SILURIAN TIMES

NEWSLETTER OF
THE INTERNATIONAL SUBCOMMISSION ON SILURIAN STRATIGRAPHY (ISSS)
(INTERNATIONAL COMMISSION ON STRATIGRAPHY, ICS)

No. 27 (*for* 2019)

***Edited by* ZHAN Renbin**

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Cover photo

Group photo of the STRATI 2019 in Milano Italy in early July 2019 (by courtesy of CHEN Qing).

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SILURIAN TIMES Number 27 (for 2019)

CHAIRMAN'S CORNER

Dear Silurian Colleagues,

Major activity of the ISSS concentrated on 3rd International Congress on Stratigraphy (STRATI) held in Milano, Italy in July 2–5, 2019. I was very pleased to meet some of our titular and corresponding members at the STRATI 2019 Congress and associated ISSS business meeting. Five titular members and 24 corresponding members participated on our thematic scientific session entitled „A Silurian odyssey towards advanced stratigraphy and correlation" which was devoted to all aspects of Silurian stratigraphy, including a focus on our recent efforts to establish new GSSPs for some of the Silurian stages and series.

In this context, the principal work of the Silurian Subcommission continued in 2019 on long time intended replacement of those previously ratified but currently inadequate basal stratotypes. Two of our three respective working groups were expected to submit their official proposals for new GSSPs of the Aeronian Stage and Telychian Stage until the 36th IGC in Delhi in March 2020. It did not happen but the Geological Congress itself had to be postponed by Indian Government due to Coronavirus epidemic. As a consequence, there is still a real chance that we can complete, discuss and vote on our official proposals in time, in the fall 2020.

The Aeronian working group focused on two remaining candidate sections for a new base Aeronian GSSP in Wales, U.K. and Sichuan, China. A comprehensive study on Czech candidate section – the Hlásná Třebaň Section in the Barrandian area – has been already published by Štorch *et al*. (2018) and supplemented by Butcher (2019). A final report on classic Rheidol Gorge section in Wales by Mike Melchin *et al*. is near its completion and will be submitted for publication in a few months. Further field work conducted by Fan Junxuan, Sun Zongyuan, Petr Štorch and Mike Melchin continued on Yuxian section in Sichuan province in May 2019 (Fan Junxuan *et al*. 2019). Supplementary sampling of the latter section took more time then planned as the roadcut section changed due to a considerable broadening of the local road. We found that FAD of the proposed marker species (*Demirastrites triangulatus* s.l.) is actually 0.2 m below the one recorded in the section by 2018 sampling campaign. Carbon isotope analyses are currently in progress, work on graptolite fauna too.

The working group for base Telychian GSSP focused its work on a single remaining candidate – El Pintado Reservoir section in Seville province of Spain (Loydell 2019a). Aeronian/Telychian boundary and lower Telychian part of the El Pintado succession was described by Loydell *et al*. (2015), the Aeronian part of the section was presented by Štorch et al. (2019) to the ISSS in the frame of the Silurian thematic session at STRATI 2019 in Milano. Manuscript describing the Aeronian part of the section will be submitted in 2020. This submission will be followed by formal proposal of the El Pintado Reservoir section for new boundary stratotype of the Telychian Stage to be considered and discussed by the subcommission. Please expect discussion and formal ballot later this year.

Our search for candidate sections which could be considered as new boundary stratotype for Sheinwoodian Stage (and Wenlock Series) has shown to be the least successful of the GSSP-related efforts. Non of the sections through the Llandovery/Wenlock boundary interval examined by David Loydell in Wales, U.K. (Loydell 2019b, c) meets relevant criteria. Therefore, the Sheinwoodian working group will suspend its activities until new promising candidate section appears on the Earth.

The ISSS, similarly as other ICS subcommissions, should have ended a four-year cycle at the IGC in India 2020. In according to the ICS Statuses 2017 and general agreement of the participants at the ISSS business meeting in Milano, we had to assess our membership and replace one third of the voting (titular) members in 2020, namely those who completed their third four-year cycle (or more) and do not actively work in one of the two groups currently working on replacement of the Aeronian GSSP and the Telychian GSSP.

I wish to thank David Holloway, Jisuo Jin, Jiří Kříž, Peep Männik, Sylvio Peralta and Zhan Renbin for their outstanding service to the global earth-science community as titular members of the ISSS. In according to requirements published in the ICS Statuses, their titular membership terminates in March 2020. We will be pleased, however, if all of them can stay with us as valued corresponding members. I will be looking forward their further collaboration.

Present titular members have been invited to nominate candidates for new titular members in order to keep regional and methodological diversity of the Subcommission in an appropriate manner. Five nominations have been received by the end of 2019. It is my pleasure to let you know that four new titular members: Alyssa Bancroft, Huang Bing, Tonu Meidla and David Ray have been approved by the ISSS voting body and the ICS executive. My congratulation to all of them. David Ray will be new secretary of the Subcommission.

Affiliations and major fields of research interests of the new titular members are as follows:

Dr. Alyssa Bancroft, Indiana Geological and Water Survey, Indiana University, USA: conodont biostratigraphy, carbonate sedimentology. Nominated by Brad Cramer and Thijs Vandenbroucke.

Dr. Huang Bing, Nanjing Institute of Geology and Palaeontology, CAS, China: brachiopods, biostratigraphy, palaeobiogeography and palaeoecology. Nominated by Zhan Renbin.

Dr. Tõnu Meidla, Faculty of Science and Technology, University of Tartu, Estonia: ostracods, biostratigraphy, palaeoecology, oceanography. Nominated by Peep Männik.

Dr. David Ray, Neftex Exploration Insights, UK: chemostratigraphy, integration with sequence stratigraphy and biostratigraphy. Nominated by David Loydell.

Major event planned for 2021 is the next bi-annual Silurian conference. I wish to express my gratitude to Valeri Sačanski from the Geological Institute of Bulgarian Academy of Sciences who is willing to organize with us the next bi-annual Silurian

Symposium and ISSS business meeting in late August, 2021 in Sofia, Bulgaria. Our aim, already discussed in Milano, is to held this conference in a new region with Silurian outcrops less well known to active titular and corresponding members of the Subcommission.

Please, send me your comments, suggestions and proposals in this matter and, in turn, stay tuned to receive further updates later this year. Please, check the e-mail address list at the end of the annual report (p. ..) and add, correct or replace your email address if needed. I would greatly appreciate this help which will also indicate your willingness to participate on present and future activities of the subcommission. We also need to improve and update our web page. I have been unable to obtain web-page access rights for Dr. Huang Bing who was kind enough to make ad-hoc updates of our web page. We are looking for a solution in cooperation with ICS executive.

I am very pleased to let you know that the Subcommission‘s award named in honor of the late secretary and vice-chair of the ISSS and eminent stratigrapher and graptolite specialist Tatiana Koren‘ belong to Dr. Huang Bing from Nanjing Institute of Geology and Palaeontology. My hearthy congratulations to Huang Bing who is the second recipient of this award. Many thanks to selection committee members

Last but not least, I wish to thank vice-chair Carlo Corradini and, in particular, secretary Zhan Renbin for their collaboration. Also Renbin‘s hard work on his last issue of the Silurian Times is much appreciated.

References:

Butcher, A. 2019. Chitinozoan biostratigraphy of the Hlásná Třebaň section (candidate replacement GSSP for the base Aeronian). 3rd International Congress on Stratigraphy (STRATI 2019), ISSS business meeting, Milano, Italy. Lecture, July 2, 2019.

Fan Junxuan et al. 2019. Chinese candidate section for replacement GSSP of the Aeronian Stage at Yuxian (Sichuan province). 3rd International Congress on Stratigraphy (STRATI 2019), ISSS business meeting, Milano, Italy. Lecture, July 2, 2019.

Loydell, D.K. 2019a. The base of the Telychian: is the El Pintado section, Spain suitable as a replacement GSSP? 3rd International Congress on Stratigraphy (STRATI 2019), ISSS business meeting, Milano, Italy. Lecture, July 2, 2019.

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Loydell, D.K. 2019c. The Llandovery/Wenlock boundary - are we any closer to finding a replacement GSSP? 3rd International Congress on Stratigraphy (STRATI 2019), ISSS business meeting, Milano, Italy. Lecture, July 2, 2019.

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proposed new global stratotype for Aeronian Stage of the Silurian System: Hlásná Třebaň section, Czech Republic. *Lethaia,* 51, 3, 357–388.

Petr Štorch
Chair, International Subcommission on Silurian Stratigraphy

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International Commission on Stratigraphy

Subcommission on Silurian Stratigraphy

ANNUAL REPORT 2019

1. TITLE OF CONSTITUENT BODY and NAME OF REPORTER

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2. OVERALL OBJECTIVES AND FIT WITHIN IUGS SCIENCE POLICY

Mission statement

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

(1) The development of an internationally agreed scale of chronostratigraphic units, fully defined by GSSPs at Series and Stage levels and related to a hierarchy of units (Substages, Standard Zones, Subzones etc.) to maximize relative time resolution within the Silurian Period;

(2) Establishment of frameworks and mechanisms to encourage international collaboration in understanding the evolution of the Earth during the Silurian Period;

(3) Working towards an international policy concerning conservation of geologically important sites (such as GSSPs, global and regional stratotype sections, *etc*.).

Goals

- Rationalization of Global chronostratigraphical classification
- Intercalibration of fossil biostratigraphies, integrated zonations, and recognition of global datums.
- Establishment of magneto- and chemo-stratigraphic scales

- Redefinition of stage boundaries and restudy of global boundary stratotype sections
- Correlation of Silurian rock successions and events, including marine and non-marine
- Application of astronomically tuned cyclostratigraphy integrated with radiometric data and biostratigraphy

3. ORGANISATION - interface with other international projects / groups

Organisation

The ISSS is a Subcommission of the International Commission on Stratigraphy. The Subcommission is organized by an Executive consisting of Chairman, Vice-Chairman and Secretary, who are all Voting Members of the Subcommission. In the Subcommission elected for 2016-2020 there were fifteen other Voting Members. Five Voting members will be replaced by new candidates in March 2020. Broad network of Corresponding Members has first of all a responsibility for communication in both directions between the Subcommission and researchers on Silurian topics in their region. Secondly they represent a broad spectrum of specialized stratigraphical disciplines from those countries or regions where Silurian rocks are extensively studied in relation to fundamental and/or applied geological research.

Current research activities and future plans are communicated through publication of the annual ISSS newsletter, *Silurian Times*, distributed as an email attachment and a web release. Website: http://silurian.stratigraphy.org/ contains newsletters, meeting announcements, discussion posting-boards, bibliography of Silurian articles, links to related sites, and other information.

Interface with other international projects / groups

IGCP project no. 652 "Reading geologic time in Paleozoic sedimentary rocks" and newly established "International Subcommission on Geochronology" under chairmanship of B. D. Cramer, titular member of the ISSS.

Collaboration continues with stratigraphically neighbouring subcommissions on Ordovician (ISOS) and Devonian (SDS) stratigraphy. ISSS members will join SDS 2020 and IGCP652 Annual Meeting in Geneseo, New York.

3a. Current Officers for 2016-2020:

Chair: **Petr Štorch** (first term)
Vice-Chair: **Carlo Corradini** (first term)
Secretary: **Zhan Renbin** (second term)

3b. Nominated Officers for 2020-2024

Chair: **Petr Štorch** (second term)
Vice-Chair: **Carlo Corradini** (second term)
Secretary: To be nominated early in 2020

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

National/regional support has been provided to active members of Aeronian, Telychian and Wenlock GSSP working groups to facilitate their work.

5. CHIEF ACCOMPLISHMENTS IN 2019 **(including any publications arising from ICS working groups)**

Silurian Times No 26 was edited by the secretary, Renbin Zhan, and distributed in April, 2019, posted on the web site for the ISSS, and circulated as an email attachment to all titular, corresponding and interested members of the Subcommission. It contained the reports on previous meetings, announcements of upcoming meetings and publications, the latest news and recent publications on Silurian research.

The restudy of the Rheidol Gorge section has been completed and full paper by Melchin *et al.* (in prep) presenting the proposal of Rheidol Gorge as a candidate section for the base of the Aeronian Stage will by submitted for publication by early 2020. Chitinozoan biostratigraphy and faunas have been already published by De Weirdt *et al*. (2019). Formal proposal of the Hlasna Treban section for new Aeronian GSSP (Štorch *et al*. 2018) was later supplemented by detailed study on morphology, systematics and evolution of *Demirastrites triangulatus* (proposed Rh/Ae boundary marker species) and related graptolites (Štorch and Melchin 2018). Report on chitinozoan biostratigraphy and fauna by A. Butcher was presented at STRATI 2019.

New results of the Silurian GSSP-related studies have been presented and discussed within a special session „Silurian odyssey towards advanced Stratigraphy and correlation“ and ISSS Business meeting held at 3rd International Congress on Stratigraphy (STRATI 2019) in Milano.

De Weirdt, J., Vandenbroucke, T.R.A., Cocq, J., Russell, C., Davies, J.R., Melchin M.J., Zalasiewicz, J. 2019. Chitinozoan biostratigraphy of the Rheidol Gorge Section, Central Wales, UK: a GSSP replacement candidate for the Rhuddanian - Aeronian boundary. *Papers in Palaeontology.* DOI: 10.1002/spp2.1260

Melchin, M.J., Davies, J.R., Boom, A.R.A., Zalasiewicz, J.A., De Weirdt, J., Vandenbroucke, T.R.A., Russell, C.T., McIntyre, A.J., Morgan, G., Phillips, S. (in prep.). Integrated stratigraphic study of the Rhuddanian-Aeronian (Llandovery, Silurian) boundary succession at Rheidol Gorge, Wales: A proposed GSSP candidate for the Base of the Aeronian Stage.

Štorch, P. and Melchin, M.J. 2018. Lower Aeronian triangulate monograptids of the genus *Demirastrites* Eisel, 1912: biostratigraphy, palaeobiogeography, anagenetic changes and speciation. *Bulletin of Geosciences*, 93, 4, 513–537.

6. SUMMARY OF EXPENDITURE IN 2019:

Expenditures (Registration fees of STRATI 2019 paid for four ISSS participants – three titular members and one student– 1590 EUR x 1.1)	US$	1,750
Total	US$	1,750

7. SUMMARY OF INCOME IN 2019:

Carried forward from 2018	US$	5,250
ICS Allocation	US$	0
Total	US$	5,250
Balance (carried forward from 2019)	US$	3,500

8. BUDGET REQUESTED FROM ICS IN 2020

Requested ICS Allocation	0

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

Two ISSS groups working on restudy of the base of the Aeronian GSSP and base of the Telychian GSSP will complete their work by submission of the formal proposals of remaining candidate sections (Junxuan Fan *et al*., Yuxian, China, Aeronian GSSP and David Loydell *et al*., El Pintado Reservoir, Spain, Telychian GSSP).

ISSS discussion and formal voting on the Aeronian and Telychian GSSP replacement candidate sections is anticipated for 2020.

Further update of the website for Silurian Subcommission by Mr. Hou Xudong. We gratefully acknowledge the support of the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences for this work.

Potential funding sources external to IUGS

Most of the costs of preparing Silurian Times and research activities of the working groups will be met by local support from host institutions and participation by individuals through national research grants and travel grants from their own authorities.

10. OBJECTIVES AND WORK PLAN FOR THE PERIOD 2020-2024

Principal work will be devoted to GSSP-related research activities – restudy of some previously ratified but currently inadequate basal stratotypes. Formal proposals of the Aeronian and Telychian GSSP replacement candidates will be completed in 2020 and new stratotypes will be chosen. We aimed to vote on these candidate sections in 2019 in Milano but the date had to be postponed due to delayed work on some of the candidate sections.

Homerian working group will be established and restudy of the Homerian GSSP will join the program, along with further search for potential sections suitable for new GSSP of the Wenlock Series.

Application of astronomically tuned cyclostratigraphy integrated with radiometric data and high-resolution biostratigraphy in conjunction with IGCP no 652 “Reading geologic time in Paleozoic sedimentary rocks”.

We will work on further development of databases that would bring together and make available information from all sources associated with the Silurian researchers. One such database, operated by the Nanjing Institute of Geology and Palaeontology (Geobiodiversity Database, GBDB), has been named as the official database of the ICS.

ISSS bi-annual field-meeting and business meeting will be organized in Sofia, Bulgaria in 2021 in collaboration with Geological Institute of Bulgarian Academy of Sciences.

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

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Working group leaders

Base of Aeronian GSSP Restudy Working Group
Leader **Petr Štorch**

Base of Telychian GSSP Restudy Working Group
Leader **Michael J. Melchin**

Base of Wenlock GSSP Restudy Working Group
Leader **David K. Loydell**

by Petr Štorch
Chair, International Subcommission on Silurian Stratigraphy

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INTERNATIONAL COMMISSION ON STRATIGRAPHY

(ICS)

STATUTES 2017

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1. PREAMBLE AND DEFINITIONS

The International Commission on Stratigraphy (ICS) is a permanent commission of the International Union of Geological Sciences (IUGS). The IUGS was founded in Paris on 10 March 1961 and is a member of the International Council of Scientific Unions (ICSU).

The organisational bodies referred to in the statutes are defined as follows:

a. The Executive Committee of ICS comprises two elected officers (Chair, Vice-Chair) and a Secretary General (appointed by the Chair) and two, non-voting, appointed officers (Informatics Officer and Graphics Officer) responsible for the objectives, purpose and daily operation of the commission.

b. Subcommissions of ICS are organisational bodies with specific, long-term scientific tasks and are managed by a chair, a secretary and one or two vice-chairs.

c. The governing and voting body of ICS is the officers of the Executive Committee

and the chairs of each of the Subcommissions, and is hereafter named the Voting Commission.

d. *Ad Hoc* Committees of ICS are organisational bodies with a specific short-term, non-scientific task, such as overseeing procedure, nomination, voting regulation, or *ad hoc* organisation. Such committees normally consist of a chair and two other members, and are appointed by the Executive Committee, or the management team of a Subcommission.

e. Task (or Working) Groups of ICS are organisational bodies for limited, short-term scientific tasks. Each Task Group addresses a single task; for example, one task can be selecting and defining a stratigraphic boundary stratotype, and another task may be consideration of abandonment of an existing stage and selecting a new one. The chair and secretary of a Task Group are selected either by the Executive Committee, or the management team of the relevant Subcommission.

f. The International Geological Congress, hereinafter referred to as IGC, is determined by the IUGS and by the IUGS statutes. IGC is the quadrennial congress of geological scientists sponsored by IUGS, and organised by an autonomous committee established by the host country or countries.

g. The International Congress on Stratigraphy is sponsored by ICS and will be held every four years. Proposals for future Congresses, which are held during the IGC inter-congress period, are invited by the ICS Executive Committee, which also selects the venue from the proposals received at least two years prior to the proposed event.

2. PURPOSE AND OBJECTIVES

ICS is a body of expert stratigraphers founded for the purpose of promoting and coordinating long-term international cooperation and establishing and maintaining standards in stratigraphy.

Its principal objectives are:

(a) the establishment, publication and revision of the ICS International Chronostratigraphic Chart which is the standard, reference global Geological Time Scale to include the ratified Commission decisions,

(b) the compilation and maintenance of a stratigraphic database centre for the global Earth Sciences,

(c) the unification of regional chronostratigraphic nomenclature by organising and documenting stratigraphic units on a global database,

(d) the promotion of education in stratigraphic methods, and the dissemination of stratigraphic knowledge,

(e) the evaluation of new stratigraphic methods and their integration into a multidisciplinary stratigraphy, and

(f) the definition of principles of stratigraphic classification, terminology and procedure and their publication in guides and glossaries.

The scientific activities shall be carried out through projects or meetings arranged in collaboration with IUGS-affiliated organisations, IUGS-joint programmes, non-governmental bodies and inter-governmental bodies.

3. ORGANISATION

ICS is managed by the Executive Committee.

ICS is organised into Subcommissions, which have longer-term scientific goals. In

addition, ICS may create short-term *Ad Hoc* Committees and short-term Task Groups for specific advice and purpose (cf. also 1e and 1f). The chairs of the Subcommissions and the members of the Executive Committee together form the Voting Commission of ICS that votes on the formal decisions.

4. EXECUTIVE COMMITTEE

The voting officers of the Executive Committee shall be the Chair, a Vice-Chair and the Secretary General. The past chair will ordinarily become consultant ex-officio member of the Executive Committee. All officers serve in an individual capacity. The other officers shall serve as advisors to the Chair and assist him/her in the performance of his/her duties. The Chair and Secretary General are responsible for its daily operation, in accordance with these statutes. The ICS Executive Committee appoints two positions of special service to ICS: the Informatics Officer and the Graphics Officer. These appointments are for 4-year terms that coincide with those of the Executive officers and are renewable.

4.1. Chair

The Chair shall be the chief executive officer of ICS. He/she shall be responsible for the management of its activities within the scope of the authority delegated to him/her by IUGS. He/she shall solicit the advice of the Voting Commission, when necessary, for the administration of ICS and consult with it on matters of major policy and scientific programmes either by correspondence or by meetings.

4.2. Vice-Chair

The Vice-Chair shall serve as chair for the remainder of the term of office if the position of chair should become vacant. The Vice-Chair assists the chairperson with his/her regular duties, activities and work, and in particular oversees stratigraphic standardisation.

4.3. Secretary General

The Secretary General is appointed by the chair of the Executive Committee, and shall assist the chair in his/her administrative and scientific work, and keeps the financial account. He/she shall record the minutes of meetings and organises the votes within the Voting Commission.

4.4. Past Chair

The past chair will ordinarily serve as consultant ex-officio member of the Executive Committee for the four-year period following his/her chair period.

4.5. Informatics Officer

The Informatics Officer is appointed by the Executive Committee and shall manage the ICS website and the ICS-linked stratigraphic database and maintain the ICS archives on the ICS website. As appropriate, the Informatics Officer will provide advice and help to subcommissions developing websites. The position is non-voting and is renewable after each 4-year term with approval of the Executive Committee.

4.6. Graphics Officer

The Graphics Officer is appointed by the Executive Committee and shall design the ICS International Chronostratigraphic Chart, updates and translations of the ICS Chart and designs appropriate for a variety of products. The position is non-voting and is renewable after each 4-year term with approval of the Executive Committee.

5. SUBCOMMISSIONS

Subcommissions of ICS are organisational bodies with specific, longer-term scientific tasks such as the standardisation of stratigraphic units, the documentation and communication of major stratigraphic data to the global earth-science community, and international stratigraphic cooperation. Subcommissions organise ballots (cf. section 9) of their voting members to decide critical scientific issues and subsequently inform the ICS Executive Committee of the result.

5.1. Composition

Each Subcommission shall be managed by a chair and a secretary. One or two vice-chairs may also be elected. Subcommissions report to the Executive Committee, and may be terminated if they become inactive or seriously ineffective, as indicated, for example, by lack of submission of annual reports, failure to respond to ICS communications, and/or show no action for longer than one year.

The voting membership of the Subcommission consists of its management team together with up to twenty members, and is referred to as the Voting Subcommission. Up to twenty voting members shall represent regional and methodological diversity in an appropriate manner. Membership may be terminated if a voting member fails to participate for 6 months or more in the work of the subcommission, and/or does not respond during this time to communications from its chair. Membership may also be terminated for conduct judged to be unprofessional by the ICS Executive Committee in consultation with the Subcommission chair or his/her deputy, as judged appropriate (cf. section 10).

Subcommissions may appoint a reasonable number of corresponding members to advise voting members in achieving the assigned scientific tasks, e.g. participating in boundary working groups. The corresponding membership shall reflect regional and methodological diversity in an appropriate manner.

5.2. Officers

The Chair shall be the leader of the Subcommission. He/she is responsible for the execution of agreed-upon scientific goals and the preparation and the contents of annual scientific and financial reports of the Subcommission. In consultation with the voting members of the Subcommission, he/she shall establish work plans and operating budget requests for the following year.

The Vice-Chair shall serve as chair when the position of chair should become vacant.

The Secretary is appointed by the Chair of the Subcommission, and shall assist the chair with scientific and administrative duties, and is responsible for the organisation of votes within the Subcommission.

5.3. Results

The progress and results of subcommissions are annually reviewed by the Executive Committee. The Executive Committee may dissolve a Subcommission upon completion of

its entrusted mandate or if the Subcommission is inactive. A Subcommission is considered inactive when it no longer elects executive officers, submits annual reports or no longer responds to communications and ballots from the Executive Committee. The decision on dissolution requires consent from IUGS.

5.4. Other Bodies

Subcommissions may appoint such Task Groups (cf. section 7), regional committees or other *ad hoc* groups, which they consider necessary to fulfill their scientific tasks. These bodies report to the chair of the respective Subcommission.

Subcommissions which are responsible for system or lower ranks of the ICS International Chronostratigraphic Chart shall establish Task (or Working) Groups for the purpose of defining the basal boundaries of component chronostratigraphical/ geochronological units, if such boundaries have not previously been defined. Boundary stratotypes are sought to the level of stages, but not at lower chronostratigraphical ranks.

6. *AD HOC* COMMITTEES

Ad Hoc Committees of ICS are organisational bodies with specific short-term, non-scientific tasks, such as overseeing procedure, nomination, voting regulation, and/or *ad hoc* organisation.

Committees normally consist of a chair and two other members, and are appointed by the Executive Committee, or the management of a Subcommission of ICS.

The organisation of an *Ad Hoc* Committee is related to its tasks, and is subject to approval by the ICS body that appointed it.

7. TASK (or WORKING) GROUPS

Task or Working Groups are organisational bodies for limited, short-term stratigraphic tasks. Task Groups are generally organised under individual Subcommissions, but the Executive Committee also may appoint Task Groups for specific tasks that relate to its activities and responsibilities. Commonly, a Task Group is created for the selection and definition of the lower boundaries of chronostratigraphical/geochronological units. Task Groups may also be created for the purpose of replacing and/or selecting new boundary definitions, stage units or other stratigraphical units. Each Task Group will have a single scientific task.

7.1. Task Groups

Task Groups have a four (4) year task that may be extended for additional four (4) year terms as appropriate, depending on sufficient progress with their entrusted task. If, after the eight (8) year allotted period, there is a need to continue, the task group should be dissolved and then reconvened at the discretion of the Subcommission Chair.

7.2. Officers and Members

Officers of a Task Group are the leader, and where deemed appropriate, a secretary. These officers are selected either by the Executive Committee, or by the management of Subcommissions, depending under which body the Task Group resides, and are expected to behave in the spirit of Section 10.

Task Groups may appoint a reasonable number of members that represent regional

and/or methodological diversity in an appropriate manner (nor exceeding 40 members). Membership may be terminated if the member does not respond to communications from its Task Group chair for 6 months.

7.3. Results

The progress and results of Task Groups are annually reviewed by the Subcommission and/or Executive Committee under which they reside. Task Groups may be terminated if they fail to respond to communications from the individual Subcommission or Executive Committee under which they reside.

7.4. Voting

Task Groups organise ballots (cf. section 9) of their voting members to decide critical scientific issues and subsequently inform the Subcommission or Executive Committee under which they reside of the result.

7.5. Terms of Office

Task Groups are automatically dissolved once they have fulfilled their objective, scheduled until the objective is completed, with an expected maximum duration of eight years (cf. section 7.1).

8. ESTABLISHMENT AND DISSOLUTION OF ICS CONSTITUENT BODIES

8.1. Subcommissions

New Subcommissions shall be established when the Executive Committee of ICS is convinced of the necessity, and makes a recommendation for the establishment of a new Subcommission first to the Voting Commission and then to IUGS. When consent is given by the Voting Commission and IUGS, the ICS Executive Committee shall appoint a temporary Subcommission chair and optionally a vice-chair. For subsequent terms of office, elections shall be held within the Subcommission by a quorum of its own voting members. Voting members of a newly formed Subcommission are elected by its officers (cf. section 9.6)

The dissolution of Subcommissions requires the consent of IUGS, based on recommendations by the ICS Executive Committee (cf. sections 5.3 and 10).

8.2. *Ad Hoc* Committees

Ad Hoc Committees may be established and dissolved by decision of the ICS Executive Committee. *Ad Hoc* Committees may be reorganised or regrouped with other ICS bodies by decision of the Voting Commission of ICS.

8.3. Task Groups

Task Groups (cf. section 7) may be established and dissolved by decision of the Executive Committee of ICS and/or the management of Subcommissions under which the Task Group resides.

9. TERMS OF OFFICE, ELECTIONS AND VOTING

9.1. Terms of Office for Officers

The terms of office for the officers of the Executive Committee, the Subcommissions, *Ad Hoc* Committees, and Task Groups shall be the period between two IGCs, normally four (4) years. All officers can be re-elected or re-appointed (Secretary General, Informatics Officer, and Graphics Officer) for one additional term of four (4) years. If circumstances necessitate the term of office to begin in the interval between two IGCs, the period of office will not be extended beyond the second IGC after the officer started in his/her function.

9.2. Terms of Office for Voting Members

The terms of office for the voting members of Subcommissions and Task Groups shall be the period between two IGCs, normally four (4) years, and can be extended for a maximum of two additional four (4) year periods.

9.3. Election of the ICS Executive Committee

Eighteen (18) months prior to the International Geological Congress, the Executive Committee appoints the chair of the Nominating Committee, which shall not include any of the Executive Committee. The chair of the Nominating Committee shall select two (2) additional Nominating Committee members.

The Nominating Committee shall invite proposals from all Subcommissions of ICS of candidates for the positions of Chair and Vice-Chair of the Executive Committee, but the Committee shall not be restricted thereby in its choice of candidates. The Chair and Vice-Chair of the Executive Committee may request re-election for one term beyond their first period of office (cf. section 9.1).

The Nominating Committee shall evaluate the merits of all proposed candidates for each position, taking into consideration their scientific qualification, managerial capability and willingness to serve. The Committee shall nominate to the ICS Chair at least two candidates for each of the two elected positions no later than twelve (12) months prior to the next IGC, bearing in mind geographical and disciplinary diversity in order to ensure that the principal schools of stratigraphic thought are represented in the Executive Committee.

Upon receipt of the Nominating Committee's submission, the Secretary General shall promptly circulate the proposal of nominated candidates to all the members of the Voting Commission for voting and election (cf. also 1c and 9.7).

The election requires approval by IUGS Executive Committee and ratification by the IUGS-IGC Council.

9.4. Election of the managing committee of a Subcommission

A chair and two optional vice-chairs of a Subcommission of ICS are proposed to ICS after appropriate ballot within each Subcommission. From these candidates, the new officers are subsequently elected by the Voting Members of the Commission (cf. section 1c) by ballot to be mailed by the general secretary not later than twelve (12) months prior to the next IGC. A secretary is appointed by the chair following his/her election. All members of the managing committee of Subcommissions are approved and ratified by the ICS Executive Committee.

9.5. Election of the leaders of Task Groups

The leaders (chair and secretary, as required) of a Task Group are proposed by the management team of the Subcommission or the Executive Committee of ICS under which the Task Group resides. Task Group leaders are confirmed by normal voting procedures in the ICS Subcommission or ICS Executive Committee under which they reside.

9.6. Election of the Voting Members of Subcommissions and Task Groups

Voting members of new Subcommissions are elected by its initial executive. New voting members of existing Subcommission are elected by its executive, upon consultation with existing voting members, and confirmed by the Executive Committee of ICS.

Voting members of Task Groups are elected by its executive, in consultation with existing voting members, and confirmed by the management or executive of the ICS body under which the Task Group resides.

9.7. Voting Procedures in ICS

The members of the Voting Commission (cf. section 1c), Subcommissions and Task Groups make their decisions by vote. For approval, all decisions, including elections, require a sixty percent (60%) majority of delivered votes, provided that a quorum of 60% has been attained. In cases where no quorum is attained the first round, a second round of voting is organised. Elections with more than one candidate will require the winner of a relative majority of less than 60% to pass a second ballot listing only him/herself, where he/she has to receive a 60% confirmation.

Voting shall be conducted by electronic mail (e-mail), giving a deadline of thirty (30) calendar days for the receipt of the votes. Voting Members may vote "yes," "no" or "abstain". Formal meetings of ICS that attain a quorum of 60% can arrange in-session ballots. Integrity of the voting process must be maintained. Discussion must take place and be allowed to run its course before ballots are distributed. Once ballots have been distributed, no voting member shall circulate materials or arguments intended to influence the vote of other voting members. A voting member doing so will have his/her ballot disqualified and will be reprimanded by the appropriate subcommission chair.

10. PROFESSIONAL BEHAVIOUR

It is expected that all voting members and officers of ICS, subcommissions, task groups and *ad hoc* groups will treat others with respect and will maintain the integrity of the voting process when votes are taken. Discussions whether orally or written (e.g. e-mail) can be contentious. Disrespectful and unprofessional comments directed at other individuals are not tolerated. Should they occur, the matter will initially be dealt with by the Subcommission chair or his/her deputy, the chair of the appropriate body is then required to report such incidents to ICS Executive Committee, which after a fair investigation can issue a reprimand or termination of the membership of the guilty party. Violations of the integrity of the voting process (cf. section 9.7) will result in disqualification of the ballot submitted by the violator and a letter of reprimand.

11. RATIFICATIONS

11.1. Ratifications by ICS

The ICS Executive Committee ratifies:

a. Election or appointment of officers (management) in subcommissions.
b. Election or appointment of voting members of subcommissions

11.2. Ratifications by IUGS

IUGS ratifies elections made by the Voting Commission of ICS, including:
a. The nomination of members of the Executive Committee,
b. Stratigraphic standards like GSSPs, formal stratigraphic stage names and units of other ranks,
c. Abolition of and/or establishment of new Subcommissions,
d. The ICS Statutes.

11.3. Ratification by the IUGS-IGC Council

Members of the ICS Executive Committee must also be ratified by the IUGS-IGC Council.

12. MEETINGS

The Executive Committee shall meet at the request of the Chair or of any two other officers of the Executive Committee.

The Voting Commission of ICS shall meet during the International Geological Congress. Additional formal meetings of the Voting Commission may be called by the Chair of ICS with the advice of the Executive Committee. Formal meetings of ICS that attain a quorum of at least 60% can arrange in-session ballots.

All Subcommissions shall endeavor to hold at least one meeting during each International Geological Congress. They are encouraged to organise additional meetings during major international conferences on their field of scientific expertise. Task Groups are also encouraged to have formal meetings during each International Geological Congress, and organise additional meetings during major international conferences on their field of scientific expertise. Formal meetings of Subcommissions and Task Groups that attain a quorum of at least 60% can arrange in-session ballots.

13. ANNUAL REPORTS

13.1. Subcommissions, Task Groups and *Ad Hoc* Committee Reports

The chairs of the Subcommissions shall transmit annual reports to the Secretary General of ICS no later than the first of November of each year. The annual reports shall include an overview of the scientific activities and achievements, together with the statement of operating accounts, for the current year and work plans and anticipated achievements, with the operating budget request, for the following year. In the case of Subcommissions with constituent bodies, these Subcommissions reports shall include the scientific achievements and plans of these bodies.

Chairs of Task Groups and *Ad Hoc* Committees shall transmit annual reports to the chair of the ICS body under which they reside. They are also responsible for including the group's operating costs in that report and projected budget for the new reporting period.

13.2. Commission Report

The Chair of ICS shall submit a consolidated annual report on behalf of ICS to the

IUGS Executive Committee at the time stipulated by that IUGS Executive Committee via its secretariat.

The ICS report shall contain (1) the reports of the individual Subcommissions, Task Groups and *Ad Hoc* Committees, and (2) an executive document that:

a. provides an executive summary report,

b. highlights the scientific achievements of the constituent ICS bodies,

c. communicates all formal decisions taken by the Voting Commission of ICS,

d. reports on administrative matters of ICS,

e. provides a consolidated statement of ICS's operating accounts for the current year, and

f. submits the work plans and recommends a consolidated operating budget request of ICS for the following year.

The ICS annual report shall be made available to the management of all Subcommissions.

14. ICS WEBSITE AS AN OFFICIAL ARCHIVE

The ICS website is the official archive of the ICS International Chronostratigraphic Chart and Table of GSSPs. These are the responsibility of ICS Executive, particularly the Informatics and Graphics officers at direction of the ICS Chair. Documents to be made available on the website include the ICS statutes and official correspondence between the ICS and IUGS EC regarding GSSP and other ratification decisions.

15. GEOBIODIVERSITY DATABASE (GBDB)

Stratigraphic information, including all relevant litho-, bio- and chronostratigraphic data together with any non-biological data, from GSSP proposals submitted to ICS voting members must be entered in the Geobiodiversity Database, in cooperation with, and supported by GBDB staff.

16. ENTRY INTO FORCE AND AMENDMENTS TO STATUTES

These statutes are now in force having been approved by ICS on 24 March 2017 and ratified by the IUGS Executive Committee on 25 April 2017. These statutes are based upon but also significantly revised from those approved by ICS on 28 August 2001, and accepted with minor modifications by IUGS in February 2002, which, in turn, supersede the statutes accepted by IUGS at its annual meeting, 15-18 January 1997.

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REPORTS OF ACTIVITIES IN 2019

1. Report on the ISSS BUSINESS MEETING 2019 (held in conjunction with the 3rd International Congress on Stratigraphy — strati 2019)

by CHEN Qing (NIGPAS, China)

Location: the Università degli Studi di Milano (the University of Milan), Italy
Time: 17:30-19:00, July 2, 2019
Attendees: Petr Štorch (Chair), Carlton E. Brett, Alyssa M. Bancroft, Bradley D. Cramer, David K. Loydell, Junxuan Fan, Andrej Spiridonov, Ladislav Slavík, Juan Carlos Gutiérrez-Marco, Qing Chen, Zhongyang Chen, Chao Li

Agenda:

(1) Progress reports from GSSP working groups:

1a) Base of the Aeronian GSSP (lead by Petr Štorch)

Anthony Butcher (University of Portsmouth, UK) made a speech (David Loydell read the speech for him) entitled "Chitinozoan biostratigraphy of the Hlásná Třebaň section (candidate replacement GSSP for the base Aeronian)". The Hlásná Třebaň section, Czech Republic (Fig. 1) was proposed as a new global stratotype for the Aeronian Stage in Štorch et al., 2017. The research work on the chitinozoans of this section has been finished. More than 1500 specimens were collected and 51 taxa were identified. It shows a mixed fauna of N. Gondwana and Baltica.

Fig. 1 Field photograph of the Hlásná Třebaň section, Czech Republic, and the red bar indicates the base of the Aeronian Stage (after Štorch et al., 2017)

Fan Junxuan (Nanjing University) made a speech entitled “Chinese candidate section for replacement GSSP of the Aeronian Stage at Yuxian (Sichuan province)”. This section was re-excavated in 2019. Hundreds of samples were recollected based on the work of 2016. *Demirastrites triangulatus*, the index fossil of the base of the Aeronian stage, was found together with a diverse graptolite fauna. The biostratigraphic works on graptolites, chitinozoans and conodonts are ongoing. The chemostratigraphic work, including isotope analysis (C, N, S), iron speciation analysis, elemental analysis and zircon dating are all in progress.

Petr Štorch, the chair of ISSS, summarized that the research work on the GSSP replacement had made some progress, but it is still too slow. According to the requirements of ICS and IUGS, all proposals of the base Aeronian GSSP candidates need to be completed in 2019 and voted in 2020.

1b) Base of the Telychian GSSP (lead by Michael J. Melchin)

David Loydell (University of Portsmouth, UK) made a speech entitled “The base of the Telychian: is the El Pintado section, Spain suitable as a replacement GSSP?”. The base of Telychian was defined by the first appearance of *Spirograptus guerichi*, and lies close to the Rumba low chemostratigraphical negative excursion. Current GSSP (Cefn-Cerig Quarry, near Llandovery, Wales, Great Britain) is not suitable because of poorly fossiliferous, and including synsedimentary slide complex and sedimentary m d ange. The El Pintado section in Spain (Fig. 2) was proposed as a candidate replacement GSSP. For this section, graptolites are common and diverse, including biostratigraphically important taxa, and organic carbon isotope record shows Rumba low; but there is no potential for carbonate carbon isotope work or radiometric dating (no bentonites), and conodonts are rare, chitinozoans are poorly preserved and difficult to extract. All the data of this section were published in Loydell et al., 2015. Juan Carlos Guti érrez-Marco said that the related study on this section was supported by the National Geopark of Spain.

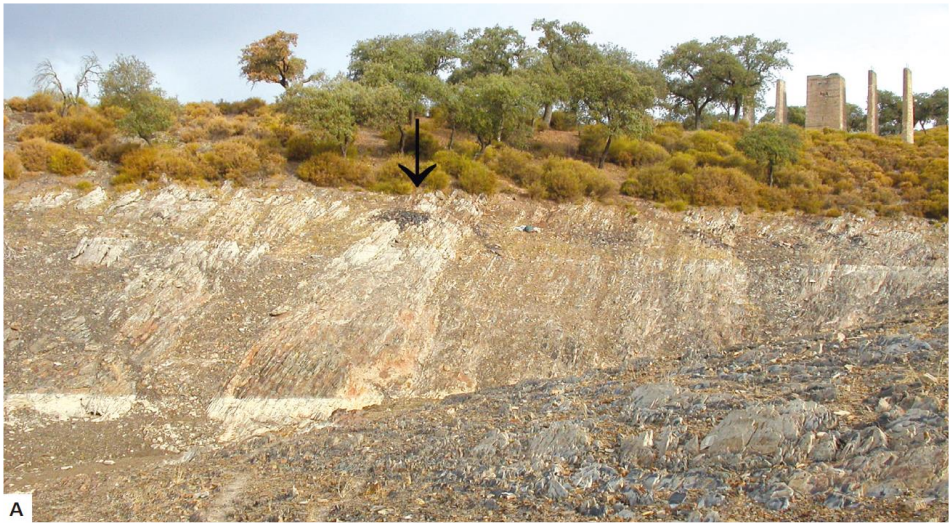

Fig. 2 Overview of the El Pintado section, Spain (after Loydell et al., 2015)

1c) Base of the Wenlock GSSP (lead by David Loydell)

David Loydell (University of Portsmouth, UK) made a speech entitled “A ~~(not so)~~

Brief history of the Llandovery/Wenlock boundary". He introduced the problems of current GSSP of the base of Wenlock Series, which was originally defined at Hughley Brook, England, and stated to correlate with base of the *Cyrtograptus centrifugus* Biozone. This section has no graptolite, and has some stratigraphic problems (for example, the golden spike is within a lithologically monotonous sequence, which can not to be located precisely, and it correlates with a level closer to the base of the *C. murchisoni* Biozone, not the base of the *C. centrifugus* Biozone, according to the chitinozoans), and also the section seems to be faulted and not well exposed, so it is not suitable to be a applicable GSSP. For the Welsh sections, the Dyfnant Forest section extends upwards to a level within the *C. centrifugus* Biozone and the Trannon River section extends downwards to a level within (unfortunately not below) the *C. murchisoni* Biozone, so neither are suitable as replacement GSSPs. The research in Gotland involved several fossil groups, graptolites, conodonts and chitinozoans, and also bentonite layers and chemistratigraphic events. There is still a long way to establish a new GSSP for the base of the Wenlock Series, and changing the golden spike to the base of the *Cyrtograptus murchisoni* Biozone might be a viable alternative.

Petr Štorch suggested that the Ziyang section, Shaanxi, China can also be used as a candidate, but still a lot of work needs to be done.

(2) Support for Anticosti Island to the UNESCO World Heritage Program

Anticosti Island is famous for its Ordovician and Silurian strata and fossils, and it was recommended as a candidate for the UNESCO world heritage site by Jin Jisuo, David Harper and others. Petr Štorch, the chair of ISSS will send them a formal support letter in a week.

(3) Location and timing of the next ISSS field meeting

The location and timing of the next ISSS field meeting has not been determined. It does not seem to be a good idea to hold in conjunction with the 36th International Geological Congress (2-8 March 2020, Delhi, India). Turkey is suggested by Petr Štorch as one of the candidate sites. New proposals and suggestions on location, organizer and sponsor will be very much appreciated.

(4) ISSS membership in response to new ICS statuses

The ISSS membership will follow the revised ICS statutes, which was approved by ICS on 24 March 2017 and ratified by the IUGS Executive Committee on 25 April 2017.

(5) Koren' Award, second call

The candidates for the Koren' Award are still continuing to be recommended.

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2. Report on the 15th International Symposium on Early/Lower Vertebrates

by ZHU Min and ZHAO Wenjin (IVPP, China)

Palaeozoic vertebrates: diversity and early evolution of early vertebrates

The 15th International Symposium on Early and Lower Vertebrates (ISLEV 2019) was held at the Qujing Normal University in Yunnan province, southern China from August 8 to 13, 2019, and organised by Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences (IVPP, CAS), Qujing Normal University, Qilin District Science and Technology Bureau of Qujing City and Hunan Museum of Geology. The Organising Committee was mainly composed of Min Zhu (chairman), Wen-jin Zhao (vice-chair), Zhi-kun Gai, Jing Lu, Tuo Qiao, You-an Zhu, Lian-tao Jia, Zhao-hui Pan, Xiao-dong Shi, Qiang Li, Plamen Andreev, Zhi-gang Wang, Li-zhou Tang, Neng-yong Hu, Qian-yun Yang and Jian-hua Wang. Over 100 fish researchers and Palaeozoic geologists from 18 countries (Australia, Belgium, Canada, China, France, Germany, Japan, Latvia, Netherlands, Poland, Russia, South Africa, Spain, Sweden, Switzerland, United Kingdom, USA and Vietnam) came to attend the symposium.

The focus of the symposium was on the diversity and early evolution of early vertebrates, including 10 technical sessions (‘Life before jaws’, ‘Early evolution and diversification of jawed vertebrates’, ‘Losing the bones: acanthodian and chondrichthyan morphology and histology’, ‘Histology and tooth development in stem gnathostomes’, ‘Early evolution and diversification of osteichthyans’, ‘Early evolution of sarcopterygians’, ‘Fishy ancestors and how they crawled into land’, ‘Morphology and evolution of

actinopterygians', 'Silurian-Devonian vertebrate faunas and related stratigraphy', and 'Paleozoic environment, climate and diversification: in memory of Dr V. K. Ting'). The topics of presentations ranged from the earliest chordates up to the origin and early radiation of land vertebrates, and touched all aspects of the study of early and lower vertebrates. 53 presentations during the symposium were mainly devoted to new scientific research advances on the taxonomy, morphology and histology of early vertebrates (mostly including Agnatha, Placodermi, Acanthodii, Chondrichthyes, Osteichthyes and Tetrapoda from Silurian-Triassic strata), and relevant biostratigraphy, biogeography, and environmental changes.

The symposium also included three field trips: Pre-Conference field trip to Siluro-Devonian sections and fossil sites in Zhangjiajie, Changde and Changsha regions, Hunan Province (4^{th} – 8^{th} August, 2019), Conference field trip to Silurian Xiaoxiang Fauna and Devonian Xitun Fauna sites close to Qujing City (11^{th} August, 2019), and Post-Conference field trip to Cambrian-Triassic Vertebrate sites in Yunnan Province (14^{th} – 18^{th} August, 2019). 38 and 43 participants from all over the world joined the Pre-Conference and the Post-Conference field excursions, respectively. All the participants took part in the conference field trip. The 11-day field excursion was a fantastic way to visit and examine the fantastic exceptionally-preserved fish-bearing sites from Cambrian to Triassic in South China, such as the Cambrian Chengjiang Fauna site, Silurian Zhangjiajie and Xiaoxiang fauna sites, Devonian Xitun Fauna site, and the Triassic Luoping Biota site.

Extended abstracts for 66 papers submitted for the ISLEV 2019 meeting were published in Ichthyolith Issues, Special Publication 14. In addition, two field guidebooks were also produced for three field trips, one of 27-pages for the Pre-Conference field trip and another of 34-pages for both Conference and Pre-Conference field trips.

Photo 1: Opening ceremony of the symposium

Photo 2: Conference highlights

A-B: Oral presentation and conference site; C-D: Poster presentation and coffee break; E: Conference registration desk; F: Reading conference news; G: Five experts who participated in the 5th ISLEV 32 years ago met again in Qujing; H: Conference dinner

Photo 3: Participants during three field trips

A-B: Triassic Luoping Biota site and section; C: Devonian Xitun Fauna site; D: Devonian Haikou Fauna section; E: Silurian Zhangjiajie Fauna site and section; F: Silurian Xiaoxiang Fauna site; G-H: Cambrian Chengjiang Fauna site and section

Photo 4: Outcome of the symposium

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3. Report on the 13th International Symposium on the Ordovician System in conjunction with the 3rd Annual Meeting of IGCP 653

by Olga OBUT and Nikolay SENNIKOV (IPGG SB RAS, Russia)

Novosibirsk, Russia (July 12-17, 2019)

More than 70 participants from 15 countries attended Novosibirsk for the 13th International Symposium on the Ordovician System and the 3rd annual meeting of IGCP 653 “The onset of the Great Ordovician Biodiversification Event”. During the scientific sessions took place at the Trofimuk Institute of Petroleum Geology and Geophysics SB RAS (IPGG SB RAS) and Novosibirsk State University (NSU) 55 oral and 30 poster presentations were done. Delegates had the opportunity to visit three museums: Central Siberian Geological Museum (IGM SB RAS), Paleontological Museum “GEOCHRON” (IPGG SB RAS), where several participants studied some key fossils, Museum of Earth’s History (NSU); and in addition a visit was arranged to the center for drill core collections (IPGG SB RAS). Participants attended two pre-conference excursions: to the Gorny Altai, SW Siberia (July 9-18) and to the St. Petersburg area (July, 15-17); and post-conference excursion to Podkamennaya Tunguska River, Siberian Platform (July, 23-30).

Please let us know if you’ll need more about the event.

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GUIDELINES FOR THE ISSS AWARD: KOREN' AWARD

Description: This award is intended to recognize and encourage excellence in research related to Silurian stratigraphy and paleontology by younger researchers. It will be presented every four years at the Silurian Symposium.

It is proposed that this award be formally termed the "Koren' Award" in honor of the late Dr. Tatiana Koren' (1935-2010), former Secretary and Vice Chair of the Silurian Subcommission (as well as member of Ordovician and Devonian subcommissions) and a global expert on graptolites who made many lasting contributions to the biostratigraphy of the Silurian System (see Memorial in 2011 in *Silurian Times* (No. 18) and *Ordovician News* (No. 28)).

Selection Procedure: Recipient of this award will be based on nominations from voting (titular) members of the Silurian Subcommission overseen by a committee of three titular members. The nomination will consist of an updated CV, including list of publications relevant to Silurian stratigraphy and letter or letters of recommendation from one or two or several voting members of ISSS. Letters should emphasize the fit of the nominee for the criteria listed below.

The nominations will be reviewed by the committee on awards (presently Carl Brett, Renbin Zhan and Petr Štorch) who will prepare a slate of candidates including brief synoptic biographies that will be voted upon by all titular members. The candidate receiving the largest number of votes will receive the award.

Criteria for selection: The candidate may be chosen from among any paleontologists/stratigraphers who fit the following criteria:

A successful candidate should:

1) be 40 years of age or younger.
2) possess a graduate degree (ideally PhD, although candidates with masters degrees may be considered).
3) have completed at least five years of professional research (PhD studies included).
4) have a substantial record of publication (mostly senior authored) related to Silurian stratigraphy, paleontology, paleobiology, paleobiogeography or paleoceanography, etc. in peer-reviewed journals.
5) be actively contributing to Silurian research at the time of the award.
6) demonstrate an outstanding ability to communicate ideas verbally (as in conference talks) and in writing.
7) be supported by two or more titular members of the Silurian Subcommission.

Besides, the ISSS will avoid awarding two continuous recipients from the same country or state in 8 years.

Certificate and bonus: Each winner of the "Koren' Award" will receive a formal Certificate issued by ISSS with the Chair's signature and $300US as bonus, both of which will be awarded at the closing ceremony of each Silurian Symposium every four years.

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ANNOUNCEMENTS OF SILURIAN RELATED MEETINGS AND ACTIVITIES IN 2020

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Lithological Meeting

GEOLOGY OF REEFS

Syktyvkar, Komi Republic, Russia

N.P. Yushkin Institute of Geology FRC Komi SC UB of the Russian Academy of Sciences

June 23-25, 2020

Topics of the Meeting

1. Basic concepts and diagnostic features of organogenous structures;
2. Biodiversity and evolution of reef ecosystems;
3. Genetic diversity of organogenous structures;
4. Microbial carbonates as components of organogenous structures;
5. The role of microbiota and fluids in the formation of carbonate buildups;
6. A complex analysis of reef formation areas.

Youth School

The leaders are Anna Antoshkina and Valentina Zhemchugova.

Practical Seminar

"Diversity of genetic types of rocks of organogenic buildups", with viewing of thin-sections and samples collections.

The leaders — Natal'ya Matveeva and Lyubov` Shmeleva.

Field Trip

"Paleozoic organogenous buildups of the Ilych River basin, Northern Urals". June 26-July 04, 2020.

Number of participants is 9 people. Estimated cost is 650 EUR.

Trip leader — Evgenij Ponomarenko.

Registration fee: 30 EUR.

The abstract submission is free of any charge

Site of the Meeting "Geology of reefs": http://conf.uran.ru/Default.aspx?cid=reefs

Contact Information:

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sandula@geo.komisc.ru. – Secretary

esponomarenko@geo.komisc.ru – Field Trip
nakaneva@geo.komisc.ru – Practical Seminar

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SILURIAN RESEARCH 2019:

NEWS FROM THE MEMBERS

(*in alphabetical order*)

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Anna ANTOSHKINA (Russia). I am working on Upper Ordovician and Silurian bioevents, palaeogeography, and Palaeozoic reefs. I am also interested in sequence stratigraphy and evolution of the Lower Palaeozoic sedimentary basin in the north-eastern part of the European Platform. The projects — Ordovician-Silurian boundary, Hirnantian, and Silurian strata exposed on the northern Urals together with my young colleagues Lyubov' Shmeleva and Evgenij Ponomarenko are continuing. A complex study with modern physics methods of various thin-grained rocks, ooids, nodules in Palaeozoic and Phanerozoic deposits of the Urals and adjacent territories continues together with my colleagues from our institute and other organizations.

Besides, together with Dr. Fei Li (the School of Geosciences and Technologies, Southwest Petroleum University, Chengdu, China), I have been also working on the geochemical analyses of ooids and microbialites (including trace and rare earth element compositions).

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****

Kyi-Pyar-AUNG (Myanmar). I am working on Silurian graptolites from Sibumasu including Myanmar. I also continue to work on the next Ordovician-Silurian boundary in Myanmar: geochemistry and paleontology. Now, together with some colleagues from China, I am working on the end-Guadalupian (Permian) extinction in Sibumasu.

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Gudveig BAARLI (USA). I am continuing work on the atrypids and athyridids of the Solvik Formation in the central Oslo Region. In 2019, I published an article on the Atrypinae. At the moment I am finishing an article on the rest of the ribbed atrypids. This makes a total of 25 ribbed atrypids from the formation. Next I will start on the smooth atrypids, a common group, together with a few athyridids.

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Chris BARNES (Canada). I am continuing research on Silurian conodont paleontology/stratigraphy/isotope geochemistry. The main current projects being: a) Ordovician and Silurian conodont biostratigraphy, bioevents, eustasy, and thermal maturation; b) analysis of the effects of climate, eustasy and tectonics on conodont evolution and ecology during the Early Palaeozoic from the major database developed from a half-century of sampling throughout the Canadian part of Laurentia; and c) early Silurian microvertebrate assemblages from the Cape Phillips Formation, Sheills Peninsula, Devon Island, Nunavut, Canada (with Susan Turner (Queensland Museum) and David Sprague (Calgary)).

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Juan Luis BENEDETTO (Argentina). I am working on the brachiopod faunas across the Hirnantian/Rhuddanian boundary from the Precordillera basin of western Argentina (Cuyania terrane) in order to shed light on the end-Ordovician mass extinction in the circumpolar region of Gondwana. A project is being carried out in collaboration with the doctoral student Florencia Leone. This long-term study also focuses the subsequent recovery during the Early Silurian and aims to identify those physical and biotic factors leading to the emergence of the Afro-South American Realm and the dynamics of the brachiopod radiation through the Silurian and the beginning of the Devonian. The material for this analysis includes the rich brachiopods faunas from the La Chilca (Llandovery) and the Los Espejos (Wenlock-Pridoli) formations of west-central Argentina. A paper dealing on the rhynchonellid phyletic lineage starting with the *Anabaia* in the early Llandovery and culminating with *Clarkeia* in the Late Silurian has been recently published. On the other hand, a taxonomic revision of the genus *Dalmanella* in the Argentinean Precordillera and an analysis of the size changes experienced by the species *D. testudinaria* across the end-Ordovician biotic crisis have also been published.

Juan Luis Benedetto (Prof.)
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Stig M. BERGSTRÖM (USA). Although I have been involved in several research projects on the lower Silurian in eastern North America and Sweden during 2019, most of my time has been devoted to Ordovician studies. In recent years, I have published several articles on the Ordovician/Silurian transition, the latest in the 2019 Wiley book on 'Chemostratigraphy across major chronological boundaries", and I continue work on aspects of that stratigraphic interval. I am also co-author (with Seth Young et al.) on a submitted paper on the geochemistry and chemostratigraphy of the Llandovery in the Röstånga-1 drill core from southern Sweden. Mark Kleffner and I have continued our investigations on the Silurian of the eastern North American Midcontinent and some results were published in a 2019 congress abstract.

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Carlton BRETT (USA). In the past year, I continued working with several colleagues on Silurian sequence, chemo- and event stratigraphy and palaeoecology of southern Laurentia and comparisons with other regions. Research is divided into three project areas.

A) Research on Silurian Sequence and Chemostratigraphy: Ohio-Kentucky-Indiana-Tennessee, Canada (with Indiana and Ohio Geological Surveys)

This year efforts were largely focused on aspects of end Ordovician- earliest Silurian stratigraphy in Ontario in conjunction with UC graduate student Cole Farnam. Cole and I did fieldwork in Ohio and in the Bruce Peninsula and Manitoulin Island in Ontario, to identify important linkages of depositional sequences and bioevents between the Cincinnati Arch and the Ontario platform and Michigan Basin. Preliminary C isotopic studies have identified the Hirnantian isotopic excursion (HICE) in strata formerly considered to be Silurian. These data indicate that the well-known Cherokee unconformity probably lies within the Upper Ordovician and marks the sea level lowstand associated with the major phase of very late, but not latest Ordovician.

Chris Waid of the Ohio Geological Survey and I continued to extend Silurian correlations through the Ohio subsurface into New York, Ontario and other adjacent regions. We are also working to determine the frequency of cycles to improve relative time scales and correlation with physical and biotic events in the North American mid-continent. We hosted a two-day field and core workshop in October, 2019 for the Eastern Section of American Association of Petroleum Geologists, aimed at integrating new data on sequence stratigraphy, geochemistry, and biostratigraphy of the lower Silurian in Ohio (Waid and Brett, 2019).

B) Silurian Echinoderms and other Invertebrate Faunas

Dr. James Thomka (now at SUNY College at Plattsburg) and I continue study of the detailed sequence and cycle stratigraphy, taphonomy, paleoecology (especially of echinoderms) and paleoenvironments of the early Wenlock interval in Indiana, Kentucky, and Tennessee. We worked on two new manuscripts dealing with Silurian echinoderms,

including an intriguing case of intergrowth among echinoderm holdfasts (Thomka and Brett, 2019). We are also working on better documenting traces formed by host-specific parasites that embedded themselves in certain species of crinoids and other pelmatozoans and submitted a chapter on paleoparasitism in Paleozoic echinoderms for a book on ancient parasites, with abundant Silurian examples (Thomka and Brett, in press). We are also working on a chapter on taphonomy for the projected new *Treatise* volume on crinoids, again drawing extensively on our Silurian examples.

In addition, a project with Andrej Ernst (Universität Hamburg) and Mark Wilson (Wooster College) on lower Silurian bryozoans in eastern North America was brought to completion with the publication of a previously undocumented diverse bryozoan fauna from the Aeronian Reynales Formation in New York State (Ernst et al., 2019). Thirteen species, including three new species were described and the paleoecology and paleobiogeography of the occurrence documented.

C) Volatility and Reefing Episodes in the Silurian

Pat McLaughlin (Indiana Geological Survey), Poul Emsbo (US Geological Survey, Denver) and I continued to pursue detailed studies that are leading to an important new synthesis that will help to shed light on critical processes in Earth and life history. In particular, this year we documented an occurrence of major event of pinnacle reef development in the mid Telychian of the Laurentian mid-continent (McLaughlin et al., 2019). This, and other Silurian "reefing" events appear to be related to carbon isotopic excursions and episodes of abrupt sea level rise. These are short-lived events (10s of kyr) that appear correlated to changes of the carbon cycle during episodes of glacioeustatic rise.

D) Stratigraphic Nomenclature

As Chair of the North American Commission on Stratigraphic Nomenclature (NACSN) in 2017-2018, I worked on developing the category of submembers as a formal lithostratigraphic subdivision to give a broader hierarchy of stratigraphic units: Formation-Members-Submembers-Beds-Bed. At the 2019 meeting in Phoenix, AZ, this proposal was unanimously approved. With commissioner Marie-Pierre Aubry and others, I am also working on formalization of the rank of subseries and the term biochron. A larger initiative is the development of a study group on chemostratigraphy. At the Phoenix GSA meeting NACSN also hosted a GSA poster session on Chemostratigraphy with some 20 presentations and posters. In early 2020, we submitted a proposal for a standardized and classification of chemostratigraphic terminology to the journal *Stratigraphy*.

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Carole BURROW (Australia). The paper co-authored by Sue Turner (QM), Gavin Young (ANU) and Kate Trinajstic (Curtin University) on late Silurian vertebrates from the Pendock-1A borehole off Western Australia, which has been in progress for the last two decades (!), was published. This year's work has concentrated on Devonian fossil fish, unfortunately with very Silurian fish remains studied in the year. A project investigating the vertebrate microfossils in thin sections of sediments from the late Silurian to Middle Devonian in the Mossgiel-DDH1 core from the Darling Basin, western NSW continues in partnership with Sue Turner and Pat Conaghan (MUCEP).

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Yves CANDELA (UK). After working more regularly on the Silurian for the past five years, with papers on machaeridians and brachiopods from the Pentland Hills (Scotland) published in various journals, I am refocussing for a time on the Ordovician with work on the brachiopods of the Fezouata Shales, machaeridians from the Girvan area and Early Ordovician brachiopods from Belgium. This year with co-authors Juan Carlos Gutiérrez-Marco and Artur Sá, we presented some preliminary work on Early Ordovician brachiopods from Spain in Candela, Y., Gutiérrez-Marco, J.C. and Sá, A.A. 2019. New data on the 'giant' obolid fauna (Brachiopoda) from the Armorican Quartzite facies (Lower Ordovician) of the Iberian Peninsula, *in*: Obut, O.T., Sennikov, N.V. and Kipriyanova, T.P. (eds), 13th International Symposium on the Ordovician System: Contributions of International Symposium, Novosibirsk, Russia (July 19-22, 2019). Trofimuk Institute of Petroleum Geology and Geophysics SB RAS, Novosibirsk National Research State University. Novosibirsk, Publishing House of SB RAS, 27–29.

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CHEN Xu (China). I am leading a research project working on Ordovician-Silurian shale gas bearing strata from the Yangtze region. The project includes research fellows from Petroleum China, China Petrochemical Cooperation, and China Geological Survey.

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CHEN Zhongyang (China). In late March 2019, I went to Yunnan (SW China) to attend the "Chinese Conodont Symposium 2019", and gave an oral presentation with the title "Silurian conodont biostratigraphy of the Laojianshan section, Baoshan, Yunnan Province, SW China. From late June to early July, 2019, I took part in the STRATI 2019 in Milan Italy, and also gave a talk "First documentation of *Astropentagnathus* in China: Progress of Silurian conodont studies in the East Qinling".

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Robin COCKS (England). 2019 was a somewhat fragmented year: In the first quarter time was spent on the final production of the substantial Llandovery Brachiopods of England and Wales monograph, which was finally published in April with two new genera and 19 new species. Subsequently, work progressed on papers with Trond Torsvik (Oslo) on the causes of Lower Palaeozoic climate change and to what extent those changes were influenced by the developing global palaeogeography, and with Trond and Wolfgang Franke (Geissen) as to whether or not Precambrian zircons can be usefully employed in elucidating Lower Palaeozoic palaeogeography. A paper with Leonid Popov (Cardiff and Iran) on Welsh Arenig brachiopods and stratigraphy was completed and work on a substantial new later Ordovician brachiopod fauna from the Chu-Ili Terrane of Kazakhstan was carried forward.

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Carlo CORRADINI (Italy). The work on Silurian conodonts and biostratigraphy continues. Last year most of the researches were devoted to the Carnic Alps, where I am investigating the Pre-Variscan Sequence Upepr Ordovician-lower Carboniferous). Studies on Silurian and Lower Devonian mainly focus on "*Orthoceras* limestones" and calcareous levels within black shales sequences, both studying new sections and updating data from classical localities. A paper on conodonts and stratigraphy across the Silurian/Devonian boundary in the whole Carnic Alps and one on a relatively new section of Pridoli-Lochkovian age were published (with various co-authors), as well as a review if

conodont studies in the area (Spalletta & Corradini, 2018). A new geological map on the central sector of the Carnic Alps will be submitted soon (Pondrelli et al.).

In Sardinia I'm studying calcareous sections (with M.G. Corriga) and black shales outcrops (with A. Baucon and others). The study of conodonts from the San Juan Precordillera (Argentina) is in progress (with M.J. Gomez, A. Mestre and S. Heredia), and a paper on the first report of the *P. siluricus* Zone in South America is published (Gomez et al, 2019).

The taxonomic study of Silurian and Lower Devonian conodonts continues together with M.G. Corriga and is mainly focused on genus *Zieglerodina*: the apparatus of *Zieglerodina eladioi* was published (Corriga & Corradini, 2019) and other papers are in progress.

In September 2019 I organized the field trip in the Carnic Alps connected with the 13th International Symposium on Fossil Cnidaria and Porifera. The excursion was mainly devoted to the Devonian reefs, but the participants had the possibility to visit some classical Silurian sections, as Cellon.

In addition, the annual meeting of the Italian Geological Society will be held in Trieste in September 2020. I will coach a three days field trip to the Pre-Variscan sequence of the Carnic Alps. For information: http://www.geoscienze.org/trieste2020/

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Maria Giovanna Corriga (Italy). I am working on conodont taxonomy and biostratigraphy across the Silurian-Devonian boundary mainly in Sardinia, the Carnic Alps and other North Gondwana regions.

In the Carnic Alps, I am investigating the Silurian and Lower Devonian *Orthoceras* Limestone: a paper on the Pridoli-Lochkovian Rio Malinfier West section and one on conodonts and stratigraphy across the Silurian/Devonian boundary in the whole Carnic Alps were published, and one on the conodont stratigraphy of Valentintörl section is in progress. Also, the geological map on the central sector of the Carnic Alps will be submitted soon (Pondrelli et al.). In Sardinia I'm studying calcareous sections (with C. Corradini). The taxonomic study of Silurian and Lower Devonian conodonts continues and is mainly focused on genus *Zieglerodina*: the apparatus of *Zieglerodina eladioi* was published (Corriga & Corradini, 2019) and other papers are in progress.

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Julie DE WEIRDT (Belgium). I'm a PhD researcher at Ghent University, Belgium. My supervisors are Prof. Thijs Vandebroucke (UGent) and Dr. Poul Emsbo (USGS). The main focus of my project lies in investigating Ordovician and Silurian biogeochemical events, characterized by dramatic stable isotope excursions that reflect major disturbances of oceanic C, O and S cycles. In doing so I am also developing a new methodology that allows a fully quantitative elemental analysis of microfossils such as chitinozoans and acritarchs.

I would like to advertise the article we have on the Rhuddanian-Aeronian boundary of the Rheidol section, Wales, UK.

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Annalisa FERRETTI (Italy). My Silurian research continues to be focused on the biosedimentology and palaeoecology of the Austrian Carnic Alps.

An integrated study on modern iron ooids from Panarea, Sicily (Di Bella et al., 2019) and a study on related sponge spicules (Ferretti et al., 2019) have been published, with important implications for fossil counterparts.

My recent papers have strictly focused on the effect of diagenesis on bioapatite mineralogy and crystallization patterns (Malferrari *et al.*, 2019; Medici *et al.*, 2020). I have also co-guest edited with Alyssa Bancroft and John Repetski (Ferretti *et al.*, 2020b) the Special Issue of *Palaeogeography, Palaeoclimatology, Palaeoecology* "GECkO: Global Events impacting COnodont evolution", a collection of 19 conodont contributions, including six Silurian papers.

Finally, a paper describing Leonardo da Vinci's contribution to stratigraphy, of broad interest to any stratigrapher, exactly five hundred years after Leonardo's death, has been recently published (Ferretti *et al.*, 2020a).

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Mansoureh GHOBADI POUR (Iran). My current research activities are on various aspects of taxonomy, biogeography and palaeoecology of the Silurian to Devonian faunas from Central Iran, Alborz and the Kopet-Dagh regions with a special attention to trilobites and brachiopods. I have got also significant new collections of silicified ostracods and bryozoans from the Aeronian of the Tabas Region, which are currently under study in cooperation with Caroline Buttler, Robert Owens and Leonid Popov.

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María José GÓMEZ (Argentina). I am working on the Silurian and Devonian conodonts from Argentina Precordillera. I am developing my PhD on the Silurian-Devonian conodonts biostratigraphy from the Los Espejos Formation at the Argentina Precordillera in collaboration to the Dra. Ana Mestre, Dra. Susana Heredia and Dr. Carlo Corradini.

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Luke HAUSER (UK). 2019, has been a hectic year, I have finally finished my Ph.D on the late Silurian Downton Bone Bed from the Welsh Borders, under the supervision of David Loydell, David Martill and Tiiu Märss. I will now start looking for employment, new research opportunities and editing my thesis into papers. I welcome collaboration on these papers so if you want to discuss the details with me (the thesis covers sedimentology, vertebrate & invertebrate palaeontology, palaeobotany and ichnology) please contact me on the supplied email addresses. I am planning to attend conferences going forward, so hope to see many of you there.

Luke Hauser
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Kathleen HISTON (Italy). I continue my studies on Silurian cephalopods, sea-level changes, oceanic cycles and biotic response in the Ordovician/Silurian of the Carnic Alps and other localities in relation to use of the migrational pathways of pelagic faunas as a tool for timing of open seaways and microterrane position along the North Gondwana margin. This includes investigation of Silurian nautiloid biozones for biostratigraphic correlation.

Kathleen Histon (Independent researcher)
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David HOLLOWAY (Australia). A large manuscript on trilobites of the order Corynexochida from the St Clair Limestone (Wenlock) of Arkansas has been completed and submitted for publication. This is a long delayed continuation of my two earlier studies on the St Clair trilobites published many years ago. A further and final part of the study, on the orders Lichida and Odontopleurida, is almost complete. A manuscript, jointly with Patrick Smith (Australian Museum, Sydney), on a new genus of calymenid and new species of *Dicranurus*, from the Upper Ordovician (Katian) of New South Wales, has been accepted for publication.

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HUANG Bing (China). I have been working on a new project from the Chinese Academy of Sciences from the end of 2018. Last year, according to the topic of the project and suggestion from Prof. Rong Jiayu, I start to investigate the Hirnantian brachiopod faunas which is the key to understand the end Ordovician mass extinction. Meanwhile, I also continue working on Silurian brachiopod fauna and stratigraphy. My international collaboration with Prof. David Harper was fruitful last year. We finished two manuscripts together about two interesting cases of *Hirnantia* Fauna that were submitted to Journal of Paleontology and Lethaia respectively (both are published online now). One is an ecological study of the *Hirnantia* brachiopod Fauna that evolved from shallow water to deeper water environment; the other reported a typical shallow water *Hirnantia* fauna and discussed the variation of the type species of *Hirnantia*. Last year, I also collaborated with Prof. Li Rongyu from Brandon University on a well preserved repaired brachiopod shell found from the lowest Silurian, the study was just accepted by Alcheringa. I also begin a monographic study on a Silurian brachiopod fauna with Prof. Jin Jisuo. The work is time consuming, and I will try to finish it in two years. Besides the studies above, I have been working with Porf. Rong Jiayu on a very important review study which is mostly about the latest Ordovician Hirnantian brachiopod faunas with a newest dataset based on comprehensive revision of related faunas (will be submitted very soon, and I am the third author). Last year, I attended the 13 ISOS in Novosibirsk and made an oral presentation. My student Zhou Hanghang got his master degree, and a new student Wang Qian begin his Msc study under my supervision.

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Markes JOHNSON (USA). At the end of 2019, the second, revised draft of a book-length manuscript was completed under the provisional title "Islands in Deep Time: Lost and Found." Five chapters out of 12 cover paleoislands from the Cambrian, Ordovician, Silurian, Devonian, and Permian with an emphasis on global marine circulation patterns and storm deposits (among other things). Once more, the book under review with a major university press in the US.

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Dimitri KALJO (Estonia). I continued some studies on the Ordovician and Silurian bio- and chemostratigraphy of Baltica as an emeritus member at the geology department of the Taltech. Beginning with March 2019, I don't have any official commitments but personal contacts and cooperation with some colleagues from USA and Europe still work.

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Steve KERSHAW (UK). I continue working on stromatoporoids of the UK Silurian and is writing a monograph of British Silurian stromatoporoids, as a major update last done by Nicholson, 1886-1892. No new taxa have been found but the range of previously recorded taxa in the UK Silurian is significantly increased in this work, which also addresses stromatoporoid palaeobiology, palaeoecology and geography of these Silurian faunas.

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LI Qijian (China). I am mainly working on Ordovician-Silurian reefs and hypercalcified sponges (e.g. calathids, stromatoporoids and sphinctozoans). In 2019, I continued my sedimentological and paleoecological research on Ordovician reefs. Apart from the materials from South China, Tarim, Malaysia and Thailand, I carried out a new project with Prof. Andrei Dronov and Prof. Anna Antoshkina, targeting the Ordovician reefs in Siberia. Moreover, I am now working on some Early Silurian reefs of South China, in collaboration with Prof. Axel Munnecke, Dr Stephen Kershaw and Dr. Andrej Ernst. I also continue my collaborations focused on quantitative paleoecological analyses of reefs at the Ordovician-Silurian transition with several colleagues.

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Steve LoDUCA (USA). In 2019, I had only one publication (an abstract) related to the Silurian, but I'll be submitting a paper on the same topic to Journal of Paleontology by the end of Febuary 2020 and, if all goes well, that will be a new entry for the next issue of Silurian Times.

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Jason Loxton (Ph.D.)
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David LOYDELL (UK). I have been heavily engaged in teaching-related activities in recent months, but should return to research soon. Completed work on the Trannon River section was presented at Strati in Milan in July 2019, together with discussion of other possible replacement GSSPs for the base of the Wenlock (none of which proved satisfactory). Various projects involving integration of geochemical and biostratigraphical data are nearing their completion.

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Peep MÄNNIK (Estonia). I continue to work on evolution, taxonomy and palaeoecology of conodonts, conodont-based high-resolution stratigraphy, bioevents and palaeogeography. I am also interested in sequence stratigraphy, palaeoclimatology and evolution of sedimentary basins. Joint studies together with colleagues from Estonia, Check Republic, Germany, Poland, Iran, Russia, Sweden, U.K. and USA on evolution and high-resolution stratigraphy of the Early Palaeozoic faunas and sedimentary basins on different palaeocontinents are going on.

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Alexander (Sandy) McCRACKEN (Canada). I am periodically working on good Ordovician-Silurian collections from Hudson Bay and Moose River basins, Ontario and Manitoba, and also has some Arctic Island Ordovician-Silurian conodonts to review. I retired to Victoria, BC in September 2017, but continue as a part-time volunteer with the GSC Calgary office. I am in email contact with the Calgary office once a week, and so may be a bit slow to respond to emails. Regular mail to the Calgary office doesn't get forwarded so please send only emails or email attachments.

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Tõnu MEIDLA (Estonia). I am working on different aspects of stratigraphy, fauna and stable isotopes in the Silurian (including the lower boundary interval) of Estonia, Latvia and Lithuania (together with L. Ainsaar, O. Tinn, B. Gul, K. Kungla, L. Lang, K. Truuver, A. Spiridonov, S. Radzevičius).

I was involved in the scientific committee (but not in the organizing committee) of the 9th European Ostracodologists' Meeting in Gdansk, Poland, July 18-22th, 2019.

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Ana MESTRE (Argentina). I mainly work in the Ordovician conodonts and stratigraphy of carbonate succession from Argentine Precordillera, but have been drifting into the Silurian conodonts study. I'm particularly interesting to study the stratigraphy and evolution of Ordovician and Silurian sedimentary Precordillera basin.

The PhD student (M.J. Gomez), Dra. Susana Heredia and I, in collaboration with the Dr. Carlo Corradini are developing the Silurian-Devonian conodonts biostratigraphy from the Los Espejos Formation at the Argentine Precordillera, with fantastic and original results on this topic, that will be extendedly develop by Lic. María José Gómez in your Silurian-Devonian conodont PhD project.

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Giles MILLER (UK). I have been working on conodonts from the Ludfordian-Gorstian boundary at the international stratotype section at Sunnyhill Quarry. I presented some preliminary data at STRATI 2019 in Milan. Since then I have carried out some final fieldwork at the section and processed a final two samples. I aim to have something published and ready to present at the International Conodont Symposium in China in 2021. I have also some nice fish and foraminiferal collections from that section that should be published.

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Tatiana MODZALEVSKAYA (Russia). I am working on Silurian stratigraphy and brachiopods from the Arctic regions of Russia within the framework of project: Atlas of compilation on the Phanerozoic stratigraphic key sections of Arctic Russia. An addition I

continue in thematic projects connected with analysis of Regional scales of Eurasian Russian regions. I took part in Conference: 13th International Symposium on the Ordovician System: Novosibirsk, Russia (July 19-22, 2019). My poster are “Brachiopods of Ordovician and Silurian boundary deposits in the Arctic”.

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Axel MUNNECKE (Germany). In 2019, I have two Silurian-related projects running – one dealing with the response of bryozoans to the Silurian climate changes (PhD student is Lene Claussen) and another one at the intersection of geology and archaelogy (age and depositional facies of the Viking age monument stones on Gotland which are made of Silurian limestones; PhD student is Patrick Hänsel). Besides, I am organising the "International Courses on Carbonate Microfacies" in March in Erlangen, Germany. In theses courses a lot of beautiful thin sections from the Silurian rocks of Anticosti and Gotland are shown (but also many others).

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Ian PERCIVAL (Australia). I have found that I am just as busy in retirement as I was when employed, so other priorities have delayed the planned submission of two manuscripts on Silurian faunas from central NSW. However, I continued a productive collaboration with Guangxu Wang and colleagues from the Nanjing Institute of Geology & Palaeontology in 2019, with a visit to China focussing on the Hirnantian extinction and ensuing faunal recovery, and stratigraphy of the latest Ordovician – earliest Silurian interval. A manuscript on this topic was submitted to *Geological Journal* and is currently being revised after review.

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José Manuel PIÇARRA (Portugal). I'm officially retired, but still being collaborator of the LNEG

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Leonid POPOV (UK). I continue my work on the Silurian (Wenlock–Pridoli) brachiopods of Nuratau and Turkestan ranges (Uzbekistan and Tajikistan) in cooperation with Irina Kim from Uzbek Geological Survey and Siulurian (Llandovery to Ludlow) brachiopods from Tabas and Kerman regions at Central Iran.

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Sigitas RADZEVIČIUS (Lithuania). Most of my research is concentrated on the construction of high-resolution Silurian time scales by means of integrated stratigraphy. I'm working on the taxonomy, stratigraphic distribution, diversity, disparity, and phylogeny of Silurian graptolites. I'm integrating stratigraphic models, taxonomic data, geochemical, and geophysical proxies in order to understanding the drivers of mid-Paleozoic global extinction and turnover events.

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David RAY (UK). My research activities over the past year have focused upon the Silurian of the Midland Platform (England and Wales). In particular, collaboration with Emilia Jarochowska, Helen Hughes, Anna Claussen and others has focused on the area between Old Radnor and Presteigne. Here we are investigating successions of Aeronian, Telychian and Sheinwoodian age, in a paleo-shoreline setting. Carbon isotopic trends have been documented, alongside analysis of sedimentology, sequence stratigraphy and faunas (trilobites, conodonts and bryozoans). In addition, work continues on the Usk inlier succession (Monmouthshire), with the first carbon isotopic results expected soon, and sequence stratigraphic interpretations made. These projects aim to further refine regional stratigraphy.

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Valeri SACHANSKI (Bulgaria). I am working on Ordovician–Devonian stratigraphy of Bulgaria and Turkey and especially on Silurian–Lower Devonian graptolite biostratigraphy.

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Lawrence SHERWIN (Australia). I have nearly completed a draft on notanopliid brachiopods at or near the Siluro-Devonian boundary from the Ootha district in central New South Wales. This required tidying the figures and is expected to be submitted for publication by mid year. At the lower end of the Silurian I am completing a paper on an Ordovician-Silurian boundary graptolite fauna from near Forbes, also in central-west NSW.

The Orange office of the Geological Survey is being relocated during 2020 but the postal address should remain unchanged.

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Andrew SIMPSON (Australia). Work continues on Silurian conodont faunas from the Broken River in north Queensland and Boree Creek NSW Australia. 2019 was spent processing material collected from both regions in 2018 from detailed sampling through

recognised Silurian extinction events. Collaborative work with former Macquarie University colleagues, David Mathieson and John Talent continues.

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Andrej SPIRIDONOV (Lithuania). I am working on the development of new correlation techniques, and new methods for the study of spatial paleobiological patterns. Completing comprehensive study of high-resolution Pridoli section. We are now organizing the 5th International Meeting of Early-stage Researchers in Palaeontology Naujoji Akmenė (Lithuania) 18-21 May 2020 https://imerp2020.weebly.com/ [Circular could be downloaded from https://imerp2020.weebly.com/uploads/1/2/6/4/126469109/1st_circular_5thimerp.pdf]

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Colin SPROAT (Canada). I have resumed my research on the Early Palaeozoic epicontinental brachiopod faunas of North America, focusing initially on quantifying the evolution and palaeoecology of several key brachiopod lineages. I am also continuing my work, in collaboration with Renbin Zhan and Yuchen Zhang, documenting a shallow water brachiopod fauna in northwest China and using this fauna to better understand the palaeogeography of the plates that now comprise China.

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Petr ŠTORCH (Czech Republic). I continued working with several colleagues on various multi-proxy studies related to the search for Aeronian, Telychian and Homerian GSSP replacement candidate sections. Work on the Aeronian part of the El Pintado reservoir section (Seville Province Spain) continued in collaboration with J. C. Gutiérrez-Marco and D. K. Loydell. This section is the only candidate to be proposed for new base Telychian GSSP. A detailed study on early and early-middle Aeronian rastritid graptolites and their worldwide palaeobiogeographical distribution has been completed in collaboration with Zongyuan Sun, Junxuan Fan and M. J. Melchin along with our continued working on Aeronian GSSP replacement candidate section in Yuxian, Sichuan Province, China. Further progress was achieved in a joint study of black-shale dominated Sheinwoodian-Homerian succession exposed in Kosov Quarry which is carried out with Š. Manda, L. Slavík and Z. Tasáryová. A new three-year project of this team, focussed on biostratigraphy and faunal dynamics of the Silurian pelagic biota in the Prague Synform, starts in January 2020.

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Paul STROTHER (USA). We are now into the third year of a project at the University of Sheffield (Charles Wellman, PI) that is exploring the fossil record of the euglenids, beginning with the well-known Silurian acritarch, Moyeria. We have re-collected from the holotype locality near Illion New York and will be working on Moyeria and other freshwater algal microfossils associated with ponded habitats. Wilson Taylor (University of Wisconsin - Eau Claire) has shown through TEM of the wall ultrastructure that Moyeria is indeed a euglenid, confirming a proposal made by Gray & Boucot in 1989. (see the above paper in Palynology).

Last year I set up a website at "www.cryptospores.com" that continues to build a resource on cryptospores, including posting images of type material. It's a work in progress, but does currently include a basic set of images related to Silurian and older cryptospores.

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Susan TURNER (Australia). I am working on Silurian thelodonts and other microvertebrates such as early 'sharks' from sites in Australia, arctic Canada, China, Morocco, Pakistan, UK, USA (Pennsylvania, Wisconsin) in co-operation for some projects with colleagues Carole Burrow and John Talent (Australia) and Chris Barnes (Canada).

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Thijs VANDENBROUCKE (Belgium). I remain interested in reconstructing the Silurian palaeoclimate and palaeo-environment. Julie De Weirdt and Tim De Backer continue their PhD research projects with me at UGent. Julie focusses on geochemistry and palynology of the Upper Ordovician - lower Silurian in N. America while Tim uses similar methods in the upper Silurian and Devonian (these are projects in collaboration with Poul Emsbo, USGS, Patrick McLaughlin, Indiana Geol. Survey and André Desrochers, UOttawa). Julie's first paper on the chitinozoan biostratigraphy from the Rheidol Gorge in Wales is now published, and will be of interest to those amongst you involved in the ongoing discussions on the new Aeronian GSSP.

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Jacques VERNIERS (Belgium). I continued on an overview paper on the Belgian Silurian formations, with the unpublished parts of previous PhD studies from Jan Vanmeirhaeghe, Jan Mortier, and some Masters theses.

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Olev VINN (Estonia). I am working on the evolution of symbiosis, predation, bioerosion and encrustation in the Silurian. I am also working on the palaeontology of problematic calcareous tubeworms from the Palaeozoic (e.g. cornulitids, tentaculitids, microconchids etc.) and evolution of tubeworm biomineralization. My other research interests include trace fossils of the Silurian of Estonia and beyond.

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WANG Guangxu (China). In 2019, a global review of benthic faunas across the Ordovician and Silurian transition is in collaboration with Renbin Zhan (NIGPAS) and Ian Percival (Geological Survey of NSW) was published in *Earth-Science Reviews*. In this paper, we recognize three successive Transitional Benthic Faunas (TBFs 1–3) within the Hirnantian, which results in an integrated, higher-resolution timescale and hence a reinterpretation of the timing and evolutionary pattern of the end-Ordovician mass extinction. Compilation of the monograph on *Silurian Rocks and Index Fossils in China* (in Chinese) with Renbin Zhan and other colleagues at NIGPAS was completed and is now in press with *Zhejiang University Press*. Also, a paper on revised stratigraphy of the O-S boundary rocks in the Meitan area of South China has been submitted for publication

with *Geological Journal*. Ian Percival was hosted for a three-week visit to Nanjing in October, with one short field trip being made and two manuscripts finalised.

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WANG Xiaofeng (China). In 2019, I was mainly dealing with two research projects together with Svend Stouge, Jorg Maletz, Wang Chuanshang (graptolites)，Yan Chunbo (conodonts) and others. One is preparing with a new research project concerning regional classification and comparison standard of Silurian System in China. The focus is on investigating and studying several represented boundary sections bearing graptolites, chitinozoans or conodonts across series or stage, especially for the Mid-Llandovery to Pridoli interval in order to fill and improve the classification and correlative for the series and stage boundaries and further solve the problem of precise comparison of Silurian choronostratigraphic unit boundaries between different tectonic- palaeogeographical regions in China.

Another research is continue to complete the restudy of a high-resolution integrated bio-, sequence-, chemo- and magneto-stratigraphic research of the Xiaoyangqiao section, Dayangcha, Jilin, China and its precise comparison to the Green Point GSSP section, Newfoundland, Canada and another sections widespread in the world. Our study indicated that the current boundary horizon defined in the Green Point GSSP section is corresponding to the upper *C. intermedius* Zone, ca 1m below the first planktic graptolite *R. proparabola* levels, and 1.5 m below the base of *Cordylodus lindstromi* Zone in the Xiaoyangqiao section, along with the negative $\delta^{13}C_{carb}$-isotope and REE excursion identified near the boundary and easy to be recognized and correlated globally (Wang et al., 2019). Now the Xiaoyangqiao section has been approved as ASSP for the base of the Ordovician System by International Committee of Ordovician System.

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YUAN Wenwei (China). I completed a short paper on the proetid trilobites from the Silurian (Telychian) in Shaanxi, China, jointly with Zhou Zhiqiang, Zhou Zhiyi and Li Qijian. We argued that *Chuanqianoproetus* represented an independent genus belonging to Warburgellinae, and the paper is in press with Palaeoword.

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ZHAN Renbin (China). I was continuing my research on the EOME (end Ordovician mass extinction) and some Silurian brachiopods based on the material from China in 2019. Compiling the global data, we had found that the EOME was actually an abrupt bioevent with one acme rather than two episodes as formerly thought. The famous Edgewood fauna, i.e. the middle continent fauna (Rong and Harper, 1988), is a survival fauna developed along the equator and in those low latitude regions after the EOME during the latest

Ordovician and the earliest Silurian. Such an one-episode-hypothesis is still being challenged by some colleagues, and we are also investigating for more evidences not only in China but also around the world. Concerning the dynamics of the EOME, we had got some new achievements last year based on new material from South China using geochronological method. At an Ordovician-Silurian boundary section in northeastern Yunnan Province (western South China palaeoplate), we had got four reliable isotope ages among 23 layers of K-bentonites. Using these absolute ages and also taking into account the sedimentation rate at that section, we have obtained new dates for the base and the top boundaries of the Hirnantian Stage. Furthermore, for the first time, we have proposed that the EOME happened within 0.2 Ma and the O/S boundary is 442.67±0.24 Ma in age, 1.13 Ma younger than the age given in the International Chronostratigraphical Chart (2018 version) with a much higher accuration. So, the Silurian Period is now 1.13 Ma shorter than previously thought.

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ZHANG Junpeng (China). In 2019, I attended two international symposia, i.e. the 11th North American Paleontological Convention (NAPC 2019), and the AGU Fall Meeting 2019. Together with my colleagues, I also edited a special issue in the journal “Palaeogeography, Palaeoclimatology, Palaeoecology” with the theme "VSI28--Early Paleozoic O_2 & Life: Marine oxygenation, de-oxygenation and life during the early Paleozoic" (Guest Editors: Junpeng Zhang, Timothy Lyons, Charles Diamond, Cole Edwards, Yuandong Zhang).

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ZHANG Yuandong (China). In 2019, I am continuously working on: **(1)** Systematic palaeontology and biostratigraphy of the late Katian to Rhuddanian sponges and graptolites (Anji Biota) in Anji, Northwestern Zhejiang Province, SE China. This work has been financially supported by President’s International Fellowship Initiatives program (PIFI) and a granted by NSF of China (2018-2021). In the Anji area, a complete graptolite succession has been revealed based on a big collection of specimens obtained in the past years, including *Dicellograptus complexus*, *Paraorthograptus pacificus*, *Metabolograptus extraordinarius*, *Metabolograptus persculptus*, *Akidograptus ascensus*, and *Parakidograptus acuminatus* biozones. This succession has be ratified by the National

Committee on Stratigraphy of China as a reference standard for the Lower Yangtze Region. A highly diverse (over 100 species), deep-water sponge-dominated community of latest Hirnantian age has been recovered, shading lights on the survival dynamics in the aftermath of End-Ordovician mass extinction. This work is jointed carried out with Drs. Joseph Botting and Lucy Muir from UK. **(2)** Geological characteristics of typified black shale in China. This has been the main task of a project supported by the Chinese Academy of Sciences (2014-2018) and one of the recently launched National Science and Technology Major Projects (2017-2019). As scheduled by the projects, over 5000 m long of drill cores of the most potential gas shale in China have been accumulated in the past years for multi-disciplinary analysis. The cores are opened to global scientists for study and sampling, and from which some samples have been collected for geochemical and microfacies analysis. Those who are interested in this work or aim at some other related approaches, please contact the project leader (Zhang Yuandong).

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ZHAO Wenjin (China). Most of my research in 2019 was still related to the Siluro-Devonian vertebrate paleontology, and relative stratigraphy. The main achievements this year can be represented by the redescription of the Silurian galespid *Sinogaleaspis shankouensis*, based on 11 new specimens collected from the type locality of the Xikeng Formation in Xiushui County, Jiangxi Province, South China. In addition, I conducted lots of field works in Yunnan, Hunan and Guizhou provinces in South China during March to August in 2019, supported by the Special Grant for Fossil Excavation and Preparation of the Chinese Academy of Sciences, the National Natural Science Foundation of China and the Strategic Priority Research Program of Chinese Academy of Sciences. Lots of new important and interesting fossil fishes have been collected from Silurian and Lower Devonian during the excursions, and some new understandings on the Siluro-Devonian stratigraphic division and correlation in South China have been obtained.

As the vice-chair of the organizing committee of 15th International Symposium on Early/Lower Vertebrates (ISLEV 2019), I spent lots of time organizing the meeting, held in August this year at the Qujing Normal University in Yunnan Province. Over 100 fish researchers and Palaeozoic geologists from 19 countries attended the meeting and discussed some important and key questions in the vertebrate evolution, such as the rise of jawed vertebrates, the early evolution and diversification of jawed vertebrate, and the origin of tetrapod, etc.

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RECENT PUBLICATIONS ON THE SILURIAN RESEARCH

[Note that a few publications are of 2018 or even earlier that were not included in previous Silurian Times, and some papers are dealing with Ordovician topics by members of ISSS. There are also a few papers in the list that are in press or online publication.]

Antoshkina, A.I. 2019. A sharp facies shift in the middle Ludfordian as a reflection of the biosphere event in the Late Silurian. Exolite-2019. Facies Analysis in Lithology: Theory and Practice / Scientific Materials. Moscow: MAKS Press, pp. 17–19 (in Russian).

Antoshkina, A.I. 2019. Genetic and Biological Features of Upper Paleozoic Reef Ecosystems from the north-eastern European Platform. Proceedings Kazan Golovkinsky Stratigraphic Meeting, 2019 Sedimentary Earth Systems: Stratigraphy, Geochronology, Petroleum Resources (Kazan, Russian Federation, 24-28 September 2019). Bologna (Italy): Filodiritto Editore – Proceedings. pp. 9–16. doi: 10.26352/D924F5001

Antoshkina, A.I. and Shebolkin, D. 2019. Update on the Wenlock-Ludlow transition in the Timan-Northern Ural region. Abstract Book of the 3th IC on Stratigraphy “Strati-2019”, 2-5 July, Milano, Italy. 2019. P. 163.

Antoshkina, A.I., Shebolkin, D.N., Shmeleva, L.A. and Isaenko, S.I. 2019. Biochemical limestones and dolomites on a nanometer scale: significance for the geological record. *Bulletin of the Institute of Geology Komi Science Center, Ural Branch of the Russian Academy of Sciences*, 8, 3–13 (in Russian). doi: 10.19110/2221-1381-2019-8-3-13.

Antoshkina, A.I., Zhegallo, E.A. and Isaenko, S.I. 2019. Microbial organomineralization in carbonate ooids. Evolution of biosphere from ancient times to the present day. *Series "Geo-biological systems in the past."* M.: PIN RAS, 61–78 (in Russian).

Ausich, W.I., Wilson, M.A. and Tinn, O. 2019. Kalana Lagerstätte crinoids: Early Silurian (Llandovery) of central Estonia. *Journal of Paleontology*, 94(1), 131–144.

Ausich, W.I., Wilson, M.A. and Toom, U. 2019. Early Silurian recovery of Baltica crinoids following the end-Ordovician extinctions (Llandovery, Estonia). *Journal of Paleontology*, 1–10. https://doi.org/10.1017/jpa.2019.89

Baarli, B.G. 2019. Survival and recovery atrypid fauna following the terminal Ordovician extinction, the Atrypinae: central Oslo Region, Norway. *Historical Biology*, 1–38.

Bancroft, A.M. and Cramer, B.D. 2020. Silurian conodont biostratigraphy of the east-central Appalachian Basin: Re-examinationof the C.T. Helfrich Collection. *Bulletin of Geosciences*, 95(1).

Barnes, C.R. 2019. Impacts of climate-ocean-tectonic changes on Lower Paleozoic conodont evolution and ecologic organization evidenced by the Canadian part of Laurentia. *Palaeogeography, Palaeoclimatology, Palaeoecology* (Special Issue) (Ferretti, A., Bancroft, A. and Repetski, J., eds), 22 p., https://doi.org/10.1016/j.palaeo.2019.02.018

Bergström, S.M. and Goldman, D. 2019. $\delta^{13}C$ chemostratigraphy of the Ordovician-Silurian boundary interval. *In*: Sial, A.N., Gaucher, C., Ramkumar, M. and Ferreira, V.P. (eds), Chemostratigraphy across major chronological boundaries. *American Geophysical Union and John Wiley and Sons Geophysical Monograph*, 240, 145–158.

Boncheva, I., Sachanski, V., Andreeva, P. and Tanatsiev, S. 2019. Evidence for the presence of the global Late Devonian Kellwasser Event in the Berende section (Parchar Formation, Western Bulgaria). *Review of the Bulgarian Geological Society*, 80(3), 113–115.

Botting, J.P., Candela, Y., Carrió, V. and Crighton, W.R.B. 2019. A new hexactinellid sponge from the Silurian of the Pentland Hills (Scotland) with similarities to extant rossellids. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh* https://doi.org/10.1017/S1755691019000045

Bowman, C.N., Young, S.A., Kaljo, D., Eriksson, M.E., Them II, T.R., Hints, O., Martma, T. and Owens, J.D. 2019. Linking the progressive expansion of reducing conditions to a stepwise mass extinction event in the late Silurian oceans. *Geology,* 47, 968–972; https://doi.org/10.1130/G46571.1

Bremer, O., Turner, S., Märss, T. and Blom, H. 2019. Silurian vertebrate remains from the Oslo Region, Norway, and their implications for regional biostratigraphy. *Norwegian Journal of Geology*, 99(1), 1–27. https://dx.doi.org/10.17850/njg99-1-07

Brett, C.E., Aucoin, C.D., Dattilo, B.F., Freeman, R.L., Hartshorn, K., McLaughlin, P.I. and Schwalbach, C.E. 2020. Revised stratigraphy of the upper Katian (Cincinnatian) strata of the Cincinnati Arch reference area: Geological and paleontological implications. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 540, 1–33. (mainly Ordovician but with some discussion of Silurian boundary).

Brett, C.E., Pratt, B. R. and Landing, E. 2019. North American Commission on Stratigraphic Nomenclature Report 13 – Revision of Articles 25-27 of the North American Stratigraphic Code to Allow Formal Submembers. *Stratigraphy*, 15(6), 3 p.

Burrow, C.J., Turner, S., Trinajstic, K. and Young, G.C. 2019. Late Silurian vertebrate microfossils from the Carnarvon Basin, Western Australia. *Alcheringa*, 43(2), 204–219. doi:10.1080/03115518.2019.1566496

Cai, J.-C. and Zhao Wenjin. 2019. Facies analysis of Silurian fish-bearing beds in eastern Yunnan, China. *Ichthyolith Issues, Special Publication*, 14, 14–15.

Candela, Y. and Crighton, W.R.B. 2019. Synoptic revision of the Silurian fauna from the Pentland Hills, Scotland described by Lamont (1978). *Palaeontologia Electronica* https://doi.org/10.26879/868

Chen Xu, Chen Qing, Kyi Pyar Aung and Lucy Muir. 2020. Ordovician graptolites from the Mandalay Region, Myanmar. *Palaeoworld*, 29(2020), 47–65.

Chen Xu, Chen Qing, Zhen Yongyi, Wang Hongyan, Zhang Linna, Zhang Junpeng, Wang Wenhui and Xiao Zhaohui. 2018. Circumjacent distribution pattern of the Lungmachian graptolite black shale (early Silurian) on the Yichang Uplift and its peripheral region. *Sceince China Earth Sciences*, 61, 11951203.

Chen Xu, Chen Zhongyang, Mitchell, C.E., Chen Qing and Zhang Linna. 2019. A restudy of the Sandbian to Katian (Upper Ordovician) graptolites from the East Qilianshan (Chilianshan), Northwest China. *Journal of Paleontology*, 93(6), 1175–1209. https://doi.org/10.1017/jpa.2019.55

Chen Xu, Fan Junxuan, Wang Wenhui, Wang Hongyan, Nie Haikuan, Shi Xuewen, Wen Zhidong, Chen Dongyang and Li Wenjie. 2017. Stage – progressive distribution pattern of the Lungmachi black graptolitec shales from Guizhou to Chongqing, Central China. *Science China Earth Sciences*, 60(6), 1133–1146.

Chen Xu, Zhang Yuandong, Daniel Goldman, Bergström, S.M., Fan Junxuan, Wang Zhihao, Finney, S.C., Chen Aing and Ma Xuan. 2016. *Darriwilian to Katian (Ordovician) Graptolites from Northwest China*. 354 pp., plus 104 plates and figures. Hangzhou: Zhejiang University Press and Elsevier.

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