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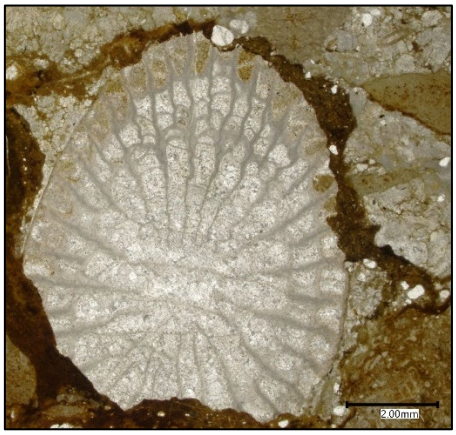

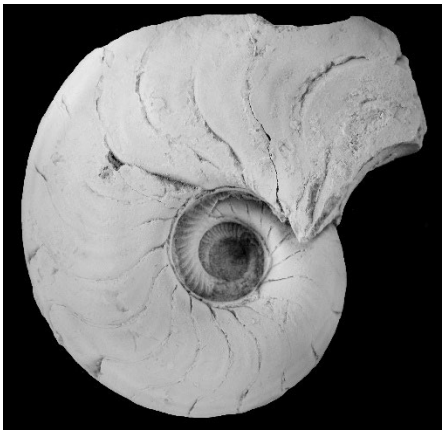

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SDS NEWSLETTER 37

Editorial

The SDS Newsletter is published annually by the International Subcommission on Devonian Stratigraphy of the IUGS Subcommission on Stratigraphy (ICS). It publishes reports and news from its membership, scientific discussions, obituaries of Devonian researchers, original science contributions (SDS Documents), scientific reviews, Minutes of SDS Meetings, SDS reports to ICS, general IUGS information, information on past and future Devonian meetings and research projects, and summaries of new Devonian publications.

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Submissions have to be sent electronically, preferably as Word Documents (figures imbedded or as separate high-resolution jpg or pdf files), to the Editor or to Mrs. S. KLAUS, IGP, Münster (sklaus@uni-muenster.de). Submission deadline for **No. 38** is the **end of August 2023**.

Please ease the editing by strictly keeping the uniform style of references, as shown in the various sections!

The Newsletter contributions should be quoted as: "SDS Newsletter, 37: x-y."

Content:

Devonian Meetings

Membership News

Chairman`s Address

Dear SDS Members,

Writing this address in the summer, which seems to be a more optimistic season, I will try to look to the future and leave all the ongoing and forthcoming global or local problems behind. Another year elapsed, the situation in the world did not get better, but the SDS is still alive! So, here are the opening words to our SDS Newsletter, which is already No. 37! Our Newsletter informs, on an annual basis, about everything related to the Devonian, being put together mostly from your contributions. I wish to take the opportunity to thank you all again for sharing Devonian information. At the same time, I ask you to continue reporting your Devonian-related activities, events and promotions, to make the next issues comprehensive and informative.

The team of SDS officers on duty remains unchanged: Ladislav SLAVÍK (Chair), Nacho VALENZUELA-RÍOS (Vice-Chair), Uli JANSEN (Secretary), Thomas BECKER (SDS Newsletter Editor) and Carlo CORRADINI (Webmaster). Last year, there was practically no chance to meet, and most information was coming from bulk e-mails from the Secretary. But, most importantly, the varied agenda regarding the re-scheduling of meetings, the new SDS webpage, Devonian sub-projects, and other issues were discussed during the on-line SDS meeting via ZOOM platform on October 19, 2021. We had 35 participants from all over the globe (18 countries). The meeting was successful, we recruited six new corresponding members from Czechia, Germany, and China. Minor problems did appear with internet connections here and there but this is usual for on-line video events today. In February 2022, the on-line meeting of the International Commission on Stratigraphy (ICS) took place. The SDS was represented by its Vice-Chair, who reported our activities and the current state of our subcommission to the ICS. There was a call from the IUGS International Commission on Geoheritage to propose "The First 100 IUGS Geological Heritage Sites". The Chair produced and submitted a proposal for Klonk (the GSSP for the Silurian/Devonian boundary at Klonk Hill near Suchomasty) as the first GSSP in the World (ratified at the 24th International Geological Congress in Montreal 1972). Since then, 77 more GSSPs have been ratified for the system, series, and stages of the ICS International Chronostratigraphic Chart – Geologic Time Scale.

The new SDS webpage was launched late last year on the ICS webpage. Many thanks again to Carlo CORRADINI and Nick CAR (ICS webmaster) for producing it and maintenance! It is more concise than the original webpage but perhaps more transparent and benefiting from cross links to the main ICS content. The idea of the ICS was to have all the websites of all subcommissions of uniform style, concentrated to one site/domain, and thus easy to be looked up. The SDS is among the first seven subcommissions with the new websites.

The organization of face-to-face meetings is still complicated but it seems to be slightly better. If the pandemic or other restrictions permit, the SDS will join the 6th International Palaeontological Congress in Khon Kaen, Thailand, this November. Let's hope that this will be the first non-virtual SDS business meeting since Milano 2019! For the IPC, Peter KOENIGSHOF and others proposed a Devonian symposium: Devonian palaeoenvironments and mass extinctions. Several abstracts have already arrived.

As you know, our planned meeting at Geneseo and field trips to New York State have been postponed for 2023 by Jeff OVER and co-organizers. We are looking forward to meet there, as this is the priority for the SDS, with a direct focus on the Devonian – including sessions and field trips. The meeting is preliminarily scheduled for 26 July to 7 August, 2023. Our official SDS annual business meeting in 2023 will take place there as well.

For 2023, the 4th STRATI (the International Congress on Stratigraphy) has been confirmed. This large international event of the ICS will take place at Lille in July 11–13, 2023. The SDS is going to propose a Devonian session with a topic

concerning Devonian palaeoenvironments at the congress.

For most of us, the last year was complicated, but our community is still active. Many thanks for all your Devonian-related activities and production that make our Devonian business going.

I wish you to stay safe and strong and optimistic!

Prague, August 2022, Ladislav SLAVÍK

OBITUARIES

Karl Peter BENDER

(22.4.1935 – 8.5.2022)

H.-G. HERBIG (Cologne), **M. R. W. AMLER** (Cologne), **G. KAUFFMANN** (Marburg), **P. KÖNIGSHOF** (Frankfurt a. M.) & **D. NESBOR** (Wiesbaden)

Dr. Karl Peter BENDER, a dedicated German field geologist and conodont worker, passed away on May, 8th 2022 at the age of 87. He was one of the best experts on the Rhenish Mountains east of the Rhine, which are part of the internal Rhenohercynian Zone of the Variscan Chain in Germany.

He was not only closely rooted in geology, but also in the region throughout his life. Born on April, 22nd 1935 in the medium-sized industrial town of Wetzlar, he spent his school and youth years there under difficult circumstances. Both parents died before he was ten years old, his mother during an allied air attack in late 1944. In 1956, he began studying geology at the Philipps University of Marburg and received his doctorate in July 1965 with a combined diploma and doctoral thesis entitled 'Der Nordostteil der Lahnmulde zwischen Salzböde-, Aar- und Biebertal' (The northeastern part of the Lahn Syncline between the Salzböde, Aar and Bieber valleys), having passed the diploma examinations a year earlier.

Starting directly after his diploma, Peter BENDER was appointed assistant and later 'Akademischer Rat' and 'Akademischer Oberrat' (academic council or senior lecturer) at the Institute of Geology and Palaeontology at the University of Marburg. He experienced the institute's period of prosperity, when under professors C. W. KOCKEL, M. LINDSTRÖM and W. ZIEGLER, numerous conodont stratigraphic and regional geological projects were carried out in the Rhenohercynian Zone and widely beyond, which made Marburg a centre of conodont research. Most of the diploma mappings (>50) and diploma theses (10) in these fields were supervised by Peter BENDER from the background. With his knowledge, he was a valued member of the German Subcommissions on Devonian and Carboniferous Stratigraphy and author/co-author of the chapters on the Lahn-Dill Syncline in the extensive monographies on the Devonian System and the Lower Carboniferous (Mississippian) Subsystem in the series 'Stratigraphy of Germany'. Personal highlights were two research visits of almost two years in Canada in 1972/73 and 1985, where he worked on Pennsylvanian conodonts from Ellesmere Island.

His special focus, however, was on the Hörre Zone and adjacent tectonic units. The Hörre Zone is a strongly imbricated, narrow, but long-stretched, for decades enigmatic zone with deviating facies development separating the Lahn and Dill synclines. In collaboration with colleagues from the Hessian Geological Survey and the University of Göttingen, he recognized already in the eighties of the last century its extension into the spatially separate Kellerwald

area at the northeasternmost edge of the Rhenish Mountains, a reason why in modern literature the Dill Syncline is named Dill-Eder Syncline.

Some of the authors very well remember the meeting of the German Subcommission on Carboniferous Stratigraphy in Marburg, 1994, when a talk by Peter BENDER on the autochthony of the Hörre directly was followed by a talk by Wolfgang FRANKE advocating its allochthonous nature. Provenance analyses of detrital zircon grains now unequivocally prove the Hörre Zone and adjacent units as superimposed nappes of Armorican origin. In spite of his life-long firm conviction, Peter BENDER open-mindedly accepted this new geodynamic model. However, his meticulous field work – many years of site inspections under changing outcrop conditions and the search for conodonts not only in limestones but on the bedding planes of the predominantly shaly rock packages of the mediocre exposed successions – made it possible to decipher the stratigraphy and to map this zone. These were the prerequisites for its structural and so important geodynamic interpretation. In addition to the Geological Map 1 : 40.000 of the Hörre (2006), his results are presented with inimitable precision in the Geological Maps 5216 Oberscheld (1997) and 5217 Gladenbach (2017), all published by the Hessian State Office for the Environment and Geology. Besides, they were set down in further publications, including many field guides for national and international meetings He also was involved in the restoration of a quarry exposing mid-Devonian reef limestones that now is classified as a national geotope ("Lahn Marmor" of the Unica Quarry), thus showing his passion for geology and generosity to share his knowledge with the public.

Unfortunately, after his retirement at the end of September 2000, Peter BENDER also had to experience the decline of the Marburg Institute and its closure in 2004. Nevertheless, he continued to work intensively on the stratigraphy and geology of his beloved Lahn-Dill Hills, although increasing health problems tied him to the house. At the end of 2021, he completed the (not yet published) explanations of the sheet 5217 Gladenbach. Thus, posthumous his work will still continue, e.g. also with mostly prepared descriptions of the formations he coined in the Hörre Zone and adjacent units in the German lithostratigraphic online encyclopedia 'Litholex'. With Peter BENDER, we have lost one of the last classical geologists with a generalistic knowledge of regional and structural geology, stratigraphy, and palaeontology. He always modestly put himself behind, generously helped and advised students, and shared his knowledge with colleagues. No one who was able to get to know him in his inimitable, thoughtful manner will forget him.

Diploma theses supervised by Peter BENDER:

Gerd KAPP (1986), Andreas STEIH (1987), Michaela HECKERS (1987), Pia HOFMANN (1987), Norbert MICHELS (1992), Uwe BUCHELT (1993), Stefan HERD (1994), Johannes GRAß (1994), Martin SALAMON (1996), Jens RÖSNER (1999), and more than 50 mapping theses in the Rhenish Massif.

Taxa named after Karl Peter BENDER:

Neohindeodella benderi (KOZUR & MOSTLER, 1970)
Polygnathus benderi WEDDIGE, 1977
Diplognathodus benderi HU, HOGANKAMP, LAMBERT & QI, 2020

Devonian bibliography

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Peter BENDER (centre left) in the Weitershausen Quarry, type locality of the uppermost Devonian Weitershausen Formation, looking to the display of his map 1 : 40.000 of the Hörre Zone. Annual meeting of the German Subcommission on Carboniferous Stratigraphy, Marburg 2011.

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Alain Robert Maurice BLIECK

(5.8.1949–6.2.2022)

Susan TURNER

Our esteemed colleague and friend, Alain Robert Maurice BLIECK-CAZEAU of Haubourdin, former CNRS senior scientist, and professor emeritus of the Université des Sciences et Technologies de Lille, Campus de Villeneuve d'Ascq, succumbed to COVID-19 in early February.

Alain, a true northern Frenchman with Dutch/Belgian/Walloon connections, conducted research on a wide range in evolutionary biology, palaeobiology and systematics (taxonomy, nomenclature, phylogeny), palaeoecology, biostratigraphy, and palaeobiogeography. His main focus was the earliest vertebrates and, in particular, the Palaeozoic jawless Pteraspidomorphs that are known from the Ordovician to the Devonian, but he also contributed on Palaeozoic microvertebrates, and sharks to tetrapods. He was in the van of cladistics applied to early vertebrates (GEE 2000).

Alain's body of work spans nearly 50 years. Through his work, he has made major contributions to Devonian geology and stratigraphy, focused especially on the biodiversity, biostratigraphy and

palaeobiogeography of Devonian pteraspidomorphs. His last as his first is on heterostracans pteraspidomorphs and is in press. Alain was a great organiser, creating or co-organising important conferences on western European palaeogeography (e.g., BLIECK & MEILLIEZ 1992; SERVAIS et al. 2003). He brought new rigor to the understanding of early vertebrates, especially their first appearance in the early/mid-Ordovician and the Early Devonian faunas from the Old Red Sandstone Continent (Spitsbergen, Arctic Russia and Canada, Europe, USA). He was one of the first to press that the vertebrates were a group fundamental to the biostratigraphy of the Middle Palaeozoic. He also pressed that conodont animals were not vertebrates (e.g., BLIECK et al. 2010).

Alain was both a field man in the classic style, with expeditions as far afield as Spitsbergen, Iran, an active member of geological societies in France and further afield; a teacher who fostered many students, taking field courses to Wimerieux on the NE French coast, and most generous to many visiting researchers and students.

Papa BLIECK (as he became known after this label was placed on his group table in a French restaurant during a conference) worked on several international projects, especially on mid-Palaeozoic geological problems related to vertebrates and notably UNESCO: IUGS IGCP 328 (1991-1996), for which he was French representative and co-leader from 1993 to 1996, which was voted one of the best projects by the Earth Sciences Division and Board of IGCP. Alain co-edited several conference proceedings, such as the GROSS Symposium series and the Final report for IGCP 328 (e.g. TURNER & BLIECK 1996; BLIECK et al. 1997, 1999; BLIECK & TURNER 2000). During this time, he hosted a major field excursion across northern France and Belgium as the last in the series in 1995, fittingly finishing in a Champagne cave near Reims. His generosity, intellect, his sense of fun will be missed by colleagues and friends. Alain was supported throughout his career by his partner Dr Edmonde RAZAFIMAHALEO and their family.

The 16th International Symposium on Early/Lower Vertebrates to be held in Valencia in mid-June has provided a memorial page: http://iselv.uv.es/in-memory-of-dr-alain-blieck/

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Semen A. KRUCHEK

(19.08.1937–06.10.2021)

The Belarusian Devonian Group

On October 6, 2021, the well-known Belarusian geologist, stratigrapher and paleontologist S. A. KRUCHEK, a leading researcher at the branch "Institute of Geology" of the State Enterprise "Scientific and Production Center for Geology", candidate of geological and mineralogical sciences, passed away.

Semen A. KRUCHEK was born on August 19, 1937, in the village of Peretoki in the Stolbtsy region (Belarus). In 1949, he graduated from the Peretok Primary School, and in 1955 from the Starosverzhansk Secondary School. At first, he worked as a physical education teacher, and then entered the geological and geographical faculty of the Belarusian State University (1956). After graduating in 1961, he started his work at the Institute of Geological Sciences of the Academy of Sciences of the BSSR (since 1970 – BelNIGRI) in the laboratory of paleontology, which was headed by A. V. FURSENKO, corresponding member of the Academy of Sciences of the BSSR. Here, S. A. KRUCHEK formed as a researcher and scientist. The results of his scientific research were summarized in 1975 in his Ph.D. thesis "Lower Famennian Intersalt Deposits of the Devonian of the Pripyat Trough", in which he substantiated an integrated approach in compiling of stratigraphic schemes, developed a detailed stratigraphy of oil-bearing deposits of the intersalt stratum in the Pripyat Trough.

Since 1978, S. A. KRUCHEK worked at the Academic Institute of Geochemistry and Geophysics, in the laboratory of lithology and geochemistry, headed b by A. S. MAKHNACH. At first, he worked as a senior researcher, and then, in 1996–2008, he led the laboratory. In 2008–2010, he was the head of the department of stratigraphy and paleontology of BelNIGRI, and since 2011 he became the leading researcher of the department of regional geology (since 2013 – the department of stratigraphy and tectonics) of the branch "Institute of Geology" of the State Enterprise " Scientific and Production Center for Geology".

Semen A. KRUCHEK was an outstanding specialist in the field of stratigraphy, palaeontology, facies analysis and palaeogeography of the Paleozoic, mainly Devonian, deposits of the western part of the East European Platform. He made a significant contribution to the development of stratigraphic schemes of the Devonian deposits of Belarus in 1981, 2005 and 2010, and their implementation in the practice of geological survey and exploration work on the territory of Belarus. The results of his research were reflected in such collective works as "The Devonian Intersalt Sequence of the Pripyat Depression" (1981), "Organogenic Buildups of the Devonian of

Belarus" (1984), "Geology and minerals of the crystalline basement and the lower part of the platform cover of Belarus" (1996), "Geology of Belarus" (2001), "National Atlas of Belarus" (2002), "Fundamentals of the Geology of Belarus" (2004), "Stratigraphic schemes of the Precambrian and Phanerozoic deposits of Belarus" (2010), and "Early and Middle Famennian sedimentogenesis in the Pripyat Rift Basin" (2017), etc.

He used the acquired scientific experience in long-term work trips abroad. In 1986–1987, he worked at the Oil and Gas Committee in India (Dehradun) as a consultant on the search for non-anticlinal hydrocarbon traps in the Assam, Bengal and Cambay oil and gas basins. From 1990 to 1992, he worked in the Department of Oil and Gas Prospection (Algeria) as the chief expert to generalize the results of geological exploration and determine the prospects for discovering new hydrocarbon deposits in the oil and gas bearing basins of the Algerian Sahara.

A significant place in the life of S. A. KRUCHEK was occupied by scientific, organizational and paedagogical activities. He was the head of the Belarusian Stratigraphic Committee, a member of the Devonian Commission of the Interdepartmental Stratigraphic Committee of Russia, and the International Subcommission on Devonian Stratigraphy. He participated in numerous scientific meetings and exhibitions and repeatedly represented the Belarusian geological science abroad. For ten years since 1997, S. A. KRUCHEK has been giving a course of lectures on “Fundamentals of Stratigraphy”. For many years, he was a member of the scientific councils of the Institute of Geochemistry and Geophysics of the National Academy of Sciences of Belarus and the Scientific and Practical Center for Geology, and a member of the editorial board of the geological journal "Lithosphere".

Semen A. KRUCHEK is the author of more than 70 scientific reports and more than 350 different publications, including 18 monographs. Also, his scientific achievements were honoured by several taxa that were named after him: the conodont *Polygnathus krucheki* STRELCHENKO, 1999; the brachiopod *Trakhalosia krucheki* PUSHKIN, 1986; the acanthodian *Cheiracanthus krucheki* VALIUKEVICIUS, 1995; and the ostracod *Gutschickia krutcheki* DEMIDENKO, 1980.

Colleagues and friends will miss S. A. KRUCHEK, a devoted researcher and a great person, who was distinguished by his wide erudition, extraordinary hard work, adherence to principles and exactingness towards himself. Cherished memories about him will forever remain in our hearts.

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SDS REPORTS

Annual Report to ICS (2021)

1. TITLE OF CONSTITUENT BODY

Subcommission on Devonian Stratigraphy
Reporting: **Ladislav SLAVÍK (Chair)**

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

In 2021, difficulties continued and many activities of the SDS were delayed. In spite of the pandimic restrictions, working groups go on with their work on revision of GSSPs (the basal Emsian and the Devonian-Carboniferous boundary). Also, SDS small subprojects that have been launched in 2020 focussed on gathering data around the problematic GSSPs, are continuing. The major problems and issues were discussed during the first SDS business videomeeting that took place in October 19th, which was successful. Many SDS members reported their activities during the "Covid year" and the regular Annual SDS Business Meeting is postponed, again, for the next year. There are several options, where the meeting could take place, but we will decide on venue depending on situation in 2022. Other activities include the postponed organisation of other Devonian stratigraphic symposia, the publication of the SDS Newsletter, and the launching of the new Devonian webpage housed on the ICS web. Also, two monographic books/journal volumes have been published, on the D-C boundary global review and on the Devonian-Lower Carboniferous of the Western Moroccan Meseta.

The main objectives of the Subcommission on Devonian Stratigraphy fit within IUGS science policy:

- to develop of an internationally approved chronostratigraphical timescale for the Devonian with maximum time resolution, as part of the ICS standard global stratigraphic scale;
- to produce a stratigraphic table displaying agreed subdivision to stage and substage level marking boundaries that are defined by a GSSP.
- to promote of new and modern stratigraphical techniques and their integration into Devonian multidisciplinary schemes.

3. ORGANISATION - interface with other international projects/groups

Actively supporting *IGCP 652, Reading geologic time in Paleozoic sedimentary rocks: the need for an integrated stratigraphy*

3a. Current Officers for 2020-2024 period:

Chair: Ladislav (Lada) SLAVÍK

Vice-Chair: José Ignacio (Nacho) VALENZUELA RÍOS

Secretary: Ulrich (Uli) JANSEN

Webperson: Carlo CORRADINI

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

University of Münster continue to support the staff costs of the SDS Newsletter production and the mailing. The IUGS support pays for the printing. The Newsletter has an ISSN and status as a publication. Since 2021, it is published and printed partly in colour.

We have regular annual meetings (this year only virtual). SDS members support their own attendance at these.

The major part of SDS subprojects are supported from other sources (home institutes and national funding agencies).

5. CHIEF ACCOMPLISHMENTS IN 2021 (including any publications arising from ICS working groups)

SDS meeting took place via ZOOM platform in October 19, 5 p.m. CEST. We were able to inform directly about the current situation in the Devonian community, on-going Devonian projects (accumulation of data in the Eifel Mts, the Rhenish Mts, the Carnic Alps and the Prague Synform, special ICS project for Pyrenees), publications, and future meetings. We had 35 participants from all over the globe (18 countries). The meeting was successful; we recruited six new Corresponding Members from Czechia, Germany, and China.

Launching of the new SDS webpage – housed on the ICS web (stratigraphy.org)

Publications: Two announced important Devonian-related volumes have appeared: A special volume of Palaeobiodiversity and Palaeoenvironments "**Global Review of the Devonian-Carboniferous Boundary**" (Guest-editors: M. ARETZ & C. CORRADINI) with 15 contributions on 370 pages, and a special volume of the Scientific Journal of the Hassan II Academy of Science and Technology "**Devonian to Lower Carboniferous stratigraphy and facies of the South-Western Moroccan Meseta: Implications for palaeogeography and structural interpretation**" (Guest editors: R. T. BECKER, A. EL HASSANI & Z. S. ABOUSSALAM, 333 pp.).

6. SUMMARY OF EXPENDITURE IN 2021 ($USD):

ICS special project to SDS Vice-Chair VALENZUELA-RÍOS	$ 5.000
SDS Newsletter	$ 700
Devonian subprojects:	
SDS Newsletter editor BECKER (Pragian-Emsian boundary sections, Morocco)	$ 600
SDS Webmaster CORRADINI (Lochkovian-Pragian Boundary in the Carnic Alps)	$ 600
SDS Secretary JANSEN (Pg/Em brachiopod biostratigraphy in the Eifel region)	$ 600
SDS Chair SLAVÍK (Praha Fm - in search for basal Emsian GSSP level)	$ 600

7. SUMMARY OF INCOME IN 2021:

ICS $USD 3.000
ICS special project $USD 5.000

8. BUDGET REQUESTED FROM ICS IN 2021

The long planned SDS meeting and field-based conference in New York State, USA, has been postponed for 2023. For the next year, there are two possibilities, where to meet, if situation permits: **The International Palaeontological Congress (IPC6) in Thailand** (November 2022). The SDS members have proposed a Devonian symposium: Devonian palaeoenvironments and mass extinctions. There is also the opportunity for SDS to join the bi-annual conference and field meeting of the Silurian Subcommission (ISSS), planned for the next Summer 2022 in Bulgaria. Our focus will again be the redefinition of the base Emsian GSSP and a meeting to discuss the D-C boundary for redefinition of the base of the Carboniferous. We request contributions to travel costs for one of these meetings.

If none of these events take place in 2022, we will organize a virtual SDS meeting again instead. The funding would then be alternatively used for continuation of the Devonian subprojects mainly focussed on accumulation of data for GSSP redefinitions launched in 2020.

SDS Chair travel costs	$ 900
SDS Vice-Chair travel costs	$ 900
SDS Secretary travel costs	$ 900
In addition, we request the partial support for production of the SDS Newsletter	$ 700
Total Sum requested from IUGS	$ 3400

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

- Work on formal proposals or progress reports submitted for the revision of the basal Emsian GSSP from several areas.
- Continuation of Devonian subprojects aimed at GSSP redefinition.

- Revision of the D/C boundary with the D/C Boundary Task Group in close collaboration with the Carboniferous Subcommission. Progress towards selection of candidate stratotypes.
- Real or virtual SDS business meeting and Devonian symposia

10. KEY OBJECTIVES AND WORK PLAN FOR NEXT 4 YEARS (2020-2024)

- Redefine the base of the Emsian Stage.
- Redefinition of the Devonian/Carboniferous Boundary with the joint Task Group.
- Annual meetings

APPENDIX

Names and Addresses of Current Officers and Voting Members

CHAIR: Ladislav SLAVÍK
Department of Paleobiology and Paleoecology, Institute of Geology of the Czech Academy of Sciences, Rozvojová 269, CZ-165 02 Praha 6, Czech Republic, Tel.: 00420 233087247; slavik@gli.cas.cz

VICE-CHAIR: José Ignacio VALENZUELA RÍOS
Department de Geología, Universitat de València C/. Dr. Moliner 50, E-46100, Burjassot, Spain, Tel.: 0034 96 3543412; Jose.I.Valenzuela@uv.es

SECRETARY: Ulrich JANSEN
Palaeozoology III, Senckenberg Gesellschaft für Naturforschung, Senckenberganlage 25, 60325 Frankfurt, Germany, Tel.: 0049-69-97075 1146; Ulrich.Jansen@senckenberg.de

SDS NEWSLETTER EDITOR: R. Thomas BECKER
Westfälische Wilhelms-Universität, Geologisch-Paläontologisches Institut, Corrensstr. 24, D-48149 Münster, Germany, Tel.: 0049-251-83 339 51, Fax: 0049-251-83 339 68; rbecker@uni-muenster.de

WEBMASTER: Carlo CORRADINI
Dipartimento di Matematica e Geoscienze, Università di Trieste, via Weiss 2 - 34128 Trieste, Italy, Tel.: 0039 040 558-2033; ccorradin@units.it

Voting members, address, country, phone, email, special fields:

R. T. BECKER, Westfälische Wilhelms-Universität, Geologisch-Paläontologisches Institut, Corrensstr. 24, D-48149 Münster, Germany, Tel.: 0049-251-83 339 51, e-mail: rbecker@uni-muenster.de; ammonoids, conodonts

C. E. BRETT, Department of Geology, University of Cincinnati, 500 Geology-Physics Bldg., Cincinnati 45221-0013 OH, U.S.A, Tel.: +1-513-5564556, e-mail: brettce@ucmail.uc.edu; sequence stratigraphy

R. BROCKE, Senckenberg Forschungsinstitut und Naturmuseum Frankfurt, Senckenberganlage 25, D-60325 Frankfurt am Main, Germany, Tel.: 0049-69-970751162, e-mail: rainer.brocke@senckenberg.de; palynology

C. CORRADINI, Dipartimento di Matematica e Geoscienze, Università di Trieste, via Weiss 2 - 34128 Trieste, Italy, Tel.: 0039 040 558-2033, e-mail: ccorradin@units.it; conodonts

C. CRONIER, Unité Evo-Eco-Paléo (EEP) - UMR 8198. CNRS / Université de Lille - Sciences et Technologies, Batiment SN5, bureau 324, 59655 Villeneuve d'Ascq, France, Tel.: 33 (0)3-20-43-41-51, e-mail: catherine.cronier@univ-lille1.fr; trilobites

A-C. DA SILVA, Pétrologie sédimentaire, B20, Allée du Six Août, 12, Quartier Agora, Université de Liège, 4000 Liège, Belgium, Tel.: +32 – 43662258, e-mail: ac.dasilva@ulg.ac.be; astrochronology;

Y. GATOVSKY, Moscow State University, Dept. of Paleontology, Geological Faculty, Vorob'evy Gory, 1, Moscow, GSP-1, 119991, Russia, Tel.: 007 495 9394960, e-mail: gatovsky@geol.msu.ru; conodonts

N. G. IZOKH, Institute of Petroleum Geology and Geophysics, Siberian branch of Russian Academy of Sciences, Acad. Koptyug. Av. 3, 630090 Novosibirsk, Russia, Tel.: + 7 (383) 333-24-31, e-mail: IzokhNG@ipgg.nsc.ru; Russia, conodonts

MA, Xueping, Peking University, Department of Geology, Beijing 100871, China, e-mail: maxp@pku.edu.cn; brachiopods

J. E. A. MARSHALL, School of Ocean and Earth Science, University of Southampton, National Oceanography Centre, European Way, Southampton SO14 3 ZH, UK, Tel.: +44-23-80592015, e-mail: jeam@noc.soton.ac.uk, plants

D. J. OVER, SUNY Geneseo, Department of Geological Sciences, Geneseo 14454 N.Y., U.S.A., Tel.: +1-585-24552945291, e-mail: over@geneseo.edu; conodonts

QIE, Wenkun, CAS Key Laboratory of Economic Stratigraphy and Palaeogeography, Nanjing Institute of Geology and Palaeontology and Center for Excellence in Life and Paleoenvironment, Chinese Academy of Sciences, Nanjing 210008, China, e-mail: wkqie@nigpas.ac.cn; chemostratigraphy

G. RACKI, University of Silesia, Faculty of Earth Sciences, Department of Palaeontology and Stratigraphy, Będzińska str. 60, 41–200 Sosnowiec, Poland, Tel.: 48–32–3689-229, e-mail: racki@us.edu.pl; brachiopods, event & sequence stratigraphy

C. SPALLETTA, Dipartimento di Scienze della Terra e Geologica Ambientali, Università di Bologna, I-40126 Bologna, Italy, Tel.: +39-051-2094578, e-mail: claudia.spalletta@unibo.it; conodonts

K. TRINAJSTIC, Faculty of Science and Engineering, School of Science, Department of Environment and Agriculture, Bentley Campus 311.117, Australia, Tel.: Phone: +618 9266 2492, e-mail: kate.trinajstic@uwa.edu.au; fish

Working (Task) Groups and their officers:

Devonian/Carboniferous Boundary Working Group (DCBWG)

The DCBWG was established in 2008, with the goal to redefine the GSSP for the Tournaisian (equivakent to base of the Carboniferous System), when problems both with the type section (La Serre E', Montagne Noire, France - photo) and the index fossil (Siphonodella sulcata, conodont) arose. It includes members named by the Devonian (SDS) and Carboniferous (ISCS) subcommisions. Several meetings and workshop took place up to now, and the new GSSP is expected to be proposed in the near future.

Members

Markus ARETZ (France) - Chair
Carlo CORRADINI (Italy) – Vice-Chair
Ondrej BABEK (Czech Republic)
R. Thomas BECKER (Germany)
Raimund FEIST (France)
Yuri GATOVSKY (Russia)
Sandra I. KAISER (Germany)
Tomáš KUMPAN (Czech Republic)
John E. MARSHALL (United Kingdom)
Hanna MATYJA (Poland)
Svetlana NIKOLAEVA (Russia)
D. Jeffrey OVER (Usa)
Qie WENKUN (China)
Eddy POTY (Belgium)
Cirille PRESTIANNI (Belgium)
Barry RICHARDS (Canada)
Claudia SPALLETTA (Italy)

Emsian Working Group Members

Ladislav SLAVÍK (Czech Republic)
José Ignacio VALENZUELA-RÍOS (Spain)
R. Thomas BECKER (Germany)
Maya ERINA (Uzbekistan)
Jindřich HLADIL (Czech Republic)
Nadya IZOKH (Russia)
Olga IZOKH (Russia)
Ulrich JANSEN (Germany)
Aleksey KIM (Uzbekistan)
Tomáš WEINER (Czech Republic)
Hedvika WEINEROVÁ (Czech Republic)

SDS DOCUMENTS

Quantitative approach by miospores of the Devonian-Carboniferous transition

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Abstract

The abundance of selected species at geological scale has been noted to be a useful criterium to correlate sedimentary sequences. In this work, we take as an example two groups of species, the *lepidophyta* and *pusillites*, which are noted to characterize the Devonian-Carboniferous transition. From formerly obtained results in rare Famennian coal-beds, it is known that the parent plants of the two groups of spores were living near swamps in deltaic marshes. Spores (miospores), often with diameters around 50 µm, have the advantage, compared to other microfossils, to be produced by each individual terrestrial plant in thousands of specimens, which are transported into the sediments by wind and fluvial or marine currents. In this context, the group *lepidophyta*, the most widespread and stratigraphically narrowest, was chosen to be considered in priority.

We selected the geological sections studied in the northern Rhenish Massif (Sauerland, Germany) as reference because they are the best known for animal macrofossils, such as goniatites, in particular those species that had been used to fix the DCB before the use of conodonts (and spores), which prevail to-day. In the reference sections in Sauerland, the extinction of the group *lepidophyta* is observed in two steps. Initially it is most often dominant, with more than 50 % of the total of all spores counted. The first extinction step is characterized by a strong decline of the group *lepidophyta,* which persist to be present in all samples, but rarely exceeds 5 % of the total of all spores counted. The second extinction step led to the complete absence of the group.

These two extinction steps have been noted in several localities in Europe (Ireland, England, Poland, Portugal) but also in Greenland in a sedimentary sequence in which the extinction of the group *lepidophyta* is linked to warming and humidity increase and the collapse of the final Devonian glacial episode.

We have searched this interval in North and South America, but most of palynological analysis have no quantitative approach, and often the extinction level of the DCB is hampered by the erosion of Upper Devonian deposits or unfavorable lithofacies for palynology. Additionally, the presence of reworked Devonian palynomorphs is frequent and, especially, those from the Upper Devonian were redeposited into Mississippian deposits in South America.

1. Introduction

Since the middle of last century (KEDO 1957), attention has been drawn on the significance of Famennian species often designated then as belonging to the genus *Hymenozonotriletes* NAUMOVA, but known, now, as belonging to the genera *Retispora* and *Vallatisporites.* Quantitative studies bearing these taxa were used to approach the definition of the Devonian/Carboniferous boundary (see STREEL 1970, pp. 121-147, and CHIBRIKOVA et al. 1978, fig. 2). In the present contribution, we will focus on the transitional period between the *Retispora* group optimum (4 and 5 in Fig. 1) and the *Vallatisporites* group optimum (6, 7, and 8 in Fig. 1) time-interval, which corresponds more or less to the paleo climatic events called Hangenberg Crisis (STREEL 1999).

Spores (miospores), often with diameters around 50 µm, have the advantage, compared to other microfossils, to be produced by each individual terrestrial plant in thousands of specimens, which are transported into the sediments by wind and fluvial or marine currents. The abundance of selected species at geological scale has been noted to be a useful criterium to correlate sedimentary sequences.

The intention is to consider the stratigraphic correlations available between miospores data and other micro- and macro-fossil groups helpful for age diagnostics, as well as the presence of diamictitic deposits within the postglacial sequence, and the eventual recognition of positive carbon isotope excursions (PCIE).

Most of the biostratigraphic data available for these time-intervals have been displayed in "assemblage zones", rarely in "concurrent range zones". Although, correlations with other groups of fossils other than miospores require the latter (STREEL & LOBOZIAK 1996).

Furthermore, the lowest record of any taxon (First Occurrence Biohorizon = FOB) is dependent of the amount of miospores observed below the FOB (ALPERN 1970) and, of course, of a homogenous concept of the involved taxon.

2. The *lepidophyta* Group

The *Retispora lepidophyta* FOB, base of the former LV miospore Zone (STREEL et al. 1987), equated to the base of Fa2d chronozone after BOUCKAERT et al. (1968), was recorded in the Chanxhe I section 20 cm higher than the base of Bed 94 of CONIL (1964). One specimen of 127 counted spores was found, followed successively by seven specimens of 224 counted spores, 10/203, 7/103, 28/631, 31/432, and more than 100 specimens in the biometric zone C, one meter higher than Bed 97 (STREEL et al. 1976, p. 29 and pl. 4. *Vallatisporites pusillites* was also first recorded at that last level.

A reexamination, with new slides of the same section (Chanxhe 1), led to the conclusion that the *Retispora lepidophyta* FOB (base of the LL miospore Zone) was about 2 m below the top of the Evieux Formation (in Bed 93 of CONIL 1964) and the first *Knoxisporites literatus* enters immediately above the top (MAZIANE-SERRAJ et al. 1999, 2007).

The sedimentary context of these FOBs was displayed in STREEL (1999, figs. 2 and 3) and dated as the Middle *expansa* conodont zone, characterizing the Fontin Event (HIGGS et al. 2013). In the Etroeungt area (northern France), the *Retispora lepidophyta* FOB is found (1/171 counted spores), in unit i of the "Schistes de l'Epinette", i.e. immediately below the *Eoendothyra communis radiata* (Df3d) Zone, marking the base of the Epinette Event (CONIL et al. 1974; STREEL et al. 2005). The uppermost Famennian Substage, or Strunian, has been widely used and internationally in a chronostratigraphic sense based on macrofossils described from the Etroeungt area. A new definition based on microfossils is still proposed for international agreement (STREEL et al. 1998, 2006) but is already widely used.

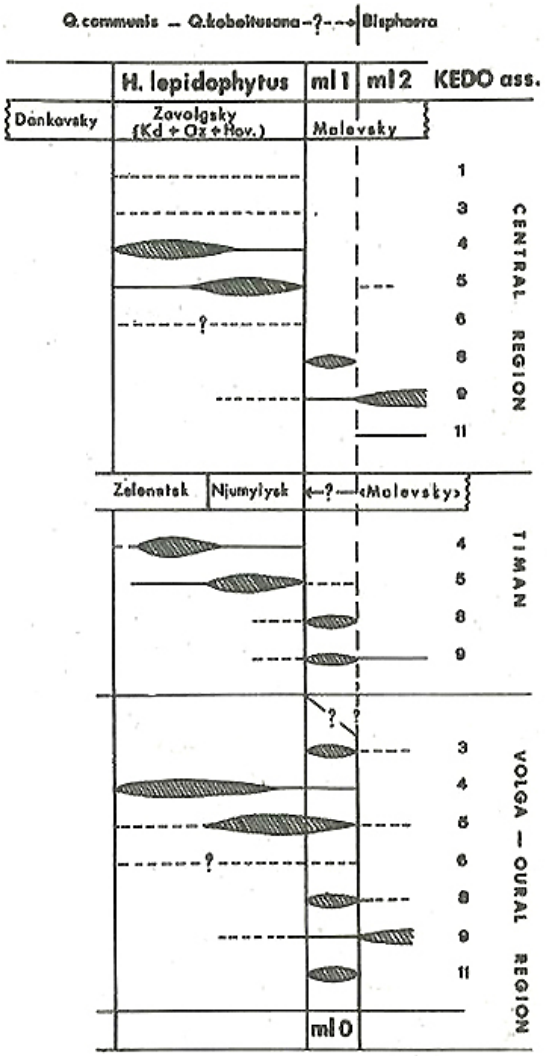

Fig. 1. Distribution of key spores on the Russian platform (CHIBRIKOVA et al. 1978). Data from RASKATOVA, UMNOVA, NASARENKO, BYVSHEVA and KHOLOVAYA (central region), SENNOVA (Timan), and BYVSHEVA (Volga-Oural region).

1 = "*macroreticulatus*
2 = "*admirandus*"
3 = "*flexuosus-radiatus*"
4 = *lepidophytus "typicus"*
5 = *lepidophytus minor* and *tener*
6 = *Vallatisporites* n. sp. (*pusillites* DEL. & NEV.)
7 = *verrucosus*
8 = "*pusillites*" (*vallatus* HACQ.)
9 = "*Dictyotriletes*"
10 = *nitidus*
11 = *explanatus*

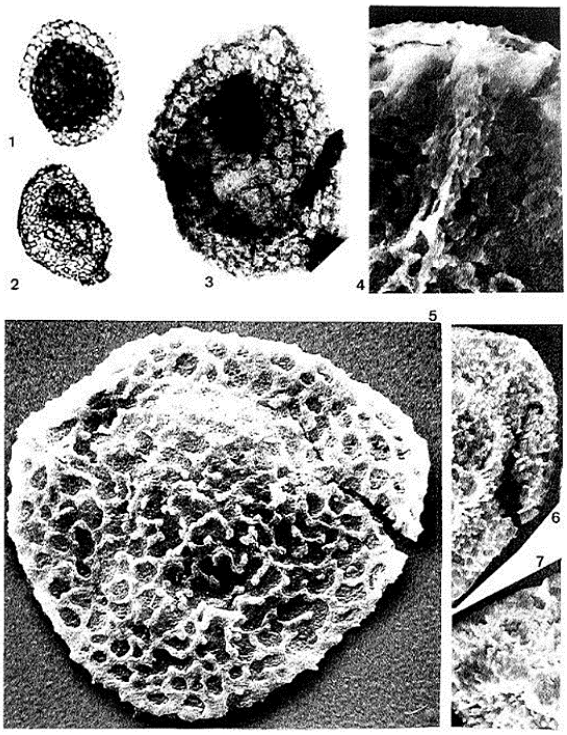

Fig. 2. Original reproduction of Plate IV from STEEMANS et al. (1996). **1, 5.** *Retispora lepidophyta* (KEDO) PLAYFORD 1976; 1. Evieux Formation, Langlier Quarry, Dinant Basin, Belgium, x 500; 5. SEM photo showing muri and additional ornament, well visible at the equator, x 2.500. **2, 6, 7.** *Retizonomonoletes hunanensis* FANG et al., 1993; 2. Oujiachong Formation, Malanbian, Hunan, x 500; 6-7. SEM photo showing density of ornamentation, x 2.500. **3, 4.** *Retispora macroreticulata* (KEDO) BYVSHEVA 1985; 3. Evieux Formation, Evieux railway section, Dinant Basin, Belgium, x 500; 4. SEM photo showing muri and additional apiculate ornament, x 2.500.

The uppermost Famennian starts about at the level of the first occurrence of the Foraminifer *Quasiendothyra kobeitusana (*or Df3e*)*. It corresponds to the Upper *expansa* conodont zone (= *Bispathodus ultimus ultimus* Zone) and to the change from larger forms of *Retispora lepidophyta* sensu lato (or typical form) into *R. lepidophyta* var *minor.*

Retispora lepidophyta var. *tener* of KEDO (1957 = *Retispora lepidophyta* type a of STREEL 1966) and *R. lepidophyta* var. *minor* also, appear slightly later than larger forms of *Retispora lepidophyta* sensu lato (or typical form), and increase in frequency closer to the Devonian-Carboniferous boundary. *Retispora lepidophyta* var *tener* is more frequently documented just below the DCB. It is distinguished from *Retispora lepidophyta* sensu lato (or typical form) due to its irregular pattern of foveolate/reticulum in distal face. It was attributed to a short event of abnormal spores (*tener* Eent) discussed in detail by FILIPIAK & RACKI (2010) and PRESTIANNI et al. (2016) (see also STREEL & STEEMANS 2020).

The taxonomical context of the FOB is, of course, often easier to control when used by the same researchers. Conflict may arise, however, as from the interpretation on a possible ancestor of *Retispora lepidophyta* named *R. l.* var. *macroreticulata* by KEDO or *Retispora macroreticulata* by BYVSHEVA 1985. These forms occur in the Ardennes area in the Uppermost *marginifera* conodont zone (STREEL & LOBOZIAK 1996), i.e. much below the *Retispora lepidophyta* FOB, as characterized above (Fig. 2). *Retispora archaeolepidophyta* (KEDO) MCGREGOR & CAMFIELD 1982 appearing in the Eifelian-Givetian to Frasnian is another example of a possible ancestor of *Retispora lepidophyta,* occurring much below the *Retispora lepidophyta* FOB.

Following F. L. STAPLIN (personal communication from 7.2.1971), below the larger forms of *Retispora lepidophyta sensu lato* (or typical form), known in the Famennian in Western Canada, specimens again become smaller, and are more granulose-apiculate than reticulate. They seem to represent another species.

Another misinterpretation may arise from the occurrence of malformed spores. This is perhaps the case with the abundant monolete spore named *Retizonomonoletes hunanensis* FANG et al., 1993, which, after GAO (1990), have the same time-range as *Retispora lepidophyta* from biozones LL to VI in the Malabian section (Hunan, South China, Fig. 2). This coincides with the Df3 Foraminifer Zone (HANCE et al. 1994).

Retispora lepidophyta was produced by a small, still unknown, annual, herbaceous, short living plant, without a strong vegetative growth,

and producing only sterile spores (MARSHALL 2021). Species of the *lepidophyta* group disappeared at the end of the Devonian (e.g. STREEL et al. 2000; MATIJA et al. 2020; MARSHALL et al. 2020).

3. The *pusillites* Group

Hymenozonotriletes pusillites KEDO, 1957 is known in the highest Zavolsk and Malevka beds in eastern regions of the Russian Platform (BYVSHEVA 1976) and was then considered to belong to what "western palynologists" were calling *Vallatisporites vallatus* HACQUEBARD, 1957. *Vallatisporites pusillites* (KEDO) DOLBY & NEVES 1970 was considered then to be different (CHIBRIKOVA et al. 1978).

Another confusion aroused with the definition of *Cirratriradites hystricosus* by WINSLOW in 1962, due to a gradual change of ornamentation from *Cirratriradites hystricosus* to *Vallatisporites vallatus* was suggested later by STREEL & TRAVERSE (1978) in DC strata from the Horseshoe Curve section in Pennsylvania, U.S.A.

Spores with the same size, but different sculpture, were described as *Hymenozonotriletes pusillites sensu lato* KEDO & GOLUBTSOV, 1971. KEDO indicated that it would be possible to recognize some variations or even new species within this taxon. The CIMP Working Group *Vallatisporites,* managed then by Bernard OWENS (unpublished, 2002-2006), had recorded 31 different species, which all show the characteristic vacuoles of the genus *Vallatisporites*. RICHARDSON et al. (2022) retained nine of these taxa, their stratigraphic distribution and a list of synonyms based on the analysis by AVCHIMOVITCH et al. (2021).

4. Palaeoenvironmental approaches

Coal beds and lateral fluvial mud incursions give obviously the best chance to reconstruct the paleoenvironment of marsh complexes. Unfortunately, preserved Famennian coal beds are rather rare (e.g. PRESTIANNI et al. 2010).

1. One of these is at the locality of Elkins, Hampshire Formation, West Virginia (USA), where both large deltaic marshes and smaller upland backswamp are dominated by the prefern *Rhacophyton* and its microspores known to belong to the *Diducites plicabilis-Auroraspora varia* Complex. "Other plants contributed to the swamp peats only as a result of transport during floods and storms or by increased proximity of flood plain communities to swamp as lateral encroachment occurred during ecological succession" (SCHECKLER 1986). Samples collected in and near coals in that locality do not contain *Retispora lepidophyta,* only *Vallatisporites hystricosus (*STREEL & SCHECKLER 1990).

Samples of coal (Samples Hc and Hc pyr on fig. 2 in STREEL & SCHECKLER 1990) contain only 3 or 4 % of *V. hystricosus* among a complete dominance of miospores of the *Diducites plicabilis-Auroraspora varia* Complex. On the contrary, Sample Hd coming from a more shaly part of a hummocky cross-stratified sandstone overlying the coal-bed, contains 34 % of *V. hystricosus* against 39 % of miospores of the *Diducites plicabilis-Auroraspora varia* Complex. The miospore assemblage from Sample Hd might well represent a mixture of the swamp and near-swamp environments. Evidently the plants producing *V. hystricosus* spores were living near the swamp. The Elkins locality corresponds to a deltaic marsh characterized by rare introduction of acritarchs (Sample Hb).

2. Another locality with coal at Rawley Springs (U.S.A.), where no *hystricosus* and no *lepidophyta* spores were recorded, corresponds to a back-swamp on the upstream floodplain characterized by other spores, dominated (66 %) by *Retusotriletes* cf. *coniferus* (SCHECKLER 1986; STREEL & SCHECKLER 1990).

3. In a section of the Catskill Formation, carbonaceous shales including pockets and small beds of pyritic, vitrinitic, high-volatiles, a bituminous "coal" (with > 40 % ash) was uncovered in Centre County, Pennsylvania (WARG & TRAVERSE 1973). The carbonaceous shales and coals contain abundant spores, mostly *R. lepidophyta* and *V. hystricosus*. *Retispora*

lepidophyta decreases in size and then disappears toward the top of the Devonian sequence. Only *V. hystricosus* has been found higher. A sample from the top of the section studied yielded an assemblage where *R. lepidophyta,* usually abundant, was missing. Instead, *V. hystricosus* increased in relative abundance by a factor of about 15 times. The complete absence of *R. lepidophyta* was in a sample that came from the "Lower Sandstone Member" of the Pocono Formation (see below).

4. A section of sandstones and shales of the Catskill and Pocono formations spanning the transition Devonian – Mississippian was sampled (STREEL & TRAVERSE 1978) at the famous Horseshoe Curve between Altoona and Gallitzin in Pennsylvania (U.S.A.), 80 km southwest of Centre County, Pennsylvania (WARG & TRAVERSE 1973). Plants recorded from the highest part of the "Middle Sandstone and Shale Member" are representative of the widespread Mississippian *Triphyllopteris* flora of READ & MAMAY (1964).

Samples 1 and 2 from the "Lower Sandstone Member" on top of the Catskill Red Beds have *V. hystricosus* but lack *R. lepidophyta.* They correspond to the HYS Interval Zone of the VH Oppel Zone (= Middle *expansa* conodont Zone, now *Bi. aculeatus aculeatus* Zone) in the Evieux Formation of the Ourthe Valley in Belgium (HIGGS et al. 2013).

Samples 3 and 4 from the "Middle Sandstone and Shale Member" have *R. lepidophyta* (11.500 spores scanned below). Sample 4 has also *Indotriradites explanatus* (20.000 spores scanned below). They correspond, respectively, to the LL and LE Oppel Zones in the Chanxhe reference section in East Belgium.

Sample 5 from the same "Middle Sandstone and Shale Member" has no *R. lepidophyta* but *Vallatisporites verrucosus, V. vallatus,* and probable *Spelaeotriletes pretiosus* (see pl. I, fig. 3 in STREEL & TRAVERSE 1978). It should correspond to the PC Zone of Middle Tournaisian age (CLAYTON et al. 1977).

Obviously, the plants producing the *pusillites* group started to occupy the Famennian complex of marshes before (in the middle Famennian?) and continue after (in the lower Tournaisian?) the plants producing the *lepidophyta* group.

5. Time-interval between the *lepidophyta* group dominance and the *pusillites* group dominance

Detailed spore data are found in the Hangenberg shales and sandstones of the Rhenish Massif in Germany (HIGGS et al. 1993, 2013) but are not mentioned by ARETZ et al. (2021, fig. 2) in their global review on the DCB. Spore stratigraphy can however be related (STREEL 2015) to different intervals of the Hangenberg crisis (BECKER et al. 2021).

6. The Devonian – Carboniferous LN-LN*-VI palynozones in Sauerland (Germany)

The LN-LN*-VI transition corresponds to the Middle and Upper Hangenberg Crisis intervals ranging from the *Bi. costatus-Pr. kockeli* Interregnum (*ck*i) to the *Pr. kockeli* Zone, followed by the *Pr. kuehni-Si. (Eosi.) sulcata* Zone (CLAUSEN et al. 1994; BECKER et al. 2021). We have condensed the Upper Crisis intervals I and II on our correlation chart (Fig. 3). The interval I (a black nodule layer) has been documented from the Drewer section of the Rhenish Massif, but occurs also in the Borkewehr section of the Balve region. (R. T. Becker personal communication 2022).

In the Stockum trench II (HIGGS et al. 1993), the sandy part (Hangenberg Sandstone = HSst) contains an atypical LN assemblage of spores (LN*), very rich in *Retusotriletes* ssp., and where *R. lepidophyta* is rare (about 1 % - but a consistent element). A quantitative palynological study allows to recognize in the Stockum trench II (STREEL 1999) some changes in the paleoenvironment of the deposits based mainly on the type of palynodebris: more heterogenous, better preserved and more translucid debris suggesting more anoxic conditions in the Hangenberg Shales (HSh)

between the HBS (Hangenberg Black Shales) and the HSst.

All studied assemblages never contain acritarchs except immediately above the last sandstone (Sample 94 in HIGGS et al. 1993), where a very abundant single form of *Micrhystridium* occurs, accounting for 70 % of the total palynomorphs. A detailed analysis of the spore content of 21 successive samples (HIGGS et al. 1993, tab. 1) allows to characterize the sequence LN-LN*-VI. Above the HBS, the LN Zone occurred from samples 150 to 121, the LN* Zone from samples 118 to 104, and the VI Zone from samples 102 to 94.

The following taxa start in the LN* informal zone: *Cyrtospora cristifer* in samples 106 and 118 (HIGGS et al. 1993), present also in the Hasselbachtal section samples Hb83, Hb15-17, and Hb 22-23 (HIGGS & STREEL 1983) but absent from the corresponding Hasselbachtal Borehole Bh1 Sample. *Bascaudaspora mischkinensis* (= ?*B. submarginata* PLAYFORD) HIGGS et al. 1988) starts in the LN* informal zone (samples 106, 110, 113), if one accepts that LN* starts at the level 29, 40 in the Hasselbachtal Borehole Bh1 (HIGGS et al. 1993).

No spore species starts at the base of the so-called VI Zone: *Vallatisporites verrucosus, V. vallatus,* and *Retusotriletes incohatus* are known since the LN Zone in the Stockum trench II (HIGGS & STREEL 1984; HIGGS et al. 1993).

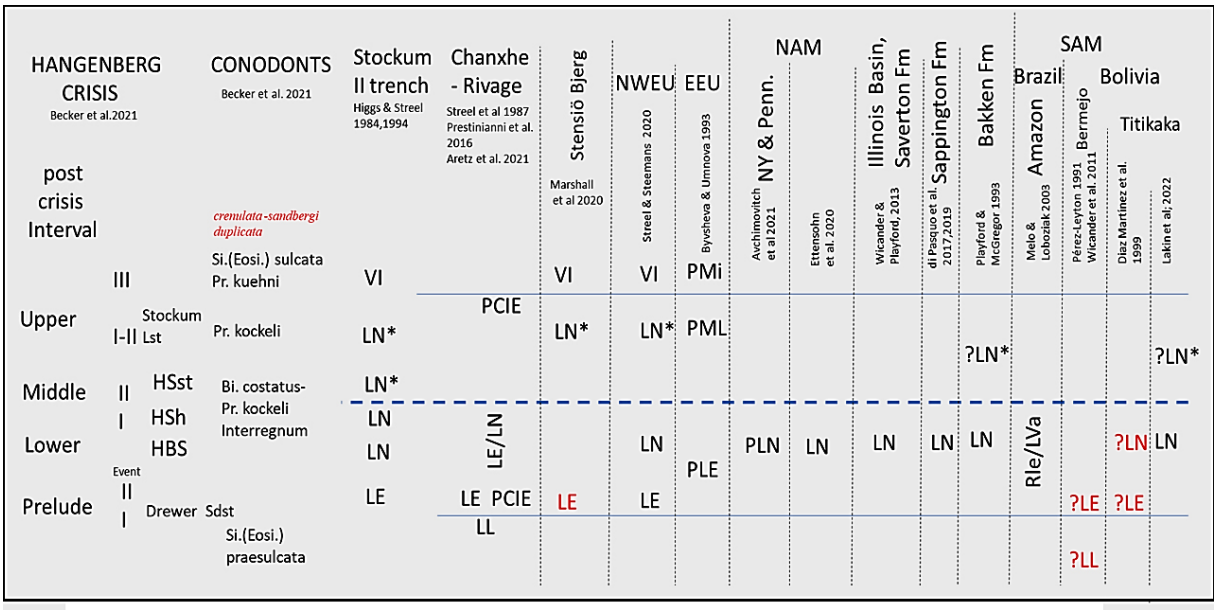

Fig. 3. Correlation chart of the Devonian – Carboniferous LN-LN*-VI palynozones. References and abbreviations: NWEU= North-West Europe (see in Streel & Steemans 2020: South-West England 5.1, 5.2, South-Ireland: 6.1, 6.2, 6.3; South-Poland: 7.1, 7.2; South-Potugal: 8; Germany: 10.5). EEU=East Europe. NAM= North America. SAM= South America. PCIE=Positive Carbon Isotope Excursion. ?LL and ? LE are reinterpreted herein as likely reworked Rl assemblages in Tournaisian of Bolivia (for more information see text).

7. The Devonian – Carboniferous LN-LN*-VI palynozones in Ireland

CLAYTON et al. (1974), working in the South Munster Basin (the Cork beds) in southern Ireland, subdivided the NV Zone of NEVES et al. (1972) into two subzones, the LN Subzone and the VI Subzone. They were proposed as Concurrent Range Zone by HIGGS et al. (1988).

The LN *(Retispora lepidophyta-Verrucosisporites nitidus)* Biozone has most of the taxa of the preceding (LE) Biozone. *Lophozonotriletes malevkensis* NAUMOVA (KEDO), *Vallatisporites verrucosus* HACQUEBARD and *Densosporites spitsbergensis* PLAYFORD appear close to the base of the LN Biozone. *Verrucosisporites nitidus* is rather

sparse in the basal LN Zone, usually represented by the smaller verrucate forms (HIGGS et al. 1988).

The VI (*V. verrucosus-Retusotriletes incohatus*) Biozone is marked by the disappearance of *R. lepidophyta, V. pusillites, Rugospora flexuosa,* species of the genera *Ancyrospora* and *Hystricosporites*, *Diducites versabilis,* and *D. plicabilis.* The basal VI Biozone assemblages, in contrast to the preceding LN assemblage, are very restricted in composition, usually dominated by simple laevigate forms (HIGGS et al. 1988). *Vallatisporites vallatus* was originally considered by CLAYTON et al. (1974) as characterizing the *V. vallatus-R. incohatus* Zone.

An important contribution to the quantitative approach of the transitional Devonian to Carboniferous palynozonation is obviously the descriptive and quantitative analysis, with illustrations of miospores in the Ballycrovane Harbour (VAN VEEN 1981, fig. 2; see also HIGGS et al. 1988) and Bantry Bay (VAN VEEN 1981, fig. 3) sections (County Cork, southern Ireland). It shows that the most distinct DCB palynological change is taking place between the *Retispora lepidophyta-Verrucosisporites nitidus* (LN) and the *Retispora lepidophyta-Cyrtospora cristifera* (LCr) Phases in the basal part of a widespread pelitic unit: the Castle Slate Member of the Kinsale Formation (STREEL & STEEMANS 2020).

Cyrtospora cristifera var A VAN DER ZWAN 1979 covers the range of phases LCr and NR in southern Ireland (VAN VEEN 1981) across the Coomhola/Kinsale formations transition. It is present until the Courtmascherry Formation according to VAN DER ZWAN (1979). *Cyrtospora cristifera* is distinguished from other members of the *C. cristifera* morphon in having a distal crassitude. *Cyrtospora cristifera* var A is distinguished from *C. cristifera* var B, which has a reduced distal crassitude, rosette shaped. Most occurrences of the *C. cristifera* morphon are documented in Euramerica, *Cyrtospora cristifera* var A being the most often recognized by VAN DER ZWAN (1979, fig. 3). Almost all occurrences of recorded *C. cristifera* were from marine strata or from continental strata with marine excursions. One may think of an exclusively coastal-deltaic environment for these plant taxa (VAN DER ZWAN 1979).

The *C. cristifera* morphon might be another example of malformed land plant spores due to the destruction of the Ozone layer resulting from direct effects of volcanic gazes derived from large igneous province (LIP) eruptions (PISARZOWSKA et al. 2020) or/and UV-B radiations resulting in the loss of that protective Ozone layer (MARSHALL et al. 2020).

8. The Devonian – Carboniferous LN-LN*-VI palynozones in Belgium

The reference section of the Ourthe Valley Chanxhe 1 (MAZIANE et al. 2002, 2007), interrupted by a fault in its upper part, has been duplicated on the left bank of the river at Rivage Pont de Scay (PRESTIANNI et al. 2016). About the same section had been studied by KUMPAN et al. (2014), using the original log of CONIL (1964) and providing correlations with two positive carbon isotope excursions (PCIE in Fig. 3).

The juxtaposition of lithologies indicates that the lower recorded positive excursion (around 3 %, equivalent to the unnamed positive excursion in the Upper *expansa = Bi. ultimus ultimus* Zone known from the Carnic Alps, after KAISER et al. 2008), is to be searched around the transition LL/LE in the Ourthe Valley sections. The positive excursion is accompanied with increased values of the U/Th palaeoredox proxy, which reached values 0.75 indicative for hypoxia (JONES & MANNING 1994). The positive $\delta^{13}C_{carb}$ excursion in the level of facies progradation may be related to a cooling event, as reported from various glacial periods of the Earth history (e.g. SALTZMAN 2003; personal communication of T. KUMPAN in 2020).

This is also observed at the level of Chanxhe 1, where acritarch diversity regresses significantly and where the level of the first appearance of *I. explanatus* marks the contact of palynozones LL/LE. It is also the level, where

shallow water ostracods enter in this locality (CASIER et al. 2005), arguing for a lowering of the sea level.

The higher recorded positive excursion near the base of the Tournaisian Hastiere Formation, devoid of conodonts and miospores, should correspond to the DC Boundary. It gives also some credibility to the attribution of the last samples (83-94) studied in the Rivage Pont de Scay to a combine LE/LN zone rather than a LE Zone alone. Notably, the occurrence in the highest sample (94) of *Bascaudaspora mischkinensis* and *Vallatisporites vallatus?* is coincident with the first thick shaly beds (Bed 156 after CONIL 1964) of the Hangenberg Black Shale (HBS) in Sauerland.

9. The Devonian – Carboniferous LN-LN*-VI palynozones in Greenland

The discovery in East Greenland (Stensiö Bierg) of the LN* Zone allowed to better understand the End-Devonian Mass Extinction (EDME) succeeding a significant arid interval of the LN Zone, and representing warming and humidity increase and the collapse of the final Devonian glacial episode (MARSHALL 2021).

10. The Devonian-Carboniferous LN-LN*-VI in Western, Central and Southern Europe

A review of localities, where spores had been studied in the range of the DCB was attempted by STREEL & STEEMANS (2020) in order to verify the "practibility" of the new sequence LN-LN*-VI (Fig. 3). Ten of 25 were positive in that they display the full sequence, notably Kowala (in southern Poland), Burrington Combe and the Barnstaple area (in South-West England), Old Head Kinsale (in southern Ireland), and the Tercenas Formation in southern Portugal.

11. The Devonian-Carboniferous LN-LN*-VI in Eastern Europe

Based on many boreholes in eastern Europe, the spore zonation near the DCB has been established, and the *Vallatisporites pusillites* (P) Zone, being divided into three Subzones (BYVSHEVA & UMNOVA 1993). The lower *Vallatisporites pusillites - Retispora lepidophyta - Hymenozonotriletes explanatus* Subzone (PLE) has abundant *Retispora lepidophyta*. The middle *Vallatisporites pusillites - Tumulispora malevkensis - Retispora lepidophyta* Subzone (PML) may include rare *Retispora lepidophyta*. The upper *Vallatisporites pusillites – Tumulispora malevkensis* Subzone (PM) does not contain *Retispora lepidophyta*. The PM Subzone has been changed subsequently into the *Vallatisporites pusillites - Bascaudaspora mischkinensis* (PMi) Subzone.

The succession PLE-PML-PMi corresponds to the LN-LN*-VI sequence (Fig. 3), the PML including rare *Retispora lepidophyta*.

Some boreholes were studied in the central part of the Russian Platform, which cross the DCB limit. Spores of the *Vallatisporites pusillites - Bascaudaspora mischkinensis* (PMi) Subzone of the *Vallatisporites pusillites* (P) Zone may be disconformably overwhelming the *Retispora lepidophyta tenera* (Ltn) Subzone of the *Retispora lepidophyta* (L) Zone).

The assemblages of spores of the PMi Subzone and M Zone *(Tumulispora malevkensis* Zone) overwhelming the P Zones are closely comparable in their composition of species. In the assemblage of the PMi Subzone, *V. pusillites* varies from 6 to 58 % but is reduced to near its total disappearance in the M Zone. Neither *Retispora lepidophyta* nor any of its varieties has been found in the PMi Subzone.

12. The Devonian – Carboniferous LN-LN*-VI palynozones in North America (NAM)

Several publications are available in NAM, which associate palynomorphs and conodonts, such as SANDBERG et al. (1972).

12.1. New York State and Pennsylvania

The material formerly studied by RICHARDSON & AHMED (1988) from the upper and uppermost Famennian of New York State and Pennsylvania (see also RICHARDSON & MCGREGOR 1986) has been restudied by AVCHIMOVITCH et al. (2021) and compared with

contemporaneous palynozonations in Western Europe and Belarus.

The highest palynozone is named PLN (*V. pusillites-R. lepidophyta-V. nitidus). Retispora lepidophyta* is represented by the var. *tenera* and var. *minor*. *Vallatisporites pusillites* sensu lato are abundant; *V. pusillites* sensu stricto*, V. kedoae,* and *V. hystricosus* dominate. *Vallatisporites higgsii, V. enigmus, V. mcgregorii, V. drybrookensis,* and *V. dolbii* are present. Typical Carboniferous species are said to occur, such as *Vallatisporites vallatus, V. verrucosus,* and *V. splendens*. Also, *Bascaudaspora mischkinensis, Camptotriletes paprothii, Vallatisporites streelii*, and small amounts of *Verrucosisporites nitidus* occur. All species are known in the highest Famennian.

The PLN Zone is comparable, if not similar, with the lower part of the P Zone of Eastern Europe.

12.2. Appalachian Basin (Morehead-Kentucky)

ETTENSOHN et al. (2020a, 2020b) gathered the most recent information about a glacigenic succession recognized by a belt of in situ terrestrial diamictite 400 km long and 40 km wide in the Appalachian Basin. This interval is assigned to the lower Spechty Kopf Formation, the Rockwell Formation, and the Cussewago Sandstone of Pennsylvania and Maryland, and the Bedford Shale and Berea Sandstone of Ohio (cf. BREZINSKI et al. 2010). The diamictite was deposited during a single glacial advance and retreat sequence as parts of shallow, marginal-marine transgressive sequences, which inundated Hampshire/Catskill alluvial plains, and ended Upper Devonian alluvial sediment accumulation across most of the area. Palynology from this interval indicated that all the diamictites examined occur in the LE and LN miospore zones, following CLAYTON et al. (2010, 2012).

The Logan Hollow section (N38°11'36'', W83°29'37''), located 0.2 miles north of the junction of Bratton Branch and Logan Hollow roads in the east-central part of the Morehead quadrangle, includes the Robinson boulder or "lonestone" (see OJAKANGAS 1985; ETTENSOHN et al. 2009) in the upper Cleveland Member of the Ohio Shale Formation, interpreted as a glacial dropstone removed from the Ordovician (ETTENSOHN et al. 2009, 2020a, 2020b).

This shale interval from Cleveland, Bedford and the Berea sandstone are dated as uppermost Famennian *Retispora lepidophyta–Verrucosisporites nitidus* (LN) miospore Zone (CLAYTON et al. 2010, 2012), based on these two taxa and others, such as *Densosporites spitsbergensis*, *Indotriradites explanatus*, *Knoxisporites concentricus*, *Latosporites* sp., and *Retusotriletes crassus*. A more quantitative study is not available from the abstracts, which would have allowed a more detailed approach of the LN-VI sequence.

12.3. Illinois Basin (Iowa)

The Upper Devonian Saverton Shale Formation is present in outcrop and subsurface in southern Iowa (Iowa Basin), western and southeastern Illinois, as part of the Illinois Basin, and in northeastern Missouri. Three samples of the Upper Devonian Saverton Shale and three of the Lower Mississippian Hannibal Shale were collected along the bluff at Atlas South, Pike County, Illinois (WICANDER & PLAYFORD 2013).

The assemblage of the Saverton Shale yielded prasinophytes, acritarchs, and spores, such as *Punctatisporites hannibalensis, Retusotriletes incohatus, Emphanisporites rotatus, Auroraspora macra*, *Retispora lepidophyta,* and *Verrucosisporites nitidus*, which were assigned to the LN miospore Zone (WICANDER & PLAYFORD 2013). The overlying Hannibal Shale yielded an overall depauperate palynoflora bearing several taxa from the underlying palynoassemblage, such as *M. stellatum* and other species of *Micrhystridium* that are the most frequent acritarchs, and rare appearances of *G. ohioense*, *G. winslowiae*, *S. micropolygonale*, and *Veryhachium trispinosum*. Among the spores, *Punctatisporites hannibalensis, Retusotriletes incohatus, Auroraspora macra*, and *Verrucosisporites*

nitidus are still documented. Instead, *Retispora lepidophyta, Grandispora cornuta, Vallatisporites hystricosus, Indotriradites explanatus,* and species of *Ancyrospora* and *Teichertospora* are absent (WICANDER & PLAYFORD 2013).

A Kinderhookian (Lower Mississippian) age is given based on conodonts of the lower *Siphonodella sandbergi* - lower *S. crenulata* zones (WORK et al. 1988; LANE & BRENCKLE 2005). The Hannibal microphytoplankton assemblage contains the same morphologically simple and stratigraphically long-ranging taxa that are found globally in Lower Mississippian strata, together with a few taxa, notably *Gorgonisphaeridium ohioense* and *G. winslowiae*, which possibly extend from the Devonian into the Lower Mississippian. The Saverton miospore assemblage features a number of species known to be restricted to the uppermost Devonian, and that serve as reliable index fossils for that time interval, in particular, *Retispora lepidophyta*. The Hannibal miospore assemblage is both less abundant and diverse than its microphytoplankton counterpart, and is suggestive of a Lower Mississippian age.

The transition between the Saverton Shale and the Hannibal Shale, interrupted by the Glen Park Limestone, has not been studied.

12.4. Sappington Basin (Montana)

The palynology of the green burrowed shale (Unit 4) of the Sappington Formation at Logan Gulch in Montana studied by DI PASQUO et al. (2017) allowed the description of the latest Famennian *Retispora lepidophyta-Verrucosisporites nitidus* LN Zone. Age-diagnostic taxa include spores (e.g. *Grandispora echinata, G. praecipua, Endoculeospora setacea, Retispora lepidophyta, Verrucosisporites nitidus* and *Vallatisporites* spp.) and less frequent phytoplankton species (e.g. *Dictyotidium fairfieldense, Gorgonisphaeridium winslowiae*, *Maranhites, Tasmanites, Botryococcus*). This palynoassemblage is correlated with that one at Hardscrabble (Peak 9559) in Bridger Mountain recorded by SANDBERG et al. (1972). A sandstone bed (Unit 5) over Unit 4 at Logan Gulch, palynologically barren, is unconformably followed by the base of the Mississippian CCM Lodgepole Formation (DI PASQUO et al. 2017).

From the Koch section located in the Madison Range of southwestern Montana (USA), a detailed palynological analysis of the uppermost Devonian Sappington Formation provides a whole association from four samples composed of 87 trilete spore species that dominated over microphytoplankton (13 species) (DI PASQUO et al. 2019a). Among the most representative spore species are *Convolutispora oppressa, Cymbosporites loboziakii, Cyrtospora cristifera, Diaphanospora perplexa, Grandispora echinata Knoxisporites concentricus, Knoxisporites literatus, Kraeuselisporites explanatus, Punctatisporites hannibalensis, Pustulatisporites dolbii, Retispora lepidophyta* (very abundant), *Retusotriletes incohatus, Spelaeotriletes crustatus, Tumulispora rarituberculata*, and *Vallatisporites drybrookensis*. These species are diagnostic of the LN Zone yet documented in Unit 4 shale at Logan Gulch (DI PASQUO et al. 2017, 2019b) and other locations in SW Montana documented by RICE et al. (2016) aforementioned.

The type section for the *Siphonodella (Eosi.) praesulcata* conodont fauna in North America at the Lick Creek locality was revisited and sampled for palynology and conodonts due to its importance as a reference section for ongoing Devonian-Mississippian boundary (DCB) studies within the Sappington Formation and correlative Exshaw and Bakken formations (see ISAACSON et al. 2015, RICE et al. 2017).

As yet discussed by STREEL (2009), the upper Famennian through basal Carboniferous interval embraces six conodont zones (see also KAISER et al. 2015; BECKER et al. 2016), i.e., the Middle *expansa* (= *Bi. aculeatus aculeatus*) through *sulcata* zones, which correspond to the Western European LL, LE, and LN miospore interval zones, and the succeeding *Vallatisporites vallatus - Retusotriletes incohatus* (VI) assemblage zone (Fig. 3).

As originally described, the *Si. (Eosi.) praesulcata* conodonts occur in a 2 foot (ft) thick

oolitic grainstone presumed to be at or near the top of the Sappington Formation (in Unit 5), but the exact stratigraphic position within the Sappington is poorly known. RICE et al. (2017) found in Unit 4 the uppermost Devonian *Retispora lepidophyta* spore assemblage, not recorded previously. So, there was concern about the relative age of *Si. (Eosi.) praesulcata* and if the oolitic grainstones, that are part of Unit 5 elsewhere, could possibly be part of the overlying Cottonwood Canyon Member. Detailed stratigraphic studies of the Lick Creek section and other nearby sections resolve much of the uncertainty concerning the stratigraphic position of the *Si. (Eo.) praesulcata* conodonts. The Sappington at Lick Creek consists of a normal Sappington succession from Unit 1 through Unit 5, with the addition of over 8 ft of oolitic grainstones near the top. Unit 4, which has been found beneath a veneer of cover, provides the key evidence to show that the oolitic grainstones occur near the top of Unit 5 based on regional thickness. The overlying Cottonwood Canyon Member is only 4 cm thick at Lick Creek, but at other localities nearby, its correlatives reach more typical thicknesses of 3-4 ft, where it also rests on oolitic grainstones. This suggests that very little of Unit 5 has been eroded at Lick Creek, thus placing the *Si. (Eo.) praesulcata* locality somewhere near the top of Unit 5. This new analysis confirms that the *R. lepidophyta* spore assemblage underlies the *Si. (Eo.) praesulcata* fauna at Lick Creek, although they may overlap. The preliminary results by RICE et al. (2017) indicate that Sappington Unit 4 at Lick Creek, and at some other localities studied, are Devonian in age based on conodonts and other organic microfossils. The transition between the LN Zone sensu stricto (with very abundant *R. lepidophyta*) and the VI Zone being interrupted by a sandstone bed (Unit 5) is still unpublished (RICE 2021; DI PASQUO et al. 2021).

12.5. Williston Basin (North Dakota and Montana)

HOGANCAMP & POCKNALL (2018) documented new paleontological data from the Bakken Formation in the Williston Basin of North Dakota and combined the new data with those previously published in a revised biostratigraphic framework. From three wells, 81 samples were taken from the Bakken Formation (23 from the lower, 34 from the middle, and 24 from the upper members), and three from the Lodgepole Formation. Palynological data from the Middle Bakken indicates that the historical Devonian-Carboniferous Boundary should be placed at the unconformable contact between the lower Middle Bakken (Middle Bakken 1) and the upper Middle Bakken (Middle Bakken 2), based on the highest stratigraphic occurrence of *Retispora lepidophyta*.

The acritarchs *Gorgonisphaeridium ohioense*, *G. winslowiae, Unellium winslowiae*, *Puteoscortum polyankistrum*, and *Stellinium micropolygonale* are only found in the Lower and Middle Bakken. Although *Gorgonisphaeridium absitum* and *G. plerispinosum* are rarely recorded in the Middle Bakken, they are common components of Upper Bakken assemblages. The spores *Lophozonotriletes magnus*, *Retispora lepidophyta, R. macroreticulata*, *Vallatisporites splendens*, and *Verrucosisporites nitidus* are restricted to the Middle Bakken.

Although no conodont data were analyzed from the Middle Bakken, the Lower Bakken provided conodonts of the *Pseudopolygnathus granulosus* Zone to the *Bi. ultimus ultimus* Zone, and possibly to the basal Tournaisian *Protognathodus kockeli* Zone, and the Upper Bakken may range from the Tournaisian *Si. (Si.) duplicata* Zone to the *Si. (Si.) quadruplicata* Zone (the utility of the latter has been questioned by BECKER et al. 2021).

DI PASQUO et al. (2018) provided new palynological data from three stratigraphic intervals of the Middle Bakken Formation (Enterprise Archer well core) in the Williston Basin of northeastern Montana. Two samples from the top of the lower Middle Bakken siltstone (Archer 1 = 7,625.0-7,626.7 feet), six samples from silty shale facies above the Middle Bakken sandstone (A2 = 7,600.4-7602.7 ft), and

two samples from the silty shales above a bioclastic lag, below a limestone bed of the upper Middle Bakken (A3 = 7,599.0-7599.8 ft).

Retispora lepidophyta is recorded throughout A1-A3 assemblages (A1: 28 spores, 13 phytoplankton, 1 scolecodont; A2: 65 spores, 14 phytoplankton; A3: 30 spores, 4 phytoplankton). These assemblages share 22 spore species (e.g. *Cristatisporites mattheusii, Diaphanospora perplexa, Grandispora echinata, Grandispora senticosa, Pustulatisporites dolbii, Spelaeotriletes crustatus, Tumulispora rarituberculata,* and *Velamisporites perinatus*) and few acritarchs/prasinophytes (*Gorgonisphaeridium winslowiae, G. absitum*). The "Marine Index" (A1 = 150, A2 = 121.5 and A3 = 113.3) confirms that A1 was deposited in a shallow marine setting whilst A2 and A3 in brackish embayments, as suggested previously from ichnologic and sedimentologic analyses.

A comparison of these assemblages with the Middle Bakken Formation of the Montague Lake core (C-69809-21/26) of southern Canada studied by PLAYFORD & MCGREGOR (1993) and HOGANCAMP & POCKNALL (2018) and also with the Middle Sappington Formation (RICE et al. 2016, DI PASQUO et al. 2017), suggest their correlation possibly coeval with the *R. lepidophyta-Verrucosisporites nitidus* (LN) Zone, based on the occurrence of *Claytonisporites rarisetosa, Convolutispora major, Cymatiosphaera* sp., *Dictyotriletes flavus, Endoculeospora setaceae, Grandispora praecipua, Knoxisporites literatus, Navifusa bacilla*, *Retusotriletes crassus, Vallatisporites drybrookensis, V. splendens, Verrucosisporites mesogrumosus,* and *V. papulosus*, amongst others.

12.6. Western Canadian or South Alberta Basin

The Bakken Formation, in the Williston Basin of Western Canada, constitutes part of a widespread, predominantly black shale sequence that covered much of the North American craton in Upper Devonian and Lower Carboniferous time.

24 samples constitute the base of this study (PLAYFORD & MCGREGOR 1993) from cores of five wells in southern Saskatchewan. Two thirds of the samples are from the Middle Sandstone Member of the Bakken Formation, five are from the Upper Shale Member, and only one from the Lower Shale Member.

Among the acritarchs, *Gorgonisphaeridium winslowiae* is often the most abundant. It is confined to the uppermost Famennian or Strunian in the Ourthe Valley reference sections in Belgium (VANGUESTAINE 1986). Among the miospores, *Retispora lepidophyta* is present everywhere, except in one sample (or two!), of the Upper Shale Member of one of the cores. This might be taken as an indication that *R. lepidophtya* is rare at that level of the Bakken Formation (LN* Zone?) but it also supports the opinion of the authors that it could be reworked in the next VI Zone.

In Alberta, a total of 23 core samples obtained from Exshaw and Banff formations were analyzed in boreholes by RICHARDS et al. (2002).

From the base of the Lower Black Shale Member of the Exshaw Formation, conodont data of the Lower *expansa* conodont Zone have been documented. From both the lower and upper shale units of the Exshaw Formation, the "*Vallatisporites pusillites – Retispora lepidophyta* Zone "is characterized by *Retispora lepidophyta* and other spores (*Cyrtospora cristifera, Grandispora echinata, G. saurota, Pustulatisporites dolbii, Spelaeotriletes crustatus, Tumulispora rarituberculata, Vallatisporites drybrookensis,* and *V. splendens*) and microplancton taxa (*Gorgonisphaeridium winslowiae, Stellinium micropolygonale, Leiosphaeridia* and rare *Maranhites*).

The *Retispora lepidophyta – Verrucosisporites nitidus* Zone was recovered from the Upper Member of the Exshaw beneath the basal Banff Formation. Tuff samples interbedded allowed the recovery of absolute age dates associated with conodont and palyno-biostratigraphy, supporting an uppermost Devonian age (e.g. 363.34 ± 0.39 Ma from the

Nordegg tuff) as summarized by RICHARDS et al. (2002) and discussed by BECKER et al. (2020, pp. 777-778).

Conodonts from the overlying Upper Siltstone Member of the Exshaw Fm were not common, but the Mississippian Upper *duplicata* Zone to *crenulata* Zone from the basal black shale of the Banff Formation were indicated in southwestern Alberta (RICHARDS et al. 2002; JOHNSTON et al. 2010).

13. The Devonian-Carboniferous boundary in South America (SAM)

Several publications are available for SAM, which associate palynomorphs, diamictites and glacio-marine strata.

13.1. Amazon Basin, northern Brazil

In the Amazon Basin as well as in other Brazilian Palaeozoic basins, uppermost Famennian assemblages are often characterized by the joint occurrence of *R. lepidophyta* and *Indotriradites explanatus*. Two Interval Zones are recognized in the Curiri Formation and are shown between two erosional surfaces in PLAYFORD & MELO (2012). Diamictites and glacio-marine strata are common in these intervals (see Fig. 3).

In the Rle Zone, the FOB of *R. lepidophyta* occur, also containing *Vallatisporites verrucosus* and many additional species of the genera *Convolutispora, Corbulispora, Cristatisporites, Cymbosporites, Densosporites,* and *Verrucosiporites*. All these taxa range upwards into the succeeding *R. lepidophyta-V. vallatus* (LVa) Interval Zone, containing *Verrucosisporites nitidus,* and many persist even higher (MELO & LOBOZIAK 2003).

The next *Radiizonates arcuatus-Waltzispora lanzonii* (AL) Interval Zone, succeeding the LVa Zone in the Oriximana Formation, corresponds to the LOB of important Upper Devonian miospores, headed by *R. lepidophyta.* This unit is characterized by a proliferation of miospores with simple morphology and laevigate forms. In certain AL Zone sections and even in higher Tournaisian and Viséan intervals, *R. lepidophyta* and some of its uppermost Famennian associates may still persist, usually in reduced numbers, due to recycling processes (MELO & LOBOZIAK 2003).

13.2. Los Espejos Range between Santa Cruz de la Sierra – Cochabamba, Bolivia

The Bermejo river outcrop studied by PÉREZ LEYTON (1990) between Bermejo-La Angostura in the highway connecting Santa Cruz de la Sierra and Cochabamba, revealed a great diversity of spores, acritarchs and chitinozoan species in the Itacua (ex Saipurú) Formation, composed of turbiditic resedimented diamictites with glacial influence, and the unconformably underlying Los Monos/Iquiri formations. A biostratigraphic interpretation is given by PÉREZ LEYTON (1990) and was revised and changed in PÉREZ LEYTON (1991). The main composition of the three samples of the Itacua Fm is as follow.

M19: ***Colatisporites decorus****, Rugospora radiata, Retusotriletes planus, Knoxisporites* sp., and *Cristatisporites* sp. (scarce specimens), whereas reworked spores from the Devonian and acritarchs are abundant, especially *Umbellasphaeridium saharicum*. *Verruciretusispora famenensis* and the absence of *Retispora lepidophyta* were used to attribute this sample to the VCo Zone of STREEL et al. (1987).

M12-13: Notably rich in diverse palynomorphs, among them *Retispora lepidophyta, Colatisporites decorus, Cordylosporites glumaceus* (= *C. marciae, Dictyotriletes fimbriatus,* see PLAYFORD & MELO 2012), ***Cristatisporites echinatus***, *Cyrtospora cristifera, Knoxisporites literatus, Kraeuselisporites explanatus, Raistrickia spathulata, Tumulispora rarituberculata, Vallatisporites verrucosus,* and the chlorophycean ***Botryococcus***.

This assemblage was akin to the uppermost Famennian LE Zone of STREEL et al. (1987) and a younger age was rejected due to the absence of index taxa, such as *S. balteatus, S. pretiosus, Umbonatisporites* spp., and *Aratrisporites saharensis*.

Hence, DI PASQUO & AZCUY (1997) indicated with certainty a Lower Carboniferous age, most likely mid-Tournaisian, for the three samples M19, 12 and 13 of this diamictitic deposit of Itacua Formation, and the separation of indigenous and reworked set of palynomorphs. A revision of this outcrop by STREEL et al. (2012) did agree with the presence of Mississippian spores in this diamictitic unit.

From the same area of the Bermejo outcrop described above, more diamictitic deposits are exposed along the La Angostura-Bermejo-Samaipata-Mairana highway in the Espejos Range, west of Santa Cruz de la Sierra. WICANDER et al. (2011) studied the palynological content of a diamictite at Lajas area, and it was correlated to the LL and LE zones due to the absence of *Verrucosisporites nitidus*. STREEL et al. (2012) doubted this zonal correlation and age given to this deposit bearing exotic blocks in view of the doubtful distribution of taxa along the samples.

13.2. Sol, Mina Matilde and Hinchaka sections, Titikaka Lake, Bolivia

DÍAZ MARTÍNEZ et al. (1993, 1999) referred to the Famennian glaciation of western Gondwana, based on the palynologic information from diamictites of the Cumaná Formation (VAVRDOVÁ et al. 1991, 1993) at Isla del Sol and in the Mina Matilde and Hinchaka sections.

VAVRDOVÁ et al. (1993) presented the palynologic result of two sections in the Titikaka lake area, and established an upper Famennian age for the samples IS 2 and IS 3 (Isla del Sol) and MM4a and 9a (Mina Matilde), due to the presence of *Retispora lepidophyta* along with *Kraeuselisporites explanatus, Raistrickia macrura, R. spathulata, R. variabilis, Retusotriletes incohatus*, and the acritarch *Umbellasphaeridium saharicum.* The samples MM4a and 9a also document important taxa associated to *Retispora lepidophyta,* such as *Verrucosisporites nitidus, Lophozonotriletes malevkensis, Knoxisporites literatus, Cordylosporites marciae,* and *Convolutispora vermiformis*.

In the Sample MM9b, species with Tournaisian ranges, such as ***Densosporites spitsbergensis,*** *Grandispora conspicua, G. echinata, Spelaeotriletes obtusus, S. pretiosus,* ***Rugospora polyptycha****, Tumulispora rarituberculata,* and *Cyrtospora cristifera* allowed their attribution to the lowewr Tournaisian VI Zone. Other Devonian species associated to those spore taxa include numerous acritarchs that were considered indigenous. *Retispora lepidophyta* is absent. DÍAZ MARTÍNEZ et al. (1999) cited also the presence of *Dibolisporites distinctus*, another exclusive species of the Tournaisian in Europe and Australia.

DÍAZ MARTÍNEZ et al. (1999) described a section at Hinchaka and its palynological content of samples HI2-HI4 from a diamictite of the Cumaná Formation, characterized as poor in palynomorphs nut bearing *Retispora lepidophyta*, *Convolutispora vermiformis, Cordylosporites marciae, Kraeuselisporites explanatus, Raistrickia macrura, R. spathulata, Spelaeotriletes resolutus,* and *S. obtusus*. It was akin to the *R lepidophyta – K explanatus* (LE) Zone. The overlying Sample HI6 yielded *Raistrickia clavata* and *D. spitsbergensis,* and it was assigned to the lower Tournaisian VI Zone.

It must be mentioned that several acritarchs and other palynomorphs recycled from the Devonian *sensu lato* are associated to the indigenous taxa in all the samples of the three localities.

DI PASQUO & AZCUY (1997) and DI PASQUO (2003) warned about the presence of Devonian olistoliths intercalated in Mississippian and Pennsylvanian successions locally, and also, that clasts of very different sizes in the diamictites yielded different Devonian ages through specific palynologic analysis, including *Retispora lepidophyta* and other allied taxa (see also DI PASQUO & STREEL 2022a, with many data presented in abstracts, still unpublished).

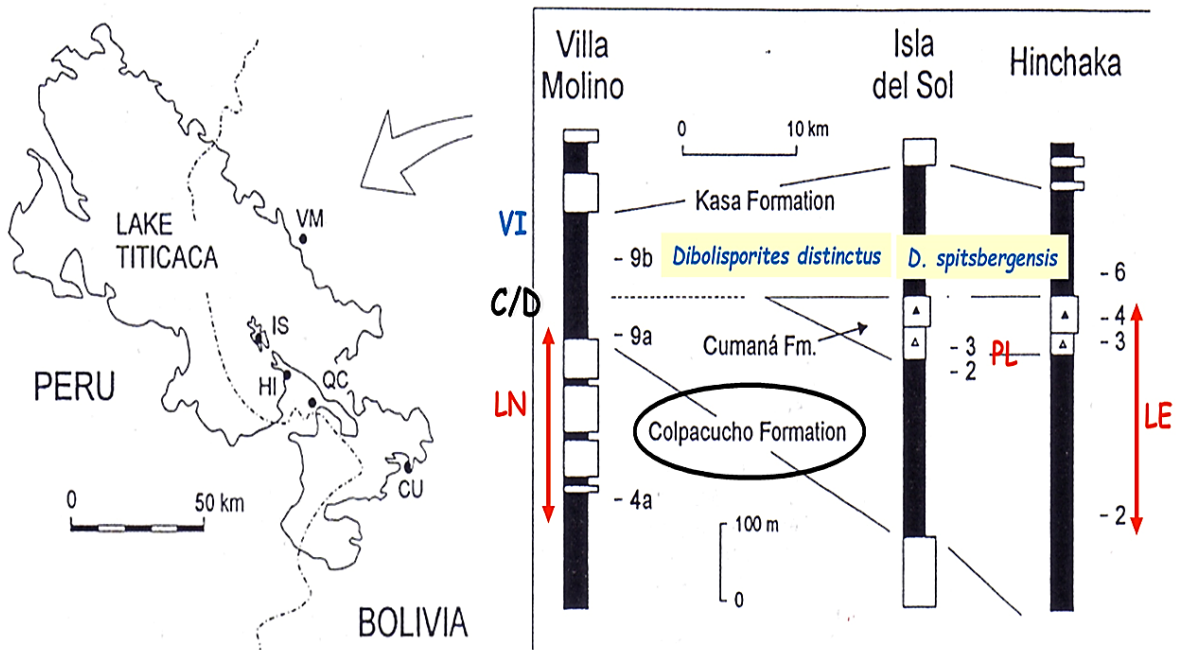

Fig. 4. Correlation of DCB sections in the Titicaca Lake region after DÍAZ MARTÍNEZ et al. 1999). The "indigenous" taxa in the *Rerispora lepidophyta* and VI assemblages mixed with other reworked from the Devonian s.l., characteristic of the diamictites in South America, could preclude accurate datings of those microfloras.

13.4. Chaguaya, NE shore at Titicaca lake, Bolivia

LAKIN et al. (2021) analyzed an uninterrupted D-C sequence in the Titicaca region, and it was characterized by three palynoassemblages:

AI-1 corresponds to the range of *Retispora lepidophyta,* which comprises up to the third of the total miospore count and is confined to the Colpacucho Formation. Single wall, non-apiculate miospore taxa are common (half of the total miospore count). The assemblage contains *Knoxisporites literatus, Indotriradites explanatus,* and *V. nitidus.* The phytoplankton is rich and characterized by a high relative abundance of *Umbellasphaeridium saharicum.*

AI-2 is constrained within the lower unit of the Kasa Formation. The miospore fraction is dominated by single wall, non-apiculate taxa (60% of the total miospore count), but there is a relative increase in single-wall apiculate miospores (*Anapiculatisporites, Apiculatisporites, Apiculiretusispora,* and *Raistrickia*). Age-diagnostic miospore taxa are extremely rare, and difficult to speciate with confidence. Only a single age-diagnostic species, *Anapiculatisporites semicuspidatus,* appears. The phytoplankton fraction is relatively impoverished and characterized by a high relative abundance (73 % of phytoplankton) of *Gorgonisphaeridium* spp.

AI-3 is defined by the loss of the phytoplankton fraction and ranges entirely within the upper Kasa Formation. It contains up to 49 % of single wall, non-apiculate taxa, the remaining being single wall apiculate taxa. Phytoplankton are almost nonexistent. Mississippian miospore taxa (including *Anapiculatisporites ampullaceus, Indotriradites dolianitii morphon, Indotriradites viriosus,* and *Waltzispora lanzonii*) are extremely rare or limited to single occurrences.

The Assemblage-Intervals 2 and 3 are both attributed by the authors to the Tournaisian. Alternatively, one may consider that at least in part, the basal AI-2 could correspond to the LN* range with occasional *R. lepidophyta.* Although, the reworked character of the AI-2 and AI-3 of the Kasa Formation is noticed, in coincidence

with other Mississippian deposits in SAM (see DI PASQUO & STREEL 2022a, 2022b).

14. Final remarks

Most, if not all, of the miospore records published around the DCB in North and South America lack the quantitative approach, which allow to identify the LN* Zone and consequently the VI Zone. Both zones are dependent, by definition, on the low percentage or absence of *Retispora lepidophyta*. This criterium alone is not applicable to characterize a zonal subdivision when one realizes the enormous quantity produced by this taxon, often more than 50 % of the total of miospores, during the millions of years of the upper/uppermost Famennian.

Most of the sections investigated around the DCB in North and South America are hampered by the presence of unfavorable lithofacies for palynology. The probability to have been affected by reworking processes is very important and should not be ignored in DCB studies (cf. STREEL & BLESS 1980; DI PASQUO & STREEL 2022a, 2022b).

Also, we have not recognized in the description of all reviewed assemblages any taxon first occurrence (FOB), which might serve as an alternative criterium. The base of the LN* Zone, probably the beginning of the collapse of the final Devonian glacial episode, is only recognizable by a quantitative approach.

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DEVONIAN PUBLICATIONS

New monograph on Lower Devonian Rhynchonellida of the Rhenish Massif

WENNDORF, K.-W. (2022). Nucinulidae (Brachiopoda, Rhynchoneöllida) aus dem Unter- und Mitteldevon des Rheinische Schiefergebirges und benachbarter Regionen. – Mainzer Naturwissenschaftliches Archiv, Beiheft, **36**: 1-189; ISSN 0174-6626.

The monograph concentrates on the Emsian Nucinulidae of the Mosel Syncline and Lahn region but derscribes also material from other regions, such as North Africa. Two new genera and various species/subspecies are introduced:

Lapinulus eichelei n. sp.
Lap. pila taunusiensis n. ssp.
Lap. pila luxemburgensis n. ssp.
Lap. haigerensis n. sp.
Lap.? leudersdorfensis n. sp.
Lap.? molliformis n. sp.
Lap. frankei n. sp.
Lahninulus n. gen.
Lahn. flabelliplicatus n. sp. (type-species)
Lahn. emsiensis n. sp.
Lahn. steinmeyeri n. sp.
Fuchsinulus n. gen.
F. lahnsteinensis n. sp. (type-species)
Cuninulus filiplicatus n. sp.
Cun. vitelliacensis n. sp.
Cun. eulenbergensis n. sp.
Cun. trosti n. sp.

Nine more forms are described in open nomenclature. Impressive is the long list of localities, with data on stratigraphy. There are 19 high-quality plates, with explanations both in German and English.

SDS FIELD MEETING 2023

The North American members of the SDS look forward to welcoming all members to the 2023 annual meeting and field trips this coming July and August in Geneseo, New York, in the heart of the classic Devonian strata of New York State. The pre-meeting field trip will focus on Middle and Upper Devonian strata, a mid-meeting field trip during the technical sessions will visit the Frasnian-Famennian boundary or give attendees a chance to visit Niagara Falls and the Silurian strata it flows over, and a post meeting trip will focus on Lower and Middle Devonian strata.

Homepage:
https://www.geneseo.edu/SDS_2023

Devonian Stratigraphy of New York State
SDS 2023 Annual Meeting, IGCP 652
Geneseo, New York, 26 July – 07 August 2023

Please complete and return to:

SDS New York 2023 c/o D. Jeffrey Over
Department of Geological Sciences
1 College Circle – SUNY Geneseo
Geneseo, New York 14454
over@geneseo.edu
conference web page - https://www.geneseo.edu/SDS_2023

Name: _____ E-Mail: _____
Institution: _____
Address: _____
City: _____ State/Province: _____
Country: _____Postal Code: _____
Telephone: _____ Fax: _____

Please indicate participation in conference, estimated cost $250US:
possibly probably almost certainly

I will present:
oral paper poster attend but not present

Pre-conference field trip, estimated cost $500US:
possibly probably almost certainly
Need transport from Rochester/Geneseo to Cleveland on 26 July, 2023 yes no

Intra-conference field trip, estimated cost $50US:
1) Upper Devonian strata **or** **2) Niagara Falls and Silurian strata**
possibly probably almost certainly possibly probably almost certainly

Post-conference field trip, estimated cost $700US:
possibly probably almost certainly
Need transport from Catskill, NY to Rochester/Geneseo on 07 August, 2023. yes no

Official invitation needed: yes no

Tentative schedule:
26 July – Arrive Cleveland, Ohio for pre-meeting field trip
27 July – field trip departs, Upper Devonian strata - spend night in Erie, PA
28 July – field trip, Upper Devonian strata - spend night in Fredonia, NY
29 July – field trip, Upper Devonian strata - spend night in Geneseo, NY
non-field trip conference participants arrive in Geneseo, NY – welcoming party
30 July – conference begins, stay in Geneseo
31 July – intra-conference field trip – Upper Devonian strata **or** Niagara Falls, stay in Geneseo
01 Aug – conference, stay in Geneseo
02 Aug – field trip to Lower and Middle Devonian strata and PRI-MOTE in Ithaca, banquet, spend night in Cortland, NY
post-meeting field trip starts in Ithaca/Cortland
03 Aug – field trip, Middle Devonian strata - spend night in Cortland, NY
04 Aug – field trip, Middle Devonian strata - spend night in Cortland, NY
05 Aug - field trip, Lower and Middle Devonian strata - spend night in Oneonta, NY
06 Aug – field trip, Lower and Middle Devonian strata – spend night in Catskill, NY – end of field trip
07 Aug – return to Geneseo/Rochester

Abstracts Due: 1 May 2023 **Meeting Registration Due: 1 May 2023**

Fall Brook, New York, waits to refresh the SDS Field Meeting Members during the excursion!

4th International Congress on Stratigraphy

strati 2023

11th -13th July 2023, Lille, France

FIRST CIRCULAR

Following the 1st congress in Lisbon (Portugal) in 2013, and additional congresses organized in Graz (Austria) in 2015 and Milan (Italy) in 2019, the 4th International Congress on Stratigraphy has been assigned by the International Commission on Stratigraphy (ICS) to Lille (France). We are thus pleased to invite you to attend **STRATI 2023, at Lille, France, 11th-13th July 2023.**

With famous pioneers, such as Cuvier and Lamarck, France is considered the birthplace of palaeontology (the word '*paléontologie'* was created by de Blainville in 1822), and French scientists were also the first to develop stratigraphical concepts. For instance, d'Orbigny introduced stages as subdivisions of strata with unique fossil assemblages. Many international geological series and stage names have been defined in France, such as the Jurassic System, named after the French-Swiss Jura Mountains, or the Givetian Stage (Devonian), named after Givet, a city in northern France. Many Mesozoic and Cenozoic standard stages derive from French localities: Hettangian, Sinemurian, Toarcian, Bajocian (Jurassic); Berriasian, Valanginian, Hauterivian, Barremian, Aptian, Albian, Cenomanian, Turonian, Coniacian, Santonian, and Campanian (Cretaceous); Lutetian (Palaeogene), Aquitanian and Burdigalian (Neogene). Lille, in the northernmost part of France, close to the Belgian border, has a long tradition of stratigraphical studies on the Upper Palaeozoic, being close to the famous Devonian-Carboniferous type localities, but also to the Ypresian and Rupelian (Palaeogene) type-sections in Belgium.

We are pleased to announce that together with the 3 days indoor sessions, four excursions and two one-day field trips will be organized, covering stratigraphical successions from the Palaeozoic, Mesozoic and Cenozoic. The congress will also host meetings of the ICS and its subcommissions, together with workshops and social activities.

We are looking forward to welcome many of you in Lille for STRATI 2023!

LILLIAD LEARNING CENTER INNOVATION

Evo-Eco-Paléo

cnrs

Université de Lille

VENUE

The **indoor sessions** with keynote talks and regular lectures (partly scheduled online) will take place in the new **Congress Centre of Lille University 'Lilliad'** on the Campus of the *Cité Scientifique* (Science Campus) at Villeneuve d'Ascq (15 minutes by metro from Lille city centre). They are scheduled from Tuesday, July 11th to Thursday, July 13th 2023. Plenary and parallel sessions will take place, with numerous workshops and business meetings in smaller rooms available to all subcommissions of the ICS.

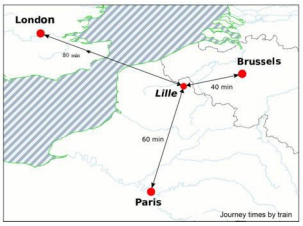
The new Lilliad buildings (Lille University Learning Center) on the Campus 'Cité Scientifique' at Villeneuve d'Ascq

LOCATION

Lille, capital of the French Flanders, is located in the northernmost part of France. As a major Flemish city, like the nearby cities of Ghent and Bruges (Belgium), Lille has a complex history as it was the object of quarrel between the Counts of Flanders and the Kings of France during centuries. Lille also belonged to Austria and Spain, before becoming French in the late 17th century. Lille is therefore ideally located at the major crossroads of north-western Europe.

Although Lille has an international airport, it is very convenient to travel to one of the major international airports in Paris (France), Brussels (Belgium), or London (UK). High speed train connections are regular and very practical, with very short travel times to Lille. Hotels and restaurants are available in all price categories, mostly in walking distance from the metro and train stations.

Palais des Beaux Arts



90 minutes from London
60 minutes from Paris
45 minutes from Brussels

Lille 'Place Général de Gaulle'

SCIENTIFIC PROGRAM

As for previous editions of STRATI, the congress is the main scientific meeting of the ICS. It is thus dedicated to all topics and questions in updating and improving the geological time scale. The scientific program is intended to give space to all stratigraphic fields, methodologies and applications. We are happy to announce the following **keynote speakers** and the topics of their talks (list to be completed):

Laia Alegret (Zaragoza, Spain): Global events of the Palaeogene
Lucia Angioloni (Milano, Italy): Carboniferous-Permian environments and climate
Steven Holland (Athens, GA, USA): Stratigraphic palaeobiology
Michael Joachimski (Erlangen, Germany): Chemostratigraphy
Jacques Laskar (Paris, France): Astronomy and stratigraphy
Christopher Scotese (Evanston, IL, USA): Phanerozoic geography and climate

Scientific themes will be mostly organized as plenary sessions, but parallel sessions will also be scheduled, as well as large poster sessions. Group meetings and workshops are possible, with smaller rooms available for all ICS subcommissions (and other groups) that wish to organize their official business meetings.

CALL FOR PROPOSALS OF SESSIONS, MEETINGS AND WORKSHOPS

We invite the whole community of stratigraphers to propose sessions within the frame of the congress that are of general interest (plenary sessions). We also encourage all ICS subcommissions to submit proposals for business meetings to be held during the congress (to be scheduled at the end of each day, between Monday July 10th and Thursday July 13th). We also invite the submission of workshop proposals on specific stratigraphic topics.

Deadline for the submission of proposals is 30st September 2022.

LANGUAGE

English will be the official language of the meeting and the field trips.

SOCIAL ACTIVITIES

Social activities include the **icebreaker party** and reception on Monday July 10th, as well as a visit to the **Natural History Museum Lille**, and a **conference dinner** that will be organized on Wednesday, July 12th, at the Hermitage Gantois, an ancient hospice of the late 15th Century.


Musée d'Histoire Naturelle


Salle des Hospices


Hospice Gantois

EXCURSION WITH DEVONIAN CONTENT:

Post-congress excursion 4
Friday July 14th to Sunday July 16th 2023

Belgian Classics: Devonian-Carboniferous of southern Belgium and northern France
Costs: ca 420 € (3 days), from and to Lille, France

ESTIMATED REGISTRATION FEES

Full registration	ca 300 € (early)	ca 400 € (late)	ca 500 € (on site)
Reduced (students, etc.)	ca 150 € (early)	ca 200 € (late)	ca 250 € (on site)
Daily rate			ca 150 € (on site)
Accompanying	ca 100 € (early)	ca 150 € (late)	ca 200 € (on site)

Registration includes congress documents, morning and afternoon coffee breaks and lunches, ice-breaker party and social events.

Conference Dinner (Hermitage Gantois Hospice, Wednesday July 12th) ca 100 €

IMPORTANT DATES

July 2022:	1th Circular issued
September 30th 2022	Deadline for proposals of sessions and workshops
November 2022:	2nd Circular issued
February 28th, 2023:	Abstract submission and registration deadline
May 1th 2023:	Distribution of Final Circular with Programme

The second circular will be distributed in November 2022 and will provide information about approved scientific sessions, abstract submission, social program and field trips, including full details of the excursions, related deadlines and fees.

ORGANIZATION

Organizing Committee
Thomas Servais, Lille, France (chair), Catherine Crônier, Lille, France (vice-chair)

Markus Aretz, Toulouse, France (Chair Stratigraphy Section, *Société Géoloqique de France*)
Anne-Christine Da Silva, Liège, Belgium (Secretary, Subcommission Time Scale Calibration)
Bertrand Lefebvre, Lyon, France (Secretary Ordovician Subcommission)

Emanuela Mattioli, Lyon, France (Vice-Chair Jurassic Subcommission)
Bernard Mottequin, Brussels, Belgium

Congress e-mail address: <strati2023@univ-lille.fr>

Postal address: STRATI2023, UMR 8198, SN5, Univ Lille, 59655 Villeneuve d'Ascq, France
Congress website: to be announced. Link will be available at <**https://stratigraphy.org**

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MEMBERSHIP NEWS

CM Gordon C. BAIRD

Completed large, near-final submissions of Devonian geochronological samples to be curated through the Paleontological Research Institution, Ithaca, New York as part of ongoing National Science Foundation grant supported, digital curation effort (with Carlton E. BRETT and P.R.I. staff). Information relating to 2500 Middle and Upper Devonian rock and fossil samples from New York and adjacent states is being digitally upgraded through the entire period 08/21 – 08/22. It is anticipated that curation will proceed through the coming year and that the collection will be housed in a new wing at P.R.I. currently under construction.

It is understood that portions of this and other P.R.I. corrections will be on view for SDS members participants on the upcoming IGCP 652 Annual Meeting, *Devonian Stratigraphy of New York State* to be held in the period 26 July-07 August 2023.

Publications

G. BAIRD, as senior author, is in final stages of completion of two large chapters, as well as coauthor on three additional chapters as parts of a large summative volume **Devonian of New York**, edited by Chuck VER STRAETEN in the *Bulletins of American Paleontology*, projected to be published through P.R.I. later in annum 2022. Chapters in which I am involved are listed below:

Chapter 4

Charles A. VER STRAETEN, Carlton E. BRETT, Gordon C. BAIRD, Alexander J. BARTHOLOMEW & D. Jeffrey OVER: Lower Middle Devonian (Eifelian-lower Givetian) strata of New York State: The Onondaga Formation and Marcellus subgroup.

Chapter 5

Carlton E. BRETT, Gordon C. BAIRD, James J. ZAMBITO IV & Alexander J. BARTHOLOMEW: Stratigraphy and Facies of the Middle Devonian (Givetian) Hamilton Group in New York State and Adjacent Areas.

Chapter 7

Gordon C. BAIRD, James J. ZAMBITO IV & Carlton E. BRETT: Tully Formation and Pre-Frasnian Genesee Group Succession.

Chapter 8

D. Jeffrey OVER, Gordon C. BAIRD & William T. KIRCHGASSER: The Frasnian Strata - lower Upper Devonian - of New York State.

Chapter 11

Gordon C. BAIRD, John A. HARPER, D. Jeffrey OVER, Joseph T. HANNIBAL, Scott C. MCKENZIE & Irving H. TESMER: Conneaut Group to Basal-Mississippian Stratigraphic Succession and Geochronology, New York-Pennsylvania Borderland and Lake Erie Region.

TM R. Thomas BECKER, CM Z. Sarah ABOUSSALAM, and the Münster Group

This report covers the interval from the last Newsletter to the end of August 2022. As it will be true for most other SDS Members, the corona pandemic still had a significant influence on our work. For example, we had to cancel our usual spring field trip to Morocco. But eventually we succeeded to add to the family summer holiday at the end of July five geology days, jointly with Ahmed EL HASSANI, in the Middle Atlas region between Ifrane, Azrou, and Mrirt. Even in the mountains it was too hot to work between 12.00 and 16.00 but we did not have to suffer the 45° that prevailed at the time in the Marrakech region, which we had to pass through coming from Agadir. Our main goal was to fill sampling gaps in six sections that will be dealt with in our planned third issue of the Moroccan Meseta series. It will be published, again (in spring 2023), in *Frontiers in Science and Engineering, Earth, Water and Oceans, Environmental Sciences*, by the prestigious Hassan II Academy of Science and Technology of Morocco. The third Meseta volume will have 6-7 chapters (on the Tiflet, Oulmes, Azrou, Bou Trou/Bou Khedra, Dechra Aït Abdallah, and Khenifra region/Ziyyar successions).

Due to the special financial support by SDS, we had a focus on Pragian-Emsian successions, notably in the sections Jebel ben Arab, Bab-al-Ari (Fig. 1), and Bou Trou, all in the wider Azrou region. Each succession differs considerably, reflecting variable tectonic settings (parautochthonous or allochthonous Klippen within the Variscan flysch). The three sections contain pelagic

flaserlimestone/griotte facies but, as we learned in the Anti-Atlas (see ABOUSSALAM et al. 2015), this does not mean that we can necessarily expect polygnathid faunas. In any case, the Meseta and Anti-Atlas Pragian-Emsian sequences will be important since any revised basal Emsian GSSP proposal will have to include documentation how it can be correlated internationally. As our Meseta research progresses, we realize that there are further interesting sections that we have not yet touched.

Fig. 1. Sarah and Ahmed standing in front of partly slumped Emsian "griotte" limestones of Bab-al-Ari, northeast of Azrou, Moroccan Meseta (July 2022).

Other activities on the Moroccan Devonian are multifold. Taxonomic work on Givetian and Frasnian goniatite and conodont faunas is continuing steadily; several manuscripts have started or are close to completion (see report by Till below). Pharciceratoids and their Frasnian homoeomorphs (Triainoceratoidea) remain a focus. Our collaboration with the project on Devonian contourite systems by Heiko HÜNEKE and his Group at Greifswald resulted in several manuscripts, which are in the state of revision after reviews. We sent some goethitic Givetian plant remains from hypoxic shales of the Tafilalt to Brigitte MEYER-BERTHAUD in Montpellier, to be included in a new study (see abstract by MEYER-BERTHAUD et al. 2022).

Unfortunately, there was no time to make publication progress with the Givetian oncoceratids and discosorids studied by Lukas AFHÜPPE and with the Dra Valley Givetian gastropods studied some while ago by Maro PASCAL-ELLERKAMP. After many years of preparation, we are glad that a joint study on an important ostracod fauna from near the Lower/Middle Devonian boundary of the western Dra Valley was eventually published by GROOS-UFFENORDE et al. (2022). Equally interesting Emsian-Eifelian ostracods of the Torkoz region await their publication under the lead of Claudia DOJEN (Klagenfurt).

The allochthonous successions of olistolites from between Tinerhir and Tinejdad south of the High Atlas, the large glide block at Oued Ferkla north of Tinejdad (see WARD et al. 2013), and very different, strongly cleaved and faulted basinal succession just to the north are the remnants of the Devonian Tisdafine Basin at the poorly studied boundary between the Anti-Atlas and Meseta realms. The stratigraphy and facies analysis formed a major part of the Ph.D. project of **Amine TALIH** (Rabat). Results are about to be published in the *Bulletin of the Institute Scientifique* (TALIH et al. 2022 in press).

After our extensive review of most Rhenish sections (BECKER et al. 2021), the research focus on the revision of the Devonian-Carboniferous boundary culminated in our joint proposal (HARTENFELS et al. 2022) for the Borkewehr section near Balve as a potential future GSSP. It has many advantages, including its proximity to the old Oberrrödinghausen GSSP, and its placing within the context of many neighboring sections that provide additional data for different facies settings. Most important is our proposal to place the base of the Carboniferous within a sequence of conodont faunas slightly above the major facies breaks associated with the Hangenberg Regression. Due to Sven´s new position with the Geological Service NRW at Krefeld, the unfinished work on the most important Moroccan D-C boundary section for conodonts at Lalla Mimouna slowed down. Unfortunately, this is also true for the revision of siphonodelloids, the planned continuation/finalization of the work of the late Harald TRAGELEHN. Morphometric and taxonomic studies of German (Franconia) and Moroccan (especially M´karig, eastern Tafilalt) D/C boundary *Acutimitoceras* faunas are ca. half way through (Fig. 2).

Fig. 2. New, nicely ornamented juvenile *Acutimitoceras (Stockumites)* from the Devonian/Carboniferous boundary shales of Mkarig, easternmost Tafilalt.

Other work in the Rhenish Massif, apart from the studies by Till and Felix (see below), concerned sampling with high resolution in the lower Frasnian of Beringhauser Tunnel (eastern Sauerland), where conodont stratigraphy, microfacies analysis, carbon isotope stratigraphy, and trace element geochemistry (by Tomáš KUMPAN), will be combined. Along the northern margin of the East Sauerland Anticline, we explored the potential for B.Sc. projects on the biostromal *Sparganophyllum* Limestone (lower Givetian) and turbiditic Beisinghausen Limestone, which middle Givetian to lower Frasnian conodont stratigraphy was never studied in detail. For the Ph.D. project of Nina WICHERN (see report of CM David DE VLEESCHOUWER), we re-sampled the levels below the Lower Kellwasser Limestone at Steinbruch Schmidt (Kellerwald). The previous sampling by ZIEGLER & SANDBERG (1990) left some gaps to be filled by more data.

Our research focus on Devonian reef developments and extinctions continued in the Moroccan Meseta, e.g. on reefal debris in the Azrou/Mrirt regions, and with respect to the Ph.D. project of Stephan EICHHOLT (see below). Sarah´s conodont data enable a joint metastudy on the timing of reef growth and extinctions in southern latitudes, planned for a high-ranked journal. Our cooperation project with the Lhoist Rheinkalk GmbH in the Hönne Valley (northern Rhenish Massif) is coming to an end, as manifested by the extensive two new papers on the initial (LÖW et al. 2022) and final reef phases (STICHLING et al. 2022). The first yielded an unusual new discosorid nautiloid, which was described and named as *Binoleniceras* n. gen. by AFHÜPPE & BECKER (2022). A review of all Givetian nautiloid reports from the Rhenish Massif revealed how little is known in reality and how much revision should be done. But by whom? For the extinction of the youngest German reef complex around the Velbert Anticline, there are many unpublished data from the northeast (samples have been picked over the last five years), the new work by Felix (see below) at Schlupkothen, and data from youngest coral debris flow beds of the Wiedenhof section (Fig. 3), currently the most western Frasnian outcrop before the Rheingraben that is filled by thick Tertiary and Quaternary sediments.

Fig. 3. Middle/upper Frasnian reefal debris flow beds at Wiedenhof, western Velbert Anticline, Rhenish Massif.

About two years ago, a lengthy review on the development of Devonian and Lower Carboniferous global events has been written for a thick volume on the mid-European Variszides, edited by Ulf LINNEMANN (Dresden). After revision, this book chapter hopefully will be out soon. It includes illustrations of various event beds and a ranking according to distribution patterns. Event preservation is restricted to specific shelf facies while large basinal and tectonically complex parts of the Variszides, mostly with poor biostratigraphy, mask their development,

The long-term cooperation with TM MA Xueping and co-authors from Beijing continued successfully. Xueping had loaned a long time ago

important brachiopod collections from our old friend, the late Volker EBBIGHAUSEN, which are, after some years of pause, now gradually worked up. The first contribution (WANG et al. 2022a) deals with spiriferids from the Bergisch Gladbach area. The second paper (WANG et al. 2022b) describes lower Famennian spiriferides of the classical Frasnian-Famennian boundary succession of the Ardennes. It will soon be published in Chinese in *Acta Palaeontologica Sinica*.

A new cooperation started with Ahmed ZEGHARI from Chlef University (Algeria). His highly interesting research project deals with the shallow-water Lower Devonian at the southern margin of the Tindouf Basin, starting from close to the Mauritanian border towards the east. We involve our Senckenberg friends Uli JANSEN and Eberhard SCHINDLER for their expertise on brachiopods and tentaculitoids, and David DE VLEESCHOUWER for XRF-based sedimentary geochemistry.

Early in August, WANG Zhihong from Wuhan arrived for a one-year stay, in order to continue cooperation started many years ago in the frame of his Ph.D. studies. There is still an incomplete manuscript on new Famennian conodonts from the Wulankeshun section of the western Junggar Basin. Other work in progess deals with the detailed geochemistry of Frasnian-Famennian boundary sections of the Rhenish Massif and southern Morocco. The latter project includes cooperation with David DE VLEESCHOUWER, Tomáš KUMPAN, Harald STRAUSS, Lawrence PERCIVAL, and others.

CM Zhor Sarah ABOUSSALAM

Sarah has been very busy with preparations for the third Meseta volume, which includes conodont identifications (excluding Famennian faunas), SEM photography, plate compilations, and carbonate microfacies analyses. Biostratigraphic dating was sometimes complicated by complex reworking of Eifelian to Frasnian faunas in lower/middle Famennian flaserlimestone/breccia successions (Fig. 4). Strongly mixed assemblages may alternate with mostly Givetian-Frasnian associations, which recycling may not become apparent if only small spot samples were taken. As previously known from the Lower Devonian of the Anti-Atlas, floods of *Belodella* (*Belodella* Biofacies) may occur in Middle Devonian limestones that in the field appear to belong to a pelagic setting. There are plans to further develop conodont biofacies models in future. As a first step, two new specimen-poor biofacies types (with simple cones, such as *Neopanderodus* and *Dvorakia*, or *Bipennatus*) were recognized in lower Givetian biostrome facies of the Hönne Valley (BECKER & ABOUSSALAM in LÖW et al. 2022).

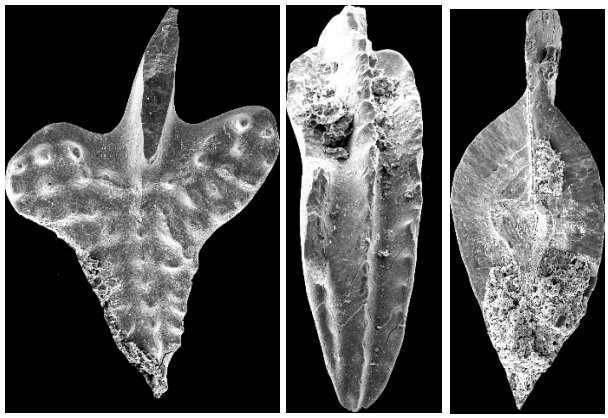

Fig. 4. Mixed Givetian and Frasnian conodonts from a Famennian breccia bed of the Dechra-Aït-Abdallah region, west of Mrirt, eastern part of Western Meseta, Morocco.

Partly unexpectedly rich faunas, especially in the upper Frasnian, were recovered from small samples of drill cores that penetrated the beds overlying the youngest Hönne Valley Reef. The conodont biostratigraphy in STICHLING et al. (2022) is based on joint efforts with Thomas and Sven HARTENFELS. Further work in the Rhenish Massif consists of rich lower Frasnian ancyrodellid faunas from Beringhausener Tunnel, samples from the Wülfrath region, beds overlying the western Hagen-Balve Reef, and the completion of conodont biostratigraphy of the Padberg Limestone in the eastern Sauerland.

Markus ARETZ and Elise NARDIN (Toulouse) supplied Devonian Montagne Noire samples taken for stratigraphic orientation in the frame of regional mapping. Age data were provided were possible, partly by Sven, as a service and for future collaboration. Conodonts were also identified for the “Moroccan contourite project” of Heiko.

Ph.D. students

Felix SAUPE completed the joint manuscript with Thomas on the microfacies development and conodont stratigraphy around the global *semichatovae* Event/Transgression of the well-known Martenberg section. The paper includes a global review of the event distribution, a critical review of the controversial *Palmatolepis jamieae* Zone, and a proposal for the future definition of a formal upper Frasnian substage that is based on the original proposal of W. ZIEGLER and C. A. SANDBERG. The paper has recently (July 2022) been published online as part of the Rhenish *Palaeobiodiversity and Palaeoenvironment* volume.

A second manuscript on high precision conodont stratigraphy and alpha diversity around the extended Kellwasser Crisis at the famous (e.g., for isotope stratigraphy) Beringhauser Tunnel section (East Sauerland) is nearing completion and should be submitted late this year. On the global scale, it yields one of the richest upper Frasnian conodont record, including various range extensions (Fig. 5).

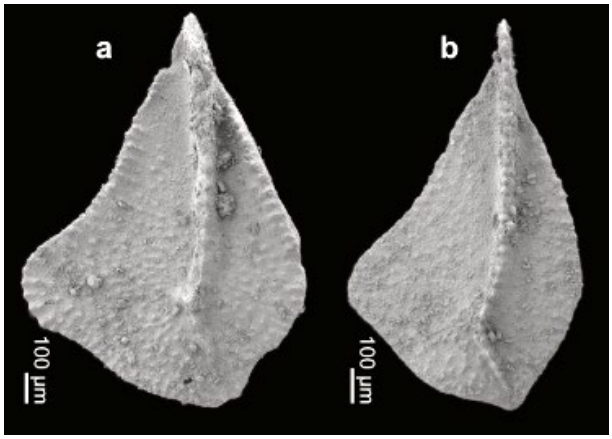

Fig. 5. Co-occuring, stratigraphically youngest *Palmatolepis jamieae jamieae* (a) and *Pa. jamieae savagei* (b) from the upper Frasnian *bogartensis* Zone (FZ 13a) at Beringhauser Tunnel.

A third manuscript on the conodont stratigraphy and carbonate microfacies of the microbial top-Frasnian Schlupkothen section (southeastern end of the Velbert Anticline and Wülfrath Reef Complex), which was investigated before by Alexander KLEMENT in the frame of his B.Sc. project, is in good progress and will conclude the Ph.D. project on upper Frasnian conodont biodiversity in the Rhenish Massif.

Till SÖTE finished his Ph.D. project on the upper Frasnian tornoceratids with a successful defence in early July. Additionally, his monographic study on the tornoceratid fauna of Büdesheim passed the peer-review process and will be published online in *Palaeontographica* still this year (SÖTE & BECKER 2022a in press). Furthermore, the joint paper on the middle/upper Frasnian tornoceratid fauna of Oued Mzerreb in the Dra Valley (Fig. 6) should be submitted within the next months (SÖTE & BECKER 2022b, in prep.). It includes the first pictured Frasnian ammonoids from the Dra Valley at all. Another joint project together with many co-authors from Frankfurt focuses on the measurement of nitrogen isotopes in Devonian corals from the Rhenish Massif to answer the question if these lived with photosymbionts or not (JUNG et al. 2022). Lastly, Till was strongly involved (as corresponding author) in the extensive study on the initial reef fauna of Binolen in *Palaeobiodiversity & Palaeoenvironments* (LÖW et al. 2022).

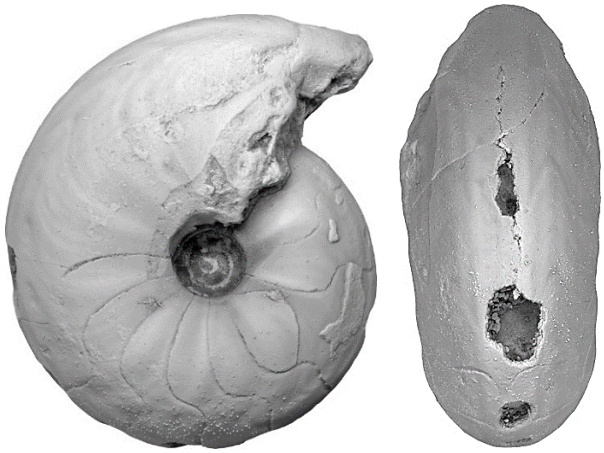

Fig. 6. Well-preserved, new *Aulatornoceras* from the middle Frasnian of Oued Mzerreb in the eastern Dra-Valley, southern Morocco.

Stephan EICHHOLT is working episodically, aside his full-time job in environmental geology, on his third first-authored paper on the reef microfacies and development of the Oulmes region, planned for *Facies*, as his first paper on the Givetian reefs of the Oued Cherrat, Al Attamna, and Mdakra regions (EICHHOLT & BECKER 2013). Hopefully, he will receive his doctorate in 2023.

M.Sc. Students

In the western Rhenish Massif, a core through the northern Hofermühle Reef was logged and studied in detail for microfacies and carbonate diagenesis by **Maximilian KERN**. The M.Sc. project was supervised jointly with Stephan BECKER from the Krefeld Survey, in the frame of a larger project on the geothermal energy potential of subsurface Devonian/Carboniferous reefs in the region.

Alexander KLEMENT started a M.Sc. project on the morphometry, taxonomy, and palaeobiogeographic relationships of middle Famennian ammonoids from the Canning Basin. The material was collected a long time ago by Michael HOUSE and RTB, mostly in the Mt. Pierre region, from where the first Devonian ammonoids of Australia were described. A main task is to clarify by detailed ontogenetic morphometry how close the Canning Basin material is to the German type populations. In the past, the extremely distant faunas were thought to include the same species. This leads to the question whether there were uniformly evolving pan-Prototethys populations, despite the large spatial record gap for most taxa.

Mieke LÖW made considerable efforts to publish the interesting results of her pioneer study on microfaunas from the initial reef phase of the Hönne Valley Reef in the northern Rhenish Massif. She gave an online presentation at the Annual Meeting of the Paläontologische Gesellschaft (LÖW et al. 2021) and the main paper has just been published online in the *Palaeo x 2* volume dedicated to more than 150 years of research on the Devonian of the Rhenish Massif (LÖW et al. 2022). For her M.Sc., she will change the topic completely. She could be persuaded to attempt the long overdue taxonomic revision of manticoceratids (Gephuroceratidae) of the Rhenish Massif, based on the restudy of types (Fig. 7) and morphometry. This revision will be essential for future better analyses of Moroccan, Belgian, French, Russian, and Australian manticoceratid faunas and to establish the global diversity trends, as Till has done it for the upper Frasnian tornoceratids. So, there is an important Ph.D. project as a perspective. First results of Mieke´s work will be presented at the International Palaeontological Congress in Thailand, in November 2022.

Fig. 7. Syntype of *Goniatites intumescens* var. *acutus* from the G. & F. SANDBERGER Collection of the Wiesbaden Museum (photo supplied by D. HEIDELBERGER).

B.Sc. students

Sarah PAWELLEK started preparations to revise the taxonomy and diversity of lower Famennian polonoceratids (Tornoceratidae), based on the rich collections of BECKER (1993) and on new material from the Sauerland, Montagne Noire, and Tafilalt. Since the holotype of the French *Polonoceras subundulatum* (FRECH, 1897) was re-discovered, and since the morphometry and regional variabilities have to be critically re-considered, the revision is expected to lead to the recognition of new taxa.

Based on the recovery of new material during road work by the LWL Museum of Natural History in Münster (under the lead of Lothar SCHÖLLMANN) at the famous Fretter site (Attendorn-Elspe Syncline, central Rhenish Massif), it was agreed that a future B.Sc. project will be devoted to the middle Givetian goniatites of the locality. Other rich material is housed in the museum collection of our institute. Apart from the ammonoids, new gastropod material was obtained.

Publications

Peer-reviewed papers (mostly open access)

AFHÜPPE, L & BECKER, R. T. (2022 online). A new discosorid and some other nautiloids from the Givetian of the Rhenish Massif, Germany. - Palaeobiodiversity and Palaeoenvironments, 15 pp.; doi.org/10.1007/s12549-022-00541-3.

GROOS-UFFENORDE, H., SCHINDLER, E., BECKER, R. T., DOJEN, C., BROCKE, R. & JANSEN, U. (2022, online): Late Early Devonian ostracodes from the Torkoz area (SW Morocco) and the Emsian/Eifelian boundary. - Paläontologische Zeitschrift, 59 pp.; doi.org/10.1007/s12542-022-00603-z.

HARTENFELS, S., BECKER, R. T., HERBIG, H.-G., QIE, W., KUMPAN, T., DE VLEESCHOUWER, D., WEYER, D. & KALVODA, J. (2022 online). The Devonian-Carboniferous transition at Borkewehr near Wocklum (northern Rhenish Massif, Germany) – a potential GSSP section. - Palaeobiodiversity and Palaeoenvironments, 67 pp.; doi.org/10.1007/s12549-022-00531-5.

HELLING, S. & BECKER, R. T. (2022 online). Two new species of *Gondwanaspis* (Trilobita, Odontopleurida) from the Givetian-Frasnian transition of the northern Rhenish Massif (Germany). - Palaeobiodiversity and Palaeoenvironments, 13 pp.; doi.org/10.1007/s12549-022-00525-3.

LÖW, M., SÖTE, T., BECKER, R. T., STICHLING, S., MAY, A., ABOUSSALAM, Z. S. & ZOPPE, S. F. (2022 online). The initial phase of the Hönne Valley Reef at Binolen (northern Rhenish Massif, Middle Devonian). – Palaeobiodiversity and Palaeoenvironments, 40 pp.; doi.org/10.1007/s12549-022-00540-4.

SAUPE, F. & BECKER, R. T. (2022 online). Refined conodont stratigraphy at Martenberg (Rhenish Massif, Germany) as base for a formal middle/upper Frasnian substage boundary. - Palaeobiodiversity and Palaeoenvironments, 51 pp.; doi.org/1007/s12549-022-00537-z.

SÖTE, T. & BECKER, R. T. (2022a, in press). Upper Frasnian ammonoids (Tornoceratidae) from Büdesheim (Eifel Mountains, Rhenish Massif, Germany). – Palaeontographica, Abt. A.

SÖTE, T. & BECKER, R. T. (2022b, in prep.). Middle/upper Frasnian tornoceratids (Goniatitida) of Oued Mzerreb (Dra Valley, Morocco). – Neues Jahrbuch für Geologie und Paläontologie.

STICHLING, S., BECKER, R. T., HARTENFELS, S., ABOUSSALAM, Z. S. & MAY, A. (2022 online). Drowning, extinction, and subsequent facies development of the Devonian Hönne Valley Reef (northern Rhenish Massif, Germany). - Palaeobiodiversity and Palaeoenvironments, 68 pp.; doi.org/10.1007/s12549-022-00539-x.

TALIH, A., ABOUSSALAM, Z. S., BECKER, R. T., SAADI, M. & BENMLIH, A. (2022, in press). Stratigraphy and tectono-sedimentary processes of allochthonous Devonian deposits of the Tisdafine Basin, Eastern Anti-Atlas, Morocco. - Bulletin de l´Institute Scientifique, **44**.

WANG, Y.-N., MA, X.-P., EBBIGHAUSEN, V. & BECKER, R. T. (2022a, in press). Spiriferide and spiriferinide brachiopods from the Frasnian (Upper Devonian) of the Bergisches Land, Germany. – Paläontologische Zeitschrift.

WANG, Y.-N., MA, X.-P., EBBIGHAUSEN, V. & BECKER, R. T. (2022b, in press). Spiriferide brachiopods from the early Famennian (Late Devonian) of the Ardennes (western Europe). - Acta Palaeontologica Sinica.

Abstracts

BECKER, R. T. (2022). Iterative evolution (homoplasy) as the rule in cephalopod evolution – implications for phylogenetic reconstructions. – In: The 11th International Symposium on Cephalopods – Present and Past, 12-16 September 2022, Natural History Museum London, Abstracts: 4.

JUNG, J., ZOPPE, S. F., SÖTE, T., DUPREY, N., FOREMAN, A., SIGMAN, D. M., HAUG, G. H., VONHOF, H. & MARTÍNEZ-GARCÍA, A. (2022): Photosymbiosis on a Mid-Devonian Reef: Evidence from Coral-Bound Nitrogen Isotopes. – Goldschmidt Conference, Honolulu, Hawai'i, USA, 10-15 July 2022.

MEYER-BERTHAUD, B., BECKER, R. T., BERT, C., DECOMBEIX, A.-L., EL HASSANI, A., KLUG, C., LACAND, M., RAMEL, M. & TAHIRI, A. (2022). A new Givetian assemblage of permineralized plants from Anti-Atlas, Morocco. – 11th European Palaeobotany and Palynology Conference, June 2022, Stockholm, Sweden: 143-144; hal-03731986.

SÖTE, T. & BECKER, R. T. (2022c). The impact of the Lower Kellwasser Event (Devonian, upper Frasnian) on ammonoids (Tornoceratidae) at Büdesheim (Rhenish Massif, Germany). - In: The 11th International Symposium on Cephalopods – Present and Past, 12-16 September 2022, Natural History Museum London, Abstracts: 24.

WICHERN, N. M. A., NOHL, T., KASKES, P., PERCIVAL, L. M. E., BECKER, R. T. & DE VLEESCHOUWER, D. (2022). Climatic variability during the Late Devonian Kellwasser Crisis on astronomical and millennial timescales. – In: 21st International Sedimentological Congress, Aug. 22-26, 2022, Beijing [online].

Devonian thesis

KERN, M. (2022). Microfacies and diagenesis of a Middle Devonian reef limestone east of Hofermühle (Bergisches Land). – M.Sc. Thesis, 209 pp. [in German].

TM Carlton E. BRETT

As a major new initiative in 2022, I have begun collaborative research with CM Jay ZAMBITO (Beloit College), and Thomas ALGEO (University of Cincinnati), on the thick (>600 m) core drilled by Cargill Salt Company at Portland Point, Lansing Township, on Cayuga Lake in central New York. This "Lansing core" has been loaned by the New York State Geological Survey to the University of Cincinnati for 1-2 years. The core features the Lochkovian Helderberg Group (including well preserved coral biostromes), Pragian Oriskany Sandstone, and a nearly continuous succession of Eifelian (Onondaga Limestone-lower Marcellus black shale) and Givetian (Hamilton, Tully, and Genesee groups), as well as upper Silurian (Ludlow-Pridoli) carbonates and evaporites. It is our objective to establish a standard reference section for litho-, chemo-, and sequence stratigraphy for the northern Appalachian Basin. To date, we have logged the entire core for lithology, sedimentary features, and all identifiable fossils, boundaries and thicknesses of all formations, member and submembers, and most key beds have been established (including Silurian units) and the core has been photographed. In addition, magnetic susceptibility has been recorded at regular intervals through the entire core and powders have been drilled through all calcareous units (most of the core) at 0.6 to 0.15m intervals for analysis of $\delta^{13}C_{carb}$, C/S, and XRF for major and trace elements. Thomas ALGEO also intends to analyze B/Ga of the samples as a proxy for paleosalinity. The core also will be scanned for high-resolution gamma ray profiles.

We intend to work with Anne-Christine DA SILVA (Université de Liège) and her students on time-series analysis of magnetic susceptibility and high-resolution gamma ray, as well as elemental profiles to examine cyclostratigraphy of the Eifelian-Givetian interval. This can be calibrated with the known conodont and other biostratigraphic record projected from outcrop into the core. We hope to refine the estimates of stage and biozone duration based on astrochronology.

Much of my other research efforts have been devoted to Ordovician and Silurian projects, However, I have continued to work on final revisions of three chapters on Middle Devonian stratigraphy for a *Bulletins of American Paleontology* volume on New York State Devonian, edited by CM Charles VER STRAETEN, New York State Geological Survey and TM Jeff OVER (SUNY College Geneseo). CM Gordon BAIRD (SUNY College Fredonia), CM Alex BARTHOLOMEW (SUNY College, New Paltz), CM Jay ZAMBITO and I have prepared two extensive manuscripts on stratigraphic terminology, re-description of units, chronostratigraphy, and facies analysis of the Middle Devonian of New York and adjacent regions. The full volume will be published electronically (print on demand) within a few months. Our intent remains to have the text and charts published in time for the upcoming SDS Devonian meeting in New York State.

During 2021 to 2022 Gordon BAIRD and I continued work with the Paleontological Research Institution (PRI) on a National Science Foundation (NSF) Grant to assemble, integrate, and digitize of our combined collections from the Devonian of New York State and elsewhere. This effort is combined with plans for a digital atlas of Middle Devonian fossils and an extensive database of geographic and stratigraphic data, based on these collections. We hope to showcase this collection at the SDS meeting.

Finally, Chuck VER STRAETEN, Gordon BAIRD, Jay ZAMBITIO and others are involved in a project to review sedimentological, paleontological and other evidence for water depths in Devonian black shales. We present evidence for two end members with highly distinctive features: shallow water black

shales < 10 m that typify restricted onshore settings and more widespread deeper water black shales that accumulated in ~50-100 depths. With my colleagues, I presented two invited talks on this topic in 2021 and 2022 at meetings of the *Geological Society of America* and hope to produce a review article within the next year.

Publications

Four papers in press for the book *Devonian of New York*. Hopefully published late in 2022. I am involved in the following chapters:

Chapter 4

Charles A. VER STRAETEN, Carlton E. BRETT, Gordon C. BAIRD, Alexander J. BARTHOLOMEW & D. Jeffrey OVER: Lower Middle Devonian (Eifelian-lower Givetian) strata of New York State: The Onondaga Formation and Marcellus subgroup.

Chapter 5

Carlton E. BRETT, Gordon C. BAIRD, James J. ZAMBITO IV & Alexander J. BARTHOLOMEW: Stratigraphy and Facies of the Middle Devonian (Givetian) Hamilton Group in New York State and Adjacent Areas.

Chapter 7

GORDON C. BAIRD, JAMES J. ZAMBITO IV & CARLTON E. BRETT: Tully Formation and Pre-Frasnian Genesee Group Succession.

TM Rainer BROCKE

Unfortunately, research activities in 2021 – including lab work - was still deeply affected by Covid 19. Only two days of field work in the Rheinisches Schiefergebirge could be realised. We visited and sampled a reopened classical trench known for the Silurian-Devonian boundary transition.

A paper on Eifelian ostracodes from Morocco (Anti-Atlas) together with H. GROOS-UFFENORDE and other colleagues has been submitted. It also shows some palynological results.

We continued our work from the Eifel and Hunsrück areas and a further paper from Turkey is in preparation.

TM Anne-Christine DA SILVA

We finished (with J. DENAYER and master students from Liege university) the sampling and measurement of portable XRF of the Devonian-Carboniferous boundary of Chanxhe in Belgium for cyclostratigraphy.

The work on the Route 199 record, near Kingston (New York State, U.S.A.), encompassing part of the Emsian, in collaboration with C. E. BRETT (Cincinnatti), C. VER STRAETEN (New York State Museum), A. BARTHOLOMEW (University of SUNY New Paltz), and F. HILGEN and M. DEKKERS (Utrecht University) is following its (slow) course. The magnetic susceptibility as well as Portable XRF, have been measured on the whole set of samples, lightness and carbon and oxygen isotopes on portion of the outcrop and ICPMS on selected samples.

A new project funded by the National Belgian Science foundation (FNRS) started (in June 2022) in collaboration with Michel CRUCIFIX (PI) from Louvain-la-Neuve University, called WarmAnoxia. The aim is to evaluate how astronomical climate forcing can have an impact on anoxia development during the Devonian. In this framework, the PhD candidate **Jarno HUYGH** will be working on reassessing existing data and producing new data to highlight the link between astronomical forcing and key Devonian anoxic events, while **Justin GÉRARD** will focus on testing the physical and biogeochemical consistency of different hypotheses through modelling.

Our funding in the framework of the IGCP-652 project “Reading time in Paleozoic sedimentary rocks” allowed to support some young researcher to participate to the international association of sedimentologists virtual meeting (ICS, Beijing, virtual).

I participated to those publications in relation with the Devonian:

PERCIVAL et al. (2022) focus on nitrogen-isotope and cyclostratigraphy to get insight into the temporal and spatial variability of anoxia during the around the Frasnian-Famennian boundary. The work combines nitrogen-isotope, organic-

biomarker, phosphorus, and Rock-Eval data from Iowa (H-32 core), Poland (Kowala) and Belgium (Sinsin), allowing to pinpoint regional differences in the timing and nature of marine perturbations at the Frasnian-Famennian boundary.

VAN DER BOON et al. (2022) question the fact Devonian paleomagnetic data are generally difficult to interpret and have complex partial or full overprints. The paper reviews a large amount of data and proposes that the Earth magnetic field during the Devonian might have been so weak, and in part non-dipolar, which could explain that obtaining reliable primary paleomagnetic data from Devonian rocks is challenging.

Furthermore, the paper of WOUTERS et al. (2022) might be of interest for the Devonian community because it proposes a package (StratigrapheR) for the generation of lithologs on the open-access R platform.

Publications

PERCIVAL, L. M. E., MARYNOWSKI, L., BAUDIN, F., GODERIS, S., DE VLEESCHOUWER, D., RAKOCIŃSKI, M., DA SILVA, A.-C. & CLAEYS, P. (2022). Combined Nitrogen-Isotope and Cyclostratigraphy Evidence for Temporal and Spatial Variability in Frasnian–Famennian Environmental Change. - Geochemistry, Geophysics, Geosystems, **23** (5), e2021GC010308.

VAN DER BOON, A., BIGGIN, A. J., THALLNER, D., HOUNSLOW, M. W., BONO, R., NAWROCKI, J., WÓJCIK, K., PASZKOWSKI, M., KÖNIGSHOF, P., DE BACKER, T., KABANOV, P., GOUWY, S., VANDENBERG, R. & DA SILVA, A.-C. (2022). A Persistent Non-uniformitarian Paleomagnetic Field in the Devonian? - Earth Science Reviews, **231**: 104073.

WOUTERS, S., DA SILVA, A.-C., BOULVAIN, F. & DEVLEESCHOUWER, X. (2021). StratigrapheR: Concepts for Litholog Generation in R. - R Journal, **13** (2): 153-178.

CM David DE VLEESCHOUWER

In January 2022, I started a Junior Professorship (with tenure) in Earth System Science at the University of Münster (Germany). In this context, I purchased a portable X-Ray Fluorescence (pXRF) analyzer that I am currently calibrating for Palaeozoic carbonate-rich lithologies.

The pXRF device acts as the main analysis tool within a German Research Foundation (DFG) funded project (2021-2024) titled *"Astronomical signatures in Late Devonian black shales of the Rhenish Massif."* The main objective of the project is to understand the cyclicity of Devonian sedimentary sequences in the Rhenish Massif. To attain this objective, **Nina WICHERN** (Ph.D. student) will construct high-resolution cyclostratigraphies, while also providing palaeoclimate insights. Within the project, astrochronologies for three Late Devonian time slices at three different field sites will be constructed: The Kellwasser events at the Winsenberg roadcut near Diemelsee-Adorf (sampling carried out in autumn 2021), the *Annulata* and Dasberg crises at the Effenberg Quarry (sampling carried out in summer 2022), and the Hangenberg Crisis at the Borkewehr section (sampling planned for autumn 2022). Nina WICHERN seeks to combine cyclostratigraphic age-depth models with well-established biostratigraphies (provided by Thomas BECKER and his team in Münster) to provide global correlations towards other Late Devonian reference sections. With the ambition to provide global correlations, Nina WICHERN visited the Late Devonian New York state sections (e.g., Walnut Creek) with Jeffrey OVER and Linda HINNOV in the spring of 2022. This project provides an opportunity to evaluate the role of astronomical Milankovitch forcing in prompting and pacing Late Devonian carbon cycle perturbations and extinction pulses.

I am also active in a collaborating role in an ongoing Late Devonian project ("WarmAnoxia"), hosted by the Liège and Louvain-la-Neuve Universities in Belgium. This project is coordinated by Anne-Christine DA SILVA (Liège) and Michel CRUCIFIX (Louvain-la-Neuve), respectively. The project is designed to test the eccentricity hypothesis for the development of Late Devonian anoxia (DE VLEESCHOUWER et al. 2017) by means of new proxy data and through numerical simulations with an Earth System model.

Activity in the framework of the IGCP-652 "Reading Time in Paleozoic sedimentary rock" project is slowly picking up again, after some delays

due to the pandemic. Several international conference contributions were presented and different student exchanges took place between IGCP-652 members.

CM Mercedes di PASQUO

Meetings 2022

The **27th Brazilian Congress of Paleontology 2022,** held in the city of Cuiabá, Brazil (https://www.even3.com.br/cbp2022/), and the **1st Gondwana Devonian Symposium,** took place on May 5th. The symposium focused on "Calibrating the Devonian in South America" and included short contributions and lectures (some of them virtually), with different kind of fossiliferous news from Bolivia, Brazil, South Africa and Australia, and also from Europe that were compared with those of Gondwana. Fruitful discussions occurred at the final round table between all the attendants (virtually and in person). This symposium was in part transmitted on YouTube via the channel:

https://youtube.com/channel/UCyGW_e-UGkhbhGnmOrkyG1Q

The abstract volume of our symposium is acailable at:

https://sbpbrasil.org/publications/index.php/paleodest/issue/view/127/72. Hope you like it!

The **Asociación Latinoamericana de Paleobotánica y Palinología (ALPP),** in its "50 years", supports the organization of these events (see also the ALPP website at:

alpaleobotanicapalinologia.blogspot.com):

The **AASP-TPS annual meeting, August 7-11 2022**. This meeting will take place for the first time in Manizales, Colombia, outside USA, in a hybrid format (in-person/virtual). The submission of abstracts was extended up to June 15th. All information about the conference can be found on the website of the AASP-TPS:

https://palynology.org/54th-annual-meeting-of-aasp-the-palynological-society-manizales-colombia-august-7th-11th-2022-54-encuentro-anual-de-la-sociedad-palinologica-de-aasp-tps-manizales-colombia-agosto-7/

The XVII Argentinian Paleobotanic and Palynology Symposium (*Simposio Argentino de Paleobotánica y Palinología*), will be held at Jujuy city (Jujuy province, Argentina), only in person, on September 28th - 30th. Submission of abstracts is open till June 30th. More information is provided at:

http://www.sapp2022.com.ar/

Among the activities developed between 2018-2022, in collaboration with colleagues from Argentina and elsewhere, several contributions were published and others still ongoing dealing with Devonian palynofloras in Argentina and Bolivia (NOETINGER et al. 2018; DI PASQUO et al. 2019a; QUETGLAS et al. 2019), Brazil (MATSUMURA et al. in press 2022) and USA (DI PASQUO et al. 2019b, 2019c; FILIPIAK et al. 2021; ZATOŃ et al. 2021; HU et al. 2021), and especially several referred to the Devonian-Carboniferous Boundary from Bolivia (DI PASQUO et al. 2019c) and from Montana in USA bearing palynofloras and conodonts (RICE et al. 2018a, 2018b; DI PASQUO et al. 2018, 2021). Two Ph.D. theses were also finished in 2021 under my supervision (RICE 2021; QUETGLAS 2021).

Another recent multi-author contribution dealing with the Devonian Stratigraphy of the Devonian System of Argentina, which involves updated geological and paleontological information on the stratigraphic and biostratigraphic units, is available at the Repository of SEGEMAR at:

https://repositorio.segemar.gov.ar/handle/308849217/4160

and the Asociación Geológica Argentina at:

https://geologica.org.ar/devonico/

Publications 2018-2022

Reprints and abstracts are available at:

http://www.palino.com.ar
http://independent.academia.edu/MercedesDiPasquo
https://www.researchgate.net/profile/Mercedes_Di_Pasquo/)

The two last volumes with contributions published in the ALPP journal can be consulted at our website at:

http://alpaleobotanicapalinologia.blogspot.com.ar, or can be downloaded from:

volume 2020:

http://www.palino.com.ar/alpp/BoletinesALPP/DAntoni-ALPPvol2020-final.pdf

volume 2021:

https://www.palino.com.ar/alpp/BoletinesALPP/Volumen-ALPP-boletin-2021.pdf

Journal and book articles

DI PASQUO, M., HU, M., ZATOŃ, M. & MYROW, P. (2022). Microspores, megaspores, palynofacies, and depositional history of the upper Givetian Maywood Formation, Northern Wyoming, USA. - Review of Palaeobotany and Palynology, **299** (104604); doi.org/10.1016/j.revpalbo.2022.104604.

DI PASQUO, M. & VILÁ, J. (2019). SEM Observation of Non-Metallized Samples in Paleopalynology. - M&M-Microscopy & MicroAnalysis Journal, **26**: 149-150; doi.org/10.1017/S1551929519000798.

DI PASQUO, M., GRADER, G. W., KONDAS, M., DOUGHTY, P. T., FILIPIAK, P., RICE, B. J. & ISAACSON, P. E. (2019a). Lower Sappington Formation palynofacies in Montana confirm Upper Famennian black shale paleoenvironments and sequences across western North America. - Palaeogeography, Palaeoclimatology, Palaeoecology, **536** (109370); doi.org/10.1016/j.palaeo.2019.109370.

DI PASQUO, M., GRADER, G. W., ANDERSON, H., IANNUZZI, R., DÍAZ MARTÍNEZ, E., LÓPEZ, S., RICE, B. J. & ISAACSON, P. E. (2019b). Delineating the Devonian-Mississippian boundary based on Palynology at Zudañez in Bolivia. - In: Instituto Geológico Minero y Metalúrgico – INGEMMET, special volume "II Simposio Internacional de Paleontología de Perú, Tendencias modernas de la Paleontología aplicadas a la Geología" (Lima, 2018): 72-77; ISBN: 978-612-47898-1-6, http://repositorio.ingemmet.gob.pe.

FILIPIAK, A., KONDAS, M., DI PASQUO, M., RICE, B., DOUGHTY, T., GRADER, G. W. & ISAACSON, P. E. (2021). New colonial acritarch *Involusphaeridium gutschicki* gen. et sp. nov. from the Lower Sappington Formation (Upper Famennian), western Montana, USA. - Review of Palaeobotany and Palynology, **284** (104344); doi.org/10.1016/j.revpalbo.2020.104344.

MATSUMURA, W. M. K., DI PASQUO, M., IANNUZZI, R. & BOSETTI, E. (2022). Plant diversification through the Middle Devonian in Brazil. - In: IANNUZZI, R., RÖßLER, R. & KUNZMANN, L. (eds.), Brazilian Paleofloras. From Paleozoic to Holocene. Springer Nature, ISBN 978-3-030-22525-4, eReference ISBN 978-3-030-22526-1.

NOETINGER, S., DI PASQUO, M. & STARCK, D. (2018). Middle-upper Devonian palynofloras from Argentina, systematic and correlation. - Review of Palaeobotany and Palynology, **257**: 95–116; doi.org/10.1016/j.revpalbo.2018.07.009.

QUETGLAS, M., DI PASQUO, M. & MACLUF, C. (2019). Morphology of the megaspore *Lagenoisporites magnus* (CHI & HILLS, 1976) CANDILIER et al. (1982), from the Carboniferous (lower Mississippian: mid-upper Tournaisian) of Bolivia. - Annals of the Brazilian Academy of Sciences, **91** (Suppl. 2): e20180750; doi.org/10.1590/0001-3765201920180750.

ZATOŃ, M., HU, M., DI PASQUO, M. & MYROW, P. (2021). Adaptive function and phylogenetic significance of novel skeletal features of a new Devonian microconchid tubeworm (Tentaculita) from Wyoming, USA. - Papers in Palaeontology, **96** (1): 112–126; doi.org/10.1017/jpa.2021.71.

Abstracts 2018-2022

DI PASQUO, M. (2022). Can fluorescence be helpful to discriminate between indigenous taxa of Carboniferous age from those reworked of Mid-Upper Devonian rocks? - 54th Annual meeting of AASP - The Palynological Society, Manizales, Colombia. August 7-11, 2022.

DI PASQUO, M. & STREEL, M. (2022). When is *Retispora lepidophyta* a reliable proxy to define the Devonian-Carboniferous Boundary (DCB)? - 27th Brazilian Congress of Paleontology (https://www.even3.com.br/cbp2022/), 1st Gondwana Devonian Symposium; https://sbpbrasil.org/anais-e-resumos/.

DI PASQUO, M., MATSUMURA, W. M. K. & IANNUZZI, R. (2022). Palynologic analysis of the Barreirinha Formation (Famennian) bearing *Protosalvinia* from southern margin of the Amazonas Basin, Brazil. - 27th Brazilian Congress of Paleontology (https://www.even3.com.br/cbp2022/), 1st Gondwana Devonian Symposium; https://sbpbrasil.org/anais-e-resumos/.

MATSUMURA, W. M. K., DI PASQUO, M. & IANNUZZI, R. (2022). Plant diversification through the Devonian in Brazil. - 27th Brazilian Congress of Paleontology (https://www.even3.com.br/cbp2022/), 1st Gondwana Devonian Symposium; https://sbpbrasil.org/anais-e-resumos/

DI PASQUO, M., RICE, B. J., GRADER, G.W., DOUGHTY, P. T., ISAACSON, P. E. & SILVESTRI, L. (2021). Biostratigraphy of Devonian-Mississippian Sappington Formation in southwestern Montana, U.S.A. - XII Congreso de la Asociación Paleontológica Argentina (CAPA, November 23-26th); https://www.congresoapa.org.ar/.

HU, M., MYROW, P. M., DI PASQUO, M. & ZATOŃ, M. (2021). Paleoecology and paleoenvironment of a peculiar microconchid tubeworm from the Devonian of Wyoming, USA. - XVII RAS (Reunión Argentina de Sedimentología) y VIII CLS (Congreso Latinoam. de Sedimentología), Paraná (October 27-30th); http://www.sedimentologia.org.ar/spa/xvii-ras/.

DI PASQUO, M., QUETGLAS, M. & NOETINGER, S. (2019). Morfología de una megaspora presente en asociaciones palinológicas del Devónico Medio a Tardío de Bolivia y su posible afinidad botánica. - XV Simpósio Brasileiro de Paleobotânica e Palinologia (Cuiabá-MT), Brasil, Boletín ALPP, **19**; http://www.palino.com.ar/alpp/BoletinesALPP/ALPP-boletin19-2019.pdf, http://alpaleobotanicapalinologia.blogspot.com.ar.

DI PASQUO, M., RICE, B. J., GRADER, G. W., DOUGHTY, P. T. & ISAACSON, P. E. (2019). First record of *Lagenicula devonica* CHALONER, 1959 from the Middle Sappington Formation of Montana, USA and its significance for the Devonian-Carboniferous boundary. - XV Simpósio Brasileiro de Paleobotânica e Palinologia (Cuiabá-MT), Brasil, Boletín ALPP, **19**. http://www.palino.com.ar/alpp/BoletinesALPP/ALPP-boletin19-2019.pdf, http://alpaleobotanicapalinologia.blogspot.com.ar.

QUETGLAS, M., DI PASQUO, M. & MACLUF, C. (2019). *Hystricosporites* (MCGREGOR, 1960), megasporas con procesos bifurcados de Bolivia. - XV Simpósio Brasileiro de Paleobotânica e Palinologia (Cuiabá-MT), Brasil, Boletín ALPP, **19**. http://www.palino.com.ar/alpp/BoletinesALPP/ALPP-boletin19-2019.pdf, http://alpaleobotanicapalinologia.blogspot.com.ar

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RICE, B. J., DI PASQUO, M., DOUGHTY, P. T., GRADER, G. W. & ISAACSON, P. E. (2018). Creatures from the Bakken Lagoons: Palynology confirms the brackish depositional environment with implications for Basin evolution. - AAPG meeting, Salt Lake City, May 2018, Control ID: 2857447; https://www.aapg.org/.

Supervised Ph.D. thesis

QUETGLAS, M. (2021). Estudio morfológico y evolutivo de megasporas dispersas presentes en depósitos del Devónico y Carbonífero del Noroeste Argentino y Bolivia. Universidad Nacional de La Plata. - Ph.D. Thesis, Facultad de Ciencias Naturales y Museo, 208 pp.

RICE, B. J. (2021). Biostratigraphy of Devonian-Mississippian Sappington Formation and Devonian Trident Member of Three Forks Formation in Southwestern Montana, U.S.A. - Ph.D. Thesis, University of Idaho (Moscow, Idaho, USA), 201 pp. and supplementary files.

CM James EBERT

I retired in 2021 from the Department of Earth and Atmospheric Sciences at SUNY Oneonta after 36 years. Although retired, I am continuing research in the Přídolí – Lochkovian Helderberg Group in New York State. My chapter in the upcoming volume on the Devonian of New York with my co-author Damon MATTESON is supposed to be published later this summer. So, much time has been spent editing and fixing figures. In the near future, I plan to focus on additional gamma ray

profiling of outcrops and the chitinozoan biostratigraphy in greater depth.

Publications

Journal article

EBERT, J. R. & MATTESON, D. K. (in press). Chapter 2: Lithostratigraphy, Multi-Taxa Biostratigraphy and Sequence Stratigraphy of the Helderberg Group (Přídolí – Lochkovian**)** in New York State. - In: VER STRAETEN, C., OVER, D. J. & WOODRUFF, D. (eds.), Devonian of New York. - Bulletins of American Paleontology.

Abstracts

EBERT, J. R. & MATTESON, D. K. (2022). Chapter 2: Lithostratigraphy, Multi-Taxa Biostratigraphy and Sequence Stratigraphy of the Helderberg Group (Přídolí – Lochkovian) in New York State. - Geological Society of America, Abstracts with Programs, **54** (3); doi:10.1130/abs/2022NE-373601.

EBERT, J. R. (2021). The Power of a Paradigm: Misidentification and Miscorrelation of the Kalkberg and New Scotland Formations (Helderberg Group, New York State). - Geological Society of America, Abstracts with Programs, **53** (1); doi:10:1130/abs/2021NE-361552.

WAIS, P. **&** EBERT, J. R. (2021). Cyclic input of siliciclastic sediments in the New Scotland Formation revealed by gamma ray spectrometry. - Geological Society of America, Abstracts with Programs, **53** (1); doi:10.1130/abs/2021NE-361651.

VER STRAETEN, C., OVER, D. J., WOODROW, D. L., EBERT, J. R., BOYER, D. & COLOSIMO, A. (2021). BRETT and BAIRD, and the Devonian of New York: A new, extensive volume on the North American Standard Succession. - Geological Society of America, Abstracts with Programs, **53** (6); doi:10.1130/abs/2021AM-370839.

VER STRAETEN, C., OVER, D. J., WOODROW, D. L., EBERT, J. R., BOYER, D. L. & COLOSIMO, A. (2021). Devonian of New York: A New, Extensive Volume on the North American Standard Section - Geological Society of America, Abstracts with Programs, **53** (1); doi:10.1130/ABS/2021NE-361843.

LARSEN, C. M., MURPHY, D. P., WAIS, P. V., SHORT, M. E., MEDINA, C. C., KERPEZ, N. P., HRYSKO, M. A., MASTROPIETRO, N. A., VANALSTYNE, A. M. & EBERT, J. R. (2020): Correlation of Synthetic Gamma Ray Profiles from Outcrops of the New Scotland Formation, Helderberg Group (Lochkovian) at Cherry Valley and Schoharie, New York. - Geological Society of America, Abstracts with Programs, no. 344617.

EVERY, M., RASCOE, S., SILBERT, Z., HARRISON, S., VITEVITCH, C., HARRINGTON, P., WESTMAN, D., ADAMS, D. & EBERT, J. R. (2019). Orientation of Cephalopods as Paleocurrent Indicators in the Green Vedder Member, Manlius Formation, New York State. - Geological Society of America, Abstracts with Programs, **51** (1); doi:10.1130/abs/2019NE-328273.

RETTEW, E., MARRONE, T., MAKARIUS, G., SZAWIEL, A., HARSHA, G., ELDRED, J., MORLANG, D. & EBERT, J. R. (2019). Orientation of Gastropods as Paleocurrent Indicators in the Green Vedder Member, Manlius Formation, New York State. - Geological Society of America, Abstracts with Programs, **51** (1); doi:10.1130/abs/2019NE-328288.

EBERT, J. R. (2019). A Synthetic Gamma Ray Log of the Onondaga Formation at Cherry Valley, New York. - Geological Society of America, Abstracts with Programs, **51** (1); doi:10.1130/abs/2019NE-326924

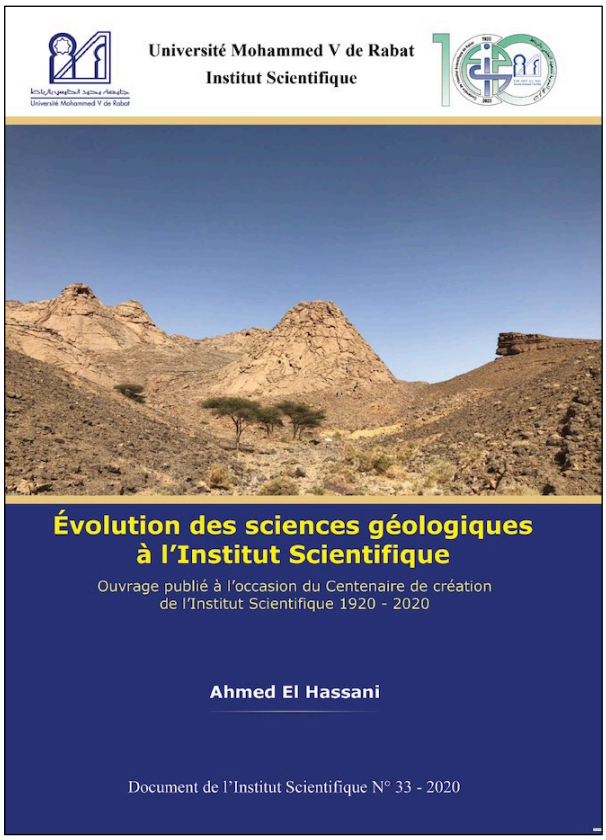
CM Ahmed EL HASSANI

After the obligatory stop due to covid 19, fieldwork resumed fortunately in 2022. As for my Devonian investigations on the Moroccan Meseta, indicated by TM R. T. BECKER in the previous SDS-Newsletter (no. 36), I have conducted fieldwork with him and CM Z. S. ABOUSSALAM in the eastern part of the Central Morocco. This area, named the *Azrou-Khénifra Carboniferous basin*, is characterized by the sliding of syn-sedimentary nappes. Different sizes of olistoliths include the Devonian series mainly. These researches were carried out within the framework of preparing the 3rd volume of the Scientific Journal (Frontiers in Science and Engineering) edited by the Hassan II Academy of Science and Technology, and is dedicated to the ***Devonian and the Lower Carboniferous series of the Western Moroccan Meseta***. They were additional studies to previous works in the same region. Our research, performed outside the appropriate season (end of July), was challenging because of the high heat (up to 35°C in the shade); therefore, the working conditions were not easy. Our laboratory work will continue at the

University of Munster, and, depending on the results, we expect to produce the third volume on Devonian and Lower Carboniferous series in early 2023.

Moreover, after I retired from the Mohammed V University of Rabat (in September 2020), I moved to my new office at the Hassan II Academy of Science and Technology, where the working conditions are better.

Since this new situation, I have published two general culture books on Moroccan Geology. These two books, voluntarily written in French, are fundamental for anyone who begins geology work in Morocco (Ph.D. students, university or high school teachers, and natural environment managers). They are:



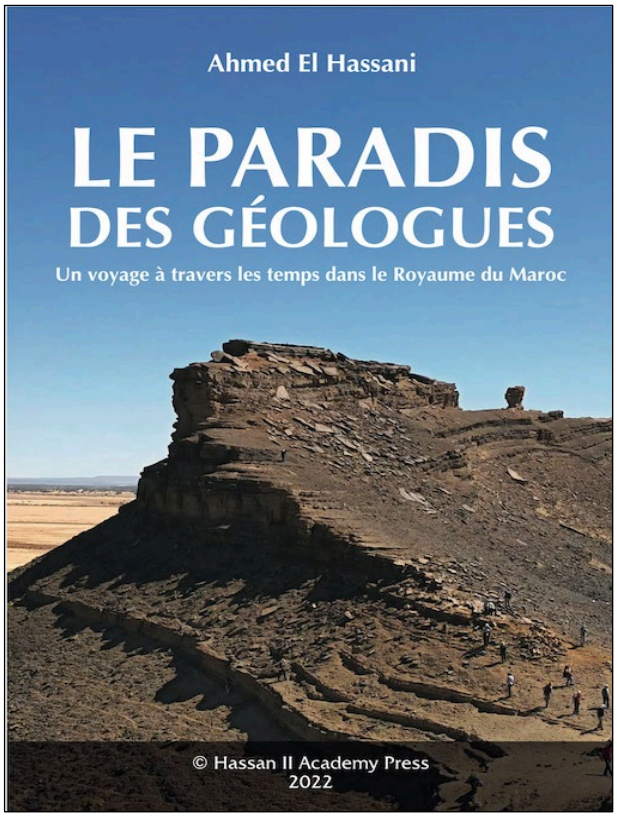
EL HASSANI, A. (2020). **Évolution des sciences géologiques à l'Institut Scientifique (Geological sciences Evolution at the Scientific Institute).** - Document de l'Institut Scientifique, **33**: 137 pp.

This book was published on the occasion of the Scientific Institute (Cherifian) Centenary (1920-2020). Indeed, it was time to assess the Earth Sciences part, undoubtedly brief, but retracing with rigor the main stages of its development and the involved scientists. This book reproduces the principal works and indicates the ideas developed by the author or by the group of authors (or department) to which they belong. In this document, I have focused on three main periods:

-- The first is that of the explorers and initiators (the pioneers) of geology; it is the period of the unquestionable pioneer`s contributions, which is a basis for discussion. This research is often based on mapping and the regional monographs accompanying them (descriptive notes). These explorers were naturalists and knew various disciplines (geology, geomorphology, climatology, water resources, botany);

-- The second, started in 1966-67, is a milestone for the Earth sciences with the emergence (or rather the acceptance by the geological community) of the theory of plate tectonics. This theory allows a better understanding of the geodynamics of our planet Earth. From this date onwards, we are witnessing a true revolution in geology. By introducing this theory of plate tectonics, taking up the mobile conceptions of Alfred WEGENER, who in 1912 presented the continental drift hypothesis, it develops and provides a solid theoretical foundation based on this hypothesis, then very recently, of the expansion of the ocean floor. In this regard, Bernard BALAN (2011) asked if geology was a science. Obviously, in his book, he traces the history of ideas. Bernard BALAN noted in his book on the evolution of geology that geologists agree today to recognize that the introduction of this theory of plate tectonics would be the real birth of geology as a science.

-- An impressive development of Ph.D. studies characterizes the third stage (end of the 1970s up to now). In addition, the realization of geological maps within the National Program of Geological Cartography framework, books, and scientific articles contribute to Moroccan geology's knowledge and progress. The Scientific Institute has actively participated in this evolution as it is documented in its annals, many of which exist on the web (digital library) and help, in this way, to make known the patrimonial value that Morocco jealously keeps.



EL HASSANI, A. (2022). **Le Paradis des géologues: Un voyage dans le temps au Royaume du Maroc** (Geologists' Paradise: A Journey through time in the Morocco Kingdom). - Hassan II Academy Press (Hassan II Academy of Science and Technology), 350 pp. [with the Jebel Mech Irdane base Givetian GSSP on the front cover].

Morocco is considered geologically among the countries that describe the geological history of the globe (from the Archean to the Quaternary) reasonably wholly. Therefore, it is of great interest to the international scientific community and many geologists from the five continents to visit, in addition to the diversity of geological terranes. As a result, several stratigraphic patterns and fossil groups have been identified in Morocco and are among the most representative of the planet. The country also offers many geological landscape curiosities that are rare in the world:

- the Hamar Lakhdad Devonian mud-mounds in the Tafilalet area (Southeastern Anti-Atlas),
- the Peridotite of Beni Bouzera in the northern Rif,
- the numerous caves,

This asset is still unknown by most Moroccans, including managers of natural areas or the scientific community not specialized. Therefore, inventory studies are encouraged to raise public awareness of this heritage's conservation, development, and rational use.

Unfortunately, the market value of this natural heritage currently prevails in Morocco; this generates massive exploitation, even abuse, of mineral and fossil resources that will inevitably lead to their disappearance in the short or medium term. This book, of 350 pages, includes four parts: A historical part summarizing the first discoveries and studies in the nineteenth and early twentieth century; then in the second part, this book explains the importance of the "Institut Scientifique Chérifien" in the development of Moroccan geology; the third part describes the various aspects of the geology of Morocco. Finally, the last part deals with the notion of geological heritage and its importance in Morocco.

CM Robert W. GESS

With the support of the Millennium Trust and GENUWS (the DSI-NRF Centre of Excellence in Palaeosciences), the Devonian Ecosystems Project, based at the Albany Museum in Makhanda, Eastern Cape, South Africa, has had a very successful year.

This year the trustees and management of the Albany Museum have made available a small building for the exclusive use of the project, including the production of a public gallery highlighting the fossils of the Waterloo Farm lagerstätte on the outskirts of town.

Published papers have included announcement (by R. W. GESS and C. PRESTIANNI) of Africa's earliest terrestrial ecosystems in Scientific Reports (Fig. 1). These vegetative ecosystems (excavated from strata near Humansdorp) are interesting for a number of reasons, amongst them that during the early Devonian southern South Africa was already situated in the Antarctic circle, and as with the Late Devonian, the early Devonian of South Africa was once considered to be unlikely to produce a rich terrestrial record. This was seemingly born out by

the fact that only one species of plant of this age had ever been described from South Africa, having been recorded in the 1930s. Our initial report itemises 15 taxa, making it one of the most diverse floras of its age from anywhere in the world. Three new genera and species were diagnosed (*Krommia parvapila*, *Elandia itshoba*, and *Mtshaelo kougaensis*). Ongoing excavations at the site are producing additional valuable material.

This report is furthermore of interest as, hitherto, the dating of the Baviaanskloof Formation (uppermost member of the Table Mountain Group, Cape Supergroup) was uncertain. The abovementioned report, however, provides a fairly good biostratigraphic estimate for the Karredouw Member (which is the middle of three members comprising the Baviaanskloof Formation). This member at least may now be fairly confidently assigned to the Lochkovian. Invertebrates fossils from the overlying 'Upper Member' are consistant with a Pragian to earliest Emsian age. This fits well with the Emsian age traditionally assigned to the Gydo Formation at the base of the overlying Bokkeveld Group (Cape Supergroup.

Work on the Late Devonian (Famennian) fossils from the Waterloo Farm lagerstätten is also ongoing. These, likewise, show deposition in a polar estuarine environment during the Devonian period, and are preserved within the Witpoort Formation (Witteberg Group, Cape Supergroup).

Chris HARRIS is conducting fieldwork and analysis of the geology of the Witpoort Formation for his Ph.D., for which he is registered at the Evolutionary Studies institute of the University of the Witwatersrand (supervised by Zubair JINNAH, Asinne TSHIBUBUDZE, Robert GESS, and Cameron PENN-CLARKE). He is simultaneously writing up papers based on his master´s degree, which focussed on a selection of plant fossils from the Witpoort Formation, with a particular focus on the new Coombs Hill locality 30 km to the east of Waterloo Farm.

During this period, he was the lead author on a paper in *Review of Palaeobotany and Palynology* describing two species of the lycopod genus *Colpodoxylon* (*Colpodexylon pullumpedes* and *Colpodexylon mergae*) from Waterloo Farm and Coombs Hill (Fig. 2).

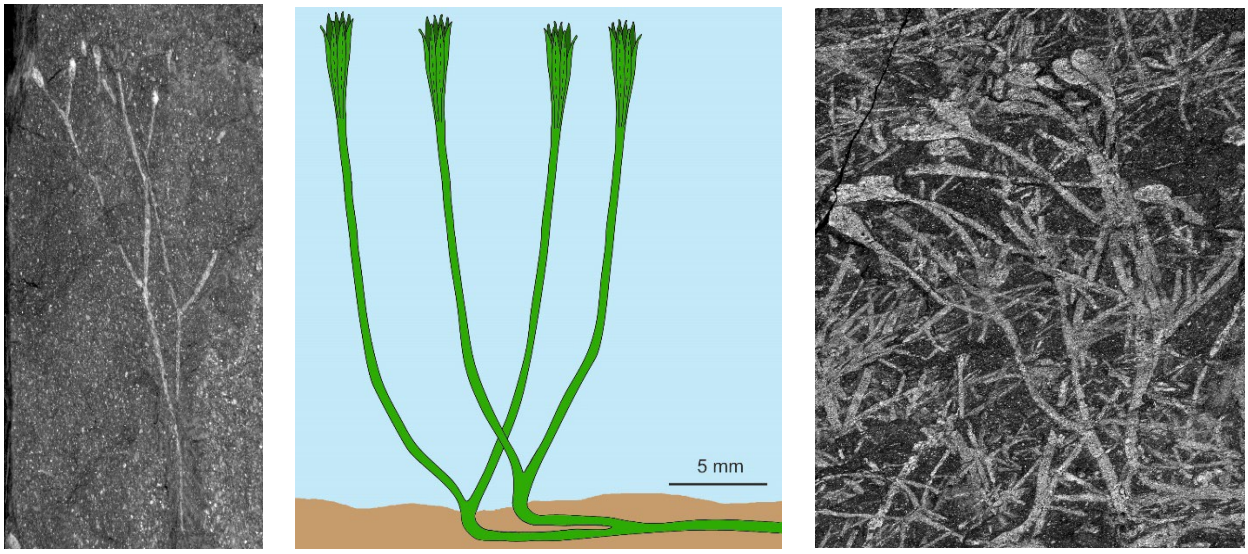


Fig. 1. Plants from Africa's earliest (420 ma) terrestrial ecosystem: *Elandia itshoba* (2.5 cm high), *Mtshaelo kougaensis*, and *Uskiella spargens* (5.1 cm high).

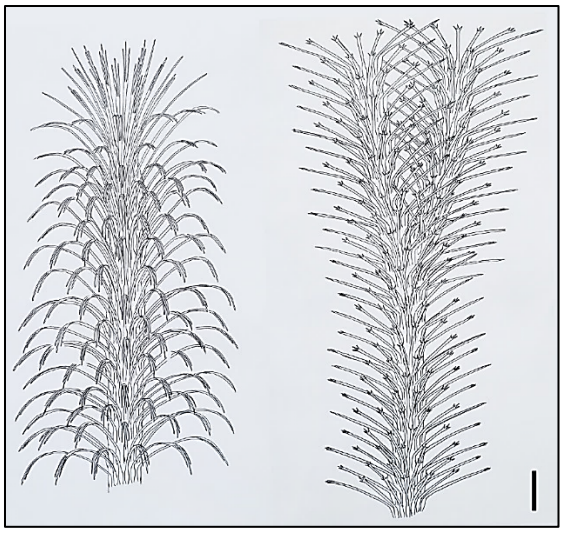


Fig. 2. Reconstruction of 360 ma old lycopod plants, newly described species, *Colpodexylon mergae* (left) and *Colpodexylon pullumpedes* (right).

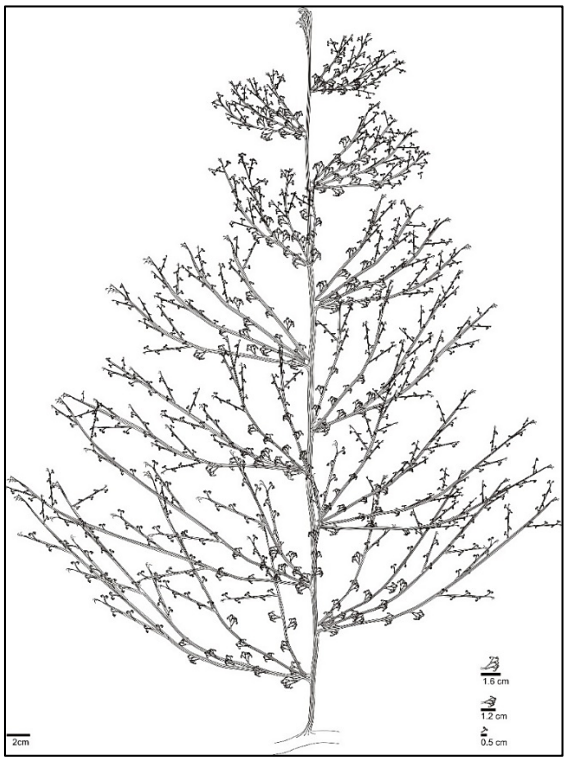


Fig. 3. Whole plant reconstruction of the newly described 360 ma old plant, *Flabellia lococannis.*

An intrigueing new fern-like taxon, *Flabellia lococannis* (Fig. 3), was described from the Waterloo Farm lagerstätte in *Review of Palaeobotany and Palynology* by Rob GESS and Cyrille PRESTIANNI. Frank SHOLZ and Robert GESS furthermore formalised the diagnosis of the non-marine bivalve *Naiadites devonicus*, from the Waterloo Farm lagerstätte, representing the only Devonian representative of this genus.

Ryan NEL has begun a Ph.D. in the lab, registered at Rhodes University, conducting an analysis of South African placoderm fish, including those in the Devonian Ecosystems Project collection. He is studying under the dual supervision of Robert GESS and Kate TRINAJSTIC of Curtin University, Australia.

Cait REDDY has also joined the lab this year, conducting a taxonomic analysis of early Devonian ophiuroid echinoderms from the uppermost Tabe Mountain Group. These will comprise her B.Sc. Honours dissertation under the dual mentorship of Robert GESS and Mhairi REID (currently a Ph.D. candidate at Oxford University).

In July, I presented a paper (co-authored by Per AHLBERG, Uppsala University) at the 16th ISELV (International Symposium on Early and Lower Vertebrates) held in Valencia, Spain, between the 20th and 24th June, on a new species of *Hyneria* (tristichopterid fish) from the Waterloo Farm lagerstätte.

Publications

Journal contributions

GESS, R. W. & PRESTIANNI, C. (2021). An early Devonian flora from the Baviaanskloof Formation (Table Mountain Group) of South Africa. - Scientific Reports, **11** (1): 11859; doi: 10.1038/s41598-021-90180-z.

HARRIS, C., GESS, R. W., PRESTIANNI, C. & BAMFORD, M. K. (2021). A Late Devonian refugium for *Colpodexylon* (Lycopsida) at high latitude. - Review of Palaeobotany and Palynology, **293**: doi.org/10.1016/j.revpalbo.2021.104481.

GESS, R. W. & PRESTIANNI, C. (2022, in press). *Flabellia lococannis* gen. et sp. nov.: a new fern-like taxon plant from the Famennian of South Africa. - Review of Palaeobotany and Palynology, **11** (1): 11859: 1-23; doi: 10.1038/s41598-021-90180-z.

SCHOLZE, F. & GESS, R. W. (2021). Late Devonian non-marine *Naiadites devonicus* nov. sp. (Bivalvia: Pteriomorphia) from the Waterloo

Farm Lagerstätte in South Africa. – *Geobios,* **69**: 55-67; doi.org/10.1016/j.geobios.2021.07.002.

Abstract

GESS, R. W. & AHLBERG, P. E. (2022). A new Famennian species of *Hyneria* from the terra incognito of southern Gondwana – evidence from the Waterloo Farm lagerstätte in South Africa. - 16th International Symposium on Early and Lower Vertebrates, Vanencia, Spain, Abstracts Volume.

CM Stephan HELLING

Due to my work as a freelancer in the context of palaeontological and archaeological ground monument preservation within North Rhine-Westphalia, I am no longer exclusively concerned with the Devonian. A major project of the last year, in this context, was a big construction site in Bergisch Gladbach within the Paffrath Syncline (Northern Rhenish Massif). During excavation work, several sections of the late middle Devonian to upper Devonian Plattenkalk were exposed, logged and sampled. Field work there is still going on till the end of the year. The scientific work will focus on biostratigraphy and carbonate microfacies. Since July 2022, I also have a half time-position at the LVR Office for the preservation of ground monuments. In the course of this position, smaller construction sites and quarries in the Rhineland part of the Rhenish Massif and the Eifel region in particular are monitored and sampled palaeontologically. The results of this work will be published at regular intervals in a summarized form.

But taxonomic work on Devonian trilobites of the Rhenish Massif and Morocco will also be continued. One contribution about two new species of the cosmopolitan genus *Gondwanaspis* was published in the spring of this year as part of the special issue of *Palaeobiodiversity and Palaeoenvironments* "The Rhenish Massif: More than 150 years of research in a Variscan mountain chain"; another one is in progress. In the course of the activity for the preservation of ground monuments, there are also some other trilobite findings that are waiting for their taxonomic treatment.

TM Nadezhda G. IZOKH and the Novosibirsk Group

Our team continues the investigation of Devonian and Lower Carboniferous bio-, litho- and chemostratigraphy in the Russian Arctic region (lower riches of the Lena River), Siberia and Central Asia.

The research group includes:

Drs. N. G. IZOKH, O. T. OBUT, S. V. SARAEV, A. S. GANASHILIN and E. S. SOBOLEV, research fellow T. A. SHCHERBANENKO, and Ph.D. student B. M. POPOV from the Trofimuk Institute of Petroleum Geology and Geophysics (SB RAS).

Dr. O. P. IZOKH from the SOBOLEV Institute of Geology and Mineralogy (SB RAS).

Different topics were under investigation:

TM Nadezhda G. IZOKH: Devonian and Lower Carboniferous conodonts of Siberia, Russian Arctic region (lower riches of the Lena River) and Central Asia.

CM Olga T. OBUT: Upper Devonian radiolarians of the Central Asia and Rudny Altai.

CM Olga P. IZOKH: Isotope-geochemical studies of the Devonian of the Salair, Kuznetsk Basin, Russian Arctic region (lower riches of the Lena River) and Kitab State Geological Reserve (Uzbekistan).

Stanislav V. SARAEV: Devonian sedimentology of the Salair, Kuznetsk Basin and Russian Arctic region (lower riches of the Lena River).

Evgeny S. SOBOLEV: Middle Devonian ammonoids of the West Siberia.

Alexandr S. GANASHILIN: Devonian sedimentology of Salair and Kuznetsk Basin.

Boris M. POPOV: Devonian ostracods of Siberia and Russian Arctic region (lower riches of the Lena River).

Tatiana A. SHCHERBANENKO: Devonian brachiopods of Siberia.

Main results on Devonian biostratigraphic data of the Salair and Kuznetsk Basin (south of the West Siberia)

The biostratigraphic data on the ammonoid, brachiopod, conodont and ostracod associations of the Mamontovian and Zarechnian Regional Substages of Salair were revised and analyzed. The stratigraphic succession of the Middle Devonian sediments of Salair is clarified and the new Zarechnian Regional Substage is proposed, which includes the Akarachkino, Safonovo, and Kerlegesh beds. The upper Eifelian ammonoid association of the *Agoniatites* Genozone was found in the upper part of the Akarachkino Beds and it is the biostratigraphic level for global correlations. The upper Eifelian and lower Givetian brachiopod *Indospirifer padaukpinensis* (= *I. pseudowilliamsi*) association characterizes the Safonovo Beds. Two Middle Givetian brachiopod zones were defined in the Kerlegesh Beds: *Rhynchospirifer hians* (= *Ilmenia subhians*) and *Subrensselandia*? *salairica* (= "*Chascothyris*" *salairica*). The conodont assemblage of the Akarachkino Beds characterizes the upper Eifelian. A Middle Givetian conodont association with *Icriodus difficilis* ZIEGLER & KLAPPER, *Polygnathus linguiformis klapperi* CLAUSEN, LEUTERITZ & ZIEGLER, *Po. parawebbi* CHATTERTON beta morphotype, *Po. ovatinodosus* ZIEGLER & KLAPPER, and *Po. pseudofoliatus* WITTEKINDT was found in the upper part of the Safonovo Beds. No conodont association was found in the Kerlegesh Beds (IZOKH et al. 2021).

The new species *Belodella salairica* IZOKH and *Caudicriodus yolkini* IZOKH were described from stratotype sections of the Middle Devonian Mamontovian and Zarechnian Regional Substages of the northeastern slope of Salair (IZOKH 2022). *Belodella salairica* is characterized by the presence of additional numerous small, short denticles along the anterior side. From the known taxa of the genus *Caudicriodus*, *Caudicriodus yolkini* differs in transverse straight parallel ridges on the platform and a short posterior-lateral process with one or two denticles and/or a ridge. The new species may be a final element in the phylogeny of the genus *Caudicriodus*, numerous taxa of which were previously known only in the Lower Devonian (e.g., BULTYNCK 1976, 2003; CARLS & GANDL 1969; ZIEGLER 1960).

New data on ostracods were obtained from the Upper Devonian reference sections on the Tom' River (Kuznetsk Basin) (POPOV 2021). The biostratigraphic analysis of the ostracod associations enabled to identify three "biostratones" in the rank of Beds with fauna: *Bairdia vassinoensis* (Middle Frasnian), *Hollinella valentinae* (Upper Frasnian), and *Acratia* (*Cooperina*) *granuliformis* (Lower Famennian).

Publications

Journal contributions

IZOKH, N. G. (2022). New Middle Devonian Conodonts of the Northeast Salair, South of West Siberia. - Paleontological Journal, **56** (1): 85–90; doi:10.1134/S0031030122010075.

IZOKH, N. G., POPOV, B. M., SOBOLEV, E. S. & SHCHERBANENKO, T. A. (2021). New data on the Middle Devonian biostratigraphy of the Salair, Southwestern Siberia. - Stratigraphy and Geological Correlation, **29** (Suppl. 1): S1–S36; doi:10.1134/S0869593822020034.

POPOV, B. M. (2021). Biostratigraphic analysis of the Upper Devonian ostracods from the sections on the Tom River. - Geology and mineral resources of Siberia, Novosibirsk, SNIIGGIMC, **4**: 12-23 [in Russian].

Abstracts

IZOKH, N. G. (2022). Middle Devonian conodonts of the West Siberia. - In: Paleontology and stratigraphy: current state and ways of development. Proceedings of the LXVIII session of the Paleontological Society at RAS, dedicated to the 100th anniversary of the birth of Alexander Ivanovich ZHAMOIDA: 152; St. Petersburg Publishing House of VSEGEI [in Russian].

POPOV, B. V. & IZOKH, N. G. (2022). Middle Devonian ostracod biostratigraphy of the Salair and Nyurolka structural-facial Zone of the West Siberian Geosyneclise. - In: Paleontology and stratigraphy: current state and ways of development. Proceedings of the LXVIII session of the Paleontological Society at RAS, dedicated to the 100th anniversary of the birth of Alexander Ivanovich ZHAMOIDA: 159-160; St. Petersburg Publishing House of VSEGEI [in Russian].

TM Ulrich JANSEN

The long-term project on Silurian to earliest Devonian brachiopods from the Rhenish Massif has been continued with increased efforts. During one-week stays at the Museum für Naturkunde (Berlin) and the Smithsonian Museum of Natural History (Washington D.C.), type specimens of several brachiopod taxa were restudied and species from different continents were compared. New data on the phylogeny of mainly strophomenides, orthides and spiriferides could be obtained. Results were presented at the 27. Brazilian Congress of Palaeontology in Cuiabá (video conference). Two field trips led in the Eifel region with a focus on the basal Emsian boundary in its classical type region. Currently, the brachiopod faunas near this boundary are restudied.

For a forthcoming book on the Central European Variscides (Ulf LINNEMANN, ed.), three chapters are prepared in cooperation with colleagues: 1) Brachiopods of Central Europe (see below); 2) Fossils and age of the Hunsrück-Schiefer – a unique taphonomic window in the Lower Devonian of the Rheinisches Schiefergebirge (Germany) (E. SCHINDLER & U. JANSEN); 3) Rhenish Massif (H. G. HERBIG, P. KÖNIGSHOF, U. JANSEN & K. MENDE).

A brachiopod fauna from Lower/Middle Devonian boundary beds in the Torkoz area (southern Anti-Atlas) has been described within a project focused on the ostracodes (UFFENORDE et al. 2022).

Publications

Journal papers/book chapters

GROOS-UFFENORDE, H., SCHINDLER, E., BECKER, R. T., DOJEN, C., BROCKE, R. & JANSEN, U. (2022, online): Late Early Devonian ostracodes from the Torkoz area (SW Morocco) and the Emsian/Eifelian boundary. - Paläontologische Zeitschrift, 59 pp.

JANSEN, U., HALAMSKI, A. T. & MOTTEQUIN, B. (reviewed): Brachiopods of Central Europe (Silurian to Lower Carboniferous) – palaeogeographic and palaeobathymetric constraints. - In: U. LINNEMANN (ed.), Geology of the central European Variscides and its Avalonian-Cadomian precursors; Springer.

Abstract

JANSEN, U. (2022). Latest Silurian – Mid-Devonian brachiopod faunas from the Rhenish Massif (Germany): Evolution, palaeoecology and palaeobiogeography. - XXVII Congresso Brasileiro de Paleontologia, Cuiabá. Paleodest, **37** (ediçao especial): 16; doi: 10.4072/paleodest.2022.37.ed.especial.

CM Peter KÖNIGSHOF

Despite the present pandemic situation, current studies will continue in Iran and Mongolia were shallow-subtidal to outer ramp and hemipelagic to pelagic settings within the Central Asian Orogenic Belt (CAOB) are of special interest. In July and August 2022, a DFG-funded expedition will take place to the southern Gobi. An international working group will study Middle Devonian to Early Mississippian sections. Based on the last two years international travel limitations, research focus concentrated on sections in the Rhenish Massif, where reef limestones, particularly in the southern Rhenish Massif, have been studied. The interaction of volcanism and reef development was studied in the Lahn-Syncline and a manuscript on a volcanic island surrounded by a fringing reef will be submitted this year. Other activities concern studies on the Devonian magnetic field in collaboration with a large group of scientists, and biostratigraphy and facies studies from sections in Iran. The

International Palaeontological Congress (IPC6), which will take place in November this year in Thailand, was co-organized.

The Special Issue on the "Rhenish Massif" is collaboration with Christoph HARTKOPF-FRÖDER and Sven HARTENFELS (eds.) will be published in September 2022 in *Palaeobiodiversity and Palaeoenvironments*.

Publications

VAN DER BOON, A., BIGGIN, A., THALLNER, D., HOUNSLOW, M., BONO, R., NAWROCKI, J., WÓJCIK, K., PASZKOWSKI, M., KÖNIGSHOF, P., DE BACKER, T., KABANOV, P., GOUWY, S. & VANDENBERG, R. (2022). A persistant non-uniformitarian paleomagnetic field in the Devonian? - Earth-Science Reviews, **231**; doi.org/10.1016/j.earscirev.2022.104073.

BAHRAMI, A., KÖNIGSHOF, P., HARTKOPF-FRÖDER, C. & KAISER, S. I. (2022). Conodont biostratigraphy of the Late Devonian-Early Carboniferous Chelcheli section, NE Shahrud (Eastern Alborz, North Iran). - Paläontologische Zeitschrift, **96** (3): 449-469; doi.org/10.1007/s12542-021-00575-6.

TA, H. P., KÖNIGSHOF, P., ELLWOOD, B. B., LUU, T. P. L., NGUYEN, C. T., HUONG DOAN, D. & MUNKHJARGAL, A. (2022). Facies, magnetic susceptibility and timing of the Late Devonian Frasnian/Famennian boundary interval (Xom Nha Formation, Central Vietnam). - Palaeobiodiversity and Palaeoenvironments, **102**: 129-146; doi.org/10.1007/s12549-021-00506-y.

PARVIZI, T., BAHRAMI, A., KÖNIGSHOF, P. & KAISER, S. I. (2022). Conodont biostratigraphy of Upper Devonian-Lower Carboniferous deposits in eastern Alborz (Mighan section), North Iran. - Palaeoworld, **31**: 69-85; doi.org/10.1016/j.palwor.2021.01.008.

STRIBRNY, B., KORN, D., KÖNIGSHOF, P., ERBACHER, J. & BLUMENBERG, M. (2022). Die Kupfererzlagerstätte Marsberg. - Geologisches Jahrbuch, Reihe A, **166**.

CM Tomáš KUMPAN

My Devonian research activities were focused on the following topics during the last year:

-- Origin of Devonian and Carboniferous micrites from the Moravian Karst, Czechia – petrological and geochemical perspective (collaboration with Axel MUNNECKE; DAAD research stay, GeoZentrum Nordbayern, Erlangen, Germany)

-- Element geochemistry (laser ablation) of ferruginous microstromatolites from Pragian of the Prague Basin, Czechia (VODRÁŽKOVÁ et al. 2022)

-- Element microgeochemistry of Frasnian/Famennian microbialite-rich facies from the Moravian Karst, Czechia (collaboration with Hedvika WEINEROVÁ, Tomáš WEINER, and Jiří KALVODA).

-- Element geochemistry of Frasnian and F/F sections at Beringhauser Tunnel, Rhenish Massif, Germany (collaboration with R. Thomas BECKER and others).

-- Conodont biostratigraphy and microfacies analysis of new Frasnian, /Famennian/Tournaisian sections in the Mokrá quarry, Moravian Karst.

-- Geochemistry of Frasnian and Famennian red limestones of the Montagne Noire (Coumiac, Col des Tribes; cooperation with Ondřej BÁBEK, Stáňa VODRÁŽKOVÁ, Catherine GIRARD, and Raimund FEIST).

-- Hangenberg disaster fauna from the Moravian Karst (KUMPAN & VIKTORÝN 2022).

Publications

BÁBEK, O., VODRÁŽKOVÁ, S., KUMPAN, S., KALVODA, J., HOLÁ, M. & ACKERMAN, L. (2021). Geochemical record of the subsurface redox gradient in marine red beds: A case study from the Devonian Prague Basin, Czechia. – Sedimentology **68** (7): 3523-3548; doi.org/10.1111/sed.12910.

HARTENFELS, S., BECKER, R. T., HERBIG, H.-G., QIE, W., KUMPAN, T., DE VLEESCHOUWER, D., WEYER, D. & KALVODA, J. (2022). The

Devonian-Carboniferous transition at Borkewehr near Wocklum (northern Rhenish Massif, Germany) – a potential GSSP section. - Palaeobiodiversity and Palaeoenvironments; doi: 10.1007/s12549-022-00531-5.

KUMPAN, T. & VIKTORÝN, T. (2022). The disaster fauna of the Devonian-Carboniferous biotic crisis preserved in microbial limestones from the Moravian Karst, Czech Republic. FEKETE, K. (Ed.): 21st Slovak-Czech-Polish Paleontological Conference. Field Trip Guide and Abstracts Book. Bratislava, State Geological Institute of D. Štúr; ISBN 978-80-8174-064-0 155-157.

VODRÁŽKOVÁ, S., KUMPAN, T., VODRÁŽKA, R., FRÝDA, J., ČOPJAKOVÁ, R., KOUBOVÁ, M., MUNNECKE, A., KALVODA, J. & HOLÁ, M. (2022). Ferruginous coated grains of microbial origin from the Lower Devonian (Pragian) of the Prague Basin (Czech Republic) – Petrological and geochemical perspective. - Sedimentary Geology, **438**: 106194; doi: 10.1016/j.sedgeo.2022.106194.

TM John E. A. MARSHALL & the Southampton Group

It's now possible to think that 2022 might be the start of some return to normality. This year has seen changes in that all the other three palaeontologists in Southampton left inside 12 months. This means I had to take on all the palaeontology teaching but with the upside that I have dropped doing anything else like meetings or student fieldwork. Importantly, we have been recruiting new palaeontologists.

We managed to get to fieldwork sessions on our new NERC grant to study the Devonian palynology of the Cantabrian sections in northern Spain. This is led by **Charlie WELLMAN** from Sheffield and includes **David BOND** (Hull) on the stable isotopes and geochemical indicators of extinction. We visited sections in both Asturias and Leon in September and June. Some of these sections are very well known, having been studied by CRAMER in the 1960's at the very beginning of palynology. We have been greatly assisted in our sample collection by our local Project Partners Javier SANZ-LÓPEZ and Silvia GARCÍA-LÓPEZ, who some of you may remember from various conodont meetings. We have also taken on a post-doc **Gilda LOPES**, who will specialise on the acritarchs and chitinozoans.

For a month in July and August of 2022, I am back to East Greenland on a Swedish expedition led by Per AHLBERG from Uppsala and focusing on tetrapods and fish at the D-C boundary. This is funded by the ERC. It's an opportunity to revisit the D-C boundary extinction level on Celsius Bjerg and I am taking a Shaw backpack drill to acquire shallow cores. This should give us the ability to generate lots of additional information on this important boundary and extinction level.

Noteworthy publications include that by **Jon LAKIN** on the sedimentology and palynology of a D-C boundary section on the Bolivian Altiplano. This demonstrates a significant downcut that is filled with latest Famennian sediment including clear evidence for part of it being glacigenic in origin.

We also finally completed the work which we started in 2015 on the Devonian *Archaeopteris* forests of Wyoming. These are remarkable assemblages of *Archaeopteris* microspores, megaspores and plants that accumulated in a freshwater pond on the otherwise monotonous carbonate platforms that formed along the western edge of Laurentia. It appears that equally monotonous *Archaeopteris* forests colonised these areas during lowstands.

Led by Charlie WELLMAN, we published a paper in *Nature Plants* resulting from our 2018 cruise around the north coast of Spitsbergen. The attraction to going there is that it's at the Devonian equator, whereas most of our information is from the higher latitude more arid climate zones occupied by Euramerica. This showed that the Spitsbergen Early Devonian sections had a lower spore diversity than found at higher palaeolatitudes. So, the tropics were not the cradle of Devonian plant diversity.

Conference attendance has been virtual including the Palaeontological Association

Annual Meeting, TMS and AASP. Both Ian TROTH and Gilda LOPES gave talks at the 1st Gondwana Devonian Symposium in Cuiabá, Mato Grosso, Brazil. Ian managed to attend in person. In June, I managed to get to my first real meeting since 2019 which was the 11th European Palaeobotany and Palynology Conference in Stockholm. It was well attended with over 25 Devonian talks and posters.

Publications

LAKIN J. A., MARSHALL, J. E. A. & TROTH, I. (2021). An investigation of a Devonian/Carboniferous Boundary section on the Bolivian Altiplano. - Geological Magazine, **158**: 2209-2230.

WELLMAN, C. H., BERRY, C. M., DAVIES, N. S., LINDEMANN, F-J., MARSHALL, J. E. A., & WYATT, A. (2022). Low tropical diversity during the adaptive radiation of early land plants. - Nature Plants; doi.org/10.1038/s41477-021-01067-w.

PENG, H.-P., QIE, W.-K., MARSHALL J. E. A., ZHU, H.-C., GOU, W., SONG, J.-J. & LIU, F, (2022). Reinvestigation of Devonian-Carboniferous palynostratigraphy in Yalai village, Nyalam County, southern Tibet, China. - Review of Palaeobotany and Palynology, **304**: 104702.

KOEHL, J. P. B., MARSHALL, J. E. A. & LOPES, G. (2022). The timing of the Ellesmerian Orogeny in Svalbard: A review. - Solid Earth Discussions, **2022**: 1-38.

KOCHEVA, L., KARMANOV, A., TELNOVA, O., MARSHALL, J. E. A., LUTOEV, V. & POKRYSHKIN, S. (2022). Structural and chemical features of seed fossils from Paleozoic and Mesozoic sedimentary strata. - Organic Geochemistry, **164**: 104370

MARSHALL, J. E. A., HOLTERHOFF, P. F., EL-ABDALLAH, S. R., MATSUNAGA, K. K. S., BRONSON, A. W. & TOMESCU, A. M. F. (2022). The Archaeopterid forests of lower Frasnian (Upper Devonian) westernmost Laurentia: biota and depositional environment of the Maywood Formation in northern Wyoming as reflected by palynoflora, macroflora, fauna, and sedimentology. - International Journal of Plant Science, **183**; doi.org/10.1086/720736.

CM Marek NARKIEWICZ

As in the previous year, the main focus was on the Kačák Episode Project, funded by the Polish National Science Center, to be finished early next year. Part of the new results from the Skały Quarry section (northern Holy Cross Mts.) was incorporated into the contribution on the uppermost Eifelian-lower Givetian stratigraphy of the region. The paper by G. RACKI, K. WÓJCIK, A. T. HALAMSKI, and M. NARKIEWICZ has been submitted for a publication in *Annales Societatis Geologorum Poloniae.* Materials from several other section are being interpreted and further publications are under construction.

The other ongoing project is a preparation of the *Devonian Chapter* for the the two-volume monograph summarizing the geology of Poland, to be published in 2024, according to the schedule. So far, the section on the stratigraphy of the Devonian of Sudety Mts. (part of the Bohemian Massif/Variscan Orogen in Poland) has been compiled.

TM D. Jeffrey OVER

I am continuing the study of conodonts, geochemistry, magnetic susceptibility, and astrochronology of Middle through Upper Devonian strata and the Devonian-Carboniferous boundary. Focus is in the Appalachian Basin and shallow water platform of the Dyer Formation in Colorado, the later in cooperation with colleagues at the Denver Museum of Nature and Science and Tomáš Kumpan at Masaryk Univeristy in Brno, Czechia. The new “Devonian Stratigraphy of New York”, in cooperation with VER STRAETEN, WOODROW, BAIRD, BRETT, BARTHOLOMEW, ZAMBITO, EBERT, and others, is in the final review and print production stage. It will be available for the SDS 2023 meeting in Geneseo and Ithaca New York in Summer 2023.

CM Dmitry P. PLAX and the Belarusian Devonian Group

We regret to inform that this year the leader of our research group, Dr. Semen A. KRUCHEK, who contributed greatly to the study of the Devonian of Belarus and the East European Platform in general, passed away on the 6th October 2021 (see obituary).

In 2021–2022, the Belarusian Devonian Group, including D. P. PLAX (ichthyofauna) from the Belarusian National Technical University and V. Y. OBUKHOVSKAYA (miospores), O. V. MURASHKO & T. V. STRELCHENKO (conodonts), T. F. SACHENKO (brachiopods), O. F. KUZMENKOVA & A. G. LAPTSEVICH (magmatic complexes) and others from "The Institute of Geology", Branch of the State Enterprise "Research and Production Centre for Geology", have been exploring different aspects (mostly stratigraphic, paleontological, lithological, etc.) of the Devonian of Belarus. Publications of research results are presented below.

Publications

Journal papers

MURASHKO, O. (2021). Systematic composition and stratigraphic distribution of conodonts in the Devonian sediments of Belarus – Lithosphere, **54** (1): 23–35 [in Russian, with English summary].

PLAX, D. P., MALYSHKINA, T. P. & BRIGAS, I. V. (2021). On the findings of the teeth of Paleogene sharks in the area of the settlement Krasnoselsky (Grodno region, Belarus) – Lithosphere, **54** (1): 150–155 [in Russian].

MAKHNACH, A., POKROVSKY, B., STRELTSOVA, G., MURASHKO, O. & PETROV O. (2021). Variations of carbon and oxygen isotopic composition in the Lower and Middle Devonian deposits in the south-west of the Voronezh anteclise – Lithosphere, **55** (2): 81-95 [in Russian, with English summary].

MAKHNACH, A. A., STRELTSOVA, G. D., MURASHKO, O. V. & LUCHINA G. I. (2021). On the content of organic matter in the Lower-Middle Devonian deposits of Belarus – Lithosphere, **55** (2): 149–152 [in Russian].

PLAX D. P., NEWMAN, M. J. (2021). Middle Devonian acanthodians from Belarus – new data and interregional biostratigraphy – Acta Geologica Polonica, **71** (4): 393–414; doi:10.24425/agp.2020.134568.

PLAX, D. P. (2022). A new species of the ray-finned fish (Osteichthyes, Actinopterygii) from the Upper Emsian and Lowermost Eifelian deposits of Belarus – Lithosphere, **56** (1): 30–39 [in English, with Russian summary].

MAKHNACH, A., POKROVSKY, B., MURASHKO, O. & PETROV O. (2022). Variations of the carbon and oxygen isotopic composition in the Emsian and Eifelian deposits in the south-east of the Latvian saddle – Lithosphere, **56** (1): 67-79 [in Russian, with English summary].

Abstracts

KUZMENKOVA, O. F., LAPTSEVICH, A. G. (2021). Section of Late Devonian igneous rocks from the parametric borehole Privolye (North-Pripyat shoulder, Belarus) – In: Current problems of the Earth sciences: the use of natural resources and the preservation of the environment, Proceedings of the V. International scientific and practical conference, Brest, 27-29 Sept. 2021, **1**: 72–75 [in Russian].

OBUKHOVSKAYA, V. Y., SACHENKO, T. F. & KRUCHEK, S. A. (2021). Biostratigraphic section of the Devonian deposits of the parametric well Severo-Polotskaya 1 (Latvian saddle) – In: Current problems of the Earth sciences: the use of natural resources and the preservation of the environment, Proceedings of the V International scientific and practical conference, Brest, 27-29 Sept. 2021, **1**: 109–114 [in Russian].

STRELCHENKO, T. V., KRUCHEK, S. A. (2021). About conodonts of the Frasnian stage of the Upper Devonian of the Zhlobin saddle (Belarus) – In: Current problems of the Earth sciences: the use of natural resources and the preservation of the environment, Proceedings of the V International scientific and practical conference, Brest, 27-29 Sept. 2021, **1**: 141–146 [in Russian].

CM Eberhard SCHINDLER

Scientific work in 2021 was (again) greatly influenced by the Corona pandemic. Everything outside was still at halt (fieldwork, meetings) and even meeting colleagues inhouse was very rare. So, it was mainly work in home office wrapping up a number of (partly long-lasting) projects and bringing papers forward.

One of these "well-hung" issues was a paper on latest Emsian ostracodes from the Moroccan Anti-Atlas together with Helga Groos-UFFENORDE and other colleagues.

Preparation of manuscripts with results from our Turkish–German cooperation projects continued – special items with respect to possible geosites in the Taurides have been presented (YALÇIN et al.; NAZIK et al.).

Documentation of the Kellwasser Event in its type area (Harz Mountains) has been published in a proceedings book (see SCHINDLER 2021)

Work on the Eifel area continued – but slowly.

As a result from the find of a probable Ediacaran "leftover" in Lower Devonian rocks of the Mosel area (work is still ongoing), an "excursion" was made into the latest Precambrian (Ediacarian).

Publications 2021

SCHINDLER, E. (2021). Kellwasser – der Name eines Harzer Baches steht weltweit für ein globales Massenaussterbe-Ereignis im Devon. – Gaussiana, **1**: 8-17.

YALÇIN, M. N., ELLWOOD, B. B., YILMAZ, İ., WEHRMANN, A. & SCHINDLER, E. (2021). Milankoviç Döngülerini İçeren Doğu Toroslar Devoniyen İstifi Potansiyel Bir Jeosit Olabilir mi? / Could the Eastern Taurides Devonian Sequence Bearing Milankovitch Cycles be a Potential Geosite? – In: NAZIK, A., AKYILDIZ, M. & ŞEKER ZOR, E. (eds.), Adana'nın Jeolojik Mirası Çalıştayı, Bildiri Özleri Kitabı, Workshop on Geoheritage of Adana, Abstracts Book: 19-22; Adana.

NAZIK, A., HAUDE, R., SCHINDLER, E. & YALÇIN, M. N. (2021). Halevikdere Kesiti (Doğu Toroslar) Siluriyen/Devoniyen Geçişi ve Orta Devoniyen'inde Paleontolojik Jeosit Önerileri (Paleontological Geosite Proposals in the Silurian/Devonian Transition and Middle Devonian Sequences of the Halevikdere Section, Eastern Taurides). – In: NAZIK, A., AKYILDIZ, M. & ŞEKER ZOR, E. (eds.), Adana'nın Jeolojik Mirası Çalıştayı, Bildiri Özleri Kitabı (Workshop on Geoheritage of Adana), Abstracts Book: 23-26; Adana.

TM Ladislav Slavík and Czech CMs

Years 2021–2022 were dedicated mostly to the "Pragian/Emsian boundary project" in the Prague Synform. During these years, new geo-chemo-petrophysical and biostratigraphic data were obtained from the Praha Formation, which formerly represented the original Pragian stage before the current GSSP definition. Our team consisting of **CM JINDRA HLADIL, CM TOMÁŠ WEINER** and **CM HEDVIKA WEINEROVÁ** of the Institute of Geology of the Czech Academy of Sciences focused on the most important level and correlation horizon within the upper parts of the Praha Formation – the Bohemian Graptolite Event (BGE). The best sections with regard to the presence of BGE with good accessibility and diverse sedimentology were studied (Pod Barrandovem, Mramorka Quarry, Fig. 1, and Požár 3 Quarry). These sections were sampled for microfacies study and faunal content: conodont samples in dense intervals, sampling of available microfauna and macrofauna, samples for magnetic susceptibility logs, samples for $\delta^{13}C$ and $\delta^{18}O$ isotopes, samples for INAA geochemical analyses and GRS measurements. In some sections we used also previously obtained data (from MS and GRS). The studied sections show similar geochemical and petrophysical patterns around the BGE.

Late in 2021, we launched a collaboration with **CM Petr BUDIL** of the Czech Geological Survey, who was a leader of the "Protective Palaeontological Research" project in the unique Radotín–Špička Quarry.

Fig. 1. Outcrop conditions at Mramorka section**.**

In cooperation with the owners of the Quarry, which is going to be subjected to reclamation, the most important parts for the Lower Devonian stratigraphy were saved for the future.

Early in 2022, a review manuscript (FERRETTI et al.) on the Silurian/Devonian boundary conodonts was finished and published.

In June 2022, **CM Aneta FORMÁČKOVÁ** accomplished her Ph.D. on the Silurian/Devonian boundary ozarkodinids (conodonts). The thesis was defended on June 29.

A joint paper with Katarína HOLCOVÁ and others on Early Palaeozoic microboring organisms in various substrates is still in a review process.

In addition to Devonian activities, the late Silurian project "Přídolí Series in the Prague Synform – a proposal for chronostratigraphic subdivision" was finished by the final comprehensive manuscript with a proposal for a two-fold subdivision of the Series. It was published in the summer of 2022.

CM Claudia SPALLETTA

I am continuing research on the biostratigraphy and taxonomy of Middle-Late Devonian and Early Carboniferous conodonts, mainly from the Carnic Alps. I am also involved in studies on the Devonian-Carboniferous boundary within the activity of the International Task Group on the redefinition of the Devonian/Carboniferous Boundary (led by M. ARETZ and C. CORRADINI).

Studies proceed on the lithostratigraphy of the Devonian-Carboniferous units of the Carnic Alps, mainly in collaboration with Monica PONDRELLI and Carlo CORRADINI. We are trying to reconstruct the physiography of the Devonian basin of the Carnic Alps by means of accurate facies analysis, using conodonts in order to trace timelines for correlation between the different litostratigraphic units.

CM Thomas J. SUTTNER and Erika KIDO

2021 was quite productive. Our paper concerning the palaeotemperature record across the Late Eifelian Kačák Episode has been published (see https://rdcu.be/ct8ws). Erika's study on the Middle Devonian rugose corals from the Carnic Alps is ongoing. The manuscript on late Devonian conodonts from the Indert Formation in the Shine Jinst area,

Mongolia, is still in preparation, because we decided to include new data from the Yamaan Us section, which together with results from the Tsagaankhaalga-2 section, will give a better age constrain for the boundary of the Heermorit and Shombon members. Thanks to additional field- and laboratory work by our Mongolian friends Uuganaa, Ariuna and Manchuk, that manuscript can be submitted in the near future.

Early in 2022, I was chosen for a part time position at the Czech Geological Survey in Prague, which allows Erika and me to go ahead with our Devonian studies. Finally, it was the strong support by Jiří FRÝDA and Stana VODRÁŽKOVÁ, which led to employment, wherefore we are truly grateful! On 6th July 2022, I obtained the *venia docendi* for Palaeontology at the Department of Palaeontology, University of Vienna.

Publications

SUTTNER, T. J., KIDO, E., JOACHIMSKI, M. M., VODRÁŽKOVÁ, S., PONDRELLI, M., CORRADINI, C., CORRIGA, M. G., SIMONETTO, L. & KUBAJKO, M. (2021). Paleotemperature record of the Middle Devonian Kačák Episode. – Scientific Reports, (2021) **11**: 16559.

CM Sue TURNER

I am pleased to say that after a year work on the Birch Creek fauna of Nevada, it has finally been refereed: Carole BURROW, Mike MURPHY and I look at the vertebrate and conodont evidence from this most important Ludlow, Pridoli to Lochkovian series of sections, investigated by Mike.

I am also trying to finish various projects on Devonian fish and biostratigraphy, notably from Australia, Turkey and Pakistan (with Carole BURROW, Cemek and Yakut GONCUGLO and Phil JANVIER).

I will be attending and presenting a talk regarding aspects of his life's work at the special memorial for our colleague, the late Alain BLIECK on September 28th at the Société géologique du Nord. Also, I wish to mention that Valya-Valentina KARATAJUTE-TALIMAA has died on August the 3rd 2022, at the age of 91.

TM José Ignacio (Nacho) VALENZUELA-RÍOS and CM LIAO Jau-Chyn (Teresa)

Activities during September 2021-July 2022 have, again, been affected by the worldwide pandemic state, which has cancelled many envisaged meetings and other activities. Besides, the continuous changes from face to face, to on-line and to "hybrid" teaching, research meetings and other commitments has forced us to invest a great amount of time in getting ready and, then, change to a new way.

As in previous years, the main activities of have been focused on Lower, Middle and Upper Devonian conodont biostratigraphy, Middle Devonian conodont biofacies, and Lower and Middle Devonian microfacies analysis from selected Pyrenean sections. In the second half of the year 2021, Teresa has started a research stay in Greifswald working with Heiko HÜNEKE in a joint Devonian project, which implies the combined studied of microfacies and conodont biostratigraphy in several European sections. In May and the first half of June 2022, Teresa has continued her direct study on selected sections and intervals from the Montagne Noire in cooperation with Catherine GIRARD, Raimund FEIST and Felix NESME. She spent this time in Montpelier including a fieldwork week in May with Catherine and Nacho, who travelled from Spain to join them for fieldwork. Some results will be presented at this year IPC.

We keep processing samples and analysing sequences from the Pyrenees and the Iberian Cordillera. This year, the focus has been on Lochkovian, Emsian and Givetian sections. Regarding the latter, a paper was published. Additionally, we have analysed a short interval regarding de F/F boundary in one Pyrenean section (see publications). As continuation of this study, we will supervise a new Ph. D student (**Héctor BARRERA**, University of Zaragoza); his, mainly, conodont research will

focus in a diachronic stratigraphic unit that spans through the F/F boundary in the Pyrenees.

Four oral contributions are planned for the Spanish Paleontological meeting to be held at the beginning of October in Cuenca. One of them presents new conodont data around the upper Eifelian and lower Givetian in the Iberian Chains.

As mentioned in previous reports, both in the Spanish Central Pyrenees and in the Iberian Chains multidisciplinary studies on Devonian sections and outcrops have started. This year we have focussed on the palaeomagnetic and magnetic susceptibility sampling from two selected Pyrenean sections (Isábena.1 and Baliera-6), which include the Pragian-Emsian transition (Figs. 1-2). The latter one was visited during the ICOS IV fieldtrip. At the same time, sample "leftovers" will be carefully treated and prepared for geochemical analysis. In this endeavor, we have attracted colleagues from the GEOtransfer Research Group, University of Zaragoza and for the National Research Centre (CSIC), Geochemical Lab in Granada.

Fig. 1. Belen OLIVA taking samples for paleomagnetism and magnetic susceptibility in section Isábena-1.

Fig. 2. Aspect of the Pragian/Emsian transition at Isábena-1 section after drilling for paleomagnetic and magnetic susceptibility. Belen OLIVa and Antonio CASAS (GEOtransfer Research Group) taking oriented measurements.

The long-term project of detail analysis of Bohemian conodont faunas around the S/D interval that started together with Mike MURPHY and the late Peter CARLS is in progress.

Cooperation with palaeobotanists records, with the plant record starting already in the Lower Devonian strata of the Iberian Chains, continues. We want to augment the palaeontological characterization of Lower Devonian strata in the Iberian Chains by adding to the already rich invertebrate and vertebrate data base, the palaeopalynological record. This on-going project extends to the Middle and Upper Devonian strata of the Iberian Chains. New Upper Devonian records are in preparation and prove the first evidence for land plants in the Frasnian of the Iberian Chains.

We have also started to pay close attention to the identification of "Events" in the Spanish Pyrenees and to study them from a multidisciplinary point of view.

Teresa continues the Middle and Upper Devonian joint project with **Susana GARCÍA-LÓPEZ** (University of Oviedo) on selected localities of the Cantabrian Mountains. She is focussing now on the Kačák Event in several Spanish sections.

The cooperation we started with the late and lovely friend CHEN Xiuquin (Suzi) and with her/our former Ph.D. student **LU Jianfeng**, continues to produce results, mainly regarding Pragian and Emsian outcrops in South China. They represent the first steps in the envisaged long-term Chinese-Spanish cooperation.

Continuing the Spanish-Portuguese Devonian cooperation, a multidisciplinary paper was presented on the occasion of the retirement of a Spanish professor from the University of Badajoz (Teodoro PALACIOS, a Precambrian-Palaeozoic expert). This paper deals with an Eifelian quarry in Portugal.

Regarding Heritage Protection Actions, we are involved in a project affecting Devonian outcrops in the Spanish Pyrenees. A company has launched a proposal of extending the current sky-resort near Cerler connecting two valleys. As this action implies the construction of a new road at high elevation (over 2,200 m), where Devonian rocks crop out, we were called again to analyse the impact of this road. Preliminary results prove the presence of Pragian, Emsian, Givetian, and Frasnian rocks. In the first phase, we reported the need of preserving such outcrops and the company and the government have accepted our proposal; the road will be deviated in order not to affect the outcrops and we were able to obtain a variety of Devonian microfossils, including conodonts. This year, as new parts of the mountain will be affected, they contacted us again and a new fieldwork (and subsequent lab processing and report writing) is envisaged.

Other important actions in relevant Spanish outcrops include:

-- The stratigraphical and palaeontological study of Lower Devonian outcrops in Ossa-Morena and Central-Iberian areas in south-western Spain, together with other Spanish colleagues (Miguel PARDO and Esperanza FERNÁNDEZ). This project entails large field-campaigns and mapping in rough areas.

-- Keep going in the long-term collaboration started with the late Peter CARLS on the Devonian of the Iberian Chains, a classical and key area for "Rhenish" (neritic) facies.

-- CM Jenaro L. GARCÍA-ALCALDE continues publishing large monographies on brachiopods from the Cantabrian Mountains.

-- The Ph.D. proposal, dealing with the Silurian-Devonian outcrops in Spain and Portugal (Centro-Iberian and South Portuguese Zones), co-supervised with Noel MOREIRA, was granted and, consequently, the doctoral student **Gonçalo SIVÉRIO** has started his Ph.D. under this cooperation.

-- A new Ph.D. proposal focus on upper Frasnian and lower and middle Famennian rocks, fossils (mainly conodonts) and geophysical and geochemical signals has been launched. The candidate (Héctor BARRERA) will start fieldwork in early September.

-- Thanks to the DAAD-WELTRISE program, student **Sandra MAUK** (University of Hamburg) spent a three months research stay; she focused mainly on Lower Devonian stratigraphy and conodonts from Spain.

Publications

Journal papers

LIAO, J.-C. & VALENZUELA-RÍOS, J. I. (2021). Upper Eifelian and Givetian (Middle Devonian) Conodont sequence at Renanué (Aragonian Pyrenees, Spain). A relevant section for Givetian Chronostratigraphy. - Historical Biology: 15 pp.; doi:10.1080/0891 2963.2021.1962853.

LU J.F., VALENZUELA-RÍOS, J. I., KÖNIGSHOF, P., LIAO, J.-C., WANG, Y., QIE, W.-K. & SU, H. H. (2021). Emsian (Lower Devonian) Conodonts from the Daliantang Formation at Daliantang (eastern Yunna, China). – Palaeoworld; doi.org/10.1016/j.palword.2020.11.003.

SILVÉRIO, G., VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2021). Upper Frasnian and lower Famennian conodonts of the CP section (Spanish Central

Pyrenees). - Spanish Journal of Paleontology, **36** (2): 205-220; doi.org/10.7203/sjp.36.2.21950.

Abstracts

LIAO, J.-C. & VALENZUELA-RÍOS, J. I. (2022). Givetian (Middle Devonian) conodont diversity patterns from the Spanish Pyrenees. - 2022 Pander Society Fifth International Conodont Symposium (ICOS 5), Abstracts: 25-26

VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2022): Lochkovian (Lower Devonian) conodont evolution episodes in the Spanish Pyrenees. - 2022 Pander Society Fifth International Conodont Symposium (ICOS 5), Abstracts: 19-20.

SILVÉRIO, G., LIAO, J.-C., VALENZUELA-RÍOS, J. I., MACHADO, G., MOREIRA, N. & BARRETO, P. (2022). Biostratigraphy of the Eifelian (Middle Devonian) Pedreira da Engenharia Formation, SW Ossa-Morena Zone. Ossa Morena and beyond: a tribute to Teodoro Palacios. – In: Jensen, S. (ed.), Abstracts from meeting held in Badajoz 26 and 27 January 2022: 37-38.

VALENZUELA-RÍOS, J. I & LIAO, J.-C. (2021a). Relevancia Internacional de las secciones altoaragonesas para la redefinición y elección del estratotipo mundial de referencia (GSSP) para a base del Emsiense (Devónico Inferior). - XXXVI Jornadas de la Sociedad Española de Paleontología, Lucas MALLADA, **23**: 241-242.

VALENZUELA-RÍOS, J. I & LIAO, J.-C. (2021b). "*Ozarkodina malladai*" un spatognatodontidae (Conodonta) de posición sistematica incierta en el Lochkoviense (Devónico Inferior). - XXXVI Jornadas de la Sociedad Española de Paleontología, Lucas MALLADA, **23**: 239-240.

CM Charles VER STRAETEN

As in the previous year, much of my work in the last year continued to focus on editing, revising, and some addition writing for the coming **Devonian of New York** volume. It will be published in *Bulletins of American Paleontology* (BAP), by the Paleontological Research Institution. The volume will be released in 2023, prior to the 2023 New York SDS meeting; the current plan calls for it to be available in hard cover, paper cover, and digital downloads. The lengthy volume consists of a Preface, Dedication, and 12 chapters, examining many aspects of the Devonian geology and paleobiology in New York, often with comparisons beyond the state. The volume will also include a poster-size time-rock graphic correlations chart of the Devonian rock in New York, using the most recent Devonian time scale of HARRIGAN et al. (2021, table S11).

The release of the Devonian of New York volume will be accompanied by digital republication of the 1981 and 1997 SDS New York volumes. SDS officers were pleased to have the Palaeontological Research Institution release these in time for the 2023 SDS New York meeting.

The bulk of my research for over ten years now is focused on Givetian to Frasnian terrestrial strata in the Catskill Mountains region of eastern New York. Its large area, extensive cover, the highly homogenous character of the strata, and poor bio-, chrono- and sequence stratigraphic control through the terrestrial strata create a great challenge, which needs the effort of multiple researchers. At this point there are only a few known correlations between the Catskills terrestrial succession and the well-documented marine succession of central to western New York. Chapter 12 of the Devonian of New York is an extensive overview of the geology and paleobiology of the New York terrestrial strata, with new findings by the author.

In addition, I am interacting with several other researchers, including graduate students, on studies in paleosols and terrestrial/aquatic paleobiological studies. Furthermore, I am assisting local government with plans to protect the lower Givetian "Cairo Fossil Forest", currently the oldest known Devonian forest (ca. 385 ma). This site, where the root trace fossils of three types of trees are exposed across a large quarry floor. will be one of the last stops for the 2023 New York SDS meeting,

In other research, I am working with paleontologists Robert BLODGETT, Howard FELDMAN, and others on brachiopod and gastropod faunas of the upper Pragian Glenerie

Limestone of eastern New York, and their paleobiogeography. These faunas have had little to no study in over 100 years.

Publications

Journal and book chapters

BARTHOLOMEW, A. J. & VER STRAETEN, C. A. (2023 in press.). Chapter 6: Marine strata of the middle to upper Hamilton Group (Middle Devonian, lower Givetian), eastern outcrop belt in New York State. - In: VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. L. (eds.), Devonian of New York. Bulletins of American Paleontology.

BLODGETT, R. B., FELDMAN, H. R., VER STRAETEN, C. A., BARANOV, V. V. & GARCIA-ALCALDE, J. L. (2022 in press). *Leptaenella ventricosa* (HALL, 1857) from the middle Early Devonian (Pragian) of New York and eastern North America and a redescription of the brachiopod genus *Leptaenella* FREDERIKS, 1918. – In: LUCAS et al. (eds.), Fossil Record 8. New Mexico Museum of Natural History and Science Bulletin, **90**.

VER STRAETEN. C. A. (2023a in press). Preface. - In: VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. L. (eds.), Devonian of New York. Bulletins of American Paleontology.

VER STRAETEN, C. A. (2023b in press). Dedication. - In: VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. L. (eds.), Devonian of New York. Bulletins of American Paleontology.

VER STRAETEN, C. A. (2023c in press). Chapter 1. An Introduction to the Devonian Period, and the Devonian in New York State and North America. - In: VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. L. (eds.), Devonian of New York. Bulletins of American Paleontology.

VER STRAETEN, C. A. (2023d in press). Chapter 3: The Port Jervis, Oriskany, Esopus, and Schoharie Formations, and Equivalents: Pragian and Emsian Strata of New York. - In: VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. L. (eds.), Devonian of New York. Bulletins of American Paleontology.

VER STRAETEN, C. A., C. E. BRETT, G. C. BAIRD, A. J. BARTHOLOMEW & D. J. OVER (2023 in press). Chapter 4. Lower Middle Devonian (Eifelian-lower Givetian) strata of New York State: The Onondaga Formation and Marcellus subgroup. - In: VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. L. (eds.), Devonian of New York. Bulletins of American Paleontology.

VER STRAETEN, C. A. (2023d in press). Chapter 12: The Devonian Terrestrial System in New York. - In: VER STRAETEN, C. A., OVER, D. J. & WOODROW, D. L. (eds.), Devonian of New York. Bulletins of American Paleontology.

Abstracts

VER STRAETEN, C. A., OVER, D. J., WOODROW, D. L., EBERT, J. R., BOYER, D. L. & COLOSIMO, A. (2021a). Devonian of New York*:* A New, Extensive Volume on the North American Standard Section. - Northeastern Section, Geological Society of America Meeting, March 2021.

VER STRAETEN, C. A., OVER, D. J., WOODROW, D. L., EBERT, J. R., BOYER, D. L. & COLOSIMO, A. (2021b). Devonian of New York*:* A New, Extensive Volume on the North American Standard Section. - Geological Society of America Meeting, October, 2021.

BARTHOLOMEW, A. & VER STRAETEN, C. A. (2021). Middle Hamilton Group Strata (Lower Givetian) of the eastern outcrop belt in New York State. - Geological Society of America Meeting, October, 2021.

BRETT, C. E., BAIRD, G. C., VER STRAETEN, C. A., OVER, D. J., WITZKE, B. & BOYER, D. L. (2021). Paleobathymetry of Widespread Devonian Black Shales: Going Deeper, But Not That Deep. - Geological Society of America Meeting, October, 2021.

VER STRAETEN, C. A. (2022a). An Introduction to the Devonian of New York. - Geological Society of America, Abstracts with Programs, **54** (3); doi: 10.1130/abs/2022NE-375379.

VER STRAETEN, C. (2022b). Chapter 1. An Introduction to the Devonian Period, and the Devonian in New York State and North America. - Geological Society of America, Abstracts with Programs, **54** (3); doi:10.1130/abs/2022NE-375384.

VER STRAETEN, C. A. (2022c). Chapter 3: The Port Jervis, Oriskany, Esopus, and Schoharie Formations, and equivalents: Pragian and Emsian Strata Of New York. - Geological Society of America, Abstracts with Programs, **54** (3); doi:10.1130/abs/2022NE-375387.

VER STRAETEN, C. A. (2022d). Chapter 4. Lower Middle Devonian (Eifelian-Lower Givetian) Strata of New York State: The Onondaga Formation and Marcellus subgroup. - Geological Society of America, Abstracts with Programs, **54** (3); doi:10.1130/abs/2022NE-375388.

VER STRAETEN, C. A. (2022e). Chapter 6: Middle Hamilton Group Strata (Lower Givetian) of the eastern outcrop belt in New York State. - Geological Society of America, Abstracts with Programs, **54** (3); doi:10.1130/abs/2022NE-375145.

VER STRAETEN, C. A. (2022f). Chapter 12: The Devonian Terrestrial System of New York. - Geological Society of America, Abstracts with Programs, **54** (3); doi:10.1130/abs/2022NE-375390.

BLODGETT, R. B. FELDMAN, H. R., VER STRAETEN, C. A., BARTHOLOMEW, A. & WEISS, L. (2021). Brachiopods of the Glenerie Limestone in New York. - Geological Society of America, Abstracts with Programs, **54** (3); doi: 10.1130/abs/2022NE-374418.

BRETT, C. E., ZAMBITO IV, J,, BAIRD, G. C. & VER STRAETEN, C. A. (2022). Contrasting depositional settings of epicontinental organic rich facies: Shallow vs. deep water black shales. - Geological Society of America, Abstracts with Programs, **54** (3); doi:10.1130/abs/2022NC-375685.

GREB, S., BREZINSKI, D., CARTER, K., CLARK, R., DINTERMAN, P., HARRISON, W., LASEMI, Y., SLATER, B., SOLIS, M., VER STRAETEN, C. A. & WAID, C. (2022). Regional Stratigraphic Charts Keyed To carbon storage potential For the Midwest and Northeastern United States. - Geological Society of America, Abstracts with Programs, **54** (3); doi:10.1130/Abs/2022NC-375557.

CM Stanislava VODRÁŽKOVÁ

Together with Radek VODRÁŽKA, Tomáš KUMPAN, Jiří KALVODA, Jiří FRÝDA and Axel MUNNECKE, we have been working on the project on Devonian and Devonian/Carboniferous microbial sediments. We finished our study on microbial ferruginous coated grains from the Lower Devonian deposits of the Prague Basin (VODRÁŽKOVÁ et al. 2022). We are further focusing on microbial sediments around the Basal Choteč, Kačák and F/F boundary events.

Publication

VODRÁŽKOVÁ, S., KUMPAN, T., VODRÁŽKA, R., FRÝDA, J., ČOPJAKOVÁ, R., KOUBOVÁ, M., MUNNECKE, A., KALVODA, J. & HOLÁ, M. (2022). FERRUGINOUS coated grains of microbial origin from the Lower Devonian (Pragian) of the Prague Basin (Czech Republic) – Petrological and geochemical perspective. – Sedimentary Geology, **438**; doi:10.1016/j.sedgeo.2022.106194.

CM James J. ZAMBITO

Over the past year, my Devonian research has been focused on understanding how the evolution of forests changed the global carbon cycle and the organic matter composition of marine black shale. Various core and outcrops of late Givetian and Frasnian strata of the North American Appalachian, Illinois, and Michigan Basins have been studied utilizing an integrated litho-, chemo-, bio-, and sequence stratigraphic approach to constrain regional black shale compositional changes within a high-resolution stratigraphic framework. This project is in its third and final year of funding (American Chemical Society Petroleum Research Fund #60525-UR2), and has resulted in a variety of undergraduate senior theses and conference presentations that will ultimately be published in the near future. An unrelated senior thesis by my former student **Andrew RICH** on latest Middle Devonian fish taphonomy from the Milwaukee Formation was published early this year.

During 2022, I also began a long-planned project with Carlton BRETT (Cincinnati) and Anne-Christine DA SILVA (Liège) to reconstruct a geochemical and carbon isotopic record through the entirety of the Middle Devonian Hamilton Group in order to undertake cyclostratigraphic analysis and improve the chronostratigraphy of this important succession. This builds on our work with a variety of other

New York State Devonian researchers to revise the Devonian stratigraphic framework in the northern Appalachian Basin, which will be highlighted at the Geneseo, New York SDS Meeting in 2023.

Publication

RICH, A. & ZAMBITO, J. (2022). Insights from fossil fish taphonomy into the depositional environment of the lower Milwaukee Formation (Berthelet Member, latest Middle Devonian). - Palaios, **37** (1): 1-15; doi.org/10.2110/palo.2021.040.