie, Meiobenthology”. A. Beniamovsky V.N. Plantronic foraminifera infrazonal of the Middle Eocene of the Crimea – Caucasian region and its phylogenetic and paleobiogeographic foundation. B. Oreshkina T.V., Radionova E.P. PETM event in biosiliceous deposits of the “Russian Paleogene”: C. Shcherbinina E.A., Gavrilo Yu.O., Iakovleva A.I., Golovanova O.V., Alexandrova G.N., Pokrovsky B.G. Environmeny dynamics during PETM in northeastern Peri-Tethys deciphering from high-resolution micropaleontological and geochemical study.

12. September 19-25. *International conference diatomists. Zvenigorod, Moscow district. Zvenigorodskaya station of Moscow University.* A. Oreshkina T.V., Radionovas E.P. Diatoms and silicoflagellates on P/E Transition in “Russian Paleogene” Record. Stratigraphical and Taxonomical revision.

13. October 3-5. *All-Russian scientific school for young paleontologists. Paleontological Institute Russian Acad. Sci., Moscow.* A. Malyshkina T.P. History Paleogene sharks genera Abdonia (Elasmobranchii: Carcharhiniformes).

Total: 49 oral presentation on Meetings, 44 publication. 3 books, 1- Doctor Thesis, 8 Papers published in International and Russian magazines with index-quotation, 16 short paper published “Materials...”, Transactions .. others”. More than 20 Abstracts to Conference and Meetings.

**Books:** Atlas of Paleogene Dinocysts of Ukraine, Russia and adjacent countries. Kiev: Naukova Dumka, 2011. 219 p. 64 plates (Andreeva-Grigorovich A.S., Zaporozhets N.I., Alexandrova G.N., Vassilieva O.N., Iakovleva A.I. et al.).

Herman A.B. Albian-Paleocene Flora of the North Pacific Region. Moscow: GEOS, 2011. 280 p. (Trans. Of the Geological Institute; Vol. 592).

Zykin V.S. Late Cenozoic of the Southwest Siberia and Altai (Oligocene-Pleistocene stratigraphy, paleogeography and paleoclimatology). 2011. Novosibirsk, Nauka, 316.p.

Doctor Thesis Zakrevskaya E. Yu. Paleogene large foraminifera of the North East Peri-Tethys (Taxonomy, zonal stratigraphy, palaeobiogeography). Moscow. 2011 St Geological. Mus. (293 p.)

**Papers:** Akhmetiev M.A. Problems of Paleogene stratigraphy and paleogeography Central Eurasia (Middle latitudes) // Geology and Geophysics. 2011. Vol. 52. N 10. P. 1367–1387.

Akhmetiev M.A. Questions of Paleogene stratigraphy (memory Academician A.L. Yanshin, review of his publications) // Bull. Mosc Natural History Soc. Depart. Geology. 2011. Vol. 86, Issue 2. P. 39-46.

Alexandrova G.N., Beniamovsky V.N., Zaporozhets N.I., Zastrozhnov A.S., Oreshkina T.V. et al. // Stratigraphy. Geol. Correlation 2011 Vol. 19. N 3. P. 70–95.

Alexandrova G.N., Shcherbinina E.A. Stratigraphie and environments of the Paleocene-Eocene Transitions of the Eastern Crimea // Stratigraphy. Geol. Correlation. 2011. Vol. 19. N 4. P. 62–88.

Sun Ge, Akhmetiev M.A., Kodrul T.M., Kezina T. M. et al. Late Cretaceous Biota and Cretaceous-Paleogene Boundary in Jiayn Heilongjiang, China // Global Geology. 2011. Vol. 14. N 3 P. 115–143.

Vetoshkina O.S., Zakrevskaya E. Yu.  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  into shells of Nummulitides and limestones Ypresian-Lutetian transition of the Bakhchisaray section (Crimea). Palaeogeographic interpretation // Vestnik Comi Republic Ur Branch RAS, Syktyvkar. 2011. N 8. P. 6–12.

Zakrevskaya E. Yu. New Larger Foraminifers from the Eocene of the Crimea (Ukraine) and Mangyshlak (Western Kazakhstan) // Paleontological Journal. Vol. 45. 2011. N 5. P. 483–493.

### **Working group on Paleogene Stratigraphy of the North Pacific**

#### **Chairman: Yuri B. Gladenkov, Russia**

1. In April 2011 a workshop on Paleogene stratigraphy of the Sakhalin, Kamchatka and Japan region was held in Saint-Petersburg. Special attention was attracted to absolutely new data on Ypresian foraminifers and mollusks (sharp appearance of abundant warm-water assemblages in North Kamchatka) and diatoms (first finds in the Middle Eocene deposits of Kamchatka).

2. In August 2011 the Working Group met in Yuzhno-Sakhalinsk to discuss correlations of Paleogene stratigraphic charts for different regions of the Northwestern Pacific.

3. A large summarization “Discovery of marine Ypresian in North Kamchatka (stratigraphy, paleontology, and paleogeography)” has been completed and prepared for press. It contains stratigraphic analysis of assemblages of planktonic and benthic foraminifers and mollusks. Some zones and beds with fauna were distinguished. The Paleogene correlations between Kamchatka and North America revealed a large similarity (up to 50-70% common forms), which evidences for wide connections of shelf basins at this time. The biotic compositions suggest that the Ypresian period in the North Pacific was characterized by paratropical climate.

### **6. CHIEF PROBLEMS ENCOUNTERED IN 2011**

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 countries. Most of the secretarial and other expenses have been covered by the institutions of the officers and other members of ISPS. Since money becomes tighter everywhere, these sources may dry up.

### **7. SUMMARY OF EXPENDITURES IN 2011:**

#### **INCOME**

Carried forward from 2010

Euro 0

ICS Allocation for 2011	Euro 1991
TOTAL	Euro 1991

#### EXPENDITURE FROM 2011 BUDGET

General office expenses	Euro 291
Professional help with the website	Euro 500
Support for Working Groups and Regional Committees	Euro 1200
TOTAL	Euro 1991

### 8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2012):

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 the Ninth International Workshop on Agglutinated Foraminifera, Zaragoza, Spain, 3-7 September 2012.  
 Attend to the 34<sup>th</sup> International Geological Congress, Brisbane, Australia, 5-10 August 2012.

### 9. BUDGET AND ICS COMPONENT FOR 2012

Projected Budget for 2012:

General office expenses	Euro 300
Professional help with the website	Euro 500
Contributions to Officers travel costs	Euro 900
Support for Working Groups and Regional Committees	Euro 2000
TOTAL BUDGET PROJECTED	----- Euro 3700 -----

Please note that the financial situation has deteriorated in recent years, 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 (2008-2011)

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 Lutetian (= lower/middle Eocene), 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, the base of the Selandian and Thanetian stages were defined by the Paleocene Working Group by unanimous majority, both GSSPs were approved by the ISPS and the ICS, were ratified by the IUGS in September 23, 2008 and at present the official publication is in press in *Episodes*.

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 (2012-2015)

Complete and publish the GSSPs of the Paleogene. We hope to present proposals for the remaining GSSPs in the year 2012 (Priabonian and Chattian), maybe before the next International Geological Congress, and the remaining one by the year 2013 (Bartonian).

Support the organization of the Ninth International Workshop on Agglutinated Foraminifera, Zaragoza, Spain, 3-7, September, 2012.

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](mailto:emolina@unizar.es)

##### **Vice-Chairman:**

**Noël Vandenberghe**, Departement Geografie-Geologie, Afdeling Geologie, Redingenstraat, 16, B-3000 Leuven, Belgium.  
[noel.vandenberghe@ees.kuleuven.be](mailto:noel.vandenberghe@ees.kuleuven.be)

##### **Secretary:**

**Simonetta Monechi**, Dipartimento di Scienze della Terra, Università di Firenze.  
4 Via la Pira, I-50121 Firenze, Italy.  
[monechi@unifi.it](mailto:monechi@unifi.it)

#### *List of Working (Task) Groups and their officers*

- Paleocene Working Group.** Chairman: Birger Schmitz, Sweden. [birger.schmitz@geol.lu.se](mailto:birger.schmitz@geol.lu.se)  
**Ypresian/Lutetian Boundary Stratotype Working Group.** Chairman: Eustoquio Molina, Spain. [emolina@unizar.es](mailto:emolina@unizar.es)  
Secretary: Silvia Ortiz, Spain. [silortiz@unizar.es](mailto: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](mailto:fluegem@bsu.edu)  
**Bartonian/Priabonian Boundary Stratotype Working Group.** Chairwoman: Isabella Premoli Silva, Italy.  
[isabella.Premoli@unimi.it](mailto:isabella.Premoli@unimi.it)  
**Rupelian/Chattian Boundary Stratotype Working Group.** Chairwoman: Isabella Premoli Silva, Italy.  
[isabella.Premoli@unimi.it](mailto:isabella.Premoli@unimi.it)  
**Paleogene Planktonic Foraminifera Working Group.** Chairman: Bridget Wade, USA. [wade@geo.tamu.edu](mailto:wade@geo.tamu.edu)  
Secretary: Helen Coxal, UK. [hkc@gso.uri.edu](mailto:hkc@gso.uri.edu)  
**Paleogene Larger Foraminifera Working Group.** Past-chairman: Lukas Hottinger, Switzerland.  
[lukas.hottinger@bluewin.ch](mailto:lukas.hottinger@bluewin.ch)  
**Paleogene Deep-Water Benthic Foraminifera Working Group.** Chairman: Michael Kaminski, UK.  
[m.kaminski@ucl.ac.uk](mailto:m.kaminski@ucl.ac.uk) Secretary: Laia Alegret, Spain. [laia@unizar.es](mailto:laia@unizar.es)  
**Paleogene Calcareous Nannofossils Working Group.** Chairwoman: Simonetta Monechi, Italy. [monechi@unifi.it](mailto:monechi@unifi.it)  
**Regional Committee in North-European Paleogene Stratigraphy.** Chairwoman: Gitte Vestegaard Laursen, Norway.  
[gila@statoil.com](mailto:gila@statoil.com) Secretary: Rui da-Gama, Netherlands.  
**South-American Regional Committee on Paleogene Stratigraphy.** Chairman: Juan Carlos Silva Tamayo, Colombia.  
[jsilvatamayo@yahoo.com](mailto:jsilvatamayo@yahoo.com) Secretary: Diana Ochoa, Panama. [dianita.ochoa@gmail.com](mailto:dianita.ochoa@gmail.com)  
Website: <http://striweb.si.edu/jaramillo/committee/index.html>  
**Russian Paleogene Commission.** Chairman: Mikhail A. Akhmetiev, Russia. [akhmetiev@ginras.ru](mailto:akhmetiev@ginras.ru) Secretary: G. N. Aleksandrova.  
**Working Group on Paleogene Stratigraphy of the North Pacific.** Chairman: Yuri B. Gladenkov, Russia.  
[gladenkov@ginras.ru](mailto:gladenkov@ginras.ru)

#### *List of Voting Members*

- Mikhail A. Akhmetiev**, Russian Academy of Science, Moscow, Russia, [akhmetiev@ginras.ru](mailto:akhmetiev@ginras.ru)  
**Mary Pierre Aubry**, Rutgers University, New Jersey, USA, [aubry@rci.rutgers.edu](mailto:aubry@rci.rutgers.edu)  
**Rodolfo Coccioni**, Università di Urbino, Italy, [cron@info-net.it](mailto:cron@info-net.it)  
**Vlasta Cosovic**, University of Zagreb, Croatia, [vcosovic@geol.pmf.hr](mailto:vcosovic@geol.pmf.hr)  
**Richard H. Fluegeman**, Ball State University, Indiana, USA, [fluegem@bsu.edu](mailto:fluegem@bsu.edu)  
**Jean Pierre Gély**, Museum d'Histoire naturelle Paris, France [jean-pierre.gely@gazdefrance.com](mailto:jean-pierre.gely@gazdefrance.com)  
**Philip D. Gingerich**, University of Michigan, USA, [gingeric@umich.edu](mailto:gingeric@umich.edu)  
**Yuri B. Gladenkov**, Russian Academy of Science, Moscow, Russia, [gladenkov@ginras.ru](mailto:gladenkov@ginras.ru)  
**Jan Hardenbol**, Global Sequence Chronostratigraphy, Houston, USA, [jhardenbol@sbcglobal.net](mailto:jhardenbol@sbcglobal.net)  
**Christopher Hollis**, GNS Science, Lower Hutt, New Zealand, [c.hollis@gns.cri.nz](mailto:c.hollis@gns.cri.nz)

**Jerry J. Hooker**, Natural History Museum, London, UK, [jjh@nhm.ac.uk](mailto:jjh@nhm.ac.uk)  
**Kenneth G. Miller**, Rutgers University, New Jersey, USA, [kgm@rci.rutgers.edu](mailto:kgm@rci.rutgers.edu)  
**Eustoquio Molina**, Universidad de Zaragoza, Spain, [emolina@unizar.es](mailto:emolina@unizar.es)  
**Simonetta Monechi**, Università di Firenze, Italy, [monechi@unifi.it](mailto:monechi@unifi.it)  
**Carolina Náñez**, Servicio Geológico, Buenos Aires, Argentina [cnaniez@fullzero.com.ar](mailto:cnaniez@fullzero.com.ar)  
**Heiko Pälike**, University of Southampton, UK, [heiko@noc.soton.ac.uk](mailto:heiko@noc.soton.ac.uk)  
**Birger Schmitz**, University of Lund, Sweden, [birger.schmitz@geol.lu.se](mailto:birger.schmitz@geol.lu.se)  
**Ellen Thomas**, Yale University, Connecticut, USA, [ellen.thomas@yale.edu](mailto:ellen.thomas@yale.edu)  
**Noël Vandenberghe**, K.U. Leuven, Belgium, [noel.vandenberghe@ees.kuleuven.be](mailto:noel.vandenberghe@ees.kuleuven.be)  
**Dalila Zaghbib-Turki**, University of Tunis, Tunisia, [dalila.zaghbib@fst.rnu.tn](mailto:dalila.zaghbib@fst.rnu.tn)

## SUBCOMMISSION ON CRETACEOUS STRATIGRAPHY

### ANNUAL REPORT 2011

#### 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”  
Via Mangiagalli, 34, 20133 MILANO, Italy  
**telephone:** 39-02 5031 5528 (direct line)  
**telefax:** 39-02 5031 5494  
**Email:** [isabella.premoli@unimi.it](mailto:isabella.premoli@unimi.it)

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

#### 3a. Officers for 2008-2012:

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

*Thanks to Silvia Gardin, the WEB site of the Cretaceous Subcommission is now active at <<http://www2.mnhn.fr/hdt203/info/iscs.php>> and can be reached also through the ICS web site.*

#### 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*, held in Plymouth in September 2009, it was decided that the *9th International Symposium on Cretaceous System* will be convened in 2013 at Ankara, Turkey. The Symposium is now scheduled for September 2013 and will be hosted by the Middle East Technical University in Ankara. For up-dated informations visit the WebSite <http://www.cretaceous2013.org/en/>. Contact Person: Ass. Prof. Dr. Ismail Omer Yilmaz <[iyilmaz@metu.edu.tr](mailto:iyilmaz@metu.edu.tr)>.

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 liason 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 important international Projects as IODP, IGCP, and CHRONOS (Mesozoic Planktonic Foraminifera Working Group, MPFWG).

## **5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2011**

### General Activities

The chair of the Cretaceous Subcommittee called for the election of its chair and vice-chair(s). As several nominations have been received, the procedure will be completed soon. The results will be forwarded to ICS Executive for approval before the end of 2011.

A wealth of data on various aspects of Cretaceous stratigraphy had continued to be published in 2011 providing a continuous amelioration of the multiple stratigraphic framework that today spans the whole Cretaceous in increasing higher resolution.

Increasing knowledge on carbon isotope stratigraphic patterns and magnetostratigraphy from continuous pelagic successions, especially deep-sea, through the Cretaceous, provoked an increase of interest in the scientific community for a more traditional stratigraphic aspects. In 2011 this resulted in an increase of activities among the ammonite specialists as well as on other fossil groups and other proxy tools. In particular, the Cretaceous Subcommittee members have been very active in revising ammonite taxonomy and stratigraphic distribution of key taxa; and field trips to solve specific topics have been organized visiting some key sections (i.e. Albian, Berriasian type-area, etc.). In addition, the Berriasian Working Group called one official meeting in October (Sofia, Bulgaria) and the exhaustive report of the activities up to the 2009 Plymouth meeting with the chairperson (Wimbledon) as first author in collaboration with numerous WG members is now out of press. Important Cretaceous issues have been considered also by the IGCP 555 - "Rapid Environmental/Climate Change in the Cretaceous Greenhouse World: from Ocean to Land" (referente below).

Of general interest:

The final results of IGCP 555 – "Rapid Environmental/Climate Change in the Cretaceous Greenhouse World: from Ocean to Land" have been published in 2011 in a special issue of *Sedimentary Geology* (v. 235, 1-2, 132 pp.), that includes 13 articles.

### **The Kilian Group (Lower Cretaceous Ammonite Working Group).**

The full report of the 4<sup>o</sup> meeting of the Kilian Group, held at the University of Burgundy at Dijon (France), on 30 August 2010, was published in *Cretaceous Research* in 2011. Its authors are Reboulet (chair), Rawson and Moreno-Bedmar (reporters), and 23 co-authors from Argentina, Austria, Bulgaria, Czech Republic, France, Hungary, Madagascar, Mexico, Russia, Spain, and United Kingdom. The published report includes also the written communications by not attending members and a Table of the standard zonation from Berriasian to Albian.

The Kilian Group confirmed the plans to have the next meeting in September 2013 at the 9<sup>o</sup> International Symposium on the Cretaceous System in Ankara (Turkey). For the new meeting the Kilian Group is expected to focus on the Berriasian, Valanginian and Hauterivian stages and to calibrate different ammonite zonations of the Tethyan, Boreal and Austral realms with the "standard" Mediterranean region zonation.

Stéphane Reboulet, Peter F. Rawson, Josep A. Moreno-Bedmar, Maria B. Aguirre-Urreta, Ricardo Barragán, Yuri Bogomolov, Miguel Company, Celestina González-Arreola, Vyara Idakieva Stoyanova, Alexander Lukeneder, Bertrand Matrimon, Vasily Mita, Hasina Randriana, Zdenek Vasicek, Evgenij J. Baraboshkin, Didier Bert, Stéphane Bersac, Tamara N. Bogdanova, Luc G. Bulot, Jean-Louis Latil, Irina A. Mikhailova, Pierre Ropolo, & Ottilia Szives, 2011. Report on the 4th International Meeting of the IUGS Lower Cretaceous Ammonite Working Group, the "Kilian Group" (Dijon, France, 30th August 2010). *Cretaceous Research*, v. 32, p. 786-793.

### **The Berriasian GSSP and the J/K boundary.**

This is a summary of progress for the Berriasian WG, amended from the report given at its Sofia meeting, written by the chair, W.A.P. Wimbledon.

### **Meetings**

The Working Group held a very successful meeting in Sofia in October 26-28, 2011, hosted by the Geological Institute of the Bulgarian Academy of Sciences. Local organisers were Drs Kristalina Stykova, Daria Ivanova, Iskra Lakova and Platon Tchoumatchenco. Two days of meetings, of presentations (poster and oral) and workshops on ongoing team studies on Berriasian sites, were complemented by a field excursion to the J/K boundary site at Barlya on the Bulgarian/Serbian border. In addition, the chairman as part of a survey of group's progress, was able to present limited materials from WG members who could not be present at the meeting, notably on Tibet, from Dr Li Jianguo and Dr Wan Xiaoqiao.

The chairman opened the meeting with apologies for absence from a large number of friends who are active WG members. And then gave an account of progress that is being made through team activity, notably in France and Crimea, with continuing activity in Italy and central Europe, but highlighting new prospects for cooperation in Iraq, Tibet and China/Russia. Papers and posters are listed in the appendix to this text. Two additional papers, not listed below, were read by Daniela Reháková (on capionellid results from Le Chouet) and another by Luc Bulot (on first ammonite results from Le Chouet). A most valuable part of the meeting was the time allocated to meet new participants and to discuss, and for group work on WG shared site projects

A WG meeting in Tunisia that had been planned for early 2011 was postponed due to political changes. Happily, it has now been re-scheduled for May 2012 under the guidance of Dr. Mabrouk Boughdiri and colleagues at the University of Carthage, Bizerte. A meeting that we anticipate with much pleasure.

### **New members joining the WG**

Since the last WG meeting, in Paris, the following valued colleagues have joined the group: Pierre Olivier Mojon (Switzerland), Ibrahim M.J. Mohyaldin (Iraq), Jennifer Galloway (Canada), Andrea Concheyro (Argentina), Subhendu Bardhan (India), Dhirendra Pandey (India), Li Jianguo (China), Wan Xiaoqiao (China), Oksana Dzyuba (Russia), Emile Pessagno (USA)

### **Activity of the Working Group, work in progress**

Progress has been made on a broad front. Below are a few highlights, building upon earlier discussions and announcements.

The WG has held six workshops since the first tentative discussion in Bristol, plus a short meeting at the Plymouth Cretaceous Symposium. New members are listed above and new projects are mentioned below. The implementation of the early WG decision to study the interval between the *Berriasella jacobi* subzone base and the *Pseudosubplanites grandis* subzone base is spreading. The WG continues to localise and calibrate a number of key markers, and expand activity to new regions. Developments are as follows:

#### **BOREAL**

**Canada:** New palynological studies of the Sverdrup basin are in progress by Jennifer Galloway

New paleogeographic maps are in preparation and news on that is expected from Terry Poulton soon.

**Russia:** Continued progress is being made by members of the WG on the issue of making connections outward from the landlocked Russian boreal. Notably Mitta with his correlation of Tethyan ammonites, and Peschevitskaya et al. and Harding et al. who have published two substantial works on the palynology. Similarly by Oksana Dzyuba working on belemnites and chemostratigraphy (see reference list below).

**Greenland:** Peter Alsen is studying newly collected ammonite material from Kuhn Ø

#### **TETHYS**

**France:** At Le Chouet, further nannofossil and calpionellid samples were collected from the top part of the profile in September 2011, in *jacobi* subzone (Rehakova, Halasova, Casellato). Dense geochemical sampling commenced in September (Schnyder and Galbrun), and the rich ammonite fauna from the Durangites/*B. jacobi* interval was further expanded (Frau, Bulot, Wimbledon).

Magnetozone boundaries at Le Chouet were refined, and new sampling was started in the *P. grandis* subzone at St Bertrand's Spring (Les Combes) (Pruner/Grabowski teams)

**Slovakia/Poland:** The Bratislava, Warsaw and Prague teams are active on sites in southern Poland and Slovakia, notably on the Strapkova locality (Sofia presentation below, Michalik et al.).

**Italy:** Work progresses at several sites, (1) Integrated calcareous nannoplankton and calpionellid biostratigraphy at Torre dei Busi, Monte Pernice (southern Alps) and Guidaloca (Sicily) and DSDP Site 574 (Casellato, Erba, Andreini and Parisi); (2) In Umbria-Marche, integrated Tithonian-Valanginian magneto- and biostratigraphy across at Fonte del Giordano, and also at Curasci (Andreini, Parisi, Perilli and Speranza).

In addition, Andreini and Parisi study chitinoideidellid biostratigraphy in Southern Spain.

**Bulgaria:** Komshtitsa/Barlya: new work on the magnetostratigraphy was started with preliminary collecting by the Prague team in October 2011. To add to the previous biostratigraphic analysis by Lakova, Tchoumatchenco et al.

Berende: nannofossils and ammonites are still being collected from this promising profile (Stoykova, Ivanov), and results are predicted to be given at the Tunisia meeting,

**Tunisia:** Two important demonstrations of the Tunisian sequences were given at the Sofia meeting (by Houaida Sallouhi and Sana Ben Nsir). The first magnetostratigraphic collecting in Tunisia will begin March 2012 (Boughdiri team, Wimbledon), to be continued in May (Schnabl).

**Morocco:** Mohamed Benzaggadh presented new results from Morocco at the Paris meeting.

**Mexico/Cuba:** Ricardo Barragan and Rafael Lopez continue their bed by bed analysis of key Mexican sites. First presentation of results were given in Sofia.

**Ukraine:** Work on calpionellids, nannofossils (Rehakova, Halasova, Casellato) and ammonites continues - from the *B. jacobi* subzone, and Daria Ivanova joins the team to examine the anomalous foraminiferal faunas. Sampling at higher levels in *P. grandis* subzone commenced in 2011. Magnetostratigraphy is in its third season (Bakhmutov, Sofia presentation detailed below).

**Tibet:** Drs Li Jianguo and Wan Xiaoqiao have joined the WG, studying Tibetan palynology and ammonites and nanofossils, respectively. They currently make an analysis of the best prospect for future research in the Cimmerian and Eurasian terrains of Tibet, and the integration of previously separately obtained data on ammonites and microfossils, plus palynology. A next step will be the first magnetostratigraphic study.

#### SUB TETHYS/GONDWANA

**Iraq:** Dr Ibrahim Mohyaldin has worked on the chemostratigraphy of the Berriasian in Turkestan. The first palaeontological fieldwork in the type area of the Chia Gara formation for 60 years is due to take place in June 2012. Dr Michael Howarth has been assisting with work on older ammonites collections, to help localise the activity in the most productive areas. Also, the first-ever collecting for microfossils is intended, and Kristalina Stoykova and Emile Pessagno have volunteered to look at preliminary materials for nanofossils and radiolaria.

**Yemen:** No activity is possible in the field because of the political situation. But it is intended to do some sampling of recently collected, well-localised macrofossils from the top Tithonian-lower Berriasian to see if they yield useful calcareous nanofossils.

**India:** Kutch: reconnaissance for nanofossil sampling is due in January 2012, to be undertaken by Dr Pandey.

**Argentina:** New work on nanofossil and ammonite integration in the Vaca Muerta formation is in progress by our colleagues Vennari, Lescano and Concheyro.

Work in Iraq may give new opportunities for links and collaboration with friends in Argentina, for there are distinct faunal (ammonite) links already identified.

#### NON MARINE

**United Kingdom:** Non-marine Purbeck: the M19-M18 magnetostratigraphic interval was sampled extensively (300 samples) in June 2011 by colleagues Pruner, Schnabl and Slechta.

**China/Russian far east:** Fieldwork on non-marine/marine correlation is planned for 2012 by Jingeng Sha, Eugenia Bugdaeva and Valentina Markevich. Research is at the planning stage.

#### BERRIASIAN MAP PROJECT

Dr Chris Scotese (Geomap Project) is providing his invaluable expertise through the creation of a new base map for use in the group work. Several colleagues, notably Alberto Riccardi, Peter Rawson and Terry Poulton, have already contributed most valuable materials to help to make an accurate reconstruction for the earliest Berriasian.

#### REFERENCES

A number of key references have appeared in recent times that make significant contributions to the compilation of primary data at the J/K boundary, and to its discussion.

W.A.P. Wimbledon, C. E. Casellato, D. Reháková, L. G. Bulot, E. Erba, S. Gardin, R.M.C.H. Verreussel, D. K.

Munsterman and C.O. Hunt, 2011. Fixing a basal Berriasian and Jurassic/Cretaceous (J/K) boundary - is there perhaps some light at the end of the tunnel? *Rivista Italiana Paleontologia e Stratigrafia* 117, 295-307

J. Michalík and D. Reháková, 2011. Possible markers of the Jurassic/Cretaceous boundary in the Mediterranean Tethys: A review and state of art. *Geoscience Frontiers* 2, 475-490

J.E.T. Channell, C.E. Casellato, G. Muttoni and E. Erba, 2010. Magnetostratigraphy, nanofossil stratigraphy and apparent polar wander for Adria-Africa in the Jurassic/Cretaceous boundary interval. *Palaeogeography, Palaeoclimatology, Palaeoecology* 293, 51-75

J. Michalik, D. Rehakova, E. Halasova and O. Lintnerova, 2009. The Brodno section – a potential regional stratotype of the Jurassic/Cretaceous boundary (Western Carpathians). *Geologica Carpathica* 60, 213-232

A. Lukeneder, E. Halasova, A. Kroh, S. Mayrhofer, P. Pruner, D. Rehakova, P. Schnable, M. Sprovieri, and M. Wagreich, 2010. High-resolution stratigraphy of the Jurassic/ Cretaceous boundary interval in the Gresten Klippenbelt (Austria) *Geologica Carpathica* 61, 365-381

P. Pruner, V. Housa, F. Oloriz, M. Košťák, M. Krs, O. Man, P. Schnabl, D. Venhodova, J.M. Tavera, and M. Mazuch, 2010. High-resolution magnetostratigraphy and biostratigraphic zonation of the Jurassic/Cretaceous boundary strata in the Puerto Escano section (southern Spain) *Cretaceous Research* 31, 192-206

K. Žák, M. Košťák, O. Man, V.A. Zakharov, M.A. Rogov, P. Pruner, J. Rohovec, O.S. Dzyuba and M. Mazuch, 2011. Comparison of carbonate C and O stable isotope records across the Jurassic/ Cretaceous boundary in the Tethyan and Boreal Realms. *Palaeogeography, Palaeoclimatology, Palaeoecology* 299, 83-96

N.Y. Bragin, 2011. Radiolarians of the Volgian and Berriasian Stages of the North of Central Siberia. *Stratigraphy and Geological Correlation* 19, 173-187

Mitta V.V., 2010. Late Volgian Kachpurites Spath (Craspeditidae, Ammonoidea) of the Russian Platform. *Palaeontological Journal* 44, 622-631

Mitta V. V. 2011. Ammonites of Tethyan origin in the Ryazanian Stage of the Russian Platform: genus *Riasanella* gen. nov. *Palaeontological Journal* 45, 13-22

I.C. Harding, G.A. Smith, J.B. Riding and W.A.P. Wimbledon, 2011. Inter-regional correlation of Jurassic/Cretaceous boundary strata based on the Tithonian-Valanginian dinoflagellate cyst biostratigraphy of the Volga Basin, western Russia. *Review of Palaeobotany and Palynology* 167, 82-116

- E. Pestchevitskaya, N. Lebedeva and A. Ryabokon, 2011. Uppermost Jurassic and lowermost Cretaceous dinocyst successions of Siberia, the Subarctic Urals and Russian Platform and their interregional correlation. *Geologica Carpathica* 62, 189-202
- O.S. Dzyuba, 2010. Cylindroteuthid belemnite correlation of the Jurassic/Cretaceous Boundary Strata in Northern Siberia and Northern California. In *Earth Science Frontiers* 17, Special Issue
- M.I. Bagaeva, V.V. Arkadiev, E.Y. Baraboshkin, E.Y. Gorbenko, A.Y. Guzhikov, A.G. Manikin and V.A. Perminov, 2011. New bio- and magnetostratigraphic data on the Berriasian-Valanginian boundary deposits of the eastern Crimea. In Shurygin B.N., Lebedeva N.K., Goryacheva A.A. (eds.), *Palaeontology, stratigraphy and palaeogeography of Mesozoic and Cenozoic of Boreal basins: materials of scientific session Vol. I. Mesozoic*. Novosibirsk: IPGG SB RAS. pp 23-26 (In Russian)
- F. Cecca, K. Seyed-Emami, J. Schnyder, M. Benzaggagh, M. R. Majidifarde, 2011. (in press). Early Berriasian ammonites from Shal, Talesh region (NW Alborz Mountains, Iran). *Cretaceous Research*
- Zakharov V.A., 2011. The Jurassic-Cretaceous boundary: the appraisal of Working Group's methodology on the choice of Berriasian GSSP. In Shurygin B.N., Lebedeva N.K., Goryacheva A.A. (eds.), *Palaeontology, stratigraphy and palaeogeography of Mesozoic and Cenozoic of Boreal basins: materials of scientific session Vol. I. Mesozoic*. Novosibirsk: IPGG SB RAS. pp 87-90. (In Russian)

#### APPENDIX - Talks and posters at the Sofia 2011 workshop

- Wimbledon, W. - Progress generally for the WG, and at Le Chouet and in Crimea specifically.
- Michalík J., Reháková D., Lintnerová O., Halásová E. - Complex stratigraphy of another key J/K Boundary section (Strapková) in the Pieniny Klippen Belt (Western Carpathians, Slovakia).
- Grabowski, J., Pruner, P., Schnabl, P., Sobien, K., Šifnerová, K. - Magnetostratigraphic results from the J/K section at Le Chouet (France).
- Rogov, M. - Changes in ammonite assemblages across the J/K boundary in the Panboreal Superrealm: speciation, extinction and immigrational events.
- Pestchevitskaya, E., Lebedeva, N., Ryabokon, A. - Uppermost Jurassic and lowermost Cretaceous dinocyst successions of Siberia, Subarctic Urals and Russian Platform and their interregional correlation.
- Guzhikov, A. - Berriasian bio- and magnetostratigraphy of Feodosia region (Mountainous Crimea).
- Dzyuba, O., Izokh, O., Shurygin, B. - Carbon isotope composition and correlation across the Jurassic-Cretaceous boundary: new data from north of Asia (Russia).
- Zakharov, V. - What must be key event to define a GSSP for the base of the Berriasian?
- Wimbledon, W. - How is the base of the *Calpionella alpina* Subzone defined?
- Lakova, I., Ivanova, D., Petrova, S., Boncheva, I. - Joint microfossil events and bioevents on calpionellids, calcareous dinocysts and radiolarians across the Jurassic/Cretaceous boundary interval in the West Balkan Mts, Bulgaria.
- Boughdiri, M., Sallouhi, H., Ben N'sir, S. - Ammonite-supported calpionellid biostratigraphy in Central and Northern Tunisia.
- Ben N'sir, S., Boughdiri, M., Sallouhi, H. - Radiolarians, biomicrofacies and calpionellids of the Upper Jurassic-Lower Cretaceous in the "Tunisian Trough".
- Ben N'sir, S., Boughdiri, M., Sallouhi, H. - Preliminary results on calpionellid and ammonite biozonations across the Jurassic/Cretaceous boundary in the Tunisian Dorsale (the type section of J. Beni Kleb).
- Bakhmutov, V., Wimbledon, W.A.P. - Magnetostratigraphy of the Lower Berriasian sediments of Feodosia, eastern Crimea (Ukraine): preliminary results
- Michalík, J., Reháková, D., Lintnerová, O., Halásová, E. - Complex stratigraphy of the key J/K Boundary sections in the Pieniny Klippen Belt (Western Carpathians, Slovakia)
- Arkadiev, V., Platonov, E. - Correlation of the Jurassic-Cretaceous boundary of the Mountainous Crimea and Western Europe.
- Bakhmutov, V., Wimbledon, W. - Magnetostratigraphy of Lower Berriasian sediments from Eastern Crimea (Feodosia, Cape St. Elias).
- Lopez-Martínez, R. A. - Calpionellid biostratigraphy and facies evolution across the Jurassic/Cretaceous boundary in western Cuba and Mexico.
- Antuñano, S., López-Martínez, R. - An unconformity at the base Cretaceous in Mexico: Its significance around the world.
- Zakharov, V., Rogov, M. - The Nordvik section (Laptev Sea), GSSP candidate for the Ryazanian Stage and reference section for the J/K boundary of the Panboreal Superrealm.
- Arkadiev, V., Guzhikov, A., Bagaeva, M., Manikin, A., Perminov, V., Yampolskaya, O. - New data on Tithonian-Berriasian Bio- and Magnetostratigraphy of Feodosia region (Mountainous Crimea).
- Dzyuba, O. - Correlation of the J/K boundary strata based on cylindroteuthid belemnites.

#### **Base Valanginian GSSP.**

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

The chair of the Valanginian WG, Luc Bulot, and the Spanish colleagues are looking if a WG meeting can be organized at short issue. Bulot is also exploring the possibility of having a field trip in the Caravaca area in Spring 2012 to look at the Caneda Luega-Cehegin sections.

#### **Base Hauterivian GSSP.**

Since October 2010 when Luc Bulot (chair of the WG) and I. Premoli Silva (SCS chair) started to assembling the data available so far on La Charce section (Drome, France), the major candidate for the Hauterivian GSSP, the draft of the proposal did not make any progress due to new problems, such as the need of new sampling for up-dating the nannofossil and planktonic foraminiferal distributions across the Valanginian/Hauterivian boundary. Moreover, the chair Luc Bulot was deeply involved on collecting and studying Berriasian ammonites from Le Chouet. Hopefully the Hauterivian GSSP proposal will be completed in 2012.

#### **Base Barremian GSSP.**

The formal proposal of the Río Argos section as GSSP of the Barremian stage is in advanced preparation by the chairman, Miguel Company, and the numerous members of the Task Group. A multidisciplinary study was carried out on the section, including ammonites (J. Sandoval, J.M. Tavera and M. Company), calcareous nannoplankton (R. Aguado), planktonic and benthonic foraminifera (R. Coccioni, F. Frontalini and L. Giusberti), organic matter (F. Baudin), stable isotopes (H. Weissert), and multi-proxy cyclostratigraphy (a team from the University of Dijon). Unfortunately, the magnetostratigraphic methods could not be applied because of a strong Neogene remagnetization that hinders any correlation with the magnetic polarity scale. Nevertheless, an indirect calibration is possible (although not very accurate) through data from the Gorgo a Cerbara section (central Italy). The identification and characterization of the boundary event (First Occurrence of *Taveraidiscus hugii*) in the section do not pose any problem, as ammonites are abundant and well preserved. The main problem the Task Group faces is the correlation of this event to other palaeogeographic domains (as Boreal or Andean regions) because of the strong provincialism displayed by faunas, microfaunas and microfloras at that time. The report is expected will be finished by the end of 2011 to be presented to the members of the Barremian Working Group and, then, to the Subcommittee.

#### **Base Aptian GSSP.**

A wealth of data have been collected and published on the Aptian stage in the last few years by our French colleagues on the stratotype sections of the Bedoulian and Gargasian substages including revised biostratigraphies,  $\delta^{13}C$  curve and cyclostratigraphy (see Moullade et al., 2009, Ann. Muséum Hist. Nat. Nice, v. 24/1). 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 ogranlensis* Zone. The formal proposal of the Aptian GSSP at Gorgo a Cerbara (central Italy) is still pending.

#### **Base Albian GSSP.**

As reported in previous reports, the formal proposal for the base Albian at Tartonne (SE France), prepared by J. Kennedy, never reached the quorum. Voting Members against the proposal commented 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 base Albian GSSP. In addition, the sampling across the Aptian/Albian boundary was considered at a resolution not adequate for such critical interval and the proposed event (FO of *L. tardefurcata*) is poorly applicable to other sections, especially outside SE France.

In Spring 2010 members of the new Working Group, set up at Plymouth in 2009 (Paul Bown, coordinator), re-sampled at high resolution the Col de Pré-Guittard section, Kennedy's ancillary section near tartonne. A multidisciplinary study of the new sample set was carried out during 2011 by members of the WG. One of the most important results concerns the planktonic foraminifera which display a major turnover across the Niveau Kilian, in correspondence with a

1‰ delta13C excursion. A paper describing exhaustively this abrupt turnover was already submitted by Petrizzo and co-authors to be published on NewsLetters on Stratigraphy. Meanwhile, a formal proposal dealing with a new criteria for identifying the base Albian, replacing the FO of the unsuitable *L. tardefurcata*, is in preparation.

#### **Base Coniacian GSSP.**

The main paper describing the criteria for identifying the base Coniacian and the proposal of a candidate composite GSSP section was published in Acta Geologica Polonica at the end of 2010. Besides multiple up-dated biostratigraphies, the paper also includes the isotope curves for both the Salzgitter-Salder (northern Germany) and Slupia Nadbrzeżna (central Poland) sections. It is confirmed that the inoceramid-based lower Coniacian boundary (= first appearance of *C. deformis erectus*), slightly post-dates the traditional ammonite (FAD of *Forresteria petrocoriensis*) position of the boundary. Last September the chair of the WG, Irek Walaszczyk, circulated the published proposal to the Working Group members asking for comments and eventually approval. So far, nine members replied but more replies are expected soon. For the time being all replies support the proposal of having a composite section as a base Coniacian GSSP. Although it is not an ideal choice, there is not a single perfect section which satisfies the GSSP for the base of the Coniacian. The formal proposal to be submitted to the Voting Members of the Subcommittee is now in preparation by the WG chair.

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

#### **Base Santonian GSSP.**

The final proposal for the base Santonian at Olazagutia (Spain), prepared by the chair Marcos Lamolda, was distributed for approval and/or comments to the Voting Members of the Subcommittee three times since 2008, and finally reached the quorum of positive votes in 2010. On October 1, 2010 the proposal was returned to the WG chair for an up-date and few corrections. The final GSSP proposal was submitted to the ICS on 20 December 2010. On 29 May 2011 the Santonian GSSP proposal was circulated to the Commission Voting Members for comments. The proposal along with the comments was sent back to M. Lamolda on 8 July 2011 for corrections and editing. The final version was returned to ICS on 3 October 2011 and is waiting for the ballot.

#### **Base Campanian GSSP.**

Members of the WG have been searching for a new section across the Santonian/Campanian boundary to be proposed as base Campanian GSSP. So far, the only section not affected by hiatus and/or major dissolution is the Bottaccione section (Gubbio, central Italy), in which the calcareous plankton bioevents are calibrated to magnetostratigraphy. The distribution of planktonic Foraminifera across the Santonian–Campanian interval at Bottaccione was recently revised and up-dated (Petrizzo et al. 2011). Moreover, as the available carbon isotope stratigraphy was considered at too low resolution for reliable supraregional correlations, a new sets of carbon isotope analyses across the critical interval were undertaken by Silke Voigt on the original samples (Premoli Silva & Sliter 1995), calibrated to paleomagnetic scale, and on new samples collected at higher resolution along the same road section and on the opposite side of the valley by Gale and Voigt. A paper with the obtained carbon isotope curves correlated to that from Laegerdorf (N Germany) is ready to be submitted for publication. The main bias of the Bottaccione section is that planktonic foraminifera across the critical interval could not be properly disaggregated from the hard limestones, using cold acetolysis method, and are poorly preserved.

M.R. Petrizzo, F. Falzoni & I. Premoli Silva, 2011. Identification of the base of the lower-to-middle Campanian *Globotruncana ventricosa* Zone: Comments on reliability and global correlations. Cretaceous Research, v. 32, 387-405.

#### **Base Maastrichtian GSSP.**

To overcome the problem of correlation between the GSSP and coeval sections, stable isotopes were measured in high resolution from Tercis les Bains GSSP (Thibault et al. 2011). In this paper the Tercis isotope curve was successfully correlated to the isotope curve from two Danish Basin cores (DK), that could represent the standard carbon isotope curve for the Boreal realm being calibrated to the nannofossil and dyncyst biostratigraphies. Moreover, Gardin et al. revised the biostratigraphy of the Bottaccione section, already calibrated to magnetostratigraphy, and gathered new calcareous plankton biostratigraphic and magnetostratigraphic data of the upper Campanian-Maastrichtian interval from the nearby Contessa section (Gubbio, central Italy). The latter section was also sampled for stable isotopes in fall 2010 by Silke Voigt who completed the analyses in 2011. The Contessa and Bottaccione isotope curves, correlated to her new one from Tercis GSSP, will be presented in a specific paper which should be published very soon.

N. Thibault, R. Harlou, N. Schovsbo, P. Schiøler, F. Minoletti, B. Galbrun, B.W. Lauridsen, E. Sheldon, L. Stemmerik & F. Surlyk, in press. Upper Campanian-Maastrichtian nannofossil biostratigraphy and high-resolution carbon-isotope stratigraphy of the Danish Basin: Towards a standard d13C curve for the Boreal Realm. Cretaceous Research (2011), 19

## 6. CHIEF PROBLEMS ENCOUNTERED IN 2011

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.

Another problem is the lack of fundings in most countries for carrying out studies strictly stratigraphic, apparently poorly fashionable, for attending workshops and/or conferences.

## 7. SUMMARY OF EXPENDITURES IN 2011 (ANTICIPATED THROUGH MARCH 2012):

### I. INCOME

ICS subvention for 2011 (4000 \$)	Euro	2785.00
		-----
Total income	Euro	<b>2785.00</b>

### II. EXPENDITURE

Contribution to J/K meeting, Sofia (organization+lodging)	Euro	1000.00
Contribution to Ukraina field work	Euro	600.00
Attendance to Italian Strat. Commission Meeting GEOITALIA2011 – Turin, 21 Sept (Chair)	Euro	178.00
Attendance to MPFWG meeting, Washington, 26-30 Sept (partial) (Chair)	Euro	350.00
1st Contribution to J/K meeting in Bizerte (Tunisia)	Euro	500.00
Office (chair & secretary) expenses	Euro	150.00
Bank Expenses	Euro	20.00
		-----
Total expenditure	Euro	<b>2798.00</b>

## 8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2012):

### Membership of Cretaceous Subcommittee.

Several Voting Members of the Cretaceous Subcommittee will terminate their mandate with the 34th Geological Congress, August 2012. Call for nominations is underway and the new membership is expected to be completed at the beginning of 2012.

### Meetings

- The 8° meeting of the Berriasian and J/K boundary WG is planned in Tunisia (Bizerte), May 2012
- The 9° meeting of the Berriasian and J/K boundary WG in Russia, prior to or after the 6th meeting of the “Cretaceous of Russia and adjacent region” in September 2012, in Gelendzhik (Caucasus) (organizer E. Baraboshkin).
- Valanginian Workshop and field trip, Caravaca area, Spain, pending.

### Work Plan and anticipated Results

- To bring recommendations for the remaining GSSPs to ICS as soon as possible.
- Submission of the Santonian GSSP to ICS
- Votes on the Coniacian GSSP and submission to ICS after Subcommittee approval
- Votes on the Hauterivian GSSP and submission to ICS after Subcommittee approval
- Preparation of the first draft on Aptian GSSP
- To complete the study of the Col de Pré-Guittard section for the Albian GSSP, preparation of the formal proposal and submission to ICS after Subcommittee approval

- Definition of criteria for identifying the base of the Berriasian and the J/K boundary
- Choose the appropriate section for the Campanian GSSP

## 9. BUDGET AND ICS COMPONENT FOR 2012

Office expenses (Fax, phone, postage, etc)	Euro	150
2nd Contribution to the J/K Tunisia Meeting (organization)	Euro	500
Support to participants to the J/K Tunisia Meeting	Euro	1500
Support to J/K field trips (i.e Ukraina, S France, others)	Euro	1500
Participation di 34st IGC Brisbane (Registration, Air Ticket, Lodging) (chair)	Euro	2900
<b>Total estimated expenditure</b>	<b>Euro</b>	<b>6550</b>

## 10. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2007-2011)

*See Accomplishments in ICS Annual Reports 2007 to 2011 (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, 2008 Oslo and 2009 Plymouth meetings.
- 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).
- 2<sup>nd</sup> 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.
- 3<sup>rd</sup> 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).
- 33<sup>rd</sup> 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).
- 5th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Smolenice (Slovakia) (April 2010).
- 4th Workshop of the Kilian Group on the Aptian and Albian zonation, held in Dijon (August 2010).
- 6th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Paris (November 2010).
- 7th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Sofia (October 2011).

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

- 1<sup>o</sup> meeting of the *Berriasian and J/K boundary Working Group*, Bristol (UK), July 2007
- 2<sup>o</sup> 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<sup>o</sup> Geological Congress, August 2008, Olso:  
3<sup>o</sup> meeting of the *Berriasian and J/K boundary Working Group*, Milan, March 2009  
4<sup>o</sup> meeting of the *Berriasian and J/K boundary Working Group*, Plymouth, September 2009  
5<sup>o</sup> meeting of the *Berriasian and J/K boundary Working Group*, Smolenice, April 2010  
ICS Meeting, Prague, May 2010

## 11. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2011-2015)

### Meetings

- May 2012 – the 7th Workshop of the Berriasian and J/K boundary WG in Tunisia
- August 2012 - Subcommission Official Meeting at the 34<sup>th</sup> International Geological Congress, Brisbane, Australia
- September 2013 – 9th International Symposium on Cretaceous System, Middle East Technical University, Ankara, Turkey. Convenor: Ismail Omer Yilmaz
- September 2013 – 5<sup>th</sup> Workshop of the Kilian Group at the 8<sup>th</sup> International Symposium on Cretaceous System, Ankara.

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 submit the proposal of Coniacian GSSP to ICS, and to submit it to Episodes for publication
  - To submit a new proposal of Albian GSSP to the Cretaceous Subcommission Voting Members, then to submit it to ICS, and possibly to Episodes for publication
  - To submit the proposal of Barremian GSSP to the Cretaceous Subcommission Voting Members, then to submit it to ICS, and possibly to Episodes for publication
  - To bring recommendations for the remaining GSSPs to ICS as soon as possible
  - To propose the 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

2012 – Finalize the proposal for the base of the Albian

2012 - Finalize proposals for the base of Valanginian, Hauterivian, Barremian, Aptian, Coniacian, and possibly Campanian

2012-2013 - Finalize the proposal for the base of Berriasian (Jurassic/Cretaceous boundary)

2011 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  
[isabella.premoli@unimi.it](mailto:isabella.premoli@unimi.it)

**Vice Chair:** Dr. I. Walaszczyk

Faculty of Geology, University of Warsaw, Al. Zwirki i Wigury 93, PL02-089 Warsaw, Poland  
[i.walaszczyk@uw.edu.pl](mailto:i.walaszczyk@uw.edu.pl)

**Secretary:** Dr. Silvia Gardin

CNRS-CR2P "Centre de Recherche sur la Paleobiodiversite et les Paleoenvironnements", case 104, University of Paris VI, 4, Place Jussieu, 75252 Paris, FRANCE  
[silvia.gardin@upmc.fr](mailto:silvia.gardin@upmc.fr)

### *List of Voting Members*

E Baraboshkin (Russia) [barabosh@geol.msu.ru](mailto:barabosh@geol.msu.ru)  
Prof. Jim Channell (USA) [jetc@geology.ufl.edu](mailto:jetc@geology.ufl.edu)  
Dr. James Crampton (New Zealand) [J.Crampton@gns.cri.nz](mailto:J.Crampton@gns.cri.nz)  
Dr. Jim Haggart (Canada) [jhaggart@nrcan.gc.ca](mailto:jhaggart@nrcan.gc.ca)  
Prof. Malcom Hart (UK) [M.Hart@plymouth.ac.uk](mailto:M.Hart@plymouth.ac.uk)  
Dr. Peter Hochuli (Switzerland) [peter.hochuli@erdw.ethz.ch](mailto:peter.hochuli@erdw.ethz.ch)  
Dr. Brian Huber (USA) [Huber.Brian@NMNH.SI.edu](mailto:Huber.Brian@NMNH.SI.edu)  
Dr. Elena Jagt-Yazykova (Poland) [eyazykova@uni.opole.pl](mailto:eyazykova@uni.opole.pl)  
Dr. Fumihisa Kawabe (Japan) [fkawabe@aoni.waseda.jp](mailto:fkawabe@aoni.waseda.jp)  
Dr. Eduardo Koutsoukos (Brazil) [koutsoukos@petrobras.com.br](mailto:koutsoukos@petrobras.com.br)  
Prof. Marcos Lamolda (Spain) [mlamolda@ugr.es](mailto:mlamolda@ugr.es)  
Dr. Sarah Niebuhr (Germany) [niebuhr.birgit@googlemail.com](mailto:niebuhr.birgit@googlemail.com)  
Prof. David Watkins (USA) [dwatkins@unlserve.unl.edu](mailto:dwatkins@unlserve.unl.edu)  
Prof. Helmut Weissert (Switzerland) [helmut.weissert@erdw.ethz.ch](mailto:helmut.weissert@erdw.ethz.ch)  
Dr. Frank Wiese (Germany) [frwiese@snafu.de](mailto:frwiese@snafu.de)  
Dr. William A.P. Wimbledon (UK) [newaberdon@tiscali.co.uk](mailto:newaberdon@tiscali.co.uk)

### *List of Task Groups and their officers*

**Maastrichtian WG:** *GSSP ratified.* Giles Odin, France. [gilodin@moka.ccr.jussieu.fr](mailto:gilodin@moka.ccr.jussieu.fr)  
**Campanian WG:** jim.kennedy@oum.ox.ac.uk, Andy Gale (UK) [Andy.Gale@port.ac.uk](mailto:Andy.Gale@port.ac.uk)  
**Santonian WG:** Marcos Lamolda, Spain. [mlamolda@ugr.es](mailto:mlamolda@ugr.es)  
**Coniacian WG:** Irek Walaszczyk, Poland. [i.walaszczyk@uw.edu.pl](mailto: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](mailto:mhart@plymouth.ac.uk)  
**Aptian WG:** Elisabetta Erba, Italy. [elisabetta.erba@unimi.it](mailto:elisabetta.erba@unimi.it)  
**Barremian WG:** Peter Rawson, UK. [peter.rawson1@btinternet.com](mailto:peter.rawson1@btinternet.com)  
Miguel Company, Spain. [mcompany@ugr.es](mailto:mcompany@ugr.es)  
**Hauterivian WG:** Jörg Mutterlose, Germany. [joerg.mutterlose@rub.de](mailto:joerg.mutterlose@rub.de)  
**Valanginian WG:** Luc Bulot, France. [lucgbulot@aol.com](mailto:lucgbulot@aol.com)  
**Berriasian (J/K boundary) WG:** William A.P. Wimbledon, UK. [newaberdon@tiscali.co.uk](mailto:newaberdon@tiscali.co.uk)

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

## SUBCOMMISSION ON JURASSIC STRATIGRAPHY

### ANNUAL REPORT 2011

## 2. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

### International Subcommission on Jurassic Stratigraphy

#### *SUBMITTED BY*

József Pálffy, Subcommission Chair  
Department of Physical and Applied Geology,  
Eötvös University (ELTE)  
Pázmány P. sétány 1/C, Budapest, H-1117 Hungary  
Tel. +36 1 372-2500 / ext. 8728  
Fax: +36 1 338-2728  
Email: palfy@nhmus.hu

## 2. OVERALL OBJECTIVES AND FIT WITHIN IUGS SCIENCE POLICY

### 2a. Mission statement

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

### 2b. Goals

These fall into 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) Fostering chronostratigraphic research and international collaboration, including the application, where possible, of cyclostratigraphy to develop astrochronologic estimates of durations of chronostratigraphic units, and integration of radiometric dates to improve the numerically calibrated time scale of the Jurassic;
- (c) 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 Congresses 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; the second encourages collaboration and liaison with non-professionals, notably fossil collectors, who have valuable data to contribute towards the Subcommission's goals.

### 2c. Fit within IUGS Science Policy

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

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

### 3. ORGANIZATION

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

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

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

The Subcommittee sponsors an International Congress on the Jurassic System every four years. The 8<sup>th</sup> Congress was held in 2010 in China, and preparation is now underway to organize the 9<sup>th</sup> Congress in 2014 in Jaipur, Rajasthan, India.

#### 3a. Officers for 2008-2012:

Chair:	József PÁLFY, Hungary
Vice-Chair:	Jingeng SHA, China
Secretary:	Stephen HESSELBO, UK

Web address for Subcommittee: <http://jurassic.earth.ox.ac.uk/>

### 4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

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

4a. International Geoscience Programme (IGCP) *Project 506: Marine and Non-marine Jurassic: Global correlation and major geological events*. **This project, led by Vice Chair SHA Jingeng (China), was completed in 2010 but its scientific results have been continued to be published in 2011.**

#### 4b. ProGEO and Geoparks Initiatives.

The Subcommittee Geoconservation Working Group (Convenor Voting Member Kevin PAGE, UK) has several links with international and national Geoconservation bodies and advisory groups (including himself and Corresponding Members Maria Helena HENRIQUES, Portugal, Platon TCHOUMATCHENKO, Bulgaria and Bill WIMBLEDON, UK).

#### 4c. UNESCO World Heritage Sites.

Several UK members of the Subcommittee, including Voting Member Kevin PAGE, Corresponding Members Robert CHANDLER, and William WIMBLEDON, and others, are members of the Science and Conservation Advisory Group (SCAG) advise and support the work the Management of the UNESCO East Devon and Dorset Coast (informally known as the Jurassic Coast) World Heritage Site. ISJS has been involved in lively ongoing consultations and discussions about the balance of public outreach (with, for example, guided fossil-collecting days for the public) and the geoconservation of important sensitive sites.

### 5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2011

#### 5a. Progress with selection of GSSPs for Jurassic Stages.

Six of the eleven Jurassic Stages now have ratified GSSPs (Hettangian, Sinemurian, Pliensbachian, Aalenian, Bajocian, and Bathonian). The first one, which is also the GSSP of the Triassic/Jurassic system boundary, was ratified in 2010, and an official inauguration ceremony was held on August 20, 2011. The site, a newly cleaned artificial outcrop in proximity of the originally proposed section at Kuhjoch, Austria, was visited by an international group of invited stratigraphers and local officials, and the symbolic but real “Golden Spike” was driven in as a permanent marker for the base of the Jurassic. The same day another event was held at the Visitor Center of the local Karwendel Nature Park in the village of Hinterriss,

where speeches were delivered by the Austrian Federal Minister of Research (Mr. Karl-Heinz Tochterle), the Chair of the Austrian Stratigraphic Commission (Werner Piller), ICS Chair Stan Finney and ISJS Chair József Pálffy.

The status of the other five stages is summarized below.

**Toarcian.** There is generally accepted, albeit so far informal agreement, 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. A formal proposal is now at an advanced stage, it was further edited in 2011. Work is coordinated by Task Group chair Rogerio Rocha, based on extensive previous compilation by the late Serge Elmi, the previous TG chair. Emanuela Mattioli has assumed the role of TG Secretary. A ballot within the Task Group was postponed until the updated proposal is completed, it shall be held in early 2012. We aim to complete the subsequent ballot within the Jurassic Subcommittee prior to the 34<sup>th</sup> IGC in Brisbane.

**Callovian.** Activities of the Callovian TG were set back by the death of TG Convenor John Callomon in 2010. Eckhard Mönnig has been identified as a suitable TG Convenor, but he has not been ready to assume this duty until a major exhibition project in the museum under his direction will have been completed. With due respect to Callomon's legacy, the new convenor will need to revitalize the GSSP selection process. The *Kepplerites keppleri* horizon in the Albstadt-Pfeffingen, Swabia (S. Germany) section has been long identified as the best candidate but a formal proposal needs to be formulated.

**Oxfordian (Middle/Upper Jurassic boundary).** The Oxfordian Task Group, under guidance of Convenor Guillermo Melendez, has identified two candidate sections, at Savournon (SE France) and Redcliff Point, Dorset (SW England). The TG felt close to a stage when formal proposals should be assembled, but in the French stratigraphic community there is an increasing demand by some workers for reconsideration of an alternative section at Thuoux. An update of the ammonite biostratigraphy, a critical step for consideration as a formal GSSP candidate, has been prepared by D. Marchand and coworkers and has been circulated soliciting comments. A manuscript is nearly ready to be submitted to *Volumina Jurassica*. A field workshop planned for May 2012 should clarify the situation.

**Kimmeridgian.** There was little change in the status of this boundary in 2011. It has been agreed before, through formal votes within both the Kimmeridgian TG and the ISJS that the base of the Kimmeridgian Stage should be defined at the base of the Baylei Zone at the Flodigarry section, Isle of Skye, Scotland. However, a subsequent ballot was inconclusive regarding the exact horizon at which the GSSP should be fixed, either the *Pictonia flodigarriense* Horizon or the *Pictonia densicosta* Horizon. Ongoing work, under the guidance of TG Convenor Andrzej Wierzbowski, is aimed at shedding light on correlations with high northern paleolatitudes and also to South America. Together with new paleomagnetic data to be generated, this should resolve disagreements which principally concerned ammonite-based correlations within Europe. As soon as such new results will be available, they will be submitted to the Task Group members for a new vote.

**Tithonian.** Progress in identifying a possible GSSP for the base of the Tithonian is the least advanced of any of the Jurassic Stages. The Task Group faces difficulties of precise correlation between sections as a result of provincialism of the ammonite faunas has caused problems with finding and selecting potential candidate sections for the Kimmeridgian-Tithonian boundary. The TG is encouraging more work on a possible candidate sections at Canjuers (France). Efforts are underway to organize a field workshop in that area in May 2012.

### **5b. Preparation for the 9<sup>th</sup> International Congress on the Jurassic System**

One of the main activities of ISJS is to sponsor a major international congress every fourth year. Following the 8<sup>th</sup> Congress in 2010, the Voting Members of ISJS officially decided that the 9<sup>th</sup> Congress will be held in Jaipur, Rajasthan, India. The Organizing Committee will be led by Prof. Dharendra K. Pandey. The First Circular of the Congress has been published in July 2011.

A website devoted to the Congress has been launched at the following address: <http://www.jurassic2014.in> The meeting dates have been set as January 6-9 2014. Planning has started for the scientific program and the field trips. The pre-congress excursion visiting the Kachchh Basin and a post-congress excursion to the Jaisalmer Basin is in the early stage of organization.

### **5c. Volumina Jurassica – an ISJS-sponsored periodical**

In 2010 the ISJS entered into a strategic partnership with the periodical *Volumina Jurassica*. This journal is seeking its role as a renowned publication medium for the entire international Jurassic research community. The Chair, Vice Chair and Secretary of ISJS serve in the Editorial Board. Publication and delivery of Volume 8, with a printed date of 2010,

was completed by early 2011. This year papers have been assembled and edited for Volume 9, foreseen to be published in 2012.

#### **5d. ISJS website**

The ISJS website, revamped in 2009, continued to be updated on a regular basis in 2011. The website is hosted by the Oxford University, home institution of our Secretary, who is responsible for keeping the website up-to-date. It is accessible at <http://jurassic.earth.ox.ac.uk>

### **6. CHIEF PROBLEMS ENCOUNTERED IN 2011**

For other professional commitments, the executive has found their time and energy limited and not fully adequate to carry on ISJS businesses as originally envisioned. The chair started to serve as head of the Department of Geology at Eötvös University of Budapest in August 2011, only a year after he took up a new and demanding professorship there. The Secretary served as Acting Master of a college at Oxford University, which position constrained his availability to attend ISJS matters.

Similarly, many of the Task Group convenors found that their other commitments had to be given priority over ISJS-related matters. This unfortunately hindered progress in the GSSP selection process, most notably for the Toarcian and Oxfordian.

### **7. SUMMARY OF EXPENDITURES IN FISCAL YEAR 2011 (UP TO DATE OF REPORT)**

Finances of the ISJS are dealt with at University of Oxford, on a dedicated account set up by the Secretary and managed by the Finance Officer, Department of Earth Sciences, University of Oxford.

#### **Income**

Balance carried forward to 2011

ICS Allocation in 2011

#### **Expenditures in 2011**

Subtotal

**Balance as of 30 November 2011**

### **8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED IN 2012**

#### **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 Subcommittee, with five remaining to be defined: the Toarcian, Callovian, Oxfordian, Kimmeridgian and Tithonian. Activities are planned for 2012 towards the selection of each of these GSSPs.

- (i) The *Toarcian* is at an advanced stage. A proposal for the Peniche section in Portugal under the leadership of R. Rocha, is at an advanced editing stage, with major stratigraphic research work completed. It is expected that the proposal will be finalized and the TG will conduct a vote in 2012. If successful, it will be followed by the vote within the Subcommittee, possibly before the 34<sup>th</sup> IGC in Brisbane.
- (ii) The *Callovian* suffered a major setback by the death of TG convenor J. Callomon in 2010. The new TG chair needs to be appointed as soon as possible, Eckhard Mönnig being the leading candidate. The Albstadt section has been long regarded as the sole candidate for the Callovian GSSP. Steps will be taken in 2012 towards a formal proposal, identifying possible need for further research in fields other than ammonoid biostratigraphy, which was the main priority in previous research.
- (iii) For the *Oxfordian*, important details of two candidate sections (Redcliff Point, UK; Savournon, France) were published recently. However, there has been renewed interest in another section at Thuoux, recommended by some French workers. A field workshop at the two sections in southeast France is needed to resolve the situation. This meeting would also provide a forum for discussion about the respective merits of candidates. Organization of this event, in conjunction with a visit to a Tithonian section (see below), will be the top priority of ISJS in 2012.
- (iv) *Kimmeridgian*: The basal zone accepted by WG and SC vote, section selected and confirmed by WG vote; precise level/horizon and marker not yet decided. The resolution of this situation is expected from new data

about the correlation potential of the debated ammonite markers with other bioprovinces, and new magnetostratigraphic work at the candidate section in the Isle of Skye.

- (v) *Tithonian*: The Canjuers section has been identified as a potential candidate GSSP. Further work is needed, and the section should be visited by the TG members. Therefore a field meeting is planned, to be held in conjunction with that of the Oxfordian TG, as the sections are relatively close to each other and several Upper Jurassic specialists have common interest in both the Oxfordian and Tithonian GSSP issue. Organization of this field meeting is planned as the critical activity within ISJS in 2012 (postponed from 2011), for which the majority of funds received in 2011 were reserved and further financial support in the next fiscal year is requested.

### **8b. Proceedings of 8<sup>th</sup> International Congress on the Jurassic System**

Papers arising from the Jurassic Congress in 2010 and dealing with issues of Jurassic stratigraphy, paleontology, palaeogeography, and palaeoclimate will be published in *Volumina Jurassica*, a periodical now sponsored by ISJS.

### **8c. Preparation for the 9<sup>th</sup> International Congress on the Jurassic System**

The 9<sup>th</sup> Jurassic Congress, to be held in India in 2014, is sponsored by ISJS. The executive, as members of the Scientific Committee of the congress, will assist the local Organizing Committee led by D. Pandey to design the scientific focus of the meeting, including outstanding problems of Jurassic stratigraphy.

## **9. BUDGET AND ICS COMPONENT FOR FISCAL YEAR 2012**

For year 2012 the main activities of the Jurassic Subcommittee will be focussed on the following:

- (i) With a notable exception of the Tithonian, most of the Stage Working Groups have completed most of the fieldwork related to the investigation of candidate GSSP sections and selection of preferred section to be proposed to the Subcommittee. To ensure progress in the base Tithonian, however, organization of a field workshop is necessary;
- (ii) Stage Working Groups which have completed Stage GSSP procedures will continue work on definitions of Substages. There is a long tradition of using two substages in the Pliensbachian; their boundary definition would benefit from site visits by WG convenor and key experts;
- (iii) Regular update and maintenance of the ISJS website, to be hosted at the Oxford University;
- (iv) Preparation for the 9<sup>th</sup> International Congress on the Jurassic System in 2014.

**9a. Budget request.** Provision is requested in the budget to meet the above goals, with priority given to the organization of an "Upper Jurassic GSSP Workshop in SE France", focussed on the Oxfordian GSSP candidate sections (Savournon, Thuoux) and Tithonian GSSP prospect Canjuers.

General office expenses	\$ 150
Contributions to ISJS and Task Group officers' travel costs	\$ 1000
Support for combined Oxfordian and Tithonian Task Group meeting in SE France	\$ 5000
Seed funds for organization of 9 <sup>th</sup> Jurassic Congress	\$ 1000
<b>TOTAL BUDGET PROJECTED</b>	<b>\$ 7150</b>
Carried forward from 2011	\$ ~4100
<b>BUDGET REQUEST FOR 2012</b>	<b>\$ 3000</b>

## **10. OUTLOOK AND OBJECTIVES FOR THE YEARS AHEAD**

The primary objectives for the immediate future for the Jurassic Subcommittee remain the completion of the long-standing project for definition of the Stages by GSSPs. Of the five stages lacking GSSPs agreed upon by formal votes within ISJS, four (Toarcian, Callovian, Oxfordian, and Kimmeridgian) are at an advanced stage so that formal proposals and a start of the voting procedure is expected either in 2012 or soon after. The Tithonian is at a less advanced stage and effort needs to be increased to find the most suitable marker event and location so that the definition of this stage boundary could also be completed within the next few years.

As the term of office for ISJS executive will end in 2012 by the 34<sup>th</sup> IGC in Brisbane, the nomination procedure for the election of officers for the 2012-2016 term has started by the appointment of a nomination committee consisting of three voting members of ISJS. Although an overall continuity in the ISJS agenda is anticipated, steering the activities for the years ahead will be the responsibility of the new executive.

## SUBCOMMISSION ON TRIASSIC STRATIGRAPHY

### ANNUAL REPORT 2011

#### 1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Triassic Stratigraphy

#### *SUBMITTED BY*

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

#### 2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

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

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

#### 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 (117). The Secretary hosts a web site for STS announcements and task group discussions.

Subcommission members represent a broad spectrum of specialized stratigraphical disciplines from those countries or regions where Triassic rocks are extensively studied in relation to fundamental and/or applied geological research. Current research activities and future plans are communicated through publication of the bi-annual STS newsletter *Albertiana* as web release.

##### 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 once in the year in Utrecht is downloadable at the STS website: <http://paleo.cortland.edu/sts/>  
Previous issues, up to #38 are available at  
<http://www.uu.nl/faculty/science/EN/organisation/depts/biology/research/chairs/Palaeoecology/projects/ALBERTIANA/Pages/default.aspx?refer=/EN/faculties/science/organisation/depts/biology/research/chairs/Palaeoecology/projects/ALBERTIANA/Pages/default.aspx>

The web site of the STS is hosted at SUNY – Cortland, where all the information on the Subcommittee 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 2011**

##### **Publications**

*Albertiana* #39 has been printed in April 2011. This issue (95 pp.) is dedicated to workshop held in Palermo in September 2010 “New developments on Triassic integrated stratigraphy”. It includes the guidebook (29 pp.) of the two day excursion, as well as all the abstracts of the 21 oral presentations and of the 9 poster presentations.

The Abstract volume of the 21<sup>st</sup> Canadian Paleontological Conference has been printed in August 2011. The volume includes the abstracts of the 12 oral and 5 poster presentations of the special Triassic Session in commemoration of E.T. Tozer (see below). In order to ensure the dissemination of the information the Organizing Committee of the Conference has agreed on allowing the publication of these abstract in the next issue of *Albertiana* (#40), whose editing is in progress.

The primary aim of *Albertiana* is to promote the interdisciplinary collaboration and understanding among members of the Subcommittee 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://paleo.cortland.edu/sts/>.

Over the years, the number of original contributions printed in *Albertiana* has decreased and the authors are much more oriented to publish original articles in ISI ranked journals. In 2011 the number of papers published on STS topics is about 30.

Summary of these publications is given in *Albertiana* issues under section “Triassic annotated literature”.

##### **Meetings:**

##### **19-22 August 2011. Vancouver, Canada. 21st Canadian Paleontology Conference.**

##### **Special Session: Studies on the Triassic in Commemoration of Edward Timothy Tozer.**

During the 21<sup>st</sup> CPC the organizers included a special session in honour of Edward Timothy Tozer (1928-2010), one of the most famous contemporary Canadian paleontologists as well as the doyen of the Subcommittee on Triassic Stratigraphy, who passed away on December 26, 2010. The Special session included 12 oral presentations by Canadian specialist, but also foreigner specialists from Italy, Japan, Russia, Switzerland and United States.

##### **4-8 September 2011. Toulon (France). 8th International Field Workshop on Triassic. Triassic of Southeast France.**

The workshop consisted of 4 days of field trip, aimed at visiting outcrops in a variety of landscapes (from coastal cliffs in the Toulon area up to mountains about 2,000 m as the Dôme de Barrot), and successions including various modes of Permian-Triassic unconformable boundary, and a Triassic series that presents both “Germanic” characters by its lithofacies, and “Sephardic” (Tethyan) characters by its palaeontological content. About 26 participants from 9 countries attended the workshop.

#### **Progress on outstanding Triassic GSSPs:**

##### **Induan-Olenekian**

The Task Group re-activated in October 2009, is one of the most active in the STS. The discussion started again at the beginning of 2010 by Hugo Bucher and Nick Goudeman (Switzerland), who obtained new data on ammonoids and conodonts from the Induan-Olenekian transition in both Salt Range in Pakistan (Nammal section) and Central Himalayas (Mud section).

The Switzerland group, guided by H. Bucher (Zurich) already published some data in 2010, namely from Tulong (Tibet: Brühwiler et al. 2010a) and Mud-Spiti (Himalaya, India: Brühwiler et al. 2010b). Dinerian ammonoids faunas

from Nevada (Candelaria Hills, USA) have been described by Ware et al. (2011). A comprehensive summary of the investigations carried out in Salt Range (Nammal, Pakistan) and again Spiti (Himalaya, India) has been announced by Ware et al. (2011) at the 21st Canadian Paleontology Conference, which took place in Vancouver (August 2011). These results are going to be submitted for publication by Ware et al. Most probably the paper will be printed by the end of 2012, but some elements useful for discussion hopefully will be anticipated in Albertiana early in 2012.

Intensive sampling of the Early Triassic successions at the Nammal, Chiddru and Zalach localities in the Salt Range shows that the Induan-Olenekian boundary there is within the Ceratite Marls (e.g., Ware et al., 2011) and that ammonoid and conodont beds of the Salt Range correlate perfectly well with those of Spiti (Brühwiler et al., 2010a). From the twelve ammonoid beds known in the Smithian of the Salt Range the seven ones, including the basal *Flemingites bhargavai* beds, are present in the Mud section in Spiti.  $\delta^{13}\text{C}_{\text{org}}$  and  $\delta^{13}\text{C}_{\text{carb}}$  data from Nammal and Chitta-Landu sections, Salt Range (Hermann et al., 2011), show an increase of  $\delta^{13}\text{C}$  that coincides with the Induan-Olenekian faunal turnover there. As it follows from author's note (Ware et al., 2011), among all potential candidates, the Nammal section, yielded high resolution palaeontological (including palynological) and C-isotope records, provides by far the most complete GSSP for the base of the Olenekian stage. No calibration with magnetostratigraphy is available up to now, but the potential for correlation with continental facies is provided by the palynology (Hermann et al. 2011).

Another group active on the Induan/Olenekian boundary is Russian-Japanese, that is studying successions from South Primorye (Russian Far East). Some results have been already published (Zakharov et al., 2010, 2011), while others are in press (e.g., Smyshlyaeva & Zakharov, in press). The main results of this group are on ammonoid taxonomy and bio-chronostratigraphy. The study of the Dinerian faunas suggests the correlations of the *Gyronites subdharmaus* Zone in South Primorye with the *Prionolobus rotundatus* beds in the Himalayas and Salt Range and the *Prionolobus-Gyronites* Zone in Chaohu. Some group of Smithian ammonoids are revised and new collections of early Olenekian ammonoid allow a better subdivision of the boundary interval. The Induan-Olenekian boundary in the Abrek section is determined by the first appearance of the flemingitid ammonoid *Ussuriflemingites abrekensis*, recently discovered just near the base of the Zhitkov Formation.

The significant progress of the knowledge achieved in 2010 and especially 2011, leads to reasonably suppose a final ballot on a proposal for a GSSP defined at Nammal section (Salt Range, Pakistan) by 2012, especially if the synthetic manuscript by Ware et al. (in progress) is accepted for publication in a short time.

### **Olenekian-Anisian**

The slow progress on the definition of the GSSP of the base of the Anisian has continued during the 2011.

For about 10 years Desli Caira (Rumania) appeared to be the most suitable section for the definition of the base of the Anisian and the best primary marker candidate appeared to be the FAD of the conodonts *Chiosella timorensis*. For years the research focused on multistratigraphic calibration of the *C. timorensis* event at Desli Caira. However, in the last 2 years the significance of this conodont event has become matter of discussion, on the basis of new data from western United States. At the very end of 2010 a manuscript reporting the first occurrence of *Chiosella timorensis* in the in the Haugi Zone (Olenekian) of western US has been submitted to **Geobios** (Goudemand et al, submitted). The review procedure has been completed and the paper will be published in a very short time. The data included in this long announced paper surely will stimulate a reopening of the discussion on this important boundary.

New ammonoid collections have been done at Desli Caira by E. Gradinaru, exactly around the supposed O/A boundary. The collection is significantly enriched and its study is reported as in progress.

### **Ladinian-Carnian**

The GSSP, defined at Prati di Stuares/Stuares Wiesen (Dolomites, Italy), has been ratified in June, 2008. The manuscript with the presentation of the GSSP has been submitted to **Episodes**. The review is going to be completed and the final paper will be published by 2012.

### **Carnian-Norian**

Task Group for the Carnian/Norian boundary has been one of the most active of the STS also in 2011. If 2010 was dedicated to the visit of the two candidate sections Black Bear Ridge (British Columbia, Canada) and Pizzo Mondello (Sicily, Italy) and to a first comparison of the paleontological record of the two sections (Palermo Workshop, September 2010), this year has been mostly devoted to the publication of new data. A large monograph on bivalves from Pardonet Formation (Willistone Lake, BC) has been published on the *Journal of Paleontology* by McRoberts (2011). This monograph includes the taxonomic description of bivalves from 11 stratigraphic sections, including the GSSP candidate section Black Bear Ridge. Nine species of *Halobia* are described and their biochronologic significance is discussed. The stratigraphic record of the pelagic bivalves from Willistone Lake has been also compared with the record from the Tethys realm by McRoberts & Krystyn (2011), who presented their view at the 21<sup>st</sup> CPC in Vancouver (August 2011). As the result the authors propose the definition of the GSSP of the Norian Stage at Black Bear Ridge section level 18F, on

the basis of the FOD of *Halobia austriaca*. The study of conodonts from Black Bear Ridge section by Orchard is in progress. The publication of this contribution is crucial step for the final discussion of the correlatability of the bioevents. The most important results of the investigations carried out at Pizzo Mondello have been submitted to the *Rivista Italiana di Paleontologia e Stratigrafia* to be printed in the proceedings of the Palermo workshop. The description of the *Halobia* from the Upper Carnian-Lower Norian has been submitted by Levera. The manuscript (more than 50 pages), is accepted for publication and includes the taxonomic description of 10 species of *Halobia* as well as the discussion of *Halobia* biostratigraphy. Another large sized manuscript (about 95 pages), accepted for publication is by Mazza & Rigo, who describe and discuss the taxonomy of the conodont record. These two manuscripts are complemented by a manuscript by Preto et al. on the calcareous nannofossils (accepted for publication), and by a manuscript by Balini et al. on the taxonomic description of the ammonoid faunas. The latter manuscript is still under review.

On the whole, 2011 has seen a tremendous increasing of knowledge on the faunal and floral changes across the Carnian/Norian boundary and after the publication of the proceedings of Palermo workshop, expected by February-March 2012, a second round of discussion will take place. So far, the pelagic bivalves, namely the FO/FOD of *Halobia austriaca*, seems to be the best candidate for the definition of the boundary. Due to faunal differences between North America and Tethyan realm, the conodont events seem to be useful only as additional markers. At the present the main problem that has to be solved before the final decision on the GSSP seems to be the chronostratigraphic calibration of the first occurrence of *H. austriaca* at Black Bear Ridge and at Pizzo Mondello. In both the sections the FO of *H. austriaca* is recorded in levels that are rather poor in ammonoids.

In order to provide additional data to the calibration of the first occurrence of *H. austriaca*, another section of great significance was sampled in 2010 by Balini et al. in the West Union Canyon (Shoshone Range, Central Nevada). This locality, the best site in North America for the paleontologic record of the Upper Carnian, is characterized by a rich record of ammonoids. Preliminary investigations by Balini et al. (2011) demonstrate the occurrence of conodonts and *Halobia*. Taxonomic analysis of conodonts is in progress but the conodont faunas show a good affinity with British Columbia. Hopefully the rich ammonoid record will allow the calibration of some of the conodont and bivalve events.

### **Norian-Rhaetian**

The correlation of the GSSP candidate section Steinbergkogel (Hallstatt area, Austria) with Slovakia and Northern Italy seem to be calibrated.

The first occurrence of coccolithophore is illustrated in a manuscript by Gardin, Krystyn, Richoz, Bartolini & Galbrun, submitted in Lethaia. The FO of coccolithophore has been detected some cm above the FO of the conodont *Misikella posthersteini* at Steinbergkogel. This event looks like to be an important proxy for the N/R boundary. The presentation of the final proposal, already scheduled for the end of 2010 (see Annual Report 2010), has been promised by the Task Group leader by the end of 2011.

## **6. CHIEF PROBLEMS ENCOUNTERED IN 2011**

The crisis in the life of the STS already described in the Annual Report 2010 has continued in 2011. The problems are exactly the same already outlined in 2010:

1. Severe cuts of budget for research at every level in many countries, due to the global economic crisis. notably reduce not only the research in the field, but also the possibility for the Task Group members to attend meetings and workshops. The definition of the GSSPs requires both the type of activities, then the work of the Task Groups is notably slowed down.
2. Decrease of interest on the STS activities of some experienced members close to retirement. This is a very severe problem affecting directly the life and vitality of the Subcommittee. Several STS members started their research career in the 1960's and are close to retirement, or retired in the very last years. Difficulties in getting full positions make the turnover with young scientists very difficult. At the present the main consequences of the decreasing of interest are:
  - a) Lack of suggestions for the activities and the program of the Subcommittee.
  - b) Difficulties in finding candidates for the organization of workshops and excursions.
  - c) Reduction of the contributions to the STS newsletter *Albertiana*, that was almost regularly published twice a year until 2007 (issue #36), while since then only 2 issues have been published in 3 years.
3. Lack of IGCP cover. After the end of the successful IGCP 467 in 2008, only the IGCP 572 still provides support for some of the activities of the STS, notably the investigations on the Early Triassic. This IGCP will end in 2012.

## 7. SUMMARY OF EXPENDITURES IN 2011 (in US\$)

ICS FUNDING	
Subcommission allocation	3000
STS EXPENDITURES	
Contribution to participants to 21 <sup>st</sup> CPC, August 19-22, 2011	2000
Contribution to the organization of 21 <sup>st</sup> CPC, August 19-22, 2011	500
Albertiana - STS Newsletter production	500
TOTAL	3000

## 8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2012):

### Organization of the Subcommission

In order to try to increase the vitality of the Subcommission (see above point 6.2 and the Annual Report 2010), STS chairman has started a general revision of the list of the Corresponding members of the Subcommission. At first a list of possible candidates has been assembled, by collecting suggestions from STS Voting Members, then every candidate has been personally contacted by the STS chairman. Thirty out of 34 of them have accepted to join the Subcommission. Most of the new members are between 30 and 45 years old, and all of them have been active on Triassic stratigraphic topics in the last 5-10 years.

This recruitment of new Corresponding member increases the number of the STS CM of 35% and is the major revision ever done on the STS.

### Meeting/field workshop schedule

May 30-June 7, 2012, Eger (Hungary), IGCP572, Closing conference. Organizing Committee chaired by János Haas, Budapest, Hungary (haas@ludens.elte.hu).

August 8, 2012, Brisbane, Australia, 34 IGC. Business meeting of the STS.

August 2012, Brisbane, Australia, 34 IGC. Symposia 35.1 "GSSPs (Global boundary-stratotype section and point) as global geostandards". Convenors: Stan Finney (scfinney@csulb.edu; USA), Marco Balini (Italy) and Jim Ogg (USA)

September 2, 2012, 9<sup>th</sup> International Field Workshop on Triassic. Canton Tessin (Switzerland) and Lombardy (Italy). Organizing Committee chaired by Andrea Tintori, Milano, Italy ([andrea.tintori@unimi.it](mailto:andrea.tintori@unimi.it)).

September 10-13, 2012, Schladming (Austria), 29th IAS Meeting of Sedimentology.

This meeting could be a good opportunity to meet and discuss the Upper Triassic boundaries, even if the IAS meeting are not traditionally time scale-oriented. The scientific programme of the Schladming meeting actually would provide this opportunity as suggested by the field trip and session programme.

Pre-meeting field trip A1: End-Triassic crisis events recorded in platforms and basins of the Austrian Alps. The Triassic/Jurassic and Norian/Rhaetia GSSPs (Austria).

Session T8 S3 "From the Late Permian to the Middle Triassic perturbation around the Permian/Triassic boundary".

Conveners: M. Horacek (Tulln, Austria), R. Brandner (Innsbruck, Austria) & D. Aljinovic (Zagreb, Croatia).

Session T8 S4 "Late and End-Triassic events, a multidisciplinary approach", Conveners S. Richoz (Graz, Austria), L. Krystyn (Vienna, Austria), S. Gorican (Ljubljana, Slovenia).

<http://www.sedimentologists.org/ims-2012/>.

November 4-7, 2012, Charlotte, North Carolina (USA), 2012 Annual meeting GSA. Proposed Pardee Symposium "Honoring Norman J. Silberling for contribution to international Triassic stratigraphy, biostratigraphy, tectonostratigraphic terranes and geology of Nevada". Proposers Chris McRoberts (Christopher.McRoberts@cortland.edu) and George Stanley (george.stanley@umontana.edu).

### GSSP deliberations

*The I-O Boundary:* The Task Group, reactivated at the end of 2009, is expected to vote a proposal in 2012.

*The O-A Boundary:* The Task Group is going to be re-organized.

*The L-C Boundary:* The GSSP has been ratified by IUGS in June, 2008. The final presentation of the GSSP has been submitted to Episodes.

*The C-N Boundary:* Good progress in the selection of the best events to mark the boundary. At the moment the best candidate event for the definition of the GSSP is the FO of the bivalve *Halobia austriaca*. The conodonts species *Metapolygnathus echinatus* and *M. communisti* might provide additional marker events. Investigations are focused on the calibration of the FO, namely on the search for the FAD of the species. The Task Group might be ready as soon as the monograph on the conodonts from the Black Bear Ridge section is published. Hopefully this will happen in 2012.

*The N-R Boundary:* The primary marker event and the candidates section were already designated in 2008. Three years have been dedicated to test the correlatability of the proposed marker event. The final proposal has been announced by the end of 2011.

## 9. BUDGET AND ICS COMPONENT FOR 2012 (in US\$)

Albertiana - STS Newsletter production	500
Contribution to the STS executives attending the 34 IGC, Brisbane 2012	3500
Contribution for the invitation of Triassic specialists at IAS sessions on Upper Triassic	2000
TOTAL	6000

### *Potential funding sources outside IUGS*

The situation is stable since the end of IGCP 467 (2008) and is as follows:

- 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.
- Some support is available through IGCP 572 for activities concerning the Lower Triassic stage boundaries.

## 10. REVIEW CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2006-2010)

### *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. 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.
2. Symposium on *Triassic Conodonts: Taxonomy and Time Scales*, at the First International Conodont Symposium (ICOS1), in Leicester, England, July 17-21, 2006.
3. Conference, *The Boreal Triassic*. Longyearbyen, Svalbard, Arctic Norway, August 16-20, 2006.
4. International meeting on *The Global Triassic*. Albuquerque, New Mexico, USA. May (19-)23-25, 2007.
5. Field workshop on the *Carnian-Norian boundary*, Williston Lake, NE BC, Canada. May 27-31, 2007.
6. Symposium, *The Triassic climate*, Bolzano/Bozen, Italy, June 3-6, 2008.
7. Symposium and field workshop, *Upper Triassic subdivisions, zonation and events*, Bad Goisern, Austria, September 28-October 2, 2008.
8. International workshop *New developments on Triassic integrated stratigraphy*, Palermo, Italy, 12-16 September 2010.

### *Publications*

- Four issues of *Albertiana* (#35-38) were published in 2006 thru 2010, for a total of 558 printed pages. Each of these issues was made available for download from the *Albertiana* website.
- Abstract volumes/ field guides prepared for meetings in Chaohu, Wellington, Leicester, Longyearbyen, Albuquerque, Bolzano, Bad Goisern and Palermo.
- *Triassic of the American West*, Lucas S.G & Spielmann J.A. (eds) 2007, *New Mexico Museum of Natural History and Science Bulletin* 40, 247 pp.
- *The global Triassic*, Lucas S.G & Spielmann J.A. (eds) 2007, *New Mexico Museum of Natural History and Science Bulletin* 41, 415 pp.
- *Geological Society of London Special publications* 334 "The Triassic Timescale" S.G. Lucas (ed.). The volume, printed in 2010, includes 15 contributions (515 pages) reviewing the state-of-the-art of the main tools for the

definition of the Triassic time-scale, from classic fossil tools (ammonoids, bivalves, conodonts, radiolarians, palynomorphs, conchostracans, tetrapods and tetrapod footprint) to magnetostratigraphy, geochronologic data ages, isotope variations and cyclostratigraphy.

- The proceedings of "The Triassic climate" workshop, Bolzano/Bozen, 2008 have printed in April 2010 as issue #290 of *Palaeogeography, Palaeoclimatology, Palaeoecology*, The volume includes 13 contributions spanning from the Permo-Triassic to the end of the Triassic.

#### *Task groups*

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.

The **Induan-Olenekian boundary** Task Group, stated 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. Afterwards in 2004 a section in Chaohu, Anhui Province, China became the focus of intensive study of ammonoid and conodont biostratigraphy, magnetostratigraphy, and chemostratigraphy. The FAD of the conodont *Neospathodus 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  $\delta^{13}\text{C}$ . 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* subspp. 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 (2006).

Two ballots were organized in 2007, based on the FAD of *Neospathodus waageni sensu latu* 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 latu* first appears about 1 m below the level MO4-13A3. In October 2009 the Task Group is reactivated, under the leadership of Y. Zakharov. The composition revised and the discussion re-opened at the beginning of 2010 by Hugo Bucher and Nick Goudeman (Switzerland), who obtained new data on ammonoids and conodonts from the Induan-Olenekian transition in both Salt Range in Pakistan (Nummal section) and Central Himalayas (Mud section). Other new data were provided by Brühwiler et al. (2008 and 2010) who described Griesbachian and Dinerian ammonoid faunas from Guangxi and Smithian ammonoids from Tulong (Tibet). Orchard (2010), analysed Induan-Olenekian conodont successions of Central Himalayas (Mud section) and South China.

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 in a relatively short time. 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 (2006), 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 2007 (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., 2007) 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). Another field sampling of Desli Caira section was carried out in 2010, in order to improve the ammonoid collection from the boundary interval and, hopefully, to reduce the gap between the Olenekian and the Anisian ammonoids.

The **Anisian-Ladinian boundary** was voted by the STS during 2004, and the IUGS ratified the choice on 21st March 2005. The GSSP is defined at Bagolino (Italy) section B, on the basis of the FAD of the ammonoid the *Eoprotrachyceras curionii*, at top of "*Chiesense groove*". 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 by the Natural History Museum of Brescia.

The final discussion on the **Ladinian-Carnian boundary** GSSP proposal started in 2004, during the Spiti Workshop, after new samplings of the three most interesting sites for the boundary: Prati di Stuores (Dolomites, Italy), Spiti (Himalaya, India) and South Canyon (Nevada, USA). Final discussion took place in 2007 at the Albuquerque symposium, where all the data from the three most interesting sections have been compared. 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 Museum Bulletin (#40 and #41: Balini et al., Balini & Jenks; Orchard; Orchard & Balini; Mietto et al.). Before the workshop (June 2006) M. Gaetani, the task group chair, distributed a questionnaire 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. The summary of the results is as follows:

1. 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*.
2. 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 cooked out content in palynomorphs, and the accessibility limited to the summer months, due to the altitude.
3. In the successions in New Pass Range, Nevada, *Frankites sutherlandi* overlaps the lower part of the range of *Trachyceras* gr. *T. desatoyense*, several meters above the FAD of *desatoyense*. *Halobia* appears in the same beds from where *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. The detailed bed-by-bed study of South Canyon, the most important site to test the correlations of the tethyan bioevents with northamerican 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*, *Metapolygnathus 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 *Metapolygnathus 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.

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. In a very few years the research focused on two sections. Black Bear Ridge (British Columbia, Canada) interesting for the rich conodont record, and Pizzo Mondello section (Sicily, Italy) important for the complete magnetostratigraphic record encompassing the Upper Carnian to the Rhaetian interval.

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 theses 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. The year 2010 has been crucial for the definition of the GSSP of the Norian stage as both the candidate sections have been visited. Black Bear Ridge was visited in May by the Task Group chair and members of the working groups studying the Black Bear Ridge and Pizzo Mondello section. Pizzo Mondello section was visited in September 2010, during the field trip of the Palermo workshop. During the indoor session several contributions on BBR and PM section were presented and discussed. The significance of the pelagic bivalve *Halobia austriaca* was emphasized by McRoberts, Krystyn and Levera. The significance of conodonts for the selection of the primary marker event was reduced by faunal differences. The suggested marker at Black Bear Ridge *Metapolygnathus echinatus* is not documented at Pizzo Mondello, while *Metapolygnathus communisti*, one of the possible markers at Pizzo Mondello, is unknown at Black Bear Ridge. *Epigondolella quadrata* documented in both the sections, actually seems to be notably diachronous.

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. In 2005, field sampling in the Gabbs Valley Range of Nevada lead to identify for the first time in North American autochthon the 'Tethyan' conodont *Misikella*.

In Austria the investigations focused first on Zlambach section (Hallstatt and Zlambach formations) that 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.

Better results were achieved at Steinbergkogel, Austria, that soon became a potential GSSP candidate. At this section 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., 2007, 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 led 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. In 2009 and 2010 the research group working on the Steinbergkogel section was engaged with search and sampling of reference sections, crucial to demonstrate the significance of the rather thin Steinbergkogel section.

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 2011.

The slowing down of the research activities started in 2009 with the world economic crisis, has strongly influenced the previous schedule of the GSSP definition. Taking into account the reduction of the active members (see 6.s) the original schedule established at the beginning of the four-year term has been revised. The STS is focusing on three GSSPs (I-O, C-N and N-R), with the hope to ratify at least one of them by 2012.

Work plan:

2012: a vote of the N/R boundary Task Group is expected for the beginning of the year. A vote of the O/A Task Group is scheduled the end of the year. Hopefully a vote of the C/N Task Group can be also expected by the end of the year.

2013: further ballots, if necessary.

\*\*\*\*\*

### 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](mailto:morchard@nrcan.gc.ca)

**Vice Chairman:** Yin Hongfu, China University of Geosciences, Yujiashan, Wuhan, Hubei, 430074, Peoples Republic of China. [hfyin@cug.edu.cn](mailto:hfyin@cug.edu.cn)

**Vice Chairman:** Marco Balini, Dipartimento di Scienze della Terra, via Mangiagalli 34, I-20133 Milano, Italy. [Marco.Balini@unimi.it](mailto:Marco.Balini@unimi.it)

Secretary/ STS web: Christopher A. McRoberts, Department of Geology, State University of New York at Cortland, P.O. Box 2000, Cortland, New York 13045 USA. <mailto:microberts@cortland.edu>

**Albertiana Editor/ Webmaster:** Wolfram M. Kuerschner, Laboratory of Palaeobotany and Palynology, Utrecht University, Budapestlaan 4, 3584 CD Utrecht, The Netherlands. [W..M.Kuerschner@bio.uu.nl](mailto:W..M.Kuerschner@bio.uu.nl)

#### 2008-2012 Subcommission officers (with addresses)

**Chairman:** Marco Balini, Dipartimento di Scienze della Terra, via Mangiagalli 34, I-20133 Milano, Italy. [Marco.Balini@unimi.it](mailto:Marco.Balini@unimi.it)

Vice Chairman: Mark Hounslow, Centre for Environmental Magnetism and Palaeomagnetism, Geography Dept, Farrer Avenue, Lancaster University, Lancaster, UK., LA1 4YQ. [m.hounslow@lancaster.ac.uk](mailto:m.hounslow@lancaster.ac.uk)

**Vice Chairman:** Jinnan Tong, GPMR and BGEG laboratories at China University of Geosciences, Wuhan 430074, China. [jntong@cug.edu.cn](mailto:jntong@cug.edu.cn)

Secretary/ STS web: Christopher A. McRoberts, Department of Geology, State University of New York at Cortland, P.O. Box 2000, Cortland, New York 13045 USA. <mailto:microberts@cortland.edu>

**Albertiana Editor/ Webmaster:** Wolfram M. Kuerschner, Department of Geosciences, University of Oslo, P.O. box 1047, N-0316 Oslo, Norway. [w.m.kuerschner@geo.uio.no](mailto:w.m.kuerschner@geo.uio.no)

*Task Groups and their officers*

**Base Induan (Triassic):** Yin Hongfu, China. [hfyin@cug.edu.cn](mailto:hfyin@cug.edu.cn). Mission ended in 2001.

**Base Olenekian:** Y. Zakharov, Russia. [yurizakh@mail.ru](mailto:yurizakh@mail.ru)

**Base Anisian:** pending, new chairman is going to be defined

**Base Ladinian:** A. Baud, Switzerland. [Aymon.Baud@sst.unil.ch](mailto:Aymon.Baud@sst.unil.ch). Mission ended in 2004.

**Base Carnian:** M. Gaetani, Italy. [maurizio.gaetani@unimi.it](mailto:maurizio.gaetani@unimi.it) Mission ended in 2008.

**Base Norian:** L. Krystyn, Austria. [leopold.krystyn@univie.ac.at](mailto:leopold.krystyn@univie.ac.at)

**Base Rhaetian:** L. Krystyn, Austria. [leopold.krystyn@univie.ac.at](mailto:leopold.krystyn@univie.ac.at)

**Non-marine auxiliaries:** S. Lucas, USA. Lucas, Spencer, DCA. [spencer.lucas@state.nm.us](mailto:spencer.lucas@state.nm.us)

*List of Voting Members (2008-2012)*

**Yoshiaki Aita**, Utsunomiya, JAPAN

**Marco Balini**, Milan, ITALY

**Om N. Bhargava**, INDIA

**Hugo Bucher**, Zurich, SWITZERLAND

**Hamish Campbell**, Dunedin, NEW ZEALAND

**Mark Hounslow**, Lancaster, ENGLAND

**Dennis Kent**, Palisades, USA

**Heinz W. Kozur**, Budapest, HUNGARY

**Leopold Krystyn**, Vienna, AUSTRIA

**Wolfram M. Kuerschner**, Oslo, NORWAY

**Max Langer**, BRAZIL

**Spencer Lucas**, Albuquerque, USA.

**Christopher R. McRoberts**, Cortland, USA

**Manfred Menning**, Potsdam, GERMANY

**Paolo Mietto**, Padova, ITALY

**Alda Nicora**, Milano, ITALY

**Michael J. Orchard**, Vancouver, CANADA

**Bruce Rubidge**, Wits, SOUTH AFRICA

**Kazem Seyed-Emami**, Tehran, IRAN

**Michael A. Shishkin**, Moscow, RUSSIA

**Jinnan Tong**, Hubei, CHINA

**Attila Voros**, Budapest, HUNGARY

**Wolfgang Weitschat**, Hamburg, GERMANY

**Hongfu Yin**, Hubei, CHINA

**Yuri D. Zakharov**, Vladivostok, RUSSIA

[aida@cc.utsunomiya-u.ac.jp](mailto:aida@cc.utsunomiya-u.ac.jp)

[marco.balini@unimi.it](mailto:marco.balini@unimi.it)

[onbhargava@yahoo.co](mailto:onbhargava@yahoo.co)

[Hugo.Bucher@pim.unizh.ch](mailto:Hugo.Bucher@pim.unizh.ch)

[H.Campbell@gns.cri.nz](mailto:H.Campbell@gns.cri.nz)

[m.hounslow@lancaster.ac.uk](mailto:m.hounslow@lancaster.ac.uk)

[dvk@rci.rutgers.edu](mailto:dvk@rci.rutgers.edu)

[kozurh@helka.iif.hu](mailto:kozurh@helka.iif.hu)

[leopold.krystyn@univie.ac.at](mailto:leopold.krystyn@univie.ac.at)

[w.m.kuerschner@geo.uio.no](mailto:w.m.kuerschner@geo.uio.no)

[mclanger@ffclrp.usp.br](mailto:mclanger@ffclrp.usp.br)

[SLucas@nmmnh.state.nm.us](mailto:SLucas@nmmnh.state.nm.us)

[microberts@cortland.edu](mailto:microberts@cortland.edu)

[menne@gfz-potsdam.de](mailto:menne@gfz-potsdam.de)

[paolo.mietto@unipd.it](mailto:paolo.mietto@unipd.it)

[alda.nicora@unimi.it](mailto:alda.nicora@unimi.it)

[morchard@nrcan.gc.ca](mailto:morchard@nrcan.gc.ca)

[rubidgeb@geosciences.wits.ac.za](mailto:rubidgeb@geosciences.wits.ac.za)

[kemami@ut.ac.ir](mailto:kemami@ut.ac.ir)

[schsz@orc.ru](mailto:schsz@orc.ru)

[jntong@cug.edu.cn](mailto:jntong@cug.edu.cn)

[voros@nhmus.hu](mailto:voros@nhmus.hu)

[wolfgang.weitschat@uni-hamburg.de](mailto:wolfgang.weitschat@uni-hamburg.de)

[hfyin@cug.edu.cn](mailto:hfyin@cug.edu.cn)

[yurizakh@mail.ru](mailto:yurizakh@mail.ru)

**SUBCOMMISSION ON PERMIAN STRATIGRAPHY**  
**ANNUAL REPORT 2011**

**1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER**

International Subcommission on Permian Stratigraphy (SPS)

**SUBMITTED BY:**

Charles M. Henderson, Chairman SPS  
 Department of Geoscience, University of Calgary,  
 Calgary, AB Canada T2N 1N4  
 Phone: 403-220-6170; Fax: 403-284-0074;  
 Email: charles.henderson@ucalgary.ca  
 Website: www.ucalgary.ca/conodont/

**2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY**

**Subcommission Objectives:** The Subcommission's primary objective is to define the series and stages of the Permian, by means of internationally agreed GSSP's, and to provide the international forum for scientific discussion and interchange on all aspects of the Permian, but specifically on refined regional correlations.

**Fit within IUGS Science Policy:** The objectives of the Subcommission involve two main aspects of IUGS policy:

1. The development of an internationally agreed chronostratigraphic scale with units defined by GSSP's where appropriate and related to a hierarchy of units to maximize relative time resolution within the Permian System; and
2. Establishment of framework and systems to encourage international collaboration in understanding the evolution of the Earth during the Permian Period.

**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 seventeen 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 [www.nigpas.ac.cn/permian/web/index.asp](http://www.nigpas.ac.cn/permian/web/index.asp) . This site includes all back issues of *Permophiles* in downloadable PDF format (#1 in 1978 to #55 December 2010). A link to *Permophiles*/Permian research has also been established at [www.ucalgary.ca/conodont/sps](http://www.ucalgary.ca/conodont/sps) .

**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 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 GeoStratSys. 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 2011**

**GSSPs:** Progress was made on the three remaining Lower Permian (Cisuralian) stage GSSPs including base-Sakmarian, base-Artinskian, and base-Kungurian. The section and point for the base-Sakmarian has been changed to the Usolka section in Russia and a proposal was to have been voted on in 2011, but there have been some delays. 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. Detailed conodont samples from the approximate GSSP interval were collected by V. Davydov and were processed in Calgary during 2011. The isotopic ages are now in press in a paper by Mark Schmitz and Vladimir

Davydov in GSA Bulletin. This material will form the basis of a report that will be prepared early in 2012 and then followed by a vote. A penultimate proposal for the base-Artinskian is appeared in *Permophiles* 55, and some input was received. At both of these sections the Sr isotopes of conodonts have also been shown to be an accurate correlation tool. A revised proposal will be submitted to SPS voting members early in 2012. The Mechetlino section in Russia is not satisfactory for a base-Kungurian GSSP – samples did not yield conodonts, zircons are all reworked, and the rocks are too deeply weathered to produce meaningful carbon isotopic values. New work on a nearby section has shown better conodont recoveries and Sr-isotopic values are being analysed. It is possible that the Mechetlino section will be named as a supplementary reference section. The primary section under consideration for base-Kungurian GSSP is the Rockland section in northern Nevada, USA. The GSSP will be defined using the same point (FAD of *Neostreptognathodus pnevi*) as considered in Russia; hopefully, Sr-isotopic values will match. Funds were requested and granted from ICS for a workshop on this proposal. It was determined that June 2011 was too soon as originally planned; instead a workshop with Bruce Wardlaw, Charles Henderson, Vladimir Davydov and Mark Schmitz was held at Boise May 29 to June 3. Two sets of samples were previously collected and processed separately in Boise and Calgary. During the workshop Wardlaw and Henderson picked all samples and independently picked the same sample/point within the chronomorphocline from *N. pequopensis* to *N. pnevi*. This narrowed the interval to about 2 metres and V. Davydov collected continuous samples later in the summer and these are currently being processed in Calgary. Invitations have gone out for an international workshop to be held June 7-10, 2012. This workshop will include presentations and a field excursion to the proposed GSSP. We anticipate that a vote can go out following this meeting. It remains the goal that this will be the last GSSP vote for the Permian System and hopefully it can be completed in time to be reported at Brisbane.

**Publications:** The December 2010 issue of *Permophiles* (#55) was produced online late in 2010 and was distributed as a pdf document to a mailing list of 280. Owing to reduced submissions SPS is producing only one issue in 2010 (#55), which went online early in 2011. We have a complete series of *Permophiles* on our website (1978 to 2009). Issue 56 is not complete as of this report, but is planned for December 2011.

**Meetings:** The SPS conducted a business meeting in association with the ICCP meeting in Perth Australia, July 2011.

**Membership:** There were no changes to the membership in 2011. We 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 2011

There were no major problems in 2011, but progress was slow because of sample processing delays and major commitments by all individuals associated with this work.

## 7. SUMMARY OF EXPENDITURES IN 2011:

### INCOME

University of Calgary (1): \$1444.00

NIGPAS (2): \$1000.00

ICS (3): \$ 3000.00

**TOTAL: \$5444.00** (quoted in US\$; divide by 1.02 to convert to Canadian\$). (1) University of Calgary support from NSERC grant to Charles Henderson for travel to Nanjing China March 2011. (2) NIGPAS (Nanjing Institute of Geology and Palaeontology) support from NSF-C grant to Shuzhong Shen in support of Henderson in Nanjing. (3) ICS allocation to SPS for international workshop.

### EXPENDITURES (\$US)

Printing, Mailing, and Web support *Permophiles*: \$196.05

Travel Costs for Henderson to Nanjing: \$2444.00

Travel costs for Boise Workshop (for Henderson and partially for Wardlaw) \$1803.20

**TOTAL: \$4443.25** (quoted in US\$)

**BALANCE: \$1000.75**

## 8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2012):

1. Production of *Permophiles* #56 in Calgary Dec 2011 and #57 in March 2012 in Nanjing.
2. Vote on base-Artinskian in February 2012.
3. Vote on base-Sakmarian in April 2012.
4. Submit two GSSP proposals to ICS for ratification in March and May 2012.
5. Workshop for base-Kungurian in Boise Idaho and Wells Nevada June 7-10, 2012.
6. SPS business meeting during IGC meeting in Brisbane Australia during August 2012.
7. Vote for base-Kungurian late June 2012 and hopefully submit to ICS for voting at Brisbane.

8. Vote for new SPS executive in 2012. Nominating committee has been set with Bruce Wardlaw (USGS) as Chair and Galina Kotlyar (Russia) and Ausonia Ronchi (Italy) as members.

## **9. BUDGET AND ICS COMPONENT FOR 2012**

### **EXPENDITURES**

We have sufficient funds for the minor cost of website and limited printing. The primary budget request for 2012 is for a workshop at Boise Idaho with field excursion to the Rockland Section near Wells Nevada. This workshop is essential if we are to convince the international Permian community that the Rockland section is appropriate for the base-Kungurian GSSP. This is the biggest hurdle confronting SPS because we have rejected a long viewed potential section in Russia. This workshop is essential for SPS to complete the GSSP process before IGC in 2012. Financial support is necessary to bring at least 3 foreign researchers (including Kotlyar, Chernykh and Biakov from Russia) to Boise Idaho by paying for airfare and subsidizing accommodation (\$5000). Other SPS members will be invited, but subsidies will be limited (\$1000). Workshop will be conducted over two days at Boise State University between June 7-10 with fieldtrip to the potential GSSP field site and a look at Carlin Canyon. Fieldtrip costs will include vehicle rentals and 2 night's accommodation in Wells Nevada (\$2000) for the group. Samples can be collected by participants. Workshop at Boise State will include presentations and viewing of conodonts and fusulinids as well as the isotope labs of Mark Schmitz. SPS Executive will attend using their research funding. They will also attend the IGC meeting in Brisbane in August 2012.

### **TOTAL 2012 BUDGET**

**(this does not include costs associated with travel to IGC in Brisbane for current Chair/executive and incoming Chair/executive)**

**Funds requested for SPS Workshop \$8,000.00**

**Funds left over from last year's contribution \$1000.75**

Requested ICS contribution \$6999.25 + any support for IGC in Brisbane

**TOTAL BUDGET REQUEST (ICS) \$6999.25**

## **10. REVIEW CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2007-2011)**

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 Subcommittee. 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; eight issues were published during the five year period.

## **11. OBJECTIVES AND WORK PLAN FOR NEXT 2 YEARS (2011-2013)**

The primary objectives are to complete the GSSP's for the last three GSSP's (Sakmarian, Artinskian, and Kungurian). We will produce one or two issues of *Permophiles* each year depending on input. The schedule for the next year is indicated in section 8 above. The agenda for 2013 will be set by the incoming Chair and Executive, but will likely focus on testing correlation of the GSSPs, especially in Tethys sections and extending correlations into the terrestrial realm.

## **12. WEBSITE STATUS AND ACTIVITIES:**

SPS website is located at [www.nigpas.ac.cn/permian/web/index.asp](http://www.nigpas.ac.cn/permian/web/index.asp). This site is updated regularly and includes all back issues of *Permophiles* in downloadable PDF format (#1 in 1978 to #55 December 2010) 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 ACTIVITIES:**

**GSSP's:** 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. The most significant decision was to reject the base-Kungurian section at Mechetlino. Detailed samples were collected at the Rockland section in Nevada and a workshop is proposed to “sell” the merits of this section.

**Publications:** We have a complete series of *Permophiles* on our website (1978 to 2010). 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 and #54 was produced online. #55 was produced in Nanjing China and dated December 2010.

**Meetings:** 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. A business meeting was held at Prague, Czech Republic in late May 2010 during the ICS workshop. A business meeting was held at the XVII International Congress on the Carboniferous and Permian in Perth, Western Australia in July 2011.

**Membership:** 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 Honorary 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 Yugan 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 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. 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. There were no changes to the membership in 2010.

**Summary (2007-2011):** 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* #47 to #55 have been produced with #56 to come very soon. 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 2011”

**Dr. Lucia Angiolini**  
Dipartimento di Scienze Terra “A. DEsio”  
Via Manggiagalli 34, 20133  
Milano, Italy

**Dr. Boris I. Chuvashov**  
Institute of Geology and Geochemistry  
Urals Branch of  
Russian Academy of Science  
Pochtovy per 7  
Ekaterinburg 620154 Russia

**Dr. Nestor R. Cuneo**

Director, Museo Paleontologico Egidio Feruglio  
(U9100GYO) Av. Fontana 140,  
Trelew, Chubut, Patagonia Argentina  
**Dr. Vladimir Davydov, SPS Vice-Chairman**  
Department of Geosciences  
Boise State University  
1910 University Drive  
Boise ID 83725 USA

**Dr. Marc Durand**  
Universite de Nancy-I, GES, BP239  
54506 Vandoeuvre-les-Nancy cedex  
France

**Dr. Yoichi Ezaki**

Department of Geosciences  
Osaka City University  
Sugimoto 3-3-138  
Sumiyoshi-Ku, Osaka, 558-8585, Japan

**Dr. Clinton B. Foster**

Australian Geological Survey Organization  
G.P.O. Box 378  
Canberra 2601 Australia

**Prof. Charles M. Henderson, SPS Chairman**

Department of Geoscience  
University of Calgary  
NW Calgary, Alberta  
Canada T2N1N4

**Dr. Galina Kotlyar**

All-Russian Geological Research Institute  
Sredny pr. 74  
St. Petersburg 199026 Russia

**Prof. Ernst Ya. Leven**

Geological Institute  
Russian Academy of Sciences  
Pyjevskiy 7  
Moscow 109017 Russia

**Dr. Tamra A. Schiappa**

Department of Geography, Geology and the  
Environment  
Slippery Rock University  
Slippery Rock, PA 16057 USA

**Prof. Joerg W. Schneider**

Freiberg University of Mining and Technology  
Institute of Geology, Dept. of Palaeontology,  
Bernhard-von-Cotta-Str.2 Freiberg, D-09596, Germany

**Dr. Shuzhong Shen, SPS Secretary**

Nanjing Institute of Geology and  
Paleontology, 39 East Beijing Rd.  
Nanjing, Jiangsu, China 210008

**Dr. Guang Shi**

Deakin University, Resden Campus  
School of Aquatic Science and Natural Res.  
Management  
662 Blackburn Rd.  
Clayton, Victoria, Australia 3168

**Dr. Xiangdong Wang**

Nanjing Institute of Geology and  
Paleontology, 39 East Beijing Rd.

**Prof. Yue Wang**

Nanjing Institute of Geology and  
Paleontology, 39 East Beijing Rd.  
Nanjing, Jiangsu, China 210008

**Dr. Bruce R. Wardlaw**

U.S. Geological Survey  
926A National Center  
Reston, VA 20192-0001 USA

**Honourary Members****Prof. Giuseppe Cassinis**

Earth Sciences Dept.  
University of Pavia, 1 Via Ferrata,  
27100 Pavia, Italy

**Prof. Brian F. Glenister**

Department of Geology  
University of Iowa  
Iowa City, IA 52242 USA

**Dr. Heinz Kozur**

Rezsú u 83  
Budapest H-1029 Hungary

**Prof. Claude Spinosa**

Department of Geosciences  
Boise State University  
1910 University Drive  
Boise ID 83725 USA

**Dr. John Utting**

Geological Survey of Canada  
3303 - 33rd Street N.W.  
Calgary Alberta T2L2A7 Canada

**SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY**  
**ANNUAL REPORT 2011**

**7. SUMMARY OF EXPENDITURES IN 2011:**

STATEMENT OF OPERATING ACCOUNTS FOR NOVEMBER 1<sup>st</sup>, 2010 TO OCTOBER 31<sup>st</sup>, 2011

Prepared by Barry Richards, Chairman SCCS

(Accounts maintained in Canadian currency)

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

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

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

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

**BALANCE SHEET (2010 – 2011)**

Funds carried forward from October 31, 2010	\$1,215.00
Plus Income November 1, 2010 – October 31, 2011	<u>\$1,779.57</u>
Total assets	<b>\$2,994.57</b>
Less Expenditures November 1, 2010 – October 31, 2011	<u>\$2,000.00</u>
<b>BALANCE CARRIED FORWARD (to 2011 - 2012 fiscal year)</b>	<b>\$994.57</b>

**9. BUDGET AND ICS COMPONENT FOR Nov. 1, 2011 - Oct. 31, 2012 fiscal year**

**PROJECTED EXPENSES**

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

---

<b>TOTAL PROJECTED EXPENSES</b>	<b>\$4,525.00</b>
---------------------------------	-------------------

---

**INCOME**

Carryover (from CREDIT balance at end Nov. 1, 2010 - Oct. 31 2011 fiscal year)	\$994.57
Estimated donations	\$200.00

---

<b>TOTAL PROJECTED INCOME</b>	<b>\$1,194.57</b>
-------------------------------	-------------------

---

**BALANCE**

Estimated (deficit) / credit from above	-\$3,339.43
<b>BUDGET REQUEST FROM ICS for 2011</b>	<b>\$3,330.00</b>

---

**SUBCOMMISSION ON DEVONIAN STRATIGRAPHY**  
**ANNUAL REPORT 2011**

**1. TITLE OF CONSTITUENT BODY**

Subcommission on Devonian Stratigraphy

*Submitted by:*

R. Thomas BECKER, *Chair of SDS*

Westfälische Wilhelms-Universität,

Institut für Geologie und Paläontologie, Corrensstr. 24, D-48149 Münster, Tel. +49-251-83 339 51, fax – 49-251-83 339 68; [rbecker@uni-muenster.de](mailto:rbecker@uni-muenster.de)

**2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY**

SDS has continued in 2011 its work on the revision of problematical GSSPs (Emsian, Devonian-Carboniferous boundary) and on the formal definition of substages. Discussions on GSSP revisions were held at the Annual Business Meeting in Novosibirsk, in summer 2011. Other continued activities include multidisciplinary international correlation, the Devonian chapter to GTS 2012, the organisation of Devonian stratigraphic symposia, the publication of its SDS Newsletter and of monographic books/journal volumes, and improvements of the SDS Homepage. SDS objectives for 2011 can be summarized as:

- 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 the D/C Boundary Task Group (Chairman: M. ARETZ) and in close collaboration with the Carboniferous Subcommission.
- Close co-operation with the new IGCP 596 on “Climate Change and Biodiversity Patterns in the Mid-Paleozoic”, coordinated by P. KÖNIGSHOF et al.
- Publication of volumes on Devonian stratigraphy, partly in co-operation with IGCP 596.
- Compilation and distribution of SDS Newsletter 26.
- Annual Business Meeting in conjunction with the “International Conference on Biostratigraphy, Paleogeography and Events in Devonian and Lower Carboniferous”, Novosibirsk, 20<sup>th</sup> July to 10<sup>th</sup> August 2011.
- Field trips to the Devonian of the southern Urals and Kuznetsk Basin in conjunction with the Novosibirsk conference.
- Support for additional international Devonian symposia (at GSA, Northeastern 46<sup>th</sup> Annual and North-Central 45<sup>th</sup> Annual Joint Meeting, 20-22<sup>nd</sup> March 2011, Pittsburgh; 2011 Annual GSA Meeting, Post Meeting Field Trip on “Event history and sequence architecture of the Middle-Upper Devonian epeiric carbonate platform of the Iowa Basin”, led by T.M.J. DAY).
- Finalization of Devonian chapter for the GTS 2012 volume.
- New GSSP presentation and other updates on the SDS Homepage.

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, Institut Scientifique, Université Mohammed V, Rabat, Morocco

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

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

The SDS Membership includes representatives of Australia, Austria, Belarus, Belgium, Bolivia, Bulgaria, Canada, China, Czechia, Estonia, France, Germany, Great Britain, Iran, Italy, Latvia, Lithuania, Morocco, Myanmar, New Zealand, Pakistan, Poland, Portugal, South Africa, Spain, Switzerland, USA, Uzbekistan, Tadjikistan, Turkey, and Vietnam. At national level Devonian Subcommissions exist in various countries.

**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. The main current project is IGCP 596 on “Climate change and biodiversity patterns in the Mid-Paleozoic”, led by P. KÖNIGSHOF, T. SUTTNER, and others. The mentioned Novosibirsk symposium and excursions were the first joint SDS/IGCP 595 conference. In autumn 2011, the first circular for a joint meeting in Morocco in spring 2013 has been finalized. SDS also cooperates with IGCP 591 on “The Early to Middle Paleozoic Revolution: Bridging the Gap between the Great Ordovician Biodiversification Event and the Devonian Terrestrial Revolution”, led by B.D. CRAMER, T.R.A. VANDENBROUKE, and others. Several SDS members contribute actively to IGCP 580 on “Application of magnetic susceptibility as a palaeoclimate proxy on Palaeozoic sedimentary rocks and characterization of the magnetic signal”.

#### 5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2011

##### Chronostratigraphic definitions:

The continuing struggle for formal substage recognition resulted in the acceptance of this topic for the future work plan of ICS and for raising the issue within IUGS. SDS will present its substage work at the forthcoming Brisbane IGC. There are also plans to provide reviews of decided boundaries in manuscripts for Lethaia.

##### PRAGIAN SUBSTAGES

The use of the current basal Emsian GSSP for the definition of a future Upper Pragian substage has been given some support by the Czech Devonian workers (SLAVIK et al. 2011, HLADIL et al. 2011) but the absence of the defining species, *Eocostapolygnathus kitabicus*, in the Pragian type region is a small obstacle. VALENZUELA-RIOS & MARTINEZ-PÉREZ (2011) showed the potential of Spanish Pyrenees sections to correlate the polygnathid succession with the more shallow-water icriodid sequence. Specialists from Russia and Uzbekistan still prefer to maintain the Zinzilban GSSP. Any formal decision on Pragian substages has to await the Emsian revision

##### REVISION OF BASAL EMSIAN GSSP

An extensive revision of lithostratigraphy and faunal ranges in the current Zinzilban GSSP section has been compiled in a special supplement (No. 15) to the Geologiya I Geofizika series published by the Siberian Branch of the Russian Academy of Sciences in Novosibirsk. It documents the significant progress concerning conodonts, dacroconarids, brachiopods, corals, and Bryozoa.

The problematical results from the first re-sampling campaign at the assumed critical interval for a future Zinzilban GSSP, possibly to be defined by *Eoc. excavatus* “Morphotype 114”, has been summarized by IZOKH et al. (2011) in SDS Newsletter 26. At the Novosibirsk meeting it was agreed that a second re-sampling campaign will take place in the Kitab Reserve in summer 2012.

BECKER & ABOUSSALAM (2011) published on a southern Moroccan lower Emsian section and found that the region, despite its generally outer shelf setting, is too poor in polygnathids to trace both the entry of *Eoc. kitabicus* or of *Eoc. excavatus*. However, “Morphotyp 114” was found and there is some evidence that at least parts of the regional “Pragian Limestone” in fact already falls in the lower Emsian, using either the current or envisaged future definition.

##### EMSIA SUBSTAGES

The long awaited revision of Emsian dacroconarids from Bohemia still has not been published but CM FRYDA announced that important new results will soon become available. BECKER & ABOUSSALAM (2011) further emphasized the distinction between the global Upper Zlichov and Daleje Events in SE Morocco. The latter is very sharply developed but attempts to recover any conodonts from rare interbedded calcareous beds have failed so far. Cyclic basal upper Emsian strata of SW Morocco were studied by BRETT et al. (2011 in press).

##### GIVETIAN SUBSTAGES

General papers on Givetian magneto- and sequence stratigraphy by VER STRAETEN et al. (2011) and ELLWOOD et al. (2011) include important data for the international correlation of the Lower/Middle stage boundary. Several new publications deal with the global Taghanic Crises, which marks the Middle/Upper Givetian boundary: BRETT et al. (2011), ABOUSSALAM & BECKER (2011), MARSHALL et al. (2011), BRETT & ZAMBITO (2012 in press). These cover different regions and terrestrial to outer shelf settings. The available data are extensive and allow a reliable chronostratigraphic definition.

#### FRASNIAN SUBSTAGES

The significant isotopic spike near the Lower/Middle Frasnian boundary led to a continuing interest in the global Middlesex or *punctata* Event. There are new papers on the Ardennes (DA SILVA et al. 2010) and Western Canada (SLIWINSKI et al. 2010). The substage transition, therefore, can be traced with the help of conodonts, ammonoids, sea-level change, magnetic susceptibility signals, and carbon isotopes.

There are not so many new data on the Middle/Upper Frasnian substage boundary. DENAYER & POTY (2010) showed the significance of the *semichatovae* Transgression as extinction and eustatic event on the Ardennes shelf. In summer 2011, a small re-sampling campaign started at the German Martenberg section, where the so-called standard conodont zonation of the critical interval was established.

#### FAMENNIAN SUBSTAGES

There are no new reports on the base of the Middle Famennian. A voluminous monograph by HARTENFELS (2011) partly concentrated on the global, transgressive *Annulata* Events, as one candidate interval for the definition of the Upper Famennian. Further information comes from the Holy Cross Mts. of Poland (RACKA et al. 2010) and from Bulgaria (BONCHEVA et al. 2011). The placing of the base of the Uppermost Famennian at the base of the Upper *expansa* or *ultima* Zone is strengthened by new data from Morocco.

#### REVISION OF THE D/C BOUNDARY

SDS Newsletter 26 includes the report on the activities of the D/C Boundary Task Group by M. ARETZ until early 2011. Subsequently the group held a meeting in conjunction with the International Carboniferous/Permian congress, which took place in July in Australia. The nature of this meeting, logically, did not attract many of the Devonian workers.

Considerable progress was made by the publication of revisions of the critical *Siphonodella* (KAISER & CORRADINI 2011) and *Protognathodus* lineages (CORRADINI et al. 2011). An extensive manuscript by H. TRAGELEHN on Uppermost Famennian siphonodelloids from Franconia/Thuringia is practically complete, but has not yet been submitted for publication. The same, so far hardly known conodont group also occurs in Morocco, as shown in a preliminary report on the Lalla Mimouna North section (northern margin of the Maider, eastern Anti-Atlas) by BECKER et al. (2011). This section seems to have the globally richest conodont faunas from the interval right after the Hangenberg Regression, into the *kockeli* (= Upper *praesulcata*) Zone. Work on that section will continue in spring 2012. Uppermost Famennian “siphonodelloids” also occur in the Tafilalt (HARTENFELS & BECKER, in prep.). A detailed summary of the D/C boundary sections of the eastern Anti-Atlas was published by KAISER et al. (2011) and these will be shown during the planned Field Symposium in spring 2013.

BAHRAMI et al. (2011) provided new conodont data for the D/C boundary of the eastern Iran but the sections are not suitable for the current GSSP search. Active research is also taking place in Moravia, the Moroccan Meseta, and Russia. Unfortunately, specialists of neritic faunal groups have been less active in 2011.

#### Publications:

- BECKER, R. T. (Ed.) 2011. SDS Newsletter **26**. - 113 pp., Westfälische Wilhelms-Universität Münster. [ISSN No. 2074-7268]
- BRETT, C.E., SCHINDLER, E. & KÖNIGSHOF, P. (Eds., 2011). Sea-level cyclicity, climate change, and bioevents in Middle Devonian marine and terrestrial environments. – *Palaeogeography, Palaeoclimatology, Palaeoecology*, **304** (1-2): 1-193.
- SENNIKOV, N. V. & IZOKH, N. G. (Eds.). News on Palaeontology and Stratigraphy. – *Geologiya i Geofizika*, **15**, Supplement: 1-246 [special issue on the Zinzilban Emsian GSSP/Kitab Reserve Devonian]
- OBUT, O. A. & KIPRIYANOVA, T. P. (Eds.). Biostratigraphy, Paleogeography and Events in Devonian and Lower Carboniferous (SDS / IGCP 596 joint field meeting). – Contributions to International Conference in memory of Evgeny A. YOLKIN, July 20 – August 10, 2011, Ufa, Novosibirsk, 191 pp (Novosibirsk Publishing House SB RAS, ISBN 978-5-7692-1187-4).
- ARTYUSCHKOVA, O. V., MASLOV, V. A., PAZUKHIN, V. N., KULAGINA, E. I., TAGARIEVA, R. C., MIZENZ, L. I. & MIZENZ, A. G. (2011). Devonian and Lower Carboniferous Type Sections of the Western South Urals. – Pre-

Conference Field Excursion Guidebook, Ufa, Sterlitamak, Russia, July 20-25, 2011, 91 pp. (Ufa, ISBN 978-5-901900-54-3).

- BAKHAREV, N. K., IZOKH, N. G., OBUT, O. T. & TALENT, J. A. (Eds.). Middle-Upper Devonian and Lower Carboniferous Biostratigraphy of Kuznetsk Basin. – Field Excursion Guidebook, 96 pp. (Novosibirsk Publishing House SB RAS, ISBN 978-5-7692-1190-4).
- HARTENFELS, S. (2011). Die globalen *Annulata*-Events und die Dasberg-Krise (Famennium, Oberdevon) in Europa und Nord-Afrika – hochauflösende Conodonten-Stratigraphie, Karbonat-Mikrofazies, Paläoökologie und Paläodiversität. – Münstersche Forschungen zur Geologie und Paläontologie, **105**, 527 pp.

Additional SDS / IGCP 596 volumes are in preparation for the journals “Bulletin of Geosciences” and “Palaeobiodiversity and Palaeoenvironments”.

#### Meetings:

SDS Annual Business Meeting at International Conference in memory of Evgeny A. YOLKIN on “Biostratigraphy, Paleogeography and Events in Devonian and Lower Carboniferous (SDS / IGCP 596 joint field meeting)”, Novosibirsk, 27<sup>th</sup> to 28<sup>th</sup> July 2011. Field trips to the southern Urals (20<sup>th</sup> to 25<sup>th</sup> July) and Kuznetsk Basin (29<sup>th</sup> July to 10<sup>th</sup> August). SDS Members also took an active role in the Opening Meeting of IGCP 569, at Graz, Austria (19<sup>th</sup> – 24<sup>th</sup> September 2011).

#### Membership:

New Corresponding Members elected at the Business Meeting include young representatives from Switzerland, Portugal, China, and Russia.

One of the outstanding, long-term SDS Members from Germany, Prof. O. H. WALLISER from Göttingen, died unexpectedly just after Christmas 2010. His immense, to a large extent unpublished knowledge is lost this way.

The following new officers have been proposed for the period 2012-2016 (voting is currently under way):

Chairman: Dr. John E. MARSHALL, Southampton, U.K. (currently SDS Secretary)

Vice-Chairman: Prof. Dr. Carl E. BRETT, Cincinnati, Ohio, USA

#### 6. CHIEF PROBLEMS ENCOUNTERED IN 2011

- The still unresolved procedure for the ratification of formal Devonian substages.
- The rarity of polygnathids at Zinzilban in the critical interval for a re-definition of the Emsian GSSP.
- The still unpublished early siphonodellids from the Uppermost Famennian of Franconia/Thuringia.
- The continuing lack of SDS Members from most South American countries.
- The decline of Devonian stratigraphy in other countries (e.g., Canada, Australia) by the lack of replacement of retiring specialists by new active researchers.

#### 7. SUMMARY OF EXPENDITURES IN 2011

##### INCOME

Carried over from 2010	456 \$
IUGS subvention 2011	2000 \$
Sum	2456 \$

##### EXPENSES

Support for two members from Uzbekistan to attend the Novosibirsk Meeting	1900 \$
SDS Newsletter 27, printing/ mailing (due in February 2012)	500 \$
Support for three members to attend IPC3	
Sum	2400 \$
Balance early 2011	56 \$

## 8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2012)

- **Annual Business Meeting and symposium on “The Devonian of Asia and Australia” in conjunction with the 34<sup>th</sup> IGC, Brisbane, Australia.**
- Manuscript on Givetian and Frasnian substages for Lethaia.
- Editorial work for of a Proceedings Volume of the Novosibirsk Meeting in “Palaeobiodiversity and Palaeoenvironments”.
- New sample campaign for the revised Emsian base in the Kitab Reserve, Uzbekistan (summer 2012).
- Publication of SDS Newsletter 27 in February 2012.
- Update of SDS homepage (pdf files of former SDS Newsletters and new GSSP illustrations).
- Active participation in joint Devonian/Carboniferous Boundary Task Group with a focus on conodont revisions and pelagic-neritic correlations.
- Progress on Famennian substage definitions.
- Preparations for International Field Meeting, jointly with IGCP 596 and D/C Boundary Task Group, in the Tafilalt/Maider region of Morocco (spring 2013).

## 9. BUDGET AND ICS COMPONENT FOR 2012

### INCOME

Balance from 2011 56 \$

### EXPENSES 2012

SDS Newsletter 28 500 \$

Support for SDS Chairman to attend the 34<sup>th</sup> IGC in Brisbane, Australia 2500 \$

Support for 2<sup>nd</sup> SDS Member to attend the 34<sup>th</sup> IGC 1500 \$

**Request for support/subvention from IUGS/ICS 4500 \$**

## 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](mailto:rbecker@uni-muenster.de)

#### VICE-CHAIRMAN

Ahmed EL HASSANI, Département de Géologie, Institut Scientifique, B.P. 703-Rabat-Agdal, Marokko; [elhassani@israbat.ac.ma](mailto: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](mailto:jeam@soc.soton.ac.uk)

#### WEBMASTER

Carlo CORRADINI, Dipartimento di Scienze della Terra, Università di Cagliari, Via Trentino 51, I-09127 Cagliari, Italy; [corradin@unica.it](mailto:corradin@unica.it)

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

1. A. BLIECK: France, micro- and macro-vertebrates; [alain.blieck@univ-lille1.fr](mailto:alain.blieck@univ-lille1.fr)
2. C.E. BRETT: Eastern U.S., sequence and cyclostratigraphy; [carlton.brett@uc.edu](mailto:carlton.brett@uc.edu)
3. J.-G. CASIER: Belgium, ostracods; [casier@naturalsciences.be](mailto:casier@naturalsciences.be)
4. CHEN Xiuqin: Nanjing, brachiopods; [xqchen@nigpas.ac.cn](mailto:xqchen@nigpas.ac.cn)
5. J. HLADIL: Czechia, stromatoporoids, tabulate corals, various modern stratigraphic methods; [hladil@gli.cas.cz](mailto:hladil@gli.cas.cz)
6. N. IZOKH: Siberia, Asian Russia, conodonts; [izokhn@uiggm.nsc.ru](mailto:izokhn@uiggm.nsc.ru)
7. MA Xueping: Beijing, brachiopods; [maxp@pku.edu.cn](mailto:maxp@pku.edu.cn)

8. R. MAWSON: Australia, conodonts; [rmawson@laurel.ocs.mq.edu.au](mailto:rmawson@laurel.ocs.mq.edu.au)
9. J. OVER: U.S., conodonts; [over@geneseo.edu](mailto:over@geneseo.edu)
10. M.C. PERRI: Italy, conodonts; [perri@geomin.unibo.it](mailto:perri@geomin.unibo.it)
11. G. RACKI: Poland, brachiopods, event and sequence stratigraphy; [racki@uranos.cto.us.edu.pl](mailto:racki@uranos.cto.us.edu.pl)
12. J. DAY, USA/Canada, brachiopods, sequence stratigraphy; [jeday@ilstu.edu](mailto:jeday@ilstu.edu)
13. E. SCHINDLER: Germany, tentaculites, event stratigraphy; [eberhard.schindler@senckenberg.de](mailto:eberhard.schindler@senckenberg.de)
14. V. TSYGANKO: European Russia, corals; [tsyganko@geo.komisc.ru](mailto:tsyganko@geo.komisc.ru)
15. J. I. VALENZUELA-RIOS, Spain, conodonts; [jose.i.valenzuela@uv.es](mailto:jose.i.valenzuela@uv.es).
16. U. JANSEN, Germany, brachiopods; [ulrich.jansen@senckenberg.de](mailto:ulrich.jansen@senckenberg.de)
17. G. YOUNG: Australia, micro- and macrovertebrates, general stratigraphy; [gyoung@geology.anu.edu.au](mailto:gyoung@geology.anu.edu.au) [term ends at Brisbane IGC]
18. ZHU Min: Beijing, vertebrates; [zhumin@ht.rol.cn.net](mailto:zhumin@ht.rol.cn.net) [term ends at Brisbane IGC]

**SUBCOMMISSION ON SILURIAN STRATIGRAPHY  
ANNUAL REPORT 2011**

**1. TITLE OF CONSTITUENT BODY**

**International Subcommittee 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  
E-mail: mmelchin@stfx.ca

**2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY**

**Mission statement**

The objectives of the Subcommittee 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 important sites (such as GSSPs, global and regional stratotype sections, etc.).

**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 Subcommittee of the Commission on Stratigraphy. The Subcommittee is organized by an Executive consisting of Chairman, Vice-Chairman and Secretary, who are all Voting Members of the Subcommittee. In the Subcommittee 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 Subcommittee 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 two special volumes of the journal *Palaeogeography, Palaeoclimatology, Palaeoecology* were published in 2010 containing the contributions of ISSS and ISOS members to this project. Members of the ISSS have

spearheaded a collaboration with ISOS and ISDS members in the proposal of a follow-up project proposal for IGCP 503. This new project IGCP Project 591, “The Early to Middle Paleozoic Revolution”, was approved and began its work in 2011.

## 5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2011

Silurian Times No 18 was edited by the secretary in May, 2011, posted on the web site for the ISSS, and circulated as an email attachment to all titular, corresponding and interested members of the Subcommittee. It contained the reports on previous meetings, announcement of upcoming meetings and publications, and the latest news and recent publications on Silurian research.

The International Symposium on the Silurian System “Siluria Revited” took place July 9-15, 2011, in Ludlow, England. There were two days of oral presentations focusing on a wide range of Silurian topics and many of the presentations were also contributions to IGCP 591. Of particular significance were the pre- and post meeting field trips that toured the type areas for the Llandovery Series in Wales and the Wenlock and Ludlow series in England. These trips gave the opportunity to a new generation of Silurian researchers to view the GSSPs for all of the Llandovery, Wenlock and Ludlow series and stages (except the base of the Llandovery, which is in Scotland). This meeting resulted in the publication of a program and abstracts volume, a field guide, which includes many new observations and interpretations of the localities, including the GSSPs visited. This field guide is available for download at: <http://www.igcp591.org/books.php>. In addition, a conference volume of submitted papers, to be published as a special issue of *Bulletin of Geosciences*, is in preparation. The ISSS thanks the organizing committee for producing an excellent meeting and set of field trips: David Loydell, Anthony Butcher and their students, and also to the organizers of the pre-conference excursion Jerry Davies and Dick Waters and of the post-conference excursion David Ray and many co-authors, plus a special thanks to Brad Cramer. ISSS also thanks the sponsors of the conference: The Palaeontological Association, The Geological Society, Neftex, Natural England, IGCP project 591. We also thank the persons who volunteered to organize the meeting in Sub-polar Urals (Russia), the late Tania Koren', Peep Männik, Anna Antoshkina, and Anna Suyarkova, which could not take place and which was replaced by the Siluria revisited meeting in Ludlow.

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 Subcommittee, particularly focusing on the restudy of the type areas for the GSSPs for the Silurian, all of which occur in the UK except for the base of the Pridoli. Such work is forming the basis of future refinement of the definition and correlation of the GSSP, particularly those in Wales and the Welsh borders, including the bases of Aeronian, Telychian, Wenlock (Sheinwoodian), Homerian, Ludlow (Gorstian), and Ludfordian. Each of these GSSPs can be shown to be in need of refinement or redefinition and these features were highlighted during the Siluria Revisited field trips. New research by the BGS has resulted in considerable refinement of the stratigraphic and structural framework for this region and this will form an important basis for future deliberations regarding the merits of these GSSPs and their possible need for reconsideration. As a result, a number of the BGS researchers were key participants and co-leaders of the Siluria Revisited field trips and made substantial contributions to the field guide for that trip.

As noted elsewhere in this report, the current GSSP for the base of the Wenlock Series has been shown not to correlate with the biostratigraphic level that was stated in its original definition. This has led many ISSS members to suggest that a new GSSP is required for this level. As part of the ongoing efforts to resolve this problem the ISSS voting member Dr. P. Štorch visited a relatively known Llandovery-Wenlock boundary section in Ziyang, China. The results of this and other recent investigations have shown that we are still lacking a strong candidate for a new GSSP for the Base of Wenlock. However, a PhD student, Alex Ayling, has begun study of a potential GSSP section for this interval in Wales under the supervision of Dr. D. Loydell. The results will be presented at a future ISSS meeting.

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

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

The ISSS Chair, with several colleagues, has been preparing the chapter on the Silurian System for the 2012 edition of *The Geologic Time Scale*. This chapter is now completed and has been submitted for publication.

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

## 6. CHIEF PROBLEMS ENCOUNTERED IN 2011

No major were encountered except for the old problem related to difficulties in obtaining grants for research on stratigraphical topics and travel to meetings of Subcommittee. 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 2011

Income		
	Carried forward from 2010	nil
	ICS Allocation	US\$4000
Total		US\$4000
Expenditure		
	Expenses for ISSS Executive members to attend annual ISSS meeting	US\$4000
<u>Balance</u>		<u>US\$0</u>

## 8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2012):

Regular updating the website for Silurian Subcommittee. We gratefully acknowledge the support of the Nanjing Institute of Geology and Palaeontology Academia Sinica for this work. It is planned that the ISSS web site will be migrated from the Silurian.cn domain to a .org domain, which also hosts the ICS web site.

Publication of Silurian Times Newsletter 19

Publication of Bulletin of Geosciences on current research on the Silurian System/Period. Although this volume emerges from the Ludlow meeting, contributions to the volume have not been restricted to papers presented at that meeting.

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

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 under way and planned for 2012, and much of the focus will be through the new working group on the restudy of the Base of the Aeronian Stage.

The ISSS is a key partner in IGCP 591 – The Early to Middle Paleozoic Revolution. The planned milestone for IGCP 591 for 2012 is “Reconstructing global sea levels, sequence stratigraphy and paleogeography”. The planned activities for IGCP 591 for 2012 are:

EGU General Assembly - Vienna, Austria, April 22-27, 2012

Programme Group: SSP – Stratigraphy, Sedimentology & Palaeontology

**Session: SSP2.2 Palaeozoic global sea level: linking stratigraphy, bioevents, and the stable isotope record,**

convener: Dr Ž. Žigaitė, co-Conveners: D. Ray, T. Vandenbroucke, B. Cramer

IGCP 591 Annual Meeting - Cincinnati, Ohio, USA, July 22-28, 2012

Organised by Cramer & Brett. Pre-conference excursion to Katian-Wenlock - Southern Appalachian Basin (KY, OH, IN); post-conference excursion to Wenlock-Lochkovian - Illinois Basin/Michigan Basin (IL, IN, MI). Special volume in *Stratigraphy* (eds. Cramer & Melchin).

GSA North Central Symposium and Pander Society Meeting Dayton, Ohio, USA, April 22-24, 2012 - IGCP 591 special session will be organized by Kleffner and Bauer.

34th International Geological Congress, Brisbane, Australia, August 6-10, 2012  
Symposium 3.5 in technical program, Theme 3, organized by Histon, Tewari, & Melchin.

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 are focusing on generation of new, high-resolution radiometric dates that are well constrained within the Silurian time scale. This is essential to achieve better calibration of this scale, which is has been a serious weakness for the Silurian System.

#### 9. BUDGET AND ICS COMPONENT FOR 2012

Contribution toward transportation, accommodation & registration of the Chair, to participate in the in the IGC in Brisbane, Australia

\$3500.00

Financial support for field meetings to Silurian GSSPs, particularly for the working groups restudying the base of Aeronian and Wenlock.

\$6000.00

The ISSS has done pioneering work in the area of restudy of previously ratified GSSPs (see below). Recent work has shown that many of the Silurian GSSPs, all of which were ratified in the mid-1980s, have serious deficiencies in terms of their potential use as benchmarks for high-resolution global correlation. Two working groups are currently focusing on restudy of the base of the Aeronian Stage and the base of the Wenlock Series. Future working groups will study the other GSSPs

**Total requested from ICS:**

**\$9,500.00**

#### 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 (2007-2011)

Over the period of 2007-2011 the Subcommittee 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 2011". In addition to those, the following are the most significant accomplishments of the past five years.

1) 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.

2) 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 remains 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 shortcomings, 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 in Sardinia 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 Subcommittee, including a new PhD thesis underway by Alex Ayling, supervised by Dr. D. Loydell at University of Portsmouth, studying a promising Llandovery-Wenlock succession in Wales.

3) 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 Palaeontologica Sinica*.

4) ISSS members participated in 19 conferences in which IGCP 503 held sessions or symposia and undertook collaboration on planning of a followup IGCP project proposal, IGCP 591.

5) The Silurian Field Meeting, called "*Time and life in the Silurian: a multidisciplinary approach*" was held between 4-11 June 2009 in Sardinia, Italy. The meeting (organized by Petr Storch, Enrico Serpagli and Annalisa Ferretti) consisted of three days of scientific communications followed by a four days field trip in southern Sardinia. More than fifty scientists from fifteen countries attended the meeting. The scientific sessions were filled with talks dealing on any aspect of Silurian stratigraphy and palaeontology; the poster session included 18 posters.

In connection with the meeting, three special volumes were published in the series of the *Rendiconti della Società Paleontologica Italiana*: A. The Silurian of Sardinia - Corradini C., Ferretti A. & Storch P. (Eds.), 170 pp. The volume is dedicated to Prof. Enrico Serpagli, to celebrate his more than 40 years of activity in the Lower Palaeozoic of Sardinia. The volume comprises contributions that include an historical overview of the studies already carried out on the Silurian faunas of Sardinia, a global overview of the palaeoenvironment and palaeogeography, and seven research papers that illustrate current knowledge of major fossil groups encountered in the Silurian limestones and shales of southern Sardinia. B. Time and Life in the Silurian: a multidisciplinary approach - Field Trip Guidebook - Corradini C., Ferretti A. & Storch P. (Eds.), 96 pp.

A brief geological and stratigraphical overview of the Silurian of Sardinia introduces to the excursion itinerary with locality descriptions. C. Time and Life in the Silurian: a multidisciplinary approach - Abstracts - Corriga M.G. & Piras S. The volume includes the forty-seven abstract of the talk or posters presented at the meeting. The pdf of the volume is available in the meeting web page ([www.unica.it/silurian2009](http://www.unica.it/silurian2009)).

As noted above proceedings volume was published in a special issue of *Bollettino of the Società Paleontologica Italiana in 2010*.

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

#### **OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2012-2015)**

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 Subcommittee for the next four years include:

Silurian Field Meeting in 2013, the proposed location is Lund, Sweden, in association with a meeting of IGCP 591, organised by Calner & Eriksson. Pre-conference excursion to Katian-Wenlock – Mainland Sweden & Norway; post-conference excursion to Llandovery-Ludlow – Gotland. Special volume in *GFF* (eds. Calner & Albanesi)

The research objectives for IGCP Project 591 are to investigate the biological, chemical and physical evolution of the ocean-atmosphere-biosphere system during this dynamic interval of Earth history by addressing in detail the relationships between climate, sea level, tectonics, biology, oceanography, volcanism, and the stratigraphic record of Early to Middle Paleozoic global planetary change. This project is being conducted in collaboration with the International Subcommissions on Ordovician, Silurian, and Devonian Stratigraphy (SOS, SSS, SDS), and will be accomplished in successive steps over the five-year duration of the project (2011-2015).

- 2011 – Improving global biostratigraphic and chronostratigraphic correlation
- 2012 – Reconstructing global sea levels, sequence stratigraphy and paleogeography
- 2013 – Identifying biological, chemical and physical indicators of global planetary change
- 2014 – Addressing evolutionary paleoecology, paleobiodiversity and paleobiogeography
- 2015 – Oceanographic and climate modeling of Early to Middle Paleozoic events

International and regional conferences are planned for the five-year duration of the proposed projects, as well as special publications each year, and, as noted above some of those meetings will coincide with ISSS meetings.

As noted above, ISSS members are collaborating 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, which was well demonstrated during the Siluria Revised field trips. 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 are working on the establishment of data-bases which would bring together and make available information from all sources associated with the Silurian researchers. One such database has been created at the Nanjing Institute of Geology and Palaeontology by Dr. Fan Junxuan, who is also Webmaster for ISSS. This database, called Geobiodiversity Database (GBDB) is currently in the advanced development stage. 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](mailto:mmelchin@stfx.ca).

**Vice Chairman:** Peep Mannik, Institute of Geology at Tallinn University of Technology Ehitajate tee 5, 19086 Tallinn, Estonia; [mannik@gi.ee](mailto: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](mailto:Jacques.Verniers@ugent.be).

###### ***List of Voting Members in 2011***

C.E. Brett, Cincinnati, USA, [brettc@email.uc.edu](mailto:brettc@email.uc.edu)

D. Holloway, Melbourne, Australia, [dhollow@museum.vic.gov.au](mailto:dhollow@museum.vic.gov.au)

Jin Jisuo, London, Canada, [jjin@uwo.ca](mailto:jjin@uwo.ca)

M.E. Johnson, Williamstown, USA, [Markes.E.Johnson@williams.edu](mailto:Markes.E.Johnson@williams.edu)

T.N. Koren, St. Petersburg, Russia, [koren@vsegei.sp.ru](mailto:koren@vsegei.sp.ru)

J. Kríž, Prague, Czech Republic, [kriz@cgu.cz](mailto:kriz@cgu.cz)

A. Le Hérisse, Brest, France, [alain.le.herisse@univ-brest.fr](mailto:alain.le.herisse@univ-brest.fr)

D.K. Loydell, Portsmouth, UK, [david.loydell@port.ac.uk](mailto:david.loydell@port.ac.uk)

P. Mannik, Tallinn, Estonia, [mannik@gi.ee](mailto:mannik@gi.ee)  
M.J. Melchin, Antigonish, Canada, [mmelchin@stfx.ca](mailto:mmelchin@stfx.ca)  
A. Munnecke, Erlangen, Germany, [axel.munnecke@gzn.uni-erlangen.de](mailto:axel.munnecke@gzn.uni-erlangen.de)  
S. Peralta, San Juan, Argentina, [speralta@unsj.edu.ar](mailto:speralta@unsj.edu.ar)  
P. Štorch, Prague, Czech Republic, [storch@gli.cas.cz](mailto:storch@gli.cas.cz)  
J. Verniers, Ghent, Belgium, [Jacques.Verniers@ugent.be](mailto:Jacques.Verniers@ugent.be)  
Zhan Renbin, Nanjing, China, [rbzhan@nigpas.ac.cn](mailto:rbzhan@nigpas.ac.cn)

**SUBCOMMISSION ON ORDOVICIAN STRATIGRAPHY**  
**ANNUAL REPORT 2011**

1. Name of constituent body:

**Subcommission on Ordovician Stratigraphy (SOS)**

Submitted by:

David A.T. Harper  
 Chairman, ISOS  
 Department of Earth Sciences  
 Durham University  
 Durham DH1 3LE  
 UK  
 Tel. 0044 1913347143  
 Fax 0044 1913345991  
 E mail: [david.harper@durham.ac.uk](mailto:david.harper@durham.ac.uk)

J. C. Gutiérrez-Marco  
 Vice-Chairman, SOS  
 Instituto de Geología Económica (CSIC-UCM)  
 Facultad de Ciencias Geológicas  
 28040 Madrid  
 Spain  
 Tel.: +34 915 44 54 59  
 Fax: +34 913 94 48 74  
 E-mail: [jcgrapto@geo.ucm.es](mailto:jcgrapto@geo.ucm.es)  
 URL: <http://www.ucm.es/info/paleo/personal/gutierrez.htm>

I.G. Percival  
 Secretary, SOS  
 Geological Survey of NSW  
 NSW Department of Primary Industries  
 W.B. Clarke Geoscience Centre  
 47-953 Londonderry Road  
 Londonderry  
 New South Wales 2753  
 Australia  
 E-mail: [ian.percival@industry.nsw.gov.au](mailto:ian.percival@industry.nsw.gov.au)

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

The Subcommission promotes international cooperation on all aspects of Ordovician geology, specifically stratigraphy. It has a global network involving both academia and industry.

Specific objectives are:

- a. To delimit and subdivide the Ordovician System (and Period) as a part of the overall ICS mission to elaborate the standard global stratigraphic scale. This work aims to establish the boundaries (GSSPs), the correlation of the subdivisions (Stages and Series), the nomenclature of the subdivisions and periodically review the effectiveness and utility of these decisions.
- b. To promote regular international meetings on all aspects of Ordovician geology, especially those devoted to clarifying stratigraphic procedures, nomenclature and methods for use in establishing a unified global time scale and to prepare correlation charts with explanatory notes (the main phase of this latter task is now completed).
- c. To encourage, promote, and support research on all aspects of Ordovician geology worldwide and to provide outlets, *Ordovician News*, international meetings, and a web page, for promoting discussions and reporting results of this research.
- d. To encourage, promote, and support interdisciplinary research on the Ordovician global Earth system, addressing topics that require high-resolution, global correlation.

d. The ultimate goal of the Subcommittee 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 Subcommittee 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>A. ascensus</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-Fågelång)
		DAPINGIAN	← <i>U. austrodentatus</i> (GSSP-Huangnitang)
		FLOIAN	← <i>B. triangularis</i> (C), (GSSP-Huanghuachang)
	LOWER	TREMADOCIAN	← <i>T. approximatus</i> (GSSP-Diabasbrottet)
			← <i>I. fluctivagus</i> (C) (GSSP-Green Point)

### 4. Organization

#### a. Subcommittee Executive (from August 2008)

Chairman, David A.T. Harper (UK)  
 Vice Chairman Juan Carlos Gutiérrez-Marco (Spain)  
 Secretary, Ian G. Percival (Australia)  
 16 other Voting Members  
 Over 100 Corresponding Members

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

The Subcommittee officers and voting members have been agreed for the next term from 2008-2012. Following the Subcommittee's business meeting during the Nanjing conference (2007) a postal ballot confirmed the election of the new Subcommittee officers, and elected a new group of voting members. Details of the procedure and results were included in the report for 2007. The new Subcommittee 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).

Three members are due to retire next year and one has resigned due to heavy administrative commitments. Replacements are being sought.

### 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. The final volume 'Early Palaeozoic biogeography and palaeogeography' will be published next year (2012).

IGCP Project 591: The early to middle Palaeozoic revolution. This new project involving some 400 participants from nearly 40 countries will have a strong Ordovician component and is supported by the subcommission. The project has already featured at Ordovician and Silurian international congresses in Spain and the UK, respectively.

### 6. Chief accomplishments and products in 2011 cycle

a. The 11th International Symposium on the Ordovician System took place in Spain during May, 2011. The conference itself and associated business meetings and workshops were held in the environs of Madrid at Alcalá de Henares with field excursions to various parts of the Iberian Peninsula including the Iberian Chains and northern Portugal. A substantial volume, 'Ordovician of the World' was published together with a number of field guides (see also below)

b. Although 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. The proceedings of this conference (Early Palaeozoic biogeography and geography) of some 25 manuscripts to be published as a Memoir of the Geological Society are currently being edited by Harper and Servais. Publication will be in 2012 supported by ICS.

c. 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 planned for 2012 dependent on funding and will be distributed to colleagues at the IGC in Brisbane 2012 and in different countries if finance permits.

c. *Ordovician News No. 28* was produced and posted on the Subcommission website and is available for download.

### 7. Chief problems encountered in 2011

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. A lack of travel support limited the participation of Voting Members in the 33<sup>rd</sup> 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. An excellent turnout, not surprisingly, at Alcalá de Henares this year (2011), allowed a proper discussion of issues facing the subcommission in the coming years. However numbers are likely to be low at the Brisbane IGC in 2012.

## 8. Summary of expenditure for 2011-2012

TOTAL INCOME (from ICS): USD 3000

Support for attendance of subcommission officers at ISOS meeting in Madrid USD 1500

Grant towards production of Geol. Soc. Memoir on Early Palaeozoic biogeography and geography USD 1000

Contingency fund USD 300

Miscellaneous expenditure USD 200

TOTAL EXPENDITURE USD 3000

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

The new Subcommission came into force during the 33<sup>rd</sup> 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).

**This was addressed in a session at the Madrid Meeting.**

b. Will establish a forum to assess the efficacy and utility of the newly-established international stages. **This too was addressed at the Madrid meeting.**

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. **During the Prague meeting in May those present agreed to begin discussions in their own regions regarding the possibilities of providing simple correlation charts, linking regional chronostratigraphies to the global stages. Results will be presented in Brisbane, 2012.**

d. Will open debate on the applicability of non-biologic methods of correlation of Ordovician strata.

d. Production and internet distribution of *Ordovician News No. 27* in 2010.

e. 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. **Little progress has been made on this front.**

f. Production and internet distribution of *Ordovician News No. 28* in 2011.

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

1. There may be a requirement to evaluate the efficacy and utility of our stages and stage boundaries. Where appropriate and/or necessary we will have to move to establish some small advisory groups. **One major boundary problem may need urgent attention and was raised at the congress in Madrid. A position paper is in preparation.**
2. Clearly the Subcommission can now move with some confidence towards confirming and establishing finer divisions of Ordovician time. In this respect Bergström et al. (2009: *Lethaia*) have divided our international stages into stage slices based mainly on existing biozones. Finer time slices were also proposed by Webby (2004: *The Great Ordovician Biodiversification Event*, Columbia University Press) and used effectively in developing data for the GOBE. As these time divisions are more widely adopted, it would be useful to confirm their definition and status. These time slices have been used in the recent *Palaeogeography, Palaeoclimatology, Palaeoecology* special issue on the palaeoecology of the GOBE edited by Servais and Owen (2010). **This was addressed at the Madrid meeting.**
3. Over the last few years we have neglected somewhat the role of the regional groups and the many important regional and diverse stratigraphies that make our system so exciting. A number of the key regional successions were included in the correlation charts provided by Bergström et al. (2009), but there more that require calibration with our new stages. Moreover a few regions such as Baltoscandia and SE Asia were never

formally published. This is a priority for our system and work that can involve all our colleagues. **This will be fully addressed at the IGC in Brisbane.**

4. Work is now far advanced on a Carbon stable isotope curve for the Ordovician. Consistent results have been already achieved for parts of the column. There are of course other stable isotopes and it will be appropriate and useful to evaluate if we can help develop these curves not least as one of our nonbiologic means of correlation. There are other nonbiologic techniques that we could also consider. **These issues were addressed in a recent issue of *Palaeogeography, Palaeoclimatology, Palaeoecology* edited by Munnecke, Calnar and Harper (2010).**
5. A more difficult area is sea-level or water-depth curves for the period. There have been a number of curves for the Ordovician and many more for particular parts of the period. It would be useful to examine these curves more carefully and the criteria upon which they are based with a move towards developing more standardised curves for the Ordovician. **Some of these issues were addressed in the recent issue of *Palaeogeography, Palaeoclimatology, Palaeoecology* edited by Munnecke, Calnar and Harper (2010) and will be addressed further at the Brisbane IGC.**
6. We now have a number of accurate palaeogeographic maps for our period. Not everyone agrees with all the reconstructions and perhaps they never will. But it is possible to engage in cooperation with some of the groups to develop a more standard set of base maps for the period. **This is now an active area research with the wide availability of Trond Torsvik's BugPlates program that is forming the basis for many chapters in the forthcoming *GSL Memoir on Early Palaeozoic biogeography and geography* edited by Harper and Servais and to be published in 2012.**
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. **Discussions are now ongoing with a number of geochronology laboratories, for example the StarPlan group in Copenhagen, whose terrestrial dating facility is headed up by Jim Connelly. These discussions are ongoing.**
8. We have tended as a group to ignore the economic potential of our system. But, for example in New South Wales, nearly all the gold and copper mines are hosted in Ordovician volcanics of the Macquarie Arc and in China considerable funding is being made available through SINOPEC (the Chinese petroleum company) to support research into Ordovician biostratigraphy. **A strategy is under discussion.**

## 10. Budget and ICS component for 2012

- a. Support for publication of Geological Society Special Paper on Ordovician regional stratigraphy (with fold out charts), arising out of the Brisbane IGC, edited by Harper and Percival. The ICS will be credited as a main sponsor. **5000 USD**
- b. Preparation of an Ordovician Time Table, carried over from last year: **1000USD**
- c. Support for attendance at IGC in Brisbane, August 2012: **5000USD**
- d. Support for production of revised regional correlation charts: **2500 USD**
- e. Startup funding for potential review of GSSPs, in particular that at the base of the system: **2500 USD**

TOTAL 2012 BUDGET: 25,000 USD

REQUESTED FROM ICS: **10,000USD**

### 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 10<sup>th</sup> Ordovician conference China and further relevant meetings in 2008: The project has continued for a final year in 2009 but without funding and was marked by two volumes of *Palaeogeography, Palaeoclimatology, Palaeoecology* in 2010. This project has in the past provided travel support to a significant number of Ordovician specialists, including voting members of the Subcommittee, allowing for regular meetings at the annual workshops scheduled for the project. A new successor project has been initiated by Brad Cramer and colleagues and will continue to support Ordovician together with Silurian geology.

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

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

## 11. Review chief accomplishments over last ten years (2001-2011)

- 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 9<sup>th</sup> International Symposium on the Ordovician System held in San Juan, Argentina, in August 2003, in conjunction with the 7<sup>th</sup> International Graptolite Conference and a Field Meeting of the Subcommittee on Silurian Stratigraphy and publication of 556 page proceedings, 130 participants represented 18 countries, 124 papers were presented in technical sessions.
- g. Publication of *Ordovician News* nos. 17-27 and their posting on the Subcommittee'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 Subcommittee'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 32<sup>nd</sup> 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 2<sup>nd</sup>, 3<sup>rd</sup>, 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> 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 10<sup>th</sup> Ordovician Conference) that was combined with the 3<sup>rd</sup> 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: 7<sup>th</sup> 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; 33<sup>rd</sup> IGC in Oslo during August 2008 and the IGCP 503 'International Congress on Palaeozoic Climates' in Lille, France during August, 2008.
- t. Support, participation and sponsorship of the following major conferences during 2009. NAPC Cincinnati 21-26 June and IGCP 503 Copenhagen 31 August – 4 September.
- u. Agreement in principle to establish a new range of working groups tackling a wide spectrum of areas of Ordovician with a view to developing new products for the community.
- v. Support, participation and sponsorship of Ordovician session at IPC3 in London, June 2010.
- w. Publication of a *Special Paper, Geological Society of America* (2010) on Ordovician research (edited by Finney and Berry).
- x. Publication of two volumes of *Palaeogeography, Palaeoclimatology, Palaeoecology* (2010) on Ordovician research (edited by Servais and Owen together with Munnecke, Calnar and Harper).
- z. Sponsorship of the 2011 Madrid Conference (the 11<sup>th</sup> Ordovician Congress), held in the spectacular surroundings of Alcalá de Henares, with field excursions to Portugal and central and northern Spain. The proceedings 'Ordovician of the World' was sponsored by the Subcommittee on Ordovician Stratigraphy. It contains 100 contributions, most of which in the form of short papers, which were delivered as oral presentations or posters at the symposium. This volume

represents a wealth of cutting-edge research on Ordovician rocks from around the world, and includes contributions from 228 authors and coauthors from 23 countries on four continents. Three field guides were also printed.

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

**SUBCOMMISSION ON CAMBRIAN STRATIGRAPHY  
ANNUAL REPORT 2011**

**1. TITLE OF CONSTITUENT BODY**

**International Subcommittee on Cambrian Stratigraphy**

*Prepared by* Prof. Loren E. BABCOCK, Secretary  
 Department of Earth and Ecosystem Sciences  
 Lund University  
 Sölvegatan 12  
 223 62 Lund, Sweden  
 Email: loren.babcock@geol.lu.se  
 and  
 School of Earth Sciences  
 125 South Oval Mall  
 The Ohio State University  
 Columbus, OH 43210, USA  
 and  
 Prof. Shanchi PENG, Chair  
 Nanjing Institute of Geology and Palaeontology  
 39 East Beijing Road  
 Nanjing, China 210008  
 scpeng@nigpas.ac.cn

**2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY**

**Mission Statement**

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

**Goals**

The goals of the Subcommittee 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 Subcommittee 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 Subcommittee is organized by an Executive consisting of Chairman, two Vice-Chairs, and Secretary, who are all Voting Members of the Subcommittee. 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 Subcommittee 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 Subcommittee 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 Subcommittee.

**Officers for 2008-2012:**

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

**Website:** The Subcommittee website has been transferred to an Uppsala University server and is under reorganization and updating. It is now visible on the web as

[http://www.palaontology.geo.uu.se/ISCS/ISCS\\_home.html](http://www.palaontology.geo.uu.se/ISCS/ISCS_home.html).

**4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS**

Members of the Cambrian Subcommittee are involved in a number of international projects, normally in an individual capacity but sometimes facilitated by contacts through activities related to the Subcommittee. In 2011, VMs of the Cambrian Subcommittee participated in a variety of international and regional meetings.

**5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2011.****5a. 16th International Field Conference on Cambrian Stage Subdivision, Southern Great Basin, SW USA, June 2010.**

The 16th International Field Conference on Cambrian Stage Subdivision was held in June 2010 in Arizona and Nevada, USA. The meeting was organized principally by Frederick Sundberg, J. Stewart Hollingsworth, and John Foster. A field guide and abstract volume was published in association with the meeting (Museum of Northern Arizona Bulletin 67).

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

A proposal for the Jiangshanian Stage (formerly provisional Stage 9), which was overwhelmingly approved within the ISCS in 2009, was approved by ICS and ratified by IUGS in 2011. The base of the Jiangshanian Stage coincides with the FAD of the agnostoid *Agnostotes orientalis*, and the GSSP section, the Duibian B section, is in Zhejiang Province, China. The stage name and concept were ratified in 2010.

Work toward definition of a GSSP for the base of provisional Stage 5 (and Series 3) continues. Two potential boundary levels have been identified, and it is expected that in the coming year attention will narrow to one horizon. At that point, it can be expected that GSSP proposals will be solicited by the Working Group.

The Subcommittee is working toward establishing GSSPs of the remaining undefined series and stages. Working Groups have been formed to investigate potential GSSP horizons for stages 2, 3, and 4. These Working Groups replace the Working Group on the Lower Half of the Cambrian, which was successful in determining the best choices of horizons for intercontinental correlation within the first two series of the Cambrian.

A Working Group investigating the Stage 10 base is in early stages of progress. Multiple potential horizons have been suggested for the base of the terminal Cambrian stage, and it is expected that within a few years the Working Group will narrow the field to a single horizon.

At the ISCS field conference (Las Vegas, Nevada) discussion was opened on the matter of the definition and long-range correlation of the Cambrian base. Imprecision in correlating the lower boundary of the Cambrian System have been encountered on all paleocontinents, and the ISCS will endeavor to find a practical solution to remedy the problem.

**6. CHIEF PROBLEMS ENCOUNTERED IN 2011**

The principal difficulties encountered in 2011 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 2011:****INCOME**

Carried forward from 2010	\$ 45.11
ICS Allocation	\$ 4000.00

SUBTOTAL 2011 income	\$ 4045.11
EXPENDITURE FROM 2011 BUDGET	
Contribution to officer's travel expenses	\$ 2921.91
Publishing cost of Bulletin of Geosciences volume (ISCS 2010 proceedings)	\$ 1000.00
SUBTOTAL 2010 expenditures	\$ 3521.91
To be carried forward to 2012	\$ 123.20

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

### **8a. GSSP proposals and plans for meetings.**

Organization of the 17th Cambrian Stage Subdivision Working Group Conference is underway. The meeting is being organized by Zhao Yuanlong (Guizhou University, China) and his colleagues, and will be held in Guiyang, Guizhou, South China, during August 2012. Plans are also moving forward for a special session devoted to the Cambrian System that will be held at the IGC meeting in Australia in 2012.

As of November, 2011, there are no GSSP proposals in process. Work toward a decision on Cambrian Stage 5 is nearing completion, however, and balloting for a horizon and section may take place during 2012.

### **8b. Newsletter**

An annual newsletter, highlighting activities of the Subcommission, is expected to be issued by email in late 2011.

## **9. BUDGET REQUESTS AND ICS COMPONENT FOR 2011**

In order to accelerate the pace of work in establishing GSSPs within the Cambrian, we request a modest increase in funds from ICS as compared to previous years. This will be especially important in 2012 because of the need for Voting Members of the Subcommission to be present at the ISCS field meeting in China and at the IGC meeting in Australia (where the Cambrian Subcommission plans to sponsor a symposium on the Cambrian System). The proposed increased funding is also targeted at field research on key sections by Working Group members and young scientists.

INCOME	
Carry-over from 2011	\$ 123.20
PLANNED EXPENDITURES FOR 2012	
Preparation for the 17th Cambrian Stage Subdivision Working Group Conference in China	\$ 2000.00
Executive and VMs travel costs, Cambrian Subcommission field meeting	\$ 3000.00
Support for 3 young scientists to attend the field meeting	\$ 3000.00
General office expenses	\$ 100.00
TOTAL 2012 PLANNED EXPENSES	\$ 8100.00
ICS 2012 BUDGET REQUEST	
<b>Total ICS 2012 budget request</b>	<b>\$ 8100.00</b>

## **11. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2007-2011)**

The accomplishments of the Cambrian Subcommission have been summarized in a recent paper by Shanchi Peng and Loren Babcock (2011, *Bulletin of Geosciences*).

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 prior to five year ago are 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), and South Australia (2006). In the last five years, the ISCS has made reconnaissance visits, associated with field meetings, to East Laurentia (2007), Siberia (2008), Kazakhstan (2009), the Czech Republic and Germany (2010), and the southern Great Basin, USA (2011).

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. Early successful GSSP proposals arising from the Cambrian Subcommittee were for the bases of the Paibian Stage and Furongian Series (2004), and the Drumian Stage (2006). In the last five years, successful proposals have been made for the Guzhangian Stage (2007) and the Jiangshanian Stage (2011). In addition, names have been ratified for the Terreneuvian Series (2007) and Fortunian Stage (2007).

#### 12. SELECTING ISCS OFFICERS AND VOTING MEMBERS FOR TENURE OF 2012-2016.

The current ISCS chair and vice-chairs will retire in August 2012, having served two terms. In August 2011, the ISCS distributed a ballot to all voting members for selecting its next Chair and Vice-Chair. The vote result showed that L. E. Babcock and Xingliang Zhang were supported by majority of Voting Members, and were elected respectively Chair and Vice-Chair for the term 2012-2016. Following discussions among the executive officers during the 16<sup>th</sup> ISCS Field Conference and subsequently, a set of voting members for the next term was proposed to ICS. The slate of voting members includes some new members, and some long-serving voting members will retire from their positions. The proposed slate of voting members is awaiting approval from ICS.

#### 13. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2012-2016)

The primary objective for the immediate future for the Cambrian Subcommittee remains the completion of definition of the stages by GSSPs. There is one stage (Stage 10) remaining to be defined in the upper half of the system, and it is hoped that it will be defined by a GSSP within the next couple of years. Stages of the lower half of the Cambrian are expected to be defined by GSSPs by around 2016.

\*\*\*\*\*

#### 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](mailto:scpeng@nigpas.ac.cn)

**First Vice Chair:** Malgorzata Moczydlowska-Vidal, Department of Earth Sciences, Palaeobiology, Uppsala University, Villavägen 16, 752 36 Uppsala, Sweden, Email: [malgo.vidal@pal.uu.se](mailto:malgo.vidal@pal.uu.se)

**Second Vice-Chair:** Gerd Geyer, Bayerisches Landesamt für Umwelt, Hans-Högn-Straße 12 95030 Hof, and Department of Earth Sciences, Palaeobiology, Uppsala University, Villavägen 16, 752 36 Uppsala, Sweden, Email: [gerd.geyer@geo.uu.se](mailto:gerd.geyer@geo.uu.se).

**Secretary:** Loren E. Babcock, Department of Earth and Ecosystem Sciences, Lund University, Sölvegatan 12, 223 62 Lund, Sweden, and School of Earth Sciences, 125 South Oval Mall, The Ohio State University, Columbus, OH 43210, USA, [loren.babcock@geol.lu.se](mailto:loren.babcock@geol.lu.se).

***List of Working (Task) Groups and their officers*****Stage 2:** Michael Steiner [Michael.Steiner@FU-Berlin.de](mailto:Michael.Steiner@FU-Berlin.de)**Stage 3:** Xingliang Zhang [xizhang69@126.com](mailto:xizhang69@126.com)**Stage 4:** James B. Jago [jim.jago@unisa.edu.au](mailto:jim.jago@unisa.edu.au)**Stage 5:** Linda McCollum [lmccollum@ewu.edu](mailto:lmccollum@ewu.edu)**Series 9:** Duck K. Choi [dkchoi@snu.ac.kr](mailto:dkchoi@snu.ac.kr)**Stage 10:** Per Ahlberg [per.ahlberg@geol.lu.se](mailto:per.ahlberg@geol.lu.se)**Geochemistry:** Matt Saltzman [saltzman.11@osu.edu](mailto:saltzman.11@osu.edu)***List of Voting Members (other than officer) for 2009-2012***Per Ahlberg, Lund, Sweden [per.ahlberg@geol.lu.se](mailto:per.ahlberg@geol.lu.se)José-Javier Álvaro, Villeneuve d'Ascq, France [Jose-Javier.Alvaro@uni-lille1.fr](mailto:Jose-Javier.Alvaro@uni-lille1.fr)Duck K. Choi, Seoul, Korea [dkchoi@snu.ac.kr](mailto:dkchoi@snu.ac.kr)Gappar Kh. Ergaliev, Almaty, Kazakhstan [ergaliev@nursat.kz](mailto:ergaliev@nursat.kz)Rodolfo Gozalo, Valencia, Spain [rodolfo.gozalo@uv.es](mailto:rodolfo.gozalo@uv.es)James B. Jago, Mawson Lakes, Australia [jim.jago@unisa.edu.au](mailto:jim.jago@unisa.edu.au)Pierre D. Kruse, Adelaide, Australia [archaeo.kruse@gmail.com](mailto:archaeo.kruse@gmail.com)Ed Landing, Albany, New York, USA [elanding@mail.nysed.gov](mailto:elanding@mail.nysed.gov)Elena Naimark, Moscow, Russia [naimark@paleo.ru](mailto:naimark@paleo.ru)Tatyana V. Pegel, Novosibirsk, Russia [pegel@mail.ru](mailto:pegel@mail.ru)Brian Pratt, Saskatoon, Saskatchewan, Canada [brian.pratt@usask.ca](mailto:brian.pratt@usask.ca)Matthew R. Saltzman, Columbus, Ohio, USA [saltzman.11@osu.edu](mailto:saltzman.11@osu.edu)Michael Steiner, Berlin, Germany [Michael.Steiner@FU-Berlin.de](mailto:Michael.Steiner@FU-Berlin.de)Stephen R. Westrop, Norman, Oklahoma, USA [swest@hoth.gen.ou.edu](mailto:swest@hoth.gen.ou.edu)Xingliang Zhang, Xi'an, China [xizhang69@126.com](mailto:xizhang69@126.com)Maoyan Zhu, Nanjing, China [myzhu@nigpas.ac.cn](mailto:myzhu@nigpas.ac.cn)Andrey Yu. Zhuravlev, Zaragoza, Spain [ayzhur@mail.ru](mailto:ayzhur@mail.ru)**Total number of Voting Members for term 2008-2012: 21.*****Preparer information:***

Prof. Shanchi Peng  
 Nanjing Institute of Geology and Palaeontology  
 39 East Beijing Street  
 The Chinese Academy of Sciences  
 Nanjing 210008, China  
 Email: [scpeng@nigpas.ac.cn](mailto:scpeng@nigpas.ac.cn)

Prof. Loren E. Babcock  
 Department of Earth and Ecosystem Sciences  
 Lund University  
 Sölvegatan 12  
 223 62 Lund, Sweden  
 Email: [loren.babcock@geol.lu.se](mailto:loren.babcock@geol.lu.se)  
 and  
 School of Earth Sciences  
 125 South Oval Mall  
 The Ohio State University  
 Columbus, OH 43210, USA

Date: 24 November 2011

**SUBCOMMISSION ON NEOPROTEROZOIC (EDIACARAN AND CRYOGENIAN) STRATIGRAPHY**  
**ANNUAL REPORT 2011**

**1. TITLE OF CONSTITUENT BODY**

**Subcommission on Neoproterozoic (Ediacaran and Cryogenian) Stratigraphy**

*Submitted by:*

Dr James GEHLING, Chairman  
 South Australian Museum, North Terrace, Adelaide, 5000, Australia  
 Tel. +61-8-8207-7441, Fax. +61-8-8207-7222  
 Email: jim.gehling@samuseum.sa.gov.au

**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 established “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 Subcommittee is organized by an Executive consisting of Chairman, Vice-Chairman and Secretary, who are all Voting Members of the Subcommittee. These officers were nominated and elected by voting members of the now terminated Terminal Proterozoic Subcommittee during late 2003. There are currently 32 other Voting Members, making a total of 35 voting members. 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 subcommittee, and their willingness to take an active role in the subcommittee's activities. Four voting members are required to be officers of the Cambrian and Precambrian Subcommittees.

#### 4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

Members of the Neoproterozoic (Ediacaran and Cryogenian) Subcommittee are lead investigators and officers in a number of related international projects:

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

Other, now completed international projects include: IGCP 478 (*Neoproterozoic-early Paleozoic events in SW Gondwana*) led by voting members **Claudio Gaucher, Hartwig Frimmel and Paulo Boggiani**; 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 2011

- An international conference on Neoproterozoic Sedimentary Basins and a Neoproterozoic Subcommittee workshop on Ediacaran paleobiology (Novosibirsk, 30 July – 1 August, 2011), followed by a field excursion to the East Sayan Mountains (2 – 14 August, 2011). These events were sponsored by Russian Foundation for Basic Research, Trofimuk Institute of Petroleum Geology and Geophysics, Russian Academy of Sciences, ICS Subcommittee on Neoproterozoic Stratigraphy, and two IGCP projects [IGCP 512 “Neoproterozoic Ice Ages” led by G. Shields and Emmanuelle Arnaud, and IGCP 587 “Of Identity, Facies and Time: The Ediacaran (Vendian) Puzzle” led by Patricia Vickers-Rich, Mikhail A. Fedonkin, James G. Gehling, and Guy M. Narbonne]. Following the Swedish Workshop on Ediacaran Acritarch Taxonomy (SWEATshop) in Uppsala (2008) and Lucknow (2010), the Novosibirsk workshop offered participants the opportunity to examine the Russian material, including acritarchs, from central Siberia, the northern East European Platform, southeastern and southwestern Siberia. The materials were kindly provided by Konstantin Nagovitsin (Novosibirsk), Elena Golubkova (St. Petersburg), and Elena Raevskaya (St. Petersburg). Fifteen palaeontologists from Brazil, China, Germany, Russia, and USA participated in the workshop. Twenty six geologists participated in the field excursion to the eastern Sayan Mountains led by Julius Sovetov to study the carbonate and siliciclastic Cryogenian rocks, and Ediacaran (Vendian) molasse successions, for which a detailed and well illustrated guide book was produced.
- For *The New Geologic Time Scale*, due to be published in 2012, two chapters on periods of the Neoproterozoic are included for the first time. The *Ediacaran Period* has been completed by Narbonne, Xiao, Shields and Gehling; The *Cryogenian Period* has been completed by Shields, Hill and MacGabhann.
- IGCP 512's book *Neoproterozoic Ice Ages* (Arnaud, Halverson and Shields), which summarises present knowledge on Cryogenian Period glacial units around the world and their correlation in a Memoir of the Geological Society of London, has now been published (ISBN 978-1-86239-334-9).
- The Neoproterozoic Subcommittee has voted on a proposition to divide the Neoproterozoic into separate Ediacaran and Cryogenian subcommittees to enable each SC to concentrate on separate issues of correlation, subdivision and proposals for GSSPs.

#### 6. CHIEF PROBLEMS ENCOUNTERED IN 2011

- Continuing inadequacy of geochronological control in key sections. This is being addressed continually using new U-Pb and Lu-Hf ages and chemostratigraphy.
- Challenging logistics have caused difficulties in organizing a formal subcommittee excursion to Svalbard. This was to be arranged for 2011 but proved impossible, although a smaller group of communicating members (Fairchild, Halverson) did manage a fact-finding mission albeit cut short due to poor weather conditions. It appears unlikely that a sufficient number of subcommittee members would be able to attend a subcommittee excursion to Svalbard in the near future, due to a combination of logistic and funding issues.

## 7. SUMMARY OF EXPENDITURES IN 2011:

### INCOME

Carried forward to 2011		US\$ 2200
	ICS	US\$ 3000
	TOTAL	US\$ 5200

### EXPENDITURE FROM 2011 BUDGET

IGC Travel expenses and support for Siberian conference and field trip (Feb)	US\$ 3000	
Administration	US\$150	
Preparation for 34 IGC Neoproterozoic Field Trip	US\$350	
TOTAL		US\$ 3500
To be carried forward to 2012		US\$ 1700

## 8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2012):

### (a) End of year Newsletter

### (b) Proposal Dissolution of Neoproterozoic SC set up Ediacaran SC and Cryogenian SC:

Considering the large number of corresponding and voting members in the Neoproterozoic SC reflecting an increasing level of publication on the geochemistry, geochronology, stratigraphy and palaeontology of the Neoproterozoic, the Neoproterozoic executive considered that a split into two subcommissions should be considered.

**Results:** In favour of the dissolution = 24 ; Against = 2; Undecided =1; no response = 8. Total =35

Voting members have therefore decided to request dissolution of the subcommission, and request establishment of two new subcommissions (Ediacaran and Cryogenian). This request will be formalized in time for the appointment of two new subcommissions and memberships (2012-2016) in time for the August IGC in Australia.

### (c) 34<sup>th</sup> International Geological Congress (Brisbane, Australia), August 2012

The Subcommission will support the following symposia and field trips:

- 1) **Symposium 35.3** International Subcommission on Neoproterozoic stratigraphy: Neoproterozoic chronostratigraphy and the evolution and diversification of metazoa and evolution of the Earth system.
- 2) **Theme 23: Evolution of the Biosphere.**
  - Symposium 23. 1 Martin Glaessner Symposium: The Ediacaran and Cambrian Explosion.
  - 23.5 Oxygen and evolution.
  - 23.6 Proterozoic life.
- 3) **Theme 18. The Proterozoic Earth.**
  - 18.2 The Neoproterozoic Earth
  - 18.3 Proterozoic supercontinents, processes, models, myths, and possibilities.
- 4) **Post Congress Field Trip: S-4 Ediacaran-Cambrian of South Australia** — Saturday 11 August to Saturday 18 August 2012.

### (d) Subcommission workshop in Svalbard 2012:

A meeting in Svalbard to discuss the base of the Cryogenian GSSP is currently on hold in 2012 (chief organizer: Ian Fairchild).

**(e) New Geological Time Scale book:** The new Geological Time Scale book which is due out in 2012 will be the first to contain full chapters on the Ediacaran and Cryogenian periods. IGCP 512 publish its compendium of Neoproterozoic regional geology in 2011.

### (f) Fermor meeting of the Geological Society of London:

A large international meeting has been organized for September 19-23, 2012 (convenors: Ian Fairchild, Graham Shields, Tim Lenton, Daniel Condon) on 'The Neoproterozoic Era: evolution, glaciations and oxygenation'. The related field trip will visit key Ediacaran localities in England (chief organizer: Martin Brasier)

## 10. BUDGET AND ICS COMPONENT FOR 2012

We anticipate that more than US \$5,000 will be required during 2011 to ensure maximum participation at the IGC in Australia, considering that several members of the subcommission are from developing countries.

Projected Budget for 2012:

Carried over from 2011	US \$1700
General office expenses	US \$250
Preparation and production of Newsletter/web support	US \$250
34 <sup>th</sup> IGC travel expenses	US \$4000
<b>TOTAL BUDGET PROJECTED</b>	<b>US \$6200</b>

### Potential funding sources outside IUGS

National IGCP committees and project groups for IGCP project 587.

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 has been sought from petroleum companies and consortia but currently to no avail.

## 11. REVIEW CHIEF ACCOMPLISHMENTS OF PAST SIX YEARS (2006-2011)

**2006:** 2<sup>nd</sup> 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. “*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).

**2009:** The Neoproterozoic Subcommission officers received 87% overall response following the request to vote on a working definition for the Cryogenian Period. 79% of replies were positive, which gives us a mandate to move forward on this issue. The vote and the lengthy discussion preceding that vote establish a clear priority order with regard to the criteria likely to be used in the future definition and correlation of the Cryogenian Period. Final definition: “*The base of the Cryogenian should be placed within an outcrop section at a precisely defined stratigraphic level (GSSP) beneath the oldest clearly glaciogenic deposits in a Neoproterozoic succession. The chosen section should demonstrate proven*”

*potential for global C- and Sr-isotope stratigraphic correlation and preferably be amenable to microfossil biostratigraphy, isotope geochronology and other forms of global correlation such as magnetostratigraphy"* (17.08.2009).

A good response (31/36) was also received with regard to the Ediacaran Period Questionnaire resulting in a clear consensus that stable carbon isotopes, acritarchs, and Ediacara fossils are the most practical correlation tools. Ediacaran glaciations and oxidation events may be useful. There is very little support for stromatolites or the Acraman impact events as interregional correlation tools. Consequently, most people believe that we should focus on successions with mixed lithologies, geochronological constraints, and chemostratigraphic and biostratigraphic potential; and proceed from Series to Stages, rather than from Stages to Series (as practiced in Phanerozoic stratigraphy). The Ediacaran System can be divided into two or more Series.

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

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

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

**2011:** International conference on Neoproterozoic Sedimentary Basins and a Neoproterozoic Subcommittee workshop on Ediacaran paleobiology (Novosibirsk, 30 July – 1 August, 2011), followed by a field excursion to the East Sayan Mountains (2 –14 August, 2011).

Publication of *Neoproterozoic Ice Ages* (editors: Arnaud, Halverson and Shields; Geological Society of London Memoir 36: ISBN 978-1-86239-334-9).

Ballot on dissolution of Neoproterozoic Subcommittee and establishment of two separate subcommittees for the Cryogenian and Ediacaran periods, respectively.

## **12. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2012-2016)**

The Neoproterozoic (Ediacaran and Cryogenian) Subcommittee aims to encourage research that will facilitate a consensus subdivision of the late Neoproterozoic (circa 800 – 542 Ma).

### **2012**

- Neoproterozoic Symposium at 34<sup>th</sup> International Geological Congress, Brisbane, Australia: 5-10 August, 2012. Excursion: *Ediacaran and Cambrian of South Australia*. Submission and discussion of informal proposals to subdivide the Ediacaran Period and define the base of the Cryogenian. Strategy meetings for Ediacaran and Cryogenian working groups/subcommittees.
- 34 IGC Field trip S-4 Ediacaran-Cambrian of South Australia with a focus on the search for appropriate criteria for the subdivision of the Ediacaran Period.
- Preparatory field excursion to Cryogenian succession of Svalbard followed by Geological Society of London, Fermor Meeting in September: "*The Neoproterozoic Era: evolution, glaciation and oxygenation*" (Fairchild, Lenton, Condon and Shields).

### **2013-2014**

- Additional field trips to be organized to examine potential GSSP sections for the basal Cryogenian boundary and Ediacaran subdivisions.
- Submission and discussion of formal proposals for a Cryogenian GSSP and Ediacaran Stage GSSP.

### **2014-16**

- Ratification of formal proposals for a Cryogenian GSSP and Ediacaran Period GSSP.

\*\*\*\*\*

**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](mailto: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](mailto: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](mailto:g.shields@ucl.ac.uk)

*Voting Members*

1. **Jose-Javier Alvaro**, Lille, France; [Jose-Javier.Alvaro@univ-lille1.fr](mailto:Jose-Javier.Alvaro@univ-lille1.fr)
2. **Paulo César Boggiani**, São Paulo, Brazil; [boggiani@usp.br](mailto:boggiani@usp.br)
3. **Martin D. Brasier**, Oxford, UK; [martin.brasier@earth.ox.ac.uk](mailto:martin.brasier@earth.ox.ac.uk)
4. **Nicholas Butterfield**, Cambridge, UK; [njb1005@esc.cam.ac.uk](mailto:njb1005@esc.cam.ac.uk)
5. **Nicholas Christie-Blick**, New York, USA; [ncb@ldeo.columbia.edu](mailto:ncb@ldeo.columbia.edu)
6. **Nikolay Chumakov**, Moscow, Russia; [chumakov@ginras.ru](mailto:chumakov@ginras.ru)
7. **David A.D. Evans**, New Haven, USA; [dai.evans@yale.edu](mailto:dai.evans@yale.edu)
8. **Mikhail Fedonkin**, Moscow, Russia; [mfedon@paleo.ru](mailto:mfedon@paleo.ru)
9. **Hartwig Frimmel**, Wuerzburg, Germany; [hartwig.frimmel@mail.uni-wuerzburg.de](mailto:hartwig.frimmel@mail.uni-wuerzburg.de)
10. **Claudio Gaucher**, Montevideo, Uruguay; [gaucher@chasque.apc.org](mailto:gaucher@chasque.apc.org)
11. **Dmitri V. Grazhdankin**, Novosibirsk, Russia; [dima.grazhdankin@gmail.com](mailto:dima.grazhdankin@gmail.com)
12. **Kathleen Grey**, Perth, Australia; [kath.grey@doir.wa.gov.au](mailto:kath.grey@doir.wa.gov.au)
13. **Karl-Heinz Hoffmann**, Windhoek, Namibia; [khhoffmann@mme.gov.na](mailto:khhoffmann@mme.gov.na)
14. **Richard Jenkins**, Adelaide, Australia; [jenkins.richard@saugov.sa.gov.au](mailto:jenkins.richard@saugov.sa.gov.au)
15. **Sören Jensen**, Spain; [soren@guadiana.unex.e](mailto:soren@guadiana.unex.e)
16. **Alan Jay Kaufman**, Maryland, USA; [kaufman@geol.umd.edu](mailto:kaufman@geol.umd.edu)
17. **Vsevolod Komentovskiy**, Novosibirsk, Russia; [vkhom@uiggm.nsc.ru](mailto:vkhom@uiggm.nsc.ru)
18. **Andrew H. Knoll**, Cambridge, USA; [aknoll@oeb.harvard.edu](mailto:aknoll@oeb.harvard.edu)
19. **Ulf Linnemann**, Dresden, Germany; [ulf.linnemann@snsd.smwk.sachsen.de](mailto:ulf.linnemann@snsd.smwk.sachsen.de)
20. **Victor Melezhik**, Norway; [Victor.Melezhik@ngu.no](mailto:Victor.Melezhik@ngu.no)
21. **Malgorzata Moczydlowska-Vidal**, Uppsala, Sweden; [malgo.vidal@pal.uu.se](mailto:malgo.vidal@pal.uu.se)
22. **Guy M. Narbonne**, Kingston, Canada; [narbonne@geol.queensu.ca](mailto:narbonne@geol.queensu.ca)
23. **Peng Shanchi**, Beijing, China; [scpeng@nigpas.ac.cn](mailto:scpeng@nigpas.ac.cn), [speng@pub.jlonline.com](mailto:speng@pub.jlonline.com)
24. **Vibhuti Rai**, Lucknow, India; [vibhutihrai@rediffmail.com](mailto:vibhutihrai@rediffmail.com)
25. **Robert Rainbird**, Ottawa, Canada; [rrainbir@nrcan.gc.ca](mailto:rrainbir@nrcan.gc.ca)
26. **Mikhail A. Semikhatov**, Moscow Russia; [semikhatov@ginras.ru](mailto:semikhatov@ginras.ru)
27. **Martin Van Kranendonk**, Geological Survey of Western Australia; [martin.vankranendonk@doir.wa.gov.au](mailto:martin.vankranendonk@doir.wa.gov.au)
28. **Sun Weiguo**, Nanjing, China; [weiguo@jlonline.com](mailto:weiguo@jlonline.com)
29. **Malcolm Walter**, Sydney, Australia; [mwalter@els.mq.edu.au](mailto:mwalter@els.mq.edu.au)
30. **Yin Chongyu**, Beijing, China; [chongyuyin@cags.net.cn](mailto:chongyuyin@cags.net.cn)
31. **Yuan Xunlai**, Nanjing, China; [xlyuan@nigpas.ac.cn](mailto:xlyuan@nigpas.ac.cn)
32. **Zhu Maoyan**, Nanjing China; [myzhu@nigpas.ac.cn](mailto:myzhu@nigpas.ac.cn); [zhumaoyan@gmail.com](mailto:zhumaoyan@gmail.com)

## APPENDIX 2

Institute of Petroleum Geology, Geological Institute, Siberian Research Institute of Geology and Geophysics, Siberian Branch Russian Academy of Sciences Geology, Geophysics and Mineral Russian Academy of Sciences Resources (SNIIGGiMS)

### **International Conference**

#### **Neoproterozoic Sedimentary Basins:**

#### **stratigraphy, geodynamics and petroleum potential**

#### **Neoproterozoic Subcommission (ICS) Workshop**

#### **Ediacaran Paleobiology**

#### **IGCP 512 Excursion to the East Sayan Mountain Ranges**

#### ***International Conference on Neoproterozoic Sedimentary Basins, Neoproterozoic Subcommission Workshop on Ediacaran Paleobiology, and IGCP Field Excursion to the East Sayan Mountain Range***

*30 July – 14 August 2011, Novosibirsk, Russia*

Numerous Neoproterozoic sedimentary basins were developed on the Siberian Craton, and the Siberian successions play an important role in the Neoproterozoic biostratigraphy, chemostratigraphy, basin dynamics, and petroleum exploration. To take advantage of Siberia's rich geological and paleobiological heritages, Russian geologists at the Trofimuk Institute of Petroleum Geology and Geophysics in Novosibirsk organized an international conference on Neoproterozoic sedimentary basins and a workshop on Ediacaran paleobiology (Novosibirsk, 30 July – 1 August, 2011), followed by a field excursion to the East Sayan Mountains (2 – 14 August, 2011). These events were sponsored by Russian Foundation for Basic Research, Trofimuk Institute of Petroleum Geology and Geophysics, Russian Academy of Sciences, ICS Subcommission on Neoproterozoic Stratigraphy, and two IGCP projects [IGCP 512 “Neoproterozoic Ice Ages” led by G. Shields and Emmanuelle Arnaud, and IGCP 587 “Of Identity, Facies and Time: The Ediacaran (Vendian) Puzzle” led by Patricia Vickers-Rich, Mikhail A. Fedonkin, James G. Gehling, and Guy M. Narbonne]. The main goal of the combined conference, workshop, and field excursion was to encourage interdisciplinary investigations of Neoproterozoic Earth history through international collaborations.

The conference was inaugurated by a keynote address on the petroleum potential of Neoproterozoic basins in eastern Siberia by Aleksei Kontorovich, who summarized results from decades of petroleum exploration in eastern Siberia. Kontorovich's seminar was followed by four more keynote addresses: Nikolai Chumakov provided a synthesis on Neoproterozoic ice ages, Jay Kaufman discussed the use of chemostratigraphic data for Neoproterozoic stratigraphic correlation and paleoenvironmental studies, Shuhai Xiao offered insights into the Ediacaran evolution through multiple taphonomic windows preserved in the Doushantuo Formation, and Patricia Vickers-Rich reported new discoveries in Ediacaran paleontology from Namibia. The rest of the conference was broken into six sessions that covered a wide range of topics including Neoproterozoic biostratigraphy, chemostratigraphy, paleoenvironments, basin analysis, geodynamics, paleogeography, petroleum geology, as well as new paleontological advancements from Siberian Proterozoic successions. A number of presentations/abstracts (Boris S. Sokolov, Nikolai M. Chumakov, Yulii K. Sovetov, Boris B. Kochnev) also touched upon the important issue of Ediacaran-Vendian correlation. The “Vendian System”, which is stratigraphically more complete in peripheral zones the Siberian Craton (e.g., the Patom, Baikal and Sayan areas), has much to contribute to the subdivision and global correlation of the Ediacaran System. There were a total of 69 abstracts, which have been compiled in a proceedings volume (“Neoproterozoic sedimentary basins: stratigraphy, geodynamics and petroleum potential. Proceedings of the International conference, edited by D. V. Grazhdankin and V. V. Marusin, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of the Russian Academy of Sciences, Novosibirsk: IPGG SB RAS, 2011. – 115 p. – ISBN 978-5-4262-0014-2).

The workshop on Ediacaran paleobiology was a follow-up of two previous workshops: the Swedish Workshop on Ediacaran Acritarch Taxonomy (SWEATshop; Uppsala, August 2008) and the Indian Workshop on Acritarchs (Lucknow, February 2010). The Uppsala workshop focused on the taxonomy of some 80 genera and 260 species of Ediacaran acritarchs that have been described in the literature, but unfortunately no Russian materials were available for examination at the Uppsala or Lucknow workshops. Thus, the Novosibirsk workshop offered participants a valuable opportunity to examine the Russian materials, including acritarchs from the Ura Formation in central Siberia, the Vychedga Formation in the Kel'tminskaya region of northern East European Platform, the Lakhanda Group in southeastern Siberia, and the Kamo Group in southwestern Siberia. The materials were kindly provided by Konstantin Nagovitsin (Novosibirsk), Elena Golubkova (St. Petersburg), and Elena Raevskaya (St. Petersburg). Fifteen palaeontologists from Brazil, China, Germany, Russia, and USA participated in the workshop.

Twenty six geologists participated in the field excursion to the eastern Sayan Mountains led by Julius Sovetov. The trip started with a 22 hour ride on the Trans-Siberian train from Novosibirsk to Nizhneudinsk and a 7 hour bus ride to the

field camp on the Uda River. Sovetov showed participants Riphean and Vendian rocks that he has been investigating in several decades. In the field area, the upper Riphean Karagassy Group consists of the Shangulezh, Tagul, and Ipsit formations, and the Vendian Oselok Group is divided into, in ascending order, the Marnya, Uda, and Aisa formations. The participants of the Sayan field trip crossed the forested highland terrains on off-road vehicles, boated along the Uda River, and climbed up steep hills to examine Neoproterozoic sedimentary successions in a remote part of the world. A complete guidebook prepared specifically for this excursion (original text by Julius Sovetov, English text by Tatiana Perepelova, photographs by Julius Sovetov and Lyudmila Solovetskaya) provided an overview of the stratigraphy and sedimentology of the Karagassy and Oselok groups and detailed descriptions of the sections.

One objective of the trip was to examine the Karagassy Group (possibly Cryogenian) that consists of >740 Ma carbonate and siliciclastic rocks deposited on a passive continental margin in dry and hot climatic conditions. Although there are no glacial sediments in the Karagassy Group, impressive paleokarsts at the Tagul (dolostone) – Ipsit (sandstone) boundary implies a significant change in the base level and this is regarded as an important marker for regional correlation.

The Oselok Group does contain beautiful glacial deposits of early Vendian (or late Cryogenian) age, and this was one of the main focuses of the excursion. Three intervals of breccia in the Marnya Formation have been interpreted as glacial in origin, and one of them (the Ulyakha diamictite) contains abundant striated clasts and faceted clasts in a fine-grained matrix, as well as polished pavement in the underlying rocks. The Ulyakha glaciation is a potential manifestation of the Marinoan snowball Earth event based on preliminary chemostratigraphic data, although currently there are no geochronometric constraints, other than the stratigraphic relationship with the Riphean Karagassy Group and the early Cambrian Ust-Tagul Formation. A possible ash bed was identified within the Ulyakha diamictite and samples are being analyzed by geochronologists. With luck there will soon be a direct age constraint on the Ulyakha glaciation in southwestern Siberia.

Other trip highlights include the early Vendian transgression facies and putative macrofossils. The transgression deposits in the Bolshaya Aisa Member of the Marnya Formation lie above postglacial continental outwash-plain sandstone or channel-bar quartzite and cap dolomite. This member contains imprints and casts that Sovetov reported as soft-bodied macrofossils.

In the late Ediacaran Period, the Siberian Craton underwent an orogeny that produced thick (up to 1500 m) molasse in foredeeps along the southwestern craton margin. The sedimentary fill of the Sayan Foredeep includes channel deposits of the Aisa Formation. The excursion participants examined them at the Plity locality where a high-energy braided river system developed at the onset of the foredeep sedimentation. The late Ediacaran orogeny in Siberia, along with the subsequent extension and transgression deposits with trace fossils such as *Treptichnus pedum*, is another tie for global correlation.

The logistic support for the field excursion was excellent. Boris B. Kochnev, with a team of students (Natalia V. Bykova, Yuriy Y. Goy, Anton V. Kolesnikov, Vasiliy V. Marusin, Vladimir I. Rogov, and Daniel V. Krechetov), helped to run the field excursion smoothly. Lyudmila V. Solovetskaya assisted in a preparatory trip in 2010 and shared with the participants her fabulous field photographs. Tatiana I. Perepelova did an excellent job in translation. Dmitry Vitoshkin and his family offered warm hospitality and a Russian banya at the freezing Karapchatui Homestead, making this excursion truly enjoyable. For those who did not have a chance to participate the conference and field excursion, they are welcome to download ([http://web.me.com/f6oeoua/Site/Neoproterozoic\\_Sedimentary\\_Basins.html](http://web.me.com/f6oeoua/Site/Neoproterozoic_Sedimentary_Basins.html)) or request the conference proceedings and the excursion guide from Dmitry Grazhdankin ([dima.grazhdankin@gmail.com](mailto:dima.grazhdankin@gmail.com)).

***Shuhai Xiao***

Department of Geosciences, Virginia Polytechnic and State University, Blacksburg, Virginia 24061, USA

***Dmitriy V. Grazhdankin, Julius K. Sovetov***

Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of the Russian Academy of Sciences, Koptyug Avenue 3, Novosibirsk 630090, Russia

***Alan J. Kaufman***

Departments of Geology and Earth System Science Interdisciplinary Center, University of Maryland, College Park, Maryland 20742, USA

***Patricia Rich***

School of Geosciences, Monash University, Victoria 3800, Australia

**SUBCOMMISSION ON PRECAMBRIAN STRATIGRAPHY**  
**ANNUAL REPORT 2011**

**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](mailto: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 2008-2011:**

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](http://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 599 (2011-2014) The Changing Early Earth (Van Kranendonk, continental leader, Australia), at <https://sites.google.com/a/helsinki.fi/early-earth-tectonics/home>
- 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 2011

- The chair ran a workshop at the Geological Society of America Meeting in Minneapolis, Minnesota (Oct., 2011), where he made a final presentation regarding the proposed plan for revising the Precambrian timescale. This was well received by the ~40 attendees and new connections were made with researchers from the USA, some of whom expressed interest in being involved and suggestions of how to move forward.
- Successful completion of the Precambrian timescale chapter to be published in *The Geologic Time Scale 2012*, Gradstein, F.M, Ogg, J.G., Schmitz, M.D., Ogg, G.J, *et al.*, 2012. Boston, USA: Elsevier. This includes a review of the geotectonic and geobiological evolution of the whole of the Precambrian, and which provides recommendations for a fully revised Precambrian timescale (Eons, Eras and Periods, possible names and possible type sections for GSSPs) to be debated and refined by subcommission members over the coming years.
- The Chair visited the Geological Survey of Norway to view the FARDEEP drillcores, as they apply to Proterozoic timescale issues.
- Further analysis of samples collected from the Australian transition section across the proposed Archean-Proterozoic boundary have been undertaken, including new S isotope analyses. Results are consistent with changes recorded in other sections and have been submitted for publication.
- Project initiated with Prof. Philipoot (IPG Paris) for scientific drilling of the Archean-Proterozoic transition in western Australia and around the world, to commence in 2012.

## 6. CHIEF PROBLEMS ENCOUNTERED IN 2011

The busy regular job of Chair, Martin Van Kranendonk, and his writing of the comprehensive book chapter for *The Geologic Time Scale 2012* book has meant that the establishment of working groups for the Hadean and Archean-Proterozoic boundary have been delayed. However, this problem will be overcome in 2012 by the chair moving to a university position at the start of the New Year with the express aim of being able to pursue the revised Precambrian timescale.

## 7. SUMMARY OF EXPENDITURES IN 2011:

\$2700 was granted to Van Kranendonk to help him to travel to the GSA meeting and run the Friends of the Precambrian workshop, and to attend the Prague Goldschmidt conference.

## 8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2012):

- Revise the subcommission to enable active participants a voting role.
- Establish a working group to formalize the Hadean Eon and write a formal proposal for voting by the Precambrian Subcommission and whole of the ICS.
- Establish a working group on the Archean-Proterozoic boundary and write a formal proposal for voting by the Precambrian Subcommission and whole of the ICS.
- Prepare and run a special session on the Precambrian timescale and associated fieldtrip to potential GSP sites within Western Australia for the 34<sup>th</sup> ICG in Brisbane in 2012.
- Continued research on the Archean-Proterozoic transition in Western Australia.

## 9. BUDGET AND ICS COMPONENT FOR 2012

- Support is requested to run a workshop on establishing a Hadean Eon at the 34<sup>th</sup> ICG in Brisbane, 2012; \$1500.

- Support is requested to help run the IGC fieldtrip through the Pilbara region of Western Australia to display and inspect several potential Precambrian GSSPs; airfare Sydney-Paraburdoo, return \$1100.

#### **10. REVIEW CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2007-2011)**

- The new Subcommittee on Precambrian Stratigraphy is now fully activated.
- Chapter contributed to The Geologic Time Scale 2012, edited by Gradstein et al.
- Website up and running (<http://stratigraphy.org/precambrian/>).
- Operational links with allied subcommittees (e.g., on the Cryogenian Period) firmly established.
- Follow-up workshops held in conjunction with IGCP 509, in 2007, the Australian Earth Sciences Convention, Perth, 2008 and the GSA meeting in 2011.
- Active participation at the 33<sup>rd</sup> 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, continuing.
- Active participation in the overall body of ICS.

#### **11. OBJECTIVES AND WORK PLAN FOR NEXT 5 YEARS (2012-2016)**

- 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.
- Advance the idea of a formalized Hadean Eon and derivative eras, defined by chronometric boundaries.
- Natural subdivisions of the Archean Eon into Paleo-, Meso-, and Neoproterozoic eras and derivative periods, defined by chronometric (Paleoarchean) and GSSP boundaries (Mesoarchean and Neoproterozoic).
- In cooperation with the Neoproterozoic Subcommittee, an advanced plan on how to naturalize the time scale for the Neoproterozoic.
- Full incorporation of latest insights from planetary science in the earliest part of the terrestrial Precambrian time scale.
- Submit an ICDP project proposal to investigate the Archean-Proterozoic boundary in Western Australia, through drilling.

\*\*\*\*\*

December, 2011,  
Perth, Western Australia

**SUBCOMMISSION ON STRATIGRAPHIC CLASSIFICATION  
ANNUAL REPORT 2011**

Chair: Prof. Brian R. Pratt

Vice-Chairs: Profs. Helmut Weissert and Jan Zalasiewicz

2011 was a relatively quiet year for ISSC in terms of conference participation. The proposed special session co-sponsored by ISSC at the annual meeting of the Geological Society of America did not take place owing to too few submissions. Those submissions that were received were re-directed into other sessions. In the meantime, application was made to the International Geological Congress organizers to sponsor a special session at the conference in Brisbane, Australia, next August, and this was accepted.

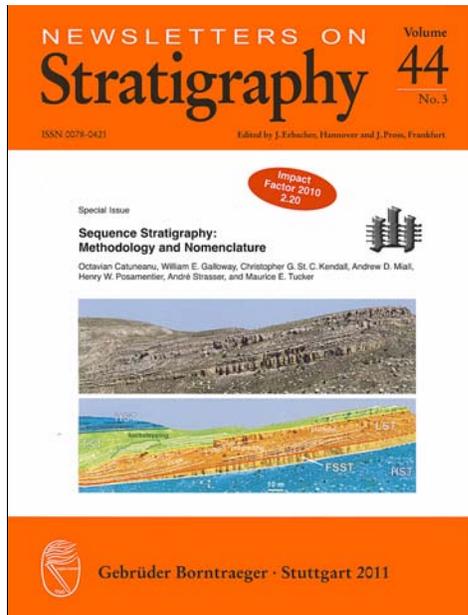
2011 did see the publication of the latest instalment of ISSC's series on stratigraphy which has already been well received. It is a special issue of the journal with a handsome front cover. It is currently available for free download under "Papers

PDF files" in Octavian Catuneanu's website: <http://research.eas.ualberta.ca/catuneanu/files/>

Catuneanu, O., Galloway, W.E., Kendall, C.G.St.C., Miall, A.D., Posamentier, H.W., Strasser, A., and Tucker, M.E., 2011. Sequence stratigraphy: Methodology and nomenclature: Newsletters on Stratigraphy, Vol. 44(3), p. 173–245.

There are three remaining instalments of the stratigraphy series: Lithostratigraphy, Chronostratigraphy and Biostratigraphy. These are in preparation. As a precursor to the Chronostratigraphy paper, on behalf of ISSC the authors will be submitting a short essay to GSA Today that fields some nomenclatural choices, asking for feedback.

Attached pdfs: front cover of Newsletters on Stratigraphy issue; Catuneanu et al. 2011.



**SUBCOMMISSION ON STRATIGRAPHIC INFORMATION  
ANNUAL REPORT 2010**

**TITLE OF CONSTITUENT BODY**

**STRATIGRAPHIC INFORMATION group**  
*(former, and potential future, ICS Subcommittee for Stratigraphic Information)*

*Submitted by James Ogg, chair*

**1. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY**

**Mission Statement**

The Stratigraphic Information *group* (SSI) promotes and coordinates the gathering of selected stratigraphic information worldwide and organizes logically its presentation through the ICS website. The SSI's 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 former Subcommittee for Stratigraphic Information was established in 2000, and assigned an extensive set of goals, that were streamlined in 2003.

SSI's assigned main goals are 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 SSI 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, as assigned in 2002, 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**

There are currently 14 official members in the SSI group (listed in section 10). Beginning in June, 2010, the chairs of other ICS subcommittees serve as ex-official members to provide guidance and expertise for vetting posted information and aiding in new compilations. This group is task-oriented, and it is expected that the membership will be individually active in fulfilling the goals of SSI or coordinating activities of SSI with other international programs in geoinformatics, regional geological syntheses and public outreach.

**Officers [through Aug'2008]**

Name	Office or Expertise	Country (Institution)
<b>Ogg, James G.</b>	<i>Chair</i> ; GTS2012 book; TS-Creator database and visualization	USA (Purdue University)
<b>Ogg, Gabi M.</b>	<i>Secretary/Webmaster</i> ; graphics, GSSP tables	USA (Purdue University)
<b>Crampton, James S.</b>	<i>Vice-Chair</i> , Global Change Through Time Programme of GNS	NEW ZEALAND (Inst. Geol. Nucl. Sci.)

The SSI group would appreciate nominations for voting members from other regions (e.g., Africa, Mideast) and additional international programs which can contribute to the SSI mission.

### 3. Interfaces with other international projects

(1) National Geological Surveys and Strat Commissions. As of Nov, 2011, the SSI has official joint projects (mainly *TimeScale Creator* datapacks) with several national bodies: Geoscience **Australia**, **New Zealand** geologic survey, **British** Geologic Survey, Geological Survey of **Canada** (Calgary branch), **Belgium** Stratigraphy Commission, **Norwegian** offshore lexicon, Austria Stratigraphy Commission, **German** Stratigraphy Commission and German Geological Survey (BGS), **Russia** (All Russian Geological Institute) and **China** (Geodiversity Database and regional stratigraphy data center, Nanjing, China). Details of these projects are given below.

(2) UNESCO **Commission for the Geologic Map of the World** (CGMW). In addition to collaboration in outreach materials, we are coordinating with CGMW on inter-linking our *TimeScale Creator* databases and different regional lexicons to their geological maps. Bruno Vrielynck is jointly serving on SSI as the CGMW liaison.

(3) **GeoSciML**, **One-Geology** and geoinformatics. 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, but awaits additional standards from GeoSciML. The SSI plans to eventually place its entire database of earth history (datums, zones, magnetochrons, geochem, etc.) with interpolated numerical age assignments onto a similar RSS-feed when GeoSciML standards are established.

### 4. Chief accomplishments and products in 2011

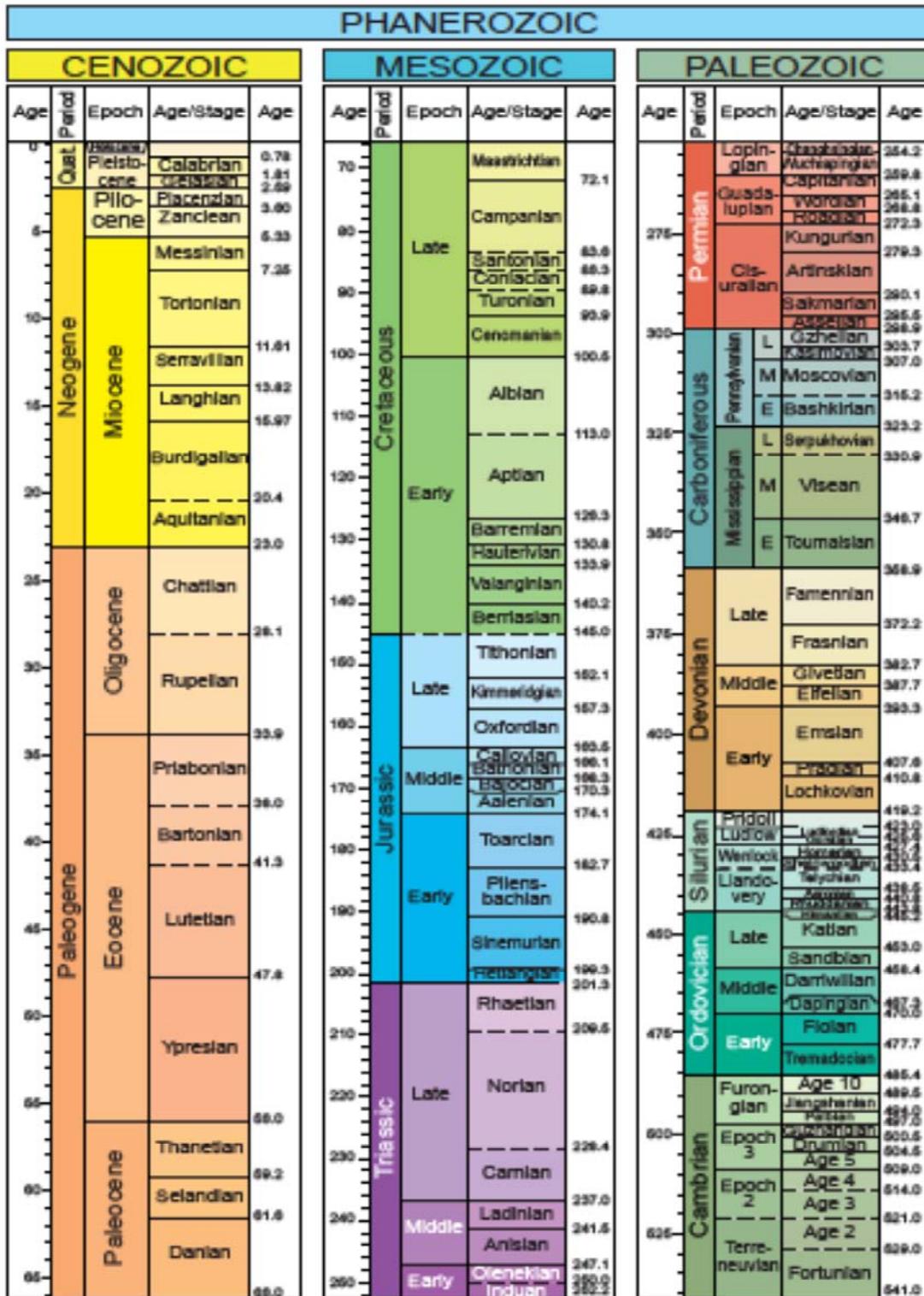
#### a. *BOOK – Geological TimeScale 2012*



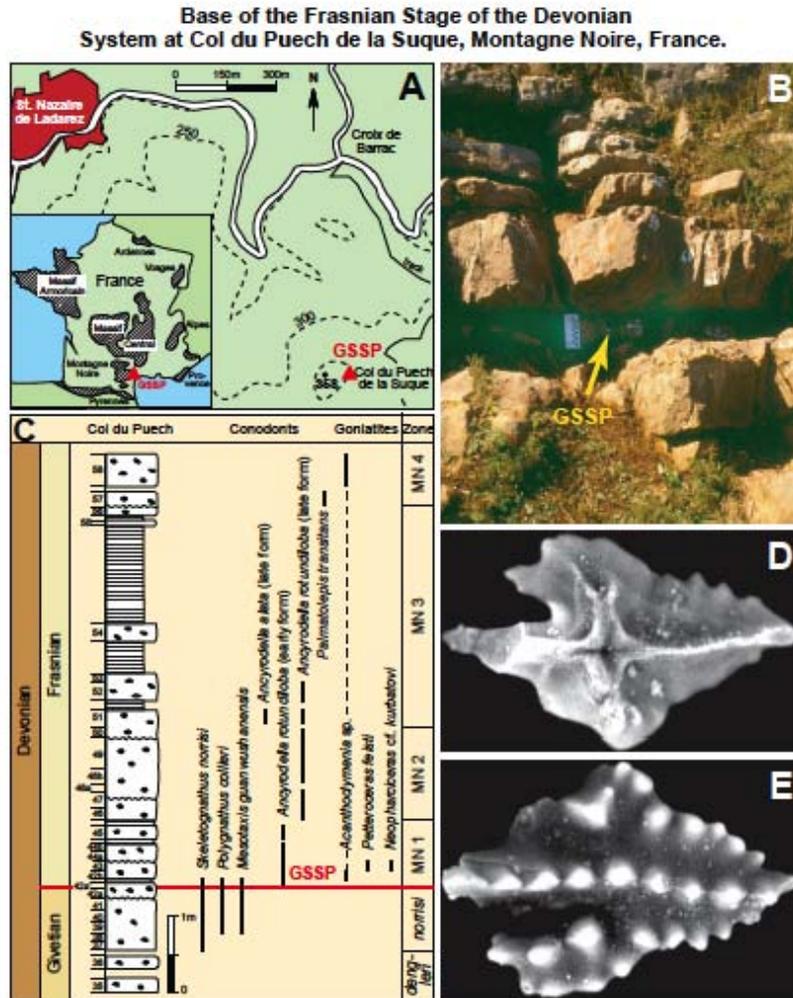
10. Several ICS chairs and officers compiled period-level syntheses for this extensive (850-pages in 2 volumes; 350 full-color illustrations; priced at \$95 including fold-out chart) update and enhancement to the previous ICS-associated *Geologic TimeScale 2004* compilation. In addition to the new GSSPs, these summarized the major advances in bio-mag-sealevel-geochem stratigraphy of the past decade. In addition to the officers of several ICS subcommissions, the total of 60 authors spanned all types of stratigraphy (see appendix to this report). The book is currently being type-set (Dec'2011) and will be printed in April 2012 for distribution at the International Geological Congress in Brisbane in August 2012. Even though this compilation is not a direct product of ICS, it should be considered as a scientific product of ICS expertise – all chapters were either written or reviewed by officers of the relevant subcommissions.
11. Each GSSP (about 70) has a composite map-section-image suite. Two examples are on the following pages. The age models were compiled by EarthTime (e.g., Mark Schmitz et al.) by cycle-stratigraphy teams, and by statistical methods (e.g. CONOP).
12. The ICS Executive has offered to review the usage of stratigraphic terminology (as was done quite well for the 2008 *Concise Geologic TimeScale* book) when the type-set version is available.

Below is the summary timescale (images of the two back-cover diagrams) plus examples of two GSSP diagrams:

# GEOLOGIC TIME SCALE







Post-Publication plans (early 2012):

13. Prepare posters and cards for distribution at the Brisbane IGC in 2012.
14. Website posting of updated numerical age models for divisions of geologic time.
15. Website posting of updated period-level charts for zonations and events, and for inter-regional correlations; including revised numerical age models.
16. Update all the *TimeScale Creator* reference datasets (internal, and all external regional datapacks) to reflect revised inter-zonal correlations and numerical age models.
17. Create a GTS2012 “app” for tablet computers with all GSSPs, main graphics and excerpted text.

#### **b. Websites and RSS-feeds**

Two websites are populated with a wide array of information. These sites are hosted at Purdue University:

- (1) The main SSI site, <http://stratigraphy.science.purdue.edu/>, active since Nov 2008, 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 and display of graphics are dynamically generated; therefore any other web-service can access and display this information (RSS-feed).

- (b) 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.). Therefore, a dynamic feed was successfully 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.
  - (c) CHARTS – From the popular page-sized geologic time scale (*divisions of geologic time*) to poster-sized Earth’s history, all in official CGMW colors.
  - (d) STRATIGRAPHIC GUIDE – a concise version of the official manual.
  - (e) RESOURCES – links to lexicons (national rock formations), diagrams of inter-regional correlations, “GeoWhen” database of historic and regional stage names (*by R. Rohde; Univ. Calif. Berkeley*), and selected links to other Earth history sites.
  - (f) Link to our TS-CREATOR public site.
- (2) TS-CREATOR website – The *TimeScale Creator* site, <http://www.tscreator.org/>, is affiliated with ICS which guides the majority of the scientific content. The SSI members and other groups (e.g., an extensive review by the Univ. College of London micropaleontology conference; and all contributors to *GTS2012* book) have provided the majority of the datasets on Earth’s global and regional history (described later). These are viewed through the *Time Scale Creator* visualization package, a free JAVA program for all platforms to explore Earth history:

The screenshot shows the homepage of the TimeScale Creator website. At the top, there is a navigation bar with links: Home, Manuals, Datapacks, Download, FAQs, Contact Us, News Letter, TSC Pro, Sponsors, and Login. The main heading is "TimeScale Creator". Below the heading, there is a paragraph describing the software: "TimeScale Creator, a free JAVA package, enables you to explore and create charts of any portion of the geologic time scale from an extensive suite of global and regional events in Earth History. The internal database suite encompasses over 20,000 biologic, geomagnetic, sea-level, stable isotope, and other events – details are given on the [BUILT-IN DATA](#) page. All ages are currently standardized to *Geologic Time Scale 2004*, and to the *Concise Geologic Time Scale* compilation of the *International Commission on Stratigraphy* and its *Subcommission on Stratigraphic Information*." There is also a "How to use the program" section with a link to the "MANUAL" pages. A central graphic titled "From Data to finished Chart in 3 simple steps" illustrates the workflow: Step 1: Pick Time Interval, Step 2: Select stratigraphy, Step 3: GENERATE. Below this graphic is a "click to enlarge" link. At the bottom, there is a "DOWNLOAD" link for the free TimeScale Creator, a "FAQs" link, and a paragraph about additional "DATAPACKS" of selected regional geology and stratigraphy.

In addition to providing the free software and manuals in on-line/PDF formats, the site provides an array of datapacks ranging from British Isles geology to Russian biostratigraphic zones to New Zealand fossil ranges. These have been mainly developed in coordination with SSI members (described below).

### c. Printed Material on Earth's History

We have concentrated on global distribution of free or “at cost” teaching resources for Earth History. Production, printing and distribution of these products have been sponsored by EAS/Purdue, Australian National University, Geoscience Australia, and a consortium of petroleum companies (ExxonMobil, ChevronTexaco, BP, Statoil, Shell, ENI, Conoco, Neflex). Some are joint products to be distributed by UNESCO (Commission for Geologic Map of the World).

The list below is what was produced in 2011, and what is planned for 2012:

Chart “**International Divisions of Geologic Time**” is freely available through the International Commission of Stratigraphy website ([www.stratigraphy.org](http://www.stratigraphy.org)) and the SSI website. This chart is updated each time a GSSP has been ratified by IUGS.

Plastic card “**International Geologic Time Scale**”. Versions were sponsored by Neflex, Chevron, ExxonMobil, ConocoPhillips and ENI.

Mousepad “**International Divisions of Geologic Time**”. This was initially a joint production with the UNESCO Commission for the Geologic Map of the World. The first printing was sold out at the International Geological Congress (Oslo, August, 2008). The second printing is available through the CGMW website. A separate printing was done by Geoscience Australia (but including ICS icon) for distribution throughout that country; and they are planning a “GTS2012” mousepad for distribution to all attendees at the Brisbane IGC.

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.

Book, **Concise Geological Time Scale 2008**, (full-color, 160-page, hardback via Cambridge Univ. Press; \$30) is a comprehensive review of all geological time divisions and the associated absolute (millions of years) time scale. This compilation involved a large global network of geoscientists (mainly ICS chairs) contributing their expertise. IUGS reviewed the contents. A plastic timescale card is included in each book. Approximately 3000 copies were sold between Aug, 2008 and Sept, 2011. In 2011, a Japanese-language version was produced.

Poster “**History of the Earth**” (geologic time scale, life-through-time, and global reconstructions). This was one of our contributions for the United Nations 2008-09 “*International Year of Planet Earth*”. The target audiences are secondary schools. The IYPE reviewed and approved the product.

2500 copies were printed/distributed during 2007-09 in Australia.

3000 copies were printed/distributed in 2007-11 through Purdue University; mainly to K-12 teachers.

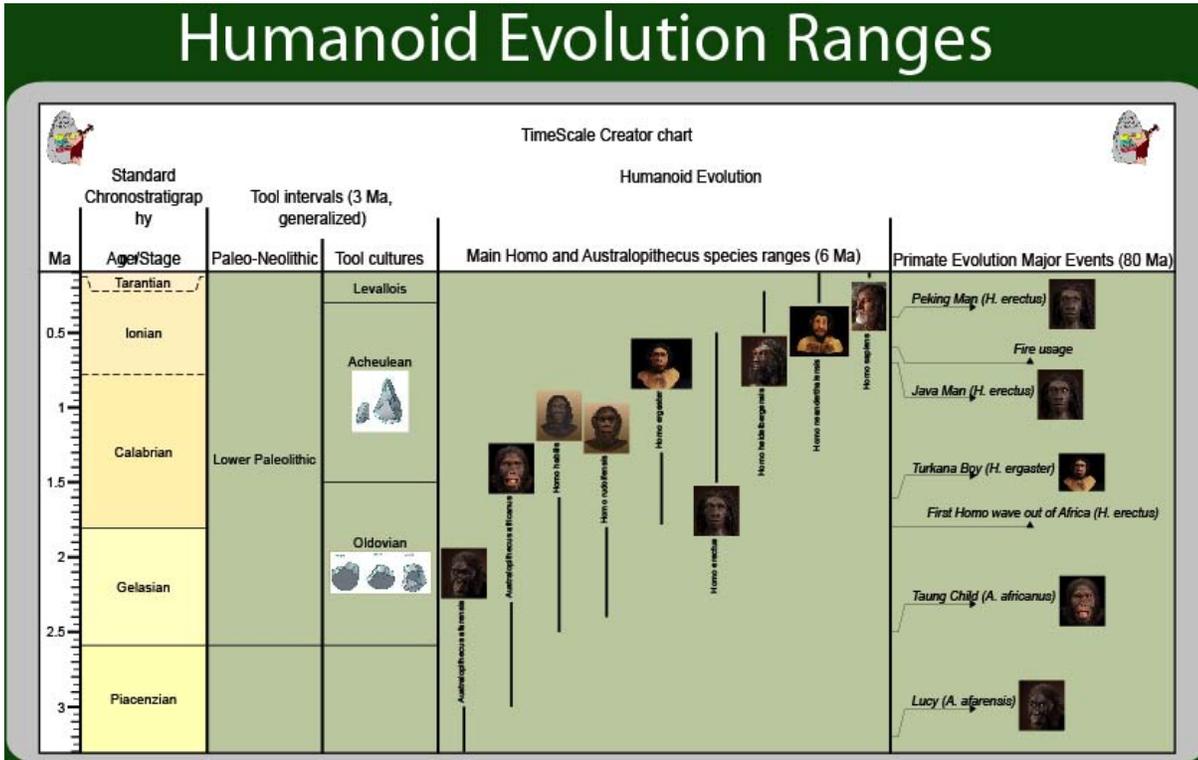
Poster “**A Geologic Time Scale 2008**” (3x2 feet; prepared and printed in coordination with UNESCO Commission for the Geologic Map of the World). This is available through the SSI or CGMW websites.

### d. Global databases and Visualization

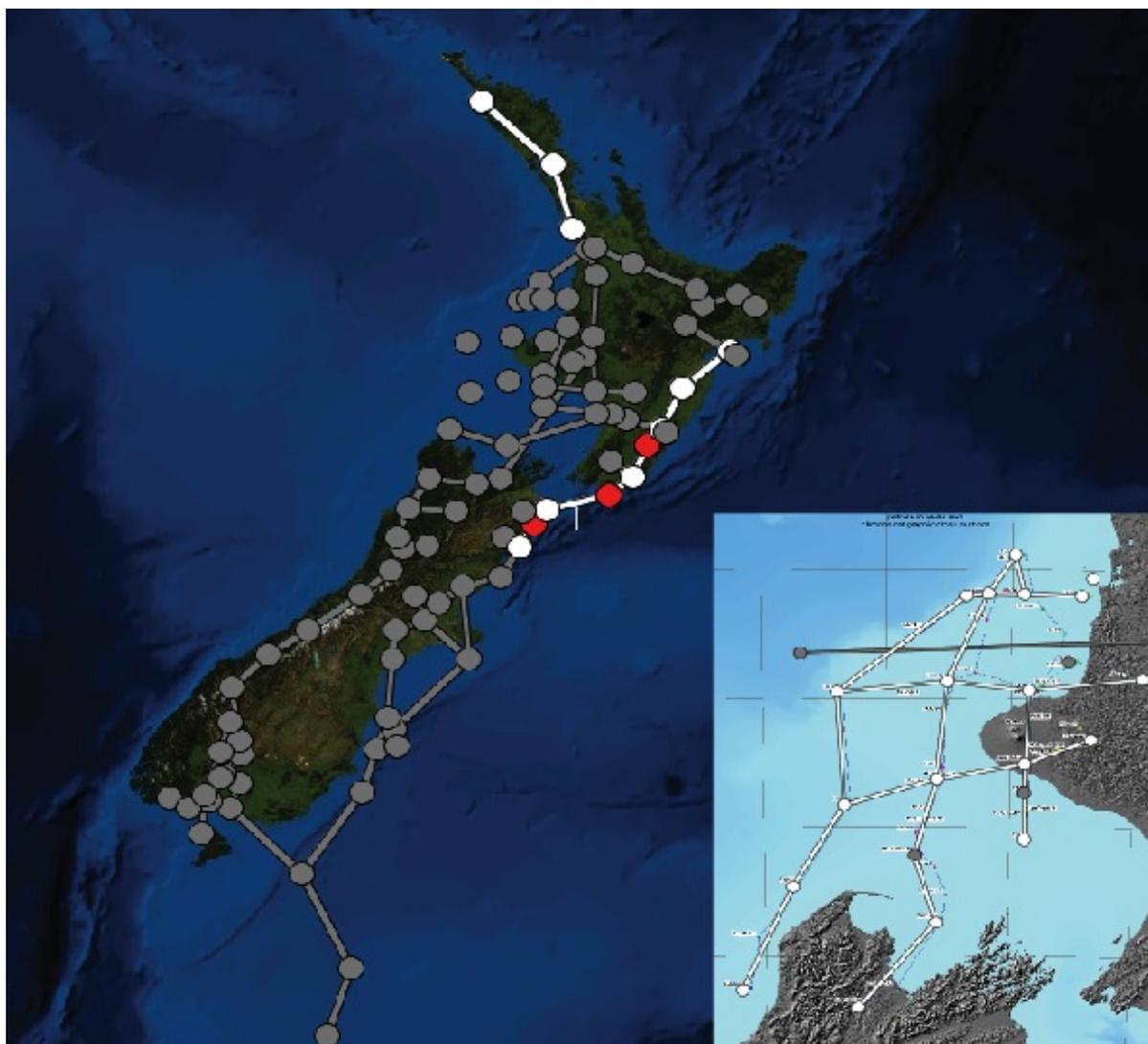
“**TimeScale Creator**”: Version 5.2 of this free JAVA suite was released in Nov, 2011; and Version 6 with the GTS2012 age models will be released in April, 2012. This is a continuously expanding database-visualization system with hyperlinks to our stratigraphic-information and other websites. The internal database contains approximately 30,000 biologic, magnetic and other major events in Earth's history (*status in Nov'11*), plus an extensive set of geochemical and sea-level curves. This and other datasets are collaborations among the SSI group, ICS chairs who are participating in the GTS2012 projects, Purdue University and many data providers. Database updates/enhancements are mounted approximately every three months. 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. Additional manuals explain how people can enter their own datasets, transects, geographic interfaces, cross-plots, etc.

Version 5.0 (May 2011) includes capabilities for lithologic columns, images of paleogeographic maps, range charts, URL-hotlinks, geographic interface (both vertical perspective and “rectangular”), basin transect capability with floating labels and pop-ups, depth-vs-time on-screen cross-plot capabilities followed by automated outcrop-to-time conversion routine (*which also converts geochem curves or other logs*), superimposed geochemistry curve system, enhanced “focus-in” capabilities, ability to display images within range-charts or within pop-up windows, auto-priority display option to avoid overcrowding and many other features. We worked with PaleoStrat and with the GeoBiodiversity database teams to install systems to display their outcrop information for on-line users.

Example of Range chart with images (raw output from TS-Creator):



Example of Geographic Interface for TimeScale Creator (strat sections; transects):



In the above example, after selecting a time interval and vertical scale (a separate window), the user clicks on intervals and locations to generate a summary chart of the geologic history of those regions. All formations are hot-linked to the New Zealand lexicon. This is a collaboration with the New Zealand geological survey.

In summer, 2011, our supported computer-science students prepared a web-based prototype to augment the current JAVA download version. They are working in spring 2012 to release this after running user-interface tests with selected volunteers.

In 2011, we presented workshops to educational and research audiences in Houston (microfossil conference hosted by Chevron), Norway (workshop on regional stratigraphy) and Venezuela (PDVSA presentation and one-day workshop) on how to utilize the educational exercises, create one's own datasets, and apply the datapacks for geoscience research. Posters and talks were presented at Geol. Soc. Amer. meeting (Oct, 2011), Shell Energy Day (Sept, 2011) and other venues.

***e. Regional Lexicon-linked databases and Other datapacks (2009-11 and ongoing 2012)***

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 2009-2011 or are nearly completed for mounting for early 2012:

**Australian Geo-History** – this was greatly enhanced in 2009-10 with Geoscience Australia (the Australian geological survey). In addition to all types of Australian biostratigraphy with full references of calibrations, the datapack 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”.

**New Zealand Geo-History** – In collaboration with the NZ Geological and Nuclear Sciences (their geological survey), an extensive (ca. 3000 entries) array now includes the main and all secondary biostratigraphic events and ranges for this region. Palynology events are linked to the NZ-hosted pollen-spore database. Lithostratigraphy and transects was added in 2010 for half of the New Zealand basins, and the entire region will be completed in 2011.

**British Isles Lithostratigraphy.** An extensive (ca. 2000 entries) array 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.

**Belgium Lithostratigraphy.** This was a joint project with the Belgium stratigraphic commission (Dr. Van den Bergh, coordinator).

**Russian Biostratigraphy.** An extensive (7000 entries) array includes most biostratigraphic zones and major bioevents for all regions of Russia through the entire Phanerozoic. The suite was provided by T. Koren’ (All-Russian Geological Research Institute), and is based on her institutes book and extensive charts.

**Russian Lithostratigraphy (NE Russia).** Dr. T. Koren’ and her institute has provided a detailed compilation of Phanerozoic stratigraphy for NE Russia (ca. 80 columns for each system). The SSI has translated most of these charts, and the dataset will be mounted in early 2012. It is planned that this program with the All-Russian Geological Research Institute will eventually include syntheses for all of the Russian basins.

**Russian Hydrocarbon Basins Lithostratigraphy.** This set was mainly compiled from Siberian, Caspian and other regional reports of the U.S. Geological Survey.

NOTE: All three of these Russian datasets will be enhanced in 2011 in coordination with colleagues at the Academy of Science (with their funding provided by BP-Russia).

**Canada Geo-History.** A collaboration with the Geological Survey of Canada (G. Nowlan, coordinator) has completed approximately 200 stratigraphic columns spanning the Phanerozoic of interior Canada and its Arctic islands, plus an extensive Arctic transect. This project was distributed in mid-2011 for vetting before mounting for public use.

**China Geo-History.** An initial set of major biostratigraphic zonation (all major fossil groups) and of the lithostratigraphy for most major Chinese basins was completed during the summer of 2010 in collaboration with Nanjing’s Institute for Stratigraphy and Paleontology. The GeoBiodiversity group in Nanjing is proceeding with a much more detailed version in late 2011.

**Gulf of Mexico Geo-History** – An extensive (ca. 2000 entries) 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*).

**Svalbard and Norwegian Sea Lithostratigraphy.** All formations are tied to entries in Norlex.

**Alaskan and other Arctic Hydrocarbon Basin Lithostratigraphy.** This includes conversions of many regional reports of the U.S. Geological Survey.

**Marine Genera ranges.** 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.

**Austria Lithostratigraphy.** This is based on charts produced by the Austrian stratigraphic commission and includes the Phanerozoic of basins and mountain belts. The dataset will put on-line in conjunction with the publication of the extensive book *Geology of Austria* (W. Piller et al.) by the Austria Stratigraphic Commission. Simultaneously, they will complete the on-line Lexicon for inter-linking.

**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 and awaits review from the BGR and German Commission on Stratigraphy. All formations are linked to the German stratigraphic on-line Lexicon.

**India-Pakistan-Burma and Adjacent Regions Lithostratigraphy.** This datapack 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.

**Middle East Lithostratigraphy** – This is based on charts produced by GeoArabia and includes the Phanerozoic of basins and mountain belts. ExxonMobil and Qatar Petroleum have offered to aid in enhancing this public database.

### 5. Chief problems encountered in 2011

The production of *GTS2012* book took a year longer than originally anticipated. Other than this major *GTS2012* book, the achievements “of the SSI group” were mainly accomplished by a core group of about a dozen dedicated researchers and students (USA, Austria, Belgium, Australia, China, New Zealand, etc.), who devoted their academic and summer time to accomplishing these products. In order to maintain a high level of activity, it is essential that more international researchers and students become actively involved to contribute their expertise and datasets in a coordinated suite of tasks. 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 and dependent upon external funding, in 2012, our student group will be working to provide “on-line” data-pack creation systems and “wiki” systems for public contributions of datasets. This will be a graduate-student project. Our goal is for the SSI system to be both an exchange of authoritative stratigraphic compilations as well as a “top-down” suite of guided syntheses.

We hope that our combined activities in 2010-2011 will enable the ICS-IUGS leadership to recognize that the SSI progressive accomplishments, the efforts to have international programs and the long-term goals are best maintained and attained under a regular subcommission officer/voting-member system.

### 6. Summary of expenditures in 2011

TOTAL: **\$1000** [from IUGS via ICS Executive]

\$1000 – To Purdue’s school of engineering for partial support of the geographic interface (see example above), maintaining dynamic GSSP tables for the SSI website, a prototype “web-based” TS-Creator for educational audiences, and partial support of the *GTS2012* graphics of GSSP sections.

*Another \$5000 in matching funds was provided through research funds of James Ogg for graphics, engineering-computing project suites, and other products described above.*

NOTE: Nearly all of the *TimeScale Creator* software development and datapack preparations and SSI website maintenance and mailings (charts, time-scale cards, etc.) during 2011 were funded through contributions of time and personal funds by SSI members, donations by and to Purdue University (especially by Geoscience Australia, Halliburton and BP), and US National Science Foundation grants. These funds supported 5 part-time students (*geoscience, computing*) during Spring of academic year 2011, 5 full-time students during summer 2011, and 6 part-time students during Fall 2011; plus travel to display the system at Geol. Soc. Amer. and other venues. We hope to obtain similar external donations or contributions during 2012 as we work with the different geological surveys and authoritative teams.

### 7. Work plan, anticipated results and communications to be achieved in 2012

#### a. BOOK – *Geological TimeScale 2012*

18. See the above section 4-a for planned posters, website and other items associated with the Brisbane IGC in 2012.

#### b. *Printed and Digital Material on Earth’s History – especially for Brisbane IGC*

19. Mousepad for distribution to all IGC attendees. This will a joint project with Geoscience Australia, who will print the mousepads at their expense (if current discussed arrangements are approved).
20. School-level educational posters and cards in both printed and Internet form – continued distribution, as in 2009-2011. We will a free PDF version on-line of the *GTS2012*-revisions 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.
21. Post the comprehensive summary of all GSSPs that was compiled in *GTS2012*. The SSI will continue to provide standardized descriptions and graphics when new/revised GSSPs are formally published. NOTE: Some approved GSSPs have yet to be published by some subcommission groups (e.g., those in middle Permian).
22. Website: We will continue to enhance the SSI website for easy usage and add *GTS2012* content. 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 original Subcommission in this area.*]

23. Prepare for 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.
24. 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.
25. RSS 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. This project is part of our submission to NSF for outreach; and having supporting letters from ICS-IUGS officers may enhance the funding possibilities.
26. Promote *TimeScale Creator* visualization package for exploring Earth history. Currently, this is very poorly displayed and advertised.

***c. Enhance the TimeScale Creator, plus a public browser-version***

27. Release the **on-line Web-based “TimeScale Creator Lite”** with user-friendly interfaces. A prototype was made in summer, 2011; but needs polishing. [*NOTE: This project is part of our submission to NSF for outreach; and having supporting letters from ICS-IUGS officers may enhance the funding possibilities.*]
28. Produce and distribute versions with menus in different languages (e.g., Hindi, Spanish, Russian, etc.).
29. Work with geoscience educators on creating modules for exploring Earth history, and link to existing ones.
30. Place additional databases on-line to support “hot-link” version of TimeScale Creator; especially of images. Plus, add more datapacks to TimeScale Creator for public usage: Circum-Arctic, North Atlantic and offshore Canada, preliminary South America, additional China basins, OneGeologyEurope sets.
31. **Evolutionary tree visualization software.** In summer 2011, we developed a capability to generate phylogeny trees that include images of fossils/organisms. Our goal are flexible user-friendly evolutionary trees. The first posting will be a general overview of evolution of all major organisms at the family level; plus selected ones at the genera level (e.g., humanoids). This “family tree” project will involve collaborations with the Paleobiology database and other geobiodiversity groups.
32. 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.]

NOTE: Some of the above projects will undoubtedly require continuation into 2013.

**8. Budget and ICS component for 2012**

As in 2011, the SSI is planning a very active program of publications, regional and thematic databases for research and public usage, education outreach and public awareness, web enhancements, and extensive international linking. Accomplishing this involves supporting students for the database preparation, web-related expenses, paying a programmer for visualization software enhancements, etc.

We anticipate partial support from Purdue University, Geoscience Australia, New Zealand GNS, and the Halliburton Foundation. As indicated above, J.Ogg is applying for possible NSF assistance for the international outreach activities of SSI and TS-Creator geoinformatics. Therefore, we are submitting a budget that optimistically presumes that the majority of our costs will covered by external donations/grants and internal support:

PROJECTED “ICS-SUPPORTED” EXPENSES (a fraction of the actual total)

(1) Brisbane IGC participation:

Registration fee for IGC	\$1000
Travel to IGC (co-funded by Purdue, I hope)	\$1000
Lodging, food at IGC	\$ 250

---

**TOTAL IGC EXPENSES (ICS portion only) \$2250**

---

(2) Other SSI functions:

Placing GTS2012 graphics on-line, plus as a computer-tablet app	\$ 500
Web-based visualization system ( <i>partial support</i> )	\$ 500
Printing posters/cards/etc; shipping to IGC; and mailing tubes	\$ 500
Partial student support for datapacks and modules	\$ 500

---

**TOTAL SSI EXPENSES (ICS portion only) \$1000**

---

**TOTAL (IGC, plus SSI): \$3250**

## 9. Objectives and Work Plan for the Next 3 Years (2012-2014)

The main aspects will be:

(1) Concise GTS book (*GTS2016*) and website that summarizes all aspects of global stratigraphy, inter-regional correlations, and estimated numerical ages.

(2) Coordinating international volunteers to place a full *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. This will include reference lithostratigraphy (on time scale) for all major basins. The databases and visualization package are envisioned as a convenient reference tool, chart-production assistant, and a window into our planet's fascinating history.

(3) Developing additional tools and modules for different audiences; and provide an essential "ICS authoritative reference site for Earth History" to serve both geoscience research and public exploration purposes.

## 10. Voting members (2009-2012)

### ICS Subcommittee for Stratigraphic Information

#### 2009-Sept, 2012 – Voting Members

NAME	COUNTRY/Organization	Specialty	Mail address
<b>Asch, Kristine</b>	GERMANY (OneGeology Europe; BGR; Chair IUGS Comm. Geoscience Information)	Compiled "interactive Geological web map of Europe and adjacent areas"	Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Geozentrum Hannover, Stilleweg 2; D-30655 Hannover, GERMANY
<b>Crampton, James S.</b>	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
<b>Fan, Junxuan</b>	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
<b>Filipescu, Sorin</b>	ROMANIA (Babes- Bolyai Univ.)	Webmaster; microfossils (Ceno-Mesoz.)	Department of Geology, Babes- Bolyai University, Str. Kogalniceanu 1, 3400, Cluj- Napoca, ROMANIA
<b>Galeotti, Simone</b>	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
<b>Howe, Richard</b>	USA (Chevron)	Global stratigraphy	CHEVRON Energy Technology Co., Biostratigraphy Team , 1500 Louisiana St., Houston, TX 77002
<b>IODP (Jamus Collier)</b>	JAPAN (IODP)	Information and Data Manager of IODP	Hokkaido University, CRIS Bldg. 05-104 & 105; N21 W10, Kita- ku, Sapporo, 001-0021, Japan
<b>Koren', Tat'yana N. (died autumn 2010; replacement yet</b>	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

<i>to be named).</i>			
<b>Nowlan, Geoffrey S.</b>	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
<b>Leanza, Héctor A.</b>	ARGENTINA (Univ. Nat.)	Argentinean Geological Survey (and Argentinean Committee on Stratigraphy)	SERVICIO GEOLÓGICO MINERO ARGENTINO (SEGEMAR), Universidad Nacional de La Plata; Avda. J.A. Roca 651, Piso 10, Buenos Aires, ARGENTINA
<b>Ogg, Gabi M.</b>	USA (Purdue University)	Secretary/Webmaster; graphics, GSSP tables	Dept. Earth & Atmos. Sci, Purdue University, 550 State Street, West Lafayette, Indiana, 47907 USA
<b>Ogg, James G.</b>	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
<b>Piller, Werner</b>	AUSTRIA (Univ. Graz)	Chair of the Austrian National Committee of Geology; Chair of Commission of the Strat. and Paleont. Research of Austria (Austrian Acad. Sci.)	Institute of Earth Sciences (Geology and Palaeontology) University of Graz Heinrichstrasse 26, A-8010 Graz, Austria
<b>Richard, Stephen</b>	USA (Arizona Geol. Survey)	Geologic mark-up language (GeoSciML); N. Amer. geologic map data model; GSA Geoinformatics)	Arizona Geological Survey, 416 W. Congress St., #100; Tucson, Arizona, 85701 USA
<b>Vrielynck, Bruno</b>	FRANCE (Comm. Geol. Map World)	UNESCO Commission for the Geological Map of the World; and Darius database (Eurasia history)	CCGM/CGMW; 77, rue Claude-Bernard, 75005 Paris, FRANCE; Dr. Bruno Vrielynck, Institut des Sciences de la Terre Paris (UMR 7193 UPMC-CNRS) UPMC Paris Universitatis Case courrier 129 4 place Jussieu 75252 Paris cedex 0
<b>Waters, Colin N.</b>	ENGLAND (Brit. Geol. Survey)	Manager of Geoscience Standards & Nomenclature project	British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG GREAT BRITAIN

2010-Sept, 2012 – *invited; not yet formally accepted*

NAME	COUNTRY/Organization	Specialty	Mail address
<b>Menning, Manfred</b>	GERMANY (GFZ)	Chair of German Strat. Comm.; Devon-Tri paleo database	GeoForschungsZentrum Potsdam; Section 5.2: Climatic Dynamics and Landscape Evolution; Telegrafenberg, C 128; D-14473 Potsdam, GERMANY

<b>Soller, Dave (and Nancy Stamm) -- joint</b>	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
--	------------	---	---

**Ex-Official Members**

All Chairs of ICS subcommissions; and ICS Executive.

\*\*\*\*\*

*Appendix:***A Geologic Time Scale 2012****Book Part 1***List of contributors**Foreword**Table of Content**List of abbreviations and acronyms***PART I INTRODUCTION****1 Introduction**

F. M. GRADSTEIN

**2 The chronostratigraphic scale**

F. M. GRADSTEIN AND J.G. OGG

**PART II CONCEPTS AND METHODS****3. Biochronology**

F.M. GRADSTEIN

**4 Cyclostratigraphy and Astrochronology**

L.A. HINNOV AND F.J. HILGEN

**5 The geomagnetic polarity time scale**

J.G. OGG

**6 Radiogenic isotopes geochronology**

M.D. SCHMITZ

**7 Strontium isotope stratigraphy**

J. M. MCARTHUR, R.J. HOWARTH AND G.A. SHIELDS

**8 Osmium isotope stratigraphy**

B. PEUCKER-EHRENBRINK AND G.E. RAVIZZA

**9 Sulfur isotope stratigraphy**

A. PAYTAN AND E.T. GRAY

**10 Oxygen isotope stratigraphy**

E.L. GROSSMAN

**11 Carbon isotope stratigraphy**

M.R. SALTZMAN AND E. THOMAS

**12 A brief history of plants**

S.R. GRADSTEIN AND H. KERP

**13 Sequence stratigraphy and sea level change**

M.D. SIMMONS

**14 Statistical procedures**

F.P. AGTERBERG, O. HAMMER AND F.M. GRADSTEIN

**PART III GEOLOGIC PERIODS Planetary and Precambrian****15 The Planetary time scale**

K.L. TANAKA AND W.K. HARTMANN

**16 A chronostratigraphic division of the Precambrian: possibilities and challenges**

M.J. VAN KRANENDONK AND CONTRIBUTORS

**17 The Cryogenian Period**

G. A. SHIELDS, A.C.HILL AND B.A. MACGABHANN

**18 The Ediacaran Period**

G. M. NARBONNE, S. XIAO AND G.A. SHIELDS

**Book Part 2****PART III Geologic Periods Phanerozoic****19 The Cambrian Period**

S. PENG, L.E. BABCOCK AND R.A. COOPER

- 20 The Ordovician Period**  
R.A. COOPER AND P.M. SADLER
- 21 The Silurian Period**  
M.J. MELCHIN, R.A. COOPER AND P.M. SADLER
- 22 The Devonian Period**  
R.T. BECKER, F.M. GRADSTEIN AND O. HAMMER
- 23 The Carboniferous Period**  
V.I. DAVYDOV, D. KORN AND M.D. SCHMITZ
- 24 The Permian Period**  
C.M. HENDERSON, V.I. DAVYDOV AND B.R. WARDLAW
- 25 The Triassic Period**  
J. G. OGG
- 26 The Jurassic Period**  
J. G. OGG AND L.A. HINNOV
- 27 The Cretaceous Period**  
J. G. OGG AND L.A. HINNOV
- 28 The Paleogene Period**  
N. VANDENBERGHE, R.P. SPEIJER AND F.J. HILGEN
- 29 The Neogene Period**  
F.J. HILGEN, L.J. LOURENS, AND J.R. VAN DAM
- 30 The Quaternary Period**  
B. PILLANS AND P.L. GIBBARD
- 31 The prehistoric human time scale**  
J.A. CATT AND M.A. MASLIN
- 32 The Anthropocene**  
J. ZALASIEWICZ, P.J. CRUTZEN AND W. STEFFEN

Appendix 1- Recommended color coding of stages

Appendix 2 - Radiometric ages used in GTS2012

M.D. SCHMITZ

Appendix 3 – Biochronology of Paleogene and Neogene Microfossils

D.E. ANTHONISSEN, J.G. OGG.

Index

### *The Geologic Time Scale 2012*

#### **Senior authors**

James G. Ogg  
Department of Earth and  
Atmospheric Sciences  
Civil Building 1397  
Purdue University  
West Lafayette, Indiana, 47907-  
1397  
USA  
[jogg@purdue.edu](mailto:jogg@purdue.edu)

Felix M. Gradstein  
Geological Museum  
University of Oslo  
P.O.Box 1172 Blindern  
N-0318 Oslo  
Norway  
[felix.gradstein@nhm.uio.no](mailto:felix.gradstein@nhm.uio.no)

Mark D. Schmitz  
Department of Geosciences  
Boise State University  
1910 University Drive  
Boise, Idaho, 83725-1535  
USA  
[markschmitz@boisestate.edu](mailto:markschmitz@boisestate.edu)

Gabi M. Ogg  
1224 N. Salisbury St.  
West Lafayette, Indiana, 47906  
USA  
[gabiogg@hotmail.com](mailto:gabiogg@hotmail.com)

Frits P. Agterberg  
Geological Survey of Canada  
601 Booth Street  
Ottawa, Ontario, K1A 0E8  
Canada

[Frits.Agterberg@NRCan-RNCan.gc.ca](mailto:Frits.Agterberg@NRCan-RNCan.gc.ca)

D. Erik Anthonissen  
Chevron Corporation  
Chevron Energy Technology  
Company  
1500 Louisiana St, Rm 27-108  
Houston, Texas, 77002  
USA  
[erik.anthonissen@chevron.com](mailto:erik.anthonissen@chevron.com)

Thomas R. Becker  
Geologisch-Paläontologisches  
Institut  
Westfälische Wilhelm-  
Universität  
Correnstrasse 24,  
D-48149 Münster

Germany  
*rbecker@uni-muenster.de*

John A. Catt  
 Geography Department  
 University College London  
 Pearson Building  
 Gower Street  
 London, WC1E 6BT  
 United Kingdom  
*j.catt@ucl.ac.uk*

Roger A. Cooper  
 GNS Science  
 P.O. Box 30368  
 Lower Hutt, 5040  
 New Zealand  
*r.cooper@gns.cri.nz*

Vladimir I. Davydov  
 Permian Research Institute  
 Boise State University  
 1910 University Drive  
 Boise, Idaho, 83725-1535  
 USA  
*vdavydov@boisestate.edu*

Stephan R. Gradstein  
 Muséum National d'Histoire  
 Naturelle  
 Dept. Systématique et Evolution  
 57 rue Cuvier  
 75231 Paris cedex 05  
 France  
*gradstein@mnhn.fr*

Ethan L. Grossman  
 Department of Geology &  
 Geophysics  
 Texas A&M University  
 College Station, Texas, 77843  
 USA  
*e-grossman@tamu.edu*

Charles M. Henderson  
 Department of Geoscience  
 University of Calgary  
 Calgary, Alberta, T2N 1N4  
 Canada  
*cmhender@ucalgary.ca*

Frederik J. Hilgen  
 Department of Earth Sciences  
 Faculty of Geosciences  
 Utrecht University  
 Budapestlaan 4  
 3584 CD Utrecht  
 The Netherlands

*F.J.Hilgen@uu.nl*

Linda A. Hinnov  
 Dept. of Earth and Planetary  
 Sciences  
 The Johns Hopkins University  
 Baltimore, Maryland, 21218  
 USA  
*hinnov@jhu.edu*

John M. McArthur  
 Departement of Earth Sciences  
 University College London  
 Gower Street  
 London, WC1E 6BT  
 United Kingdom  
*j.mcarthur@ucl.ac.uk*

Michael J. Melchin  
 Department of Earth Sciences  
 St. Francis Xavier University  
 P.O. Box 5000  
 Antigonish, Nova Scotia, B2G  
 2W5  
 Canada  
*mmelchin@stfx.ca*

Guy M. Narbonne  
 Department of Geological  
 Sciences & Geological  
 Engineering  
 Miller Hall, Queen's University,  
 Kingston, Ontario, K7L 3N6  
 Canada  
*narbonne@geol.queensu.ca*

Adina Paytan  
 Earth and Planetary Science  
 University of California Santa  
 Cruz  
 1156 High St  
 Santa Cruz, CA 95064  
 USA  
*apaytan@ucsc.edu*

Shanchi Peng  
 State Key Laboratory of  
 Paleobiology and Stratigraphy  
 Nanjing Institute of Geology and  
 Palaeontology  
 The Chinese Academy of  
 Sciences  
 39 East Beijing Road  
 Nanjing, 210008  
 China  
*scpeng@nigpas.ac.cn*

Bernhard Peucker-Ehrenbrink

Woods Hole Oceanographic  
 Institution  
 360 Woods Hole Road, MS25  
 Woods Hole, Massachusetts,  
 02543-1541  
 USA  
*behrenbrink@whoi.edu*

Bradley Pillans  
 Research School of Earth  
 Sciences  
 The Australian National  
 University  
 Canberra, ACT 0200  
 Australia  
*Brad.Pillans@anu.edu.au*

Matthew R. Saltzman  
 School of Earth Sciences  
 275 Mendenhall Laboratory  
 Ohio State University  
 Columbus Ohio, 43210-1398  
 USA  
*saltzman.11@osu.edu*

Michael D. Simmons  
 Neftex Petroleum Consultants  
 Ltd  
 97 Milton Park  
 Abingdon, OX14 4RY  
 United Kingdom  
*mike.simmons@neftex.com*

Graham A. Shields  
 Departement of Earth Sciences  
 University College London  
 Gower Str.  
 London, WC1E 6BT  
 United Kingdom  
*g.shields@ucl.ac.uk*

Kenneth L. Tanaka  
 Astrogeology Science Center  
 U.S. Geological Survey  
 2255 N. Gemini Dr.  
 Flagstaff, AZ 86001  
 USA  
*ktanaka@usgs.gov*

Noël Vandenberghe  
 Department of Earth and  
 Environmental Sciences  
 K.U. Leuven  
 Celestijnenlaan 200E  
 B-3001 Leuven  
 Belgium  
*Noel.Vandenberghe@ees.kuleuven.be*

Martin J. Van Kranendonk  
Geological Survey of Western  
Australia  
100 Plain Str.  
East Perth, WA 6004  
Australia  
*martin.vankranendonk@dmp.wa.  
gov.au*

Jan Zalasiewicz  
Department of Geology  
University of Leicester  
University Road  
Leicester, LE1 7RH  
United Kingdom  
*jaz1@leicester.ac.uk*

#### **Junior authors and contributors**

Wladyslaw Altermann  
Department of Geology  
University of Pretoria  
Pretoria 0002  
Republic of South Africa  
*wlady.altermann@up.ac.za*

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

Brian L. Beard  
Department of Geoscience  
NASA Astrobiology Institute  
1215 W. Dayton St.  
University of Wisconsin  
Madison, WI 53706  
USA  
*beardb@geology.wisc.edu*

Alan G. Beu  
Paleontology Department  
GNS Science  
PO Box 30368  
Lower Hutt, 5040  
New Zealand  
*a.beu@gns.cri.nz*

Andrew F. Boyes  
Paleontology Department  
GNS Science

PO Box 30368  
Lower Hutt, 5040  
New Zealand  
*afboyes@gmail.com*

Bradley D. Cramer  
Kansas Geological Survey -  
Department of Geology  
University of Kansas  
1930 Constant Avenue  
Lawrence, KS 66047  
USA  
*cramerbd@gmail.com*

Paul J. Crutzen  
Max-Planck-Institute for  
Chemistry  
Department of Atmospheric  
Chemistry  
PO Box 3060  
D-55020 Mainz  
Germany  
*paul.crutzen@mpic.de*

Jan A. van Dam  
Institut Català de Paleontologia  
Miquel Crusafont (ICP)  
Campus de la UAB  
Mòdul ICP, E-08193 Cerdanyola  
del Vallès  
Spain  
*jan.vandam@icp.cat*

James G. Gehling  
South Australian Museum  
Adelaide, SA 5000  
Australia  
*jim.gehling@samuseum.sa.gov.a  
u*

Philip L. Gibbard  
Cambridge Quaternary  
Department of Geography  
University of Cambridge  
Downing Street  
Cambridge, CB2 3EN  
United Kingdom  
*plg1@cam.ac.uk*

Ellen T. Gray  
Earth and Planetary Science  
University of California Santa  
Cruz  
1156 High St.  
Santa Cruz, CA 95064  
USA  
*eltgray@gmail.com*

Øyvind Hammer  
Geological Museum  
University of Oslo  
P.O.Box 1172 Blindern  
N-0318 Oslo  
Norway  
*oyvind.hammer@nhm.uio.no*

William K. Hartmann  
Planetary Science Institute  
1700 E Ft. Lowell, #106  
Tucson, Arizona 85719  
USA  
*hartmann@psi.edu*

Andrew C. Hill  
Centro de Astrobiología (INTA-  
CSIC)  
Instituto Nacional de Técnica  
Aeroespacial,  
Ctra de Ajalvir, km 4,  
28850 Torrejón de Ardoz  
Madrid  
Spain  
*andrew.hill@cliffsnr.com*

Paul F. Hoffman  
1216 Montrose Avenue  
Victoria, British Columbia,  
V8T2K4  
Canada  
*paulfhoffman@gmail.com*

Christopher J. Hollis  
GNS Science  
PO Box 30368  
Lower Hutt, 5040  
New Zealand  
*c.hollis@gns.cri.nz*

Jerry J. Hooker  
Department of Palaeontology  
Natural History Museum  
Cromwell Road  
London, SW7 5BD  
United Kingdom  
*j.hooker@nhm.ac.uk*

Richard J. Howarth  
Department of Earth Sciences  
University College London  
Gower Street  
London, WC1E 6BT  
United Kingdom  
*r.howarth@ucl.ac.uk*

Chunju Huang  
The Faculty of Earth Resources

China University of Geosciences  
(Wuhan)  
Wuhan, Hubei,  
P.R. China 430074  
*cathycjhuang2010@gmail.com*

Clark M. Johnson  
Department of Geoscience  
University of Wisconsin-Madison  
1215 W Dayton St.  
Madison, WI 53706  
USA  
*clarkj@geology.wisc.edu*

James F. Kasting  
Department of Geosciences  
Pennsylvania State University  
443 Deike Bldg.  
University Park, PA 16802  
USA  
*kasting@essc.psu.edu*

Hans Kerp  
Forschungsstelle für Paläobotanik  
Am Institut für Geologie und  
Paläontologie  
Westfälische Wilhelms-  
Universität  
Hindenburgplatz 57,  
D-48143 Münster  
Germany  
*kerp@uni-muenster.de*

Dieter Korn  
Museum für Naturkunde  
Leibniz Institute for Research on  
Evolution and Biodiversity  
Humboldt University Berlin  
Invalidenstrasse 43  
10115 Berlin  
Germany  
*dieter.korn@mfn-berlin.de*

Wout Krijgsman  
Department of Earth Sciences  
Faculty of Geosciences  
Utrecht University  
Budapestlaan 17  
3584 CD Utrecht  
The Netherlands  
*W.Krijgsman@uu.nl*

Lucas J. Lourens  
Department of Earth Sciences  
Faculty of Geosciences  
Utrecht University  
Budapestlaan 4  
3508 TA Utrecht

The Netherlands  
*L.J.Lourens@uu.nl*

Breandán A. MacGabhann  
Earth and Ocean Sciences  
School of Natural Sciences  
National University of Ireland,  
Galway  
University Road  
Galway  
Ireland  
*b.macgabhan1@nuigalway.ie*

Mark A. Maslin  
Geography Department  
University College London  
Pearson Building  
Gower Street  
London, WC1E 6BT  
United Kingdom  
*m.maslin@ucl.ac.uk*

Victor A. Melezhik  
Geological Survey of Norway  
Postboks 6315 Sluppen  
N-7491 Trondheim  
Norway  
*victor.melezhik@ngu.no*

Allen P. Nutman  
School of Earth and  
Environmental Science  
University of Wollongong  
Wollongong, NSW 2522  
Australia  
*allen.nutman@gmail.com*

Dominic Papineau  
Department of Earth and  
Environmental Sciences  
Boston College  
213 Devlin Hall  
140 Commonwealth Ave.  
Chestnut Hill, MA 02467  
USA  
*dominic.papineau@bc.edu*

Werner E. Piller  
Institut für Erdwissenschaften,  
Bereich Geologie und  
Paläontologie  
Universität Graz  
Heinrichstrasse 26  
A-8010 Graz  
Austria  
*werner.piller@uni-graz.at*

Franco Pirajno

Geological Survey of Western  
Australia  
100 Plain St.  
East Perth, WA 6004  
Australia  
*franco.pirajno@dmp.wa.gov.au*

Gregory E. Ravizza  
Department of Geology &  
Geophysics  
University of Hawaii at Manoa  
1680 East-West Rd.  
Honolulu, HI 96822  
USA  
*ravizza@hawaii.edu*

Peter M. Sadler  
Department of Earth Sciences  
University of California at  
Riverside  
Riverside, CA 92521  
USA  
*peter.sadler@ucr.edu*

Robert P. Speijer  
Department of Earth and  
Environmental Sciences  
K.U.Leuven  
Celestijnenlaan 200E  
B-3001 Leuven  
Belgium  
*Robert.Speijer@ees.kuleuven.be*

Will Steffen  
Climate Change Institute  
The Australian National  
University  
Canberra, ACT 0200  
Australia  
*will.steffen@anu.edu.au*

Ellen Thomas  
Department of Geology &  
Geophysics  
Yale University  
P. O. Box 208109  
New Haven, CT 06520-8109  
USA  
*ellen.thomas@yale.edu*

Bruce R. Wardlaw  
U.S. Geological Survey  
926A National Centre  
Reston, VA 20192-0001  
USA  
*bwardlaw@usgs.gov*

Douglas S. Wilson

Department of Earth Science  
University of California Santa  
Barbara  
Santa Barbara, CA 93106-9630  
USA  
*[dwilson@geol.ucsb.edu](mailto:dwilson@geol.ucsb.edu)*

Shuhai Xiao  
Department of Geosciences  
Virginia Polytechnic Institute and  
State University  
4044 Derring Hall

Blacksburg, Virginia, 24061-  
0420  
USA  
[xiao@vt.edu](mailto:xiao@vt.edu)