INTERNATIONAL UNION OF
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COMMISSION ON STRATIGRAPHY

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SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

NEWSLETTER No. 35

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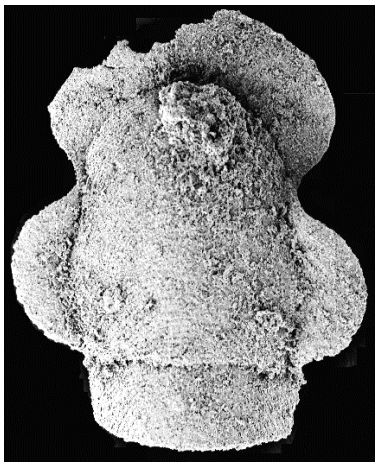

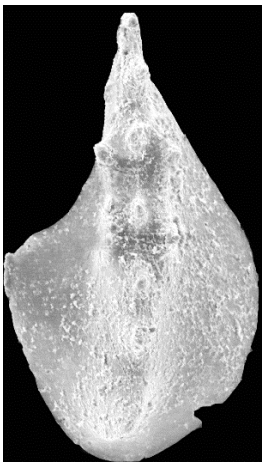

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SDS NEWSLETTER 35

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, Minutes of SDS Meetings, SDS reports to ICS, general IUGS information, information on past and future Devonian meetings and research projects, and reviews or 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. 36** is the **end of August 2021**.

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, 35: x-y."**

Content:

Devonian Publications

Membership News

Chairman‘s Address

Dear SDS Members,

I hope all of you are doing well and staying safe despite the present difficult situation caused by the COVID 19 disease. Here are the opening words to our SDS newsletter No. 35! The Newsletter compiles annually everything related to the Devonian and is put together mostly from your contributions.

As you might have noticed from bulk e-mails with SDS information, the new team of SDS officers have already started their work. On behalf of the new team, I would like to thank John MARSHALL (Chairman) and Carl BRETT (Vice-Chair) for their work for our Subcommission. During the last term, there was a lot of visible and invisible agenda and the former team kept the SDS going, moving things forward. We had the opportunity to meet (at least!) once every year and held many special Devonian sessions at various events, e.g., IPC, STRATI and several related IGCP meetings. The new coming team is: Ladislav SLAVÍK (Chair), Nacho VALENZUELA-RÍOS (Vice-Chair), and Uli JANSEN (Secretary). Thomas BECKER will kindly continue our SDS Newsletter production and Carlo CORRADINI kindly stays as the webperson.

The ICS was expected to ratify the new teams of all stratigraphic subcommissions during the 36th International Geological Congress in New Delhi, India, last March. As many of you know, the original date of the IGC was cancelled and the Congress was postponed at a very late stage. As a consequence, the ICS executive had no chance to meet. We agreed with the former SDS Chair John MARSHALL on the handover of the SDS on 1st June 2020. It looks that our new team should be formally ratified by the IUGS in the summer, and, following recommendation of the ICS, we have officially started as of 1st August 2020. The replacement was scheduled for the regular SDS meeting to take place this summer (2020) in Geneseo, New York State, USA. It is a great pity that we could not have met there. The organizers – Jeff OVER and many others of the team – have invested a lot of time to welcome us in NY. In spite of the ever changing global/regional/local situation with COVID, there is still a chance for us to gather there in the next year.

For all of us, this year is very strange, with various kinds of problems being challenged. As we cannot meet anywhere due to the restrictions, we are missing scientific discussions on the Devonian, many individual professional or friendly meetings, as well as discussions on technical topics related to the running of our Subcommission. Thus, in the meantime, we have to communicate various topics on the internet and make certain decisions without directly listening to your opinions and proposals and without any benefit from the debate that takes place at our regular business meetings.

Anyway, this opening address should not be a list of things/events that did not happen. Allow me a more cheerful note: from the communication with many of you, I got the impression that our community keeps to be active and strong under these “special” conditions. Many Devonian publications have been released and many were submitted. The Subcommission on Devonian Stratigraphy will stay active and we hope that with your help and support we will finish several pending issues, including further refinements and subdivisions within the Devonian period and the GSSP redefinitions.

A few other news you should know:

1. Our SDS website that was run by Carlo CORRADINI at University of Cagliari will no longer be maintained. The International Commission on Stratigraphy has offered a solution for the websites of all subcommissions. Using the same platform, the websites will be of uniform style. This should be launched soon. Then, we will start to feed our SDS sub-website with information about the SDS itself, membership, SDS newsletters, and other documents.

2. The ICS executive applied to the IUGS for additional funding for ‘special projects’ last year. The project ‘Regenerating the Time Lords: Towards the completion, calibration, digitization and outreach of the geological timescale’ was awarded $50k over two years. The current global crisis and restrictions prompted a call for proposals for a single year cycle. This summer, we applied for an ICS special grant in order to obtain mainly geochemical data from Pragian–Emsian sections of the Spanish Central Pyrenees.

3. As many other things this year, the long-desired Geological Time Scale 2020 volume is a bit delayed and can be expected late this year. The Devonian

chapter by Thomas BECKER, Anne-Christine DA SILVA, and John MARSHALL, with further help and input by Frits AGTERBERG, Felix GRADSTEIN, and Jim OGG, has been much expanded (78 pp.).

Please, keep in mind that all SDS members are expected to contribute their news. And it is always good to be informed about ongoing projects, publications in preparation, conferences, organizations of meetings, and many other activities. Also, it is a good place to let the others know about studies in regional journals that are not easily available.

The Devonian is not only a time period and wonderful rocks, it is mostly you – Devonian workers that form a strong and big family, which is making the ancient Devonian times still attractive and exciting! Let us hope the situation is settled a bit in 2021 and all of us are able to work in good conditions. Let us also hope that in the near future we are able and allowed to gather at our regular business meetings, work in the field together and go successfully ahead with our Devonian business!

Ladislav SLAVÍK

Letter from the outgoing Chairman, John MARSHALL

Hi, I hope you are all well and staying safe in these difficult times.

Covid-19 as I am sure you know has had a direct effect on the SDS in that we had to postpone the long-planned fieldtrip and conference to New York State. That decision to postpone was taken quite early but was clearly the right one.

An indirect effect was that the IGC in New Delhi was postponed at a very late stage. This means that the ICS never met and they have to ratify the incoming SDS team led by the new Chair Ladislav before they can officially take office.

Sadly, they seem unable to make these decisions by Zoom, TEAMS, or whatever. So, after many discussions with David HARPER it has been left as our own decision to decide when the new team takes over. In discussion with Ladislav we think that 1st June is a good date. But we must remember that the new team has yet to be formally ratified. So, given the endless debate over the validity of the new Chibanian GSSP, its probably best not to take any 'quick' decisions on the Emsian GSSP until the new team is formally approved!

Its always been a pleasure to attend SDS meetings. Stratigraphy has a bad image within some areas of the earth sciences but its essential to any understanding as to how the Earth System works. So, SDS goes far beyond mere GSSP's and leads the way in understanding the Devonian world. There has certainly been a rush of Devonian geochemistry and modelling paper by people we don't know, so our favourite Period has become very topical. We now just need to get these workers to attend SDS meetings.

Thanks to you all for entertaining me as Secretary and then Chair for 16 years. I have certainly travelled everywhere in that time. I have learnt a lot and hopefully you know a little more about spores.

I have not contributed anything technical to the base Emsian GSSP debate. But we certainly can to the D-C boundary redefinition. We have just had this paper published in Science Advances.

https://www.sciencemag.org/news/2020/05/no-asteroids-or-volcanoes-needed-ancient-mass-extinction-tied-ozone-loss-warming

This explains why I come to SDS meetings, talk about the D-C boundary, but never really come to any real conclusion as to its cause. This is because the British research evaluation system is driven by publications in Science and Nature. These journals are strict as to any pre-publication in abstracts. Anyway, the main finding it that at 'exactly' the D-C boundary a concentrated burst of UV-B radiation rendered most plants sterile and collapsed the terrestrial ecosystem. We expect a debate as to its cause but it is going to be very useful for defining the D-C boundary. It shows us that the UV-B burst was very brief and directly related to the extinction of many groups of spores. So, now we know what happened I think we have a time plane by which we can globally define the GSSP. Clearly something to discuss but a potential way forward.

Time to hand over to the new team. I am sure we will all support them in their essential work.

Many thanks for all your support and I think the current sign off is

Go Devonian, Regards, **John**

OBITUARIES

Vladimir KHROMYKH

(15.09.1936-23.03.2020)

Vladimir KHROMYKH, Russian paleontologist and stratigrapher passed away in Novosibirsk following a long illness. Vladimir was born in a small village, Verkhoyanie, in the Orlov region, Central Russia. After graduation from the Geological Department of the Moscow State University in 1960, he started his carrier in the geological survey at Chukotka, North-East Russia. A few years later, he moved to Novosibirsk and joined the laboratory of Paleozoic paleontology and stratigraphy at the Institute of Geology and Geophysics SB USSR AS (later the Trofimuk Institute of Petroleum Geology and Geophysics SB RAS). In 1968, Vladimir finished his doctor course (aspirantura) and defended his Ph.D. thesis dedicated to Devonian stromatoporoids of the North-East of Russia. He continued research on Lower Paleozoic stratigraphy and Ordovician, Silurian and Devonian stromatoporoids from the Siberian Platform, Central Siberia, Urals, Uzbekistan, and Kirgizia for more than 50 years. He published about 60 scientific papers and chapters in monographs. Recently, Vladimir summarized results of his long-term investigation in a personal monograph (see references below).

Vladimir was a very open minded and cheerful person. He was very fond of fishing and gardening. Many colleagues would remember him as a sincere singer performing various distinctive ballades. Cherished memories about Vladimir KHROMYKH will forever remain in our hearts.

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Bruno MISTIAEN

(1.5.1946 – 19.10.2019)

Denise BRICE [(1)] & Alain BLIECK [(2)]

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[(2)] 38 rue Paul Doumer, 59320 Haubourdin; alain.blieck@yahoo.fr

1. Youth and background

Bruno MISTIAEN was born on May 1, 1946, in t Chapelle d'Armentières ("Nord"» French department) in the family home, where he has spent his whole life. The fact that Bruno was born on May 1st (Labour Day in France) is symbolic. During his life, Bruno got a great capacity of work, peacefully and over time. His father, Georges MISTIAEN (1901-1975), was a fabric seller in the house of La Chapelle d'Armentières, going door to door and on markets too. His mother, Jeanne LEGRAIN (1912-1999), accompanied her husband on markets. Both were born in Armentières. They had two children, Bruno, and a daughter, Marie-Edith, who was one year and a half younger than him.

Bruno went to boy primary school of Saint Edouard in Armentières, where he got the elementary certificate. Then, he entered the Saint Just college of Armentières until the final year, where he got the French baccalaureate in experimental sciences on 1966. Bruno lived a happy childhood, truly loved by his mother. He began to be a naturalist in the family home garden. He liked natural sciences (plants, insects, rocks…) and wished to be a missionary or an explorer. When he was a teen ager, he made jogging every morning in the neighbouring country, which gave him an excellent physical fitness. After Sunday mass, he went to Sangatte with his family and used to pick up stones. Before his geologist vocation, he was gladly a zoologist. Someday, he got a calf carcass in a farm, removed its skin and reconstituted its skeleton. Many years later, he brought back a living snake from China!

Bruno MISTIAEN entered the Sciences Faculty of the Catholic University of Lille on 1967 in order to follow a «University Degree of Higher Learning» (DUES, in French) during 2 years, completed in 1969. Then, he entered The Sciences and Technology University of Lille (USTL or Lille 1) in order to follow a Master's Degree of Geology, completed in 1971 (Petrology and Historical Geology Certification during 1969-1970, Applied Geology and Structural Geology during 1970-1971). Bruno did his military service in Germany in 1972. Then, when he came back to Lille (USTL), he completed a Master of Advanced Studies (DEA in French) in Geology in 1973. The subject was: "Contribution to Blacourt Limestone Stromatoporoids study (Givetian of Ferques, Boulonnais)". Bruno MISTIAEN was a dedicated field palaeontologist, with Boulonnais, the Ardennes Massif (including Avesnois), and Afghanistan as favourite areas. For his doctoral thesis, he accompanied Professor Albert de LAPPARENT in Afghanistan from 1973, as part of

CNRS (National Centre of Scientific Research) RCP 44 (Program Coordinate Research 44). After this first mission in the Afghanistan Central Mountains, there were three further ones (three months each, 1975, 1976, and 1978), as part of a "Permanent Mission of CNRS". These missions, mainly devoted to stromatoporoids, were interrupted by the Soviet invasion of 1979. On 1973, Claude HEDDEBAUT, professor at the Catholic University of Lille, accompanied him. During this mission, Claude HEDDEBAUT contracted malaria (endemic in Afghanistan) and died at the age 48. Denise BRICE accompanied Bruno in Afghanistan in 1973 and 1975 and Alain BLIECK accompanied him in 1978. At that time, Bruno had an excellent physical fitness because he used to come back to his vehicle with tens of kilograms backpack. The collected fossil material has been the thematic of his two doctoral thesis: Ph.D. Thesis (USTL) in 1976 entitled "*Devonian Stromatoporoids of Ferques"*, State Doctoral Thesis in 1985, entitled *"Reef phenomena in the Devonian of Aghanistan (Central Mountains). Stromatoporoids analysis and systematics"*. At the end of his university career, his colleagues tenderly called him "ayatollah", due to his long grey beard and his afghan years.

2. Academic career

After one year as a delegated assistant at the Picardie University (Amiens), Bruno MISTIAEN started his university career on 1975, as a teacher-researcher in the Faculty of Sciences and Techniques (FLST) of the Catholic University of Lille, then in the Higher Institut of Agriculture (ISA). He was successively lecturer, university lecturer, substitute teacher, and full professor in Earth Sciences at the FLST. He taught courses and practical exercises in geology (cartography, petrology, soil sciences) and entomology, particularly a course devoted to destructive insects. He supervised many students in the field, in geology, and entomology. They really appreciated him and he transmitted them his passion for natural sciences in a relaxed atmosphere. Bruno liked joking, he never hesitated to be clown, and most of the time, got a knowing smile, which made him sympathetic to his students and colleagues. As a true "boute-en-train", he especially liked to sing Jacques BREL'S songs.

Bruno MISTIAEN did many administration and teaching tasks in ISA. He had the responsibility and animation of agronomic weeks for 1st year students (from 1977), the responsibility of internships for 1st year and 3rd year students (1977-1980), the responsibility of sandwich course (1977-1978), the responsibility and animation of the earth sciences domain (1977-1992), the management of soil sciences contracts (1979-1992), and the responsibility of the environment and landscape planning department (1992-2003). He also did preparation and animation of training sessions in geology for natural sciences teachers of the Secondary Education (1977: Bray Country, 1979: Brittany; 1981: North of France geomorphology; 1983: Devonian reefs of Belgium and France Ardennes; 1985: Pyrenees; 1987: Vosges mountains; 1989: Normandy; 1991: Boulonnais; 1993: Corbières, Mouthoumet; 1995: Brittany; 1997: Vosges mountains; 1999: Ardennes). He taught 2nd year master students at USTL as part of the Master's Degree BEFA ("Biodiversity and fossil and living environments"). Bruno was also involved in associative activities, especially at the North Geological Society (SGN), where he was a member since 1970. He was a SGN adviser during many years and became the first vice president in 2010-2012. He also was a member of the North-Pas de Calais Environment Scientific Committee, of the North-Pas de Calais Natural Sites Conservatory, of the French Committee of Stratigraphy, and of the Regional Commission of Geological Patrimony, (CRPG) since 2013. At the international level, he was a Member of the Subcommission on Devonian Stratigraphy (SDS), of the International Commission of Stratigraphy (ICS), one of the commissions of the International Union of Geological Sciences (IUGS).

After his afghan period, Bruno MISTIAEN studied stromatoporoids and other fossil organisms (Tabulates Corals, Worms), alone or in collaboration with colleagues, coming from many areas all over the world. The material was given by foreign colleagues or collected during several scientific missions in Europe, Iran, Mongolia, China, Australia, Vietnam, Morocco, and Siberia, as part of research unities of CNRS (GRECO 007 from 1976 to 1988, URA 1365 from 1989 to 1997, UPRESA 8014 from 1998 to 2001), and also of the International Geological Correlation Program of UNESCO (IGCP 421 and IGCP 499). Bruno supervised or co-supervised many research dissertations (Master's Degrees and Ph.D. thesis):

Ph.D. Thesis at USTL by Francis DOUAY in 1993 on "*Soil sciences and superficial geology of Inner Flander"*.

Ph.D. Thesis at Bruxelles University by F. EZZOUBAÏR in 2000 on "*Permian Tabulate Corals from Timor and biological affinities of Trias Spongiomorphids from Austria"*.

Master's Degree by Elvire HEIDINGER in 2005 on "*Stromatoporoids microstructure and ultrastructure"*.

Ph.D. Thesis at Western Brittany University by Yves PLUSQUELLEC in 2006 on "*Pleurodictyforms (Cnidaria Tabulata, Devonian) from Armorican Massif and Maghrebo-European areas*".

Ph.D. Thesis at USTL and Liège University (jointly supervised with Professor Frédéric BOULVAIN) by Benoît HUBERT in 2008 on "*Devonian Stromatoporoids from Ardenne and Boulonnais"*.

Habilitation to Conduct Researches (HDR) thesis at USTL by Jean-Pierre NICOLLIN in 2008 on "*Lias Foraminifera and Devonian and Carboniferous basis Brachiopods"*.

Ph.D. Thesis at USTL and Warshaw University (jointly supervised with Professor Jerzy TRAMMER) by Mikolaj ZAPALSKI in 2008 on "*Tabulata (Anthozoa) from the Devonian of the Southern Region of the Holy Cross Mountains, Poland"*.

Ph.D. Thesis at USTL and Shahid Beheshti University of Teheran, Iran (jointly supervised with Professor M.R. MOSAVI) by Reza AARIPOUR in 2009.

Ph.D. Thesis at USTL by Emilie PINTE in 2011 on "*Devonian and Carboniferous Tabulate Corals from western Europa"*.

His papers on Devonian Corals and Stromatoporoids got international recognition. As long enigmatic fossils, stromatoporoids were associated to Porifera (Sponges). Spicules discovered by him in 1981 in Palaeozoic forms supported the affiliation of stromatoporoids to Sponges as well as the systematic singleness strongly discussed between Palaeozoic and Mesozoic forms until now (see papers listing). Bruno is the author of a hundred of papers in periodic reviews and books chapters.

Bruno MISTIAEN received many awards from the Lille Sciences, Agriculture and Arts Society (SSAAL): the GOSSELET Medal in 1981, the GOSSELET Award in 1986, and the KUHLMANN Great Award in 2005. He became a titular member of this society in 2007.

3. Boulonnais

The Boulonnais occupies a special part in Bruno MISTIAEN'S papers. This area, located at the northwest part of Pas de Calais, is a half exhumed and eroded anticlinal fold, notched by the Pas de Calais sound. Due to erosion, such a situation makes many old grounds particularly Devonian and Carboniferous outcrop. Quarries exploited and still exploit those grounds from, which extracting materials have evolved through time ("marble", limestone, "aggregates"). Bruno devoted several papers to fossil reef builders collected in these grounds, especially from the Givetian (Middle Devonian) and specifically concentrated on sStromatoporoids in his Ph.D. Thesis.

From 1973, Bruno MISTIAEN, either alone, or generally accompanied by Denise BRICE and Christian LOONES (independent geologist) went very often to the Boulonnais, more precisely to Ferques, looking for stromatoporoids (and brachiopods for D. BRICE and C. LOONES) in the Givetian of the Griset and Banc Noir quarries (exploited by the Stinkal Company). Usually, these visits took place on Saturday because the Stinkal Company workers were then at rest. The results of these researches were subject to his Master of Advanced Studies in 1973, then to his Ph.D. Thesis in 1976. However, his visits to the Stinkal quarries regularly continued because the exploitation of limestone in both quarries produced constantly new stromatoporoid outcrops at different levels. Bruno wanted to check if it was the same species in order to give a maximum of precisions in the publication published on 1980 in the *Bulletin du Museum national d'Histoire naturelle*. These regular visits allowed close links with the Stinkal Company management that was interested in information concerning the extension of the exploited limestone. After discussions about the exceptional richness of the faunas and their excellent conservation, Bruno and his colleagues asked the company about the possibility of safeguarding a mine face at the end of the exploitation on the east side of the Griset quarry, which would become a reference section for the international scientific community. After the

agreement of the Stinkal Company, Bruno and some colleagues created an association called "Association highlighting the Griset Devonian" (AVDG) in June 2006, in order to safeguard, highlight and promote the geological patrimony of the exposed Givetian. Bruno MISTIAEN was the president of this association. The AVDG scientific committee was composed of researchers from Lille and Paris (France), London (England), and Brussels (Belgium)

4. Bruno´s humanitarian involvement

At the beginning of the 2000s, the Esquermes House (Lille) contacted Bruno and asked him to be an interpreter for young afghan refugees. He had learned Dari, an afghan version of Persian, when he was in Afghanistan. In this light, he met Hocen REZAI on 2003 in Frelinghien. Hocen was 16 years old. Bruno became Hocen's legal guardian in 2004, adopted him in 2005. During this period, Bruno was daily involved in the "Calais jungle" (expression, which means migrants and refugees camps, settled at the beginning of the 2000s in Calais, Coquelles and Sangatte, not very far from the French entrance of the Channel tunnel and the harbour area of Calais), to help afghan refugees. In the Catholic University and especially in ISA, Bruno found students for teaching French to young afghan men, who had true learning capacities; they managed to speak French in three months. Bruno helped them in their administrative actions with the Lille prefecture and the Afghanistan embassy in Paris to obtain resident papers. Bruno did this humanitarian involvement in several associations, such as the Franco-Afghan Friendship (AFRANE) he has contributed to create in 1979, the Refugees Network of Hospitality in Lille (RAIL), and the "Tissage Réseau Armentiérois Accueil Migrants" association (TRAAM). When they got their papers, the afghan residents could register in schools, such as Saint-Charles primary school and college. Thus, Hocen got the S baccalaureate, followed higher studies (DUT) in civil engineering in Béthune, and a professional degree in building economy in Valenciennes. Now he works in the Botte Foundation Company in Lomme as a building design draughtsman.

Bruno, as a practicing Catholic participated to "Silence Circles", a movement initiated by the Franciscan Brothers to protest against undocumented migrant incarceration in France. Bruno joined a circle, forgathered every last Tuesday of the month, to denounce the human rights infringements.

Bruno officially retired on 2012. However, he still did research and teaching and continued to go to the field. In October 2018, he was diagnosed a lung cancer at a late stage of the illness. He entered the private hospital of La Louvière in Lille, then the Tourcoing hospital, where he quietly died on the 19thOctober 2019, at the age of 73. He will be remembered among his family, friends, numerous students and colleagues as a strongly humanist being, much sociable, but a reserved person at the emotional level, as well as a jolly fellow in the society.

Acknowledgements. — We thank Marie-Edith MISTIAEN, Bruno's sister, who gave lights, especially on his youth years, Gaëlle GUYÉTANT with whom Bruno collaborated as an administrator at the North-Pas de Calais Natural Sites Conservatory, and Françoise DEBRENNE, one of his colleagues, expert in fossil reef builders of Palaeozoic.

Further reading

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Peter CARLS

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José Ignacio VALENZUELA-RÍOS

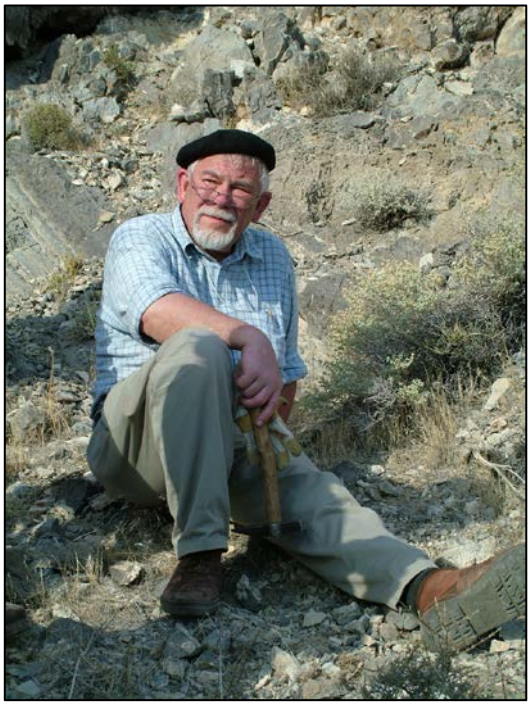

Fig. 1. Peter at the Frasnian Alamo Breccia in Nevada, September 2007

Peter CARLS, age 83, died in Braunschweig on September 8, 2020. He is a key figure for the progress of palaeontological and stratigraphical studies in the Palaezoic of Spain, specially of Aragón. He demonstrated the worldwide relevance of Devonian strata from the Iberian Chains, as contributions to the progress of scientific research in several topics and by creating a multidisciplinary team and facilitating the establishment of a network of researchers that continue to be very active. His enormous contribution represents a "quantum leap forward" in the knowledge of the Devonian, and specially in many palaeontological aspects of several fossil groups. Among them, the conodonts and brachiopods stand out.

Peter CARLS was born in Hannover (Germany) on January 3, 1937. However, he spent most of his childhood in Lüneburg, a small and beautiful city in Lower Saxony, which was a rich medieval town thanks to the salt trade. Peter liked to talk about the geology of this city and the consequences of the diapiric movements on the houses. He spent much time helping and learning in the workshop his uncle

owned. Peter learnt the basics of many techniques he later applied in his professional carrier. He also was enchanted in "gutting" motors to unlock the secrets these engines held. This curiosity in knowing in detail how things are related and work and in trying to explain every single step accompanied him all his life. And most important, in this town he met his beloved wife, Leveke (Fig. 2), when they were still teenagers.

Fig. 2. Peter and Leveke CARLS having breakfast at their home in Salzdahlum, August 2019.

He started his BSc in Geology in Hamburg in 1957; the following year he left northern Germany and moved to the University of Würzburg in Franconia. There, he continued his studies of Geology and especially of Palaeontology under the supervision of Prof. Dr. Klaus SDZUY. Two years later, in August 1959, he came for the first time to Aragón (Spain), a tough territory with charming, friendly and honest people, and a complex geology that captured Peter's attention. The people and geology of Aragón trapped Peter's heart and he started one of the most prolific and outstanding scientific carriers on the Palaeozoic strata of the Iberian Chains. He also became one of the best, and cheapest, ambassadors that Aragón has had.

He is so closely linked to Aragón that he named numerous genera and species after this region, its mountains and inhabitants. Here, I would like to highlight some of them. The genus *Baturria*, dedicated to the "Baturros", who are the inhabitants, especially the peasants, from Aragón; and the species *Baturria simonae* dedicated to his beloved "Tía Simona". This love is reciprocal and in 2008, the city of Badules paid him an extremely moving homage that ended with the nomination of Peter as "Adoptive son of Badules". Later on, this city decided to name the municipal library after him, and since then this library is the "Peter CARLS library" (Figs. 3-4).

Fig. 3. Peter was nominated "Adoptive son of Badules" in October 4, 2008.

Fig. 4. Peter and the Badules City Major (Alejandro ESPINOSA) at the opening ceremony of the City Library named after Peter.

During these sixty years of love with Aragón's Geology and People, he spent large field campaigns, in occasions almost a year, walking up and down in the hills, rivers, paths… enjoying the torrid summers, the freezing winters and the chilly wind, and overall making friends everywhere he was. His skin turned brown and his ears were many times peeled off. Also, his relation with thorny and spiny bushes, such as gorses, brambles, rosebushes… is remarkable. The combination of sun-dried skin with these spiny shrubs produced red-dyed patches; however, these by-products of field geology in Aragón never suggested him to give up his job. Oak trees helped him in repairing the handle of many research field tools (hammers, pick-axes, mattocks, shovels, axes…). His tenacity and hard work rendered soon the first results. In December 1962, Peter finished his Master Thesis ("*Diplom-Hauptprüfung für Geologie*") with the title "*Erläuterungen zur geologischen Kartierung*

bei Luesma und Fombuena in den Östlichen Iberischen Ketten". Subsequently, in July 1965, he successfully completed and defended his Ph. D. Thesis on "*Jung-silurische und unterdevonische Schichten der Östlichen Iberischen Ketten (NE-Spanien)*" before Prof. Dr. SDZUY and Prof. Dr. KNETSCH. In this work, Peter already described with extremely precision the Silurian and Lower Devonian succession and introduced the subdivisions into formations and alphanumeric units, which due to the enormous practical value are widely used for researchers everywhere.

He continued his teaching and research activities as Assistant Professor under the direction of Prof. Dr. SDZUY at the University of Würzburg until 1977. Then, he gained the position of Professor of Palaeontology at the Institut für Geologie und Paläontologie, TU Braunschweig. Shortly after, in January 1978, he was in charge of the Palaeontology Section, until his retirement in 2002. During all these years and even after the retirement, his department, and in particular the charm, beloved and highly productive "Baracke", has been a mandatory visiting place for many researchers from all over the world. The Braunschweig Baracke, led by Peter, resulted in one of the more effective places for generating massive amounts of important scientific data, sharing knowledge, fomenting interpersonal relations, and at the same time favouring the development of individual learning in a family atmosphere. The cooperative character developed in the Baracke crossed political and economical boundaries and facilitated cooperation and understanding between geologists of different ages, from different cultures, many countries, and with diverse educational backgrounds. Peter was able to manage this "multicultural pot" for making possible a huge transfer of scientific, technical and vital knowledge in a healthy environment. Anyone who paid a visit to Peter returned home with the work well done and with the desire to come back as soon as possible to share again science and friendship with Peter. And most likely, everyone who has experienced the Brauschweig Baracke, will have been able to weave a social network of true friends, who share more than just scientific knowledge and who endure over time (Fig. 5).

Unfortunately, new university policies resulted in the recent demolition of the Baracke, one scientific symbol in Braunschweig for all of us who worked there, and one of the most cost-efficient places in the world I know.

Fig. 5. Enjoying a nice rest after a working day in Nevada, September 2007, together with Mike MURPHY (left) and the author (middle).

In Spain we are most grateful to Peter for his generosity, comradeship and for his teachings and practical lessons in the field, as well. He has shown us with extreme passion and knowledge the Geology and Palaeontology of the Iberian Chains. He has also managed the lending of unpublished works (mostly Master and Ph. D. Thesis) of German students dealing with the geology and palaeontology of the Palaeozoic when the young Department of Palaeontology in the University of Zaragoza started to investigate the Palaeozoic outcrops. His vast knowledge on geology was also instrumental for structural geologists, mineralogists, petrologists, stratigraphers, and geomorphologists; all them have learnt and have been inspired from the great experience, knowledge and wisdom of this wise Professor. His contacts in Spain included also other research groups, such as the Devonian group of Oviedo. The Members of this group will never forget the long and hot fieldwork days in the Aragonian hills, neither the long and well wine-watered nights in the Aragonian small country inns and taverns. The mutual respect and admiration for the Oviedo's team led Peter to visit Asturias, its geology, and to enjoy the Asturian people and traditions. Now they are not only colleagues but also deep friends. In fact, he dedicated one brachiopod species, *Vandercammenina ovetensis*, to his friends of this cosy city. To this point, I remember a long, and friendly discussion between Peter and, the charming "ovetense", Jenaro GARCÍA-ALCALDE, regarding the proper use of Latin for the species name. This debate lasted several years until they met Leandro

SEQUEIROS in a symposium in Aragón. Leandro, an excellent palaeontologist, and outstanding connoisseur of Latin was consulted and, Peter was right!!

Besides his lectures in the Spanish field, he opened his department and laboratory for anyone who wanted to travel to Germany and keep learning with him. Even in the 1980's he organised a practical fieldwork on Actuogeology and Actuopalaeontology in Amrum, an island in the North Sea, for Spanish geologists. Also, the several weeks-long teaching fieldtrips he organised for his Braunschweig students, both in Spain and in Germany, were always open for anyone who wanted to learn and enjoy an unforgettable experience (Fig. 6).

Fig. 6. Three generations of the Conodont family started by Peter. From left to right Sofie GOUWY, Teresa LIAO, Nacho VALENZUELA, Carlos MARTÍNEZ and Jianfeng LU. Peter was Nacho's "Doctorvater" and Nacho has supervised four Devonian conodont students.

Peter is one of the pioneers who fuelled the takeover by conodonts as the premier fossil group for use in chronostratigraphy. Although couched in form taxonomy, his two 1969 papers (one co-authored with J. GANDL) and subsequent 1975 paper improving and expanding them, have withstood the test of time, little changed except for adaptation to multi-element taxonomy, and still stand as the standard for Celtiberian stratigraphy for most part of the Early Devonian. Perhaps, just as importantly, he integrated the conodont sequences with coeval brachiopod sequences to make the pair an even stronger tool for deciphering the geological record.

Peter is a world-renown specialist in conodonts, brachiopods, and Devonian stratigraphy. Until his passing, he was for many decades a Corresponding Member of the International Subcommission on Devonian Stratigraphy (SDS) and a member of the German Subcommission on Devonian Stratigraphy. Other areas of expertise include other fossil groups, geological systems and laboratory techniques, especially those applied to micropalaeontology. An example of this tenacity and meticulous application of a wide array of laboratory techniques to a single fossil, he improved and implemented, based on his "Lüneburg experience", the preparation (which lasted several years) of one of the more important and spectacular fossils housed in the Natural Sciences Museum, University of Zaragoza, the long-snouted arthrodire *Carolowilhelmina geognostica* (Fig. 7).

Fig. 7. Peter with his "long-snouted" placoderm *Carolowilhelmina geognostica*. He prepared himself the beast, after many years of tedious, ingenious and careful work. It is deposited in the Museum of Natural Sciences in Zaragoza.

Peter has been a leader in discussions concerning the relations between the European Hercynian and Rhenish Facies emphasizing an integrated approach and subsequently to correlate European sequences to the Zinzilban GSSP (Fig. 8). His extensive and excellent research is demonstrated by profuse papers that are highly appreciated by colleagues, numerous reports to the SDS, the coordination and effective leadership of scientific fieldtrips, and the supervision of more than 30 Master Thesis and 5 Ph. D. Thesis. Regarding SDS, he was the first in opposing the current official criterion and position for the base of the Emsian in the SDS meeting held in Rennes in 1988. Subsequently, he has been very active in providing sound arguments against the "*kitabicus* boundary" being the base of the Emsian. Many of you will remember his "practical lessons" in the

field during the Uzbekistan 2008 SDS meeting in the Kitab Reserve. Currently, the SDS is considering the revision of this boundary according to his initial proposal.

Fig. 8. Peter and young friends having a break after hard work in the Zinzilban Emsian GSSP section. Photo taken at the entry to the dorms in the Kitab reserve, August 2008. From left to right: Claudia ("Dodo") DOJEN, Ladislav SLAVÍK, Nacho VALENZUELA, Uli JANSEN, and the late Mena SCHEMM-GREGORY.

His study of the "Geschiebe" of the north German plain partially published in the more recent 2004 paper with Mike MURPHY and myself (see Fig. 5) has basically changed the way we look at the extremely important but broadly defined *steinhornensis* group of conodonts.

In the last ICOS meeting (Fig. 9), jointly organised with the SSS and SDS in 2017 in Spain, he enjoyed the field and shared many stories and knowledge with participants. He also gave a provocative opening talk titled "Last six decades of conodonts, problems, and solutions for late Silurian and Lower Devonian Stratigraphies and Correlations". Among other topics, he also discussed palaeographic connections in Europe and opposed the existence of a broad and deep "Rheic" ocean during early Devonian times. In this meeting he received the PANDER Medal for his long-life excellent contribution to conodont studies (Fig. 10). Before, in 2007, he was highly recognized by the Royal Sciences Academy of Zaragoza, which named him as Corresponding Academic.

Fig. 9. Peter holding the banner of the ICOS-SDS-SSS triple international meeting held in Spain, at Laspaúles in the Aragonian Pyrenees, June 2017.

His language ability allowed him to be a panel member of many Ph. D. Thesis defended in several European countries and a Member of the Editorial Board of diverse journals, reviewing papers written in different languages. His great cooperative spirit is demonstrated by the co-authorship with more than 40 colleagues from different nationalities from Europe, America and Asia.

Fig. 10. Peter receiving the PANDER Medal for his life-time achievements from Xulong LAI (Chief Pander) in Valencia, June 2017.

Peter was the first conodont and Devonian worker that I met when I was still a graduate student at the University of Zaragoza; he was so charm, generous, open-minded, encouraging and ready to help that all my fairs on starting conodont research on Lower Devonian and contacting the "Big guys of Conodont and Devonian Research" disappeared. Subsequently, he was my Ph. D. Thesis' co-advisor and, after that we have continued our cooperation. As a result, many joint papers have been published and collaboration with other friends and colleagues, especially with Mike MURPHY, continued until the last day.

Last but not least, I want to mention that his legacy goes further beyond the briefly aforementioned curriculum, and crosses generations and cultures. I'm very proud of being his disciple, to start a scientific carrier and promote a scientific network that tries to continue the labour of the Master. His teaching, care, love, passion for the improvement of scientific knowledge, friendship, and the liberal atmosphere that one felt when approaching Peter are values that can be passed along through generations.

Thanks Peter for being the lighthouse that illuminates the way through the cloudiness and helps people to find the path of things that are important in life and science. Peter left this world on the 8th of September 2020 but his legacy, beyond his numerous and elegant contributions, remains alive in us.

Now you are, as your beloved wife Leveke says, in the Geological Heaven!!

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SDS REPORT TO ICS

1. TITLE OF CONSTITUENT BODY

Subcommission on Devonian Stratigraphy

Reporting J.E.A. MARSHALL (Chair)

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

In 2019 SDS has continued its work on the revision of problematic GSSPs (base Emsian and the Devonian-Carboniferous boundary). A short session on the revision of the base Emsian GSSP was held during the SDS sponsored sessions at STRATI-19. These discussions continued during the Annual Business Meeting. Other continued activities include multidisciplinary international correlation, the organisation of Devonian stratigraphic symposia, publication of the SDS Newsletter and of monographic books/journal volumes.

All listed objectives fit the directions of IUGS and ICS:

- Development of an internationally approved chronostratigraphical timescale for the Devonian with maximum time resolution.
- Promotion of new and modern stratigraphical techniques and their integration into Devonian multidisciplinary schemes.
- Application of GSSP decisions internationally and as a base for a better understanding of patterns and processes in Earth History, including Devonian major global environmental changes.

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. Nominated Officers for 2020-2024:

Chair: Ladislav SLAVÍK

Vice-Chair: José Ignacio (Nacho) VALENZUELA-RÍOS

Secretary: Ulrich JANSEN

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.

We have a yearly meeting. SDS members support their own attendance at these.

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

Following failure of the joint SDS/Uzbekistan/RAS field expedition to Zinzilban Gorge, Uzbekistan to find the nominated conodont taxon *Polygnathus excavatus* 114, SDS reluctantly came to the conclusion that the base Emsian cannot be defined at this level in Zinzilban. The SDS is disappointed by this outcome as it was our intent that the GSSP should remain in Uzbekistan. During 2017-18 we have informally considered how to progress with redefinition of the GSSP. We continued these discussions at the IPC in Paris with two presentations on new GSSP sections from Spain and the Czech Republic. We met again at STRATI 19 in Milan and had hoped to receive formal proposals for the base Emsian GSSP. We can then vote on these and move one forwards for formal consideration by the ICS. In August, SDS Secretary L. Slavik visited the GSSP area in Uzbekistan during a Geoturism forum and on behalf of the SDS communicated the main issues and problems to the local specialists.

6. SUMMARY OF EXPENDITURE IN 2019:

SDS Newsletter	€530
Attendance of SDS Vice-Chair BRETT at STRATI-19	€1200
Attendance of SDS Secretary SLAVÍK at STRATI-19	€600
Attendance of SDS Chair MARSHALL at STRATI-19	€200

7. SUMMARY OF INCOME IN 2019:

ICS €2400, (as $USD3000)

8. BUDGET REQUESTED FROM ICS IN 2020

In 2020 the new chair of the SDS will go to the IGC India to take part on the ICS Bussiness meeting and to formally start the new term on behalf of the new SDS officers.

Then the SDS will meet for a field based conference in New York State, USA. This will include 9 total days of fieldwork looking at the new Devonian sections being worked on by our US colleagues. There will be 2 days of formal conference, including a business meeting at the SUNY Campus in Geneseo. Our focus will again be redefinition of the base Emsian GSSP and meeting to discuss the D-C boundary for redefinition of the base of the Carboniferous. We always have an annual meeting and it can be challenging for SDS Officers to continually attend. We request contributions to travel costs for:

SDS Chair SLAVIK to travel from Prague to India and to the USA $800

SDS Vice-Chair to travel from Spain to the USA $800

SDS Secretary to travel from Germany to the USA $800

In addition, we request part support for production of the SDS Newsletter $600

Total Sum requested from IUGC $3000

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

- Formal proposals submitted for the revision of the basal Emsian GSSP.
- Revision of the D/C boundary with the D/C Boundary Task Group (Chairman: M. ARETZ) in close collaboration with the Carboniferous Subcommission. Progress towards selection of candidate stratotypes at STRATI 2019. SDS contributions to the Palaeo^2 special volume on the D-C boundary.
- Meet in New York State for fieldwork/conference in Geneseo with 3 days fieldwork before the meeting, 5 days after and 1 day during the 3 day conference.

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

- 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

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LIST OF WORKING (TASK) GROUPS AND THEIR OFFICERS

There is a working group appointed to reinvestigate the D-C boundary. This has 10 members from the SDS and 9 from the SCS.

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SDS DOCUMENTS

The Devonian/Carboniferous transition based on miospores in Europe

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Foreword: Mrs. G.I. KEDO (Fig. 1; photo taken during the first C.I.M.P. meeting in Moscow, September 1975) was at the origin of all the papers recorded here below, most being concerned by the miospore assemblages containing *Retispora lepidophyta* (KEDO) PLAYFORD, a late Devonian miospore among the most abundant "form species" known around the world (Fig. 2).

Fig. 1. G.I. KEDO, photo from 1975.

Introduction: Malformed land plant spores

During the 2020 epidemic wave, several papers related to the Devonian/Carboniferous transition were published. Among them, two, referring to the Late Devonian Hangenberg Crisis, involve different causes to explain malformed land plant spores, such as direct effects of volcanic gazes from large igneous province (LIP) eruptions (PISARZOWSKA et al. 2020) or UV-B radiations related to the loss of the protective ozone layer (MARSHALL et al. 2020).

Malformed spores were described at different levels of the Famennian and Tournaisian all around the world. Some are limited to the DC Boundary transition.

The lower and middle Famennian vegetation crisis was underlined by an unexpected phenomenon affecting the mean size of miospores that are significantly smaller in the Famennian than in the Frasnian (NAUMOVA 1953; RICHARDSON & MCGREGOR 1986, p. 21). This phenomenon was contemporaneous to the progressive development in size of the megaspore, its reduction in number within the megasporangium and, later, the initialization of the first seed (STREEL et al. 2000).

One of these Famennian miospores is *Aneurospora greggsii*, believed to be the microspore of the heterosporous *Archaeopteris*, the major tree of the upper Devonian. A slight reduction of the maximum diameters of this species was demonstrated from the lower to the upper Famennian (STREEL in BECKER et al. 1974, enclosure II, fig. 3).

The most spectacular reduction of miospore size was demonstrated by KEDO (1957) between the middle part and the upper part of the Dankov-Lebedyan beds (upper Famennian) of the Pripyat Depression in Belarus in the very abundant miospore, she named *Hymenozonotriletes lepidophytus*. KEDO (1957). Aside *H. lepidophytus lepidophytus or H. lepidophytus "typicum"*, she described *H. lepidophytus minor* which were identified soon in the late Famennian type regions of the Ardenne in Belgium (STREEL 1966) and in the Sauerland of Germany (STREEL 1969; PAPROTH & STREEL 1971; ALBERTI et al. 1974). This reduction of size was applied there (and confirmed later by MAZIANE et al. 2002) to subdivide the "upper Famennian" into an upper Famennian covered by biometric zones B, C and an uppermost Famennian (or Strunian) covered by biometric zones D, E, F (THOREZ et al. 2006).

OWENS (1971) analyzed with much details the then published occurrences of *H. lepidophytus* (KEDO) around the world, which he named the *Hymenozonotriletes lepidophytus-Endosporites lacunosus- Leiozonotriletes naumovae* complex appearing as a characteristic of the uppermost Devonian in Ohio, Western Australia, Belarus, and Belgium. MCGREGOR (1971, p. 324) completed the data for Canada giving a list of most taxa associated with *H. lepidophytus* (KEDO). The species was renamed *Retispora lepidophyta* (KEDO) by

PLAYFORD (1976). A more complete list of synonyms is given by HIGGS et al. (1988). Its geographical distribution worldwide was shown by STREEL et al. (2000, fig. 28). Presence of this taxon in Siberia was also demonstrated by M.O. ROMANOVNA (2003) in the Saïan-Baïkal mountain area.

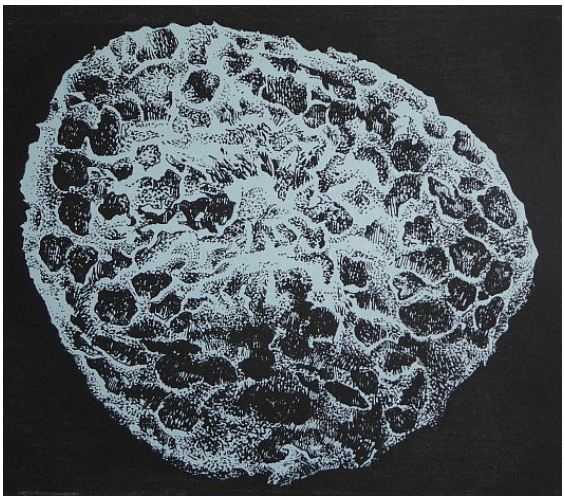

Fig. 2. Drawing by DI CLEMENTE (1985) of a specimen (max. diameter: 60 µm) of *Retispora lepidophyta* found in the "Carrière Langlier" in the Bocq Valley, Belgium.

The early Famennian miospore size reduction was attributed to cooling climate (see ZHANG et al. 2018), consequence of a hypothetic glaciation (STREEL et al. 2000). The uppermost Famennian miospore size reduction coincided with the last Devonian glacial phase in the Parnaiba Basin in Brazil (CAPUTO & DOS SANTOS 2019). It is indirectly registered by the lowering of sea level at the base of the miospore zone LE (former PLs Subzone in PAPROTH & STREEL 1971), interrupting the classical Comblain-au-Pont transgression in the reference section of Chanxhe, Eastern Belgium (MAZIANE et al. 2007).

In the near Rivage section, KUMPAN et al. (2014) identified, in the same sequence as above, a short positive $\delta^{13}C_{carb}$ excursion reaching 3‰. The positive excursion is accompanied by increased values of U/TH palaeoredox proxy, which reach values of 0.75 indicative for hypoxia (JONES & MANNING 1994). A similar gentle increase in $\delta^{13}C$ was also identified in the Carnic Alps in the upper part of the *praesulcata* Zone (KAISER et al. 2008), which approximately correspond to the LE Zone. The positive $\delta^{13}C_{carb}$ excursion at the level of facies progradation could evidence cooling event, as reported from various glacial periods of the Earth history (e.g. SALTZMAN 2003; personal communication by T. KUMPAN on 11/02/2020). Extensive marine anoxia associated with the Late Devonian Hangenberg Crisis is also demonstrated by ZHANG et al. (2020).

The "*tener* event"

The recognition of *H. lepidophytus tener* by KEDO (1957) in the lowest part of the Malevka beds on top of the Dankov-Lebedyan beds was a first contribution to the occurrence of malformed plant spores during the Late Devonian Hangenberg Crisis. STREEL (1966) recorded also significant morphological variations in the population of *H. lepidophytus:* variation in the form of the lumina in the distal surface of the spore (trend a of STREEL 1966, fig. 3). In some specimens the distal lumina may be separated by extremely narrow ridges, which may eventually become discontinuous and ultimately represented by a series of irregular crests or verrucae. Sometimes (trend b of STREEL 1966, fig. 3), the exoexine shows a relatively narrowed expansion, which looks thicker than expected when compared to the translucent central body.

Reproducing plate 1 of STREEL (1966), KEDO & GOLUBKOV (1971, tab. IV, figs. 7- 10) identified four specimens as *H. lepidophytus* KEDO var. *tener* KEDO. These four specimens were collected in three different Strunian (biometric zones D/E/F) sections (Royseux and Rivage–gare in Belgium, Cromford in Germany) and correspond to trends a and b (STREEL 1966, fig. 3). Based on these criteria, PRESTIANNI et al. (2016) proposed a "*tener* event" in the upper part of a new Rivage section.

Other descriptions and pictures of the taxon "*tener*" can be found in the Russian literature, for instance in several BYVSHEVA or CHIBRIKOVA papers (e.g. BYVSHEVA & UMNOVA 1993). They demonstrate the variability of the taxon. A similar taxon was described as *Hymenozonotriletes molestus* by ISCHENKO (1958) from the Dnyeper-Donets Depression and believed to be present there until the Visean. It recalls the presence of *Retispora florida* STAPLIN 1960, in the Upper Mississippian of Alberta (Canada), a taxon not easily separated from *Retispora lepidophyta* (KEDO) PLAYFORD 1976 (see PLAYFORD 1976, p. 76). The eventuality that these Lower Carboniferous *Retispora* were reworked from older sediment was discussed by OWENS & STREEL (1967) and STREEL & BLESS (1980) who mentioned

no less than seven records (single grains) of obvious reworked *Retispora lepidophyta* in the literature.

The LE to VI Zones in Europe

From MARSHALL et al. (2020), we know that the palynological assemblages from terrestrial sediments in East Greenland registered (Stensiö Bjerg and Celsius Bjerg sections) significant steps towards a DCB microfloral extinction:

First step: The inception of *Retispora lepidophyta*, possibly containing the characteristic miospores of a late? LE Zone, when seasonality increases.

Second step: The occurrence of a wetter climate and an early? LN Zone at the base of a stratified lake.

Third step: A first permanent stratified lake (lower lake) coincident with the occurrence of a warm and wet climate and a late LN Zone (LN*), characterized by more abundant *Verrucosisporites nitidus and* smooth acamerate spores but rare *R. lepidophyta*.

Fourth step: Characterized by the absence of *R. lepidophyta*, *Ancyrospora* spp. and *Rugospora flexuosa* (VI Zone), containing in another section (Rebild Bakker section) malformed spores of *Grandispora cornuta* and *V. nitidus.*

These steps are founded on quantitative criteria which will be tested below (Tab. 1), mostly from Western and Central Europe:

1. Belarus

AVKHIMOVITCH (1974) added a major contribution to the work of KEDO, giving a description of miospores of all boreholes available in the Upper Salt Group of the Pripyat Basin in Belarus. She wrote that the Upper part of the Dankov Beds is characterized by two miospore assemblages, where *R. lepidophyta* var. *tener* KEDO and *C. cristifer* are present and where miospores with a simple structure *(Lophotriletes, Trachytriletes, Leiotriletes*) are particularly abundant (see also AVKHIMOVITCH et al. 1988: zones PLE and PM). AVKHIMOVITCH et al. (1993) recorded a rare occurrence of *R. lepidophyta* observed at a level just below the DCB in the Pripyat Depression.

2. Russian Platform

BYVSHEVA (1976, p. 72) illustrated within a borehole through the Zadonsk and Malevka Horizons in the eastern region of the Russian Platform, a distinct occurrence of maxima of *R. lepidophyta* var. *tener* higher than maxima of *R. lepidophyta "typicum"*. The last occurrences of these taxa are recorded in the upper part of the Malevka Horizon, preceded by the last occurrence of *C. cristifer*, *Rugospora radiata*, and several other "Devonian" taxa; see also BYVSHEVA et al. (1984): mlo in Udmurtia, Russian Platform.

3. Petchora region

SENNOVA (1972) described three assemblages of miospores from boreholes in the Petchora region, middle and upper assemblages being correlated to the uppermost part of the Dankov Horizon. The middle assemblage is characterized by the abundance of *R. lepidophyta* with quite variable size and reticulum sculpture. The third assemblage shows much less *R. lepidophyta*, which size is decreasing significantly.

4. Northern France

4.1. Brevilliers core-drill

Another quantitative approach was published by COMBAZ & STREEL (1971) in the Strunian part of the Brevilliers core-drill (Northern France). Maxima of *R. lepidophyta* (Biometric zones D & E) were recorded with several miospore species, some being also listed by STREEL (1966, fig. 4) and PAPROTH & STREEL (1971, p. 374). Among these species are *Vallatisporites pusillites*, *Corbulispora (*cf. *subalveolaris)*, *Knoxisporites (*cf. *literatus)*, *Pustulatisporites (*cf. *gibberosus)* restricted to the lower interval of the core-drill, but also *Raistrickia ponderosa, R. variabilis, R. corinoges, R. macrurus, Hystricosporites multifurcatus, Verrucosisporites* div. sp., known in all the Strunian part of the core-drill. COMBAZ & STREEL (1971, p. 229) also noticed and figured (pls. 3 and 4) the quasi teratological character of the ornamentation of *Raistrickia*, *Hystricosporites* and others, bearing deformed appendices, sometimes reduced in size or abnormally thickened. They also mention the same contemporaneous phenomena occurring in *R. lepidophyta* assemblages from the northern Sahara and also from Canada (MCGREGOR & OWENS 1966, pl. XXVIII, figs. 26-27, pl. XXIX, figs. 9-10).

4.2. Etroeungt and Avesnelles sections

The miospores of the reference section of the Etroeungt Limestone are poorly known due to adverse facies conditions. The parastratotype of Avesnelles is not better known as far as the contact with the equivalent of the Hastière Limestone, the

"Calcaire noir d'Avesnelles", is concerned. Both sections contain, at that level, *R. lepidophyta* biometric zone E and possible *Verrucosisporites nitidus* but no *Indotriradites explanatus*, an assemblage corresponding possibly to the LN Zone (PAPROTH & STREEL 1971, Avesnelles, fig. 1).

5. Southwest England

5.1. Burrington Combe

NEVES & DOLBY (1967) and, better documented, DOLBY & NEVES (1970) demonstrated in the Portishead beds of Burrington Combe (Mendip Hills, England) the succession of two *R. lepidophyta* assemblages, both corresponding to biometric zone E, but differing by simple, laevigate miospores *(Leiotriletes, Punctatisporites,Trachytriletes* and *Retusotriletes)* being more common in the upper horizon. On the contrary *R. lepidophyta* is less abundant in the upper horizon: 22% instead of 82% in the lower horizon. Specimens with partial breakdown of the muri (trend a of STREEL 1966) are illustrated. *Raistrickia variabilis* DOLBY & NEVES, 1970 is defined and the variation of the terminal multifurcation on their processes is discussed. The Lower Limestone Shales, on top of the Portishead Beds, do not contain *R. lepidophyta* but *Verrucosisporites nitidus* and *Retusotriletes incohatus* dominate the assemblages, which were very poor and made up of essentially simple, laevigate spores (see also TURNER et al. 1989).

5.2. Barnstaple area

The succession of marginal marine Baggy Formation with LL-LE Zones into the marine Pilton Formation with LE-LN-VI Zones has been studied by O'LIATHAIN (1993) in North Devon. Percentages of main taxa are given in each zone. Simple, laevigate spores may reach 60% in the VI Zone.

6. Southern Ireland

Concurrently with the subdivision of the older miospore zonation (PL, NV zones) of the British Isles into the successive LL, LE, LN, VI (NEVES et al. 1972, CLAYTON et al. 1974, 1978), VAN DER ZWAN & VAN VEEN (1978) developed in southern Ireland a new concept of zonation emphasizing the gradual nature of the succession of miospore assemblages (LM-LE-LN-LCr-NR-NDi-NH Phases) and also a new taxonomic concept emphasizing all kinds of transition from one species to another (the "morphon" concept). For instance, the quantitative analysis and illustrations of variant A of the *Cyrtospora cristifer* Morphon in the LCr-NR-NDi phases of the Bantry Bay Kinsale Formation, southwest Ireland, by VAN DER ZWAN (1979, figs. 1 and 2, pls. I and II) underline the quasi teratological character of the ornamentation of this taxon and its relative abundance on top of the *R. lepidothyta* range.

6.1. Ballycrovane Harbour and 6.2 Bantry Bay

An important contribution to the quantitative approach of the transitional Devonian to Carboniferous palynozonation (see Fig. 3) is obviously the descriptions, quantitative analysis, and 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 cristifer* (LCr) Phases in the basal part of a widespread (? transgressive) pelitic unit: The Castle Slate Member of the Kinsale Formation.

6.3 Old Head of Kinsale

In the top of the Old Red Sandstone Formation, is the Courceyan stratotype in the Old Head of Kinsale Formation. It was described by HIGGS et al (1988, fig. 10). There, *R. lepidophyta* rapidly diminishes in numbers from >30% to <1%, over a 6.5 m interval at the top of the LN Zone (HIGGS et al. 1993, p. 553).

The contact between LN and VI Zones is recorded in many tenths of sections of South Munster Basins and in Southeast Midlands (HIGGS et al. 1988, figs. 15 and 22).

7. Southern Poland

7.1. Kowala Borehole

The Famennian deposits of the southern Holy Cross Mountains in Poland provided four successive spore assemblages in the Kowala 1 Borehole (TURNAU 1985, 1990), three (LL, LN, VI) being correlated with the stratigraphic scheme of STREEL et al. (1987) (TURNAU 1990, figs. 1 and 2). The succession of LN and VI zones across the DCB is

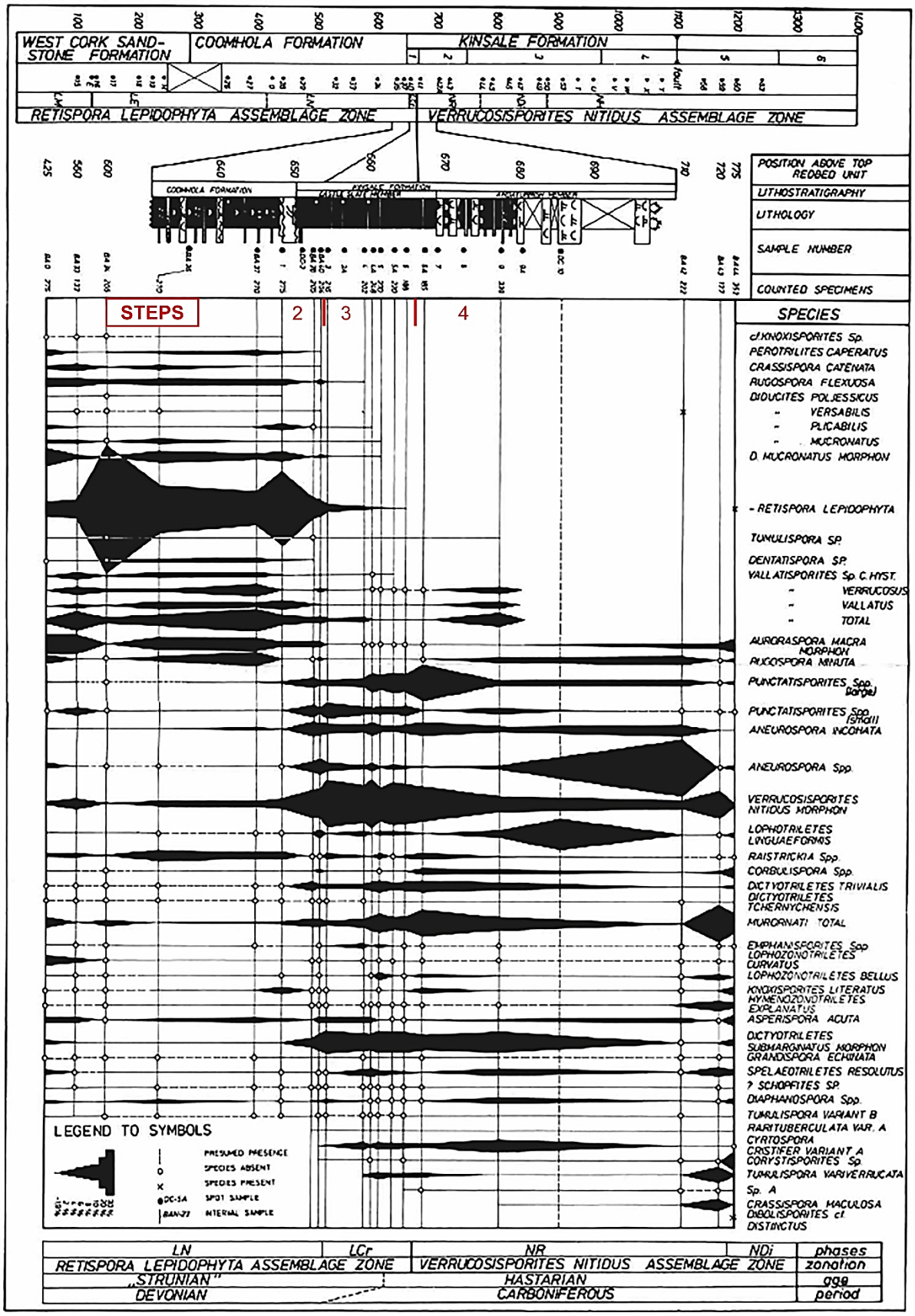

Fig. 3. Spore record at Ballycrovane, Ireland (after VAN VEEN 1981, fig. 2, modified).

characterized by the lack of *R. lepidophyta* and *Rugospora radiata. Retispora lepidophyta* at 10.7 m. (tab. II, fig. 8) might well correspond to *R. lepidophyta* var. *tener* KEDO. The presence of *C. cristifer, V. vallatus* and *Umbonatisporites abstrusus* suggests a correspondence with the upper part of the LN zone corresponding to the LCr Phase. This part of the LN zone is dated by the occurrence of the lower *Protognathodus* fauna (TURNAU 1985; ZAKOWA et al. 1985).

7.2. *Kowala Quarry*

Producing several papers on miospores (and acritarchs) in the same region as TURNAU, FILIPIAK (2004, 2005) investigated the boreholes but also the Kowala trench and the Kowala Quarry. MARYNOWSKI & FILIPIAK (2007) recognized in the upper part of the quarry section an equivalent of the Hangenberg Black Shale (HBS) with a LN assemblage of miospores, followed immediately by a rapid increase of terrestrial input and charcoal (see CHALONER 1989), with many abnormal tetrads above the HBS. FILIPIAK & RACKI (2010) interpret the presence of anomalous spore morphology as reflecting the mutagenic effect of regional acidification due to explosive volcanism.

8. Southern Portugal

PEREIRA et al. (1996) reported miospores of LN and VI Zones (and acritarchs) from two sections crossing the DCB at Pedra Ruiva (SW Portugal). The DCB is considered to occur below a quartzitic package at the top of the Tercenas Fm. The assemblages from the quartzitic sandstones are dominated by smooth acamerate spores and contain *C. cristifer*. Small number of *R. lepidophyta* and other Devonian miospores are interpreted as reworked. A correlation scheme (PEREIRA et al.1996, see 6.) compares the quartzitic sandstones with the Castle Slate Formation in the Munster Basin (Southern Ireland).

9. Belgium

From the west to the east, one should consider successively the Tournai, Menen, Bossuit and Wépion Boreholes, the Bocq Valley, the Hoyoux Valley, the Ourthe Valley and to the south, the Anseremme section.

9.1. Tournai Borehole

It offered the first opportunity to recognize *R. lepidophyta* in Belgium (CARO-MONIEZ 1962, reinterpreted by STREEL 1966). Four samples ranging from 315m to 325m were also studied by MONTEIRO BARRETO (1965), interpreted by STREEL (submitted 1973, published 1977) and are updated here. The three higher samples belong to biometric zone F and to ?LN Zone but are largely dominated by *Retusotriletes* div. sp. They contain among others *Verrucosisporites nitidus, Diducites versabilis, Vallatisporites pusillites, Grandispora cornuta, Rugospora flexuosa, Hystricosporites multifurcatus,* and *Raistrickia variabilis* but no *Indotriradites explanatus*, which were characteristics of the former PLs2 Florizone (PAPROTH & STREEL 1971).

9.2. The Menen Borehole

It contains a single sample (176m) with *R. lepidophyta, Indotriradites explanatus* and *Verrucosisporites nitidus* but also *Corbulispora cancellata, Raistrickia variabilis, Diducites versabilis, D. mucronatus*, and *Rugospora radiata*. *Verrucosisporites nitidus* and *Spelaeotriletes optivus* indicate the highest level in the range of *R. lepidophyta*, i.e. the LN Zone (LOBOZIAK et al. 1994).

9.3. Bossuit K and Bossuit D7 Boreholse

These reached a "basal clastic complex" included in the Tournaisian Hastière Formation and containing very rich and diverse assemblages with, among many others species, *V. nitidus, R. incohatus, Corystisporites costatus*, many *Convolutispora* div. sp., and specimens of the *Bascaudaspora mischkinensis/B. submarginata* complex. The wide diversity in composition of these assemblages indicates that they probably correlate with the middle to upper part of the VI Zone (HIGGS *et al*. 1992).

9.4. The Wépion Borehole

It drilled through the "southern limb of the Namur Synclinorum" and penetrated the Strunian in two sections (autochthonous and reversed sections) in the underlying Brabant Parautochton (GRAULICH 1960, BERANGER et al. 2012). The Famennian/Tournaisian transitional spore assemblages were studied by MONTEIRO-BARRETO (1965) and described by STREEL (1966 and 1977) in both sections. A quantitative analysis (STREEL 1966, fig. 5) shows the spectacular increasing number of *R. lepidophyta* specimens, from 1.000/gr in biometric zone C to 10.000/gr in biometric zone E, which contains also *Vallatisporites pusillites, Grandispora cornuta, Rugospora flexuosa, Hystricosporites*

multifurcatus, Raistrickia variabilis, and abundant *Retusotriletes incohatus*, but neither *Indotriradites explanatus* nor *Verrucosisporites nitidus*, an assemblage corresponding therefore to the ?LL Zone. The contact with the presumed Tournaisian sandstone of the borehole was not analyzed.

9.5. The Bocq Valley

The Yvoir-Bocq section (CONIL 1960, 1968) was known (see VAN VEEN 1981, p. 82) as the most informative one showing a relatively continuous palynological succession across the DCB. Based on miospores data of STREEL (1969), PAPROTH & STREEL (1971) and DI CLEMENTE (1985) in the section Yvoir-tunnel (which is the lower part of the Yvoir-Bocq section), the shales underlying the Hastière Formation (Shale 28 in CONIL 1960, fig. 1; shale 41 in PAPROTH & STREEL 1971) contain *R. lepidophyta* biometric zone F and possibly *Verrucosisporites nitidus* but no *Indotriradites explanatus*, an assemblage corresponding possibly to the ?LN Zone. Shale 26 in Conil 1960 (fig. 1) and 48-50 in PAPROTH & STREEL 1971) contains several smooth acamerate spores and possibly *Verrucosisporites nitidus* or doubtful (deformed) *R. lepidophyta*; it may correspond to the LN* Zone.

9.6. The Hoyoux Valley

The first miospores record in the upper part of the Comblain-au-Pont Formation was noted in the Royseux railroad section by AUSTIN et al. 1970 (= section Huy 15) and was supplemented in MAZIANE et al. (2002; = section Royseux). The first occurrence of *Indotriradites explanatus* (Zone LE) allows an accurate correlation with the reference section of Chanxhe 1 in the Ourthe Valley. The biometric zone F is noted at Royseux railroad section and in two other close sections (AUSTIN et al. 1970) at about the same level. The first *R. lepidophyta* var. *tener* were recognized as low as the biometric zone D (Bed 11) by STREEL (1966) and KEDO & GOLUBKOV (1971, table IV, figs. 7-8).

The Royseux railroad section is also used to identify the basal bed (Beds 104-105) of the Hastière Formation as an equivalent of the Hangenberg Sandstone (HBS; DENAYER et al. 2015, 2019), which underlies both the Stockum and Hangenberg Limestones in Germany. This is consistent with the occurrence of Carboniferous conodonts including *Siphonodella cooperi* in Bed 111 (AUSTIN et al. 1970).

9.7. The Ourthe Valley

The Chanxhe 1 section was used by STREEL (1966) to define the biometric criteria based on the change of size and morphology of *Retispora lepidophyta*, supplemented by a more detailed analysis by MAZIANE (1999) and MAZIANE-SERRAJ et al. (2002). The highest part of the Comblain-au-Pont Fm at the Chanxhe 1 section is interrupted by a fault, which does not allow to observe the DCB. The palynology of the lateral section Chanxhe 2, which is not faulted, has been poorly studied (STREEL 1993) but the highest shales belong to the LE Zone.

Evidence from the Rivage-gare section (STREEL 1966, fig. 4) tried to complete the data, showing the presence of *Hystricosporites multifurcatus, Lophozonotriletes rarituberculatus* and *Raistrickia* sp. in the last shaly bed below the Hastière Formation. The first *R. lepidophyta* var. *tener* are recognized in the biometric zone E (Bed 161) by STREEL (1966) and KEDO & GOLUBKOV (1971, tab. IV, fig.10).

The Tohogne Borehole (BOUCKAERT et al. 1978) presents a large development of the Strunian beds from the base of the VH Zone to the LE Zone after MAZIANE et al. (2002; their biometric zones X-Y-Z). The interest of this borehole lies in the numerous shales interbedded in thick limestones, belonging all to the LE Zone.

The Pont-de-Scay section (PRESTIANNI et al 2016) completed the Ourthe Valley data, mentioning many taxa of the LE Zone. The three shaly layers (Beds 89, 91, 94) belonging to biometric zone F, demonstrated more malformed palynomorphs than below (the *tener* event), about 2 to 3 meters below a proposed DCB at the base of Bed 102a.

9.8. Anseremme section

It is the neostratotype of the Hastarian and best illustration of the DCB in the vicinity of Dinant (VAN STEENWINKEL 1984, 1988). Very few miospores have been reported from this mainly limestone area due to adverse facies conditions. The presence of single grains of *R. lepidophyta* is known in shales between Beds 147 and 153, one to two meters below Bed 159 considered as the basal bed of the Hastière Limestone (STREEL in BOUCKAERT et al. 1974; BOUCKAERT & GROESSENS 1976) and which contains, among several conodonts, the index species of the German Lower Stockum Limestone level, *Protognathodus kockeli.*

Protognathodus kockeli is also known (but no miospores !) at the same stratigraphic level in the Gendron-Celles and Hastiere-Lavaux localities and, a few meters higher, in the Custinne locality (BOUCKAERT & GROESSENS 1976). This last level is also the level where *Siphonodella duplicata* was recorded in Beds 174-8 of the Anseremme section (VAN STEENWINKEL 1984).

A relative sea-level curve has been deduced from facies analysis. It shows a relative sea-level fall at the end of the Devonian that resulted in an unconformity surface and non-deposition (VAN STEENWINKEL 1988).

10. Western Germany

One will consider successively the Velbert Anticline, the Paffrath Syncline, the Dill Syncline, Riescheid, Hasselbachtal, Seiler trenches, Oese, Apricke, Oberrödinghausen, and Stockum trenches, which locations are given in HIGGS & STREEL (1984, map fig. 2).

10.1. Velbert Anticline

Ten kilometers east of the Rhine River, the Ratingen section (Cromford in CONIL 1964) shows miospores in the shales of the zone Eα, immediately below the zone Eβ of PAUL (1939), at the base of the "Ostracod Limestone", containing *Cymaclymenia euryomphala*, possibly an equivalent of the basal Hastière Fm. (CONIL 1964). The shales contain *R. lepidophyta*, zone biometric F with many specimens of *R. lepidophyta* var. *tener* and several smooth acamerate spores but no *Verrucosisporites nitidus* nor *Indotriradites explanatus* (STREEL 1966, 1967; PAPROTH & STREEL 1971).

10.2. Bergisch Glasdbach-Paffrath Syncline

It is situated south of the Velbert Anticline, east of the Rhine, opposite to Cologne. Miospores are known from three shallow boreholes and are exceptionally well preserved. *Retispora lepidophyta* is a common element totaling up to 20 % and must be assigned to the biometrically defined zone C. Among the 35 taxa listed, the presence of *Knoxisporites* aff. *literatus* and *Cyrtospora cristifera* are noted but no *Verrucosisporites nitidus* nor *Indotriradites explanatus* were present, corresponding therefore to Zone ?LL. (HARTKOPF-FRÖDER & STREEL 1994).

10.3. Dill Syncline

It is situated about one hundred km southeast of the Velbert Anticline. A section at Langenaubach exhibits in the middle part of Wocklum shales five thin diabasic intrusions, where the reflectance of vitrinite, although slight, corresponds to badly preserved spores in the same sequence. Samples taken in the highest part of the section, corresponding to the Hangenberg Shales and better preserved, were assigned to the former PLs Zone (SOMERS & STREEL 1978). Abundant (reaching 45%) *R. lepidophyta* correspond to the biometrically defined zones E and F. However, no *Verrucosisporites nitidus* nor *Indotriradites explanatus* were present.

10.4. Riescheid section

It is situated near Wuppertal-Barmen, about twenty km east of the Velbert Anticline. Known previously as "Obere Cypridinenschiefer", the Brahm Formation (HARTENFELS et al. 2016) contains many calcareous turbidites instead of the nodular limestone present in the Velbert Syncline. The about 9 m thick exposed succession contains the miospore zones LL-LE-LN. The Lower LE assemblage occurs at a level more or less equivalent to a *costatus* conodont fauna (of old zonal terminology) and is, therefore, considered to be just below the Hangenberg Event level but there is no evidence for a black Shale (HBS). The upper six meters fall in the LN Zone (HIGGS & STREEL 1994) including small verrucate forms of *V. nitidus.* The uppermost meter of the succession is composed of a black shale identified as the Middle Tournaisian Lower Alum Shale (now Kahlenberg Formation) containing many smooth acamerate spores and many *V. vitidus.* It has been equated with the HD Zone based on one single occurrence of *Kraeuselisporites hibernicus.* However, since several other characteristics of the HD Zone are lacking (see HIGGS et al. 1988), this dating is questionable. ARETZ et al. (2006, fig. 40) accepted the existence of a Lower Tournaisian Hangenberg Formation in the uppermost decimeters of the section. The section has been re-sampled by C. HARTKOPF-FRÖDER for palynostratigraphy but results are not yet available.

10.5. Hasselbachtal stream and borehole sections

The Hasselbachtal, as all following sections (except Stockum), are located on the northern flank of the Remscheid-Altena Anticline in the Northern "Rheinisches Schiefergebirge". Northern and

southern stream sections were described by BECKER et al. (1984) and BECKER (1988, 1996). The northern section has been selected as an auxiliary stratotype section for the Global Stratotype GSSP for the Devonian-Carboniferous Boundary (BECKER & PAPROTH 1993). Most of the Hangenberg Shales sensu lato (including the HBS on top of the Wocklum Limestone) has been proved to belong to the LN Zone (HIGGS & STREEL 1994). The LN/VI boundary is present at 14 cm below the top of Bed 85H (HIGGS & STREEL 1984), which is followed by a thin oolithic and crinoidal bed (Bed 84H, supposedly with the oldest *Siphonodella sulcata*) and Upper Stockum Limestone equivalents with *Pr. kuehni* (Beds 83H to 81H).

HIGGS et al. (1993) also described the LN Zone in the Hangenberg Shales from the nearby Hasselbachtal Borehole sequence and observed that *R. lepidophyta* comprised 10-20% of the spore content. However, the presence of this species is noticeably diminished in the highest sample (45 cm below the basal bed of the Stockum/Hangenberg Limestone), where it is less than 2% of the overall assemblage, which is characteristically dominated (>50%) by specimens of *Retusotriletes*.

10.6 *Seiler trenches*

These contain particularly sandy and silty sediments. In Trench 1 (HIGGS & STREEL 1984), three samples correspond to the LN Zone, the highest being 40 cm below the Stockum Limestone, where a *Protognathodus* fauna was discovered. These samples contain *Vallatisporites vallatus* but no *V. pusillites.*

10.7. Oese section

The Wocklum Limestone is succeeded by Hangenberg Black Shales with *Postclymenia* cf. *evoluta* sensu ZHANG et al. (2019) at the base. There is a thick sandstone development (the Hangenberg Sandstein or HSS) above the shales in this area. The LN Zone was recorded in the uppermost part of the HSS, followed just above by silty, laminated limestone with *Pr. kockeli.* (Bed A). The overlying Upper Stockum Limestone equivalent (Bed B) contains *P. kuehni* (HIGGS & STREEL 1984), followed at the base of the Hangenberg Limestone (Bed C) by *S. sulcata*.

10.8. Apricke section.

A LN assemblage was obtained from a level close to the top of the Hangenberg Shales. It contains the three species of *Vallatisporites* (*V. pusillites, V. vallatus*, and *V. verrucosus*) and, therefore, was considered to belong to a level high in the LN Zone (HIGGS & STREEL 1984)

10.9. Oberrödinghausen section and borehole

Reexamination of the PAPROTH & STREEL (1971) and HIGGS & STREEL (1984) conclusions and of a few new samples containing rare *I. explanatus* and *V. nitidus* possessing small verrucate ornaments, allows a more appropriate assignment to the LN Zone of the Hangenberg Shales (HIGGS & STREEL, 1994; see also HIGGS et al. 1988, p. 12). The possibility of the reworking of older spores of Zone LL and biometric zone D (PAPROTH & STREEL 1971 and HIGGS & STREEL 1984) was discussed by BLESS et al. (1993, p.697).

10.10. Stockum trenches.

These trenches are situated on the northeast flank of the Ebbe Anticline. Since the publications of ALBERTI et al. (1974) and CLAUSEN et al. (1994), the locality is known to exhibit a spectacular amount of various fossil groups: ammonoids, trilobites, ostracodes, miospores, and a very detailed *Protognathodus* fauna (ZIEGLER 1969). Trench I was dug in less than 10 m into the forest from the road side outcrop. Trench II was opened through the forest in 1982 and miospores and goniatites published respectively by HIGGS & STREEL (1984) and KORN (1984). A new deeper trench along trench II was resampled by D. KORN and E. PAPROTH in 1988 and 1989 and restudied by HIGGS et al. (1993). The sample interval was 16.5 m in thickness and comprised in ascending order, the Hangenberg Black Shale (HBS), the Hangenberg Shales and Sandstones (HSS), including more sandstones near the top of the HSS, the Stockum Limestone, and the base of the Hangenberg Limestone.

Two distinct types of LN Zone were recognized – an older more typical LN assemblage, and a younger transitional LN* assemblage. In the LN assemblage, *V. nitidus* and *I. explanatus* are consistently present but only in small numbers. In the LN* assemblage, *R. lepidophyta* is a rare (<1%) but consistent element. The LN* assemblage is dominated (up to >50%) by various species of *Retusotriletes* (mainly *R. incohatus* and *R. coniferus*). It contains also *C. cristifer* and *Bascaudaspora mischkinensis*. A VI assemblage is present in the interval containing the Stockum Limestone lenses (see also STREEL & KORN 2016),

where *R. lepidophyta* is lacking and which is dominated by *Retusotriletes* species.

A palynofacies quantitative analysis has been attempted to evaluate the conditions of transportation, sedimentation and diagenesis of the organic particles in Stockum Trench II (STREEL 1999). Permanent **anoxic** conditions and short transport preserve palynofacies rich in thin, more or less translucid, heterogeneous debris. Primary or subsequent **oxic** conditions and/or long transport provide palynofacies, where these heterogeneous debris are destroyed and, therefore, are rich in black homogeneous debris.

At Stockum, after the oxic HBS deposition, a quick drop of the sea-level involved the deposition of the Hangenberg Shales and Sandstone (HSS) in anoxic conditions. "Coal" swamps must have been reintroduced in the vicinity because *R. lepidophyta* and *V. pusillites*, characteristics of "Downstream Swamp Margin" (MAZIANE et al. 2002), may be abundant. Palynofacies returned with the LN* Zone to oxic conditions. Coarser sediments and oxic conditions resulted probably from increased river runoff after a wetter climatic development and coincided with the lowest sea-level (the Hangenberg Sandstone Lowstand). *Retusotriletes incohatus* and *R. coniferus (*= smooth acamerate spores), characteristics of "Upstream Swamp Margin" (MAZIANE et al. 2002), become abundant and continue into the VI Zone.

Discussion

The localities in West Germany, Stockum (10.10) and Hasselbachtal (10.5) obviously allow the best approach to meet the four steps considered in Tab. 1. Additionally, it is also obvious that eight other localities should be considered as candidate to support at least the succession of steps 2 to step 4. In Southwest England, they are Burrington Combe (5.1) and Barnstaple (5.2), in Southern Ireland, Ballycovane Harbour (6.1), Bantry Bay (6.2), and Old Head of Kinsale (6.3), in Poland, the Kowala region (7.1 and 7.2), and in Portugal, the Terceras Fm (8.).

As very explicitly demonstrated by VAN VEEN (1981, fig. 2 and 3) in Southern Ireland, the most distinct palynological change is between step 2 and step 3, i.e. the limit LN/LN* in the Stockum reference section, which marks the end of the latest Famennian glaciation in western Gondwana (CAPUTO & DOS SANTOS 2019), a change of climate, and the replacement of the "Downstream Swamp Margin" miospores by various species of small acamerate miospores believed to belong to the "Upstream Swamp Margin".

Five other localities in West Germany (10: 4, 6, 7, 8, 9) do not reach this LN/LN* limit although they probably contain *V. nitidus*. The presence *of V. nitidus* may be doubtful in two other localities from West Germany (10.1, 10.3) but the biometric characteristics of abundant *R. lepidophyta* (E or F Zones) and the presence of *R. lepidophyta. tener* suggest that they might belong to the LN Zone.

Again, five localities in Northern France and Belgium (4.1, 4.2, 9.1, 9.2, 9.5) contain also doubtful *V. nitidus* but *R. lepidophyta* with biometric E or F Zones, three of them showing various species of small acamerate miospores suggesting that they might perhaps reach the LN* Zone.

Three localities in Belgium and one in West Germany (9.4, 9.6, 9.7, and 10.2) start in the LL Zone with biometric characteristics of *R. lepidophyta* belonging to C or D Zones, i.e. across the base of the Strunian. The Belgian localities reach the LE Zone (Biometric E Zone), two of them reaching maybe the LN Zone (Biometric F Zone and presence of *R. lepidophyta tener)* but they do not contain *V. nitidus*.

The other localities, including one in Belgium (9.8) and three in Russia, might well cross the here recommended limit LN/LN* but the Russian data are much more abundant needing a more careful approach.

Obviously, the main problem in identifying steps 2 and 3 is the presence or absence of *V. nitidus.* PRESTIANNI et al. (2016) suggested that the LN Zone should be considered as an ecozone rather than a biozone. They note that *V. nitidus* is present in the proximal Menen borehole (9.2) in Belgium but absent everywhere in the more distal Namur-Dinant Basin (their fig. 7) because it is a heavy spore deposited only in proximity of the littoral zone. This suggestion is difficult to accept as long as the hundred sequences, where *V. nitidus* is present around the world, are not investigated to know if they fit in such a scheme. One wonders also why the many heavy miospores, such as *Knoxisporites, Lophozonotriletes, Tumulispora, Corbulispora,* and *Convolutispora*, all present in the LE Zone of the Pont de Scay section in the Ourthe Valley

(PRESTIANNI et al. 2016, figs. 4 and 5), were not controlled by the same littoral condition?

We also know that the development of the *tener* event is not an argument for the identification of a ?LN Zone since this variety of *R. lepidophyta* was already seen near the contact of the biometric zones D/E in the reference section of Chanxhe (STREEL 1966), not near the contact E/F, as indicated by mistake in PRESTIANNI et al (2016, fig 3).

Better arguments to identify the LN Zone would have been the possible presence in that ?LE Zone of ?*Vallatisporites vallatus*. their rather long spines (PRESTIANNI et al. 2016, fig. 5J) fitting with the observations made in the latest Devonian in Pennsylvania (STREEL & TRAVERSE 1978). Also, the presence of *Bascaudaspora mishkinensis* in the highest shales of the Pont-de-Scay section, a miospore known only in the LN* Zone of the reference section of Stockum (HIGGS et al. 1993), might have been a better argument for a ?LN Zone. However, none of these arguments seem decisive to oppose the still common opinion that the upper part of the Strunian in Belgium might present lacunae resulting from non-deposition.

The now nearly classical demonstration of non-deposition at the end of the Strunian is obviously the work of VAN STEENWINKEL (1988) in the Anseremme section (9.8) in the Dinant Basin, but it is known also (see Streel 1977) that most of the Strunian beds (the old Tn1a) was not deposited or were extremely reduced on the Brabant Massif. The HMS OTS (Haine-Sambre-Meuse Overturned Thrust Sheets) at the southern border of the Brabant Parautochton, "characterized by a lithostratigraphic succession thinner than their equivalent in the Dinant Synclinorium, owing to a more proximal position and the occurrence of depositional gaps (DENAYER et al. 2016)", was not palynologically dated above the controversial (STREEL & THOREZ 2017) Middle or Upper Famennian famous Strud quarry.

In the Ourthe Valley section (9.7), MAZIANE et al. (2002) wrote that local synsedimentary tectonic movements (THOREZ & DREESEN 1986) are responsible for small changes in edaphic conditions of deposition of LL and early LE Zones within a Hoyoux-Ourthe tilting-block. If these synsedimentary tectonic movements had persisted during the LE-LN zones time equivalent, they might explain a latest Strunian non-deposition.

Conclusions

To make a choice between the different causes which might explain malformed land plant spores during the transitional Devonian to Carboniferous steps is uneasy. Of course, they are not incompatible. Volcanic gazes from LIP eruptions might have also played a role in the destruction of the ozone layer. But a paroxysm was certainly reached when, during the LN-LN* Zones, several late Devonian miospores characterizing the "Downstream Swamp Margin" collapsed under postglacial maybe extremely warm conditions.

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Tab. 1. (next page)

		LL ***K. literat*** **First *R.l.***	**LE** ***I. explanat*** **Step 1**	**LN** ***V. nitidus*** **Step 2**	**LN*** **Few *R. lepido.*** **Step 3**	**VI** **No *R. lepido.*** **Step 4**
	Greenland:		Increased seasonal.	Arid interv. (=Glaciation)	Warm & wet	Very warm Ozone lost
	Stensiö Bjerg		Top LE ?	Base LN?	>>acamer.sp.	?malform.sp
	Celsius Bjerg				>>acamer.sp.	?malform.sp
	Rebild Bakker					malform.sp
10.10	Stockum trenches			LN	LN*1%R.lep. 50%acamer.sp	VI 50%acamer.sp
10.5	Hasselbachtal		LE	LN20%R.lep	LN*2%R.lep. 50%acamer.sp	VI 50%acamer.sp
5.1	Burrington Combe			LN82%R.lep	LN*22%R.lep >acamer.sp	VI >>V.nitidus >>acamer.sp
5.2	Barnstaple area	LL 40%R.l.	LE 40%R.lep	LN 33%R.lep	LN*?33%R.lep>acamer.sp	VI >acamer.sp
6.1	Ballycrovane Higgs et al:	Van LL	Veen: LE	LN phase LN	LCr phase ?LN*	NR phase VI
6.2	Bantry Bay	Van	Veen:	LN phase	LCr phase	NR phase
6.3	Old Head Kins.	LL	LE	LN30%R.lep	LN*<1%R.lep.	VI
7.1	Kowala 1bor.			LN	?LCr phase	VI
7.2	Kowala Quarry			LN=HBS	malform.tetrads	
8	Tercenas Fm			LN	<R.lep.>acam.sp	VI
10.4	Riescheid	LL	LE	LN		HD?
10.6	Seiler trench.			LN		
10.7	0ese			LN		
10.8	Apricke			LN		
10.9	Oberrrödingh.			LN+rew.LL-D		
4.1	Brevilliers bor.	-D	-E	?LN	malform.sp	
4.2	Etroeungt			?LN -E		
9.1	Tournai bor.			?LN -F	?LN* acamer.sp	
9.2	Menen bor.			?LN	?LN* acamer.sp	
9.5	Bocq Valley			?LN -F	?LN* acamer.sp	
10.3 10.1	Dill Syncline Velbert Anticl.			?LN -E-F 45%R.lep ?LN–F >*tener*		
9.4	Wépion bor.	-C 9%R.lep.	-E 37%R.lep.			
9.6	Hoyoux Valley	LL -D	LE	?LN -F		

9.7	Ourthe Valley	LL –C-D	LE -E	?LN–F >*tener*		
10.2	Paffrath Syncl.	?LL –C 20%R.l.				
9.8	Anseremme			?LN	?LN*	
9.3	Bossuit bor.					Mid-late VI
1.	Belar. Pripyat Up.Dankov b.			?LN	?LN* acamer.sp >*tener*	
2.	Russ. Platform Up.Malevka h.			?LN	?LN* *tener* last occur.	
3.	Petchora Up.Dankov ?			?LN	?LN* Few R.lep.	

Late Eifelian Kačák Episode in the epeiric Belarusian Basin (SE Euramerica)

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The Kačák Episode/Event (KE) belongs to several important turning points in the Devonian (HOUSE 1996, 2002; WALLISER 1996) but its nature and origins are still far from having received a comprehensive explanation. The possible reason for this unsatisfactory situation is that, similar to other Devonian "black shale events", the KE has been investigated mostly in deeper-shelf settings (e.g., BUDIL 1995; HOUSE 1996; KIDO & SUTTNER 2010; WARD et al. 2013). The present study aimed to expand the cognitive perspective by incorporating observations from the Middle Devonian intracontinental Belarusian Basin located in a near-equatorial position (ca. 10° S) in the SE part of Euramerica (Fig. 1).

It has many attributes of an epeiric tropical sea, similar to those located north of present Australia (ALGEO et al. 2008).

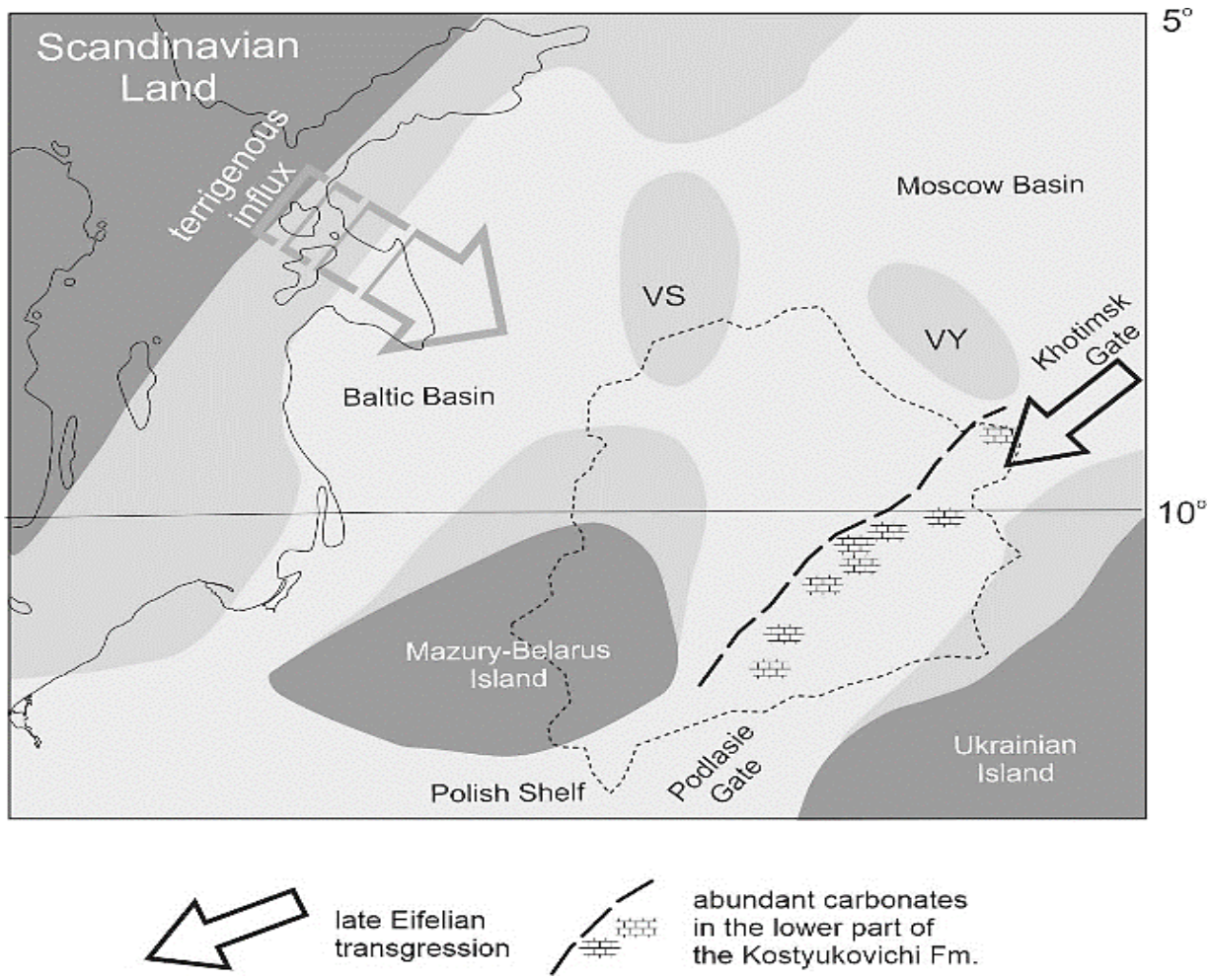

Fig. 1. Palaeogeography of the Belarusian Basin during the late Eifelian Kačák Episode. The state boundary of Belarus is marked with a dotted line. Abbreviations: VS – Viliakskiy Swell, VY – Vyazhma-Yartsevo Shoal. Main cities: K – Kiev, Mi – Minsk, Mo – Moscow, R – Riga, W – Warsaw.

The subject of the study is the Kostyukovichi Formation corresponding to a transgressive-regressive cycle underlain by lagoonal dolomites and sulphates of the Osveya and Gorodok formations. It

is topped by an erosional unconformity onlapped by continental terrigeneous deposits of the Polotsk Fm. The cycle is developed in fossiliferous siliciclastic-carbonate facies in the lower part and as greenish to variegated siltstones to claystones with restricted marine and terrestrial fauna predominantly upwards in the section, and towards the northern part of the basin. The conodont assemblages from the transgressive part document the *ensensis* Zone, thus pointing to the correlation with the global KE, while the basal Kostyukovichi transgression coincides with the base of the eustatic If cycle (Fig. 2).

The study comprised 18 borehole sections distributed over almost the entire sub-Meso-Cenozoic subcrop area of the basin. The investigations comprised the sedimentological study of cores and geochemical analyses of C and O isotopes in carbonates, O isotopes in bioapatite (NARKIEWICZ et al. 2017), and Nd-Sm isotopes in bioapatite and carbonates. Investigations of biota included a conodont biofacies study and the analyses of rich miospore assemblages and abundant vertebrate microremains.

The results demonstrate that the sedimentation was characterized by intermittent hypoxic conditions and salinity fluctuations. It was controlled by increasing terrigenous and freshwater influx from the northern Scandinavian Land, with carbonates limited mostly to the early stage of the basin development, particularly in its SE part (Fig. 1). The exceptional diversity of miospores and the frequent occurrence of phytoclasts document terrestrial plants bloom, while the abundance and high diversity of fish remains attest to the proliferation of vertebrates. These bioevents are attributed to transgression, climate humidization, and the expansion of aquatic environments in neighbouring land areas. The acme of *Rhabdosporites langii* and related miospores, attributable to progymnosperm plants, suggests a bloom of arborescent aneurophytalean flora in lowlands surrounding the basin.

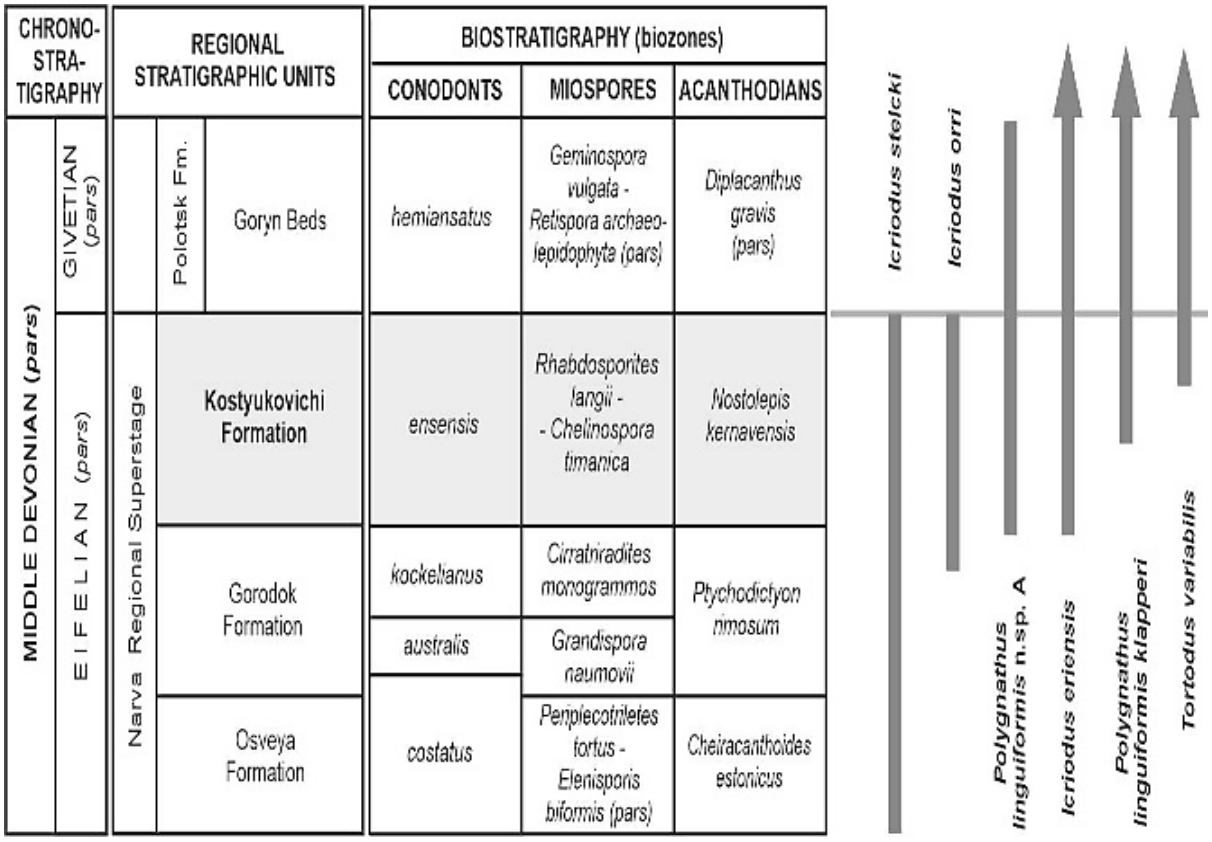

Fig. 2. Stratigraphic framework of the Kostykovichi Fm. with ranges of selected conodont taxa constraining the age of the Kačák Episode

The regional review suggests that such attributes of the Belarusian KE as the initial If transgression, marine hypoxia, land plants bloom, carbonate crisis and terminal regression, are characteristic for various other palaeogeographic settings of the episode worldwide. The episode is here explained as a result of complex interrelations of various processes and events on land and in the marine realm

associated with the eustatic transgression and climate humidization. It is hypothesized that the ultimate cause was the climatic warming induced by astronomically forced increase in solar radiation (as proposed by MARSHALL et al. 2007). An alternative explanation is a geologically rapid influx of CO_2 and/or CH_4 into the atmosphere from volcanic and/or methanogenic sources.

It is proposed that the important component of the terrestrial-marine teleconnections during the KE was the late Eifelian plant bloom presumably including the expansion and radiation of progymnosperm arborescent plants with deepened root systems (DAHL & ARENS 2020). It contributed to transiently increased denudation rates and, indirectly, to the development of marine hypoxia. The episode was terminated by the low-amplitude regression related to a climatic cooling resulting from the enhanced CO_2 sequestration in sediments.

Acknowledgments

This study is a part of the project no. 2018/29/B/ST10/00411 *Palaeoenvironmental records and causes of the global Kačák Episode in the late Eifelian (Middle Devonian)* funded by the Polish National Science Center and partly supported by the PGI statutory funds (project 61.2908.1802.15). Its early phase started within the framework of the NSC-funded Project 2011/03/B/ST10/05468 (years 2012-2015) led by Katarzyna NARKIEWICZ (PGI-NRI, Warszawa).

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Preliminary report on the brachiopods in the Givetian Jiwozhai reef, Dushan section, South China

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Introduction

The Dushan (previously spelled Tushan) section (Fig. 1), which has been studied for nearly 100 years (TING 1929; YU & LIAO 1978; HUANG et al. 2020), is regarded as one of the most famous shallow water stratotype sections in South China for its typical Lower-Upper Devonian successions and the diverse and abundant benthic organisms. Documented are stromatoporoids (YANG & DONG 1963), rugose corals (YU & LIAO 1978), tabulate corals (DENG, 1979), bryozoans (Hu 1980), brachiopods (Ma 2009), ostracods (SONG & GONG, 2019), and reefs (HUANG et al. 2020). It seems that all these organisms attracted extensively attentions. However, in most studies taxa were preliminary listed, with only few genera fully described, e.g., the rugose corals (LIAO & BIRENHEIDE 1984, 1985; BIRENHEIDE & LIAO 1985; LIAO & BIRENHEIDE 1989; LIAO 2003).

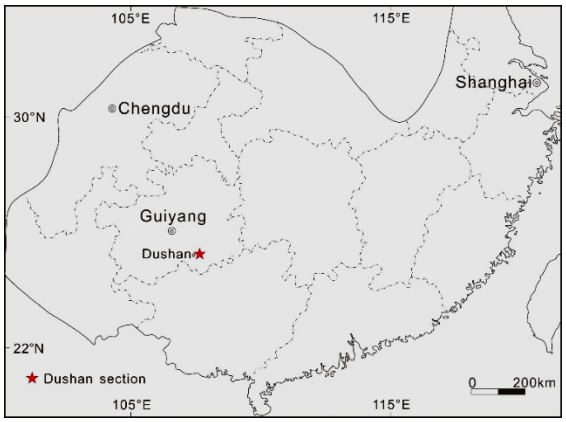

Fig 1. Location of the Dushan section in South China.

With the purpose to evaluate the biodiversity of Givetian reef ecosystem in South China, we carried out a detailed palaeontological and paleoecological description of the Jiwozhai reef in Dushan section (HUANG et al. 2020). Twenty-eight quadrats (0.5 m × 0.5 m), occupying 7 m^2 in total were selected from the vertical outcrop of the Jiwozhai reef for quantitative analyses (Fig. 2). Finally, 16 species belong to 8 genera of brachiopods were identified (Tab. 1; Fig. 3).

	Species	Number
1	*Ambothyris panxiensis*	1
2	*Ambothyris* sp.	5
3	*Athyris maweiensis*	2
4	*Athyris* sp. A	8
5	*Athyris*? sp. B	1
6	*Athyris*? sp. C	1
7	*Desquamatia* sp.	1
8	*Emanuella pentagona*	2
9	*Emanuella plicata*	1
10	*Emanuella* sp. A	4
11	*Emanuella*? sp. B	1
12	*Howittia dushanensis*	5
13	*Leiorhynchus* sp. A	51
14	*Leiorhynchus* sp. B	1
15	*Spinatrypa* sp.	1
16	*Undispirifer* sp.	1

Tab. 1. List of the brachiopod community and its corresponding sample number.

Abundance and diversity

In the brachiopod community, *Leiorhychus* sp. A (number = 51) is the quantitatively dominant species, with a minor role of the genera *Athyris* (number = 12). The other genera, *Ambothyris* (number = 6), *Emanuella* (number = 8), *Howittia* (number = 5), *Desquamatia* (number = 1), *Spinatrypa* (Number=1) and *Undispirifer* (number=1) are relatively rare.

As for diversity, *Athyris* and *Emanuella*, each possessing four species, are more diversified than the other genera, followed by *Ambothyris* and *Leiorhynchus* with two species. *Desquamatia*, *Howittia*, *Spinatrypa*, and *Undispirifer* are monospecific. The SHANNON-WIENER index is available for the evaluation of the diversity of the local brachiopod community.

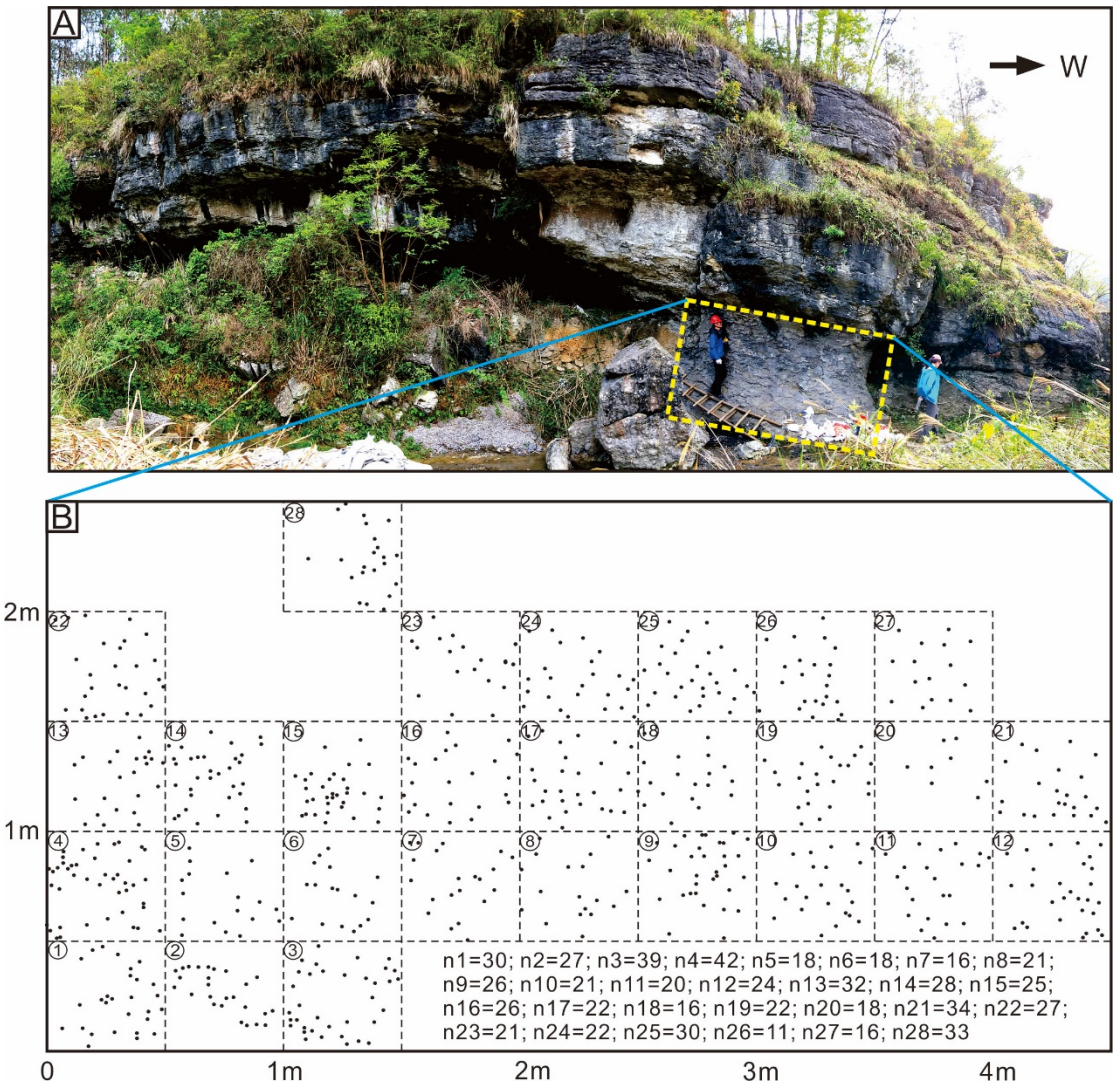

Fig. 2. Field photographs (A) and division of the quadrats (B) in the studied Jiwozhai reef, with sample number and positions in each quadrat.

SHANNON-WIENER diversity index:

$$H = -\sum_{i=1}^{s}(P_i)(\log_2 P_i)$$

H: diversity index; *S*: total species number of the brachiopod community; P_i: The proportion of the species *i* in the samples, if the total sample number is *N*, the sample number of species *i* is n_i, then $P_i = n_i/N$.

Results show that the diversity index *H* amounts to 2.374. Considering the total size of the quadrats, this index suggests a relatively high diversity of the Dushan brachiopod community.

Ecological implications

Brachiopod assemblages characterized by *Leiorhychus* and ambocoelioids are widely reported in the Givetian of South China (HOU et al. 1988; ZHONG et al. 1992; MA & ZONG 2010). This assemblage often appears accompanied by stringocephalids. In the studied Jiwozhai reef, almost all the brachiopods are small-sized, with the width ranging from 5 to 10 mm. Stringocephalids are abundant in both the underlying and overlying strata of the reef, but none was obtained inside the reef. This is probably because the crowded Jiwozhai reef ecosystem was an unfavourable habitat for the large-sized brachiopods to dwell in.

The collections of the dominant taxon *Leiorhynchus* sp. A in the Jiwozhai reef show relatively large morphological variations. The outline of the shell could be subcircular, transversely oval, or subrhomboidal. The lateral views show moderate to strong convexity, with maximum thickness at midlength or anterior of midlenth. The relatively high degree of morphological plasticity of *Leiorhynchus* sp. A may be significant for a future

ecological study on the reef-dwelling brachiopod community.

Both well-preserved and disarticulated (convex-up or convex-down) brachiopod shells can be observed in the outcrop and in microfacies, which may suggest that the environment varied between high-energy and low-energy, with depth around the major storm wave-base.

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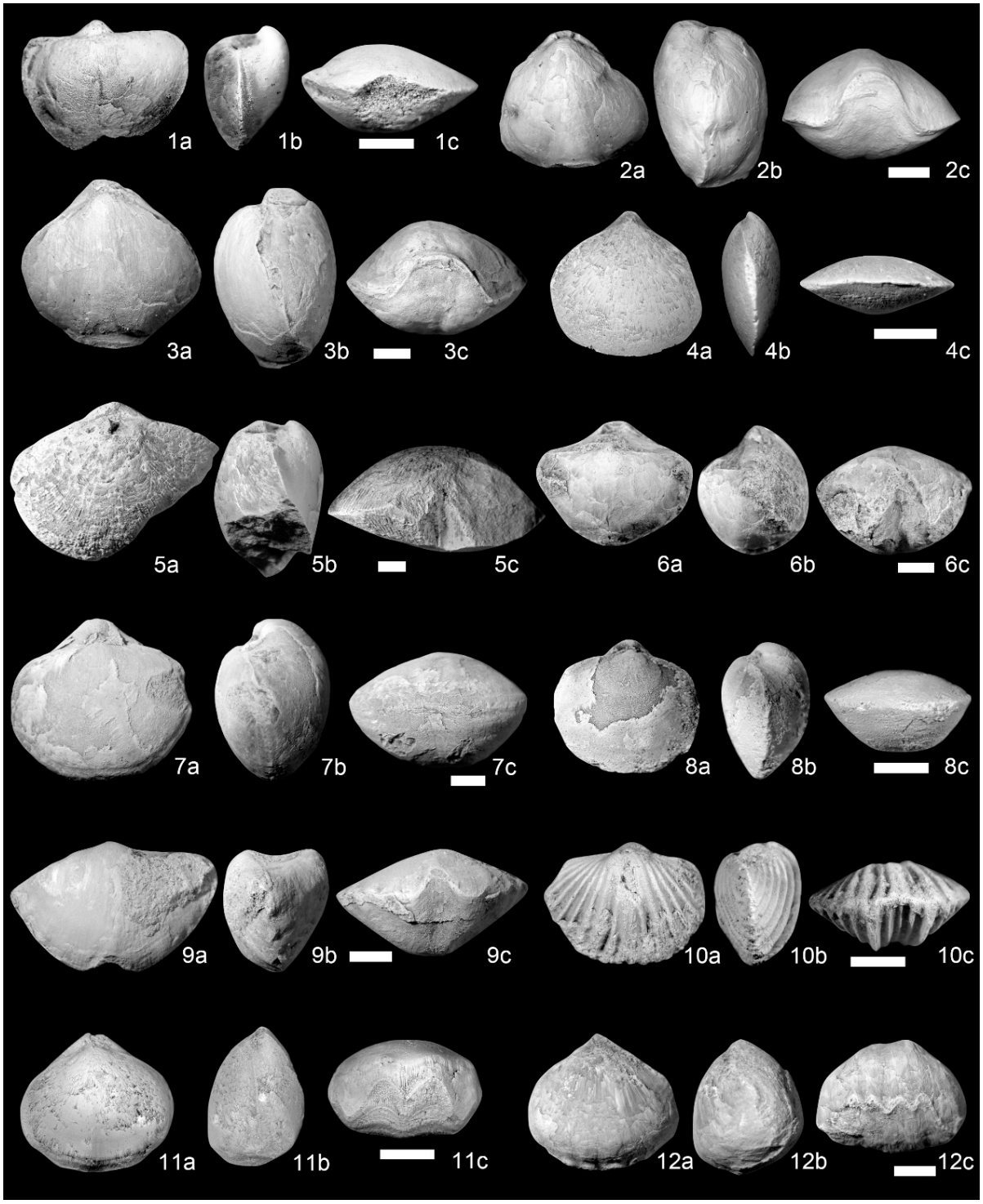


Fig. 3. Brachiopod community from the Jiwozhai reef, Dushan Section. **1a-c.** Dorsal, lateral, and anterior views of *Ambothyris panxiensis*; **2a-c.** Dorsal, lateral, and anterior views of *Athyris maweiensis*; **3a-c.** Dorsal, lateral, and anterior views of *Athyris* sp. A; **4a-c.** Dorsal, lateral, and anterior views of *Athyris*? sp. B; **5a-c.** Dorsal, lateral, and anterior views of *Desquamatia* sp.; **6a-c.** Dorsal, lateral, and anterior views of *Emanuella pentagona*; **7a-c.** Dorsal, lateral, and anterior views of *Emanuella plicata*; **8a-c.** Dorsal, lateral, and anterior views of *Emanuella* sp. A; **9a-c.** Dorsal, lateral, and anterior views of *Emanuella* sp. B; **10a-c.** Dorsal, lateral, and anterior views of *Howittia dushanensis*; **11a-c.** Dorsal, lateral, and anterior views of *Leiorhychus* sp. A; **12a-c.** Dorsal, lateral, and anterior views of *Leiorhychus* sp. B.

SDS MEETINGS

POTENTIAL NEW YORK STATE SDS MEETING IN SUMMER 2021

D. J. OVER

Given the current global Covid-19 situation and uncertainty of travel to and in the United States in the foreseeable future, there cannot be any commitment at this time for the SDS to meet in July-August 2021 in Geneseo, NY. Please look for information in February 2021, when a definitive decision can be made in regard to New York and other SDS meetings.

DEVONIAN PUBLICATIONS

Homage to CM Mike A. MURPHY

KLAPPER, G. (2019). Mike MURPHY'S Impact. - 11th North American Paleontological Conference, Programs with Abstracts: 200-201.

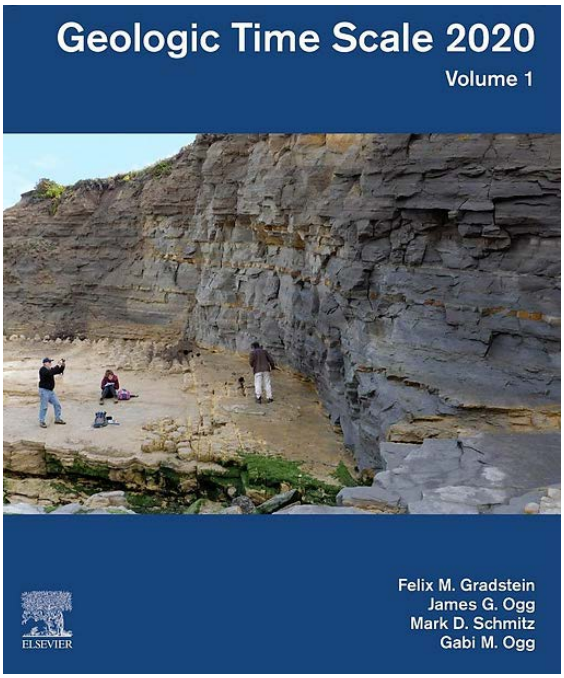
Paleontology and biostratigraphy in the last half of the 20th century into the 21st have been dominated by specialists who characteristically focused on one fossil group and only one, or part of one period of the time scale. Michael A. MURPHY is one of the major exceptions to this generalization. In a long career Mike has accomplished groundbreaking research on the evolutionary patterns and resulting biostratigraphic value of Cretaceous ammonites, Silurian and Devonian conodonts, as well as graptolites. His diverse fields have included biostratigraphy and taxonomy (including significant publications on the morphometrics of conodonts), lithostratigraphy, sedimentology and geologic mapping. After B.A. and Ph.D. degrees at U.C.L.A., he spent most of his teaching and research career at the University of California, Riverside, where he continues as an Emeritus Professor. Mike trained a consequential number of research students, three of whom are the organizers of this symposium in his honor.

In teaching the U.C.L.A. field course in central Nevada in the late 1950s, he came in contact with J.G. "Jess" JOHNSON then beginning his Ph.D. field work there on Lower Devonian stratigraphy and brachiopods. After Jess contracted polio, Mike was responsible for many of the collections used in the dissertation and Jess' subsequent GSA Memoir on Lower Devonian brachiopods. His prolific publications made him one of the, if not the leading Devonian researcher(s). Furthermore, during Jess' long teaching and research career at Oregon State University, Mike field checked many of Jess' 27 M.S. and four Ph.D. students' stratigraphic and mapping research in Nevada.

In summary, Mike MURPHY continues to be an inspiration and mentor to many, including the greatly appreciative author of this abstract.

Geological Timescale 2020 (GTS 2020)

GRADSTEIN, F. M., OGG, J. G., SCHMITZ, M. & OGG, G. (Eds., 2020). Geological Time Scale 2020, 2nd Edition. – ca. 1300 pp., Elsevier, ISBN 9780444637987.



Geologic Time Scale 2020, Second Edition, contains contributions from leading scientists who present information in an easy-to-understand format that includes numerous color charts, maps and photographs. The book covers projects such as GTSNext, Earth Time Europe and Chronos, explaining how and why the time scale is being updated and offering expanded coverage of paleontology and stratigraphy. The authors are on the forefront of chronostratigraphic research and initiatives surrounding the creation of an international geologic time scale, and the included charts present the most up-to-date, international

standard as ratified by the International Commission on Stratigraphy and the International Union of Geological Sciences.

As the framework for deciphering the history of our planet Earth, this book is essential for practicing Earth Scientists and academics.

Key Features

- Completely updated time scale, including research from projects such as GTSNext, Earth Time Europe, and Chronos
- Includes all-new atlas of index taxa at the end of each section to expand coverage of paleontology and stratigraphy
- Provides the most detailed international geologic time scale available that contextualizes information in one reference
- Gives insights on the construction, strengths and limitations of the geological time scale that greatly enhances its function and its utility

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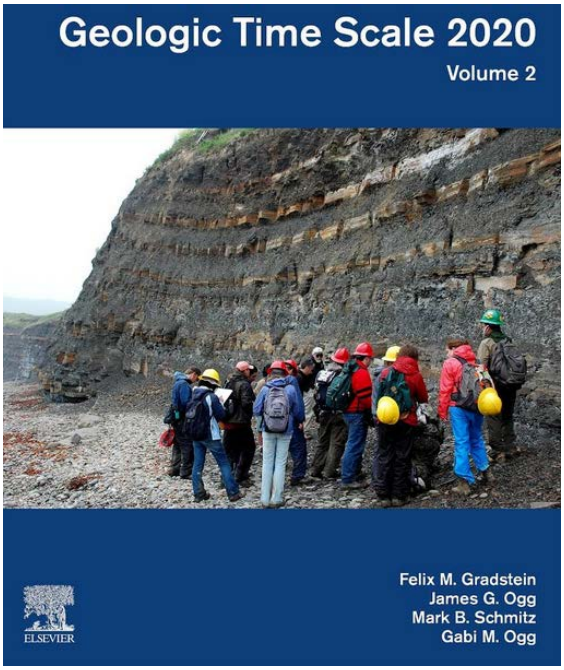

Volume 2:

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(by R. Thomas BECKER, Anne-Christine DA SILVA & John E. A. MARSHALL, with contributions by Frits P. AGTERBERG, Felix M. GRADSTEIN & Jim G. OGG: 78 pp.)
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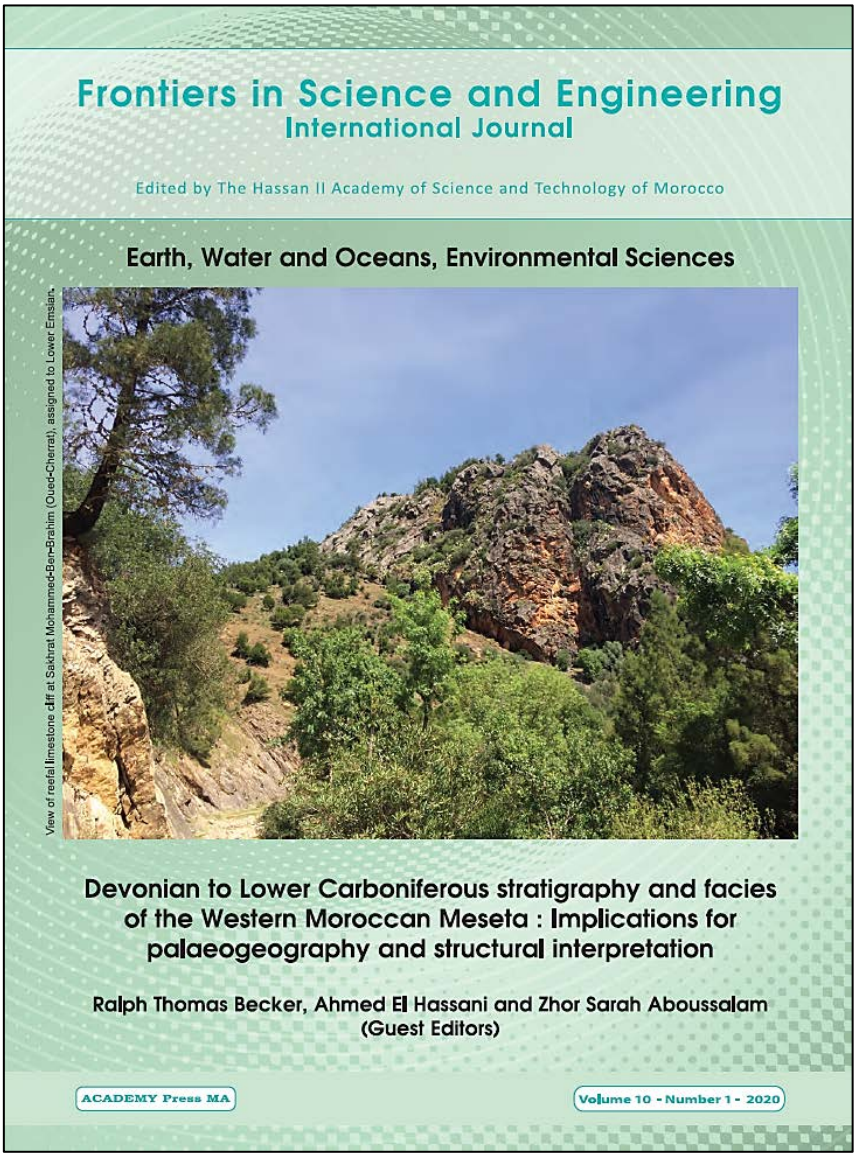
29. The Neogene Period
30. The Quaternary Period
31. The Anthropocene

Appendix 1. Color code according to the Commission for the Geological Map of the World
Appendix 2. Radioisotopic dates used in GTS2020

Expected release: 13th November 2020
Price: ca. 111 US

Apart from Felix GRADSTEIN for pushing the whole project, SDS owes special thanks to Jim and Gabi OGG for their considerable assistance concerning the time scale scaling, figures, and the stratigraphic charts [the Editor].



The volume stems from the fruitful long-term co-operation between the Devonian group at Münster and various Moroccan Devonian workers, notably with CM Ahmed EL HASSANI. The journal selection acknowledges the long-term support by Moroccan authorities and the recent special support from the Hassan II Academy of Science and Technology of Morocco. Since the journal is Open Access (at http://www.academie.hassan2.sciences.ma/pdf/journal_scientifique_10.pdf), we are confident that the results will be acknowledged by other Devonian workers although it has not previously featured Devonian stratigraphic contributions. A second issue is in progress and due in spring 2021.

Content

nomenclature, brachiopods, and a new Viséan coral described by D. WEYER].

ABOUSSALAM, Z. S., BECKER, R. T., RICHTER, J., HARTENFELS, S., EL HASSANI, A. EICHHOLT, S. The unique Devonian of Immouzer-du-Kandar (Middle Atlas basement) – biostratigraphy, faunas, and facies development. – p. 127-173 [with the first upper Givetian ammonoids of the Meseta, 12 possibly new conodonts recorded in open nomenclature, a new Emsian *Pandorinellina* Biofacies, records of brachiopods, corals, and shark teeth].

BECKER, R. T. References. – p. 175-194.

Devonian global changes - recent advances and challenges in different domains

RACKI, G. & WIGNALL, P. (Eds. 2020 online). Devonian global changes – recent advances and challenges in different domains. – Global Planetary Change.

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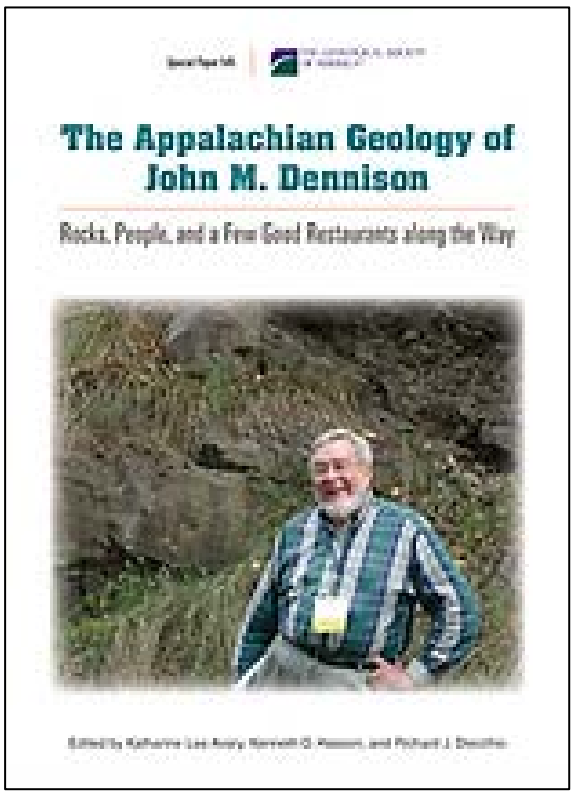

AVARY, K. L., HASSON, K. O. & DIECCHIO, R. J. (EDS., 2020). The Appalachian Geology of John M. DENNISON: Rocks, People, and a Few Good Restaurants along the Way. – Geological Society of America, Special paper, **545**: 249 pp., ISBN 978-0-8137-2545-1.

Dr. John M. DENNISON spent his career studying the Appalachians; teaching and mentoring his students and professional colleagues; publishing papers; leading field trips; and presenting ideas at regional, national, and international conferences. This volume is a collection of papers contributed by former students and colleagues to honor his memory. Topics include stratigraphy and paleontology ranging in age from Ordovician to Mississippian in Kentucky, New York, Tennessee, Virginia, and West Virgini, The stratigraphic and geologic diversity of the papers reflects DENNISON'S many interests and collaborative relationships.

Devonian content

ETTENSOHN, F. R., CLAYTON, G., LIERMAN, R. T., MASON, C. E., KRAUSE, F. F., DEBUHR, C., BRACKMAN T. B., ANDERSON, E. D., DENNIS, A. J. & PASHIN, J. C. Late Devonian lonestones, diamictites, and coeval black shales from the Appalachian Basin : Discerning relationships and implications for Late Devonian Appalachian history and glacially driven seafloor anoxia.

KIRCHGASSER, W. T. Ammonoids from the Tully Formation and Harrel Shale in Pennsylvania: Markers of sea-level highstands in the Middle to Late Devonian transition, Appalachian foreland basin, eastern North America. [Bill´s good-bye to Devonian ammonoid work]

NEWTON, C. R., NEWMAN, W. B. & BROWER, J. C. Quantitative paleoecology of marine faunas in the lower Hamilton Group (Middle Devonian, central New York) : Significance for probing models of long-term community stability.

ROSSBACH, T. J. Late Devonian fossils and position of the Frasnian-Famennian boundary in the Foreknobs Formation of Virginia and West Virginia.

VER STRAETEN, C. A., OVER, D. J. & BAIRD, G. C. Arc-to-craton: Devconian air-fall tephras in the eastern United States.

WYNN, T. C. & BLOOM, J. M. Using Fischer plots to identify third-order sequences in the Middle Devonian, mixed carbonate-siliciclastic strata of West Virginia.

Further Devonian volumes in the pipeline

HARTENFELS, S., HARTKOPF-FRÖDER, C. et al. (Eds.). Special Issue on the "Devonian and Mississippian of the Ardenno-Rhenish Massif". - Palaeobiodiversity and Palaeoenvironments [manuscripts due at the end of October].

LINNEMANN, U. (Ed.). Geology of the Central European Variscides and its Avalonian-Cadomian precursors. – Springer [with more than 30 announced/promised contributions, deadline end of October – going to be a thick volume even if not all chapters will make it].

VER STRAETEN, C. (Ed.) New monograph on the New York State Devonian Stratigraphy. - Bulletins of American Paleontology [a thick volume with many contributions by Carl BRETT, Chuck VER STRAETEN, Gordon BAIRD, Alex BARTHOLOMEW, Jay ZAMBITO, and others. It was originally hoped to be ready for this year´s SDS Meeting in Geneseo, which didn´t take place – should be ready next summer].

MEMBERSHIP NEWS

CM Gordon C. BAIRD

Most of 2019 and 2020 was devoted to writing parts of three summative chapters on Devonian chronostratigraphy as part of a multi-authored geochronological volume on the Devonian of New York and adjacent region. One chapter, co-authored with Carlton BRETT (University of Cincinnati) and Alexander BARTHOLOMEW (S.U.N.Y. New Paltz), reviews numerous unit divisions of the Givetian Hamilton Group. A second chapter, co-authored with Jay ZAMBITO (Beloit College) and Carlton BRETT, is devoted to the medial-to-Late Givetian Taghanic Stage succession and succeeding Geneseo Formation. A third Chapter, with several co-authors, synthesizes the regional stratigraphy of the Late Famennian stratigraphy and events through the states of New York, Pennsylvania, and Ohio. This volume, both honoring and updating the work of L.V. RICKARD, is being assembled by Charles VER STRAETEN, the New York State Stratigrapher at the New York State Geological Survey, to be published through the Paleontological Research Institution with anticipated publication in late 2020.

Efforts continue, in conjunction with Carlton BRETT and museum staff at the Paleontological Research Institute in Ithaca, NY, to build and organize a large, digitally curated, stratigraphic collection of Devonian-age rock samples and associated fossils that we have assembled over a 45 – year period. Over 2360 samples, mainly from New York divisional units from the Pragian Stage to the D/C boundary, had been labeled, boxed, and transported to P.R.I. as of August 2020.

Baird also conducted stratigraphic fieldwork on Late Famennian rock units (Cleveland Shale Member, Bedford Formation, and Berea Formation) in northern and central Ohio to better characterize the signatures of end-Devonian Hangenberg biocrisis events in that area. This work, leading to a collaborative AAPG guidebook article (see below) was completed in autumn 2019.

Two chapters, respectively on Devonian ammonoids and tephras, as part of the John DENNISON festschrift volume (*Geological Society of America Special Paper*, **545**) were brought to completion in early 2020 (see below).

Publications

KIRCHGASSER, W. T., **BAIRD, G. C.** & BRETT, C. E. (2020). Ammonoids from the Tully Formation and Harrell Shale in Pennsylvania: Markers of sea-level highstands in the Middle to Late Devonian transition, Appalachian Basin, eastern North America. - In: AVERY, K. L., HASSAN, K. O. & DIECCHIO, R. J. (Eds.), The Appalachian Geology of John M. DENNISON: Rocks, people, and a few good restaurants along the way. Geological Society of America Special Paper, **545**: 1-28, doi.org/10.1130/SPE545(10).

VER STRAETEN, C. A., OVER, D. J., & **BAIRD, G. C.** (2020). Arc-to-craton: Devonian airfall tephras in the eastern United States. - In: AVERY, K. L., HASSAN, K. O., & DIECCHIO, R. J. (Eds.), The Appalachian Geology of John M. DENNISON: Rocks, people, and a few good restaurants along the way, Geological Society of America Special Paper, **545**: 35-53, doi.org/10.1130/SPE545(03).

VER STRAETEN, C., BRETT, C. E., **BAIRD, G. C.**, BOYER, D., LINDEMANN, R., IVANY, L., OVER, D. J. & WITZKE, B. (2019). Shallow-water onlap model for the deposition of Devonian black shales in New York. - Geology Forum, **e495.** https://pubs.geoscienceworld.org/geology/.

BLOOD, D. R., **BAIRD, G. C.**, DANIELSEN, E. M., BRETT, C. E., HANNIBAL, J. T. & LASH, G. G. (2019). Upper Devonian paleoenvironmental, diagenetic, and tectonic enigmas in the western Appalachian Basin: New discoveries and emerging questions associated with the Frasnian-Famennian boundary and end-Devonian disturbances in central Ohio. - Field Trip Guidebook, Eastern Section, American Association of Petroleum Geologists, 48th Annual Meeting, 2019, 1-80, Columbus, Ohio.

TM R. Thomas BECKER, CM Zhor Sarah ABOUSSALAM, CM Stephan HELLING, and the Münster Group

The first half year after our last report was devoted to the first issue of a planned series of monographs on the Devonian and basal Carboniferous of the Moroccan Meseta (see Devonian publications), published under the auspice of the Hassan II Acdemy of Science and Technology of Morocco. It combines results of work in the last ca. 10 years in the Meseta, in close

cooperation with our good friend (and Moroccan CM) Ahmed EL HASSANI. We are aware that the academy journal does no rank very high internationally, but we want to make sure that our data are easily and widely available to the community of Moroccan geoscientists. And it is also a decent way to honor our long-term cooperation and the support from Moroccan science authorities over many years. A second joint issue, mostly with Sarah and Ahmed, is planned for the spring of 2021 and will cover central to more southernly Meseta regions (Benahmed region, Rehamna (Fig. 1), Jebilet, Skoura region).

Fig. 1. Devonian ridge at Foum-el-Mejez in the eastern Rehamna.

Of course, the Corona pandemy strongly affected our Devonian group at Münster strongly. We had to cancel our annual field work in Morocco and the university did not allow over-night stays outside Münster. Therefore, field work was restricted to Rhenish localities, where, however, some important discoveries were made in the frame of B.-Sc./M.Sc. studies (see below).

The only good side effect of Corona was, that it gave the time to finish important review papers. The summary of 30 Rhenish D/C boundary sections (BECKER et al. in press) has been submitted to the DCB boundary volume of Palaeo x 2, under the main editorship of Markus ARETZ. The joint and significantly expanded Devonian chapter for GTS 2020, with John MARSHALL and Anne-Christin DA SILVA as co-authors, has passed the proofs stage; originally the thick GTS 2020 books were announced for August but Corona slowed down the editing process. Our chapter benefitted tremendously from the help by Jim and Gabi OGG. The three main authors did not conduct the statistical treatments of the still too few absolute ages. Felix GRADSTEIN, Jim OGG, and Fritz AGTERBERG are to praise (or blame?) for the absolute time-scale. Currently, there are still many discrepancies between scaled absolute ages and cyclostratigraphic ages, which are summarized and illustrated. Another review paper, which is not yet complete, concerns the recognition and developments of Devonian and Lower Carboniferous events in the Central European Variscides (Ardennes-Rhenish Massif-Harz Mts.-Saxothuringian Zone-Barrandian-Sudetes-Holy Cross Mts.-Moravia). It will go into a thick volume on many aspects of the Variscides edited by Ulf LINNEMANN (Dresden).

My favorite topic, Devonian ammonoids, lagged a little bit behind. I am glad that Till took over the upper Frasnian tornoceratids, where he is making good progress with several faunas. In this context, I should emphasize the continuing good and fruitful cooperation with Jürgen BOCKWINKEL (Leverkusen). For the first paper on the fauna from Bergisch Gladbach-Sand, we are very glad to have Carlo HERD on board, who collected many of the new goniatites and who enabled access to the collections of other amateur collectors of the region. Concerning other ammonoids, there are half written manuscripts on middle Frasnian triainoceratids from the Tafilalt, upper Givetian faunas from the Rudny Altai (southern Siberia), D/C boundary goniatites of M´karig near the Moroccan/Algerian border, on a revision of *Ponticeras*, on the lower Famennian ammonoids of the Canning Basin (Till´s M.Sc. results), and on the topmost Givetian *Petteroceras* faunas of Morocco.

In autumn 2019, ZHONG Pu came over from Beijing in order to continue joint studies on Chinese Devonian ammonoids. Our cooperation focuses currently on new gonioclymeniid material from Xinjiang and on a long-neglected *Manticoceras* fauna from Hunan, brought to Münster many years ago by MA Xueping. The latter investigations fit well a new project submitted to the DFG with the main aim to revise fundamentally the upper Frasnian Gephuroceratidae of Germany, Morocco, and Australia, using modern morphometrics and statistical approaches. We hope that the application goes through this time.

The cooperation with Polish Devonian geochemical workers continued and resulted in the paper by PISARZOWSKA et al. (2020) on the Middlesex Event at Padberg, eastern Sauerland. The stratigraphic chapter by Sarah and Thomas was heavily shortened after the reviews but the

remaining part includes a very important point: the major positive excursion did not begin in the *punctata* Zone, as suggested by the past wide use of the term "*punctata* Event", it started everywhere slightly earlier, at the level of oldest *Ancyrodella nodosa* (= *gigas* M1), which does occur in the black Middlesex Shale of eastern North America. The truth always lies in the fine details. A close look at the conodont data from Nevada suggests that the Alamo Impact could well correlate with the Middlesex Event. This may be a coincidence – or not. It is planned to publish all the details (biostratigraphy, geochemistry) that did not make it into the first paper in a second joint contribution. The conodont workers should be reminded that Padberg is the type locality of several important species, which precise ranges have never been published in a bed-by-bed survey.

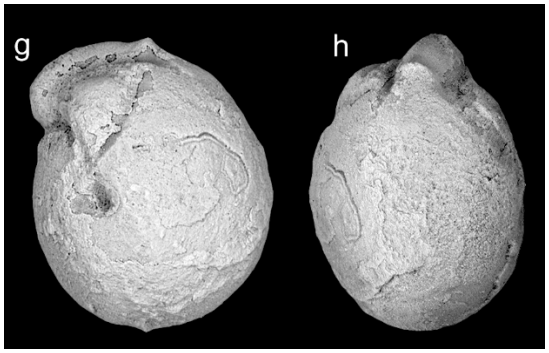

Fig. 2. The irregularly constricted and paedomorphic goniatite *Kenseyoceras rostratum* from the top-Famennian at Borkewehr.

Concerning the D/C boundary revision, a team of researchers, with Sven HARTENFELS as leading author, is currently finalizing the revision of the Borkewehr/Wocklum section. It is the type locality of the famous Wocklum Limestone and rich in top-Devonian ammonoids (Fig. 3). Since it is currently the best exposed, complete DCB locality, it is planned to become our Rhenish GSSP candidate. This will not prevent us to complete in the near future the conodont and ammonoid work at Lalla Mimouna (northern Maider, Morocco).

CM Zhor Sarah ABOUSSALAM

The first issue of our work on the Moroccan Meseta, published in the "Frontiers in Science and Engineering" international journal of the Hassan II Academy of Science and Technology, meant quite an effort. It was presented at the annual meeting of the academy in late February in Rabat. It gave an opportunity to present many new conodont faunas for the region (e.g., Fig. 4), ranging, for my part of the work, from the Lochkovian to top-Frasnian. A range of possibly new taxa was illustrated in open nomenclature; most of these require re-sampling in order to retrieve more specimens. Unfortunately, this was impossible this year. There is still so much more unpublished work to show. Therefore, I have started preparations (e.g., microfacies and conodont plates) for the 2nd Meseta issue due in spring 2021.

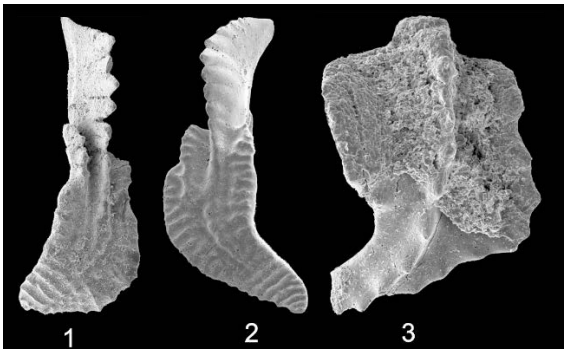

Fig. 3. Eifelian and Givetian conodonts from Immouzer-du-Kandar (Middle Atlas basement), with new records of Chinese taxa for Morocco, such as the irregularly ornamented *Linguipolygnathus qinjiaensis* (1-2) and the robust *L. oviformis* (3); ABOUSSALAM et al. (2020, fig. 17).

In the Rhenish Massif, the conodont faunas from the Padberg section were important to align the isotope and chemostratigraphy closely with biostratigraphy. We established parallel, well-correlated lower/middle Frasnian zones based on ancyrodellid and *Mesotaxis-Zieglerina-Palmatolepis* evolution. This supported the isotopic recognition of the Middlesex Event and its international correlation. Work on lower Frasnian conodont faunas from Beringhauser Tunnel (started by Kevin DUDA) is continuing. There is also a limited amount of identifications of new samples from around the Hofermühle Reef (Velbert Anticline, NW Rhenish Massif).

Based on new samples taken by Thomas in 2019, the precise conodont biostratigraphy around the Taghanic Crisis at Seheb-el-Rhassal (Tafilalt Platform) was checked – and confirmed. The section is important for the still initial search for a basal Upper Givetian GSSP since it yields both good conodonts and ammonoids. Unfortunately, condensation is locally strong – as in most good Taghanic localities. For comparison, some samples from sections in the Pyrenees (taken by Thomas at the ICOS field meeting) were identified.

Apart from the conodont work, various theses on Moroccan palaeontology topics (Givetian nautiloids, Lukas AFHÜPPE; Emsian trilobites, Konrad SEYFFERT) were co-supervised.

CM Stephan HELLING

He was mostly involved with various excavation campaigns, both of geological and archaeological nature. He is close to complete a first manuscript on Famennian trilobites excavated at Wuppertal-Üllendahl (Bergisches Land, Germany). A second forthcoming trilobite contribution, jointly with Thomas, partly based on specimens collected by Manfred SCHLÖSSER, will describe very rare, new odontopleurids from the upper Givetian/lower Frasnian of the Hofermühle and Hönne Valley Reefs. The Moroccan trilobite collections are not forgotten (see brief contribution on the Pragian assemblage of Ain-as-Seffah in the Meseta Volume).

Research assistants/Ph.D. students

Till SÖTE continued his study on the morphometry, taxonomy, palaeobiogeography and phylogeny of tornoceratids (Goniatitida) around the global Kellwasser Crisis. His joint manuscript together with Carlo HERD and Jürgen BOCKWINKEL on an undescribed intra-Kellwasser fauna from the Bergisch Gladbach-Sand area will be published in the Paläontologische Zeitschrift (PalZ). Another manuscript on intra-Kellwasser ammonoids from the classical Büdesheim region, jointly with Jürgen BOCKWINKEL, is in good progress and should be finished by the end of the year. Further steps in his Ph.D. will concentrate on other localities such as Ouidane Chebbi in the eastern Anti-Atlas, Oued Mzerreb in the western Dra-Valley of Morocco, and Martenberg in the eastern Rhenish Massif. New Frasnian material from several further locations will be kindly provided by Hartmut KAUFMANN. The current studies already prove the existence of very diverse tornoceratid ammonoid faunas after the Lower Kellwasser Event, further underlining the much more devastating impact of the Upper Kellwasser Event on ammonoids, resulting in the complete extinction of the Gephuroceratina and of most Tornoceratina as well.

In the frame of a larger Ph.D. project on upper Frasnian conodont stratigraphy and diversity in the Rhenish Massif, **Felix LÜDDECKE** progressed significantly with the new faunas from around the middle/upper Frasnian boundary at Martenberg (eastern Sauerland), one of type-sections for the Frasnian "standard zonation" of ZIEGLER & SANDBERG (1990), and key section for the correlation with the Montagne Noire zonation (KLAPPER & BECKer 1999). Apart from new data for the disputed *Pa. jamieae* Zone, the idea of the study is to document with highest precision conodont ranges across the now physically recognized *semichatovae* Transgression. This will become an important data base for the planned formal upper Frasnian substage definition. Martenberg can become a GSSP candidate.

Sören STICHLING had to pause his Ph.D. studies on the Devonian reef of the Hönne Valley region (northern Sauerland, Germany). He was appointed at the Geologischer Dienst at Krefeld, where his new position concentrated on various non-Devonian geology.

Stephan EICHHOLT has a full-time position in an environmental geology company near Münster, but, whenever times allows, he continues his study on Givetian/Frasnian reefs in the Moroccan Meseta. Therefore, he was involved with the Devonian volume of the Moroccan Academy of Sciences and co-authored the paper on Immouzer-du-Kandar south of Fes. He will also contribute to the planned second issue, with data on the Givetian reef development of the Rehamna.

Master students

Lukas AFHÜPPE finished his study of Givetian Oncoceratida and Discosorida from the Tafilalt (southern Morocco). In the end, he struggled hard because both groups have hardly been dealt with in the last decades. The reasons are multifold: the complex research history did not lead to clear taxonomic concepts, not even of higher systematic categories (e.g., the unequivocal distinction of the orders), the often poor and outdated descriptions of many genera and species, a high variability of shell form, distinction of external and internal (siphuncle) shell features, and the lack of a morphometric approach by previous authors. He will stay for some more time at the Münster institute, which will give him time to write manuscripts.

Lara HOLDERIED is finishing her M.Sc. Thesis on middle Frasnian goniatite faunas from the McIntyre and McPhee Knolls areas of the Canning Basin, Western Australia, by part-time work. She is using ontogenetic morphometry for new taxonomic definitions and comparisons with contemporaneous

European and eastern North American (e.g., Cashaqua Shale) faunas.

Fig. 4. The discorid *Cyclopoceras* from the upper Givetian at Mdoura-East, Tafilalt, Morocco, showing traces of the serial muscle scars (from AFHÜPPE 2020).

Konrad SEYFFERT finished his study on Emsian phacopids from southern Morocco, including material from localities that have not been frequented by the economic trilobite business (e.g., Hamar Laghdad, Ouidane Chebbi, western Dra Valley). He made a considerable effort to test as many quantitative shell parameters as possible in order to re-define taxa/populations by detailed morphometry. It was no surprise that the eye field proved to be especially important. He recognized new regional records, a new species, and plans to present results in two publications. He hopes to continue trilobite studies in the frame of a Ph.D. project.

Phillip HERBERS will finish soon his M.Sc. project on cluster analyses as a tool for advanced conodont biofacies distinctions in the Famennian. He used unpublished assemblages from the Montagne Noire as a starting point but the statistical processing involved many other publications with detailed species counts. As previously done by Felix LÜDDECKE (B.Sc. and M.Sc. Theses), he divided the mega-genera (e.g., *Polygnathus*, *Palmatolepis*) into morphological groups that mostly present phylogenetical lineages, which deserve genus-level distinction (e.g., *Neopolygnathus*, *Polynodosus*, different *Palmatolepis* species groups, such as *Tripodellus* = *Pa. gracilis* Gp.). Their often very different biofacies distributions strongly support taxonomic distinctions.

Lars OTTO continues his M.Sc. project on lower/middle Frasnian bactritids from the Canning Basin. He tries to improve the previously crude taxonomy within the group by morphometrics. This is essential for biogeographic comparisons with European and North American Frasnian forms. It seems that the region features new and endemic taxa.

Devonian stratigraphy and facies analysis can make an important contribution to the essential change towards renewable energy supplies. There is a big potential of Devonian and Lower Carboniferous reefs for deep geothermal energy, which is currently explored in a pilot study lead by the Geologische Dienst at Krefeld. In this context, **Max KERN** started a M.Sc. Thesis on a borehole in the Hofermühle Reef area (Velbert Anticline). Diagenesis and secondary porosities formed by late dolomitizations are key features of reef limestones.

B.Sc. Students

Kevin DUDA re-studied the upper part of the lower cliff of the Beringhauser Tunnel section in the eastern Sauerland, from where BUGGISCH & JOACHIMSKI (2006) had reported a positive carbon isotope excursion in the higher "*falsiovalis* Zone". His task was to document (with the help of Sarah) the detailed conodont stratigraphy, to study the local microfacies of proximal reef debris limestones, and to find the carbon isotope signal. We expected to find the Middlesex Event, at documented at Padberg (see above; PISARZOWSKA et al. 2020). However, this assumption proved to be wrong. A manuscript is planned, which will have to incorporate subsequent samples taken in order to add precision to conodont ages and to the isotope curve. Tomas KUMPAN declared his interest to work on the elemental geochemistry of the section.

Alexander KLEMENT investigated for his B.Sc. project a series of sections at the top of the Schlupkothen Quarry, which lies at the southeastern end of the Velbert Anticline in the NW Rhenish Massif. The quarry exploited formerly a thick Frasnian reef succession and is now filled by a lake. It gave the name to the strongly microbial Schlupkothen Facies and Member of the Wülfrath

Reef/Formation. Fortunately, the reef extinction interval is preserved at the southern rim of the quarry and safe as part of a recreation area. And the Upper Kellwasser Event and Frasnian/Famennian boundary, with highly intriguing sedimentological details, could be precisely located at a single spot in the woods. After additional samples have been processed, a paper shall be written for an international journal.

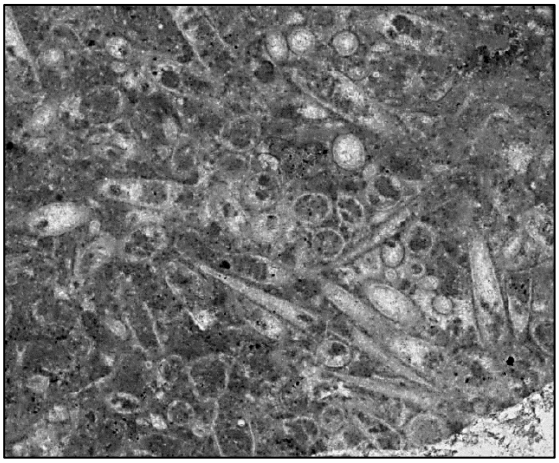

Fig. 5. Upper Kellwasser Event developed as dark-grey homoctenid packstone at Schlupkothen (SE Velbert Anticline, NW Rhenish Massif).

Marie GOTTLOB wanted to do trilobites. So, under the joint supervision by Stephan HELLING and RTB, she finished a study on an Eifelian faunule collected in the isolated Devonian olistolite SW of the Bou Tisdafine between Tinerhir and Tinejdad, southern Morocco, right at the southern Variscan Front. The outstanding results, including one new phacopid species, shall be published.

Mieke Maria LÖW studied as a B.Sc. project the microfaunas (agglutinating foraminiferes, heteractinid sponge spicules, holothurian sclerites, other echinoderm remains, scolecodonts etc.) found during conodont sample processing by Sören in the initial reef phase of the Hönne Valley Reef complex at Binolen. The quantitative analysis of the microfaunas will complement Sören´s microfacies analysis. They are significant fluctuations of microfossil assemblages, a pattern that previously has not been documented for German Devonian reef settings.

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Regular Publications

BECKER, R. T., EL HASSANI, A. & ABOUSSALAM, Z. S. (Eds., 2020). Devonian to Lower Carboniferous stratigraphy and facies of the Western Moroccan Meseta: Implications for palaeogeography and structural interpretation. – Frontiers in Science and Engineering, **10** (1): 1-194. [open access at: http://www.academie.hassan2.sciences.ma/pdf/jounal_scientifique_10.pdf; for the individual chapters see Devonian Publications]

BECKER, R. T., HARTENFELS, S. & KAISER, S. I. (2020 in press). Review of Devonian-Carboniferous Boundary sections in the Rhenish Slate Mountains (Germany). – Palaeobiodiversity and Palaeoenvironments.

BECKER, R. T., MARSHALL, J. E. A., DA SILVA, A.-C., AGTERBERG, F. P., GRADSTEIN, F. & OGG, J. G. (2020 in press). The Devonian Period. – In GRADSTEIN, F. (Ed.), Geologic Time Scale 2020, Vol. **2**: 78 pp., doi.org/1016/B978-0-444-63798-7.00022-7.

PISARZOWSKA, A., BECKER, R.T., ABOUSSALAM, Z.S., SZCZERBA, M., SOBIEN, K., KREMER, B., OWOCKI, K. & RACKI, G. (2020). Middlesex/*punctata* Event in the Rhenish Basin (Padberg section, Sauerland, Germany). Geochemical clues to the early-middle Frasnian perturbation of global carbon cycle. – Gondwana Research, **191**: 103211, doi.org/10.1016/j.gloplacha.2020.103211 [open access].

SÖTE, T., BECKER, R. T., HERD, K. J. & BOCKWINKEL, J. (2020 in press). Upper Frasnian Tornoceratidae (Ammonoidea) from the Sand Formation (Bergisch Gladbach-Paffrath Syncline, Rhenish Massif). – Paläontologische Zeitschrift.

Popular Science contributions

HELLING, S. & SCHREIBER, G. (2020). Wachstumsstadien von Trilobiten aus oberdevonischen Schichten von Wuppertal-Uellendahl. - Archäologie im Rheinland, for **2019**: 39-41.

BECKER, R. T., LÜDDECKE, F., BECKER, S., HARTKOPF-FRÖDER, C., SCHRIJVER, D. & WEBER, H. M. (2020). Ein spektakulärer Goniatitenhorizont im Oberdevon des Steimbruchs Prangenhaus. – Archäologie im Rheinland, for **2019**: 41-44.

SÖTE, T., BECKER, R.T., HERD, K.J. & BOCKWINKEL, J. (2020). Die Ammonoideen von Bergisch Gladbach-Sand – Diversität an der

globalen Kellwasser-Krise. - Archäologie im Rheinland, for **2019**: 44-46.

B.Sc./M.Sc. Thesis

AFHÜPPE, L. (2020). Brevikone Nautiloideen aus dem Givetium (Mitteldevon) von Süd-Marokko. – M.Sc. Thesis, WWU, 86 pp. + 10 pls. + 21 tabs.

DUDA, K. (2020). Der Grenzbereich Unter-/Mittel-Frasnium am Beringhauser Tunnel (Ostsauerland) – Biostratigraphie, Mikrofazies, Isotopengeochemie. – B.Sc. Thesis, WWU, 43 pp.

GOTTLOB, M. (2020). Trilobiten aus dem unteren Mitteldevon eines Olistholithes westlich von Tinejdad (Süd-Marokko) – Taxonomie und Paläobiogeographie. – B.Sc. Thesis, WWU, 96 pp.

KLEMENT, A. M. (2020). Das Ende der Karbonatplattform bei Schlupkothen (Wülfrather Riffkomplex) – Conodontenstratigraphie und Mikrofazies. – B.Sc. Thesis, WWU, 96 pp.

LÖW, M. M. (2020). Mikrofaunen aus dem initialen Riffstadium von Binolen im Hönnetal (Sauerland, Givetium). – B.Sc. Thesis, WWU.

SEYFFERT, K. (2020). Emsian phacopids from the Anti-Atlas (South Morocco) – Ontogenetic morphometry, taxonomy and biostratigraphy. – M.Sc. Thesis, WWU, 117 pp.

CM Alain BLIECK

I had nearly no Devonian activity in the last months, except in participating in a thick report on the geology of the Ardenne massif (France-Belgium). This is part of a series of activities in relation with the 150th anniversary of the Société Géologique du Nord that was founded in 1870. Conferences, field trips and a plenary meeting will follow along end of 2020 until spring 2021. See the following Web addresses for information and programme:

https://sgn.univ-lille.fr,

https://www.facebook.com/Société-Géologique-du-Nord-139747266828005/,

https://www.s-pass.org/fr/portail/171/societe-geologique-du-nord-sgn.html.

I remain interested in Devonian agnathans, in particular Heterostracans (Vertebrata: Pteraspidomorphi) on which I work with Prof. David K. ELLIOTT (Northern Arizona University, KS, USA).

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GOEMAERE, E., BLIECK, A., COEN-AUBERT, M., CUVELIER, J., DEJONGHE, L., DE WEVER, P., FRONTEAU, G., HALLET, V., MOTTEQUIN, B. & QUINIF, Y. 2020. Le géopatrimoine du Massif ardennais [Geological heritage of the Ardenne massif]. - In: MEILLIEZ, F. & GOEMAERE, E. (Coordinators), Le Massif ardennais, un jeune massif ancien. Géochronique, **154**: 56-60.

CM Robert B. BLODGETT

My research interest are spread afar these day (in part to economic survival), but I currently have two Devonian articles going (one on Lower Devonian inarticulate brachiopods; the other on Emsian brachiopods from the central Alaska Range).

HOLMER, L. E., BLODGETT, R. B., LIANG, Y. & ZHANG Z. (2020). The Early Devonian (Emsian) acrotretid microbrachiopod *Opsiconidion minor* POPOV, 1981, from the Alaska/Yukon Territory border and Novaya Zemlya. – Estonian Journal of Earth Sciences, 69 (3): 143-153.

BARANOV, V. V., LI, Q. & BLODGETT, R. B. (2020 online). Givetian Stringocephalid brachiopods from eastern Yunann of southwest China with notes on global distribution of the family Stringocephalidae. – Palaeoworld, doi.org/10.1016/j.palwor.2020.03.005.

TM Carlton E. BRETT

Although field study of Devonian rocks 2020 was minimal, I worked extensively on final revisions of large chapters on the Middle Devonian for a *Bulletins of American Paleontology* volume New York State Devonian Stratigraphy, edited by Charles VER STRAETEN, New York State

Geological Survey. Gordon BAIRD (SUNY College Fredonia), Alex BARTHOLOMEW (SUNY New Paltz), Charles VER STRAETEN, Jay ZAMBITO (Beloit College) and I have prepared three extensive manuscripts stratigraphic terminology, re-description of units and facies analysis of the Middle Devonian of New York and adjacent regions. At present, two manuscripts are in final revision, one on the upper Eifelian to Givetian Hamilton Group (BRETT et al., in press, and a second on the mid-upper Givetian Taghanic (Tully-Geneseo) interval (BAIRD et al., in press). The full volume will be published electronically (print on demand). Our intent remains to have the text and charts published in time for the upcoming SDS Devonian meeting in New York State.

Gordon BAIRD and I are continuing to work with the Paleontological Research Institution (PRI) to assemble and fully document our combined collections made over the past four decades, from the Devonian of New York State and elsewhere. As part of this initiative, a wing of a building at PRI is being renovated, in part, to accommodate the several ton stratigraphic collection. 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.

Gordon BAIRD and I finalized a co-authored manuscript by the late William KIRCHGASSER (formerly SUNY Potsdam: long time TM of the SDS). The paper, on Middle and Upper Devonian goniatites in central Pennsylvania, was just published as part of a *Geological Society of America Special Paper* on Devonian studies in honor of the late John DENNISON. This project also involved curation of a suite of goniatite and conodont specimens collected by Bill KIRCHGASSER; these are now reposited at the US National Museum.

I also continued to work collaboratively with researchers on Gondwana Devonian paleontology and taphonomy with Luiza PONCIANO (CM, SDS) Universidade Federal do Estado do Rio de Janeiro, Brazil. Finally, research continued with Dr. Damien PAS (Utrecht University) and Anne-Christine DA SILVA (Université de Liège) and on the Devonian cyclostratigraphy of New York State. This research aims a well-tuned geochronology for the upper Emsian and Eifelian stages. A paper recently published by PAS et al. (2020) utilizes cyclicity in the relatively complete Eifelian succession in west central New York to calculate a duration of 5.6 +/- 1.9 m.y. We continue work on the Lower Devonian (Emsian) Schoharie Formation, which shows distinct facies osillations to short, intermediate, and long term cyclicity mediated by climatic change and/or eustatic sea level oscillations.

Publications

BLOOD, D. R., BAIRD, G. C., DANIELSEN, E. M**., BRETT, C. E**., HANNIBAL, J. T. & LASH, G. G. (2019). Upper Devonian paleoenvironmental, diagenetic, and tectonic enigmas in the western Appalachian Basin: New discoveries and emerging questions associated with the Frasnian-Famennian boundary and end-Devonian disturbances in central Ohio. - Field Trip Guidebook, Eastern Section, American Association of Petroleum Geologists, 48th Annual Meeting, 2019, 1-80; Columbus, Ohio.

KIRCHGASSER, W. T., BAIRD, G. C. & **BRETT, C. E.** (2020). Ammonoids from the Tully Formation and Harrell Shale in Pennsylvania: Markers of sea-level highstands in the Middle to Late Devonian transition, Appalachian Basin, eastern North America. - In: AVERY, K. L., HASSAN, K. O. & DIECCHIO, R. J. (Eds.), The Appalachian Geology of John M. DENNISON: Rocks, people, and a few good restaurants along the way. Geological Society of America Special Paper **545**: 1-28, doi.org/10.1130/SPE545(10).

PAS, D., DASILVA, A.-C., OVER, D. J., **BRETT, C. E.**, BRANDT, L., OVER, J. D., HILGEN, F. J. & DEKKERS, M. J. (2020). Cyclostratigraphic calibration of the Eifelian Stage (Middle Devonian, Appalachian Basin, Western New York, USA). – GSA Bulletin, 10 pp., doi.org/10.1130/B35589.1.

VER STRAETEN, V., **BRETT, C. E.,** Baird, G.C., BOYER, D., LINDEMANN, R., IVANY, L., OVER, D.J., and WITZKE, B. (2019). Shallow-water onlap model for the deposition of Devonian black shales in New York. - Geology Forum, **e495**. https://pubs.geoscienceworld.org/geology/.

TM Rainer BROCKE, Germany

The year 2019 was still affected by settling down in the new facilities - now close to the Senckenberg Museum and the reorganisation of our palaeontological and geological collections and

laboratories. Thus, time for science and field work was also quite limited in this year.

Our activities in the Eifel area and the Hunsrück are going on. One contribution on vendobionts was presented in Munich. A further paper of results from our Turkish–German cooperation projects was published.

Publications

ÖZKAN, R., NA**9**ZIK, A., MUNNECKE, A., SAYDAM-DEMIRAY, D. G., SCHINDLER, E., AYDIN ÖZBEK, T., ŞEKER ZOR, E., YILMAZ, I., BROCKE, R., SANCAY, R. H., WILDE, V. & YALÇIN, M. N. (2019). Givetian/Frasnian (Middle/Upper Devonian) transition in the Eastern Taurides, Turkey. – Turkish Journal of Earth Sciences, **28** (2): 207-231, doi: 10.3906/yer-1804-20

SCHINDLER, E., BROCKE, R., WEHRMANN, A. & WILDE, V. (2019. A vendobiont from the Lower Devonian of Germany? – Paleo & Life, Abstracts of the 90th Annual Meeting of the Paläontologische Gesellschaft, Munich 2019: 132.

CM Carole BURROW

I am still working on the Early and Middle Devonian gnathostomes of Scotland and Spitsbergen with Mike NEWMAN and Jan DEN BLAAUWEN. Many of the acanthodian species described have also been recorded from the Baltic. She is also collaborating with John Maisey and colleagues on investigations into the structure of the hard tissues of early sharks. A manuscript is in preparation with Sue TURNER on microvertebrate assemblages from the ?Early Devonian of the Northern Territory, however this work is dependent on Sue's re-evaluation of all the Australian late Early-early Middle Devonian thelodont taxa. Carole is also undertaking further work on the Cravens Peak Beds fauna from a small limestone outcrop in the Georgina Basin of western Queensland – the only such deposit anywhere in the Devonian of central Australia.

Publications

BURROW, C. J., DEN BLAAUWEN, J. & NEWMAN, M. (2020). A redescription of the three longest known species of the acanthodian *Cheiracanthus* from the Middle Devonian of Scotland. - Palaeontologia Electronica, **23** (1): a15, 11-43, doi.org/10.26879/1035.

BURROW, C. J., NEWMAN, M. J. & DEN BLAAUWEN, J. L. (2020). First evidence of a functional spiracle in stem chondrichthyan acanthodians, with the oldest known elastic cartilage. - Journal of Anatomy, **236** (6): 1154-1159, doi:10.1111/joa.13170.

BURROW, C. J., NEWMAN, M. J. & DEN BLAAUWEN, J. L. (2020). Cheiracanthid acanthodians from the lower fossil fish bearing horizons (Eifelian, Middle Devonian) of the Orcadian Basin, Scotland. - Scottish Journal of Geology, doi:10.1144/sjg2020-006.

MAISEY, J. G., DENTON, J. S. S., BURROW, C. J. & PRADEL, A. (2020). Architectural and ultrastructural features of tessellated calcified cartilage in modern and extinct chondrichthyan fishes. - Journal of Fish Biology, doi:10.1111/jfb.14376.

NEWMAN, M. J., BURROW, C. J. & DEN BLAAUWEN, J. L. (2020). A new species of ischnacanthiform acanthodian from the Givetian of Mimerdalen, Svalbard. - Norwegian Journal of Geology, **99** (4): 619-631, doi.org/10.17850/njg99-4-5.

NEWMAN, M. J., DEN BLAAUWEN, J., BURROW, C. J. & JONES, R. (2020 in press). Earliest vertebrate embryos in the fossil record (Middle Devonian, Givetian). – Palaeontology, doi:10.1111/pala.12511.

TM Carlo CORRADINI

My research is mainly devoted to conodont biostratigraphy from the Silurian to Lower Carboniferous in several regions, specially focusing on the Silurian/Devonian and Devonian/Carboniferous boundaries. The latter is mainly related with the International Task Group on the redefinition of the Devonian/Carboniferous Boundary (led by M. ARETZ, Toulouse). Some manuscripts on the D/C boundary in various areas intended for the thematic volume to be published in *Palaeobiodiversity and Palaeoenvironments* are already available online.

The Carnic Alps represents my main research area. Geology and stratigraphy of several sectors are investigated (together with several colleagues). Beside a review of the Devonian/Carboniferous sections (SPALLETTA et al.), a paper on conodont distribution across the Silurian/Devonian boundary (CORRADINI et al.), and one on the classical, strongly tectonized Valentintörl section (CORRIGA

et al.) were published, as well as a new geological map of the central sector of the Carnic Alps (PONDRELLI et al.), updated according to the recent lithostratigraphical scheme.

Beside the Carnic Alps, I'm involved with research on other regions, together with several colleagues: in the Montagne Noire (France), research deals with conodonts, stratigraphy and facies in the Famennian and lowermost Tournaisian (with C. GIRARD, R. FEIST and others); studies on conodonts from some sections in the Ardennes are in progress (with J. DENAYER and E. POTY); conodonts from selected intervals in Poland and Uzbekistan are studied with a Polish team (K. NARKIEWICZ and others).

Extra-European Devonian research deals with conodont stratigraphy of the Silurian and lowermost Devonian of the Precordillera, Argentina (with M.-J. GOMEZ, A. MESTRE and S. HEREDIA);

Taxonomic studies on Early (with Maria G. CORRIGA) and Late Devonian (with C. GIRARD, L. SOUQUET and others) conodonts are in progress. A paper on *Ancyrodelloides carlsi* and one on a new species of unornamented *Siphonodella* were published.

Publications

CORRIGA, M. G. & CORRADINI, C. (2019). Ontogeny of *Ancyrodelloides carlsi* (Boersma) and comments on its generic attribution (Conodonta, Lower Devonian). - Geobios, **57**: 25-32, doi: 10.1016/j.geobios.2019.10.002.

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SPALLETTA, C., CORRADINI, C., FEIST, R., KORN, D., KUMPAN, T., PERRI, M. C., PONDRELLI, M. & VENTURINI, C. (2020). The Devonian/Carboniferous Boundary in the Carnic Alps (Austria and Italy). - Palaeobiodiversity and Palaeoenvironments: 19 pp., doi: 10.1007/s12549-019-00413-3.

CORRADINI, C., MOSSONI, A., CORRIGA, M. G. & SPALLETTA, C. (2020). The Devonian/Carboniferous Boundary in Sardinia (Italy). - Palaeobiodiversity and Palaeoenvironments: 8 pp., doi: 10.1007/s12549-019-00411-5.

PONDRELLI, M., CORRADINI, C., SPALLETTA, C., SUTTNER, T. J., SIMONETTO, L., PERRI, M. C., CORRIGA, M. G., VENTURINI, C. & SCHÖNLAUB, H. P. (2020). Geological map and stratigraphic evolution of the central sector of the Carnic Alps (Austria-Italy). - Italian Journal of Geosciences, 16 pp., doi: 10.3301/IJG.2020.

SOUQUET, L., CORRADINI, C. & GIRARD, C. (2020). *Siphonodella leiosa* (Conodonta), a new unornamented species from the Tournaisian (lower Carboniferous) of Puech de la Suque (Montagne Noire, France). - Geobios, 6 pp., doi: 10.1016/j.geobios.2020.06.004.

SOUQUET, L., CORRADINI, C. & GIRARD, C. (2020). 3D models related to the publication: *Siphonodella leiosa* (Conodonta), a new unornamented species from the Tournaisian (lower Carboniferous) of Puech de la Suque (Montagne Noire, France). - MorphoMuseuM, **6** (3), e115, doi:10.18563/journal.m3.115.

CORRIGA, M. G., CORRADINI, C., PONDRELLI, M., SCHÖNLAUB, H. P., NOZZI, L., TODESCO, R. & FERRETTI, A. (2020). Uppermost Ordovician to lowermost Devonian conodonts from the Valentintörl section and comments on the post Hirnantian hiatus in the Carnic Alps. - Newsletters on Stratigraphy, **54**: 25 pp. doi:10.1127/nos/2020/0614.

CM Maria G. CORRIGA

My research is mainly devoted to Silurian and Devonian conodonts and biostratigraphy in several regions (mainly the Carnic Alps and Sardinia). In the Carnic Alps I'm studying several classic and new sections of Silurian and Early Devonian age, mainly in the central sector of the chain.

A paper on the classical, strongly tectonized, Valentintörl section, including a taxonomical part (CORRIGA et al.), and one on conodont distribution across the Silurian/Devonian boundary (CORRADINI et al.) were published. A new geological map of the central sector of the Carnic Alps according to the recent lithostratigraphical scheme with discussion

on the Devonian units is also realised online (PONDRELLI et al.).

In Sardinia I'm revising the conodont fauna of the classical Mason Porcus section.

My research also deals with Silurian and Devonian conodont taxonomy. The reconstruction of the conodont apparatus of *Ozarkodina eladioi* has been published (CORRIGA & CORRADINI, 2019), as well as a paper on the ontogeny of *Ancyrodelloides carlsi*. Other taxonomic studies on Lower Devonian ozarkodinids are in progress (with Carlo CORRADINI).

Publications

CORRIGA M. G. & CORRADINI C. (2019). The conodont apparatus of *Zieglerodina eladioi* (Valenzuela Rios, 1994). - Bollettino della Società Paleontologica Italiana, **58**: 181-185, doi:10.4435/BSPI.2019.14.

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CORRADINI, C., CORRIGA, M. G., PONDRELLI, M. & SUTTNER, T. J. (2020). Conodonts across the Silurian/Devonian boundary in the Carnic Alps (Austria and Italy). - Palaeogeography, Palaeoclimatology, Palaeoecology, **549**, 109097. doi: 10.1016/j.palaeo.2019.02.023.

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CORRIGA, M. G., CORRADINI, C., PONDRELLI, M., SCHÖNLAUB, H. P., NOZZI, L., TODESCO, R. & FERRETTI, A. (2020). Uppermost Ordovician to lowermost Devonian conodonts from the Valentintörl section and comments on the post Hirnantian hiatus in the Carnic Alps. - Newsletters on Stratigraphy, **54**: 25 pp. doi:10.1127/nos/2020/0614.

TM Anne-Christine DA SILVA

This specific covid19 year didn't allowed any of the planned field trip and didn't allow participation to any live meeting. Our 2019 activities in the framework of IGCP-652 project "Reading time in Paleozoic sedimentary rocks" were evaluated positively, and we thus continue to receive financial support from UNESCO and IUGS. However, because of the pandemic, we were granted the possibility to pause our activities in 2020, resume the project in 2021, and extend IGCP-652, so to keep the project over five funded years. The annual IGCP-652 meeting in conjunction with the SDS meeting planned in New York State, Geneseo in August 2020 has been postponed to 2021 or 2022.

I participated in different publications in relation to the Devonian:

DA SILVA et al. (2019a) focused on small scale cycles (~10 cm) in a Czech Republic Pragian to Emsian record. A previously published astrochronology was used to transform the studied series from the stratigraphic into the time domain. Spectral analysis of the time-calibrated log-transformed Ti records reveal obliquity and precession cycles, confirming the applied astrochronology. Additional spectral peaks with sub-orbital periods of 2.3–2.7, 6–8, and 10–12 k.y. appear in both records. We interpret these periodic components as combination tones of Milankovitch cycles, and related to the Hallstatt cycle. These new observations strengthen the case for an external origin of millennial-scale features.

This paper has led to some debate on the origin of the lithological cycles recorded in the studied Pragian-Emsian record (MATYS GRYGAR 2019; SMITH 2019, DA SILVA et al. 2019b).

PAS et al. (2020) focused on a million year Givetian sequence from the southern margin of the Ardennes carbonate platform (France). Sedimentological analyses revealed a complex platform evolution displaying a variety of shallow- and off-reef paleoenvironmental rocks, which ultimately allowed us to improve the sedimentological model of this area and to constrain the main sea-level fluctuations within the southern margin of the Ardennes platform. The paper also proposes a comparison of the magnetic

susceptibility curve of this succession with previously published time-equivalent records in Belgium and Germany.

DA SILVA et al. (2020) focused on the Frasnian-Famennian boundary and on the Lower and Upper Kellwasser, through high-resolution magnetic susceptibility, X-ray fluorescence elemental geochemistry and carbon isotope datasets obtained from the well-known Steinbruch Schmidt F–F boundary section (Germany). Cyclostratigraphic interpretation indicates deposition of the black argillaceous Lower and Upper Kellwasser horizons over ~ 90 and ~ 110 kyr, respectively; approximately equivalent to the duration of one short eccentricity cycle. The new floating chronology established for the Steinbruch Schmidt section is anchored in numerical time by means of a radio-isotopic date, obtained from a bentonite layer interbedded between the two Kellwasser horizons (372.36 ± 0.053 Ma, PERCIVAL et al. 2018). After anchoring, this time scale gives a high-precision age of 371.870 ± 0.108 Ma for the F–F boundary.

PAS et al. (in press) proposes a high-resolution geochemical data set collected in the early to late Eifelian outer-ramp and deep-shelf deposits of the Seneca section (Appalachian Basin, Western New York, USA). To estimate the duration of the Seneca section sampled, we applied multiple spectral techniques such as harmonic analysis, the multitaper, and evolutionary spectral analysis, and tuning on different detrital proxy elements. Using the approximate position of the Emsian–Eifelian and Eifelian–Givetian boundaries, constrained within <1 m, the proposed estimation of the total duration of the Eifelian age is ∼5 m.y. Interpolated from the high-resolution U-Pb radiometric age available for the Tioga F Bentonite, the numerical ages of the Emsian–Eifelian and the Eifelian–Givetian were respectively recalibrated at 393.39 Ma and 388.24 Ma.

FERGUSSON et al. (in press) worked on the Frasnian reef complexes along the northern margin of the Canning Basin, in north-western Australia. The Frasnian Hull platform developed on an active tilted fault-block, and reveal significant lateral and vertical facies variations superimposed on prominent metre-scale cyclicity. This study uses numerical analyses of facies and magnetic susceptibility data from three measured sections along the Hull platform to test whether a tectonic signal can be distinguished from eustatic and other signals, through geostatistical analysis of facies variations, power and wavelet spectral analyses and Markov analysis. The results indicate a complex set of controls on deposition on the Hull platform, with orbital record embedded with local tectonic effects underlying eustatic signals and autogenic processes adding a localized stochastic response.

Publications

DA SILVA, A.-C., DEKKERS, M. J., DE VLEESCHOUWER, D., HLADIL, J., CHADIMOVA, L., SLAVÍK, L. & HILGEN, F. J. (2019). Millennial-scale climate changes manifest Milankovitch combination tones and Hallstatt solar cycles in the Devonian greenhouse world. - Geology, **47** (1): 19-22.

DA SILVA, A.-C., DEKKERS, M.J., DE VLEESCHOUWER, D., HLADIL, J., CHADIMOVA, L., SLAVÍK, L. & HILGEN, F. J. (2019). Millennial-scale climate changes manifest Milankovitch combination tones and Hallstatt solar cycles in the Devonian greenhouse world: REPLY. - Geology, **47** (10): e489-490.

DA SILVA, A.-C., SINNESAEL, M., CLAEYS, P., DAVIES, J. H. F. L., DE WINTER, N. J., PERCIVAL, L., SCHALTEGGER, U. & DE VLEESCHOUWER, D. (2020). Anchoring the Late Devonian mass extinction in absolute time by integrating climatic controls and radio-isotopic dating. - Scientific Reports, **10**: 12940, https://doi.org/10.1038/s41598-020-69097-6

FERGUSSON, I. J., DA SILVA, A.-C., CHOW, N. & GEORGE, A. D. (2020 in press). Interplay of eustatic, tectonic and autogenic controls on a Late Devonian carbonate platform, northern Canning Basin, Australia. - Basin Research, doi: 10.1111/bre.12468.

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MATYS GRYGAR, T. (2019). Millennial-scale climate changes manifest Milankovitch combination tones and Hallstatt solar cycles in the Devonian greenhouse world: Comment. - Geology, **47**, e487.

SMITH, D. G. (2019). Millennial-scale climate changes manifest Milankovitch combination tones and Hallstatt solar cycles in the Devonian greenhouse world: Comment. - Geology, **47**, e488.

CM David DE VLEESCHOUWER

Our 2019 activities in the framework of the IGCP-652 project "Reading time in Paleozoic sedimentary rocks" were evaluated positively, and we thus continue to receive financial support from UNESCO and IUGS. However, because of the pandemic, we were granted the possibility to pause our activities in 2020, resume the project in 2021, and extend IGCP-652 into 2022 so to keep the project over 5 funded years. We gratefully accepted this option, and we would like to explicitly thank UNESCO and IUGS for their flexibility. The annual IGCP-652 meeting in conjunction with the SDS meeting planned in New York State, Geneseo in August 2020 has been postponed to 2021.

I contributed to three publications with a Devonian aspect.

The Cyclostratigraphy Intercomparison Project (SINNESAEL et al., 2019) is a community effort that assessed the robustness of cyclostratigraphic methods, using an experimental design of three artificial cyclostratigraphic case studies with known input parameters. Relevant for this community is Case 3, which represents a synthetic Late Devonian proxy record with a low signal-to-noise ratio in the absence of a specific astronomical target curve (i.e. an astronomical solution) for the Paleozoic. Each case was analyzed by a test group of 17-20 participants, with varying experience levels, methodological preferences and dedicated analysis time. The main conclusion of this experiment is that cyclostratigraphy is a powerful tool for deciphering time in sedimentary successions and, importantly, that cyclostratigraphy is a trainable skill.

DA SILVA et al. (2019a) focused on small scale cycles (~10 cm) in a Czech Republic Pragian to Emsian record. These sedimentary rhythms were interpreted to be of sub-orbital (10^3-year) time-scale, and we formulated a hypothesis that ascribes these cycles to Milankovitch combination tones and Hallstatt solar cycles. These interpretations instigated some debate on the exact origin of the observed Pragian and Emsian lithological cycles, published in the form of a comment-and-reply (MATYS GRYGAR 2019; SMITH 2019; DA SILVA et al. 2019b).

DA SILVA et al. (2020) presents new data from the well-known Steinbruch Schmidt Frasnian–Famennian boundary section (Kellerwald, Germany). We constructed a floating astronomical timescale that was subsequently anchored in numerical time by means of a recent U-Pb zircon age for the bentonite layer that is interbedded between the Lower and the Upper Kellwasser horizons (372.36 ± 0.053 Ma, PERCIVAL et al. 2018). At Steinbruch Schmidt, we thus managed to directly combine and integrate cyclostratigraphic and radio-isotopic dating techniques in a single section.

Publications

DA SILVA, A. C., SINNESAEL, M. CLAEYS, P., DAVIES, J. H. F., DE WINTER, N. J., PERCIVAL, L. M. E., SCHALTEGGER, U. & DE VLEESCHOUWER, D. (2020). Anchoring the Late Devonian mass extinction in absolute time by integrating climatic controls and radio-isotopic dating. - Scientific Reports, **10**:12940.

DA SILVA, A.-C., DEKKERS, M. J., DE VLEESCHOUWER, D., HLADIL, J., CHADIMOVA, L., SLAVÍK, L. & HILGEN, F. J. (2019). Millennial-scale climate changes manifest Milankovitch combination tones and Hallstatt solar cycles in the Devonian greenhouse world. - Geology, **47** (1): 19-22.

DA SILVA, A.-C., DEKKERS, M.J., DE VLEESCHOUWER, D., HLADIL, J., CHADIMOVA, L., SLAVÍK, L. & HILGEN, F. J. (2019). Millennial-scale climate changes manifest Milankovitch combination tones and Hallstatt solar cycles in the Devonian greenhouse world: REPLY. - Geology, **47** (10): e489-490.

PERCIVAL, L. M. E., DAVIES, J. H. F. L., SCHALTEGGER, U., DE VLEESCHOUWER, D., DA SILVA, A.-C. & FÖLLMI, K. B. (2018). Precisely dating the Frasnian–Famennian boundary:

implications for the cause of the Late Devonian mass extinction. - Scientific Report, **8**: 9598.

SINNESAEL, M., DE VLEESCHOUWER, D., ZEEDEN, C. & CIP PARTICIPANTS (2019). The Cyclostratigraphy Intercomparison Project (CIP): consistency, merits and pitfalls. – Earth-Science Reviews, **199**: 102965.

CM James R. EBERT

Lithostratigraphic, biostratigraphic (chitinozoans), and sequence stratigraphic research in the Helderberg Group (Přídolí to Lochkovian) of New York State is ongoing. My current focus is on building and correlation of synthetic gamma ray logs from outcrops to test lithostratigraphic relationships. This project has been aided by undergraduate students in my Sedimentary Geology class. In the fall of 2019, the class measured stratigraphic sections and collected gamma ray data from outcrops of the New Scotland Formation at Cherry Valley and I-88 (Schoharie area), New York. The results of this class project were to be presented also at the 2020 regional meeting of the Geological Society of America, but the meeting was canceled owing to the pandemic. However, the abstract is available on the GSA website (listed below in recent publications).

The gamma ray logs revealed that Judds Falls Bentonite (a.k.a. "Kalkberg" bentonite; a.k.a. H1-1 of HUSSON et al. 2015) at Cherry Valley produced the highest API peak in the New Scotland Formation but this peak does not correlate with the highest peak at I-88, which occurs in a tephra bed ~ 8 m above the contact with the Kalkberg Formation (H2-4 of HUSSON et al. 2015). The shapes of the gamma ray curves indicate that the Judds Falls Bentonite correlates with a tephra bed approximately 2 m above the Kalkberg - New Scotland contact (H2-2 of HUSSON et al. 2015).

The gamma ray profile at Schoharie revealed small scale (2-8 m) cycles within the New Scotland that are not obvious on the outcrop. These cycles are characterized by abrupt shifts to high radioactivity at the base followed by an up section decline in radioactivity. These cycles likely reflect rapid, short-lived onsets of dysoxia followed by gradual increases in oxygenation. Preliminary data on vertical variations in macrofauna lend further support to the interpretation that these oxygenation cycles represent small scale (5^{th} or 6^{th} order) eustatic cycles. A student from the class is continuing this work as a senior thesis which should be completed in the fall of 2020.

Publications

EBERT, J. R. & MATTESON, D. K. (2019). The Lac au Renard Tephra Cluster: a record of Lochkovian (Lower Devonian) volcanism in the Indian Point Formation, Gaspe Peninsula, Quebec, Canada. - Atlantic Geology, **55**: 361–378, doi:10.4138/atlgeol.2019.012.

EBERT, J. R. & MATTESON, D. K. (2020 in press). Litho-, Bio-, and Sequence Stratigraphy of the Helderberg Group in the Appalachian Standard Succession (New York). - Submitted for eventual publication in revised Devonian stratigraphic chart of New York State to be published by the Paleontological Research Institution.

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, 52 (2), doi: 10.1130/abs/2020SE-344617.

CM Raimund FEIST

Current research is devoted on evolutionary trends towards eye-reduction in Late Givetian through Late Devonian trilobites and their bearing on interpretation of outer-shelf environmental changes through time. Indeed, sighted biotas from bottom-level habitats such as trilobites are sensitive to the degree of light penetration, and normally sighted populations indicate shallow habitats within the photic zone. Changes of bathymetric conditions are reflected by morphological changes in the visual complex (eye and facial sutures). In particular, adaptation to eustatic deepening may lead to the regression of the visual surface and even to eye-loss at the terminal stage of development. Consequently, these evolutionary trends constitute an independent mean to control the timing and intensity of sea-level falls. We have recently used this method when comparing bathymetric conditions prior to and following the Hangenberg Event both in the Montagne Noire and in the Carnic Alps.

I have conducted major revisions of off-shore Frasnian and early Famennian phacopid lineages aiming to establish a phacopid-based biozonation in this realm. Knowledge on Frasnian trilobites remained rather poor to a degree that this period was considered a crisis in biodiversity. In recent years, I have gathered a fair amount of new phacopid taxa mainly from the Montagne Noire that are currently subjected to taxonomic and conodont-based biostratigraphic investigations in collaboration with G. KLAPPER. Taking into account hitherto known taxa, nine genera (four new) with 30 species (17 new) are currently present in the Frasnian bringing into question previous thoughts.

Publications

FEIST, R. & WEYER, D. (2018). The proetid trilobite *Perliproetus*, a marker of the late Famennian in Central Europe and North Africa. – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, **287** (2): 195-206.

FEIST, R. & BELKA, Z. (2018). Late Emsian trilobite communities from the Kess-Kess mounds, Hamar Laghdad (Anti-Atlas, Morocco). – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, **290** (1/3): 277-290.

BELKA, Z., SKOMPSKI, DOPIERALSKA, J. & FEIST, R. (2018). Flow paths of hydrothermal vent fluids in the Devonian Kess-Kess mounds, Anti-Atlas, Morocco. – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, **290** (1/3): 49-63.

MAHBOUBI, A., CORNÉE, J.-J., FEIST, R., CAMPS, P. & GIRARD, C. (2019). Frasnian (Upper Devonian) integrated facies analysis, magnetic susceptibility and sea-level fluctuations in the NW Algerian Sahara. – Geological Magazine, **156** (8): 1295-1310.

FEIST, R. (2019). Post-Kellwasser event recovery and diversification of phacopid trilobites in the early Famennian (Late Devonian). – Bulletin of Geosciences, **94** (1): 1-22.

SCHMITZ, B., FEIST, R., MEIER, M. M., MARTIN, E., HECK, P. R., LENAZ, D., TOPA, D., BUSEMANN, H., MADEN, C., PLANT, A. A. & TERFELT, F. (2019). The micrometeorite flux to Earth during the Frasnian-Famennian transition reconstructed in the Coumiac GSSP section, France. – Earth and Planetary Science Letters, **522**: 234-243.

FEIST, R. CORNÉE, J.-J., CORRADINI, C., HARTENFELS, S., ARETZ, M. & GIRARD, C. (2020). The Devonian-Carboniferous boundary in the stratotype area (SE Montagne Noire, France). – Palaeobiodiversity and Palaeoenvironments, doi: 10.1007/s12549-019-00402-6.

SPALLETTA, C., CORRADINI, C., FEIST, R., KORN, D., KUMPAN, T., PERRI, M. C., PONDRELLI, M. & VENTURINI, C. (2020). The Devonian-Carboniferous boundary in the Carnic Alps (Austria and Italy). – Palaeobiodiversity and Palaeoenvironments, doi:10.1007/s12549-019-00413-3.

CM Sven HARTENFELS

Field work in 2020 concentrated on Famennian and lower Mississippian successions of the Rhenish Massif. In cooperation with R. Thomas BECKER (Münster), Hans-Georg HERBIG (Cologne), Wenkun QIE (Nanjing), Tomáš KUMPAN (Brno), David DE VLEESCHOUWER (Bremen), Dieter WEYER (Berlin), and Jiří KALVODA (Brno), our multi-proxy survey of the complete "Rhenish Standard Succession" of the extended Hangenberg Crisis Interval at Borkewehr continued. Litho-, bio-, cyclo-, sequence-, and chemostratigraphy will be revised and the manuscript should be published in the forthcoming Palaeobiodiversity and Palaeoenvironments Special Issue on "Devonian and Mississippian of the Ardenno-Rhenish Massif". It is also planned to publish Famennian foraminifera data of Anna SAUPE (Cologne) as well as Famennian conodonts from Hönne Valley bore holes (Sören STICHLING, Krefeld) and from the Frasnian/Famennian transition at Rohdenhaus (Hendrik NOWAK, Bolzano). Studies on other Rhenish sections started or continued, jointly with Stephan BECKER and Christa CLASSEN (both Krefeld), Sarah ESTEBAN LOPEZ (Cologne), Christoph HARTKOPF-FRÖDER (Krefeld), Hans-Georg HERBIG (Cologne), Peter KÖNIGSHOF (Frankfurt/Main), Martin SALAMON (Krefeld), Sören STICHLING (Krefeld), Hans Martin WEBER (Bergisch Gladbach/Ruhrland Museum Essen), and the Münster Group. Together with R. Thomas BECKER and S. I. KAISER (Stuttgart), the review of thirty Rhenish Devonian/Carboniferous Boundary sections was finalized. The manuscript has been accepted for publication in the Special Issue "Global review of the Devonian/Carboniferous

Boundary" of *Palaeobiodiversity and Palaeoenvironments*. The terminology of the Hangenberg Crisis Interval was refined and it provides an uodated lower Tournaisian conodont biostratigraphic scheme.

Famennian conodonts from the Moroccan Meseta, e.g., Gara de Mrirt and Immouzer-du-Kandar, were published in BECKER et al. (2020) and ABOUSSALAM et al. (2020). Furthermore, we continue our work on the early siphonodellid faunas of Lalla Mimouna (northern Maider).

The cooperation with Raimund FEIST, Catherine GIRARD, Jean-Jacques CORNÉE (all Montpellier), Markus ARETZ (Toulouse), and Carlo CORRADINI (Trieste) continued. A review of Devonian/Carboniferous Boundary sections of the Montagne Noire, which also includes a high amount of new data, was published in FEIST et al. (2020).

Conodonts of the Famennian (*Palmatolepis minuta minuta* to at least the *Pa. rugosa trachytera* Zone) shallow-water siliciclastic shelf deposits at the Hushoot Shiveetiin gol section were investigated in the Baruunhuurai Terrane of the Central Asian Orogenic Belt (ARIUNTOGOS et al. accepted).

Jointly with Matthias PIECHA and Sascha SANDMANN (both Krefeld), I supervised the B.Sc. Thesis of Katharina BAHR (Cologne), who mapped the region south of the Borkewehr section in the Rhenish Massif. Saskia RÖMER (Cologne, B.Sc. Thesis) worked on carbonate microfacies analyses across the Devonian/Carboniferous Boundary and Paula GRÜNEWALD as well as Marie SCHEEL (both Cologne) will start their B.Sc. Thesis on Famennian conodont biofacies analysis (section at Ainkhausen, Rhenish Massif) and conodont biostratigraphy around the Dasberg Crisis Interval at Ziyyar (Moroccan Meseta), respectively.

Publications

ABOUSSALAM, Z. S., BECKER, R. T., RICHTER, J., HARTENFELS, S., EL HASSANI, A. & EICHHOLT, S. (2020). The unique Devonian of Immouzer-du-Kandar (Middle Atlas basement) – biostratigraphy, faunas, and facies development. - In: BECKER, R. T., EL HASSANI, A. & ABOUSSALAM, S. (Eds.), Devonian to Lower Carboniferous stratigraphy and facies of the Western Moroccan Meseta: Implications for palaeogeography and structural interpretation. Frontiers in Science and Engineering, International Journal, **10** (1): 127–173, (references: 175–194).

ARIUNTOGOS, M., KÖNIGSHOF, P., HARTENFELS, S., JANSEN, U., NAZIK, A. CARMICHAEL, S. K., WATERS, J. A., SERSMAA, G., CRÔNIER, C. & ARIUNCHIMEG, Y. (2020 accepted). The Hushoot Shiveetiin gol section (Baruunhuurai Terrane): Sedimentology and facies from a Late Devonian island arc setting. - Palaeobiodiversity and Palaeoenvironments.

BECKER, R. T., ABOUSSALAM, Z. S., EL HASSANI, A., HARTENFELS, S. & HÜNEKE, H. (2020). Devonian and basal Carboniferous of the allochthonous nappes at Mrirt (eastern part of Western Meseta) – review and new data. - In: BECKER, R. T., EL HASSANI, A. & ABOUSSALAM, S. (eds.), Devonian to Lower Carboniferous stratigraphy and facies of the Western Moroccan Meseta: Implications for palaeogeography and structural interpretation. Frontiers in Science and Engineering, International Journal, **10** (1): 87–126, (references: 175–194).

BECKER, R. T., HARTENFELS, S. & KAISER, S. I. (2020 accepted). Review of Devonian-Carboniferous boundary sections in the Rhenish Slate Mountains (Germany). - Palaeobiodiversity and Palaeoenvironments.

FEIST, R., CORNÉE, J.-J., CORRADINI, C., HARTENFELS, S., ARETZ, M. & GIRARD, C. (2020 online). The Devonian/Carboniferous boundary in the stratotype area (SE Montagne Noire, France). - Palaeobiodiversity and Palaeoenvironments, doi:10.1007/s12549-019-00402-6.

CM Rodrigo Scalise HORODYSKI and Brasilian colleagues

My diverse research includes studies of Organic Geochemistry, Palynology, Biostratigraphy, Paleogeography, Paleoclimatology, Paleoecology, Paleoceanography, Paleoenvironments, Petroleum System, Biomarkers, Taxonomy and bioevents in Brazilian Devonian basins. Furthermore, an effort of fieldwork by Prof. Dr. Sandro M. SCHEFFLER (Museu Nacional, Rio de Janeiro) discovered new fossiliferous areas in Mato Grosso do Sul State. He is the head of an important project in this region.

I like to highlight one paper by VARGAS et al (2020). This work integrated the sedimentological data from 64 outcrops, 35 well logs, and ca. 500 palaeocurrent measurements distributed along the SE, NE, and NW flanks of the Early to Late Devonian Ponta Grossa and São Domingos formations, Paraná Basin (South America). A novel 3rd order Transgressive-Regressive stratigraphic framework was built, which in turn revealed the key factors that generated the accommodation space and allowed new paleogeographical insights into the studied interval. During the Early Devonian, the Paraná Basin was mainly affected by tectonic processes related to the propagation of far-field stresses generated by the Famatinian geodynamic cycle and related phenomena. On the other hand, during the Middle to Late Devonian, the main factor in the accommodation space was eustatic and correlatable with several events worldwide. This evolutionary pattern is also observed in adjacent basins, such as the Tarija (Bolivia and Argentina), Precordillera and Sierras Australes (Argentina), Chaco-Paraná (Uruguay), Falkland Islands (South Atlantic), and Cape Province (South Africa), which suggests the interregionality of climatic, eustatic and tectonic processes along the SW Gondwana.

Ph.D. and M.Sc. Thesis

Victor Rodrigues RIBEIRO: Middle Devonian brachiopod paleobiogeography (Paraná, Parecis, Parnaíba and Amazonas basins). Ph.D. Supervisor: Renato PIRANI GHILARDI.

Isabelle DE SIQUEIRA TAVARES: Devonian worms from the Paraná Basin, Brazil: paleoecologic and bioestratigraphic implications. M. Sc. Supervisor: Elvio PINTO BOSETTI, Co-supervisor: Jeanninny Carla COMNISKEY.

Publications

ABRAM, M. B. & HOLZ, M. (2020). Early to Middle Devonian ironstone and phosphorite in the northwestern Gondwana Parnaíba Basin, Brazil: A record of an epeiric margin paleoceanographic changes. - Sedimentary Geology, **402**: 105646.

ANDRADE, C. L. N., CARDOSO, T. R. M., SANTOS, R. R., DINO, R. & DE JESUS MACHADO, A. (2020). Organic facies and palynology from the middle to late Devonian of the Pimenteiras Formation, Parnaíba Basin, Brazil. - Journal of South American Earth Sciences, **99**: 102481.

CAPUTO, M. V. & DOS SANTOS, R. O. B. (2019). Stratigraphy and ages of four Early Silurian through Late Devonian, Early and Middle Mississippian glaciation events in the Parnaíba Basin and adjacent areas, NE Brazil. - Earth-Science Reviews, 103002.

FRAGA, M. C. & VEGA, C. S. (2020). Asterozoans from the Devonian of the Paraná Basin, South Brazil. - Journal of South American Earth Sciences, **97**: 102398.

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SOUSA, A. A., SOUSA, E. S., ROCHA, M. S., SOUSA JUNIOR, G. R., DE SOUZA, I. V., BRITO, A. S. & DE LIMA, S. G. (2020). Aliphatic and aromatic biomarkers of the Devonian source rocks from the Western Parnaíba Basin Brazil: Pimenteiras Formation. - JSAES, **99**: 102493.

VARGAS, M. R., SILVEIRA, A. S., BRESSANE, A., D'ÁVILA, R. S. F., FACCION, J. E. & PAIM, P. S. G. (2020 in press). The Devonian of the Paraná Basin, Brazil: sequence stratigraphy, paleogeography, and SW Gondwana interregional correlations. - Sedimentary Geology.

TM Nadezhda G. IZOKH, CM OLGA OBUT, CM OLGA IZOKH, and the Novosibirsk Group

Our team continued the investigation of Devonian and Lower Carboniferous stratigraphy in the Russian Arctic region (lower riches of the Lena River), Altai-Sayan Folded Area, and Central Asia (Kitab State Geological Reserve, Uzbekistan). The research group includes:

Drs. N. G. IZOKH (conodonts), O. T. OBUT (radiolaria), E. S. SOBOLEV (ammonoiods),

research fellow T. A. SHCHERBANENKO (brachiopods), and Ph.D. student B. M. POPOV (ostracods) 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.

Nadezhda IZOKH, together with **CM Maya ERINA** and **Nuridin ABDIEV,** completed a study of Late Devonian conodonts from the siliceous and carbonate rocks of the Akbasay Formation on the left side of the Kule Gorge, Zeravshan-Gissar mountainous area (Uzbekistan) (IZOKH et al. 2020). Eight conodont zones were defined for the Frasnian-Famennian interval, from the *guanwushanensis* Zone up to the *expansa* Zone. The studied collection of conodonts from the upper Akbasay Fm. is represented by cosmopolite taxa of the genera *Zieglerina*, *Palmatolepis* and *Polygnathus*, among which palmatolepids are predominant.

Boris POPOV continues a study of the Middle and Upper Devonian ostracods of the Salair and Kuznetsk Basin (south West Siberia) and of Stolb Island (lower riches of the Lena River, Arctic Russia). The analysis of the stratigraphic distribution of the Upper Devonian ostracod from the Stolb Island allowed to identify two biostratigraphic units: beds with *Bairdia sikasensis* (upper Frasnian) and beds with *Acratia (Acratia) innumer* (lower Famennian) (POPOV & IZOKH 2020).

Evgeny Sobolev studies the upper Eifelian ammonoids from the type sections of the Akarachkino Beds near Gur'evsk Town, village Zarechnoe and Prokop'evsk Town (NE Salair). These associations include *Agoniatites vanuxemi* (HALL), *Fidelites* sp., and *Cabrieroceras salairicum* NIKOLAEVA, characteristic for the upper Eifelian *Agoniatites* Zone (IZOKH et al. 2020).

Tatiana SHCHERBANENKO continues her studies on brachiopods from Ordovician and Devonian deposits of the Altai-Sayan Folded Area.

Publications

IZOKH, N. G., ERINA, M. V., OBUT, O. T., ABDIEV, N. K., KIM, A. I. & RAKHMONOV, U. D. (2020). Late Devonian Conodonts from the Zeravshan-Gissar Mountainous Area, Uzbekistan. - Paleontological Journal, **54** (2): 149–156, doi: 10.1134/S0031030120020057

IZOKH, N. G., SOBOLEV, E. S., POPOV, B. M. & SHCHERBANENKO, T. A. (2020). Middle Devonian biostratigraphic correlative levels of the Zarechnoe Horizon of the Salair. - In: Biogeography and evolutionary processes. Proceedings of LXVI Session Paleontological Society of the Russian Academy of Sciences. St.-Pb.: 68-70; Publishing House of VSEGEI. [in Russian].

POPOV, B. M. & IZOKH, N. G. (2020). Biostratigraphic and biogeographic analysis of the Upper Devonian ostracods from the Stolb Island (Lena River delta). - In: Biogeography and evolutionary processes. Proceedings of LXVI Session Paleontological Society of the Russian Academy of Sciences. St.-Pb.: 135-136; Publishing House of VSEGEI. [in Russian].

TM Ulrich JANSEN

Research in late 2019 and 2020 concentrated on Devonian brachiopods from the Rhenish Massif (Germany) and Morocco.

The free time resulting from the present conditions under the COVID-19 pandemia was used to work on the monograph on uppermost Silurian to lower Eifelian brachiopods from the Rhenish Massif, spending several weeks in the collection. It is planned to submit a general overview of the Rhenish faunas plus the proposal of a number of new taxa and a revision of problematic taxa in the next year.

In cooperation with my Polish colleagues Adam HALAMSKI and Andrzej BALIŃSKI from the Polish Academy of Sciences in Warszawa, a work on Middle Devonian rhynchonellides from Morocco and Western Europe was published (HALAMSKI et al. 2020).

A book chapter on the bathymetric distribution and palaeobiogeography of Silurian, Devonian and Carboniferous brachiopods is prepared together with Adam HALAMSKI and Bernard MOTTEQUIN for a book on the Central European Variscides (Ulf LINNEMANN, Ed., in prep.).

Finally, I was also involved in Peter KÖNIGSHOF's project on the Famennian-Lower Carboniferous in Mongolia. The Famennian part of the Hushoot Shiveetiin gol Section has yielded an interesting endemic brachiopod fauna I give a first report on in a forthcoming work (ARIUNTOGOS et al. in press).

Publications

HALAMSKI, A. T. H., BALIŃSKI, A. & JANSEN, U. (2020 online): Contribution to the study of Middle Devonian uncinuloids (Brachiopoda, Rhynchonellida) from North Africa and Central Europe. - Annales Societatis Geologorum Poloniae, **90**: 24 pp., http://www.asgp.pl/sites/default/files/in_press_90_Halamski_et_al.pdf).

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CM Peter KÖNIGSHOF

The past year and the year 2020 were dominated by research in Asian countries, such as in Iran Mongolia, Vietnam, and Thailand, which will be also the focus in the near future. Work continues on shallow-water deposits, ranging from the Middle Devonian to the D/C boundary. In summer 2019, I spent several weeks in Iran and Mongolia. New field work on D/C sections in Iran resulted in an overview paper while work on specific sections is not finished yet. Sections in western Mongolia have been investigated in several field campaigns and as a result of this, a number of papers will be published in a special series on "The Central Asian Orogenic Belt (CAOB) during Late Devonian: new insights from southern Mongolia". Recently we sampled new sections in the Mushgai region, southern Mongolian Gobi, in order to get a better understanding on the complex framework of the CAOB. An overview paper on the Mandalovoo – Gurvansayhan terranes is submitted. Furthermore, Jianfeng LU and I are working on morphometric patterns and revision of some species.

Publications

ARIUNTOGOS, M., KÖNIGSHOF, P., HARTENFELS, S., JANSEN, U., NAZIK, A., CARMICHAEL, S. K., WATERS, J. A., SERSMAA, G., CRÔNIER, C., ARIUNCHIMEG, YA, PASCALL, O. & DOMBROWSKI, A. (2020 in press). The Hushoot Shiveetiin gol section (Baruunhuurai Terrane): Sedimentology and facies from a Late Devonian island arc setting. – Palaeobiodiversity and Palaeoenvironments.

BAHRAMI, A., KÖNIGSHOF, P., VAZIRI-MOGHADDAM, H., SHAKERI, B. and BONCHEVA, I. (2019). Conodont stratigraphy and conodont biofacies of the shallow-water Kuh-e-Bande-Abdol-Hossein section (SE Anarak, Central Iran). – Palaeobiodiversity and Palaeoenvironments, **99** (3): 477-494.

CARMICHAEL, S., WATERS, J., KÖNIGSHOF**,** P., SUTTNER, T. & KIDO, E. (2019). Paleogeography and paleoenvironments of the Late Devonian Kellwasser Event: A review of its sedimentological and geochemical expression. - Global and Planetary Change, **183**: 45-62.

CRÔNIER, C., ARIUNTOGOS, M., KÖNIGSHOF**,** P., WATERS, J. & CARMICHAEL, S. K. (2020 in press). Late Devonian (Famennian) phacopid trilobites from western Mongolia. – Palaeobiodiversity and Palaeoenvironments.

KÖNIGSHOF, P., BAHRAMI, A. & KAISER, S. I. (2020 in press). Devonian/Carboniferous Boundary sections in Iran. – Palaeobiodiversity and Palaeoenvironments.

LU, J. F. & KÖNIGSHOF, P. (2020a). Eifelian (Middle Devonian) species of *Bipennatus* from the Beiliu Formation at Nalai, South China. - Palaeoworld, doi.org/10.1016/j.palwor.2019.12.002.

LU, J. F. & KÖNIGSHOF**,** P. (2020b). Morphometric patterns of the shelf-like protuberance in the late Emsian-early Eifelian polygnathid conodonts. – Lethaia, **53** (3): 345-361.

RACKI, G., KÖNIGSHOF, P., BEŁKA, Z., DOPIERALSKA, J., PISARZOWSKA, A. (2019). Diverse geochemical signature of the Frasnian-Famennian global event in the western Thailand, as the record of Palaeotethyan vs. Western Australian geotectonic affinities. – Journal of Asian Earth Sciences, doi.org/10.1016/j.jaesx.2019.100010.

MENDE, K., LINNEMANN, U., NESBOR, H.D., MILITZER, A., JANSEN, U., KÖNIGSHOF**,** P., BAHLBURG, H., HOFMANN, M., GERDES, A., BERNDT, J. & NAWRAT, J. (2019). Provenance of exotic Ordovician and Devonian sedimentary rock units from the Rhenish Massif (Central European Variscides, Germany). – Tectonophysics, **755**: 127-159.

NAZIK, A., KÖNIGSHOF, P., ARIUNTOGOS, A., WATERS, J. A. & CARMICHAEL, S. K. (2020 in press). Late Devonian ostracods from the Late Devonian Hushoot Shiveetiin gol section (Baruunhuurai Terrane, western Mongolia) and their palaeoenvironmental implication and palaeobiogeographic relationship. – Palaeobiodiversity and Palaeoenvironments.

PASCHALL, O. C., CARMICHAEL, S. K., KÖNIGSHOF, P., WATERS, J. A., P. H. TA., KOMATSU, T. & DOMBROWSKI, A. (2019). The Hangenberg Event in Vietnam: sustained ocean anoxia with a volcanic trigger? – Global and Planetary Change, **175**: 64-81.

QIE, W., LIANG, K., KÖNIGSHOF, P. (Eds., 2019). Devonian palaeoecosystems and palaeoenvironments of South China. – Palaeobiodiversity and Palaeoenvironments, **99**: 1-142.

QIE, W., LIANG, K. & KÖNIGSHOF, P. (2019). Devonian palaeoecosystems and palaeoenvironments of South China. – Palaeobiodiversity and Palaeoenvironments, **99**: 1-5.

SATTARI, E., BAHRAMI, A., KÖNIGSHOF, P. & VAZIRI-MOGHADDAM, H. (2020 in press). Late Devonian (Famennian) and Carboniferous (Mississippian-Pennsylvanian) conodonts from the Anarak section, central Iran. – Palaeobiodiversity and Palaeoenvironments.

STRIBRNY, B., KORN, D., KÖNIGSHOF, P., ERBACHER, J. & BLUMENBERG, M. (2020 in press). Die Kupfererzlagerstätte Marsberg. – Geologisches Jahrbuch, Reihe A, **166**.

WATERS, J. A., WATERS, J.W., KÖNIGSHOF, P., CARMICHAEL, S. K. & ARIUNTOGOS, M. (2020 in press). Famennian Crinoids and Blastoids (Echinodermata) from Mongolia. – Palaeobiodiversity and Palaeoenvironments.

CM Semen A. KRUCHEK, CM Dmitry P. PLAX and the Belarusian Devonian Group

In 2020 the Belarusian Devonian Group from «The Institute of Geology», Branch of the State Enterprise «Research and Production Centre for Geology», including Dr. S. A. KRUCHEK (leader of the Group), Prof. Dr. A. A. MAKHNACH, Dr. V. I. TOLSTOSHEEV, V. Y. OBUKHOVSKAYA, T. F. SACHENKO, O. V. MURASHKO, P.O. SAKHARUK (PhD student) et al., and also Dr. D.P. PLAX from the Belarusian National Technical University, have been exploring different aspects of the Devonian of Belarus: regional geology, stratigraphy, paleontology, lithology, palaeogeography, geophysics, tectonics, isotope geology, etc. Publications of research results of the second half of 2019 and the first half of 2020 are presented below. Publications of the second half of 2020, which are in print, will be listed in the next Newsletter (in 2021). Due to the fact that most of the papers are published in Russian, brief English summaries are orovided.

Publications

Journal papers

PLAX, D. (2019a). A new genus of the placoderm fish (Placodermi, Ptyctodontida) from the Upper Emsian deposits of Belarus – Lithosphere, **51** (2): 75-83.

The paper presents a new representative of the placoderm fish *Borysthenoplax lepelensis* gen. et sp. nov. from the Upper Emsian deposits of Belarus. The skeletal material is represented by separate mostly well-preserved plates of the trunk shield originating from the cores of four boreholes. Detailed characteristics of the stratigraphic occurrence of the skeletal elements are provided. Some concomitant organic remains are shown additionally. A detailed lithological description of the enclosing rocks is also presented.

PLAX, D. P. (2019b). A new species of the acanthodian fish from the Kostyukovichi Regional Stage (Middle Devonian, Eifelian) of Belarus – BarSU Herald, Series: Biological sciences, Agricultural sciences, General biology, Baranovichi, **7**: 83-97.

A new species of the acanthodian *Cheiracanthoides pinskensis* sp. nov. is described on the basis of some isolated scales from the Kostyukovichi deposits of the Eifelian Stage of the Middle Devonian of Belarus. Photographs of the external appearance of the scales and their thin sections are given in plates. Additionally, the paper presents data of associated organic remains. A detailed lithological description of the enclosing rocks is also provided. The correlation of the Kostyukovichi deposits of Belarus with the coeval sediments, which are widespread in the adjacent territories, is given. The described new species complements the taxonomic composition of the

ichthyofauna known from Upper Eifelian deposits of the west of the East European platform

PLAX, D. P. (2019c). On the redeposited Silurian ichthyofauna remains in the Quaternary deposits of Belarus – Natural Resources, **2**: 34-45.

The paper presents for the first time the information on redeposited remains (scales and tesserae) of Silurian vertebrates found in Quaternary deposits of Belarus. A complete systematic review and brief descriptions of the agnathan and fish taxa, with the identification of their material, determination of their preservation degree, location and geographical distribution, as well as with an assumption of the age of the rock enclosing these ichthyofauna remains and their redeposition type, are provided.

MAKHNACH, A., POKROVSKY, B., MURASHKO, O. & PETROV, O. (2019). Isotopic chemostratigraphy of the Upper Emsian-Middle Eifelian sediments in the Kormyanskaya parametric borehole sequence within the Zhlobin Saddle – Lithosphere, **51** (2): 64-74 [in Russian, with English summary].

The paper contains the isotopic study results of the upper Emsian-middle Eifelian sequence drilled by the Kormyanskaya parametric borehole in the Zhlobin Saddle. Carbon and oxygen isotopes in carbonate-bearing and carbonate rocks were studied. A significant negative excursion of $\delta^{13}C$ (amplitude as high as 9 ‰) associated with an evaporite episode was revealed in the interval, which includes the Osveya Horizon and the lower part of the Gorodok Horizon. This digression correlates with two similar excursions in the same parts of the Bykhovskaya borehole sequence, which is thicker and more complete than the one of the Kormyanskaya borehole. That is why the excursions in the Bykhovskaya borehole sequence are separated by an interval of normal marine $\delta^{13}C$ values, corresponding to the dolomite-marl patch of the Osveya Horizon, that is absent in the Kormyanskaya borehole sequence. The majority of $\delta^{18}O$ values in the Kormyanskaya borehole sequence (-5.5 to -1.5 ‰) are close to Emsian and Eifelian Age values (-4 to -3 ‰) in the global chemostratigraphic curve.

PLAX, D. P. & NEWMAN, M. J. (2020). New Early Devonian (Late Emsian) placoderms from Belarus – Journal of Paleontology, **94** (4): 773-787.

Four placoderm fishes are described from the Lepel Beds of the Vitebsk Regional Stage of the Lower Devonian (upper Emsian) of Belarus. Two forms are new: *Stipatosteus svidunovitchi* gen. nov. sp. nov. and *Actinolepis zaikai* sp. nov. The other two taxa are left in open nomenclature (Coccosteidae gen. indet. sp. indet.; Placodermi indet. 1). Specimens of all four forms consist of disarticulated, mostly well-preserved plates (some are worn at the edges) originating from the cores of six boreholes. Additionally, the paper presents data on organic remains associated with the placoderms. A detailed lithological description of the enclosing rocks and a taphonomic description of the ichthyofauna are also provided. The 2010 Stratigraphic Chart of the Devonian deposits of Belarus was used as the stratigraphic basis. The presence of the genus *Actinolepis* AGASSIZ, 1844 in these deposits, as well as in the Emsian of the Baltic region and Spitsbergen, suggests a regional palaeogeographic connection at this time.

PLAX, D. (2020). A new species of the Actinopterygian fish (Osteichthyes, Actinopterygii) from the Eifelian deposits of the Vileyka Buried Ridge (Belarus) – Lithosphere, **52** (1): 68-74.

A new species of ray-finned fish, *Cheirolepis aleshkai* sp. nov., is described on the basis of some isolated scales found in the deposits of the Osveya Regional Stage of the Eifelian (Middle Devonian) from the Vileyka Buried Ridge of the Belarusian Antecline. Besides a descriptive palaeontological part, the paper presents some data on the concomitant organic remains found together with the scales of this new actinopterygian, as well as the lithological description of the enclosing rocks, where the scales were found. The new data supplement the information on the taxonomic composition of the early Eifelian ichthyofauna found within the country. The Stratigraphic Chart of the Devonian deposits of Belarus (2010) was used as a stratigraphic basis.

Abstracts

KRUCHEK S. A., OBUKHOVSKAYA, V. Y. & SACHANKA, T. F. (2019). On stratigraphy of the Lower-Middle Frasnian deposits of the Orsha Depression (borehole Mstislavl'-1). – In: Actual problems of earth sciences. Study of transboundary regions: Proceedings of the IV International scientific and practical conference, dedicated to the 1000-year anniversary of Brest. Brest, 12-14 Sept. 2019, **1**: 79-82 [in Russian].

TOLSTOSHEEV, V. I., SHIMANOVICH, V. M., KRUCHEK, S. A. & SAKHARUK, P. O. (2019). On geochemical characteristics of mineral water of the Devonian deposits of the Gomel structural bridge in the southeastern Belarus – In: Actual problems of earth sciences. Study of transboundary regions: Proceedings of the IV International scientific and practical conference, dedicated to the 1000-year anniversary of Brest. Brest, 12-14 Sept. 2019 (in 2 volumes), **1**: 117-121 [in Russian].

PLAX, D. P., LAMSDELL, J. C., VRAZO, M. B., BARBIKOV, D. V. & KLABUK, A. M. (2020). New eurypterid specimens from the salt deposits of the Upper Devonian of the Pripyat Trough (Belarus) – In: BOGDANOVA, T. N. et al. (Eds.), Proceedings of the LXVI Session of the Palaeontological Society of the Russian Academy of Sciences, April 6-10, St. Petersburg: 128-129.

TM John MARSHALL & the Southampton Group

2019-2020 has been somewhat less busy than previous years with every conference, field meeting and fieldwork cancelled from March. I did hope that this would allow time to catch up on a number of projects. But I am Programme Leader for the Geology degrees in Southampton so after a brief lull it has been all about reconstructing a degree for students, sorting out replacement fieldwork, none of which has taken place yet. Conferences I did attend were the Linnean Society Palaeobotany-Palynology Groups meeting with a talk on Devonian and Carboniferous coals and which spore groups were represented in coals. The answer is that all these early wetlands were dominated by lycopod plants. The other conference was the Palaeontological Association annual meeting that took place in Valencia, Spain. The only significant fieldwork was to Nova Scotia in October to collect spores from the Tournaisian *in situ* lycopod forest beds at Blue Beach. This is part of trying to track the evolution of the Devonian and Carboniferous forest environments.

In the autumn we hosted Liu FENG from NIGPAS in China who worked on a number of extinction related projects.

The research highlight of the year was getting the D-C boundary terrestrial extinction paper published in *Science Advances*. The discovery was that spores from the D-C boundary beds show significant spine malformation exactly coincident with the plant extinctions. This type of malformation is entirely characteristic of UV-B damage to the spore's DNA before formation of its protective wall layer. This gives us a mechanism for the terrestrial extinction with significant implications for fish and tetrapod evolution in addition to the collapse of the forest environment with the extinction of several major plant groups. Given that the spore malformation was embedded within an extreme warming cycle a mechanism was argued where high global temperatures eroded the protective ozone layer. Subsequently a group of astronomers (FIELD et al. 2020) have reiterated the supernova hypothesis whereby a collapsing star releases a cosmic ray blast that briefly destroys the ozone layer. This hypothesis has been around all my professional career but has always remained a hypothesis. We are now in a position to test this hypothesis. So, interesting arguments lie ahead.

The other significant publication was Stein et al., that describes the *Archaeopteris-Wattieza* forest floor from New York State. We were due to visit this locality on the postponed SDS NYS fieldtrip this summer. Importantly it is accessible unlike the now reburied Gilboa Forest. Our role in this was relatively minor related to the palynology and environments. But now the forest floor map is out we can publish all the shallow coring and related analytical results.

2020 was also my final year as SDS Chair that completed 8 years as Secretary followed by 8 years as Chair. It has been a privilege to have undertaken these roles and I have learnt much from being in the SDS. I have been delighted to have been invited to continue as a voting member of the SDS.

Publications

MARSHALL, J. E. A., TEL'NOVA, O. P. & BERRY, C. M. (2019). Devonian and Early Carboniferous coals and the evolution of wetlands. - Vestnik IG Komi SC UB RAS, **2019** (10): 12-15, https://geo.komisc.ru/images/stories/vestnik/2019/298/12-15.pdf.

STEIN, W. E., BERRY, C. M., MORRIS, J. L., HERNICK, L. V., MANNOLINI, F., VER SRRAETEN, C., LANDING, E., MARSHALL, J. E. A**.,** WELLMAN, C. H., BEERLING, D. J., & LEAKE, J. R. (2019). Mid-Devonian *Archaeopteris* roots signal revolutionary change

in earliest fossil forests. - Current Biology, **30**: 1-11.

MARSHALL, J. E. A., LAKIN, J., TROTH, I. & WALLACE-JOHNSON, S. M. (2020). UV-B radiation was the Devonian-Carboniferous terrestrial extinction kill mechanism. - Science Advances, **6**: eaba0768, doi.org/10.1126/sciadv.aba0768.

[quoted reference]

FIELDS, B. D., MELOTT A. L., ELLIS, J., ERTELA, A. F., FRYE, B. D., LIEBERMAN, B.S., LIUA, Z., MILLER, J. A. & THOMAS, B. C. (2020). Supernova Triggers for End-Devonian Extinctions? – PNAS, August 26, 2020, doi.org/10.1073/pnas.2013774117

CM Marek NARKIEWICZ

Since the beginning of 2019 I have been involved in the project *"Palaeoenvironmental records and causes of the global Kačák Episode in the late Eifelian (Middle Devonian)"* funded by the Polish National Science Center and partly supported by the Polish Geological Institute statutory funds. Our group includes Katarzyna NARKIEWICZ and Krystian WÓJCIK (both from PGI) responsible for conodont biostratigraphy and geophysical and microfacies analyses, respectively. Zdzislaw BELKA (Adam MICKIEWICZ University, Poznań) is carrying out isotope analyses with a particular emphasis on Nd-Sm and Sr isotopes. Stanislava VODRÁŽKOVA (Czech Geological Survey, Prague) and Peter KÖNIGSHOF (Senckenberg, Frankfurt) are our Czech and German collaborators. In the final stage of the project Sophie GOUWY (Geological Survey of Canada, Calgary) will accompany us in synthesizing the stratigraphic data and providing basis for their genetic explanation.

The project, scheduled for 2019 to 2022, is aimed at comparing different records of Kačák Episode in settings ranging from epeiric to deeper shelf and pelagic platforms. As for now, the field work is nearly finished and the geophysical and biostratigraphic parts are under construction. The materials from the epeiric Belarusian Basin were collected jointly with our collegues from Minsk as a part of the earlier project (see NARKIEWICZ et al. 2017) and the final results will be reported in a paper being prepared for a publication. Essential results, whose presentation this year was planned during the postponed (alas !) Geneseo Meeting, are published in this Newsletter.

Also, of some interest for Devonian workers may be the recent publication in *Geological Quarterly* (NARKIEWICZ 2020), being an updated and expanded version of the earlier study summarizing the development of the Variscan foreland in Poland during the Devonian to Carboniferous.

Publications

NARKIEWICZ, M., NARKIEWICZ, K., KRZEMIŃSKA, E. & KRUCHEK, S. A. (2017). Oxygen isotopic composition of conodont apatite in the equatorial epeiric Belarusian Basin (Eifelian) – relationship to fluctuating seawater salinity and temperature. - Palaios, **32** (7): 439-447.

NARKIEWICZ, M. (2020). The Variscan foreland in Poland revisited: new data and new concepts. - Geological Quarterly, **64** (2): 377-401.

CM Atike NAZIK

I continue to work on Devonian Ostracods from different sections of NW Anatolia and the Taurides in Turkey. In addition, I am studying Devonian ostracods of shallow-water sections from Mongolia and Iran, together with Peter KÖNINGSHOF. Recently, work on a paper on the Hushoot Shiveetiin gol section (Baruunhuurai Terrane, Mongolia) was conducted, and the manuscript has been submitted together with the Mongolia Devonian project teams.

My Ph.D student **Emine ŞEKER** finished her Ph.D.Thesis on "Ostracods Analysis of the Devonian Sequences from Eastern Taurides (Sarız/Kayseri and Feke/Adana): Paleobiodiversity, Paleoecology and Paleogeography".

CM Cameron PENN-CLARKE

I am working on multiple projects on the Devonian at present, which are spread among sedimentology, stratigraphy, palaeontology, and geoheritage.

In terms of sedimentology and stratigraphy, I have been focusing on the Middle Devonian record at present and have produced the following papers since the end of 2019. Interestingly, these highlight and document the presence of high-latitude tidal signatures in the Bokkeveld Group which (as we all well know) are extremely rare to observe. I am hoping (once the global economy recovers,

hopefully) to secure funding for an M.Sc./Ph.D. student to further this research.

Other ongoing Devonian activities that I am currently working on at present include:

Co-supervision of a Ph.D. student on the sedimentology and stratigraphy of the Late Devonian (Famennian) Witpoort Formation. This project is to be registered at the University of the Witwatersrand and include inputs from the Council for Geoscience.

Revision of the stratigraphy of the Eifelian Waboomberg and Wupperthal formations.

Detrital zircon geochronology of the Bokkeveld Group and the palaeogeography of the Early-Middle Devonian of South Africa.

Biostratigraphy and recognition of Early-Middle Devonian extinction events in South Africa.

Publications

PENN-CLARKE, C.R., RUBIDGE, B. S. & JINNAH, Z. A. (2019). Eifelian-Givetian (Middle Devonian) high-paleolatitude storm- and wave-dominated shallow-marine depositional systems from the Bidouw Subgroup (Bokkeveld Group) of South Africa. - Journal of Sedimentary Research, **89** (11): 1140-1170, doi: 10.2110/jsr.2019.61.

PENN-CLARKE, C. R. & THERON, J. N. (2020 in press). The lithostratigraphy and sedimentology of the Tra-Tra Formation, including the Grootrivier Member (Bokkeveld Group, Cape Supergroup), South Africa. - South African Journal of Geology, **123** (3).

PENN-CLARKE, C. R. et al. (2020). Geoheritage in the Matjiesrivier Nature Reserve, a World Heritage Site in the Cederberg, South Africa. - Journal of African Earth Sciences, virtual special publication, doi: 10.1016/j.jafrearsci.2020.103818.

The paper was published in a special volume on geoheritage in Africa, with a focus on the geo- and palaeoheritage of the Cederberg region and with a focus on the Ordovician-Devonian record of the Cape Supergroup.

PENN-CLARKE, C. R. & HARPER, D. A. T. (2020). Early–Middle Devonian brachiopod provincialism and bioregionalization at high latitudes: A case study from southwestern Gondwana. - Geological Society of America Bulletin, doi: 10.1130/B35670.1.

Palaeontological work included a revision and a new model on the palaeobiogeography of West Gondwanan Devonian brachiopods, with special focus on the controls for provincialism at high latitudes. We have shown that provincialism was controlled possibly by latitudinally focused climatic differences across West Gondwana and that provincialism peaked (at least in West Gondwana) during the Pragian-Eifelian "cold period" during the Devonian. We also sought to revise the "Malvinokaffric Realm" in terms of its boundaries and constituent taxa. We showed that its area was reduced and that it was most likely a second order palaeobiogeographic "province" level division as opposed to a first order "realm" level division. In light of this (and given the racial connotations of "Malvinokaffric"), we have revised this area and renamed it as the "Malvinoxhosan bioregion" and have recognised that it may comprise at least two smaller third order "region" level subdivisions. This work is hoped to grow into a larger study that will look at revising the palaeobiogeography of Devonian brachiopods on a global scale.

You Tube seminars

The South African Committee for Stratigraphy (SACS), "Eating the greens of geology because somebody has to". - Geological Society of South Africa lunchtime talk series, https://youtu.be/OpY9-Wu0y9o.

Social distancing during the Devonian Period. - School of Geosciences GeoTalk online series, University of the Witwatersrand, Johannesburg, https://youtu.be/YdPqhZJM7CI.

The Bokkeveld of South Africa: A long-term record of environmental change at the South Pole during the Devonian Period. - Geological Society of South Africa, https://youtu.be/DlxCRW2VKPA

CM Luiza C. M. O. PONCIANO

Regarding the Parnaíba Basin, new studies on Devonian mass extinctions events in northeastern Brazil are being developed with a Master's student, J. M. P. REZENDE. Devonian marine invertebrate macrofossils are scarcer in the Longá Formation (latest Famennian to early late Tournaisian), which has poor preservation of the samples and a limited amount of material available to be analyzed. There has been, to date, no description or proper taxonomic classification of its body fossils, despite

the limited diversity. The material is from a single locality [Fazenda Barreiras: State of Piauí]. Brachiopod taxonomy was reviewed for the first time in our paper with Dr. Carlton E. BRETT. It was possible to describe a new species from the order Orthotetida, belonging to the genus *Schellwienella*, named *Schellwienella justinianoi* n. sp. We also confirmed the presence of the inarticulate brachiopods '*Lingula'*? and *Orbiculoidea*?, which have been tentatively identified by some authors.

Other results obtained from fossils of the Longá Formation are still to be published. The collaboration with Carlton BRETT continues in a new ms. on Ophiuroid taxonomy, taphonomy and paleoenvironments. From this same location, new vertebrate remains are also being studied and described with MSc. Rodrigo FIGUEROA (University of Michigan) and Dr. Valéria GALLO (UERJ) bringing new insights to the still scarcely known Devonian ichthyofauna of the Parnaíba Basin, adding important new information to the study of the Devonian fish fauna of Brazil and debating new hypothesis about connections between Gondwana and Euramerica during Late Devonian.

Future field studies are needed to document the entire biota of the Longá Formation, to elucidate the palaeobiogeographic affinities of Devonian invertebrate fossils of Brazil, and related faunas in South America, and to test ideas of marine connections between these areas. These studies provide insights regarding the impacts caused by late Devonian (Kellwasser and Hangenberg) biocrisis on the Brazilian fauna, and its palaeoecological aspects.

Regarding the Paraná Basin, the focus was the rhynchonellide brachiopod *Australocoelia*, widely distributed across the Southern Hemisphere in the Devonian. *A. palmata* was initially reported from the Ponta Grossa and São Domingos formations (Paraná Basin), later recorded from the western border of the Parnaíba Basin (Pimenteira Formation, State of Tocantins), and is now shown to occur on the eastern border of the same basin (Pimenteira Formation, State of Piauí). In the paper, we describe a fourth species from the Paraná Basin as *Australocoelia boucoti* n. sp.

From the Amazonas Basin we are focusing mostly on Brachiopod taxonomy and paleogeography, in a manuscript with Dr. Vera FONSECA (Museu Nacional) and Dr. Valéria GALLO (UERJ), reviewing fossils collected by Dr. José Henrique MELO (Petrobrás) during expeditions in 1986.

TM Grzegorz RACKI and Polish colleagues

Published results of the project "Devonian deep-water marine realm as a key to elucidate global ecosystem perturbations"

The five-year high-budget MAESTRO project (ca. 800 000 USD), funded by The National Science Centre of Poland, was carried out in 2013-2018, with me as the research leader. This project was officially supported by the Subcommission on Devonian Stratigraphy and aimed to provide a better understanding these global ecosystem perturbations beyond the traditional realm of investigation, namely warm, low-latitude, shallow-water reef-rimmed carbonate shelves. Therefore, the international studies focused on global event record in deep-water ('oceanic') as well as higher-latitude depositional settings in several regions of the World, such as Central Europe (Poland, Germany), South and North-West China, Morocco, Uzbekistan and USA (Montana, Oklahoma, Nevada). The novel nature of the research was the application of integrated interdisciplinary (event-stratigraphic and geochemical) methods to a broad range of palaeoenvironments, in order to test innovative models (e.g., volcanism as the main source of environmental stress *(*see also https://www.researchgate.net/project/Devonian-deep-water-marine-realm-as-a-key-to-elucidate-global-ecosystem-perturbations).

This grant provided funding for an extensive fieldwork program, and this activity, together with previous grants awarded to the University of Silesia, resulted in an archive of densely taken samples from 30 Frasnian-Famennian (F-F) and Devonian-Carboniferous (D-C) sections from nine countries, stored in the Global Archive of the Devonian System in the Institute of Earth Sciences at Sosnowiec, Poland. The collected materials provide a good resource for future international multidisciplinary research.

Below main publications are listed as the scientific output of the grant. The most important results are published in the special volume of '*Global and Planetary Change'*, containing 12 articles edited by me and Paul WIGNALL (https://www.sciencedirect.com/journal/global-

and-planetary-change/special-issue/101D1J0N3QJ).

In particular, the diversity of elemental and C-isotope geochemical signatures of two major biotic crises have been investigated in the context of current "multicausal" scenario. Introductory updated reviews of Late Devonian paleogeography (by GOLONKA) and Devonian large magmatic provinces (LIPs, by ERNST et al.) are recommended. Five papers address the potential role of volcanism of large magmatic provinces (LIP) in driving ecosystem changes, guided by the worldwide enhanced deposition of mercury during both of these crisis intervals. A key achievement of this grant was the discovery of anomalous mercury enrichments at the major Late Devonian extinction intervals (RACKI et al. 2018a, 2018b). Consequently, all five major biotic crises of the Phanerozoic have now been more reliably linked to volcanic cataclysms. Furthermore, pervasive methylmercury toxicity, resulting from volcanic-sourced Hg input to O_2-deficient basins, has for first time been established in the fossil record by RAKOCIŃSKI et al. (2020) for the Hangenberg Crisis, and can offer new insight into the recurring concept of the substantial Hg toxicity.

In the context, all the current scenarios are summarized in my synoptic overview (RACKI 2020a). This review updates the eight matters, given by RACKI (2005; *Developments in Palaeontology and Stratigraphy*, **20**: 5–36), for understanding the Late Devonian biocrises, but already within the conceptual framework of the integrated, press-and-pulse volcanic model. The decisive role of 'robust' time correlation with LIPs during the F-F and D-C marine biocrises is not clear-cut, not only because of time correlation constrains. There appears to be a lag-time correlation of the volcanic and biotic events, raising the possibility that other than LIPs, less well known volcanicity, such as the amplified arc magmatism and carbonatite and kimberlite-like eruptions, may have played a causal role.

Publications

Special issue in form of article collection, published in "Global and Planetary Change", *on* "Late Devonian global events - recent advances and challenges in different domains"

RACKI, G. & WIGNALL, P. B. (2020). Editorial: Devonian global changes - Recent advances and challenges in different domains. - Global and Planetary Change, **191** (103200): 1-2.

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PISARZOWSKA, A., RAKOCIŃSKI, M., MARYNOWSKI, L., SZCZERBA, M., THOBY, M., PASZKOWSKI, M., PERRI, M. C., SPALLETTA, C., SCHÖNLAUB, H. P., KOWALIK, N. & GEREKE, M. (2020a). Large environmental disturbances caused by magmatic activity during the late Devonian Hangenberg Crisis. - Global and Planetary Change, **188** (103155): 1–24.

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PERCIVAL, L. M. E., BOND, D. P. G., RAKOCIŃSKI, M., MARYNOWSKI, L., HOOD, A., ADATTE, T., SPANGENBERG, J. E. & FÖLLMI, K. B. (2020). Phosphorus-cycle disturbances during the Late Devonian anoxic events. - Global and Planetary Change, **184** (103070): 1–16.

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ZHURAVLEV, A. V. & SOKIRAN, E. V. (2020). Frasnian–Famennian (Upper Devonian) transition in the northern hemisphere (NE Laurussia and NE Siberia) – an overview. - Bulletin of Geosciences, **95**, https://10.3140/bull.geosci.1791.

CM Eberhard SCHINDLER

After the great move of the palaeontological/geological department at Senckenberg was completed by the end of the year 2018, settlement into the new "environment" took place, still influencing scientific work.

Publication of results from our Turkish–German cooperation projects continued (ÖZKAN et al.; FEIST et al.) – in the latter paper, the first finds of Palaeozoic charophytes of Turkey could be reported. Further papers are in preparation.

Work on the Eifel area continued.

A good portion of research (not at least studies of specific literature) was dedicated to a special find in the Lower Devonian of Germany (see SCHINDLER et al.) on which a talk was given at the Annual Meeting of the Paläontologische Gesellschaft in München. Hopefully more in next year's report.

Together with other Senckenberg colleagues, the Annual Meeting of the German SDS (together with the Subcommission Proterozoic – Silurian) was hosted in the new building of our institution (9/10 May 2019). At the end of the year, my second 8-year term as chair of the German SDS ended and Uli JANSEN took over (Rainer BROCKE continues as secretary). It was a great time and I much enjoyed the task.

Publications 2019

ÖZKAN, R., NAZIK, A., MUNNECKE, A., SAYDAM-DEMIRAY, D. G., SCHINDLER, E., AYDIN ÖZBEK, T., ŞEKER ZOR, E., YILMAZ, I., BROCKE, R., SANCAY, R. H., WILDE, V. & YALÇIN, M. N. (2019). Givetian/Frasnian (Middle/Upper Devonian) transition in the Eastern Taurides, Turkey. – Turkish Journal of Earth Sciences, **28** (2): 207-231. doi: 10.3906/yer-1804-20.

FEIST, M., NAZIK, A., SCHINDLER, E., WEHRMANN, A. & YALÇIN, M. N. (2019). Distribution and palaeoecology of charophyte floras in Devonian coastal environments of the Central Taurides (Turkey). – Palaeobiodiversity and Palaeoenvironments, **99** (3): 353-366, doi: org/10.1007/s12549-018-0355-y.

SCHINDLER, E., BROCKE, R., WEHRMANN, A. & WILDE, V. (2019). A vendobiont from the Lower Devonian of Germany? – Paleo & Life, Abstracts of the 90th Annual Meeting of the Paläontologische Gesellschaft, Munich 2019: 132.

TM Ladislav SLAVÍK

During 2019-2020 I was involved in various Devonian projects and events.

Together with Gil MACHADO (Almada, Portugal) and other Portugese colleagues we have finished a paper on prasinophyte bloom and putative fungi abundance near the Kačák Event (Middle Devonian) from the Odivelas Limestone, Southwest Iberia, Portugal. The new data showed that this locality is probably within the *Polygnathus hemiansatus* conodont zone, i.e. of the earliest Givetian age. The paper has been already published on-line in *Palaeobiodiversity and Palaeoenvironments*.

In Summer 2019 we finished a study on oxygen and carbon stable isotope records of the Lochkovian-Pragian boundary interval from the Prague Synform (Czech Republic). The manuscript by Hedvika WEINEROVÁ et al. has already passed reviews and will be published soon in *Palaeogeography, Palaeoclimatology, Palaeoecology*.

In summer 2019 we enjoyed the STRATI in Milano - wonderfully organized 3rd International Congress on Stratigraphy, and, especially our Devonian session and the SDS meeting, which both were well attended.

In August 2019 I accepted a kind invitation from Uzbek colleagues to take part in Kitab Geoturism Forum. This event took place in the city of Shakhrisabz and also in the Kitab State Geological Reserve, where the GSSP of the Basal Emsian boundary is positioned. The main focus of the event was to promote this wonderful geological and natural reserve (Zapovednik), and, in near future, to establish a geopark under the auspices of the UNESCO. I had the possibility to meet again many friends and local specialist, who had a crucial role in establishing the geological reserve – Alexey I. KIM, Firuza SALIMOVA, Elena TSCHMEYREK, among others. In my conference talk, I communicated the main issues and problems related to GSSP and stressed the importance of the Kitab State Geological Reserve. On behalf of the SDS, I declared strong support for keeping the reserve and supported the idea of Geopark. At the end, I remembered the late director of the Reserve and a

good friend, Utkir RACHMONOV, who was one of the most important personalities in keeping the "Zapovednik", and who will be missed by many of us. Together with Russian Colleagues (Nadya and Olga IZOKH, Dina SEMENOVA) and local Uzbek geologists, we made it to the field and sampled jointly for isotopes high up in the Zinzilban section.

Fig. 1. Back in the Zinzilban section, Kitab State Geological Reserve, Uzbekistan, August 2019.

In Summer 2020, the Devonian papers on conodont stratigraphy and bioevents included in GEcKO Special Issue of *Palaeogeography, Palaeoclimatology, Palaeoecology* have been finally published. Together with Leona CHADIMOVÁ, we finished the measurements of MS (magnetic sussceptibility) samples from the Castells section, Spanish Central Pyrenees – a part of a joint project with Nacho VALENZUELA-RÍOS and Teresa LIAO.

My PhD student CM Aneta FORMÁČKOVÁ (formerly HUŠKOVÁ) continues her Ph.D. and prepares a manuscript on Silurian-Devonian boundary ozarkodinids (conodonts). Her PhD will be probably accomplished late in 2021.

In 2019, apart from the Devonian activities, I was mostly involved in the late Silurian project "Přídolí Series in the Prague Synform - proposal for chronostratigraphic subdivision", where I acted as a team leader of the research team with members from the Institute of Geology of the Czech Academy of Sciences (P. ŠTORCH, A. FORMÁČKOVÁ) and the Czech Geological Survey (Š. MANDA, Z. TASÁRYOVÁ, P. ČÁP). This project has been accomplished by the end of the 2019).

Publications

Journal papers

DA SILVA, A.-C., DEKKERS, M. J., DE VLEESCHOUWER, D., HLADIL, J., CHADIMOVA, L., SLAVÍK, L. & HILGEN, F. J. (2018). Millennial-scale climate changes manifest Milankovitch combination tones and Hallstatt solar cycles in the Devonian greenhouse world. – Geology, **47**(1): 19-22.

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MACHADO, G, SLAVÍK, L., MOREIRA, N. & FONSECA, P. E. (2020 in press): Prasinophyte bloom and putative fungi abundance near the Kačák event (Middle Devonian) from the Odivelas Limestone, Southwest Iberia. – Palaeobiodiversity and Palaeoenvironments.

Abstracts

SLAVÍK L. & HLADIL J. (2019). Early Devonian conodonts and bioevents in the Prague Synform. - In: PETTI, F. M., INNAMORATI, G., CARMINA, B., GERMANI, D. (Eds.), 3rd International

Congress on Stratigraphy, STRATI Milano, July 2-5, 2019, Milano, Italy, Abstract book: 193.

HUŠKOVÁ A. & SLAVÍK L. (2019). Discussion on phylogeny of biostratigraphic markers among spathognathodontidae (Conodonta) around the Silurian/Devonian boundary. - In: PETTI, F. M., INNAMORATI, G., CARMINA, B., GERMANI, D. (Eds.), 3rd International Congress on Stratigraphy, STRATI Milano, July 2-5, 2019, Milano, Italy, Abstract book: 186.

DA SILVA A.-C., HLADIL J., CHADIMOVA L., SLAVÍK L., HILGEN F. J. & DEKKERS M. J. (2019). The quest for a trustworthy paleoclimatic proxy in a Lower Devonian hemipelagic succession from the Czech Republic. - In: PETTI, F. M., INNAMORATI, G., CARMINA, B., GERMANI, D. (Eds.): 3rd International Congress on Stratigraphy, STRATI Milano, July 2-5, 2019, Milano, Italy, Abstract book: 181.

TM Claudia SPALLETTA

I retired on November 26, 2019 but I am continuing my research on the Devonian, and the Devonian–Carboniferous boundary. I am currently working on biostratigraphy and taxonomy of Middle-Late Devonian and Early Carboniferous conodonts, and on lithostratigraphy of the Devonian-Carboniferous units of the Carnic Alps. The research in the Carnic Alps is carried out in collaboration with a high experienced group of colleagues, including mainly Monica PONDRELLI, Carlo CORRADINI, Hans Peter SCHÖNLAUB, Luca SIMONETTO, and Maria CORRIGA. This leading group is enriched from time to time by the collaboration of other colleagues.

On September 23, 2019, in Udine, during the Workshop “Geological research in the Carnic Alps – from the past to the future”, held at the Museo Friulano di Storia Naturale, I was honoured to present the PANDER Society Medal to Hans-Peter SCHÖNLAUB. I proposed Hans-Peter as recipient for this award for his valuable papers on conodont biostratigaphy, and his studies on the Paleozoic. He was member of the SDS, and is worldwide renowned among Palaeozoic scientists for the “legendary” and uncountable field trips he organized on the Carnic Alps.

Publications

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PISARZOWSKA, A, RAKOCIŃSKI, M. MARYNOWSKI, L., SZCZERBA, M., THOBY, M., PASZKOWSKI, M., PERRI, M. C., SPALLETTA, C., SCHÖNLAUB, H. P., KOWALIK N., & GEREKE, M. (2020 online). Large environmental disturbances caused by magmatic activity during the Late Devonian Hangenberg Crisis. - Global and Planetary Change, **190**, 24 pp., doi.org/10.1016/j.gloplacha.2020.103155.

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PONDRELLI M., CORRADINI, C., SPALLETTA, C., SIMONETTO, L., PERRI, M. C., CORRIGA, M. G., VENTURINI C. & SCHÖNLAUB, H. P. (2020). Geological map and stratigraphic evolution of the central sector of the Carnic Alps (Austria-Italy). - Italian Journal of Geosciences.

CM Maurice STREEL

Please note that the old name "Laboratory of Paleobotany and Palynology of the University of Liège" has changed since last year but that the address is almost the same: **Lab/Palaeopalynology, Bât B-18, University of Liège, B-4000 Liège, Belgium**.

During confinement we have tried to update former researches on the Upper Devonian palynology resulting in two contributions, one on the Frasnian, the other one on the latest Famennian and the Devonian–Carboniferous Boundary in Europe.

The first contribution: Updating Frasnian miospore zonation from the Boulonnais (Northern France) and comparison with new data from the Upper Palaeozoic cover on the Brabant Massif (Western Belgium) by M. STREEL, F. BOULVAIN, M. DUSAR, S. LOBOZIAK & P. STEEMANS will be online in the next weeks and published in *Geologica Belgica*, **24**/1-2 (2021).

The second contribution is published in the present SDS Newsletter and include more than one hundred references. All references carrying STREEL as first author or co-author are available on request or can be downloaded immediately using:

http://orbi.ulg.ac.be/simple-search?query=%28%28uid%3Au011081%29%29 &amp https://doi.org/10.3301/IJG.2020.16

CM Thomas J. SUTTNER and Erika KIDO

In June 2019, my years years position within the frame of the digitalizing project *Museum 2.0* at the Natural History Museum Vienna ended. Another proposal submitted to the Austrian Science Fund was rejected late in 2019. However, Erika and me keep going ahead. While Erika started a manuscript on Eifelian rugose corals from the Carnic Alps, I have submitted a paper on Euconodont basal tissue. Another manuscript on conodont oxygen isotopes across the Kačák Episode is in preparation. Sarah CARMICHAEL (Appalachian State University) and friends produced a review paper concerning the Kellwasser Event published in GLOPLACHA - one of the few highlights we are happy to be part of!

Publications

CARMICHAEL, S.K., WATERS, J. A., KÖNIGSHOF, P., SUTTNER, T. J. & KIDO, E. (2019). Paleogeography and paleoenvironments of the Late Devonian Kellwasser event: A review of its sedimentological and geochemical expression. – Global and Planetary Change, **183**: 102984, 1–17, doi.org/10.1016/j.gloplacha.2019.102984.

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

Activities during this period have been greatly affected by the worldwide pandemic state, which has cancelled many envisaged meetings and other activities; besides, the turn to on-line teaching has forced us to invest a great amount of time in getting ready and use this new way.

As in previous years, the main activities of TM VALENZUELA-RÍOS and CM LIAO focused on Lower, Middle and Upper Devonian conodont biostratigraphy, Middle Devonian conodont biofacies, and Lower and Middle Devonian microfacies analysis from selected Pyrenean sections. This year, we have been also involved in Palaeontological heritage preservation activities (see below). Besides the Pyrenees, studies in the Iberian Cordillera have been re-launched and intensified. Cooperation with Raimund FEIST and Catherine GIRARD continues. First results have been presented in several meetings in 2018, 2019, and were also envisaged for 2020, (5th IPC in Paris, Strati 2019 in Milano, XXXV Spanish Palaeontological Congress in Baza-2019).

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. Results have been presented in previous reports and we expect to continue this collaboration.

The long-term project of detailed analysis of Bohemian conodont faunas around the S/D interval is in progress together with CMs Mike MURPHY and Peter CARLS (sadly, deceased since report submission). An important report, which we dedicated to the late Prof. O. H. WALLISER, regarding two new species of lower Lochkovian *Pedavis* and a proposal for the skeletal reconstruction of the genus, was finished in 2019. This paper considers records from almost 200 samples in the Czech Republic, Spain, and Western North America.

Cooperation with paleobotanics, which already started in the Lower Devonian strata of the Iberian

Chains, continues and 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 paleopalynological record. This on-going project extends to the Middle and Upper Devonian strata of the Iberian Chains. Some results have already been presented during the fieldtrip in connection with the PALASS meeting held in Valencia (December 2019). 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.

In cooperation with CM Olga IZOKH, three selected Devonian sections (and intervals) have been sampled for geochemical studies.

CM LIAO has started a 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 Kačác Event in several Spanish sections.

The Lower Devonian of the Iberian Chains was also visited during the last International PALASS Conference (December 2019), TM José Ignacio VALENZUELA RÍOS, CMs Jau-Chyn LIAO and Peter CARLS were involved in the preparation of the guidebook and, subsequently, Nacho led the field trip.

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

The multilateral cooperation we started in Mongolia several years ago rendered the first paper co-authored by 13 colleagues led by Thomas SUTTNER.

Recently Teresa organised a special symposium on the IGCP 652 on the occasion of the XXV Spanish Palaeontological Conference. Ten presentations dealing with Devonian aspects were presented.

Teresa and Nacho co-supervised the Final Master Work of a student dealing with strata around the Frasnian-Famennian interval in a section in the Spanish Pyrenees. A publication is in process.

A first joint work with Michal MERGL on lingulate brachiopods from a Lower Devonian Pyrenean section has been finished.

Regarding Heritage protection actions, we have been 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 to analyse the impact of this road. Preliminary results prove the presence of Pragian, Emsian, Givetian, and Frasnian rocks. 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. We expect to publish scientific reports in the next years.

Last but no least, two outreach papers dealing with Devonian matters have been published.

Other important actions in relevant Spanish outcrops include 1) 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. 2) Long-term collaboration with CM Peter CARLS on the Devonian of the Iberian Chains, a classical and key area for "Rhenish" (neritic) facies. 3) CM Jenaro L. GARCÍA-ALCALDE continues publishing large monographies on brachiopods from the Cantabrian Mountains. 4) A Ph.D joint proposal, dealing with the Silurian-Devonian outcrops in Spain and Portugal (Centro-Iberian and South Portuguese Zones), co-supervised with Noel Moreira has been submitted. If granted, the candidate Gonçalo SIVÉRIO will start his Ph.D in the frame of this cooperation.

Publications

Regular papers

LU, J. F., VALENZUELA-RÍOS, J. I., LIAO, J.-C. & WANG, Y. (2019). Polygnathids (Conodonta) around the Pragian/Emsian Boundary from the Dacun 1 section (central Guangxi, South China).

Journal of Paleontology, **93** (6): 1210-1220, doi.org/10.1017/jpa.2019.31.

LU, J. F., VALENZUELA-RÍOS, J. I., HEN, X. Q. & LIAO, J.-C. (2019). Emsian (Lower Devonian) Conodonts from the Lufengshan section (Guangxi, South China). - Palaeobiodiversity and Palaeoenvironments, **99**: 45-62, doi.org/10.1007/s12549-018-0325-4.

MERGL, M. & VALENZUELA-RÍOS, J. I (2020). Uniformity of tropical micromorphic brachiopods from the Lower Devonian: lingulates from the section Compte-I of Spanish Central Pyrenees. - Bulletin of Geosciences, **95** (2): 215-230, doi.org/10.3140/bull.geosci.1783.

SIVÉRIO, G., VALENZUELA-RÍOS, J. I., LIAO, J.-C., MACHADO, G., MOREIRA, N., JORGE, J., RAMOS, M., ESTEVES, C., THEIAS, A. & CACHAO, M. (2019). Conodonts from the "Pedreira da Engenharia" Formation, western Ossa-Morena Zone: new biostratigraphic data. - Zubía **31**: 257-262.

SUTTNER, T. J., KIDO, E., ARIUNCHIMEG, YA., SERSMAA, G., WATERS, J.A., CARMICHAEL, S. K., BATCHELOR, C. J., ARIUNTOGOS, M., HUŠKOVÁ, A., SLAVÍK, L., VALENZUELA-RÍOS, J. I., LIAO, J.-C. & GATOVSKY, Y. A. (2020). Conodonts from Late Devonian island arc settings (Baruunhuurai Terrane, western Mongolia). - Palaeogeography, Palaeoclimatology, Palaeoecology549 (2020): 109099-109125, doi.org/10.1016/j.palaeo.2019.03.001.

VALENZUELA-RÍOS, J. I., MURPHY, M. A. & CARLS. P. (2019). Barrandian Lochkovian *Pedavis*, Perspective on Reconstruction of the Skeletal Apparatus of the Silurian-Devonian genus *Pedavis*. - University of California, Riverside, Campus Museum Contributions, **10**: 1-38.

Book Chapters

USERA, J. M., VALENZUELA-RÍOS, J. I., LIAO, J.-C. (2019). Geología y Paleontología: Colecciones de Micropaleontología. [Geology and Paleontology: Micropaleontological Collections]. - In: GARCIA-FORNER, A. (Ed.), Colecciones de Historia Natural de la Universitat de València. University of Valencia Publishing, **1**: 66-69, ISBN 978-84-9133-270-1.

VALENZUELA-RÍOS, J. I., ÁLVARO, J. BOTELLA, H., CARLS, P., CASCALES-MIÑANA, B., DOJEN, C., ESTEVE, J., FERRÓN, H., GUTIÉRREZ-MARCO, J. C., LIAO, J.-C., MARTÍNEZ-PÉREZ, C., PATES, S., PEREIRA, S., VILLAS, E. & COLMENAR. J. (2019). Palaezoic fossil assemblages from the Iberian Chains (Northeast Spain). - In: ZAMORA, S. & RÁBANO, I. (Eds.), 63rd Annual Meeting of the Palaeontological Association. Cuadernos del Museo Geominero, **31**: 9-11, ISBN 978-84-9138-095-5.

VALENZUELA-RÍOS, J. I. CARLS, P., DOJEN, C., MARTÍNEZ-PÉREZ, C., FERRÓN, H. G., BOTELLA, H., CASCALES-MIÑANA, B. & LIAO, J.-C. (2019). Pridoli to Early Devonian marine and terrestrial communities and strata from the Eastern Iberian Chain. In: ZAMORA, S. & RÁBANO, I. (Eds.), 63rd Annual Meeting of the Palaeontological Association. Cuadernos del Museo Geominero, **31**: 61-85.

VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2020). La Paleontología como vehículo de desarrollo y de diálogo entre naciones y culturas. - Quercus **411**: 62-64, ISSN 0212-0054.

Conference Book Chapters

LIAO, J.-C., VALENZUELA-RÍOS, J. I. (2019). Herramientas para la calibración del Givetiense (Devónico Medio): conodonto estratigrafía de alta resolución vs. Astrocronología. - In MARTÍNEZ-NAVARRO, B., PALMQVIST, P., ESPIGARES, M.P. & ROS-MONTOYA, S. (Eds.), Libro de Resúmenes de las XXXV Jornadas de la Sociedad Española de Paleontología y Simposio del Proyecto PICG 652: 145-146, ISBN 978-84-09-14609-3.

SILVERIO, G., LIAO, J.-C., ESCRIBANO, M. & VALENZUELA-RÍOS, J. I. (2019): Famennian (Upper Devonian) conodonts from the Vi-I and CP sections (Spanish Central Pyrenees): preliminary data. - In MARTÍNEZ-NAVARRO, B., PALMQVIST, P., ESPIGARES, M.P. & ROS-MONTOYA, S. (Eds.), Libro de Resúmenes de las XXXV Jornadas de la Sociedad Española de Paleontología y Simposio del Proyecto PICG 652: 291-294.

VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2019). Conodont-biostratigrafía de alta resolución en el Lochkoviense (Devónico Inferior) de los Pirineos, cambios climáticos, ciclos de Milankovitch. - In MARTÍNEZ-NAVARRO, B., PALMQVIST, P., ESPIGARES, M.P. & ROS-MONTOYA, S. (Eds.), Libro de Resúmenes de las XXXV Jornadas de la Sociedad Española de

Paleontología y Simposio del Proyecto PICG 652: 303-305.

VALENZUELA-RÍOS, J. I. (2019). Hacia un planeta sostenible, el papel de la juventud geológica y el apoyo del Programa Internacional de Ciencias Geológicas UNESCO_IUGS. - Libro de Acta IX Congresso Jovens Investigadores en Geociências, LEG 2019: 17-21.

Abstracts

LIAO, J.-C., VALENZUELA-RÍOS, J. I. & CARLS, P. (2019). Middle Devonian Global Events: examples from the Iberian Peninsula (Spain). The Palaeontological Association, 63rd Annual Meeting, Programme Abstracts AGM papers: 100.

VALENZUELA-RÍOS, J. I. & LIAO, J.-C. (2019). Timing Lochkovian (Lower Devonian) conodont bioevents: the Pyrenean experience. The Palaeontological Association, 63rd Annual Meeting, Programme Abstracts AGM papers: 135.

CM Chuck Ver STRAETEN

Most of my work time since mid-March (largely at home) has been focused on a large volume on the New York Devonian that a group of 16 of us have been working on. There will be 11 chapters beginning with an Introduction, followed by the Lochkovian Helderberg Group. Subsequent chapters will rise through the stratigraphic column, concluding with a chapter on the New York Devonian terrestrial system (lower Givetian to Famennian).

In the process of putting this together, I had a cartographer calculate the area of the State of New York that has Devonian bedrock. Based on "GIS shape files" from the state's 1970 bedrock map, the Devonian is found at the surface or below soils and glacial cover across 40% of the state, or 50.535.km^2 (19512 mi^2). Much to my surprise, the Devonian terrestrial strata of the Catskill Mountains region, the focus of the last chapter in the volume, is found across 9.4% of the state (11.882 km^2; 4588 mi^2).

For the volume I've prepared an Introduction with a focus on the New York and North American geology and paleobiology; and papers on the New York Pragian-Emsian, the Eifelian-lower Givetian (with Carl BRETT, Gordon BAIRD, Alex BARTHOLOMEW and Jeff OVER) and a broad overview of New York's Devonian terrestrial succession (lower Givetian-Famennian, with Frank FLETCHER).

We have dedicated the volume to Dr. Lawrence (Larry) V. RICKARD, Silurian-Devonian stratigrapher for the New York State Geological Survey and State Museum, from 1955 to 1985. Larry's 1975 time-rock chart, *Correlation of the Devonian Rocks in New York State*, greatly influenced the volume's authors over the years, as we carried out our subsequent research. A chart accompanying the volume updates RICKARD'S (1975) Devonian chart.

The Devonian terrestrial has become my chief research focus the recent years. Despite early reports on their rocks in the 1790s, their geology remains a relative frontier, largely unknown. In contrast, their paleobotanitical record is better known. A paper on what is now the oldest known forest in the world, from ~the mid Givetian, came out around the turn of the year, and was in the public news globally at the time. The initial discovery occurred in 2009, while three of us walked across an old quarry floor near Cairo, eastern New York. There are no fossil trees or logs preserved at the site; what is seen is the trace fossils of tree root systems, of three types of trees. For the first time, Bill STEIN and Chris BERRY, leaders of the research, could see where individual trees stood in a Devonian forest. Subsequently, but published first, a similar forest floor of root traces was found at the ca. 2 million year older Gilboa fossil forest site, which was uncovered for the first time since the early 20th century. The two sites had distinctly different tree assemblages, the former dominated by *Archeopteris*, the latter by *Eospermatopteris*.

My ongoing geological work on the lower Givetian to Frasnian terrestrial strata in the Catskill Mountains, eastern New York State, includes establishing a relatively continuous transect through the eastern Catskills. The succession, estimated at ca. 2.4 km thick, is best accessioned continuously along two transects totaling >50 km distance, following creeks, trails, and off-trail mountain ridges. Issues of extensive soil and forest cover, somewhat rugged terrain, the homogeneity of terrestrial facies (with extremely few recognizable, correlatable units, even mountain to mountain), I am trying to establish a more grounded stratigraphy. Including palynological biostratigraphy with John Marshall. In addition, I am collecting shale, sandstone and select conglomerates along the

transect for various analyses, including petrography, detrital zircon dating, elemental geochemistry and more.

An overview of the New York Devonian terrestrial, examining various geological and paleobiological subdisciplines, via extensive post-1970 references and initial results of my own research, comprises the final chapter of the coming Devonian of New York volume.

Publications 2019-2020

Regular papers

VER STRAETEN, C. A., BRETT, C. E., BAIRD, G. C., BOYER, D., LINDEMANN, R., IVANY, L., OVER, D. J. & WITZKE, B. (2019). Shallow-water onlap model for the deposition of Devonian black shales in New York, USA: COMMENT. - Geology, **47** (12): e495-e495, doi.org/10.1130/G46928C.1

VER STRAETEN, C. A., OVER, D. J. & BAIRD, G. C. (2020). Arc-to-craton: Devonian air-fall tephras in the eastern United States. - In: AVARY, K. L., HASSON, K. O. & DIECCHIO, R. J. (Eds.), The Appalachian Geology of John M. DENNISON: Rocks, People, and a Few Good Restaurants along the Way. Geological Society of America, Special Paper, **545**: 35-53, doi.org/10.1130/2020.2545(03).

STEIN, W. E., BERRY, C. M., MORRIS, J. L., HERNICK, L. V., MANNOLINI, F., VER STRAETEN, C. A., LANDING, E., MARSHALL, J. E. A., WELLMAN, C. H., BEERLING, D. J. and LEAKE, J. R. (2020). Mid-Devonian Archaeopteris roots signal revolutionary change in earliest fossil forests. - Current Biology, **30** (3): 421-431, doi.org/10.1016/j.cub.2019.11.067

HE, R., LU, W., JUNIUM, C. K., VER STRAETEN, C. A. & LU, Z. (2020). Paleo-redox context of the Mid-Devonian Appalachian Basin and its relevance to biocrises. - Geochimica et Cosmochimica Acta, doi.org/10.1016/j.gca.2019.12.019.

Abstract

DA SILVA, A.-C., BARTHOLOMEW, A., BRETT, C. E., HILGEN, F., VER STRAETEN, C. A. & DEKKERS, M. (2020). Exceptionally preserved Milankovitch cycles in Lower Devonian argillaceous limestone of the Hudson Valley, New York State (USA). - 22nd EGU General Assembly, held online 4-8 May, 2020, id.7565, http://hdl.handle.net/2268/249100

[Quoted reference]

RICKARD, L. V. (1975). Correlation of the Silurian and Devonian Rocks in New York State. - New York State Map and Chart, **24**: 16 pp., 4 pls.

CM Stanislava VODRÁŽKOVÁ

Finally, the paper focusing on conodonts from the Kačák Episode from the Barrandian area, with special emphasis on the ontogenetic and intraspecific variability within the *Polygnathus pseudofoliatus* Group, was finished in 2019 (VODRÁŽKOVÁ & SUTTNER 2020). The *Polygnathus pseudofoliatus* Group is rather problematic due to large morphological variation, the occurrence of transitional forms, and in most case unknown ontogenetic variation. We concluded that for above mentioned reasons, representatives of this group (except for *Polygnathus pseudofoliatus* WITTEKINDT) do not represent the best candidates for zonally diagnostic taxa in the upper Eifelian. From this perspective, the usage of stratigraphic ranges of *Po. eiflius*, *Po. ensensis*, and *Po. amphora* as an assemblage Zone seemed to be most reasonable. We also discussed the observed increase in morphological variability and occurrence of transitional forms in the context of ongoing environmental changes (Kačák Episode).

In 2019 I was also working with Onřej BÁBEK and his working group on the project focusing on Paleozoic red limestones. Together with Axel MUNNECKE, Tomáš KUMPAN, Jiří FRÝDA, and Jiří KALVODA, we started a new project on microbial sediments. Also, the cooperation with K. NARKIEWICZ and her working group on the Middle Devonian conodonts continues.

Publications

VODRÁŽKOVÁ, S. & SUTTNER, T. J. (2020). Middle Devonian (Eifelian, *australis* – *ensensis* zones) conodonts from the Jirásek quarry near Koněprusy (Barrandian area, Czech Republic) with special emphasis on the *Polygnathus pseudofoliatus* Group and notes on environmental changes related to the Kačák Episode. – Bulletin of Geosciences, **95** (1): 81-125.

CM Michael WHALEN

I have been less active in Devonian research over the past few years as work on an IODP core into the Chicxulub impact crater has occupied much of my research time. However, I have been working on a paper dealing with the timing of third order depositional sequences in the Devonian of western Canada based on spectral analysis of magnetic susceptibility data.

CM Anthony WRIGHT

The main publication to report is a joint monograph with Dr Ross MCLEAN on eastern Australian Early-Middle Devonian corals (plus one late Silurian species) that have been described as *Phillipsastrea*, and should be still assigned to *Phillipsastrea* or other genera. This MS, listed below, is expected out this year; we are also working on a new Silurian coral fauna from Ulah, south of Orange, NSW. Both of us are Honorary Principal Fellows at the University of Wollongong.

MCLEAN, R.A. & WRIGHT, A.J. (2020 in press). The rugose coral *Phillipsastrea* D'ORBIGNY and other plocoid genera in the late Silurian to Early Devonian of eastern Australia: revision of previously assigned species and new records. Australian. - *Palaeontological Memoir*, **54**.

Other work in progress:

WRIGHT, A. J. Revision of the Devonian tetracoral genus *Trapezophyllum*.

WRIGHT, A. J., Tong-Dzuy THANH, Ta Hoa PHUONG & Nguyen Huu HUNG. Taxonomy, evolutionary relationships and biogeographic affinities of calceolide corals from north Viet Nam.

WRIGHT, A. J. & TALENT, J. A. Occurrences of the Devonian pentameride brachiopod *Zdimir* in eastern Australia.

WRIGHT, A. J. A giant new strophodontide brachiopod genus from the Devonian Mount Frome Limestone, New South Wales, Australia.

WRIGHT, A. J., Further studies of operculate corals from eastern Australia and other regions.