INTERNATIONAL UNION OF GEOLOGICAL SCIENCES
INTERNATIONAL COMMISSION ON STRATIGRAPHY

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December 2013

Compiled ICS Subcommission Annual Reports for 2013

SUBCOMMISSION ON QUATERNARY STRATIGRAPHY
ANNUAL REPORT 2013

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1. TITLE OF CONSTITUENT BODY
Subcommission on Quaternary Stratigraphy (SQS)

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

- Chronostratigraphic subdivision of the Quaternary System/Period facilitated by the intercalibration of biostratigraphies, construction of integrated zonations, and recognition of global datum points, allowing correlation worldwide and between terrestrial and marine sequences.
- Definition of Series/Subseries/Stage/and where appropriate Substage boundaries through the selection of recommended GSSPs.
- Promoting SQS's activities within the wider Quaternary geoscience community through publications, symposia, and the SQS website, and creating opportunities to study and compare stratigraphic sections by means of field meetings.

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

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

- "The Quaternary System and its formal subdivision". A one-day special symposium held during the First International Congress on Stratigraphy, STRATI 2013, Universidade Nova de Lisboa, Lisbon, July 1–7. Coordinators of symposium: M.J. Head (Chair SQS), P.L. Gibbard, and T. van Kolfschoten. Symposium co-sponsored by SQS.
- Business meeting of SQS held during the First International Congress on Stratigraphy, STRATI 2013, Universidade Nova de Lisboa, Lisbon, Portugal, July 1–7; chaired by M.J. Head. Minutes published on SQS website: http://quaternary.stratigraphy.org.
- "The Early–Middle Pleistocene transition: significance of the Jaramillo Subchron in the sedimentary record". European Science Foundation Earthtime – European Union Scientific Meeting. Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Burgos, Spain, 25–27 September, 2013. Symposium co-sponsored by SQS.
- The following paper published last year invited discussion: Walker, M.J.C., Berkelhammer, M., Björck, S., Cwynar, L.C., Fisher, D.A., Long, A.J., Lowe, J.J., Newnham, R.M., Rasmussen, S.O. & Weiss, H. 2012. Formal subdivision of the Holocene Series/ Epoch: a Discussion Paper by a Working Group of INTIMATE (Integration of ice-core marine and terrestrial records) and the Subcommission on Quaternary Stratigraphy (International Commission on Stratigraphy). *Journal of Quaternary Science*, 27, 649–659. Valuable feedback was received throughout 2013, including contributions to a new online Discussion Forum hosted by the publishers of JQS (John Wiley).

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

- Waters, C. N., Zalasiewicz, J. A., Williams, M., Ellis, M. A. & Snelling, A. M. (eds) A Stratigraphical Basis for the Anthropocene. *Geological Society, London, Special Publications*, 395,

http://dx.doi.org/10.1144/SP395.8. Edited by members of the Anthropocene Working Group and contains numerous papers authored or coauthored by members of the Anthropocene Working Group. First batch of papers published online 2013.

- Head, M.J., Gibbard, P.L., and van Kolfschoten, T., 2013. The Quaternary System/Period: current status and future challenges. *Ciências da Terra*, 18: 77–80.

3C. PROBLEMS ENCOUNTERED, IF APPROPRIATE

The Working Group on the Upper Pleistocene Subseries Boundary has been inactive for five years. This followed notification by the IUGS EC (22nd September 2008) that a GSSP proposal it had initiated on a borehole section from Amsterdam terminal did not fulfill all requirements for a GSSP. Dr Jan Zalasiewicz has now joined the Working Group as co-convenor (with Prof. Thomas Litt), and a broadening of the Working Group membership is underway.

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

- Assemble and edit a special issue of *Quaternary International* based on papers presented at "The Quaternary System and its formal subdivision" during STRATI 2013 (above). Editors: M.J. Head (Chair SQS), P.L. Gibbard, and T. van Kolfschoten.
- Comments on the proposed subdivision of the Holocene (Walker et al., 2012, section 3B above) are being considered by the Working Group, and involve reformulating (where necessary) the proposals outlined in Walker et al. (2012). This work will continue during 2014, the aim being to bring forward a formal proposal for submission, in the first instance, to the SQS.
- Reinvigorate the Working Group on the Upper Pleistocene Subseries Boundary by broadening its membership. In addition to two potential candidate sections, the Amsterdam terminal (Netherlands) and Fronte section, Taranto (Italy), additional potential candidate sections will be sought (see Section 3C, above).
- SQS to support a field workshop organized by the *Associazionne Italiana per lo Studio del Quaternario* (AIQUA) in October, 2014 to visit two sections proposed for the Early–Middle Pleistocene Subseries boundary, Montalbano Jonico and Valle di Manche, both in southern Italy. The third such section currently under consideration, the Chiba section in Japan, will be the subject of a field workshop during the INQUA Congress in the summer of 2015. Proposals for all three sections will be solicited and evaluated soon thereafter.

5. SUMMARY OF EXPENDITURES IN 2013 (Can $)

	Payment	Deposit	Balance
Carried forward			2754.79
Prof. S. Finney (ICS funds for 2013)		3011.99	5766.78
Prof. M.J. Head (attendance STRATI 2013*)	1553.40		4213.38
Dr. Osamu Kazaoka (attendance STRATI 2013*)	2000.00		2213.38
Dr. Jan Zalasiewicz (attendance STRATI 2013*)	520.00		1693.38
Balance at November 28, 2013			1693.38

*= First International Congress on Stratigraphy, STRATI 2013, Universidade Nova de Lisboa, Lisbon, Portugal, July 1–7.

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014

Funds are requested to help support a one-week field workshop in mid-October, 2014, organized by the Associazionne Italiana per lo Studio del Quaternario (AIQUA), to discuss and visit two candidates for the Lower Pleistocene Subseries GSSP, Montalbano Jonico and Valle di Manche, both in southern Italy. A maximum of 30 participants is planned, and the field trips will be organized by Prof. Adele Bertini (President AIQUA), Prof. Neri Ciaranfi (lead proponent for Montalbano Jonico), and Prof. Luca Capraro (lead proponent for Valle di Manche). The third candidate, the Chiba section, will be visited the following summer during the INQUA congress in Japan, completing the three sections under consideration. All members of the SQS Lower/Middle Pleistocene Boundary Working Group will be invited, along with two members of the Chiba section working group. This GSSP is presently the main priority of SQS, and all three candidate sections are being researched with considerable energy and focus.

A total of $5500 is requested for 2014 to assist the chair of SQS (Canada) and two members of the Chiba working group (Japan) in attending this one-week field workshop to southern Italy. The chair of SQS (M.J. Head) is also co-convener of the SQS Lower/Middle Pleistocene Boundary Working Group, and has not seen either section.

APPENDICES

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

1. Quaternary System/Period and Pleistocene Series/Epoch defined/redefined and ratified in June 2009. References:
   Gibbard, P.L., Head, M.J., Walker, M.J.C. and The Subcommission on Quaternary Stratigraphy, 2010. Formal ratification of the Quaternary System/Period and the Pleistocene Series/Epoch with a base at 2.58 Ma. *Journal of Quaternary Science*, 25(2): 96–102.
   Gibbard, P.L., and Head, M.J., 2010. The newly-ratified definition of the Quaternary System/Period and redefinition of the Pleistocene Series/Epoch, and comparison of proposals advanced prior to formal ratification. *Episodes*, 33: 152–158.
   Finney, S.C. 2010. Formal definition of the Quaternary System/Period and redefinition of the Pleistocene Series/Epoch. *Episodes* 33, 159–163.

2. Calabrian Stage/Age ratified in December 2011. Reference:
   Cita, M.B., Gibbard, P.L., Head, M.J., and The Subcommission on Quaternary Stratigraphy, 2012. Formal ratification of the base Calabrian Stage GSSP (Pleistocene Series, Quaternary System). *Episodes* 35(3): 388–397.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2014–2018)
1. GSSP definition for the Middle Pleistocene Stage/Subseries boundary.
2. GSSP definition for the Upper Pleistocene Subseries boundary.
3. GSSP definitions for the Upper Pleistocene Stage boundaries.
4. Subdivision of the Holocene Series.
5. Explore further chronostratigraphic subdivision of the Quaternary System/Period, including the duration and status of the "Anthropocene".

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

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

Working Group on the "Anthropocene"

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Secretary: Dr. Colin Waters
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Working Group on the subdivision of the Holocene Series

Convener: Professor M.J.C. Walker
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Working Group on the Middle/Upper Pleistocene Subseries Boundary

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Working Group on the Lower/Middle Pleistocene Subseries Boundary

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9C INTERFACES WITH OTHER INTERNATIONAL PROJECTS

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

Respectfully submitted:
Martin J. Head
St. Catharines, 10th December, 2013

SUBCOMMISSION ON NEOGENE STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

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

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

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

3. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

Nomination of new Voting and Corresponding Members

Some modifications to the voting member and corresponding member lists have been made, due to the unavailability of some members to actively participate and contribute (*see Appendix for full list voting and corresponding members*).

Burdigalian and Langhian GSSPs working group

Frits Hilgen is the new chair of the working group for the remaining GSSPs, base-Langhian and base-Burdigalian. The change of the members of this working group is upcoming, and will be promptly conveyed.

Update of the studies for 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 Cessole 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, within an 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").
Research papers directed at selecting the most suitable section and guiding criterion for defining the Langhian GSSP were published in a special volume of Stratigraphy in 2011. These papers dealt with the integrated magnetobiostratigraphy (Iaccarino et al., 2011; Turco et al., 2011). Ongoing studies are focussed on the stable isotope stratigraphy, and cyclostratigraphy and astronomical tuning of these sections. These are considered important criteria 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*., 2010). 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). 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.
Moreover, in 2013 these sections have been extended further into the Burdigalian.

3b. No major publications of subcommission work

3c. CHIEF PROBLEMS ENCOUNTERED IN 2013

As already stated in the previous 2012 Report, a problem that remains is the possible lack of suitable sections in the Mediterranean for defining the Burdigalian GSSP. This is certainly the case if we prefer to have the Burdigalian GSSP defined in an astronomically tuned deep marine section in the Mediterranean that directly underlies the geologic time scale. The SNS chair will suggest to the new members of Langhian/Burdigalian WG to take into consideration the alternative option to have this boundary defined in (I)ODP cores. Hopefully, a decision about this issue should be made in the coming years.

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

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 as soon as the two studies will be completed. Following these studies a decision regarding which section and criterion are most suitable for defining the Langhian GSSP should be possibly made in 2014. The search for suitable sections and/or cores for defining the Burdigalian GSSP will continue.

5. SUMMARY OF EXPENDITURES IN 2013:

Credit on Nov 2012	**Euro**	**3968,35**
Credit on Nov 2013	**Euro**	**4610,74**

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014

Field trip to suitable section for the definition of base-Burdigalian	Euro 1500
Website updating	Euro 500

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APPENDIX

7. SUMMARY OF MAIN ACCOMPLISHMENTS OVER PAST FIVE YEARS (2009-2013)

2009

Publication of papers by members of SNS on 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 La Vedova and St. Peter's Pool 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 papers about potential Langhian GSSP sections in a special volume of Stratigraphy. Preparation of the Neogene chapter (ATNTS2012) of the GTS2012 (Hilgen et al., 2012, in press).

2012

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

2013

Presentation of a new Paleogene calcareous nannofossil zonation at the STRATI 2013 Congress in Lisbon (by I. Raffi et al.). The paper will be submitted for publication before the end of 2013.

8. OBJECTIVES AND WORK PLAN FOR NEXT 2 YEARS (2014-2015)

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, and writing of proposals for the Langhian and Burdigalian GSSPs in 2014-2015.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

The SNS is a subcommission of the ICS, founded in 1971. Reference is made to the annual report of 1995 for a brief historical resume of the SNS. The subcommission has four regional committees (Mediterranean, Pacific, Atlantic and Nordic) and keeps close contacts with the Russian Neogene Commission chaired by Prof. Yuri B. Gladenkov. Apart from the executive bureau, the SNS has 22 voting members and 24 corresponding members (*see Appendix for full list of officers and voting and corresponding members*). The SNS has presently one active working group for defining the

GSSP remaining for the Langhian and Burdigalian chaired by Frits Hilgen. The change of the members of this working group is upcoming, and will be promptly conveyed. The SNS web site (www.sns.unipr.it) is under renovation and will be published within December 2013. Support for the SNS comes from the Chairman's Institution in Italy (Università degli Studi "G. d'Annunzio di Chieti-Pescara). The Secretary's Institution in Parma (Università degli Studi di Parma) will host the SNS web-site.

9a. CURRENT OFFICIERS, VOTING AND CORRESPONDING MEMBERS

Subcommission officers (from August 1, 2012)

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9c. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

There is a close link with (I)ODP because of its important role in the development of integrated time scales for the Neogene, in testing the global correlation potential of bio-events, and in a better understanding of climate and ocean history during this time span.
There is even a link with the activity of the EARTHTIME-EU Research Networking Programme (RNP), that is part of a broader international initiative "EARTHTIME: a community-based scientific effort aimed at sequencing Earth history through an integrated geochronologic and stratigraphic approach".

SUBCOMMISSION ON PALEOGENE STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Paleogene Stratigraphy

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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Mission statement

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

Goals

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

Fit within IUGS Science Policy

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

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

The Subcommission was deeply involved into the Strati 2013 conference in Lisbon (1-7 July 2013), and we organized a very successful session dedicated to "Paleogene Events, Evolution and Stratigraphy", where more than thirty contributions on Paleogene biotic and paleonvironmental evolution, and stratigraphic events were presented.
At present most of the Paleogene GSSPs have been formalized and there are only three of them pending formal definition: the bases of the Bartonian, Priabonian and Chattian. Significant progress will be done during 2014, and the formal proposals of at least two of them will be submitted:

Bartonian GSSP:

After the conclusion by Jovane et al. (2010) in which the authors indicate the Contessa Highway section (Gubbio area) as a possible GSSP candidate for the Lutetian/Bartonian boundary, researches have been extended to other sections in the Umbria-Marche Basin including the Bottaccione section, in order to find a more suitable section and to test the reproducibility of the suggested criterion (top of Chron C19n) vs biostratigraphic events. In particular, a new sampling campaign of the Bottaccione section is in progress with the aim of defining more precisely the boundaries of magnetic reversals and to provide magnetic susceptibility and calcium carbonate data series at a very high resolution for detecting orbital cycles across the middle Eocene interval.
In the search of a potential candidate section for the base of the Bartonian the Oyambre section in the Basque Country (Spain) is under investigation. Preliminary results are promising and this section seems quite interesting as a GSSP

candidate. Although demagnetization quality is quite poor, preliminary magnestostratigraphic data suggest that Chron C19n, which most likely defines the Bartonian GSSP, could be recorded in the upper part of the La Acebosa Formation. A denser magnetostratigraphic and biostratigraphic sampling is required in the upper part of this unit in order to accurately identify Chron C19n and establish the sequence of events across the Lutetian/Bartonian transition. Several studies as well as a fieldtrip will be carried out during the next year.

Priabonian GSSP:
Several actions have been undertaken during 2013 on the Alano section, to date the only candidate section for defining the GSSP of the Priabonian.
First of all, the Alano section (Belluno Province, NE Italy) has been officially declared as **"geosito",** i.e. a locality of special scientific interest by ISPRA (the Italian Institute for Environmental Protection and Research), in October 2013. A technical sheet is now available on ISPRA website. This action will guarantee preservation and access to the GSSP.
Second, U-Pb dating of zircons from seven volcanoclastic levels in Alano section (including the Tiziano bed, the base of which is the preferred definition of the Priabonian by Padua researchers) is in the final stage of data elaboration by Daniel Condon and co-workers. This and previous studies will be integrated with the cyclostratigraphic analysis of the entire section, which is now in progress by Simone Galeotti and co-workers.
A further study on the Alano section across the Bartonian-Priabonian interval has been performed as to the bryozoan and micromorphic brachiopod content. Preliminary data have been presented in June 2013 at the 16th International Conference of the Bryozoology Association. Finally, investigations have been extended to the Varignano section (Trento, NE Italy), located 80 km west of the Alano section, which contains eight resedimented bioclastic levels bearing larger foraminifera (LF), to directly correlate regionally calcareous plankton and LF biostratigraphic scales.
Preliminary results indicate that the morozovellid/large acarininid extinction event and the *Cribrocentrum erbae* acme fall within the Shallow Benthic Zone (SBZ) 18.
Anticipate plans are, (1) the voting of the Tiziano Bed as GSSP of the Priabonian within the Priabonian WG in December 2013, and, then, (2) submit a formal proposal to ISPS in 2014.

Chattian GSSP:
Since the main publication in 2008 (see below), the candidate section at Monte Cagnero (central Italy) has been re-visited. Calcareous plankton biostratigraphy have been implemeted with the high resolution dinocyst biostratigraphy accurately calibrated to magnetostratigraphy. In addition, some critical calcareous plankton bioevents will be controlled across some key-intervals.
A synthesis of all data available on the candidate Chattian GSSP at Monte Cagnero has been presented at STRATI 2013 by Coccioni et al., and well accepted by the audience.
The GSSP proposal is in advanced progress by the leaders of the WG Coccioni and Montanari and will include the astrochronological calibration of the Monte Cagnero section based on orbital tuning of high-resolution magnetic susceptibility and calcium carbonate data series.
The GSSP proposal is expected to be submitted officially to the Paleogene Subcommission in Spring 2014.

3b List of major publications of subcommission work

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3c. Problems encountered

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

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

- Full support will be given to the working groups on the GSSPs of the Bartonian, Priabonian and Chattian.
- Prepare and submit to the Subcommission the proposals for the establishment of a basal GSSP for the Priabonian and Chattian.
- Formalisation of the GSSPs for the bases of the Priabonian and Chattian stages.
- Support of the field workshop of the Bartonian WG in Central Italy and northern Spain to evaluate the potential value, as GSSP, of three potential candidate sections.
- Organize and support of a meeting of the Paleogene Subcommission in Ferrara (Italy) during the conference "Climate and Biotic Events of the Paleogene 2014".
- Support of the field workshop in the Gubbio area (Central Italy) to evaluate the auxiliary sections of the GSSP of the Selandian.
- Screen and rejuvenate the list of the Corresponding Members.
- Reactivate or close those Regional Committees and Working Groups that are asleep.
- Update and renew the ISPS website.

4b. Specific GSSP Focus for 2014

Bartonian GSSP: In search of a possible candidate section for the base Bartonian GSSP.

Jovane et al. (2010) indicate the Contessa Highway section (Gubbio area) as an excellent GSSP candidate for the Lutetian/Bartonian boundary. However, due to the presence of few serious forthcomings found in the CHS section, researches have been extended to other sections in the Umbria-Marche Basin including the Bottaccione section. This was done to test the reproducibility of the suggested criterion (top of Chron C19n) vs biostratigraphic events. A new sampling campaign has been carried out on the Bottaccione section. High-resolution studies on magnetic susceptibility and calcium carbonate data series will be performed during the next year to detect orbital cycles across the middle Eocene interval and to define more precisely the boundaries of magnetic reversals.

During the next year studies will continue on the Oyambre section in the Basque Country (Spain). A denser magnetostratigraphic and biostratigraphic sampling will be carried out during the next year in order to accurately identify Chron 19n and establish the sequence of events across the Lutetian/Bartonian transition. A field workshop will be organized.

Priabonian GSSP:

Several actions will be undertaken during 2014 on the Alano section, candidate section for defining the GSSP of the Priabonian.

Studies will continue on the Alano section: U-Pb dating of zircons from seven volcanoclastic levels in Alano section (including the Tiziano bed, the base of which is the preferred definition of the Priabonian by Padua researchers) is in the final stage of data elaboration by Daniel Condon and co-workers. This and previous studies will be integrated with the cyclostratigraphic analysis of the entire section, which is now in progress by Simone Galeotti and co-workers.
A further study on the bryozoan and micromorphic brachiopod content will be performed.
Investigations will be extended to the Varignano section (Trento, NE Italy), located 80 km west of the Alano section, which contains eight resedimented bioclastic levels bearing larger foraminifera (LF), to directly correlate regionally calcareous plankton and LF biostratigraphic scales.
Voting of the Tiziano Bed as GSSP of the Priabonian within the Priabonian WG will be held in December 2013-January 2014, and, the GSSP formal proposal will be submitted to ISPS in 2014.

Chattian GSSP:
During the next year the astrochronological calibration of the Monte Cagnero section based on orbital tuning of high-resolution magnetic susceptibility and calcium carbonate data series will be completed. The calcareous plankton biostratigraphy will be implemented with a new high-resolution dinocyst biostratigraphy and accurately calibrated with the magnetostratigraphy. Some critical calcareous plankton bioevents will be controlled across some key-intervals.
The GSSP proposal will be submitted officially by the leaders of the WG R. Coccioni and A. Montanari to the Paleogene Subcommission in 2014. A field-workshop will be organized in Spring 2014.

5. SUMMARY OF EXPENDITURES IN 2013:

INCOME

Carried forward from 2012	Euro 0
ICS Allocation for 2013	Dollar 2666
TOTAL	Dollar 2666

EXPENDITURE FROM 2013 BUDGET

General office expenses	Dollar 466
Professional help with the website	Dollar 600
Support of Working Groups and Regional Committees,	Dollar 1600
TOTAL	Dollar 2666

6. BUDGET REQUEST AND ICS COMPONENT FOR 2014

Projected Budget for 2014:

General office expenses	Dollar 400
Professional help with the website	Dollar 1000
Contributions to Officers travel costs	Dollar 1300
Support for GSSP's field meetings (Priabonian, Chattian, Bartonian) Working Groups and Regional Committees	Dollar 3700
TOTAL BUDGET PROJECTED	Dollar 6400

Please note that the financial situation has deteriorated in recent years, an increase would help us to support the travel cost and the participation of the members of the ISPS to GSSP's field meetings in Italy and Spain. We also will need some seed money to start new regional committees or working groups.

APPENDICES

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

See Accomplishments in ICS Annual Reports 2009 to 2013 for additional details.

- Auxiliary sections and correlation of the GSSP for the base of the Danian published in Episodes (2009)
- The Subcommission sponsors International Meeting on the Paleogene: Wellington, New Zealand (2009), Salzburg, Austria (2011).
- Formalization of the GSSP for the bases of the Selandian (Middle Paleocene) and Thanetian (Upper Paleocene) stages have been defined at Zumaia, Spain. The GSSP was officially published in *Episodes* (2011).
- Formalization of the GSSP for the base Lutetian Stage (early/middle Eocene boundary) was defined in the Gorrondatxe section (Basque Country, northern Spain). The GSSP was officially published in *Episodes* (2011).
- On February 13, 2012 the official ceremony to define the Global Stratotype Section and Point (GSSP) for the base of the Lutetian Stage took place in Getxo village and Gorrondatxe beach (Northern Spain).

- Field workshop of the Priabonian WG in Alano (June 2012) and proposal of the Alano section as the Stratotype section of the base of Priabonian.
- Ninth International Workshop on Aglutinated Foraminifera, Zaragoza, Spain, 3-7, September, 2012.
- VIII South American Symposium on Isotope Geology (VIII. SSAGI), Medellin, 2012
- The Subcommission helds a session "Paleogene events, evolution and stratigraphy" during the Strati 2013 meeting in Lisbon.

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

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

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

9) ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

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

9a Names and Addresses of Current Officers and Voting members

Subcommission officers

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

List of Voting Members

Laia Alegret Departamento de Ciencias de la Tierra, Facultad de Ciencias. University of Zaragoza. 50009 Zaragoza Spain, laia@unizar.es
Rodolfo Coccioni, Dipartimento di Scienze della Terra, della Vita e dell'Ambiente, Universita' degli Studi "Carlo Bo" Campus Scientifico. Localita' Crocicchia I-61029 Urbino (Italy) rodolfo.coccioni@uniurb.it, cron@info-net.it
Margaret Collinson, Department of Earth Sciences Royal Holloway University, of London Egham, Surrey, TW20 0EX, UK, m.collinson@es.rhul.ac.uk

Vlasta Cosovic, Department of Geology, University of Zagreb, Horvatovac 102, 10 000 Zagreb, Croatia, vcosovic@geol.pmf.hr
Richard H. Fluegeman, Department of Geological Sciences, Ball State University, Muncie, IN 47306. Indiana, USA, fluegem@bsu.edu
Jean Pierre Gély, Museum d'Histoire Naturelle Paris, France jean-pierre.gely@gazdefrance.com
Andrej Gladenkov, Geological Institute Russian Academy of Sciences. Pyzhevskii per., 7Moscow 119017, Russia gladenkov@ginras.ru
Yuri Gavrilov, Geological Institute Russian Academy of Sciences. Pyzhevskii per., 7Moscow 119017, Russia, yugavrilov@gmail.com
Claus Heilman-Clausen, Department of Earth Sciences, Aarhus University, *DK*-8000 Århus C DK, claus.heilmann@geo.au.dk
Christopher Hollis, GNS Science, Institute of Geological and Nuclear Sciences, PO Box 30-368, Lower Hutt, New Zealand., c.hollis@gns.cri.nz
Eustoquio Molina, Departamento de Ciencias de la Tierra, Facultad de Ciencias. Universidad de Zaragoza. 50009 Zaragoza, Spain, emolina@unizar.es
Simonetta Monechi, Dipartimento di Scienze della Terra, Università di Firenze. 50121 Firenze, Italy, simonetta.monechi@unifi.it
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Noël Vandenberghe, Department of Earth and Environmental Sciences,Afdeling geologie,K.U. Leuven.Celestijnenlaan 200E 3001 Heverlee, Belgium
noel.vandenberghe@ees.kuleuven.be
Bridget Wade, Dept. of Earth Sciences, University College London, Gower St. London WC1E 6BT, UK b.wade@ucl.ac.uk
Dalila Zaghbib-Turki, Département de Geologie, University of Tunis. 2092 Tunis El Manar Tunisia, dalila.zaghbib@fst.rnu.tn
Jim Zachos, Earth & Planetary Sciences Univ. of Calif., Santa Cruz CA, USA, jzachos@ucsc.edu

9b *List of Working (Task) Groups and their officers*
Paleocene Working Group. Chair: Birger Schmitz, Sweden. birger.schmitz@geol.lu.se
Ypresian/Lutetian Boundary Stratotype Working Group. Chair: Eustoquio Molina, Spain. emolina@unizar.es Secretary: Silvia Ortiz, Spain. silortiz@unizar.es Website: http://wzar.unizar.es/perso/emolina/ypresian.html
Lutetian/Bartonian Boundary Stratotype Working Group. Chair: Richard Fluegeman, USA. fluegem@bsu.edu
Bartonian/Priabonian Boundary Stratotype Working Group. Chair: Isabella Premoli Silva, Italy. isabella.Premoli@unimi.it
Rupelian/Chattian Boundary Stratotype Working Group. Chair: Isabella Premoli Silva, Italy. isabella.Premoli@unimi.it
Paleogene Planktonic Foraminifera Working Group. Chair: Bridget Wade, USA. b.wade@ucl.ac.uk Secretary: Helen Coxall, UK. hkc@gso.uri.edu
Paleogene Deep-Water Benthic Foraminifera Working Group. Chair: Michael Kaminski, UK. kaminski@kfupm.edu.sa Secretary: Laia Alegret, Spain. laia@unizar.es
Paleogene Calcareous Nannofossils Working Group. Chair: Simonetta Monechi, Italy. Simonetta.monechi@unifi.it
South-American Regional Committee on Paleogene Stratigraphy. Chair: Juan Carlos Silva Tamayo, Colombia. jsilvatamayo@yahoo.com Secretary: Diana Ochoa, Panama. dianita.ochoa@gmail.com
Russian Paleogene Commission. Chair: Mikhail A. Akhmetiev, Russia. akhmetiev@ginras.ru Secretary: G. N. Aleksandrova.
Working Group on Paleogene Stratigraphy of the North Pacific. Chair: Yuri B. Gladenkov, Russia. gladenkov@ginras.ru, agladenkov@ilran.ru

9c Interfaces with other international project
Some of our members participate also in the work of the following International projects:

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

10. Annual reports 2013 of the other working groups:
The detailed and complete reports of activities during 2013 of the Working Groups and Regional Committees are included in the ISPS website: **http://wzar.unizar.es/isps/index.htm**

Report on 2013 Activities in Italy
Of General Interest
Studies on the Paleogene succession of the Umbria-Marche (U-M) and Belluno Basins (Alano) were continuous along the years by several scientists and some key results have been presented in quite few papers published recently. Among them it is worth mentioning the paper by Coccioni et al. (2013) that presents the "integrated stratigraphy" (magneto-, bio-, chronostratigraphy) and "geochronology" framework for the entire Paleogene based on the correlation of all sections investigated and dated in the U-M basin, including the base Oligocene GSSP at Massignano (see also STRATI 2013, Poster).

F. Boscolo Galazzo, L. Giusberti, V. Luciani, E. Thomas, 2013. Paleoenvironmental changes during the Middle Eocene Climatic Optimum (MECO) and its aftermath: The benthic foraminiferal record from the Alano section (NE Italy) Palaeogeography Palaeoclimatology Palaeoecology 378, 22-35.

R. Coccioni, M. Sideri, G. Bancalà, R. Catanzariti, F. Frontalini, L. Jovane, A. Montanari & J. Savian, 2013. Integrated stratigraphy (magneto-, bio- and chronostratigraphy) and geochronology of the Palaeogene pelagic succession of the Umbria–Marche Basin (central Italy). *In* Jovane, L., Herrero-Bervera, E., Hinnov, L. A. & Housen, B. A. (eds), Magnetic Methods and the Timing of Geological Processes, *Geological Society, London,* Special Publications, v. 373, p. 111–131. doi: 10.1144/SP373.4

R. Coccioni, R. Catanzariti, F. Frontalini, L. Jovane, S. Montanari, J. Savian, M. Sideri - Integrated stratigraphy (magneto-, bio- and chronostratigraphy) and geochronology of the Paleogene pelagic succession of the Umbria–Marche Basin (central Italy) – Poster. *STRATI 2013*, Lisbon, July 1-7, 2013, *Ciencias da Terra*, Numero Especial VII, p. 15.

S. Galeotti, M. Moretti, C. Cappelli, J. Phillips, L. Lanci, K. Littler, S. Monechi, M. R. Petrizzo, I. Premoli Silva, J. C. Zachos, 2013. The Bottaccione section at Gubbio, central Italy: a classical Paleocene Tethyan setting revisited. *STRATI 2013,* Lisbon, July 1-7, 2013, *Ciencias da Terra*, Numero Especial VII, p. 21.

L. Jovane, J. F. Savian, R. Coccioni, F. Frontalini, G. Bancalà, R. Catanzariti, V. Luciani, S. M. Bohaty, P. A. Wilson & F. Florindo, 2013. Integrated magnetobiostratigraphy of the middle Eocene–lower Oligocene interval from the Monte Cagnero section, central Italy. *In* Jovane, L., Herrero-Bervera, E., Hinnov, L. A. & Housen, B. A. (eds), Magnetic Methods and the Timing of Geological Processes, *Geological Society, London*, Special Publications, v. 373, p. 79–95. doi: 10.1144/SP373.13

J. F. Savian, L. Jovane, R. I.F. Trindade, F. Frontalini, R. Coccioni, S. M. Bohaty, P. A. Wilson, F. Florindo & A. Roberts, 2013. Middle Eocene Climatic Optimum (MECO) in the Monte Cagnero section, Central Italy. *Latinmag Letters*, v. 3, Special Issue, PC02, p. 1-8 (extended abstract), Proceedings Montevideo, Uruguay.

Russian Paleogene Commission.
Chair: Mikhail A. Akhmetiev, Russia. Secretary: G.N. Aleksandrova. Russia.
Meetings and Conferences
28.01–30.01 2013. Annual meeting of the Moscow Department All Russian
Paleontological Society (PALEOSTRAT-2013).
January- beginning of April 2013. Works Commission activity for preparing new regional stratigraphic scheme Oligocene-Miocene North Caucasus.
September-October 2013. Revision of stratigraphic scheme (Volga basin and Precaspian depression for new geological map (Shick, Aleksandrova, Beniamovskiy)

Working group on Paleogene Stratigraphy of the North Pacific
Chair: Yuri B. Gladenkov, Russia
In 2013 two working meetings were held in Moscow (May) and Sakhalin (October). They discussed regional stratigraphic schemes for Paleogene of Kamchatka and Sakhalin in relation to a new stage of geological mapping and stratigraphic investigations. A special attention was paid to correlations of marine and continental formations.

In 2013 a monograph by Gladenkov Yu.B., Sinel'nikova V.N., Ben'yamovskii, & Fregatoba N.A. and titled "Stratigraphy of the marine Paleocene and lower Eocene in West Kamchatka" (paleontological characteristics, Paleogeographic environments" (Moscow, Geokart-GEOS Publishers, 2013. 160 pp., in Russian) has been published. Furthermore, several papers on the Paleogene were also published.

Annual Report 2013 of the Paleogene Deep-Water Benthic Foraminifera Working Group.
Secretary: Laia Alegret, Spain.

A special volume of Micropaleontology has been edited containing selected contributions that were presented in 2012 in the 9th International Workshop on Agglutinated Foraminifera (IWAF-9). This volume will be published in 2014.

During 2013 the Working Group continued the work on taxonomy and evolution of Paleogene benthic foraminifera:
- Transient benthic foraminiferal assemblage changes have been documented across the K/Pg boundary at Site 690 (Alegret and Thomas, 2013; Marine Micropaleontology, 105: 40-51). Faunal composition during the Danian may have been influenced by a combination of changes in food flux and increasing carbonate saturation due to extinction of pelagic calcifiers.
- The recently recovered Dababiya Corehole (Egypt) provided excellent material to document the benthic foraminiferal turnover from the Upper Cretaceous to the lower Eocene (Alegret & Ortiz, 2013, Stratigraphy, 9).
- The early Eocene *Glomospira* acme has been further investigated (Arreguín-Rodríguez et al., Journal of Foraminiferal Research, 43; Arreguín-Rodríguez et al., Micropaleontology, in press) and combined with organic biomarker studies, supporting an enhanced terrestrial input at Alamedilla section (Spain) during the PETM.
-Work on the benthic foraminiferal turnover across Eocene hyperthermal events at various ODP sites is in progress.
- The Eocene-Oligocene turnover of deep-water aglutinated foraminifera has been documented at ODP Site 647 (North Atlantic) by M.A. Kaminski and S. Ortiz (Micropaleontology, in press).

Annual Report of the Paleogene Planktonic Foraminifera Working Group 2013
Bridget Wade (Chair)

The Paleogene Planktonic Foraminifera Working Group has been progressing towards the completion of the Atlas of Oligocene Planktonic Foraminifera. Many chapters have now been submitted, with plates, synonymies and phylogenies, and are undergoing internal review and revision. Some issues regarding the wall texture and phylogeny of certain groups are still being debated and studied. Our next meeting is in March 2014, hosted by Mark Leckie. Most members of the working group can attend this meeting, where we will discuss the status of each chapter, and remaining issues that need to be resolved.

SUBCOMMISSION ON CRETACEOUS STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Cretaceous Stratigraphy (SCS)
SUBMITTED BY
Prof. Malcolm Hart, Chair
School of Geography, Earth & Environmental Sciences
School of Geography, Earth & Environmental Sciences
Plymouth University
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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

_ *To facilitate international communication in all aspects of Cretaceous stratigraphy and correlation*
_ *To establish a standard global stratigraphic subdivision and nomenclature for the Cretaceous, as part of the ICS standard global stratigraphic scale;*
- *To produce a stratigraphic table displaying agreed subdivision to substage level and intervals of disagreement, marking boundaries that are defined by a GSSP.*

3. ORGANIZATION

SCS is a Subcommission of the International Commission on Stratigraphy.

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

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

3a. Officers for 2013-2016:

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

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

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 since taken over the responsability for selection of future venues, though the successful applicants will organize individual congresses. The

8th International Symposium on the Cretaceous System was held in Plymouth during September 2009, and the *9th International Symposium on the Cretaceous System* was held in Ankara (Turkey) during September 2013. This Symposium was held from the 1st to 7th September 2013 at the Middle East Technical University in Ankara. The local organisation was managed by Ass. Prof. Dr. Ismail Omer Yilmaz, who will also act as an Editor of a special volume of *Cretaceous Research*.

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

The Subcommission had strong links with IGCP projects: IGCP 507 – "Cretaceous paleoclimatology", IGCP Project 506 - Marine and Non-marine Jurassic: Global correlation and major geological events (Project Co-Leader W. Wimbledon) and IGCP Project 608 "Asia – Pacific Cretaceous Ecosystems". The 1st Meeting of IGCP 608 was held at the Birbal Sahni Institute of Paleobotany over the Christmas period in December 2012. As a result, Western European and American attendance was limited! The 2nd Meeting of the project is scheduled for 4th to 11th September 2013, which – unfortunately – clashes with the cephalopod meeting in Zurich and is close to the IPA conference in Argentina.

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

5. CHIEF ACCOMPLISHMENTS IN 2012 and 2013

General Activities

The chair of the Cretaceous Subcommission called for the election of its chair and vice-chair(s) in fall 2011. As several nominations were received, the election process was completed by the end of 2011 and the results forwarded to the ICS Executive for approval in January 2012. In addition, the former Chair (I. Premoli Silva) called for the election of new Voting Members of the Subcommission for the 2012-2016 period**.** After having received thirteen nominations, the current Voting Members have been elected with 8 new members (see below).

A wealth of data on various aspects of Cretaceous stratigraphy has continued to be published during 2012 and 2013 providing a continuous stream of new data that spans the whole Cretaceous in increasing higher resolution. This is particularly true in the fields of stable isotopes and the astronomical tuning of sedimentary sequences.

Increasing knowledge on carbon isotope stratigraphic patterns and magnetostratigraphy from continuous pelagic successions, especially deep-sea, through the Cretaceous, stimulated the revision of earlier datasets. In particular, the Cretaceous Subcommission 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 two official meetings in Spring (Biserte, Tunisia) and Autumn (Prague), and its chair organized a field trip to Iraq in September 2012 plus an additional visit to Ukrainian sections. Important Cretaceous issues have been considered by the ICDP, within which coring was undertaken in the Cretaceous Songliao Basin (northeastern China) with the aim to recover a nearly complete Cretaceous terrestrial sedimentary record. The first results of the multidisciplinary study are now on-line (see below).

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

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

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

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

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

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

Of general interest:

Fernando A.G.S., Nishi H., Tanabe K., Moriya K., Iba Y., Kodama K., Murphy M.A., Hokada H., 2011. Calcareous nannofossil biostratigraphic study of forearc basin sediments: Lower to Upper Cretaceous Budden Canyon Formation (Great Valley Group), northern California, USA. *Island Arc*, **20**, 346–370.
K. B. Foellmi, M. Bole, N. Jammet, P. Froidevaux, A. Godet, S. Bodin, T. Adatte, V. Matera, D. Fleitmann,J. E. Spangenberg, 2012**.** Bridging the Faraoni and Selli oceanic anoxic events: late Hauterivian to early Aptian dysaerobic to anaerobic phases in the Tethys. *Climate of the Past*, **8**, 171–189.
O. Friedrich, R.D. Norris, J. Erbacher, 2012. Evolution of middle to Late Cretaceous oceans—A 55 m.y. record of Earth's temperature and carbon cycle. *Geology*, **40**/2, 107-110.
Y. Huang, G. Yang, C. Wang, H. Wu, 2012. The stabilisation of the long-term Cretaceous greenhouse climate: Contribution from the semi-periodical burial of phosphorus in the ocean. *Cretaceous Research*, **38**, 7**-**15.
G.D. Price, I. F**ő**zy, N.M.M. Janssen, J. Pálfy, 2011. Late Valanginian**–**Barremian (Early Cretaceous) palaeotemperatures inferred from belemnite stable isotope and Mg/Ca ratios from Bersek Quarry (Gerecse Mountains, Transdanubian Range, Hungary). *Palaeogeography, Palaeoclimatology, Palaeoecology*, **305**, 1**–**9.
G.D. Price, T. Williamson, R.A. Henderson, M.K. Gagan, 2012. Barremian**–**Cenomanian palaeotemperatures for Australian seas based on new oxygen-isotope data from belemnite rostra. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **358–360**, 27**–**39.
S. Reboulet, F. Giraud, C. Colombié, A. Carpentier, 2013. Integrated stratigraphy of the Lower and Middle Cenomanian in a Tethyan section (Blieux, southeast France) and correlations with Boreal basins. *Cretaceous Research*, **40**, 170-189.
L. Simone, S. Bravi, G. Carannante, I. Masucci, F. Pomoni-Papaioannou, 2012. Arid versus wet climatic evidence in the **"**middle Cretaceous**"** calcareous successions of the Southern Apennines (Italy). Cretaceous Research, **36**, 6**-**23.

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

The Berriasian GSSP and the J/K boundary.
This is a summary of progress for the Berriasian WG, written by the chair, W.A.P. Wimbledon.
Meetings
The spring meeting (May 2012) in Tunis was hosted by Mabrouk Boughdiri and colleagues, from the University of Bizerte, and was an opportunity to see sites on the southern side of Tethys. For the first time we also had first-hand discussion of developments in both north Africa and Argentina.
An excellent autumn meeting was held in Prague (25-29 October 2012), hosted by the Charles University and Geological Institute of the Czech Academy of Sciences. Thanks to Petr Pruner, Martin Kostak, Petr Schnabl, Stanislav Slechta and Kristyna Cizkova and their colleagues. WG members from as far away as Mexico and Novosibirsk made the long journey to Prague and we had a diverse discussion on Tethyan, Gondwanan, non-marine and boreal correlations, with twenty-five talks and posters presented.
Working Group Activity
A range of activities is listed below, geographically. At present activities are focussed on better documentation and improved calibration of stratigraphically useful markers and datums in the Tithonian/Berriasian boundary interval. The group's horizons broaden and we consider new geographical areas for multidisciplinary treatment. This means bringing integrated paleomagnetic and/or calpionellid/nannofossil studies to some areas for the very first time: e.g., North Africa, Iraq and Mexico.
Mexico - Riccardo Baraggan presented the latest results at Prague on the 'new' J/K Apulco site, and a publication on the locality, near to the formerly described site of Mazatapec, is in press (Barragan, Lopez, Rehakova). New ammonite and calpionellid evidence was discussed at Sofia and Prague. Nannofossils are being processed, and new ammonite finds assessed.
Spain - Rio Argos: new work on nannofossil and calpionellids (Casellato, Rehakova, Jamrichova) has been undertaken on samples from the *Jacobi* Subzone collected by Philip Hoedemaeker in past years. Some of the early calpionellid results were discussed in Prague: they are rather surprising.
Italy - In recent months Gloria Andreini has undertaken a revision of the calpionellid distribution and zonation at Torre de Busi.
France - Documentation of "template" sites for the *jacobi* and *grandis* subzones continues.
Le Chouet, Drome: completion of the first paper on Le Chouet (Reháková, Casellato, Halásová, Frau, Bulot, Grabowski, Sobien, Pruner, Schnabl, Čížková , Tchoumatchenco, Wimbledon) is imminent, describing the *Chitinoidella* – B, *jacobi* subzone interval, its nannofossil, calpionellid and ammonite biostratigraphy and magnetostratigraphy. More focussed publications are intended, including one to name several new ammonite taxa.

St Bertrands Spring, Drome: initial logging and sampling for paleomagnetism (Pruner, Schnabl, Slechta, Grabowski); calponellids, nannofossils, ammonites (Frau, Bulot, Wimbledon) focussing on the nominal P. *grandis* subzone were carried out in May 2012. Preliminary determinations of paleomagnetism are currently in progress. The next step is a second phase of logging and micropaleontological collecting of the lowermost Berriasian and topmost Tithonian.
Tunisia - Beni Kleb was the subject of a first J/K paleomagnetic sampling in May 2012 (by Petr Schnabl). These samples are currently being studied (Petr Pruner talk at Prague)**.** Initial reconnaissance sampling for nannofossils was undertaken in March 2012 at Jebel Rheouis, Beni Kleb and in central Tunisia at Sidi Kralif, near Sidi Bousid
Silvia Gardin has just reported that the Sidi Kralif samples have produced the first (and rich) Berriasian nannofossils to be found locally. This step forward was discussed at Prague. Work continues on Sidi Kralif and the other two sections. Kamel Maaloui is completing is study of the Sidi Kralif ammonites.
Slovakia - Further study continues on the Strapkova section (examined droning our Slovakia excursion), its micropaleontology and magnetostratigraphy (Michalik, Grabowski, Rehakova, Lintnerova, Halasova)
Bulgaria - The SW Bulgaria sites at Berende and Kopanitsa, with their marly successions, have been intensively studied for ammonites and calcareous nannofossils (Ivanov, Vyara Idakieva, Stoykova). First results were presented in Prague, with obvious correlations possible to both Crimea and Mediterranean Tethys.
Burlya, in NW Bulgaria, a carbonate succession (visited by the WG in 2011) is undergoing new paleomagnetic sampling on its Berriasian part (Grabowski, Schnabl, Sobien) in collaboration with Platon Tchoumatchenco and Iskra Lakova. Marin Ivanov and Vyara Idakieva have also been making fresh collections of ammonites.
Ukraine - Vladimir Arkad'ev has just published a substantial book on the "Mountain Crimea" Jurassic/Cretaceous, a very large accumulation of data. He and Andrey Guzhikov presented new data at Prague, plus tintinnid results by E. Platonov.
Vladimir Bakhmutov has been at the Feodosia Tithonian/Berriasian sections in October collecting new paleomagnetic data. Preliminary results were presented by him at the Sofia meeting, and these are currently being improved and updated. New results on the nannofossils of the Feodosia sections were also presented in Prague by Eva Halasova. This data will be integrated with already collated information on lithostratigraphy, nannofossils (Casellato), foraminifers (Daria Ivanova), calpionellids (Rehakova), ammonites (WAPW) and magnetostratigraphy, and a publication is anticipated in 2013.
Iran - Mohamed Bezaggagh presented important new data at Prague on typical Tethyan calpionellid biotas in the Shal and Kolur sequences of the Alborz chain of Iran.
Caucasus - Valery Vuks has been making a reconnaissance of prospective sections near the J/K boundary in the western Caucasus, collecting samples for micropaleontology.
India - Samples collected from limestones in Kutch (by Dr Pandey) are being processed in the hope of finding microfossils.
Tibet - Work continues, including efforts at trying to integrate past results (?Tith/?Berr.ammonites, Liu et al.) with more modern collecting for palynology (Li) and nannofossils and ammonites (Wan).
Russian Platform and Siberia - Important new work has been undertaken on the Nordvik section with a revision of paleomagnetic zonation. This work (by Bragin, Kazansky, Shurygin and Dzyuba) has M17r commencing in the *Chataetes chetae* Zone instead of the *Hecteroceras kochi* Zone.
In addition, Zanin, Zamirailova and Eder have just published an interesting new paper on presumed J/K calcareous nannofossils from the Bezhanov Formation (2012, Open Geology Journal 6, 25-31)
Vasily Mitta continues with his important work on ammonite biostratigraphy, notably on links from the Russian Platform to Tethys during the Berriasian, and happily was able to contribute to the Prague discussions.
Kurdistan - After a gap in research of 64 years, reconnaisance fieldwork in northern Iraq in July 2012 focussed on Tithonian/Berriasian Chia Gara limestone/marl successions in the Gara Anticline and at Banik, but examination of accessory sequences at Sargelu and Barzanja was also carried out. Logging of the two major sections was undertaken as the first requirement. Samples from Gara and Banik are currently under investigation by: Ibrahim Mohyaldin (geochemistry), Daniela Rehakova and Gloria Andreini (calpionellids), Kristalina Stoykova (calc. nannofossils), and Jim Riding and Ian Harding (palynomorphs).
Argentina - Hector Leanza and Alberto Riccardi are considering new possibilities for J/K profile studies. And, in the University of Buenos Aires, ammonite and nannoplankton biostratigraphy are being applied to the new site of Las Loicas, where there are possibilities for geochronological results from interbedded tuffs (using TIMS, SHRIMP and Laser Ablation U/Pb on zircons). The team consists of Beatriz Aguirre-Urreta, Veronica Vennari (ammonites), Andra Concheyro, Marina Lescano (nannofossils), Victor Ramos (field geology/tectonics), and Marcio Pimentel (geochronology; Universidade Federal do Rio Grande do Soul, Brazil).
South Primorye - A new team undertook its first fieldwork near Vladivostok in early October 2012 (Valentina Markevich, Eugenia Bugdaeva, Viktor Nechaev, Sha Jingeng, Li Jianguo, and WAPW). Preliminary fieldwork on the coast of Ussuri Bay and adjacent sections was for the purposes of testing the usefulness of published local lithostratigraphy and of trying to locate fossiliferous horizons, notably those identified by Sey and Kalacheva and

Konovalov and Konovalova. In particular, the intention was to localise examples of Tethyan berriasellids in a section with multiple *Buchia* horizons. The reputedly 600m-thick predominantly sandstone Chigan Formation is affected by a number of major faults which disrupt the sequence, as well as gabbroic intrusions. Work has been initiated on recording all stratigraphically significant past fossil finds and then it will be necessary to integrate these records with new observations made in the field.

North Primorye - The team from Novosibirsk (B.N. Shurygin, O.S. Urman & O.S. Dzyuba) have been extending their extensive studies in Siberia and making new studies on sites in the Russian far east in the Komsomolsk area, on sequences with common *Buchia* and very rare Tethyan ammonites.

California - A new team has been formed for field and laboratory study for the sections of the northern Great Valley of California, as follows: Melissa Grey (Canada) *Buchia*, Jennifer Galloway (Canada) palynology, Oksana Dzyuba (Russia) belemnites, and from USA Alex Barnard mapping/lithostratigraphy, Emile Pessagno radiolarians, and Kathleen Surpless (radiometric dating). Nannofossils have not yet been assigned. It is some decades since the nannofossil work of Bralower at Grindstone Creek and even longer since the work of Jones on *Buchia* in the Paskenta-Grindstone area. First fieldwork is scheduled for May 2013.

Greenland - Work continues on the east Greenland sequences. Peter Alsen and Stefan Piasecki talked at Prague about new results from sections in the Wollaston Forland and other areas, and improved palynomorph/ammonite correlation from there to other boreal regions, notably, for the first time, to the *S. primitivus* Zone of England. Consideration is being given to a next step of magnetostratigraphic sampling of cores on which an ammonite and palynological study has already been performed.

United Kingdom - Paleomagnetic sampling of the non-marine Purbeck Formation (Tithonian-Valanginian) of Dorset was discussed at Prague. The work in summer 2011 (Pruner, Slechta, Schnabl) is on the putative M19-M18 interval, an interval previously sampled for magnetostatigraphy (by Ogg et al.) but not conclusively and with much much less resolution. 300 samples were collected and are in the process of study.

Recent Meetings
Perugia – May 25-28, 2013 [report awaited]
Warsaw – October, 2013 [report awaited]

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

Base Valanginian GSSP.

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

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

Base Hauterivian GSSP.

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

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

Base Barremian GSSP.

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

1. Geographical and geological setting

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

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

2. Fossil record

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

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

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

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

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

3. Stable isotopes and organic matter

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

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

4. Cyclostratigraphy

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

5. Magnetostratigraphy

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

6. Protection

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

Publications relevant to the Hauterivian/Barremian boundary (2011-2013)

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

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

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

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

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

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

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

<u>Base Aptian GSSP</u>.

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

A. Cherchi, R. Schroeder, 2013. The Praeorbitolina/Palorbitolinoides Association: an Aptian biostratigraphic key-interval at the southern margin of the Neo-Tethys. *Cretaceous Research*, **39**, 70-77.

M. Ivanov, V. Idakieva, 2013. Lower Aptian ammonite biostratigraphy and potential for further studies of OAE 1a in Bulgaria. *Cretaceous Research*, **39**, 47-69.

M.V. Kakabadze, I.M. Kakabadze, 2012. Biostratigraphy and interrelationship of the Lower and Middle Aptian (Cretaceous) sedimentary sequences in Georgia and adjacent regions of the Caucasus. *Revue de Paléobiologie, Vol. spéc.*, **11**, 103-111.

J-P. Masse, M. Fenerci-Masse, 2013. Stratigraphic updating and correlation of Late Barremian-Early Aptian Urgonian successions and their marly cover, in their type region (Orgon-Apt, SE France). *Cretaceous Research*, **39**, 17-28.

J.A. Moreno-Bedmar, M. Company, J. Sandoval, J.M. Tavera, T. Bover-Arnal, R. Salas, G. Delanoy, F.J.-M.R. Maurasse, R. Martinez, 2012. Lower Aptian ammonite and carbon isotope stratigraphy in the eastern Prebetic Domain (Betic Cordillera, southeastern Spain). *Geologica Acta*, 10/4, 1-12 DOI:1 0.1344/105.000001752

Moullade M., Tronchetti G., Balme C., Mauroux P., 2012. A new upper Bedoulian section in the Aptian stratotypic area: Croagnes (5 km NW of Gargas, Vaucluse, SE France). *Carnets de Géologie* [Notebooks on Geology], Brest, Letter 2012/03 (**CG2012_L03**), p. 193-199.

M.L. Quijano, J-M. Castro, R.D. Pancost, G.A. de Gea, M. Najarro, R. Aguado, I. Rosales, J. Martín-Chivelet, 2012. Organic geochemistry, stable isotopes, and facies analysis of the Early Aptian OAE—New records from Spain (Western Tethys). *Palaeogeography, Palaeoclimatology, Palaeoecology*, **365–366**, 276–293.

B. Granier, R. Busnardo, 2013. New stratigraphic data on the Aptian of the Persian Gulf. *Cretaceous Research*, **39**, 170-182.
J. Moreno, R. Barragan, M. Company, L.G. Bulot, 2013. Aptian (lower Cretaceous) ammonite biostratigraphy of the Francisco Zarco Dam stratigraphic section (Durango State, north-east Mexico). *Journal of South American Earth Sciences*, **42**, 150-158.

Base Albian GSSP.

As indicated in previuos reports, the formal proposal for the base Albian at Tartonne (SE France), prepared by J. Kennedy, never reached the quorum. Voting Members against the proposal commented on the change of lithofacies at the critical level (from marl to organic-rich laminated black shale), the regional/provincial distribution of the index-species *Leymeriella (L.) tardefurcata,* and the low stratigraphic value of ancillary markers (few, poorly diagnostic planktonic foraminifera; *Predicosphaera* taxonomic problems, etc.), made the Tartonne section unsuitable as the base Albian GSSP. In addition, the sampling across the Aptian/Albian boundary was considered at too low resolution 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 (work is still in progress) by members of the WG. One of the most important results concerns the planktonic foraminifera which display a major turnover across the Niveau Kilian, in parallel with a 1‰ $\delta^{13}C$ excursion. Petrizzo *et al.* (2012) reported that (1) the latest Aptian assemblage, dominated by few long-ranging *Hedbergella* and large-sized *Paraticinella* completely disappear near the base of the Niveau Kilian organic-rich level, (2) planktonic foraminiferal assemblages from across the Niveau Kilian to the top of the studied section are composed of minute, but very distinctive smooth-surfaced species of *Microhedbergella miniglobularis* and *Mi. renilaevis*, (3) the appearance of *Mi. renilaevis* in the middle part of the Niveau Kilian represents a major step in the evolution and diversification of the Albian planktonic fauna. The same sequence of events was reported from several deep-sea sites in the Atlantic and Indian Oceans (Huber & Leckie, 2011). Therefore, documentation of the planktonic foraminiferal turnover, combined with the carbon-isotope stratigraphy in the Col de Pré-Guittard section, provide new criteria, replacing the FO of the unsuitable *L. tardefurcata*, for defining the GSSP for base Albian in a stratigraphically complete succession. The formal proposal dealing with the new criteria for identifying the base Albian is in preparation and is expected to be circulated during 2014.

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

Base Coniacian GSSP.

The main paper describing the criteria for identifying the base Coniacian and the proposal of a candidate composite GSSP section was published in *Acta Geologica Polonica* at the end of 2010. Besides multiple up-dated biostratigraphies, the paper also includes the isotope curves for both the Salzgitter-Salder (northern Germany) and Slupia Nadbrze~na (central Poland) sections. It is confirmed that the inoceramid-based lower Coniacian boundary (= first appearance of *C. deformis erectus*), slightly post-dates the traditional ammonite (FAD of *Forresteria petrocoriensis*) position of the boundary.
In September 2011 the chair of the WG, Irek Walaszczyk, circulated the published proposal to the Working Group members asking for comments and eventual approval. For the time being all replies, received so far, 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 Subcommission is in advanced 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 Nadbrzena river cliff section (central Poland): a proposed candidate composite Global Boundary Stratotype Section and Point for the Coniacian Stage (Upper Cretaceous). *Acta Geologica Polonica*, **60**/3, 445-477.

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 Subcommission 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. The proposal for the base Santonian at Olazagutia (Spain) was approved by the ICS on 9th April 2012. Meanwhile, the quarry, in which the GSSP is located, has changed the ownership and the new owner in April 2012 denied the access even to the inactive part of the quarry, a fact that prevented to forward the proposal to IUGS for ratification. After several actions by ICS Chair, S. Finney, and the proponent, M. Lamolda, the owner changed his/her mind allowing the access at the inactive part of the quarry to scientists who have to fill and sign an application form for the visit. After having clarified the problem of access, the proposal has now been submitted to IUGS and approved. The article for *Episodes* is expected in 2014.

Base Campanian GSSP.

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

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

Base Maastrichtian GSSP.

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

S. Gardin, B. Galbrun, N. Thibault, R. Coccioni, I. Premoli Silva, 2012. Bio-magnetochronology for the upper Campanian – Maastrichtian from the Gubbio area, Italy: new results from the Contessa Highway and Bottaccione sections. *Newsletters on Stratigraphy*, **45**/1, 75–103.
M. Machalski, 2012. Stratigraphically important ammonites from the Campanian–Maastrichtian boundary interval of the Middle Vistula River section, central Poland. *Acta Geologica Polonica*, **62**/1, 91–116.
F. Surlyk, S.L. Rasmussen, M. Boussha, P. Schiøler, N.H. Schovsbo, E. Sheldon, L. Stemmerick, N. Thibault, 2013. *Cretaceous Research*, **46**, 232-256.
N. Thibault, R. Harlou, N. Schovsbo, P. Schiøler, F. Minoletti, B. Galbrun, B.W. Lauridsen, E. Sheldon, L. Stemmerik, F. Surlyk, 2012. Upper Campanian-Maastrichtian nannofossil biostratigraphy and high-resolution carbon-isotope stratigraphy of the Danish Basin: Towards a standard $\delta^{13}C$ curve for the Boreal Realm. *Cretaceous Research*, **33**, 72-90.
N. Thibault, D. Husson, R. Harlou, S. Gardin, B. Galbrun, E. Huret, F. Minoletti, 2012. Astronomical calibration of upper Campanian–Maastrichtian carbon isotope events and calcareous plankton biostratigraphy in the Indian Ocean (ODP Hole 762C): Implication for the age of the Campanian–Maastrichtian boundary. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **337–338**, 52–71.

S. Voigt, Gale A., Jung C., Jenkyns H., 2012. Global correlation of Upper Campanian - Maastrichtian successions using carbon isotope startigraphy: development of a new Maastrichtian timescale. *Newsletters on Stratigraphy*, **45**/1, 25–53.
P.D. Ward, J.W. Haggart, R. Mitchell, J.L. Kirschvink, T. Tobin, 2012. Integration of macrofossil biostratigraphy and magnetostratigraphy for the Pacific Coast Upper Cretaceous (Campanian–Maastrichtian) of North America and implications for correlation with the Western Interior and Tethys. *GSA Bulletin*, **124** (5/6), 957–974.

6. CHIEF PROBLEMS ENCOUNTERED IN 2013

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

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

7. SUMMARY OF EXPENDITURES IN 2013 (ANTICIPATED THROUGH MARCH 2014):

I. INCOME

ICS subvention for 2013	£ 3513.70
Other income	£ 0.00
Total income	**£ 3513.70**

II. EXPENDITURE

Attendance at STRATI 2013 in Lisbon	£ 1187.68
Attendance at ISCS 2013 in Ankara	£ 1482.40
Contribution to J/K meetings in 2013 still under discussion	£ 0000.00
Total expenditure (to date)	**£ 2670.08**

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED IN 2013 and 2014:

Membership of Cretaceous Subcommission.
Several Voting Members of the Cretaceous Subcommission had terminated their mandate with the 34th Geological Congress, August 2012. The call for nominations was completed in September 2012 and the new membership was elected by the end of October 2012.

Meetings

- The 10th meeting of the Berriasian and J/K boundary WG was held in Perugia (Italy), May 2013.
- The 1st International Congress on Stratigraphy (STRATI) was held in Lisbon from the 1st to 7th July 2013.
- The official meeting of the Cretaceous Subcommission was held at the 9th International Symposium on the Cretaceous System in Ankara, Turkey, 1st to 7th September 2013.
- The 5th Workshp of the Kilian Group was held during the 9th International Symposium on the Cretaceous System, Ankara, September 2013.
- The 11th meeting of the Berriasian and J/K boundary WG was held in Warsaw, October 2013.

- As a part of the Annual Meeting of the Geological Society of America (October 25th), a ceremony was held at Pueblo, Colorado, marking the inauguration of the GSSP 'spike' for the base of the Turonian Stage.
- A number of sessions on Cretaceous stratigraphy and the K/Pg boundary are being arranged as part of the Annual Meeting of the European Geosciences Union in Vienna, Austria (27th April to 2nd May 2014).
- The 2nd Meeting of IGCP 608, 4th – 11th September, 2014, Waseda University, Tokyo, Japan.
- The 2nd International Congress on Stratigraphy (STRATI) which is to be held in Graz, Austria, during July 2015.
- The International Geological Congress (IGC) which will be held in Cape Town (South Africa), 27th August to 4th September 2016.
- The 10th International Symposium on the Cretaceous System will be held in 2017. There are possible offers of a location in Saltzburg, Vienna, Lausanne and Heidelberg.

Work Plan and anticipated Results

· To bring recommendations for the remaining GSSPs to ICS as soon as possible.
· Submission of the *Episodes* article on the base of the Santonian Stage.
· Votes on the Coniacian GSSP and submission to ICS after Subcommission approval.
· Votes on the Hauterivian GSSP and submission to ICS after Subcommission approval.
· Preparation of the first draft for the 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 Subcommission approval.
· Identification of the criteria for recognition of the base of the Berriasian and the (important) J/K boundary.
· Choose the appropriate section for the Campanian GSSP.

9. BUDGET AND ICS COMPONENT FOR 2014

Office expenses (Fax, phone, postage, etc)	£ 50.00
Contribution to a J/K boundary Meeting (organization+ participants' support)	£ 1000.00
Contribution to a J/K boundary Meeting (organization+ participants' support)	£ 1000.00
Contribution to a meeting (possibly in France) that will push ahead with Barremian, Hauterivian and Valanginian GSSP proposals (organization+ participants' support)	£ 3000.00
Funds to support some of the Killian Group in travel to the Cephalpod meeting in Zurich, at which it is anticipated that further discussion on Lower Cretaceous GSSPs will take place	£ 2000.00
Total estimated expenditure	**£ 7050.00**

10. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2009-2013)

See Accomplishments in ICS Annual Reports 2007 to 2012 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, 2009 Plymouth and Ankara 2013 meetings.
· The 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).
· The 4th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Plymouth (September 2009).
· The 5th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Smolenice (Slovakia) (April 2010).
· The 4th Workshop of the Kilian Group on the Aptian and Albian zonation, held in Dijon (August 2010).
· The 6th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Paris (November 2010).
· The 7th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Sofia (October 2011).

· The 8th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Bizerte, Tunisia (May 2012).
· The 9th official meeting of the Working Group on the Berriasian GSSP and the J/K boundary, chaired by W.A.W. Wimbledon in Prague (October 2012).

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

- The 2nd 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 33rd Geological Congress, August 2008, Oslo.
- The 3rd meeting of the *Berriasian and J/K boundary Working Group*, Milan, March 2009.
- The 4th meeting of the *Berriasian and J/K boundary Working Group*, Plymouth, September 2009.
- The 5th meeting of the *Berriasian and J/K boundary Working Group*, Smolenice, April 2010.
- ICS Meeting, Prague, May 2010.
- The ICS official meeting, at 34th Geological Congress, August 2012, Brisbane.
- The 1st International Congress on Stratigraphy, Lisbon, July 2013. This was a well-attended and well-organised congress, building on the two STRATI meetings previously held in Paris. It is planned that this series of meetings will be held every two years: Graz, Austria, is to host the 2015 congress. Papers on the Cretaceous were well-represented in the programme and some of the field excursions (led by Jacques Rey) looked at the Cretaceous sections both north and south of Lisbon.
- The 9th International Symposium on the Cretaceous System, Ankara, September 2013. This major meeting at the Middle East Technical University, Ankara, Turkey was organised by Ass. Prof. Ismail Omer Yilmaz. Though less well attended than comparable meetings in Western Europe, there was a full programme of lectures, although the number of posters was down on the symposium held in Plymouth. There were informative mid-symposium and post-symposium field trips. Prof. Bruno Granier was accepted as the new SCS Secretary and there were thanks to the past Chair (Isabella Premoli Silva) and Secretary (Sylvie Gardin). There were updates on outstanding GSSP definitions. The 10th International Symposium on the Cretaceous System will be held in 2017 (though this could clash with the two-yearly STRATI meeting), though a venue was not decided. Possible locations include Saltzburg, Vienna, Lausanne and Heidelberg.
- The inauguration of the Turonian GSSP at Pueblo, Colorado, 25th October 2013. At an event organised by Rangers at the Pueblo State park, the GSSP 'marker' was ceremonially placed in the succession. Within the park there is now a comprehensive display board, static binoculars that can be used by visitors to view the 'marker' and a programme of outreach events to involve the community (especially schools). Dr Brad Sageman was thanked for preparing the information boards and choreographing the event. There were speeches by Stan Finney (Chair, ICS), Malcolm Hart (Chair, SCS), Suzanne Mahlburg Kay (President, Geological Society of America) and Brad Sageman. All the speakers and guests were thanked for their attendance and support by the Park Ranger responsible for education and outreach. Later, Brad Sagemen led a geological walk around the site and the various features of the Cenomanian to Turonian succession.
- The Chair (Malcolm Hart) will be attending all the Cretaceous-based sessions at the EGU Annual Meeting in Vienna (27th April to 2nd May, 2014)

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

Meetings

- July 2013 – ICS meeting at the 1st International Congress on Stratigraphy, Lisbon, Portugal
- September 2013 – Subcommission Official Meeting at the 9th International Symposium on the Cretaceous System, Ankara
- September 1-7, 2013 – 9th International Symposium on the Cretaceous System, Middle East Technical University, Ankara, Turkey. Convenor: Ismail Omer Yilmaz
- September 2013 – 5th Workshp of the Kilian Group at the 8th International Symposium on Cretaceous System, Ankara.
- October 2013 – the 11th Workshop of the Berriasian and J/K boundary WG in Warsaw, Poland.
- September 2014 – the 9th International Symposium "Cephalopods Past and Present", University of Zurich, Switzerland.
- July 2015 – 2nd International Congress on Stratigraphy, Graz, Austria.
- August 2016 – International Geological Congress, Cape Town, South Africa.
- September 2017 – 10th International Symposium on the Cretaceous System (location to be finalized).

Details of other meetings are not yet available.

Objectives

· To submit the proposal of Santonian GSSP to *Episodes* for publication
· To submit the proposal for the Coniacian GSSP to the Cretaceous Subcommission Voting Members, then submit it to ICS, and possibly to *Episodes* for publication
· To submit a revised proposal for the Albian GSSP to the Cretaceous Subcommission Voting Members, then to submit it to ICS, and possibly to *Episodes* for publication
· To submit the proposal for the Barremian GSSP to the Cretaceous Subcommission Voting Members, then to submit it to ICS, and possibly to *Episodes* for publication
· To bring recommendations for the remaining GSSPs to ICS as soon as possibile
· **To propose the definition of the criteria for the recognition of the base of the Berriasian and the J/K boundary. This is deemed as 'High Priority' and the Working Group have been informed of this, with the expectation that this will be resolved as soon as possible.**
· To communicate the results as widely as possible
· To develop new directions for the Subcommission as GSSP proposals are completed. This specifically concerns the subdivision of stages, with the definition of substages and related GSSPs.

Work Plan

2014 – Finalize the proposal for the base of the Albian
2013 – Finalize proposals for the base of Valanginian, Hauterivian, Barremian, Aptian, Coniacian, and possibly Campanian
2013–2014 –Finalize the proposal for the base of Berriasian (Jurassic/Cretaceous boundary)
2014–2014 – Definition of substages.

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

Subcommission officers (with addresses)

Chair: Prof. Malcom Hart
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List of Task Groups and their officers

Maastrichtian WG: *GSSP ratified.* Giles Odin, France. gilodin@moka.ccr.jussieu.fr
Campanian WG: Andy Gale (UK). Andy.Gale@port.ac.uk
Santonian WG: *GSSP ratified*. Marcos Lamolda <gpplapam@lg.ehu.es>
Coniacian WG: Irek Walaszczyk, Poland. i.walaszczyk@uw.edu.pl
Turonian WG: *GSSP ratified*. No chairman at present.
Cenomanian WG: *GSSP ratified.* No chairman at present.
Albian WG: Malcolm Hart, UK. mhart@plymouth.ac.uk
Aptian WG: Elisabetta Erba, Italy. elisabetta.erba@unimi.it
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Berriasian (J/K boundary) WG: William A. P. Wimbledon, UK. mishenka1@yahoo.co.uk

Kilian Group *[formerly Lower Cretaceous ammonite WG]:*
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Vice-Chairmen: Peter Rawson, UK. peter.rawson1@btinternet.com
Jaap Klein, NL. j.klein@amc.uva.nl

SUBCOMMISSION ON JURASSIC STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

International Subcommission on Jurassic Stratigraphy

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2. OVERALL OBJECTIVES AND FIT WITHIN IUGS SCIENCE POLICY

2a. Mission statement

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

2b. Goals

These fall into two main areas:

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

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

Progress towards these goals are showcased and scientific communications between experts of various aspects of Jurassic stratigraphy is facilitated by the organization of the International Congresses on the Jurassic System, held in every fourth year and sponsored by ISJS. The next congress will be held in Jaipur, India, January 2104.

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

2c. Fit within IUGS Science Policy

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

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

3. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

The chief accomplishments in 2013 were as follows:

- *Revised GSSP proposal for the base-Toarcian GSSP*. Following the receipt of constructive comments form the ICS in 2012, the Chair (ROCHA) and Secretary (MATTIOLI) of the Toarcian Task Group has thoroughly revised the proposal and resubmitted it to the ICS for further consideration. We hope that the proposal will be accepted early in 2014.
- *Base Oxfordian field workshop, Provence, September/October 2013*. A three-day field workshop was organized by the Groupe Francais pour Stratigraphie Jurassique under the leadership of Pierre PELLENARD (Université Bougogne). The Chair (MELENDEZ) and secretary (PAGE) of the Oxfordian Task Group attended the workshop as did the chair of the ISJS (HESSELBO). New biostratigraphic, chemostratigraphic and cyclostratigraphic data were presented which will inform choice of the GSSP. A follow up field workshop based on sections in the southern UK will be held in 2014 (see below).
- *Base Callovian Task Group*. Following a hiatus after the death of its chair, John Callomon, the Callovian task group has been reinvigorated under the leadership of Eckhard MÖNNIG. This group is now very active and we can be optimistic about significant future progress on definition of this boundary.
- *ISJS Membership*. A significant number of ISJS voting members have retired in 2013 and have now been replaced. Full details are given below.

3b List of major publications of subcommission work (books, special volumes, key scientific paper).
The full account of the base Jurassic GSSP was published in Episodes: Hillebrandt et al. 2013. The Global Stratotype Sections and Point (GSSP) for the base of the Jurassic System at Kuhjoch (Karwendel Mountains, Northern Calcareous Alps, Tyrol, Austria) *Episodes* v. 36, no. 3, p. 162-198.

3c. Problems encountered, if appropriate
Some delays in co-ordination of the subcommission work resulted as a result of the Chair moving from the University of Oxford to the University of Exeter in the summer of 2013. The website is in the process of migration from the University of Oxford to be hosted under more direct ICS control.

4a. OBJECTIVES AND WORK PLAN FOR NEXT YEAR (2014)
Jurassic Congress 2014. The Jurassic Congress will be held in Jaipur, India, in January 2014. The congress will provide a forum for stock-taking and review of next steps, particularly in relation to progress on the remaining GSSPs. Topics that will need consideration and planning in the near future substage definition, and integration of astrochronology and geochronology into GSSP-based stage definitions.

4b Specific GSSP Focus for 2014
Oxfordian Task Group Field Workshop. Following the successful workshop in Provence in autumn 2013 a further workshop is planned in the UK for the early summer of 2014. We expect that the 2014 workshop will provide the basis for reaching a final decision on which location to recommend officially for the base-Oxfordian GSSP. A December 2014 date for submission of the case to ICS would not be unreasonable.

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

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

5. SUMMARY OF EXPENDITURES IN 2013
Opening balance (£3,595.15*)
Travel expense Oxfordian Task Group (Melendez, Chair Oxfordian Task Group: £489.38)
Travel and accommodation expense Oxfordian Task Group (Hesselbo, Chair ISJS : £662.64)
Travel and accommodation expense Oxfordian Task Group (Palfy, former Chair ISJS and present voting member: £246.99)
Sponsorship of the Jurassic Congress, Jaipur, £1000
Closing balance (£1196.49)

* The amount cited is significantly larger than that given in the 2012 report because the chair had received a stated balance from the Oxford Earth Sciences finance department that did not take into account amounts received into the account in previous years.

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014

We request £2000 to support attendance of non-UK participants at the 2014 Oxfordian Task Group Field Workshop at the candidate GSSP section at Redcliff, UK.

APPENDICES

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

- **Volumina Jurassica** In 2010 the ISJS entered into a strategic partnership with the open access periodical Volumina Jurassica. Volumnia Jurassica hosts a 'news and views section' which now routinely contains Jurassic Newsletter articles – previously only available as an informally assembled PDF available from the ISJS website. The editors of Volumina Jurassica, Andrzej WIERZBOWSKI and Grzegorz PIEŃKOWSKI, have also encouraged the Jurassic community to contribute to a discussion on the problems of the Jurassic substage boundaries.
- **Triassic-Jurassic Boundary** Definition of the base Hettangian GSSP, Kujoch, Austria.
- **ISJS website** The ISJS website, revamped in 2009, continued to be updated in 2012. The website is hosted by the Oxford University, home institution of the ISJS chair, who is responsible for keeping the website up-to-date. It is accessible at http://jurassic.earth.ox.ac.uk Plans for a radical overhaul of the website to be more responsive to the needs of Jurassic (and other) stratigraphers is still underway.
- Definition of the base of the Toarcian

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

- Completion of the stage GSSP definition process
- Develop strategy for substage definition process
- Develop strategy for integration of cyclostratigraphy and geochronology into knowledge of stages and substages
- Develop website as forum for exchange ideas in relation to Jurassic stratigraphy
- Begin bottom-up review of activities of ISJS with a view to longer term forward planning. This is a process that will be initiated at the Jurassic congress in 2014.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

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

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

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

The Subcommission sponsors an International Congress on the Jurassic System every four years. The 8th Congress was held in 2010 in China, and preparation is now underway to organize the 9th Congress in 2014 in Jaipur, Rajasthan, India. The present ISJS Voting Membership is as follows.

Executive				
		Role	*e-mail*	*Address*
Hesselbo	Stephen	Chair	s.p.hesselbo@exeter.ac.uk	Camborne School of Mines, University of Exeter, Penryn Campus, Penryn, Cornwall TR10 9EZ, UK
Sha	Jingeng	Vice Chair	jgsha@nigpas.ac.cn	Nanjing Institute of Geology & Palaeontology, Chinese Academy of

				Sciences, Nanjing 210008, P.R. China
Coe	Angela	Sec	a.l.coe@open.ac.uk	Department of Environment, Earth and Ecosystems, The Open University, Walton Hall, Milton Keynes, Buckinghamshire, UK
Voting Members				
Boughdiri	Mabrouk		mab_boughdiri@yahoo.fr	University of Carthage, Département de Sciences de la terre, Carthage, Tunisia
Pálfy	Joseph		palfy@nhmus.hu	Department of Physical and Applied Geology, Eötvös University	Pázmány Péter sétány 1/C, Budapest, H-1117 Hungary
Feist-Burckhardt	Suzanne		feistburkhardt@gmail.com	SFB Geological Consulting and Services, Odenwaldstrasse 18, D-64372 Ober-Ramstadt, Germany
Galbrun	Bruno		bruno.galbrun@upmc.fr	Université Pierre et Marie Curie, UMR 7193 ISTeP "Institut des Sciences de la Terre-Paris", Case 117 - Couloir 66-56 - 5è étage, 4 place Jussieu, 75252 Paris cedex 5 - France
Hinnov	Linda		lahinnov@gmail.com	Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD 21218 USA
Matsuoka	Atsushi		matsuoka@geo.sc.niigata-u.ac.jp	Department of Geology, Niigata University, , Niigata 950-2181, Japan
Meister	Christian		christian.meister@ville-ge.ch	Muséum d'Histoire Naturelle de Genève, Département de Géologie et de Paléontologie, 1 Rte de Malagnou, cp 6434, CH-1211 Genève 6, Switzerland.
Olóriz	Frederico		foloriz@ugr.es	Department of Stratigraphy and Paleontology, Faculty of Sciences, University of Granada, Av. Fuentenueva, s/n - 18071 Granada, Spain.
Rogov	Mikhail		russianjurassic@gmail.com	Geological Institute of Russian Academy of Sciences, Pyshevskii Lane 7, Moscow 119017
Wang	Yongdong		ydwang@nigpas.ac.cn	Nanjing Institute of Geology & Palaeontology, Chinese Academy of Sciences, Nanjing 210008, P.R. China
Bown	Paul		p.bown@ucl.ac.uk	Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT, UK
Damborenea	Susan		sdambore@fcnym.unlp.edu.ar	Departamento Científico Paleontología Invertebrados, Museo de Ciencias Naturales La Plata, Paseo del Bosque, s/n 1900 La Plata, Argentina
Ogg	James		jogg@purdue.edu	Department Earth & Atmospheric Science, Purdue Universiry, USA
Ahmad	Fayez		fayezahmad3@hotmail.com	Faculty of Natural Resources and Environment, Department of Earth and Environmental Sciences, The

				Hashemite University, P.O. Box 150459, 13115 Zarqa, Jordan
Dzyuba	Oksana		dzyubaos@ipgg.sbras.ru	IPGG SB RAS, pr. Akademika Koptyuga 3, Novosibirsk 630090, Russia
Mönnig	Eckhard		e.moennig@naturkunde-museum-coburg.de	Naturkunde-Museum Coburg, Park 6, 96450 Coburg, Germany
Pieńkowski	Grzegorz		gpie@pgi.gov.pl	Polish Geological Institute - National Research Institute, 4 Rakowiecka St., 00-975 Warszawa, Poland
Pandey	Dhirendra		dhirendrakp@gmail.com	Department of Geology, University of Rajasthan, Jaipur, India.
Mattioli	Emanuela		emanuela.mattioli@univ-lyon1.fr	Laboratoire de Géologie de Lyon:, Terre, Planètes, Environnement,UMR 5276 CNRS, Observatoire de Lyon, Université Lyon 1
Goričan	Špela		Spela@zrc-sazu.si	Institute of Paleontology, ZRC SAZU, Novi trg 2, SI-1000 Ljubljana, Slovenia

9b List of Working (Task) Groups and their officers
The active task Groups are as follows

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

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

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

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

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

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

9c Interfaces with other international projects
Members of the Jurassic Subcommission are involved in a number of international projects, normally in an individual capacity but sometimes facilitated by contacts through activities related to the Subcommission such as its Task and Working Groups and the Jurassic Congresses.

International Continental Drilling Program (IGDP) Proposal Workshop – Mochras Revisited: A New Global Standard for Early Jurassic Earth History. This project, led by ISJS Chair Stephen HESSELBO (UK), has proceeded to the third stage – full drilling proposal to be submitted January 2014. The aim is to re-drill the >1 km thick Early Jurassic succession of the Cardigan Bay Basin, UK, as a means to calibrate biostratigraphy, chemostratigraphy, magnetostratigraphy and astrochronology for what appears to be an exceptionally complete mudrock succession. ISJS members Linda HINNOV, Susana DAMBORENEA, Christian MEISTER, and Gregory PIENKOWSKI, have contributed to the proposal and/or will be members of the science team.

ProGEO and Geoparks Initiatives. The Subcommission Geoconservation Working Group (Convenor Voting Member Kevin PAGE, UK) has several links with international and national Geoconservation bodies and advisory groups

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

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

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

S.P. Hesselbo December 13th 2013.

SUBCOMMISSION ON TRIASSIC STRATIGRAPHY

ANNUAL REPORT 2013

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

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

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013
Four meetings were originally included in the program of the STS for 2013.

June 13-15, 2013, Wuhan (China), IGCP572, World Summit on P-Tr Mass extinction & Extreme climate change. More than 150 delegates from 13 countries including Australia, Austria, China, Croatia, France, Germany, Italy, Israel, Japan, Slovenia, Sweden, Switzerland, and USA attended this summit. The summit received >150 abstracts addressing various aspects on the P-Tr event and Triassic recovery as well as their causes and consequences. The program included two plenary sessions and 6 parallel sessions focusing on the causes and consequences of Permian-Triassic biocrisis and ecosystem recovery, as well as extreme climatic changes during the this critical period. Total 70 oral talks including 22 keynote lectures and 20 posters were presented at the Summit.

July 1-7, 2013, Lisboa, Strati 2013. A business meeting of the STS was originally planned for this Symposium, however, the Organizing Committee did not provide a time slot for such a meeting. The number of participants of the STS was also rather low, then the contact and discussions between the members were rather informal. Most of the STS participants attended the presentation of Spencer Lucas on Triassic chronostratigraphy.

September 23-27, 2013, 10th International Field Workshop on Triassic. The Triassic of the Iberian Range (Spain). Organizing Committee chaired by Jose Lopéz Goméz. Twentythree participants from Spain, Germany , France, Italy, Poland and China attended the meeting. Four days of the tour provided a comprehensive overview of the sequence of layers and structure of the Permo - Triassic of northeastern Spain. The focus of the trip was on developments within the Iberian basin of the initial stage in the Early Permian through to the first and second marine ingression of the Tethys in the Middle Triassic.

September 10-15, 2013, Xingyi (Guizhou, China). The 2nd International Symposium on Triassic and later marine Vertebrate faunas. The Organizing Committee included in the program one session specifically dedicated to the discussion of the problems of dating the worldwide known Anisian to Carnian Fossillagerstätten of Guizhou and Yunnan (Panxiang, Guanling, Xingyi and Luoping). About 56 participants, mostly vertebrate paleontologists, from 7 countries (China, Japan, USA, UK, Germany, Italy and Switzerland) attended the symposium and the field excursion.

The participants were notably impressed by the huge excavations carried out in the four sites. Xingyi locality (Ladinian to Carnian), in particular stood out for the accurate description and sampling of the stratigraphic section that were carried out in 2012. The preliminary data on ammonoids emphasize some significant faunal differences with respect to the Tethys and North America. The south China collections are crucial not only to date the vertebrate localities but also to complete the Late Ladinian/Early Carnian Tethyan-North America correlation chart that was calibrated in 2008 by the Ladinian/Carnian boundary Working Group of the STS in the framework of the definition of the GSSP of the Carnian stage.

Working Groups
Four formal Working Groups are active: Induan/Olenekian, Olenekian/Anisian, Carnian/Norian and Norian Rhaetian.

Induan/Olenekian
The study of the Lower Triassic is attracting quite a lot of specialists, but most of them are interested on the Early Triassic recovery (IGCP 572). Pending the publication of the revision of the Induan/Olenekian boundary conodonts, crucial for the definition of the GSSP, some members of the WG are improving the knowledge on the ammonoid faunal sequence and on its worldwide correlation. Here the most significant improvements.

- New data on Smithian (Brayard et al. in press) and early Spathian (Jenks et al., 2013) ammonoids from western US.
- Description of new Smithian ammonoid taxa by Zakharov and Moussavi Abnavi (2013) and Zakharov et al. (2013).
- Investigation of Smithian sediments at Artyom area (Smid section) in South Primorye led to identify rich ammonoid assemblages of the *Anasibirites nevolini* Zone with a nearly complete conodont record (Bondarenko et al., 2013; Zakharov et al., 2013). On the basis of the available data, the *Anasibirites* nevolini Zone in the Primorye can be correlated at least with the *Wasatchites distractus, Subvishnuites posterus* and *Glyptophiceras sinuatum* beds, recently documented in Spiti and Nammal Nala.
- New paper on gastropods from Salt Range Nammal and Chhidru sections (Kaim et al. 2013). Although not crucial for the definition of the GSSP, this paper is of great interest because the Nammal section is one of the two best sections in the world for the definition of the GSSP of the Olenekian stage.

Olenekian/Anisian
The definition of this GSSP is extremely difficult because most of the best sections in the world for this interval of time show a rather condensed record. The Working Group was completing the study of the Desli Caira section in order to support the FAD of the conodont *Chiosella timorensis* , already selected by the WG as primary event, with as many additional events as possible, when in 2012 Goudemand et al. published the discovery of this species together with Olenekian ammonoids in North America.

- In 2013, the main improvement on the O/A boundary are on the ammonoid faunal succession at Desli Caira. New collections led E. Gradinaru to recognize the a rich fauna of the *Stenopopanoceras* beds followed in sequence by the *Aegeiceras* beds. This constrains for the first time an accurate correlation of the Early Anisian ammonid faunas of the Tethyan Realm with those from the Boreal Realm, and with those from the Western Panthalassa. These earliest Anisian ammonoid faunas are in close succession with the uppermost Spathian ammonoid fauna. The WG is searching for new possible marker events in replacement of the FAD of *C. timorensis*.

Carnian/Norian
The Working Group has already selected two candidate sections: Black Bear Ridge (British Comumbia, Canada) and Pizzo Mondello (Sicily, Italy). A wealth of data have been published in 2011 and 2012, but the description of conodont record from Black Bear Ridge is still in progress. In 2011 two members of the WG have proposed the FAD of the bivalve *Halobia austriaca* as possible marker event and since then the two research groups studying Black Bear Ridge and Pizzo Mondello sections are working on the calibration of the FO of this taxon in the two candidate sections. In this respect the conodonts from Black Bear Ridge are crucial but they have never been described in a publication. The major achievements for 2013 are:

- A first paper on Black Bear Ridge conodont (Orchard, 2013) has been published. This paper contain the description of five new genera. This contribution ideally will be followed by a large sized monograph with the full description of about 80 species, that is almost ready.
- An important manuscript on ammonoids, bivalves and conodonts from the historical locality of Berlin Ichthyosaur State Park (Nevada, USA) has been submitted for publication in December by Balini et al.. Berlin section is the type section of the latest Carnian Macrolobatus Zone and shows also a good record of the earliest

Norian Kerri Zone. This section is crucial for the calibration of correlations between Tethys (Pizzo Mondello) and North America (Black Bear Ridge), because it shows and ammonoid and bivalve record with significant tethyan affinity and a conodont record with strong affinity with Black Bear Ridge.

Norian/Rhaetian

The Rhaetian stage is the most debated and poorly known stage of the Triassic system. Since 2008, Steinbergkogel, in the historical Hallstatt area (Austria), has became the most significant section for the definition of the Norian-Rhaetian boundary for its record of ammonoids, pelagic bivalves, conodonts, the additional occurrence of rare radiolarians and palynomorphs, as well as for magnetostratigraphy. In 2009, the WG selected the FAD of the conodont *Misikella posthernsteini* as primary marker event. Since then the WG is working on the building a correlation chart in support of the FAD of *M. posthernsteini*. In 2013 the activity of the WG involved:

- Attempt at the numerical calibration of the duration of the Rhaetian by using radiometric data and cyclostratigraphy.
- Replacement of the chairman of the WG. M. Balini has replaced L. Krystyn who is directly involved in the preparation of the final dossier for Steinbergkogel proposal.

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

- Tanner L.H., Spielmann J.A. and Lucas S.G. eds. (2013) The Triassic System: New Developments in Stratigraphy and Paleontology. *New Mexico Museum of Natural History & Science Bulletin* 61. 612 pp.

This special volume was conceived as an opportunity to emphasize the results of the ongoing research on Triassic, five years after the very successful volumes 40 and 41 of the New Mexico Bulletin. This time the volume is not related to a symposium, but simply it groups together contributions of the authors who accepted the open invitation of the Editors to the STS members. A total 44 contributions have been collected. A little less than 50% of them are on vertebrate paleontology, while the others cover a wide range of groups and stratigraphic tools (plants, mollusks, condonts, stable isotope, magnetostratigraphy, chronostratigraphy). All the contributions to this volume are available at the STS website: http://paleo.cortland.edu/globaltriassic2/index.html

- Albertiana. In 2013 no issues of Albertiana have been published. The newsletter has been totally re-organized (see section 3c) and is ready to publish new contributions from 2014.
- The 2nd International Symposium on Triassic and Later Marine Vertebrate Faunas. Abstract and field guidebook. V. of 82 pp. Peking University.

The volume includes 25 abstracts and extended abstracts on Triassic marine vertebrates and invertebrates. It provides a good and rather comprehensive update on the ongoing research on Anisian to Carnian fossiliferous successions from south China and their correlation with Tethys and Panthalassa.

3c. Problems encountered, if appropriate

Since several years the STS activities are affected by problems related to the global economic crisis, the aging of the STS members, the reduction of interest on GSSPs in favor of increasing interest on more appealing ad fashionable topics such as mass extinctions, the lack of IGCP cover. Some of these problems are out of any control from the Executives of the STS, but since 2011 the Executives are trying to take actions against these negative drifts.

The main action taken in 2011 was to update the list of the Corresponding members, with 31 new members. In 2012 the organization of the Working Groups was discussed by the Executives, and 2013 has been devoted to the re-organization of Albertiana, the newsletter of the STS. Albertiana is now totally renewed with a new Editor (Chris McRoberts), a new Editorial Board (M. Balini, A. Baud., P. Gianolla, M. Fraser, M. Hounslow, W. Kuerschner, S. Lucas, M. Orchard) and a new organization. The new Albertiana is now a strictly peer-reviewed journal published twice a year. The deadline for the first issue of the new Albertiana is scheduled by February 2014.
In 2014 the Voting Member list will be revised. Such a revision is usually done at the beginning of every new term, but retirements and decline of health conditions of some Voting Members require an action before the next IGC (2016).

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

- **February 12–16, 2014**. 11th International Field Workshop on Triassic. NW Gondwana margin of the Neo-Tethys (Negev, southern Israel). Organizing Committee: Dorit Korngreen (dorik@gsi.gov.il), Or Bialik, Chaim Benjamini, Rivka Rabinovich.

- **September 4-14, 2014**. 9th International Symposium Cephalopods – Present and Past ISCPP 9, Zurich, Switzerland. Organizing Committee chaired by Christian Klug (University of Zurich, chklug@pim.uzh.ch).

One session will be devoted to Triassic biochronology, biostratigraphy and chronostratigraphy. A Business Meeting of the STS is also scheduled.

- **October 19-22, 2014**. GSA Annual Meeting in Vancouver. Session "Biotic and abiotic interactions during the Early Triassic recovery", convenors H. Bucher & P. Roopnarine.

4b Specific GSSP Focus for 2014

- **Rhaetian**. Since four years, the GSSP of this stage is the one that seems to be closer to the definition. Some years ago the WG voted for the best primary marker event and the FAD of *Misikella posthernsteini*, got the majority of votes. For 3 years the Working Group has been working on the calibration of this event. This has not been an easy task, because of the small number sections with multistratigraphic record and their rather different stratigraphic settings (condensed vs expanded). The replacement by M. Balini of the past chairman of the WG, L. Krystyn, hopefully will speed the organization of the W and will leave Krystyn more time to finalize the final proposal.

- **Norian**. The production of data (range charts, taxonomic revisions) that started in 2010 is continuing. After the peak of publication in 2012, this year the first part of the revision of the Canadian conodont faunas has been published (Orchard 2013). This first contribution consists in the definition of five new conodont genera, and will be completed by a monographic description of about 80 conodont species. The long awaited monograph on north American conodont faunas is crucial for the calibration of the conodont correlations between Tethys realm and north America, then the Working Group has decided to take time and delay the ballots. Realistically if the second part of Orchard's monograph is published in 2014, the Working Group might be ready to make a decision in 2015.

- **Olenekian**. More difficult is the estimate of the time necessary for the definition of the base of the Olenekian Stage. The selection of the marker event is under discussion, but for during 2014 the leader of the research group working on the Nammal Nala section will be invited to submit to the WG a formal proposal for a ballot organized in the second half of the year.

- **Anisian**. As far as the GSSP of the Anisian Stage, there are no possibility for its definition in 2014 and probably also in 2015, due to the lack of bioevents suitable for the definition of the GSSP. The stratigraphic position of the FAD of *Chiosella timorensis*, that for several years was considered the only event suitable for the definition of the base of the Anisian, was significantly revised in 2012 and now is recognized to occur together with Olenekian ammonoids. The WG is testing the possibility to define this boundary on the basis of ammonoids.

5. SUMMARY OF EXPENDITURES IN 2013

ICS FUNDING to STS		2665
Albertiana - STS Newsletter production		500
Contribution for the invitation of Triassic specialists to Xingyi (China), September 2012		1600
Travel costs for Working Group Leaders		565
	TOTAL	2665

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014 (US$)

- Contribution to participants to the 9th Cephalopod Symposium. 2000

The ammonoids are the bio-chronostratigraphic tool with the highest power of resolution in the marine Triassic successions as demonstrated by the two last GSSPs, that have been defined on ammonoid events. The 9th Cephalopod Symposium is a very good opportunity to discuss the reasonable solutions for the GSSP of the Olenekian and that of the Norian.

- Contribution to participants to GSA Annual Meeting 2014-Session Biotic and abiotic interactions during the Early Triassic recovery. 2000

This session is an important step toward the definition of the GSSP of

the Olenekian stage.

- Travel costs of Working Group leaders 1500

Some WG leaders will be invited to attend the 9th Cephalopod Symposium or GSA Annual meeting 2014, even if these events are not in their research schedule. Their participation, however, might be crucial for the discussion on the GSSPs.

TOTAL 5500

APPENDICES

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

Organization

- Reactivation of the Induan/Olenekian Working Group in 2009, with the past chair (Y. Zakharov) confirmed.
- New chair for the Carnian/Norian boundary Working Group appointed in 2009 (L. Krystyn).
- Renewal of STS corresponding membership in 2011. Thirtyone new corresponding members have been involved in the STS.
- In November 2012 W. Kuerschner has replaced L. Krystyn as chair of the Carnian/Norian boundary Working Group, being Krystyn involved in one boundary proposal.
- In 2013 Albertiana, the newsletter of the STS, has been completely renewed. The new Editor is Chris McRoberts and the Editorial Board is now consisting of M. Balini, A. Baud, P. Gianolla, M. Fraser, M. Hounslow, W. Kuerschner, S. Lucas, M. Orchard.
- New chair for the Norian/Rhaetian boundary Working Group appointed in 2013. M. Balini has replaced L. Krystyn, who is directly involved in the preparation of the proposal.

Meetings/ workshops

- International workshop *New developments on Triassic integrated stratigraphy* , Palermo, Italy, September 12-16, 2010.
- Canadian Paleontology Conference, Vancouver, Canada, August 19-22, 2011. *Special session: Studies on the Triassic, in commemoration of Edward Timothy Tozer*.
- About 10 meetings and field workshops organized in the framework of the IGCP 572 between 2008 and 2012.
- Five International field workshops on Triassic organized every year, in the first week of September, in: Central Germany (2009), Dolomites (2010), Southern France (2011) Western Lombardy (2012) and Spain (2013).
- 2nd International Symposium on Triassic and later marine Vertebrate faunas, Xingyi (China), September 10-15, 2013.

Publications

- Three issues of **Albertiana** (#38-40) were published in 2009 thru 2012. Each of these issues was made available for download from the Albertiana website.
- Abstract volumes/ field guides prepared for meetings in Bad Goisern, Palermo, Vancouver and Xingyi.
- **Geological Society of London Special publications 334 "The Triassic Timescale"**, S.G. Lucas (ed.). The volume, printed in 2010, includes 15 contributions (515 pages) reviewing the state-of-the-art of the main tools for the definition of the Triassic time-scale, from classic fossil tools (ammonoids, bivalves, conodonts, radiolarians, palynomorphs, conchostracans, tetrapods and tetrapod footprint) to magnetostratigraphy, geochronologic data ages, isotope variations and cyclostratigraphy.
- The proceedings of "The Triassic climate" workshop, Bolzano/Bozen, 2008 have printed in April 2010 as issue #290 of **Palaeogeography, Palaeoclimatology, Palaeoecology**, The volume includes 13 contributions spanning from the Permo-Triassic to the end of the Triassic.
- The Proceedings of Palermo workshop "New developments on Triassic integrated stratigraphy", held in September 2010 has been printed in March 2012 in the **Rivista Italiana di Paleontologia e Stratigrafia**, volume 118/1.
- **New Mexico Museum of Natural History & Science Bulletin 61**, "The Triassic System: New Developments in Stratigraphy and Paleontology". Tanner L.H., Spielmann J.A. and Lucas S.G. eds. Printed in 2013, 612 pp.

Working Groups (2009-2013)

Induan-Olenekian boundary Working Group

- The Working Group has been reactivated in October 2009 (chair Y. Zakharov).

- After intensive samplings, in 2010 Hugo Bucher and his team (Switzerland), emphasized Nammal Nala section in Salt Range (Pakistan) as another possible candidate for the GSSP.
- In 2012, after the publication of ammonoid and conodont data, the Nammal Nala section results to be the more complete section and the best candidate for the GSSP. The data are presented by Goudemand et al. at 34 IGC, Brisbane, Session 35.1 GSSPs as global geostandards.
- In 2013, in the lack of the publication of the revision of the I/O boundary conodonts, the WG has improved the taxonomy and correlation of ammonoid faunal successions.

Olenekian-Anisian boundary Working Group

- In 2009 the discussion in the Working Group stalled on the isochrony of the first occurrence of *C. timorensis*. 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 to reconsider other sections as Guandao (China), characterized by good conodont record accompanied by stable isotope variations and paleomag record, or Nevada, where all the late Olenekian to early Anisian ammonoid faunas are present but not in the same section. Unfortunately no good ammonoids have been reported so far from Guandao, while the Nevada successions are usually remagnetized.
- In 2012 Goudemand et al. published the discovery of *Chiosella timorensis* from the Olenekian Haugi Zone of western Nevada (USA). This finding questions the adequacy of the FAD of this species for the definition of the GSSP of the Anisian Stage.
- In 2013 the study of new ammonoid collection done in 2012 leads to complete the record of the earliest Anisian ammonoid zones.

Ladinian-Carnian boundary Working Group

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

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

Carnian-Norian boundary Working Group

Since 2008 the Working Group has been focusing the research on two sections Black Bear Ridge (British Columbia, Canada) and Pizzo Mondello (Sicily, Italy).

- In 2009 some data from the two sections have been submitted for publications. These include stratigraphic and sedimentologic description of Black Bear Ridge section (Zonneveld et al., 2009) and conodont data from Pizzo Mondello section (Mazza et al., 2009). 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 from the two sites and discussed taxonomy in a meeting at SUNY Cortland.
- In 2010 both the candidate sections have been visited. Black Bear Ridge was visited in May by the Working Group chair and by members of the two teams working at Black Bear Ridge and Pizzo Mondello sections.
- Pizzo Mondello section was visited in September 2010, during the field trip of the Palermo workshop. During the indoor session several contributions on BBR and PM section were presented and discussed. The significance of the pelagic bivalve *Halobia austriaca* was emphasized by McRoberts, Krystyn and Levera. The significance of conodonts for the selection of the primary marker event was reduced by faunal differences.
- In 2011 the bivalve faunas from British Columbia, including the Black Bear Ridge section have been described in a large monograph by McRoberts. The possibility to define the GSSP at Black Bear Ridge section, on the basis of the FAD of the bivalve *Halobia austriaca* in anticipated by McRoberts & Krystyn, at Vancouver Conference.
- In 2011 McRobert & Krystyn proposed in a poster presentation the FAD of the bivalve *Halobia austriaca* as possible marker events. Such proposal was already discussed in some informal and formal meetings of the Working Group (2010).
- The taxonomy and biostratigraphy of ammonoids (Balini et al.), bivalves (Levera) and conodonts (Mazza et al.) from Pizzo Mondello section is published in 2012 in the Proceedings of the Palermo workshop

(**Rivista Italiana di Paleontologia e Stratigrafia**, v. 118/1), together with a paper on nannofossils (Preto et al., 2012).

- A first paper on Black Bear Ridge conodonts has been published in 2013. This paper includes the description of five new genera. A manuscript containing new ammonoid, bivalve and conodont data from the Berlin section (Berlin Ichthyosaur State Park, central Nevada, USA) has been submitted for publication. Berlin is a key section for the north American Triassic chronostratigraphic scale, because it is the best in North America for the latest Carnian ammonoid faunas but provides also a good record of the earliest Norian.

Norian-Rhaetian boundary Working Group

Since 2008, Steinbergkogel (Austria), in the historical Hallstatt area, has became the most significant section for the definition of the Norian-Rhaetian boundary.

- 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. A distinctive dinoflagellate change, which occurs with the FO of *Rhaetogonyaulax rhaetica* in the Zlambach section, is stratigraphically higher than the other two options and corresponds to another ammonoid change with the FO of the widely distributed genera *Cycloceltites* and *Vandaites*.
- In 2009, the FAD of *M. posthernsteini* was voted by the members of the WG as the best event to be used to define the boundary.
- The thickness of the boundary succession is unfortunately rather thin, and the facies is not constant, then from 2009 the research group working on the Steinbergkogel section is engaged with the search and sampling of some reference sections, in Northern and Southern Alps, crucial to demonstrate the significance of the rather thin Steinbergkogel section.
- Gardin et al. (2012) reported the occurrence of the first coccolithophores from the Norian-Rhaetian boundary interval in three sections from Northern Alps, including Steinbergkogel section. This first occurrence strengthens the position of Steinbergkogel as the best GSSP proposed section for the base of the Rhaetian.
- At the present a correlation chart for sections in the Tethyan Realm is almost ready and some possibilities of direct correlations with north America, based on conodonts of the group of *Epigondolella mosheri* is under evaluation.

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

- Full revision of the STS Website by Spring 2014.
- Definition of the GSSP of the Rhaetian Stage by 2015. The deadline for the WG is Strati 2015.
- Definition of the GSSP of the Norian stage by 2015. The deadline for the WG is Strati 2015.
- Definition of the GSSP of the Olenekian. At the present is not possible to estimate a deadline for the final decision, because the members of the Working Group are considering different boundary options (i.e., Mud Bed 12-equivalent or Mud Bed 10-equivalent) as well as different sections (Nammal Nala or Mud). Hopefully this GSSP will be defined by 2016.
- Definition of the base of the Anisian Stage by 2018. This is the most difficult boundary to be defined, for the combination of scarcity of sections and frequent condensation. The progress of the WG has been delayed in the last 10 years by the very slow progress of the investigations on the Desli Caira section in Romania.
- Improvement of the marine-land correlations, especially as regard the calibration of the correlations between the Newark Basin succession with its superb astrochronological record and the marine successions from the Tethys. Despite of several attempts, thus far the indirect correlation of the Newark with the German basin and the Tethys are still a matter of strong and lively discussions. Other continental successions of great interest are those of the Western Interior (USA) and Karoo (South Africa).
- Improvement of the numerical calibration of the Triassic chronostratigraphic scale, with special care on the definition of the duration of the Induan, Norian and Rhaetian stages. The main problem of the Induan Stage is its short duration, based on radioisotopic dating on zircons, while interpretation of sedimentary cycles in terms of Milankovitch cyclicity would suggest an about 50% longer duration. The duration of the Norian Stage has been a matter of strong discussions during the last 8 years, mostly because of the lack of tuff layers in biostratigraphically calibrated sections. Two notably different estimates have been thus far suggested, one postulating a short 10-12 myr duration while the second estimates a much longer 28myr duration.

- Establishment of Working Groups aimed at the definition of the stratotype of the Triassic Substages. The formalization of the Triassic chronostratigraphic scale below the rank of Stage, however, would be possible only after the completion of the definition of all the GSSP of the Stages.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

STS is a Subcommission of the International Commission on Stratigraphy.
Officers (chairman, two vice-chairmen, secretary), Editor/ Webmaster of newsletter Albertiana, 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.

9a Names and Addresses of Current Officers and Voting Members

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Vice Chairman: Jinnan Tong, GPMR and BGEG laboratories at China University of Geosciences, Wuhan 430074, China. jntong@cug.edu.cn
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Albertiana Editor/ Webmaster: Christopher A. McRoberts, Department of Geology, State University of New York at Cortland, P.O. Box 2000, Cortland, New York 13045 USA. mailto:mcroberts@cortland.edu

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

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***Base Rhaetian*:** M. Balini, Italy. Marco.balini@unimi.it
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9c Interfaces with other international project

The IGCP 572, that was proposed with the support of the STS ended in 2013. Some of the IGCP 572 leaders have submitted at the end of 2013 a proposal for a new IGCP on the Early and Middle Triassic recovery, biostratigraphy and marine-land correlations. This new project is fully overlapping with the STS mission but the STS was not asked to support it. As a result, the STS has no interface with IGCP project for 2014.

SUBCOMMISSION ON PERMIAN STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

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

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

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

Progress was made on the three remaining Lower Permian (Cisuralian) stage GSSPs including Sakmarian-base, Artinskian-base, and Kungurian-base.Ttwo proposals for the Kungurian-base GSSP were voted within SPS voting members, but the voting was suspended because one of the voting members circulated his vote with his favorite opinion during the last stage of voting. Although the voting continued until the deadline, no consensus was reached. Thus, SPS suggested more work to do for both candidates and will open a new voting process for those two proposals in the next future. An SPS business meeting was held on the 21st of May, 2013 at Albuquerque, New Mexico, USA during the Carboniferous-Permian Transition Meeting. Two executives and four voting members attended the workshop.

In addition, the proposals of the Sakmarian-base and Artinskian-base GSSPs have already been prepared by a working group led by Valery Chernyk and Charles Henderson. These two proposals will be published soon in the next issue of *Permophiles* (Issue 58). After the proposals are published, a one-month term for discussion will be set up, followed by a voting process within SPS voting members in 2014.

In addition, we have organized an international group to do a joint field excursion on the Guadalupian Series in West Texas in May, 2013. During this field excursion more than 800 kg samples were collected for conodonts and high-resolution geochemistry. Three GSSP markers were placed at the GSSP sections.

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

One issue of ***Permophiles*** (Issue 57) has been published in March 2013. Another issue is nearly ready to be finished. We will publish Issue 58 before the end of this year.
Two volumes of special issues on the Carboniferous-Permian Transition have been published in 2013. These two special issues have been edited by Spencer Lucas (Bulletin 59 and 60 of New Mexico Museum of Natural History & Science). More than 100 papers/abstracts including a latest Permian timescale (Shen et al., 2013) have been published in these two special issues.

3c. Problems encountered, if appropriate

We have encountered a problem when we voted for the two proposals of the Kungurian-base GSSP candidates. One of the voting member circulated his vote with his favorite opinion during the last voting stage, thus the voting was suspended.

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

The primary objectives are to complete the last three GSSPs (Sakmarian, Artinskian, and Kungurian stages). We will publish the two proposals of the Sakmarian-base and Artinskian-base GSSPs in the forthcoming issue of *Permophiles* in 2013.

4b. Specific GSSP Focus for 2014
The priority of 2014 for GSSP is voting for the proposals of the Artinskian-base and Sakmarian-base GSSPs which are now available.

5. SUMMARY OF EXPENDITURES IN 2013
A completely new website for SPS was established (http://permian.stratigraphy.org/index.asp). This website costs US$1290. Both SPS Secretary Lucia Angiolini and the former SPS Chair Charles Henderson visited Nanjing in in February, 2013 for *Permophiles* and field work in Laibin, Guangxi Province. The fund from ICS has been partly spent on paying their stay in Nanjing (US$1320). As invited by ICS, SPS chair Shuzhong Shen attended the 1st International Congress on Stratigraphy which was held in Lisbon (US$3174.6). Originally, a part of the cost to attend the congress in Lisbon should have been paid by the funds from ICS according to the Budget established in 2013, however, the expenditure has been much beyond the funds given by ICS ($2000), thus all the costs for the congress have been paid by Shuzhong Shen's project money. In addition, four bronze markers for three Guadalupian GSSPs have been made in China, and they costed $200.

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014
1) An international symposium on the Permian issues in early 2014 has been proposed by SPS Vice-Chair Joreg Schneider. We will organize a SPS business meeting to solve the last GSSP (Kungurian-base GSSP) problem and future directions for SPS ($2500). The money will be used to support the participation of some colleagues who lack funding.
2) Supporting Lucia Angiolini (SPS secretary) to come to Nanjing in March, 2014 for *Permophiles* and discussion on the plan for completion of the Sakmarian-base and Artinskian-base GSSPs within 2014: US$1500.0
3) Supporting Charles Henderson who is in charge of the two proposals to come to Nanjing in March, 2014 to 1) revise proposals, prepare voting process for the Sakmarian-base and Artinskian-base GSSPs; 2) consider and discuss a possible replacement of the Lopingian-base GSSP nearby the Penglaitan GSSP section, because the current GSSP section will be flooded within about 5-8 years, and consult local officials regarding the protection of the GSSP ($1000).

In total: US$5000.00

APPENDICES
7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2009-2014)
1) Three GSSP bronze markers have been placed on the GSSPs in the Guadalupe National Park in USA.
2) A new executive committee of SPS has been elected and nominated. Shuzhong Shen has been elected as the new chair, Jörg Schneider has been elected as the new vice-chair and Lucia Angiolini has been nominated as the new secretary of SPS. Four voting members have been replaced by new members.
3) A high-resolution timescale of the Permian system has been significantly refined (see SPS webpage Permian Timescale).
4) SPS decided to search new GSSP candidate for the Kungurian Stage after an investigation on the previous candidates. Now two candidates for the Kungurian-base GSSP are available, but further work is necessary before a voting process is conducted.
5) Significant progress on the Sakmarian-base and Artinskian-base GSSP candidates has been made. Proposals for voting will be published soon.
6) Two monuments have been built and a protected area has been established at Penglaitan, Laibin, Guangxi Province, China for the Wuchiapingian-base GSSP.
7) Five formal issues and two supplementary issues of *Permophiles* have been published since 2009.

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2014-2018)
1) Establishing the three GSSPs for the Cisuralian.
2) Establishing a working group on the Guadalupian and global correlation for chemostratigraphy and geochronologic calibration.
3) Developing a large working group on the correlation between marine and continental sequences. This has already been initiated.

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

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

1) Kungurian-base GSSP Working Group; Chair-Bruce Wardlaw.
2) Sakmarian-base and Artinskian-base GSSPs Working Group; Chair-Valery Chernykh respectively.
3) Guadalupian Series and global correlation; Chair-Charles Henderson.
4) Correlation between marine and continental Permian System; Chair-Joerg Schneider.

5) Neotethys, Paleotethys, and South China correlations; Chairs Lucia Angiolini and Yue Wang.

9c Interfaces with other international project

SPS interacts with many international projects on formal and informal levels. SPS has taken an active role in the development of a project on the correlation between marine and continental Permian sequences bilaterally supported under the foundation of the Sino-German Centre for Research Promotion (SGCRP) by NSFC and DFG. SPS is also involved in a NSFC supported key study of major biological events in the Palaeozoic. Shuzhong Shen and Yue Wang are focused on establishing a section-based Permian database in Geobiodiversity Database which has been basically completed.

SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

SUBMITTED BY
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Not yet submitted

SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY
Subcommission on Devonian Stratigraphy
Submitted by:
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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY
SDS has continued in 2013 its work on the revision of problematical GSSPs (Emsian, Devonian-Carboniferous boundary) and on the formal definition of substages. Discussions on GSSP revisions were held at the Annual Business Meeting during the SDS, SCS and IGCP 596 in March 2013. Other continued activities include multidisciplinary international correlation, the organisation of Devonian stratigraphic symposia, the publication of the SDS Newsletter and of monographic books/journal volumes. SDS objectives for 2014 onwards 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 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 28.
- Annual Business Meeting in conjunction with the 4th IPC in Mendoza, Argentina.

All listed objectives fit the directions of IUGS and ICS:

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

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013
3b List of major publications of subcommission work (books, special volumes, key scientific papers)

El Hassani, A., Becker, R.T. & Tahiri, A. 2013. International Field Symposium," The Devonian and Lower Carboniferous of northern Gondwana", Abstracts Book. *Documents de L'Institut Scientifique* N° 26, 2013, Rabat, 1-134.

Becker, R.T., El Hassani, A. & Tahiri, A. 2013. International Field Symposium," The Devonian and Lower Carboniferous of northern Gondwana", Field Guidebook. *Documents de L'Institut Scientifique* N° 27, 2013, Rabat, 1-150.

3c. Problems encountered, if appropriate

- The rarity of polygnathids at Zinzilban in the critical interval for a re-definition of the Emsian GSSP.
- The still unpublished early siphonodellids from the Uppermost Famennian of Franconia/Thuringia.
- The 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.

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

- Annual Business Meeting, jointly with IGCP 596 and D/C Boundary Task Group, at the 4th IPC, Mendoza, Argentina (October 2014).
- Editorial work for a volume on *Devonian Climate, Sea Level and Evolutionary Events* as a Special Publication of the Geological Society of London, edited by Becker, Brett & Königshof. Papers to be submitted by end January 2014
- Publication of SDS Newsletter 29 in February 2014.
- Update of SDS homepage (pdf files of former SDS Newsletters and new GSSP illustrations).

4b Specific GSSP Focus for 2013

- Active participation in joint Devonian/Carboniferous Boundary Task Group with a focus on conodont revisions and pelagic-neritic correlations.

Manuscript on Givetian and Frasnian substages for *Lethaia*.

- Active work on the redefinition and sub-division of the Emsian Stage. SDS members are collaboratively working on conodonts from Zinzilban, Uzbekistan and the Pyrenees, Spain in an attempt to find a resolution. Czech colleagues are actively pursuing the problem in the Barrandian Basin.
- Progress on Famennian substage definitions.

5. SUMMARY OF EXPENDITURES IN 2013

INCOME

Balance from 2012	0 $

EXPENSES 2013

SDS Newsletter 28	500 $
Support for SDS Vice-Chair and Secretary to attend the SDS/ICS Morocco meeting	833 $
Support/subvention from IUGS/ICS	**1333 $**

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2013

$600 for 2013 SDS Newsletter

$1500 for Vice-Chair and Secretary to attend 4th IPC in Mendoza, Argentina

$1000 for SDS TM's Valenzuela Ríos (Spain), Kim (Uzbekistan) to meet and discuss base Emsian redefinition to promote progress. New conodont samples need to be collected. This stage redefinition is the main activity that we are required to do to complete all our GSSP's.

Total Request $3100

APPENDICES

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

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

2009 9th NAPC, Cincinnati, USA
2010 3rd IPC London, UK
2011 SDS Novosibirsk, Russia
2012 34rd IGC Brisbane, Australia
2013 SDS/IGCP 596 Morocco

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

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2014-2017)

- Redefinition of the Devonian/Carboniferous Boundary with the joint Task Group.
- Publish the definitions of the Givetian and Frasnian substages in *Lethaia*.
- Redefine the base of the Emsian Stage and the new 'Zinzilbanian' sub-stage.
- Define and publish the Famennian substages.
- Annual meetings, for 2015 this is in Frankfurt jointly with IGCP 596 on completion of their project.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

CHAIR

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

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

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

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

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

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

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

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

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

The Carboniferous members are:
Jim Barrick, USA: conodonts <jim.barrick@ttu.edu>
Paul Brenckle, USA: foraminifers <saltwaterfarm1@cs.com>
Geoff Clayton, Ireland: palynomorphs <gclayton@tcd.ie>
Jiri Kalvoda, Czech Republic: foraminifers <dino@sci.muni.cz>

Rich Lane, USA: conodonts <hlane@nsf.gov>
Svetlana Nikolaeva, Russia: ammonoids <44svnikol@mtu-net.ru>
Vladimir Pazukhin, Russia: conodonts <pazukhin@mail.ru>
Edouard Poty, Belgium: corals <e.poty@ulg.ac.be>
Barry Richards, Canada, incoming Chair of SCCS: stratigraphy, Sedimentology <brichard@NRCan.gc.ca>
Yuan Jin-Liang, China: trilobites <yuanjl403@sohu.com>

9c Interfaces with other international project

SDS is traditionally strongly tied with IGCP projects that have a Devonian focus. The main current project is IGCP 596 on "Climate change and biodiversity patterns in the Mid-Paleozoic", led by P. Königshof, T. Suttner, and others. We have a joint meeting at the 4th IPC in Mendoza, Argentina.

SUBCOMMISSION ON SILURIAN STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY

International Subcommission on Silurian Stratigraphy ISSS

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

Mission statement

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

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

Goals

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

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

Silurian Times No 20 was edited by the outgoing secretary, Jacques Verniers, in March, 2013, posted on the web site for the ISSS, and circulated as an email attachment to all titular, corresponding and interested members of the Subcommission. It contained the reports on previous meetings, announcement of upcoming meetings and publications, and the latest news and recent publications on Silurian research.

The ISSS Website was moved to a more secure server and also extensively redesigned by our webmaster, Junxuan Fan. The new web site can be found at: http://silurian.stratigraphy.org/. This page is still in the process of being populated and updated in terms of content.

A major Silurian meeting was held in Lund, Sweden, in June 2013, in association with IGCP 591, as well as the Ordovician and Cambrian subcommissions. The principal conference organizers were Mikael Calner and Oliver Lehnert. An excellent field trip visited localities in SE Sweden and the Oslo region of Norway.

Work proceeds on the restudy of potential GSSP candidate sections for the Base of Wenlock and the Base of Aeronian. Four papers were presented at the Silurian meeting in Lund pertaining to recent progress related to these boundaries.

The ISSS is a key partner in IGCP 591 – The Early to Middle Paleozoic Revolution. The following additional IGCP 591 meetings occurred in 2013, involving the ISSS members of IGCP 591:

- 3rd International Conodont Symposium and IGCP 591 regional field meeting, Mendoza, Argentina , July 15-19, 2013, Organized by Guillermo L. Albanesi and colleagues.
- STRATI 2013, 1st International Congress on Stratigraphy, Lisbon, Portugal, July 3-5, 2013
- IGCP 591 project workshop at STRATI 2013: Chemostratigraphy versus biostratigraphy: reuniting micropalaeontology and geochemistry.
- IGCP 591 session at GSA Meeting, Denver, United States, 27–30 October 2013, Biological and environmental feedbacks in the colonization of the water column (T236)

3b. ISSS MAJOR PUBLICATIONS IN 2013

Lindskog, A. & Mehlqvist, K., 2013: Proceedings of the 3rd IGCP 591 Annual Meeting – Lund, Sweden, 9–19 June 2013. Lund University. 368 pp.

Holloway, D.J. & Laurie, J.R., 2013. Siluro-Devonian Studies 2. Memoirs of the Australasian Association of Palaeontologists 44, 207 pp.

A volume of short papers from the Lund meeting is in preparation.

3c. CHIEF PROBLEMS ENCOUNTERED IN 2013

There remains the old problem related to difficulties in obtaining grants for research on stratigraphical topics and travel to meetings of Subcommission. Applications are often given low priority by national grant-awarding agencies.
Last year it was reported that a potential GSSP candidate section for the Base of Wenlock, Trannon River, Wales, was under study by David Loydell and a student of his. Unfortunately, the boundary interval at that section has been proven to be inaccessible for the past three years as a result of high water levels. As a result, Dr. Loydell has shifted some of his research interest to study of a potential mid-Llandovery GSSP section in Spain. We continue to search for potentially suitable GSSP candidate sections for the base of the Wenlock.

4. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2014):

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

Publication of Silurian Times Newsletter 21 (scheduled to be out by the end of March 2014)

The ISSS will be co-sponsoring the IGCP 591 regional meeting in Kunming, China, in August, 2014. There will be several very important ISSS activities at this conference:

- A workshop on the Rhuddanian-Aeronian Boundary Working Group. At this workshop, it is planned that presentations will be made on the results of current research on R-A boundary candidate sections in Wales, Bohemia, China, and possibly Spain. Based on these results, the working group will consider criteria for definition of the boundary and further work that is required. This group also plans a meeting in Europe in 2015 to visit the European sections and then proceed to decision-making process.
- The Rhuddanian-Aeronian Boundary Working Group is discussing a proposal to implement a new, innovative approach to consideration of GSSP candidate sections and improving correlation among sections. It is proposed that as the data from each candidate section are assembled, all of the biostratigraphic, chemostratigraphic, and other data useful for correlation, will be assembled into a database (the Geobiodiversity Database), along with data from other sections, globally. These data will then be studied using quantitative correlation methods, such as CONOP9 and Horizon Annealing. These methods allow for simultaneous correlation of many sections using a range of different types of stratigraphic data, producing a high-resolution correlation between all sections. This approach permits integration of data from different fossil groups that only rarely co-occur, as well as chemo- and lithostratigraphic and radiometric data, thus permitting correlation between different facies and paleogeographic regions. They also permit quantitative assessment of the precision with which particular levels at any given section can be placed within the composite succession. We feel that this may be a good approach to find a GSSP level that can be correlated globally with the highest level of precision and confidence.
- We are planning a field trip to a locality in the western Hubei Province that is being proposed as a potential GSSP candidate section for both the base of the Aeronian and the base of the Telychian. It will probably be arranged just before the Kunming meeting next August, and will take about 4 days. We hope to secure funding from ICS through a separate grant proposal that will help make it possible for all of the members of the R-A boundary working group to participate in this field trip.
- The ISSS proposes to establish a working group for restudy of the Aeronian-Telychian Boundary.

The ISSS is a key partner in IGCP 591 – The Early to Middle Paleozoic Revolution. The planned milestone for IGCP 591 for 2014 is “Biological and chemical indicators of climate events”. Besides the Kunming meeting, noted above, the main annual meeting of IGCP 591 for 2014 will take place in June, in Tartu, Estonia.

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

5. SUMMARY OF EXPENDITURES IN 2013

Income	
Carried forward from 2012	US$4,000
ICS Allocation	US$3,333
Total	US$7,333
Expenditures	
Expenses for ISSS Chair to attend ISSS Meeting, Lund	US$2,500
Expenses, ISSS Chair to travel to China to study GSSP candidate section for base of Aeronian and Base of Telychian	US$1,500
Bank fees for ISSS account	US$ 14
Total	US$4,014
Balance	US$3319

6. BUDGET AND ICS COMPONENT FOR 2014

Contribution toward transportation, accommodation & registration of the Chair and Vice-Chair, to participate in the field meeting of the the ISSS in China	US$4000
Financial support for other members studying potential GSSP candidate sections for the base of Aeronian and base of Telychian (includes six other researchers).	US$12,000

The ISSS has done pioneering work in the area of restudy of previously ratified GSSPs. Recent work has shown that many of the Silurian GSSPs, all of which were ratified in the mid-1980s, have serious deficiencies in terms of their potential use as benchmarks for high-resolution global correlation. Two working groups are currently focusing on restudy of the base of the Aeronian Stage (R-A boundary) and the base of the Wenlock Series. Future working groups will study the other GSSPs of Silurian System. The money carried over from 2013 combined with our requested will be used to help fund the ISSS Chair and Vice-chair and other members of the R-A boundary working group travel to China for the 2014 meeting in Kunming. The funds will be particularly directed at young members of the working group, and members who have no access to other funds for international travel. The ISSS will be submitting a separate proposal for funds to support the costs of the R-A Boundary Working Group field trip within China, to the western Hubei Province, to study the potential GSSP candidate sections there.

Total proposed budget for 2014	US$16,000
Balance forward from 2013	US$3319
Total requested from ICS for 2014:	**US$12,681**

Potential funding sources outside IUGS

Most of the remaining costs of Working Group newsletter, meetings and other activities will be met by local support from host institutions and participation by individuals through national research grants and travel grants from their own authorities. However, such sources of funding are getting increasingly difficult to secure, particularly in North America and Europe.

APPENDIX

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

Over the period of 2009-2013 the Subcommission on Silurian Stratigraphy was active in several respects. The most recent of these activities are summarized above under the heading of "CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013". In addition to those, the following are the most significant accomplishments of the past five years.

ISSS members organized or participated in 15 conferences related to IGCP 503 and 591. ISSS members were also leaders in the planning and are actually leading the conduction of IGCP 591.

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., which was dedicated to Prof. Enrico Serpagli. B. Time and Life in the Silurian: a multidisciplinary approach - Field Trip Guidebook **-** Corradini C., Ferretti A. & Storch P. (Eds.), 96 pp. 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*).

A proceedings volume from this conference was published in a special issue of *Bollettino of the Società Paleontologica Italiana in 2010*.

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.

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

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

As part of the ongoing efforts to resolve this problem of the GSSP for the Base of the Wenlock the ISSS voting member Dr. P. Štorch has been working with Chinese researchers on a 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. As noted above, new research on this problem is under way.

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. Petr Štorch has agreed to lead this working group.

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

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

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

A thematic volume of twelve papers emerging from the ISSS field meeting of 2011 was published in 2012 in the Bulletin of Geosciences, edited by David Loydell.

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

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2014-2017)

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

Research is currently under way or planned to begin in 2014 by ISSS members, colleagues and students on base of Aeronian, Telychian and Sheinwoodian sections in UK, Czech Republic, Spain and China, as part of the process of selection of possible new GSSP sections.

A field meeting is being planned for the summer of 2015 in Europe, possibly in association with the International Congress on Stratigraphic in Graz, Austria. This field meeting will be a workshop to visit and discuss GSSP candidate section in Europe. We hope to be in a position to vote on proposals for the Base of the Aeronian shortly after that meeting.

Silurian Symposium for 2015. Ottawa, Canada, July, 2015, final dates TBA. This meeting will be held in association with the annual meeting of IGCP 591 and the International Subcommission on Cambrian Stratigraphy. Planning is under way for the conference sessions, a Silurian field trip to Anticosti Island and a published volume of papers. Discussions with Canadian Journal of Earth Sciences are under way for the conference volume.

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

Upcoming IGCP 591 meetings include:
Evolutionary paleoecology and paleobiogeography, IGCP 591 Annual Meeting, Estonia
June 10-19, 2014

IGCP 591 Field Workshop, Kunming, China, August 12-22, 2014. This will also be a Field Meeting of ISSS.

IGCP 591 Annual Meeting, Ottawa, Canada, July, 2015

IGCP 591 Annual Meeting, Lille, France, 2016.

We are working on the development of databases 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 Geobiodiversy Database (GBDB) is currently in the advanced development stage.

9. ORGANIZATION

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

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

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

Subcommission officers

Chairman: Michael J. Melchin, Department of Earth Sciences, St. Francis Xavier University, Antigonish, NS, Canada, B2G 2W5; mmelchin@stfx.ca.
Vice Chairman: Peep Mannik, Institute of Geology at Tallinn University of Technology Ehitajate tee 5, 19086 Tallinn, Estonia; peep.mannik@ttu.ee.
Secretary: Renbin Zhan, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China, rbzhan@nigpas.ac.cn

List of Voting Members in 2013

A. I. Antoshikina, Syktyvkar, Russia, antoshkina@geo.komisc.ru
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Zhan Renbin, Nanjing, China, rbzhan@nigpas.ac.cn

Working Task Groups
Base of Wenlock GSSP Restudy – Chair – David Loydell
Base of Aeronian GSSP Restudy – Chair - Petr Štorch

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

SUBCOMMISSION ON ORDOVICIAN STRATIGRAPHY

ANNUAL REPORT 2013

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

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

Specific objectives are:

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

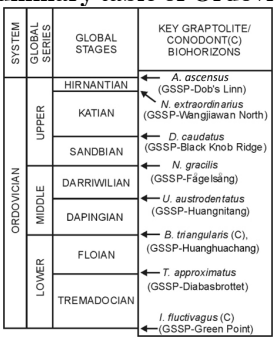
b. To promote regular international meetings on all aspects of Ordovician geology, especially those devoted to clarifying stratigraphic procedures, nomenclature and methods for use in establishing a unified global time scale and to prepare correlation charts with explanatory notes (the main phase of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

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

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

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

3. Summary table of Ordovician subdivisions



4. Organization

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

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

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

5. Interfaces with other international projects

IGCP Project 503 (now completed): 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. IGCP project n° 503, a new successor project (IGCP project n° 410) developed a better understanding of the environmental changes that influenced the biodiversity trends in the Ordovician and Early Silurian. In this project, the major objectives were 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 of the project 'Early Palaeozoic biogeography and palaeogeography' published by the Geological Society (Harper and Servais [eds], Memoir 38) has now been printed (see below).

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

6. Chief accomplishments and products in 2013 cycle

a. ***Ordovician News No. 30*** was produced and posted on the Subcommission website and is available for download.

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

c. **Publication of the Geological Society, London Memoir 38, 'Early Palaeozoic biogeography and palaeogeography'.** This Memoir, edited by Harper and Servais, first introduces the content, some of the concepts involved in describing and interpreting palaeobiogeography, and the changing Early Palaeozoic geography is illustrated through a series of time slices. The subsequent 26 chapters, compiled by some 130 authors from over 20 countries, describe and analyse distributional and in many cases diversity data for all the major biotic groups plotted on current palaeogeographic maps. Nearly a quarter of a century after the publication of the 'Green Book' (Geological Society, London, Memoir 12, edited by McKerrow and Scotese), improved chronostratigraphic and taxonomic data together with more accurate, digitized palaeogeographic maps, have confirmed the central role of palaeobiogeography in understanding the evolution of Early Palaeozoic ecosystems and their biotas. All the articles are now available online through the Geological Society's 'Lyell Collection'.

d. A substantial GFF special issue, arising from the IGCP 591 meeting in Lund, edited by Calner, Lehnert, Albanesi, Babcock, Harper & Melchin: Early Palaeozoic Global Change, is near completion and many articles are already available online through the Taylor and Francis website.

7. Chief problems encountered in 2013

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

8. Summary of expenditure for 2012-2013

TOTAL INCOME (from ICS): USD 2666

a. Support for attendance of officers and presenters at the Lund, IGCP 591: 1630 USD.
b. Grant towards production of Geol. Soc. Memoir on Early Palaeozoic biogeography and geography (colour figures): USD 980.
c. Miscellaneous costs: USD 56

TOTAL EXPENDITURE **USD 2666**

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

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

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

c. Management of Subcommission will move to Tallinn with a new webmaster, Dr Olle Hints. **This has been achieved.**

d. The subcommissions will participate in various meetings (and publications arising from these meetings) during 2014, notably in Kunming (August) and Tartu (June).

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. This remains the case.**
2. Clearly the Subcommission can now move with some confidence towards confirming and establishing finer divisions of Ordovician time. In this respect Bergström et al. (2009: *Lethaia*) have divided our international stages into stage slices based mainly on existing biozones. Finer time slices were also proposed by Webby (2004: *The Great Ordovician Biodiversification Event*, Columbia University Press) and used effectively in developing data for the GOBE. As these time divisions are more widely adopted, it would be useful to confirm their definition and status. These time slices have been used in the recent *Palaeogeography, Palaeoclimatology, Palaeoecology* special issue on the palaeoecology of the GOBE edited by Servais and Owen (2010).**This was addressed at the Madrid and Brisbane meetings. There is been no strong commitment to take this forward to date.**
3. Over the last few years we have neglected somewhat the role of the regional groups and the many important regional and diverse stratigraphies that make our system so exciting. A number of the key regional successions were included in the correlation charts provided by Bergström et al. (2009), but there more that require calibration with our new stages. Moreover a few regions such as Baltoscandia and SE Asia were never formally published. This is a priority for our system and work that can involve all our colleagues. **This was fully addressed at the IGC in Brisbane.**
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 were 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 has formed the basis for many chapters in the recently published GSL Memoir on Early Palaeozoic biogeography and geography edited by Harper and Servais (2013).**
7. We already have a number of robust absolute dates for parts of the system but it would useful to develop more, not least to be able to calibrate the true rates of biological and geological process occurring during the period. **Discussions are now ongoing with a number of geochronology laboratories, for example the StarPlan group in Copenhagen, whose terrestrial dating facility is headed up by Dr Jim Connelly. These discussions are ongoing (see workplan for 2014).**
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 requested for 2012-2013

1. Seedcorn funding for Radiogenic dating programme, mainly fieldwork costs: 2500 USD
2. Support for attendance at IGCP Annual Meeting, Tartu (June 2014): 1000 USD
3. Support for attendance at IGCP Field Meeting, Kunming (August 2014): 2500 USD.

TOTAL 2013-2014 BUDGET: 6000 USD
REQUESTED FROM ICS: **6000 USD**

Potential funding sources outside IUGS
The Subcommission officers are mainly supported by their research projects for most of their activities.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

cc. Publication of the Geological Society, London Memoir 38, 'Early Palaeozoic biogeography and palaeogeography'. This Memoir, edited by Harper and Servais, first introduces the content, some of the concepts involved in describing and interpreting palaeobiogeography, and the changing Early Palaeozoic geography is illustrated through a series of time slices. The subsequent 26 chapters, compiled by some 130 authors from over 20 countries, describe and analyse distributional and in many cases diversity data for all the major biotic groups plotted on current palaeogeographic maps. Nearly a quarter of a century after the publication of the 'Green Book' (Geological Society, London, Memoir 12, edited by McKerrow and Scotese), improved chronostratigraphic and taxonomic data together with more accurate, digitized palaeogeographic maps, have confirmed the central role of palaeobiogeography in understanding the evolution of Early Palaeozoic ecosystems and their biotas. All the articles are now available online through the Geological Society's 'Lyell Collection'.

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

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

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

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

SUBCOMMISSION ON CAMBRIAN STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY
International Subcommission on Cambrian Stratigraphy

Prepared by: Prof. Per AHLBERG, Secretary, per.ahlberg@geol.lu.se
Prof. Loren E. BABCOCK, Chair, loren.babcock@geol.lu.se
Date: 24 December 2013

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY
2.a. Mission Statement
The Subcommission is the primary body for facilitation of international communication and scientific cooperation on Cambrian stratigraphy.

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

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

3.a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

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

1) 18th International Field Conference on Cambrian Stage Subdivision, Sweden, Norway
The 18th International Field Conference on Cambrian Stage Subdivisions was held in association with meetings of the Ordovician and Silurian subcommissions in June 2013 in Lund, Sweden. The meeting was organized under International Geoscience Programme Project 591, as its 3rd Annual Meeting, with Mikael Calner as the chief organizer. An abstract volume and a field guide (Sveriges geologiska undersökning, Rapporter och meddelanden 133) were published, and a theme issue of GFF containing papers resulting from presentations at the meeting is nearly completed. The GFF issue is being published under the lead editorship of Mikael Calner.

2) ISCS Webpage
The Cambrian Subcommission's webpage was completely revised, updated, and posted in 2013. The webpage accounts for the many important changes that have occurred with respect to global chronostratigraphy of the Cambrian System, and includes updated contact information, lists of important publications, and other essential information.

3.c. Problems encountered
The principal difficulties encountered in 2013 were: 1, obtaining funding to support basic research on key stratigraphic intervals (potential GSSP horizons and sections); and 2, obtaining funding to support travel. A modest increase in funding for the coming year would be of great benefit to members of some of the Working Groups on key horizons who have limited access to funding through nationally competitive research grants.

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

In 2014 the Cambrian Subcommission will continue work toward defining GSSPs for provisional stages 2, 3, 4, 5, and 10. In addition, the Subcommission will examine issues surrounding possible redefinition of the Cambrian GSSP.

4.b. Specific GSSP Focus for 2014

Within the next year, provisional Stage 5 (and Series 3) is expected to be defined. Earnest work toward definition of a GSSP for the base of provisional Stage 5 has been ongoing for several years, and it is hoped that we can arrive at a decision in the next year.

5. SUMMARY OF EXPENDITURES IN 2013

INCOME	
Carried forward from 2012	$ 0.00
ICS Allocation	$ 3666.70
SUBTOTAL 2013 income	$ 3666.70
EXPENDITURE FROM 2013 BUDGET	
Contribution to officer's travel expenses	$ 3666.70
(travel expenses actually exceeded the budget)	
SUBTOTAL 2013 expenditures	$ 3666.70
To be carried forward to 2014	$ 0.00

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014

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 2014 because of the need for Voting Members of the Subcommission to be present at the ISCS field meeting in Morocco. The proposed increased funding is also targeted at field research on key sections by Working Group members and young scientists.

INCOME	
Carry-over from 2013	$ 0.00
PLANNED EXPENDITURES FOR 2014	
Preparation for the 19th Cambrian Stage Subdivision Working Group Conference in Morocco	$ 1000.00
Executive and VMs travel costs, Cambrian Subcommission field meeting	$ 3000.00
Support for 2 young scientists to attend the field meeting	$ 2000.00
General office expenses	$ 100.00
TOTAL 2014 PLANNED EXPENSES	$ 6100.00
ICS 2014 BUDGET REQUEST	$ 6100.00

APPENDICES

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

- From 2009 to 2013 the Cambrian Stage Subdivision Working Group has made five reconnaissance visits to sections in association with international field conferences. Areas visited are Kazakhstan (2009), the Czech Republic and Germany (2010), the southern Great Basin, USA (2011), Guizhou, China (2012), and Scandinavia (2013).
- In association with each of the field conferences, regional and/or global correlation charts have been published in technical papers.
- The Cambrian Subcommission has devised a plan for subdividing the Cambrian System into four series and 10 stages. The two lower series will embrace two stages each, and the upper two series will embrace three stages each. Through 2007, two series (Terreneuvian and Furongian) and four stages (Fortunian, Drumian, Guzhangian, and Paibian) had been ratified. Since that time, one stage, the Jiangshanian has been ratified (2011).
- Beginning with the Jiangshanian Stage, the Cambrian Subcommission has been interested in establishing ASSPs. An ASSP for the Jiangshanian was approved in 2012.

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

- The principal objective of the Subcommission for 2014 is to narrow possibilities for horizons and GSSP stratotypes for the remaining undefined stages, which are provisionally identified as stages 2, 3, 4, 5, and 10.
- The ISCS has developed a prioritized plan for formalizing definition of the remaining undefined GSSPs. The plan is:
  1) Within the next year, provisional Stage 5 is expected to be defined.
  2) Provisional Stage 10 is expected to be defined next, but a decision on a GSSP is likely to be at least two years away.
  3) Following a decision on Stage 10, provisional stages 2, 3, and 4, are expected to be defined in rapid succession. A decision on the preferred GSSP horizon of any one of the three stages will restrict choices for the remaining two stages, so the ISCS is approaching work toward definition of the three stages as closely linked.
  4) A more long-term objective is re-examination of the Cambrian System (Terreneuvian Series, Fortunian Stage) GSSP. Imprecision in correlating the lower boundary of the Cambrian System has been encountered on all paleocontinents, and the ISCS is now engaged in seeking a practical solution to remedy the problem. A decision on how to proceed with the Cambrian GSSP is expected to be made following ratification of GSSPs for stages 2, 3, and 4.

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9.a. Names and Addresses of Current Officers and Voting Members

Subcommission officers (2012-2016)

Chairman: Loren E. Babcock (USA, Sweden) loren.babcock@geol.lu.se
Vice-Chair: Xingliang Zhang (China) xzhang69@nwu.edu.cn
Secretary: Per Ahlberg (Sweden) per.ahlberg@geol.lu.se

List of Voting Members (including officers) for 2012-2016

1) Per Ahlberg, Lund, Sweden per.ahlberg@geol.lu.se
2) José-Javier Álvaro, Villeneuve d'Ascq, Spian jose-javier.alvaro@uni-lille1.fr, alvarobjj@cab.inta-csis.se
3) Loren E. Babcock, Columbus, USA, and Lund, Sweden loren.babcock@geol.lu.se, lbabcock@ccad.edu
4) Gabriella Bagnoli, Pisa, Italy bagnoli@dst.unipi.it
5) Duck K. Choi, Seoul, Korea dkchoi@snu.ac.kr
6) Olaf Elicki, Freiberg, Germany elicki@geo.tu-freiberg.de
7) Gerd Geyer, Germany gerd.geyer@mail.uni-wuerzburg.de.
8) Rodolfo Gozalo, Valencia, Spain rodolfo.gozalo@uv.es
9) James B. Jago, Mawson Lakes, Australia jim.jago@unisa.edu.au
10) Pierre D. Kruse, Darwin, Australia pierre.kruse@dme.nt.gov.au
11) Linda B. McCollum, Cheney, Washington, USA lmccollum@ewu.edu
12) Malgorzata Moczydlowska-Vidal, Sweden malgo.vidal@pal.uu.se
13) Elena B. Naimark, Moscow, Russia naimark@paleo.ru
14) Tatyana V. Pegel, Novosibirsk, Russia pegel@mail.ru
15) Shanchi Peng, Nanjing, China scpeng@nigpas.ac.cn
16) Leonid Popov, Wales, UK leonid.popov@museumwales.ac.uk
17) Brian R. Pratt, Saskatchewan, Canada brian.pratt@usask.ca
18) Matthew R. Saltzman, Columbus, Ohio, USA saltzman.11@osu.edu
19) Michael Steiner, Berlin Germany michael.steiner@FU-Berlin.de
20) Alexey I. Varlamov, Moscow, Russia varlamov@sniiggims.ru.vcf
21) Mark Webster, Chicago, Illinois, USA mwebster@geosci.uchicago.edu
22) Xingliang Zhang, Xi'an, China xzhang69@nwu.edu.cn
23) Maoyan Zhu, Nanjing, China myzhu@nigpas.ac.cn
24) Anna Zylinska, Warsaw, Poland anna.zylinska@uw.edu.pl

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

1. WG on Stage 10 GSSP, chaired by Per Ahlberg (Sweden)
2. WG on Stage 5 GSSP, chaired by Linda B. McCollum (USA)
3. WG on Stage 4 GSSP, chaired by James B. Jago (Australia)
4. WG on Stage 3 GSSP, chaired by Xingliang Zhang (China)
5. WG on Stage 2 GSSP, chaired by Michael Steiner (Germany)

9.c. Interfaces with other international projects

In 2013, the Cambrian Subcommission held its annual meeting and field conference jointly with the Ordovician and Silurian Subcommissions in Lund, Sweden. The joint meeting was coordinated under International Geoscience Programme Project 591, as its 3rd Annual Meeting. The Chairman of the Organizing Committee was Mikael Calner, Lund, Sweden.

In 2014, the Cambrian Subcommission will hold its annual field meeting in Morocco in September. Javier Álvaro is coordinating the meeting plans with the Moroccan Geological Survey, which is actively working on Neoproterozoic and lower Paleozoic stratigraphy in that country.

The Cambrian Subcommission is also co-sponsoring two other meetings in 2014. One is in India in January, and the other is in Yunnan, China, in August.

SUBCOMMISSION ON EDIACARAN STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY

Subcommission on Ediacaran Stratigraphy

Submitted by:

Dr. Shuhai Xiao, Chair
Department of Geosciences, Virginia Tech, Blacksburg, VA 24061, USA
Tel. 540-231-1366, Fax. 540-231-3386
Email: xiao@vt.edu

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Mission statement

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

Goals

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

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

Fit within IUGS Science Policy

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

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

- Corresponding member Alexander Liu is preparing a list of Ediacaran fossil sites in order to promote some of them as UNESCO world heritage sites. One example of his compilation can be found at http://www.charniaresearchgroup.com/index.html.
- The first annual newsletter was disseminated in February 2013.
- An international field workshop, sponsored by the Subcommission and entitled "The Neoproterozoic Paraguay Belt (Brazil): glaciation, iron-manganese formation and biota" was held at Campo Grande and Corumbá, Brazil, August 4-9, 2013. The workshop was organized by corresponding member Detlef Walde at Universidade de Brasília. Voting members (Alan J. Kaufman, Chuanming Zhou) and corresponding members (Paulo Boggiani, Claudio Gaucher, Patricia Rich) participated in the workshop.
- Corresponding member James D. Schiffbauer and Chair Shuhai Xiao organized a symposium on Ediacaran-Cambrian transition at the 2012 Geological Society of America annual meeting in Charlotte, North Carolina.

Based on this symposium, a special issue of Journal of Paleontology edited by Schiffbauer and Xiao will be published in March 2014.

- Following the 2012 Subcommission field trip in South China and in preparation for the 2014 Subcommission field workshop in Yichang (June 11-22, 2014), Subcommission chair Shuhai Xiao, voting members (Chuanming Zhou and Xunlai Yuan), and corresponding member (Pengju Liu) carried out joint field excursion to examine outcrops and sections to be visited in 2014. Extensive discussion with members of the Cryogenian Subcommission (Graham Shields-Zhou, Maoyan Zhu, and Linzhi Gao) resulted in a joint field workshop with the Cryogenian Subcommission. Logistic arrangement has been made and the first circular has been sent out.
- Subcommission chair organized a symposium "Critical Transition in the History of Life and Earth" at the GSA-GSC joint meeting in Chengdu, China, on June 17-19, 2013.
- The 2014 International Field Workshop on the Marwar Supergroup, Rajasthan, western India will be held on 20th-28th January 2014. Corresponding member Mukund Sharma is the organizer of this field workshop, which is co-sponsored by the Subcommission. This field trip will examine the Ediacaran and Cambrian successions, as well as numerous Ediacara fossils reported by Indian paleontologists.
- Voting members Jim Gehling and Guy Narbonne are organizing a symposium on "Neoproterozoic palaeobiology: preservation, palaeobiology, environments and phylogeny" at the 4th International Paleontological Congress (September 28 - October 3, 2014; Mendoza, Argentina)
- Voting member Jose-Javier Alvaro is organizing a field workshop on the Ediacaran-Cambrian stratigraphy of Morocco (September 15-24, 2014; Ouarzazate, Morocco). This field workshop is jointly sponsored by the Ediacaran and Cambrian Subcommissions.
- Secretary Marc Laflamme is putting together a symposium on "Ediacaran Environments and Ecosystems" at the 10th North American Paleontological Convention (February 15-18, 2014; Gainesville, Florida). Abstracts have been accepted from several international voting and corresponding members.

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

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3c. PROBLEMS ENCOUNTERED IN 2012

None.

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

- Subcommission annual newsletter will be distributed in the Spring of 2014. Secretary Dr. Marc Laflamme has solicited information from voting and corresponding members and is presently compiling the annual newsletter.
- Continue to update Subcommission webpage (http://www.paleo.geos.vt.edu/Ediacaran/).
- Several field workshops and symposia, with a strong focus on Ediacaran stratigraphy, will occur in 2014. These are listed below.
    - International Field Workshop on the Marwar Supergroup, Rajasthan, western India (20th-28th January 2014): First circular has been sent out; Organizer: Dr. Mukund Sharma (corresponding member);

- Symposium "Ediacaran Environments and Ecosystems" at the 10th North American Paleontological Convention (15th-18th February 2014; Gaineville, Florida): http://www.flmnh.ufl.edu/napc/; Organizers: Lydia Tarhan and Marc Laflamme (secretary and voting member);
- ICS Ediacaran-Cambrian Joint Field Workshop on Ediacaran-Cambrian Stratigraphy (15-24th September 2014, Ouarzazate, Morocco): First circular has been sent out; Organizer: Dr. J. Javier Álvaro (voting member);
- ICS Ediacaran-Cryogenian Joint Field Workshop on Cryogenian-Ediacaran Stratigraphy (11-22nd June 2014, Yichang, China): First circular has been sent out; Organizers: Shuhai Xiao (Chair), Chuanming Zhou (voting member), Linzhi Gao, Pengju Liu, Chongyu Yin (voting member), Xunlai Yuan (voting member), Maoyan Zhu (voting Member),
- Symposium "Neoproterozoic palaeobiology: preservation, palaeobiology, environments and phylogeny" at the 4th International Paleontological Congress (September 28 - October 3, 2014; Mendoza, Argentina): http://www.ipc4mendoza2014.org.ar/; organized by Jim Gehling and Guy Narbonne (both voting members)

- Participants in these field workshops and symposia will discuss the criteria and protocols for the subdivision of the Ediacaran Period, following guidelines resulting from a 2009 survey, which are summarized below.
  - There is very clear consensus that stable carbon isotopes, acritarchs, and Ediacara fossils are the most practical correlation tools. Ediacaran glaciations and oxidation events may be useful. There is very little support for stromatolites or the Acraman impact events as interregional correlation tools.
  - We should focus on successions with mixed lithologies, geochronological constraints, and chemostratigraphic and biostratigraphic potential.
  - We should proceed from Series to Stages, rather than from Stages to Series (as practiced in Phanerozoic stratigraphy). The Ediacaran System can be divided two or more Series.
  - Although the Series boundary should be unambiguously defined, at the present it is perhaps unrealistic to use the FAD or LAD of an Ediacaran species (with possible exception of *Cloudina hartmannae*) for global correlation. Thus, we should aim at characterizing the Series using a combination of bio- and chemostratigraphic features (e.g., one or two Series in the lower Ediacaran System characterized by Ediacaran acanthomorphs; one or two Series in the upper Ediacaran System characterized by macroscopic Ediacara fossils and skeletal fossils; alternatively, three Series each characterized with a carbon isotope cycle).
  - The broad congruency between evolutionary and physical events in the Ediacaran Period is encouraging, but the uncertainties about each individual criterion demand that we should adopt a holistic approach (i.e., using multiple criteria in order to maximize the usefulness of the GSSP).
  -

4b Specific GSSP Focus for 2014

- Following discussion at the China field workshop, a vote will be called to decide

(1) What criteria will be the most useful in Ediacaran subdivision and correlation? The results from this vote will be used as a basis for subsequent decisions concerning System-level subdivisions.
(2) Whether the Ediacaran System should be divided into two or three series.

5. SUMMARY OF EXPENDITURES IN 2013:

INCOME
Forwarded from 2012 US$ 458
ICS US$ 3333
Total US$ 3791

EXPENDITURES
2013 Travel expenses US$ 2550
Administration, website development and maintenance US$ 350
Total US$ 2900

To be carried forward to 2014 US$ 891

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014

In 2014, there will be three field workshops sponsored by the Subcommission. These field trips will be in South China, western India, and Morocco. Additional Subcommission activities are planned at the IPC (Argentina), NAPC (Florida), and GSA (Vancouver) meetings. Of these, the South China field trip—Yangtze Gorges 2014—is critical for Ediacaran

subdivision and eventually the establishment of series-level GSSPs of the Ediacaran System. The organization committee of the Yangtze Gorges 2014 field trip has already received several applications for financial assistance from graduate students, post-doctoral fellows, and young scientists. We anticipate multiple awards, equivalent to the full waiver of the $1,200 registration fees for seven participants (total amount $8,400). To meet this financial challenge, we have already submitted a proposal to the Chinese Academy of Sciences to request some modest financial assistance. We are also requesting **$3,000** from the ICS NSF grant to support this field workshop, in addition to the regular budget request of **$5,109**.

PROJECTED EXPENSES
General office expenses and website maintenance US$ 400
Travel expenses for China, India, and Morocco field trips US$ 4,200
Financial assistance for graduate students and young scientists who will participate in the Yangtze Gorges 2014 workshop US$ 8,400
Total US$ 13,000

PROJECTED INCOME:
Carried over from 2013 US$ 891
Requested: ICS NSF project to support the Yangtze Gorges 2014 field workshop US$ 3,000
Requested: Chinese Academy of Sciences grant to support the Yangtze Gorges 2014 workshop US$ 4,000
Total US$ 891

BUDGET REQUESTS US $5109

APPENDICES
7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2008-2013)

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.

2009:

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

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

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

2010:

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

2011:

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

- Ballot on dissolution of Neoproterozoic Subcommission and establishment of two separate subcommissions for the Cryogenian and Ediacaran periods, respectively.

2012:

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

2013:

- See above.

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

The Ediacaran Subcommission aims to encourage research that will facilitate a consensus subdivision of the Ediacaran System (circa 635 – 542 Ma).

2014:

- Field workshops and symposia to be held in India, South China, and Morocco, with a focus on the search for appropriate criteria for the subdivision of the Ediacaran Period.
- After initial discussion at the South China workshop, a vote will be called to decide whether the Ediacaran System should be divided into two or three series and what criterion or criteria will be the most useful in Ediacaran subdivision and correlation.

2015-2016:

- Additional field trips to be organized to examine potential GSSP sections for Ediacaran subdivisions.
- Submission and discussion of formal proposals for Ediacaran Stage GSSP(s);

2016-2017:

- Review and vote on Ediacaran Stage GSSP proposals.

2017:

- Ratification of Ediacaran Stage GSSP(s).

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

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

Officers

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

Voting Members

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

Corresponding Members

• Antcliffe Jonathan	Bristol University, UK
• Boggiani, Paulo César	São Paulo, Brazil
• Butterfield, Nicholas	Cambridge, UK
• Chen, Xiaohong	Wuhan
• Chumakov, Nikolay	Moscow, Russia
• Erwin, Douglas	Smithsonian NMNH, USA
• Evans, David A.D.	Yale University, USA
• Fedonkin, Mikhail	Moscow, Russia
• Frimmel, Hartwig	Wuerzburg, Germany
• Gaucher, Claudio	Montevideo, Uruguay
• Hoffmann, Karl-Heinz	Windhoek, Namibia
• Hofmann, Mandy	Germany
• Jenkins, Richard	Adelaide, Australia
• Khomentovsky, Vsevolod	Novosibirsk, Russia
• Knoll, Andrew H.	Harvard University, USA
• Kochnev, Boris	Novosibirsk, Russia

• Linnemann, Ulf	Dresden, Germany
• Liu, Alex	Cambridge, UK
• Liu, Pengju	Beijing
• Melezhik, Victor	Norway
• Nagovitsin, Konstantin	Novosibirsk, Russia
• Patricia Vickers-Rich	Monash University, Australia
• Pokrovskii, Boris G.	Russia
• Rainbird, Robert	Ottawa, Canada
• Schiffbauer, James D.	University of Missouri, USA
• Semikhatov, Mikhail A.	Moscow Russia
• Sergeev Volodya	Russia
• Sperling, Erik	Harvard University, USA
• Van Kranendonk, Martin	University of New South Wales
• Detlef Walde	Universidade de Brasília
• Walter, Malcolm	Sydney, Australia
• Wang, Xiaofeng	Wuhan
• Weiguo, Sun	Nanjing, China

9b List of Working (Task) Groups and their officers
Task Group to redefine the Ediacaran-Cambrian boundary, led by voting member Dr. Maoyan Zhu, with Dr. Shuhai Xiao as a member;
A new Working (Task) Group focusing on the subdivision of the Ediacaran System will be formed after initial discussion at the South China workshop in June 2014.

9c Interfaces with other international project
Members of the Ediacaran Subcommission are lead investigators and officers in a number of related international projects:
IGCP 587 (*Of Identity, Facies and Time, the Ediacaran Puzzle: Factors Controlling the Observed Diversity and reality of the Relationships of the Earliest Metazoans*) led by Mikhail Fedonkin (Paleontological Institute, Russian Academy of Sciences, Moscow, Russia), **Patricia Vickers-Rich** (School of Geosciences, Monash University, Melbourne, Victoria), **Jim Gehling** (South Australian Museum, South Australia) and **Guy Narbonne** (Dept of Geology, Queens University, Kingston, Ontario, Canada).Tel. 540-231-1366, Fax. 540-231-3386

Email: xiao@vt.edu

SUBCOMMISSION ON CRYOGENIAN STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY

Subcommission on Cryogenian Stratigraphy

Submitted by:

Dr. Graham Shields-Zhou, Chairman
Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT, UK
Tel. +44 207 679 7821
Email: g.shields@ucl.ac.uk

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Mission statement

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

Goals

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

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

Fit within IUGS Science Policy

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

3a. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

- The first Cryogenian Subcommission field workshop took place in the Dalradian Supergroup, Scotland, in September 2013, attended by 6 voting and 4 corresponding members. The field trip was led by Ian Fairchild*, Anthony Spencer, and Graham Shields-Zhou*; participants were Carlos de Alvarenga*, Marie Busfield, Maree Corkeron, Dan Le Heron, Galen Halverson*, Anton Kuznetsov*, Breandan MacGabhann, Susannah Porter*, Yusuke Sawaki, Ying Shields-Zhou, and Julius Sovetov. (* = voting member).
- A Subcommission Meeting was held September 9th, 2013, in Oban, Scotland, in conjunction with the Dalradian field workshop.
- It was decided at the September 9th meeting that because ratifying a GSSP for the Cryogenian is going to take some time, in the interim, we will apply a revised numerical age for the start of the Cryogenian (currently 850 Ma) so that it corresponds more closely to the likely level of the future rock-based GSSP. **A formal application to change the numerical age for the Cryogenian base to 720 Ma is imminent.**

- Creation of a Subcommission Google Group, allowing easy dissemination of information among voting members and other interested scientists. Promotion of upcoming field workshops organized by the Ediacaran Subcommission to examine primarily Ediacaran, but also Cryogenian successions in South China and Brazil.

3b LIST OF MAJOR PUBLICATIONS OF SUBCOMMISSION WORK (BOOKS, SPECIAL VOLUMES, KEY SCIENTIFIC PAPER) - none; 3c. PROBLEMS ENCOUNTERED IN 2013 - none

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

- It was decided at the September 9th, 2013 meeting that subcommission members as well as non-members with relevant expertise will write an overview of each potential GSSP section, addressing its suitability with respect to a) existing ICS criteria for establishing GSSPs, and b) specific points mentioned in the previously agreed basal Cryogenian GSSP definition statement. Criteria include: locality/accessibility; history of study; degree of continuity of sedimentation/facies; potential for biostratigraphy and reported fossil finds; isotopic coverage and potential for global stratigraphic correlation using isotopes; time-specific facies, e.g. molar-tooth structure/stromatolites; and geochronology – current and potential age control. Anthony Spencer, Ian Fairchild and Graham Shields-Zhou have begun writing an overview of the Dalradian Succession as a template for other papers.
- Joint organization of South China workshop/ conference / field excursion (June, 2014)
- Subcommission meeting at AGU/GSA in December 2014
- Creation of new Subcommission webpage to be hosted at NIGPAS, Nanjing, China.

4b Specific GSSP Focus for 2014

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

5. SUMMARY OF EXPENDITURES IN 2013 (US$):

INCOME
ICS $3500

EXPENDITURE
General subsidy for Scotland field excursion $1200
Registration waiver for three voting members $2000

Total $3200

To be carried forward to 2014 $300

6. BUDGET REQUESTS AND ICS COMPONENT FOR 2014

PROJECTED EXPENSES
Travel/Registration assistance for China conference (June) $1000
Travel bursaries for voting members to attend field workshop in USA (December) $3000

Total $4000

PROJECTED INCOME:
Carried over from 2012 $300

BUDGET REQUEST $3700

APPENDICES

7. CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2008-2012)

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).
- 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 Neoproterozoic Era.

2009:

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

2010:

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

2011:

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

2012:

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

8. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2014-2017)

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

2014-2015:

- Application for revision of numerical age for the base of the Cryogenian to 720 Ma – with effect from 2014.
- Ongoing discussion with the ICS and the Precambrian Subcommission regarding the status of the Tonian Period.
- Field workshops and symposia to be held jointly with the Ediacaran Subcommission in South China, June 2014, with a focus on the search for appropriate criteria for the subdivision of the Ediacaran Period but also addressing evidence for a synchronous onset to glaciation after c. 720 Ma.
- Additional field trips to be organized to examine potential GSSP sections (Death Valley (2014), northwest Canada (?), Yukon (2016), Svalbard (?) and/or East Greenland (?) –application for additional funding from the ICS for the Yukon trip.
- Completion of template paper for Cryogenian GSSPs (Dalradian succession of SW Scotland) and call for remaining template papers for at least the localities above.

2015-2016:

- Review of template papers ahead of Yukon and other field excursions.

2017-2020:

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

9. ORGANIZATION AND SUBCOMMISSION MEMBERSHIP

9a Names and Addresses of Current Officers and Voting Members

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

Officers

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

Voting Members

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

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

No Working (Task) Groups are formed yet.

9c Interfaces with other international projects

Members of the Cryogenian Subcommission are lead investigators and officers in a number of related international projects, including:

IGCP 587 (*Of Identity, Facies and Time, the Ediacaran Puzzle: Factors Controlling the Observed Diversity and reality of the Relationships of the Earliest Metazoans*).

SUBCOMMISSION ON PRECAMBRIAN STRATIGRAPHY

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY

Subcommission on Precambrian Stratigraphy

Submitted by:
Martin Van Kranendonk, *Chair*
University of New South Wales, School of Biological, Earth and Environmental Sciences, Kensington, NSW 2052, Australia, e-mail: martin.vankranendonk@unsw.edu.au

Not yet submitted

SUBCOMMISSION ON STRATIGRAPHIC CLASSIFICATION

ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

Subcommission on Stratigraphic Classification (ISSC)

submitted by:
Prof. Brian R. Pratt[1]
Chair, ISSC
Dr. Maria Rose Petrizzo[2]
Secretary, ISSC
[1]Department of Geological Sciences, University of Saskatchewan, Saskatoon, Saskatchewan S7N 5E2, Canada; Tel.: +1-306-966-5725; Fax: +1-306-966-8593; E-mail: brian.pratt@usask.ca
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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

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

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

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

3. ORGANIZATION

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

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

4. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

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

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

5.1 ISSC Newsletter

Owing to the pace of developments of the subcommission and various personal commitments, newsletters are being issued once a year for the time being. ISSC Newsletter no. 18 was distributed in December 2012. It advertised the status of review papers on the subdisciplines of Stratigraphy. Newsletter no. 19 is in preparation. Newsletters and other documents are available on the ISSC website: http://users.unimi.it/issc

5.2 CONFERENCE PARTICIPATION

ISSC (through ICS and NACSN) co-proposed two Topical Sessions at annual meeting of the Geological Society of America in Denver (T198. Earth Deep Time Revolution by Global Chronostratigraphic Correlation; T199. Impact of GSSPs on The Evolution of North American Chronostratigraphy).

Vice-Chair Weissert held an informal business meeting of ISSC at the First International Congress on Stratigraphy, STRATI 2013, in Lisbon.

5.3 New developments in stratigraphic classification

5.3.1 The Project

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

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

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

Background and motivation of this ambitious project are clearly expressed in the introductory article (Cita, 2007) printed in *Newsletters on Stratigraphy* where the various review articles are being published. This series of articles falls under the umbrella of "New Developments on Stratigraphic Classification".

After all the various review articles in the coordinated series are published, the reprinting of the various articles in a textbook is foreseen, after passing the prescribed check points for approval in order to obtain the permission to use the ICS and IUGS logos. A planned publication date of 2015 or 2016 would be a fitting tribute to the fine achievements made by IUGS in so many stratigraphic matters.

5.3.2 THE ORGANIZATION

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

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

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

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

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

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

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

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

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

5.3.3 STATE OF THE ART (as of December 2013)

Papers published:

Cita, M. B. , 2007. New developments in stratigraphic classification. A project of the International Subcommission on Stratigraphic Classification ISSC: Newsletters on Stratigraphy, v. 42(2), p. 69–74.

Strasser, A., Hilgen, F. and Heckel, P., 2007. Cyclostratigraphy – concepts, definitions, and applications: Newsletters on Stratigraphy, v. 42(2), p. 75–114.

Weissert, H., Joachimski, M. and Sarthein, M., 2008. Chemostratigraphy: Newsletters on Stratigraphy, v. 42(3), p. 145–179.

Langereis, C., Krijgsman, W., Muttoni, G., and Menning, M., 2010. Magnetostratigraphy – concepts, definitions, and applications: Newsletters on Stratigraphy, v. 43(2), p. 207–233.

Catuneanu, O., Galloway, W.E., Kendall, C.G.St.C., Miall, A.D., Posamentier, H.W., Strasser, A., and Tucker, M.E., 2011. Sequence stratigraphy: Methodology and nomenclature: Newsletters on Stratigraphy, Vol. 44(3), p. 173–245.

Zalasiewicz, J., Cita, M.B., Hilgen, F., Pratt, B.R., Strasser, A., Thierry, J., and Weissert, H., 2013. Chronostratigraphy and geochronology: A proposed realignment. GSA Today, v. 23, no. 3, p. 4–8.

5.3.3.1 Task Groups

Cyclostratigraphy

Leader: **Andreas Strasser**, Switzerland, andreas.strasser@unifr.ch
Fritz Hilgen, Netherlands, fhilgen@geo.uu.nl
Philip Heckel, USA, philip-heckel@uiowa.edu

Outline distributed in ISSC Newsletter 7 (June 2005).
Comments forwarded to the leader; available in the ISSC archive
Full text distributed in January 2006, comments received.
Paper published: Strasser A., Hilgen F. and Heckel P., 2007.

Chemostratigraphy

Leader: **Helmut Weissert**, Switzerland, helmut.weissert@erdw.ethz.ch
Michael Joachimski, Germany, joachimski@geol.uni-erlangen.de
Michael Sarnthein, Germany, ms@gpi.uni-kiel.de

Outline distributed in ISSC Newsletter 9 (June 2006).
Comments received and distributed in ISSC Newsletter 10 (November 2006)
Full text distributed in appendix to ISSC Newsletter 11 (June 2007), comments received
Paper published: Weissert, H., Joachimski, M. and Sarthein, M., 2008.

Sequence Stratigraphy

Leader: **Octavian Catuneanu**, Canada, octavian@ualberta.ca
Andreas Strasser, Switzerland, andreas.strasser@unifr.ch
Andrew Miall, Canada, miall@geology.utoronto.ca
William Galloway, USA, galloway@mail.utexas.edu
Maurice Tucker, UK, m.e.tucker@durham.ac.uk
Christopher Kendall, kendall@geol.sc.edu
Henry Posamentier, USA, henry.posamentier@chevron.com

Outline was distributed by the current group and one was distributed by previous group.
Comments from the first outline were forwarded to the leader, and made available in the ISSC archive.
Full text was distributed in 2010, and comments were incorporated.
Paper published: Catuneanu, O., Galloway, W.E., Kendall, C.G.St.C., Miall, A.D., Posamentier, H.W., Strasser, A., and Tucker, M.E., 2011 (as a stand-alone issue of the journal).

5.3.3.2 Working Groups

Biostratigraphy

Leader: **Maria Rose Petrizzo**, Italy, mrose.petrizzo@unimi.it
Yuri Gladenkov, Russia, gladenkov@ginras.ru
Mike Melchin, Canada, mmelchin@stfx.ca
Brian Pratt, Canada, brian.pratt@usask.ca

Outline distributed in ISSC Newsletter 9 (June 2006).
Comments received and distributed in ISSC Newsletter 10 (November 2006).
Full text in progress; new and replacement members of the group carried out

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

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

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

6. CHIEF PROBLEMS ENCOUNTERED IN 2013.
The ICS subvention allocated to ISSC was rather low and disproportionate to the overall importance and significance attributed to this subcommission at the IUGS Ad-hoc Review Committee (ARC) meeting in Paris (November 7–8 2005). The entire allocation for 2013 ($500) was devoted to maintaining the website and assembling the newsletter. Vice-Chair Weissert was able to attend the Strati 2013 meeting in Lisbon because he had separate funding.
In the meantime, progress is somewhat slow but sure, and headway is being made in the preparation of the three remaining chapters on facets of Stratigraphy.

7. SUMMARY OF EXPENDITURES IN 2013:
I. INCOME
2013 ICS subvention $ 500

II. EXPENDITURES
Newsletter preparation and website maintenance € 340

8. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED NEXT YEAR (2014):
Final draft form:
- *Biostratigraphy*
- *Chronostratigraphy*
- *Lithostratigraphy*

Newsletter:
- December 2014

Membership:
- Updated list by January 2014

9. BUDGET AND ICS COMPONENT FOR 2014

ISSC Newsletter no. 20, Annual Report and website maintenance	$ 500
Subsidies to help attendance at conferences to work over manuscript drafts	$4500
Total request	$5000

Rationale—The remaining manuscripts should be prepared in 2014. It would be desirable that as many authors as possible of individual working and task groups should have a face-to-face meeting along with other ISSC members who can contribute with their special expertise. The most obvious venues for this are the AAPG–SEPM, EGU and GSA annual meetings.

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

10. SUMMARY OF CHIEF ACCOMPLISHMENTS OVER PAST FIVE YEARS (2008-2013)

See Accomplishments in ISSC Annual Reports 2008–2013 as well as relevant newsletters.

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

(1) All the remaining review papers on the various branches of Stratigraphy will have been submitted and printed over this period.
(2) The series of papers may form the core of a textbook. Publication details, including arrangements with Nägeli & Obermiller, Stuttgart (the publishers of *Newsletters on Stratigraphy*) remain to be worked out, and will be done so under the general auspices of IUGS and ICS and timed to coincide with the 50th anniversary of IUGS.
(3) ISSC will take the initiative to encourage special sessions and symposia at conferences that advance stratigraphic principles, in collaboration with other ICS subcommissions. A session entitled *Earth Systems History - the Need for Integrated Stratigraphy* is slated for EGU General Assembly 2014 (EGU2014), 27 April - 02 May 2014, Vienna, Austria, and key speakers have been invited.
(4) ISSC will continue to participate in GSSP discussions with ICS subcommissions.
(5) ISSC continues to interface with national stratigraphic commissions although only in an advisory capacity.
(6) ISSC is updating its membership list, in order to eliminate dormant colleagues and incorporate new ones.
(7) ISSC will take the initiative to contact journal editors and scholarly book publishers to remind them of the basic tenets in the existing International Stratigraphic Guide as well as relevant national codes, as well as the background in the review papers.
(8) Potential new executive members will be canvassed from stratigraphically disposed colleagues.
(9) The **ULTIMATE GOAL** of ISSC is the publication of a new, multi-authored, truly multinational International Stratigraphic Guide—a guide not a code, simple, clear, concise, user-friendly, for world wide distribution and acceptance.

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

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