



International Commission on Stratigraphy

ANNUAL REPORT 2016

1. TITLE OF CONSTITUENT BODY

The 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 programmes 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. ORGANISATION

ICS is organized in two types of constituent bodies: Subcommissions for longer-term study, and Executive Task Groups (working 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	

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INTERNATIONAL UNION OF GEOLOGICAL SCIENCES

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 50-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 16 Subcommissions) represent seven countries: United Kingdom (4 members), Canada (2), Italy (4), USA (1), China (3), Russia (1) and Czechia (1). Among all subcommission officers and the ICS executive, 15 countries are represented: United Kingdom (7 members), Canada (5), USA (5), China (5), Italy (8), Australia (2), Spain (2), Russia (3), Czech Republic (2), France (3), Germany (1), Sweden (1), Poland (1), Austria (2) and Norway (1). The voting members of ICS, i.e. all voting members of all subcommissions who replied to our request to report include officers represent over 30 countries: USA (31), China (13), United Kingdom (11), Russia (16), Canada (7), France, (5), Germany (12), Italy (21), Australia (16), Spain (13), France (12), Japan (6), New Zealand (5), Argentina (2), Belgium (4), Netherlands (3), Brazil (3), Poland (5), Czech Republic (3), Denmark (3), Sweden (3), Switzerland (1), Hungary (1), India (3), South Africa (1), Austria (2), Estonia (1), Finland (1), Iran (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/geoscience/?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:	being established
Precambrian:	www.precambrian.stratigraphy.org
Stratigraphic Classification:	http://users.unimi.it/issc

3a. ICS Executive Officers for 2012-2016:

Chair: Stanley Finney (California, USA)

Vice-Chair: Shanchi Peng (Nanjing, China)

Secretary: Paul Bown (London, UK)

ICS Executive Officers for 2016-2020:

Chair: David Harper (Durham, England)

Vice-Chair: Brian Huber (Washington, USA)

Secretary: Philip Gibbard (Cambridge, England)

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

Only a few of the subcommissions have formal financial contributions from external sources other than IUGS (through ICS), and they are very limited and listed in the individual reports. Some activities that are associated with ICS goals, such as distributing charts of the Geological 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 nor executive receives any salary compensation from IUGS or other ICS funds. Indeed, most officers personally contribute towards 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 standardisation of chronostratigraphy and its colour 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, 653, 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, Brachiopods, 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 Chattian Stage
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)
Base Albian Stage

Jurassic:

Base Bathonian Stage
Base Bajocian Stage
Base Aalenian Stage (= Base of Middle Jurassic Series)
Base Toarcian Stage
Base Pliensbachian Stage
Base Sinemurian Stage
Base Hettangian 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 IN 2016

Full commission

- Participation in the International Geological Congress, Cape Town, South Africa, September 2016.
- 2016 version of ICS Chronostratigraphic Chart, which includes revised numerical ages, was posted on the ICS website and was distributed at the IGC in Cape Town.
- Several authors, university professors and other educators, and professional societies were granted permission to use and reproduce the ICS International

Chronostratigraphic Chart in their productions.

- The GSSP for the base of the Albian was ratified by IUGS in April 2016. The article will be published in *Episodes* in early 2017.

- GSSP proposal for base of Chattian Stage (Oligocene Series/Epoch, Paleogene Series/Period) ratified by IUGS Executive Committee. It will be dedicated in May 2017.

- The ICS Chair (S. Finney) and incoming Secretary-General (P. Gibbard) were interviewed by journalists of several different publications and television regarding consideration of the 'Anthropocene Epoch' by ICS following the International Geological Congress in September.

- GSSPs for three Jurassic stages previously ratified were dedicated in 2016: Bajocian Stage, Cabo Mondego, Portugal, 24 July; Toarcian Stage, Peniche, Portugal, 25 July; Aalenian Stage (Middle Jurassic Series), Fuentelsaz, Spain, 28 July.

- Following discussions at the STRATI 2015, an *ad-hoc* group was established to address the question of formalization of subseries/subepochs for the Paleocene to Holocene Series/Epochs. A proposal for formalization was submitted to voting members of the Paleogene, Neogene and Quaternary subcommissions, but it did not receive the 60% super majority required for approval. Thus the matter was tabled for now.

- Because of a long period of inactivity in the Precambrian Subcommittee and serious discord among its officers, the ICS voted to dissolve the Subcommittee and that decision was approved by the IUGS EC. Subsequently, Bruce Eglington was appointed by the ICS EC to serve as chair and to reconstitute a new Precambrian Subcommittee.

- ICS Chair Finney gave an invited keynote lecture at the 100th Anniversary Celebration of the Geological Survey of Colombia. His lecture was titled: The 'Anthropocene' epoch: is it relevant for national geological surveys?

- Elections were completed for executive officers of ICS and all of its subcommission for terms of 2016-2020.

- A transition meeting of outgoing and incoming ICS executive officers was held in London, March 10, 2016

- Initiated process of revision of ICS statutes and guidelines.

Quaternary Subcommittee

- Formal subdivision of Holocene Series. The Working Group for the Subdivision of Holocene presented three proposals: **(1)** Greenlandian Stage/Age = Lower/Early Holocene subseries/subepoch. Utilises the pre-existing Holocene Series GSSP (ratified 2008): NorthGRIP ice core, Greenland. Age: 11,700 a b2k (before AD 2000). **(2)** Northgrippian Stage/Age = Middle Holocene subseries/subepoch. Proposed GSSP: NorthGRIP1 ice core, Greenland. Global Auxiliary Stratotype: Gruta do Padre Cave speleothem, Brazil. Age: 8326 a b2k. **(3)** Meghalayan Stage/Age = Upper/Late Holocene Subseries/Subepoch. Proposed GSSP: Mawmluh Cave speleothem, Meghalaya, India. Global Auxiliary Stratotype, Mount Logan ice core, Canada. Age: 4200 ca. a BP (before 1950).

- All three proposals were approved unanimously by the Working Group. Following consultation, a revised set of proposals was distributed to the SQS voting membership on 11 February 2016 along with the ballot form, with a closing deadline of March 14. There was a 100% return of ballot forms. Results were as follows: Proposal 1 = 19 yes (90.5%), 1 no (4.8%), 1 abstain (4.8%). Proposal 2 = 19 yes

(90.5%), 1 no (4.8%), 1 abstain (4.8%). Proposal 3 = 17 yes (80.9%), 2 no (9.5%), 2 abstain (9.5%). All three proposals exceeded supermajority. The proposals were then passed to Stan Finney, then Chair of ICS on May 3, 2016. The proposals have been tabled by ICS pending resolution of the subseries issue.

- Formal subseries for the Cenozoic. E-mail discussions on whether subseries for the Cenozoic should be formal or informal were held between the Cenozoic subcommission chairs and others from August 2015 through to July 2016, and moderated by Stan Finney. The position for formal subseries was authored by Martin J. Head, Marie-Pierre Aubry, Mike Walker, Kenneth G. Miller, and Brian R. Pratt. Position statements for and against formal subseries for the Cenozoic along with the ballot forms were distributed by Stan Finney to the voting memberships of the three Cenozoic subcommissions. The results overall were inconclusive and the matter was held over for the incoming ICS Executive.

- Second Anthropocene Working Group Meeting. This open meeting was held 24th–25th November 2015, and hosted and financially supported by McDonald Institute for Archaeological Research at Cambridge University, UK.

- Third Anthropocene Working Group Meeting. Hosted and financially supported by Fridtjof Nansen Institute, Oslo, and the Research Council of Norway, this closed internal meeting was held 22nd–23rd April 2016. Martin Head, Chair of SQS, and Felix Gradstein, Past Chair of ICS, were invited speakers.

- 35th International Geological Congress (IGC), Cape Town, South Africa. SQS and its constituent working groups were involved in several activities, as follows:

- Symposium 'Anthropocene: utility and definition', was convened and chaired by M.J. Head.

- Symposium 'The Quaternary System: precision and reliability in global correlation', was convened and chaired by M.J. Head.

- The SQS website. The SQS website has been migrated from Cambridge to a server at Brock University and will be managed by M.J. Head. The URL is unchanged: <http://quaternary.stratigraphy.org>.

Neogene Subcommission

- During 2016, the debate about 'formal and informal stratigraphic units, sub-epoch/subseries' (this arose during the ICS open assembly held in the STRATI 2015 Congress in Graz) developed between a group supporting formalisation and a group favoring informal status, both including members of the Subcommissions on Quaternary, Neogene and Paleogene Stratigraphy (SQS, SNS, SPS respectively). Discussion and exchange of opinions led to a vote within SQS, SNS and SPS, and resulted in documents that, together with a summary document by the ICS Officers, will be published in *Episodes* in the near future.

- A paper dealing with the astronomical tuning of the La Vedova section, one of the Mediterranean candidate sections for the definition of the Langhian GSSP, has been published: "Astronomical tuning of the La Vedova section between 16.3 and 15.0 Ma. Implications for the origin of megabeds and the Langhian GSSP" by Turco E. Hüsing S., Hilgen F., Cascella A. Gennari R. Iaccarino S.M., Sagnotti L. published online September 2016 in *Newsletters in Stratigraphy*.

Paleogene Subcommission

- The proposal for the definition of the GSSP for the base of the Chattian, which was voted and accepted by the ISPS voting members, was submitted to the ICS and approved by the IUGS during the 35th IGC 2016 in Cape Town. The GSSP, defined at

the Monte Cagnero section (Piobbico, Central Italy), was ratified by the IUGS Executive Committee in September 2016.

- A special issue was agreed with the peer-review journal *Newsletters on Stratigraphy*, dedicated to the Paleogene contributions presented during the STRATI 2015 meeting (Graz, Austria, July 2015). This issue will be published in 2017.

- A comprehensive review of reference sections from Iberia and from the Barton area (UK) has been carried out, pointing out the relevance of these sedimentary successions for the Paleogene stratigraphy and timescales.

Cretaceous Subcommission

- In 2016, a paper on the carbon isotope stratigraphy and cyclostratigraphy of the Santonian (Thibault et al. 2016) was published, allowing precise correlation between the planktonic foraminiferan zonation of the Tethyan Realm (Gubbio) and the Boreal Realm (Europe, USA) chalk successions. The most likely outcome will be a choice of a GSSP as the base of C34R at the Bottaccione Gorge, Gubbio. Thibault, N. et al. 2016. Astronomical calibration and global correlation of the Santonian (Cretaceous) based on the marine carbon isotope record. *Paleoceanography*, 31, doi:10.1002/2016PA002941.

- On 27 November, 2015 a new Global Stratotype Section and Point for the base of the Santonian Stage (Upper Cretaceous Series, Cretaceous System) was formally inaugurated at Olazagutia, in Navarra, Spain. The working group was represented by Prof. Josep Pons of the University of Barcelona. Prof. Jose Calvo (IUGS Secretary General), attended the ceremony.

- Additional studies concerning definition of the Coniacian Stage GSSP have been carried out on the Salzgitter Salder (northern Germany) and Slupia Nadbrzezna (central Poland) sections. In 2016 a succession in the Big Bend National Park (SW Texas, Hot Spring section) has been restudied.

- The GSSP for the base of the Albian was ratified by IUGS in April 2016. The article submitted to *Episodes* has been accepted and it will be published in early 2017.- W.J. Kennedy, A.S. Gale, B.T. Huber, M.R. Petrizzo, P. Bown, H.C. Jenkyns. The Global Boundary Stratotype Section and Point (GSSP) for the base of the Albian Stage, of the Cretaceous, the Col de Pré-Guittard section, Arnayon, Drôme, France. *Episodes*, in press.

- During 2016 the SCS has continued working on the Río Argos section (candidate GSSP of the Hauterivian-Barremian boundary). The formal proposal will include data on biostratigraphy (ammonites, calcareous nannofossils, and benthic and planktonic forams), stable isotopes stratigraphy, organic matter and cyclostratigraphy. It is hoped to complete it by the first half of 2017. In addition two complementary sections covering the whole Barremian stratigraphic interval (Arroyo Gilico and Barranco de Cavila sections) will be analysed to determine the magnetic susceptibility variations in order to calibrate the duration of the stage.

- The Valanginian WG has not been active in 2016. The current list of the group (30 members, see the 2004 SCS Annual Report) is now 12 years old and requires updating. The new chairs will reorganise the activities with respect to the recent work published on the Valanginian and invite active specialists of main fields of stratigraphy (palaeontology, isotope stratigraphy, magnetostratigraphy, etc.).

- Berriasian GSSP: New fieldwork has been undertaken in the 2016 documenting the Tithonian-Berriasian boundary interval, its biotas, multiple fossil groups, and magnetostratigraphy, and several key papers have been published. Fieldwork included continuing documentation of outcrops (Les Combes, Beaume)

and new work (Charens, Tre Maroua) in SE France, southern Ukraine (Theodosia, Velikiy Kamenets) and the Czech Republic (Kurovice, Stramberk), with continuing magnetostratigraphic studies in Tunisia (Beni Kleb) and Mexico (Mazatapec).

- One major working group meeting was held in May 2016 in Slovakia. This was held jointly with the Polish Jurassic meeting, and was most successful. The discussions focussed on putative J/K boundary markers. The discussion led to a formal vote on the selection of a primary marker for the base of the Berriasian Stage. Thus, a postal ballot was held in June 2016, and the group considered a paper on the issues, advocating a proposal that the base of *Calpionella alpina* Subzone (that is the turnover from a *Crassicollaria*-dominated fauna to one dominated by small *C. alpina*, plus *C. parvula* and *T. carpathica*, in mid-M19n.2n) be chosen as the primary marker for the stage base. Of those voting (only 7 did not vote), a 76% majority voted in favour of the proposal. Therefore, the base of the *C. alpina* Subzone was agreed as the primary marker.

- The current Lower Cretaceous standard ammonite zonation was established during the 5th International Workshop of the Kilian Group in Ankara (Turkey, 31st August 2013) and published by Reboulet et al. (2014). During the Kilian Group meeting the standard zonation, which is the zonal scheme of the West Mediterranean province, was calibrated with different ammonite zonal schemes of the Boreal, Austral and Central Atlantic realms for some stratigraphic intervals.

Jurassic Subcommission

- *Base Kimmeridgian GSSP Proposal*. Following from the workshop held at the Polish Geological Institute, Warsaw, in 2015, under the leadership of Prof. Andrzej Wierzbowski, the GSSP Working Group has formally adopted the *flodigarriensis* ammonite horizon as the lowest level of the Subboreal Baylei Zone in the Flodigarry section, Staffin Bay of Skye (northern Scotland) defining the Global Stratotype Section and Point for the base of the Kimmeridgian Stage. A summary proposal and supporting papers will be sent to the ISJS members before the end of the year (2016).

- *GSSP dedications*. Golden Spike dedication events were organized in June 2016 by the municipalities for existing Jurassic GSSPs in Iberia. These included the base-Toarcian GSSP at Peniche, Portugal, the base-Bajocian GSSP at Capo Mondego, Portugal, and the base Aalenian GSSP at Fuentelsaz, Spain. The events in Portugal were attended by the ISJS chair, and all three events were attended by the ICS chair. All three events were very successful exercises in community engagement.

- Publication: da Rocha, R., Mattioli, E., Duarte, L.V., Pittet, B., Elmi, S., Mouterde, R., Cabral, M.C., Comas-Rengifo, M.J., Gomez, J.J., Goy, A. (2016) Base of the Toarcian Stage of the Lower Jurassic defined by the Global Boundary Stratotype Section and Point (GSSP) at the Peniche section (Portugal), *Episodes* 39, p. 460-481, DOI:10.18814/epiiugs/2016/v39i3/99741.

Triassic Subcommission

- Rhaetian GSSP: Albertiana 43 (67 pages) was published in April 2016 summarising the work on the Norian/Rhaetian boundary, which includes the two candidates at a) Pignola-Abriola, Italy (Rigo et al., 2016; Maron, 2016; Bertinelli et al., 2016), with a primary marker of conodont *Misikella posthernsteini* s. str. (with

proposed main secondary marker of 60/00 negative excursion in ternary magnetostratigraphic and radiolarian zonal indicators) and the b) Steinbergkogel section, Austria (FAD of *Misikella posthernsteini*, with secondary ammonoid, magnetic polarity and palynology markers). The original proposal of a primary 13Ccarb by Rigo et al. (2016) was updated to a primary *M. posthernsteini* ss marker by Bertinelli et al. (2016).

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- Rhaetian GSSP: The FAD of *M. posthernsteini* had been proposed by the working group some years ago, but now its chronomorphocline has been clarified (Bertinelli et al. 2016), leading to a clearer understanding of conodont changes across the proposed boundary. This proposed revision is being discussed for its impact on the proposed Steinbergkogel section, hopefully leading more swiftly to a decision on this GSSP.

- Anisian GSSP: The FAD of the conodont *Chiosella timorensis* had been informally proposed by the working group some years ago as the guide for the base of the Anisian using the Desli Caira section in Romania (Grădinaru et al., 2007, vol. 37 in *Albertiana*), supported by an ammonoid and foraminiferan turnovers, magnetic polarity and 13Ccarb data.

Permian Subcommission

- A field excursion to the potential GSSP sections in the southern Urals, Russia was organised during the ICCP 2015 in Kazan. After the field excursion, a special SPS workshop was held to discuss the advantages and disadvantages of the potential GSSP sections. Most of the voting members agreed that the Sakmarian-base GSSP section at Usolka is good. However, the potential GSSP candidates for the base of the Artinskian and Kungurian stages are not well exposed, thus, both sections need to be excavated. Russian colleagues organised a team in August, 2016 to dig two long trenches to make the strata of the Dalny Tulkas and Mechetlino Quarry sections fully outcropped now. The proposals of these two potential GSSPs will be prepared after the Sakmarian-base GSSP proposal was voted on.

- A revised and updated proposal of the Sakmarian-base GSSP has been published in *Permophiles* (2016, Issue 63). A group e-mail was sent to all SPS voting members for one-month discussion before the working group organises a formal proposal for the subcommission. Some comments and suggestions on how to improve the proposal have been received. A few comments which conodont lineage to be selected for the definition of the Sakmarian-base GSSP have also been received.

Carboniferous Subcommission

- A potential index for the Viséan-Serpukhovian boundary definition, the first evolutionary occurrence of the conodont *Lochriea ziegleri* Nemirovskaya, Perret & Meischner, 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957)–*Lochriea ziegleri*, has been selected, but not voted on by the task group and SCCS for final approval. Work is well advanced at two prime GSSP candidate sections: the Verkhnyaya Kardailovka in the southern Ural Mountains of Russia and the Naqing (Nashui) section in southern Guizhou Province, China. In the Cantabrian Mountains of northwest Spain, work continued on the Millaró and Vegas de Sotres sections, two other potential candidate sections for the GSSP. *L. ziegleri* appears in the Brigantian Substage of NW Europe somewhat below the current base of the Serpukhovian as defined by its lectostratotype section in the Zaborie quarry near Serpukhov in the Moscow Basin, Russia (Kabanov *et al.*, 2012, 2014a,b).

- An international workshop of the working group on the Bashkrian-Moscovian boundary was held in Saint Petersburg, Russia, during September 5-10, 2016. It was held in the Geological Research Institute, Ministry of Natural Resources and Environment of the Russian Federation. Two conodont taxa, *Declinognathodusdonetzianus* and *Diplognathodusellesmerensis* are potentially index fossils. Fusulinids can be used as an auxiliary fossil group to define the boundary. *Depratinaprisca* is a first choice, and *Aljutovellaaljutovica* is the second. The Basu section in Ural Mts and the Naqing Section in Guizhou, South China are two potential sections for the boundary and the Gas Section in Kyrgyzstan is a possible alternate.

- The Devonian-Carboniferous boundary redefinition task group held a workshop in Montpellier, France, 20-22 September, 2016. Although no consensus about the DCB criterion was made during this workshop, most participants agreed that the DCB index events should be lowered down below the current definition, i.e. the FAD of *Siphonodella sulcata* and above the base of the Hangenberg black shale (the main phase of Hangenberg extinction event). High-resolution and multiproxy stratigraphic analysis of the Devonian-Carboniferous boundary intervals around the world should be completed before the vote on the new DCB definition by the task group and SCCS.

Devonian Subcommittee

- The joint SDS/Uzbekistan/RAS field expedition to Zinzilban George, Uzbekistan to resample and redefine the base Emsian GSSP using multiproxy criteria. This was supported by the ICS. SDS members are now analysing the collected samples for conodonts and made a preliminary report at Ghent and Cape Town in 2016. Final report to be at ICOS in 2017.

- Meeting, jointly with IGCP 591 in Ghent, Belgium (July 2016).

- Publication in 2016 of *Devonian Climate, Sea Level and Evolutionary Events* as *Geological Society of London Special Publication*, **423**, edited by Becker, Brett & Königshof.

Silurian Subcommittee

- *Silurian Times* No 23 was edited by the secretary, R. Zhan, and distributed in March, 2016, posted on the web site for the ISSS, and circulated as an email attachment to all titular, corresponding and interested members of the Subcommittee. It contained the reports on previous meetings, announcements of upcoming meetings and publications, and the latest news and recent publications on Silurian research.

- Two special issues of the *Canadian Journal of Earth Sciences* were published in 2016 representing the proceedings of the joint meeting of the 5th International Symposium on the Silurian System and the Annual Meeting of IGCP 519, held in Quebec, Canada, in July, 2015. These issues were edited by Jisuo Jin and Michael Melchin.

- The ISSS annual symposium was held jointly with the IGCP Project 591 Closing Meeting in Ghent, Belgium, 6-9 July, followed by post-meeting field trip to the lower and middle Palaeozoic of Wales, 10-15 July. A special session was devoted to "Silurian boundaries and GSSPs". Particular attention was devoted to the Rheidol Gorge locality – a candidate section for the base of the Aeronian GSSP.

- Work is in progress on the restudy of potential GSSP candidate sections for

the base Wenlock (Banwy River Section, Wales), the Base Aeronian (Shennongjia and Yuxian sections, China; Hlasna Treban Section, Czech Republic and Rheidol Gorge Section, UK and base of the Telychian (Shennongjia Section, China). The working group for the Base of Aeronian GSSP visited potential candidate section of the base of Aeronian GSSP at Yuxian, China.

Ordovician Subcommission

- Colleagues voted by a super majority to support the establishment of an ASSP for the base of the Ordovician at Lawson Cove (see Miller, J.F. *et al.*, 2016: *Stratigraphy* 12, 219-236).
- A new IGCP project, 653, ‘Onset of the Great Ordovician Biodiversification Event’ was established in early 2016 and a series of events (in cooperation with ISOS) is already planned (see <http://www.igcp653.org/>).
- Ordovician News 33 was published and is available from the ISOS webpage (<http://ordovician.stratigraphy.org/>).
- ISOS supported the closing meeting of IGCP 591 in Ghent during July 2016 and the opening meeting of IGCP 653 in Durham, UK during September 2016.
- Two officers (Harper and Dronov) attended the 35th International Geological Congress in Cape Town, presented research and held informal meetings with Ordovician colleagues.

Cambrian Subcommission

- Palaeo Down Under 2, Adelaide, South Australia, 11–15 July 2016. The Cambrian Subcommission held its annual meeting in association with the Palaeo Down Under 2 Meeting in Adelaide, Australia (organised by the Association of Australasian Palaeontologists). Several talks were devoted to primarily toward the lower part of the Cambrian System. Most of the major Cambrian stratigraphic issues remaining to be solved are in the lower half of the system, and the sessions were partly aimed at addressing potential solutions.
- ISCS Webpage. The Cambrian Subcommission’s webpage was updated in 2016. 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.
- Cambrian Stage 5. Following the Working Group’s recommendation (in 2015) to use the FAD of the oryctocephalid trilobite *Oryctocephalus indicus* as the primary marker for provisional Stage 5, two GSSP proposals were submitted to ISCS in 2016. One proposal is from the Split Mountain Section, Nevada, USA, and the other one is from the Wuliu-Zengjiayan Section at Balang Village, eastern Guizhou, China.

Ediacaran Subcommission

- The Mistaken Point site was selected as a UNESCO World Heritage site.
- During the 35th IGC in Cape Town (South Africa), the Subcommission organised a field workshop to examine terminal Ediacaran successions in Namibia and co-sponsored a symposium at the IGC. In addition, the Subcommission co-sponsored the Palaeo Down Under 2 conference in Adelaide, Australia (10th - 15th

July 2016) and organized a field workshop to examine Ediacaran successions in South Australia. A publication resulting from this workshop has published in “Episodes” (Xiao S, Narbonne GM, Zhou C, Laflamme M, Grazhdankin DV, Moczydłowska-Vidal M, Cui H, 2016, Toward an Ediacaran time scale: problems, protocols, and prospects. *Episodes*, 39, 540–555.)

- In 2016, the Subcommittee established a new category of membership – honorary membership, and selected Andrew Knoll and Malcolm Walter as the first slate of honorary members. In addition, the Subcommittee selected five new voting members (Alexander Liu, Pengju Liu, James D. Schiffbauer, Mukund Sharma, and Rachel Wood) to replace five incumbent voting members (Martin Brasier – deceased, Kathleen Grey, Sören Jensen, Vibhuti Rai, and Chongyu Yin).

Cryogenian Subcommittee

- This is a new subcommittee, the primary body for facilitation of international communication and scientific cooperation in Cryogenian stratigraphy directed at better understanding Earth system evolution during the Cryogenian Period (c.720 – c.635 Ma). Its priority is the unambiguous definition, by means of global stratotype section and points (GSSP), of a hierarchy of chronostratigraphic units that provide the framework for correlation of Cryogenian strata.

Precambrian Subcommittee

- This subcommittee is currently being reconstituted; no report received.

Stratigraphic Classification Subcommittee

- 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 under the Chairmanship of Maria Bianca Cita 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 articles are/will be published in *Newsletters on Stratigraphy* and reprinting of the various articles in a textbook is expected.

6. SUMMARY OF EXPENDITURE IN 2016:

In its 2015 Annual Report, the ICS Executive requested \$105,170, which was reduced from \$105,353 that included full amounts requested by Subcommittees. The ICS request was almost 50% more than its budget allocation of ~\$50,000 for the last several years and it was expected that ICS would receive a supplemental allocation for the IGC year. However, the IUGS Executive Committee awarded ICS a budget of only \$50,000 for 2016 with allocations for most subcommittees considerably

reduced (Table 1) thus limited activities of subcommissions, particularly participation in the IGC. Furthermore, the last limited funds of the NSF grant were spent out as shown in the table of allocations for 2016.

Subcommission	Final Allocation
Quaternary	3000
Neogene	0
Paleogene	3500
Cretaceous	0
Jurassic	2035
Triassic	2500
Permian	3000
Carboniferous	3200
Devonian	1800
Silurian	3500
Ordovician	3035
Cambrian	2500
Ediacaran	3000
Cryogenian	0
Precambrian	1000
Stratigraphic Classification	3000
ICS Executive (3)	9715
Reserve	5200
Total	\$49,985

Table 1

7. SUMMARY OF INCOME IN 2016:

The IUGS Executive Committee awarded ICS a budget of \$50,000 for 2016. That was the only income to ICS in 2016.

Subcommission	ICS Allocation to Subcommissions & Executive US\$	carried forward	Total Allocations US\$
Quaternary	3000.00	0	3000.00
Neogene	0	€3894.00 = \$4193.00	0
Paleogene	3500.00	0	3500.00
Cretaceous	0	7740.00	7740.00
Jurassic	2035.00	0	2035.00

Triassic	2500.00	0	2500.00
Permian	3000.00	0	3000.00
Carboniferous	3200.00	1460.00	4660.00
Devonian	1800.00	0	1800.00
Silurian	3500.00	0	3500.00
Ordovician	3035.00	0	3035.00
Cambrian	2500.00	0	2500.00
Ediacaran	3000.00	0	3000.00
Cryogenian	0	3347.00	3347.00
Precambrian	1000.00	41940	3000.00
Stratigraphic Classification	3000.00	0	3000.00
ICS Executive (3)	9751.00	0	9751.00
Reserve	5200.00	0	5200.00
Total	\$49985.00	\$16740.00	\$64883.00

8. BUDGET FROM ICS IN 2017

The following table is based on the budget requests from all Subcommissions submitting annual reports and the ICS Executive. The total amount is \$105,177. 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. This year reduced amounts have not been determined, which must await knowledge of the ICS allocation to be set by the IUGS Executive Committee.

Subcommission	Request for 2017 US\$	Justification
Quaternary	4000.00	Attend WG meeting
Neogene	0	N/A
Paleogene	4800.00	Mainly to support inauguration of Chattian GSSP
Cretaceous	0	Funding not requested
Jurassic	20000.00	Support student attendance at 10 th Int. Conf. in Mexico, 2018 (20 students). Over a 2-yr cycle?
Triassic	7350.00	Field workshops
Permian	5000.00	Field meetings
Carboniferous	800.00	Attend SCCS conference, Kazakhstan
Devonian	1800.00	Attend meeting, newsletter costs
Silurian	8250.00	GSSP field meeting travel
Ordovician	5000.00	Meetings attendance, develop 'Global Ordovician' book
Cambrian	6100.00	Conference and stage workshop in Nfld
Ediacaran	5486.00	Office expenses, field workshop
Cryogenian	3000.00	Attend meeting
Precambrian	0	No report received
Stratigraphic	5200.00	Meetings of contributors and editors of 'stratigraphic'

Classification		guide book.
ICS Executive (3)	7500.00	IGC attendance, organizational meeting of new officers of reconstituted Precambrian Subcomm.
Reserve	3000.00	GSSP dedication ceremonies.
Total	87,286.00	

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

- Bullet point each key achievement anticipated, limited to three maximum for subcommissions.

ICS Executive

1. Oversee process of reconsideration of subseries/subepochs for Paleocene to Holocene.
2. Develop strategy for dealing with problem proposed by Holocene GSSPs defining not only stages but also subseries.
3. Finish revision of ICS statutes and guidelines, receive approval from ICS voting members and submit to IUGS EC for approval.
4. Initiate planning for STRATI 2019 - 3rd International Congress on Stratigraphy to be held in Milan, Italy, summer 2019. Set dates (giving consideration to major meetings of subcommissions), invite sponsors of related professional societies, promote the Congress on the ICS website and other outlets.
5. Review and initiate planning for selection of awardees of ICS medals that will be presented at STRATI 2019.
5. Develop more translations of ICS Chart; regularly update Chart and Table of GSSPs as GSSPs are ratified.
6. Direct support to those activities (field meetings, business meetings) of subcommissions that promote progress on GSSPs.
7. Update ICS website, review websites of all Subcommissions and commend those that are good and suggest rejuvenation of others to appropriate subcommissions.
8. Encourage links between ICS Subcommissions and the Geobiodiversity Database to ensure that data acquired in studies for GSSP proposals are archived at GBDB.

Quaternary Subcommission

- Resolve the issue of formal subseries for the Quaternary so that SQS can get on with its job of proposing GSSPs to ICS.
- Request that ICS EC move the already-submitted SQS Holocene subdivision proposal to a vote as soon as the issue of formal subseries is resolved.

- Encourage the proponents of the three Middle Pleistocene candidate GSSPs to submit their proposals by the end of May, 2017.
- Expand the case for using an Antarctic ice core as a GSSP for the Late Pleistocene, as presented by M.J. Head at the 35th IGC in Cape Town.
- Organize an SQS-sponsored open workshop on the Anthropocene, tentatively scheduled for the first half of June and prospectively hosted by the Fridtjof Nansen Institute, Oslo. In particular, the SQS voting membership and the executive of ICS would be encouraged to attend.
- Continue to explore the fine-scale subdivision of the Quaternary.
- M. J. Head will update and maintain the SQS website now that it has moved to Brock University.

Neogene Subcommission

- The activity of the working group for the definition of Langhian and Budigalian GSSPs (BurLan Working group - chaired by Frits Hilgen) was focused on a programme to reach an agreement for a Langhian GSSP proposal. Two good candidate stratigraphic sections are available, La Vedova (Central Italy) and St. Peter's Pool (Malta Island), studied by two different research groups that have been asked to complete their studies and submit a proposal. The study of La Vedova section has been completed, with the publication of the astronomical tuning of the section (Turco et al., 2016). In the next months the Working group's aim to propose a reliable/reproducible guiding criterion, complemented by additional criteria useful for correlation, and reach a decision on the GSSP section.

Paleogene Subcommission

- Full support will be given to the working groups on the GSSPs of the Bartonian and Priabonian.
- Organization of the ceremony to place the golden spike for the GSSP of the Chattian in the Monte Cagnero section (Marche, central Italy), in Spring 2017.
- The proposal for the GSSP of the Priabonian will be submitted by the Working group, and voted by the Subcommission.

Cretaceous Subcommission

- A new website will be built in early 2017. It is planned to construct a user-friendly platform that can be updated by officers and working group leaders allowing easy communication among members and a prompt update of progresses and news.
- The 10th International Symposium on the Cretaceous System is scheduled for August 21-25, 2017 and will be held in Vienna, Austria, organised by Prof. M. Wagreich and Benjamin Sames and colleagues from Vienna (webpage: <https://10cretsymp.univie.ac.at/>). The symposium will include sessions on each stage (and substages) of the Cretaceous, led by the chairs of the Working group and/or by the officers of the subcommission. This will also enable the chairs of the Working group to organise working group meetings dedicated to intensive and productive discussions on each stage

and substage boundaries and definitions. It will also include meetings of the IGCP 609 and IGCP 608 groups.

- The next meeting of the Kilian Group is planned on Sunday 20th August 2017 in the Natural History Museum of Vienna, together with the 10th International Symposium on the Cretaceous, Vienna 21-26 August 2017.

Jurassic Subcommission

- *Oxfordian Task Group*. Following the successful workshops in Provence in 2013 and Dorset in 2014 (and the publication of reports from both workshops) we expect rapid progress towards a formal proposal. The Chair has been liaising with the Task Group secretary for the Oxfordian in particular with a view to agreeing a timetable for progress in 2017.
- *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.

Triassic Subcommission

- The stasis with the progress on the Rhaetian and Carnian working groups is in large part caused by continual changes in the taxonomy of the conodonts across these two boundaries, leading to re-assessment of correlation relationships between the proposed candidate sections. The plan is to resolve this by the Pignola-Abriola workshop, which brings conodont workers together to identify the common ground between definitions of species and genera.
- A field meeting to the Pignola-Abriola section in Italy, so the Rhaetian Working Group can examine and discuss this new proposed section in more detail.
- A volume of *Albertiana*, with elicited contributions on the Carnian-Norian boundary, to try and summarise progress to date on the two candidates at Black Bear Ridge in Canada and Pizzo Modello in Sicily. This will be linked to a field workshop (organised by JP Zonnefeld, M. Orchard and M. Goldring) to Black Bear Ridge, British Columbia in spring 2017. The field workshop will be mostly sponsored by the SEPM (but partly by the STS).

Permian Subcommission

- The primary objectives are to complete the last three GSSPs (Sakmarian, Artinskian, and Kungurian stages). An updated proposal for the Sakmarian-base potential GSSP has been completed (*Permophiles* 63). This proposal will be revised again after the one-month discussion during all SPS voting members. The Russian Stratigraphic Committee has excavated the Dalny Tukay and Mechetlino Quarry sections, then SPS will organise an international joint field excursion to collect various samples in those sections.

Carboniferous Subcommission

- A final report in *Episodes* needs to be published for the chosen GSSP of the Tournaisian-Viséan boundary in the Pengchong section, southern China, following its approval by the SCCS in late 2007 and its ratification by the ICS and IUGS.
- An index for the Viséan-Serpukhovian boundary needs to be voted on by the task group and SCCS in the next year.
- A joint workshop/field excursion will be organised by M. Sh. Omirserikov from the Academician Kazakh Academy of Natural Sciences in Bolshoi Karatau Range, Kazakhstan, August 15-21.

Devonian Subcommission

- Revision of the basal Emsian GSSP in Uzbekistan. Presentation of results at ICOS 4 meeting, Valencia, June 2017.
- Revision of the D/C boundary in the frame of the D/C Boundary Task Group (Chairman: M. Aretz) in close collaboration with the Carboniferous Subcommission. Progress towards selection of candidate stratotypes following selection of boundary criteria in September 2016.
- Publication of Brussels IGCP 591 meeting presentations in *Palaeobiodiversity & Palaeoenvironments*.

Silurian Subcommission

- The major meeting of the ISSS for 2017 will be held in collaboration with the Symposium ICOS4 “Progress on Conodont investigation” organised by the Pander Society in collaboration with SDS and ISSS. This will be held in Valencia, Spain, June 25-30, predated by a pre-conference fieldtrip to Central Pyrenees (June 20-25) and followed by a post-conference field trip to Prague Synform and Carnic Alps (July 1-9).
- Field meeting in Yichang, central China in mid-October 2017 will be organized together with IGCP 653 “the Onset of the Great Ordovician Biodiversification Event”.
- Three ISSS groups working on restudy of the base of the Aeronian GSSP, base of the Telychian GSSP and base of the Wenlock GSSP, continue their study of selected candidate sections in Shennongjia, China (Junxuan Fan *et al.*, GSSPs of the Aeronian and Telychian stages); Yuxian, China (Junxuan Fan *et al.*, Aeronian GSSP); Hlasna Treban, Czech Republic (Petr Storch *et al.*, Aeronian GSSP), Rheidol Gorge, Wales, UK (Michael Melchin *et al.*, Aeronian GSSP), El Pintado reservoir, Spain (David Loydell *et al.*, Telychian GSSP) and Banwy River, Wales (David Loydell *et al.*, GSSP of the base of the Wenlock Series). Submission of the first formal proposal of an Aeronian GSSP candidate section is anticipated in 2017, with further submissions anticipated for 2018.
- General update of the website for Silurian Subcommission by Dr Junxuan Fan.

Ordovician Subcommission

- A thematic set in *Lethaia* dedicated to the ‘Onset of the Great Ordovician Biodiversification Event’ will be published in late 2017 supported jointly by IGCP 653 and ISOS.
- The Ordovician website will be updated including the development of a database for GSSPs.
- Data will be gathered for Ordovician News 34.

Cambrian Subcommission

- The Cambrian Subcommission is finalising a decision on the GSSP of provisional Stage 5 (and Series 3), and expects to submit a proposal to ICS for ratification in 2017.
- In 2017, the Subcommission hopes to make significant progress toward a decision on provisional Stage 10.

Ediacaran Subcommission

- The Subcommission will discuss the 2016 white paper published in *Episodes* (Xiao S, Narbonne GM, Zhou C, Laflamme M, Grazhdankin DV, Moczyłowska-Vidal M, Cui H, 2016, Toward an Ediacaran time scale: problems, protocols, and prospects. *Episodes*, 39, 540–555.)
- A field trip to celebrate the 50 year anniversary of the discovery of the Mistaken Point biota is planned for the year 2017. This will be a good opportunity to discuss criteria for the subdivision of the Ediacaran System into series.
- The establishment of the SES (Second Ediacaran Stage) and TES (Terminal Ediacaran Stage) Working Groups has been formalized. These working groups will organise focused symposia, field workshops, and surveys in order to (1) evaluate potential criteria for the definition of SES and TES; (2) visit, assess, and select GSSP candidates; and (3) formalise the stratigraphical names for the SES and TES, as well as the first Ediacaran stage (FES). Following the successful examples of the Subcommission on Cambrian Stratigraphy, we will discuss the recommendation that the informal stage names FES, SES and TES be used in scientific communication before GSSPs and formal stage names are ratified.

Cryogenian Subcommission

- A special issue (Descent into the Cryogenian) was accepted by *Precambrian Research* and 24 papers are in preparation that will detail the most current information pertaining to the Tonian-Cryogenian transition around the world. This special issue (online publication deadline: December 2017) will form the basis of discussions at the International Meeting of Sedimentology, Toulouse, France on October 10-12, and at the June 2018 field workshop to Namibia that will cement future plans to establish a basal Cryogenian GSSP.
- 4b Specific GSSP Focus for 2016. The basal GSSP for the Cryogenian System will remain the priority of the subcommission for the foreseeable future.

Precambrian Subcommission

- no objectives reported for 2017.

Stratigraphic Classification Subcommission

- The chapter on Lithostratigraphy will be finished in 2017 and submitted for publication to *Newsletters on Stratigraphy*.
- For the chapters Biostratigraphy and Chronostratigraphy new members of the work groups will be invited and the old concepts have to re-evaluate and/or new concepts have to be developed.
- The session SSP2.2 - The Need for Integrated Stratigraphy - recent advances in cyclostratigraphy, astrochronology, radioisotopic dating and age modelling' will be held at the EGU General Assembly 2017 (EGU 2017), 23–28 April 2017, Vienna, Austria.
- The white paper by Hilgen *et al.* on Unit-stratotypes and Chronozones will be discussed including voting and corresponding members of ISSC, but also by other individuals interested in stratigraphy.
- A proposal for formalising Subseries/Substages in the Cenozoic was submitted to ICS in 2016. This proposal was, however, only discussed within the Subcommissions on Paleogene, Neogene and Quaternary Stratigraphy. Since this is a topic of broader importance it should be discussed again including all voting and corresponding members of ISSC and also from outside ISSC.

10. OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2016-2020)

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.

ICS Executive

- Define a substantial number of GSSPs, particularly for stage in the Carboniferous, Triassic, Jurassic, Cretaceous, and Cambrian systems; re-evaluate GSSPs for the several Silurian stages and the Devonian-Carboniferous boundary, and of the Cambrian System (Paleozoic Erathem, Phanerozoic Eonothem), and select GSSP-defined subdivisions of the Precambrian.
- Maintain website and its formal, permanent archive of the global geostandards - GSSPs and the ICS International Chronostratigraphic Chart.
- 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.
- Encourage subcommissions to regularly re-assess GSSPs and to develop new initiatives and projects that utilise the refined International Stratigraphic Chart.

- Encourage the recruitment by subcommissions of members from under-represented countries/regions and of those at early career stages.
- 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.
- Produce a new edition of the *International Stratigraphic Guide* with its joint publication by IUGS and the Geological Society of America
- Continue development of a strong link between ICS and the Geobiodiversity DataBase at the Nanjing Institute of Geology & Palaeontology
- Maintain close collaboration with all national stratigraphic commissions.
- 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.
- Serve as the primary international body setting global standards and illustrating best practices in stratigraphy.

Quaternary Subcommission

- Work with colleagues in ICS to ensure acceptance of formal subseries at least for the Quaternary.
- Nominate GSSP for the Middle Pleistocene Subseries/Stage boundary and its equivalent stage/age.
- Nominate GSSP for the Upper Pleistocene Subseries/Stage boundary and its equivalent stage/age.
- Explore further chronostratigraphic subdivision of the Quaternary System/Period, including the duration and status of the 'Anthropocene'.

Neogene Subcommission

- Proposal(s) for the Langhian GSSP will be submitted and published, with the purpose of reaching a final decision within the working group and subsequently within the SNS Subcommission.
- The definition of Burdigalian GSSP is a recurrent problem. The option to have the Burdigalian GSSP defined in an astronomically-tuned deep marine section, possibly in the Mediterranean, seems to make this problem very difficult to be solved. A section in the Mediterranean guarantees the stratigraphic contiguity with the other GSSP sections, but to date no good candidate section is available. Therefore, search for suitable sections and/or cores for defining the Burdigalian GSSP will continue. In absence of suitable Mediterranean sections for defining the Burdigalian GSSP, the option to formally designate this boundary in an (I) ODP core will be seriously considered within SNS and discussion within the working group will involve voting and corresponding members.

Paleogene Subcommission

- To investigate and agree on the GSSPs of the Paleogene stages that remain to be formally defined.
- To submit the ratified proposal of the Chattian GSSP to the journal *Episodes* for publication during 2017.

- To submit the proposal of the Priabonian GSSP to the Paleogene Subcommittee voting members, and then to ICS and possibly to *Episodes* for publication during 2017.
- Results of the multidisciplinary study of the Barton area.
- To advance on the definition criteria for identifying the base of Bartonian, choose a type section and submit a proposal to Paleogene Subcommittee voting members.
- To submit the proposal of the Bartonian GSSP to ICS and possibly to *Episodes* for publication within 2018.
- Support of the organization of the field workshops and meetings to define the remaining GSSPs.
- Support the organisation of Strati 2019 in Milan, as well as the attendance of ISPS members.
- Produce an updated version of an integrated Paleogene Time Scale.
- Preparation of standardised regional correlation charts and palaeogeographic maps by the regional Committees.

Cretaceous Subcommittee

- 2017-2019: Inauguration of the Albian GSSP.
- 2017-2019: Finalisation of the proposals by the Working Groups for the base of the Berriasian and the J/K boundary, base Valanginian, base Hauterivian, base Barremian, base Aptian, base of the Coniacian, base Campanian. Voting by members of the Working Groups to select a single GSSP candidate section.
- 2019-2020: Submission of the proposals GSSP candidate sections approved by the Working Groups to the Cretaceous Subcommittee Voting Members, submit it to ICS, and possibly to *Episodes* for publication.
- 2017-2020: Continue to work and preparation of proposals for the definition of substages for discussions at the forthcoming meetings: 10th International Symposium on the Cretaceous (Vienna 21-26 August 2017), STRATI 2019- 3rd International Congress on Stratigraphy (Milan, Italy, July 2019), 36th International Geological Congress (Delhi, India, 2-8 March 2020).

Jurassic Subcommittee

- Completion of the stage GSSP definition process.
- Develop strategy for substage definition process.
- Develop website as forum for exchange ideas in relation to Jurassic stratigraphy.

Triassic Subcommittee

- No new work is planned on the two proposed Carnian GSSPs, and the proposals just need updating prior to going to vote on the candidate boundary marker and the section. This should be achieved by the end of 2017.
- The introduction of the Pignola-Abriola section as one of the proposed Rhaetian GSSPs will delay a decision on this boundary until 2018, unless the new controversial conodont taxonomy can be resolved quickly. The

boundary interval at Pignola-Abriola is being sampled at greater resolution for conodonts and $\delta^{13}\text{C}_{\text{org}}$, since the proposed primary marker is in the top of a ~ 2 m gap in conodont data with only two $\delta^{13}\text{C}_{\text{org}}$ data points in this interval.

- There are two proposed candidates for the Olenekian GSSP (1) West Pingdingshan (Chaohu, South China) and (2) Mud (Spiti, India). The Mud section was the preferred option by the Olenekian working group based on a previous informal vote. Re-sampling of both conodonts and ammonoids at Mud has informally suggested the base the I/O boundary at Mud should be based on the FAD of *N. waageni* s. str. (L. Krystyn pers. com.). This event is one bed below the original proposal (Krystyn et al., 2007) and within a positive $\delta^{13}\text{C}_{\text{org}}$ excursion. Hugo Bucher has informally suggested an Olenekian GSSP proposal may come forward on the Nammal (Salt Range, Pakistan)- a section with a better ammonoid succession than other proposals. If this Nammal proposal does not appear by 1 April 2017, the working group chairman plans to go to a formal vote on the existing proposals in late spring 2017.
- The proposed Anisian GSSP at Desli Caira (Romania) has failed to yield detailed published work on the ammonoids, which has stalled this proposal for many years. However, recently more work has begun on this, and Grădinaru and others have indicated a published work (in progress now) may appear in 2017. Realistically it is more than possible we will not resolve the Anisian GSSP until 2019 or 2020.

Permian Subcommission

- Publishing the revised version of the proposals, organising the field excursions and establishing the three (at least two) GSSPs for the Cisuralian.
- Continue to work on the Guadalupian and global correlation for chemostratigraphy and geochronological calibration. Publish the official papers for the three Guadalupian GSSPs.
- Searching the replacement of the Lopingian-base GSSP nearby the stratotype section at Penglaitan, Guangxi, South China because the original will be flooded in 5-10 years by a dam for electric power.

Carboniferous Subcommission

- Within the next 4 years, it will be possible to select the defining events for all of the stage boundaries and progress toward selecting candidate sections for the GSSPs. We intend to use high-resolution biostratigraphy and combine it with a multi-discipline approach (use of sedimentology, geochemistry, and geological events) to establish as many of the remaining GSSPs as possible. The realistic objective is to have two GSSPs ratified in the next four years.
- We will encourage and pay more attention to finding volcanic ash beds for radiometric dating, in order to establish a more precise Carboniferous time scale and facilitate the correlation of important Carboniferous events at global scale.
- To establish working groups on dividing the Tournaisian and Viséan stages because both of them represent too much time.
- To strengthen and to vivify the SCCS website, with membership lists

revised, tasks and newsletters updated in time, making it a genuine platform to bring Carboniferous specialists together for collaboration and exchange of new ideas and results.

- Integrate the Carboniferous databases from the entire World, combining the Geobiodiversity Database (GBDB, a large compilation of data about sections) at Nanjing Institute of Geology and Palaeontology, the Paleobiology Database (a large compilation of data about fossils) at the University of Wisconsin-Madison, and other major databases, to facilitate the studies on Carboniferous biota and stratigraphy.

Devonian Subcommission

- Redefine the base of the Emsian Stage and the new ‘Zinzilbanian’ sub-stage. To bring the technical work to completion for the ICOS meeting in Valencia in 2017.
- Redefinition of the Devonian/Carboniferous Boundary with the joint Task Group.
- Publish the definitions of the Givetian and Frasnian substages in *Lethaia*.
- Define and publish the Famennian substages.

Silurian Subcommission

- Principal work will focus on GSSP-related research – restudy of some previously ratified but currently inadequate basal stratotypes. Research on Aeronian and Telychian GSSP candidates will be completed within this time span and new stratotypes will be chosen. We hope to be able to vote on these candidate sections. Restudy of the Homerian GSSP will subsequently join, along with further study on the Wenlock Series GSSP.
- Application of astronomically-tuned cyclostratigraphy integrated with radiometric data and high-resolution biostratigraphy. In 2016 the ISSS supported proposal on new IGCP project “Reading geological time in Palaeozoic rocks: the need for an integrated stratigraphy” submitted by Dr A.-Ch. da Silva from Liège.
- We are working on the development of databases that would bring together and make available information from all sources associated with the Silurian researchers. One such database has been created at the Nanjing Institute of Geology and Palaeontology by Dr Junxuan Fan, who is also Webmaster for ISSS. This database, called Geobiodiversity Database (GBDB), is fully operational and has been named as the official database of the ICS.

Ordovician Subcommission

- A volume to be published under the auspices of ISOS on the Ordovician Regional Stratigraphy and Geology of the World is in the final stages of planning. This will include an attempt to correlate Ordovician depositional sequences around the World.

Cambrian Subcommission

- The principal objective of the Subcommittee for 2017 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 ICS has developed a prioritized plan for formalising 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 one or 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 palaeocontinents, and the ICS is now engaged in seeking a practical solution to remedy the problem (Babcock, L.E. et al. 2014: Proposed reassessment of the Cambrian GSSP. *Journal of African Earth Sciences* 98, 3–10).

Ediacaran Subcommittee

- The Subcommittee will discuss the 2016 white paper published in *Episodes* (Xiao S, Narbonne GM, Zhou C, Laflamme M, Grazhdankin DV, Moczyłowska-Vidal M, Cui H, 2016, Towards an Ediacaran time scale: problems, protocols, and prospects. *Episodes*, 39, 540–555.)
- A field trip to celebrate the 50 year anniversary of the discovery of the Mistaken Point biota is planned for the year 2017. This will be a good opportunity to discuss criteria for the subdivision of the Ediacaran System into series.
- The establishment of the SES (Second Ediacaran Stage) and TES (Terminal Ediacaran Stage) Working Groups has been formalised. These working groups will organize focused symposia, field workshops, and surveys in order to (1) evaluate potential criteria for the definition of SES and TES; (2) visit, assess, and select GSSP candidates; and (3) formalise the stratigraphic names for the SES and TES, as well as the first Ediacaran stage (FES). Following the successful examples of the Subcommittee on Cambrian Stratigraphy, we will discuss the recommendation that the informal stage names FES, SES, and TES be used in scientific communication before GSSPs and formal stage names are ratified.

Cryogenian Subcommittee

- The special issue (Descent into the Cryogenian) (online publication deadline: December 2017) will form the basis of discussions at the International Meeting of Sedimentology, Toulouse, France on 10-12 October, and at the June 2018 field workshop to Namibia that will cement future plans to establish a basal Cryogenian GSSP.
- Specific GSSP Focus for 2016
- The basal GSSP for the Cryogenian System will remain the priority of the subcommittee for the foreseeable future.

- *Precambrian Subcommission*
- no report of 4-year objectives received.

- *Stratigraphic Classification Subcommission*
- All the remaining review papers on the various branches of *Stratigraphy* will be submitted and printed over this period.
- The series of papers may form the core of a textbook. Publication details, including arrangements with Nägele & Obermiller, Stuttgart (the publishers of *Newsletters on Stratigraphy*) remain to be worked out.
- ISSC will take the initiative to encourage special sessions and symposia at conferences that advance stratigraphic principles, in collaboration with other ICS subcommissions.
- ISSC will continue to participate in GSSP discussions with ICS subcommissions.
- ISSC continues to interface with national stratigraphic commissions although only in an advisory capacity.
- ISSC is updating its membership list, in order to eliminate dormant colleagues and incorporate new ones.
- The ULTIMATE GOAL of ISSC is the publication of a new, multi-authored, really multinational *International Stratigraphic Guide* - a guide not a code, simple, clear, concise, user-friendly, for worldwide distribution and acceptance.

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