



INTERNATIONAL UNION OF GEOLOGICAL SCIENCES
INTERNATIONAL COMMISSION ON STRATIGRAPHY



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ANNUAL REPORT 2013

1. TITLE OF CONSTITUENT BODY

International Commission on Stratigraphy (ICS)

Summary and compilation of subcommission reports submitted jointly by:

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2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

Objectives

The International Commission on Stratigraphy (ICS) is a body of expert stratigraphers founded for the purpose of promoting and coordinating long-term international cooperation and establishing standards in stratigraphy. Its principal objectives are:

- (a) Establishment and publication of a standard global stratigraphic time scale and the preparation and publication of global correlation charts, with explanatory notes.
- (b) Compilation and maintenance of a stratigraphic data base center for the global earth sciences.
- (c) Unification of regional chronostratigraphic nomenclature by organizing and documenting stratigraphic units on a global database.
- (d) Promotion of education in stratigraphic methods, and the dissemination of stratigraphic knowledge.

- (e) Evaluation of new stratigraphic methods and their integration into a multidisciplinary stratigraphy.
- (f) Definition of principles of stratigraphic classification, terminology and procedure and their publication in guides and glossaries.

Fit within IUGS Science Policy

The objectives satisfy the IUGS mandates 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 geology worldwide.
- Attracting competent students and research workers to the discipline.
- Fostering an increased awareness among individual scientists worldwide of what related programs are being undertaken.

In particular, the current objectives of ICS relate to three main aspects of IUGS policy:

- (a) Development of an internationally agreed scale of chronostratigraphic units, fully defined by Global Stratotype Sections and Points (GSSPs) where appropriate and related to a hierarchy of units to maximize resolution throughout geological time.
- (b) Promotion of international consensus on stratigraphic classification and terminology, which is essential for advancement of earth-science research and education.
- (c) Establishment of frameworks and systems to encourage international collaboration in understanding the evolution of the Earth.

3. ORGANIZATION

ICS is organized in two types of constituent bodies: Subcommissions for longer-term study, and Executive Task Groups for more limited, shorter-term tasks. ICS is managed by the Executive Committee, which consists of elected and appointed officers. The current structure of ICS consists of the Executive Committee and 16 Subcommissions that deal with the major chronostratigraphic units and aspects of stratigraphic classification. The ICS Executive has initiated two new Executive Task Groups on geochronology and web-page development. The web-age task group has produced revisions to the ICS website and encouraged the rejuvenation of websites for several subcommissions. Members are being recruited for the geochronology task group.

Subcommissions:

Quaternary	Permian	Ediacaran
Neogene	Carboniferous	Cryogenian
Paleogene	Devonian	Precambrian
Cretaceous	Silurian	Stratigraphic Classification
Jurassic	Ordovician	
Triassic	Cambrian	

The reports of each Subcommission are appended to this ICS summary compilation.

The subcommissions of ICS together have more than 350 titular members. When the corresponding members of Subcommissions are added, several thousand stratigraphers worldwide participate in the activities of ICS, and several thousand more over the 45-year history of ICS. In addition, ICS maintains contacts with many national stratigraphic committees. The members of the Full Commission (i.e. the 3 members of the Executive and the chairs of the 15 Subcommissions) represent six countries: United Kingdom (6 members), Canada (4), Italy (3), USA (2), China (2), and Australia (1). Among all subcommission officers and the ICS executive, 15 countries are represented: United Kingdom (9 members), Canada (9), USA (8), China (7), Italy (6), Australia (3), Spain (2), Russia (2), Belgium (1), Czech Republic (1), Estonia (1), France (1), Germany (1), Sweden (1), Switzerland (1). The voting members of ICS, i.e. all voting members of all subcommissions including officers represent 40 countries: USA (58), China (37), United Kingdom (32), Russia (31), Canada (25), Germany (24), Italy (21), Australia (16), Spain (13), France (12), Japan (10), New Zealand (8), Argentina (7), Belgium (7), Netherlands (7), Brazil (6), Poland (6), Czech Republic (5), Denmark (5), Sweden (5), Switzerland (5), Hungary (4), India (3), Korea (3), South Africa (3), Tunisia (2), Austria (2), Estonia (2), Finland (2), Iran (2), Bulgaria (1), Colombia (1), Croatia (1), Greece (1), Lithuania (1), Namibia (1), Norway (1), Portugal (1), Turkey (1), and Ukraine (1).

ICS and its subcommissions maintain websites; the URLs of the websites are as follows:

Websites:

ICS main site	www.stratigraphy.org
Quaternary	www.quaternary.stratigraphy.org
Neogene	www.geo.uu.nl/SNS
Paleogene	wzar.unizar.es/isps/
Cretaceous	www.univ-brest.fr/geosciences/ISCS/
Jurassic	www.jurassic.stratigraphy.org
Triassic	paleo.cortland.edu/sts/
Permian (newsletter)	www.permian.stratigraphy.org
Carboniferous	www.stratigraphy.org/carboniferous/
Devonian	www.unica.it/sds/
Silurian	www.silurian.stratigraphy.org
Ordovician	www.ordovician.stratigraphy.org
Cambrian	www.palaeontology.geo.uu.se/ISCS/ISCS_home.html
Ediacaran	www.paleo.geos.vt.edu/Ediacaran/
Cryogenian	<i>being established</i>
Precambrian	www.precambrian.stratigraphy.org
Stratigraphic Classification	http://users.unimi.it/issc

ICS Executive Officers for 2012-2016:

Chair: **Stanley Finney** (California, USA)

Vice-Chair: **Shanchi Peng** (Nanjing, China)

Secretary: **Paul Bown** (London, UK)

ICS Subcommittee officers:

A full listing of current officers (with addresses, telephones, e-mails) is at the end of this main ICS report. The individual subcommission reports include a listing of all voting members (typically 20 in each subcommission).

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

In 2013, ICS was awarded a grant for \$75,000 (\$25,000/year for 3 years) from the U.S. National Sciences Foundation. Only a few of the subcommissions have formal financial contributions from external sources other than IUGS (through ICS), and these are very limited and listed in the individual reports. Some activities that are associated with ICS goals, such as distributing charts of the Geologic Time Scale and placing this information onto public websites, have received some support from private companies and professional organizations. Informally, every officer and member of ICS donates their own time, office space, institutional facilities, and other components to the activities of the organization. No officer or executive receives any salary compensation from IUGS or other ICS funds. Indeed, most officers personally contribute toward their own travel and operational expenses.

5. INTERFACES WITH OTHER INTERNATIONAL PROJECTS

Active and highly fruitful interfaces with many international organizations and geo-projects are a standard feature of ICS activities. ICS maintains a strong link with the International Quaternary Association (*INQUA*) Commission on Stratigraphy regarding the stratigraphy of the Quaternary, and with the Commission for the Geological Map of the World (*CGMW*) in Paris regarding standardization of chronostratigraphy and its color scheme on charts, as well as producing the *ICS International Chronostratigraphic Chart*. In addition, ICS is collaborating with the IUGS Commission on Geoscience Information (CGI) as it develops GeoSciML as an interchange format for geoscience data. ICS subcommissions are traditionally affiliated with a considerable number of **IUGS** and **IGCP** activities. For example, ICS members lead or participate in numerous, active IGCP projects: 572, 575, 580, 587, 591, 596, and 599, and others serve on IGCP national committees and the scientific board. ICS members maintains active links with international research groups, including The Micropalaeontology Society (**TMS**), the North American Micropaleontology Society (**NAMS**), International Nannoplankton Association (**INA**) and the Association of American Stratigraphic Palynologists (**AASP**), and international paleontological research groups on Graptolites, Conodonts, Ammonites, Radiolarians (**Interrad**), Nannofossils, Foraminifers, etc., and many ICS members serve on national stratigraphic commissions and as editors of journals. There are close links between many ICS stratigraphers and the International Ocean Drilling Project (**IODP**). ODP cores routinely test the global correlation potential of a great number of bio-events since the Jurassic, and this record is vital to develop integrated timescales at several scales of resolution, and global paleo-climate models. The designation of GSSPs necessitates close interaction with local and international groups concerned with conservation, such as **UNESCO** (Geoparks Program), **IUGS** (Geosites Program) and **ProGEO** (Geosites and Geoparks initiatives).

6. CHRONOSTRATIGRAPHIC STAGE AND SERIES NAMES AND DEFINITIONS ESTABLISHED IN ICS

Quaternary:

- Base Holocene Series
- Base Calabrian Stage
- Base Gelasian Stage (= Base Pleistocene Series and Base Quaternary System)

Neogene:

- Base Piacenzian Stage
- Base Zanclean Stage (= Base Pliocene Series)
- Base Messinian Stage
- Base Tortonian Stage
- Base Serravallian Stage
- Base Aquitanian Stage (= Base Miocene Series and Base Neogene System)

Paleogene:

- Base Rupelian Stage (= Base Oligocene Series)
- Base Lutetian Stage
- Base Ypresian Stage (= Base Eocene Series)
- Base Thanetian Stage
- Base Selandian Stage
- Base Danian Stage (= Base Paleocene Series and Base Paleogene System)

Cretaceous:

- Base Maastrichtian Stage
- Base Santonian Stage
- Base Turonian Stage
- Base Cenomanian Stage (= Base Upper Cretaceous Series and Base Cretaceous System)

Jurassic:

- Base Bathonian Stage
- Base Bajocian Stage
- Base Aalenian Stage (= Base of Middle Jurassic Series)
- Base Pliensbachian Stage
- Base Sinemurian Stage
- Base Hittangian Stage (= Base Lower Jurassic System and Base Jurassic Series)

Triassic:

- Base Carnian Stage (= Base Upper Triassic System)
- Base Ladinian Stage
- Base Induan Stage (= Base Triassic System)

Permian:

- Base Changhsingian Stage
- Base Wuchiapingian Stage (= Base Lopingian Series)
- Base Capitanian Stage
- Base Wordian Stage
- Base Roadian Stage (= Base Guadalupian Series)
- Base Asselian Stage (= Base Cisuralian Series and Base Permian System)

Carboniferous:

- Base of Bashkirian Stage (= Base Lower Pennsylvanian Series and Base Pennsylvanian Subsystem)
- Base Viséan Stage
- Base Tournaisian Stage (= Base Lower Mississippian Series and Base Mississippian Subsystem and Base Carboniferous System)

Devonian:

- Base Famennian Stage
- Base Frasnian Stage (= Base Upper Devonian Series)
- Base Givetian Stage
- Base Eifelian Stage (= Base Middle Devonian Series)
- Base Emsian Stage
- Base Pragian Stage
- Base Lochkovian Stage (= Base Lower Devonian Series and Base Devonian System)

Silurian:

- Base Pridoli Series
- Base Ludfordian Stage
- Base Gorstian Stage (= Base Ludlow Series)
- Base Homerian Stage
- Base Sheinwoodian Stage (= Base Wenlock Series)
- Base Telychian Stage
- Base Aeronian Stage
- Base Rhuddanian Stage (= Base Llandovery Series and Base Silurian System)

Ordovician:

- Base Hirnantian Stage
- Base Katian Stage
- Base Sandbian Stage (= Base Upper Ordovician Series)
- Base Darriwilian Stage
- Base Dapingian Stage (= Base Middle Ordovician Series)
- Base Floian Stage
- Base Tremadocian Stage (= Base Lower Ordovician Series and Base Ordovician System)

Cambrian:

- Base Jiangshanian Stage
- Base Paibian Stage (= Base Furongian Series)
- Base Guzhangian Stage
- Base Drumian Stage
- Name Terreneuvian Series
- Base Fortunian Stage (= Base Terreneuvian Series and Base Cambrian System)

Neoproterozoic:

- Base Ediacaran System

7. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2013

Full Commission

- Sponsorship by ICS of successful 1st International Congress on Stratigraphy (STRATI2013) held in Lisbon, Portugal, 1-7 July 2013 with attendance of more than 300 stratigraphers. ICS held an open business meeting and a business meeting. Several subcommissions held business meetings and organized sessions for the technical program. One of the several field excursions visited Peniche, Portugal to examine the proposed GSSP for the Toarcian Stage.
- Selected the location, dates, and organizing chair for STRATI2015 - 2nd International Congress on Stratigraphy, which will be held in Graz, Austria, 19-23 July 2015, co-sponsored with SEPM (Society of Sedimentary Geology).
- Awarded grant from U.S. National Science Foundation for \$75,000 (\$25,000/yr for 3 years).
- 2013 ICS Chronostratigraphic Chart and explanatory text was published in September 2013 issue of *Episodes* and posted on the ICS website.
- The ICS Chart is now translated into Chinese, Japanese, French, Spanish, Portuguese, Basque, Catalan, and Norwegian. Translations are now being prepared for Estonian, Finland, and Thailand.
- 2013 ICS Chronostratigraphic Chart has been produced as a 5-story mural in the building that houses the exploration geologists at Shell International Headquarters, The Hague, the Netherlands.
- S. Finney presented a Plenary Lecture at STRATI2015 titled "The Reality of GSSPs", which was published in the STRATI2013 proceedings volume.
- S. Finney published the paper "The 'Anthropocene' as a ratified unit in the ICS International Chronostratigraphic Chart: fundamental issues that must be addressed by the Task Group, in Waters, C.N., Zalasiewicz, J., Williams, M., and Snelling, A., (eds.), A Stratigraphical basis for the Anthropocene, Geological Society Special Publication 395, doi 10.1144/SP395.9.
- Ratification by IUGS of the GSSP proposal for the base of the Santonian Stage (Upper Cretaceous Series, Cretaceous System).
- ICS voted on a GSSP proposal for base of Toarcian Stage (Lower Jurassic Series, Jurassic System).
- Dedication of the GSSP for the Turonian Stage (Upper Cretaceous Series, Cretaceous System).
- Formal Markers placed at GSSPs for bases of Guadalupian Series (Permian) and its three Stages (Roadian, Wordian, and Capitanian) in Guadalupian Mountains, Texas.
- ICS Sponsorship, along with the North American Commission on Stratigraphic Nomenclature, of two theme sessions at the 2013 Annual Meeting of the Geological Society of America in celebration of GSA's 125th Anniversary: "GSSPs, Global Chronostratigraphic Correlation, and the application to North American Stratigraphy" and "Global Chronostratigraphic Correlation: its impact on assessing Earth History (time and rates of geologic events and processes) and exploring for Earth resources".
- ICS Chair participated in workshop on America's Geologic Heritage, Denver, Colorado, 18-19 March 2013 and gave presentation on significance of GSSPs and their preservation.

- With the Commission on the Geological Map of the World, produced 500 memory cards that holds several important products of ICS and CGMW-CCGM and will be distributed freely at upcoming meetings and conferences.
- Initiated steps to establish ICS Executive Task Groups on geochronology and ICS websites.
- Distributed a communication on important ICS activities and accomplishments to all voting members of all ICS subcommissions as a first step in establishing a regular line of communication in order to encourage greater participation of all voting members in the activities of the Subcommissions and ICS.

Quaternary Subcommission

- “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.
- Business meeting of SQS held during the First International Congress on Stratigraphy, STRATI 2013, Universidade Nova de Lisboa, Lisbon, Portugal, July 1–7; 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.
- 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).
- 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.
- The Subcommission website continues to be maintained at: <http://www.quaternary.stratigraphy.org.uk> This site is used as the main form of communication for the Subcommission, and it continues to be sponsored by the *Journal of Quaternary Science* and *Boreas*.

Neogene Subcommission

- Election of some new voting members and corresponding members due to inavailability of some members to actively participate and contribute.
- Selected a new chair of the working group for the remaining GSSPs, base-Langhian and base-Burdigalian. A change in the members of this working group is upcoming.

- Further studies are were carried out on the stable isotope stratigraphy and cyclostratigraphy and astronomical tuning of the La Vedova beach section in northern Italy and St. Peter's Pool on Malta, which are the candidate GSSPs for the base Langhian GSSP.

Paleogene Subcommittee

- A very successful session dedicated to “Paleogene Events, Evolution and Stratigraphy”, where more than thirty contributions on Paleogene biotic and paleoenvironmental evolution, and stratigraphic events were presented, at STRATI2013 in Lisbon.
- After concluding that the Contessa Highway section (Gubbio area) is a possible GSSP candidate for the Lutetian/Bartonian boundary, research has 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.
- Because of concerns with the Contessa Highway section, Italy, the Oyambre section in the Basque Country, Spain, is now being studied as a better GSSP candidate for the Bartonian Stage.
- The Alano section (Belluno Province, NE Italy), to date the only candidate section for defining the GSSP of the Priabonian, 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. This and previous studies will be integrated with the cyclostratigraphic analysis of the entire section.
- A further study on the Alano section across the Bartonian-Priabonian interval has been performed as to the bryozoan and micromorphic brachiopod content.
- 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.
- A synthesis of all data available on the candidate Chattian GSSP at Monte Cagnero has been presented at STRATI 2013. The GSSP proposal is in advanced progress by the leaders of the WG 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 Subcommittee in Spring 2014.
- Numerous papers published on Paleogene stratigraphy (see Subcommittee Report).

Cretaceous Subcommittee

- 9th International Symposium on the Cretaceous System was held in Ankara, Turkey during September 2013.
- The 10th meeting of the Berriasian and J/K boundary WG was held in Perugia (Italy), May 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.
- The 5th Workshop of the Kilian Group was held during the 9th International Symposium on the Cretaceous System, Ankara, September 2013.
- The working group on the Jurassic-Cretaceous boundary and the Berriasian-Stage GSSP was very active with considerable biostratigraphic and magnetostratigraphic investigations at numerous sections around the world, including Spain, Italy, France, United Kingdom, Slovakia, Bulgaria, Ukraine, Tunisia, Iran, Caucasus, India, Tibet, Russian Platform and Siberia, South and North Primorye, Kurdistan, Greenland, Argentina, Mexico, and California.
- Studies continued on candidate stratotype sections for GSSP for Valanginian Stage.
- Ratification by IUGS of GSSP for base of Santonian Stage at Olazagutia, Spain.
- A high resolution stable isotope stratigraphy of the ratified Tercis les Bains GSSP for the Maastrichtian Stage and new biostratigraphy and magnetostratigraphic data from Contessa section improved correlation between the GSSP and coeval sections.

Jurassic Subcommittee

- Revision, following comments from ICS, of GSSP proposal for the Toarcian Stage, Peniche section, Portugal, and forwarded to ICS for approval.
- Base Oxfordian field workshop, Provence, France, September/October 2013.
- Fundamental taxonomic work undertaken on key ammonites for defining base of Callovian Stage.
- Base Callovian Task Group reinvigorated under leadership of Eckhard Mönning.
- A significant number of voting members retired in 2013 and have been replaced.
- Ratified base Jurassic GSSP was published in *Episodes*, v. 36, no. 3, p. 162-198.

Triassic Subcommittee

- World Summit on P-Tr Mass extinction & Extreme climate (IGCP 572) held in Wuhan (China) 13-15 June 2013 with more than 150 participants from 13 countries and more than 150 presentations.
- 10th International Field Workshop on Triassic, The Triassic of the Iberian Range (Spain), 23-27 September 2013.
- Several important biostratigraphic studies on Induan and Olenekian stages in western US, Russia, and Pakistan.
- Important study of Anisian ammonoid succession at Desli Caira section completed and allows for correlation of ammonoid faunas of the Tethyan Realm with those of the Boreal Realm and Western Panthalassa.
- Important biostratigraphic results relevant to definition of the base Norian GSSP were published on the conodonts of the Black Bear Ridge section (British Columbia, Canada) and the ammonoids, bivalves and conodonts at the Berlin section (Nevada, USA). “Publication of issue 40 of *Albertina*
- Numerical calibration of the duration of the Rhaetian carried out. New chair of Rhaetian working group made progress on developing GSSP proposal for the Steinbergkogel section near Hallstatt (Austria).
- Publication of 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.

- *Albertiana*, the newsletter of the Triassic Subcommittee, was reorganized with a new Editor, a new Editorial Board, and a new organization. The new *Albertiana* is a strictly peer-reviewed journal published twice a year.

Permian Subcommittee

- Vote on two proposals for base Kungurian GSSP was taken, but no consensus was reached and more work on the candidate sections was completed in 2013.
- SPS business meeting was held on 21 May 2013 at Albuquerque, New Mexico, USA during the Carboniferous-Permian Transition Meeting.
- Subcommittee business meeting held at STRATI2013.
- GSSP proposal for base Sakmarian Stage was prepared.
- GSSP proposal for base Artinskian Stage was prepared.
- Excursion to the Guadalupian Series (West Texas) resulted in extensive resampling for conodonts and high-resolution chemostratigraphy.
- GSSP markers were placed for the Guadalupian Series and the Wordian, Roadian, and Capitanian Stage the comprise it.
- Two issues of *Permophiles* (57 and 58) were published.
- Two volumes of special issues on the Carboniferous-Permian Transition were published in 2013 as Bulletin 59 and 60 of New Mexico Museum of Natural History & Science.

Carboniferous Subcommittee

- Report not yet submitted.

Devonian Subcommittee

- 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.

Silurian Subcommittee

- Silurian Times No. 20 produced and distributed and posted on ISSS website
- Major Silurian meeting held in Lund, Sweden, in June 2013, in association with IGCP 591, as well as the Ordovician and Cambrian subcommittees.
- 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: 1) 3rd International Conodont Symposium and IGCP 591 regional field meeting, Mendoza, Argentina, July 15-19, 2013; 2) STRATI 2013, 1st International Congress on Stratigraphy, Lisbon, Portugal, July 3-5, 2013; 3) IGCP 591 project workshop at STRATI 2013: Chemostratigraphy versus biostratigraphy: reuniting micropalaeontology and geochemistry; 4) IGCP 591 session at GSA Meeting, Denver, United States, 27–30 October 2013, Biological and environmental feedbacks in the colonization of the water column.

- 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.

Ordovician Subcommission

- Ordovician News No. 30 was produced, distributed and posted on the Subcommission website. www.ordovician.stratigraphy.org.
- Publication of the *Geological Society, London Memoir 38*, 'Early Palaeozoic biogeography and palaeogeography'. This Memoir illustrates the changing Early Palaeozoic geography through a series of time slices. Twenty-six 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.
- A substantial GFF special issue *Early Palaeozoic Global Change*, arising from the IGCP 591 meeting in Lund, is near completion and many articles are already available online through the Taylor and Francis website.

Cambrian Subcommission

- The 18th International Field Conference on Cambrian Stages was held in association with meetings of the Ordovician and Silurian subcommissions in June 2013 in Lund, Sweden.
- 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.

Ediacaran Subcommission

- Preparation of a list of Ediacaran fossil sites in order to promote some of them as UNESCO world heritage sites.
- 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.
- 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.
- Completed preparations for a joint Ediacaran-Cryogenian subcommissions field meeting in China to be held in 2014.

Cryogenian Subcommission

- The first Cryogenian Subcommission field workshop took place in the Dalradian Supergroup, Scotland, in September 2013.
- A Subcommission Meeting was held September 9th, 2013, in Oban, Scotland, in conjunction with the Dalradian field workshop.
- Because ratifying a GSSP for the Cryogenian is going to take some time, in the interim, the Subcommission 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 Subcommittee Google Group, allowing easy dissemination of information among voting members and other interested scientists. Promotion of upcoming field workshops organized by the Ediacaran Subcommittee to examine primarily Ediacaran, but also Cryogenian successions in South China and Brazil.

Precambrian Subcommittee

- Report not yet submitted.

Stratigraphic Classification Subcommittee

- 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).
- An informal business meeting of ISSC at the First International Congress on Stratigraphy, STRATI 2013, in Lisbon.
- Publication of: 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.
- ISSC Newsletter nos. 18 and 19 produced and distributed.

8. CHIEF PROBLEMS ENCOUNTERED IN 2013

Full Commission

- In past years, the major problem reported for all Subcommissions was the lack of financial support for travel to hold business and field meetings and to investigate potential candidate stratotype sections. This problem also existed in 2013; however, the additional support available from the NSF grant will partly alleviate this problem.
- Some boundary task group leaders have been inactive; some boundary task groups need rejuvenation.
- Some subcommissions appear to be making no progress developing GSSP proposals.
- Webpages of several subcommissions are very out of date and lacking of information on GSSPs.

Quaternary Subcommittee

- 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. But, steps have been taken to reconstitute the leadership and membership of the Working Group.

Neogene Subcommittee

- Lack of suitable sections in the Mediterranean for defining the Burdigalian Stage GSSP in an astronomically-tuned, deep-marine section. The newly reconstituted boundary working group will consider defining the boundary in (I)ODP cores.

Paleogene Subcommittee

- Subcommission budgets are inadequate to support travel necessary for boundary working groups to make significant progress, nor to support regional committees in under-developed regions (e.g. Africa, Indian subcontinent, SE Asia).

Cretaceous Subcommission

- Reinvestigation of candidate stratotype sections for several stages to document magnetostratigraphy, stable isotope stratigraphy, etc. and to integrate multiple stratigraphies has demonstrated that candidate sections for some boundaries are unsuitable as GSSPs. This means that new sections must be considered.
- Lack of funding in most countries for carrying out studies strictly stratigraphic for attending workshops and field conferences.

Jurassic Subcommission

- Some delays in co-ordination of the subcommission work 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.

Triassic Subcommission

- Severe budget cuts for research in many countries, due to the global economic crisis, reduce not only research in the field but also the possibility of Task Group members attending meetings and workshops necessary for progress on GSSP definitions.
- Retirements and poor health have greatly reduced the number of active subcommission members, and new voting members must be selected in the coming year rather than waiting until the next IGC in 2016.

Permian Subcommission

- Voting on the base Kungarian GSSP was suspended following an irregularity.

Carboniferous Subcommission

- Report not yet submitted.

Devonian Subcommission

- 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
- Lack of formal members from a range of countries with extensive and important Devonian outcrop, such as Algeria, Libya, Brazil, Bolivia, Argentine, Turkey, and Caucasian 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.

Silurian Subcommission

- 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.

Ordovician Subcommission

- Lack of participation of all regional groups in needed data collection and its integration with the global standard.
- Improvement needed in regional chronostratigraphies, isotope curves, and zonal schemes.

Cambrian Subcommission

- The principal difficulty encountered in 2013 was lack of funding to support basic research on key stratigraphic intervals (potential GSSP horizons and sections) and to support travel to field business meetings.

Cryogenian Subcommission

- none

Precambrian Subcommission

- Report not yet submitted.

Stratigraphic Classification Subcommission

- The ICS budget allocation was very small, particularly given the overall importance and significance of the Subcommission.
- Progress is somewhat slow but sure, and headway is being made in the preparation of the three remaining chapters on facets of Stratigraphy

9. SUMMARY OF EXPENDITURES IN 2013:

In its 2012 Annual Report, the ICS Executive requested \$72,750, which was reduced from \$92,270 that included full amounts requested by Subcommissions. The ICS request was 50% more than its budget allocation of ~\$50,000 for the last several years. The IUGS Executive Committee awarded ICS a budget of \$50,000 for 2013. Accordingly a reduction factor was applied to the ICS recommendations to the Subcommissions and the ICS executive to arrive at the final allocations within ICS as shown in the following table.

Subcommission	Request from subcommissions for 2013 USD	ICS Recommendation to IUGS for 2013 USD	Reduction factor applied equally to all
Quaternary	4500.00	4500.00	2997.0
Neogene	9000.00	1300.00	866.7
Paleogene	4900.00	4000.00	2666.7
Cretaceous	8411.00	8700.00	5800.0
Jurassic	3189.00	5000.00	3333.3
Triassic	4000.00	4000.00	2666.7

Permian	4270.00	3000.00	2000.0
Carboniferous	0.00	2000.00	1333.3
Devonian	2000.00	2000.00	1333.3
Silurian	10,000	5000.00	3333.3
Ordovician	12500.00	4000.00	2666.7
Cambrian	7100.00	5500.00	3666.7
Ediacaran (new)	5650.00	5000.00	3333.3
Cryogenian (new)	5250.00	5250.00	3500.0
Precambrian	5000.00	1000.00	666.7
Stratigraphic Classific.	5000.00	2500.00	1666.7
ICS Executive (3)	7500.00	6000.00	4000.0
Reserve	4000.00	4000.00	4169.7
Total	\$92,270	\$72,750.00	\$50,000.03

10. WORK PLAN, CRITICAL MILESTONES, and ANTICIPATED RESULTS TO BE ACHIEVED FOR March 2014-February 2015:

ICS Executive Committee

- The primary attention of the ICS Executive will be to promote progress on GSSPs by the Subcommissions. The ICS budget and the NSF grant will be allocated among Subcommissions to support those boundary-working groups that demonstrate the potential to make significant progress.
- STRATI2015 – the 2nd International Congress on Stratigraphy is expected to be a most noteworthy event. The goal is to establish this Congress as the premier international meeting for stratigraphers worldwide. Planning for a successful Congress will be an important activity of ICS during 2014.
- Encourage recruitment of colleagues from under-represented groups, particularly young workers, to field meetings of ICS subcommissions.
- Maintain and further develop communication between ICS and important parts of the geoscience community it serves; complete and maintain a current contact list for all national stratigraphic commissions so that all can be informed of deliberations related to selection of GSSPs and definition and redefinition of international chronostratigraphic units.
- Set up system of regular notification to all relevant parties, including national stratigraphic commissions and professional societies, concerning new GSSP proposals being considered by subcommissions so that interested parties are invited to discussions of GSSP proposals by means web-based discussion pages for input on proposals; Rejuvenate the discussion page on the ICS website.
- Initiate consultations with the greater stratigraphic community as the first step in producing a new edition of the *International Stratigraphic Guide*.
- Maintain the permanent archive of the ICS global standards (GSSPs and the International Chronostratigraphic Chart) on the ICS website.

- The ICS executive will work closely with the chair of the IUGS Commission on the Management and Application of Geoscience Information to further incorporate the ICS International Chronostratigraphic Chart into the computer language being used to store, access, and archive geoscience information.
- The ICS executive will work closely with the President of the CGMW (Commission on Geologic Map of the World) to produce regular updates and translations of the ICS International Chronostratigraphic Chart/Geologic Time Scale.
- Establish an ICS Executive Task Group on Geochronology and recruit experienced colleagues with expertise in a range of techniques to participate with the goal of providing ICS Executive and Subcommission Chairs on numerical ages to apply to the ICS International Chronostratigraphic Chart
- The ICS Executive Task Group on ICS Webpages will continue to assist Subcommissions with developing and maintaining excellent websites as they become the primary source of information on the activities and accomplishments of the Subcommissions.
- Further develop the relationship with the Geobiodiversity Database so that it evolves into a widely used site for the archiving and use of stratigraphic data produced in developing GSSP proposals.
- Set up system for effective communication between ICS Executive and voting and corresponding members of all subcommissions.
- Determine those ratified GSSPs that are not marked by a plaque and work with relevant, national stratigraphic committees, geological surveys, governmental organizations, and private landowners to install plaques and, if possible, erect educational exhibits.
- Collaborate with the World Heritage Committee of UNESCO for recognition of all GSSPs as sites of the World Natural Heritage.

Quaternary Subcommission

- Assemble and edit a special issue of *Quaternary International* based on papers presented at “The Quaternary System and its formal subdivision” during STRATI 2013.
- Comments on the proposed subdivision of the Holocene will be considered by a Working Group. This work will continue during 2014 with 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.
- SQS to support a field workshop organized by the *Associazione 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.

Neogene Subcommission

- 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 are completed. Following

these studies a decision regarding which section and criterion are most suitable for defining the Langhian GSSP should be made in 2014.

- Selection of most suitable section/ODP core and guiding criteria for defining the Burdigalian GSSPs

Paleogene Subcommittee

- Prepare and submit to the Subcommittee the proposals for the establishment of GSSPs for the Priabonian and Chattian.
- Field workshop of the Bartonian WG in Central Italy and northern Spain to evaluate the potential value, as GSSP, of three potential candidate sections.
- Business meeting of the Paleogene Subcommittee in Ferrara (Italy) during the conference “Climate and Biotic Events of the Paleogene 2014”.
- Field workshop in the Gubbio area (Central Italy) to evaluate auxiliary sections for the GSSP of the Selandian.
- Screen and rejuvenate the list of the Corresponding Members.
- Reactivate or close those Regional Committees and Working Groups that have long been inactive.
- Update and renew the ISPS website.

Cretaceous Subcommittee

- 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, 27 April to 2 May 2014.
- The 2nd Meeting of IGCP 608, 4-11 September 2014, Waseda University, Tokyo, Japan.
- Submission of the *Episodes* article on the ratified GSSP for the Santonian Stage.
- Vote on the Coniacian GSSP and submission to ICS.
- Vote on the Hauterivian GSSP and submission to ICS.
- Preparation of GSSP proposal for Aptian Stage.
- Completion of study of Col de Pré-Guittard section for the GSSP for the Albian Stage; preparation of GSSP proposal.
- On-going stratigraphic studies worldwide to evaluate the criteria for identifying the base of the Berriasian Stage and the J/K boundary.
- Arrive at decision on stratotype section for the GSSP for the Campanian Stage.

Jurassic Subcommittee

- *Jurassic Congress 2014*. The Jurassic Congress will be held in Jaipur, India, in January 2014. The congress will provide a forum for evaluation 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.
- Approval by ICS and Ratification by IUGS of the GSSP proposal for the Toarcian Stage, Peniche section, Portugal.
- Oxfordian Task Group Field Workshop in UK in summer 2014 that will lead to a final decision on the base Oxfordian GSSP with submission in ICS by end of 2014.

Triassic Subcommittee

- February 12–16, 2014. 11th International Field Workshop on Triassic. NW Gondwana margin of the Neo-Tethys (Negev, southern Israel).
- September 4-14, 2014. 9th International Symposium Cephalopods - Present and Past ISCPP 9, Zurich, Switzerland. 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”.
- Finalization of GSSP proposal for Rhaetian Stage, Steinbergkogel, Austria and its consideration and vote by the Subcommittee.
- Possible submission to the boundary working group of a GSSP Proposal for the Olenekian Stage (Nammal Nala section).
- Revision of Subcommittee website.

Permian Subcommittee

- Complete Subcommittee vote on GSSP for Kungurian Stage and forward to ICS.
- Complete Subcommittee vote on GSSP for Artinskian Stage.
- Complete Subcommittee vote on GSSP for Sakmarian Stage.

Carboniferous Subcommittee

- Report not yet submitted.

Devonian Subcommittee

- 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. 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).
- 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.

Silurian Subcommittee

- Update and add content to redesigned website
- Publication of Silurian Times Newsletter 21.
- 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:
 1. 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.

2. 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.
3. A field trip visit 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.
 - Establish of a working group for restudy of the Aeronian-Telychian Boundary.
 - 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.

Ordovician Subcommittee

- Design and execute a programme of radiogenic dating of key Ordovician horizons (using Pb-Pb isotopes) making use of the state-of-the-art StarPlan laboratory in the University of Copenhagen. Work has already commenced on some key sections in Baltoscandia.
- 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.
- The Subcommittee will participate in various meetings (and publications arising from these meetings) during 2014, notably in Kunming (August) and Tartu (June).

Cambrian Subcommittee

- 19th Subcommittee field meeting in Morocco in September.

- Continue work toward defining GSSPs for provisional stages 2, 3, 4, 5, and 10.
- Within the next year, provisional Stage 5 (and Series 3) is expected to be defined.
- Examine issues surrounding possible redefinition of the Cambrian GSSP.

Ediacaran Subcommittee

- ICS Ediacaran-Cryogenian Joint Field Workshop on Cryogenian-Ediacaran Stratigraphy, 11-22 June 2014, Yichang, China, followed by a vote to be used in subsequent decisions on System level subdivisions and whether to subdivide the System into two or three Series.
- International Field Workshop on the Marwar Supergroup, Rajasthan, western India, 20-28 January 2014.
- Symposium “Ediacaran Environments and Ecosystems” at the 10th North American Paleontological Convention, 15-18 February 2014, Gainesville, Florida.
- ICS Ediacaran-Cambrian Joint Field Workshop on Ediacaran-Cambrian Stratigraphy, 15-24 September 2014, Ouarzazate, Morocco.
- Symposium “Neoproterozoic palaeobiology: preservation, palaeobiology, environments and phylogeny” at the 4th International Paleontological Congress, 28 September - 3 October 2014, Mendoza, Argentina.
- Continue to update Subcommittee webpage and to produce and distribute Annual Newsletter

Cryogenian Subcommittee

- Preparation of written overviews 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.
- Joint organization of South China workshop/ conference /field excursion, June 2014.
- Subcommittee meeting at AGU/GSA in December 2014.
- Creation of new Subcommittee webpage to be hosted at NIGPAS, Nanjing, China.

Precambrian Subcommittee

- Report not yet submitted.

Stratigraphic Classification Subcommittee

- First drafts of papers on Biostratigraphy, Chronostratigraphy, and Lithostratigraphy will be completed and distributed for review.
- ISSC will sponsor a session entitled *Earth Systems History - the Need for Integrated Stratigraphy* at the EGU General Assembly 2014 (EGU2014), 27 April - 02 May 2014, Vienna, Austria; key speakers have been invited.
- ISSC Newsletter No. 20 will be produced and distributed.
- Membership will be updated.

11. BUDGET REQUEST TO IUGS FOR 2014 (\$ US)

The following table is based on the budget requests from all Subcommittees submitting annual reports and the ICS Executive. The total amount is \$94,453. In past years, the ICS Executive has evaluated these requests and reduced them so that the total amount is closer to the \$50,000 normally allocated to ICS (except for years with IGCs). This year reduced amounts

have not been determined. For 2014, such determinations will be done after the ICS allocation has been set by the IUGS Executive Committee, and consideration will be given to allocation of funds from the NSF grant to ICS. In some instances, a Subcommittee reduced the total budget planned for 2014 by the carryover from its 2013 budget allocation. The budget for the Ediacaran Subcommittee was planned to be \$12,100 with \$7,000 of that to derive from special requests to the Chinese Academy of Sciences and the NSF grant; thus, the request for the Ediacaran Subcommittee is shown as \$5,100.

Subcommission	Request for 2014 USD	Justification
Quaternary	5500.00	GSSP workshop, Italy
Neogene	2730.00	website; GSSP Burdigalian trip, to be decided??
Paleogene	6400.00	website; Chair travel; GSSP meetings (no details)
Cretaceous	11567.00	support for 2 J/K mtgs, 1 mtg in France, support for Kilian Gp mtg
Jurassic	3275.00	Oxfordian GSSP meeting/field trip
Triassic	5500.00	support for Cephalopod Symp., GSA meeting, WG leader travel
Permian	5000.00	travel support for meetings
Carboniferous	0.00	no report
Devonian	3100.00	Newsletter, IPC attendance, field workshop
Silurian	12681.00	3 field meetings
Ordovician	6000.00	funding for dating + 2 IGCP meeting attendance
Cambrian	6100.00	funding for GSSP meeting in Morocco
Ediacaran	5100.00	3 field trips and support for Yangtze Gorge trip
Cryogenian	4000.00	China conf. and USA field workshop
Precambrian	0.00	no report
Stratigraphic Classific.	5000.00	to help travel to conferences to work on manuscripts
ICS Executive (3)	7500.00	
Reserve	5000.00	
Total	\$94,453	

12. REVIEW CHIEF ACCOMPLISHMENTS SINCE 2000

A. GSSPs (boundary-stratotypes) created since 2000 (*listed in stratigraphic order*)

Quaternary

1. base of the **Holocene** Series in archived Greenland NorthGRIP (NGRIP) ice core (2008)
2. base of **Quaternary** Period formally defined at base of Gelasian Stage (2009)

3. base of **Calabrian** Age formally defined at Vrica, Calabria, Italy at the GSSP that defined the base of the Pleistocene Epoch from 1984 to 2009
4. base of **Pleistocene** Epoch redefined at base of Gelasian Stage with Gelasian transferred from Neogene (2009)

Neogene

5. base of the **Zanclean** Stage and of the **Pliocene** Series at Eraclea Minoa, Italy (2000)
6. base of the **Messinian** Stage at Oued Akrech, Morocco (2000)
7. base of the **Tortonian** Stage at the Monte dei Corvi beach section near Ancona, Italy (2003)
8. base of the **Serravallian** Stage at Ras il Pellegrin section on Malta (2006)

Paleogene

9. base of the **Lutetian** Stage at Gorrondatxe, Spain (2011)
10. base of the **Eocene** Series (and **Ypresian** Stage) in the Dababiya Section near Luxor, Egypt (2003)
11. base of the **Thanetian** Stage at Zumaia, Spain (2008)
12. base of the **Selandian** Stage at Zumaia, Spain (2008)

Cretaceous

13. base of the **Maastrichtian** Stage at Tercis, France (2000)
14. base of the **Santonian** Stage at Olazagutia, Spain (2013)
15. base of the **Turonian** Stage at Pueblo, Colorado, USA (2003)
16. base of the **Cenomanian** Stage and of the **Upper Cretaceous** Series, at Risou, France (2002)

Jurassic

17. base of the **Pliensbachian** Stage at Robin Hood Bay, England (2004)
18. base of the **Aalenian** Stage and of the **Middle Jurassic** Series at Fuentalsaz, Spain (2000)
19. base of the **Sinemurian** Stage at East Somerset, England (2001)
20. base of the **Bathonian** Stage at Ravin du Bès, Bas Auran, near Digne, France (2008)
21. base of the **Hittangian** Stage and of the **Lower Jurassic** Series and **Jurassic** System at Kuhjoch, Northern Calcareous Alps, Tyrol, Austria (2010)

Triassic

22. base of the **Carnian** Stage at Prati di Stuares, Italy (2008)
23. base of the **Ladinian** Stage at Bagolino, Italy (2005).
24. base of the **Triassic** System and of **Lower Triassic** Series and of **Induan** Stage at Meishan, China (2001)

Permian

25. base of the **Changhsingian** Stage at Meishan, China (2005)
26. base of the **Wuchiapingian** Stage and of the **Lopingian** Series (Upper Permian) in China (2004)
27. base of the **Guadalupian** Series (Middle Permian) and component **Roadian**, **Wordian** and **Capitanian** Stages in Guadalupian Mountains, USA (2001)

Carboniferous

28. agreement on Series-level divisions (2004)
29. ratification of Series names, and Stage names (2006)

30. base of *Visean* Stage in Guangxi, China (2008)

Devonian

31. all Devonian stage boundaries are defined by a GSSP

32. publication of two volumes (*Courier Forschungsinstitut Senckenberg*, 220 (205 pp.) and 225 (347 pp.) in 2000, in which the GSSPs of all Devonian stages have been updated and their correlative value for worldwide correlation is demonstrated.

Silurian

33. all Silurian stage boundaries are defined by a GSSP; however, some of these appear to be more useful for regional correlation, rather than having global applicability.

34. Revision to taxonomy and biostratigraphy of graptolites used to define base-*Rhuddanian* (**Ordovician-Silurian** boundary and **Llandovery** Series) in stratotype section, Dob's Linn, Scotland.

Ordovician

35. base of the *Hirnantian* Stage in China (2005).

36. base of the *Katian* Stage in Oklahoma, USA (2006)

37. base of the *Sandian* Stage and the **Upper Ordovician** Series at Fågelsång in Sweden (2002).

38. base of *Dapingian* Stage and the **Middle Ordovician** Series in China (2006, named 2007)

39. base of the *Floian* Stage at Diabasbrottet in southern Sweden (2002).

40. base of the **Ordovician** System and the **Lower Ordovician** Series and of the *Tremadocian* Stage at Green Point, Newfoundland, Canada (2000).

Cambrian

41. base of the *Jiangshanian* Stage at Duibian, China (2011)

42. base of the *Paibian* Stage and the **Furongian Series** (uppermost series of Cambrian) in the Paibi section, NW Hunan province, south China (2003)

43. base of *Guzhangian* Stage (Series 3) in China (2007)

44. base of *Drumian* Stage (Series 3) in USA (2007)

45. vote to subdivide the Cambrian into **four series** and **10 stages** (2004)

46. Vote to name lowest series and stage as **Terreneuvian** and *Fortunian*, respectively (2007)

Proterozoic Era

47. base of the **Ediacaran System** (uppermost system of Proterozoic) in the Flinders Range, Australia (2004).

B. Stratigraphic Classification

Publication in *Newsletters on Stratigraphy* of papers on Cyclostratigraphy (2006), Chemostratigraphy (2008), Magnetostratigraphy (2010), and Sequence Stratigraphy (2011).

C. The International Stratigraphic Chart

The ICS International Chronostratigraphic Chart highlights all units that are formally defined by a GSSP or anticipated by a future GSSP decision, plus presents the ratified nomenclature of global chronostratigraphy. The Chart is regularly updated and translations into a number of languages are being prepared. It can be downloaded at www.stratigraphy.org. The January 2013

version was published along with an explanatory text in the September 2013 issue of Episodes. The Chart and all its prior versions together with the Table of GSSPs on www.stratigraphy.org comprise the recognized archive of the international geostandards developed by the International Commission on Stratigraphy.

13. OBJECTIVES AND WORK PLAN FOR NEXT 5 YEARS (2014-2019)

The following is a summary of objectives of the ICS Executive Commission and a selection of key goals noted in the detailed reports of each subcommission. See Section 10 for a summary of objectives for 2014.

ICS Executive Committee

1. Define a substantial number of GSSPs, particularly for stage in the Carboniferous, Triassic, Jurassic, Cretaceous, and Cambrian systems; re-evaluate GSSPs for several Silurian stages and the Devonian-Carboniferous boundary, and of the Phanerozoic Era, and select GSSP-defined subdivisions of the Precambrian.
2. Maintain website and its formal, permanent archive of the global geostandards - GSSPs and the ICS International Chronostratigraphic Chart.
3. Coordinate websites and the information they contain among all subcommissions and the Commission in order that they become the primary global web-based entry point to information on the activities and accomplishments of the subcommissions and ICS.
4. Plan for and promote STATI2015 - the 2nd International Congress on Stratigraphy to be held in Graz, Austria, 19-23 July 2015 - as the premier international meeting for stratigraphers worldwide.
5. Encourage subcommissions to regularly re-assess GSSPs and to develop new initiatives and projects that utilize the refined International Stratigraphic Chart.
6. Encourage the recruitment by subcommissions of members from under-represented countries/regions and of those at early career stages.
7. Promote the preservation of GSSPs by local communities and national stratigraphic commissions and dedication ceremonies, including the placement of permanent markers, at all ratified GSSPs.
8. Produce a new edition of the *International Stratigraphic Guide* with its joint publication by IUGS and the Geological Society of America
9. Have a strong presence at the 35th IGC in 2016 with exciting symposia, varied field excursions, business meetings, and other activities sponsored by ICS and its subcommissions, and hold a ICS workshop..
10. Develop a strong link between ICS and the Geobiodiversity DataBase at the Nanjing Institute of Geology & Palaeontology
11. Maintain close collaboration with all national stratigraphic commissions.
12. Cooperate with One-Geology and the Commission on the Geologic Map of the World to ensure that these projects continually incorporate the latest revisions to the International Stratigraphic Chart.
13. Serve as the primary international body setting global standards and illustrating best practices in stratigraphy.

Quaternary Subcommission

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”.

Neogene Subcommittee

1. Selection of boundary criteria and sections for the definition of the 2 remaining Miocene stage boundaries, namely the base-Langhian and base-Burdigalian.
2. Apply high-resolution integrated stratigraphies to global aspects of the Earth system.

Paleogene Subcommittee

1. Submit the proposals for Priabonian and Chattian GSSPs to the Paleogene Subcommittee voting members, then to ICS and possibly to *Episodes* for publication during 2014-2015.
2. Decide the definition for the base of Bartonian, choose a type section and submit a proposal to Paleogene Subcommittee voting members 2014.
3. Submit the proposed Bartonian GSSP to ICS and possibly to *Episodes* for publication within 2015.
4. Paleogene Subcommittee business meeting in Ferrara (Italy) during the CBEP 2014 conference, July 2014.
5. Field workshops and meetings for the remaining GSSPs.
6. Attendance at the IGC 35, South Africa.
7. Produce an updated version of an integrated Paleogene time scale.
8. Produce a state-of-the-art review of the stratigraphic tools used in the Paleogene.
9. Preparation of standardized regional correlation charts and paleogeographic maps by the Regional Committees.
10. Revise and find auxiliary sections to better characterize the:
 - a. P/E boundary (i.e Alamedilla, Caravaca, Zumaia, Spain; Forada, Italy, Contessa highway Italy, Polecat Bench (Wyoming),
 - b. Danian/Selandian: Contessa, Bottaccione, Sopelana, Italy; Caravaca, Spain
 - c. Selandian/Thanetian: Contessa, Italy
 - d. Priabonian: Egypt Wadi Hitan Valley, in the Fayum
 - e. E/O: Monte Cagnero, Italy, Fuente Caldera, Spain.

Cretaceous Subcommittee

1. October 2013 – the 11th Workshop of the Berriasian and J/K boundary WG in Warsaw, Poland.
2. September 2014 – the 9th International Symposium “Cephalopods Past and Present”, University of Zurich, Switzerland.
3. July 2015 – 2nd International Congress on Stratigraphy, Graz, Austria.
4. August 2016 – International Geological Congress, Cape Town, South Africa.
5. September 2017 – 10th International Symposium on the Cretaceous System (location to be finalized).
6. 2014-2015: Approval of GSSP proposals for the bases of the Albian, Valanginian, Hauterivian, Barremian, Aptian, Coniacian, and Campanian stages by 2014.
7. 2015 - Finalize GSSP proposal for the base of Berriasian (Jurassic/Cretaceous boundary).
8. 2015 to 2016 – Define substages.

Jurassic Subcommittee

1. 2014-2018 - Finalize proposals for the bases of the Bathonian, Callovian, Oxfordian, Kimmeridgian, and Tithonian stages.
2. Stage Working Groups to standardise and propose GSSPs for Substages as appropriate, but named ONLY as Lower/Middle/Upper.
3. Develop strategy for integration of cyclostratigraphy and geochronology into knowledge of stages and substages
4. Develop website as forum for exchange ideas in relation to Jurassic stratigraphy
5. 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.

Triassic Subcommittee

1. Completion of Triassic GSSPs: 2015 – Rhaetian and Norian, 2016 – Olenekian, and 2018 - Anisian.
2. Improvement of numerical calibration of Triassic chronostratigraphic units, particularly the durations of the Induan, Norian, and Rhaetian stages.
3. 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.
4. Once GSSPs for all stages are ratified, establishment of working groups to define substages.

Permian Subcommittee

1. Completion of Permian GSSPs with voting in 2014 on proposals for the Sakmarian, Artinskian and Kungurian stages, Cisuralian Series.
2. Establish working group on chemostratigraphy and geochronologic calibration of the Guadalupian Series.
3. Correlations into continental deposits and across provincial boundaries.

Carboniferous Subcommittee

1. Report not yet submitted.

Devonian Subcommittee

1. Selection of a new GSSP for the Devonian-Carboniferous boundary.
2. Resolution of the GSSP for the base of the Emsian Stage.
3. Formalize the substage subdivision of stages.

Silurian Subcommittee

1. 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.
2. 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.
3. Silurian Symposium for 2015. Ottawa, Canada, July 2015. This meeting will be held in association with the annual meeting of IGCP 591 and the International Subcommittee on Cambrian Stratigraphy.
4. Upcoming IGCP 591 meetings include: 1) Evolutionary paleoecology and paleobiogeography, IGCP 591 Annual Meeting, Estonia, June 10-19, 2014; 2) IGCP 591 and

- ISSS Field Workshop, Kunming, China, August 12-22, 2014; 3) IGCP 591 Annual Meeting, Ottawa, Canada, July 2015; 4) IGCP 591 Annual Meeting, Lille, France, 2016.
5. Development of databases that will bring together and make available information from all sources associated with the Silurian researchers.

Ordovician Subcommittee

1. Production of revised correlation charts, linking regional chronostratigraphic schemes to the global stages for each major paleogeographic region.
2. Develop a global sealevel curve for the Ordovician.
3. Develop a standard set of paleogeographic base maps for the Ordovician.
4. Develop more robust absolute ages for the Ordovician.
5. Rejuvenate regional working groups with the purpose of refining correlations.
6. Evaluate the GSSP for the Cambrian-Ordovician boundary, base of Tremadocian stage.

Cambrian Subcommittee

1. Provisional Stage 5 is expected to be defined in 2014.
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 ICS 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 ICS 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.

Ediacaran Subcommittee

1. 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 and a vote 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.
2. 2015-2016 Additional field trips to be organized to examine potential GSSP sections for Ediacaran subdivisions, and submission and discussion of formal proposals for Ediacaran Stage GSSP(s);
3. 2017: Review and vote on Ediacaran Stage GSSP proposals.
4. 2017: Ratification of Ediacaran Stage GSSP(s).

Cryogenian Subcommittee

1. 2014-2015: Application for revision of numerical age for the base of the Cryogenian to 720 Ma – with effect from 2014.
2. Ongoing discussion with the ICS and the Precambrian Subcommittee regarding the status of the Tonian System.
3. Field workshops and symposia to be held jointly with the Ediacaran Subcommittee in South China, June 2014, with a focus on the search for appropriate criteria for the subdivision of the Ediacaran System but also addressing evidence for a synchronous onset to glaciation after c. 720 Ma.

4. 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.
5. Completion of template paper for Cryogenian GSSPs (Dalradian succession of SW Scotland) in 2014 and call for remaining template papers for at least the localities above.
6. 2015-2016: Review of template papers ahead of Yukon and other field excursions.
7. 2017-2020: Discussion and voting on Cryogenian GSSP candidates, and ratification of Cryogenian GSSP at 2020 IGC.

Precambrian Subcommission

1. Report not yet submitted.

International Stratigraphic Classification Subcommission

1. Publication of separate papers on Lithostratigraphy, Biostratigraphy, and Chronostratigraphy in *Newsletters on Stratigraphy*.
2. Production of a new edition of the *International Stratigraphic Guide*.

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