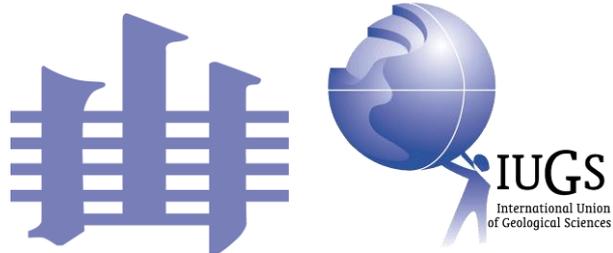


# ORDOVICIAN NEWS

**SUBCOMMISSION ON ORDOVICIAN STRATIGRAPHY  
INTERNATIONAL COMMISSION ON STRATIGRAPHY**

**Number 36 (for 2018)**

**Edited by Ian G. Percival**



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## **Cover photo**

Outcrop IV on the left bank of Stolbovaya River, a right tributary of Podkamennaya Tunguska River, Tungus basin, Siberian Platform. This section allows inspection of the upper part of the Siberian Upper Ordovician cool-water carbonate succession including topmost Baksian and the Dolborian regional stages (Katian). Dolborian K-bentonite layers can also be examined here. This outcrop will be visited during the post-conference excursion of the 13<sup>th</sup> International Symposium on the Ordovician System and IGCP 653 Annual Meeting in July 2019 to be held at Novosibirsk, Russia. Photo by Andrei Dronov in July 2017.

For further details of this meeting and the excursion, see pp. 19-26 of this newsletter.

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# ORDOVICIAN NEWS Number 36 (for 2018)

## Chairman's Message

Dear Colleagues,

This year we celebrate the 140<sup>th</sup> anniversary of the proposal of the Ordovician System. As we all know, it was introduced by Charles Lapworth in the article "On the tripartite classification of the lower Paleozoic rocks" which appears in the 1<sup>st</sup> (January) number of *Geological Magazine* for 1879. Charles Lapworth's compromise solution of the great Cambrian-Silurian conflict between Adam Sedgwick and Sir Roderick Murchison was not accepted immediately. Many people argued that Ordovician was only a formal, artificial construction which did not reflect a natural stratigraphic subdivision of the Palaeozoic rocks as the other Systems did. As time passed, however, it became obvious that Lapworth's Ordovician as a time interval between the first appearance of the planktonic graptolites and the Hirnantian extinction had meaningful stratigraphic boundaries and reflected a primary and objective subdivision of the geological and palaeontological record. In 1960 the Ordovician System was formally ratified during the 21<sup>st</sup> International Geological Congress on Copenhagen.

Due to intense provincialism of biotas and the wide range of facies differentiation in the Ordovician, many regional stratigraphic scales were elaborated for different countries, regions and palaeocontinents. Traditionally, the British Series were usually used as a basis for correlation of the regional units. Since 1989, however, international efforts have been directed towards establishing a reliable global chronostratigraphy for the Ordovician. As a result, three global Series and seven Stages were discussed and recommended by the Subcommission, ratified by the ICS and are now internationally accepted (Bergström et al., 2009). The new Ordovician timescale provides a truly global infrastructure to study all the local, regional and global events which constitute Ordovician history, so underpinning a better understanding of the origins of climatic, oceanographic, palaeogeographic and biotic changes. Today, detailed studies of the boundary intervals for global stages in different regions based on the Auxiliary Boundary Stratigraphic Section and Point (ASSP) concept are on the agenda. These studies and resulting proposals aim to increase precision of global correlation of the key Ordovician boundaries.

During 2018, thanks to the ongoing IGCP 653 project "The onset of the Great Ordovician Biodiversification Event", Ordovician workers had a highly successful Annual Meeting in June at Athens, Ohio (USA), organized by Alycia Stigall, followed in July by a special session during the 5<sup>th</sup> International Palaeontological Congress in Paris, organized by Thomas Servais. This year a special IGCP 653 session (combined with IGCP 669) is planned at UC Riverside (California) during the **11<sup>th</sup> North American Paleontological Convention** (<https://napc2019.ucr.edu>) from June 22-27. The main Ordovician event of 2019 will be the **13<sup>th</sup> International Symposium on the Ordovician System** combined with the **Annual Meeting of the IGCP 653 project** (<http://isos13.ipgg.sbras.ru>), which will take place in Novosibirsk (Russia) from June 19-22, together with associated field trips. Contributions to *A Global Synthesis of the Ordovician System* will be discussed during the Ordovician Symposium. I hope many of you will be able to participate in these important conferences.

With all good wishes,

Andrei Dronov

Chair, Subcommission on Ordovician Stratigraphy

\*\*\*\*\*



**International Commission on Stratigraphy  
Subcommission on Ordovician Stratigraphy**

**ANNUAL REPORT 2018**

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

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

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

Specific objectives are:

- a. To delimit and subdivide the Ordovician System (and Period) as a part of the overall ICS mission to elaborate the standard global stratigraphic scale. This work aims to establish the boundaries (GSSPs and ASSPs), the correlation of the subdivisions (Stages and Series), the nomenclature of the subdivisions and periodically review the effectiveness and utility of these decisions.
- b. To promote regular international meetings on all aspects of Ordovician geology, especially those devoted to clarifying stratigraphic procedures, nomenclature and methods for use in establishing a unified global time scale and to prepare correlation charts with explanatory notes (the main phase of this latter task is now completed).
- c. To encourage, promote, and support research on all aspects of Ordovician geology worldwide and to provide outlets, *Ordovician News*, international meetings, and a web page, for promoting discussions and reporting results of this research.
- d. To encourage, promote, and support interdisciplinary research on the Ordovician global Earth system, addressing topics that require high-resolution, global correlation.
- d. The ultimate goal of the Subcommittee is to provide a high-resolution geological time scale that will be a critical foundation for interdisciplinary research on the global Earth system during the Ordovician Period. The work is broad based and must include specialists in palaeontology, all subdisciplines of stratigraphy (bio-, litho-, chemo-, and magneto-), sedimentology, geochemistry, and tectonics. With a large network including active participants from more than 25 countries, the Subcommittee thus involves much of the global geological community.

### 3. ORGANISATION - interface with other international projects / groups

#### 3a. Nominated Officers for 2016-2020 period:

Chairman, Andrei Dronov (Russia)

Vice Chairman, Thomas Servais (France)

Secretary, Ian G. Percival (Australia)

15 other Voting Members

Over 100 Corresponding Members

The Subcommittee not only includes a broad national representation and coverage of key fossil groups but also specialists in interdisciplinary fields such as geochemistry, sequence stratigraphy and sedimentology.

The Subcommittee on Ordovician stratigraphy works in close cooperation with IGCP 653 project "The onset of the Great Ordovician Biodiversification Event". The Annual meeting of IGCP 653 was held in Athens, Ohio, USA during June 2018.

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

Nil

### 5. CHIEF ACCOMPLISHMENTS IN 2018 (including any relevant publications arising from ICS working groups)

- An article on the second Auxiliary Boundary Stratigraphic Section and Point (ASSP) for the base of the Ordovician System in the Dayangcha section (Northern China) have been

prepared and submitted for publication in *Palaeoworld* (Wang et al., in press). When it is published the proposal will be submitted for voting in the Subcommission.

- Ordovician News 35 was published and is available from the ISOS webpage (<http://ordovician.stratigraphy.org/>).
- ISOS supported Annual meeting of IGCP 653 in Athens, Ohio, USA during June 2018.

#### 6. SUMMARY OF EXPENDITURE IN 2018:

Support for travel to IGCP 653 meeting in Morocco USD 1667; support for travel to IGCP 653 meeting in Athens, Ohio USD 833.

#### 7. SUMMARY OF INCOME IN 2018:

NIL

#### 8. BUDGET FROM ICS IN 2018:

USD **2500**

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

- ISOS supported Annual meeting of IGCP 653 project will be held in Novosibirsk, Russia during July 2019
- An updated summary on Ordovician regional stratigraphy and geology: *A Global Synthesis of the Ordovician System* is planning to compile.
- Data will be gathered for *Ordovician News* 36.

#### 10. KEY OBJECTIVES AND WORK PLAN FOR THE PERIOD 2016-2020

For further advancement and increased precision in correlation we need to pay more attention to regional stratigraphy, regional scales and regional chronostratigraphic schemes.

There is a growing awareness that many biotic, chemical and physical changes are not always synchronous, and that there are strong local and regional signals that often depart from global compilations. Ordovician regional stratigraphy and geology will be the main goal for the period 2016-2020.

- To compile and publish an updated summary on Ordovician regional stratigraphy and geology: *A Global Synthesis of the Ordovician System*. Special attention is going to be paid to precise correlation of the Ordovician depositional sequences and sea level curves as well as stable isotope and regional biodiversity curves. Our target should be to compile the book by the time of the 13<sup>th</sup> International Symposium on the Ordovician System in Novosibirsk in July 2019.
- To correlate Ordovician depositional sequences throughout the World.
- To design and execute a Programme of radiogenic dating of key Ordovician horizons (using Pb-Pb isotopes).
- The Ordovician website will be updated including the development of a database for GSSPs and ASSPs.

## **11. Budget and ICS component requested for 2018-2019**

1. Meetings for contributors and editors of “*A Global Synthesis of the Ordovician System*”.  
2500 USD

2. Support for attendance and participation of Subcommittee officers at ISOS/IGCP meeting in Novosibirsk, Russia (July 2019): 2500 USD.

As in previous years it is envisaged that officers will supplement any aid from the ICS with their own research funds. We have not quantified this support.

TOTAL 2018-2019 BUDGET: 5000 USD

REQUESTED FROM ICS: **5000 USD**

Potential funding sources outside IUGS:

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

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## **Announcement**

### ***A Global Synthesis of the Ordovician System***

**David Harper, Andrei Dronov, Ian Percival and Thomas Servais (eds)**

It is now more than four decades since Alwyn Williams convened the Second International Symposium on the Ordovician System in Birmingham, followed two years later by the publication of *The Ordovician System* (Bassett, M.G. 1976). This 696 page volume contained regional synthesis of the Ordovician stratigraphy from almost every corner of the world, and for many years was a much-cited source of such information. Additional regional stratigraphic and biostratigraphic data were documented in a series of IUGS Publications featuring detailed correlation charts, which served as state-of-the-art guides to Ordovician stratigraphical hierarchy and correlation in many areas of the globe. However, this series (now ended), was unfortunately incomplete in its coverage. The past 20 years has seen arguably the most intense period of research into the Ordovician System (driven largely by a succession of highly successful IGCP projects involving global collaboration). Particularly important has been the rise of precise means of geochemical correlation using stable isotopes. Concurrently, international series and stages covering the entire Period have now been adopted and virtually all Ordovician researches are using this global chronostratigraphy in their studies.

The time is now optimal to not only update regional stratigraphic data covered by the earlier publications referred to, but also to place this new information in the context of the internationally accepted chronostratigraphic and biostratigraphic framework. It is critical for further advancement and increased precision in correlation that we align the many excellent, workable regional stratigraphic schemes with the global standard. The proposed

volume will focus on the Ordovician geology of the regions where data are captured and initially analysed, and will hopefully stand as the authoritative source of such information to a global audience for the next several decades, like its predecessors.

Each chapter will tie in any regional chronostratigraphic scheme and/or a typical lithostratigraphy with the global series and stages. There is a growing awareness that many biotic, chemical and physical changes are not always synchronous, and that there are strong local and regional signals that often depart from global compilations. In addition, therefore, any available stable isotope or other geochemical curves should be mapped onto the chronostratigraphy as should any regional biodiversity and sea-level curves. Our aim is to produce a series of comprehensive yet succinct summaries of each of the key regions of Ordovician geology, continuing to emphasize the great regional diversity of the Ordovician System but within a global framework. The highly successful IUGS correlation charts focused mainly on the lithostratigraphy of the regions. In the light of the huge amount of new excellent research on the biotas and changing climate and environmental conditions during the Ordovician Period it is now very timely and topical to review these new data and their significance and move to a better understanding of the Ordovician earth system.

The initial impetus for such a book was provided by an Ordovician Subcommittee-sponsored symposium held as part of the International Geological Congress held in Brisbane, Australia in 2012. Preliminary discussions have been held with editorial staff of the Geological Society of London, exploring the possibility of publication in one of their series. We envisage that each regionally-focused chapter will not exceed 20-25 printed pages. The main idea is that these chapters will serve as an introduction to the Ordovician geology of the regions with updated summaries on regional stratigraphy, tectonics, palaeogeography, facies etc, accompanied by a listing of the most recent and significant publications on relevant topics. We also plan to have several overview chapters reviewing current approaches and best practice in the main areas of correlation methods, such as biostratigraphy of significant groups, stable isotope correlation methods, sea-level curves etc., as well as a chapter on palaeogeographic reconstructions.

Already we have received offers to participate in this project, including draft outlines of regional chapters and special interest topics from colleagues in Australasia, China and Estonia. There remains considerable scope to be part of the volume, so other potential contributors are kindly asked to contact Andrei Dronov (avdronov@gmail.com) by June 15, 2019. Further discussions on the content will take place at the 13<sup>th</sup> International Symposium on the Ordovician System in Novosibirsk in July 2019. If you are unable to attend the ISOS it is especially important to contact Andrei to indicate your willingness to contribute to what will be a landmark volume on Ordovician stratigraphy and global correlation.

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## CONFERENCE REPORTS

### IGCP Project 653 Morocco Workshop & Field Excursion, February 2018

IGCP Project 653 (The Onset of the Great Ordovician Biodiversification Event) had an outstanding workshop and field excursion in the Marrakech and Zagora region of Morocco from February 12-16, 2018.

The workshop was an excellent introduction to Ordovician geology and paleontology with a particular focus on Moroccan deposits. Dr. Khadija El Hariri and her associates at Cadi Ayyad University, Faculty of Sciences and Technics did an excellent job organizing the workshop, which was attended by 25 international participants plus more than 20 local students. We all enjoyed examining and discussing Fezouata and other specimens, engaging in fruitful discussions during the coffee breaks, and the final musical ceremony. It was an honor to be joined by Mohommad “Ou Said” Ben Moula, the discoverer of the Fezouata Biota, as he received the Mary Anning Award from the Palaeontological Association.

A group of 28 international scientists followed the workshop with a field excursion to the Fezouata Formation that was expertly organized by Bertrand Lefebvre. We crossed the High Atlas Mountains via the Tizi n’Tichka Pass then descended to the Ternata Plain. En route to Zagora, we stopped for an overview of the stratigraphy and structural geology of the Jbel Kissing and the Draa Valley.

A highlight of the trip was examining the Fezouata Formation at You Izargane, where participants were able to examine the late Tremadocian (*A. murrayi* zone) portion of the Fezouata replete with trilobites, incredibly well preserved graptolites, and the lagerstatte bearing layers. In the afternoon, we visited Jbel Bou Zeroual (with directional assistance from a local camel shepherd on a motorbike) to examine the Floian section of the Fezouata Formation. Here we collected many trilobites, echinoderms, and other typical Ordovician shelly fauna.



Collecting fossils from the Fezouata Formation during the post-workshop excursion



Participants in the post-workshop field excursion on site at the Fezouata Formation

On the return drive to Marrekech, the group stopped to examine the spectacular Late Neoproterozoic stromatolites at Amane n'Tourhart.

The workshop and field excursion provided a tremendous opportunity to learn more about the transition from a Cambrian to Ordovician world and expand our understanding of the Great Ordovician Biodiversification Event. The ability to connect and collaborate with a diverse group of scientists from more than 10 nations, truly enhanced the scientific understanding and progress of the event.

(Conference report courtesy of Alycia Stigall)

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## **IGCP Project 653 Annual Meeting, Ohio University, June 2018**

The main Annual Meeting of the IGCP 653, titled “Trekking Across the GOBE (Great Ordovician Biodiversification Event): From the Cambrian through the Katian”, was a great success. The main meeting on the Ohio University campus at Athens, OH, brought together a group of 60 scientists from eight nations.

26 participants joined the pre-conference excursion to visit classic late Cambrian to Mid Ordovician strata of the Great Basin, and 28 scientists participated in the post-conference excursion to Late Ordovician strata of the Cincinnati Arch.

Daily updates were posted on the [IGCP 653 Facebook](#) account during the meeting and are summarized below. Many additional photos are posted on the Facebook page.

### **Pre-conference excursion (May 30-June 2)**

This outstanding four day field trip was led by Bob Gaines, Seth Finnegan, and Sara Pruss, who guided us through classic exposures of the House Range of Utah and Shingle Pass area of Nevada.

Day 1 of the field excursion provided an overview of Utah geology as we travelled from Salt Lake City to Delta which was our staging area for the next two days.

Day 2 focused on visiting classic Cambrian sections in the House Range. Fantastic fossils and stratigraphy! Thanks so much to Bob Gaines for leading us through his favorite rocks.

On Day 3 we worked our way from the Tremadoc to the Darriwilian in the Ibex Valley. We finished the day experiencing the contrast between Utah and Nevada culture, driving over the state border and through the scenic Basin and Range scenery to Ely.

On the final day of the excursion, we visited Sawmill Canyon and Shingle Pass in the Egan Range to see wonderful exposures of Cambrian and Ordovician strata before the long drive back to Salt Lake City for our flights to Columbus OH and the shuttle to Ohio University.



Bob Gaines, Seth Finnegan, and Sara Pruss, coleaders of the pre-conference excursion



Alycia Stigall, Ian Percival and Christian Rasmussen on site in the Ibex Valley

### **Indoor sessions in Athens, Ohio (June 3-6) + midconference excursion**

Day 1 featured talks and posters exploring various aspects of geochemical and biotic change with an emerging theme that the Darriwilian is a particularly exciting interval for coordinated Earth-life change.

Day 2 of the annual meeting focused on biostratigraphy and Cincinnati stratigraphy and paleontology—including some epic talks.



Part of the audience for the presentations held at Ohio University

The midconference field trip, ably led by Carl Brett, had something for everyone. Sequence stratigraphy, sedimentology, earthquakes, invasions, bourbon tasting, taphonomy, brachiopods, trilobites, echinoderms, bryozoa, and more brachiopods!



Group photo, IGCP 653 Annual Meeting 2019 mid-conference field excursion, Katian limestones, northern Kentucky

The final day of talks and posters at Ohio University included more discussion of paleontological patterns and chemostratigraphy. Following the end of the formal session a group visited the Geology Department and OHIO Museum Complex on optional tours. The conference concluded with a banquet at the Dairy Barn, a regional arts center, where participants dined surrounded by entries in an international quilt competition.

**Post-conference excursion (June 9-10)**

Carl Brett and his colleagues, Kyle Hartshorn, Allison Young, and Cameron Schwalbach led the participants through an impressive series of outcrops throughout northern Kentucky spanning the superbly exposed Katian stratigraphy and depositional environments from offshore to tidal. Much work had been put into compiling an excellent field guide, reflecting many years of work (and recent updates) undertaken in the region by Carl and his students. Day 1 of the excursion was a case study in a classic Carl Brett expedition. Many fossils, much stratigraphy, lots of localities, and final departure from the outcrop at 8:26pm. Day 2 of the excursion focused on primarily in the stratigraphy and paleontology of the Mohawkian succession in Kentucky. Although the afternoon heated up to 90 degrees F, it was a spectacular day, concluding with an excellent buffet meal.



Participants on the post-conference field excursion

Field trip leader, Carl Brett, in full flight

(conference report based on Alycia Stigall’s daily updates on the IGCP 653 webpage and Facebook)

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## Report on post congress field trip to Anticosti Island, August 18 to 23, 2018 (associated with International Sedimentological Congress, Quebec City)

### The stratigraphic record of the End Ordovician mass extinction, Anticosti Island, Eastern Canada

More than 900 earth science specialists participated in the International Sedimentological Congress, sponsored by the International Association of Sedimentologists, to discuss the latest advances in the broad field of sedimentology in Quebec City from August 13-17, 2018. Following the congress, 18 participants from all over the world visited the early Paleozoic sections superbly exposed on Anticosti Island in the Gulf of St-Lawrence. This field trip provided an introduction of the Upper Ordovician to Lower Silurian sedimentary geology of Anticosti Island, which consists of approximately 900 m of undeformed fossil-rich limestone and minor siliciclastic rocks that were deposited on a storm-dominated tropical carbonate ramp. Participants examined the multi-order, orbital-scale sedimentary cycles present in the Katian Vauréal Formation; the classic O/S boundary outcrops of the Upper Vauréal-Ellis Bay-Lower Becscie formations within a modern multi-proxy stratigraphic framework; the Late Hirnantian microbial-metazoan reef complexes and oncolites associated with a major far-field Hirnantian deglacial event; and the thick Llandovery carbonate succession of Anticosti Island including superb karsted hardground omission surfaces present in the Telychian Chicotte Formation. The 6-day field trip was a fantastic way to conclude a very successful congress for all participants.

André Desrochers (University of Ottawa, Canada)



Field trip participants about to leave the island after six days examining key sections of the Anticosti succession.



Lunch stop at Lousy Cove at the eastern end of Anticosti Island with Hirnantian Ellis Bay strata in the background.

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## Ordovician award



Juan Carlos Gutiérrez-Marco (Institute of Geosciences, Madrid), celebrates the gold medal awarded by the Peruvian Geological Survey and the Geological Society of Peru for his contributions to the Andean Ordovician geology of that country, after having been designated also as the first “Peruvianist” palaeontologist.

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## Conference Announcement

Join us at the 11<sup>th</sup> North American Paleontological Convention at UC Riverside, June 22-27. The NAPC meeting (website: <https://napc2019.ucr.edu>) will feature a Cambro-Ordovician symposium. The session description is:

**Session 13 (IGCP 653-668 combined symposium):** The end of the Cambrian “boom and bust” and the onset of the Great Ordovician Biodiversification Event (GOBE): Diversity patterns, paleoecology, and biogeography.

The Late Cambrian to Early Ordovician brought a transition between a “boom and bust” pattern of rapid short-term diversifications followed by dramatic collapses of diversity to the ‘Great Ordovician Biodiversification Event’ (GOBE), which established a more diverse, stable marine ecosystem. This series of diversifications completely modified marine food webs and, for the first time, established modern marine ecosystems. Timing of the Ordovician radiations varied among clades and paleocontinents and may have its roots in the Cambrian. The goal of this session is to bring together paleontologists with diverse background and expertise sets to present new research bearing on the initiating factors and timing of the GOBE, including the Cambrian events that led up to it, on a global and local scale.

Organizers: Alycia Stigall, Sara Pruss, Rebecca Freeman, Shelly Wernette

Contact: [stigall@ohio.edu](mailto:stigall@ohio.edu)

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**13<sup>th</sup> INTERNATIONAL SYMPOSIUM  
ON THE ORDOVICIAN SYSTEM  
International Geoscience Programme  
Project 653 – Annual Meeting  
Novosibirsk, Russia (July 19-22, 2019)**

**Note changed dates!**

**THIRD CIRCULAR**

We are delighted to announce that the **Thirteenth International Symposium on the Ordovician System** will be held from **July 19<sup>th</sup> to July 22<sup>th</sup>, 2019** in Novosibirsk (Russia). The 13<sup>th</sup> ISOS will be hosted at a most extraordinary district of Novosibirsk located about 30 km to the south of the city center on the shore of an artificial “Ob’ Sea”. Officially, it is called the Novosibirsk Scientific Center, but people call it simply Academy Town (Akademgorodok). Akademgorodok began its history in 1958 and now it is a world-renowned scientific center. At its core are buildings of Novosibirsk State University and scientific research institutes of the Siberian branch of Russian Academy of Sciences. Akademgorodok is an isolated district of Novosibirsk located in a natural forest in the outskirts of the city. Scientific sessions will be organized in the conference hall of the House of Scientists (“Dom Uchenykh”), the conference hall of the Trofimuk Institute of Petroleum Geology and Geophysics (Fig. 1) and the conference room of Novosibirsk State University as

required. Hotel, conference halls, cafes, restaurants, shore of the Ob' sea are all within a walking distance from any point of the Akademgorodok.



Fig.1. Main building of the Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of Russian Academy of Sciences

### **Significant and Important Dates:**

**December 2018:** Distribution of the Third Circular

**December 2018-February 2019:** Registrations for the Symposium

**15 April 2019: Deadline for submission of abstracts**

**late April or early May 2019:** Distribution of the Fourth Circular with final Program and Arrival Instructions

**Pre-Symposium field trip 1 (Ordovician of St. Petersburg): July 15-17, 2019**

**Pre-Symposium field trip 2 (Ordovician of the Altai Mountains): July 09-18, 2019**

**Scientific sessions, Novosibirsk: July 19-22, 2019**

**Mid-Symposium field trip (Ordovician of the Salair Range): ~~cancelled~~**

**Post-Symposium field trip (Ordovician of the Siberian Platform): July 22-30, 2019**

### **Organizing Committee:**

NIKOLAY V. SENNIKOV, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of Russian Academy of Sciences, Novosibirsk (**Chair**)

ANDREI V. DRONOV, Geological Institute of Russian Academy of Sciences, Moscow. (**Co-Chair**)

ALEXANDR V. KANYGIN, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of Russian Academy of Sciences, Novosibirsk (**Co-Chair**)

OLGA T. OBUT, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of Russian Academy of Sciences, Novosibirsk (**Secretary**)

TATIANA Yu. TOLMACHEVA, All-Russian Research Geological Institute (VSEGEI), St. Petersburg

SERGEI V. ROZHNOV, Boryssiak Paleontological Institute of Russian Academy of Sciences, Moscow

ALEXANDR V. TIMOKHIN, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of Russian Academy of Sciences, Novosibirsk

TARAS V. GONTA, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of Russian Academy of Sciences, Novosibirsk

VERONIKA B. KUSHLINA, Boryssiak Paleontological Institute of Russian Academy of sciences, Moscow

ELENA G. RAEVSKAYA, FGUNPP “Geologorazvedka”, St. Petersburg.

DMITRY A. TOKAREV, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of Russian Academy of Sciences, Novosibirsk

### **Supporting organizations, University & Institutions:**

- International Subcommittee on Ordovician Stratigraphy (ICS-IUGS)
- Interdepartmental Stratigraphic Committee of Russia
- Russian Academy of Sciences
- Russian Foundation for Basic Research
- Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of Russian Academy of Sciences, Novosibirsk
- Novosibirsk State University (NSU), Novosibirsk
- Geology and Geophysics Department of the NSU, Novosibirsk
- Geological Institute of Russian Academy of Sciences, Moscow
- Boryssiak Paleontological Institute of Russian Academy of Sciences, Moscow
- Russian Research Geological Institute (VSEGEI), St. Petersburg

### **Sponsorship:**

- Russian Academy of Sciences (RAS)
- Russian Foundation for Basic Research
- Novosibirsk State University

### **Accommodation:**

Accommodation for all participants will be organized in a hotel “Zolotaya Dolina” (Golden Valley) in walking distance (10 min) from the House of Scientists (“Dom Uchenykh”) and the main building of the Trofimuk Institute of Petroleum Geology and Geophysics where scientific sessions are to be held.

- Deluxe – 130-100 Euro
- Single room – 35-40 Euro
- Shared room – 30-35 Euro
- Meals in Akademgorodok – 30-50 Euro per day
- For student rooms at the Novosibirsk State University hostel – single room 15 Euro (breakfast is not included)

Please note that costs for accommodation, excursions etc. are estimates only. They could change in the next months with inflation and the general economic and political situation.

### **Travel:**

Buses departing every half an hour (100 min, 2 Euro) provide travel from Tolmachevo Airport (Tolmachevo-Novosibirsk city-Akademgorodok). Direct taxi from the Airport (50km) is the fastest way (45 min, about 30 Euro). A special minibus will also be organized from the Institute to meet participants of the Symposium arriving at Tolmachevo Airport. The Organizing Committee strongly advises all participants to provide information about their travel schedules in order to organize pick up in the airport.

### **Visa Information:**

Please note that to obtain a Russian visa, participants will need to receive a special Invitation letter that will be prepared and posted by the Organizing committee. Usually this takes about one month. Originals of the Invitation Letters will be sent by air-mail. The information requested is in the Registration form and should be sent to *Secretary* O.T. Obut.

### **Medical Care:**

The participants should have health insurance for the journey. All foreign participants are required to bring with them health insurance contracts, for the time of the trip, from the insurance company that provides an international insurance policy program. This information can be obtained from your travel agency. You should bring with you any necessary medicine.

### **Scientific sessions:**

#### **19-22 July, 2019**

*July 19* – Morning session: opening ceremony, invited speakers.

Afternoon session: scientific talks.

Evening: *Ice-breaking party*.

*July 20* – Morning session: scientific talks.

Afternoon session: scientific talks.

Ordovician Subcommittee business meeting.

*July 21* – Morning session: scientific talks, IGCP 653 business meeting.

Afternoon session: scientific talks, special session for IGCP 652.

Evening: *Conference Dinner*.

*July 22* – Morning session: scientific talks.

Afternoon session: scientific talks.

Closing ceremony.

### **Field Excursions:**

Selection of Novosibirsk for the Symposium provides a good opportunity to learn more about the Ordovician geology of both the Siberian Platform and Altai Mountains. We also added to the program a pre-Symposium excursion to the St. Petersburg region. Therefore, participants who attend both the pre-Symposium and post-Symposium excursions on the platforms (Russian and Siberian respectively) will have a chance to compare the sea-level story, long-term lithological changes and faunal differences in the two Ordovician palaeocontinents.

#### ***Pre-Symposium field trip 1.* July 15-17, 2019 (3 days). Ordovician of St. Petersburg region.** Co-leaders: T.Yu. Tolmacheva and A.V. Dronov.

Excursion starts and ends in St. Petersburg. Participants will have an opportunity to examine classical Ordovician sections connected with the names of R. Murchison, Ch. Pander, A. Volborth and many other famous scientists. We will study Cambrian and basal Ordovician (Tremadoc) siliciclastics including traces of permafrost on the Middle/Upper Cambrian boundary. The cool-water carbonate succession (Floian –Lower Sandbian) and warm-water carbonates (Upper Sandbian –Katian) including supratidal sabkha dolomites, unusual for the other parts of the Ordovician basin of Baltoscandia, will be demonstrated and discussed. Ordovician limestones of St. Petersburg region are extremely fossiliferous. Rich fauna include trilobites, brachiopods, cephalopods, gastropods, bryozoans etc. Discussions at most stops will include summary findings from conodont, trilobite, brachiopod and graptolite

biostratigraphic investigations as well as palaeoclimatic, sequence stratigraphic, facial and palaeobathimetric interpretations. Special attention will be made to trace fossils distribution and their potential for regional high-resolution correlation. Unique cool-water Middle Ordovician reefs (Hecker-type mud mounds) will be demonstrated and studied in detail. The first and second days will be devoted to the Cambrian, Lower and Middle Ordovician of the eastern part of the St. Petersburg Region. The localities to be visited during the first day include Tosna River and Sablinka River canyons, Sablino caves, “Pander’s anticline” (Popovka River canyon), Putilovo quarry and Lava River canyon. The first night participants will spend in the town of Volkhov on the Volkhov River in the eastern part of St. Petersburg Region. The localities to be visited in the second day include Volkhov River valley, Babino quarry (Fig. 2), Lynna and Says River valleys (Fig. 3). Tourist stops during the excursion include Fortress in Old Ladoga (the first capital of Russia) and Viking burial mounds on the banks of Volkhov River. At the end of the day participants return to St. Petersburg and spend a night there. The third day will be devoted to the Lower, Middle and Upper Ordovician of the western part of St. Petersburg region. Localities to be visited include Kaskovo quarry, Elizavetiono quarry, Alekseevka quarry, Suma river canyon and Pechurki quarry. We return to St. Petersburg the evening of July 17, and on July 18<sup>th</sup> participants will fly to Novosibirsk. For the flight St. Petersburg –Novosibirsk participants need to make their own arrangements. Field trip fee covers guidebook, transportation all meals and accommodation in hotels during the excursion. Registration is 300 Euro for a minimum of 8 and maximum of 40 participants. In July, the day temperature in St. Petersburg region is usually between +17°C and +27°C. Occasionally there could be rain.

Fig.2 (left). Fresh exposure of Dikari Limestone (Lower Dapingian) in Babino quarry

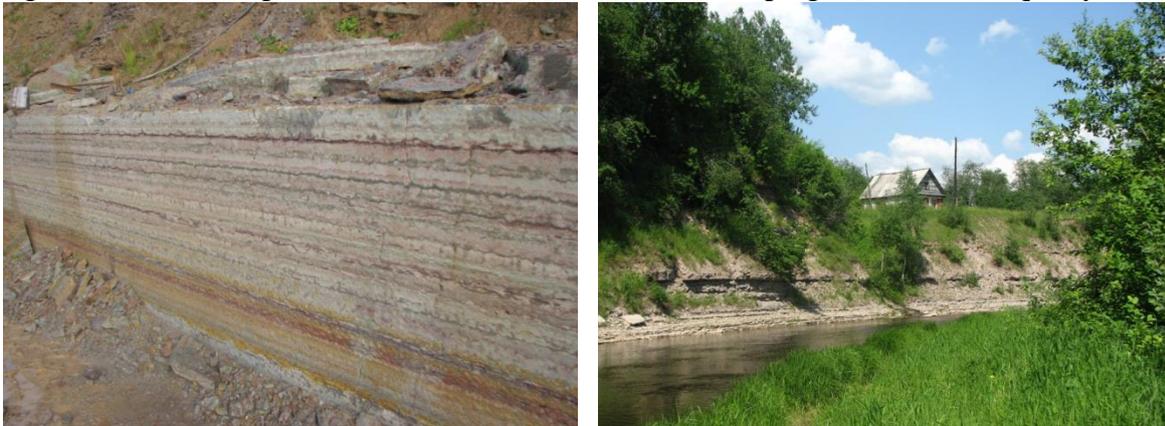


Fig.3. Middle Ordovician (Upper Dapingian-Lower Darriwilian) outcrop on Lynna River

***Pre-Symposium field trip 2.*** July 09-18, 2019 (10 days). **Ordovician of the Altai Mountains.** Co-leaders: N.V. Sennikov, O.T. Obut and E.V. Lykova.

The field trip is planned to demonstrate the most important Ordovician localities of the Gorny Altai Mountains (Fig. 4 & frontispiece of this Circular). Excursion starts and ends in Novosibirsk (Akademgorodok). The first and last days are mainly driving. Distance from Novosibirsk to the first field camp (tourist camping) in North-East Altai is about 500 km. Transportation in the field will be by bus, 4WD tracks and jeeps. The Altai is usually called the Siberian Switzerland for its beauty but it is not high mountains. Altitude on the route of the excursion varies between 500 m and 1500 m above sea level. Mountains are covered by taiga forest and mountain meadows. Exposures are mainly along the river banks, road cuts, on mountain slopes and in active quarries. Participants of the excursion will have an

opportunity to examine all the Ordovician succession of the Gorny Altai Mountains represented in different shallow to deep-water facies including: 1) delta front; 2) inner shelf (ramp); 3) inner slope of the carbonate platform; 4) central part and outer slope of the carbonate platform; 5) deep-water shelf; 6) continental slope; 7) open ocean deposits and sea mounts. Fossils are represented by graptolites, conodonts, chitinozoans, radiolarians, trilobites, ostracods, brachiopods, gastropods, crinoids, scolecodonts, tabulate and rugose corals, bryozoans and algae.



Fig.4. Upper Ordovician reef limestones, Gorny Altai.

Tourist sites on the route include:

- 1) Boat trip along Teletskoe Lake, which is known as “Altaian Baikal”.
- 2) Denisova Cave which represents one of the most ancient dwelling places of humans in Siberia (more than 200 000 years B.C.).
- 3) Scythian burial mounds (IV-II centuries B.C.).
- 4) Kolyvan’ stone factory founded in 1802 which is famous for its giant jasper vases now stored in Paris and St. Petersburg (Hermitage).

Typical temperatures for July in Gorny Altai are about +20-25°C, rarely +30°C during the day and +5-15°C at night. Occasional rain is possible. Heavy dew is typical in the mornings. It is planned to stay in four field camps (tourist camps) during the excursion with distances between camps of about 250-400 km. Participants are advised to bring field boots, warm sweaters, raincoats, umbrellas as well as caps and swimming suits. Tents, sleeping bags and other camp facilities will be provided by the organizers.

Field trip fee (900 Euro) covers guidebook, all meals, accommodation in field camps, and transportation during the excursion. This field trip is restricted to a minimum of 8 and a maximum of 25 participants.

***Post-Symposium field trip.*** July 22-30, 2019 (8 days). **Ordovician of the Siberian Platform: Podkamennaya Tunguska and Stolbovaya Rivers.** Co-leaders: A.V. Dronov, A.V. Timokhin and T.V. Gonta.

Excursion starts in Novosibirsk and ends in Krasnoyarsk. Late in the evening of July 22 we will take a night train Novosibirsk – Krasnoyarsk (800 km). On July 23, we will fly from Krasnoyarsk to the town of Bor (600 km) on the Yenisei River opposite the mouth of the Podkamennaya Tunguska River. The same day the flight by helicopter from Bor to the field camp (120 km) on the Stolbovaya River, tributary of Podkamennaya Tunguska will be organized. For transportation between the outcrops during the excursion, rubber boats and

motorboats will be used. Accommodations are in a field camps (Fig. 5). Motorboats will arrange the way back to Bor downstream to Podkamennaya Tunguska at the end of the excursion (July 30). Organizers will provide the flight from Bor back to Krasnoyarsk (July 30) but for the hotel in Krasnoyarsk participants need to make their own arrangements. Participants of the excursion will have an opportunity to visit important Ordovician localities of the Tungus Basin on the banks of Podkamennaya Tunguska and Stolbovaya Rivers. They will see the Lower Darriwilian tropical carbonates with stromatolite buildups and oolitic grainstone that represent the uppermost part of the “Great Siberian Carbonate Bank” an analogue of the Great American Carbonate Bank. The Upper Darriwilian shallow water quartz sandstones of the Baykit formation with *Skolithos*, *Kouphihniium* and giant Siberian *Rusophycus* trace fossils will be examined in several outcrops. The Lower Sandbian phosphate conglomerates of Ust’Stolbovaya formation overlying Baykit sandstone and marking the beginning of the Upper Ordovician transgression associated with upwelling of the cool-water oceanic waters into the epicontinental Tungus Basin, as well as the cool-water carbonate series (Sandbian –Katian), will be also examined in several localities. The Upper Ordovician K-bentonite layers within the cool-water tempestites of Mangazea and Dolbor formations will be traced and studied at several localities along the Podkamennaya Tunguska and Stolbovaya Rivers (Fig. 6). These deposits are also rich in body fossils, which include trilobites, brachiopods, bryozoans, crinoids, ostracods, corals and gastropods etc, as well as trace fossils including *Rhizocorallium*, *Halopoa*, and *Balanoglossites* etc. At some of the outcrops, contact with the Lower Silurian deposits will be seen. Discussions at most stops will include summary on biostratigraphic investigations as well as palaeoclimatic, facial and palaeobathymetric interpretations. Sea-level changes and sequence stratigraphy will be discussed as well.



Fig.5 (left). Field camp. Tributary of Podkamennaya Tunguska River

Fig.6 (right). Upper Ordovician cool-water carbonates with K-bentonite beds. Stolbovaya River – see also cover photograph of this issue of *Ordovician News*

In July, the day temperature in this part of Siberia is usually between +17°C and +25°C. Occasionally could be rain. Participants are advised to bring field boots, warm sweaters, raincoats, umbrellas as well as caps and swimming suits. The tents, sleeping bags and other camp facilities including repellents against mosquitos will be provided by the organizers. Field trip fee (1300 Euro) covers guidebook, all meals, accommodation in field camps and transportation during the excursion. This field trip is restricted to a minimum of 10 and maximum of 20 participants.

## **Social and Cultural Highlights:**

For accompanying persons during the Symposium a boat trip on the Ob' River could be recommended. The other tourist attractions are listed in the outlines of the field trips.

## **Publication:**

A Proceedings volume of the Symposium and additional materials on the Ordovician Geology of Russia will be published in a monographic series of the Trofimuk Institute of Petroleum Geology and Geophysics, Russian Academy of Sciences. After the meeting, all the materials will be freely accessible through the web page.

## **Costing:**

**Registration fee** covers costs of publication, conference bag, coffee breaks, symposium excursion (full accommodation and meals) and social activities.

- General participants: **350 Euro**
- Student participants: **200 Euro**

**Conference Dinner:** 50 Euro

**Pre-Symposium field trip 1.** Ordovician of St. Petersburg region (3 days); **300 Euro** (covers field guide, transportation, all meals and accommodation).

**Pre-Symposium field trip 2.** Ordovician of Gorny Altai (10 days); **900 Euro** (covers field guide, transportation, all meals and 9 nights' accommodation).

**Post-Symposium field trip.** Ordovician of the Siberian Platform: Podkamennaya Tunguska and Stolbovaya Rivers (8 days); **1300 Euro** (covers field guide, transportation, all meals and accommodation except for the hotel in Krasnoyarsk at end of the excursion).

## **Contacts:**

Olga Obut, Secretary of the 13<sup>th</sup> ISOS

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**For all current news about the 13<sup>th</sup> ISOS and pre- and post-symposium field trips, please refer to the symposium webpage**

<http://isos13.ipgg.sbras.ru/en>

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## IN MEMORIUM



**Maya M. Oradovskaya (1933 - 2019)**

It is with deep regret we report that Dr Maya M. Oradovskaya passed away on January 5<sup>th</sup>, 2019 at the age of 86. She was one of the best specialists on Ordovician and Silurian brachiopods and stratigraphy of the Russian North-East, a former employee of the North-Eastern Scientific Center of the Far Eastern branch of Russian Academy of Sciences in Magadan, a member of the Ordovician and Silurian commissions of the Interdepartmental Stratigraphic Committee of Russia.

She started her career with study of Mesozoic, mainly Jurassic sediments under the leadership of I. I. Tuchkov – well known Russian researcher of the Jurassic and Triassic of the North-East. Her first field works were carried out at the foothills the Verkhoysk Range. However since 1957 she shifted her interest to the Ordovician of the Kolyma Region. During a numerous field seasons, spent in these remote area she studied in detail many Ordovician sections including the most famous section of the Mirny Creek, which was previously found by A. A. Nikolayev. Her detailed and comprehensive works on the Ordovician-Silurian boundary as well as the lower boundary of the Hirnantian Stage in this section are of particular interest.

During the XIV Pacific Scientific Congress in Khabarovsk in August-September 1979 Maya Oradovskaya together with Rimma Sobolevskaya were among the main organizers of International geological excursion to Mirny Creek section. Later this section has been proposed as a one of GSSP candidates for the base of the Global Hirnantian Stage. Maya Oradovskaya studied also the Ordovician sections of Chukchi Peninsula in the most extreme North-Eastern point of the Eurasian continent. She published several monographs on the Ordovician stratigraphy and facies of the Russian North-East territory.

After her retirement she lived in St. Petersburg where she continued consulting geologists on different aspects of Ordovician stratigraphy of the Russian North-East. In 2002 Maya Oradovskaya participated in the 3<sup>rd</sup> Interdepartmental Regional Stratigraphic Conference on Precambrian, Paleozoic and Mesozoic of the North-East of Russia in VSEGEI (St. Petersburg).

In her work, Maya Oradovskaya showed herself as a high rank professional and she demanded the same quality from the people around her. She has a strong character but at the same time she remained a loving and careful mother, a friendly and sympathetic person. The memory of Maya Oradovskaya will remain in the hearts of her colleagues and friends forever.

I.V. Polubotko, V.I. Shpikerman, T.Yu. Tolmacheva, A.V. Dronov

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## RESEARCH REPORTS

**Datu ADIATMA (USA)** has just finished a master's program with Matt Saltzman at Ohio State University and now is commencing a PhD there. My master's project focused on chemostratigraphy of the Sandbian stage. I utilized high resolution carbon isotopes and strontium isotopes stratigraphy to document and constrain a baseline shift in carbon isotopes that took place in the Sandbian, which may be related to the evolution of early land plants at this time. I have not decided a specific theme for my PhD project, but will continue working on chemostratigraphy of Ordovician sequences.

### **Y. Datu Adiatma**

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**Guillermo ALBANESI (Argentina)** is working on conodonts from the lower Paleozoic of South America, including diverse interests as indicated. A number of projects from the Precordillera, Eastern Cordillera, Famatina, Sierras Subandinas, and Puna of northwestern Argentina are being carried out with G. Ortega, several former PhD students, and colleagues from Argentina and other countries. In association with graduate students M. Mango & G. Della Costa, working under my direction by means of CONICET scholarships, investigations are continuing on conodont biostratigraphy, paleoenvironments and evolution from carbonate and siliciclastic sequences of the Argentine Ordovician System.

I am Professor of Paleontology and the director of the "Centro de Investigaciones Geológicas Aplicadas" (CIGEA, <http://www.efn.uncor.edu/investigacion/CIGEA>) at the Facultad de Ciencias Exactas, Físicas y Naturales (FCEFyN), Universidad Nacional de Córdoba (UNC), which includes a micropaleontology laboratory especially equipped for conodont preparation. My current place of work as CONICET researcher is at the CICTERRA (CONICET-UNC, <http://cicterra.conicet.unc.edu.ar/es/>) in the university campus, and I maintain a repository space for the conodont collections at the Museo de Paleontología (FCEFyN, UNC).

### **Dr. Guillermo L. Albanesi**

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**J. Javier ÁLVARO (Spain)** has co-edited an issue of the *Journal of Iberian Geology* containing 7 papers presented to the international meeting "Ordovician Geodynamics: the Sardinian Phase in the Pyrenees, Mouthoumet and Montagne Noire massifs", which took place in Figueres (Spain), in September, 2017.

**J. Javier Álvaro**

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**Anna ANTOSHKINA (Russia)** is actively working on Upper Ordovician and Silurian bioevents and palaeogeography. I am also interested in sequence stratigraphy and evolution of sedimentary basins. The project — ‘Ordovician–Silurian boundary and Hirnantian strata exposed on the Northern and Subpolar Urals’ together with my young colleague Lyubov’ Shmeleva has concluded with a paper published in *Litosfera*. Results were also published of a complex study on the significance and nature of ooids and concretions in some Ordovician, Silurian, and Lower Carboniferous deposits of the Northern, Subpolar Urals and Chernyshev Swell that has revealed a distinct signal of microbial activity.

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**Chris BARNES (Canada)** continues his conodont paleontology/stratigraphy/isotope geochemistry research. The main projects being: a) Ordovician paleotemperature record for tracking the Argentine Precordillera across Iapetus Ocean determined from SHRIMP oxygen isotope measurements from conodonts (with Guillermo Albanesi (CONICET, Cordoba), Julie Trotter (UWA), Ian Williams (ANU), and Stig Bergström (OSU)); analysis of the effects of climate, eustasy and tectonics on conodont evolution and ecology during the early Paleozoic from the major database developed from a half-century of sampling throughout Canadian part of Laurentia; c) Global Ordovician Biodiversification Event (GOBE), with emphasis on Laurentian conodont and isotopic data; d) Ordovician and Silurian conodont biostratigraphy, bioevents, eustasy and thermal maturation.

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**Matilde Sylvia BERESI (Argentina)** is continuing work on Ordovician algae and sponges and also cancelloriid and sponge faunas from the Cambrian of the Argentine Precordillera and Mexico. This collaborative project is underway with J.J. Palafox, F. Cuen and B. Buitrón Sánchez, colleagues from the Universidad de Sonora –México- and Universidad Autónoma de

México. Recently we have published an article on a new chancelloriid fauna of Central Sonora. Jéssica Gómez (PhD student) is working on the conglomerates and oolite levels post-Hirnantian glaciation of the San Juan Precordillera. Tatiana Soria finished a doctoral thesis on the carbonate microfacies and biostratigraphy of conodonts of the San Juan Formation/Gualcamayo boundary in the northern extreme (along the river Gualcamayo) of the San Juan Precordillera.

**Dr. Matilde Sylvia Beresi**

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**Stig M. BERGSTROM (USA).** During 2018 I have continued my studies on mainly Ordovician chemostratigraphy, and on conodont and graptolite biostratigraphy, in Baltoscandia, North America, Great Britain, China and Argentina. Unfortunately, due to major illnesses in Spring and early Summer, my scientific activities became restricted during part of 2018 but I now feel recovered, as shown by the fact that I conducted fieldwork in the mountains of the Precordillera of NW Argentina during late November-early December. In terms of publications, 2018 was a good year with seven articles and four conference abstracts published. Several other articles are in press or submitted. I enjoyed meeting several Ordovician workers during the 2018 Annual Meeting of the Geological Society of America in Indianapolis this Fall.

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**Carlton E. BRETT (USA)** continued during 2018 to work on several projects related to Ordovician stratigraphy and paleoecology with present and former students. We continued research on high-resolution stratigraphy, depositional cycles and paleoenvironments of the Upper Ordovician in the Cincinnati region and elsewhere. Major research projects continued in two major areas as discussed below.

**Late Ordovician Cincinnati Stratigraphy and Paleoecology: Ohio-Indiana-Kentucky**

During 2018 I began a synthesis of research on the Ordovician of Ohio, Kentucky and Indiana. For the Annual Field Meeting of IGCP 653: The Great Ordovician Biodiversification Event, Kyle Hartshorn (an independent geological researcher), graduate students Allison Young, Cameron Schwalbach and I produced a 160 page guidebook that documents a decade of study on the sequence stratigraphy, correlation and paleoecology of the Katian (Mohawkian and Cincinnati) on the eastern and southern flank of the Cincinnati Arch (Brett et al., 2018a). We ran three days of field trips (mid- and post-meeting) to showcase these spectacularly exposed rocks and fossils around the Cincinnati Arch, from Maysville,

Kentucky through Lexington and Frankfort, returning north along US 127 at Swallowfield and Owenton, Kentucky.

Subsequently, in cooperation with Kyle and Chris Waid of the Ohio Geological Survey, I produced a 60-page document as a Geological Society of America guidebook, on the revised Ordovician-Silurian-Devonian stratigraphy of the western side of the Cincinnati Arch (Brett et al., 2018b). This article, likewise, documents some of our more recent studies on spectacular new roadcuts south of Louisville. On the basis of these syntheses we are now moving ahead with a pair of papers that completely revise the long-standing sequence stratigraphy of Holland and Patzkowsky. We are also working toward a new volume through the Cincinnati Museum Center: *Stratigraphic Renaissance of the Cincinnati Arch, Part 2*. Kyle Hartshorn, Pat McLaughlin (Indiana Geological Survey), Ben Dattilo (Indiana Purdue University, Fort Wayne), Christopher Aucoin (PhD candidate) and I are collaborating on sequence and event stratigraphy of the highest part of the Upper Ordovician Richmond Group. Finally, new field work was focused on the highest portions of the Cincinnati successions in the so-called Whitewater and Elkhorn formations. New sections in Ohio and Indiana were examined and correlated in high resolution. There is still at least another year's work to finally shore these up and to use C-isotope analysis to test our sequence based correlations.

In addition, with new MS student Cole Farnam, I am studying the highest possibly Ordovician strata (formerly assigned to Silurian). Some preliminary studies suggest that these may be a record of the very late, post-glacial part of the Hirnantian Stage. In December, we obtained samples for carbon isotopic analysis in Ohio as well as one from probably correlative strata in Ontario, Canada. This study, to be completed in 2019, should further test the age of this succession.

### **Late Sandbian-Katian Sequences across a platform to basin transect**

PhD student Allison Young and I are continuing to work on correlation of the upper Sandbian-lower Katian (Chatfieldian-Edenian in North American terminology) Lexington Limestone and Kope Formation of the shallow water Lexington Platform and its transition into dark, shale-rich facies of the "Point Pleasant" and "Utica" formations in the deeper water Sebree Trough north of Cincinnati. Newly studied drill cores from Ohio and Indiana are providing new data on submarine erosion and infilling that will have strong implications for the tectonic origin of this topographic feature.

We are also extending our detailed correlations of the Lexington and Point Pleasant formations southward into both eastern Tennessee and the Nashville Dome, using a combination of gamma ray, chemo-, C-isotope and sequence stratigraphy. In 2018, we completed detailed documentation of new roadcuts near Tazewell, Tennessee and sampled these at 50 cm spacing for carbon isotopic analysis.

### **Upper Ordovician Katian of southern Ontario**

Research on the Upper Ordovician of southern Ontario was largely concluded in 2018, with the acceptance of a paper in *Canadian Journal of Earth Sciences* with former student Tim Paton that presents the first high resolution isotope curve, completely revises the stratigraphy of the Bobcaygeon Formation (lower Trenton) of Ontario, and newly correlates it with successions in the Cincinnati Arch (Paton and Brett, in press).

### **Comparative Stratinomy and Paleoecology of Upper Ordovician Hardgrounds**

Tim Paton and I made comparative studies of spectacular hardgrounds (cemented sea floors) spectacularly encrusted by intact fossil communities from the Ordovician in Ontario, Kentucky, and Tennessee. New research during 2018 involved study of petrography and

cathodoluminescence that indicates the presence of very similar equant, primary marine cements in all cases. This rules out subaerial exposure or substantial diagenetic alteration. We also present a model for the development of formation of progressively modified hardgrounds and for the development of a “sweet spot” for hardground peak hardground development in the Late Ordovician. A manuscript on this topic was recently submitted to *Palaeo-3*; a third manuscript is in preparation to document the spectacular hardground attached faunas.

### **Stratigraphic Nomenclature**

As Chair of the North American Commission on Stratigraphic Nomenclature (NACSN) I worked on developing the category of submembers as a formal subdivision to give a broader hierarchy of stratigraphic units: (Formation-Member-Submember-Beds-Bed). I further illustrated the use of these ranks in discussing stratigraphy of the Tristates area as a Geological Society of America post-meeting field trip, which was a cooperative effort sponsored by the NACSN, the Ohio Geological Survey and Indiana Geological Survey. We also hosted a GSA poster session on Integrated Biostratigraphy with some 20 presentations. A larger initiative is the development of a study group on chemostratigraphy.

### **Carlton E. Brett**

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**Yves CANDELA (Scotland)** continues working with David Harper (Durham University) on the Lower Ordovician brachiopod faunas of the Fezouata Lagerstätte (Morocco); Michal Mergl (University of West Bohemia, Pilsen) is also working on the project. The article led by Farid Saleh, and co-authored by Bertrand Lefebvre, Bernard Pittet (ENS Lyon and Université de Lyon), David Harper, Marika Polechová (Czech Geological Survey, Prague) and myself on taphonomic processes in the Fezouata is now published. Work is still continuing with David Harper on the description of brachiopod (linguliforms) and associated faunas from the Glenkiln Shales (Sandbian) and the Raven Gill Formation (Floian), along the Wandel Burn and its tributaries, SE Scotland. In 2018 I have published on matters regarding the Silurian (Archie Lamont Collection and a sponge from the Pentland Hills with Joe Botting), and am continuing working on this period too.

I have also started several projects with Juan Carlos Gutiérrez-Marco (Institute of Geosciences, Madrid) on Ordovician brachiopods from Spain.

### **Yves Candela**

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**Josefina M.T. CARLOROSI (Argentina)** is still working on biostratigraphy and taxonomy of Lower and Middle Ordovician conodonts from different areas of Northwest Argentina (Cordillera Oriental and Sierras Subandinas) and the Famatina Ranges. I am also collaborating on taxonomical investigation of the Ordovician conodonts from Peru with Drs. Juan Carlos Gutierrez Marco and Graciela Sarmiento. Currently in collaboration with Dr. Ana Mestre I am conducting a research project funded by CONICET to study Lower Ordovician conodont biostratigraphic correlations between the Eastern Cordillera and Precordillera. I am part of Laboratorio de Micropaleontología (CONICET – CIGEOBIO - UNSJ), a working group focused on Ordovician conodonts of Argentina composed of Drs. Susana Heredia & Ana Mestre. At the moment I participate in projects studying different Ordovician fossil groups of Northwestern Argentina in collaboration with Drs. Franco Tortello, Susana Esteban and Maria del Milagro Vergel. At the same time I am part of the INSUGEO staff and am carrying out the task of Editor of the magazine *Serie Correlación Geológica (SCG)*.

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**Marcelo G. CARRERA (Argentina)** is actively working on the evolutionary history of Palaeozoic sponges and bryozoans (taxonomy, paleoecology and paleobiogeographic significance). In particular, I'm currently studying new findings related to Lower Ordovician reefs from western Argentina and finishing a paper related to the Ordovician sponges from the Lenoir Limestone in Tennessee. I am also studying sponge spicules from Peru associated with ostracods, and Lower Ordovician sponges from Northwestern Argentina.

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**Robin COCKS (England)** 2018 was a year dominated by joint work, mainly with Leonid Popov (Cardiff, Wales and Gorgan, Iran) on the Lower Ordovician (Floian to Early Darriwilian) stratigraphy and brachiopods of south-western Wales on which a paper was completed and is now accepted and in press with *Proceedings of the Geologists' Association*. In addition good progress was made with him on a relatively large paper on Late Darriwilian to Early Katian brachiopods of South Betpak-Dala and the West Balkhash Region within the Chu-Ili Terrane of Kazakhstan. A global analysis of Telychian brachiopod genera with Rong Jiayu (Nanjing) was completed and is now in press with *Alcheringa*. Time was also spent on the final changes and proof corrections for my large (260 printed pages and 41 plates) Palaeontographical Society Monograph on *The Llandovery Brachiopods of England and*

*Wales*, which will be published in March 2019. I attended and read a paper at the Brachiopod Congress in Milan, Italy, in September and visited Oslo, Norway, in October to further progress work with Trond Torsvik on Lower Palaeozoic palaeogeography, and a paper on revised Early Ordovician palaeogeography and faunal provinces with him is well advanced.

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**André DESROCHERS (Canada)** is working on the Upper Ordovician to Lower Silurian strata of the Anticosti Island in Eastern Canada. My research program focuses on high-resolution stratigraphic studies integrating carbonate sedimentology, sequence stratigraphy, biostratigraphy, and chemostratigraphy. One current M Sc project (Marili Vincent-Couture) is examining nearshore depositional systems in a mixed carbonate-siliciclastic succession at the eastern end of Anticosti Island. A number of collaborative projects are also in progress including (i) testing global anoxia an alternative cause for the Hirnantian mass extinction (with Julie De Weirdt and Thijs Vanderbrouke), (ii) time-series analyses derived from high-resolution stable isotope data of the Upper Ordovician Anticosti succession (with Matthias Sinnesael and Thijs Vanderbrouke), (iii) stratigraphy and timing of the End Ordovician mass extinction (with Joshua Zimmt and Seth Finnegan), (iv) sedimentology and paleoecology of Telychian encrinites (with Bill Ausich), (v) High Resolution  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  chemostratigraphy across the Ordovician-Silurian Boundary (with Matthew Braun, Alain Mauviel, and Pascale Daoust) and (vi) Diagenesis, Ca and Li isotopes at the O/S boundary (with Rachel Wood, Philip Pogge von Standman, and Will Newton).

Anticosti Island was recently placed on the Canada's Tentative List for World Heritage Sites on the basis of its outstanding record of fossil life for the upper Ordovician to lower Silurian time interval. This interval represents a milestone event in the history of the Earth, the first global mass extinction of animal life. The local and provincial governments are planning to build an interpretation centre with accommodation facilities available for visiting geoscientists in the near future.

Other ongoing research projects include: (i) the significance of widespread transgressive oolitic limestone preserved at the basin margin of the Yangtze Platform in South China (with Guangxu Wang and Renbin Zhan), and (ii) the multi-order stratigraphic record of the Lower Cambrian sandstones and limestones in the South Labrador (with Jean-François Ghienne).

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**Andrei DRONOV (Russia)** continued his work on facies, sea-level changes, biotic and abiotic events on the Siberian and Russian platforms during the Ordovician. In 2019, we started a new 3- year project “Regional and Global Aspects of the Great Ordovician Biodiversification Event on the Siberian and Russian platforms”. The project’s team includes Alexander Kanygin, Alexander Timokhin, Taras Gonta, Olga Maslova, Veronica Kushlina, Alexey Zaitsev, Elena Raevskaya and Tatiana Tolmacheva. Under the umbrella of this project, we continue investigations of the Siberian K-bentonite beds conducted in collaboration with Warren Huff and studies of carbon isotope chemostratigraphy of the Ordovician of Tungus basin in cooperation with Boris Pokrovsky, Oliver Lehnert and Peep Männik. Studies of extraterrestrial chromates in the Darriwilian sections of St. Petersburg region and Siberia together with Birger Schmitz are also on the agenda as well as investigation of the Ordovician trace fossils in cooperation with Radek Mikuláš and Dirk Knaust. This year we are engaged in preparation of the 13<sup>th</sup> International Symposium on the Ordovician System in Novosibirsk and associated geological excursions to the Russian (St.Petersburg region) and Siberian (Podkamennaya Tunguska) platforms.

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**Jan Ove R. EBBESTAD (Sweden)** continues working on Ordovician gastropods and tergomyans from peri-Gondwana settings (Morocco, Spain, South America, Iran), collaborating mainly with Juan Carlos Gutierrez-Marco (Madrid), Mansoureh Ghobadi Pour (Gorgán), and Leonid Popov (Cardiff). A monograph in collaboration Marika Polechová (Prague), Björn Kröger (Helsinki) and Juan Carlos on the Tafilalt molluscs in Morocco is now available online in *Geological Society of London Special Publications*. Continuing work on the molluscan fauna of the Ordovician Boda Limestone of the Siljan area is developing in collaboration with Alexander Gubanov (Uppsala), Anette Högström (Tromsø) and Yutaro Suzuki (Shizuoka). Field work last summer has brought new and interesting material to light. Exquisite material of rostroconchs and gastropods from erratics in the Netherlands is being studied in collaboration with Percy van Keulen (Harderwijk) and Alexander Gubanov. A monograph on the Ordovician trilobites from the Taimyr peninsula, Arctic Russia in collaboration with Richard Fortey (London) has been submitted and a paper on the biofacies of the Taimyr trilobites is in press with *Fossils & Strata*. A catalogue of the specimens described by Wahlenberg (1818) in *Petrificata Telluris Svecanae* is being prepared in collaboration with Vivianne Berg-Madsen (Uppsala). This very early work contains a number of Ordovician type specimens, and the material and types have hitherto been poorly known.

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**Cole EDWARDS (USA)** is working on Ordovician stable and radiogenic isotope stratigraphy. Ongoing projects with David Fike at Washington University in St. Louis continue to explore sulfur isotope methodology as applied to a high-resolution stratigraphic record of the Lower-Middle Ordovician. Collaborations with Matt Saltzman (Ohio State), Page Quinton (SUNY Potsdam), and David Fike continue on  $\delta^{18}\text{O}$  study of Ordovician conodonts using the Cameca f/geo Secondary Ion Mass Spectrometer (SIMS). Results from this work were presented at the IGCP Project 653 Annual Meeting in Athens, OH last June. Recent research has incorporated the use of iodine concentrations in carbonates (I/Ca), which can be used to show whether evidence for water column anoxia was present at the site of deposition. Results from this work were recently published in *Earth and Planetary Science Letters* on our Early Ordovician studies, as well as in *Science* as part of a major collaborative effort to study long-term changes to oxygen levels since the Precambrian. A review of the link between oxygen levels and biodiversification is in press and will hopefully be published soon in a special issue titled “Onset of the GOBE” for the journal *Palaeoworld*. Current and future collaborative work with Sarah Carmichael (Appalachian State University) will use similar approaches to identify intervals of anoxia as possible drivers of the Late Devonian mass extinction from sections exposed in the Great Basin region, western USA.

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**Bob ELIAS (Canada)** has papers in preparation on various aspects of Ordovician tabulate corals, with Dong-Jin Lee (Andong National University, Korea), Mirinae Lee (Korea Polar Research Institute), Kun Liang (Nanjing Institute of Geology and Palaeontology), and Ning Sun (China University of Geosciences).

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**FANG Xiang (China)**, an Assistant Researcher in NIGPAS, Nanjing, is working on the Early Palaeozoic cephalopods. Currently, his research interests are focused on the Cambrian–Ordovician transition and Middle–Late Ordovician cephalopods in South China and other Chinese regions, i.e., North China, Xizang (Tibet) and Xinjiang (Tarim), especially on their diversity and biogeographic patterns.

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**Oldřich FATKA (Czech Republic)** continues work on various aspects of biostratigraphy and palaeontology of the Ordovician System with a special focus on preservation of soft parts in trilobites as well as on Upper Ordovician Letná Lagerstätte.

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**Annalisa FERRETTI (Italy)** continues her work on Ordovician conodont faunas from Europe and elsewhere, focusing with Stig Bergström on conodonts from different localities in UK, the Carnic Alps (with Hans Peter Schönlaub) and the United Arabian Emirates (with Giles Miller). A study on new conodont material from the Late Ordovician Kalkbank unit (Germany) with Peter Königshof and Ulf Linnemann is going on.

A study on a conodont collection from Anglesey (northwestern Wales) and its geological implications has been published (Bergström & Ferretti). The fauna documents the *Baltoniodus variabilis* Subzone of the *Amorphognathus tvaerensis* Zone, and aims to be of some help in deciphering the geology of some Darriwilian–Sandbian (Ordovician) ‘ghost’ formations in the UK and North America using olistoliths in marine debris flows.

She is co-guest editing with Alyssa Bancroft and John Repetski a Special Issue of *Palaeogeography, Palaeoclimatology, Palaeoecology* focusing on “GECKO: Global Events impacting COnodont evolution”. The GECKO Issue will seek to take the concept of conodont animals beyond the simple idea that their primary utility is to serve as biostratigraphic markers and geochemical archives and to again begin looking at their temporal complexity and their potential to reflect events that occurred at a global scale. Several Ordovician papers are scheduled.

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**Richard FORTEY (UK)** reports that work on the Ordovician trilobite faunas of the Taimyr Peninsula, jointly with Jan Ove Ebbestad, is now completed, and an account of the biofacies and regional stratigraphy is in press with *Fossil & Strata*. The systematics of the trilobites has been submitted for publication with the *Journal of Systematic Palaeontology*. The fauna is rich and well preserved, and relevant to others described from the length of the Ordovician Caledonides, as well as the Siberian Platform.

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**Mansoureh GHOBADI POUR (Iran)** continues her work on trilobite faunas and biostratigraphy of Iran and Central Asia. A manuscript on the Lower and Middle Ordovician trilobite faunas of Alborz was completed and accepted for publication in *Alcheringa*. Other work in progress includes study of the Tremadocian bivalves from Alborz in cooperation with John Cope (National Museum of Wales), and a review of Tremadocian to Floian graptolites from North Iran in collaboration with Adrian Rushton (Natural History Museum London) and some Iranian colleagues. She is also involved in work on various topics of the Cambrian (Furongian) to Ordovician (Tremadocian) geology and palaeontology of Baltoscandia carried out in cooperation with Lars E. Holmer, Leonid Popov, Javier Alvaro, Heikki Bauert and others.

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**Daniel GOLDMAN (USA)** is working with Peter Sadler and Stephen Leslie on the new Ordovician Chapter for the upcoming Geologic Time Scale 2020. Our primary goals are to recalibrate the Ordovician time scale using the many new radiometric dates that have been published since 2012; to present independently calibrated sets of biozones from carbonate and clastic facies sections; to construct more precise ties between graptolite and conodont biozones; and to summarize the advances in chemostratigraphy that have been made in the last 8 years. I have also been working with Guillermo Albanesi, Gladys Ortega, and Fernanda Serra on the integration of graptolite and conodont biostratigraphies from the Argentine Precordillera. Finally, I am working with Liang Yan, Jaak Nolvak, Olle Hints, and Joseph Bernardo on morphologic variation in chitinozoans.

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**Juan Carlos GUTIÉRREZ-MARCO (Spain)** continues to work on Ordovician stratigraphy and fossils from high palaeolatitudinal Gondwanan settings of SW Europe, North Africa and northern South America. From the beginning of 2018, he has a new Spanish-funded project on the peri-Gondwanan Cambrian and Ordovician (with J.J. Álvaro), which integrates researchers from several universities of Spain and Portugal. Activities of 2018 were mainly focused on the preparation of several chapters for a special volume of the Geological Society of London devoted to the Tafilalt Biota of Morocco, and the presentation of several reports on Ordovician fossils at the II International symposium on Peruvian Palaeontology held in Lima last November.

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**David A.T. HARPER (U.K.)** reports that research continues on a variety of Ordovician brachiopod faunas. In particular he is collaborating with Yves Candela and Michal Mergl investigating the Lower Ordovician brachiopod fauna of the Fezouata Lagerstätte (Morocco), Robin Cocks on the brachiopod fauna of the Portrane Limestone (Ireland) and Thomas Servais and Bernard Mottequin on the Upper Ordovician brachiopods from Belgium. He has co-edited (with Yuandong Zhang and Thomas Servais) a special issue of *Palaeoworld* on 'Filling the Gap between the Cambrian Explosion and the GOBE'.

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**Susana HEREDIA (Argentina)** is working on taxonomy and biofacies of Middle Ordovician conodonts (*Lenodus antivariabilis* to *Eoplacognathus suecicus* zones) in the Argentine Precordillera, especially the taxonomy of the genera *Lenodus* and *Eoplacognathus*. Lower and Upper Ordovician conodonts from Precordillera are still under study as well as the stratigraphy and vertical distribution of carbonate facies from the San Juan Formation and overlying carbonate/ fine siliciclastics.

Research continues with Dr. Josefina Carlorosi on Lower-Middle Ordovician key conodonts from North Western Argentina and their relationship with those from coeval strata in the Precordillera.

PhD student Florencia Moreno Valdez is working on conodonts and microfacies of upper Floian to lowermost Darriwilian beds from the San Juan Formation in the Central Precordillera.

**Susana Heredia**

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**Nexxys Carolina HERRERA SÁNCHEZ (Argentina)** is working on her doctoral thesis with a CONICET scholarship supervised by Dra. Blanca A. Toro. She works on a temporal-space graptolite distribution analysis in the Lower - Middle Paleozoic of the Central Andean Basin (Argentinean Eastern Cordillera and Puna region, and southern Bolivia), especially on taxonomy, traditional and quantitative biostratigraphy using CONOP software, palaeoecology and palaeobiogeography using statistical methods. Also, she is working on geomorphometric analysis of different genera to test the systematic classification at species level.

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**Linda HINTS (Estonia)** continues work with the Ordovician collection database at the Institute of Geology in Tallinn. After a long break I have finished a manuscript on the Ordovician cyrtoneurid brachiopods from Baltica, which also includes data on their distribution in the Moscow Basin.

**Linda Hints**

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**Olle HINTS (Estonia)** is continuing studies on Ordovician–Silurian microfossils (especially scolecodonts and chitinozoans), geochemistry and Baltic regional geology and stratigraphy. In collaboration with Petra Tonarová and Mats E. Eriksson he is studying Ordovician and Silurian scolecodonts to provide new insights into the taxonomy, paleobiogeography and diversification history of Palaeozoic jaw-bearing polychaetes. In collaboration with Jaak Nõlvak and Yan Liang he is continuing studies on chitinozoans from Baltoscandia and South China, focusing on biostratigraphy, biogeography and palaeoecology. On these topics several papers were published in 2018 and a report documenting Early and early Middle Ordovician

chitinozoans from northern Estonia will soon be published in Palaeo3 (GOBE special issue). He is involved in studies on chemostratigraphy together with Tõnu Meidla, Leho Ainsaar, David Fike, Jocelyn Richardson and other colleagues, aiming at better documenting and understanding carbon and sulfur stable isotope signatures within the Baltoscandian carbonate sedimentary basin. Olle is also responsible for leading development of Estonian geocollections database and related services under a national research infrastructure project (various data are accessible at: <https://geocollections.info>).

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**Dimitri KALJO (Estonia)** continued some studies on the Ordovician and Silurian bio- and chemostratigraphy of Baltica as an emeritus member at the institute and as the editor-in-chief of the *Estonian Journal of Earth Sciences*. In March 2019 I will step down from the latter commitment.

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**Petr KRAFT (Czech Republic)** continues his long-term research project on detailed study of paleontological localities in the Ordovician of the Prague Basin, Czech Republic supported by the West Bohemian Museum. The main result of the year was collecting a huge number of graptolite specimens from the early Katian strata in the north-eastern part of the basin. He also contributes to the project on substrate for colonization and bioerosion together with colleagues working from the Palaeozoic to the Recent.

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**Jeong-Hyun LEE (South Korea)** is mainly working on Cambro-Ordovician reefs and related geological events. He is working with Suk-Joo Choh (Korea University), Jongsun Hong (Kangwon National University), and Dong-Jin Lee (Andong National University) on Cambro-Ordovician mixed carbonate-siliciclastic successions in Korea and China. Recently a summary on Cambro-Ordovician reefs and their relationship with marine oxygenation was published in *Earth-Science Reviews* based on collaborative work with Robert Riding (University of Tennessee). In this review, low-oxygen conditions during the mid-Cambrian to the mid-Ordovician was suggested to be an important factor affecting reef-building organisms, i.e., dominance of microbes and sponges during this time interval. Ongoing projects include investigation of early Cambrian siliciclastic deposits in Korea, Early Ordovician carbonate sedimentary structures in Korea, and Cambro-Ordovician stromatolites in Korea, China, USA and Canada.

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**Stephen LESLIE (USA)** is primarily working on Middle and Late Ordovician conodont biostratigraphy and integrating the biostratigraphy with studies of Ordovician paleoclimate change. It's been a rather slow year with many obligations related to department administration. Work continues with Dan Goldman integrating graptolite and conodont biostratigraphy in dark shale successions and also on the GTS 2020 Ordovician chapter with Goldman and Peter Sadler. Collaboration also continues Paul Myrow on Ordovician successions in China and the Himalaya, and with Achim Herrmann, Ken MacLeod, and Page Quinton testing the early Late Ordovician cool water carbonate hypothesis in the North American Midcontinent using oxygen isotopes from conodont apatite. This year I hope to expand my research into the Williston Basin, and renew studies in the Northwest Territories and Ireland.

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**Qi-jian LI (China)** is mainly working on Ordovician reefs and hypercalcified sponges (e.g. calathids, stromatoporoids and sphinctozoans). In 2018, I continued my systematic and paleoecological work on calathids. Apart from the materials from South China, Tarim and Malaysia, I carried out a new project with Dr. Apsorn Sardud and other Thai colleagues, targeting the Early Ordovician sponge-bearing microbialites in southern Thailand. Moreover, I am now working on some Late Ordovician reefs which might indicate cool-water

carbonates in South China during the Katian. I also continue my collaborations focused on quantitative paleoecological analyses of reefs at the Ordovician-Silurian transition with several colleagues.

**Qi-jian LI**

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**Yan LIANG (China)** continues her work on the Early and Middle Ordovician chitinozoans of South China and Baltica together with Olle Hints, Jaak Nõlvak, Peng Tang and Thomas Servais. Two papers focusing on the chitinozoan biodiversification and palaeoenvironmental implications based on the materials of South China have been published. One in *Lethaia* states that different chitinozoans have their own preferred palaeoenvironments and further suggests that the palaeoenvironmental implications should be considered when applying the biostratigraphical scheme. A paper in *Palaeogeogr. Palaeoclimatol. Palaeoecol.* establishes a continuous chitinozoan biodiversity curve in the Early and Middle Ordovician in the Honghuayuan section, Tongzi, South China, and compares it with other environmental curves based on data from the same section. The results show that chitinozoans were sensitive when the environment, especially the sea-level, changes significantly. She is also working with Dan Goldman on chitinozoan morphological variation based on materials from Oklahoma, USA. The study indicates that a larger morphological variation than previously known exists in these chitinozoans. Further study concerning the implications of this morphological variation is in progress.

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**Xiaocong LUAN (China)** is an assistant researcher at the Nanjing Institute of Palaeontology and Geology, Chinese Academy of Sciences, where he is part of the Lower Paleozoic Working Team. He is interested in Ordovician sedimentology and stratigraphy, especially the environmental background of bioevents, i.e., the Great Ordovician Biodiversification Event and end-Ordovician mass extinction. Ongoing studies include Early-Middle Ordovician marine red beds and special ferric oncolitic deposits in South China.

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**Peep MÄNNIK (Estonia)** is working on evolution, taxonomy and palaeoecology of conodonts, conodont-based high-resolution stratigraphy, bioevents and palaeogeography. He is also interested in sequence stratigraphy and evolution of sedimentary basins. Joint studies together with colleagues from Estonia, Germany, Iran, Japan, Poland, Russia, Sweden, U.K. and USA on evolution and high-resolution stratigraphy of the Early Palaeozoic faunas and sedimentary basins on different palaeocontinents are ongoing.

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**Alexander (Sandy) D. McCracken (Canada)** is periodically working on good Ordovician-Silurian collections from Hudson Bay and Moose River basins, Ontario and Manitoba. I retired in September 2017, and am a part-time volunteer with the GSC Calgary office. I work at my Victoria home (not in the GSC Sidney office), having moved my microscope and samples with me. I am in email contact with the Calgary office weekly, and so may be a bit slow to respond to emails.

**Alexander (Sandy) D. McCracken**

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**Tõnu MEIDLA (Estonia)** is working on different aspects of litho- and biostratigraphy, ostracods and stable isotopes in the Ordovician-Silurian boundary interval of Estonia, Latvia and Lithuania (together with L. Ainsaar, O. Tinn, L. Lang, K. Truuver, T. Paiste, T. Ani, K. Kungla, S. Radzevičius) and Anticosti (together with A. Desrochers, Z. Taha, V. Perrier, M. Williams, D. Siveter).

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**Ana MESTRE (Argentina)** continues to study the biostratigraphy, taxonomy and biofacies of Lower–Middle Ordovician conodonts from the Precordillera, in addition to developing carbonate microfacies analysis on the Ordovician carbonate platform. Also, I'm interested in the stratigraphy and evolution of Ordovician and Silurian sedimentary rocks in the Precordillera Basin.

All these topics are developed in collaboration with Dr. Susana Heredia. Lower Ordovician conodonts are under study with Dr. Josefina Carlorosi, through a collaborative project about comparison and correlation of the Floian conodonts from Argentine Precordillera and Eastern Cordillera. Also, I have a PhD student who is developing a study on microfacies and conodont biostratigraphy of the Lower–Middle Ordovician San Juan Formation from the Central Precordillera. Last year, I supervised a graduate student thesis about conodont biostratigraphy and carbonate microfacies of the Middle Ordovician of the Talacasto Range.

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**Tatiana L. MODZALEVSKAYA (Russia)** continues to work on the Upper Ordovician-Silurian-Lower Devonian brachiopods and stratigraphy in thematic projects connected with analysis of regional scales of Eurasian Russian regions.

**Tatiana L. Modzalevskaya**

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**Stewart MOLYNEUX (UK)** is currently working on a review of the palynology of the Cambrian-Middle Ordovician (pre-Hanadir) succession in Saudi Arabia for a forthcoming publication. I have contributed to a paper in preparation on Early Ordovician chitinozoans from South Wales with Chloé Amberg, Jan Zalasiewicz and Thijs Vandenbroucke.

**Stewart G. Molyneux**

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**Diego Fernando MUÑOZ (Argentina)** is a researcher at Centro de Investigaciones en Ciencias de la Tierra (CICTERRA - CONICET and Universidad Nacional de Córdoba) investigating Lower Ordovician deposits of NW Argentina. During his PhD, he studied systematics, taphonomy, diversity and palaeogeography of brachiopods. Then he became an ichnologist in training, mainly studying marine siliciclastic trace fossils, particularly cruzianids, supervised by Dr M.G. Mángano and Dr B.G. Waisfeld. He is particularly interested in the relationship between the occurrences between trace fossils and their probable producers, and in studying the ichnological record from a paleobiological perspective. Regarding the ichnology studies, he has been working in the last year with radial to rosette trace fossils, publishing two articles. Furthermore, he has collaborated with colleagues publishing a high-resolution trilobite biostratigraphic scheme for the early late Tremadocian of the Central Andean Basin, and has contributed to a palaeoecology paper based on Early Ordovician ostracods.

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**Arne Thorshøj NIELSEN (Denmark)** reports that Cambrian issues and notably the Alum Shale of Scandinavia are still taking most of his time (the upper part of the Alum Shale is, however, of Tremadocian age). I have recently published a paper on correlation of this formation using gamma logs in wells; a follow up paper will deal with gamma-logged exposed sections on Bornholm, Denmark. A master's student of mine is currently working on a late Early Ordovician trilobite fauna from the Herramb, Oslo region. It is a deep-water fauna preserved in limestone nodules in a graptolite-bearing shale. Together with various colleagues I am still working on drill cores through the Ordovician succession on the Island of Bornholm (eastern Denmark) and in Scania (southern Sweden) with focus on geochemistry; a paper is submitted. Also, I am coordinator of a revision of Ordovician stages in Scandinavia, but progress is regrettably slow. My key interest is still sea-level changes, Ordovician as well as Cambrian.

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**Alan OWEN (UK)** is making good progress with the description of Upper Ordovician trilobites from South Wales with Lucy McCobb (National Museum of Wales) and Patrick McDermott (St Clears, South Wales) and the issue of *Fossils and Strata* edited with David Bruton (Oslo) arising from the 6<sup>th</sup> International Conference on Trilobites and their Relatives is due to be published imminently. A limited amount of progress had been made on several Irish Ordovician trilobite faunas but much more is anticipated in the coming year. The same

applies to the description of the trilobites from the Hirnantian of the Scottish Southern Uplands with Keith Ingham (Glasgow). Further papers on trilobite eyes with Martin Lee (Glasgow) and former research student Clare Torney (now at Historic Environment Scotland) are still in preparation.

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**Ian PERCIVAL (Australia)** officially retired in mid-2018 and is now an Honorary Research Associate of the Geological Survey of NSW. Prior to retiring I participated in the Annual Field Meeting of IGCP 653 (The Onset of the Great Ordovician Diversification Event) held at Ohio University (Athens, Ohio, USA) and particularly enjoyed the associated field trips to the Great Basin in Utah & Nevada, and the Cincinnati Arch region of Kentucky & Ohio. My research in Australia continues to focus on Early Palaeozoic conodonts and brachiopods, working mainly with my Geological Survey colleague Yong Yi Zhen on faunas from New South Wales and Western Australia (the latter in collaboration with staff from the Geological Survey of WA). A manuscript describing Late Ordovician gastropods from New South Wales has been dusted off after many years of dormancy and is once more underway. A paper co-authored with Barry Webby and Harrison Birkett on the palaeontological significance of the Cliefden Caves area has been accepted for a special geoheritage issue of *Australian Journal of Earth Sciences* scheduled for publication in mid-2019 (the proposed dam on the Belubula River downstream from the Caves and Fossil Hill that threatened the valley with flooding has now been shelved by the State Government after considerable public opposition over the past five years). I have also been working on several papers on the Hirnantian of China in projects led by Guangxu Wang (Nanjing Institute of Geology & Palaeontology) and will visit him and other colleagues at NIGPAS this October to progress these.

Much of my time recently has been taken up in editing of *Australasian Palaeontological Memoirs*; volume 51, containing papers from the PDU2 Symposium held in Adelaide in mid-2016, was published in December 2018 and several other Memoirs are at various stages in the editorial process. I also continue as Secretary for the Subcommittee on Ordovician Stratigraphy until the next IGC in March 2020, and editing *Ordovician News* remains my responsibility until then.

**Ian Percival**

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**Leonid POPOV (United Kingdom)** continues to work on general aspects of the Ordovician brachiopod faunas of Central Asia and the Middle East focusing on taxonomy, biostratigraphy and biogeography. Recently completed research includes monographic studies of the Arenig brachiopods from south Wales (in cooperation with Robin Cocks) and of the Mid to Late Ordovician brachiopods of Ougarta Range, Algeria (in cooperation with Philippe Legrand, Boumedienne Bouterfa and Mansoureh Ghobadi Pour).

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**G. Susana DE LA PUENTE (Argentina)** continues to focus on chitinozoan studies. I am a scientific researcher for CONICET of Argentina, and a Professor in the Geology Department at the Universidad Nacional del Comahue in Neuquén, Argentina. My research is concentrated on northwestern and western Argentina, and also, in recent years, the Patagonia region of Argentina.

**Graciela Susana de la Puente**

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Note change of e-mail and contact details

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**John E. REPETSKI (USA)** is continuing with Emeritus status with USGS. We are in the midst of relocating the conodont preparation labs, but at least we will still have labs for operating. I still find time for research on numerous “left over” projects from previous years (=“Lazarus projects”?), and to help curate and protect the conodont legacy of the USGS. Fortunately, we still have our colleagues Nancy and Rob Stamm, Randy Orndorff, and David Weary here at USGS-Reston who are still actively interested in conodonts and are employing them in their projects. Randy and Dave are mapping areas with abundant Ordovician strata, and problems, so Ordovician activities promise to continue.

My own Ordovician work continues to be chiefly on conodont biostratigraphy, CAI and systematics, USA and elsewhere, with numerous colleagues: compiling CAI maps and biostratigraphy of [oil- & gas-rich] black shales in eastern U.S. basins; biostratigraphic support for USGS and other mapping projects; paleobiogeographic studies relating North American Lower Paleozoic faunas to those of other paleocontinents; conodont studies of impact structures; also age-dating of faunas and studies of Cambrian and Ordovician phosphatic problematica.

During 2018, with John Taylor and Justin Strauss, we continued refining the biostratigraphy for the Cambro-Ordovician section in easternmost Alaska using conodonts and trilobites. Also with J. Taylor and Jim Loch, I engaged in study of agnostoids and

accompanying conodonts in the search for a good GSSP for Cambrian (Furongian) Stage 10, with new data presented at GSA (Indianapolis) and Xian, PRC.

**John E. Repetski**

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**RONG Jiayu (China).** During the last year, I chiefly studied the *Hirnantia* fauna from a new locality of the Mandalay Region in Myanmar and submitted this manuscript to *Palaeoworld* (now accepted after reviews). Meanwhile, Chen Di and I finished a manuscript dealing with a new genus *Xenocrania* in the *Hirnantia* fauna of South China and Myanmar and this one has been just published in *Papers in Palaeontology*.

**Rong Jiayu**

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**Matthew SALTZMAN (USA)** continues to work on carbon, strontium and neodymium isotope chemostratigraphy. Work was completed this year on an *Earth and Planetary Science Letters* paper on Ordovician redox changes with Cole Edwards as first author. Graduate student Datu Adiatma completed his Master's thesis on Ordovician (Sandbian) chemostratigraphy in relation to land plant evolution. Datu sampled in the central Appalachians, including the Arc Hollow section in West Virginia and Union Furnace, Pennsylvania. This work was in collaboration with Seth Young and Nevin Kozik at Florida State University, and Steve Leslie, Cole Edwards and Alyssa Bancroft. Current graduate students Chris Conwell and Teresa Avila are utilizing the new Triton Thermal Ionization Mass Spectrometer installed at Ohio State (PI Elizabeth Griffith) for their Ordovician Sr and/or Nd isotope studies.

I have been working with Steve Leslie and other friends and former students of Stig Bergstrom to organize a symposium in his honor to be held on the Ohio State campus on August 10, 2019. The plans, which are still underway, include scientific sessions as well as hopefully some good storytelling by Stig!

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**Thomas SERVAIS (France)** is research director at the CNRS and currently vice-chairman of the Ordovician Subcommittee. He continues his research mainly focused on the Great Ordovician Biodiversification Event (GOBE) within the frame of the IGCP project dedicated to the onset of this event ([www.igcp653.org](http://www.igcp653.org)), and evolution of marine microphytoplankton in general. Publications in 2018 included the papers published in the first special issue dedicated to IGCP 653, in *Lethaia*, edited by Dave Harper and Thomas Servais. One of these papers (Servais & Harper) focused on the definition of the GOBE and its concept (not really an event...). Other papers include the comparison of the Ordovician and Permian extinctions (Isozaki and Servais), arthropod mandibles from the Winneshiek Lagerstätte (Nowak et al.), the precise age of the Fezouata Lagerstätte (Lefebvre et al.), or the modeling of primary production during the GOBE (Pohl et al.).

Research on the early evolution of land plants continues, partly with the new CNRS research associate at Lille University, Borja Cascales-Miñana, with first results (but not concerning the Ordovician) published in 2018 and 2019. Investigation of the palynology of the Fezouata Lagerstätte of the Ordovician of Morocco also continues, as well as the collaboration with several Chinese colleagues: Li Jun, Liang Yan, Yan Kui, Zhang Yuandong (all Nanjing Institute of Geology and Palaeontology) and Wang Wenhui (Central South University, Changsha). The analyses of the Palaeozoic phytoplankton diversity with David Kröck (Lille, France) is a PhD research project that should be finished in late 2019. In the meantime, the joint PhD programme of Houcine Benachour between Lille and Tlemcen University (Algeria) started and is focused on the Ordovician of Morocco and Algeria. Navid Navidi-Izad (Tehran, Iran) spent eight months at Lille in 2018, working on Ordovician palynology from the Alborz mountains of northeastern Iran.

Palynology is not everything, and work started now in eastern Belgium, to find the sources of ore deposits (placers) found not far or within the Ordovician formations, that are currently re-mapped by field geologists.

### **Thomas Servais**

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**Colin SPROAT (Canada)** has taken up a new position as an assistant professor at the University of Saskatchewan, following his postdoctoral fellowship in Nanjing, China (note new contact information below). Work will continue on the previously unpublished Late Ordovician brachiopods of the Tarim Basin in northwestern China and their evolutionary and paleobiogeographical significance in collaboration with Renbin Zhan, but now back in Canada, Colin is looking forward to returning to his research on the Ordovician and Silurian brachiopods of North America. He is particularly interested in evolutionary trends in terms of time and space.

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**Alycia L. STIGALL (USA)** is studying Late Ordovician brachiopod diversity, ecology, and phylogenetic patterns with an emphasis on clades with North American members. I am particularly interested in teasing apart speciation and biogeographic patterns during the GOBE and Richmondian Invasion intervals. Within that context, I am a co-leader of the IGCP 653 project on the GOBE. We had a very successful and productive meeting in June 2018 at Ohio University with associated field excursions to the Cambro-Ordovician sections of Utah and Nevada as well as Ordovician sections in Kentucky (see report elsewhere in this issue of *Ordovician News*). Christian Rasmussen, Rebecca Freeman, Cole Edwards and I are editing a special volume in *Palaeogeography, Palaeoclimatology, Palaeoecology* of studies related to IGCP 653, which will be published in late 2019 or early 2020. I also oversee the website for IGCP 653, so please email me with any posts, information, or opportunities that you would like to share with the group or your related articles when they are published so I can include them.

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**John TAYLOR (USA)** managed to move several projects on early Paleozoic trilobites and agnostoid arthropods forward over the past year, although considerably more time was spent on Cambrian faunas than Ordovician ones. In particular, work with James Loch on Furongian faunas in shelfbreak and slope deposits in Alaska and Nevada, and their relevance to deliberations over the base of Cambrian Stage 10, received the most attention (Loch et al., 2018). John Repetski of the U.S. Geological Survey contributed supportive conodont data, while Justin Strauss provided carbon isotopic data and analyzed the sedimentology of the units. John also completed preliminary work (Busch et al., 2019) on Cambrian faunas Strauss and his students/co-workers at Dartmouth College recovered from limestone conglomerates that underlie the Ordovician Bouvette Formation in the western Yukon. In situ trilobites recovered from the basal unit of the Bouvette have John expanding his horizons upward in the stratigraphic column to work on some taxa of Middle to Late Ordovician age, including the distinctive genus *Hypodicranotus*. Hopefully the coming year will see not only completion of the work on these faunas, but at least some progress on Early Ordovician faunas from the Jones Ridge Formation and the Nanook Limestone in northern Alaska, and/or coeval faunas from his earlier projects in the Appalachians southwestern USA, and northern Rocky Mountains with Paul Myrow and Rob Ripperdan.

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**Tatiana TOLMACHEVA (Russia)** is not very active but continues to work on Ordovician conodonts from different regions of Russia and Kazakhstan. Currently she is studying the collections of Ordovician conodonts from the Eastern Arctic islands, Taimyr and Siberia (with Andrei Dronov and Kirill Degryarev). This summer, she is going to participate in an expedition to the well-known section Mirny creek of the Katian and Hirnantian in the Omuleve Mountains of North-East Russia.

### **Tatiana Tolmacheva**

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**Blanca A. TORO (Argentina)** continues to focus on taxonomy, biostratigraphy and paleobiogeographic affinities of early Paleozoic graptolites from the Central Andean Basin (Cordillera Oriental and Puna region of Argentina and Bolivia). She is also training undergraduate and PhD students in quantification analyses of taxonomic and paleoecological relationships of South American graptolites. Blanca collaborates with Jörg Maletz (Germany) and numerous Argentine colleagues (from Córdoba, San Juan and Buenos Aires Universities) in a multidisciplinary project granted by the ANPCyT (Argentine Agency for Promotion of Science and Technology). As result, the first records of azygograptids, xiphograptids and Ordovician biserial graptolites from the Cordillera Oriental, Argentina, as well as the overview of the Ordovician and Silurian graptolites from Bolivia, were recently published.

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**Thijs VANDENBROUCKE (Belgium)** remains interested in reconstructing the Ordovician palaeoclimate and palaeo-environment, using fossil proxies.

Julie De Weiridt continues her PhD research project with me at UGent, focussing on geochemistry and palynology of the Upper Ordovician - lower Silurian in N. America (in collaboration with Poul Emsbo, USGS, Patrick McLaughlin, Indiana Geol. Survey and André Desrochers, UOttawa). Tim De Backer started his PhD research project and moved up-column from the Ordovician to the Devonian. Three MSc students working on related topics graduated last year (Charlotte De Boodt, Pjotr Meyvisch and Yared De Waele), and a new

MSc student (Wiebe De Grauwe) started working on the chitinozoans from an Ordovician core in the midcontinent. MSc student Cecile-Marie Lissens is finalizing her work on the chitinozoans from the Katian Penwhapple Formation in the Scottish Girvan District. I also still co-supervise Matthias Sinnesael, who continues his PhD project with Philippe Claeys at the VUB (Belgium) on astronomical forcing during the Late Ordovician. In addition, I was happy to see the postdoc results of Carys Bennett published in *Gondwana Research*, on stable oxygen isotope analysis of the eyes of pelagic Ordovician trilobites.

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**Marco VECOLI (Saudi Arabia)** works extensively on Lower Paleozoic palynology in Saudi Arabia, which includes a lot of investigations in Ordovician successions, both in outcrop and subsurface. Recent work has included the palynology of the Upper Ordovician Sarah Formation in application to paleoenvironmental reconstructions and mapping of glacial sediments in subsurface, and high-resolution palynostratigraphy in the Middle Ordovician. I am also involved in a number of studies on quantification of thermal alteration of organic-rich sediments with optical methods. I continue my activity as coordinator of the Saudi Aramco-CIMP Joint Project; in 2018 we presented our results in a special session at the 10<sup>th</sup> EPPC in Dublin, Ireland.

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**Olev VINN (Estonia)** is working on the evolution of symbiosis, predation, bioerosion and biofouling in the Ordovician. My current research interests include trace fossils of the Ordovician of Estonia and beyond. 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.

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**WANG Guangxu (China)** continues working on the end-Ordovician mass extinction event. A paper on a refined litho- and biostratigraphy of Hirnantian near-shore carbonate rocks in South China was published in *Geological Journal* in 2018. Recently I have been working on a global review of benthic faunas across the Ordovician and Silurian transition in collaboration with Renbin Zhan (NIGPAS) and Ian Percival (Geological Survey of NSW). The paper (just published online in *Earth-Science Reviews*) provides an integrated, much higher-resolution timescale for understanding the tempo and nature of this mass extinction.

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**WANG Xiaofeng (China)** in 2018 primarily continued to engage in the study of the Cambrian-Ordovician boundary in the Xiaoyangqiao section at Dayangcha, North China and its precise comparison with the Green Point GSSP section, Newfoundland, Canada on the basis of studies accumulated over more than 30 years combined with high-resolution integrated research over the latest 4 years. Our international cooperative research group consists of 7 Ordovician workers from 5 countries, including Svend Stouge (Denmark), Jorg Maletz (Germany), Gabriella Bagnoli (Italy), Elena G. Raevskaya (Russia), as well as Yiping Qi, Chuanshang Wang, Chunbo Yan and myself (all from China). A cooperative article entitled "Correlating the global Cambrian–Ordovician boundary: precise comparison of the Xiaoyangqiao (XCL) section, Dayangcha, North China with the Green Point GSSP section, Newfoundland, Canada" will be published soon.

Secondly, I was involved in organizing nearly all paleontological workers in Hubei province, including those from the China University of Geosciences (Wuhan), the Hubei Academy of Geological Sciences and my Wuhan Center for Geological Survey (formerly Yichang Institute of Geology and Mineral Resources), to complete three monographs i.e. "Paleontology in Hubei", "Precise and rare paleontological community in Hubei" and "Hubei fossils". The three books will be published by Hubei Science and Technology Press in mid 2019. The first two are applicable to tertiary education centres, institutes and related geological departments. The last book, characterized by pictures and photos with a few explanations, is intended to meet the needs of relevant management departments and will assist the popularization of paleontological science and cultural knowledge.

Thirdly, under the leadership of Dr. Wang Chuanshang, together with Jorg Maletz and myself, we continued a study concerning the subdivision and correlation of graptolite zones of uppermost Ordovician to Lower Llandovery black gas-bearing shales between the subsurface and outcrop in western Hubei Province, China. Our paper entitled "Katian (Ordovician) to Aeronian (Silurian, Llandovery) graptolite biostratigraphy of the YD-1 drill core, Yuanan County, Hubei Province, China" will soon be published in *Palaeontology*.

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**Charles WELLMAN (UK)** continues his research on early land plants, including spores and plant fragments from the Ordovician. He is currently involved in collaborative work on Ordovician spore assemblages from Oman, Saudi Arabia and South Africa. He is also working on the enigmatic palynomorph *Moyeria*, that is purported to be a euglenid, from Ordovician terrestrial deposits from North Wales.

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**Rong-chang WU (China)** is working on Ordovician stratigraphy and conodonts. Currently, my research is focused on Ordovician conodonts and carbon chemostratigraphy. Another project has been focusing on late Cambrian-Ordovician-Silurian palaeoclimatic and palaeoenvironmental changes by use of conodont apatite oxygen isotopes, carbon isotopes and microfacies analysis.

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**YAN Kui (China)** mainly worked on Ordovician acritarchs this past year. In June, I attended the IGCP 653 annual meeting in Athens, OH, USA and visit Early Palaeozoic strata from the Great Basin (Nevada, Utah) and Mid-Continent sections (Ohio, Indiana, Kentucky). In July, I attended the 5<sup>th</sup> International Palaeontological Congress in Paris and visited Devonian and Carbonifous strata from Belgium and northern France. Also in July, I visit Prof. Thomas Servais in Lille. I also went to Guizhou for a field trip to collect Tremadoc materials.

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**ZHAN Renbin (China)** was continuing his work on the Ordovician brachiopods and some related subjects under the major research project “Phanerozoic Major Biotic Events and their

Environmental Background” from the National Natural Science Foundation of China. On the one hand, together with one of his postdoc worker Colin Sproat, he was studying the late Katian brachiopod fauna from northeastern Tarim, i.e. the Kuruktag region, and found that this fauna represents a diversity acme of the GOBE in that region, and bridges the gap between South China and Kazakh terranes. On the other hand, he has also paid much attention to the dynamics of the GOBE by studying the sedimentology and geochemical changes of a unique lithological unit, the Zitai Formation, in the vast area of South China palaeoplate. It is proven that there was an apparent coevolution between the biotic and environmental changes in South China during the Ordovician. And most importantly, together with his international colleagues, Zhan Renbin has proposed a new hypothesis for the unique macroevolutionary pattern recognized in South China during the GOBE, i.e. the equatorial cold tongue that might have existed already in Ordovician.

Together with Wang Guangxu and Ian Percival, Zhan Renbin has made some further investigation on the sedimentology and biotic changes on the Upper Yangtze Platform (South China) through the Ordovician-Silurian transition, and recognized a refined and continuous stratigraphical sequence as well as a series of benthic faunas that help us get a better and more accurate view on the end Ordovician mass extinction (EOME).

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**Shunxin ZHANG (Canada)** has carried out the following projects in the Arctic area in 2018: (1) field work on the Ordovician stratigraphy and biostratigraphy on northern Baffin Island; (2) studying the Late Ordovician–Early Silurian conodonts from carbonate xenoliths preserved in the kimberlites on the Hall Peninsula, southern Baffin Island to understand the kimberlite emplacement history; (3) determining the age and stratigraphic position of the Late Ordovician petroleum source rocks in Hudson Bay, Foxe Basin and Hudson Strait areas by using her graptolite collections over the last 10 years; (4) compiling Paleozoic stratigraphy on Baffin Island as a contribution to Baffin Geological Synthesis of the Geological Survey of Canada.

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**Yuangdong ZHANG (China)** continues to work on:

(1) An integrated stratigraphy of graptolite, conodont, chitinozoan, acritarch, radiolarians, and carbon isotope chemostratigraphy, and cyclostratigraphy of the Ordovician

in China (funded by a NSFC grant and a grant from the Ministry of Science and Technology of China, 2014-2019). This work aims at a refined stratigraphic correlation of two critical transitions (late Darriwilian to early Sandbian, and late Katian to Hirnantian) in the South China and Tarim blocks. The integrated graptolite and conodont biostratigraphy is based on an international cooperation with Zhen Yongyi (Australia), Stig Bergström (USA) and Dan Goldman (USA), while the chemostratigraphic work has been conducted with Axel Munnecke (Germany) and the cyclostratigraphy with specialists from University of Geosciences in Beijing.

(2) Geological characteristics of Palaeozoic black shales in China. This has been the main tasks 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 results of these projects, over 5000 m of drill cores of the most potential gas shale in China (Lower Cambrian, Upper Katian–Llandovery) have been accumulated in the past years for multi-disciplinary analysis. The cores are available to global scientists for study and sampling, and already 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).

(3) Hirnantian Konservat-Lagerstätte in Anji (Anji Fauna), Zhejiang Province, in cooperation with Joe Botting and Lucy Muir of UK, financially supported by President's International Fellowship Initiatives (PIFI) program and a recently approved NSFC grant (2018-2021). This sponge-dominated lagerstätte, discovered in late 2012, is typified by abundant and highly diverse articulate sponges (over 75 species) often with soft tissues, in association with graptolites, nautiloids, arthropods, echinoderms, etc. The Anji Fauna is preserved within a 9-meter-thick black shale, underlain and overlain by siltstone and sandstones, in the Wenchang Formation of clastic facies. To date, over 5000 specimens have been collected from seven sections in the Anji County. The fauna is of latest Hirnantian age as constrained by the associated graptolites. A preliminary study indicates that this extraordinarily diverse, sponge-dominated community thrived immediately after the Hirnantian mass extinction in South China.

(4) IGCP Project 653 “The Onset of the GOBE”. To probe into the onset of the GOBE, I proposed a research project on the “Origination and evolution of early planktonic and nektonic ecosystems” based on the geological records from South China, and have been supported by a grant from Chinese Academy of Sciences (2018-2022). This work will focus on the early occurrence records of graptolites, conodonts, chitinozoans, cephalopods, radiolarians and the potential coincident changes of geochemical proxies for redox and oxygenations.

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**Yong Yi ZHEN (Australia)** is working on various projects focusing on research into Ordovician conodonts and their biostratigraphic and palaeobiogeographic applications. He visited Nanjing Institute of Geology and Palaeontology in December 2018 to January 2019, participated in a field trip in Guizhou and worked on several manuscripts with colleagues in

Nanjing. Currently he is working on a project revising the conodonts documented initially by Watson (1988) from the Middle Ordovician of the subsurface Canning Basin of Western Australia. He has been trying to relocate the original figured specimens in Watson's publication (1988) without success, and would be very grateful if anyone can advise him where this important collection is currently housed.

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## ORDOVICIAN RESEARCH PUBLICATIONS 2018-early 2019

[note that while the following compilation predominantly lists papers concerned solely with Ordovician topics, for completeness and comparison it also includes some publications dealing with studies of Furongian and Llandovery biota and stratigraphy]

### A

- Abuhmida, F.H. & Wellman, C.H. 2017. Palynology of the Middle Ordovician Hawaz Formation in the Murzuq Basin, south-west Libya. *Palynology* 41, 31-56.
- Akodad, M., El Hariri, K., Gutiérrez-Marco, J.C., Lefebvre, B., Lehnert, O., Martin, E.L.O., Nowak, H. & Servais, T. 2018. The precise age of the Fezouata Lagerstätte, Lower Ordovician, Morocco. In: Zhang, Y., Zhan, R., Fan, J. & Muir, L. (Eds.), *Filling the gap between Cambrian Explosion and the GOBE*. Zhejiang University Press, Zhejiang, 3-7.
- Al-Hajri, S., Vecoli, M., Breuer, P., Cesari, C. & Hooker, N. 2018. Paleozoic palynology of the Arabian Plate: a synopsis and historical perspective. *10<sup>th</sup> European Palaeobotany Palynology Conference, Dublin, Ireland, 12-17 August 2018, Abstract Book*, p. 37.
- Albanesi, G.L., Barnes, C.R., Trotter, J.A., Williams I.S. & Bergström S.M. 2018 (in press). Comparative Lower-Middle Ordovician conodont oxygen isotope palaeothermometry of the Argentine Precordillera and Laurentian margins. *Palaeogeography, Palaeoclimatology, Palaeoecology*, Special Issue (Ferretti, A., Bancroft, A. & Repetski, J., eds.).
- Álvarez, J.J., Casas, J.M. & Clausen, S. (eds) 2018. Early Palaeozoic Geodynamics. *Journal of Iberian Geology* 44(4), 551-670.
- Álvarez, J.J., Casas, J.M., Clausen, S. & Quesada, C. 2018. Early Palaeozoic geodynamics in NW Gondwana. *Journal of Iberian Geology* 44, 551-565.
- Antoshkina A.I. 2018. Bacteriomorph structures in nodules, a characteristic of euxinic conditions of nodule formation. *Paleontological Journal* 52(10), 28–39. DOI: 10.1134/S0031030118100040.
- Antoshkina A.I. & Shmeleva L.A. 2018. Peculiarities of composition, structure, and environments of the Hirnantian deposits in the Timan-northern Ural sedimentary basin. *Litosfera*, 18(4), 543–565 (In Russian with English abstract and figure descriptions).
- Asurmendi, E., Sánchez, M.L. & Heredia, S. 2018. Stratigraphy and facies analysis of the La Chilca Formation, Central Precordillera: Insights on the postglacial Ordovician-Silurian boundary and Early Silurian deposits from Argentina. *Geological Journal*. DOI:10.1002/gj.3390

### B

- Barnes, C.R. 2018. Impacts of climate-ocean-tectonic changes on Lower Paleozoic conodont evolution and ecologic organization evidenced by the Canadian part of Laurentia. Canadian Paleontology Conference, Saskatoon, 21-23 September. Program with Abstracts, Proceedings 15, 5-6.
- Barnes, C.R. 2018 (in press). 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. & Repetski, J., eds.).
- Bartlett, R., Elrick, M., Wheeley, J.R., Polyak, V., Desrochers, A. & Asmerom, Y. 2018. Abrupt global-ocean anoxia during the Late Ordovician-early Silurian detected using

- uranium isotopes of marine carbonates. *Proceedings of the National Academy of Sciences* 115(23), 5896-901. DOI: 10.1073/pnas.1802438115
- Belkin, H.E., Repetski, J.E., Dulong, F.T. & Hickling, N.L., 2018. Lithologies, ages, and provenance of clasts in the Ordovician Fincastle Conglomerate, Botetourt County, Virginia, USA. *Stratigraphy* 15(1), 1–20, text-figures 1–14, tables 1–9. DOI: 10.29041/strat.15.1.1-20
- Bennett, C.E., Williams, M., Leng, M.J., Lee, M.R., Bonifacie, M., Calmels, D., Fortey, R.A., Laurie, J.R., Owen, A.W., Page, A.A., Munnecke, A. & Vandenbroucke, T.R.A. 2018. Oxygen isotope analysis of the eyes of pelagic trilobites: Testing the application of sea temperature proxies for the Ordovician. *Gondwana Research* 57, 157-169. doi: 10.1016/j.gr.2018.01.006
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